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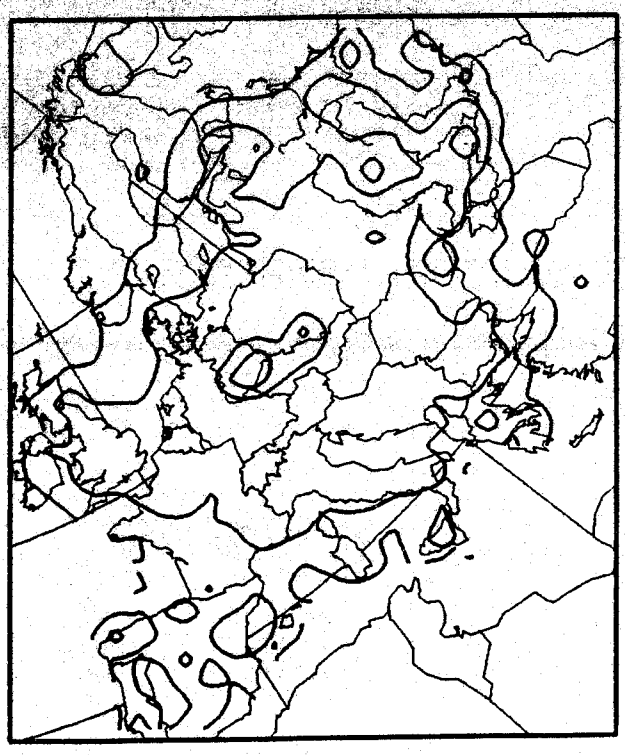
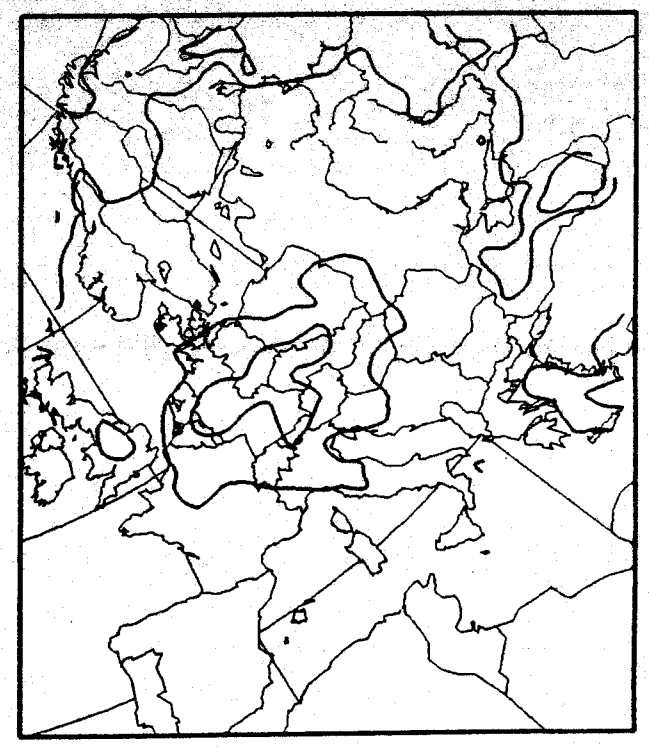
CALCULATED BUDGETS FOR AIRBORNE ACIDIFYING COMPONENTS IN EUROPE, 1985, 1987, 1988, 1989, 1990, 1991 and 1992.

Hilde Sandnes.

DET NORSKE METEOROLOGISKE INSTITUTT

Technical Report no. 109





MSC-W

METEOROLOGICAL SYNTHESIZING CENTRE - WEST
THE NORWEGIAN METEOROLOGICAL INSTITUTE
P.O.BOX 43-BLINDERN, N-0313 OSLO 3, NORWAY

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APPENDIX G : Maps of the deposition of indeterminate origin for oxidised sulphur, oxidised and reduced nitrogen. Averaged over the years 1985, 1987, 1988, 1989, 1990, 1991 and 1992.

PREFACE.

This report presents the latest budgets for deposition of sulphur and nitrogen in Europe as calculated with the ten-component model at The Meteorological Synthesizing Centre - West of EMEP. The budgets are updated according to the latest available official emissions by 8. April 1993, and preliminary estimates of 1992-budgets are also included. The model formulation is basically the same as described in the 1992 report (Sandnes and Styve., 1992; EMEP MSC-W Report 1/92), but there have been some technical changes which are described in section 1 . The model domain has been extended, the formation of new countries in Europe is included and the model has been re-run for previous years to include new information about the spatial distribution of the emissions. As earlier this report also contains full documentation of the model for the sake of completeness. We are presently able to present calculations for seven years with the same model, treating sulphur and nitrogen in a consistent way. All budgets in this report are replacing earlier published calculations. Unfortunately, we have not been able to calculate new budgets for 1986, since there is a major block of meteorological data missing for this year in our files. Nevertheless, full budgets for 1985, 1987, 1988, 1989, 1990, 1991 and 1992 should constitute representative information to assist decision-makers in their hard work to agree on new reduction protocols.

This report also includes seven appendixes. Appendix A contains diagrams comparing measurements and model calculations. Appendix B shows the deposition and concentration level of all calculated components for the last year with official emission estimates (1991). Appendix C shows the budget matrices. In the budget table for 1991 the unification of Germany and the division of USSR into new contries are reflected. The division of Yugoslavia is also reflected in the budget table for 1992. Appendix D has information about average yearly emissions for the seven years of calculations. Appendix E contains the country to grid square deposition of sulphur, the 5 percentile critical load and the total sulphur excess deposition. The excess deposition is taken as the deposition exceeding the 5 percentile critical load for sulphur deposition. Maps of the deposition from North American sources (results from an Hemispheric model Tarrason, 92 EMEP/MSC-W Note 5/92) and the deposition not responding to Eurpoean control strategies (see section 5.5) are also shown in this Appendix. Appendix F contains country to grid square depositions for oxidised and reduced nitrogen averaged for the seven years. Appendix G shows different maps of the inattributable part of the deposition for oxidised sulphur, oxidised nitrogen and reduced nitrogen (see section 5.3).

ACKNOWLEDGEMENTS.

The author appreciates valuable discussions with Professor Anton Eliassen, Dr. Trond Iversen and Dr. Erik Berge.

The author also wants to thank Helge Styve that has prepared the emission and meteorological input data, and Leonor Tarrason that has estimated the budget for biogenic sulphur emissions.

The routine activities at MSC-W strongly depend on access to high quality meteorological data. These data are provided by the routine Numerical Weather Prediction model at The Norwegian Meteorological Institute.

The data on emissions from ships in international trade have been compiled by MARINTEK, Trondheim, Norway under a contract by The Norwegian State Pollution Control Authority. The present calculations are made possible through access to a supercomputer (CRAY Y-MP4D/464) at the Technical University of Norway, SIMa/RUNIT, Trondheim, Norway. The model code has been optimized for CRAY with valuable assistance from the staff at SIMa, RUNIT, in particular Dr. Harald H. Simonsen.

1. SUMMARY OF RECENT MODEL EXTENSIONS AND IMPROVEMENTS

This chapter gives a short overview over the changes made in the EMEP/MSC-W acid deposition model during the last year.

To cover a larger part of Russia the grid where concentrations and depositions are calculated are now extended with four grid squares in the eastward direction (from 33 by 31 grid squares to 33 by 35 grid squares). The new grid is shown in Figure 6 page 37. The budgets presented in this report will therefore have larger depositions to Russia or former USSR and to the Atlantic Ocean (which includes the Barent Sea) than earlier published budget matrices, since the deposition area for these receivers is now larger. To get consistent budget matrices all years have been re-run including the new deposition domain. This extension also increases the domain where assimilation takes place.

Since many new countries recently have been established in Europe, the areas to which concentrations and depositions are allocated are now extended from 42 sub-areas to 52 sub-areas. The new sub-areas include the division of former USSR, Yugoslavia and Czechoslovakia into new contries.

In the budgets one part of the deposition is allocated to contribution of indeterminate origin (IND), i.e. the deposition that can not be allocated to any known emission source.The latest model version is now extended to keep track of how large part of the indeterminate contribution which is caused by exchange of air between the mixed layer and the free troposphere, and how large part which are caused by the inital concentrations at the trajectory start position (see section 5.3 and Appendix G).

Since all years have been re-run the latest information about emission distribution is also taken into account for all years. For some of the countries that never have given official emission data in gridded form to the Secretariat of EMEP we have used data from the OECD-MAP of emission inventory (Lubkert and Tilly, 1989). For sulphur emissions data this emission map is used for Italy and Greece, and for nitrogen emission data we have employed this map for Ireland, Italy, Greece and Portugal.

2. INPUT DATA.

Calculations of air quality and deposition of air pollutants require basic input information of two categories. Data on emissions of pollutants of anthropogenic and natural origin as well as meteorological parameters are necessary in order to calculate concentration levels and deposited amounts. The model calculates approximate solutions to a set of partial differential equations, and includes parameterizations of chemical reactions and physical processes through coefficients which depend on the meteorological and physico-chemical state of the air.

2.1 Emissions.

As far as possible, the emission data employed in the calculations are official data submitted by the countries participating in EMEP. In this context, the attention is drawn to a decision of the eighth session of th Executive Body for the Convention of Long-Range Transboundary Air Pollution (ECE/EB.AIR/24, para. 27(e)), to approve the amended reporting schedule for the submission of emission data by 31. December rather than 1. May of each year, in agreement with the recommendation made by EMEP's Steering Body at its 14. session (EB.AIR/GE.1/ 16, para 18). This recommendation reads *"starting from 1991, the MSCs should begin their preliminary calculations for the year concerned immediately after the end of the year, using the most recent emission data available. Final emission data should be submitted before 31. December of the year following the year concerned, thus giving parties 12 months to produce the data. The final calculations should be presented to the Steering Body in the second year following the year concerned."* Final emission numbers should be provided to both MSCs, in accordance with the guidelines for reporting by Parties to the 1985 Helsinki Protocol[1] (see ECE/EB.AIR/24, Annex II, section 2.2.1). For emissions of other components than sulphur, there is at present less fixed guidelines for submission of official data. However, in Article 8 of the "NOx-protocol"[2] it is stated that *"The Parties shall exchange information by notifying the Executive Body ... , and in particular on: (a) The levels of national annual emissions of nitrogen oxides and the basis upon which they have been calculated;"*. Furthermore in Article 9: *"EMEP shall, utilizing appropriate models and in good time before the annual meetings of the Executive Body, provide to the Executive Body calculations of nitrogen budgets and also of transboundary fluxes and deposition of nitrogen oxides within the geographical scope of EMEP"*. This implies in practice the same routine for reporting of NOx-emissions as for sulphur-emissions, though it is not explicitely stated. If emission data for some reason are missing, information is sought from available open sources, or estimated as far as possible by MSC-W and CCC (The Norwegian Institute for Air Research) in co-operation.

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1. The 1985 Protocol to the 1979 Convention on Long-Range Transboudary Air Pollution on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent. (ECE/EB.AIR/12)

2. The 1988 Protocol to the 1979 Convention on Long - Range Transboundary Air Pollution Concenrning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes. (ECE/EB.AIR/21)

The international ship emissions have been estimated by MARINTEK, Trondheim, Norway on a contract with The Norwegian State Pollution Control Authority, and includes traffic in the Atlantic Ocean (ATL), The North Sea (NOS), and The Baltic Sea (BAS). The extensive traffic in the Mediterranean Ocean is not covered at all. Furthermore, those ocean areas that are included are covered with incomplete data that probably underestimates the emissions, since only traffic between groups of countries, rather than between all the nations, are included. The data have been transformed into gridded form by MSC-W.

In Appendix B is shown maps of gridded emissions of SO_2, NO_x and NH_3 averaged over the seven years for which calculations have been made, in units of mass of S and N per meter squared.

2.1.1 Sulphur

Table 1 gives the national total emissions for sulphur as they are updated according to official information up to 8 April 1993. For countries that have given data only for a selection of years, linear interpolation has been applied. In general, all countries' emissions are kept constant after the latest year with information.

In this report we present budget calculations for 1985, 1987, 1988, 1989, 1990, 1991 and 1992. Up to 8. April 1993, 15 out of 36 countries have given official estimates for 1991. Only one country has never submitted any emission data (Albania), in addition 8 out of 11 new countries in Europe have not reported any official emission estimates. For those countries official numbers from former USSR and Yugoslavia are used. 21 Countries have given gridded sulphur emissions for at least one year. For Italy and Greece we have used the spatial distribution of the OECD-MAP emission inventory (Lubkert and Tilly, 1989) since no such data have been reported to EMEP. In addition to the national land-based emissions, the calculations include emissions from international trade (shipping), and an estimate of the natural biogenic emissions from the sea. The natural sulphur emission (NAT) over sea has been estimated by L. Tarrason. The calculation is based upon the observed production of dimethyl shulpide (DMS). The natural biogenic emission over sea vary with season and latitude with a maximum in the North Sea in spring time and a minimum emission rate in winter time (L.Tarrason EMEP/MSC-W Note 3/91). To adjust for the seasonally changing demand for domestic heating all other emissions of sulphur have a seasonal variation as a sine-function with maximum 1.33 in January to a minimum 0.67 in July. Figure 1 shows the gridded emission map for sulphur used for the 1991-calculations of sulphur.

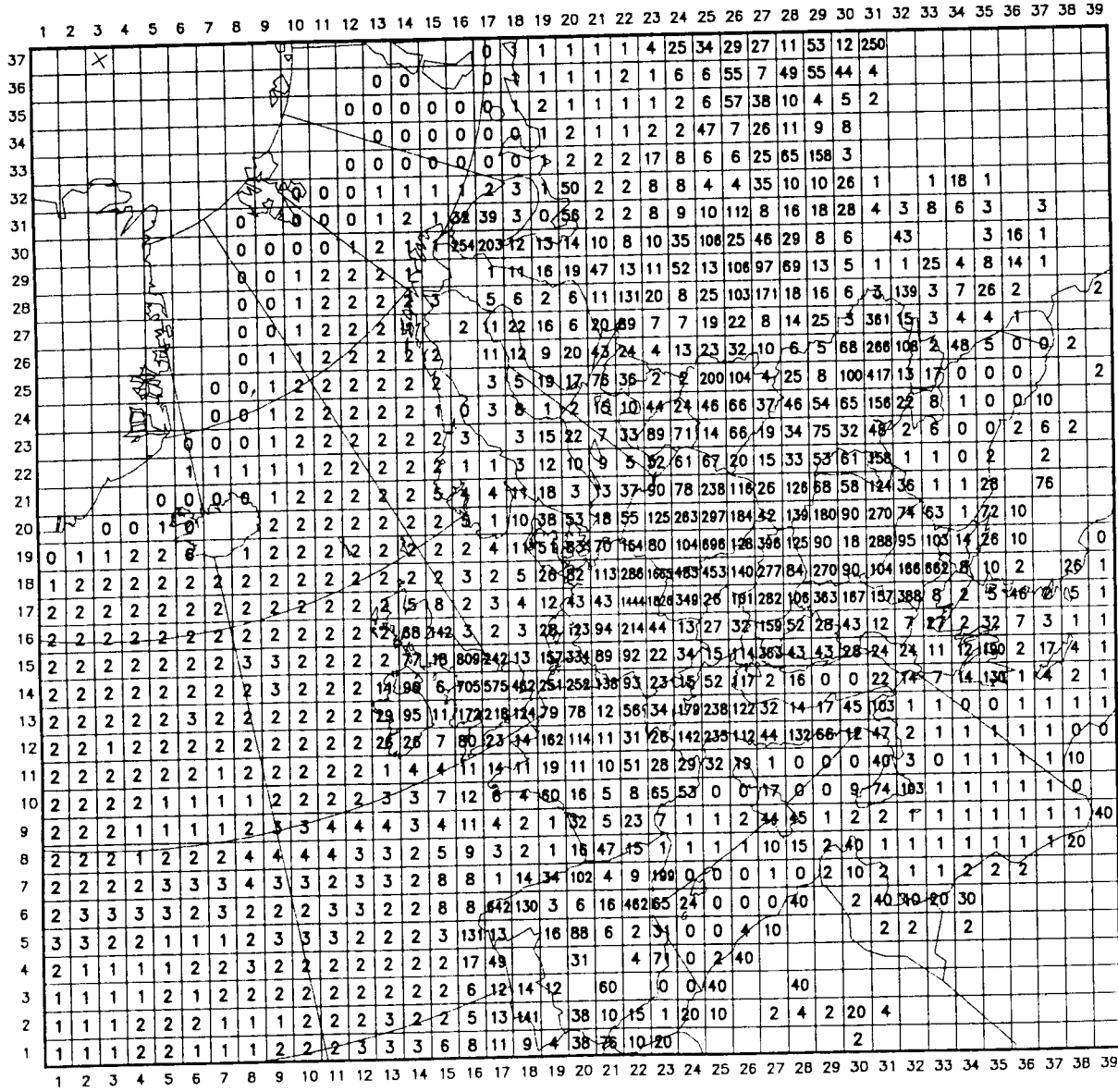
TABLE 1. Emissions of Sulphur Dioxide. Unit: 10^3 tonnes (S) per annum.

		1980	1985	1986	1987	1988	1989	1990	1991	1992
AL	Albania	(25)	(25)	(25)	(25)	(25)	(25)	(25)	(25)	(25)
AT	Austria	199	98	87	76	61	47	45	42	42
BE	Belgium	414	226	237	207	211	207	222	224	224
BG	Bulgaria	1025	1157	1183	1210	1114	1062	1010	830	830
CS	Czechoslovakia	1551	1391	1391	1385	1336	1282	1222	1100	1100
DK	Denmark	226	172	141	126	122	96	90	122	122
FI	Finland	292	191	166	164	151	121	130	97	97
FR	France	1669	735	671	645	613	667	630	685	685
DD	German Dem Rep.	2150	2700	2700	2800	2650	2650	2400		
DE	Germany, Fed. Rep.[1]	1597	1198	1132	967	619	501	470	2870	2870
GR	Greece	200	250	250	250	250	250	250	250	250
HU	Hungary	816	702	685	646	609	542	505	505	505
IS	Iceland	3	3	3	3	3	3	3	3	3
IE	Ireland	111	70	81	87	76	81	84	95	95
IT	Italy	1900	1252	1185	1205	1203	1090	1090	1090	1090
LU	Luxembourg	12	8	8	8	8	8	8	8	8
NL	The Netherlands	233	138	138	141	138	122	104	101	101
NO	Norway	70	50	46	38	34	30	27	24	24
PL	Poland	2050	2150	2100	2100	2090	1955	1605	1498	1498
PT	Portugal	133	99	117	109	102	102	102	102	102
RO	Romania	900	900	900	900	900	900	900	900	900
ES	Spain	1660	1095	1108	1120	1133	1145	1158	1158	1158
SE	Sweden	260	146	136	124	112	94	85	85	85
CH	Switzerland	63	48	32	40	37	34	31	31	31
TR	Turkey[2]	138	161	177	177	177	177	177	177	177
GB	United Kingdom	2449	1862	1948	1949	1906	1860	1887	1887	1887
BY	Byelorussia	370	345	345	345	319	298	298	298	298
UA	Ukraina	1925	1732	1696	1632	1606	1536	1391	1269	1269
MD	Moldovia	75	75	70	64	60	55	53	53	53
RU	Russia	3581	2987	2899	2811	2573	2339	2230	2106	2106
EE	Estonia	81	81	75	69	65	59	57	57	57
LV	Latvia	56	56	52	48	45	41	39	39	39
LT	Lithuania	143	143	133	122	114	105	100	100	100
SI	Slovenia	110	126	126	131	135	131	125	125	125
HR	Crotia	183	211	211	218	225	218	208	208	208
BA	Bosnia & Hercegovina	64	73	73	76	78	76	72	72	72
YU*	Yugoslavia[3]	295	339	339	350	363	350	334	334	334
REM	Remaining areas[2]	(256)	(256)	(256)	(256)	(256)	(256)	(256)	(256)	(256)
BAS	The Baltic Sea	(36)	(36)	(36)	(36)	(36)	(36)	(36)	(36)	(36)
NOS	The North Sea	(87)	(87)	(87)	(87)	(87)	(87)	(87)	(87)	(87)
ATL	Rem. Atlantic Waters	(158)	(158)	(158)	(158)	(158)	(158)	(158)	(158)	(158)
MED	The Mediteranian[2]	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)
BLS	The Black Sea	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NAT	Biogenic sea emissions	(362)	(362)	(362)	(362)	(362)	(362)	(362)	(362)	(362)
	TOTAL	**27935**	**23900**	**23571**	**23273**	**22168**	**21164**	**20072**	**19475**	**19475**
SU	Soviet-Union[2,4]	6232	5419	5270	5091	4782	4433	4168		
YU	Yugoslavia[5]	652	749	749	775	801	775	739	739	

1. Also include German Dem. Rep in 1991 and 1992
2. The Part inside the EMEP domain of calculation.
3. Former Yugoslavia excluding Slovenia, Croatia, Bosnia and Hercegovina.
4. Sum of BY,UA, MD, RU, EE, LV and LT which also is included above.
5. Sum of SI, HR, BA an d YU* which also is included above.

Data that have been officially submitted are underlined. Data estimated by MSC-W/CCC are given in brackets Other numbers are inter- and ekstrapolations of official data for countries not having reported for all years.

FIGURE 1. 1991 - emissions of Sulphur Dioxide in each grid square of the EMEP/ MSC-W grid for calculations. Unit: 1000 tonnes per annum as SO_2.



2.1.2 Nitrogen

The emissions of nitrogen oxides ($NO_x = NO + NO_2$) are as the sulphur emissions taken from officially submitted data from the countries if such are available. Otherwise, the estimates of Semb and Amble (1981) are used. Table 2 shows the status of the emissions of NO_x as reported by 8. April 1993. As for sulphur interpolations and extrapolations are made whenever possible. For the years for which calculations are made, the status is that 12 out of 36 countries have given official emissions in 1991. 18 countries have given estimates of NOx- emissions in gridded form at least once since 1980. For Ireland, Italy, Greece and Portugal we have used the spatial distribution of the OECD-MAP (Lubkert and Tilly, 1989) since no such data have been reported to EMEP. 3 countries have never given any official information on NO_x-emissions (Albania, Romania and Turkey).

The part of the NO_x-emissions reported as high emissions are assumed to include stationary sources only, and is supposed to have the same seasonal variation as the sulphur emissions. The lower emissions, being mainly from mobile sources, is not supposed to have seasonal variations.

A substantial part of the NO_x-emissions originates from mobile sources. For some countries emissions from domestic ferries, boat traffic and offshore installations are relatively large. As far as known at MSC-W, only one country (Norway) has included these emissions in its survey. Furthermore, emissions from international shipping is probably more important for NO_x than for sulphur, because oxidised nitrogen in its primary phase is almost not water soluble. Therefore the dry and wet deposition over sea is negligible until the NO_x is further oxidized to nitrate in any form. It is a hope that more countries will include NO_x emissions from domestic boat traffic and other offshore activities, and that further work will be carried out to estimate emissions from international shipping.

The budget calculations of nitrogen also require data on emissions of ammonia (NH_3), for which the major source is agricultural activity. Only six countries have provided an official estimate such emissions in 1991. In all other cases the estimates of Asman (1992) are used. It is a hope that more countries will work out national surveys of ammonia emissions in the near future. The emissions of ammonia is assumed to vary as a sine function with maximum 1.3 in early summer when the open land is fertilized and at its minimum 0.7 in winter . Table 3 shows the emissions employed for ammonia. These applied emission numbers, which vary very little between the years because of missing informations, certainly have a large potential for improvement. Figures 2 and 3 shows the gridded emissions used for the 1991 calculations.

TABLE 2. Emissions of Nitrogen Oxides. Unit: 10^3 tonnes (NO_2) per annum.

		1980	1985	1986	1987	1988	1989	1990	1991	1992
AL	Albania	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)
AT	Austria	246	245	240	234	226	221	222	216	216
BE	Belgium	442	281	292	297	312	317	334	335	335
BG	Bulgaria	416	416	416	416	415	395	376	273	273
CS	Czechoslovakia	1204	992	1046	1008	1054	1122	987	890	890
DK	Denmark	273	298	310	305	292	270	283	283	283
FI	Finland	264	262	256	270	276	284	290	299	299
FR	France	1823	1615	1618	1630	1615	1772	1750	1810	1810
DD	German Dem Rep.	590	640	640	670	670	670	630		
DE	Germany, Fed. Rep.[1]	2980	2959	3008	2927	2859	2707	2600	3230	3230
GR	Greece	746	746	746	746	746	746	746	746	746
HU	Hungary	273	262	268	276	259	249	238	238	238
IS	Iceland	13	12	12	12	12	12	12	12	12
IE	Ireland	73	91	100	115	122	127	135	130	130
IT	Italy	1480	1595	1607	1700	1755	1761	1761	1761	1761
LU	Luxembourg	23	19	19	19	19	19	19	19	19
NL	The Netherlands	548	544	559	559	552	551	552	548	548
NO	Norway	183	211	226	229	229	233	233	230	230
PL	Poland	1500	1500	1590	1530	1550	1480	1280	1205	1205
PT	Portugal	166	96	110	116	122	122	122	122	122
RO	Romania	(390)	(390)	(390)	(390)	(390)	(390)	(390)	(390)	(390)
ES	Spain	950	839	839	839	839	839	839	839	839
SE	Sweden	419	426	432	431	423	413	404	404	404
CH	Switzerland	196	214	207	200	194	183	184	175	175
TR	Turkey[2]	(175)	(175)	(175)	(175)	(175)	(175)	(175)	(175)	(175)
GB	United Kingdom	2312	2327	2416	2544	2626	2717	2729	2729	2729
BY	Byelorussia	244	220	258	287	262	263	263	263	263
UA	Ukraina	1059	1059	1112	1095	1090	1065	1097	990	990
MD	Moldovia	38	41	40	51	51	53	53	53	53
RU	Russia	1734	2178	2265	2353	2358	2553	2675	2675	2675
EE	Estonia	35	37	36	46	46	48	48	48	48
LV	Latvia	28	30	29	37	37	39	39	39	39
LT	Lithuania	53	56	56	70	70	74	73	73	73
SI	Slovenia	63	72	75	79	86	77	75	75	75
HR	Crotia	97	110	116	121	132	119	116	116	116
BA	Bosnia & Hercegovina	43	49	51	53	58	52	51	51	51
YU*	Yugoslavia[3]	148	169	177	186	204	182	177	177	177
REM	Remaining areas[2]	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
BAS	The Baltic Sea	(80)	(80)	(80)	(80)	(80)	(80)	(80)	(80)	(80)
NOS	The North Sea	(192)	(192)	(192)	(192)	(192)	(192)	(192)	(192)	(192)
ATL	Rem. Atlantic Waters	(349)	(349)	(349)	(349)	(349)	(349)	(349)	(349)	(349)
MED	The Mediteranian[2]	(13)	(13)	(13)	(13)	(13)	(13)	(13)	(13)	(13)
BLS	The Black Sea	no data								
NAT	Biogenic sea emissions	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	TOTAL	**21970**	**21919**	**22480**	**22759**	**22869**	**23043**	**22701**	**22362**	**22362**
SU	Soviet-Union[2,4]	3191	3621	3796	3939	3914	4095	4248		
YU	Yugoslavia[5]	350	400	420	440	480	430	420	420	

1. Also include German Dem. Rep in 1991 and 1992
2. The Part inside the EMEP domain of calculation.
3. Former Yugoslavia excluding Slovenia, Croatia, Bosnia and Hercegovina.
4. Sum of BY,UA, MD, RU, EE, LV and LT which also is included above.
5. Sum of SI, HR, BA an d YU* which also is included above

Data that have been officially submitted are underlined. Data estimated by MSC-W/CCC are given in brackets . Other numbers are inter- and ekstrapolations of official data for countries not having reported for all years

TABLE 3. Emissions of Ammonia. Unit: 10^3 tonnes (NH_3) per annum.

		1980	1985	1986	1987	1988	1989	1990	1991	1992
AL	Albania	(30)	(30)	(30)	(30)	(30)	(30)	(30)	(30)	(30)
AT	Austria	(85)	(85)	(85)	(85)	(85)	(85)	(85)	(85)	(85)
BE	Belgium	(110)	(110)	(110)	(110)	(110)	(110)	(110)	(110)	(110)
BG	Bulgaria	(126)	(126)	(126)	(126)	(126)	(126)	(126)	(126)	(126)
CS	Czechoslovakia	(203)	(203)	(203)	(203)	(203)	(203)	(203)	(203)	(203)
DK	Denmark	152	152	152	152	149	146	140	134	134
FI	Finland	43	43	43	43	43	43	42	42	42
FR	France	(772)	(772)	(772)	(772)	(772)	(772)	(772)	(772)	(772)
DD	German Dem Rep.	420	420	420	420	420	420	420		
DE	Germany, Fed. Rep.[1]	870	870	870	870	870	870	870	1290	1290
GR	Greece	(78)	(78)	(78)	(78)	(78)	(78)	(78)	(78)	(78)
HU	Hungary	170	170	170	170	170	170	170	170	170
IS	Iceland	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
IE	Ireland	(168)	(168)	(168)	(168)	(168)	(168)	(168)	(168)	(168)
IT	Italy	(410)	(410)	(410)	(410)	(410)	(410)	(410)	(410)	(410)
LU	Luxembourg	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)
NL	The Netherlands	251	252	253	254	254	244	234	234	234
NO	Norway	37	37	37	37	37	37	37	36	36
PL	Poland	550	550	550	550	550	550	550	508	508
PT	Portugal	(70)	(70)	(70)	(70)	(70)	(70)	(70)	(70)	(70)
RO	Romania	(371)	(371)	(371)	(371)	(371)	(371)	(371)	(371)	(371)
ES	Spain	(342)	(342)	(342)	(342)	(342)	(342)	(342)	(342)	(342)
SE	Sweden	54	54	54	54	54	54	54	54	54
CH	Switzerland	62	60	60	61	61	61	61	61	61
TR	Turkey[2]	(415)	(415)	(415)	(415)	(415)	(415)	(415)	(415)	(415)
GB	United Kingdom	(467)	(467)	(467)	(467)	(467)	(467)	(467)	(467)	(467)
BY	Byelorussia	(257)	(257)	(257)	(257)	(257)	(257)	(257)	(257)	(257)
UA	Ukraina	(926)	(926)	(926)	(926)	(926)	(926)	(926)	(926)	(926)
MD	Moldovia	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)
RU	Russia	(1699)	(1699)	(1699)	(1699)	(1699)	(1699)	(1699)	(1699)	(1699)
EE	Estonia	(31)	(31)	(31)	(31)	(31)	(31)	(31)	(31)	(31)
LV	Latvia	(61)	(61)	(61)	(61)	(61)	(61)	(61)	(61)	(61)
LT	Lithuania	(89)	(89)	(89)	(89)	(89)	(89)	(89)	(89)	(89)
SI	Slovenia	(20)	(20)	(20)	(20)	(20)	(20)	(20)	(20)	(20)
HR	Crotia	(37)	(37)	(37)	(37)	(37)	(37)	(37)	(37)	(37)
BA	Bosnia & Hercegovina	(36)	(36)	(36)	(36)	(36)	(36)	(36)	(36)	(36)
YU*	Yugoslavia[3]	(117)	(117)	(117)	(117)	(117)	(117)	(117)	(117)	(117)
REM	Remaining areas[2]	(56)	(56)	(56)	(56)	(56)	(56)	(56)	(56)	(56)
BAS	The Baltic Sea	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NOS	The North Sea	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
ATL	Rem. Atlantic Waters	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
MED	The Mediteranian[2]	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
BLS	The Black Sea	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NAT	Biogenic sea emissions	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	TOTAL	**9644**	**9643**	**9644**	**9646**	**9643**	**9630**	**9613**	**9564**	**9564**
SU	Soviet-Union[2,4]	(3113)	(3113)	(3113)	(3113)	(3113)	(3113)	(3113)	(3113)	(3113)
YU	Yugoslavia[5]	(210)	(210)	(210)	(210)	(210)	(210)	(210)	(210)	(210)

1. Also include German Dem. Rep in 1991 and 1992
2. The Part inside the EMEP domain of calculation.
3. Former Yugoslavia excluding Slovenia, Croatia, Bosnia and Hercegovina.
4. Sum of BY,UA, MD, RU, EE, LV and LT which also is included above.
5. Sum of SI, HR, BA an d YU* which also is included above.

Data that have been officially submitted are underlined. Data estimated by MSC-W/CCC are given in brackets . Other numbers are inter- and ekstrapolations of official data for countries not having reported for all years

FIGURE 2. 1991 - emissions of Nitrogen Oxides in each grid square of the EMEP/ MSC-W grid for calculations. Unit: 1000 tonnes per annum as NO_2.

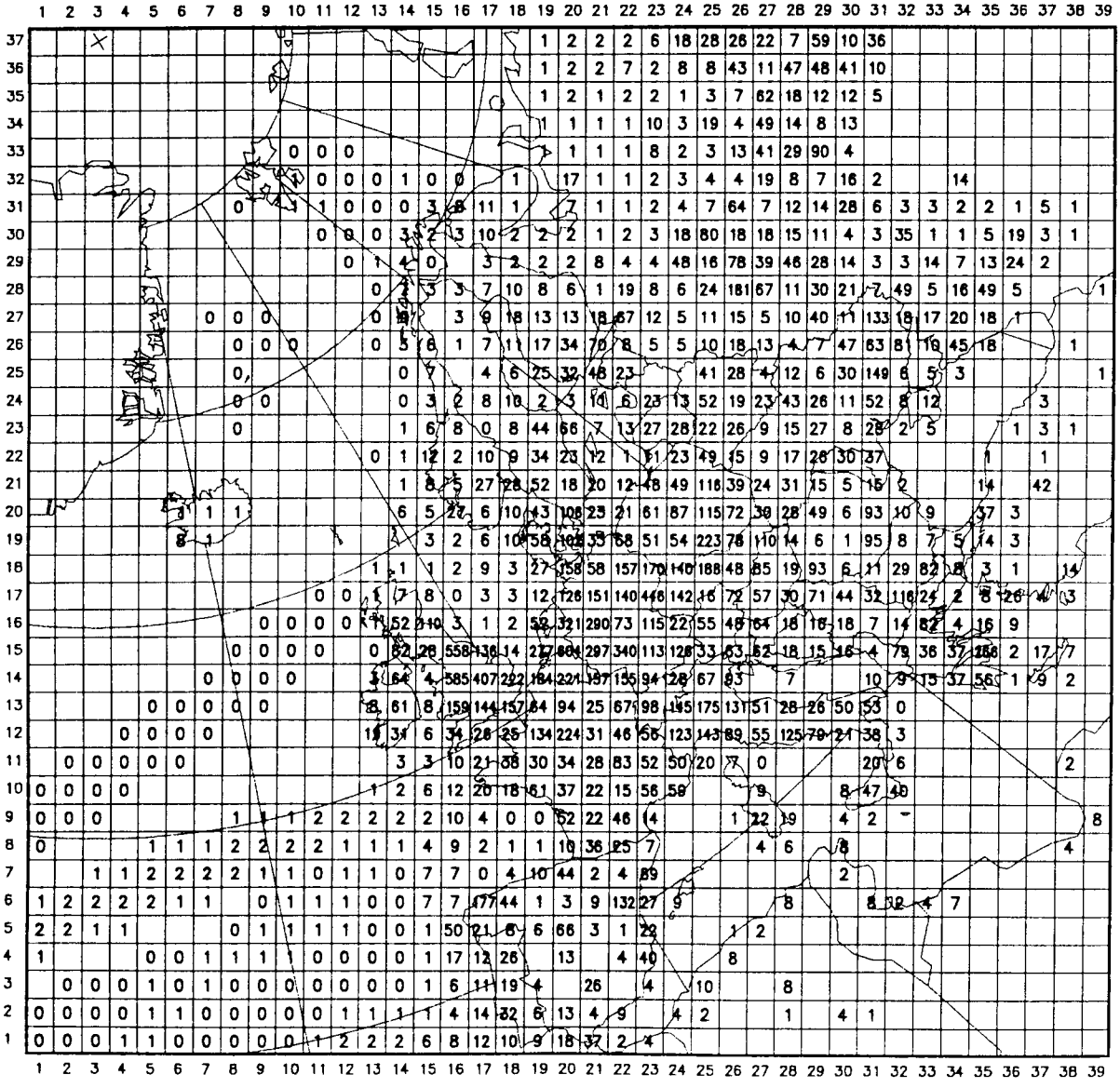
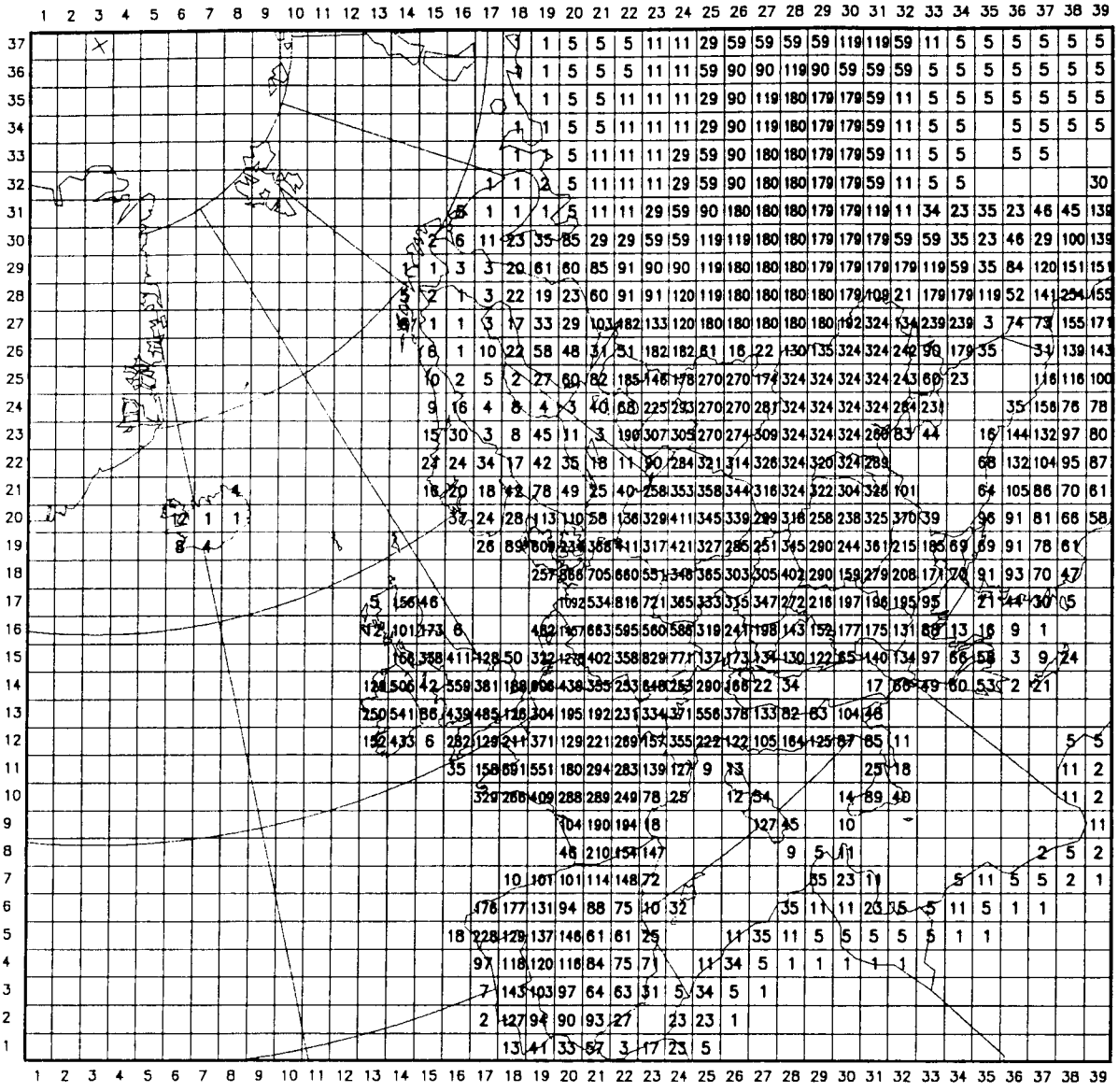


FIGURE 3. 1991 - emissions of Ammonia in each grid- square of the EMEP/MSC-W grid for calculations. Unit: 100 tonnes per annum as NH_3.



2.2 Meteorological Data.

Despite being only a one layer model, the dispersion model requires input of a considerable amount of meteorological data. The main reason for this is the ambition of using actual meteorological data rather than long term climatological information that necessarily must encompass large variabilities in the parameters, and concequently in the coefficients of the equations. Long term, statistical modelling gives with relatively modest resources, semi-quantitative information which may support the development of conceptual ideas on causal questions. In the problem area of "acid rain" such calculations were helpful in the early stage in order to check the possibilities for atmospheric long range transmission of air pollutants (Rodhe, 1972; Bolin and Persson, 1975). Later such models have been used to give a first estimate of long-term behaviour (Venkatram et al., 1982), or as research tools to test complex chemical schemes (e.g. "The Harwell Model", Derwent and Nodop, 1986) or possibilities for transport pathways not considered earlier (e.g. Whelpdale et al., 1988). In order to calculate budgets of deposition allocated to known emission areas, one must design models which have a fair chance to reproduce day to day variations. This is particularly important for components that are water soluble and can be wet deposited by precipitation. Long term, climatic models involving averaged meteorological parameters often oversimplifies this process so that it becomes purely diffusive, while it in reality leads to systematic accumulations. The investigation by Mylona (1989) revealed that interannual variations in meteorological data cause changes in the concentration levels of at least the same size as reported emission reductions. This interannual variability is not taken into account when climatological data are used. Other sources of systematic errors in climatological models are connected with the process of making long term averages. For example taking the time-averaged wind in each point in space (Eulerian mean) does not produce winds that are representative for the mass transport of atmospheric tracers.

There is a balance between the degree of detail that is necessary to include in the model and the quality of input data. The present routine dispersion models at MSC-W is aimed at describing the transport after the emitted pollutants have had time to mix evenly in the atmospheric boundary layer, but before significant mixing into the free troposphere above has taken place. This is supposed to be more or less valid for transport distances from a few hundred to a few thousand kilometers, and concentrations averaged over 1-2 days are representative measures. Presently the models take meteorological information every 6 hours with a spatial resolution of 150 km. This is in fair accordance with the required accuracy as described above.

The meteorological data needed are summarized in Table 4. Most of the data are taken from the Numerical Weather Prediction model in routine at The Norwegian Meteorological Institute. Through four-dimensional data assimilation such a routine combines, in an optimal way, meteorological observations with short term model predictions (Hollingsworth, 1987). Thus, observations are included in a way that does not contradict the physical laws of nature.

Table 4: Meteorological data presently used for routine dispersion modelling at MSC-W of EMEP

Physical Parameter		Level	Period between Input	Purpose	Source
v	Advection wind	$\sigma = 0.925$ $z \approx 750$m	6 hours	Horizontal transport, trajectories.	NWP-model
H_M	Height of mixed layer	above ground	24 hours (12 UTC)	Initial dilution of emissions	Analysed observations
P	Grid element average precipitation	ground	6 hourly accumulated	Wet deposition	Ocean: NWP-model Land: An. Obs.
w	Vertical velocity	$\sigma = 0.850$ $z \approx 1500$m	6 hours	Free troposphere exchange	NWP-model
p_s	surface pressure	$\sigma = 1.$ (z = 0m)	6 hours	Air density at the surface	NWP-model
T_2	Temperature in surface air	z = 2m	6 hours	Aerodynamic resistance to dry dep.	NWP-model
τ	Turbulent stress	Surface layer	6 hours	Aerodynamic resistance to dry dep.	NWP-model
H_d	Turbulent heat flux-density	Surface layer	6 hours	Aerodynamic resistance to dry dep.	NWP-model
C	Cloud cover	Free troposphere	6 hours	Photolysis rate of NO_2	NWP-model
T	Temperature in mixed layer	$\sigma = 0.925$ $z \approx 750$m	6 hours	Chemical reaction rates	NWP-model
U	Relative humidity	$\sigma = 0.925$ $z \approx 750$m	6 hours	Ammonium nitrate equlibrium	NWP-model

The NWP model is formulated in terrain-following " σ-coordinates". It carries prognostic equations for surface pressure, wind, temperature, water vapor and liquid water, and a diagnostic equation (the hydrostatic equation) for the height of the coordinate surfaces. In the version employed in the EMEP work, it is run with 150 km grid resolution with the EMEP grid as a subgrid. The model has 10 layers in the vertical, and includes a physical package with turbulent diffusion in the atmospheric boundary layer, stratiform and convective precipitation, and short- and long-wave radiation. The data assimilation cycle is 6 hours, and geopotential height, horizontal wind, and relative humidity is analysed from observations. More infor-

mation about the NWP model is given by Grønås and Hellevik (1982), Grønås and Midtbø (1986) and Nordeng (1986). In addition to the fields from the NWP model, the dispersion model employes fields for the height of the daytime well mixed layer analysed from vertical soundings every 1200 GMT. In Europe this approximates the afternoon maximum mixing height. Furthermore, since quantitative precipitation still is connected with considerable uncertainties, six-hourly precipitation amounts are analysed from observations over continental regions. Over oceans, however, model estimates are fully used, due to lack of reliable observations.

3. MODEL FORMULATION .

The model calculates concentrations averaged over the well mixed layer. Thus it is a one-layer model, and it calculates the horizontal transport by the Lagrangian approach. The mass balance for pollutants is calculated for air parcels following the motion along air pathway trajectories. The model is receptor oriented, trajectories that are four days long and end up in a selected set of receptor points every six hours. Points along the trajectories are determined with two-hourly intervals, hence each trajectory is defined by 49 points in space. The algorithm used for trajectory calculation given the horizontal wind is taken from Petterssen (1956), and is also summarized in the report of the OECD-project (OECD, 1979). Presently there are 1288 arrival points, 133 are measurement sites in Europe while 1155 are points in a rectangular grid of size 33 times 35 with resolution 150 km. There are 10 chemical components in the model (NO, NO_2, PAN, HNO_3, NO_3^-, NH_4NO_3, NH_3, SO_2, $SO_4^=$, $[(NH_4)_2SO_4 + NH_4HSO_4] / 2 \equiv (NH_4)_{1.5} SO_4$). Concentrations and depositions are allocated to 52 subregions in Europe, including a subdivition of different sea areas, the European part of thr earlier USSR are divided into 10 subareas, former Yugoslavia are divided into 5 subareas and former Czechoslovakia are divided into 2 subareas (more details in section 5.2). In Figure 4 the chemical scheme is outlined.

Important features of the model is the parameterisation of sub-grid scale effects of the precipitation scavenging which permits somewhat longer transport distances for pollutants that are scavenged. Background concentrations are as far as possible taken from measurements. The ozone concentrations from Isaksen and Hov (1987), which is an input parameter, has been adjusted to fit better with known measurements. The model does not include any background concentrations in precipitation. This probably leads to some underestimation of wet deposition which will be of some importance in remote areas in Europe, where the wet part of the deposition dominate over the dry.

3.1 Equations.

All concentations are assumed to be given as number densities with unit molecules/cm^3. The number density of a calculated chemical component is denoted by its chemical symbol within

a square bracket. The rate of change of a variable qi with respect to time experienced in an air parcel, is denoted by the material derivative Dq_i/dt:

$$\frac{Dq_i}{Dt} = \frac{\partial q_i}{\partial t} + \mathbf{v} \cdot \nabla q_i \qquad (1)$$

where i=1 .... 10 different components, t is time, $\partial/\partial t$ is the partial derivative, v is the horizontal advection wind ($\mathbf{v}=u\mathbf{i}+v\mathbf{j}$), and ∇ is the horizontal gradient ($\nabla q = \mathbf{i}\partial/\partial x + \mathbf{j}\partial/\partial y$)

In the following, the height of the air parcel is denoted by h, emissions by Q, dry deposition speed by v_d, wet scavenging ratios by Λ, chemical reaction coefficients by k, and photolysis rates by J. Subscripts are added to this notation to signify components and processes. Concentrations of components that are not calculated but given as external parameters are underlined and not put in square brackets.

All continuity equations for components which are not wet scavenged, are in the following standard form:

$$\frac{Dq_i}{Dt} = -\kappa_d \cdot q_i + A \qquad (2)$$

where the decay coefficient in general can be written as $\kappa_d = v_d/h + k_i$, and the inhomogeneous term as $A = Q/h + k_j q_j$, where q_j is the number density of any of the 10 components except q_i ($i \neq j$). Assuming a time-step Δt short enough to approximate κ and A as constants over the interval [t, t+Δt], the solution is

$$q_i(t+\Delta t) = \frac{A}{\kappa_d} + \left(q_i(t) - \frac{A}{\kappa_d}\right) \cdot \exp(-\kappa_d \cdot \Delta t) \qquad (3)$$

where q_i is the number density of the component in question. The model employes a time step Δt=15 min.

For components that are washed out by precipitation, the sub-grid scale distribution of the precipitation is taken into account. Depending on the total grid square averaged precipitation amount P, the probability of being hit by precipitation when $P > 0$ is Φ . Thus, even if $P > 0$, a part (1- Φ) of the grid square is not hit by precipitation, and pollutants in that part will not be depleted due to wet scavenging. This therefore extends the possible transport length of pollutants being washed out by precipitation. In section 3.4 this is outlined in further detail. The continuity equations for components that are scavenged by precipitation can be summarized in a standard form:

$$\frac{D^2 q_i}{dt^2} + (\kappa_d + \kappa_w) \cdot \frac{Dq_i}{dt} = -\kappa_d \kappa_w q_i + (\Phi \kappa_d + (1-\Phi) \cdot \kappa_w) \cdot A \qquad (4)$$

where D^2q_i/dt^2 is the second order individual derivative, κ_d and A are as above, and $\kappa_w = \kappa_d + \Lambda \cdot P/\Phi \cdot h$. If, as above all coefficients are assumed constant over [t,t+ Δt], the solution

$$q_i(t+\Delta t) = \Phi \cdot \left(\frac{A}{\kappa_w} + \left(q_i(t) - \frac{A}{\kappa_w} \right) \cdot \exp(-\kappa_w \cdot \Delta t) \right)$$

$$+ (1-\Phi) \cdot \left(\frac{A}{\kappa_d} + \left(q_i(t) - \frac{A}{\kappa_d} \right) \cdot \exp(-\kappa_d \cdot \Delta t) \right) \qquad (5)$$

In the following, values for the coefficients are given for each component. Table 5 defines all the important parameters that enter into the model equations.

3.1.1 Nitrogen Monoxide, NO

NO is neither wet nor dry deposited. The time-integration follows Eq. (3), with q = [NO].

$$A(NO) = \frac{(1-\varepsilon) \cdot Q_{NOx}}{h} + J_{NO2}[NO_2] \qquad (6)$$

$$\kappa_d(NO) = k_{11} \cdot \underline{O}_3$$

3.1.2 Nitrogen Dioxide, NO_2

Nitrogen dioxide is not wet scavenged, and the time-evolution is described by Eq. (3), with $q = [NO_2]$.

$$A(NO_2) = \frac{\varepsilon(1-\gamma) \cdot Q_{NOx}}{h} + k_{11}\underline{O}_3[NO] + \Delta[PAN] \qquad (7)$$

$$\kappa_d(NO_2) = J_{NO2} + k_{12}\underline{OH} + k_{77}\underline{CH_3COO_2} + 2k_{12}\underline{O}_3 + \frac{v_{dNO2}}{h}$$

3.1.3 *Nitric Acid, HNO_3*

Nitric acid in the gas phase is efficiently dry and wet scavenged, and the time-evolution is described by Eq. (5), with $q = [HNO_3]$.

$$A(HNO_3) = k_{21}\underline{OH}_3[NO_2] + \frac{q_a}{2} \cdot [NO_3^-] \tag{8}$$

$$\kappa_d(HNO_3) = q_a + \frac{v_{dH}}{h}$$

$$\kappa_w(HNO_3) = \kappa_d(HNO_3) + \frac{\Lambda_H \cdot P}{\Phi \cdot h}$$

The solution of (5) with these parameters does not contain all processes involving HNO_3. The obtained concentration can be further modified by an equilibrium reaction between HNO_3 and NH_3 to form or dissolve NH_4NO_3. This process is described in section 2.2.

3.1.4 *Peroxyacetyl Nitrate, PAN*

PAN is not wet scavenged, and the time-evolution is described by Eq. (3), with $q = [PAN]$.

$$A(PAN) = k_{77}\underline{CH}_3\underline{CO}\underline{O}_2[NO_2] \tag{9}$$

$$\kappa_d(PAN) = \Delta + \frac{v_{dP}}{h}$$

3.1.5 *Particulate Nitrate, NO_3^- (not including ammonium nitrate)*

Nitrate in the particulate phase is efficiently wet scavenged, and the time-evolution is described by Eq. (5), with $q = [NO_3^-]$.

$$A(NO_3^-) = 2k_{12}\underline{O}_3[NO_2] + q_a \cdot [HNO_3] \tag{10}$$

$$\kappa_d(NO_3^-) = \frac{q_a}{2} + \frac{v_{dN}}{h}$$

$$\kappa_w(NO_3^-) = \kappa_d(NO_3^-) + \frac{\Lambda_N \cdot P}{\Phi \cdot h}$$

3.1.6 *Sulphur Dioxide, SO_2*

Sulphur dioxide is wet scavenged, and the time-evolution is described by Eq. (5), with $q = [SO_2]$.

$$A(SO_2) = \frac{(1-\alpha-\beta)\cdot Q_{SOX}}{h} \tag{11}$$

$$\kappa_d(SO_2) = k_t + \frac{v_{dq}}{h}$$

$$\kappa_w(SO_2) = \kappa_d(SO_2) + \frac{\Lambda_q \cdot P}{\Phi \cdot h}$$

3.1.7 Particulate Sulphate, $SO_4^=$ (not including ammonium sulphate)

Sulphate in the particulate phase is efficiently wet scavenged, and the time-evolution is described by Eq. (5), with $q = [SO_4^=]$.

$$A(SO_4^{--}) = \frac{\beta \cdot Q_{SOX}}{h} + k_t[SO_2] \tag{12}$$

$$\kappa_d(SO_4^{--}) = \frac{v_{dS}}{h}$$

$$\kappa_w(SO_4^{--}) = \kappa_d(SO_4^{--}) + \frac{\Lambda_S \cdot P}{\Phi \cdot h}$$

3.1.8 Ammonia, NH_3

Ammonia is efficiently dry and wet scavenged, and the time-evolution is described by Eq. (5), with $q = [NH_3]$.

$$A(NH_3) = \frac{(1-\varpi)\cdot Q_{NH3}}{h} \tag{13}$$

$$\kappa_d(NH_3) = \frac{v_{dNH}}{h}$$

$$\kappa_w(NH_3) = \kappa_d(NH_3) + \frac{\Lambda_{NH} \cdot P}{\Phi \cdot h}$$

The local deposition of NH_3 in the emission grid square includes a wet part (see Table 5a), and $\varpi = \varpi_d + \varpi_w$. Since ammonia predominantly is a ground-level area source, it is necessary to correct for the vertical concentration gradient in emission areas before comparing with measurements. Calculated air concentrations are therefore added the amount

$\Delta[NH_3]_A = \varpi_d Q_{NH3}/v_{dNH}$, and calculated concentrations in precipitation the amount $\Delta[NH_3]_L = \varpi_w Q_{NH3}/P$.

Equations (5) and (13) do not include the full chemical pathway for NH_3. If available, it will combine with $SO_4^=$ to form ammonium sulphate immediately. If there still is some ammonia left after this reaction, it enters into equilibrium with HNO_3 to form or dissolve ammonium nitrate. This is described in section 3.2.

3.1.9 Ammonium Nitrate, NH_4NO_3

Ammonium nitrate is deposited as other nitrate particles, and the time-evolution is described by Eq. (5), with $q = [NH_4NO_3]$.

$$A(NH_4NO_3) = 0 \tag{14}$$

$$\kappa_d(NH_4NO_3) = \frac{v_{dN}}{h}$$

$$\kappa_w(NH_4NO_3) = \kappa_d(NH_4NO_3) + \frac{\Lambda_N \cdot P}{\Phi \cdot h}$$

Other sources and sinks for ammonium nitrate is the equilibrium reaction between NH_3 and HNO_3 to form or dissolve NH_4NO_3, section 3.2.

3.1.10 Ammonium Sulphate, $(NH_4)_{1.5}SO_4$

Ammonium sulphate may occur in two forms, $(NH_4)_2SO_4$ and NH_4HSO_4. An assumption in the model is that the concentrations of these two forms are equal, and the sum of the two components is the modelled ammonium sulphate with the chemical notation as above. Ammonium sulphate is deposited as other sulphate particles, and the time-evolution is described by Eq. (5), with $q = [(NH_4)_{1.5}SO_4]$.

$$A((NH_4)_{1.5}SO_4) = 0 \tag{15}$$

$$\kappa_d((NH_4)_{1.5}SO_4) = \frac{v_{dS}}{h}$$

$$\kappa_w((NH_4)_{1.5}SO_4) = \kappa_d((NH_4)_{1.5}SO_4) + \frac{\Lambda_S \cdot P}{\Phi \cdot h}$$

The source for ammonium sulphate is the instantaneous reaction between NH_3 and $SO_4^=$, as described in section 3.2.

TABLE 5. DEFINITION OF PARAMETERS IN THE EQUATIONS.

Table 5.A : EMISSIONS

Symbol	Definition	Reference	Value
Q_{sox}	Emission of sulphur oxides (SO_x) per unit area and time	Section 2.1.1	Seasonal sine-variation imposed by a factor: max=1.33 (Jan.), min=0.67 (July)
α	fraction of SO_x-emission deposited locally in emission grid square		0.15
β	fraction of SO_x emitted directly as particulate sulphate		0.05
Q_{nox}	Emission of nitrogen oxides (NO_x) per unit area and time	Section 2.1.2	Seasonal sine-variation, stationary part only: max=1.33 (Jan.), min=0.67 (July)
γ	fraction of NO_2-emission deposited locally in emission grid square		0.04
ε	fraction of NO_x emitted as NO_2		0.05
Q_{nh3}	Emission of ammonia per unit area and time	Section 2.1.2	Seasonal sine-variation imposed by a factor: max=1.30 (June), min=0.70 (Jan.)
ϖ	fraction of NH_3-emission deposited locally in emission grid square		$\varpi = \varpi_w + \varpi_d$ $\varpi_d = 0.19$ $\varpi_w = \varpi_d \cdot P/[P+(v_{dNH}/\Lambda_{NH})]$ $\varpi_{max} = 2 \cdot \varpi_d$

Table 5.B : PRESCRIBED FIELDS

Symbol	Definition	Reference	Value
$\underline{O_3}$	prescribed ozone concentration.	(Isaksen and Hov, 1987) (Logan, 1985) section 3.3	See Table 8
$\underline{OH}$	prescribed hydroxyl concentration	(Isaksen and Hov, 1987) section 3.3	See Table 8
$\underline{CH_3COO_2}$	prescribed peroxyacetyl radical concentration	(Isaksen and Hov, 1987) section 3.3	See Table 8

Table 5.C : CHEMISTRY

Symbol	Definition	Value
Δt	time step for chemical processes	15 min.
J_{NO2}	dissociation rate for the reaction : $NO_2 + h\nu \rightarrow NO + O$	calculated as a function of latitude, time of year, local time, and cloud cover (a complete cloud cover will reduce J_{NO2} by 50%); $J_{NO2} = a(1-C/2) \exp(-b \sec\theta)$; $a=0.01s^{-1}$, b=0.39, C is fractional cloud-cover, and θ the sun's zenit angle
k_{11}	speed of reaction $NO + O_3 \rightarrow NO_2 + O_2$	$k_{11} = a_{11} \exp(-b_{11}/T)$; $a_{11}=2.1\ 10^{-12}\ cm^3s^{-1}molecule^{-1}$, $b_{11}=1450$ K
k_{12}	speed of net model reaction $2\ NO_2 + O_3 + H_2O \rightarrow 2\ NO_3^- + 2\ H^+ + O_2$ which only takes place in darkness according to the following steps: $NO_2+O_3 \rightarrow NO_3+O_2$ $NO_3+NO_2 \leftrightarrow N_2O_5$ $N_2O_5 + H_2O \rightarrow 2NO_3^- + 2H^+$ The first step is assumed rate determining for the net reaction.	$k_{12}=a_{12} \exp(-b_{12}/T)$; $a_{12}=1.2\ 10^{-13}\ cm^3s^{-1}molecule^{-1}$, $b_{12}=2450$ K
k_{21}	speed of model reaction $NO_2 + OH \rightarrow HNO_3$	$k_{21}=1.1\ 10^{-11}\ cm^3s^{-1}molecule^{-1}$
k_{77}	speed of model reaction $NO_2 + CH_3COO_2 \rightarrow PAN$	$k_{77}=3.2\ 10^{-12}\ cm^3s^{-1}molecule^{-1}$
k_t	oxidation rate of SO_2 + (oxidant) $\rightarrow SO_4^=$, where (oxidant) is OH in the gas phase or H_2O_2 and O_3 in the liquid phase; this model reaction parameterizes all possible oxidation pathways of SO_2, and takes indirectly into account the photo-chemical activity creating oxidants as well as occurrence of cloud droplets in which liquid phase oxidation takes place efficiently	$k_t = a_t + b_t \sin[2\pi (\tau - \tau_0)/\tau_a]$, $a_t=3\ 10^{-6}s^{-1}$, $b_t=2\ 10^{-6}s^{-1}$, τ=time of year, τ_0=80days, τ_a=1year;
Δ	speed of thermal decomposition of PAN	$\Delta = a_\Delta \exp(-b_\Delta/T)$; $a_\Delta = 7.94\ 10^{14}s^{-1}$, $b_\Delta = 12530$ K
q_a	speed of gas-to-particle reaction $HNO_3 \rightarrow NO_3^-$	$q_a=10^{-5}s^{-1}$; the backward reaction (particle-to-gas) is supposed to be half of that speed

Table 5.D : DEPOSITION

Symbol	Definition	Reference	Value		
			$v_d(z_1)$ over sea	$v_d(z_1)$ over land	$v_d(z_2)$
(i) gases					
v_{dNO2}	dry dep. velocity of NO_2	sec. 3.2.4	0 cm/s	$f_d(B,\tau,t) \cdot 0.1$ cm/s	use eq. 27
v_{dp}	dry dep. velocity of PAN	sec. 3.2.4	0 cm/s	$f_d(B,\tau,t) \cdot 0.2$ cm/s	use eq. 27
v_{dH}	dry dep. velocity of HNO_3	sec. 3.2.4	4.0 cm/s	4.0 cm/s	use eq. 27
v_{dNH}	dry dep. velocity of NH_3	sec. 3.2.4	0.8 cm/s	$f_d(B,\tau,t) \cdot 0.8$ cm/s	use eq. 27
v_{dq}	dry dep. velocity of SO_2	sec. 3.2.4	0.8 cm/s	$f_d(B,\tau,t) \cdot 0.8$ cm/s	use eq. 27
(ii) particles					
v_{dN}	dry deposition of NO_3^- and NH_4NO_3	sec. 3.2.4	0.1	0.1	0.1
v_{ds}	dry deposition of $SO_4^=$ and $(NH_4)_{1.5}\,SO_4$	sec. 3.2.4	0.1	0.1	0.1

Table 5.E : SCAVENGING

Symbol	Definition	Value
(i) gases		
Λ_H	wet scavenging ratio for HNO_3	$1.4 \cdot 10^6$
Λ_{NH}	wet scavenging ratio for NH_3	$1.4 \cdot 10^6$
Λ_q	wet scavenging ratio for SO_2	the value is supposed to vary with season to account for variation in H_2O_2 ; $\Lambda_q = 3 \cdot 10^5 + 1 \cdot 10^5 \sin[2\pi (\tau - \tau_0)/\tau_a]$, see note on k_t in table 5.C
(ii) particles		
Λ_N	wet scavenging ratio for NO_3^- and NH_4NO_3	$1.0 \cdot 10^6$
Λ_s	scavenging ratio for $SO_4^=$ and $(NH_4)_{1.5}\,SO_4$	$1.0 \cdot 10^6$

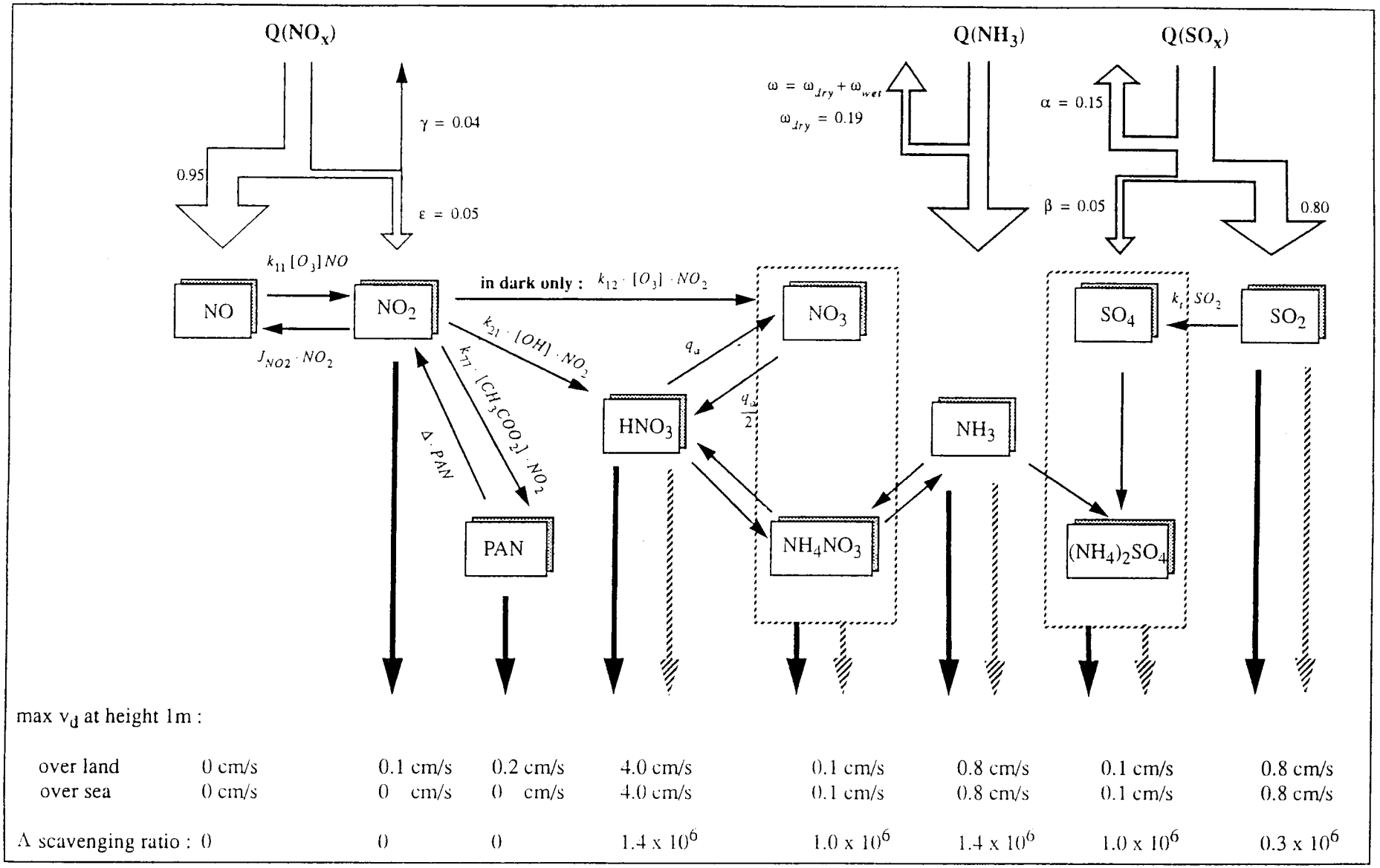


Figure 4. Overview of the chemical sceme. The 10 components inside solid boxes are calculated by the model. Species denoted in brackets are prescribed. The two dashed boxes denote nitrate and sulphate particles, which both occur in two different forms in the model.

3.2 Other Processes

The chemical processes described in section 3.1 are not complete. Two nonlinear reactions that can not be described as terms in the differential equations, are also included.

3.2.1 Production of Ammonium Sulphate

The formation of $(NH_4)_{1.5}SO_4$, which is not included in eq. (15), is assumed to take place instantaneously and irreversibly after each timestep of 15 min. Starting with the concentrations of NH_3 and $SO_4^=$ obtained from the stepping of eq. (5) with proper coefficients, ammonium sulphate is formed by assuming 3 molecules of NH_3 combine with two molecules of $SO_4^=$ to form two molecules of $(NH_4)_{1.5}SO_4$. This process goes on until there is either no ammonia left or no $SO_4^=$ left.

3.2.2 Production and Loss of Ammonium Nitrate

If any ammonia is left in the air after the instantaneous ammonium sulphate production, it enters into equilibrium with HNO_3 to form or dissolve ammonium nitrate. The equilibrium coefficient, K, is dependent on temperature ,T, and relative humidity, U. If the gases are in equilibrium with the ammonium nitrate particles, we have

$$[NH_3]_e\,[HNO_3]_e = K \tag{16}$$

where e denotes equilibrium concentrations. If the actual, non-equilibrium concentrations (denoted by ne) gives a product larger than K, then ammonium nitrate particles are created until equilibrium is reached. Otherwise, if the product between the gas concentrations is smaller than K, then ammonium nitrate particles are dissolved until equilibrium is reached if there are enough particles available. Given the non-equilibrium concentrations, the equilibrium is calculated by assuming

$$[NH_3]_e + [NH_4NO_3]_e = [NH_3]_{ne} + [NH_4NO_3]_{ne}$$

and (17)

$$[HNO_3]_e + [NH_4NO_3]_e = [HNO_3]_{ne} + [NH_4NO_3]_{ne}$$

in addition to eq. (16). Thus the sum of reduced nitrogen as well as of oxidised nitrogen are conserved in the process. These three equations with three unknowns are combined to give a quadratic equation for $[NH_3]_e$ with the following physical solution

$$[NH_3]_e = ([NH_3]_{ne}+[HNO_3]_{ne})/2 + [\,([NH_3]_{ne}+[HNO_3]_{ne})^2/4 + K\,]^{1/2} \tag{18}$$

The remaining two equilibrium concentrations are taken from (16) and one of the equations in (17). If the thus obtained ammonium nitrate concentration is negative, then there was not enough available to reach equilibrium, and the final concentrations then are zero for

ammonium nitrate, and the sum of the non-equilibrium gas and the particle concentrations for ammonia and nitric acid, are completely converted to the gaseous phase.

The equilibrium coefficient depends on temperature and relative humidity in the following manner. The point of delisquiscence for a given temperature is given by

$$\ln U_d = a_d/T + b_d \tag{19}$$

where a_d=856.23 K, T is the absolute temperature in the mixed layer, and b_d=1.2306 if U_d is given in % (b_d=-3.3746 if U_d is given with unit 1). The equilibrium coefficient at the point of delisquiscence is given by

$$\ln K_d = a_K - b_K/T - c_K \ln(T/d_K) \tag{20}$$

where it is assumed that K_d is given in units of (molecules per $cm^3)^2$, and a_K=70.78, b_K=24220K, c_K=6.1, and d_K=298K. If K also is assumed given in units of (molecules per $cm^3)^2$, the formula for its calculation is

$$\ln K = \begin{cases} \ln K_d & \text{for } U < Ud \\ \ln K_d - \left(\dfrac{20.75 + \ln K_d}{U_0 - U} \cdot \dfrac{U - U_d}{U_0 - U_d} \right) & \text{for } U \geq Ud \end{cases} \tag{21}$$

where U_0=101 and U and U_d are in units of %.

3.2.3 Free Troposphere Exchange

Even though the model is designed for calculating transport as long as the major part of the pollutants exist inside the well mixed layer, exchange with the free troposphere above must be included since it may be important for transport to the more remote parts of Europe. The mechanism is described in Eliassen and Saltbones (1983). In the present model version, the height of an air parcel starts out as the height, $H_M(t_1)$, of the well mixed layer at time t_1=1200 UTC in the point where it is situated. As the air parcel moves along its trajectory $\mathbf{r}(t)$ with time t, the height may change as a consequence of vertical motion in accordance with horizontal divergence and convergence, so that the volume is concerved. After 24 hours at time t_2, its height is

$$h(\mathbf{r}((t_2),t_1)) = H_M(\mathbf{r}((t_2),t_1)) + \int_{t_1}^{t_2} w_r(\mathbf{r}((t),t)) \tag{22}$$

where w_r is the vertical velocity on top of the mixed layer estimated from the value from the NWP-model given in Table 4 through

$$w_r(\mathbf{r},t) = \begin{cases} w(\mathbf{r},t) & \text{for } h \geq H_{1000} \\ w(\mathbf{r},t) \cdot \dfrac{h(\mathbf{r},t)}{H_{1000}} & \text{for } h < H_{1000} \end{cases} \tag{23}$$

so that the vertical velocity is reduced linearly for heights below $H_{1000} = 1000$ m. At the time t_2 the air parcel height is redefined to equal the local mixing height, $H_M(\mathbf{r}(t_2),t_2)$, at its new position $\mathbf{r}(t_2)$. Through this redefinition, the free tropospheric exchange is modelled as follows. If $q(t_2)$ is the concentration of a species in the boundary layer after integration of the above equations and the prescribed free troposphere concentration is q_a, then the new concentration after exchange is

$$q_2 = \begin{cases} q(\mathbf{r}(t_2),t_2) & \text{for } H_M \leq h \\ q_a + (q(\mathbf{r}(t_2),t_2) - q_a) \cdot \dfrac{h(\mathbf{r}(t_2),t_2)}{H_M} & \text{for } H_M > h \end{cases} \tag{24}$$

In both cases, the redefined height of the air parcel is $H_M(\mathbf{r}(t_2),t_2)$.

3.2.4 Dry deposition

The dry deposition of gases that stick to the ground surface is controled by the chemical / biochemical affinity between the gas and the surface, the molecular diffusion through the laminar sublayer very close to the ground, and the turbulent diffusion in the surface boundary layer. The dry deposition speeds for gases frequently given in the scientific literature includes the two first mentioned effects, and thus is valid on top of the laminar sublayer which typically has a thickness of several decimeters. We assume this height to be 1 m over the ground. As indicated in Table 5, the 1 m dry deposition speed for some of the gases varies considerably according to their water solubility. Thus, NO_2 and PAN is not dry deposited over water, while SO_2, HNO_3 and NH_3 is most efficiently over water. Dry deposition over non- melting snow is known to be slow for some gases (Whelpdale and Shaw, 1974; Dovland and Eliassen, 1976), and this effect also coincides with the annual variation of biochemical uptake of vegetation which also has a diurnal cycle. Over land these two effects have been roughly taken into account through the formula:

$$v_d(B, \tau, t) = a_1(\tau) \cdot \Delta(t) \cdot v_{dmax} + a_2(\tau) \cdot f(B) \cdot v_{dmax} = f_d(B,\tau,t) \cdot v_{dmax} \tag{25}$$

where $v_d(B, \tau, t)$ is the dry deposition speed at height 1 m, latitude B, time of year τ, and time of day t. The parameter v_{dmax} is the maximum summertime dry deposition speed at 1m. f(B) is a function that give a variation with latitude f(B) = r/R, where r is the distance from the actual position to the north pole, and R is the distance between equator and the north pole. At the equator f(B) = 1 whilst at the north pole f(B)=0. The factor $\Delta(t)$ takes into account the diurnal variation of biochemical uptake, and equals to 1 during daytime (04-22 Loc. T.) whereas at night it is 0.25. The factors a_1 and a_2 are squared trigonometric functions:

$$a_1(\tau) = \sin^2[\pi(\tau-\tau_0)/\tau_a]\,; \qquad a_2(\tau) = \cos^2[\pi(\tau-\tau_0)/\tau_a] \tag{26}$$

where τ_0 is 1. February and τ_a is one year. The function f_d is shown in Figure 5 for daytime conditions. Note that according to eq. (25), the wintertime dry deposition speed does not vary with the time of day. Eq. (25) is applied to NO_2 (v_{dmax}=0.1 cm/s), PAN (v_{dmax}=0.2 cm/s), NH_3 (v_{dmax}=0.8 cm/s), and SO_2 (v_{dmax}=0.8 cm/s). The value 0.1 cm/s for NO_2 is in accordance with estimates presented by Johansson (1987) where the deposition velocity is shown to be dependent on the concentration level. The concentrations occuring in connection with long range transport in Europe suggest values close to the one chosen here.

The model calculated concentrations are supposed to represent the well mixed layer, and therefore cannot be combined with the 1 m dry deposition speed without reducing its value according to the aerodynamic resistance determined by the turbulence in the surface boundary layer. This is done by applying the similarity theory for the constant flux layer which is about 50 m thick. According to this theory, the dry deposition speed in two different levels z_1 and z_2 relate to each other through the formula:

$$v_d(z_2) = \frac{v_d(z_1)}{1 + \frac{v_d(z_1)}{\kappa u_*} \cdot \left(\Psi\left(\frac{z_2}{L}\right) - \Psi\left(\frac{z_1}{L}\right)\right)} \tag{27}$$

In this case z_1 = 1m and z_2 = 50 m. The function Ψ represents the dimensionless vertical concentration profile, and we have chosen

$$\Psi(x) = \ln|x| + \begin{cases} -2\ln\left[\dfrac{1 + (1 - 15x)^{1/2}}{2}\right] & \text{for } x < 0 \text{ (unstable)} \\ 5x & \text{for } x \geq 0 \text{ (neutral and stable)} \end{cases} \tag{28}$$

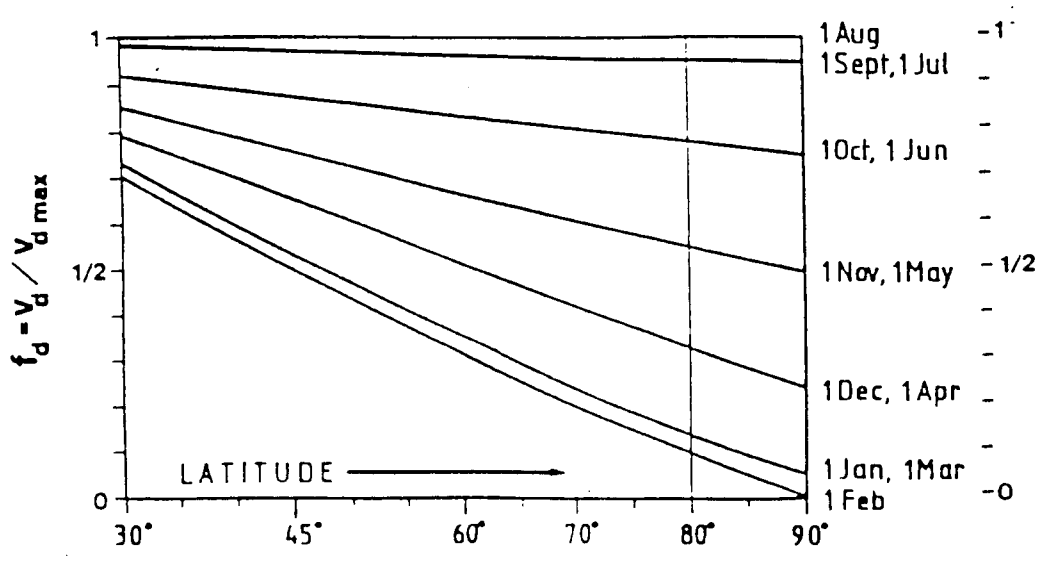


FIGURE 5. The function f_d representing the ratio between the actual daytime dry deposition speed at height 1 m and the maximum, as a function of latitude and season.

The vertical profile of concentration is

$$\frac{q(z_2) - q(z_1)}{q_*} = \Psi\left(\frac{z_2}{L}\right) - \Psi\left(\frac{z_1}{L}\right) \tag{29}$$

Where L and q_* represent the Monin-Obukhov stability length and characteristic concentration, respectively. From the input meteorological data the turbulent stress, τ, the upward heat flux density, H_d, and the absolute temperatur at heigth 2m, T_2, are given. Thus the Monin-Obukhov length can be calculated

$$L = \frac{\left(\frac{\tau}{\rho}\right)^{3/2} \cdot T_2}{\kappa \cdot g \cdot \left(\frac{-H_d}{c_p \cdot \rho}\right)} \tag{30}$$

where $\tau = \rho \cdot u_*^2$, u_* represent friction velocity, $\rho = p_s/RT_2$ is air density, p_s is the ground level pressure, R=287 J K^{-1} kg^{-1}, g = 9.8 m/s^2, c_p = 1004 J K^{-1} kg^{-2}, and κ is the von Karman constant.

The dry deposition speed of particles (sulphate and nitrate) is assumed to be representative for an old aerosol dominated by particles of size a few tenths of a micrometer (accumulation mode). Its value is assumed to be constant equal to 0.1 cm/s.

In reality the dispersion of pollution inside the atmospheric boundary layer is not instantaneous as assumed in the model. During the first phase of dispersion, the ground level concentrations are therefore systematically underestimated, and the dry deposition close to emission sources would accordingly be too small if it was not corrected. The correction is made by assuming that a fraction of the emission is deposited locally inside the same grid square as emitted. The rest of the emission takes part in the long range transport. The value of this fraction depends of the dry deposition speed and the elevation of the emissions above the ground. For SO_2 the value is 0.15, for NO zero, NO_2 0.04, and NH_3 0.19. Note that the dry deposition from a country to itself will depend quite significantly on the value of this fraction deposited locally.

3.3 Background Concentrations

Models like the present which calculates budgets for air transport within a limited part of the atmosphere (the boundary layer over Europe) over a limited time-span (four days long trajectories), phase the problem of deciding initial and boundary conditions. In the present case concentrations of 10 components must be given in the start point of each trajectory, and in the free troposphere adjacent to the atmospheric boundary layer. The origins of these concentration cannot be traced by the model, and thus contributes to concentrations and depositions of indeterminate origins in the final budgets.

Inside the boundary layer the model calculates concentrations inside a rectangular domain consisting of 1155 (=33x35) points (see Fig. 6). Back trajectories starting inside the same domain can use earlier calculated concentrations as initial condition. This procedure called assimilation is now in full use. Thus, prescribed background concentrations inside the boundary layer are only necessary for the whole domain if one starts out without calculations for the preceeding period, and otherwise outside the central domain of concentration calculations.

There are two main sources for data on background concentrations, output from other models and measurement results. For sulphur the concentrations calculated by the eulerian, multilayer, hemispheric-scale model have been used as guidelines (Iversen and Tarrason, 1990). For boundary-layer NO_x and PAN we have made use of the rather extensive measurements reviewed by Fehsenfeld et al. (1988). In the free troposphere measurements are scattered and few, and these concentations have simply been assumed to be a given fraction of their mixed-layer values. For the sum of the three possible forms of nitrate, the number density has been assumed the same as for total sulphate in the boundary layer, and half the total sulphate value in the free troposphere. This rather crude estimate is motivated by the fact that both species are secondary pollutants with emission sources having similar patterns. Nitrate is, however, faster deposited than sulphate so that older pollution, as found above the well mixed layer, should

contain relatively less nitrate than sulphate. Ammonia is very fast depleted in the atmosphere, so the concentration pattern very much follows the emission pattern which is

different from that of sulphur and NO_x because of the rural influence. For ammonia the concentration pattern earlier estimated by the model is used as guideline, together with what is assumed about the emissions. Above the boundary layer the concentrations of ammonia is assumed to be 10% of the boundary layer values.

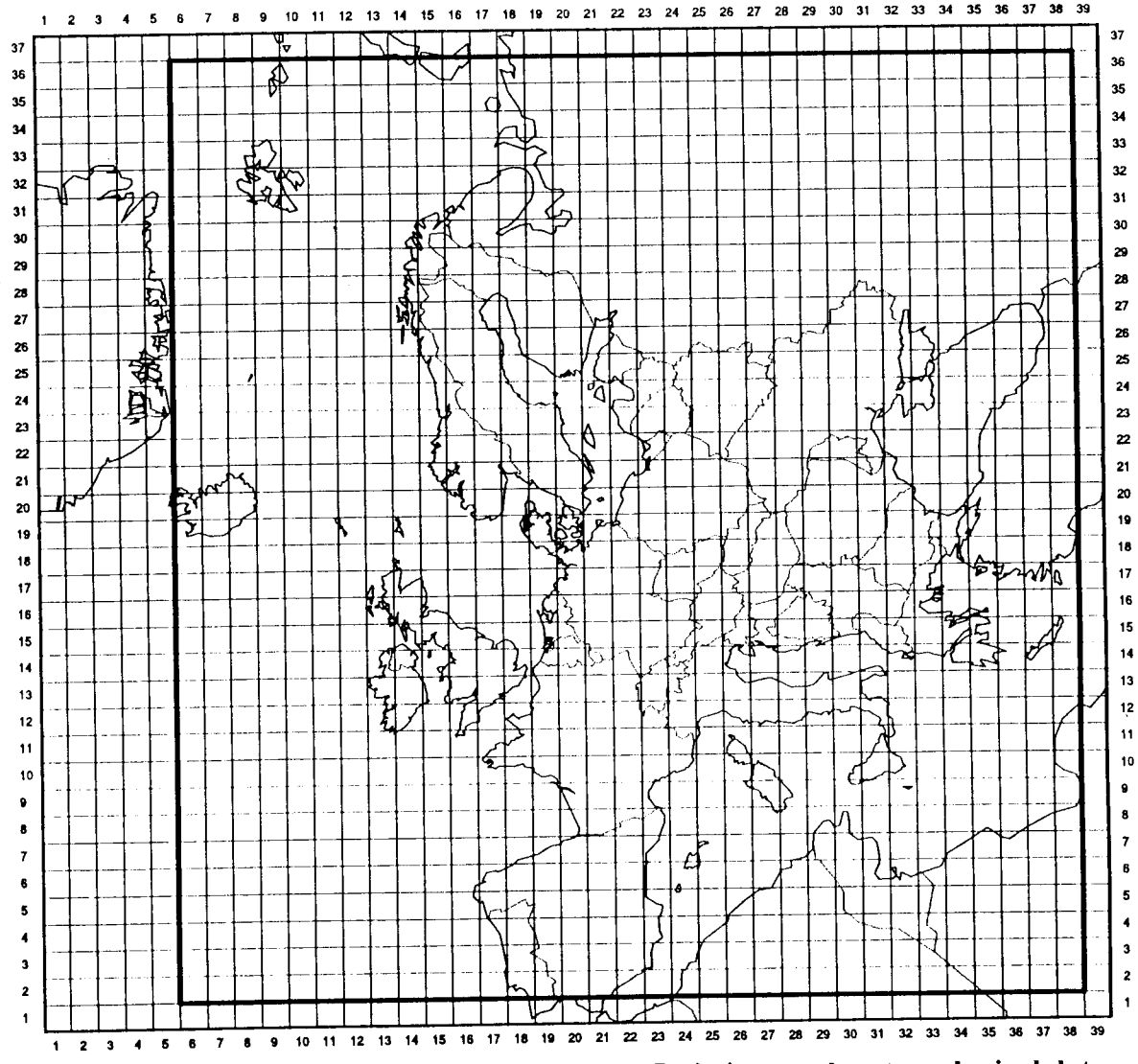


FIGURE 6. Figure 6. The applied grid system. Emissions and meteorological data are given in the entire grid. Concentrations and depositions are calculated in the rectangular subgrid of size 33 by 35. Boundary-layer concentrations are used in the assimilation procedure inside this subgrid.

Background concentrations are estimated on a monthly basis and in areas of different typical state of pollution. For NO_x such areas are central inland Europe, remote inland Europe and Northern Africa, and North Atlantic Ocean. For sulphur which is based on model results, the remote inland is separated into four subregions including the Nordic countries, Northern

Africa, and the part of USSR outside the inner domain of calculation. It leads too far to describe all the possibilities for the background concentrations. Some examples are, however, included in Tables 6 and 7. The speciation of nitrate and sulphate is determined by the immediate turnover and equilibrium described in sections 3.2.1 and 3.2.2.

Specific for the present model is that boundary-layer concentrations of another 3 components must be prescribed to estimate chemical reaction speeds. The model itself does not calculate these concentrations, so they cannot be included in the assimilation procedure. The components are ozone O_3, the hydroxyl radical OH, and the peroxy-acetyl radical CH_3COO_2. Presently their concentrations are varying with season and latitude, and the values are taken from the two-dimensional, global model of Isaksen and Hov (1987). Comparisons with measurements (Logan, 1985) show that the values for ozone are too large, especially during winter and spring and when compared with mountain sites representative of the background atmosphere. The seasonal variation of ozone is consequently reduced with a factor which is constant with latitude, in order to arrive at values that coincide better with observations. Furthermore it is assumed that the minimum ozone mixing ratio never is smaller than 25 ppb. The two radicals are also given a diurnal cycle according two the received sunlight. Table 8 shows employed values for these components.

TABLE 6. Background concentrations in the boundary layer used as initial concentrations for trajectories when assimilation is not possible. Values are shown in a point inside the most polluted subregion, and averaged over the area where assimilation of previous calculations is impossible. Four different months are selected. Units are g m^{-3} as N or S as indicated.

Component		Central Europe (10°E, 51°N)				Average (420points)			
		Jan.	Apr.	Jul.	Oct.	Jan.	Apr.	Jul.	Oct.
NO	N	0.889	0.593	0.296	0.652	0.065	0.065	0.065	0.065
NO_2	N	2.666	1.778	0.889	1.955	0.194	0.194	0.194	0.194
PAN	N	0.711	0.474	0.237	0.521	0.052	0.052	0.052	0.052
SO_2	S	8.584	5.722	5.722	5.722	0.320	0.320	0.228	0.320
NH_3	N	0.424	0.760	0.760	0.561	0.016	0.028	0.035	0.022
HNO_3	N	0.739	0.412	0.412	0.501	0.068	0.066	0.048	0.053
NO_3^-	N	1.751	1.168	1.168	1.168	0.158	0.154	0.113	0.125
NH_4NO_3	N	0.012	0.089	0.089	0.000	0.000	0.000	0.000	0.000
$SO_4^=$	S	0.000	0.000	0.000	0.000	0.009	0.008	0.007	0.008
$(NH_4)_{1.5}SO_4$	S	5.722	3.814	3.814	3.814	0.495	0.484	0.354	0.388

TABLE 7. Background concentrations in the free troposphere above the boundary layer used as ambient concentrations in the interaction between the well mixed layer and the free troposphere. Values are shown in a point inside the most polluted subregion, and averaged over the whole grid. Four different months are selected as examples. Units are g m-3 as N or S as indicated.

Component		Central Europe (10°E, 51°N)				Average (420points)			
		Jan.	Apr.	Jul.	Oct.	Jan.	Apr.	Jul.	Oct.
NO	N	0.355	0.237	0.118	0.260	0.033	0.027	0.021	0.028
NO_2	N	0.829	0.552	0.276	0.608	0.109	0.095	0.082	0.098
PAN	N	0.237	0.158	0.079	0.174	0.116	0.112	0.108	0.113
SO_2	S	0.953	0.953	0.953	0.953	0.491	0.496	0.511	0.511
NH_3	N	0.019	0.047	0.047	0.019	0.003	0.005	0.005	0.002
HNO_3	N	0.063	0.063	0.063	0.063	0.035	0.037	0.037	0.036
NO_3^-	N	0.146	0.146	0.146	0.146	0.083	0.086	0.085	0.084
NH_4NO_3	N	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$SO_4^=$	S	0.000	0.000	0.000	0.000	0.030	0.028	0.027	0.030
$(NH_4)_{1.5}SO_4$	S	0.953	0.953	0.953	0.953	0.453	0.475	0.472	0.459

TABLE 8. Mixing ratios for ozone and number densities of the hydroxyl and peroxy-acetyl radicals. The data shown are valid for January and July for five different latitudes, and the radicals are shown for 0000 and 1200 local time. The variation due to changing solar radiation assumes no cloud cover in this table.

Pos.	January					July				
	O_3 ppb	OH		CH_3COO_2		O_3 ppb	OH		CH_3COO_2	
		0000	1200	0000	1200		0000	1200	0000	1200
80° N	25	0.01	0.01	120.	120.	38	5.38	18.3	14.0	39.8
70° N	25	0.05	0.05	31.0	31.0	35	0.29	28.8	5.34	58.7
60° N	25	0.68	68.2	29.0	320.	41	0.82	82.6	9.01	99.2
50° N	25	1.21	122.	32.2	354.	46	1.41	142.	19.3	212.
40° N	26	1.38	139.	36.5	402.	46	1.58	160.	26.2	288.

3.4 Subgrid Precipitation

The six-hourly accumulated precipitation amounts used in the model for estimating wet scavenging of water soluble compounds, are estimates of grid-area averages. Thus the precipitation P has earlier been assumed to be uniformly distributed over the six-hour period and over the grid square. In reality the precipitation does not behave in such a manner, but shows a patchy distribution with pronounced fluctuations, even over areas of 150 by 150 km and over six hours. This is demonstrated by the scatter plot in Figure 7. Along the ordinate is the modelled (i. e. the objectively analysed) number of days in 1988 with precipitation on the EMEP monitoring stations, and along the abscissa the number of days in 1988 with observed precipitation. It is clearly seen that the modelled, grid-area average over-estimate the frequency of pricipitation in the different points inside the grid square. The meteorological data available for pollution calculations at MSC-W do not include information on the distribution of precipitation on a finer scale than the grid squares over six hours. This subgrid distribution is therefore taken into account statistically. If P is the grid square averaged, six-hourly accumulated precipitation amount, then the probability of precipitation in an arbitrary point in the grid square at a time wihin the six hour interval is a function of P. It is also a function of the geographical position of the grid square and the season, but this is not taken into account at present. We now assume that this probability equals the fraction, ϕ , of the grid square being hit by precipitation during the period.

Furthermore, it is assumed that the precipitation is uniformly distributed within the "wet fraction" of the area. This is a crude approximation, but is far better than assuming uniformity over the whole grid square. Moreover, it is difficult to do anything better without really increasing the space and time resolution of the precipitation fields.

With the above assumptions, the precipitation intensity in the wet fraction is

$$P_W = \frac{P}{\phi} \tag{31}$$

and the pollutant concentration, q, can be expressed as a linear combination between the concentration in the wet and dry fractions:

$$q = \phi \cdot q_w + (1 - \phi) \cdot q_d \tag{32}$$

This subgrid separation of pollution mass is defined by the area where wet scavenging is acting, and there is no physical obstruction for mixing of air between the wet and the dry fraction of the grid square. Hence, it is unphysical to keep the separation between the fractions for a longer time than it normally takes to mix the two subgrid air masses. Depending on the precipitation amount P, one should think of the area fractions in such a way that there are

patches of one of the area fractions within the other like cheese holes (fractal geometry). The mixing therefore should be rather fast. Presently we assume separate budget equations for the two fractions over the model time-step of Δt=15 min, and that they then are intermixed. Now the concentration q_d is only affected by effects not involving wet scavenging, whilst q_w is fully involved in all processes. Using the same notation as in section 2.1, the budget equations for the to subareas over Δt, are

$$\frac{Dq_d}{dt} = -\kappa_d q_d + A$$

and (33)

$$\frac{Dq_w}{dt} = -\kappa_w q_w + A$$

The budget for the average concentration in the whole grid square over Δt is obtained by differentiation of (32) and introducing from (33):

$$\frac{Dq}{dt} = \phi \cdot \frac{Dq_w}{dt} + (1-\phi) \cdot \frac{Dq_d}{dt} = -\kappa_d q - \phi \cdot (\kappa_w - \kappa_d) + A \qquad (34)$$

Differentiating (34) and utilizing the expression for q_w that can be solved for by (34), gives

$$\frac{D^2 q}{dt^2} + (\kappa_w + \kappa_d) \cdot \frac{Dq}{dt} = -\kappa_d \kappa_w q + [\phi \kappa_d + (1-\phi)\kappa_w] \cdot A \qquad (35)$$

where it is assumed that DA/dt = 0. Components that are scavenged by precipitation is assumed to follow eq. (35) with constant coefficients over the time step length Δt. The initial conditions is in accordance with the assumption that there is full intermixing every Δt. The general solution to (35) is then

$$q(t+\Delta t) = \frac{\phi \kappa_d + (1-\phi)\kappa_w}{\kappa_d \kappa_w} \cdot A + C_d \cdot e^{-\kappa_d \Delta t} + C_w \cdot e^{-\kappa_w \Delta t} \qquad (36)$$

The integration constants, C_d and C_w, are determined by the initial conditions that $[q(t+\Delta t)]_{\Delta t=0} = q(t)$ and $[Dq/dt]_{\Delta t=0}$ is given by eq. (34), thus we arrive at the solution in eq. (5). The function $\phi(P)$ has been estimated by continuous registrations of precipitation

amounts (pluviograph data), and compare momentary data with six-hourly averages. This work has been performed by a student at the University of Oslo, Mr. Per Egil Haga. In Table 9, ϕ is given for some values of P.

TABLE 9. The fraction, ϕ, of a grid square area which is hit by precipitation as a function of the six-hourly accumulated, grid square averaged precipitation amount P

P (mm/6h)	0	3	6	9	12	20	50	90	150
ϕ (%)	0	31	48	60	66	72	80	85	91

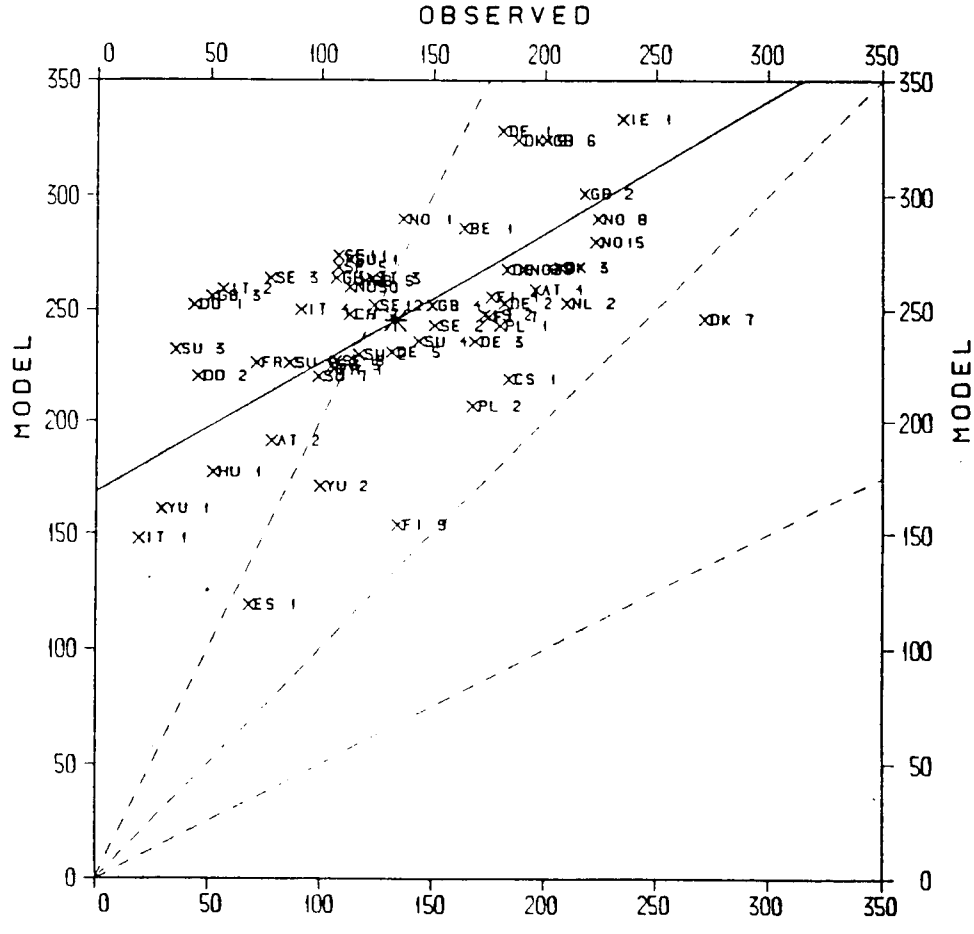


FIGURE 7. Scatter plot showing the number of days with modelled (sea) and analysed (land) precipitation against the number of days with observed precipitation on the EMEP measurement sites in 1988.

4. MODEL EVALUATION

At present we are able to compare five components in air with observations; SO_2, total particulate sulphate, NO_2, total nitrate and ammonia+ammonium. For species in precipitation we are able to compare sulphate-, nitrate-, and ammonium-ions. For ammonium, however, the comparison is very uncertain since the measurements are taken in rural areas where emission of ammonia in many places is strong; in such places they are unlikely to be representative for long-range transport. Total nitrate and ammonia+ammonium in air have been measured only at a few stations in the latest years, so verification for these components are shown only for the year 1991. For all other components, measurements are compared with model calculations over a six year period (85/87/88/89/90/91). Figures referred to in this section are found in Appendix A. Figure A1 show a map with the EMEP- stations used in the model evaluation, and in Table A1 these stations are listed with their full name and the station heigth above the sea level. Unfortunately we do not have calculations for the year 1986 because of a large data gap in our meteorological data archives. Measurements for 1992 are not yet available.

4.1 NO_2 in air.

Figure A2 shows scatter plots of calculated and measured six-year averaged NO_2 concentrations. There are 17 stations that have measured NO_2 regularly for the six year period, considerably fewer stations than measuring SO_2 in air.

As pointed out by Iversen (1993) and also shown in EMEP/MSC-W Report 1/92 a close to linear increase of NO_2 concentration with increasing grid square NO_x emission is expected. This relationship between the concentration and the grid square emission is expected to be stronger for NO_2 concentrations and NO_x emissions than for SO_2 concentration and SO_x emission since most of the NO_x emission orginate from ground level sources while a large part of the sulphur emissions are released from more elevated sources . The stations CH2, IT4, PL1 and PL2 report much higher concentrations than other stations within the same emission regime. The daily correlation at these stations is good but the levels do not coincide. This can indicate that the emission level or the measurments are wrong at these stations. There may also be a problem with local emission sources so that the measured values are not representative to compare with calculated values.

The station DE 3 is situated on a peak about 1200 meters above sea level. This partly explains why the model overestimates measurements there. At this station there is hardly any seasonal variation of NO_2 concentrations, so it seems that the station frequently stands in cleaner air above the mixing layer in the winter period. This station is also the one with the lowest daily correlation of all stations (Table A2). It seems that the station may not be sufficiently representative to compare with calculated grid averaged mean values for the boundary layer. To improve calculations at this station it is nessesary to have a model with vertical resolution.

The general impression of the model performance for NO_2 is fairly good, though the model tends to underestimate measured calculations. This is especially pronounced in the summer period with low concentrations (fig. A3 c). In winter time and mainly at German stations the calculations overestimate the observations. While at Scandinavian stations the concentrations show small underestimations also in the winter period. It may be that our imposed seasonal NO_x emission variation, on the part of the emission released from stationary sources, gives too large winter emissions or that the transport process from large emission areas to more rural areas are too weak in the model. Figure A4 shows the 3 month moving average for the 5 stations that fulfill the data coverage requierment for every 3 month period. The figure reflects mostly the situation at German stations since 4 of the 5 stations are German. We can see that the underestimation of summer concentrations and overestimation of winter concentrations at German stations is typical for all the years with model calculations. Table A2 and A8 show that most of the stations have a very good daily correlation factor. For 18% of the stations, daily correlation factors are better than 0.6, whilst 76% of the stations have correlation better than 0.4. About 40% of the stations have an relative error between +/- 25%. The underestimation is larger than a factor 2 in only a few cases. A part of this underestimation can be explained by the the omission of natural NO_x-emissions that are caused by nitrification and denitrification processes in the soils. Another possibly contributing effect is that anthropogenic NO_x is mainly emitted close to the ground and thus will take longer time to mix to the mixing height than e. g. SO_2. However, since at many stations the model underestimates systematically when concentrations are low (such as during summer), this problem might also be caused by uncertain measurements close to the detection limit. Time series with monthly mean values are shown for three stations in figures A5, one German station (DE2), one Scandinavian station (SE11) and one of the stations where the measured concentrations are much higher than expected due to the reported emission level (IT4). Additionally there are uncertanties in the model treatment of the nitrogen chemistry as further outlined in section 4.4.

4.2 SO_2 in air.

Scatter plots for SO_2 for the six year periode are shown in Figure A6. As for NO_2, the model overestimates at the mountain peak station DE 3 and even more at the station SK2, situated at 2000 meters height. Only a multilayer model can be able to calculate the concentrations at these stations.

The model tends to overestimate winter values in central Europe, especially in the last winters at the end of the eighties (Fig. A7 a) and A8). These winters have been warmer than normal and that may lead to lower actual emission rates than we have assumed in the model. In summer there are two German stations that have measured very low values (DE18 and DE19). They measure even lower values than the mountain station DE3 and the more rural station NO1. Both stations are situated in the southern part of Germany, and at present we are not able to explain such low summertime values in this area. At stations in Scandinavia the model tends to underestimate the concentrations both summer and winter, but the relative underestimation is larger in the summer period. The stations CH2, PL1 and IT4, which show large

discrepencies between measured and calculated NO_2 concentrations, are fairly good for SO_2 concentrations.

Figure A8 show 3 month moving average values for 16 stations. This plot reflects to a high degree the situation in central Europe, since most of these stations are German stations. This is particular the case for CS1 which shows a very large discrepancy between the modelled and observed values in the winter period (Fig A9b)

38 stations have measured SO_2 concentrations regularly in the six year period. 66% of the stations have a daily correlation better than 0.4. 39% of the stations have a relative error between -25% and +25% (Table A3 and A8).

4.3 $SO_4^=$ in air.

Figure A10 shows a scatter plot of particulate sulphate in air for the six year period. As for SO_2 there is satisfactory agreement between the modelled and the measured concentrations.

The model tends to underestimate the concentrations at levels below 1.0 $\mu g(S)/m^3$ and overestimate for higher values. The same can bee seen both for winter and summer situations (Figure A11). This trend for underpredicting low values and vica versa for high values is similar for SO_2 concentrations. This may indicate to small transport of sulphur components from central Europe to more remote areas in the model. As for other components in air the model overestimate the concentrations at the high elevated stations like SK2, DE3, CH1 and DE5. DK 7 situated at the Faeroe Island measures much larger values than the model can calculate, probably due to the influence of marine sulphate. The gap between the calculated and measured concentration at this station is about 1.0 $\mu g(s)m^{-3}$, and only 5% of this discrepancy can be explained as transport from North America (Tarrason, 1992).

Figure A12 reveals a quite good correspondence of calculated and observed values averaged over 21 stations, but we find some larger difference during the autumn 89. Furthermore, 69% of the stations have a daily correlation better than 0.4 and 44% of the stations do not have larger relative error than +/- 25%. Regular measurements of particulate sulphate have been obtained from 45 stations (Table A3 and A8).

4.4 Total nitrate in air

The measurements of total nitrate in air are compared with the sum of the calculated HNO_3, NO_3^- and NH_4NO_3, where NO_3^- gives the largest contribution to the sum (Figures B13, B14, B15 in appendix B). The total nitrate is compared with calculations only for the year 1991 because few stations have long measurement records. Figure A14 shows scatter plots of yearly mean values for 1991. The figure shows that the model overestimates the observations with a factor of 2 for almost all stations except at the station ES2. Since the nitrogen dioxide generally was underpredicted, this indicates that the assumed nigthtime oxidation of NO_2 to particulate nitrate is too fast. But this may not be the only explanation. There is also a large uncertainty in the speed of the gas-to-particle reaction between particulate nitrate and nitric

acid. If this reaction were faster one would produce more nitric acid. Since nitric acid has a high deposition velocity this would lower the amount of total nitrate in air. On the other hand if more nitric acid is produced there is also a possibility that it would react with ammonia to form ammonium nitrate. But usually the ammonia is used up by the faster reaction with particulate sulphate. This hypotesis will have to be investigated further, giving a certain room for model improvement. At the end of this year we hopefully will achieve some data from the NO_x measurement campaign started at the end of 1991. Such data may be useful in order to improve the nitrogen chemistry of the model.

Unfortunately there are few observations from central Europe. Most of the stations are situated in Scandinavian, and in addition there are some Spanish, Polish and British stations.

4.5 ammonia + ammonium in air

The measured sum of ammonia plus ammonium in air is compared with the sum of calculated ammonia, ammonium sulphate and ammonium nitrate. The dominating part is the ammonium sulphate especially in the central part of Europe. Due to short records of measurements at most stations verification for this component is shown only for the year 1991.

For most of the stations the model estimates are quit good in 1991 (Figure A16). There are some extreme outliers like ES2 and ES3 with underestimation. As for total nitrate in air most of the stations are situated in Scandinavia, Great Britain, Poland and in Spain. The overall picture is a small underestimation, which is to be expected since many stations are in rural sites where there may be large local emissions of ammonia. 24 stations have measured ammonia+ammonium with a sufficient data coverage for the year 1991.

4.6 Sulphate in precipitation.

Figures A18 - A21 and Table A5 show verification of sulphate in precipitation. The scatter plots reveal a reasonably good model performance on the average over the six years. But most of the stations yield an underestimation. This is especially pronounced in remote areas where wet deposition of sulphate dominates over the dry deposition, and thus the concentrations are comparatively small due to long distance from large emissions (see also Schaug et al., 1993).

In the summer season almost all stations except three stations (CS1, CH1 and GB4) are underpredicted, while in the winter season there are some more stations with extreeme overprediction, especially stations in urban areas.. Still the model underpredicts the concentration in the winter period, but to a smaller extent than in the summer. The underestimation is especially pronounced at the rural Scandinavian stations in summertime. The convective activity is large in summertime and a substantial amount of the SO_2 and sulphate may be brougth up above the mixing layer where it can be effectively transported over large distances. In addition, the concentrations of the sulphur oxidizing components are high in the summer, implying that the production rate of sulphate in some cases may considerably exceed the one employed in the model. Both these effects are difficult to describe in the present single layer

model and they may explain the underestimation in remote areas. Hopefully this problem can be more throughly examined in a multilayer model that at present is under development at EMEP/MSC-W.

Figure A20 shows that the model underpredicts the observed concentrations for most of the six year period.

The remote station DK 7 in the North Atlantic is much influenced by sea spray and to some extent intercontinental transport from North America. (see Tarrason and Iversen,1992). The emissions from ship traffic is probably also underestimated. The discrepancies between the model and the observations at this station are certainly related to these factors. Looking at Table A5 we see that the daily correlation at each site is much lower than those of the components in air. This is because it can be very difficult, may be impossible to find a station which is representative of a calculated grid square average. The reason for this is the very local nature of the daily variations in precipitation amount. 49 stations have reported observations regulary in the five year period. 12% of the stations have a daily correlation better than 0.4. 37% of the stations have relative error between +/-25%.

4.7 Nitrate in precipitation.

Diagrams for nitrate in precipitation are shown in Figures A22 - A25. This component shows a behaviour similar to that of sulphate in precipitation or somewhat better, since the underestimation is smaller. Nevertheless, as for sulphate the model underestimates systematically, and in particular for low concentrations. Again we believe that it may be related to the representation of the vertical transport processes in the model as explained in the previous section. Furthermore the model tend to underestimate nitrate in precipitation at coastal stations. Normally it is not assumed that sea spray can contaminate measurements of nitrate as it can for sulphate. Hence, it is probable that the underestimation partly is due to too small emissions from ship traffic. However, there is a possibility that the model lacks a chemical mechanism for converting gaseous nitric acid into nitrate particles by interactions with sea salt (Martin Ferm, personal communication). This process, if being effective in the marin atmospheric boundary layer, will cause an even longer transport for nitrogen than presently modelled. In the winter period the model calculates too high concentrations at the stations in central Europe, while the Scandinavian stations still are underpredicted. In the summer season most of the stations are underpredicted. However the model overestimates nitrate in precipitation at the elevated stations CH1, DE 3 and AT 3. Table A6 and A9 shows that 28% of the stations have a better correlation than 0.4, while 47% of the stations have a relative error between +/-25%

4.8 Ammonium in precipitation.

Figure A26 shows that the model tends to underestimate ammonium in precipitation. But in fact the model predicts the concentrations suprisingly well taking into account that the ammonia emissions are very uncertain compared to those for sulphur dioxide and nitrogen

oxides, and that the measurment sites are situated in rural areas where local emissions often are strong. Ammonia dissolves very fast into droplets with low pH, thus contamination of the measuring instruments by local emissions probably is more important than for sulphate and nitrate. The model underestimates the concentrations at Scandinavian stations both in the summer and the winter season, while for the stations in Central Europe the model tends to overpredict the concentrations.

The model overestimates the measurements at AT 3, AT4 and DE 3, which all are sites of quite high elevation. The model underestimates at DK 7 and SE 8. At SE 8 extremely high values are measured in the summer of 1990, about a factor of five in monthly average values more than summertime observations in other years.

Only 4% of the stations have a correlation between daily calculated and measured data better than 0.4. 46% of the stations have a relative error between +/- 25%.

4.9 Trends.

Figures A30 and A31 show six year trends for NO_2, SO_2 and particulate sulphate in air and sulphate,nitrate and ammonium in precipitation. To make the trend analysis we have to use the same stations throughout the whole period. The stations that are picked out have to fullfill the requirement of a 75% data coverage for every year for components in air. For components in precipitation the requirement is a 25% data coverage every year. Stations showing abnormal concentration levels are excluded from the trend analysis. The trends are of course affected by the emission trends, but as shown by Mylona (1989) and Iversen (1993) different meteorological conditions can affect the year to year concentration levels to a significant extent as well.

Figure A30 a) shows the trend for NO_2 concentrations in air. For this component we have to be aware of that only 8 stations are used in the trend analysis, and most of these are German stations. The observed values and the model agree quite well for 1985 and 1987, but from the year 1988 the observed values are somewhat higher than the calculated values. The calculated trend for the six-year period indicates a sligth decrease in the concentration level of NO_2 , but the observed concentrations show no trend for the same period.

For the concentration of sulphur dioxide in air there is a clear downward trend, based upon 26 stations. The observed trend takes a large step downward between 1987 and 1988, and from then on a lower yearly concentration decrease is observed. The model follows the observed trend quite well from 1985 to 1988, but in 1989 the difference between measured and calculated values increases. For all years the model overestimates the concentration level, but this overestimation becomes larger in the three last years.

The trend for particulate sulphate in air is based upon 32 stations. For particulate sulphate the trend is similar to the one for SO_2. In 1988 the calculated values are sligthly lower than the observed values, but for all other years the model overestimates the concentration level. As for SO_2 this is particulary pronounced for the three last years.

Sulphate in precipitation (Figure A31a) shows a sligth downward trend both in calculated and measured data. The model underestimates the observations systematically with nearly the same amount during the whole period. The high modelled air concentrations of SO_2 and SO_4 in 1989 and 1990 are not reflected in this component. The trend is based upon 33 stations. The yearly mean modelled and observed concentration level for nitrate in precipitation fit very well together (Figure A31b). The level is nearly constant from year to year, with only a sligth downward trend between 1989 and 1991. The analysis for nitrate in precipitation is based upon 30 stations.

For ammonium in precipitation 28 stations are used. The modelled and observed level show a good agreement (Figure A31 c). The observed concentration trend shows almost the same level all the years, but with a sligthly higher value in 1989. Similarly the modelled concentrations show almost no trend at all, only maybe a very sligth decrease in the concentration.

5. RESULTS

The model has been run for seven full years, 1985, 1987, 1988, 1989, 1990, 1991 and 1992. Results presented for 1992 are preliminary in accordance with the reporting routine of annual emissions from countries (see section 2.1). Experience has shown, however, that calculations that should be final may be changed due to late changes in emissions and changes in the model formulation according to new knowledge from research.

5.1 Acid Pollution in Europe

All Figures refered to in this section are found in Appendix B. The Figures B1, B2, B3 and B4 show calculated isolines for deposition of oxidised sulphur, oxidised nitrogen, reduced nitrogen, and total nitrogen respectively, calculated for 1991. The pattern for oxidised sulphur reflects to much higher degree than oxidised nitrogen the emission distribution. This is because oxidised nitrogen in its primary phase (NO_x) is slowly deposited, whilst SO_2 on the contrary is efficiently dry deposited. Thus, oxidised nitrogen has time to be transported longer than oxidised sulphur before it is deposited. The highest depositions of sulphur of more than 7 g(S)/m^2 are found in central parts of Europe, in the border area between the Germany, Czech-oslovakia and Poland. Oxidised nitrogen has a more flat distribution, with an area of more than 1 g(N)/m^2 extending from southern Denmark to Northern Italy and from The Netherlands and Belgium to south-east Poland. Reduced nitrogen reflects even more the emissions than oxidised sulphur. Nevertheless, the distribution in large parts of Europe is rather flat because of the emissions that are distrubuted very evenly over agricultural land areas. There are, however, sharp gradients along the coastlines. The total nitrogen deposition exceeds 1.5 g(N)/ m^2 in large parts of mainland Europe, and 2.5 g(N)/m^2 in western and central regions.

On the next few pages in Appendix B calculations of annually averaged concentrations in air for some components are shown. The Figures B5, B6, B7 and B8 show sulphur compounds, the Figures B9, B10, B11, B12, B13, B14, B15, B16 compounds of oxidised nitrogen, and the Figures B17 and B18 compounds of reduced nitrogen. Most of the sulphate (80% - 90%) is in the form of ammonium sulphate. The very fast oxidation of NO to NO_2 causes about 90% of the NO_x to occur as NO_2, even in areas of high emissions. The distribution of PAN is very flat except in coastal areas, and it constute a very small part of the available oxidised nitrogen in primary phase. Most of the nitrate (60% - 70%) is in the form of particulate nitrate (not including ammonium nitrate). Nitric acid gas and ammonium nitrate particles is about equally important, but somewhat different distributed.

5.2 Country-to-Country Deposition Budgets

All Figures refered to in this section are found in Appendix C. In addition to the total concentration fields due to all emissions, the model keeps track of subconcentrations arising from emissions in 52 different emission areas for each of the 10 calculated species. This implies that

the model keeps track of 520 concentration fields, in addition to 1040 deposition fields. Area 1 to 28 are European countries, area no. 29 (REM) is the part of North Africa that is included in the domain of calculation, area 30 to 35 are different subdivisions of sea areas, see Table C1 . In addition, the European part of former USSR has been separated into 10 emission sub areas (see Table D1), former Yogoslavia has been separated into 5 emission subareas and Czechoslovakia have been divided into 2 new emission subareas. These subdivisions are used to present the budget matrices with the new countries that have been formed in Europe the last years. From the year 1991 data for the unified Germany and the new countries formed from the former USSR are presented. From 1992 the new contries formed from the former Yugoslavia are presented in the matrices. Data from all different emission sub-domains used in the model are presented in Appendix E showing maps of area allocated sulphur depositions and Appendix F showing maps of area allocated deposition of oxidised and reduced nitrogen.

The governing differential equations in section 3.1 are all linear in the concentrations. Any two sets of solutions to this system of equations can be added to give a sum that also will be a set of solution of the equations. This means that one can calculate the concentrations due to emissions in each sub-domain, and then add the individual contributions to get the total concentrations.

The model is, however, not completely linear due to the processes producing amonium sulphate and ammonium nitrate. Both these processes depend on the concentrations of the components involved in a non-linear way. The contributions from the emission sub-domains to the concentration of these two ammonium components, are calculated in two different ways. The first allocation points to emissions of ammonia, and the second to emissions of NO_x (ammonium nitrate) or SO_2 (ammonium sulphate). Their production is only calculated on the basis of total emissions from all countries. An increment in the concentration of one of these species is allocated to emissions of ammonia when a reduced nitrogen budget is made, and to emissions of NO_x (SO_2) when an oxidised nitrogen (sulphur) budget is made. Calculated country-to-country budgets for oxidised sulphur, and oxidised and reduced nitrogen for the five years are given Appendix C (Tables C2 through C8 for oxidised sulphur; Tables C9 through C15 for oxidised nitrogen; Tables C16 through C22 for reduced nitrogen). Both SO_2 and NH_3 are efficiently dry deposited, while NO_x is not. This is reflected in the budgets on the main diagonal (contributions from a country to itself).

5.3 The Contribution of Indeterminate Origin (IND).

The deposition that cannot be attributed to any known emission source, referred to as IND in the receiver-emitter matrices, enters into the model in two different ways.

At the start position of each trajectory we assume an initial concentration. If the start position of the trajectory is inside the domain where concentrations already have been calculated, we use this pre-calculated value as the initial concentration (assimilation). If there are no calculated concentration for the actual time or the trajectory starts outside the calculation domain, prescribed background concentrations are used. In the latest model version this part of the

indeterminate contribution is referred to as INDM, or the part of the indeterminate contribution which originate in the mixing layer.

The second part of the indeterminate contribution comes into the budgets due to exchange of air between the mixed layer and the free troposphere. Above the mixed layer we use prescribed background values for all components. The part of the indeterminate contribution that comes from air penetrating into the mixed layer from the free troposphere is refered to as INDA.

In Appendix G maps of the indeterminate contribution are shown for the deposition of sulphur, oxidised and reduced nitrogen

In central Europe the IND contribution of oxidised sulphur is about 5% of the total deposition (Fig. G2 b), while in areas with a smaller total deposition the relative importance of the IND contribution is larger than 20% of the total deposition (in Norway and parts of Russia near the border of the calculation domain). About 80% of IND comes from air mixed into the PBL from the free troposphere in central and northern Europe (Fig. G3 b).

The relative IND contribution of oxidised and reduced nitrogen shows a similar pattern as for sulphur. Less than 10% of the oxidised nitrogen deposition in central Europe and about 20-30% or more in remote areas can be allocated to the IND contribution . For reduced nitrogen a smaller part of the total deposition is allocated to the IND contribution (about 5% in central Europe and about 10-20% or more in remote areas). The part of IND that originated in the free troposphere (INDA) is somewhat smaller for oxidised nitrogen (about 70% of the IND contribution) than for oxidised sulphur and reduced nitrogen (about 80% of the IND contribution). The percentage contribution of INDM is therefore larger for oxidised nitrogen than for sulphur and reduced nitrogen. This is as expected since the NO_x components have much lower wet and dry deposition rates than sulphur and reduced nitrogen components.

5.4 Excess Sulphur Deposition.

One important quantity for the emission reduction efforts under the Convention on Long-Range Transboundary Air Pollution is the so-called critical load. The critical load is defined as a deposition below which no harmful effects on the ecosystems occur according to present knowledge.

Data on the critical load for sulphur is now available, as a result of national efforts and the work under the Task Force on Mapping. These data are checked and continuosly updated at the co-ordination centre for Effects (CCE) at RIVM in the Netherlands. The critical load may of course vary across an EMEP grid square, which roughly covers an area of 150 by 150 km. An EMEP grid square may also contain areas which cannot be considered to be ecosystems to be protected from acid rain, e.g. urban areas etc. As a starting point in this report we have chosen the so-called 5-percentile critical load. If the deposition of sulphur is reduced down to the 5 percentile critical load, then 95% of the natural ecosystems in the gridsquare will be

protected against damage, and 5% will not be protected. Other percentile critical load maps are also available from the CCE.

An important basis for decisions on sulphur emission reductions is the extent to which the present sulphur deposition exceeds the critical load. It is the excess sulphur deposition that can be considered to be harmful. The excess sulphur deposition can be calculated simply by subtracting the critical load from the sulphur deposition itself. Before this is done however, the critical load must be corrected for base cation deposition from the atmosphere and base cation uptake by vegetation. Figures showing the total sulphur deposition from all sources, the 5 percentile critical load and the total excess deposition from all sources are given Appendix E. In general, the Nordic countries have large areas with very low critical loads, and the Mediterranian area has high values. In areas with low critical loads it will be difficult to eleminate the excess deposition completely, even with quite substantial emission reductions. Just as the total deposition, the total excess deposition can be broken down into contributions from each country or emission area. This is done by taking the percentage contribution of a country to the excess deposition at a certain receptor to be the same as the percentage contribution of the country to the total deposition. In other words, if a country contributes x% to the deposition at a certain receptor, it also contributes x% to the excess deposition. This makes it possible to map the excess deposition due to each country across Europe.

5.5 The use of data from the MSC-W of EMEP in integrated assessment models.

The MSC-W of EMEP has provided the modelling groups co-operating through the Task Force on Integrated Assessment Modelling (TFIAM) with calculated deposition data. The modelling work of TFIAM has up to now aimed at developing a scientific basis for a cost-effective second sulphur protocol. The TFIAM modelling groups have therefore mainly used sulphur deposition data, made available in the form of calculated deposition from each emission area. Two sets of data have been used, one set in which the emission areas are countries or aggregation of emission gridssquares, and another in which these areas are the individual gridsquares themselves (so-called grid - to - grid data, reported in EMEP/MSC-W Note 3/92). Before providing these data to the integrated assessment modellers, it has been necessary to make certain adaptions in the data. In the following, these adaptions are described and the reasons for making them are outlined.

5.5.1 Inattributable and natural deposition.

The major part of the sulphur deposition over Europe, as calculated by the EMEP/MSC-W, is attributed to European anthropogenic emissions which can be subject to various control strategies. A small part of the deposition, however, is due to either the sulphur concentrations assumed at the upper model boundary, initial trajectory concentrations or to the natural emission of $(CH_3)_2S$ from ocean. The deposition arising from the boundary and initial conditions has no source allocation and is usually called the inattributable deposition. In the sulphur budget tables, the inattributable deposition is given under the heading "IND". A major part of this deposition component may well be of anthropogenic origin, for example North American

sulphur or European sulphur re-entering the model domain having earlier escaped therefrom. Formally, neither the inattributable nor the natural sulphur deposition will change when the anthropogenic emissions are controlled. The average inattributable deposition is shown in Figure E5 of Appendix E. The natural sulphur deposition is shown in Figure E7.

5.5.2 Reallocation of a part of the inattributable deposition.

As explained above, the inattributable sulphur deposition is partly due to European anthropogenic sulphur re-entering the model domain. This implies that the model sligthly underestimates the deposition pattern from each of the European contries. To obviate this deficiency, the EMEP/MSC-W has asked the Integrated Assessment modellers to reallocate 2/3 of the inattributable deposition to each emission area or country, on the basis of the allocation key appropriate for each gridsquare. Consequently, the deposition pattern from each country are sligthly increased, and only 1/3 of the original inattributable deposition remains. The model estimate of the total deposition in Europe due to European anthropogenic sources is also sligthly incrased, to become consistent with calculations carried out at EMEP/MSC-W with a 10-level Eulerian model covering most of the Northern Hemisphere and used to investigate transatlantic sulphur transport and reported in EMEP/MSC-W Note 5/92. This latter model encompass the whole troposphere, whereas the model for European sulphur transport only includes the atmospheric boundary layer. The Northern Hemisphere model, in contrast to the detailed European transport model, therefore keeps the source allocation for the sulphur even when transport occurs from the boundary layer up into the free troposphere. This reallocation of a part of the inattributable deposition thus removes the sligth underestimation of European anthropogenic deposition. It should be recognized, however, that this reallocation is a rather rough correction of a (small) systematic error. Abetter way would be to nest the Eurpean-scale model inside the Hemispheric model. Such a nesting is planned, but it is uncertain when it can be accomplished.

After carrying out the reallocation of 2/3 of the inattributable sulphur deposition described in the preceding paragraph, the remaining deposition that will not respond to European emission control measures in the model consists of the natural sulphur deposition originating from sources inside the model domain, plus 1/3 of the original inattributable deposition. The sum of the natural and the remaining 1/3 of the inattributable deposition is shown in Figure E8 of Appendix E. A major part of the latter is due to anthropogenic North American sources. From the hemispheric model it is possible to estimate the deposition pattern due to these sources alone. The deposition from North American sources calculated using 1985 emissions and 1988 meteorology is shown in Figure E9 of Appendix E.

5.5.3 Critical loads versus natural sulphur deposition.

At the seminar in Madrid (March 1993) organized by the Task Force on Mapping the very low critical loads of 11 grid cells were discussed (EB.AIR/WG.5/R.38 para3). Nine of these cells are Norwegian or Swedish cells, and two are German or Dutch. The 11 cells are the only ones in which the original 5%-tile critical loads is lower than the calculated natural deposition. To avoid a situation where natural sulphur depsition in itself produces a deposition in excess of

the critical load, it was considered reasonable to raise the critical load values at least to the level of the natural deposition. For 10 of the cells, it was suggested to raise the critical load up to the value of deposition which would not respond to European emission controls, in other words to the natural deposition plus 1/3 of the original inattributable deposition. For the 11'th cell, on the Dutch-German border it was decided to use the higher Dutch critical load value rather than the low German values.

At the eigth session of the Task Force on Mapping in Berlin, (April 1993), the discussion of low critical loads was continued by adressing the grid cells in which the 5%-tile critical load was above the natural sulphur deposition, but lower than the sum of the natural deposition and 1/3 of the inattributable deposition. It was suggested to raise also the values of these squares up to the latter value, to make this a universal lower limit for the critical loads.

The question of exactly which values to use for the 5%-tile critical loads when these are very low, has not yet (at the time of writing) been completely resolved. It seems, however, that one migth choose to tie the low critical load values in some way either to the natural deposition or to the part of deposition which formally does not respond to changes in European anthropogenic emissions. In this context it seems relevant to note that much of the remaining 1/3 of the inattributable deposition in reality is of anthropogenic origin, and emitted in North America. The MSC-W will continue its discussion with the modelling groups of TFIAM on how the emission reductions agreed upon in North America can be taken into account when developing a cost effective European emission control strategies.

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APPENDIX A.

COMPARISON BETWEEN MODEL CALCULATIONS AND MEASUREMENTS

For componets that have regular measurements in the six year period 85/87/88/89/90/91 six types of figures are shown :

1) Scatter plots with observed and calculated six years averaged concentrations

2) Tables that show the stations and the relative number of stations grouped with respect to daily correlation and the relative error for the six year period,

3) Scatter plots showing seasonal six year averaged concentrations

   a) Winter : averaged over the months December, January and February.

   b) Spring : averaged over the months March, April and Mai.

   c) Summer : averaged over the months June, July and August.

   d) Autumn : averaged over the months September, October and November.

4) Time series showing 3 months moving averaged values over all stations that fullfill the data coverage requirement for every 3 month period.

5) Time series showing monthly mean values for some selected stations.

6) Trend plots showing yearly mean values over all stations that fullfill the data coverage requirement every year.

Only stations that fullfill the requirement of data coverage are included in the plots. For components in air there have to be observations at least for 75% of the total number of days in the period. For components in precipitation there have to be observed concentration in precipitation at least for 25% of the days where the model have precipitation.

On the scatter plots some of the stations are plotted with an empty circle and they are not taken into account in the statistical calculations. They are also excluded in the trend and 3 months moving averaged analysis. The reasons for excluding these stations are either high elevation (above 2000m) , influence by sea spray or that they are probably not very representative for model comparisons due to other reasons as explained in section 4.

The calculated mean values are averaged over days with observations.

For two components (total nitrate in air and ammonia+ammonium in air) only scatter plots with yearly mean values and time series at some stations with monthly mean values are shown.

Figure A1 : Monitoring sites utilized for model evaluation.

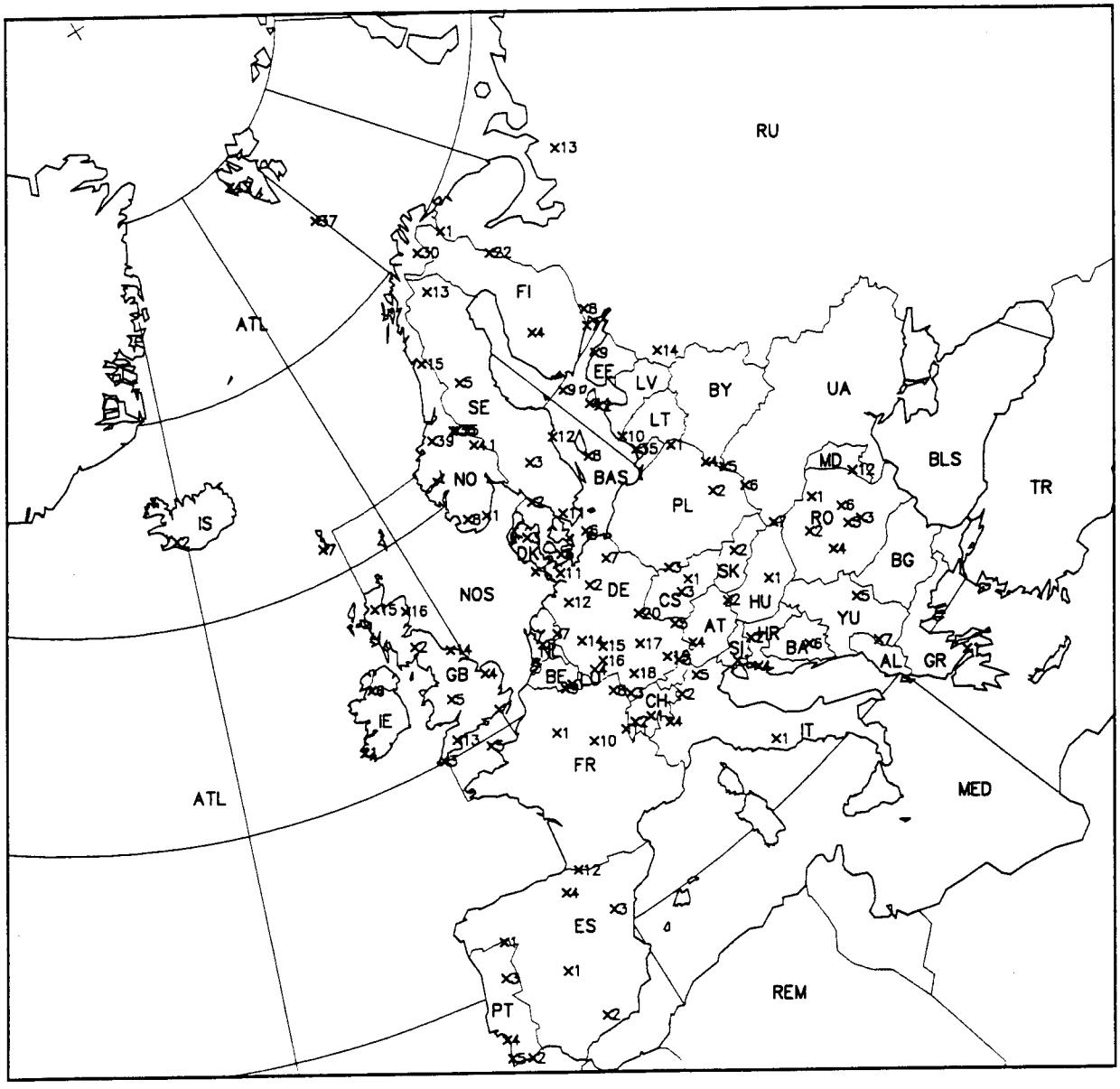
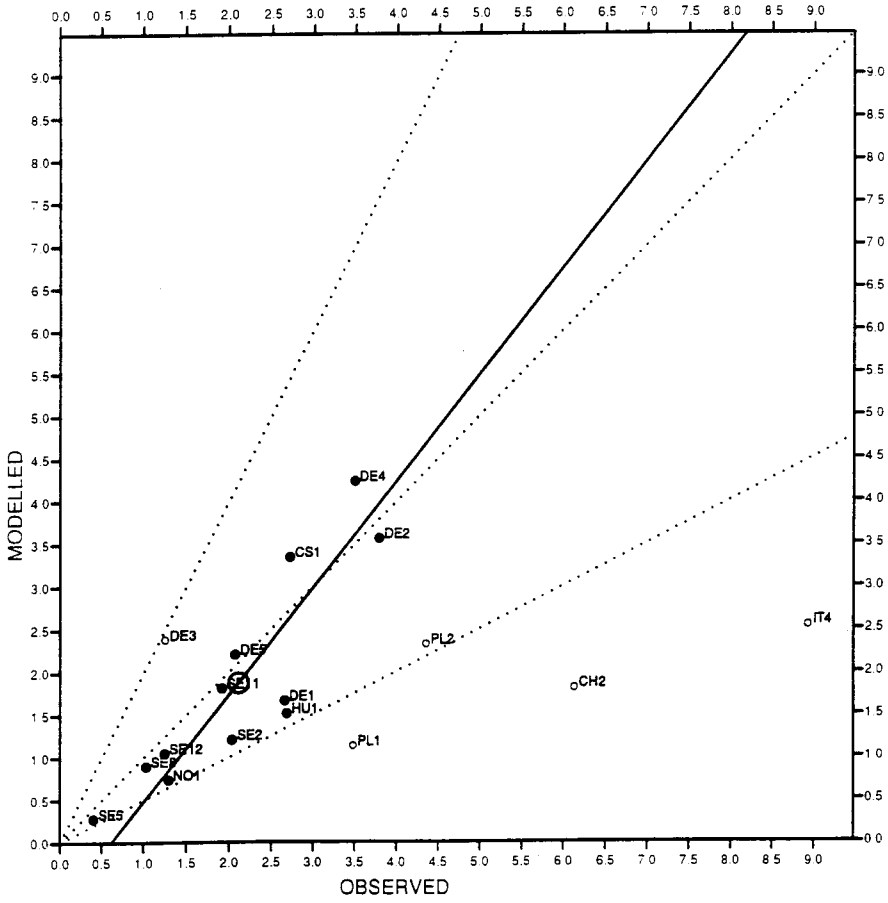


Table A1 : List of monitoring sites utilized for model evaluation

CODE		NAME	Heigth above sea (m)
AT	2	Illmitz	117
AT	3	Achenkirch	960
AT	4	St.Koloman	851
BE	1	Offagne	420
CS	1	Svratouch	737
SK	2	Chopok	2008
DK	3	Tange	13
DK	5	Keldsnor	9
DK	7	Faer.-Akraberg	90
FI	4	Athari	162
FI	7	Virolahti	8
FI	9	Utoe	7
FR	1	Vert-le-Petit	64
FR	5	La Hauge	133
DE	1	Westerland	12
DE	2	Langenbrugge	74
DE	3	Schauinsland	1205
DE	4	Deuselbach	480
DE	5	Brotjacklr.	1016
DE	6	Arkona	42
DE	7	Neuglobsow	62
DE	11	Hohenwestedt	75
DE	12	Bassum	52
DE	14	Meinerzhagen	510
DE	15	Usingen	485
DE	16	Bad Kreuznach	230
DE	17	Ansbach	481
DE	18	Rottenburg	427
DE	19	Starnberg	729
DE	20	Hof	568
GR	1	Aliartos	110
HU	1	K-puszta	125
IS	2	Irafoss	61
IE	1	Valentia Obs.	9
IT	1	Montelibretti	48
IT	2	Stelvio	1415
IT	4	Ispra	209
NL	7	Eibergen	20
NO	1	Birkenes	190
NO	8	Skreaadalen	475
NO	15	Tustervatn	439
NO	30	Jergul	255
NO	35	Narbuvoll	768
NO	36	Hummelfjell	1539
NO	37	Bjoernoeya	20
NO	39	Kaarvatn	210
PL	1	Suwalki	184
PL	2	Jarczew	180
PT	1	Braganca	691
PT	2	Faro	8
RO	1	Rarau	1536
RO	2	Stina de Vale	1111
RO	3	Semenic	1432
RO	4	Paring	1585
RO	5	Fundata	1371
RO	6	Turia	1008
ES	1	Toledo	917
SE	2	Roervik	10
SE	3	Velen	127
SE	5	Bredkelen	404
SE	8	Hoburg	58
SE	11	Vavihill	172
SE	12	Aspvreten	20
CH	1	Jungfraujoch	3573
CH	2	Payerne	510
RU	1	Janiskoski	118
RU	8	Lesogorsky	39
EE	2	Syrve	2
EE	9	Lahemaa	32
EE	11	Vilsandy	6
LV	10	Rucava	18
LT	3	Nida	17
BY	4	Vysokoe	163
UA	5	Svityatz	164
UA	6	Rava-Russkaya	249
UA	7	Beregovo	112
GB	2	Eskdalemuir	243
GB	3	Goonhilly	108
GB	4	Stoke Ferry	15
GB	5	Ludlow	190
GB	6	Lough Navar	126
GB	7	Barcombe Mills	8
SI	1	Masun	1026
HR	2	Puntijarka	988
HR	4	Zavizan	1594
BA	6	Ivan Seldo	970
YU	5	Kamenicki vis	813
YU	7	Lazaropole	1332
IT	5	Arabba	2030
ES	2	La Cartuja	720
ES	3	Roquetas	50
GB	15	Strath Vaich. D.	270
NL	8	Bilthoven	5
NO	41	Osen	440
PT	3	V.d.Castelo	16
PT	4	Monte Velho	43
MD	12	Leovo	156
GB	13	Yarner Wood	119
GB	14	High Muffles	267
GB	16	Glen Dye	85
ES	4	Logrono	370
CS	3	Kosetice	633
FI	17	Virolahti II	4
RU	13	Pinega	28
RU	14	Pushkinsk Gory	103
FI	22	Oulanka	310
FR	8	Donon	775
FR	9	Revin	390
FR	10	Morvan	620
FR	11	Bonnevaux	836
FR	12	Iraty	1300
NO	42	Spitzbergen,Z	474
PL	3	Sniezka	1604
PT	5	Foia	902

Figure A2 : Scatter plot of calculated and observed concentrations of NO_2 in air
Averaged over the years 85,87,88,89,90 and 91. The full line represents optimal linear regression, i.e. the sum of squares of distances measured from the point normal to the line is minimised. Unit : $\mu g(N)\ m^{-3}$



Average concentration of
nitrogen dioxide in air (ug(n)/m3)
year : 1985/87/88/89/90/91
period : the whole year

Averaged over days with observations

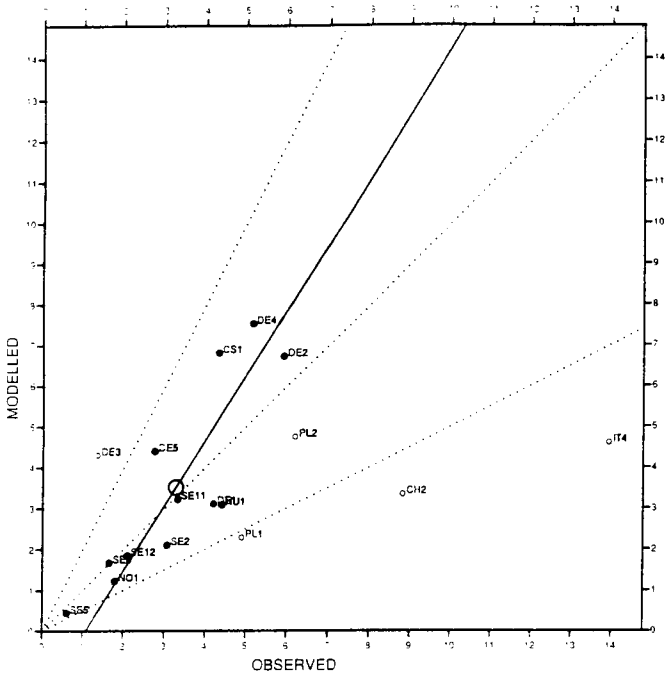
observed	mean =	2.11
modelled	mean =	1.87
correlation	=	0.88
no. of stations	=	12

Requirement : at least
75% common days with data

Table A2 : NO_2 in air. Number of stations in % grouped with respect to daily correlation and relative error. Values for the six year period 1985,87,88,89,90,91. Total number of stations : 17

RELATIVE ERROR IN % : 100 ·(MOD-OBS)/OBS	DAILY CORRELATION				
	r <= 0	0< r <=0.2	0.2< r <=0.4	0.4< r <=0.6	0.6< r <=1.0
-100<=err <-75					
-75<= err <-50				17.6% IT4 PL1 CH2	
-50<= err <-25			5.9% SE5	23.5% HU1 NO1 PL2 SE2	5.9% DE1
-25<= err < 0.				17.6% SE8 SE11 SE12	5.9% DE2
0<= err < 25			11.8% CS1 DE5		5.9% DE4
25<= err < 50					
50<= err < 75					
75<= err <100		5.9% DE3			
100<= err					

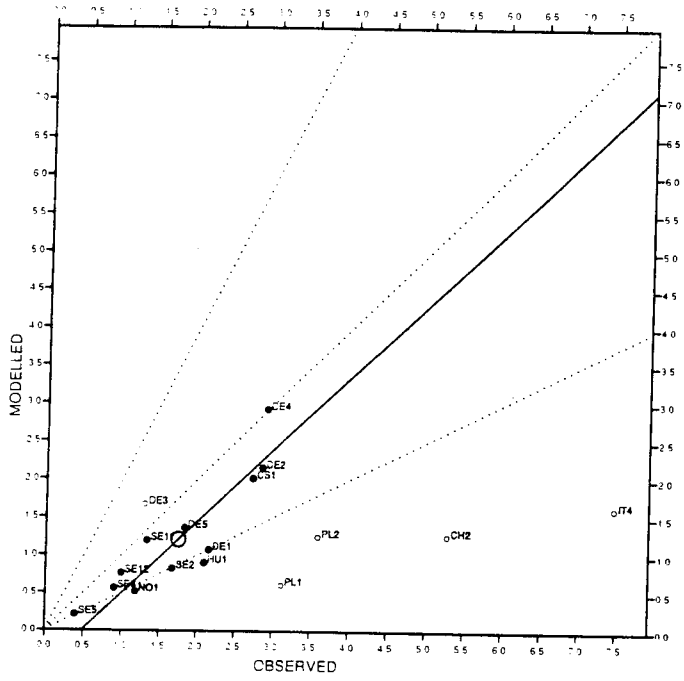
Figure A3 : Seasonal scatter plot of calculated and observed concentrations of NO_2 in air Averaged over the years 85.87,88,89,90 and 91. Unit : $\mu g(N)\ m^{-3}$



a) Winter

Averaged over days with observations

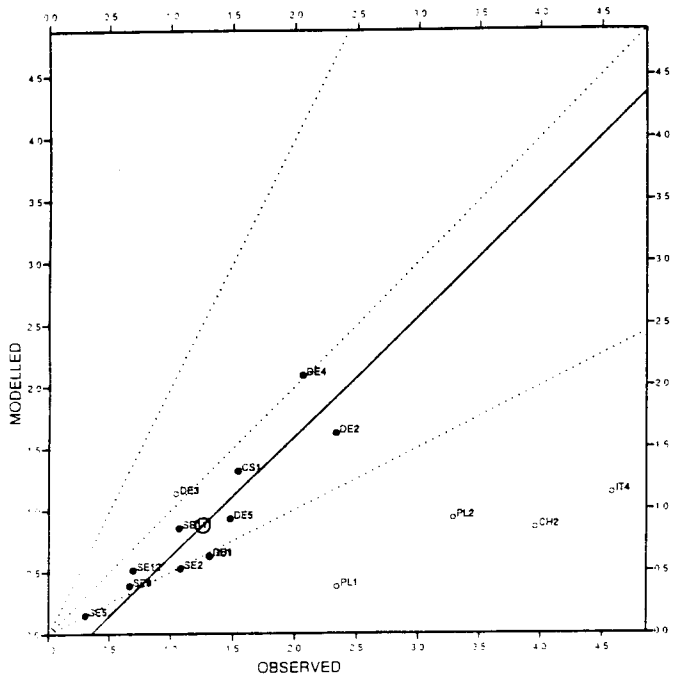
observed mean =	3.27
modelled mean =	3.51
correlation =	0.85
no. of stations =	12



b) Spring

Averaged over days with observations

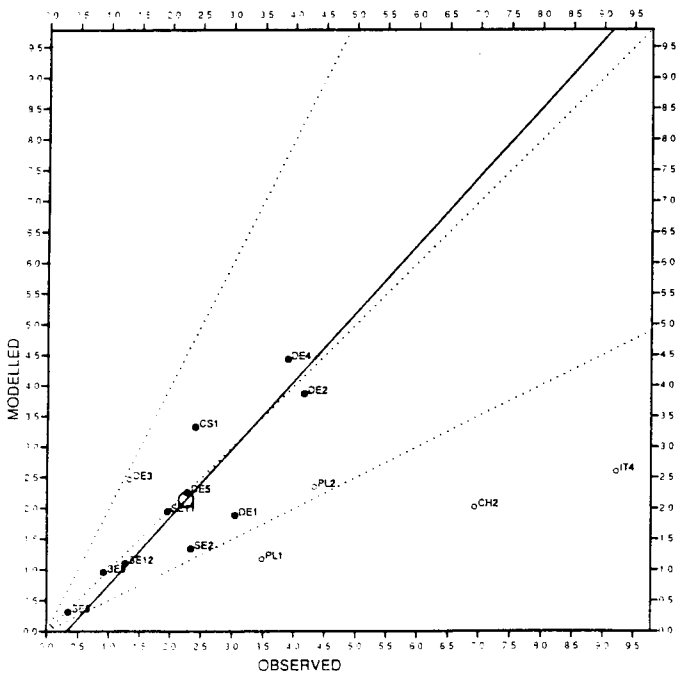
observed mean =	1.75
modelled mean =	1.21
correlation =	0.89
no. of stations =	12



c) Summer

Averaged over days with observations

observed mean =	1.25
modelled mean =	0.88
correlation =	0.90
no. of stations =	11



d) Autumn

Averaged over days with observations

observed mean =	2.25
modelled mean =	2.14
correlation =	0.89
no. of stations =	10

Figure A4 : Concentration of NO_2 in air. 3 months moving average over 5 stations that fullfill the requierment for data coverage. Stations : DE1, DE2, DE4, DE5 and SE8.

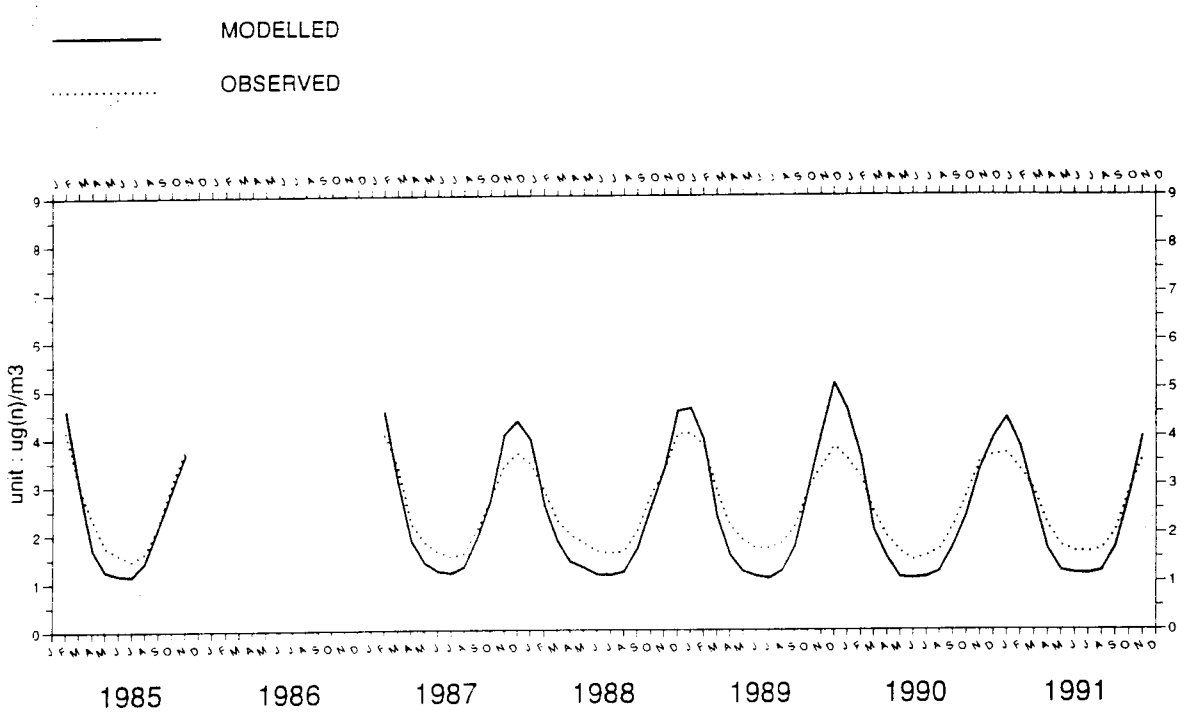
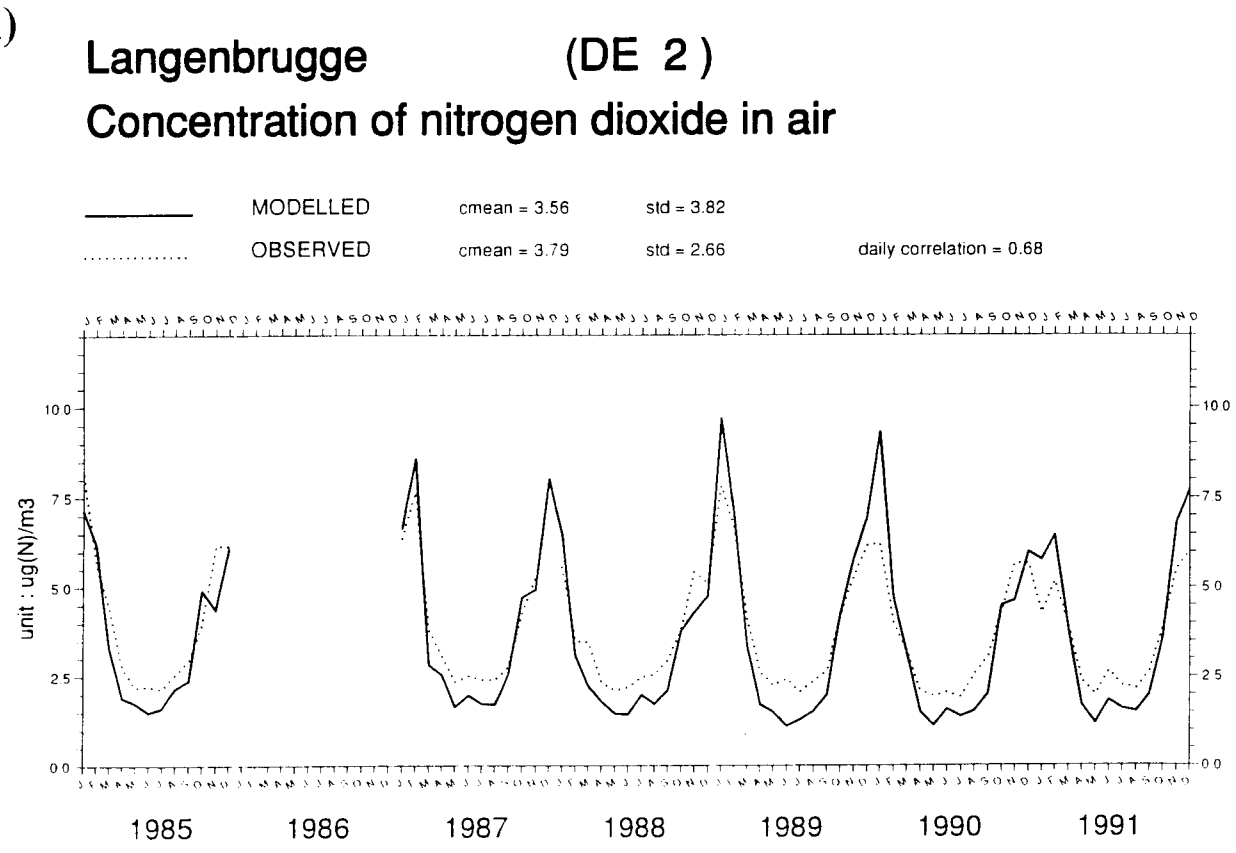


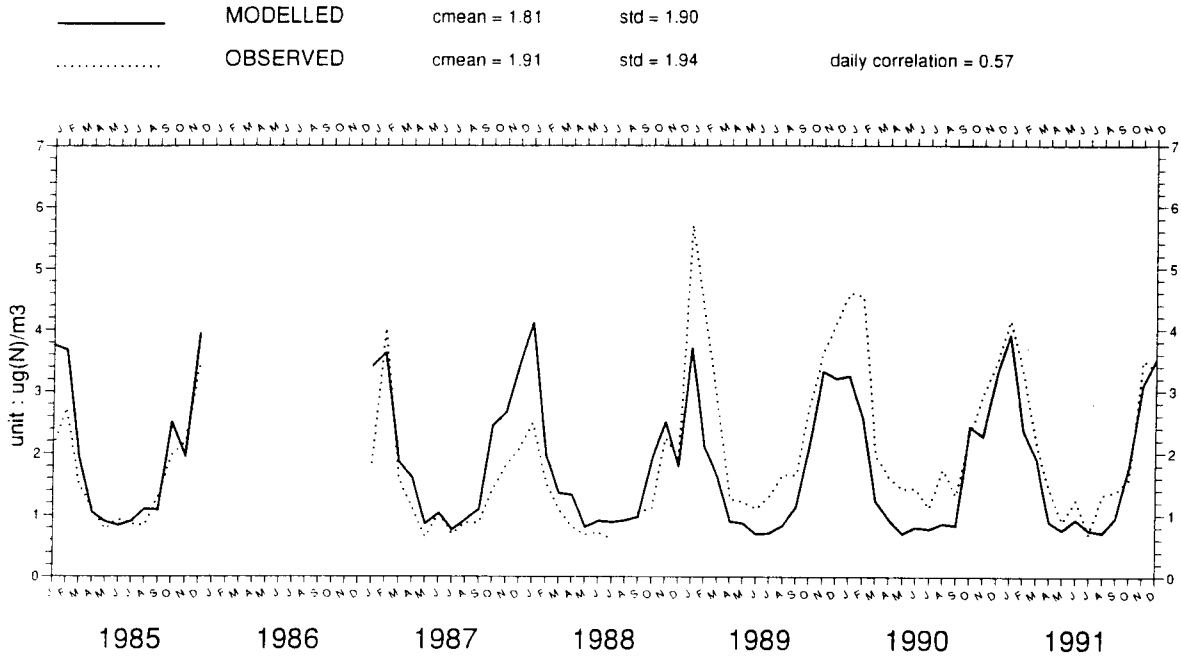
Figure A5 : Timeseries with monthly mean values for some selected stations.

a)



b) **Vavihill (SE 11)**

Concentration of nitrogen dioxide in air



c)

Ispra (IT 4)

Concentration of nitrogen dioxide in air

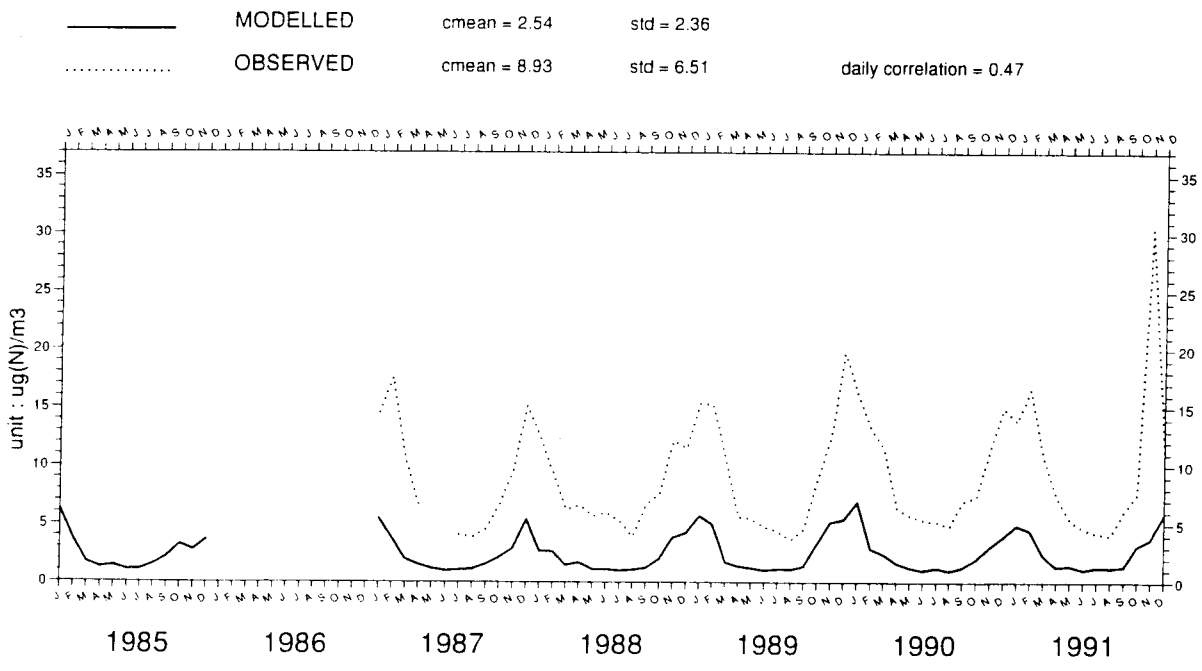
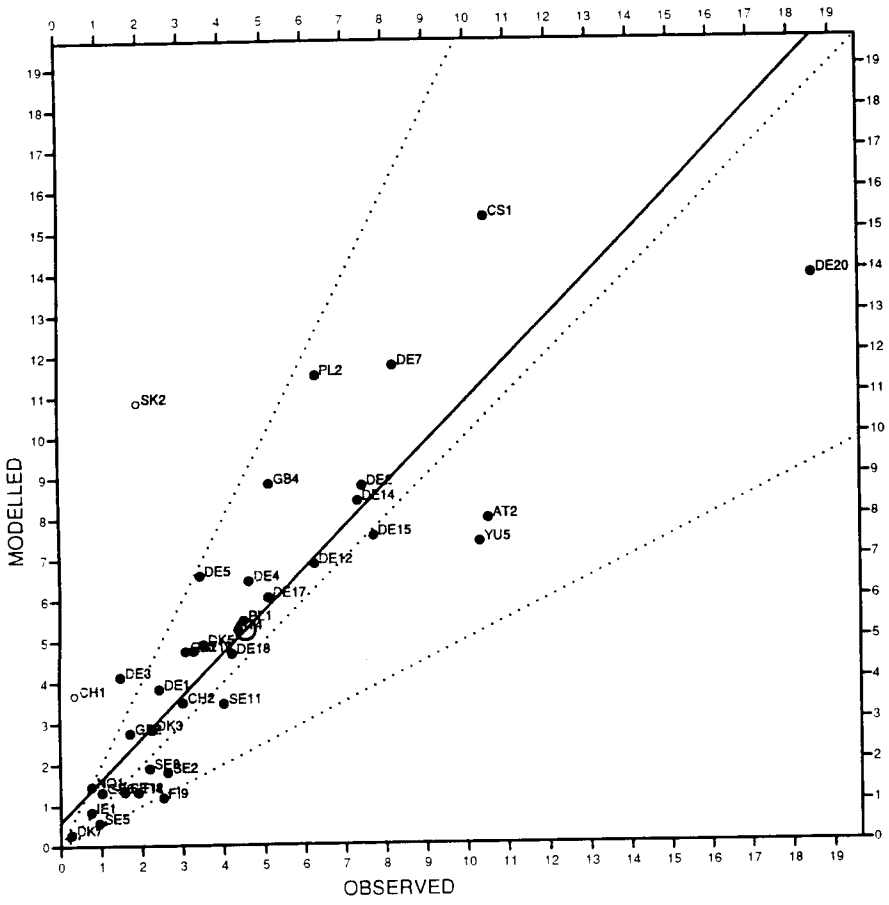


Figure A6 : Scatter plot of calculated and observed concentrations of SO_2 in air. Averaged over the years 85,87,88,89,90 and 91. The full line represents optimal linear regression, i.e. the sum of squares of distances measured from the point normal to the line is minimised. Unit : $\mu g(S)\ m^{-3}$



Average concentration of
sulphur dioxide in air (ug(s)/m3)
year : 1985/87/88/89/90/91
period : the whole year

Averaged over days with observations

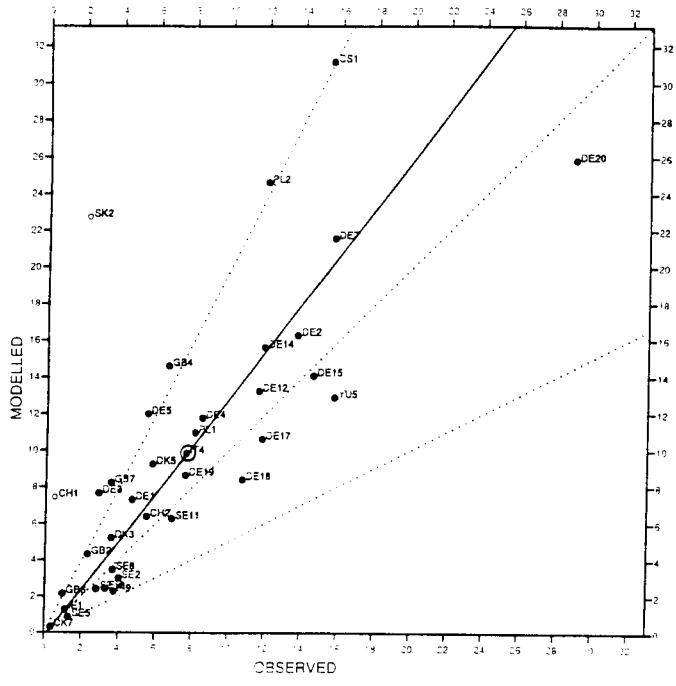
observed	mean =	4.55
modelled	mean =	5.27
correlation	=	0.86
no. of stations	=	36

Requirement : at least
75% common days with data

Table A3 : SO_2 in air. Number of stations in % grouped with respect to daily correlation and relative error. Values for the six year period 1985,87,88,89,90,91. Total number of stations : 38

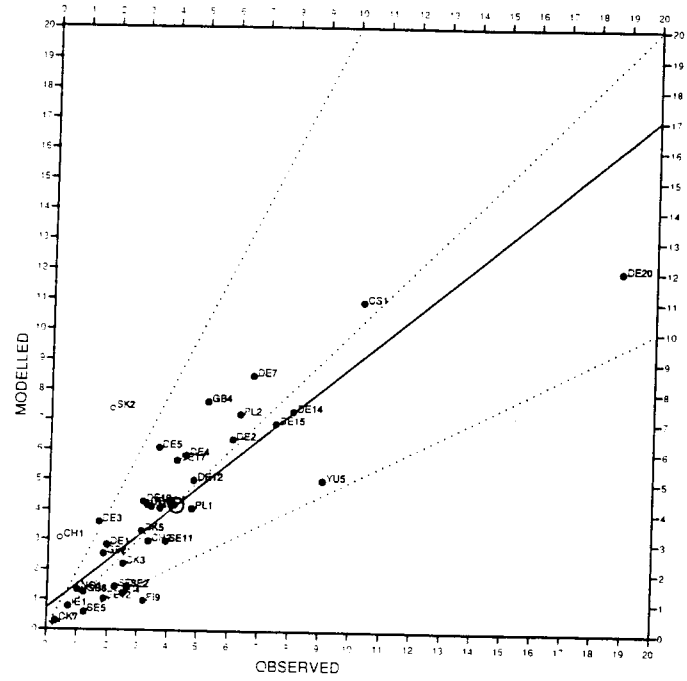
RELATIVE ERROR IN % : 100 *(MOD-OBS)/OBS	DAILY CORRELATION				
	r <= 0	0< r <=0.2	0.2< r <=0.4	0.4< r <=0.6	0.6< r <=1.0
-100<=err <-75					
-75<= err <-50				2.6% FI9	
-50<= err <-25			5.3% SE5 YU5	7.9% FI4 DE20 SE2	
-25<= err < 0.			2.6% AT2	7.9% DE15 SE8 SE12	2.6% SE11
0<= err < 25			7.9% DK7 DE18 CH2	10.5% DE14 DE17 IT4 PL1	7.9% DE2 DE12 IE1
25<= err < 50			2.6% CS1	10.5% DE4 DE7 DE19 GB6	5.3% DK3 DK5
50<= err < 75			5.3% DE1 GB4	5.3% GB2 GB7	
75<= err <100			2.6% NO1	5.3% DE5 PL2	
100<= err		5.3% SK2 CH1	2.6% DE3		

Figure A7 : Seasonal scatter plot of calculated and observed concentrations of SO_2 in air. Averaged over the years 85.87,88,89,90 and 91. Unit : $\mu g(S)\ m^{-3}$



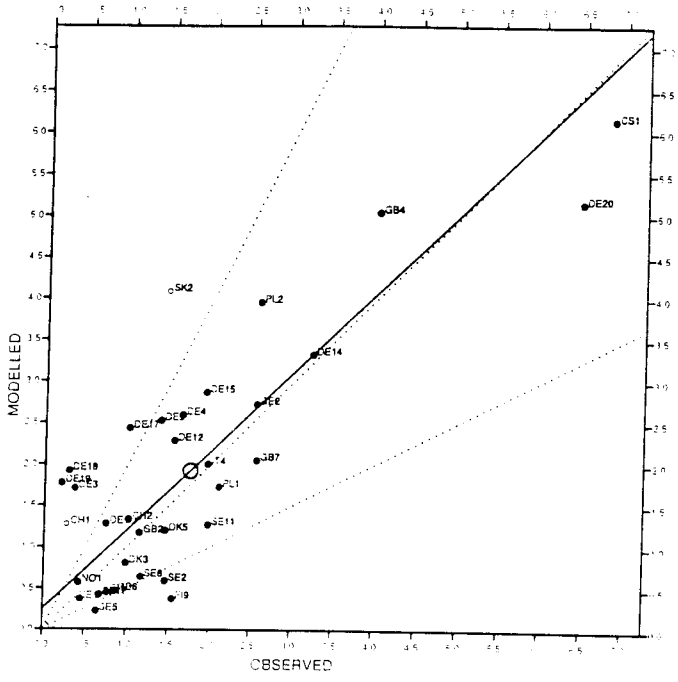
a) Winter

Averaged over days with observations
observed mean = 7.71
modelled mean = 9.84
correlation = 0.84
no. of stations = 34



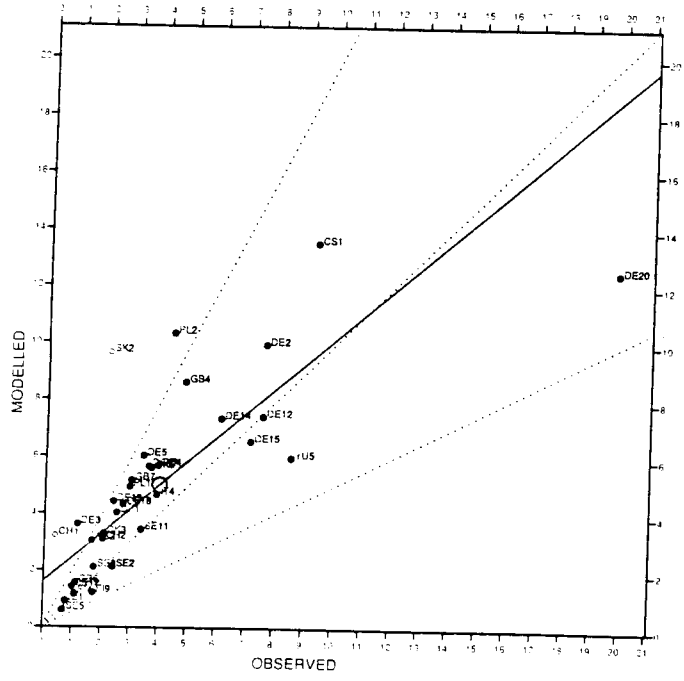
b) Spring

Averaged over days with observations
observed mean = 4.23
modelled mean = 4.16
correlation = 0.87
no. of stations = 35



c) Summer

Averaged over days with observations
observed mean = 1.75
modelled mean = 1.92
correlation = 0.85
no. of stations = 32



d) Autumn

Averaged over days with observations
observed mean = 3.99
modelled mean = 5.02
correlation = 0.81
no. of stations = 32

Figure A8 : Concentration of SO_2 in air. 3 months moving average over 16 stations that fullfill the requierment for data coverage. Stations : CS1, DK3, FI4, DE1, DE2, DE4, DE5, DE14, DE15, DE18, DE19, IE1, PL2, SE8, SE11 and GB2..

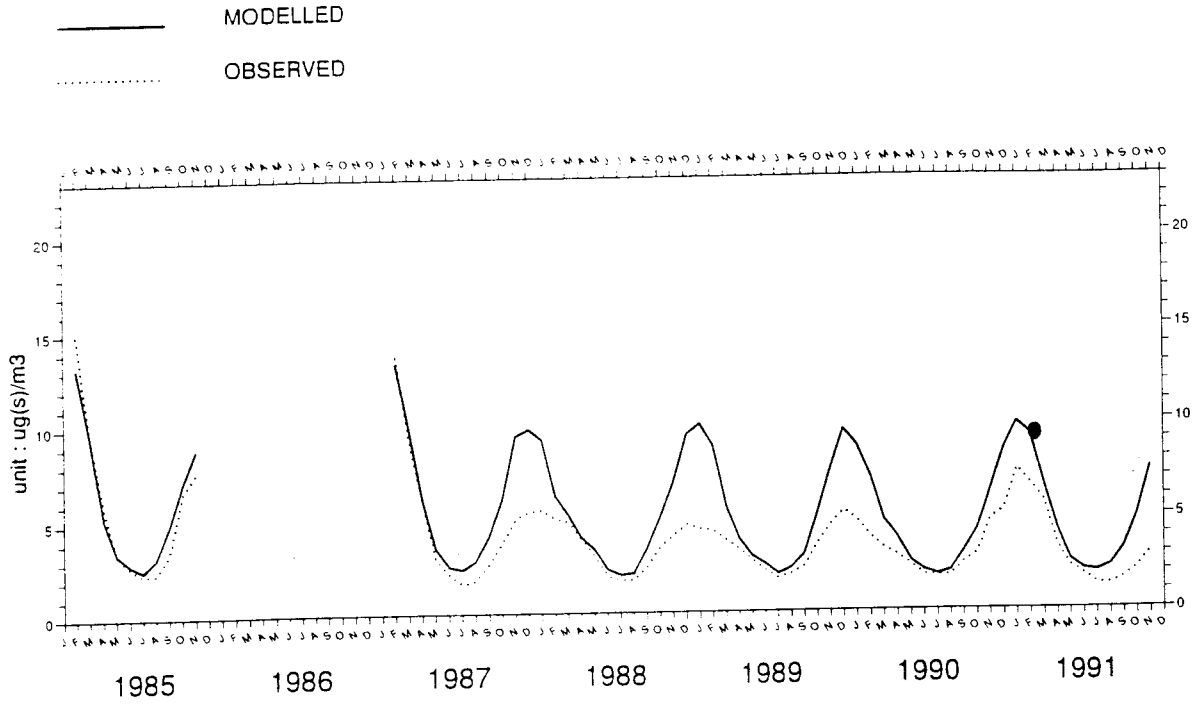
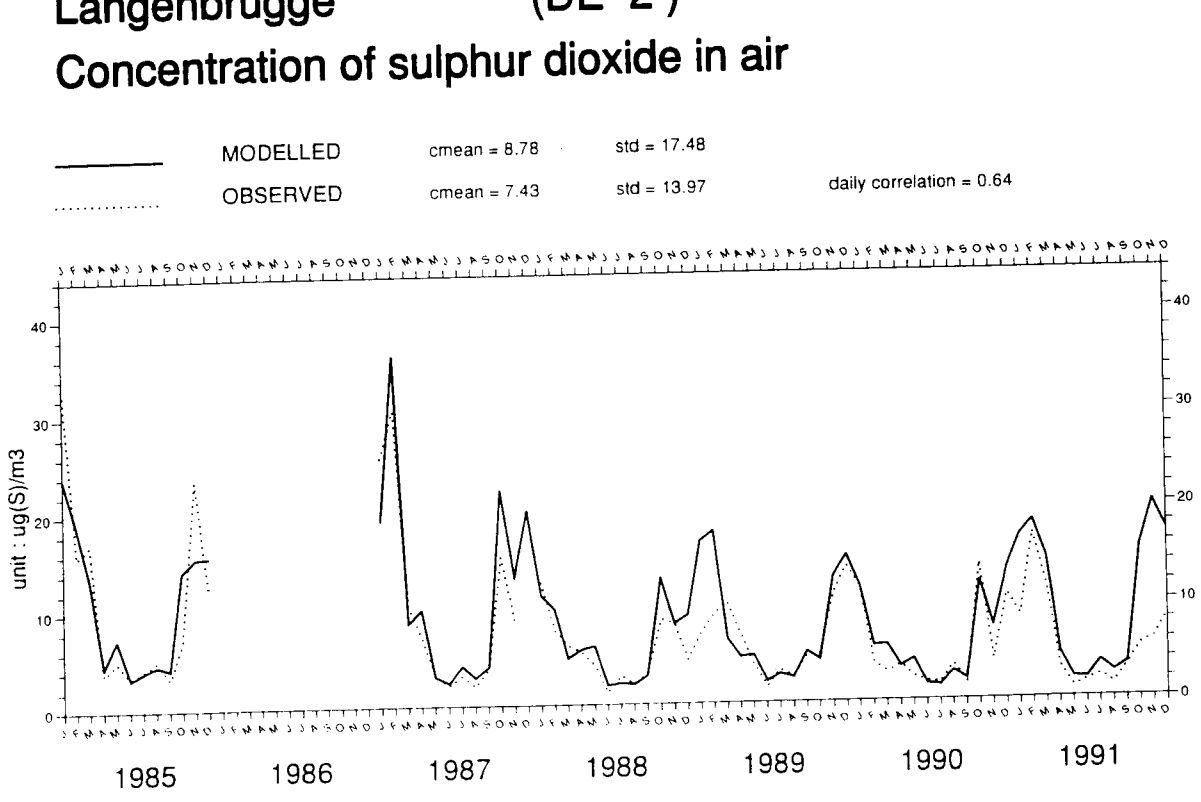


Figure A9 : Timeseries with monthly mean values for some selected stations.

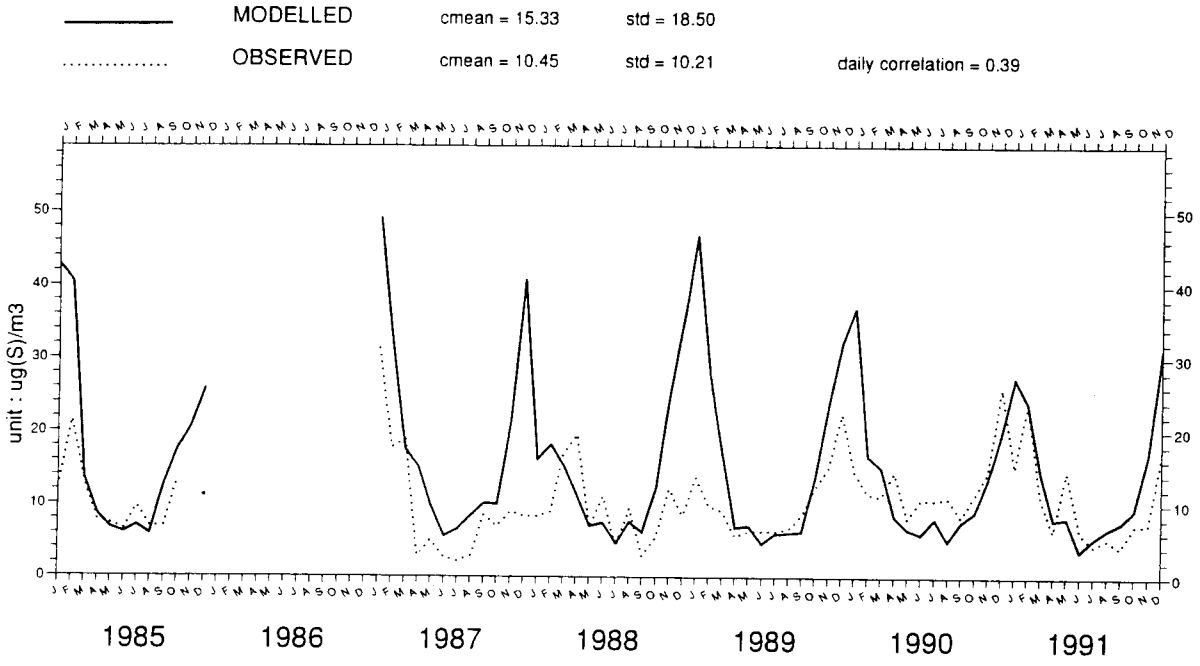
a)



b)

Svratouch (CS 1)

Concentration of sulphur dioxide in air



c)

Vavihill (SE 11)

Concentration of sulphur dioxide in air

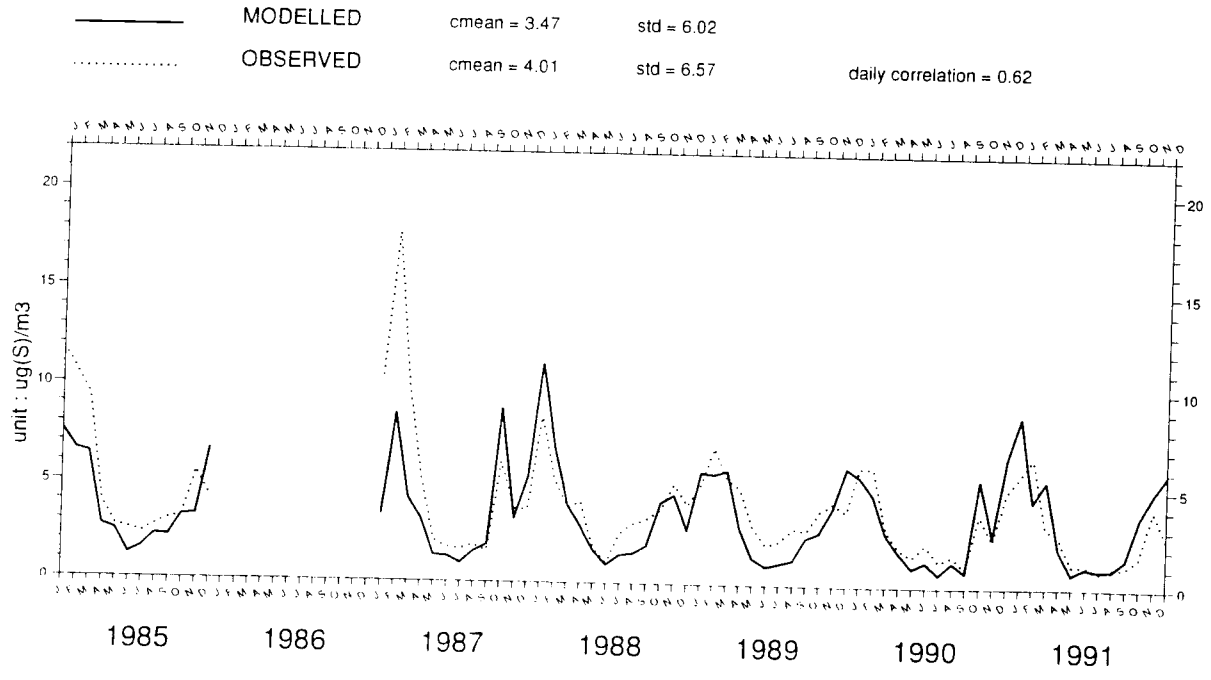


Figure A10 : Scatter plot of calculated and observed concentrations of $SO_4^=$ in air. Averaged over the years 85,87,88,89,90 and 91. The full line represents optimal linear regression, i.e. the sum of squares of distances measured from the point normal to the line is minimised. Unit : $\mu g(S)\ m^{-3}$

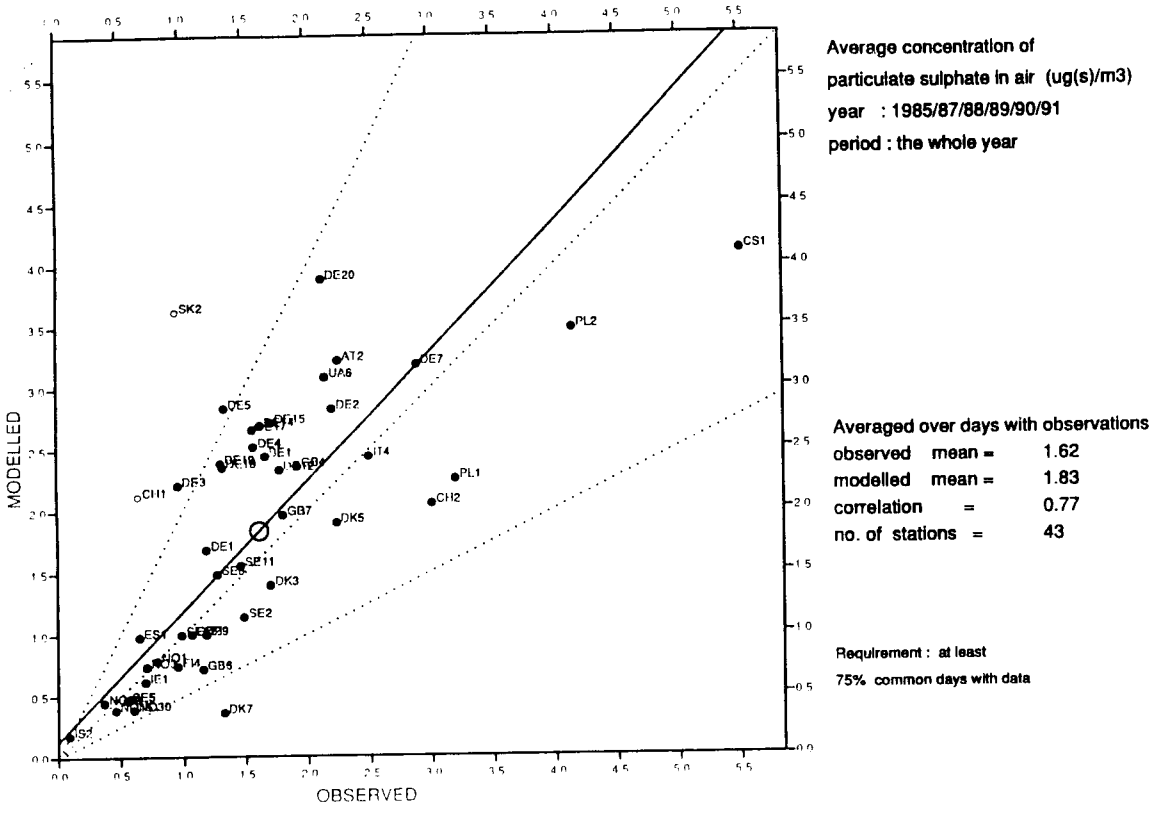
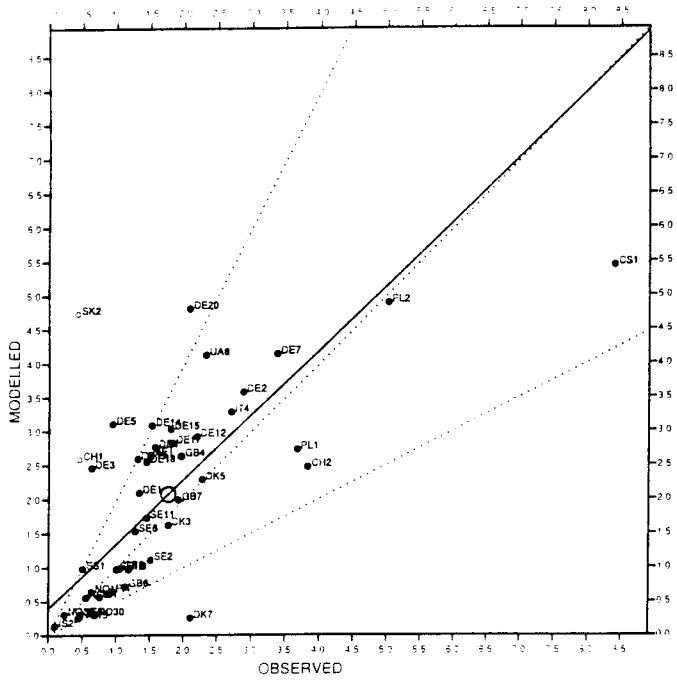


Table A4 : $SO_4^=$ in air. Number of stations in % grouped with respect to daily correlation and relative error. Values for the six year period 1985,87,88,89,90,91. Total number of stations : 45

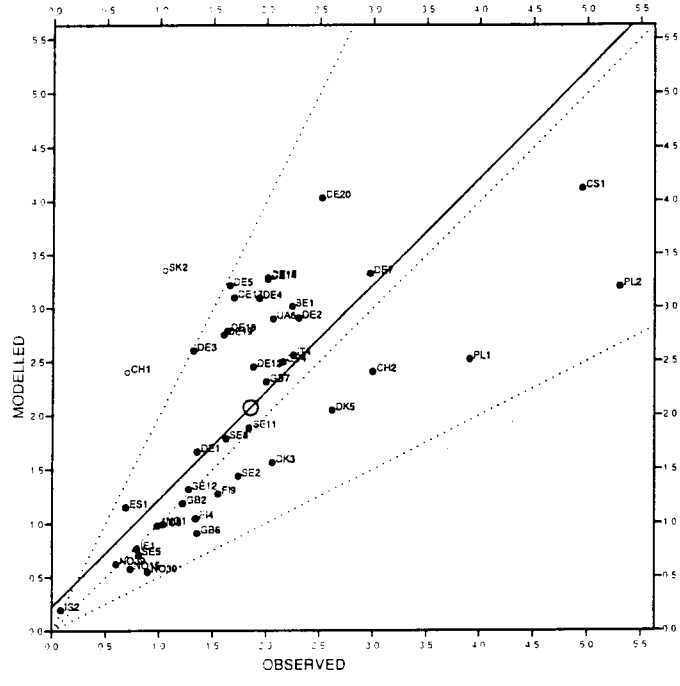
RELATIVE ERROR IN %: 100·(MOD-OBS)/OBS	DAILY CORRELATION				
	r <= 0	0< r <=0.2	0.2< r <=0.4	0.4< r <=0.6	0.6< r <=1.0
-100<=err <-75					
-75<= err <-50		2.2% DK7			
-50<= err <-25		2.2% CS1	2.2% PL1	4.4% NO30 CH2	2.2% GB6
-25<= err < 0.			4.4% IT4 PL2	17.8% DK3 DK5 FI4 FI9 NO1 NO15 SE2 SE5	4.4% IE1 GB2
0<= err < 25				17.8% DE7 NO8 NO39 SE8 SE11 SE12 GB4 GB7	
25<= err < 50			8.9% AT2 DE1 ES1 UA6	6.7% BE1 DE2 DE12	
50<= err < 75				8.9% DE4 DE14 DE15 DE17	
75<= err <100			2.2% DE19	4.4% DE18 DE20	
100<= err		4.4% SK2 CH1	4.4% DE3 IS2	2.2% DE5	

Figure A11 : Scatter plot of calculated and observed concentrations of $SO_4^=$ in air.
Averaged over the years 85.87,88.89,90 and 91. Unit : $\mu g(S)\ m^{-3}$



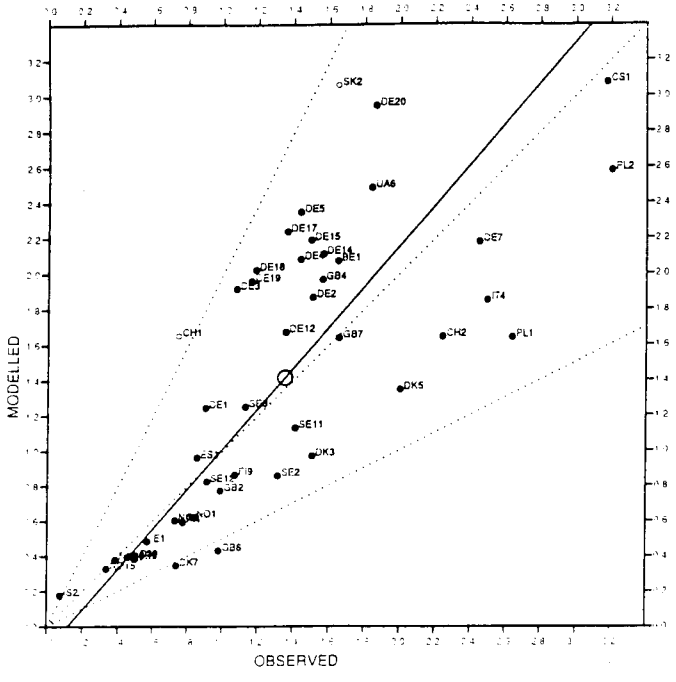
a) Winter

Averaged over days with observations
observed mean = 1.76
modelled mean = 2.07
correlation = 0.74
no. of stations = 42



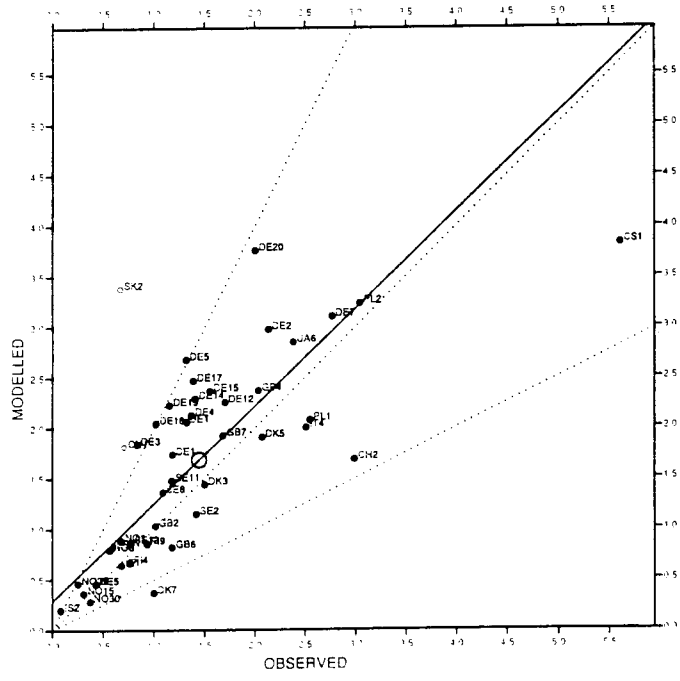
b) Spring

Averaged over days with observations
observed mean = 1.85
modelled mean = 2.07
correlation = 0.72
no. of stations = 41



c) Summer

Averaged over days with observations
observed mean = 1.35
modelled mean = 1.41
correlation = 0.77
no. of stations = 42



d) Autumn

Averaged over days with observations
observed mean = 1.45
modelled mean = 1.68
correlation = 0.78
no. of stations = 42

Figure A12 : Concentration of $SO_4^=$ in air. 3 months moving average over 21 stations that fullfill the requierment for data coverage. Stations : CS1, DK3, FI4, DE1, DE2, DE4, DE5, DE12, DE14, DE15, DE17,DE18, DE19, IE1, NO1, NO39, PL2, SE2, SE8, SE11 and CH2.

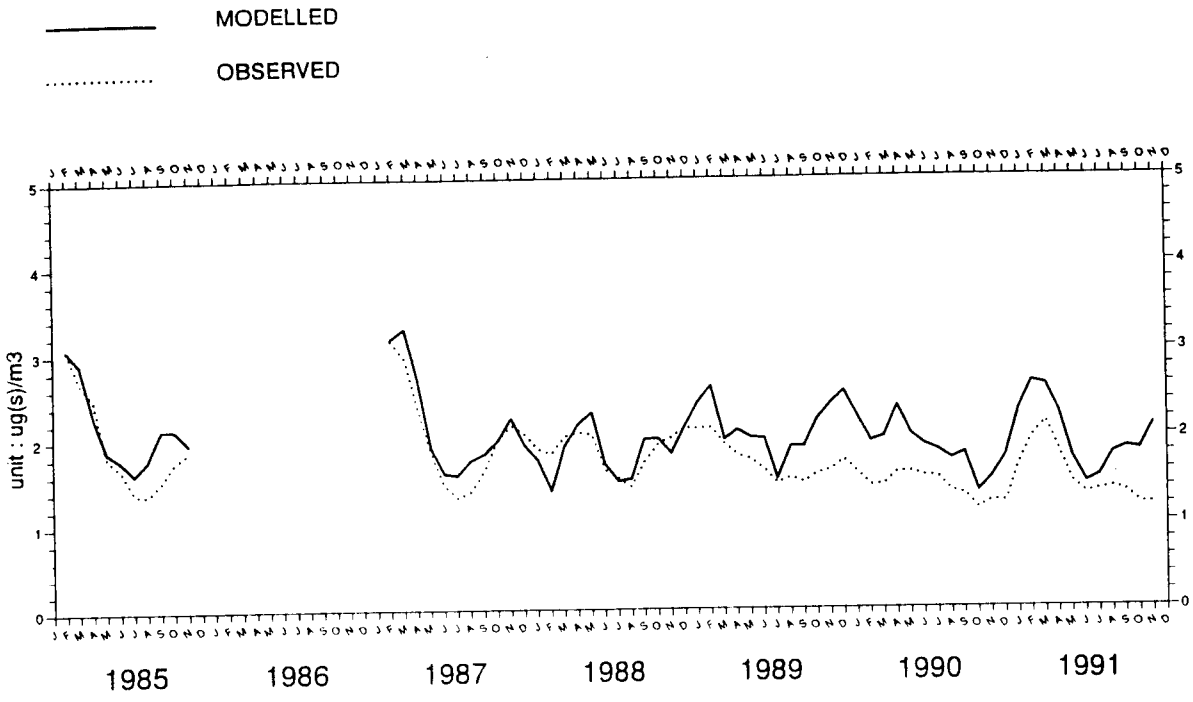
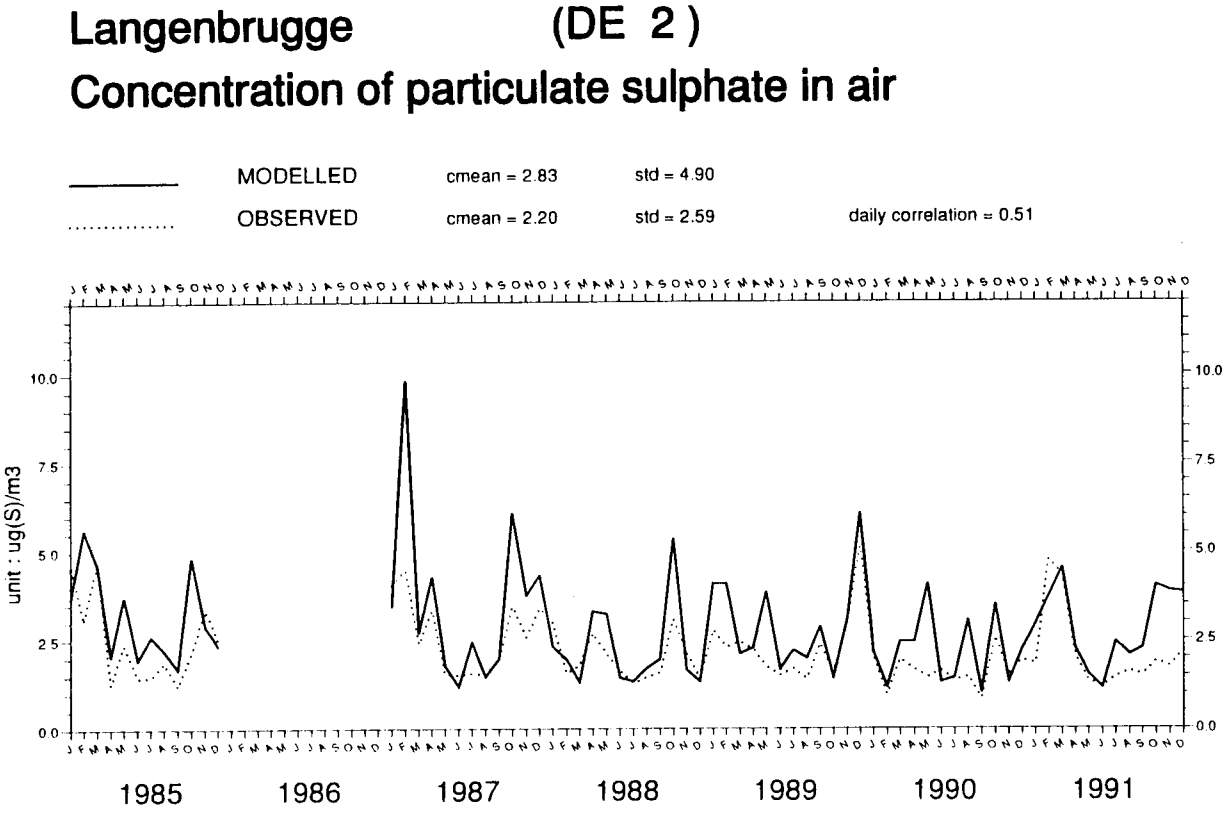


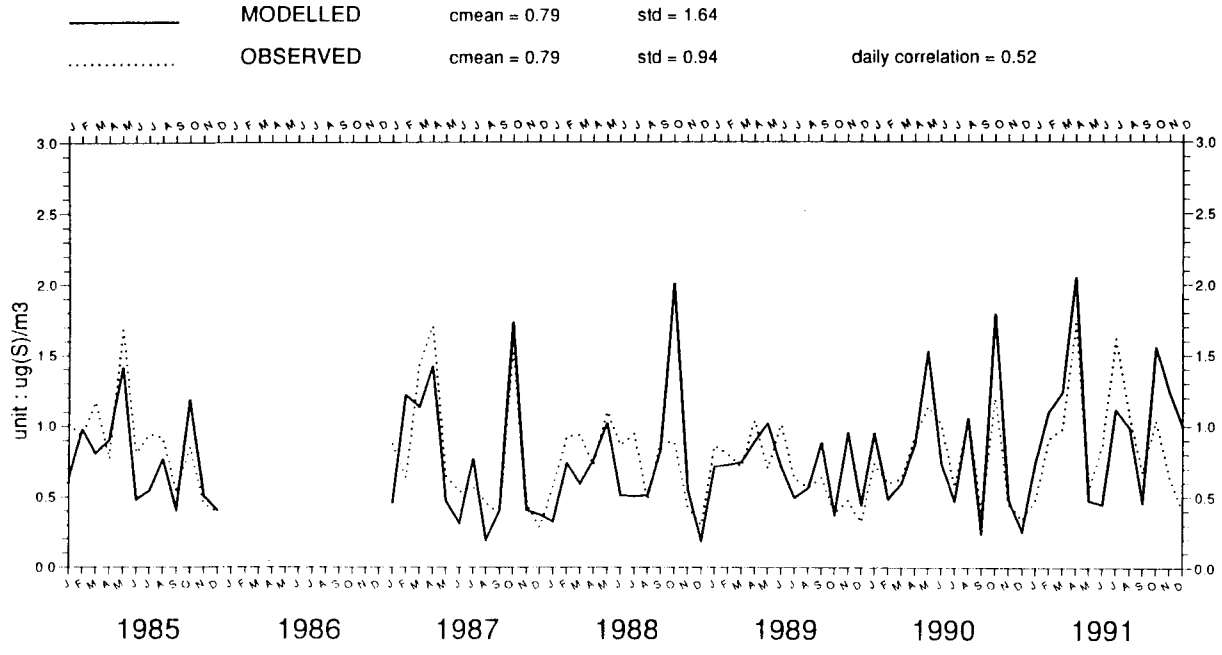
Figure A13 : Timeseries with monthly mean values for some selected stations.

a)



b) **Birkenes (NO 1)**

Concentration of particulate sulphate in air



c)

Barcombe Mills (GB 7)

Concentration of particulate sulphate in air

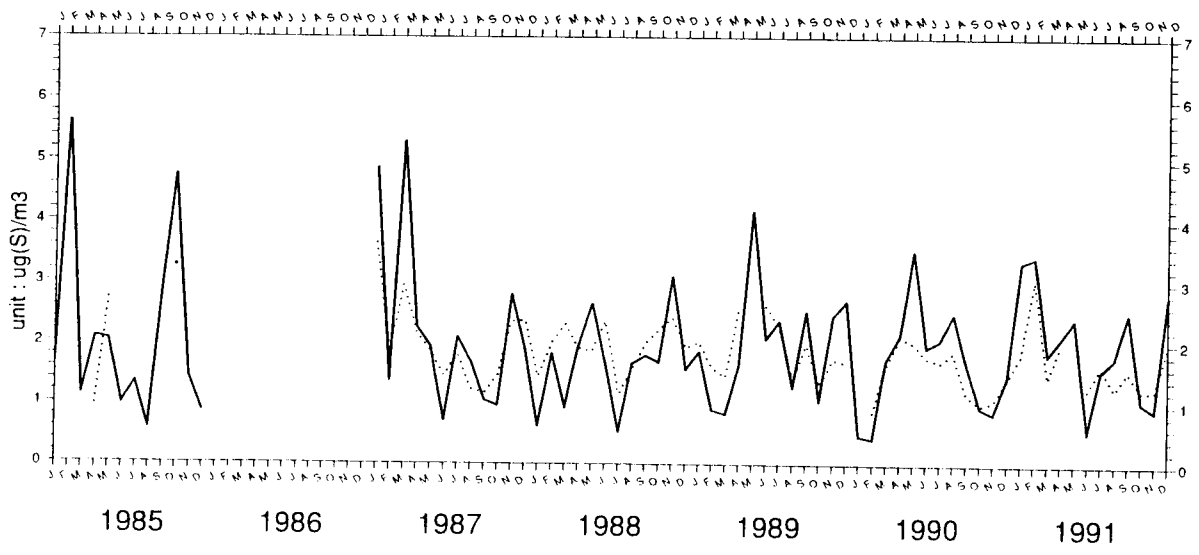


Figure A14 : Scatter plot of calculated and observed concentrations of total nitrate in air. Averaged over the year 1991. The full line represents optimal linear regression, i.e. the sum of squares of distances measured from the point normal to the line is minimised. Unit : $\mu g(N)\ m^{-3}$

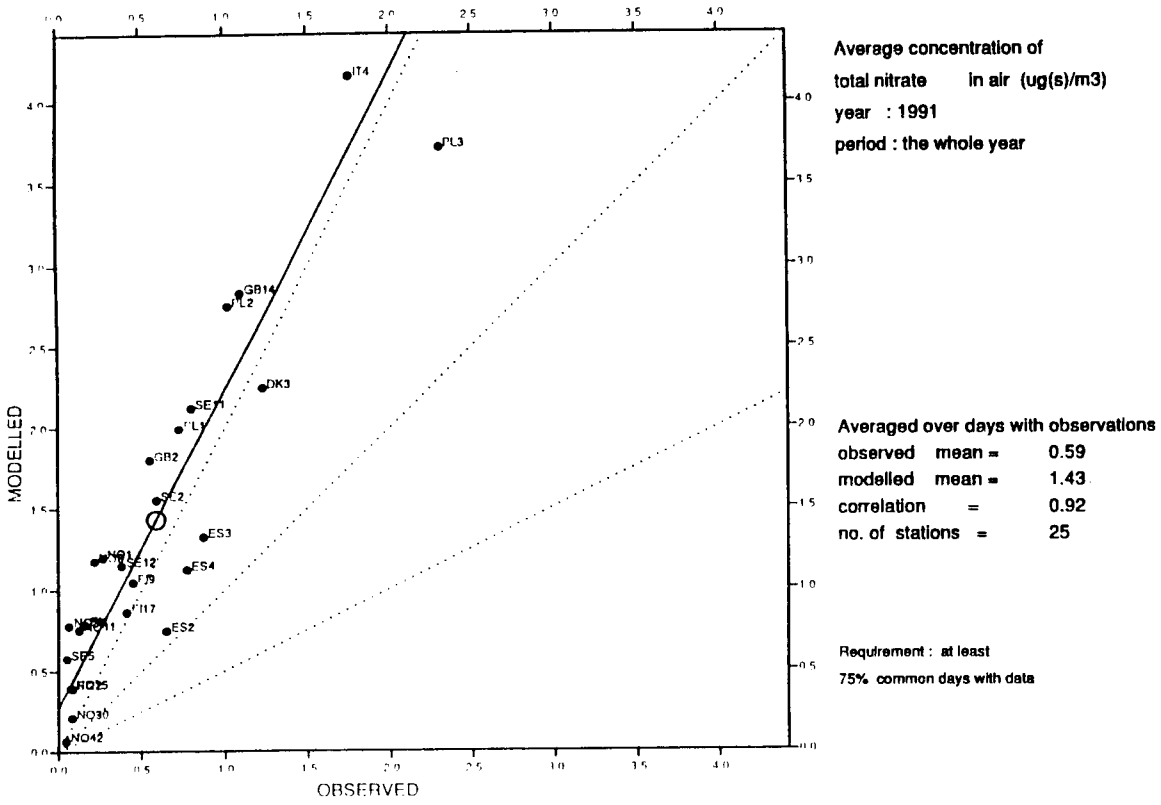
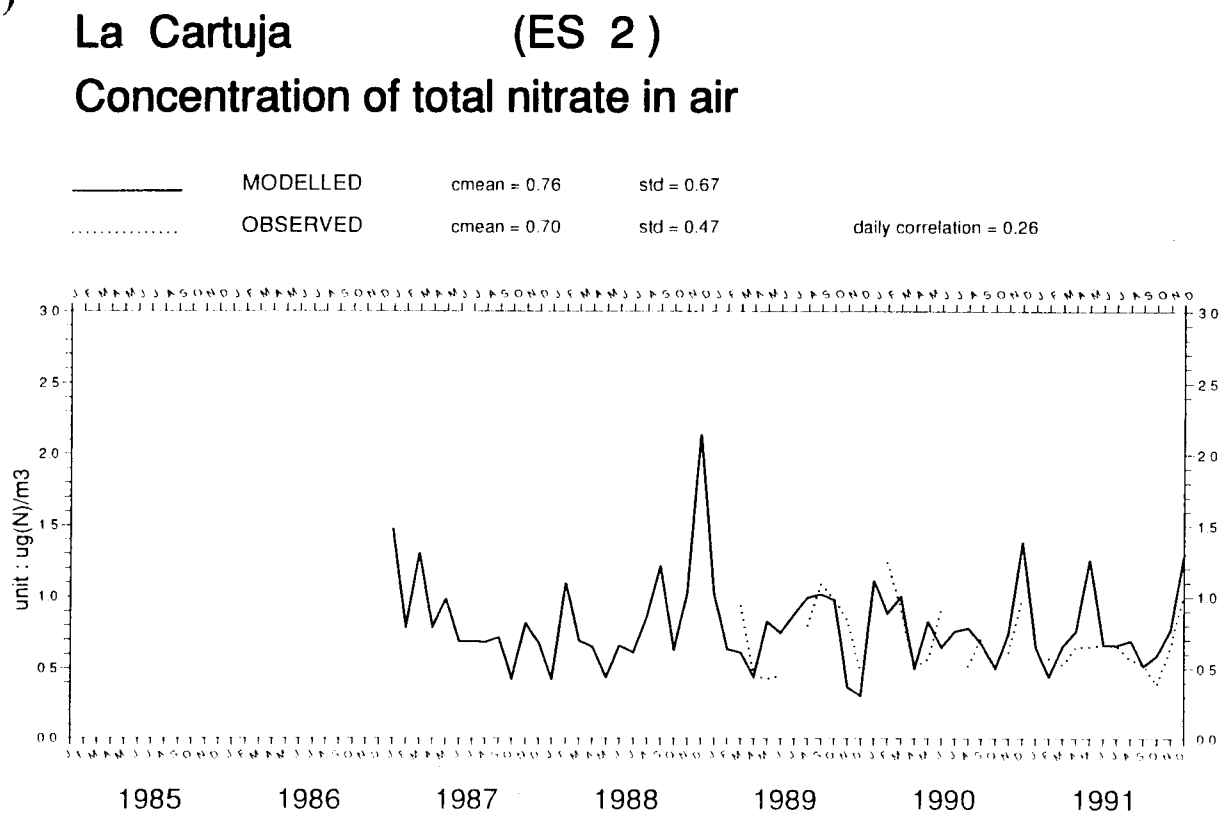


Figure A15 : Timeseries with monthly mean values for some selected stations.

a)



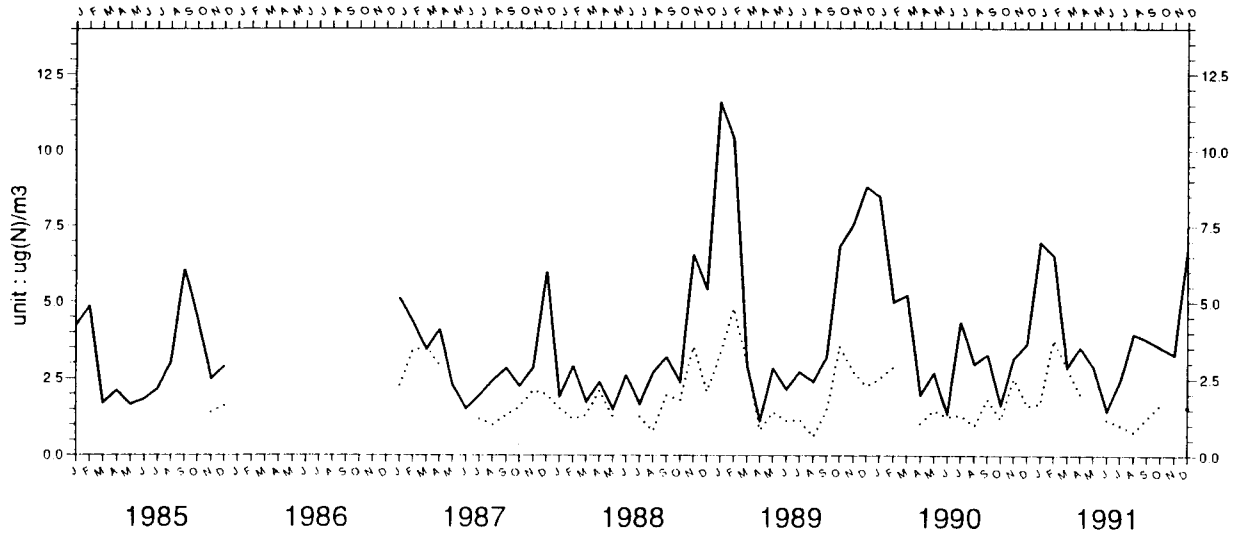
b)

Ispra (IT 4)

Concentration of total nitrate in air

MODELLED cmean = 3.84 std = 4.74

OBSERVED cmean = 1.87 std = 1.75 daily correlation = 0.35



c)

Birkenes (NO 1)

Concentration of total nitrate in air

MODELLED cmean = 1.02 std = 2.11

OBSERVED cmean = 0.28 std = 0.42 daily correlation = 0.41

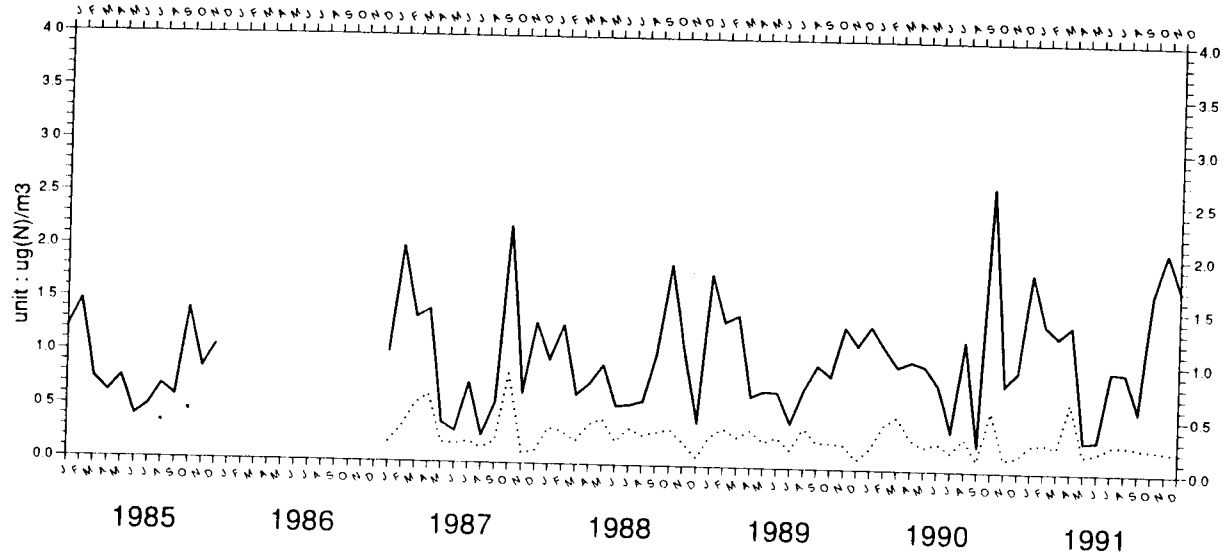


Figure A16 : Scatter plot of calculated and observed concentrations of ammonia + ammonium in air. Averaged over the year 1991. The full line represents optimal linear regression, i.e. the sum of squares of distances measured from the point normal to the line is minimised. Unit : $\mu g(N)\ m^{-3}$

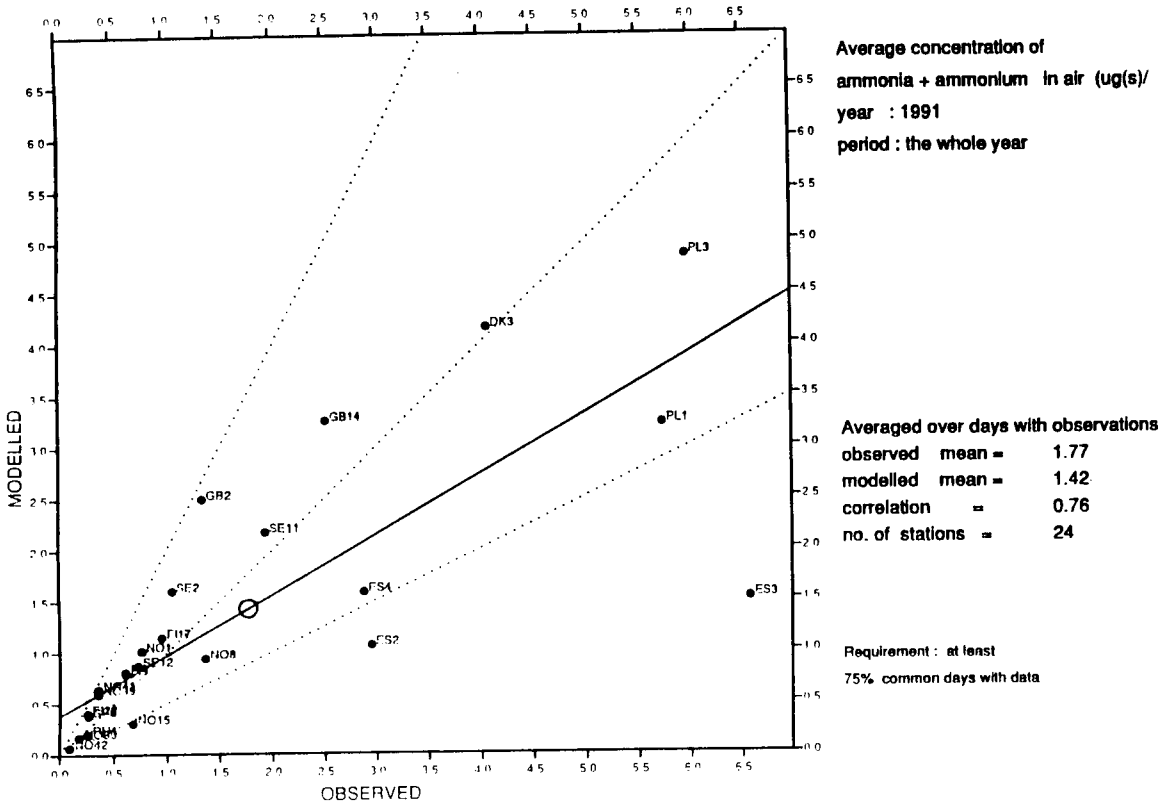


Figure A17 : Timeseries with monthly mean values for some selected stations.

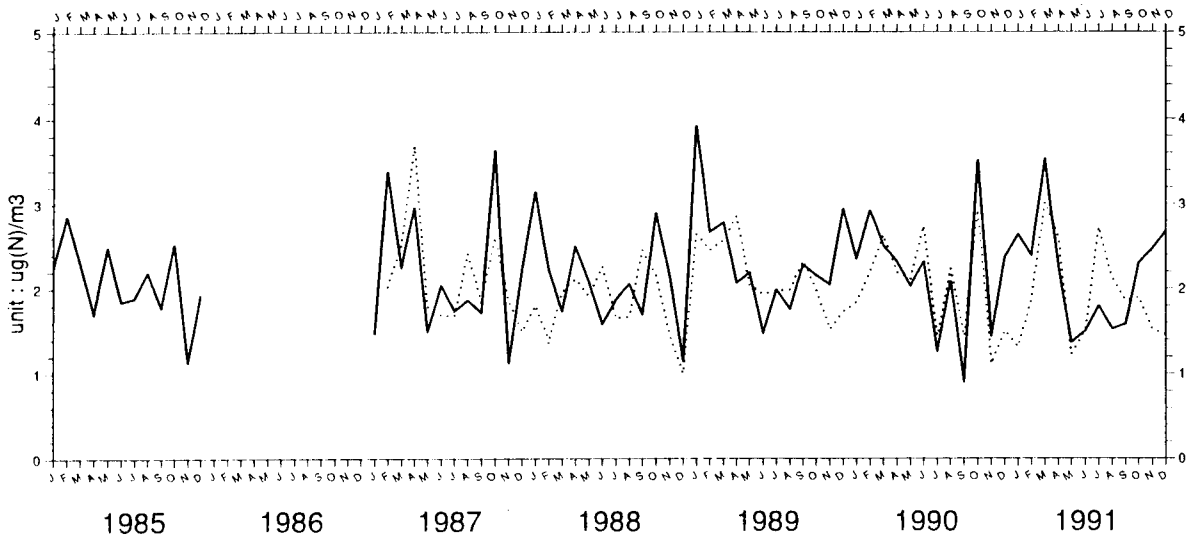
a)

Vavihill (SE 11)

Concentration of ammonia + ammonium in air

MODELLED cmean = 2.20 std = 2.45

OBSERVED cmean = 2.01 std = 1.56 daily correlation = 0.60

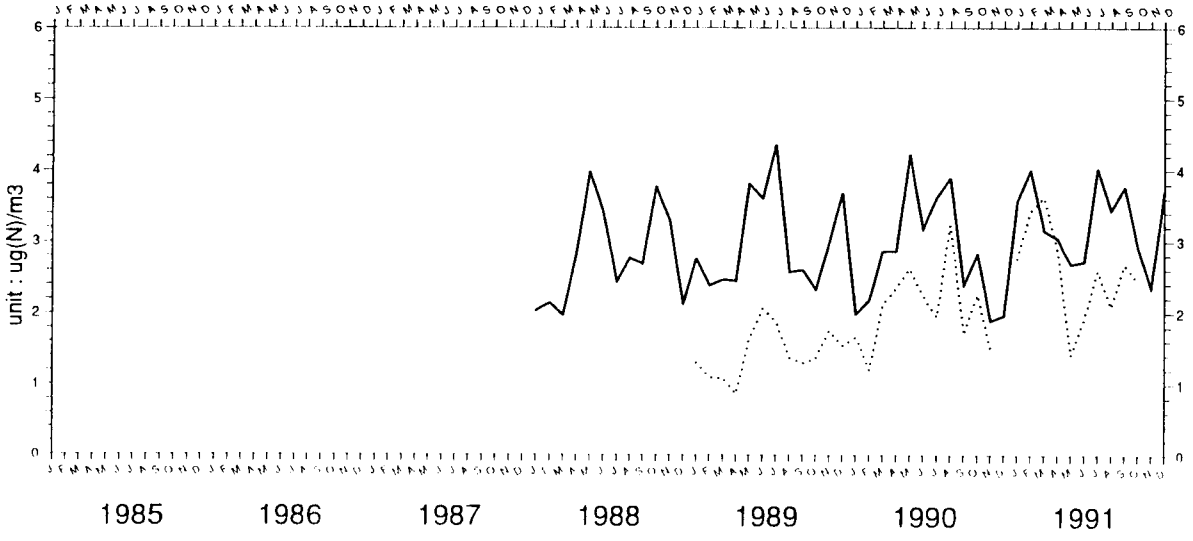


b) **High Muffles (GB 14)**

Concentration of ammonia + ammonium in air

MODELLED cmean = 3.02 std = 2.05

OBSERVED cmean = 1.98 std = 1.65 daily correlation = 0.62



1985 1986 1987 1988 1989 1990 1991

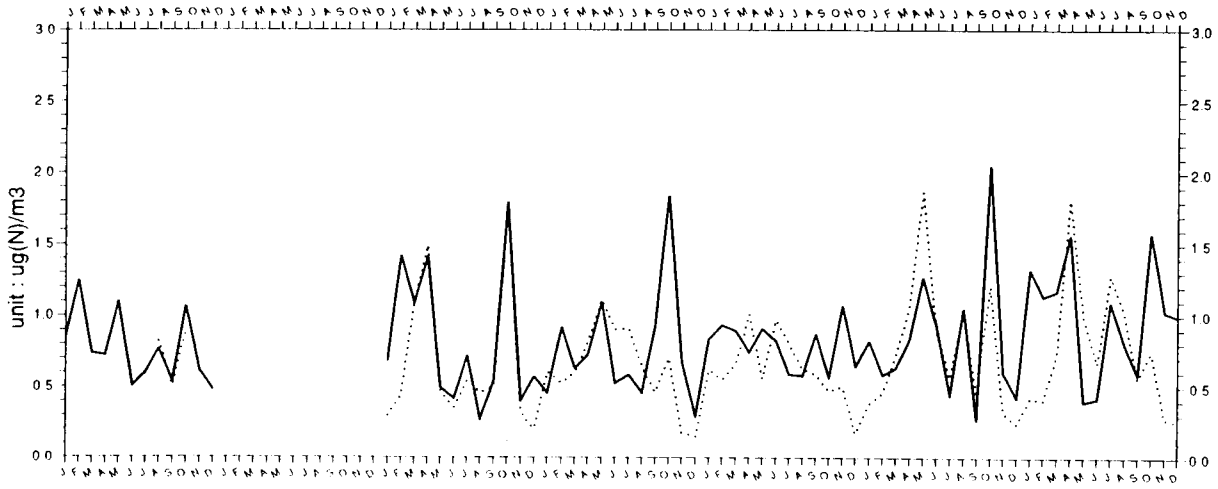
c)

Birkenes (NO 1)

Concentration of ammonia + ammonium in air

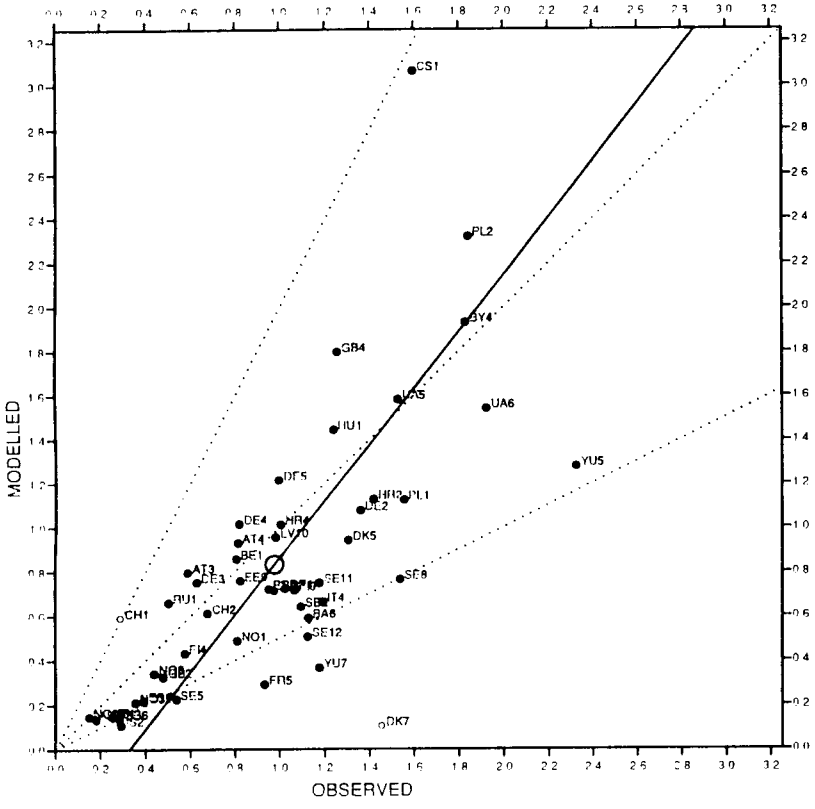
MODELLED cmean = 0.84 std = 1.53

OBSERVED cmean = 0.69 std = 0.92 daily correlation = 0.48



1985 1986 1987 1988 1989 1990 1991

Figure A18 : Scatter plot of calculated and observed concentrations of sulphate in precipitation.. Averaged over the years 85,87,88,89,90 and 91. The full line represents optimal linear regression, i.e. the sum of squares of distances measured from the point normal to the line is minimised. Unit : mg(S)/l



Average concentration of
sulphate in precipitation (mg(s)/l)
year : 1985/87/88/89/90/91
period : the whole year

Averaged over days with observations

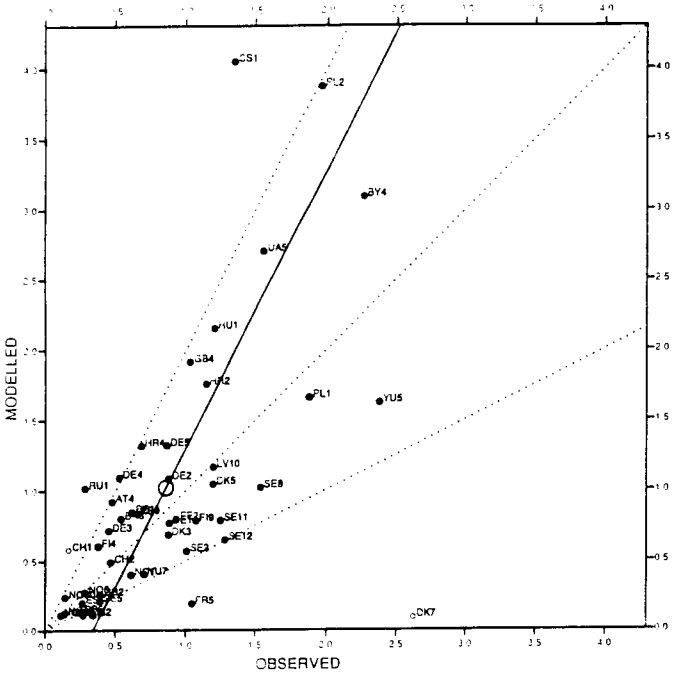
observed	mean =	0.98
modelled	mean =	0.83
correlation	=	0.75
no. of stations	=	47

Requirement : at least
25% common days with data

Table A5 : Sulphate in precipitation. Number of stations in % grouped with respect to daily correlation and relative error. Values for the six year period 85,87,88,89,90,91.
Total number of stations : 49

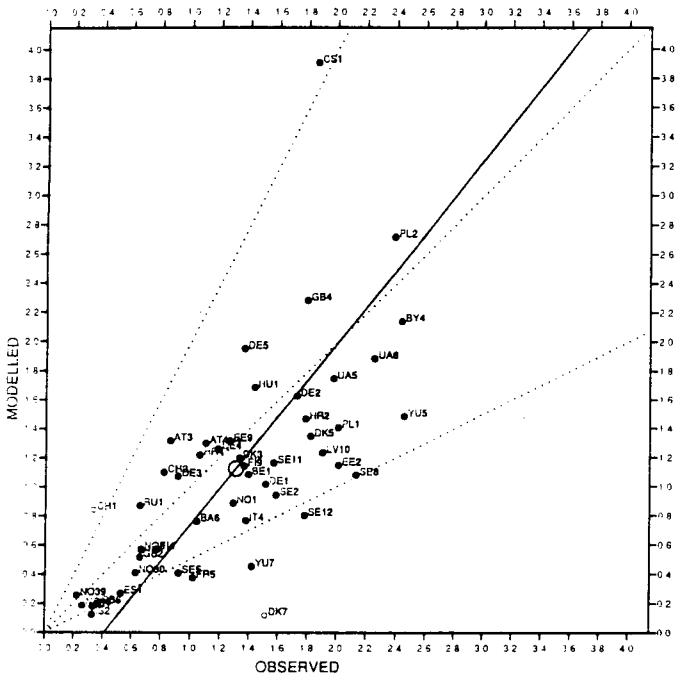
RELATIVE ERROR IN % : 100 *(MOD-OBS)/OBS	DAILY CORRELATION				
	r <= 0	0< r <=0.2	0.2< r <=0.4	0.4< r <=0.6	0.6< r <=1.0
-100<=err <-75		2.0% DK7			
-75<= err <-50		4.1% FR5 YU7	8.2% IS2 SE5 SE8 GB6	2.0% SE12	
-50<= err <-25		6.1% ES1 BA6 YU5	20.4% DK5 FI4 FI9 DE1 IT4 NO15 NO30 PL1 SE11 GB2	8.2% DK3 IE1 NO1 SE2	
-25<= err < 0.		8.2% EE2 EE9 UA6 HR2	8.2% DE2 NO39 CH2 LV10	2.0% NO8	
0<= err < 25		6.1% DE4 HU1 HR4	12.2% AT4 BE1 DE3 DE5 BY4 UA5		
25<= err < 50		6.1% AT3 PL2 RU1	2.0% GB4		
50<= err < 75					
75<= err <100			2.0% CS1		
100<= err			2.0% CH1		

Figure A19 : Scatter plot of calculated and observed concentrations of sulphate in precipitation.. Averaged over the years 85.87,88,89,90 and 91. Unit : mg(S)/l



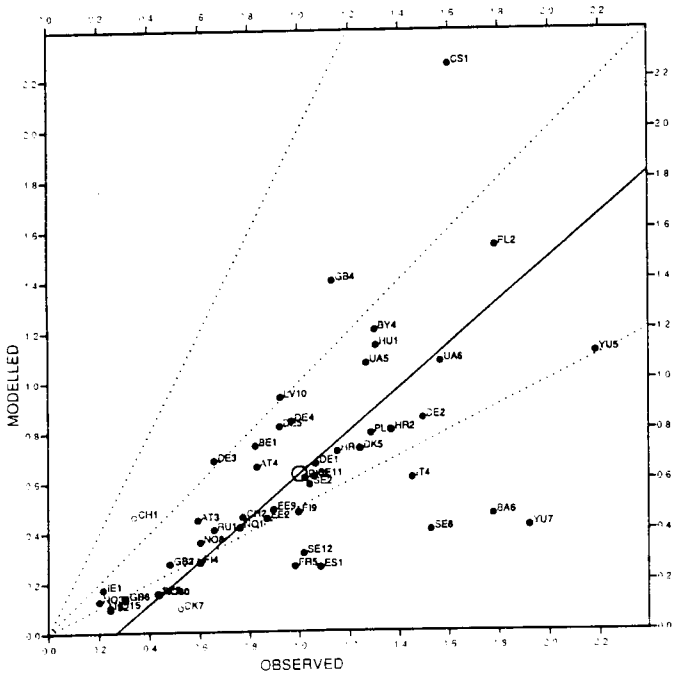
a) Winter

Averaged over days with observations
observed mean = 0.86
modelled mean = 1.02
correlation = 0.72
no. of stations = 44



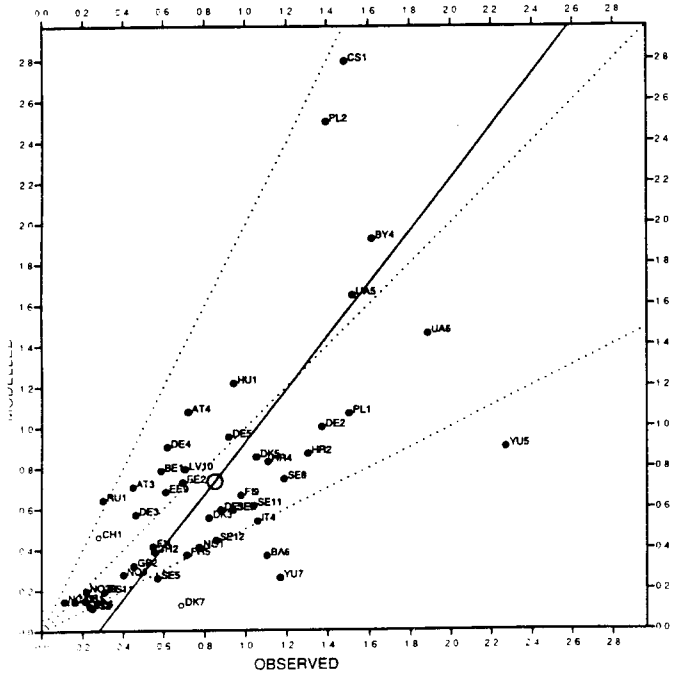
b) Spring

Averaged over days with observations
observed mean = 1.31
modelled mean = 1.12
correlation = 0.71
no. of stations = 47



c) Summer

Averaged over days with observations
observed mean = 1.00
modelled mean = 0.63
correlation = 0.64
no. of stations = 47



d) Autumn

Averaged over days with observations
observed mean = 0.85
modelled mean = 0.73
correlation = 0.67
no. of stations = 46

Figure A20 : Concentration of sulphate in precipitation.. 3 months moving average over 13 stations that fullfill the requierment for data coverage. Stations : FI4, DE4, DE5, IS2, IE1, NO1, NO8, NO15, NO39, SE2, SE12, GB2 and GB6.

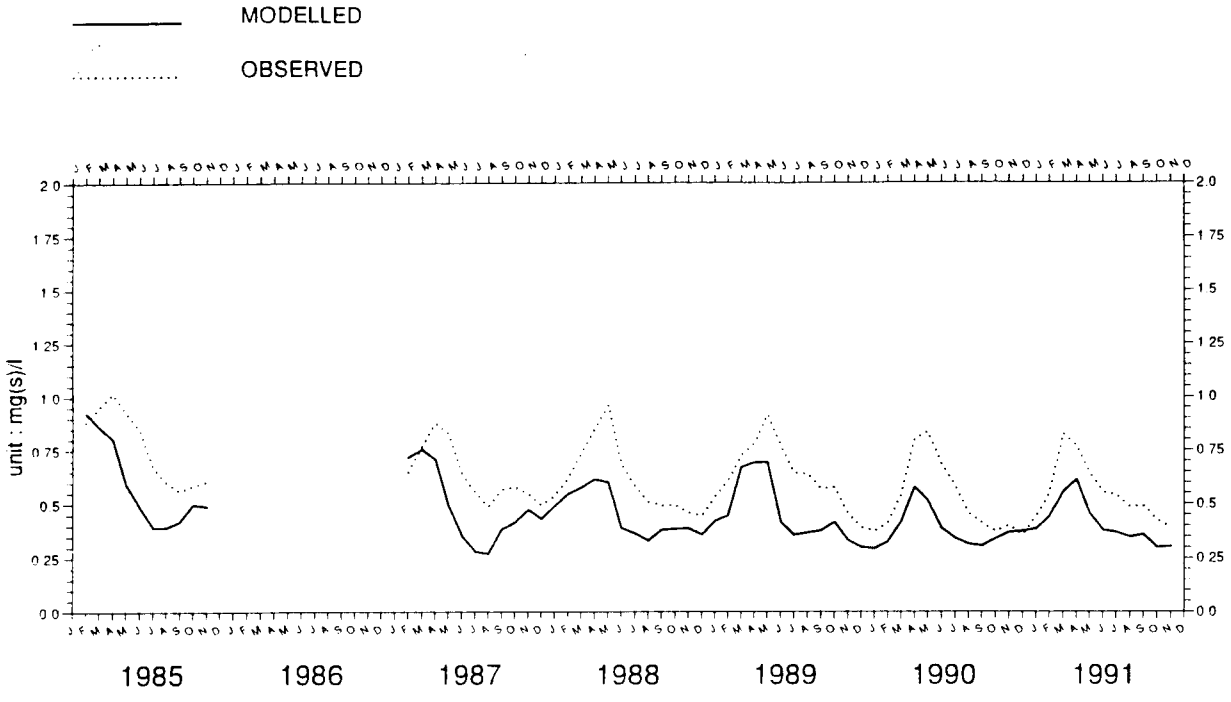
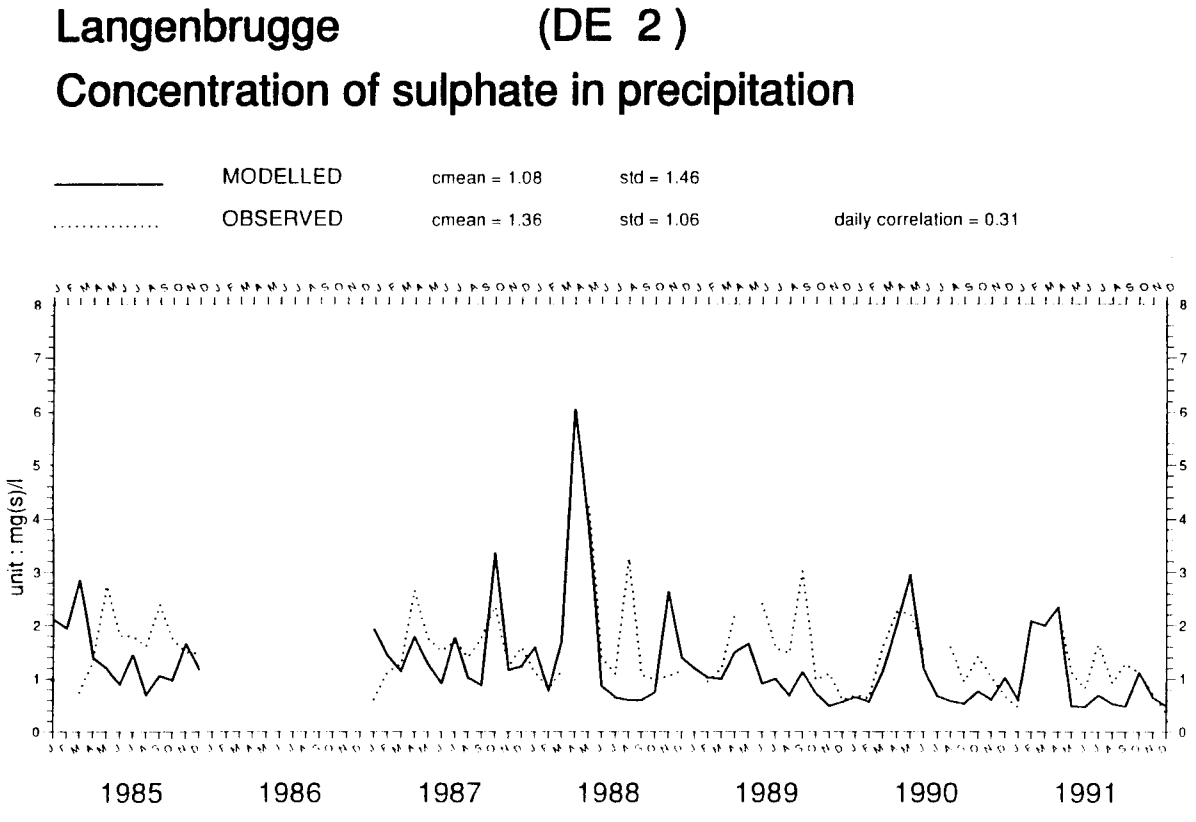


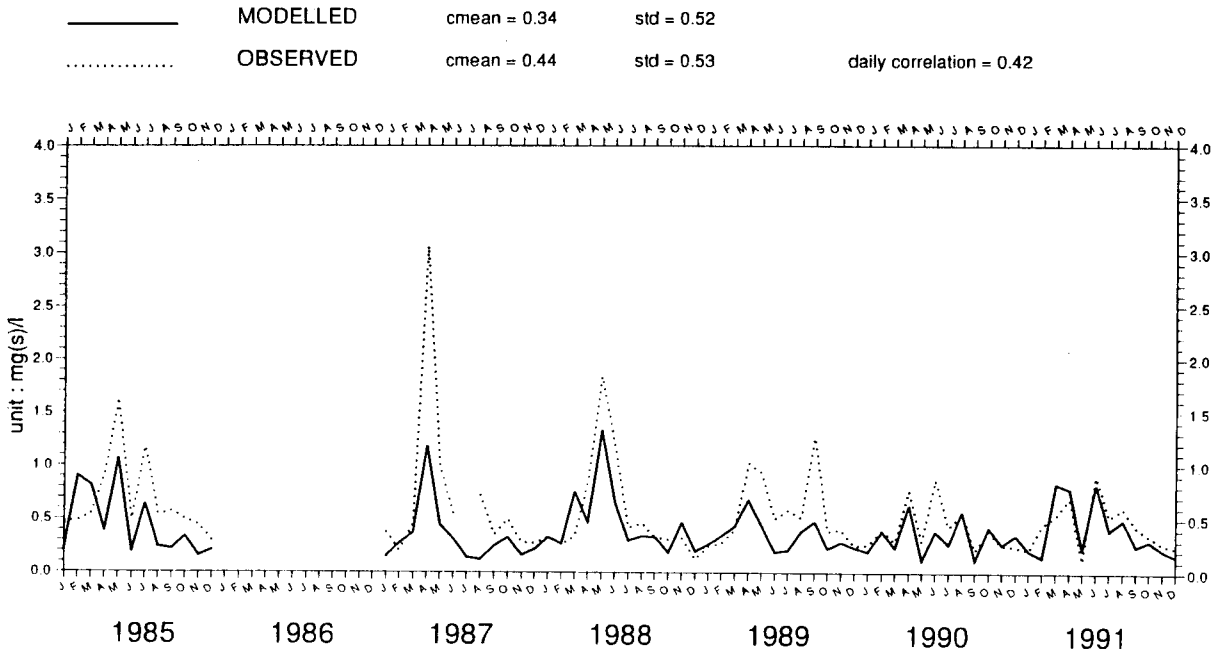
Figure A21 : Timeseries with monthly mean values for some selected stations.

a)



b) **Skreaadalen (NO 8)**

Concentration of sulphate in precipitation



c)

Eskdalemuir (GB 2)

Concentration of sulphate in precipitation

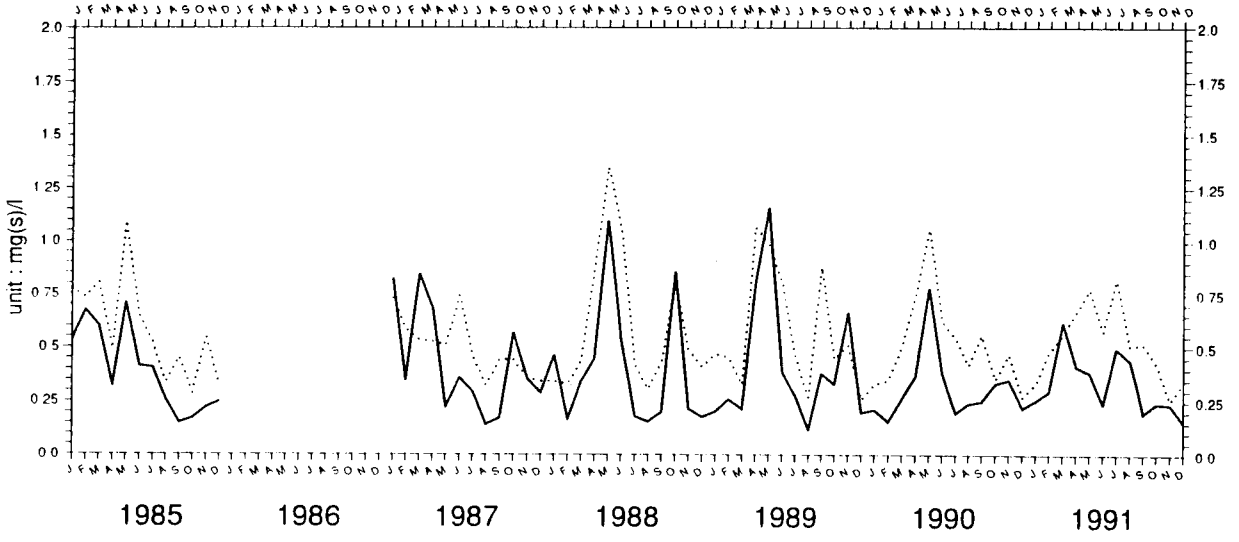
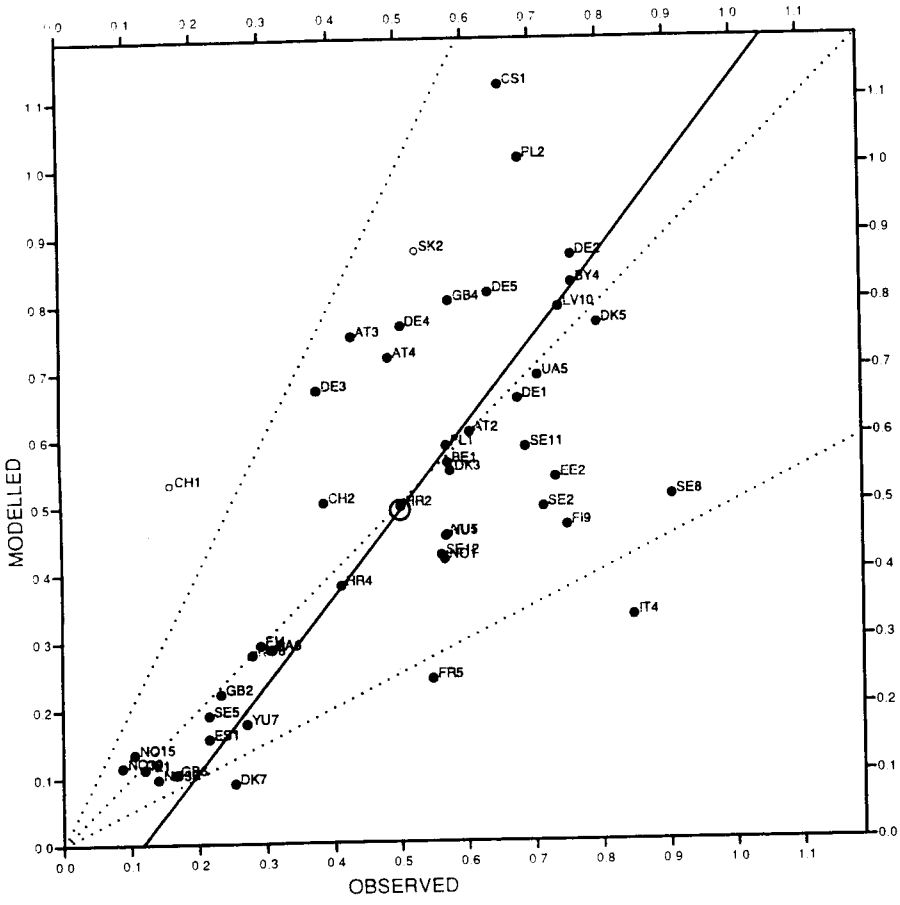


Figure A22 : Scatter plot of calculated and observed concentrations of nitrate in precipitation.. Averaged over the years 85,87,88,89,90 and 91. The full line represents optimal linear regression, i.e. the sum of squares of distances measured from the point normal to the line is minimised. Unit : mg(N)/l



Average concentration of
nitrate in precipitation (mg(n)/l)
(calculated : wet + dry)
year : 1985/87/88/89/90/91
period : the whole year

Averaged over days with observations

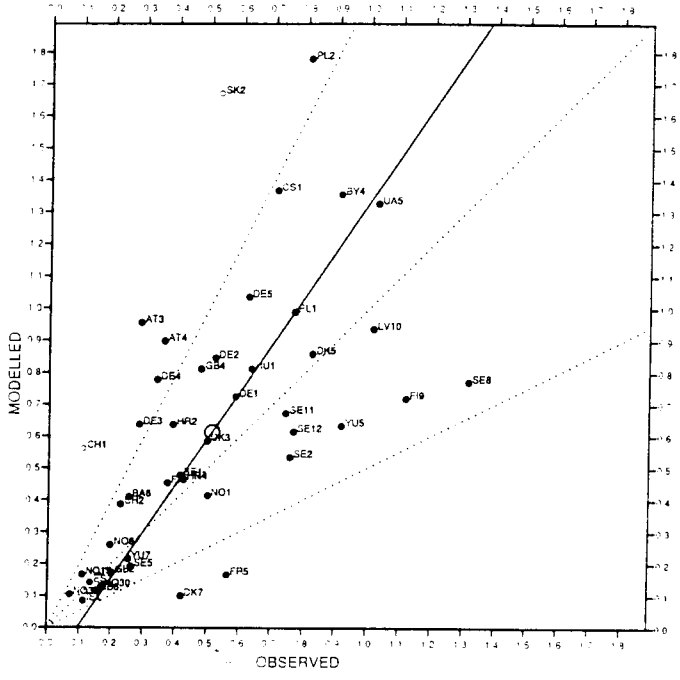
observed mean =	0.50
modelled mean =	0.49
correlation =	0.72
no. of stations =	45

Requirement : at least
25% common days with data

Table A6 : Nitrate in precipitation. Number of stations in % grouped with respect to daily correlation and relative error. Values for the six year period 1985,87,88,89,90,91. Total number of stations : 47

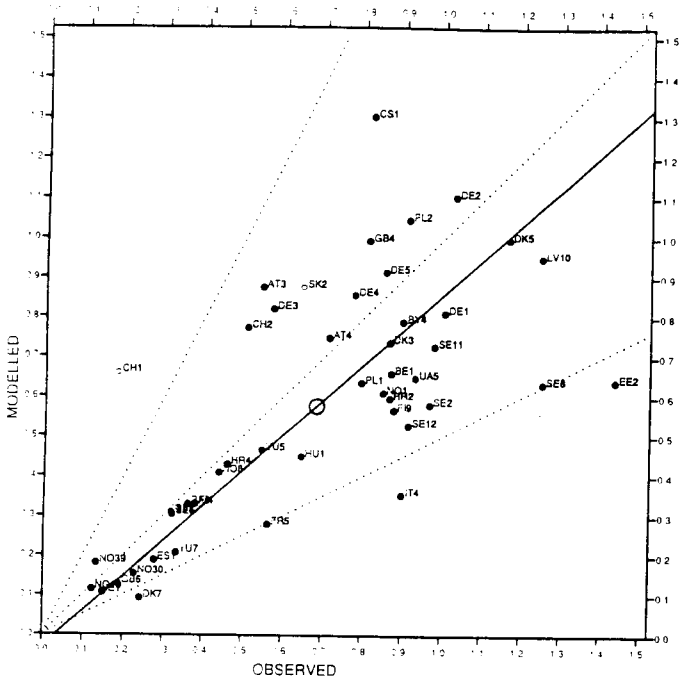
RELATIVE ERROR IN % : 100 *(MOD-OBS)/OBS	DAILY CORRELATION				
	r <= 0	0< r <=0.2	0.2< r <=0.4	0.4< r <=0.6	0.6< r <=1.0
-100<=err <-75					
-75<= err <-50		4.3% DK7 IT4	2.1% FR5		
-50<= err <-25		6.4% ES1 EE2 YU7	4.3% FI9 GB6	8.5% NO1 NO30 SE2 SE8	
-25<= err < 0.		10.6% HU1 UA5 HR2 HR4 BA6	10.6% BE1 DK5 SE5 SE11 YU5	12.8% DK3 DE1 IE1 NO8 SE12 GB2	
0<= err < 25		4.3% AT2 BY4	6.4% DE2 PL1 LV10	2.1% FI4	
25<= err < 50		4.3% AT4 PL2	6.4% DE5 NO39 CH2	4.3% NO15 GB4	
50<= err < 75		6.4% AT3 SK2 DE4	2.1% CS1		
75<= err <100			2.1% DE3		
100<= err			2.1% CH1		

Figure A23 : Seasonal scatter plot of calculated and observed concentrations of nitrate in precipitation.. Averaged over the years 85.87,88,89,90 and 91. Unit : mg(N)/l



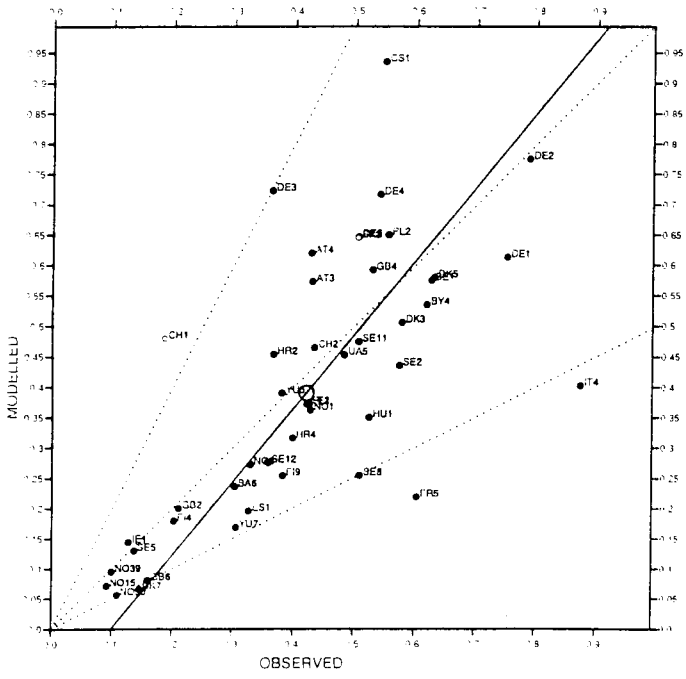
a) Winter

Averaged over days with observations
observed mean = 0.51
modelled mean = 0.61
correlation = 0.66
no. of stations = 42



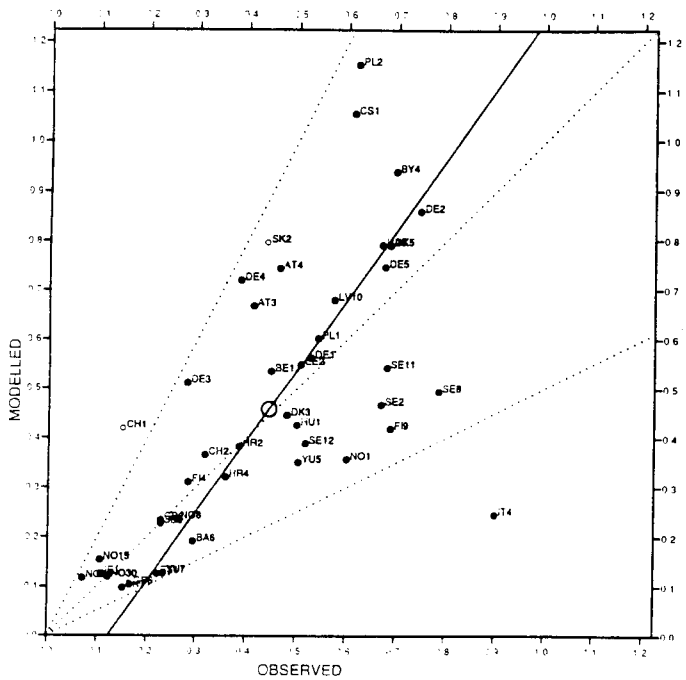
b) Spring

Averaged over days with observations
observed mean = 0.68
modelled mean = 0.58
correlation = 0.73
no. of stations = 44



c) Summer

Averaged over days with observations
observed mean = 0.42
modelled mean = 0.39
correlation = 0.73
no. of stations = 43



d) Autumn

Averaged over days with observations
observed mean = 0.45
modelled mean = 0.46
correlation = 0.68
no. of stations = 42

Figure A24 : Concentration of nitrate in precipitation. 3 months moving average over 10 stations that fullfill the requierment for data coverage. Stations : AT2, DK3, FI4, DE4, DE5, NO8, NO15, SE2, SE12 and GB2.

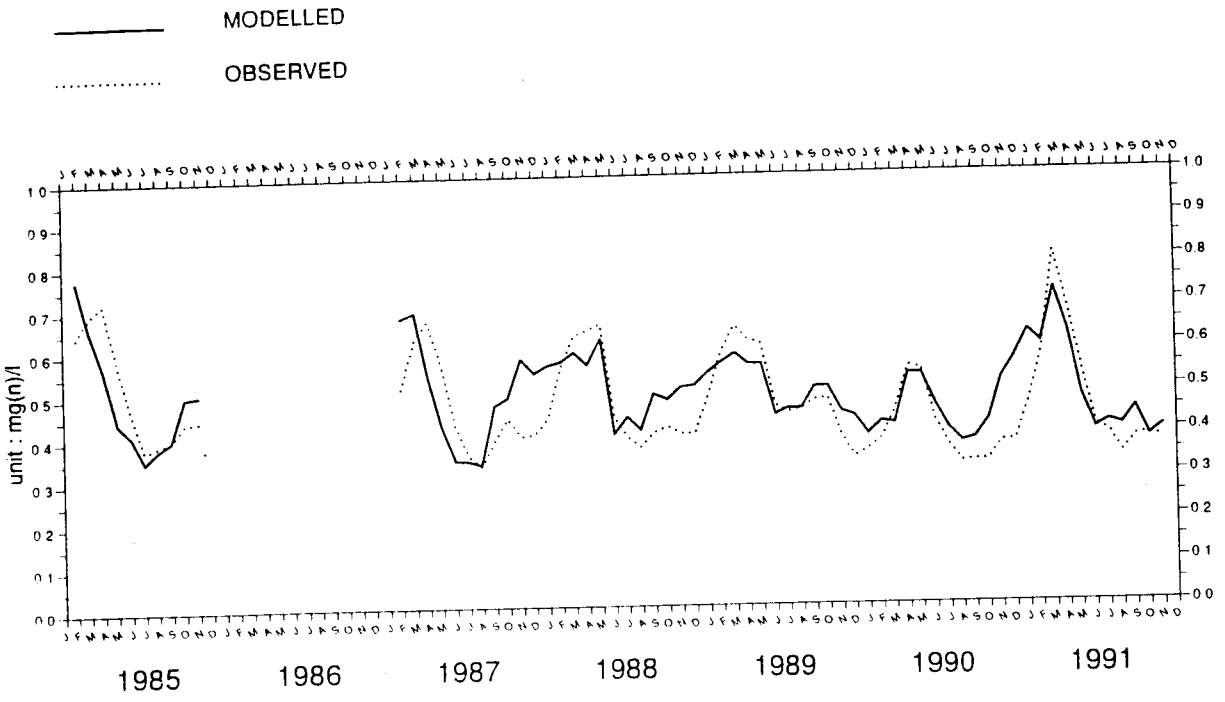
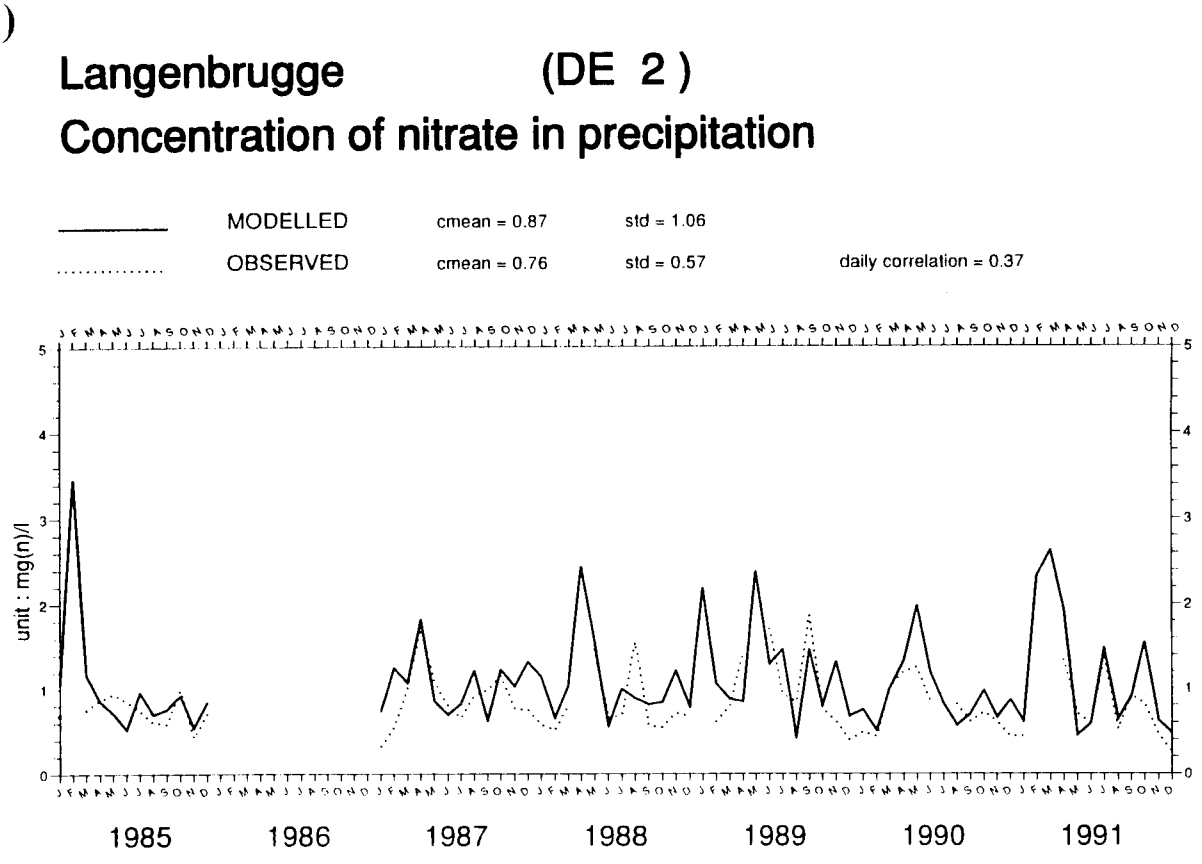


Figure A25 : Timeseries with monthly mean values for some selected stations.

a)

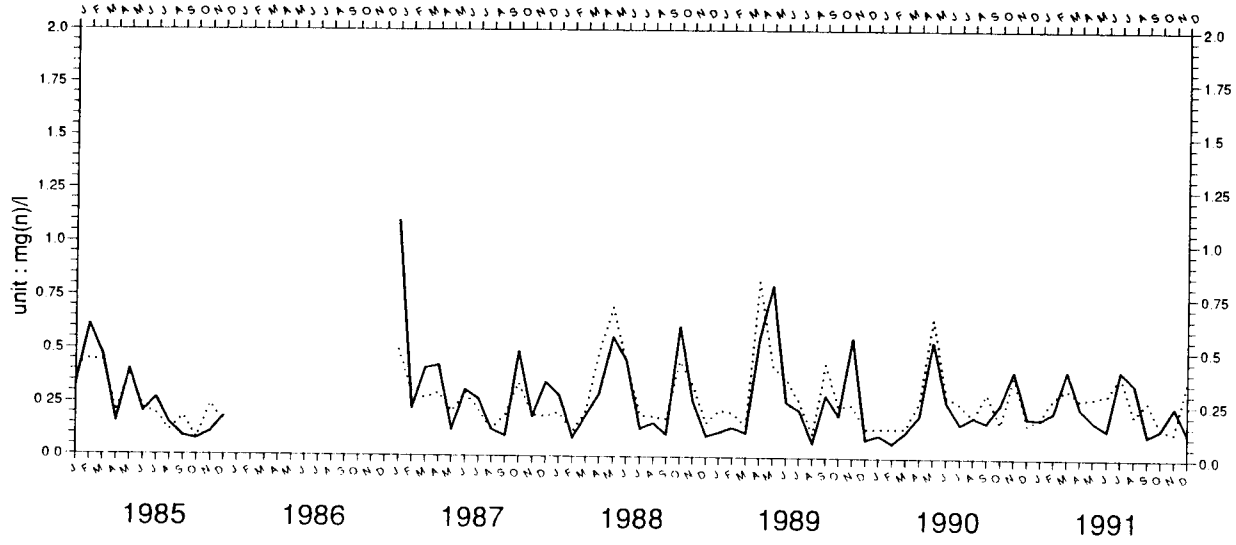


b) **Eskdalemuir (GB 2)**

Concentration of nitrate in precipitation

MODELLED cmean = 0.22 std = 0.66

OBSERVED cmean = 0.23 std = 0.34 daily correlation = 0.45



c) **Skreaadalen (NO 8)**

Concentration of nitrate in precipitation

MODELLED cmean = 0.28 std = 0.55

OBSERVED cmean = 0.28 std = 0.37 daily correlation = 0.40

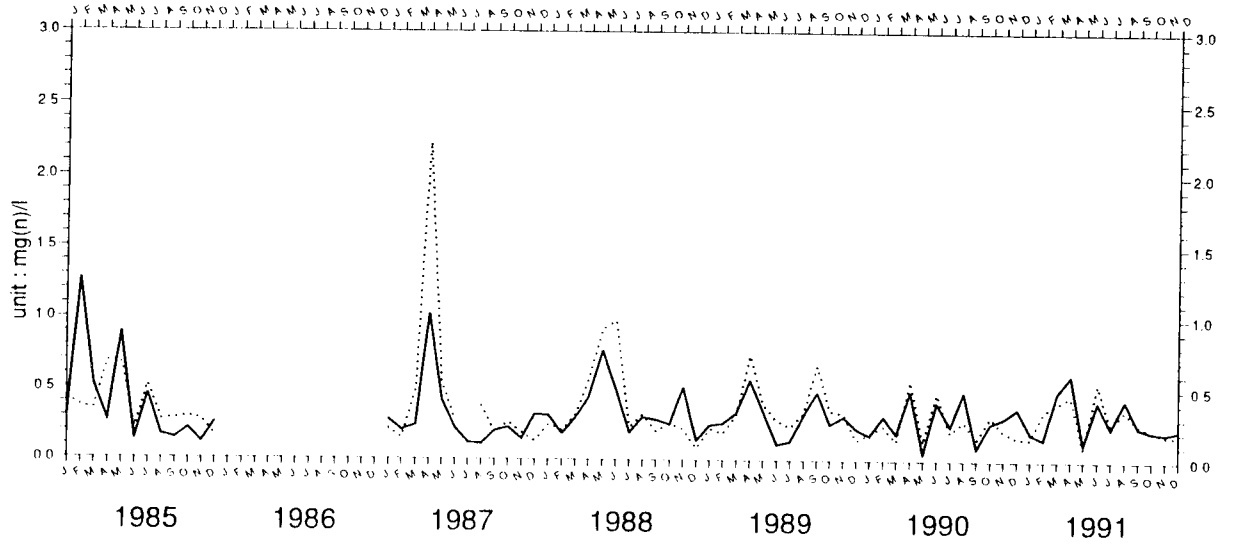


Figure A26 : Scatter plot of calculated and observed concentrations of ammonium in precipitation. Averaged over the years 85,87,88,89,90 and 91. The full line represents optimal linear regression, i.e. the sum of squares of distances measured from the point normal to the line is minimised. Unit : mg(N)/l

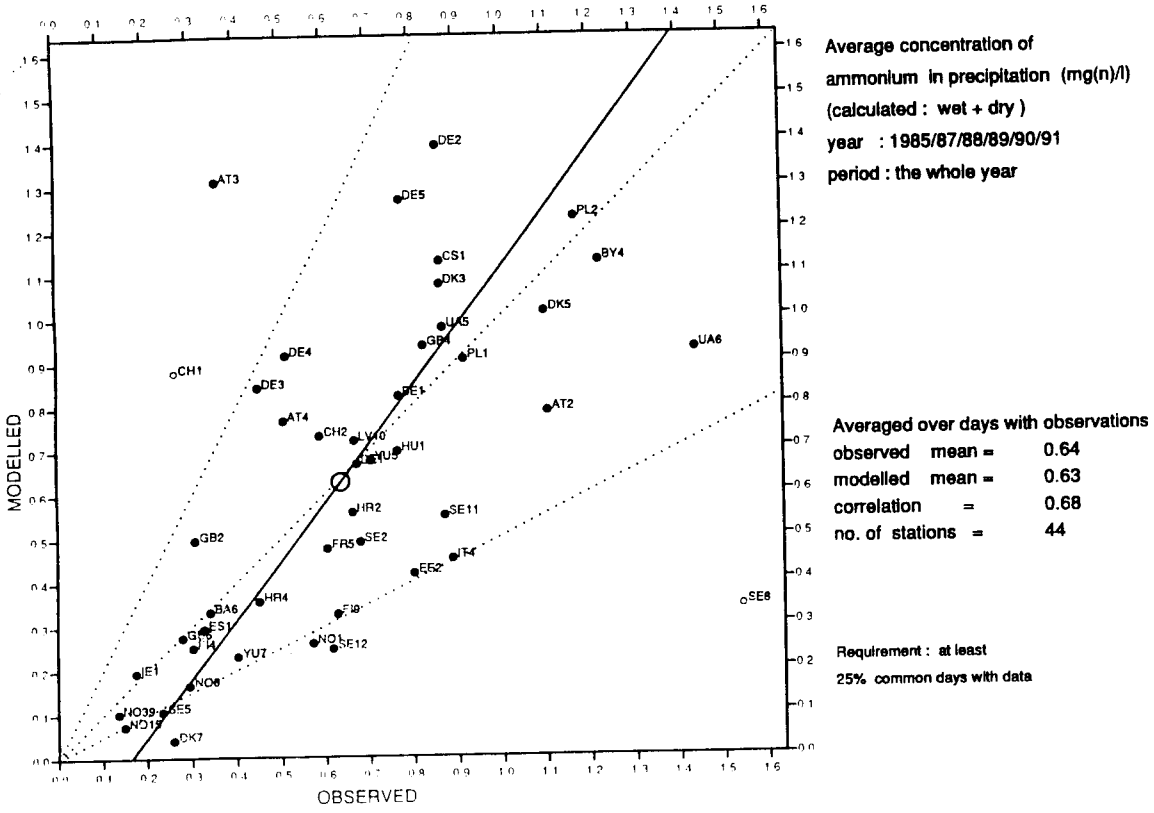
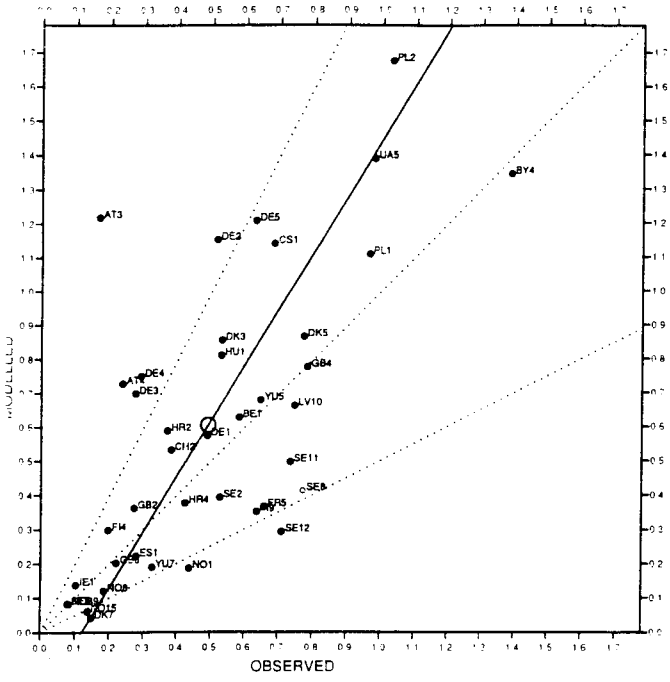


Table A7 : Ammonium in precipitation. Number of stations in % grouped with respect to daily correlation and relative error. Values for the six year period 1985,87,88,89,90,91.
Total number of stations : 46

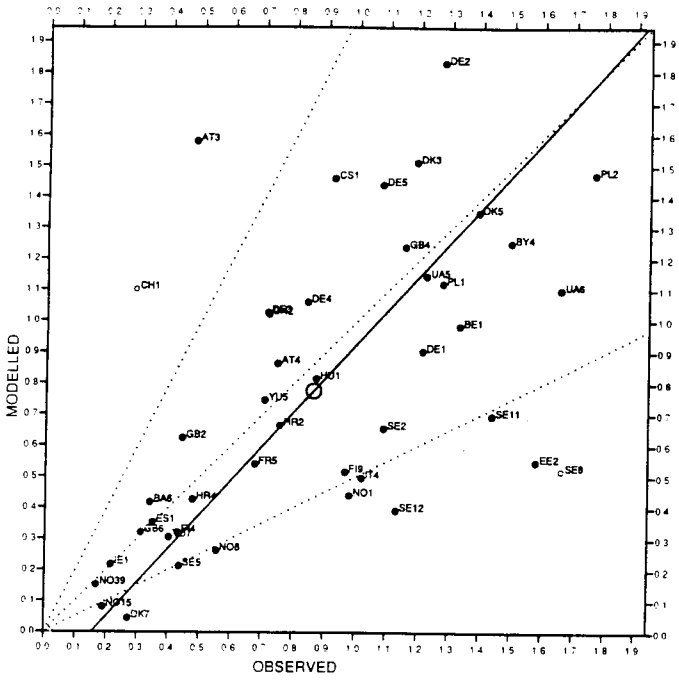
RELATIVE ERROR IN % : 100 *(MOD-OBS)/OBS	DAILY CORRELATION				
	r <= 0	0< r <=0.2	0.2< r <=0.4	0.4< r <=0.6	0.6< r <=1.0
-100<=err <-75		4.3% DK7 SE8			
-75<= err <-50			6.5% NO15 SE5 SE12	2.2% NO1	
-50<= err <-25	4.3% AT2 EE2	6.5% IT4 UA6 YU7	8.7% FI9 NO8 NO39 SE11	2.2% SE2	
-25<= err < 0.		15.2% DK5 FR5 ES1 BY4 HR2 HR4 BA6	13.0% FI4 DE1 HU1 PL1 GB6 YU5		
0<= err < 25		8.7% PL2 CH2 LV10 UA5	8.7% BE1 DK3 IE1 GB4		
25<= err < 50			2.2% CS1		
50<= err < 75		2.2% AT4	6.5% DE2 DE5 GB2		
75<= err <100		4.3% DE3 DE4			
100<= err		2.2% AT3	2.2% CH1		

Figure A27 : Seasonal scatter plot of calculated and observed concentrations of ammonium in precipitation.. Averaged over the years 85.87,88,89,90 and 91. Unit : mg(N)/l



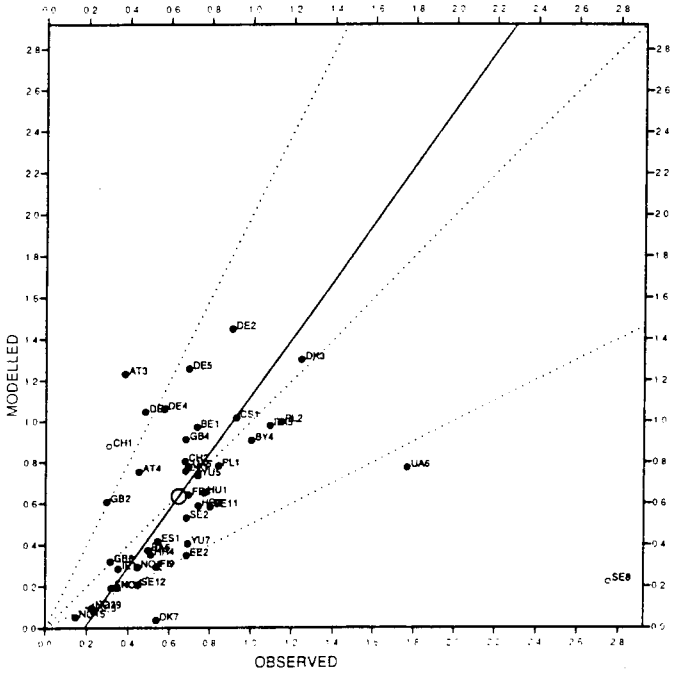
a) Winter

Averaged over days with observations
observed mean = 0.49
modelled mean = 0.61
correlation = 0.69
no. of stations = 39



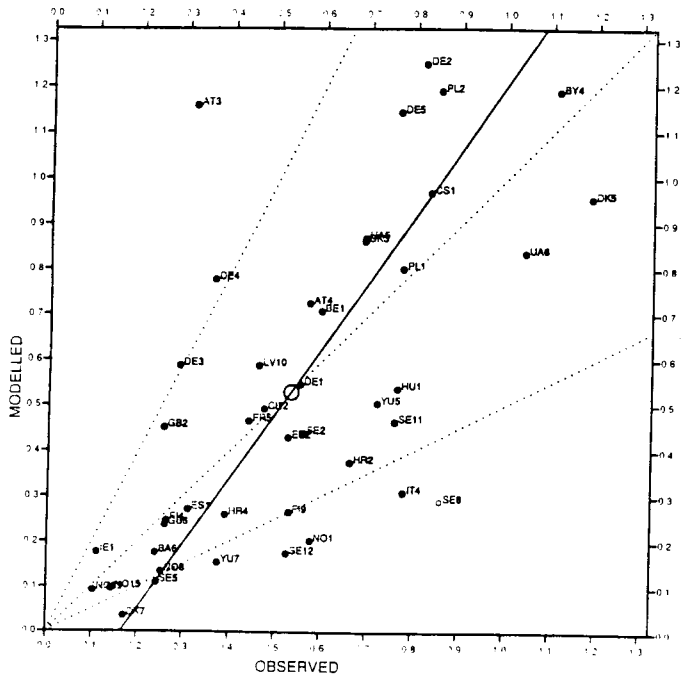
b) Spring

Averaged over days with observations
observed mean = 0.86
modelled mean = 0.78
correlation = 0.64
no. of stations = 42



c) Summer

Averaged over days with observations
observed mean = 0.65
modelled mean = 0.63
correlation = 0.58
no. of stations = 41



d) Autumn

Averaged over days with observations
observed mean = 0.53
modelled mean = 0.53
correlation = 0.70
no. of stations = 42

Figure A28 : Concentration of ammonium in precipitation. 3 months moving average over 9 stations that fullfill the requierment for data coverage. Stations : AT4, FI4, DE4, DE5, NO8, SE2, SE12, GB2 and YU5.

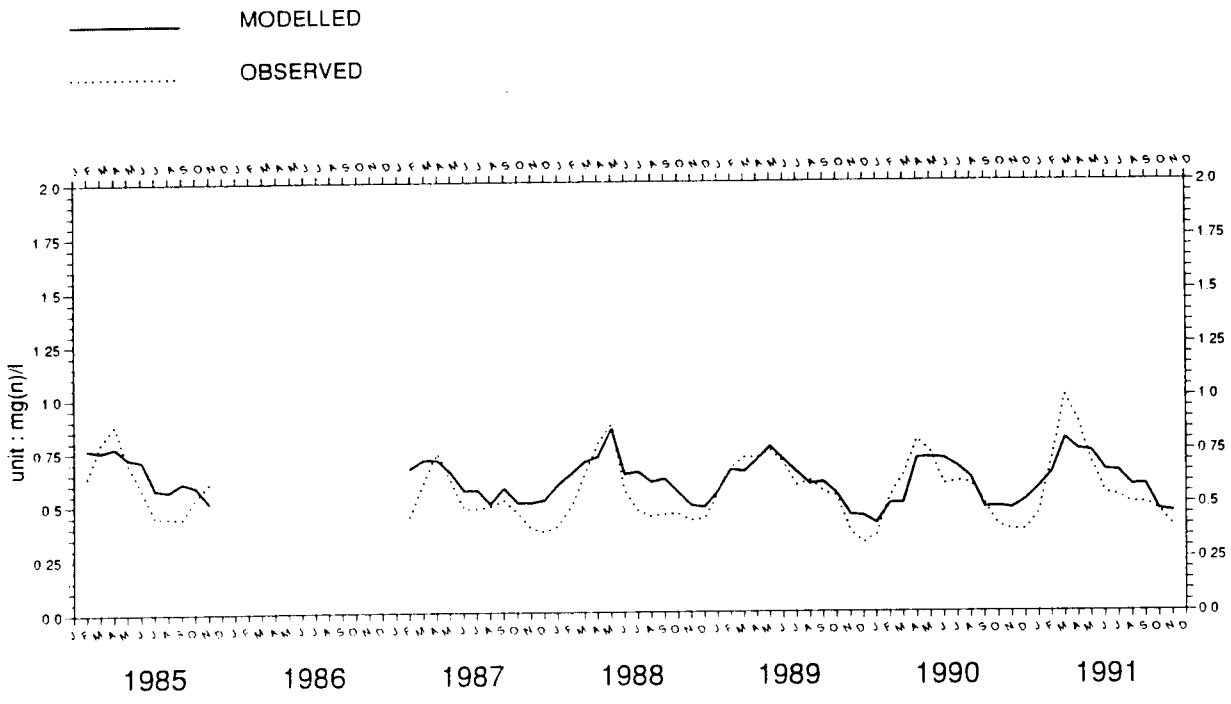
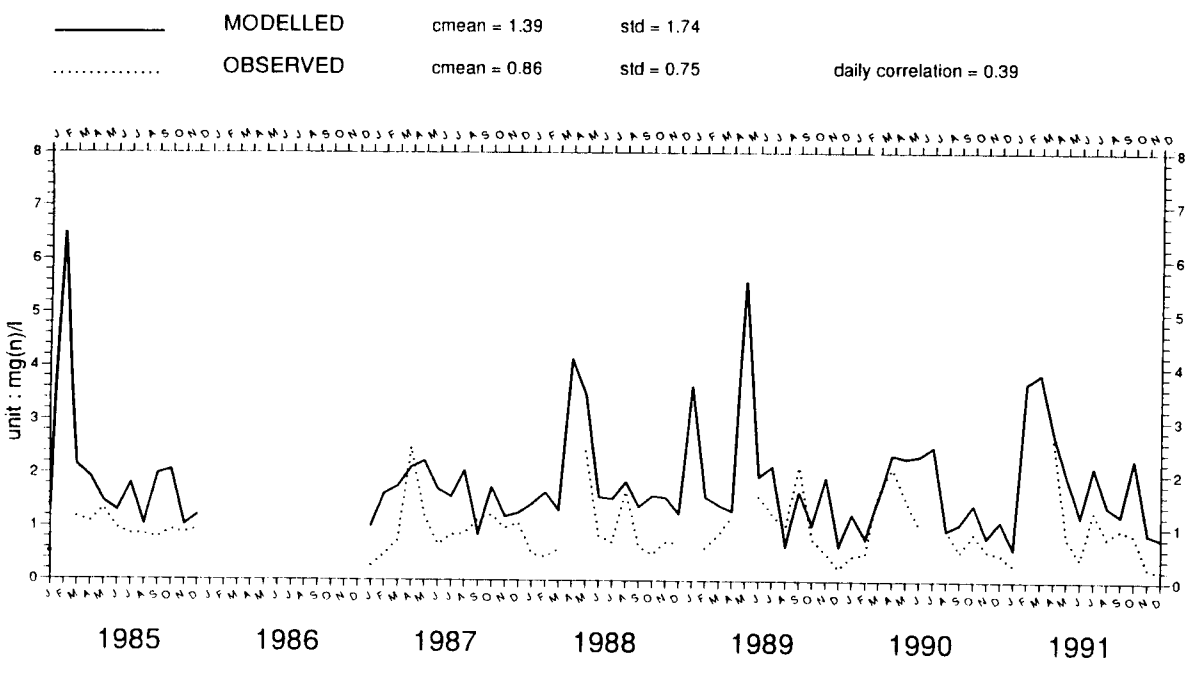


Figure A29 : Timeseries with monthly mean values for some selected stations.

a)

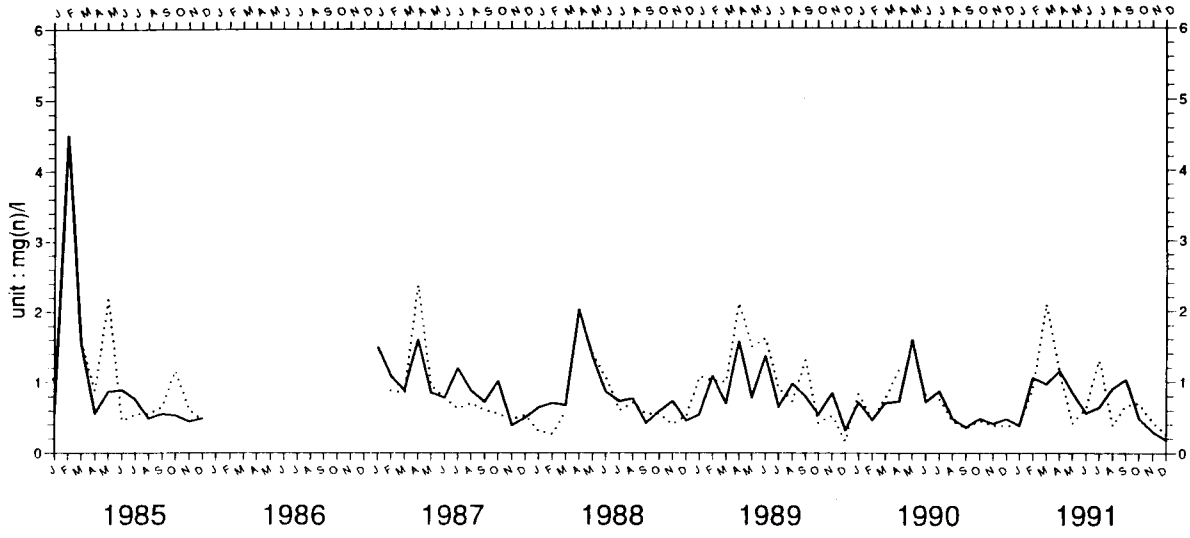


b) **Westerland (DE 1)**

Concentration of ammonium in precipitation

MODELLED cmean = 0.67 std = 0.85

OBSERVED cmean = 0.67 std = 0.71 daily correlation = 0.39



c) **Athari (FI 4)**

Concentration of ammonium in precipitation

MODELLED cmean = 0.25 std = 0.36

OBSERVED cmean = 0.30 std = 0.41 daily correlation = 0.47

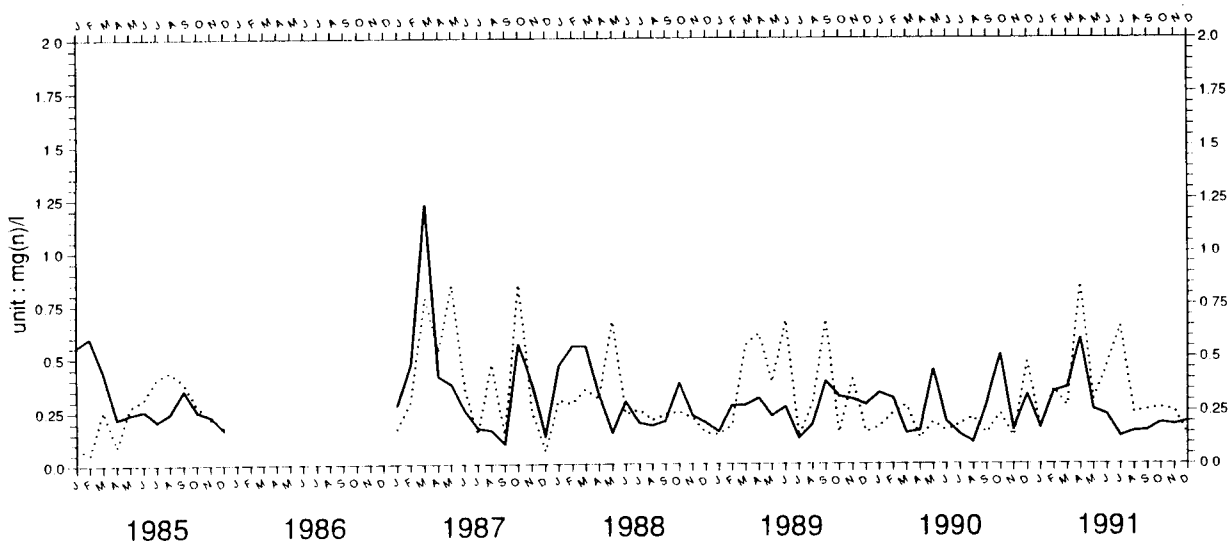


Table A8 : Summary of model evaluation for components in air.
Number of stations in % grouped with respect to relative error and daily correlation

	NO_2 in air	SO_2 in air	$SO_4^=$ in air
No. of stations	17	38	45
err < - 25%	53%	16%	13%
-25% < err < 25%	**41%**	**39%**	**44%**
err > 25%	6%	45%	42%
Daily corr. > 0.4	**76%**	**66%**	**69%**
Daily corr > 0.4 and -25% < err < 25%	**29%**	**29%**	**40%**

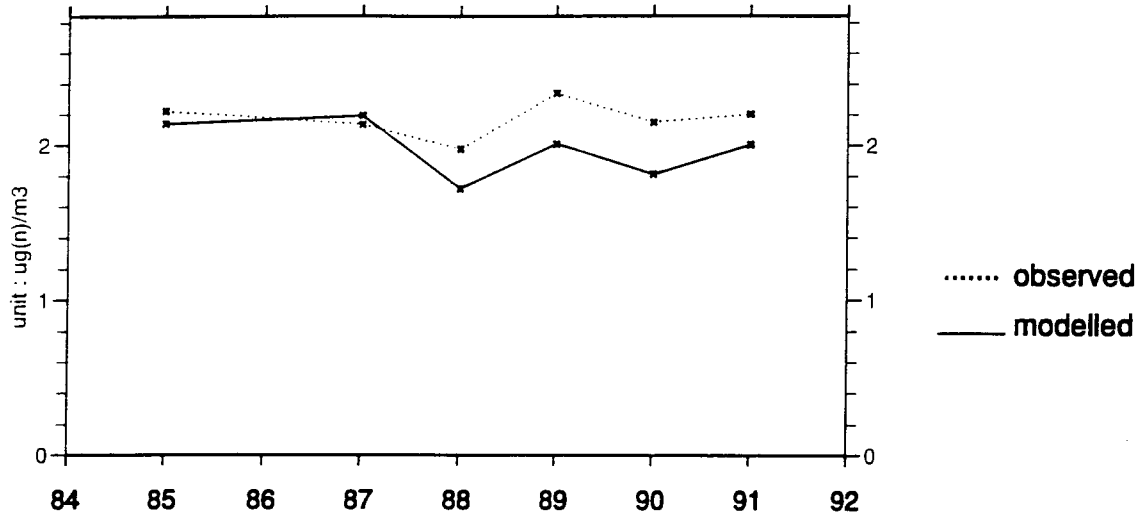
Table A9 : Summary of model evaluation for components in precipitation.
Number of stations in % grouped with respect to relative error and daily correlation

	Sulphate in prec.	Nitrate in prec.	Ammonium in prec.
No. of stations	49	47	46
err < - 25%	51%	26%	35%
-25% < err < 25%	**37%**	**47%**	**46%**
err > 25%	12%	28%	20%
Daily corr. > 0.4	**12%**	**28%**	**4%**
Daily corr > 0.4 and -25% < err < 25%	**2%**	**15%**	**0%**

Figure A30 : TREND FIGURES. Yearly averaged concentrations of NO_2, SO_2, and $SO_4^=$

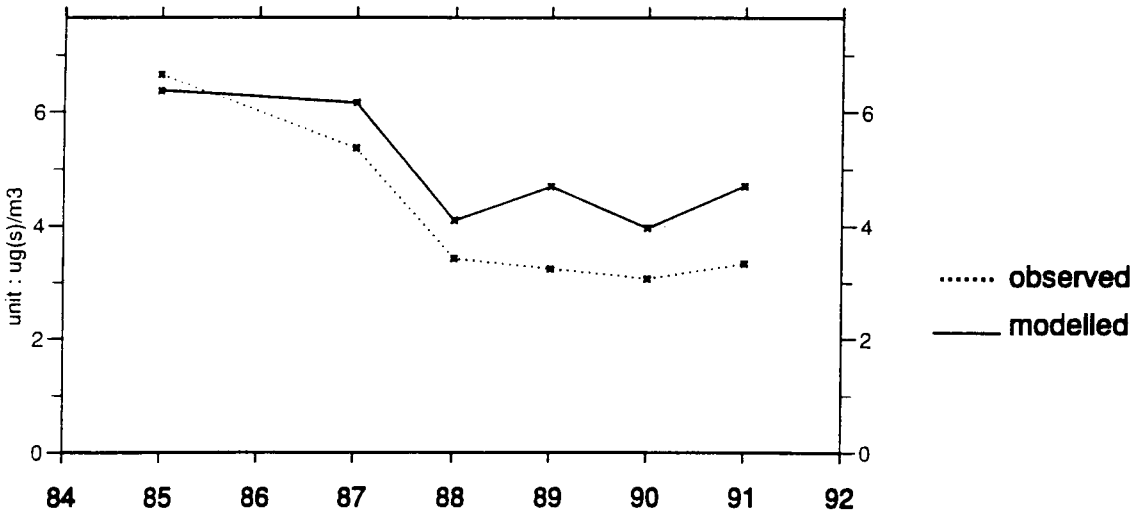
a) Concentration of **nitrogen dioxide in air.** Averaged over 8 sites.

(DE1, DE2, DE4, DE5, SE2, SE5, SE8 and SE11)



b) Concentration of **sulphur dioxide in air.** Averaged over 26 sites.

(AT2, CS1, DK3, FI4, FI9, DE1, DE2, DE3, DE4, DE5, DE12, DE14, DE15, DE17, DE18, DE19, IE1, PL1, PL2, SE2, SE5, SE8, SE11, SE12, CH2 and GB2)



c) Concentration of **particulate sulphate in in air.** Averaged over 32 sites.

(BE1, CS1, DK3, FI4, FI9, DE1, DE2, DE3, DE4, DE5, DE12, DE14, DE15, DE17, DE18, DE19, IS2, IE1, NO1, NO8, NO15, NO30, NO39, PL1, PL2, SE2, SE5, SE8, SE11, SE12, CH2 and GB2)

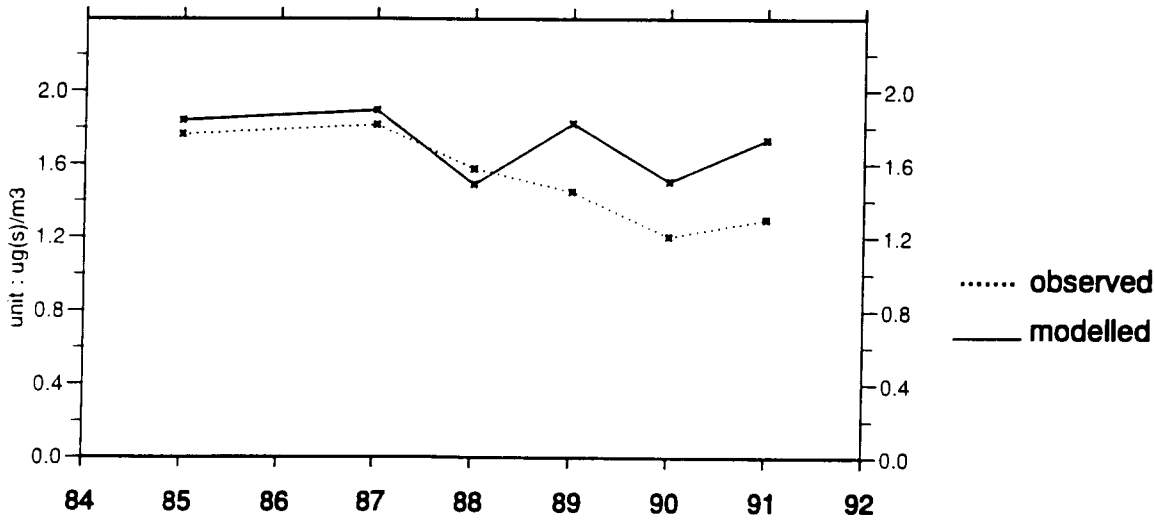
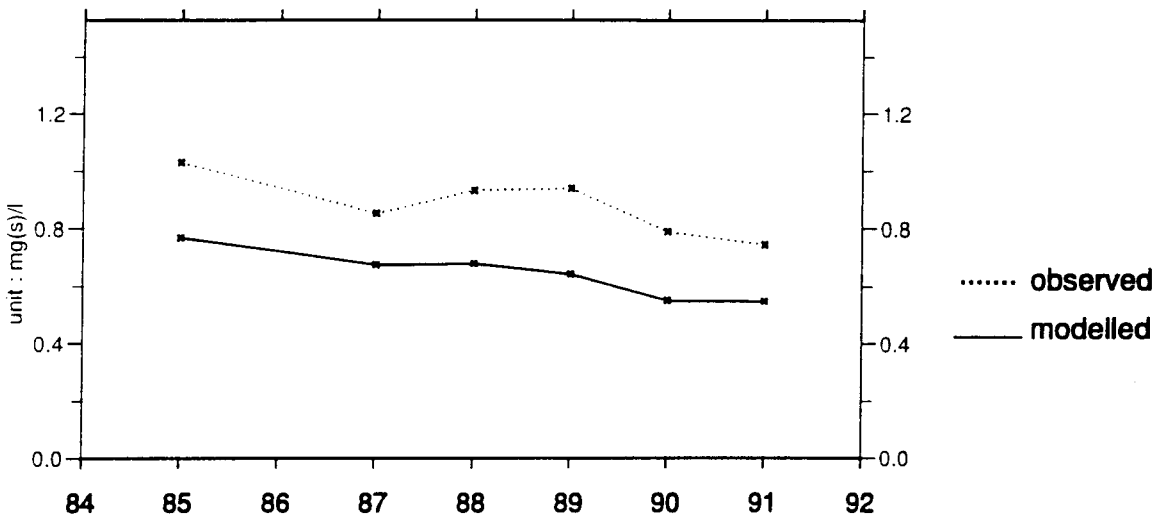


Figure A31 : TREND FIGURES. Yearly averaged concentrations of sulphate, nitrate and ammonium in precipitation.

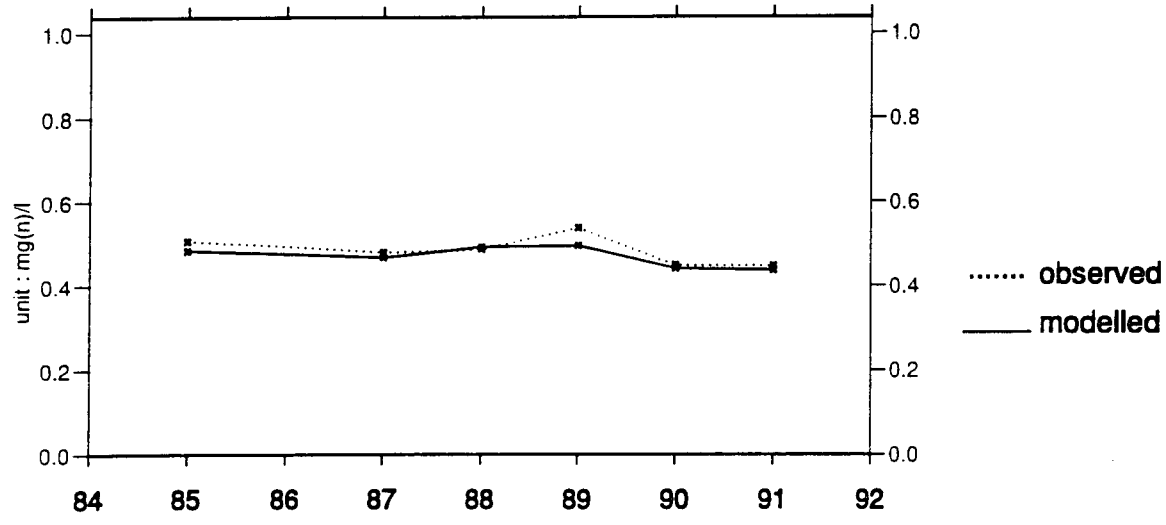
a) Concentration of **sulphate in precipitation.** Averaged over 33 sites.

(BE1, DK3, FI4, FI9, DE1, DE2, DE3, DE4, DE5, HU1, IS2, IE1, NO1, NO8, NO15, NO30, NO39, PL1, ES1, SE2, SE5, SE8, SE11, SE12, CH2, LV10, GB2, GB6, HR2, HR4, BA6, YU5 and YU7)



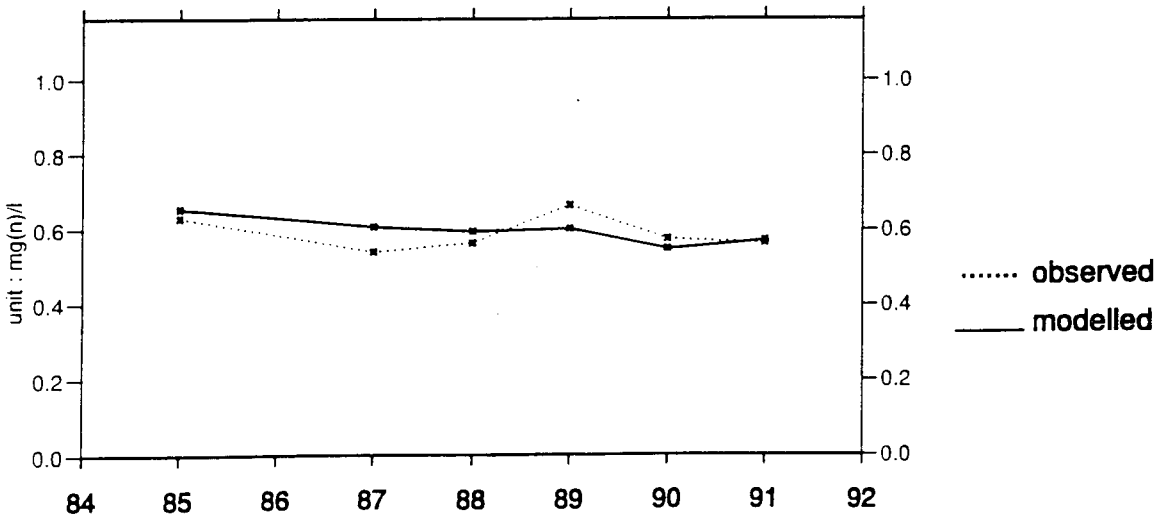
b) Concentration of **nitrate in precipitation.** Averaged over 30 sites.

(AT4, BE1, DK3, FI4, FI9, DE1, DE2, DE3, DE4, DE5, HU1, NO1, NO8, NO15, NO39, PL1, SE2, SE5, SE8, SE11, SE12, CH2, BY4,, GB2, GB6, HR2, HR4, BA6, YU5 and YU7)



c) Concentration of **ammonium in precipitation.** Averaged over 28 sites.

(AT4, BE1, DK3, FI4, FI9, DE1, DE2, DE3, DE4, DE5, HU1, NO1, NO8, NO15, NO39, PL1, SE2, SE5, SE11, SE12, BY4,, UA5, GB2, GB6, HR2, HR4, YU5 and YU7)

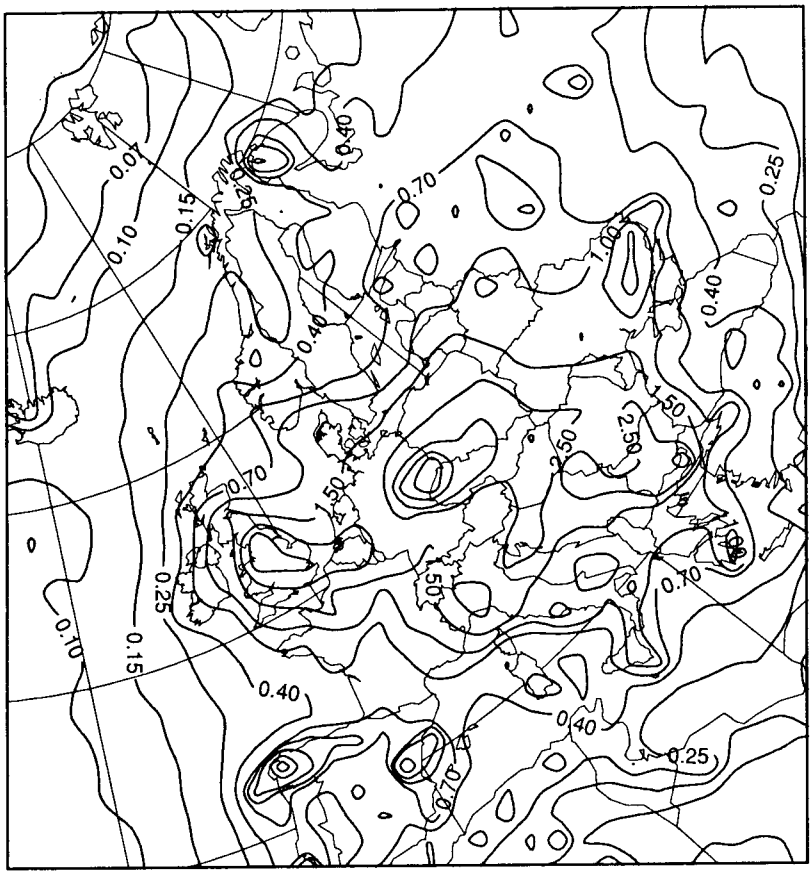


APPENDIX B.

MODEL CALCULATIONS OF ACCUMULATED DEPOSITIONS AND CONCENTRATIONS FOR THE YEAR 1991.

This appendix shows isoline maps of depositions and concentrations of all components that are calculated in the model. Data for the year 1991 are presented.

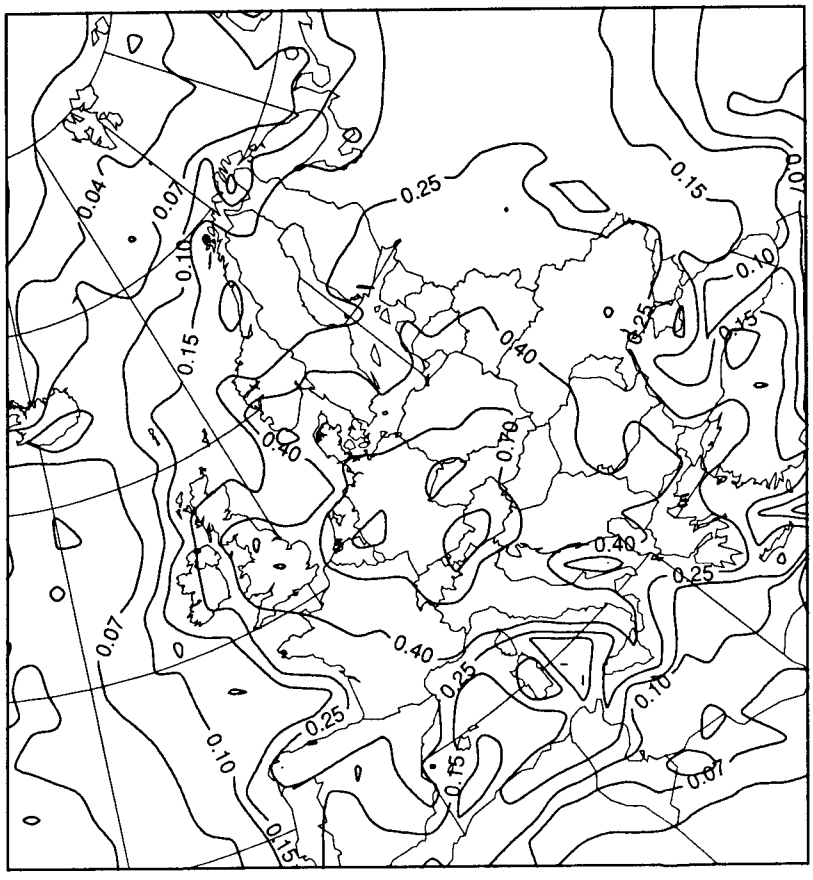
FIGURE B1 : Model estimated annual deposition of Oxidised Sulphur



Year : 1991

Isolines for 0.01, 0.02, 0.04, 0.07, 0.10, 0.15, 0.25, 0.40, 0.70, 1.00, 1.50, 2.50, 4.0, 7.0, 10.0 g(s)/m2

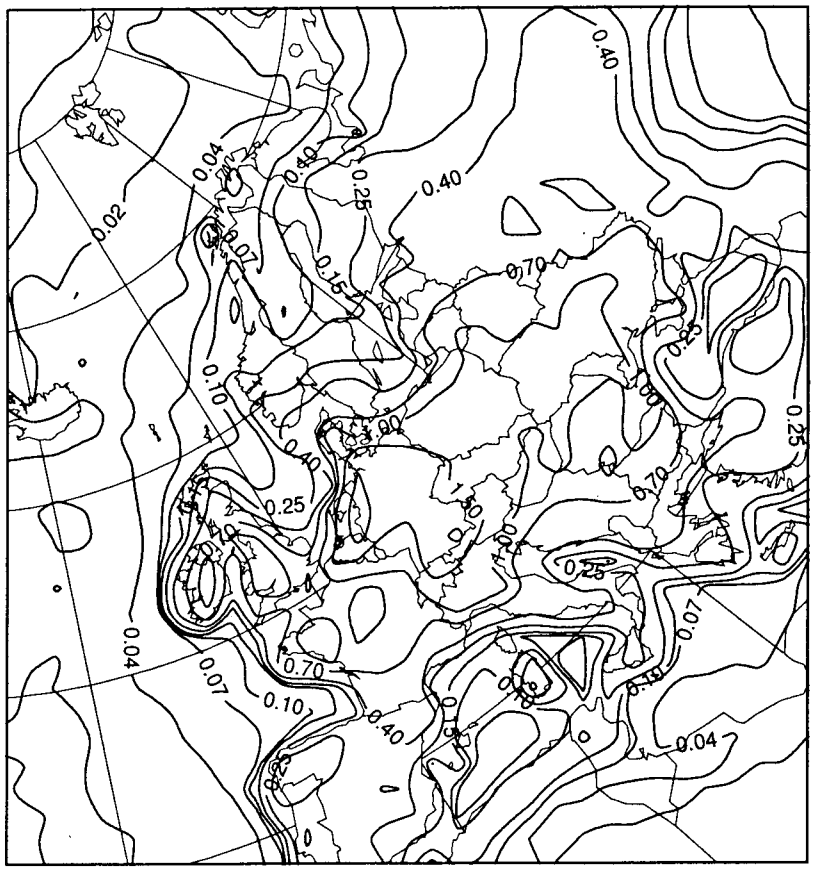
FIGURE B2 : Model estimated annual deposition of Oxidised Nitrogen



Year : 1991

Isolines for 0.01, 0.02, 0.04, 0.07, 0.10, 0.15, 0.25, 0.40, 0.70, 1.00, 1.50, 2.50, 4.0, 7.0, 10.0 g(n)/m2

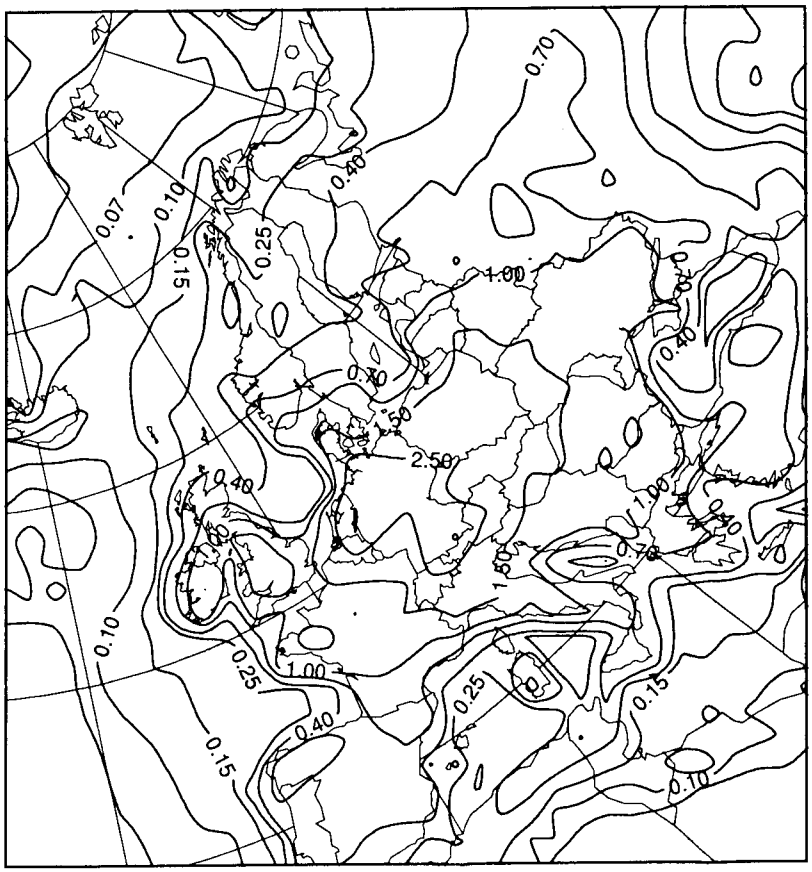
FIGURE B3 : Model estimated annual deposition of Reduced Nitrogen



Year : 1991

Isolines for 0.01, 0.02, 0.04, 0.07, 0.10, 0.15, 0.25, 0.40, 0.70, 1.00, 1.50, 2.50, 4.0, 7.0, 10.0 g(n)/m2

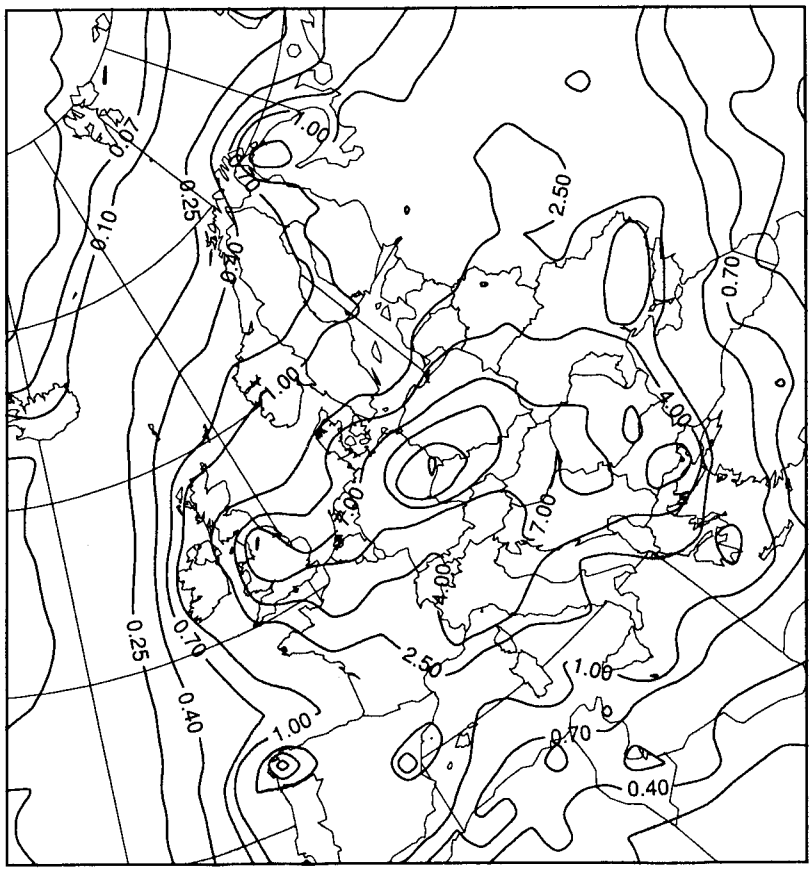
FIGURE B4 : Model estimated annual deposition of Total Nitrogen



Year : 1991

Isolines for 0.01, 0.02, 0.04, 0.07, 0.10, 0.15, 0.25, 0.40, 0.70, 1.00, 1.50, 2.50, 4.0, 7.0, 10.0 g(n)/m2

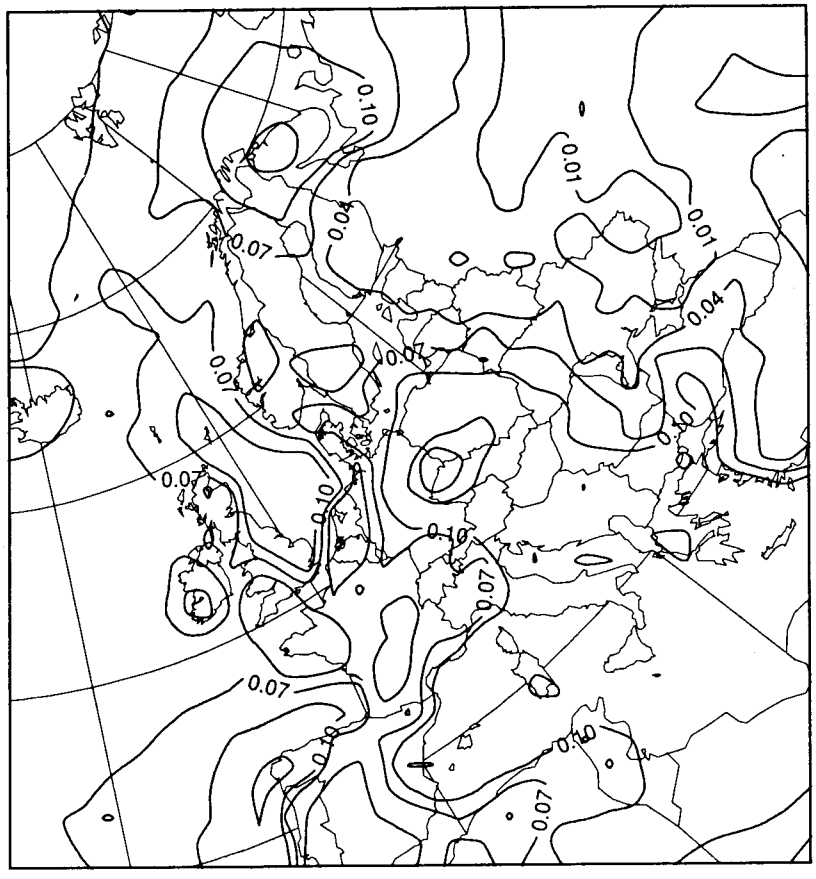
FIGURE B5 : Model estimated annual concentration of Sulphur Dioxide



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(s)/m3

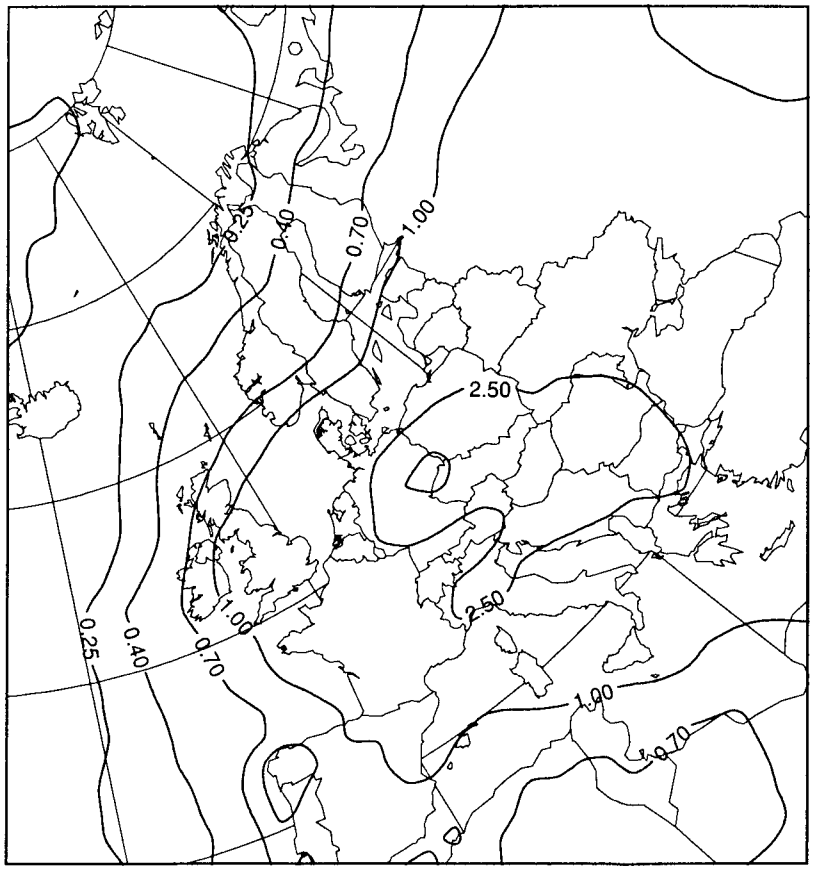
FIGURE B6 : Model estimated annual concentration of Particulate Sulphate (not including Ammonium Sulphate)



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(s)/m3

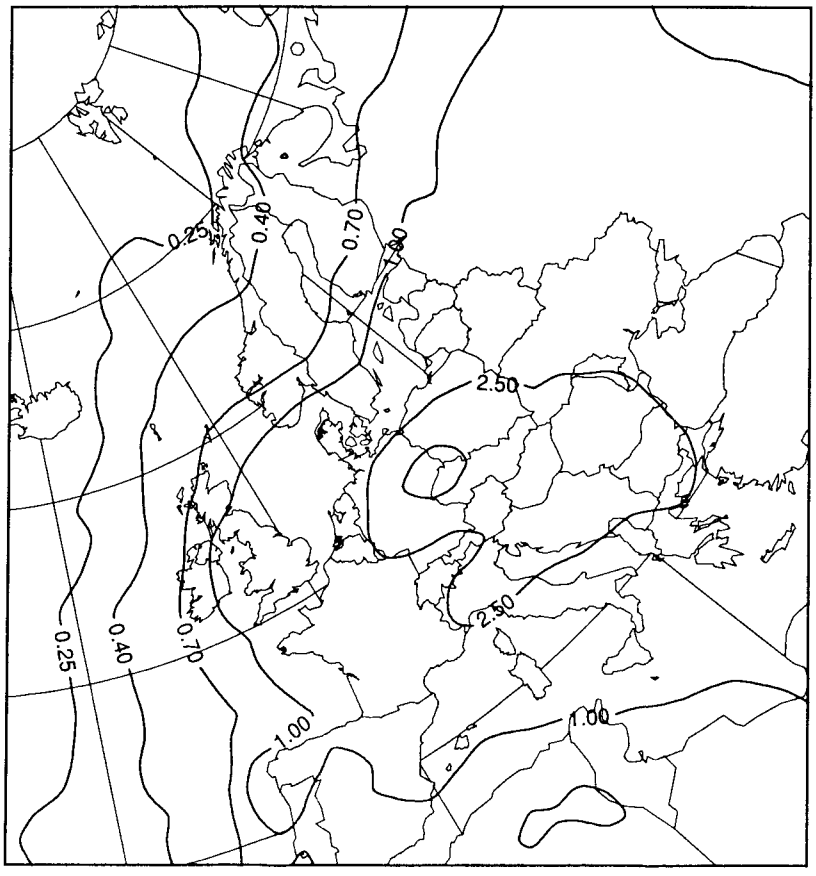
FIGURE B7 : Model estimated annual concentration of Ammonium Sulphate



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(s)/m3

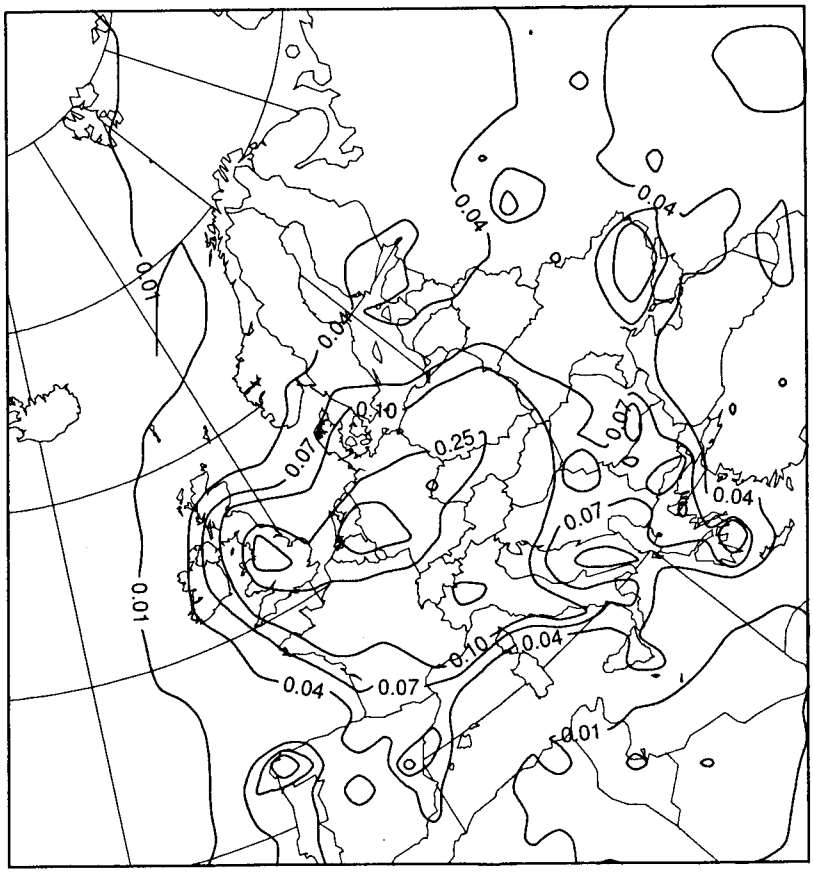
FIGURE B8 : Model estimated annual concentration of Total Particulate Sulphate



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(s)/m3

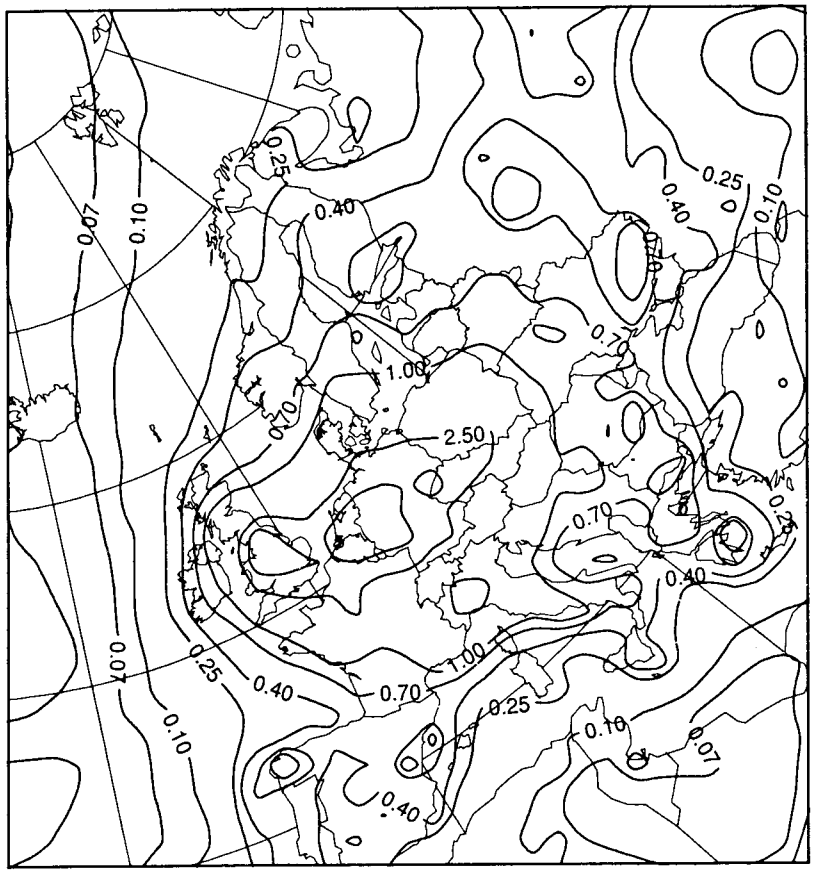
FIGURE B9 : Model estimated annual concentration of Nitrogen Monoxide



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

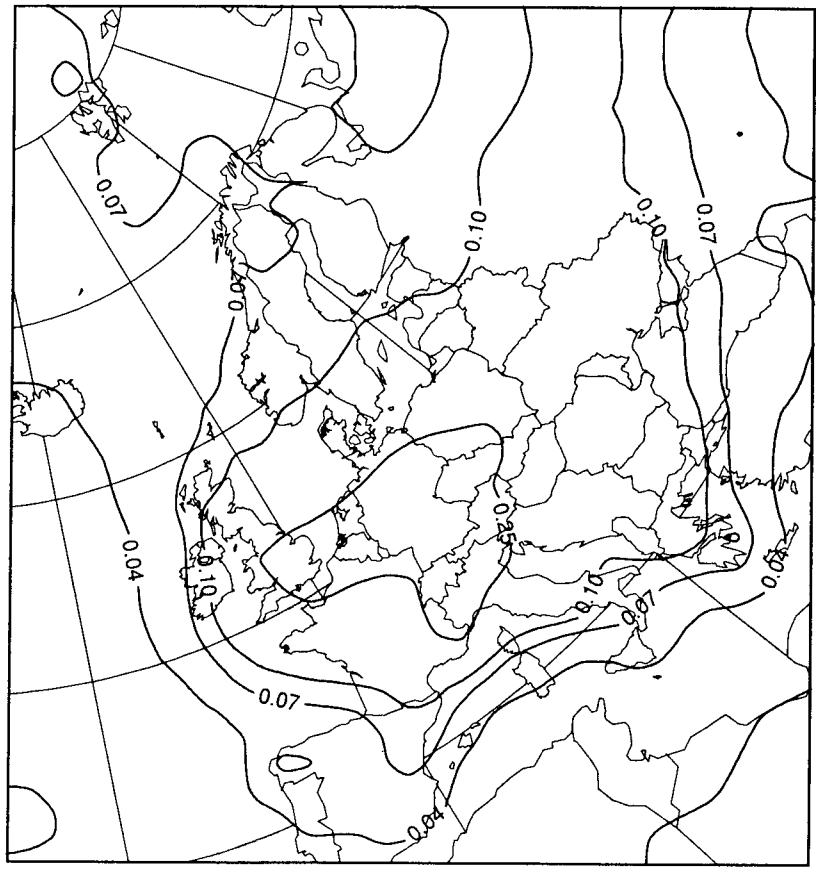
FIGURE B10 : Model estimated annual concentration of Nitrogen Dioxide



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

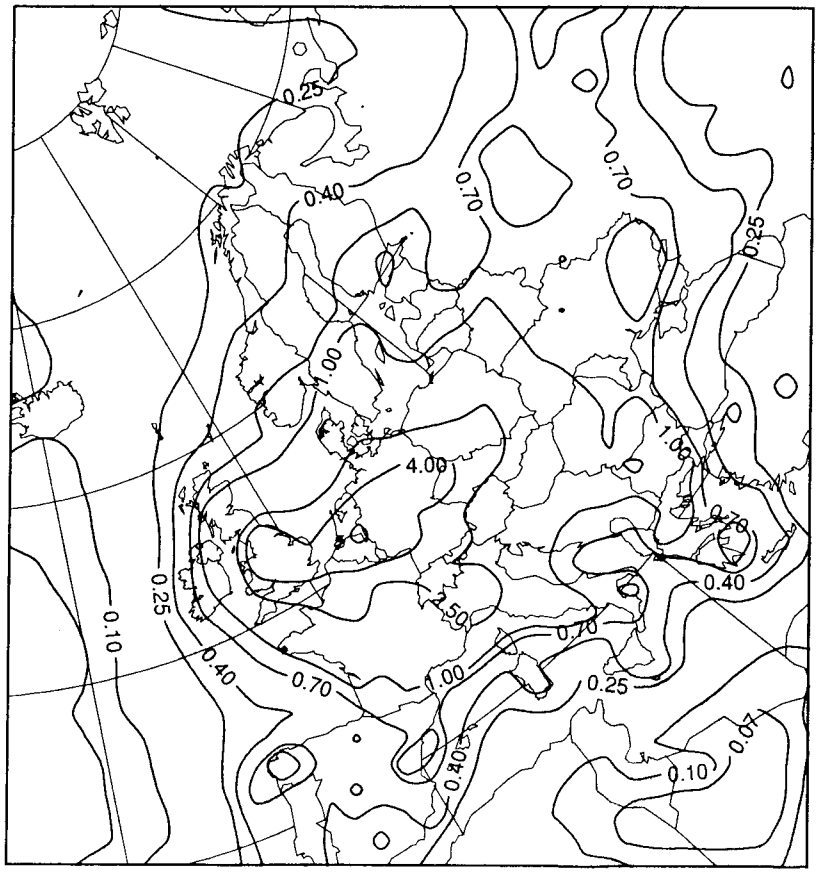
FIGURE B11 : Model estimated annual concentration of PAN



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

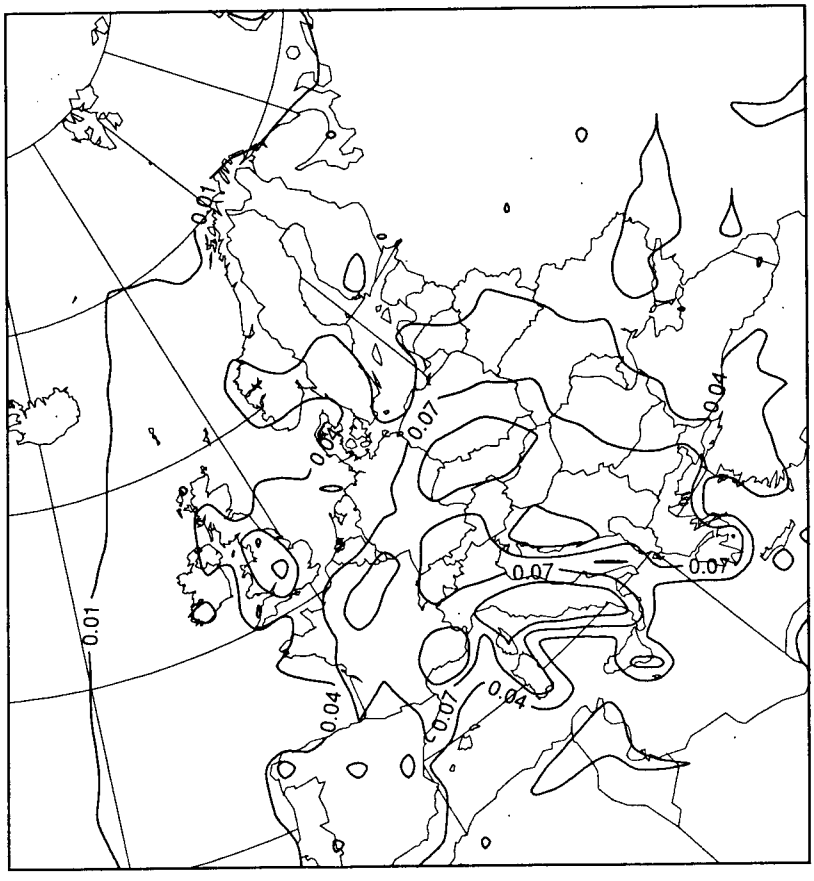
FIGURE B12 : Model estimated annual concentration of Primary Oxidised Nitrogen (NO + NO2 + PAN)



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

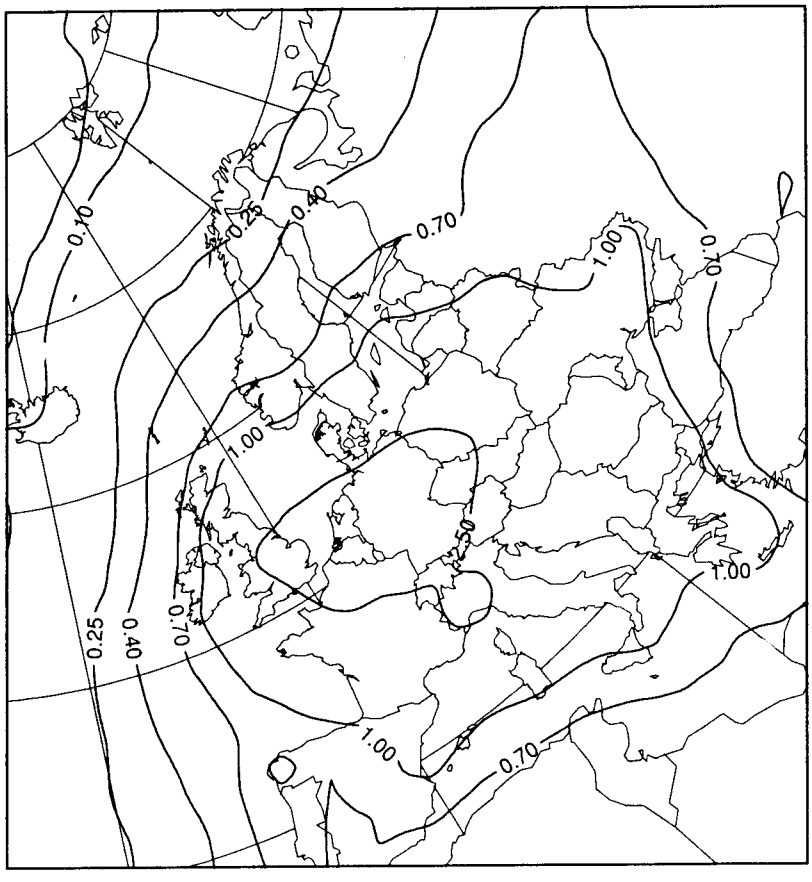
FIGURE B13 : Model estimated annual concentration of gaseous Nitric Acid



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

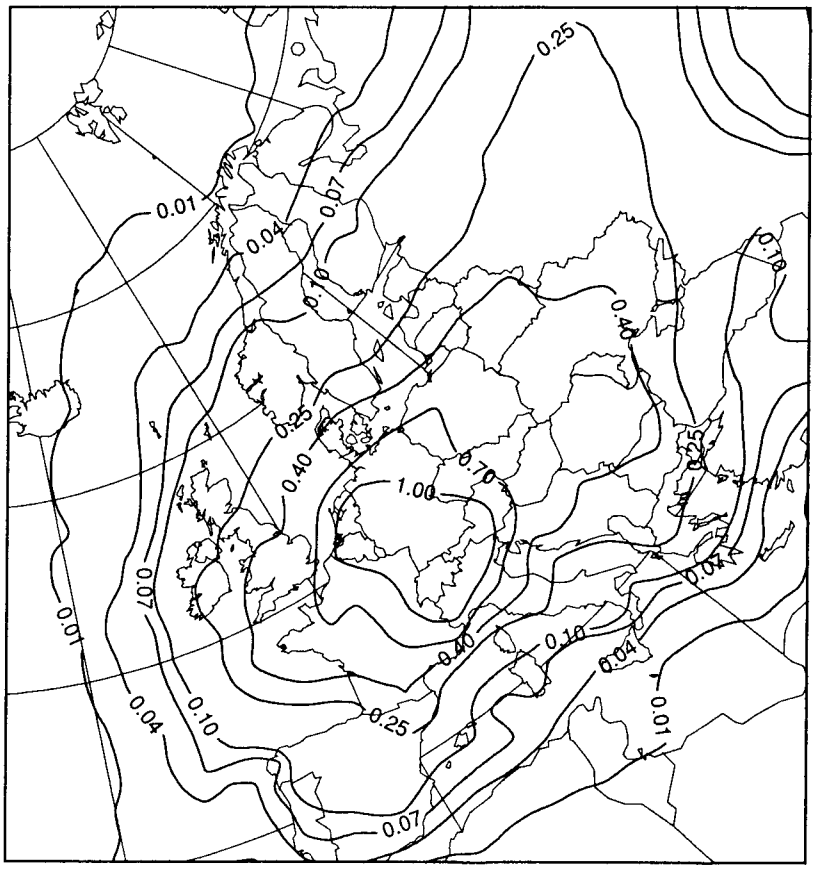
FIGURE B14 : Model estimated annual concentration of Particulate Nitrate (not including Ammonium Nitrate



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

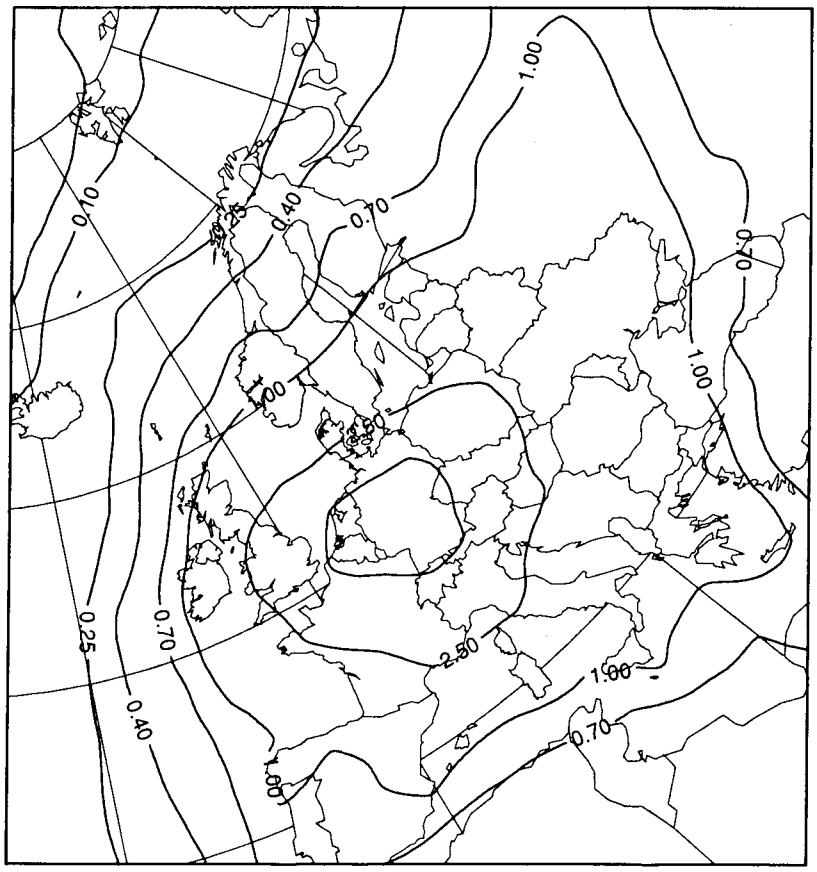
FIGURE B15 : Model estimated annual concentration of Ammonium Nitrate



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

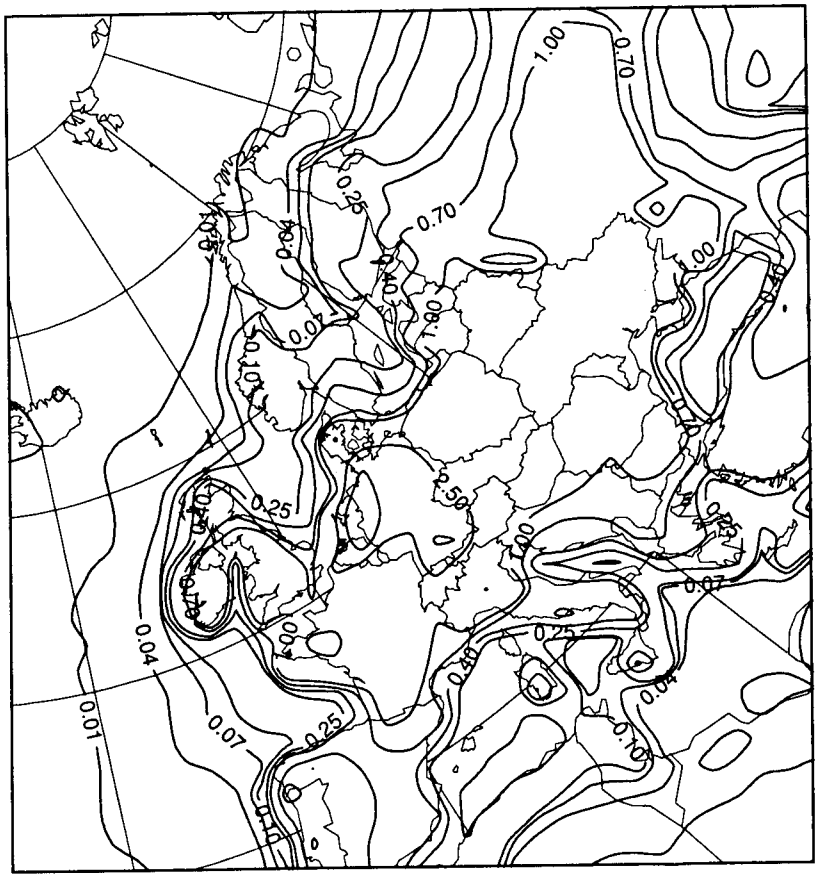
FIGURE B16 : Model estimated annual concentration of Total Nitrate



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

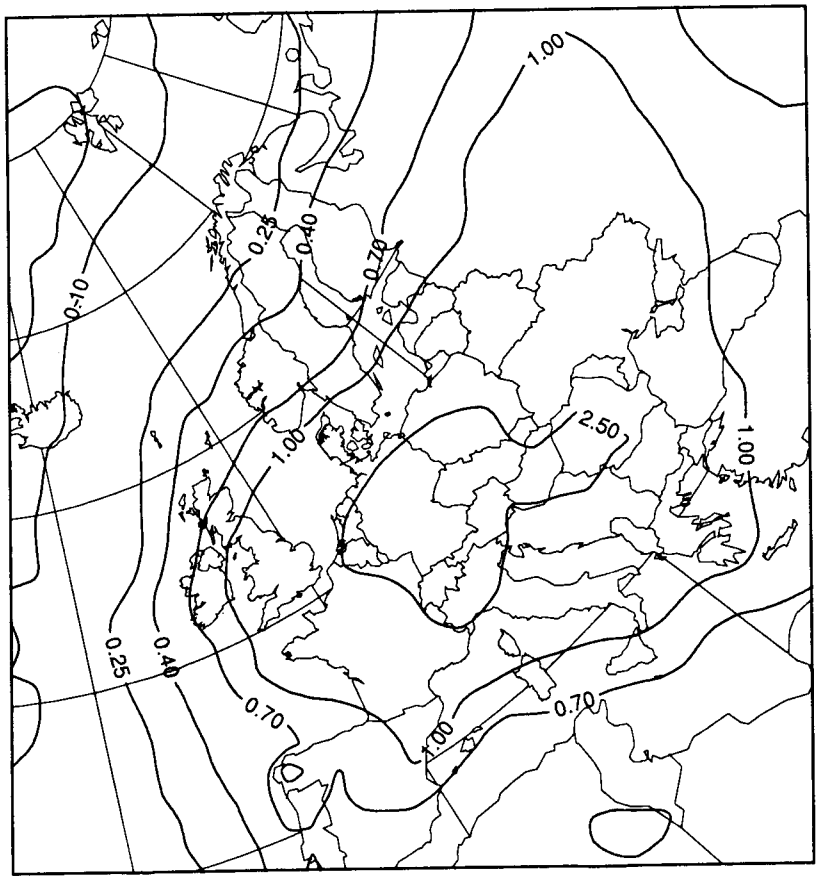
FIGURE B17 : Model estimated annual concentration of Ammonia



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

FIGURE B18 : Model estimated annual concentration of Total Ammonium



Year : 1991

Isolines for 0.01, 0.04, 0.07, 0.10, 0.25, 0.40, 0.7, 1.0, 2.5, 4.0, 7.0, 10.0, 15.0, 25.0, 40.0 ug(n)/m3

APPENDIX C.

COUNTRY TO COUNTRY DEPOSITION MATRICES FOR THE YEARS 1985, 1987, 1988, 1989, 1990, 1991 and 1992.

How to read the Budget Matrices :

The matrices are splitted into to parts. The upper part gives deposition to all areas (vertical) from about the first half of emission areas (horizontal), while the lower part gives deposition to all areas (vertical) from the second half of the emissions areas in addition to the total depositions denoted by SUM (horizontal).

To find the contributions from other countries to a certain country, follow the horizontal row starting from the relevant country code on the far left. To find the contributions to other countries from a certain country, follow the vertical collumn starting from the relevant country code at the top.

The bottom line of each matrix is the sum of each country's contribution to deposition inside the total area defined by the receivers. These sums are not equal to the countries emissions, since some of the emitted pollutants of course leave the integration domain, either through the lateral boundaries, or to the free troposphere. Some part of the the emission budget not accounted for in this way, contribute to a major part of the depositions of indeterminate origins (IND). In other words, IND includes as its major part contributions from emissions in the EMEP-area.

NOTE : For the year 1991 and 1992 East and West Germany are put together and the former Sovjet Union are divided into new countries. For the year 1992 Yogoslavia is splitted up.

Table C1 : Definition of codes for sub areas used in the emission-deposition matrices.

1	AL	Albania	19	PL	Poland
2	AT	Austria	20	PT	Portugal
3	BE	Belgium	21	RO	Romania
4	BG	Bulgaria	22	ES	Spain
5	CS	Czechoslovakia	23	SE	Sweden
6	DK	Denmark	24	CH	Switzerland
7	FI	Finland	25	TR	Turkey[1]
8	FR	France	26	SU	Soviet-Union[1]
9	DD	German Dem. Rep.	27	GB	United Kingdom
10	DE	Germany, Fed. Rep.	28	YU	Yugoslavia
11	GR	Greece	29	REM	Remaining areas[1]
12	HU	Hungary	30	BAS	The Baltic Sea
13	IS	Iceland	31	NOS	The North Sea
14	IE	Ireland	32	ATL	Rem. Atlantic Waters
15	IT	Italy	33	MED	The Mediteranian[1]
16	LU	Luxembourg	34	BLS	The Black Sea
17	NL	The Netherlands	35	NAT	Biogenic sea emissions
18	NO	Norway	36	IND	Dep. of indeterminate origins

*NEW CODES FROM **1991*** (unifying DE and DD, splitting up of SU) :

37	DE*	Germany (former DD and DE)
38	BY	Byelorussia
39	UA	Ukraine
40	MD	Moldovia
41	RU	Russia[1]
42	EE	Estonia
43	LV	Latvia
44	LT	Lithuania

*NEW CODES FROM **1992*** (splitting up of YU) :

45	SI	Slovenia
46	HR	Croatia
47	BA	Bosnia & Hercegovina
48	YU*	Former Yugoslavia excluding Slovenia, Croatia, Bosnia and Hercegovina

1. The part inside the EMEP domain of calculation.

Table C2 : Budget of Oxidised Sulphur in 1985 (Unit: 100 tonnes as S)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	42	1	1	21	14	0	0	5	18	7	17	18	0	0	42	0	1	0	12	AL
AT	0	224	39	5	295	6	1	119	414	281	2	84	0	2	198	3	16	0	153	AT
BE	0	0	428	0	18	3	0	113	61	155	0	1	0	2	2	2	35	0	15	BE
BG	5	4	3	2189	72	2	1	7	94	23	21	103	0	0	36	0	2	0	82	BG
CS	0	41	33	12	3582	16	2	70	1439	303	1	419	0	2	54	2	18	1	788	CS
DK	0	0	11	1	23	202	2	13	107	72	0	4	0	2	1	0	11	4	34	DK
FI	0	1	7	1	47	23	565	9	146	48	0	8	0	1	1	0	6	8	142	FI
FR	0	10	238	3	190	20	2	2452	549	607	1	33	0	15	288	12	73	1	161	FR
DD	0	5	51	3	563	36	2	76	6682	521	0	25	0	3	8	2	34	1	281	DD
DE	0	21	247	3	417	52	2	480	1632	3598	1	33	0	11	83	13	144	2	282	DE
GR	10	3	3	189	45	2	0	9	56	18	356	52	0	0	47	0	2	0	51	GR
HU	1	29	10	17	316	5	1	26	263	76	3	1824	0	1	81	0	5	0	225	HU
IS	0	0	0	0	0	0	0	1	1	0	0	0	4	1	0	0	0	1	1	IS
IE	0	0	6	0	5	1	0	11	21	18	0	1	0	142	1	0	3	0	6	IE
IT	2	30	27	17	219	7	1	197	356	183	19	111	0	2	3216	2	12	0	183	IT
LU	0	0	3	0	2	0	0	10	5	10	0	0	0	0	0	13	1	0	1	LU
NL	0	0	94	0	24	5	0	64	97	291	0	2	0	3	2	0	201	0	19	NL
NO	0	1	17	0	35	37	25	23	128	77	0	12	0	7	1	0	12	113	85	NO
PL	0	19	47	10	1039	66	10	86	2435	414	1	272	0	3	39	2	31	4	6705	PL
PT	0	0	1	0	1	0	0	7	4	4	0	0	0	0	2	0	1	0	2	PT
RO	3	11	10	153	316	11	3	23	376	89	10	532	0	1	84	0	8	1	478	RO
ES	0	2	16	0	27	3	1	154	85	66	0	3	0	2	38	1	7	0	31	ES
SE	0	1	27	1	91	129	121	34	323	157	0	18	0	4	2	1	20	36	239	SE
CH	0	4	13	0	24	2	0	116	77	90	1	5	0	1	179	1	4	0	17	CH
TR	2	3	4	149	79	5	2	8	124	30	111	82	0	1	32	0	4	0	135	TR
SU	2	31	80	117	1104	135	341	141	2117	561	41	766	0	8	145	2	54	18	3775	SU
GB	0	1	54	1	46	14	2	86	168	134	0	5	0	51	2	1	41	2	50	GB
YU	23	45	24	162	392	9	2	76	486	166	40	531	0	1	456	1	13	1	295	YU
REM	1	3	12	11	35	2	0	77	66	39	15	23	0	1	122	0	5	0	31	REM
BAS	0	5	48	3	259	364	298	66	976	391	0	61	0	5	10	1	39	17	981	BAS
NOS	0	3	225	3	159	202	12	387	620	600	1	29	0	49	10	2	288	66	212	NOS
ATL	0	2	128	3	122	68	92	461	474	383	1	18	9	191	16	3	81	68	193	ATL
MED	49	42	73	245	541	21	4	551	819	339	517	387	0	6	2691	4	32	1	513	MED
BLS	2	4	3	195	97	7	3	7	144	35	47	111	0	0	27	0	3	1	238	BLS
SUM	144	546	1982	3514	10200	1454	1493	5965	21365	9786	1206	5572	13	516	7916	69	1206	348	16414	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	13	2	0	0	1	7	5	31	2	0	0	0	0	0	1	60	323	AL
AT	0	21	12	2	14	0	13	102	105	1	1	7	2	0	0	4	146	2274	AT
BE	0	1	7	1	0	0	3	126	1	0	0	12	2	0	0	3	41	1034	BE
BG	0	324	3	1	0	7	91	14	163	2	0	1	0	0	0	2	172	3424	BG
CS	0	80	11	5	3	0	66	118	94	0	3	8	2	0	0	5	219	7397	CS
DK	0	2	2	14	0	0	11	97	1	0	6	9	1	0	0	5	47	682	DK
FI	0	4	1	64	0	0	704	60	2	0	14	4	2	0	0	11	349	2229	FI
FR	14	17	331	6	20	0	28	616	43	5	2	53	43	0	0	46	735	6613	FR
DD	0	11	12	7	1	0	27	154	10	0	6	14	3	0	0	6	150	8693	DD
DE	2	13	50	9	22	0	33	569	31	1	6	47	11	0	0	21	375	8210	DE
GR	0	88	4	1	0	15	41	16	70	6	0	1	0	0	0	4	212	1303	GR
HU	0	150	4	2	1	1	51	37	256	1	1	2	1	0	0	2	136	3525	HU
IS	0	0	0	1	0	0	3	21	0	0	0	0	1	0	0	18	60	115	IS
IE	0	0	2	0	0	0	2	141	0	0	0	3	9	0	0	19	70	464	IE
IT	2	25	44	3	29	4	28	93	216	18	1	6	4	0	0	12	461	5530	IT
LU	0	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0	3	54	LU
NL	0	1	7	1	0	0	4	204	1	0	0	19	2	0	0	5	52	1099	NL
NO	0	8	4	54	0	0	203	212	1	0	6	14	7	0	0	35	355	1473	NO
PL	1	98	18	25	2	0	289	177	72	0	15	15	3	0	0	10	434	12343	PL
PT	208	0	100	0	0	0	0	5	0	1	0	0	19	0	0	5	71	433	PT
RO	0	2969	5	5	1	6	459	59	390	2	2	4	1	0	0	4	395	6410	RO
ES	102	1	2738	1	2	0	3	93	9	11	0	5	43	4	0	23	360	3831	ES
SE	1	15	4	430	0	0	332	205	3	0	27	16	4	0	0	24	420	2686	SE
CH	1	2	13	1	114	0	2	44	11	0	0	3	2	0	0	3	73	803	CH
TR	0	192	7	2	0	442	229	23	59	6	1	1	0	0	0	8	822	2565	TR
SU	1	1012	32	128	3	44	26698	406	299	5	54	29	7	0	0	49	6428	44633	SU
GB	1	2	18	4	0	0	19	4761	3	0	2	47	27	0	0	42	227	5813	GB
YU	1	173	18	3	5	7	108	91	2430	5	2	6	2	0	0	7	463	6042	YU
REM	10	12	143	0	2	1	9	37	25	601	0	3	6	1	0	15	663	1971	REM
BAS	1	25	13	259	1	0	901	266	17	1	128	26	5	0	0	30	532	5728	BAS
NOS	6	15	53	55	1	0	89	3370	11	0	13	294	43	0	0	156	699	7676	NOS
ATL	199	12	1520	74	2	0	1364	2218	7	2	10	77	647	0	0	1328	4273	14046	ATL
MED	18	225	790	8	19	83	181	262	573	309	4	18	17	2	0	119	2041	11501	MED
BLS	0	406	3	3	0	106	1034	21	66	3	1	1	0	0	0	18	643	3230	BLS
SUM	571	5917	5971	1167	244	721	33034	14631	5001	983	306	748	917	8	0	2039	22185	184150	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C3 : Budget of Oxidised Sulphur in 1987 (Unit: 100 tonnes as S)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	40	1	1	25	10	0	0	2	16	4	11	12	0	0	39	0	1	0	9	AL
AT	0	185	29	7	308	3	0	96	413	218	0	98	0	1	214	2	15	0	156	AT
BE	0	0	417	0	20	2	0	125	72	141	0	1	0	2	2	3	40	0	13	BE
BG	4	4	1	2949	46	1	0	4	50	14	30	78	0	0	36	0	1	0	49	BG
CS	0	40	32	12	3682	8	1	70	1493	260	1	410	0	2	64	2	18	0	718	CS
DK	0	1	8	0	28	154	1	11	137	64	0	5	0	1	2	0	9	3	42	DK
FI	0	1	5	2	33	12	510	6	88	28	0	13	0	1	2	0	4	5	126	FI
FR	0	7	220	2	166	9	0	2269	447	430	0	35	0	17	203	12	68	1	128	FR
DD	0	5	55	1	700	24	1	78	7581	511	0	19	0	3	13	2	42	1	285	DD
DE	0	21	241	1	467	33	2	447	1793	3086	0	27	0	9	96	15	160	1	245	DE
GR	9	2	1	398	24	0	0	7	35	9	378	28	0	0	49	0	1	0	23	GR
HU	1	26	7	34	294	2	1	20	193	56	3	1729	0	0	79	0	4	0	180	HU
IS	0	0	2	0	1	1	0	2	9	6	0	0	5	2	0	0	1	0	1	IS
IE	0	0	6	0	2	1	0	13	7	9	0	0	0	181	1	0	3	0	3	IE
IT	1	22	24	13	150	4	0	167	248	117	7	93	0	2	2948	1	13	0	155	IT
LU	0	0	3	0	2	0	0	11	5	8	0	0	0	0	0	13	1	0	1	LU
NL	0	0	108	0	19	4	0	68	92	290	0	1	0	3	1	1	221	0	18	NL
NO	0	1	10	0	39	42	21	15	140	56	0	9	0	7	3	0	11	88	83	NO
PL	0	20	52	20	1186	57	6	89	2996	390	3	309	0	3	55	2	36	2	7223	PL
PT	0	0	1	0	0	0	0	3	2	1	0	0	0	1	1	0	0	0	1	PT
RO	3	12	7	423	283	4	2	18	266	65	18	478	0	0	85	0	5	0	323	RO
ES	0	1	8	1	13	1	0	80	29	23	0	10	0	3	17	0	6	0	16	ES
SE	0	3	15	1	106	98	93	23	349	104	0	31	0	3	9	0	14	29	317	SE
CH	0	4	14	0	28	1	0	107	64	63	0	6	0	1	154	1	5	0	16	CH
TR	2	2	1	281	32	1	1	9	45	13	91	38	0	0	39	0	1	0	43	TR
SU	2	22	43	320	925	94	337	68	1669	333	33	676	0	4	101	1	36	13	3469	SU
GB	0	0	56	0	31	7	1	100	139	97	0	1	0	58	5	1	39	1	26	GB
YU	14	38	14	283	270	4	1	54	297	105	27	451	0	1	499	1	10	0	257	YU
REM	0	1	6	12	17	0	0	53	31	21	23	10	0	1	63	0	4	0	17	REM
BAS	0	5	33	4	222	278	249	45	970	280	0	56	0	4	12	1	31	13	1010	BAS
NOS	0	3	222	0	181	165	13	356	817	616	0	14	0	45	15	3	319	45	239	NOS
ATL	0	2	105	0	105	47	56	397	363	253	0	12	9	255	17	3	67	48	163	ATL
MED	40	32	60	616	422	10	2	453	642	232	610	391	0	6	2486	3	35	0	483	MED
BLS	2	4	3	434	94	4	2	10	139	34	37	90	0	0	32	0	2	0	177	BLS
SUM	118	462	1808	5840	9906	1069	1302	5277	21638	7936	1272	5134	15	617	7340	69	1225	251	16015	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	10	2	0	0	1	7	3	34	2	0	0	0	0	0	1	59	288	AL
AT	0	18	9	1	14	0	16	67	91	1	1	6	2	0	0	3	143	2116	AT
BE	1	0	5	0	0	0	1	127	1	0	0	14	2	0	0	3	40	1032	BE
BG	0	296	2	0	0	7	117	5	156	2	0	0	0	0	0	2	174	4030	BG
CS	0	65	7	2	3	0	62	70	101	1	2	6	1	0	0	3	206	7342	CS
DK	0	2	2	11	0	0	9	77	3	0	6	9	1	0	0	5	45	635	DK
FI	0	8	0	47	0	0	675	26	5	0	13	3	1	0	0	8	311	1932	FI
FR	19	6	386	2	18	0	13	487	35	7	1	52	47	0	0	50	733	5869	FR
DD	1	7	6	3	2	0	25	154	10	0	5	15	2	0	0	6	138	9694	DD
DE	2	8	35	4	24	0	27	489	17	1	5	47	9	0	0	16	333	7660	DE
GR	0	66	5	0	0	17	53	7	64	5	0	1	0	0	0	4	229	1417	GR
HU	0	151	4	1	1	0	48	16	258	1	0	2	0	0	0	1	148	3260	HU
IS	0	0	1	0	0	0	1	29	0	0	0	1	2	0	0	21	76	164	IS
IE	0	0	2	0	0	0	1	166	0	0	0	3	10	0	0	17	66	492	IE
IT	3	23	62	1	25	1	22	77	199	29	1	6	4	0	0	11	504	4930	IT
LU	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	3	51	LU
NL	0	0	4	1	0	0	2	210	0	0	1	21	2	0	0	4	44	1117	NL
NO	0	5	3	50	0	0	179	208	2	0	7	15	5	0	0	31	330	1361	NO
PL	1	94	9	17	2	1	316	160	99	1	15	17	3	0	0	9	435	13628	PL
PT	246	0	109	0	0	0	0	7	1	1	0	0	21	0	0	7	70	472	PT
RO	0	2973	4	2	1	8	421	17	371	3	1	2	0	0	0	3	381	6182	RO
ES	122	1	2924	0	0	0	1	91	9	13	0	4	52	3	0	26	394	3851	ES
SE	0	13	3	375	1	0	282	135	9	0	29	13	3	0	0	21	423	2502	SE
CH	1	1	16	0	100	0	2	39	8	1	0	3	2	0	0	2	77	714	CH
TR	0	94	5	0	0	534	210	5	48	6	0	1	0	0	0	7	880	2390	TR
SU	1	940	8	109	2	65	27628	198	244	2	53	20	3	0	0	38	7590	45048	SU
GB	2	0	15	3	0	0	7	5517	2	0	1	52	23	0	0	40	198	6422	GB
YU	1	160	20	1	5	3	58	46	2539	11	1	3	1	0	0	6	487	5668	YU
REM	8	6	152	0	1	4	6	58	12	609	0	3	5	1	0	15	652	1790	REM
BAS	0	26	4	238	1	0	833	218	21	0	134	23	3	0	0	31	534	5280	BAS
NOS	3	6	41	46	2	0	72	3500	4	0	16	311	34	0	0	150	648	7887	NOS
ATL	222	5	1418	52	2	0	987	2194	6	2	9	71	617	0	0	1232	3326	12045	ATL
MED	20	234	875	3	14	129	268	268	670	389	2	19	18	2	0	137	2531	12103	MED
BLS	0	295	2	2	0	147	1092	7	76	1	1	1	0	0	0	21	805	3518	BLS
SUM	653	5516	6140	971	220	917	33441	14681	5092	1088	306	743	875	8	0	1934	23013	182888	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C4 : Budget of Oxidised Sulphur in 1988 (Unit: 100 tonnes as S)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	38	1	1	30	13	0	0	3	19	3	8	14	0	0	45	0	1	0	11	AL
AT	0	141	25	7	268	4	1	78	376	139	0	67	0	1	183	2	13	0	110	AT
BE	0	0	411	0	9	1	0	114	30	66	0	1	0	2	2	2	36	0	8	BE
BG	4	3	2	2611	61	1	1	5	68	11	27	87	0	0	41	0	2	0	58	BG
CS	0	27	29	12	3334	8	1	57	1428	159	1	334	0	1	59	2	18	1	562	CS
DK	0	0	13	0	23	136	1	16	112	51	0	4	0	2	1	0	12	2	47	DK
FI	0	1	8	3	42	17	475	11	131	34	0	12	0	1	2	0	7	5	147	FI
FR	0	3	206	2	72	7	1	2007	229	215	1	18	0	14	178	10	69	1	39	FR
DD	0	3	47	1	503	22	1	67	6401	284	0	12	0	2	13	2	35	1	185	DD
DE	0	13	231	3	261	30	1	391	1095	1868	0	28	0	9	79	14	150	2	143	DE
GR	10	2	2	355	35	1	0	7	42	8	366	38	0	0	55	0	1	0	34	GR
HU	0	19	7	23	272	2	1	17	207	33	2	1523	0	0	85	0	5	0	169	HU
IS	0	0	0	0	0	1	0	1	1	1	0	0	5	1	0	0	0	0	2	IS
IE	0	0	2	0	0	0	0	6	2	2	0	0	0	158	0	0	1	0	1	IE
IT	1	16	23	19	141	4	0	149	222	82	6	85	0	2	2775	1	12	0	95	IT
LU	0	0	3	0	1	0	0	9	2	5	0	0	0	0	0	13	1	0	0	LU
NL	0	0	98	0	15	2	0	66	52	141	0	0	0	2	1	1	204	0	16	NL
NO	0	1	25	0	49	42	14	29	208	66	0	8	0	6	1	0	23	79	121	NO
PL	0	16	55	21	1098	50	9	81	2782	263	1	230	0	3	54	2	43	2	6584	PL
PT	0	0	1	0	0	0	0	5	1	1	0	0	0	0	0	0	1	0	0	PT
RO	2	11	8	341	289	4	3	19	315	42	15	451	0	0	100	0	7	0	336	RO
ES	0	0	19	0	5	1	0	108	18	17	0	6	0	4	14	0	10	0	4	ES
SE	0	2	27	0	122	105	77	35	471	104	0	24	0	4	4	1	23	25	320	SE
CH	0	2	16	1	21	1	0	98	69	52	0	5	0	1	149	1	7	0	10	CH
TR	2	2	4	307	50	1	1	9	61	11	96	54	0	0	40	0	2	0	74	TR
SU	2	23	60	271	982	92	293	105	1760	268	23	677	0	5	123	2	45	11	3441	SU
GB	0	0	34	0	11	4	0	66	59	35	0	0	0	58	1	0	20	1	18	GB
YU	14	28	17	276	312	3	2	52	346	68	20	426	0	1	461	1	11	0	223	YU
REM	1	2	11	12	25	2	0	53	42	16	9	11	0	1	89	0	5	0	13	REM
BAS	0	4	46	4	250	250	203	62	987	220	0	49	0	5	11	1	40	10	1004	BAS
NOS	0	1	218	0	96	124	4	361	472	295	0	6	0	50	6	3	285	37	189	NOS
ATL	0	1	74	0	44	41	64	308	199	97	0	6	10	206	5	1	46	43	132	ATL
MED	40	25	57	538	355	14	2	367	510	143	545	286	0	6	2314	3	30	1	305	MED
BLS	1	2	3	369	84	3	2	6	110	16	30	78	0	0	26	0	2	0	187	BLS
SUM	116	349	1783	5207	8842	974	1157	4768	18825	4816	1151	4543	15	549	6920	65	1166	223	14587	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	11	2	0	0	1	7	4	36	2	0	0	0	0	0	1	56	308	AL
AT	1	15	13	1	12	0	9	68	80	0	1	6	2	0	0	2	140	1768	AT
BE	0	0	6	0	0	0	2	125	0	0	0	13	2	0	0	3	42	876	BE
BG	0	326	2	1	0	4	152	8	157	2	0	1	0	0	0	2	184	3821	BG
CS	0	52	9	3	3	0	39	77	82	0	2	7	2	0	0	2	185	6498	CS
DK	0	1	1	7	0	0	8	101	1	0	5	10	1	0	0	5	56	615	DK
FI	0	7	1	53	0	0	685	50	6	0	16	4	1	0	0	9	349	2078	FI
FR	16	4	419	2	15	0	7	562	24	8	1	50	50	0	0	44	736	5008	FR
DD	1	5	9	4	2	0	15	139	6	0	4	13	2	0	0	4	136	7919	DD
DE	2	9	42	5	22	0	21	473	21	1	5	46	10	0	0	15	348	5338	DE
GR	0	70	5	0	0	11	55	8	70	7	0	1	0	0	0	4	223	1409	GR
HU	0	118	4	1	1	0	37	23	232	1	1	2	1	0	0	1	127	2915	HU
IS	0	0	0	1	0	0	3	13	0	0	0	1	1	0	0	16	50	97	IS
IE	1	0	3	0	0	0	0	106	0	0	0	2	9	0	0	14	53	359	IE
IT	2	20	70	2	22	0	12	102	208	19	1	6	4	0	0	11	510	4622	IT
LU	0	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0	3	43	LU
NL	0	0	4	1	0	0	2	185	0	0	0	19	2	0	0	4	49	864	NL
NO	0	2	2	39	0	0	148	276	1	0	7	20	6	0	0	31	338	1541	NO
PL	1	88	12	17	3	1	224	210	84	0	14	18	3	0	0	7	452	12429	PL
PT	206	0	96	0	0	0	0	8	0	2	0	0	21	0	0	7	59	409	PT
RO	0	2851	5	2	1	6	499	29	383	2	1	3	1	0	0	3	408	6140	RO
ES	112	2	2810	0	1	0	1	112	4	18	0	7	48	2	0	25	366	3713	ES
SE	1	12	4	321	1	0	263	225	8	0	28	17	4	0	0	20	415	2661	SE
CH	1	1	20	0	90	0	1	50	9	1	0	3	2	0	0	2	85	702	CH
TR	0	126	5	1	0	495	234	10	63	6	0	1	0	0	0	7	743	2405	TR
SU	1	865	16	100	3	60	25090	268	289	2	53	24	6	0	0	36	7153	42148	SU
GB	2	0	17	1	0	0	3	4979	0	0	1	43	26	0	0	36	187	5603	GB
YU	1	178	19	2	3	2	73	62	2505	7	1	4	2	0	0	6	460	5586	YU
REM	8	4	140	1	1	1	4	59	24	604	0	3	5	1	0	15	600	1762	REM
BAS	1	22	7	186	1	0	670	288	23	0	119	25	4	0	0	26	516	5038	BAS
NOS	4	1	37	26	1	0	34	3624	1	0	10	294	40	0	0	152	662	7033	NOS
ATL	204	4	1493	44	1	0	1110	1851	3	4	9	64	671	1	0	1444	3944	12122	ATL
MED	24	209	867	6	11	77	169	270	627	323	3	17	18	2	0	122	2033	10319	MED
BLS	0	309	2	2	0	134	1009	13	64	2	1	1	0	0	0	17	644	3119	BLS
SUM	587	5312	6140	829	197	793	30585	14381	5013	1011	284	723	944	7	0	2096	22313	167269	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C5 : Budget of Oxidised Sulphur in 1989 (Unit: 100 tonnes as S)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	40	1	0	46	11	0	0	1	11	1	13	13	0	0	30	0	0	0	9	AL
AT	0	120	18	8	340	3	1	62	421	105	1	93	0	1	204	1	12	0	164	AT
BE	0	0	413	0	14	1	0	139	40	63	0	1	0	2	3	3	33	0	8	BE
BG	3	2	2	2574	64	1	1	4	68	7	33	84	0	0	22	0	1	0	101	BG
CS	0	24	23	10	3374	7	2	58	1468	130	2	316	0	1	43	1	14	0	707	CS
DK	0	0	13	0	21	105	1	17	100	35	0	2	0	2	2	0	11	1	27	DK
FI	0	0	10	2	41	16	358	14	146	24	0	7	0	2	1	0	8	6	127	FI
FR	0	5	211	1	92	5	1	2340	271	202	0	24	0	12	291	11	58	0	54	FR
DD	0	3	47	1	594	19	1	81	6892	267	0	16	0	2	12	2	30	1	174	DD
DE	0	16	228	3	364	22	1	442	1425	1616	0	25	0	6	103	15	134	1	131	DE
GR	9	1	1	422	28	0	0	3	34	4	386	31	0	0	35	0	1	0	41	GR
HU	0	17	5	23	318	2	1	14	201	24	4	1471	0	0	68	0	3	0	246	HU
IS	0	0	0	0	0	0	0	1	1	1	0	0	5	1	0	0	1	0	0	IS
IE	0	0	5	0	4	1	0	10	10	4	0	0	0	173	0	0	3	0	3	IE
IT	2	17	19	46	143	2	0	139	205	58	14	89	0	1	2844	1	9	0	94	IT
LU	0	0	3	0	1	0	0	11	2	4	0	0	0	0	0	13	1	0	0	LU
NL	0	0	108	0	13	2	0	80	48	135	0	1	0	2	2	1	187	0	11	NL
NO	0	0	18	3	30	27	10	27	131	41	0	5	0	10	3	0	13	67	66	NO
PL	0	12	51	18	1148	42	9	95	3130	232	2	184	0	4	39	2	35	2	6434	PL
PT	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	PT
RO	3	8	7	334	304	3	2	15	299	29	19	459	0	0	58	0	5	0	439	RO
ES	0	0	10	2	4	1	0	102	17	13	1	4	0	3	37	1	4	0	4	ES
SE	0	1	27	5	95	86	45	39	364	74	1	17	0	7	8	1	21	26	251	SE
CH	0	3	15	0	28	1	0	97	83	43	0	5	0	0	185	1	6	0	8	CH
TR	1	1	1	216	29	1	1	2	52	6	78	30	0	0	14	0	1	0	78	TR
SU	1	18	74	259	1009	96	251	120	2112	251	28	569	0	11	92	2	53	14	3441	SU
GB	0	0	48	0	16	5	1	97	66	39	0	1	0	64	3	1	29	0	34	GB
YU	13	27	7	325	341	4	1	33	322	41	31	491	0	0	369	0	4	0	253	YU
REM	0	0	6	11	6	0	0	32	8	7	12	5	0	1	70	0	2	0	4	REM
BAS	0	3	54	7	202	214	137	77	920	181	1	32	0	7	13	1	40	11	802	BAS
NOS	0	2	221	1	106	80	3	422	429	236	0	8	0	56	10	3	258	29	119	NOS
ATL	0	1	99	2	41	29	53	427	192	109	0	4	11	226	15	3	54	35	92	ATL
MED	45	17	33	655	265	4	1	285	335	71	642	244	0	3	2251	2	14	0	237	MED
BLS	1	2	3	301	71	3	2	4	131	13	26	58	0	0	11	0	2	0	231	BLS
SUM	121	300	1781	5275	9116	782	883	5294	19932	4067	1294	4283	16	599	6837	68	1046	197	14391	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	17	2	0	0	0	6	1	37	2	0	0	0	0	0	1	52	294	AL
AT	0	28	10	2	12	0	21	44	91	1	1	4	1	0	0	3	183	1955	AT
BE	0	0	6	0	0	0	1	112	1	0	0	12	2	0	0	3	40	896	BE
BG	0	368	1	1	0	11	149	5	158	2	0	1	0	0	0	2	216	3881	BG
CS	0	47	7	3	3	0	56	51	73	0	2	5	1	0	0	3	220	6651	CS
DK	0	0	3	5	0	0	4	104	1	0	5	10	1	0	0	5	50	526	DK
FI	0	8	1	51	0	0	458	78	3	0	15	5	1	0	0	10	355	1747	FI
FR	15	4	397	1	18	0	5	540	52	7	1	52	40	0	0	41	740	5489	FR
DD	0	3	8	3	1	0	15	117	8	0	5	13	2	0	0	5	146	8468	DD
DE	2	8	45	3	26	0	19	385	18	0	5	41	8	0	0	14	351	5459	DE
GR	0	91	2	0	0	14	60	2	55	5	0	0	0	0	0	4	220	1451	GR
HU	0	131	4	1	1	0	53	11	246	1	1	1	0	0	0	1	171	3021	HU
IS	0	0	1	0	0	0	0	16	0	0	0	0	1	0	0	18	49	96	IS
IE	0	0	4	0	0	0	1	115	0	0	0	3	9	0	0	17	71	433	IE
IT	3	35	62	1	22	1	14	55	261	22	1	4	3	0	0	12	565	4744	IT
LU	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	3	45	LU
NL	0	0	6	0	0	0	1	171	0	0	0	20	2	0	0	4	46	840	NL
NO	0	3	4	22	0	0	107	353	5	0	5	19	9	0	0	43	414	1439	NO
PL	1	60	12	16	3	1	209	174	73	1	16	17	3	0	0	9	487	12522	PL
PT	251	0	128	0	0	0	0	5	0	3	0	0	23	0	0	7	73	497	PT
RO	0	2880	4	2	1	12	492	20	369	2	1	2	0	0	0	3	444	6215	RO
ES	112	2	3182	0	0	0	1	78	11	28	0	5	44	3	0	25	480	4176	ES
SE	1	9	4	249	0	0	126	240	8	0	24	20	5	0	0	25	416	2194	SE
CH	1	1	21	0	90	0	1	39	9	1	0	3	2	0	0	2	82	726	CH
TR	0	110	2	1	0	489	254	6	30	4	0	0	0	0	0	8	718	2134	TR
SU	1	783	17	105	2	46	21386	414	240	2	63	33	6	0	0	38	6866	38404	SU
GB	2	0	22	1	0	0	13	5023	1	0	1	51	28	0	0	41	228	5816	GB
YU	0	244	15	1	2	2	84	19	2761	7	1	2	1	0	0	6	534	5943	YU
REM	5	4	72	0	1	1	4	13	12	604	0	1	3	1	0	16	628	1530	REM
BAS	1	18	10	161	1	0	418	315	16	1	119	30	4	0	0	29	497	4320	BAS
NOS	3	2	47	17	1	0	26	3507	4	0	8	298	42	0	0	153	625	6716	NOS
ATL	228	5	1631	36	1	0	959	1931	6	4	8	70	688	1	0	1420	3936	12315	ATL
MED	18	263	762	1	7	106	181	106	648	344	1	9	12	2	0	129	2077	9769	MED
BLS	0	291	1	2	0	119	908	14	51	1	1	1	0	0	0	16	604	2868	BLS
SUM	648	5415	6494	685	194	804	26031	14066	5249	1042	288	735	942	8	0	2115	22585	163580	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C6 : Budget of Oxidised Sulphur in 1990 (Unit: 100 tonnes as S)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	41	0	0	35	8	0	0	2	8	1	10	10	0	0	34	0	0	0	7	AL
AT	0	113	24	4	250	2	0	88	297	98	0	56	0	1	188	2	7	0	118	AT
BE	0	0	425	0	11	1	0	123	44	52	0	0	0	2	2	2	24	0	10	BE
BG	4	2	2	2512	56	1	0	6	62	8	34	75	0	0	27	0	1	0	62	BG
CS	0	23	33	13	3116	5	1	71	1192	132	1	302	0	2	50	2	12	0	474	CS
DK	0	0	14	0	16	101	1	18	87	33	0	1	0	3	1	0	9	1	22	DK
FI	0	1	7	2	31	14	386	11	90	17	0	8	0	2	4	0	4	4	87	FI
FR	0	3	192	2	100	5	0	2060	307	179	0	14	0	12	203	10	46	0	81	FR
DD	0	2	62	1	457	15	0	88	5897	249	0	8	0	4	11	3	29	1	137	DD
DE	0	12	260	3	309	18	1	466	1110	1432	0	14	0	11	80	15	108	1	164	DE
GR	9	1	2	415	24	0	0	6	27	4	377	26	0	0	40	0	1	0	27	GR
HU	0	17	8	18	262	1	0	22	176	26	2	1316	0	0	79	0	3	0	129	HU
IS	0	0	1	0	1	0	0	1	2	1	0	0	5	1	0	0	1	0	2	IS
IE	0	0	5	0	4	0	0	8	14	4	0	0	0	178	0	0	2	0	1	IE
IT	2	15	22	27	151	1	0	172	211	56	13	88	0	1	2786	1	7	0	101	IT
LU	0	0	3	0	1	0	0	11	3	4	0	0	0	0	0	13	0	0	1	LU
NL	0	0	108	0	11	1	0	73	53	107	0	1	0	4	2	1	154	0	9	NL
NO	0	0	25	1	33	28	13	38	131	40	0	5	0	10	1	0	16	60	50	NO
PL	0	12	73	19	1138	36	6	106	3009	250	1	196	0	6	40	3	36	2	5205	PL
PT	0	0	1	0	1	0	0	8	3	2	0	0	0	0	2	0	1	0	0	PT
RO	3	7	8	268	257	3	2	21	244	28	11	376	0	1	59	0	4	0	252	RO
ES	0	0	17	0	11	1	0	121	49	19	0	2	0	3	32	1	6	0	12	ES
SE	0	1	28	1	86	84	62	39	323	75	0	10	0	6	3	1	18	22	171	SE
CH	0	2	12	1	27	0	0	110	58	34	0	3	0	1	152	1	4	0	21	CH
TR	1	1	2	184	35	1	0	6	43	6	65	35	0	0	12	0	1	0	53	TR
SU	2	20	120	286	1211	95	262	174	2274	315	28	602	0	14	94	4	61	12	3161	SU
GB	0	0	29	0	14	4	0	56	62	27	0	0	0	71	2	0	16	1	12	GB
YU	14	23	13	307	241	2	1	52	256	41	18	357	0	1	421	1	4	0	162	YU
REM	0	1	4	20	27	1	0	33	45	7	22	15	0	1	93	0	2	0	15	REM
BAS	0	2	59	3	167	200	158	76	816	180	0	28	0	9	9	1	38	9	591	BAS
NOS	0	1	207	0	82	80	3	340	383	194	0	6	0	63	7	2	206	27	81	NOS
ATL	0	1	106	3	75	26	61	338	302	118	0	11	11	217	15	2	47	34	117	ATL
MED	42	18	42	518	324	4	1	335	441	78	631	241	0	4	2232	2	15	0	241	MED
BLS	1	2	4	254	70	2	2	7	92	12	23	56	0	0	13	0	2	0	128	BLS
SUM	119	280	1918	4897	8605	733	961	5084	18109	3830	1237	3862	16	628	6692	69	885	175	11704	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	12	2	0	0	1	5	2	35	2	0	0	0	0	0	1	56	274	AL
AT	0	8	11	1	12	0	13	47	84	1	1	5	2	0	0	3	150	1585	AT
BE	0	1	7	0	0	0	3	121	1	0	0	13	2	0	0	3	45	891	BE
BG	0	340	2	0	0	6	77	9	130	1	0	1	0	0	0	2	186	3608	BG
CS	0	47	8	2	3	0	33	75	92	1	2	6	2	0	0	3	204	5906	CS
DK	0	0	2	5	0	0	5	122	1	0	5	10	1	0	0	5	56	520	DK
FI	0	5	3	38	0	0	436	61	5	0	14	4	1	0	0	9	320	1563	FI
FR	10	3	339	1	14	0	14	376	30	3	1	46	45	0	0	38	694	4829	FR
DD	0	4	7	2	1	0	22	153	4	0	4	14	2	0	0	6	150	7334	DD
DE	1	7	39	3	21	0	31	486	14	0	4	47	9	0	0	16	363	5044	DE
GR	0	85	5	0	0	15	41	7	51	7	0	0	0	0	0	4	221	1396	GR
HU	0	102	6	0	1	0	23	17	248	1	1	2	1	0	0	1	147	2612	HU
IS	0	1	0	0	0	0	1	14	0	0	0	0	1	0	0	16	50	98	IS
IE	1	0	3	0	0	0	0	85	0	0	0	2	9	0	0	17	73	405	IE
IT	4	24	67	1	22	1	16	45	237	22	1	4	4	0	0	12	560	4677	IT
LU	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	4	43	LU
NL	0	0	4	0	0	0	3	238	0	0	0	20	2	0	0	4	53	851	NL
NO	1	6	12	22	0	0	109	356	3	0	5	22	8	0	0	41	431	1470	NO
PL	0	70	12	13	2	0	187	251	87	1	15	20	4	0	0	10	507	11318	PL
PT	226	0	119	0	0	0	0	8	2	2	0	0	21	0	0	6	67	471	PT
RO	0	2713	4	1	0	4	261	25	337	1	1	2	1	0	0	3	348	5245	RO
ES	112	0	3060	0	1	0	1	88	9	16	0	5	48	3	0	25	422	4064	ES
SE	0	8	8	230	0	0	177	283	7	0	25	20	6	0	0	25	457	2175	SE
CH	1	1	17	0	84	0	2	25	8	0	0	2	2	0	0	2	76	643	CH
TR	0	106	3	0	0	450	260	8	25	4	0	1	0	0	0	7	630	1940	TR
SU	1	962	24	93	3	62	20541	564	280	1	66	41	10	0	0	46	7378	38809	SU
GB	1	0	18	1	0	0	5	4703	1	0	1	39	28	0	0	41	232	5365	GB
YU	1	170	22	1	3	2	44	32	2405	8	1	3	2	0	0	6	485	5097	YU
REM	6	9	102	0	1	2	3	25	23	627	0	1	4	1	0	18	672	1780	REM
BAS	1	16	11	146	1	0	416	388	15	0	119	33	6	0	0	30	513	4040	BAS
NOS	4	2	52	18	1	0	24	3707	4	0	9	287	44	0	0	155	687	6675	NOS
ATL	207	8	1501	33	1	0	899	1747	9	3	9	62	650	0	0	1411	4121	12147	ATL
MED	22	216	858	2	8	103	139	136	592	343	1	10	16	2	0	128	2086	9829	MED
BLS	0	287	1	1	0	109	769	14	36	1	1	1	0	0	0	15	542	2448	BLS
SUM	601	5214	6332	617	181	755	24559	14221	4773	1046	288	725	932	7	0	2111	22987	155151	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C7 : Budget of Oxidised Sulphur in 1991 (Unit: 100 tonnes as S)

NOTE : For the year 1991 and later years East and West Germany are put together with the country code DE*

NOTE : For the year 1991 and later years SU are splitted up in 7 new countries (BY, UA, MD, RU, EE, LV, LT)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	
AL	41	0	1	40	8	0	0	4	12	16	13	0	0	32	0	0	0	9	0	21	1	AL
AT	0	106	19	4	281	6	0	80	503	0	84	0	1	167	1	6	0	131	0	15	7	AT
BE	0	0	441	0	13	1	0	131	109	0	2	0	1	2	3	28	0	10	0	0	5	BE
BG	4	1	2	2073	47	1	0	4	68	29	66	0	0	21	0	1	0	56	0	380	1	BG
CS	0	20	24	11	2803	9	1	63	1233	1	299	0	1	37	1	9	0	565	0	54	6	CS
DK	0	0	9	0	27	137	1	11	143	0	4	0	2	1	0	7	1	45	0	2	1	DK
FI	0	0	7	0	40	19	297	10	171	0	6	0	1	1	0	4	4	120	0	5	2	FI
FR	0	5	211	2	128	7	0	2221	578	0	39	0	11	262	10	44	0	67	9	10	324	FR
DE*	0	19	265	2	868	53	2	509	8991	0	70	0	11	76	14	117	2	381	2	13	43	DE*
GR	8	1	1	358	22	1	0	6	32	429	30	0	0	31	0	1	0	30	0	114	2	GR
HU	1	14	6	21	255	3	0	16	210	2	1355	0	0	52	0	3	0	175	0	140	2	HU
IS	0	0	1	0	0	0	0	2	4	0	0	5	2	0	0	1	0	1	0	0	0	IS
IE	0	0	4	0	4	1	0	9	22	0	0	0	206	0	0	2	0	3	0	0	4	IE
IT	2	18	19	24	163	5	0	160	329	14	134	0	1	2837	1	8	0	110	3	41	65	IT
LU	0	0	3	0	1	0	0	11	8	0	0	0	0	0	13	1	0	1	0	0	1	LU
NL	0	0	107	0	18	2	0	70	201	0	2	0	3	2	1	153	0	13	0	0	4	NL
NO	0	0	15	0	39	34	8	18	195	0	8	0	9	1	0	11	55	85	0	5	1	NO
PL	0	9	54	17	862	50	6	94	2524	1	165	0	3	34	2	25	2	4955	0	87	8	PL
PT	0	0	0	0	1	0	0	4	4	0	0	0	1	2	0	0	0	1	231	0	115	PT
RO	3	4	4	245	198	4	2	9	234	13	317	0	0	51	0	3	0	257	0	2926	2	RO
ES	0	1	15	1	18	1	0	114	79	0	3	0	4	48	1	5	0	13	102	1	3101	ES
SE	0	1	25	0	55	107	42	29	290	0	13	0	6	1	0	18	21	153	0	11	1	SE
CH	0	3	14	0	32	1	0	101	132	0	13	0	1	162	1	5	0	14	0	1	16	CH
TR	1	1	1	177	25	1	1	3	40	76	37	0	0	13	0	0	0	39	0	115	1	TR
GB	0	1	53	0	31	6	0	107	175	0	3	0	71	2	1	27	1	33	1	2	18	GB
YU	16	23	14	260	299	5	1	39	383	26	478	0	1	322	1	6	0	240	0	229	10	YU
BY	0	2	11	17	114	14	7	19	314	2	50	0	1	10	0	5	1	468	0	56	1	BY
UA	1	4	10	97	272	14	9	21	455	15	243	0	1	34	0	6	1	781	0	443	3	UA
MD	0	0	1	16	18	1	0	1	31	2	16	0	0	3	0	0	0	44	0	105	0	MD
RU	0	4	28	58	256	61	171	45	706	6	138	0	3	25	0	16	7	813	0	206	4	RU
EE	0	0	2	0	9	6	12	2	33	0	2	0	0	1	0	1	1	31	0	1	0	EE
LV	0	0	4	1	23	9	7	5	78	0	5	0	0	2	0	2	1	72	0	3	1	LV
LT	0	1	7	2	42	10	4	10	149	0	9	0	1	3	0	3	1	164	0	7	1	LT
REM	1	1	7	14	18	1	0	54	39	15	9	0	1	102	0	2	0	12	8	8	113	REM
BAS	0	2	47	2	145	274	123	63	909	0	24	0	7	5	1	29	9	607	0	18	8	BAS
NOS	0	4	257	1	223	129	4	430	1117	0	28	0	62	13	3	233	26	214	1	8	40	NOS
ATL	0	2	137	0	133	50	37	473	763	0	20	11	286	18	3	61	32	188	201	6	1613	ATL
MED	47	18	46	555	306	10	2	392	536	686	292	0	4	2258	2	18	0	281	23	337	869	MED
BLS	1	1	1	195	50	3	2	2	78	22	50	0	0	8	0	1	0	114	0	242	0	BLS
SUM	126	268	1873	4194	7848	1039	741	5344	21873	1353	4025	17	703	6640	63	863	168	11299	584	5613	6395	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	

Emitters

Receivers	SE	CH	TR	GB	YU	BY	UA	MD	RU	EE	LV	LT	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	0	1	3	37	1	5	1	0	0	0	0	2	0	0	0	0	0	1	70	319	AL
AT	1	12	0	36	88	5	8	0	2	0	0	2	1	1	4	2	0	0	3	159	1739	AT
BE	0	0	0	90	1	1	0	0	0	0	0	0	0	0	13	2	0	0	3	41	898	BE
BG	1	0	8	8	138	11	120	12	12	1	1	2	1	0	1	0	0	0	2	212	3285	BG
CS	2	2	0	56	78	13	31	1	7	1	1	6	1	2	5	1	0	0	3	212	5562	CS
DK	6	0	0	99	1	3	3	0	4	1	0	1	0	5	9	1	0	0	4	50	578	DK
FI	44	0	0	56	3	20	15	1	299	46	11	19	0	15	4	1	0	0	9	334	1564	FI
FR	2	19	0	429	55	4	5	0	1	0	0	1	6	1	47	35	0	0	34	644	5216	FR
DE*	6	20	0	467	26	9	15	0	10	2	2	5	1	9	54	10	0	0	23	514	12608	DE*
GR	0	0	21	6	57	7	56	6	6	0	0	1	4	0	0	0	0	0	5	261	1499	GR
HU	1	1	1	16	223	8	46	2	4	1	1	3	1	1	2	0	0	0	1	142	2707	HU
IS	0	0	0	16	0	0	0	0	1	0	0	0	0	0	1	1	0	0	14	47	96	IS
IE	0	0	0	132	0	0	0	0	0	0	0	0	0	0	3	9	0	0	15	62	476	IE
IT	1	19	1	65	302	6	15	1	2	0	0	1	25	1	5	3	0	0	14	568	4964	IT
LU	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	44	LU
NL	1	0	0	164	1	1	0	0	0	0	0	0	0	0	20	2	0	0	4	46	817	NL
NO	23	0	0	261	3	7	7	0	90	3	2	3	0	6	16	6	0	0	34	356	1302	NO
PL	14	2	0	151	67	65	91	4	51	7	8	37	1	16	15	3	0	0	10	523	9963	PL
PT	0	0	0	6	0	0	0	0	0	0	0	0	2	0	0	20	0	0	6	62	454	PT
RO	2	0	7	16	324	34	358	37	33	2	2	7	1	1	2	0	0	0	3	380	5483	RO
ES	0	1	0	100	12	0	0	0	0	0	0	0	20	0	6	45	3	0	25	410	4130	ES
SE	234	0	0	230	4	16	23	1	74	13	7	15	0	24	19	4	0	0	22	395	1858	SE
CH	0	81	0	45	12	1	1	0	0	0	0	0	1	0	3	2	0	0	2	84	732	CH
TR	0	0	557	6	31	12	208	10	37	1	1	3	3	0	0	0	0	0	9	821	2230	TR
GB	2	0	0	5183	1	2	7	0	1	0	0	1	1	1	53	25	0	0	40	226	6077	GB
YU	2	2	3	37	2512	12	51	3	5	1	1	5	9	1	3	1	0	0	7	512	5521	YU
BY	8	0	3	34	27	893	154	8	103	10	18	72	0	6	3	1	0	0	3	358	2792	BY
UA	6	1	23	40	111	228	4777	88	353	9	9	31	1	5	4	1	0	0	7	1113	9216	UA
MD	0	0	1	2	10	10	125	109	12	0	0	1	0	0	0	0	0	0	0	61	572	MD
RU	58	1	32	148	66	657	1892	30	9535	119	71	153	0	35	13	4	0	0	23	5986	21374	RU
EE	6	0	0	14	1	5	4	0	16	83	10	9	0	6	1	0	0	0	2	55	315	EE
LV	7	0	0	21	2	24	11	1	23	16	76	41	0	6	2	0	0	0	2	100	549	LV
LT	6	0	0	21	4	29	17	1	31	4	17	242	0	5	2	0	0	0	2	119	917	LT
REM	0	1	1	33	25	0	3	0	0	0	0	0	627	0	2	5	1	0	19	650	1771	REM
BAS	156	0	0	301	9	40	46	2	143	102	47	64	0	125	28	4	0	0	29	493	3864	BAS
NOS	22	1	0	3632	11	12	18	0	12	3	3	7	1	12	309	36	0	0	152	633	7662	NOS
ATL	34	3	0	2233	8	21	18	1	725	11	5	12	3	10	82	694	0	0	1435	4227	13555	ATL
MED	3	7	126	183	713	28	198	22	23	2	2	7	350	2	13	15	2	0	135	2247	10759	MED
BLS	1	0	138	10	37	32	768	32	150	2	2	6	0	1	1	0	0	0	18	744	2711	BLS
SUM	650	177	924	14350	5002	2218	9095	374	11769	439	299	760	1059	301	745	933	7	0	2125	23914	156166	SUM
	SE	CH	TR	GB	YU	BY	UA	MD	RU	EE	LV	LT	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C8 : Budget of Oxidised Sulphur in 1992 (Unit: 100 tonnes as S)

PROVISIONAL ESTIMATE

NOTE : For the year 1991 and later years East and West Germany are put together with the country code DE*

NOTE : For the year 1991 and later years SU are splitted up in 7 new countries (BY, UA, MD, RU, EE, LV, LT)

NOTE : For the year 1992 and later years YU are splitted up in 4 new countries (SI, HR, BA, YU*)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SB	CH	
AL	41	1	1	38	10	0	0	3	15	13	12	0	0	26	0	0	0	7	0	14	1	0	0	AL
AT	0	105	24	4	200	3	0	117	335	0	60	0	1	208	2	8	0	89	0	21	11	0	13	AT
BE	0	0	447	0	17	1	0	140	125	0	2	0	2	2	3	27	0	9	0	1	9	0	0	BE
BG	3	3	4	2016	62	1	0	11	82	17	93	0	0	21	0	2	0	59	0	352	2	0	0	BG
CS	0	21	31	9	2871	7	0	76	1309	2	282	0	2	46	2	12	0	512	0	51	8	1	3	CS
DK	0	0	9	0	13	138	0	12	101	0	2	0	2	1	0	6	1	26	0	1	2	5	0	DK
FI	0	0	7	2	33	18	289	11	154	0	9	0	2	2	0	4	5	99	0	9	3	42	0	FI
FR	0	7	212	2	143	8	0	2345	601	0	26	0	13	284	10	43	0	86	10	11	350	1	22	FR
DE*	0	17	314	4	870	46	1	593	9247	0	49	0	16	120	16	139	2	343	2	18	55	4	23	DE*
GR	10	2	2	352	36	1	0	9	54	393	44	0	0	37	0	1	0	32	0	91	3	0	0	GR
HU	1	15	9	18	243	2	0	27	198	1	1302	0	1	51	0	4	0	142	0	114	4	1	1	HU
IS	0	0	0	0	1	0	0	0	3	0	0	5	0	0	0	0	0	1	0	0	1	0	0	IS
IE	0	0	2	0	3	0	0	6	11	0	0	0	210	0	0	1	0	3	0	0	4	0	0	IE
IT	2	13	13	32	115	4	0	170	210	11	81	0	1	2970	1	4	0	96	3	31	77	1	21	IT
LU	0	0	3	0	1	0	0	12	7	0	0	0	0	0	13	0	0	1	0	0	1	0	0	LU
NL	0	0	116	0	24	2	0	77	220	0	3	0	4	1	1	160	0	15	0	1	4	0	0	NL
NO	0	1	14	0	30	31	7	19	139	0	8	0	10	1	0	10	56	46	0	2	6	20	0	NO
PL	0	9	64	13	915	53	3	105	2886	2	157	0	7	32	2	32	2	5040	0	53	16	15	2	PL
PT	0	0	2	0	2	0	0	8	5	0	1	0	0	2	0	0	0	1	228	0	123	0	0	PT
RO	2	6	14	190	269	4	1	33	289	9	394	0	1	48	1	5	0	282	0	2781	4	2	1	RO
ES	0	1	25	2	31	2	0	153	100	0	11	0	5	50	1	8	0	24	99	4	3167	0	2	ES
SE	0	1	29	0	59	114	35	37	370	0	10	0	6	3	1	16	22	131	0	6	5	231	0	SE
CH	0	3	9	0	23	1	0	114	80	0	5	0	1	215	1	2	0	13	0	1	18	0	85	CH
TR	2	2	5	230	61	2	1	13	95	74	55	0	1	26	0	2	0	76	0	167	3	1	0	TR
GB	0	1	48	0	47	5	0	87	187	0	3	0	82	2	1	24	1	37	1	1	16	1	0	GB
BY	0	2	9	15	95	14	9	17	223	1	58	0	2	19	0	6	1	426	0	65	3	7	1	BY
UA	1	5	27	109	361	17	9	43	680	10	252	0	2	36	1	13	1	960	0	437	6	9	1	UA
MD	0	0	2	14	27	1	0	3	42	1	22	0	0	3	0	1	0	53	0	96	0	0	0	MD
RU	1	5	37	126	272	64	181	59	715	14	158	0	5	27	1	21	8	911	0	279	12	62	1	RU
EE	0	0	1	1	12	4	13	3	46	0	3	0	0	0	0	1	0	32	0	3	0	5	0	EE
LV	0	0	3	2	24	9	8	5	83	0	7	0	1	1	0	2	1	80	0	6	1	6	0	LV
LT	0	1	5	3	36	10	4	9	121	0	11	0	1	2	0	3	1	177	0	7	1	6	0	LT
SI	0	8	3	3	31	1	0	15	52	0	28	0	0	92	0	1	0	23	0	8	3	0	1	SI
HR	1	6	5	10	64	1	0	19	94	2	91	0	0	108	0	2	0	49	0	18	5	0	1	HR
BA	1	4	4	14	55	1	0	14	85	2	73	0	0	67	0	1	0	43	0	22	4	0	0	BA
YU*	13	7	6	256	102	1	0	21	146	18	203	0	0	79	0	3	0	72	0	146	5	0	1	YU*
REM	1	2	6	17	26	1	0	45	38	15	15	0	1	115	0	1	0	27	4	8	103	0	1	REM
BAS	0	2	48	2	150	282	119	70	953	0	26	0	8	5	1	28	9	581	1	18	9	156	1	BAS
NOS	0	2	225	1	147	114	2	390	846	0	16	0	77	10	2	222	26	163	2	6	42	17	1	NOS
ATL	0	3	95	1	129	37	44	438	539	0	19	12	262	26	3	42	32	166	222	7	1736	31	3	ATL
MED	51	18	35	540	297	9	2	404	492	707	270	0	5	2377	2	12	0	294	17	263	886	4	9	MED
BLS	1	3	10	286	110	5	3	16	202	25	93	0	1	21	0	4	0	194	0	380	2	3	0	BLS
SUM	131	274	1925	4314	8014	1012	738	5751	22179	1317	3955	17	733	7136	67	872	171	11420	591	5500	6710	637	196	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SB	CH	

Emitters

Receivers	TR	GB	BY	UA	MD	RU	EE	LV	LT	SI	HR	BA	YU*	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	1	2	1	4	1	1	0	0	0	2	7	4	24	1	0	0	0	0	0	1	50	279	AL
AT	0	65	2	6	0	1	0	0	1	44	28	4	12	1	1	5	2	0	0	2	158	1534	AT
BE	0	124	0	1	0	0	0	0	0	0	1	0	1	0	0	14	2	0	0	2	40	971	BE
BG	5	9	7	78	10	8	0	1	2	6	19	7	148	1	0	1	0	0	0	2	178	3211	BG
CS	0	81	7	24	1	3	0	1	2	19	28	4	27	0	2	7	2	0	0	2	191	5651	CS
DK	0	93	1	1	0	0	0	0	1	0	0	0	0	0	5	9	1	0	0	4	42	480	DK
FI	0	54	19	26	1	277	46	10	16	1	1	0	1	0	14	4	1	0	0	10	327	1497	FI
FR	0	380	2	4	0	0	0	0	1	12	16	3	9	6	1	48	35	0	0	32	611	5335	FR
DE*	0	657	7	13	0	6	0	2	5	11	13	1	7	1	8	61	13	0	0	17	505	13206	DE*
GR	21	6	4	44	4	6	0	0	1	5	14	6	68	3	0	1	0	0	0	4	227	1483	GR
HU	0	23	4	25	1	2	0	0	1	34	85	13	73	1	1	2	1	0	0	1	122	2528	HU
IS	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	12	37	69	IS
IE	0	94	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8	0	0	16	58	421	IE
IT	2	46	3	12	1	1	0	0	1	70	103	22	39	20	1	4	4	0	0	12	555	4755	IT
LU	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	46	LU
NL	0	228	0	1	0	0	0	0	0	0	0	0	0	0	0	22	2	0	0	4	48	935	NL
NO	0	247	2	4	0	76	2	1	3	1	1	0	1	0	4	16	7	0	0	36	367	1169	NO
PL	0	252	47	65	2	29	3	5	26	13	23	4	27	1	16	20	4	0	0	8	473	10425	PL
PT	0	4	0	0	0	0	0	0	0	0	0	0	0	2	0	0	19	0	0	6	60	463	PT
RO	4	32	23	251	31	21	1	1	6	15	39	12	223	1	1	3	1	0	0	2	333	5340	RO
ES	0	79	1	1	0	0	0	0	0	4	7	1	3	20	0	6	42	3	0	24	421	4295	ES
SE	0	213	9	9	0	56	10	6	12	1	2	0	4	0	24	19	5	0	0	23	396	1866	SE
CH	0	33	0	1	0	0	0	0	0	4	4	1	1	0	0	2	2	0	0	2	84	709	CH
TR	562	13	15	222	13	37	1	1	4	3	9	3	41	2	1	1	0	0	0	8	801	2552	TR
GB	0	5227	2	1	0	1	0	0	1	0	0	0	0	0	1	50	26	0	0	40	205	6098	GB
BY	1	57	889	147	6	82	11	20	78	5	10	2	17	0	6	4	1	0	0	3	345	2659	BY
UA	15	95	236	4519	82	274	9	12	43	13	30	8	75	1	7	9	2	0	0	6	1033	9449	UA
MD	1	5	8	102	104	6	0	0	2	1	3	1	8	0	0	1	0	0	0	0	54	565	MD
RU	53	220	699	2255	40	10069	129	74	160	10	23	6	63	0	37	17	5	0	0	27	6678	23527	RU
EE	0	12	5	6	0	13	83	9	8	0	0	0	1	0	5	1	0	0	0	1	57	330	EE
LV	0	27	21	10	1	21	16	75	38	1	1	0	3	0	6	2	0	0	0	2	100	561	LV
LT	0	34	25	12	1	27	5	18	243	1	1	0	3	0	5	3	1	0	0	2	111	888	LT
SI	0	7	0	2	0	0	0	0	0	256	68	10	10	1	0	1	0	0	0	1	52	681	SI
HR	0	12	1	5	0	0	0	0	0	74	488	45	38	3	0	1	0	0	0	1	103	1251	HR
BA	0	11	1	6	0	0	0	0	0	27	93	170	65	3	0	1	0	0	0	1	97	870	BA
YU*	2	17	4	24	3	3	0	0	1	21	68	42	1105	2	0	1	0	0	0	2	213	2590	YU*
REM	4	18	1	6	0	0	0	0	0	6	12	3	10	666	0	2	3	1	0	19	746	1925	REM
BAS	0	313	26	26	1	115	101	45	58	2	4	1	9	0	125	29	5	0	0	29	500	3864	BAS
NOS	0	3875	6	5	0	10	1	2	6	2	3	1	2	0	10	311	42	0	0	157	658	7401	NOS
ATL	0	1689	22	25	0	779	13	6	13	2	4	0	4	3	9	63	694	0	0	1498	4255	12924	ATL
MED	158	141	17	156	14	20	1	2	6	100	257	76	228	382	3	11	14	2	0	146	2373	10801	MED
BLS	145	26	42	775	43	132	3	3	12	6	15	4	55	1	2	2	0	0	0	19	831	3476	BLS
SUM	979	14527	2161	8871	363	12085	442	297	753	774	1483	455	2407	1125	300	759	946	7	0	2186	24487	159069	SUM
	TR	GB	BY	UA	MD	RU	EE	LV	LT	SI	HR	BA	YU*	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C9 : Budget of Oxidised Nitrogen in 1985 (Unit: 100 tonnes as N)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	1	1	1	2	5	1	0	6	2	9	24	3	0	0	19	0	1	0	4	AL
AT	0	29	22	0	57	5	0	97	31	240	3	8	0	1	86	2	29	1	35	AT
BE	0	0	20	0	4	2	0	44	4	55	0	0	0	1	1	1	21	0	3	BE
BG	1	3	2	24	21	2	0	8	9	27	30	14	0	0	22	0	5	0	22	BG
CS	0	22	19	1	203	12	2	61	83	273	2	35	0	2	34	2	35	2	132	CS
DK	0	0	6	0	7	23	1	12	11	54	0	1	0	1	1	0	16	3	8	DK
FI	0	1	5	0	18	25	85	11	22	66	0	1	0	1	1	0	14	15	55	FI
FR	0	8	70	0	55	15	2	727	50	414	2	5	0	11	130	6	86	2	44	FR
DD	0	4	25	0	82	18	2	62	104	301	0	4	0	2	5	1	52	3	54	DD
DE	0	9	92	0	90	24	2	314	96	877	1	5	0	8	39	8	155	4	66	DE
GR	1	3	2	10	16	2	0	12	7	24	113	8	0	0	26	0	4	0	17	GR
HU	0	16	6	2	60	4	0	24	23	83	5	53	0	0	51	1	11	1	50	HU
IS	0	0	0	0	0	1	1	2	0	1	0	0	1	1	0	0	1	2	1	IS
IE	0	0	3	0	3	1	0	10	3	21	0	0	0	11	0	0	6	1	2	IE
IT	0	19	17	2	65	7	1	174	34	184	24	16	0	1	533	2	23	1	53	IT
LU	0	0	1	0	0	0	0	4	0	5	0	0	0	0	0	0	1	0	0	LU
NL	0	0	18	0	5	3	0	33	6	77	0	0	0	2	1	0	46	1	4	NL
NO	0	1	11	0	14	29	17	26	19	97	0	2	0	6	0	0	25	53	35	NO
PL	0	14	28	1	191	43	8	82	153	370	1	31	0	2	25	2	57	7	450	PL
PT	0	0	1	0	0	0	0	8	0	4	0	0	0	0	1	0	1	0	1	PT
RO	0	11	7	12	86	10	2	24	39	105	16	64	0	1	56	0	19	2	125	RO
ES	0	2	9	0	10	3	1	124	10	70	0	1	0	1	23	1	14	0	11	ES
SE	0	2	19	0	32	66	59	37	41	177	0	4	0	4	1	1	42	40	85	SE
CH	0	2	7	0	7	1	0	81	7	67	1	1	0	1	52	1	7	0	4	CH
TR	0	4	3	11	30	6	2	10	17	41	110	15	0	0	23	0	8	1	51	TR
SU	0	36	57	15	354	125	165	158	255	722	48	119	0	6	116	3	131	38	1050	SU
GB	0	1	16	0	16	12	2	57	19	102	0	1	0	20	2	0	41	5	18	GB
YU	2	29	14	11	105	8	1	77	45	177	60	59	0	1	243	1	24	1	80	YU
REM	0	4	8	1	14	2	0	88	8	55	18	5	0	1	66	0	11	0	12	REM
BAS	0	5	29	0	77	94	64	68	94	341	0	10	0	3	7	1	71	20	186	BAS
NOS	0	3	65	0	39	63	9	186	51	362	2	4	0	26	6	2	158	37	55	NOS
ATL	0	3	64	0	48	70	51	314	65	412	1	4	6	57	9	3	139	87	74	ATL
MED	3	31	38	14	141	17	3	418	73	343	226	46	0	3	663	3	54	2	134	MED
BLS	0	3	2	7	24	5	2	5	13	36	36	14	0	0	14	0	5	1	58	BLS
SUM	10	269	686	117	1881	697	485	3363	1394	6194	726	534	9	174	2258	44	1312	331	2979	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	2	1	0	0	1	3	4	6	1	0	0	0	0	0	0	22	118	AL
AT	0	5	5	3	17	0	4	60	16	0	1	7	3	0	0	0	61	829	AT
BE	0	0	3	1	0	0	1	52	0	0	0	6	3	0	0	0	19	241	BE
BG	0	35	1	2	1	3	28	8	24	0	0	1	0	0	0	0	54	349	BG
CS	0	15	4	7	6	0	18	72	19	0	3	9	2	0	0	0	86	1163	CS
DK	0	0	1	8	0	0	3	60	0	0	2	6	2	0	0	0	21	250	DK
FI	0	1	0	67	1	0	95	49	1	0	12	6	2	0	0	0	130	684	FI
FR	8	4	105	9	19	0	9	314	10	1	2	35	46	0	0	0	320	2511	FR
DD	0	3	5	9	2	0	8	87	3	0	4	12	3	0	0	0	63	918	DD
DE	1	3	19	12	21	0	10	300	6	0	4	36	13	0	0	0	166	2381	DE
GR	0	16	2	2	1	6	15	10	13	1	0	1	0	0	0	0	80	394	GR
HU	0	20	2	3	3	0	15	23	36	0	1	3	1	0	0	0	48	545	HU
IS	0	0	0	2	0	0	1	24	0	0	0	1	2	0	0	0	42	82	IS
IE	0	0	1	1	0	0	1	56	0	0	0	3	8	0	0	0	42	174	IE
IT	1	6	18	5	27	2	12	58	39	3	1	7	4	0	0	0	187	1526	IT
LU	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	17	LU
NL	0	0	2	1	0	0	1	85	0	0	0	9	3	0	0	0	23	324	NL
NO	0	2	1	57	0	0	29	150	0	0	6	14	7	0	0	0	170	773	NO
PL	0	16	8	34	5	0	60	110	16	0	11	16	4	0	0	0	158	1899	PL
PT	19	0	24	0	0	0	0	4	0	0	0	0	13	0	0	0	52	129	PT
RO	0	141	2	9	2	3	108	38	57	0	2	4	1	0	0	0	125	1069	RO
ES	35	0	310	2	3	0	1	62	3	2	1	6	38	2	0	0	212	957	ES
SE	0	5	2	165	1	0	79	143	1	0	18	18	5	0	0	0	173	1220	SE
CH	0	0	5	1	23	0	1	26	2	0	0	3	2	0	0	0	30	331	CH
TR	0	38	2	5	1	68	91	14	15	1	1	2	0	0	0	0	336	907	TR
SU	1	158	14	190	8	21	3298	284	73	1	52	39	8	0	0	0	2110	9654	SU
GB	1	1	6	9	1	0	7	497	1	0	2	22	23	0	0	0	114	997	GB
YU	0	32	7	6	8	3	34	53	134	1	2	6	2	0	0	0	165	1395	YU
REM	3	3	48	1	4	1	4	25	8	32	0	3	6	1	0	0	411	845	REM
BAS	1	5	5	126	4	0	122	167	4	0	29	23	6	0	0	0	181	1743	BAS
NOS	3	4	17	45	1	0	25	961	3	0	8	72	41	0	0	0	298	2549	NOS
ATL	28	3	190	89	3	0	151	909	2	0	13	64	254	0	0	0	2177	5291	ATL
MED	6	35	145	14	27	19	56	138	83	24	4	16	14	1	0	0	691	3483	MED
BLS	0	42	1	5	1	16	187	9	11	0	1	1	0	0	0	0	152	655	BLS
SUM	110	596	955	890	188	145	4477	4854	586	69	180	451	514	6	0	0	8919	46403	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C10 : Budget of Oxidised Nitrogen in 1987 (Unit: 100 tonnes as N)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	1	1	0	3	4	0	0	3	2	5	17	2	0	0	20	0	1	0	4	AL
AT	0	37	19	1	68	4	0	99	38	249	1	13	0	1	108	2	28	1	38	AT
BE	0	0	30	0	4	2	0	61	5	64	0	0	0	2	1	1	27	0	3	BE
BG	1	5	1	77	15	1	0	5	6	22	41	13	0	0	23	0	2	0	16	BG
CS	0	31	25	2	236	8	1	82	95	320	2	44	0	1	46	2	39	1	122	CS
DK	0	1	5	0	8	26	1	12	14	62	0	1	0	1	1	0	14	3	11	DK
FI	0	1	4	0	13	17	110	8	13	47	0	3	0	1	2	0	10	13	55	FI
FR	0	8	75	0	49	9	1	878	41	352	0	7	0	13	93	6	78	2	40	FR
DD	0	5	35	0	105	15	1	80	139	414	0	3	0	2	8	2	71	2	53	DD
DE	0	13	114	0	107	21	2	368	111	1070	0	5	0	7	53	9	194	3	55	DE
GR	1	3	1	32	9	1	0	10	4	16	122	5	0	0	30	0	3	0	9	GR
HU	0	21	5	5	62	2	0	24	19	80	5	67	0	0	56	1	9	0	45	HU
IS	0	0	2	0	0	2	0	6	2	15	0	0	2	3	0	0	4	2	1	IS
IE	0	0	3	0	1	1	0	17	1	12	0	0	0	15	1	0	6	0	1	IE
IT	0	18	16	2	45	5	1	176	24	138	9	15	0	1	511	1	25	1	49	IT
LU	0	0	1	0	0	0	0	6	0	5	0	0	0	0	0	0	1	0	0	LU
NL	0	0	28	0	4	4	0	42	5	99	0	0	0	2	1	0	63	1	4	NL
NO	0	2	9	0	16	43	17	21	21	93	0	2	0	6	3	0	25	62	35	NO
PL	0	24	41	3	265	51	6	114	229	515	4	47	0	2	40	3	80	6	599	PL
PT	0	0	0	0	0	0	0	4	0	3	0	0	0	0	1	0	1	0	0	PT
RO	0	15	6	46	83	5	1	23	31	101	27	71	0	0	60	1	12	1	96	RO
ES	0	1	5	0	5	2	0	75	5	31	0	2	0	3	13	0	10	0	7	ES
SE	0	4	11	0	39	78	60	28	48	150	0	7	0	3	8	1	30	45	112	SE
CH	0	2	8	0	8	1	0	94	6	58	0	1	0	1	46	1	9	0	4	CH
TR	0	4	1	26	14	2	1	14	6	25	93	8	0	0	24	0	3	0	19	TR
SU	0	33	38	49	312	133	218	85	227	561	50	127	0	3	71	2	92	42	1103	SU
GB	0	0	19	0	10	8	2	78	13	86	0	0	0	26	3	1	33	4	8	GB
YU	1	33	10	29	78	5	1	65	31	145	42	61	0	1	286	1	21	1	80	YU
REM	0	2	5	2	7	1	0	70	5	38	23	2	0	1	39	0	8	0	8	REM
BAS	0	6	23	0	63	103	66	48	94	291	0	10	0	3	9	1	58	23	211	BAS
NOS	0	3	74	0	51	77	13	192	78	500	0	3	0	24	10	2	193	36	69	NOS
ATL	0	4	65	0	40	57	37	343	49	351	0	2	6	78	14	3	122	76	61	ATL
MED	2	32	37	55	112	12	3	416	57	285	291	55	0	4	702	3	61	2	137	MED
BLS	0	5	2	33	29	4	2	14	15	49	41	15	0	0	17	0	5	1	51	BLS
SUM	8	314	720	367	1861	701	544	3562	1432	6253	769	592	10	202	2301	45	1338	329	3104	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	2	1	0	0	0	3	1	7	0	0	0	0	0	0	0	22	99	AL
AT	0	4	3	2	20	0	6	43	15	0	1	6	2	0	0	0	64	872	AT
BE	0	0	2	1	0	0	1	63	0	0	0	8	2	0	0	0	19	298	BE
BG	0	36	1	1	1	3	33	3	27	0	0	0	0	0	0	0	58	391	BG
CS	0	10	2	4	7	0	18	49	22	0	2	7	2	0	0	0	87	1270	CS
DK	0	0	0	7	0	0	3	53	1	0	2	6	1	0	0	0	19	257	DK
FI	0	2	0	57	0	0	112	22	1	0	11	4	1	0	0	0	111	618	FI
FR	10	1	124	4	20	0	6	262	9	1	1	37	52	0	0	0	317	2499	FR
DD	1	1	2	5	4	0	10	101	2	0	3	14	3	0	0	0	60	1142	DD
DE	1	1	11	7	33	0	11	294	4	0	3	38	10	0	0	0	149	2694	DE
GR	0	13	2	1	1	5	20	5	14	1	0	1	0	0	0	0	87	393	GR
HU	0	20	2	1	4	0	14	11	42	0	1	2	0	0	0	0	55	553	HU
IS	0	0	0	1	0	0	0	36	0	0	0	2	3	0	0	0	57	141	IS
IE	0	0	1	1	0	0	0	67	0	0	0	3	8	0	0	0	42	183	IE
IT	2	5	26	3	26	0	11	48	35	5	1	6	4	0	0	0	204	1412	IT
LU	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	19	LU
NL	0	0	2	1	0	0	1	104	0	0	0	11	3	0	0	0	20	398	NL
NO	0	1	1	64	2	0	26	160	1	0	7	14	5	0	0	0	162	796	NO
PL	1	17	4	27	5	0	83	117	23	0	10	19	4	0	0	0	169	2508	PL
PT	28	0	26	0	0	0	0	6	0	0	0	0	16	0	0	0	56	145	PT
RO	0	151	1	3	3	3	98	12	63	0	1	2	0	0	0	0	127	1045	RO
ES	55	1	349	1	1	0	1	60	3	3	0	4	47	3	0	0	235	921	ES
SE	0	4	1	184	2	0	86	100	3	0	20	14	3	0	0	0	172	1215	SE
CH	1	0	5	0	28	0	1	23	2	0	0	3	2	0	0	0	32	336	CH
TR	0	21	2	1	1	84	114	3	12	1	0	1	0	0	0	0	376	857	TR
SU	0	147	3	212	5	32	4702	161	61	0	54	28	4	0	0	0	2525	11080	SU
GB	1	0	5	7	1	0	5	720	1	0	1	25	21	0	0	0	107	1185	GB
YU	0	28	8	3	10	1	23	27	158	2	1	4	1	0	0	0	184	1341	YU
REM	3	2	52	0	3	2	3	39	4	33	0	3	5	1	0	0	432	795	REM
BAS	0	6	1	146	2	0	176	145	5	0	32	21	3	0	0	0	175	1722	BAS
NOS	1	2	13	48	5	0	32	1061	1	0	11	77	30	0	0	0	272	2880	NOS
ATL	31	1	162	68	4	0	100	943	2	0	10	59	210	0	0	0	1596	4495	ATL
MED	8	38	176	7	24	29	97	138	110	36	3	16	15	1	0	0	917	3880	MED
BLS	0	37	1	3	1	28	274	4	15	0	1	1	0	0	0	0	220	869	BLS
SUM	146	549	992	872	214	189	6070	4881	643	86	180	441	460	6	0	0	9128	49308	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C11 : Budget of Oxidised Nitrogen in 1988 (Unit: 100 tonnes as N)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	1	1	1	4	5	0	0	4	2	7	13	2	0	0	24	0	1	0	4	AL
AT	0	35	16	1	68	4	1	82	33	235	1	9	0	1	89	2	23	2	29	AT
BE	0	0	27	0	3	1	0	58	3	49	0	0	0	1	1	1	25	0	2	BE
BG	1	4	2	69	19	1	1	5	7	22	40	15	0	0	26	0	3	0	19	BG
CS	0	26	20	2	229	9	1	62	95	279	1	37	0	1	41	2	33	2	111	CS
DK	0	0	9	0	7	21	0	18	12	72	0	1	0	2	1	0	20	3	15	DK
FI	0	2	8	0	19	25	124	17	22	91	0	2	0	1	2	0	20	14	57	FI
FR	0	4	79	0	23	6	1	771	23	290	1	3	0	11	86	5	82	2	12	FR
DD	0	4	29	0	83	16	1	68	110	341	0	2	0	2	9	2	55	3	44	DD
DE	0	11	106	0	73	20	1	321	77	959	0	5	0	8	40	8	172	7	43	DE
GR	1	3	1	29	12	1	0	9	5	17	111	7	0	0	33	0	2	0	11	GR
HU	0	19	5	4	66	2	1	21	20	69	3	59	0	0	60	0	9	1	48	HU
IS	0	0	0	0	0	1	1	2	0	3	0	0	2	1	0	0	1	2	1	IS
IE	0	0	1	0	0	0	0	8	0	5	0	0	0	15	0	0	2	0	0	IE
IT	0	17	13	3	45	5	0	161	22	136	9	15	0	1	500	1	18	1	29	IT
LU	0	0	1	0	0	0	0	5	0	5	0	0	0	0	0	0	1	0	0	LU
NL	0	0	24	0	4	1	0	41	4	72	0	0	0	2	1	0	51	1	5	NL
NO	0	1	20	0	20	40	12	39	30	159	0	1	0	6	1	1	50	62	47	NO
PL	0	21	40	3	267	46	9	98	221	492	1	31	0	3	38	3	83	7	572	PL
PT	0	0	1	0	0	0	0	5	0	3	0	0	0	0	0	0	1	0	0	PT
RO	0	15	6	42	90	5	3	23	33	90	24	65	0	0	66	0	14	1	101	RO
ES	0	0	11	0	2	1	0	99	2	31	0	1	0	3	9	0	17	0	2	ES
SE	0	4	21	0	51	81	53	44	64	223	0	5	0	4	4	1	50	44	120	SE
CH	0	2	9	0	6	2	0	87	6	75	0	1	0	1	50	1	11	0	3	CH
TR	0	4	3	34	19	2	1	11	8	26	97	10	0	0	27	0	4	0	29	TR
SU	0	39	48	44	361	119	219	143	240	636	34	113	0	5	91	3	102	38	1091	SU
GB	0	0	14	0	4	4	1	58	8	56	0	0	0	29	1	0	23	2	7	GB
YU	1	31	12	29	101	4	2	64	36	132	35	61	0	1	272	1	19	1	72	YU
REM	0	4	9	2	11	2	0	72	6	41	11	2	0	1	56	0	11	1	5	REM
BAS	0	6	32	1	77	89	60	73	98	346	0	8	0	4	8	2	70	19	198	BAS
NOS	0	2	79	0	30	56	3	230	49	364	0	1	0	31	5	3	171	32	54	NOS
ATL	0	1	47	0	16	52	44	250	30	212	0	1	8	82	3	1	85	95	51	ATL
MED	2	26	31	43	88	13	2	310	41	228	211	34	0	4	574	2	44	3	69	MED
BLS	0	3	2	22	22	3	2	5	10	26	24	10	0	0	12	0	3	0	46	BLS
SUM	7	285	726	333	1823	632	543	3264	1316	5794	617	506	11	222	2128	41	1274	344	2896	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	2	1	0	0	0	2	3	8	0	0	0	0	0	0	0	21	108	AL
AT	0	3	4	3	19	0	3	45	15	0	1	5	2	0	0	0	63	797	AT
BE	0	0	2	1	0	0	1	60	0	0	0	7	3	0	0	0	20	265	BE
BG	0	40	1	1	1	2	44	4	27	0	0	1	0	0	0	0	64	418	BG
CS	0	8	3	6	7	0	11	55	19	0	2	7	2	0	0	0	80	1150	CS
DK	0	0	0	6	0	0	3	68	0	0	2	7	1	0	0	0	25	295	DK
FI	0	1	0	76	1	0	148	43	2	0	14	6	1	0	0	0	134	830	FI
FR	12	1	137	5	19	0	3	296	6	2	1	33	53	0	0	0	304	2270	FR
DD	0	1	3	7	4	0	6	87	2	0	3	11	3	0	0	0	61	954	DD
DE	1	2	15	9	32	0	9	276	5	0	3	34	11	0	0	0	157	2404	DE
GR	0	12	2	1	0	4	19	5	16	1	0	1	0	0	0	0	86	391	GR
HU	0	16	1	2	3	0	10	16	40	0	1	2	1	0	0	0	48	527	HU
IS	0	0	0	2	0	0	3	14	0	0	0	1	1	0	0	0	36	70	IS
IE	0	0	2	0	0	0	0	51	0	0	0	2	7	0	0	0	30	125	IE
IT	2	4	29	4	26	0	5	63	42	4	1	5	4	0	0	0	198	1364	IT
LU	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	18	LU
NL	0	0	1	1	0	0	1	84	0	0	0	9	3	0	0	0	22	327	NL
NO	0	0	1	56	1	0	27	210	0	0	7	20	6	0	0	0	157	976	NO
PL	0	14	4	30	7	0	57	150	19	0	11	18	4	0	0	0	182	2432	PL
PT	25	0	21	0	0	0	0	5	0	0	0	1	16	0	0	0	45	124	PT
RO	0	141	1	5	3	3	126	20	64	0	1	3	1	0	0	0	135	1084	RO
ES	57	0	322	1	1	0	0	72	1	4	0	6	44	2	0	0	209	901	ES
SE	0	3	2	171	2	0	103	165	3	0	20	19	4	0	0	0	174	1437	SE
CH	1	0	7	1	28	0	1	32	2	0	0	3	2	0	0	0	35	365	CH
TR	0	26	2	2	1	74	108	6	17	1	0	1	0	0	0	0	305	818	TR
SU	1	138	6	196	11	28	4442	215	78	0	52	29	7	0	0	0	2393	10920	SU
GB	1	0	7	3	0	0	1	621	0	0	1	21	24	0	0	0	93	980	GB
YU	0	31	7	4	7	1	23	37	165	1	1	4	2	0	0	0	171	1329	YU
REM	4	1	50	2	4	0	2	44	8	36	0	4	5	1	0	0	373	768	REM
BAS	0	4	2	115	3	0	139	186	5	0	27	22	5	0	0	0	179	1779	BAS
NOS	2	0	13	26	2	0	11	1060	0	0	7	75	36	0	0	0	274	2615	NOS
ATL	30	1	164	60	2	0	148	971	1	0	9	59	264	0	0	0	2015	4702	ATL
MED	10	29	153	10	17	12	45	137	93	24	2	13	14	1	0	0	670	2955	MED
BLS	0	32	0	3	1	21	223	7	11	0	1	1	0	0	0	0	152	641	BLS
SUM	148	511	963	807	202	145	5724	5110	649	76	169	428	528	5	0	0	8912	47141	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C12 : Budget of Oxidised Nitrogen in 1989 (Unit: 100 tonnes as N)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	1	1	0	6	4	0	0	1	1	3	19	2	0	0	17	0	0	0	3	AL
AT	0	51	13	1	93	5	1	67	38	218	1	14	0	0	107	1	26	1	51	AT
BE	0	1	33	0	5	1	0	72	3	57	0	0	0	1	2	1	29	0	3	BE
BG	0	3	1	76	22	2	1	4	7	17	46	14	0	0	15	0	2	0	31	BG
CS	0	29	17	2	287	9	2	64	99	266	3	38	0	1	33	1	31	2	159	CS
DK	0	1	8	0	7	19	1	18	10	54	0	0	0	2	1	0	19	3	7	DK
FI	0	1	11	0	19	26	113	21	24	76	1	1	0	2	1	0	22	20	48	FI
FR	0	9	92	0	36	6	1	960	29	327	0	5	0	11	157	6	87	2	19	FR
DD	0	4	29	0	111	17	2	78	140	388	0	3	0	2	8	2	55	3	41	DD
DE	0	17	117	0	107	18	2	361	107	1121	1	5	0	5	52	10	197	5	40	DE
GR	1	2	1	36	11	1	0	5	4	11	134	6	0	0	23	0	2	0	15	GR
HU	0	22	4	4	85	2	1	17	20	59	5	76	0	0	57	0	7	0	76	HU
IS	0	0	1	0	0	0	0	3	0	3	0	0	2	1	0	0	2	1	0	IS
IE	0	0	4	0	1	1	0	16	1	15	0	0	0	18	0	0	9	0	1	IE
IT	0	24	14	7	52	3	1	161	21	126	19	16	0	1	627	1	19	1	33	IT
LU	0	0	2	0	0	0	0	7	0	5	0	0	0	0	0	0	1	0	0	LU
NL	0	1	28	0	4	2	0	47	4	85	0	0	0	2	1	0	61	1	3	NL
NO	0	1	16	0	13	32	10	41	22	114	0	1	0	10	2	1	34	62	24	NO
PL	0	20	35	3	308	47	12	109	238	481	3	30	0	4	33	2	72	8	613	PL
PT	0	0	0	0	0	0	0	4	0	1	0	0	0	0	1	0	0	0	0	PT
RO	0	13	5	43	98	4	3	16	31	68	32	70	0	0	46	0	10	1	122	RO
ES	0	1	8	1	2	1	0	117	3	32	2	1	0	3	35	1	9	0	2	ES
SE	0	2	20	1	39	79	40	48	49	168	1	3	0	6	8	1	45	55	88	SE
CH	0	4	11	0	10	1	0	92	8	91	0	1	0	0	63	1	12	0	2	CH
TR	0	2	1	22	13	1	1	3	8	17	78	7	0	0	11	0	3	0	30	TR
SU	0	37	61	41	402	144	238	168	282	689	38	100	0	10	88	3	135	50	1040	SU
GB	0	1	22	0	7	7	1	77	8	75	0	0	0	31	2	1	40	3	13	GB
YU	2	38	5	43	116	5	2	39	34	97	50	77	0	0	248	0	10	1	87	YU
REM	0	1	5	2	3	0	0	51	1	18	16	1	0	1	48	0	6	0	1	REM
BAS	0	5	32	1	72	94	51	79	94	299	1	5	0	6	11	1	69	24	164	BAS
NOS	0	3	67	0	30	36	2	217	36	291	0	1	1	32	6	2	148	26	32	NOS
ATL	0	1	68	0	18	40	48	397	28	277	0	1	8	87	12	3	112	86	30	ATL
MED	2	23	21	53	73	4	1	251	28	144	257	31	0	2	611	2	27	1	62	MED
BLS	0	2	1	17	19	3	2	3	11	23	21	8	0	0	6	0	3	1	48	BLS
SUM	8	320	750	359	2067	612	537	3614	1391	5716	729	518	12	240	2334	42	1306	358	2888	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	3	1	0	0	0	2	0	7	0	0	0	0	0	0	0	18	93	AL
AT	0	5	3	5	19	0	7	33	16	0	2	4	1	0	0	0	75	858	AT
BE	0	0	2	1	1	0	0	64	0	0	0	7	2	0	0	0	19	304	BE
BG	0	45	0	2	0	4	44	3	24	0	1	0	0	0	0	0	69	436	BG
CS	0	7	3	8	7	0	18	40	16	0	3	6	1	0	0	0	88	1240	CS
DK	0	0	1	5	0	0	1	76	0	0	2	7	2	0	0	0	23	269	DK
FI	0	2	1	86	0	0	104	66	1	0	14	8	2	0	0	0	133	801	FI
FR	10	1	126	3	23	0	2	364	14	1	1	43	43	0	0	0	325	2703	FR
DD	0	1	3	7	3	0	6	77	2	0	4	11	2	0	0	0	66	1062	DD
DE	2	2	15	7	36	0	7	251	4	0	4	33	9	0	0	0	162	2694	DE
GR	0	16	1	1	0	4	20	2	11	1	0	0	0	0	0	0	78	387	GR
HU	0	18	1	2	2	0	16	9	42	0	1	1	0	0	0	0	58	587	HU
IS	0	0	1	0	0	0	0	18	0	0	0	1	1	0	0	0	36	70	IS
IE	0	0	3	0	0	0	0	55	0	0	0	3	8	0	0	0	40	176	IE
IT	2	7	27	2	27	0	5	38	49	4	1	5	4	0	0	0	209	1505	IT
LU	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	21	LU
NL	0	0	2	1	0	0	0	93	0	0	0	11	2	0	0	0	23	371	NL
NO	0	1	2	37	1	0	12	283	1	0	5	19	9	0	0	0	194	949	NO
PL	0	10	4	35	8	0	65	130	17	0	13	17	3	0	0	0	192	2512	PL
PT	35	0	33	0	0	0	0	5	0	1	0	0	20	0	0	0	49	151	PT
RO	0	160	1	4	1	5	126	14	59	0	1	2	0	0	0	0	133	1069	RO
ES	62	1	404	1	1	0	0	61	4	6	0	6	44	3	0	0	255	1065	ES
SE	0	2	2	153	1	0	46	193	2	0	17	21	5	0	0	0	175	1272	SE
CH	1	0	8	1	36	0	0	28	2	0	0	3	2	0	0	0	35	413	CH
TR	0	21	1	2	0	75	121	5	8	1	1	1	0	0	0	0	281	714	TR
SU	1	118	7	230	9	21	4182	349	59	0	60	39	7	0	0	0	2309	10920	SU
GB	1	0	8	3	1	0	5	733	0	0	1	24	24	0	0	0	116	1205	GB
YU	0	44	6	4	4	1	26	14	199	1	2	2	1	0	0	0	178	1339	YU
REM	2	1	31	0	2	1	1	10	4	38	0	2	3	1	0	0	376	627	REM
BAS	0	3	4	124	2	0	78	198	4	0	27	23	4	0	0	0	171	1646	BAS
NOS	2	0	15	18	3	0	7	1064	1	0	5	69	35	0	0	0	269	2421	NOS
ATL	34	1	183	57	3	0	120	1006	1	0	8	63	263	0	0	0	2016	4973	ATL
MED	7	34	130	3	12	18	45	63	87	25	1	9	10	1	0	0	653	2691	MED
BLS	0	27	0	3	0	18	179	8	8	0	1	1	0	0	0	0	134	548	BLS
SUM	162	530	1029	804	202	148	5246	5353	644	81	175	441	509	6	0	0	8962	48093	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C13 : Budget of Oxidised Nitrogen in 1990 (Unit: 100 tonnes as N)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	1	1	0	5	3	0	0	3	1	3	18	2	0	0	19	0	0	0	2	AL
AT	0	46	17	1	65	3	0	94	29	217	0	8	0	1	102	2	20	1	35	AT
BE	0	0	27	0	4	1	0	67	4	45	0	0	0	2	1	1	21	0	3	BE
BG	1	4	1	78	20	1	0	7	8	20	45	15	0	0	21	0	3	0	22	BG
CS	0	29	23	2	227	7	1	76	85	284	2	36	0	1	38	2	33	1	106	CS
DK	0	0	9	0	4	20	1	20	8	53	0	0	0	2	1	0	18	3	6	DK
FI	0	2	6	0	16	25	118	17	18	55	0	2	0	2	4	0	14	17	41	FI
FR	0	6	76	0	36	6	0	864	31	306	0	3	0	10	110	6	79	1	29	FR
DD	0	2	37	0	71	15	1	88	103	356	0	1	0	3	7	3	60	3	33	DD
DE	0	13	119	0	85	16	1	388	80	886	0	3	0	10	42	9	169	5	49	DE
GR	1	2	2	37	9	1	0	9	3	11	130	6	0	0	29	0	2	0	11	GR
HU	0	24	6	3	67	2	1	26	19	69	2	63	0	0	63	1	8	0	43	HU
IS	0	0	1	0	1	1	0	3	0	6	0	0	2	1	0	0	3	1	1	IS
IE	0	0	4	0	2	1	0	10	2	12	0	0	0	18	0	0	6	0	0	IE
IT	0	24	16	4	52	2	0	207	23	136	16	17	0	1	617	1	18	1	33	IT
LU	0	0	1	0	0	0	0	7	0	4	0	0	0	0	0	0	1	0	0	LU
NL	0	0	27	0	4	1	0	46	5	64	0	0	0	3	1	0	54	1	3	NL
NO	0	1	21	0	16	36	14	60	21	114	0	1	0	10	2	1	47	59	23	NO
PL	0	19	52	3	269	47	8	124	240	539	1	30	0	5	32	3	94	8	512	PL
PT	0	0	1	0	0	0	0	9	0	5	0	0	0	0	2	0	2	0	0	PT
RO	0	12	6	30	82	4	2	22	28	71	17	60	0	0	44	0	10	1	81	RO
ES	0	1	12	0	5	3	0	134	7	51	0	1	0	2	29	1	15	0	5	ES
SE	0	2	22	0	36	83	54	52	49	191	0	2	0	6	3	1	50	52	66	SE
CH	0	3	8	0	9	0	0	109	5	69	0	0	0	1	56	1	10	0	6	CH
TR	0	3	2	17	15	1	0	8	6	20	59	8	0	0	9	0	2	0	23	TR
SU	0	44	97	47	444	155	240	237	312	870	39	109	0	12	82	5	179	48	1048	SU
GB	0	0	13	0	8	7	0	52	11	56	0	0	0	36	1	0	24	3	6	GB
YU	1	37	10	36	83	3	1	67	29	108	32	61	0	1	278	1	12	1	58	YU
REM	0	3	4	4	12	1	0	52	6	23	27	4	0	1	66	0	5	0	6	REM
BAS	0	3	37	0	46	98	60	83	83	313	0	4	0	8	7	1	83	23	112	BAS
NOS	0	2	67	0	26	44	3	204	38	254	0	1	1	38	4	1	146	28	25	NOS
ATL	0	3	66	0	32	43	55	277	44	288	0	3	9	82	10	2	108	91	44	ATL
MED	2	27	25	44	86	6	1	300	38	161	259	33	0	3	630	2	33	1	65	MED
BLS	0	3	2	15	18	2	1	6	8	21	20	8	0	0	8	0	3	0	29	BLS
SUM	7	315	817	327	1854	635	563	3731	1346	5681	668	484	13	262	2317	45	1330	351	2528	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	2	1	0	0	0	2	1	7	0	0	0	0	0	0	0	20	94	AL
AT	0	1	4	2	21	0	6	34	14	0	1	5	2	0	0	0	64	796	AT
BE	0	0	2	0	0	0	1	64	0	0	0	7	3	0	0	0	21	278	BE
BG	0	45	1	1	1	2	28	7	23	0	0	1	0	0	0	0	61	415	BG
CS	0	8	2	5	7	0	12	54	20	0	2	7	2	0	0	0	85	1157	CS
DK	0	0	1	6	0	0	2	88	0	0	2	7	2	0	0	0	26	282	DK
FI	0	1	1	67	1	0	99	53	2	0	12	5	2	0	0	0	131	713	FI
FR	8	1	112	3	20	0	5	209	8	1	1	32	47	0	0	0	299	2309	FR
DD	0	1	2	6	3	0	9	99	1	0	3	13	2	0	0	0	65	985	DD
DE	1	1	12	7	31	0	12	307	3	0	3	35	10	0	0	0	164	2460	DE
GR	0	16	2	0	0	4	18	6	11	2	0	0	0	0	0	0	86	399	GR
HU	0	13	2	1	3	0	8	12	43	0	1	2	1	0	0	0	54	536	HU
IS	0	0	0	1	0	0	0	16	0	0	0	1	1	0	0	0	35	75	IS
IE	0	0	2	0	0	0	0	40	0	0	0	2	8	0	0	0	39	147	IE
IT	2	5	31	2	32	0	6	31	48	4	1	5	5	0	0	0	219	1559	IT
LU	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	18	LU
NL	0	0	1	1	0	0	1	122	0	0	0	10	3	0	0	0	25	374	NL
NO	1	2	6	41	1	0	19	280	1	0	6	22	9	0	0	0	214	1027	NO
PL	0	11	3	33	6	0	61	189	18	0	13	21	4	0	0	0	204	2551	PL
PT	31	0	30	0	0	0	0	8	0	0	0	1	17	0	0	0	44	153	PT
RO	0	135	1	3	1	2	67	17	55	0	1	2	1	0	0	0	116	871	RO
ES	56	0	371	1	2	0	0	61	3	3	1	5	45	2	0	0	218	1035	ES
SE	0	2	3	157	1	0	67	227	2	0	18	21	6	0	0	0	216	1390	SE
CH	0	0	6	0	34	0	1	18	2	0	0	3	2	0	0	0	33	376	CH
TR	0	20	1	1	0	61	131	6	7	1	0	1	0	0	0	0	247	652	TR
SU	1	147	8	225	12	27	4470	432	68	0	65	47	11	0	0	0	2499	11980	SU
GB	1	0	7	4	1	0	2	594	0	0	1	18	24	0	0	0	115	986	GB
YU	0	31	9	2	8	1	16	23	165	2	1	3	2	0	0	0	176	1257	YU
REM	3	3	38	1	2	1	1	21	8	40	0	2	4	1	0	0	391	730	REM
BAS	0	2	3	125	2	0	83	264	3	0	28	27	6	0	0	0	188	1693	BAS
NOS	3	0	18	25	2	0	8	1186	1	0	6	68	37	0	0	0	297	2533	NOS
ATL	29	2	145	59	3	0	128	900	2	0	9	54	245	0	0	0	2122	4856	ATL
MED	8	31	144	4	15	18	43	75	86	26	1	8	13	1	0	0	680	2869	MED
BLS	0	26	0	2	0	15	174	6	6	0	1	1	0	0	0	0	118	494	BLS
SUM	148	508	968	786	210	131	5482	5451	606	81	176	440	513	6	0	0	9274	48053	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C14 : Budget of Oxidised Nitrogen in 1991 (Unit: 100 tonnes as N)

NOTE : For the year 1991 and later years East and West Germany are put together with the country code DE*

NOTE : For the year 1991 and later years SU are splitted up in 7 new countries (BY, UA, MD, RU, EE, LV, LT)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	
AL	1	1	1	4	3	0	0	5	5	23	2	0	0	19	0	1	0	3	0	3	0	AL
AT	0	40	14	1	69	7	1	89	258	1	10	0	1	94	2	18	1	38	0	3	2	AT
BE	0	0	32	0	4	1	0	65	57	0	0	0	1	1	1	27	0	3	0	0	2	BE
BG	1	3	1	54	17	2	1	5	25	40	13	0	0	15	0	4	1	20	0	48	0	BG
CS	0	23	18	1	189	9	2	71	298	1	34	0	1	29	1	23	2	116	0	9	2	CS
DK	0	1	5	0	8	19	1	13	45	0	1	0	2	1	0	14	3	11	0	0	0	DK
FI	0	1	7	0	23	27	127	17	102	0	2	0	1	1	0	17	19	58	0	1	1	FI
FR	0	9	82	0	41	6	1	833	343	0	7	0	9	132	6	73	2	22	8	2	107	FR
DE*	0	20	131	0	166	35	4	449	1345	0	9	0	8	44	9	203	9	84	1	2	14	DE*
GR	1	2	1	28	9	1	0	8	13	157	7	0	0	22	0	2	0	12	0	20	1	GR
HU	0	18	5	3	59	3	1	20	79	3	62	0	0	39	0	7	1	51	0	18	1	HU
IS	0	0	1	0	0	1	0	4	6	0	0	2	1	0	0	3	1	0	0	0	0	IS
IE	0	0	2	0	2	1	0	12	15	0	0	0	18	0	0	4	0	1	0	0	2	IE
IT	0	26	13	4	49	5	1	186	167	18	21	0	1	620	1	20	1	34	2	9	28	IT
LU	0	0	1	0	0	0	0	6	4	0	0	0	0	0	0	1	0	0	0	0	0	LU
NL	0	1	26	0	4	2	0	41	89	0	0	0	2	1	0	58	1	3	0	0	1	NL
NO	0	1	15	0	21	34	11	27	135	0	2	0	8	1	0	36	66	40	0	1	1	NO
PL	0	16	40	2	209	46	10	114	595	1	28	0	3	28	2	69	8	465	0	15	3	PL
PT	0	0	0	0	0	0	0	5	3	0	0	0	0	2	0	0	0	0	31	0	27	PT
RO	0	7	3	24	61	5	2	11	78	22	50	0	0	37	0	8	1	80	0	148	1	RO
ES	0	2	9	0	9	2	0	115	53	0	1	0	3	40	1	12	1	5	55	0	359	ES
SE	0	3	20	0	23	76	50	39	193	0	3	0	6	1	1	55	56	53	0	2	0	SE
CH	0	4	9	0	9	1	0	93	85	0	2	0	0	58	1	12	0	3	0	0	5	CH
TR	0	2	0	16	10	1	1	4	14	84	8	0	0	10	0	1	0	18	0	23	0	TR
GB	0	1	20	0	10	6	1	89	98	0	1	0	30	2	1	36	3	12	0	1	7	GB
YU	2	35	11	26	93	6	1	46	160	41	74	0	1	215	1	18	1	86	0	37	4	YU
BY	0	4	8	2	41	17	10	23	124	3	10	0	1	9	0	15	4	142	0	10	0	BY
UA	0	9	7	13	84	16	13	26	149	20	40	0	1	29	0	15	4	227	0	59	1	UA
MD	0	1	0	2	6	1	0	1	9	2	3	0	0	2	0	1	0	13	0	9	0	MD
RU	0	11	27	8	111	86	222	67	368	9	32	0	3	29	1	59	37	339	0	46	1	RU
EE	0	1	1	0	4	8	9	3	18	0	0	0	0	1	0	3	2	12	0	0	0	EE
LV	0	1	3	0	9	12	8	7	39	0	1	0	0	2	0	7	3	23	0	0	0	LV
LT	0	2	5	1	16	12	5	12	65	1	2	0	1	2	0	9	3	46	0	1	1	LT
REM	0	3	6	3	7	1	0	79	27	19	2	0	1	71	0	8	0	4	3	3	41	REM
BAS	0	3	32	0	42	101	59	70	338	0	4	0	5	5	1	68	25	110	0	3	3	BAS
NOS	0	6	80	0	53	48	5	242	427	0	5	1	34	9	2	169	30	55	1	1	13	NOS
ATL	0	7	94	0	64	59	49	412	597	0	6	9	102	14	3	170	101	82	30	1	182	ATL
MED	3	28	28	46	82	9	3	352	209	307	41	0	2	669	2	40	2	81	9	51	155	MED
BLS	0	3	1	11	16	3	2	3	19	21	10	0	0	5	0	2	1	34	0	29	0	BLS
SUM	8	294	762	251	1622	670	602	3662	6652	776	491	14	247	2259	39	1288	392	2388	144	557	967	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	

Emitters

Receivers	SE	CH	TR	GB	YU	BY	UA	MD	RU	EE	LV	LT	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	0	0	2	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	25	110	AL
AT	4	21	0	26	15	2	3	0	1	0	0	1	0	1	5	2	0	0	0	66	792	AT
BE	1	1	0	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	BE
BG	1	0	3	6	24	4	35	3	10	0	0	1	0	0	1	0	0	0	0	67	406	BG
CS	7	6	0	41	17	5	9	1	4	1	1	2	0	2	6	1	0	0	0	18	273	BE
DK	6	0	0	73	0	1	1	0	2	0	0	0	0	2	6	1	0	0	0	83	1015	CS
FI	77	0	0	56	1	10	7	0	46	11	5	6	0	14	7	1	0	0	0	22	239	DK
FR	4	24	0	258	13	2	2	0	0	0	0	0	1	1	33	40	0	0	0	127	773	FI
DE*	14	29	0	312	6	4	5	0	3	0	0	0	2	0	6	44	11	0	0	0	282	2344
GR	1	0	7	5	12	3	21	3	7	0	0	1	1	0	0	0	0	0	0	0	221	3193
HU	2	2	0	12	37	3	13	1	1	0	0	1	0	1	2	0	0	0	0	0	96	442
IS	0	0	0	18	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	50	494
IE	1	0	0	65	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	35	78
IT	3	25	0	44	55	2	5	1	1	0	0	0	0	0	3	8	0	0	0	0	33	167
LU	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	18
NL	1	1	0	87	0	0	0	0	0	0	0	0	0	0	10	2	0	0	0	0	21	354
NO	41	0	0	227	1	4	3	0	9	1	1	1	0	6	16	6	0	0	0	0	167	885
PL	33	5	0	118	15	24	24	1	20	3	3	9	0	12	16	3	0	0	0	0	192	2133
PT	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	46	138
RO	4	1	2	12	51	11	88	10	26	1	1	2	0	1	2	0	0	0	0	0	119	872
ES	1	3	0	77	4	0	0	0	0	0	0	0	4	0	6	42	3	0	0	0	205	1013
SE	151	1	0	198	1	8	9	1	24	5	3	5	0	16	21	4	0	0	0	0	167	1193
CH	0	28	0	29	2	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	34	383
TR	1	0	92	4	8	6	92	4	46	0	0	1	0	0	0	0	0	0	0	0	340	792
GB	6	1	0	712	0	2	4	0	1	0	0	1	0	1	24	21	0	0	0	0	112	1205
YU	4	4	1	27	168	4	16	1	2	0	1	2	2	2	4	1	0	0	0	0	181	1278
BY	20	1	2	29	7	78	45	3	48	3	5	15	0	6	4	1	0	0	0	0	107	797
UA	15	2	12	34	26	68	531	21	231	3	4	9	0	5	5	1	0	0	0	0	330	2011
MD	1	0	0	2	2	3	26	5	10	0	0	0	0	0	0	0	0	0	0	0	18	118
RU	150	4	15	156	19	202	606	14	2454	43	31	51	0	40	20	4	0	0	0	0	2023	7288
EE	13	0	0	14	0	2	1	0	4	4	2	2	0	4	2	0	0	0	0	0	18	131
LV	17	0	0	19	1	6	3	0	6	3	5	6	0	5	2	0	0	0	0	0	32	224
LT	15	0	0	19	1	8	5	0	8	1	3	10	0	5	3	1	0	0	0	0	38	302
REM	1	2	1	28	7	0	2	0	0	0	0	0	38	0	3	5	1	0	0	0	405	772
BAS	132	1	0	216	2	13	12	1	30	11	7	9	0	29	25	4	0	0	0	0	171	1532
NOS	27	3	0	1115	3	5	6	0	5	1	1	2	0	7	73	32	0	0	0	0	264	2722
ATL	61	8	0	1247	3	9	8	1	82	4	3	4	0	11	77	285	0	0	0	0	2237	6021
MED	7	13	26	113	105	12	63	8	20	1	1	3	28	2	12	13	1	0	0	0	793	3342
BLS	3	0	25	9	7	10	170	7	116	1	1	2	0	1	1	0	0	0	0	0	199	711
SUM	825	189	185	5466	621	511	1817	89	3225	99	80	148	82	182	449	516	6	0	0	9560	48136	SUM
	SE	CH	TR	GB	YU	BY	UA	MD	RU	EE	LV	LT	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C15 : Budget of Oxidised Nitrogen in 1992 (Unit: 100 tonnes as N)

PROVISIONAL ESTIMATE

NOTE : For the year 1991 and later years East and West Germany are put together with the country code DE*

NOTE : For the year 1991 and later years SU are splitted up in 7 new countries (BY, UA, MD, RU, EE, LV, LT)

NOTE : For the year 1992 and later years YU are splitted up in 4 new countries (SI, HR, BA, YU*)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	
AL	1	1	0	4	3	0	0	3	6	20	2	0	0	15	0	1	0	2	0	3	1	0	0	AL
AT	0	35	16	0	45	3	0	121	203	1	8	0	1	117	2	20	0	25	0	5	4	1	21	AT
BE	0	1	33	0	5	1	0	73	68	0	0	0	2	1	1	25	0	3	0	0	4	0	0	BE
BG	0	4	3	47	20	1	1	11	35	25	15	0	0	14	0	4	0	18	0	38	1	1	0	BG
CS	0	26	21	1	193	7	1	78	315	3	31	0	2	37	2	30	1	98	0	7	3	4	7	CS
DK	0	0	5	0	4	18	0	13	43	0	0	0	2	0	0	12	3	7	0	0	1	4	0	DK
FI	0	1	7	0	17	26	112	19	105	0	2	0	2	2	0	16	20	48	0	2	1	75	0	FI
FR	0	10	79	0	43	8	0	911	380	1	5	0	10	153	6	73	2	26	8	2	120	3	27	FR
DE*	0	23	147	0	179	25	2	511	1399	1	10	0	12	81	10	223	5	95	1	3	20	8	37	DE*
GR	1	3	2	27	13	1	1	11	27	127	8	0	0	26	0	2	0	12	0	16	2	1	1	GR
HU	0	19	6	2	52	2	0	28	81	2	51	0	0	39	0	9	1	40	0	14	1	2	3	HU
IS	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	1	1	1	0	0	0	0	0	IS
IE	0	0	2	0	2	0	0	9	8	0	0	0	20	1	0	4	0	1	0	0	3	0	0	IE
IT	0	18	9	5	35	4	0	182	105	16	15	0	1	653	1	10	1	33	2	7	34	3	23	IT
LU	0	0	1	0	0	0	0	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LU
NL	0	0	29	0	6	1	0	48	96	0	0	0	3	1	0	60	1	5	0	0	2	1	0	NL
NO	0	2	13	0	16	31	11	31	116	0	2	0	9	1	1	32	64	23	0	0	3	37	0	NO
PL	0	16	46	2	215	46	5	123	653	3	25	0	6	26	2	84	8	455	0	8	6	31	6	PL
PT	0	0	1	0	1	0	0	8	4	0	0	0	0	2	0	1	0	0	29	0	27	0	0	PT
RO	0	11	10	17	76	4	2	34	118	16	54	0	1	34	1	14	1	77	0	120	2	3	2	RO
ES	0	2	17	0	13	2	0	154	80	1	3	0	4	39	1	20	1	9	54	1	372	1	4	ES
SE	0	2	24	0	27	78	41	48	213	0	2	0	5	3	1	48	55	53	0	1	2	138	1	SE
CH	0	3	6	0	6	1	0	105	47	0	1	0	1	85	1	5	0	3	0	0	7	0	31	CH
TR	0	5	4	20	25	3	2	16	54	82	11	0	0	20	0	6	1	28	0	30	1	3	1	TR
GB	0	1	22	0	17	5	0	82	93	0	1	0	34	1	1	39	4	13	1	0	7	4	0	GB
BY	0	6	6	2	33	18	12	23	93	2	11	0	1	16	0	16	3	121	0	12	1	19	2	BY
UA	0	10	19	16	114	19	13	49	250	17	41	0	2	29	1	37	5	269	0	57	2	23	3	UA
MD	0	1	1	2	8	1	0	3	15	1	3	0	0	2	0	2	0	15	0	7	0	1	0	MD
RU	0	15	32	23	126	91	232	87	401	24	39	0	4	26	1	64	40	381	0	69	6	164	4	RU
EE	0	1	1	0	5	6	9	4	22	0	1	0	0	0	0	3	2	13	0	1	0	11	0	EE
LV	0	1	2	0	10	10	9	7	34	0	1	0	1	1	0	5	2	26	0	1	0	14	0	LV
LT	0	1	4	0	13	12	5	11	54	0	2	0	1	2	0	9	2	50	0	2	1	13	1	LT
SI	0	8	2	0	8	1	0	14	28	1	4	0	0	52	0	3	0	8	0	2	1	0	2	SI
HR	0	10	3	1	18	1	0	19	45	3	12	0	0	71	0	5	0	18	0	3	2	1	2	HR
BA	0	7	3	2	18	1	0	17	42	3	12	0	0	58	0	4	0	16	0	4	1	1	2	BA
YU*	1	11	4	22	34	1	0	24	76	29	29	0	0	58	0	9	0	25	0	25	2	1	2	YU*
REM	0	4	5	3	11	1	0	63	30	20	3	0	1	83	0	5	0	10	2	2	37	1	2	REM
BAS	0	3	32	0	49	102	54	80	363	0	5	0	6	4	1	68	24	119	1	3	4	123	2	BAS
NOS	0	4	74	0	42	46	3	230	374	0	3	1	42	7	1	170	33	47	2	1	16	24	3	NOS
ATL	0	6	62	0	54	48	60	354	391	0	4	10	92	16	2	109	112	71	34	2	199	60	7	ATL
MED	3	28	23	46	80	9	2	357	224	324	39	0	3	729	2	29	2	83	7	41	165	9	17	MED
BLS	0	5	6	18	36	5	4	17	76	27	16	0	1	16	0	10	2	57	0	46	1	7	1	BLS
SUM	9	305	785	262	1674	641	584	3989	6779	749	476	14	268	2521	41	1287	398	2403	145	537	1061	793	217	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	

Emitters

Receivers	TR	GB	BY	UA	MD	RU	EE	LV	LT	SI	HR	BA	YU*	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	1	0	2	0	1	0	0	0	0	2	1	3	0	0	0	0	0	0	0	18	93	AL
AT	0	52	1	2	0	1	0	0	0	7	5	1	2	0	1	5	2	0	0	0	67	777	AT
BE	0	61	0	0	0	0	0	0	0	0	0	0	0	0	0	8	3	0	0	0	18	308	BE
BG	2	6	3	23	3	6	0	0	0	1	4	2	19	0	0	1	0	0	0	0	57	366	BG
CS	0	64	3	8	0	2	0	0	1	5	7	1	5	0	1	8	2	0	0	0	77	1050	CS
DK	0	66	1	1	0	0	0	0	0	0	0	0	0	0	0	2	6	2	0	0	19	212	DK
FI	0	58	8	10	0	39	11	5	5	0	0	0	0	0	13	7	2	0	0	0	119	736	FI
FR	0	233	1	1	0	0	0	0	0	3	4	1	2	1	2	33	40	0	0	0	252	2441	FR
DE*	0	425	4	5	0	2	0	0	2	3	4	0	2	0	4	45	15	0	0	0	217	3525	DE*
GR	6	4	2	19	2	6	0	0	0	1	4	2	11	1	0	1	0	0	0	0	81	420	GR
HU	0	16	2	7	0	1	0	0	0	6	13	3	11	0	1	2	1	0	0	0	45	462	HU
IS	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	27	45	IS
IE	0	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	0	0	33	142	IE
IT	1	33	1	5	1	1	0	0	0	11	19	5	8	4	1	3	4	0	0	0	204	1461	IT
LU	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	19	LU
NL	0	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	3	0	0	21	404	NL
NO	0	234	1	2	0	5	1	1	1	0	0	0	0	0	0	5	17	7	0	0	160	828	NO
PL	0	203	18	20	1	11	1	2	6	3	6	1	5	0	11	22	5	0	0	0	178	2259	PL
PT	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	40	133	PT
RO	1	23	8	59	9	15	0	1	2	3	8	3	29	0	1	3	1	0	0	0	111	875	RO
ES	0	61	0	0	0	0	0	0	0	1	2	1	1	4	0	7	41	2	0	0	206	1106	ES
SE	0	185	5	4	0	13	5	3	4	0	1	0	1	0	16	21	5	0	0	0	159	1165	SE
CH	0	25	0	0	0	0	0	0	0	1	1	0	0	0	0	2	2	0	0	0	35	371	CH
TR	85	9	7	91	5	41	0	0	1	1	3	1	9	0	1	1	0	0	0	0	306	876	TR
GB	0	706	1	1	0	0	0	0	0	0	0	0	0	0	1	26	23	0	0	0	104	1188	GB
BY	1	45	69	45	3	37	4	5	14	2	3	1	4	0	6	5	1	0	0	0	102	746	BY
UA	7	76	68	457	20	169	4	5	12	4	8	3	16	0	7	10	2	0	0	0	299	2141	UA
MD	0	5	3	20	5	4	0	0	0	0	1	0	1	0	0	1	0	0	0	0	17	122	MD
RU	25	189	218	738	19	2736	46	32	53	4	7	2	19	0	42	23	6	0	0	0	2148	8142	RU
EE	0	11	2	2	0	5	3	2	2	0	0	0	0	0	3	1	0	0	0	0	17	128	EE
LV	0	23	6	4	0	7	3	4	5	0	0	0	1	0	4	2	1	0	0	0	30	217	LV
LT	0	31	8	4	0	6	1	3	10	0	0	0	1	0	4	3	1	0	0	0	36	293	LT
SI	0	5	0	1	0	0	0	0	0	7	6	1	2	0	0	1	0	0	0	0	19	179	SI
HR	0	8	1	2	0	0	0	0	0	6	17	5	6	1	0	1	0	0	0	0	37	301	HR
BA	0	9	1	2	0	0	0	0	0	4	13	9	10	1	0	1	0	0	0	0	39	281	BA
YU*	0	13	2	8	1	3	0	0	0	4	13	9	61	1	0	2	0	0	0	0	76	550	YU*
REM	2	16	0	3	0	0	0	0	0	2	4	1	3	42	0	2	4	1	0	0	457	822	REM
BAS	0	227	11	10	1	23	10	7	9	1	1	0	2	0	28	25	6	0	0	0	167	1568	BAS
NOS	0	1267	2	2	0	2	1	1	2	0	1	0	0	0	7	80	39	0	0	0	276	2803	NOS
ATL	0	952	10	9	0	103	5	3	5	1	1	0	1	0	11	60	282	0	0	0	2205	5343	ATL
MED	39	88	7	55	6	18	1	1	2	14	38	14	35	32	2	9	13	1	0	0	857	3457	MED
BLS	27	17	14	174	10	101	1	1	3	1	4	1	10	0	2	2	0	0	0	0	230	950	BLS
SUM	200	5624	489	1796	89	3370	98	77	143	98	203	68	280	90	177	459	536	6	0	0	9562	49303	SUM
	TR	GB	BY	UA	MD	RU	EE	LV	LT	SI	HR	BA	YU*	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C16 : Budget of Reduced Nitrogen in 1985 (Unit: 100 tonnes as N)

VERY FEW COUNTRIES HAVE GIVEN OFFICIAL EMISSION DATA.

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	97	0	0	2	1	0	0	3	1	2	8	2	0	0	6	0	0	0	1	AL
AT	0	315	16	1	48	3	0	71	40	250	0	18	0	4	68	2	22	0	19	AT
BE	0	0	357	0	1	1	0	63	5	35	0	0	0	3	1	2	43	0	2	BE
BG	4	1	1	425	6	1	0	3	6	6	10	15	0	0	6	0	2	0	10	BG
CS	0	27	11	2	748	8	1	35	139	187	0	57	0	4	14	1	27	0	119	CS
DK	0	0	4	0	2	521	0	8	24	56	0	1	0	3	0	0	16	1	7	DK
FI	0	1	2	0	5	14	193	5	25	27	0	1	0	2	1	0	8	4	40	FI
FR	0	6	82	1	13	8	0	3655	47	173	0	6	0	30	69	6	66	0	21	FR
DD	0	3	19	0	18	21	0	41	1495	275	0	3	0	5	2	1	62	1	51	DD
DE	0	12	112	0	31	30	0	286	200	3656	0	4	0	21	22	9	311	1	43	DE
GR	9	1	0	22	4	1	0	4	4	4	234	7	0	0	7	0	1	0	6	GR
HU	1	14	3	3	45	2	0	12	20	33	1	603	0	1	20	0	6	0	30	HU
IS	0	0	0	0	0	0	0	1	0	0	0	0	10	2	0	0	0	1	0	IS
IE	0	0	2	0	0	1	0	10	3	7	0	0	0	654	0	0	3	0	1	IE
IT	2	15	8	2	19	2	0	122	26	98	5	17	0	3	1583	1	11	0	20	IT
LU	0	0	2	0	0	0	0	6	1	3	0	0	0	0	0	17	1	0	0	LU
NL	0	0	44	0	1	3	0	36	8	88	0	0	0	6	1	0	863	0	3	NL
NO	0	1	8	0	4	34	4	21	28	51	0	3	0	13	0	0	22	158	24	NO
PL	0	8	13	2	90	37	2	42	275	181	0	32	0	5	8	1	40	2	2155	PL
PT	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	PT
RO	2	5	2	50	33	6	0	10	31	33	3	106	0	1	20	0	10	0	80	RO
ES	0	1	4	0	2	1	0	112	6	16	0	1	0	3	8	0	6	0	4	ES
SE	0	1	11	0	10	81	23	21	63	92	0	4	0	7	1	0	32	21	65	SE
CH	0	2	6	0	1	0	0	96	7	62	0	1	0	2	55	1	4	0	2	CH
TR	1	1	1	26	8	2	0	2	10	9	14	13	0	0	6	0	2	0	20	TR
SU	2	18	25	32	125	72	47	77	255	258	6	128	0	10	40	1	74	8	845	SU
GB	0	1	16	0	3	10	0	70	21	47	0	1	0	129	1	0	35	1	11	GB
YU	20	26	6	24	45	3	0	40	38	67	15	104	0	2	107	0	13	0	40	YU
REM	1	1	3	2	2	1	0	49	5	10	2	3	0	1	19	0	3	0	3	REM
BAS	0	4	16	1	26	159	33	39	193	240	0	12	0	7	4	1	59	6	197	BAS
NOS	0	2	81	1	11	131	1	292	80	272	0	5	0	81	3	1	226	21	38	NOS
ATL	0	2	42	0	10	40	12	445	64	149	0	3	4	322	3	2	85	30	36	ATL
MED	32	16	16	29	41	6	0	322	52	102	62	48	0	6	391	1	23	0	55	MED
BLS	1	1	1	28	8	2	0	2	11	12	5	16	0	0	4	0	2	0	34	BLS
SUM	173	486	914	654	1364	1199	320	6008	3183	6503	367	1214	15	1327	2469	49	2085	257	3982	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	3	0	0	0	1	3	1	9	0	0	0	0	0	0	0	18	161	AL
AT	0	6	3	1	16	0	7	19	15	0	0	0	0	0	0	0	46	991	AT
BE	0	0	2	0	0	0	1	26	0	0	0	0	0	0	0	0	14	557	BE
BG	0	91	0	0	0	7	44	1	29	0	0	0	0	0	0	0	48	717	BG
CS	0	19	2	2	3	0	38	18	13	0	0	0	0	0	0	0	69	1545	CS
DK	0	0	0	6	0	0	4	18	0	0	0	0	0	0	0	0	15	689	DK
FI	0	1	0	13	0	0	181	10	0	0	0	0	0	0	0	0	109	641	FI
FR	6	5	81	1	13	0	10	126	6	1	0	0	0	0	0	0	232	4666	FR
DD	0	2	2	3	1	0	13	26	1	0	0	0	0	0	0	0	48	2094	DD
DE	1	3	11	3	30	0	13	113	4	0	0	0	0	0	0	0	125	5043	DE
GR	0	21	1	0	0	12	18	2	13	1	0	0	0	0	0	0	64	438	GR
HU	0	39	1	0	1	0	28	4	36	0	0	0	0	0	0	0	38	943	HU
IS	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	23	48	IS
IE	0	0	0	0	0	0	1	36	0	0	0	0	0	0	0	0	24	744	IE
IT	0	6	9	1	24	3	12	14	31	3	0	0	0	0	0	0	141	2178	IT
LU	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	32	LU
NL	0	0	1	0	0	0	1	41	0	0	0	0	0	0	0	0	19	1117	NL
NO	0	3	1	15	0	0	36	49	0	0	0	0	0	0	0	0	117	594	NO
PL	0	22	4	11	2	0	160	26	9	0	0	0	0	0	0	0	131	3260	PL
PT	234	0	40	0	0	0	0	1	0	0	0	0	0	0	0	0	22	304	PT
RO	0	1489	1	2	1	5	232	6	53	0	0	0	0	0	0	0	118	2302	RO
ES	64	0	1304	0	1	0	1	14	1	2	0	0	0	0	0	0	89	1642	ES
SE	0	6	1	239	0	0	118	35	1	0	0	0	0	0	0	0	132	965	SE
CH	0	0	3	0	220	0	1	10	2	0	0	0	0	0	0	0	24	498	CH
TR	0	49	1	1	0	1185	113	2	9	1	0	0	0	0	0	0	256	1731	TR
SU	1	330	7	36	3	105	15502	57	50	1	0	0	0	0	0	0	1694	19809	SU
GB	0	1	3	2	0	0	10	1903	1	0	0	0	0	0	0	0	71	2337	GB
YU	0	46	4	1	3	6	55	10	854	1	0	0	0	0	0	0	136	1667	YU
REM	2	3	22	0	1	1	3	5	4	150	0	0	0	0	0	0	175	470	REM
BAS	0	8	2	61	2	0	302	43	3	0	0	0	0	0	0	0	167	1584	BAS
NOS	3	4	8	14	1	0	33	540	2	0	0	0	0	0	0	0	210	2063	NOS
ATL	51	3	131	12	1	0	162	434	1	0	0	0	0	0	0	0	1280	3327	ATL
MED	6	45	105	2	12	43	68	31	77	33	0	0	0	0	0	0	539	2162	MED
BLS	0	100	0	1	0	112	430	1	8	0	0	0	0	0	0	0	166	947	BLS
SUM	372	2306	1753	427	336	1482	17602	3631	1232	195	0	0	0	0	0	0	6360	68268	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C17 : Budget of Reduced Nitrogen in 1987 (Unit: 100 tonnes as N)

VERY FEW COUNTRIES HAVE GIVEN OFFICIAL EMISSION DATA.

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	98	0	0	2	1	0	0	1	1	1	6	2	0	0	6	0	0	0	1	AL
AT	0	332	11	1	50	3	0	64	36	236	0	20	0	2	79	1	19	0	19	AT
BE	0	0	380	0	1	2	0	72	4	37	0	0	0	3	0	2	51	0	1	BE
BG	3	1	0	441	4	0	0	1	2	5	11	12	0	0	6	0	1	0	6	BG
CS	0	35	11	1	769	5	0	40	122	189	0	64	0	2	19	1	25	0	95	CS
DK	0	1	3	0	2	541	0	8	28	63	0	1	0	2	1	0	14	1	10	DK
FI	0	1	2	0	4	10	195	3	14	19	0	3	0	1	1	0	6	3	33	FI
FR	0	4	88	0	10	6	0	3897	31	138	0	5	0	28	41	6	54	0	15	FR
DD	0	3	21	0	22	18	0	43	1602	317	0	3	0	4	3	1	70	0	47	DD
DE	0	15	106	0	36	29	0	274	206	3873	0	3	0	13	25	9	323	1	31	DE
GR	8	1	0	18	2	0	0	4	2	4	247	4	0	0	7	0	1	0	3	GR
HU	0	16	2	3	40	1	0	11	12	29	1	626	0	0	22	0	4	0	20	HU
IS	0	0	1	0	0	2	0	3	5	8	0	0	11	4	0	0	2	0	0	IS
IE	0	0	2	0	0	0	0	14	1	4	0	0	0	647	0	0	3	0	0	IE
IT	1	13	7	1	12	2	0	122	15	67	1	12	0	1	1585	1	10	0	16	IT
LU	0	0	2	0	0	0	0	6	0	3	0	0	0	0	0	18	1	0	0	LU
NL	0	0	53	0	1	3	0	38	7	107	0	0	0	4	0	0	918	0	2	NL
NO	0	1	4	0	4	42	5	8	23	37	0	2	0	9	1	0	13	158	20	NO
PL	0	14	18	2	116	44	1	53	322	229	1	46	0	3	16	1	51	1	2394	PL
PT	0	0	0	0	0	0	0	2	0	1	0	0	0	1	0	0	0	0	0	PT
RO	2	6	2	54	28	2	0	8	17	28	5	103	0	0	21	0	5	0	44	RO
ES	0	0	2	0	1	1	0	70	3	7	0	2	0	4	4	0	4	0	3	ES
SE	0	3	5	0	13	82	19	12	59	69	0	7	0	4	3	0	18	21	78	SE
CH	0	2	5	0	2	0	0	99	5	63	0	1	0	1	46	1	5	0	2	CH
TR	1	1	0	18	3	1	0	5	3	6	14	6	0	0	6	0	1	0	6	TR
SU	2	16	14	40	117	76	57	34	203	209	9	130	0	4	27	1	49	7	787	SU
GB	0	0	17	0	1	6	0	72	15	36	0	0	0	111	1	0	23	1	4	GB
YU	13	25	3	20	32	2	0	34	17	47	12	90	0	1	126	0	9	0	36	YU
REM	0	1	2	1	1	0	0	43	2	8	2	2	0	1	9	0	4	0	2	REM
BAS	0	4	13	0	20	183	33	25	192	214	0	11	0	5	3	0	49	7	210	BAS
NOS	0	3	76	0	12	165	3	283	111	367	0	3	0	55	5	1	252	19	46	NOS
ATL	0	2	35	0	8	30	9	435	43	104	0	2	4	337	4	1	56	25	29	ATL
MED	25	15	14	34	37	4	0	322	38	80	74	60	0	5	372	1	26	0	63	MED
BLS	1	2	1	30	9	2	0	4	10	17	8	15	0	0	6	0	2	0	25	BLS
SUM	156	515	899	665	1359	1262	325	6110	3150	6620	390	1234	16	1252	2445	49	2068	246	4047	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	2	0	0	0	0	3	0	8	0	0	0	0	0	0	0	18	153	AL
AT	0	4	1	0	17	0	5	11	13	0	0	0	0	0	0	0	46	972	AT
BE	0	0	1	0	0	0	0	24	0	0	0	0	0	0	0	0	14	594	BE
BG	0	77	0	0	0	6	50	0	23	0	0	0	0	0	0	0	49	702	BG
CS	0	16	1	1	4	0	29	10	14	0	0	0	0	0	0	0	64	1518	CS
DK	0	1	0	5	0	0	5	14	0	0	0	0	0	0	0	0	14	714	DK
FI	0	3	0	10	0	0	164	4	1	0	0	0	0	0	0	0	90	565	FI
FR	7	1	87	1	15	0	4	98	4	2	0	0	0	0	0	0	232	4771	FR
DD	0	1	1	2	2	0	9	24	1	0	0	0	0	0	0	0	46	2241	DD
DE	1	2	6	2	40	0	9	84	2	0	0	0	0	0	0	0	112	5202	DE
GR	0	14	1	0	0	12	20	1	12	1	0	0	0	0	0	0	73	434	GR
HU	0	43	1	0	1	0	17	2	39	0	0	0	0	0	0	0	45	938	HU
IS	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	32	77	IS
IE	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	23	731	IE
IT	1	4	14	0	23	0	8	9	20	5	0	0	0	0	0	0	153	2103	IT
LU	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	33	LU
NL	0	0	1	0	0	0	1	34	0	0	0	0	0	0	0	0	16	1185	NL
NO	0	1	0	17	1	0	28	41	0	0	0	0	0	0	0	0	108	526	NO
PL	1	24	2	8	2	1	182	24	13	0	0	0	0	0	0	0	138	3707	PL
PT	248	0	39	0	0	0	0	1	0	0	0	0	0	0	0	0	22	315	PT
RO	0	1499	1	1	1	6	194	2	47	0	0	0	0	0	0	0	114	2189	RO
ES	77	0	1388	0	0	0	0	12	2	3	0	0	0	0	0	0	101	1685	ES
SE	0	5	0	238	1	0	109	21	2	0	0	0	0	0	0	0	132	901	SE
CH	0	0	3	0	239	0	1	6	1	0	0	0	0	0	0	0	25	507	CH
TR	0	22	1	0	0	1388	123	0	6	1	0	0	0	0	0	0	292	1904	TR
SU	0	330	2	36	2	144	17991	29	45	0	0	0	0	0	0	0	2324	22688	SU
GB	1	0	2	1	1	0	2	1962	0	0	0	0	0	0	0	0	61	2318	GB
YU	0	40	4	1	4	2	28	4	846	2	0	0	0	0	0	0	150	1548	YU
REM	2	1	22	0	1	3	2	7	2	152	0	0	0	0	0	0	178	449	REM
BAS	0	9	1	65	1	0	350	35	3	0	0	0	0	0	0	0	168	1598	BAS
NOS	1	2	6	17	2	0	30	456	1	0	0	0	0	0	0	0	184	2098	NOS
ATL	45	1	113	11	2	0	101	409	1	0	0	0	0	0	0	0	873	2681	ATL
MED	7	49	117	1	10	81	106	28	87	45	0	0	0	0	0	0	748	2449	MED
BLS	0	74	0	1	0	153	495	1	11	0	0	0	0	0	0	0	248	1115	BLS
SUM	393	2227	1817	418	371	1797	20067	3397	1205	213	0	0	0	0	0	0	6894	71609	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C18 : Budget of Reduced Nitrogen in 1988 (Unit: 100 tonnes as N)

VERY FEW COUNTRIES HAVE GIVEN OFFICIAL EMISSION DATA.

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	94	0	0	1	1	0	0	2	1	2	4	2	0	0	7	0	0	0	1	AL
AT	0	325	8	1	49	4	0	53	40	249	0	19	0	2	68	1	18	0	16	AT
BE	0	0	375	0	1	1	0	77	3	33	0	0	0	3	0	2	50	0	2	BE
BG	3	1	0	426	5	0	0	2	4	5	12	14	0	0	7	0	1	0	7	BG
CS	0	30	8	1	741	6	0	30	132	174	0	56	0	1	15	1	21	0	84	CS
DK	0	0	5	0	2	521	0	10	28	73	0	1	0	3	0	0	21	1	13	DK
FI	0	1	3	0	5	13	203	6	23	35	0	3	0	1	1	0	11	3	35	FI
FR	0	3	90	0	6	5	0	3734	29	143	0	4	0	21	37	6	67	0	7	FR
DD	0	3	16	0	18	22	0	37	1498	284	0	3	0	3	3	1	53	1	36	DD
DE	0	14	98	0	30	33	0	257	171	3802	0	6	0	13	21	9	317	2	27	DE
GR	8	1	0	18	3	0	0	3	2	4	231	6	0	0	8	0	1	0	4	GR
HU	0	14	2	2	41	1	0	9	14	26	1	604	0	0	21	0	4	0	22	HU
IS	0	0	0	0	0	1	0	2	1	1	0	0	11	2	0	0	1	0	1	IS
IE	0	0	1	0	0	0	0	7	0	2	0	0	0	659	0	0	1	0	0	IE
IT	1	13	7	1	12	2	0	114	15	80	2	16	0	2	1540	1	10	0	9	IT
LU	0	0	2	0	0	0	0	6	0	3	0	0	0	0	0	18	1	0	0	LU
NL	0	0	51	0	1	2	0	40	5	84	0	0	0	4	0	0	887	0	3	NL
NO	0	1	10	0	5	45	3	19	37	69	0	2	0	9	0	0	31	159	32	NO
PL	0	13	17	3	105	43	2	44	308	213	0	32	0	3	13	1	53	2	2293	PL
PT	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	1	0	0	PT
RO	2	7	2	54	31	2	1	9	23	29	6	100	0	0	21	0	5	0	50	RO
ES	0	0	6	0	0	1	0	97	2	8	0	1	0	5	3	0	9	0	1	ES
SE	0	2	9	0	12	89	16	21	77	101	0	6	0	5	1	0	33	20	80	SE
CH	0	2	6	0	2	1	0	99	9	78	0	1	0	1	49	1	8	0	2	CH
TR	2	1	1	22	5	1	0	4	4	6	16	9	0	0	7	0	1	0	10	TR
SU	1	19	18	37	113	64	54	60	210	235	7	120	0	5	31	1	57	7	739	SU
GB	0	0	11	0	1	4	0	67	10	24	0	0	0	122	0	0	18	0	5	GB
YU	14	24	3	19	36	2	0	32	22	43	10	93	0	1	107	0	7	0	28	YU
REM	1	1	3	1	2	1	0	45	3	9	1	2	0	1	15	0	4	0	1	REM
BAS	0	4	14	1	20	158	28	33	179	234	0	9	0	6	3	1	54	5	188	BAS
NOS	0	1	80	0	8	141	1	308	76	273	0	1	0	63	1	1	225	18	42	NOS
ATL	0	1	27	0	4	33	10	381	32	69	0	1	6	329	1	1	46	27	26	ATL
MED	22	12	13	24	23	6	0	250	23	64	54	32	0	5	301	1	20	0	22	MED
BLS	1	1	1	21	7	1	0	2	6	8	4	10	0	0	3	0	1	0	24	BLS
SUM	150	493	888	631	1289	1203	321	5862	2989	6462	349	1151	17	1270	2286	47	2037	247	3812	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	2	0	0	0	0	2	0	9	0	0	0	0	0	0	0	17	148	AL
AT	0	4	2	1	17	0	5	10	11	0	0	0	0	0	0	0	45	948	AT
BE	0	0	1	0	0	0	1	21	0	0	0	0	0	0	0	0	15	586	BE
BG	0	88	0	0	0	6	60	0	26	0	0	0	0	0	0	0	54	722	BG
CS	0	14	1	1	4	0	22	10	10	0	0	0	0	0	0	0	56	1420	CS
DK	0	0	0	5	0	0	5	18	0	0	0	0	0	0	0	0	19	724	DK
FI	0	2	0	13	0	0	215	6	1	0	0	0	0	0	0	0	110	690	FI
FR	8	1	93	1	16	0	4	93	3	2	0	0	0	0	0	0	238	4611	FR
DD	0	1	1	2	2	0	9	18	1	0	0	0	0	0	0	0	43	2055	DD
DE	1	3	7	2	40	0	13	75	3	0	0	0	0	0	0	0	117	5060	DE
GR	0	14	1	0	0	7	19	1	14	1	0	0	0	0	0	0	66	412	GR
HU	0	33	0	0	1	0	13	2	31	0	0	0	0	0	0	0	36	878	HU
IS	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	20	47	IS
IE	0	0	1	0	0	0	0	32	0	0	0	0	0	0	0	0	17	720	IE
IT	1	4	15	1	23	0	5	12	24	4	0	0	0	0	0	0	152	2066	IT
LU	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	33	LU
NL	0	0	1	0	0	0	1	30	0	0	0	0	0	0	0	0	17	1126	NL
NO	0	0	0	16	0	0	29	54	0	0	0	0	0	0	0	0	107	629	NO
PL	0	22	2	9	3	1	152	27	9	0	0	0	0	0	0	0	139	3508	PL
PT	235	0	36	0	0	0	0	1	0	0	0	0	0	0	0	0	18	296	PT
RO	0	1484	1	1	1	8	232	3	44	0	0	0	0	0	0	0	125	2238	RO
ES	75	1	1338	0	0	0	0	15	1	4	0	0	0	0	0	0	98	1666	ES
SE	0	4	1	235	1	0	128	31	1	0	0	0	0	0	0	0	128	1003	SE
CH	0	1	5	0	239	0	1	7	1	0	0	0	0	0	0	0	29	543	CH
TR	0	31	1	0	0	1089	125	1	8	1	0	0	0	0	0	0	223	1568	TR
SU	0	287	3	36	4	111	17004	36	42	0	0	0	0	0	0	0	2071	21374	SU
GB	1	0	2	1	0	0	2	1920	0	0	0	0	0	0	0	0	56	2245	GB
YU	0	40	4	1	2	2	28	5	826	1	0	0	0	0	0	0	136	1485	YU
REM	2	1	22	0	1	0	1	7	3	155	0	0	0	0	0	0	164	447	REM
BAS	0	7	1	54	1	0	287	40	3	0	0	0	0	0	0	0	156	1487	BAS
NOS	1	0	5	11	1	0	17	476	0	0	0	0	0	0	0	0	194	1947	NOS
ATL	42	1	108	9	1	0	133	431	0	0	0	0	0	0	0	0	1198	2917	ATL
MED	8	32	107	1	7	30	44	25	60	33	0	0	0	0	0	0	493	1715	MED
BLS	0	64	0	0	0	87	439	1	6	0	0	0	0	0	0	0	161	850	BLS
SUM	378	2142	1758	402	367	1343	18997	3415	1136	203	0	0	0	0	0	0	6519	68163	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C19 : Budget of Reduced Nitrogen in 1989 (Unit: 100 tonnes as N)

VERY FEW COUNTRIES HAVE GIVEN OFFICIAL EMISSION DATA.

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	100	0	0	2	1	0	0	0	1	1	6	2	0	0	5	0	0	0	1	AL
AT	0	350	6	1	67	4	0	35	44	243	0	29	0	1	75	1	19	0	36	AT
BE	0	0	375	0	1	1	0	71	4	37	0	0	0	2	1	2	48	0	1	BE
BG	2	1	0	443	6	1	0	1	3	4	14	14	0	0	3	0	1	0	14	BG
CS	0	33	6	1	771	6	1	25	125	180	1	59	0	1	11	1	22	0	123	CS
DK	0	0	5	0	2	502	0	9	22	59	0	0	0	3	1	0	17	1	6	DK
FI	0	0	4	0	4	16	197	7	25	29	0	1	0	2	0	0	12	4	35	FI
FR	0	4	95	0	8	5	0	3706	26	150	0	6	0	19	58	7	60	0	9	FR
DD	0	3	13	0	20	23	0	32	1549	306	0	2	0	2	3	1	54	1	39	DD
DE	0	19	93	0	38	30	0	231	208	3911	0	6	0	7	25	9	301	1	26	DE
GR	8	1	0	21	2	0	0	2	2	3	240	5	0	0	5	0	1	0	4	GR
HU	0	16	1	4	54	1	0	6	13	27	1	641	0	0	20	0	4	0	37	HU
IS	0	0	0	0	0	0	0	1	0	1	0	0	12	1	0	0	1	0	0	IS
IE	0	0	2	0	1	1	0	11	2	5	0	0	0	666	0	0	4	0	1	IE
IT	1	16	7	3	13	2	0	98	14	80	3	15	0	1	1618	1	10	0	12	IT
LU	0	0	2	0	0	0	0	7	0	3	0	0	0	0	0	18	1	0	0	LU
NL	0	0	50	0	1	3	0	34	5	93	0	0	0	3	0	0	862	0	2	NL
NO	0	1	7	0	4	37	3	21	26	54	0	1	0	14	1	0	20	162	18	NO
PL	0	12	12	2	107	44	2	36	309	216	1	30	0	4	9	1	46	2	2384	PL
PT	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	PT
RO	2	5	1	57	30	2	1	5	19	22	8	110	0	0	12	0	4	0	57	RO
ES	0	0	4	0	0	1	0	109	3	12	0	1	0	4	12	0	5	0	1	ES
SE	0	2	9	1	11	97	13	21	66	89	0	4	0	8	3	0	29	24	69	SE
CH	0	4	7	0	2	1	0	83	9	93	0	1	0	1	53	1	8	0	1	CH
TR	1	1	0	17	3	0	0	1	4	5	12	5	0	0	3	0	1	0	11	TR
SU	1	17	22	34	107	81	56	53	234	254	7	104	0	11	26	1	71	8	712	SU
GB	0	0	17	0	2	7	0	77	12	35	0	0	0	124	1	0	29	0	11	GB
YU	14	29	1	27	44	3	0	19	19	39	15	120	0	0	97	0	5	0	38	YU
REM	0	0	2	1	1	0	0	27	0	5	2	1	0	1	11	0	5	0	0	REM
BAS	0	3	15	1	17	174	23	33	173	215	0	5	0	7	4	1	49	6	166	BAS
NOS	0	2	71	0	7	103	1	293	51	229	0	1	0	60	2	1	189	16	25	NOS
ATL	0	1	35	0	3	29	12	480	31	92	0	1	6	327	3	1	58	25	20	ATL
MED	26	10	10	28	18	2	0	194	14	49	60	29	0	3	303	1	14	0	19	MED
BLS	0	1	0	20	5	1	0	1	7	8	3	7	0	0	1	0	2	0	21	BLS
SUM	158	532	876	664	1348	1176	312	5733	3023	6548	373	1203	18	1273	2365	47	1951	253	3903	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	2	0	0	0	0	2	0	9	0	0	0	0	0	0	0	15	148	AL
AT	0	9	1	2	15	0	18	6	14	0	0	0	0	0	0	0	65	1041	AT
BE	0	0	1	0	0	0	0	18	0	0	0	0	0	0	0	0	14	578	BE
BG	0	94	0	0	0	10	70	0	24	0	0	0	0	0	0	0	67	773	BG
CS	0	14	1	2	3	0	41	7	9	0	0	0	0	0	0	0	72	1515	CS
DK	0	0	0	4	0	0	2	18	0	0	0	0	0	0	0	0	16	669	DK
FI	0	2	0	15	0	0	159	11	1	0	0	0	0	0	0	0	110	638	FI
FR	5	1	80	1	17	0	3	100	5	2	0	0	0	0	0	0	239	4609	FR
DD	0	1	1	2	2	0	8	15	1	0	0	0	0	0	0	0	48	2126	DD
DE	1	3	7	2	45	0	13	58	2	0	0	0	0	0	0	0	122	5162	DE
GR	0	16	1	0	0	9	22	0	11	1	0	0	0	0	0	0	62	415	GR
HU	0	44	1	0	1	0	33	1	37	0	0	0	0	0	0	0	56	998	HU
IS	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	21	41	IS
IE	0	0	1	0	0	0	0	31	0	0	0	0	0	0	0	0	26	752	IE
IT	1	6	13	0	23	1	6	8	27	4	0	0	0	0	0	0	170	2155	IT
LU	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	33	LU
NL	0	0	1	0	0	0	1	27	0	0	0	0	0	0	0	0	16	1099	NL
NO	0	1	1	10	0	0	13	74	1	0	0	0	0	0	0	0	142	612	NO
PL	0	17	1	11	3	1	181	21	9	0	0	0	0	0	0	0	156	3618	PL
PT	256	0	49	0	0	0	0	1	0	0	0	0	0	0	0	0	22	334	PT
RO	0	1501	0	1	0	11	258	1	42	0	0	0	0	0	0	0	141	2291	RO
ES	77	1	1444	0	0	0	1	16	2	6	0	0	0	0	0	0	134	1835	ES
SE	0	3	1	229	1	0	63	37	1	0	0	0	0	0	0	0	131	912	SE
CH	0	0	4	0	243	0	1	6	1	0	0	0	0	0	0	0	28	549	CH
TR	0	24	0	0	0	1096	143	0	4	1	0	0	0	0	0	0	210	1542	TR
SU	0	258	2	41	2	82	15946	54	32	0	0	0	0	0	0	0	1957	20174	SU
GB	1	0	4	1	0	0	10	1954	0	0	0	0	0	0	0	0	75	2360	GB
YU	0	54	3	1	2	1	42	1	886	1	0	0	0	0	0	0	167	1629	YU
REM	2	1	14	0	0	1	1	2	2	152	0	0	0	0	0	0	175	407	REM
BAS	0	5	1	58	1	0	186	39	2	0	0	0	0	0	0	0	149	1336	BAS
NOS	1	0	6	8	1	0	12	459	0	0	0	0	0	0	0	0	183	1722	NOS
ATL	47	1	119	10	1	0	122	425	1	0	0	0	0	0	0	0	1210	3062	ATL
MED	6	37	90	0	6	40	53	14	60	32	0	0	0	0	0	0	473	1589	MED
BLS	0	54	0	0	0	78	376	1	4	0	0	0	0	0	0	0	143	736	BLS
SUM	399	2150	1850	400	370	1330	17787	3412	1192	201	0	0	0	0	0	0	6615	67463	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C20 : Budget of Reduced Nitrogen in 1990 (Unit: 100 tonnes as N)

VERY FEW COUNTRIES HAVE GIVEN OFFICIAL EMISSION DATA.

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	
AL	95	0	0	2	1	0	0	1	0	1	5	2	0	0	5	0	0	0	1	AL
AT	0	347	8	0	54	1	0	50	34	254	0	19	0	1	74	1	14	0	21	AT
BE	0	0	370	0	1	1	0	79	5	35	0	0	0	3	0	2	42	0	2	BE
BG	3	1	0	437	7	1	0	2	5	6	11	18	0	0	7	0	1	0	12	BG
CS	0	34	9	1	761	5	0	33	129	201	0	59	0	2	13	1	20	0	93	CS
DK	0	0	5	0	1	494	0	11	20	61	0	0	0	4	0	0	16	1	5	DK
FI	0	1	2	0	4	13	191	7	15	21	0	2	0	2	1	0	7	3	27	FI
FR	0	3	82	0	7	3	0	3611	28	151	0	4	0	17	44	7	61	0	16	FR
DD	0	1	19	0	15	19	0	43	1543	315	0	1	0	4	2	1	56	1	35	DD
DE	0	16	99	0	36	23	0	269	177	3857	0	2	0	14	21	9	283	1	34	DE
GR	8	0	0	22	2	0	0	3	2	2	233	5	0	0	7	0	0	0	4	GR
HU	0	17	2	2	47	1	0	10	15	31	0	627	0	0	22	0	3	0	23	HU
IS	0	0	0	0	0	0	0	1	0	1	0	0	11	1	0	0	1	0	1	IS
IE	0	0	2	0	0	0	0	10	2	4	0	0	0	673	0	0	4	0	0	IE
IT	1	16	6	2	15	1	0	132	15	80	2	19	0	1	1611	1	10	0	13	IT
LU	0	0	2	0	0	0	0	7	0	3	0	0	0	0	0	18	1	0	0	LU
NL	0	0	52	0	1	1	0	39	6	85	0	0	0	5	0	0	834	0	2	NL
NO	0	0	11	0	3	44	3	27	28	60	0	1	0	12	0	0	27	159	17	NO
PL	0	11	20	2	105	46	2	46	372	255	0	30	0	6	9	1	55	2	2415	PL
PT	0	0	0	0	0	0	0	7	1	1	0	0	0	0	1	0	1	0	0	PT
RO	2	4	1	40	30	2	0	7	19	23	3	97	0	0	12	0	3	0	44	RO
ES	0	1	5	0	1	1	0	120	8	16	0	1	0	3	8	0	6	0	5	ES
SE	0	1	8	0	11	91	16	21	62	95	0	2	0	7	1	0	28	23	55	SE
CH	0	3	5	0	2	0	0	107	5	76	0	1	0	1	50	1	8	0	3	CH
TR	0	1	0	17	3	0	0	2	3	4	8	7	0	0	2	0	0	0	8	TR
SU	2	21	35	38	136	89	54	96	275	318	7	121	0	13	26	2	89	9	838	SU
GB	0	0	10	0	2	5	0	63	11	26	0	0	0	137	0	0	17	1	4	GB
YU	13	28	3	20	33	1	0	29	22	48	8	100	0	0	109	0	5	0	27	YU
REM	1	1	1	1	3	0	0	28	4	7	3	3	0	1	17	0	2	0	2	REM
BAS	0	2	16	0	11	171	25	38	171	238	0	4	0	10	2	1	56	6	133	BAS
NOS	0	1	71	0	5	106	0	278	53	224	0	1	0	68	1	1	187	18	17	NOS
ATL	0	2	33	0	7	23	11	375	44	104	0	2	6	310	4	1	56	26	24	ATL
MED	24	11	10	24	24	2	0	234	25	54	57	37	0	3	308	1	15	0	26	MED
BLS	0	1	0	19	5	1	0	2	5	6	3	8	0	0	3	0	1	0	15	BLS
SUM	149	526	891	629	1334	1148	305	5787	3102	6663	342	1172	18	1299	2362	48	1910	251	3922	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	

Emitters

Receivers	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	2	0	0	0	0	2	0	10	0	0	0	0	0	0	0	16	144	AL
AT	0	2	2	0	18	0	7	8	12	0	0	0	0	0	0	0	50	978	AT
BE	0	0	1	0	0	0	2	24	0	0	0	0	0	0	0	0	17	584	BE
BG	0	94	0	0	0	5	41	1	25	0	0	0	0	0	0	0	54	730	BG
CS	0	12	1	1	4	0	21	10	11	0	0	0	0	0	0	0	67	1488	CS
DK	0	0	0	4	0	0	3	22	0	0	0	0	0	0	0	0	20	669	DK
FI	0	1	1	12	0	0	119	8	1	0	0	0	0	0	0	0	98	536	FI
FR	4	1	72	1	16	0	9	69	3	1	0	0	0	0	0	0	230	4439	FR
DD	0	1	1	2	2	0	15	22	0	0	0	0	0	0	0	0	53	2152	DD
DE	0	2	7	2	42	0	20	80	1	0	0	0	0	0	0	0	132	5129	DE
GR	0	19	1	0	0	8	18	0	12	1	0	0	0	0	0	0	63	411	GR
HU	0	28	1	0	1	0	11	2	37	0	0	0	0	0	0	0	45	926	HU
IS	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	21	44	IS
IE	0	0	1	0	0	0	0	25	0	0	0	0	0	0	0	0	26	748	IE
IT	1	5	14	0	27	0	6	6	31	4	0	0	0	0	0	0	172	2191	IT
LU	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	34	LU
NL	0	0	1	0	0	0	2	39	0	0	0	0	0	0	0	0	20	1089	NL
NO	0	3	2	12	0	0	19	71	1	0	0	0	0	0	0	0	153	656	NO
PL	0	15	1	11	2	0	140	36	9	0	0	0	0	0	0	0	172	3765	PL
PT	247	0	45	0	0	0	0	1	0	0	0	0	0	0	0	0	20	326	PT
RO	0	1347	0	1	0	2	154	2	43	0	0	0	0	0	0	0	104	1943	RO
ES	70	0	1362	0	1	0	0	11	1	4	0	0	0	0	0	0	110	1734	ES
SE	0	3	1	235	0	0	85	42	1	0	0	0	0	0	0	0	159	950	SE
CH	0	0	4	0	253	0	1	5	1	0	0	0	0	0	0	0	26	551	CH
TR	0	27	0	0	0	1001	163	1	3	1	0	0	0	0	0	0	167	1420	TR
SU	1	302	4	46	4	100	16602	74	43	0	0	0	0	0	0	0	2215	21561	SU
GB	1	0	3	1	0	0	3	1912	0	0	0	0	0	0	0	0	77	2272	GB
YU	0	38	4	0	3	1	17	3	817	1	0	0	0	0	0	0	146	1477	YU
REM	2	2	17	0	1	1	1	3	4	161	0	0	0	0	0	0	192	456	REM
BAS	0	3	1	59	1	0	171	52	2	0	0	0	0	0	0	0	161	1334	BAS
NOS	1	1	7	9	1	0	12	508	1	0	0	0	0	0	0	0	215	1786	NOS
ATL	45	2	108	8	2	0	96	378	1	0	0	0	0	0	0	0	1268	2935	ATL
MED	6	35	96	0	6	39	49	12	67	33	0	0	0	0	0	0	485	1684	MED
BLS	0	58	0	0	0	66	362	1	4	0	0	0	0	0	0	0	121	682	BLS
SUM	382	2003	1758	407	387	1224	18152	3430	1141	208	0	0	0	0	0	0	6878	67827	SUM
	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C21 : Budget of Reduced Nitrogen in 1991 (Unit: 100 tonnes as N)

NOTE : For the year 1991 and later years East and West Germany are put together with the country code DE*

NOTE : For the year 1991 and later years SU are splitted up in 7 new countries (BY, UA, MD, RU, EE, LV, LT)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	
AL	101	0	0	3	1	0	0	3	2	7	2	0	0	5	0	0	0	1	0	3	0	AL
AT	0	340	7	0	65	4	0	56	327	0	22	0	1	71	1	14	0	30	0	3	1	AT
BE	0	0	370	0	1	1	0	75	43	0	0	0	2	0	2	45	0	2	0	0	1	BE
BG	3	1	0	468	6	1	0	2	12	12	15	0	0	4	0	2	0	9	0	112	0	BG
CS	0	30	8	2	754	7	0	36	294	0	57	0	1	9	1	14	0	112	0	14	1	CS
DK	0	0	3	0	2	455	0	6	72	0	1	0	2	0	0	11	1	10	0	0	0	DK
FI	0	0	2	0	5	13	198	5	54	0	2	0	1	0	0	7	4	41	0	2	0	FI
FR	0	5	82	0	10	4	0	3492	198	0	6	0	14	48	6	51	0	10	4	1	71	FR
DE*	0	22	104	0	58	50	0	330	5791	0	9	0	12	21	9	315	2	70	1	3	7	DE*
GR	7	1	0	28	3	0	0	4	5	258	6	0	0	6	0	1	0	4	0	24	0	GR
HU	0	15	2	3	51	1	0	7	47	1	636	0	0	12	0	4	0	32	0	42	0	HU
IS	0	0	1	0	0	0	0	2	3	0	0	12	2	0	0	1	0	0	0	0	0	IS
IE	0	0	1	0	0	0	0	8	7	0	0	0	678	0	0	3	0	1	0	0	1	IE
IT	1	20	6	2	20	2	0	120	124	3	24	0	1	1630	1	12	0	15	1	8	14	IT
LU	0	0	2	0	0	0	0	6	3	0	0	0	0	0	17	1	0	0	0	0	0	LU
NL	0	0	50	0	1	2	0	35	106	0	0	0	3	0	0	820	0	2	0	0	1	NL
NO	0	1	6	0	5	32	2	12	80	0	2	0	8	0	0	21	155	31	0	2	0	NO
PL	0	11	16	3	102	42	2	43	513	0	30	0	4	9	1	43	2	2222	0	22	1	PL
PT	0	0	0	0	0	0	0	3	1	0	0	0	1	0	0	0	0	0	248	0	42	PT
RO	2	3	1	53	26	2	0	4	43	5	90	0	0	10	0	4	0	43	0	1501	0	RO
ES	0	1	4	0	2	1	0	93	17	0	1	0	4	15	0	5	0	2	70	0	1389	ES
SE	0	1	7	0	6	84	14	14	127	0	3	0	5	0	0	29	24	42	0	3	0	SE
CH	0	3	7	0	3	1	0	93	106	0	2	0	1	53	1	11	0	2	0	0	2	CH
TR	1	1	0	21	4	0	0	2	6	13	9	0	0	2	0	1	0	8	0	31	0	TR
GB	0	1	15	0	3	6	0	83	57	0	0	0	122	0	0	26	1	9	0	1	3	GB
YU	15	30	4	24	49	3	0	19	88	11	123	0	1	79	0	10	0	45	0	49	2	YU
BY	0	2	3	3	13	10	2	7	66	1	12	0	1	3	0	8	1	141	0	18	0	BY
UA	1	4	3	17	36	9	2	8	89	4	45	0	1	8	0	9	1	194	0	143	0	UA
MD	0	0	0	3	2	0	0	0	6	0	3	0	0	0	0	1	0	8	0	41	0	MD
RU	0	6	9	11	35	39	50	19	191	2	35	0	1	9	0	27	6	226	0	72	0	RU
EE	0	0	0	0	1	5	2	1	10	0	0	0	0	0	0	1	0	10	0	0	0	EE
LV	0	1	1	0	3	7	2	2	23	0	1	0	0	1	0	3	1	20	0	1	0	LV
LT	0	1	2	0	6	7	1	4	39	0	2	0	1	1	0	5	1	61	0	2	0	LT
REM	0	1	2	1	1	0	0	45	6	2	2	0	1	19	0	3	0	1	3	1	21	REM
BAS	0	2	13	0	12	163	25	28	371	0	4	0	5	1	0	46	7	140	0	4	1	BAS
NOS	0	4	80	0	16	114	1	317	409	0	5	0	56	3	1	215	17	43	1	2	6	NOS
ATL	0	4	47	0	16	34	10	486	277	0	5	6	361	4	2	94	28	47	45	2	114	ATL
MED	28	14	12	38	30	3	0	268	89	73	47	0	2	323	1	19	0	32	8	57	106	MED
BLS	0	1	0	19	7	1	0	1	11	3	10	0	0	1	0	1	0	18	0	58	0	BLS
SUM	163	528	870	701	1354	1105	316	5739	9709	395	1213	18	1293	2351	45	1883	252	3686	381	2225	1784	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	

Emitters

Receivers	SE	CH	TR	GB	YU	BY	UA	MD	RU	EE	LV	LT	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	0	0	1	0	10	0	2	0	0	0	0	0	0	0	0	0	0	0	0	23	167	AL
AT	1	21	0	6	13	3	6	0	2	0	1	1	0	0	0	0	0	0	0	54	1050	AT
BE	0	1	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	575	BE
BG	0	0	7	1	29	6	64	7	12	0	1	1	0	0	0	0	0	0	0	68	848	BG
CS	1	4	0	8	10	9	26	1	4	1	2	4	0	0	0	0	0	0	0	71	1482	CS
DK	5	0	0	17	0	2	2	0	1	0	0	1	0	0	0	0	0	0	0	17	611	DK
FI	13	0	0	7	1	13	12	0	67	17	12	12	0	0	0	0	0	0	0	105	591	FI
FR	1	21	0	76	4	1	2	0	0	0	0	0	1	0	0	0	0	0	0	202	4314	FR
DE*	4	43	0	73	3	4	8	0	3	0	2	2	0	0	0	0	0	0	0	177	7122	DE*
GR	0	0	14	1	13	3	29	3	4	0	0	1	1	0	0	0	0	0	0	84	502	GR
HU	0	1	0	2	35	4	24	1	2	0	1	2	0	0	0	0	0	0	0	45	972	HU
IS	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	44	IS
IE	0	0	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	757	IE
IT	0	25	1	9	32	2	6	1	0	0	0	0	5	0	0	0	0	0	0	176	2262	IT
LU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	32	LU
NL	0	1	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	1068	NL
NO	13	0	0	52	1	4	5	0	8	1	2	2	0	0	0	0	0	0	0	117	564	NO
PL	11	3	0	22	10	62	84	3	32	3	9	27	0	0	0	0	0	0	0	179	3511	PL
PT	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	314	PT
RO	1	0	6	2	40	19	207	34	27	1	2	3	0	0	0	0	0	0	0	121	2252	RO
ES	0	1	0	16	2	0	0	0	0	0	0	0	5	0	0	0	0	0	0	105	1736	ES
SE	233	0	0	33	1	10	13	1	26	6	9	10	0	0	0	0	0	0	0	124	824	SE
CH	0	242	0	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	567	CH
TR	0	0	1242	1	5	6	106	5	47	0	1	1	0	0	0	0	0	0	0	271	1786	TR
GB	1	1	0	1972	0	2	5	0	1	0	0	1	0	0	0	0	0	0	0	72	2381	GB
YU	1	2	2	4	879	5	25	2	2	0	1	3	2	0	0	0	0	0	0	162	1640	YU
BY	4	1	2	5	5	1088	163	6	84	4	26	58	0	0	0	0	0	0	0	123	1859	BY
UA	3	1	22	7	15	185	4318	66	351	3	9	17	0	0	0	0	0	0	0	377	5948	UA
MD	0	0	1	0	1	6	97	163	11	0	0	1	0	0	0	0	0	0	0	20	365	MD
RU	24	1	123	23	13	345	828	19	8484	46	93	98	0	0	0	0	0	0	0	1781	12612	RU
EE	3	0	0	2	0	4	3	0	10	108	14	6	0	0	0	0	0	0	0	18	201	EE
LV	4	0	0	3	0	21	9	0	18	13	215	36	0	0	0	0	0	0	0	32	417	LV
LT	4	0	0	3	1	30	15	1	13	2	21	335	0	0	0	0	0	0	0	39	599	LT
REM	0	1	1	4	2	0	1	0	0	0	0	0	164	0	0	0	0	0	0	192	475	REM
BAS	62	1	0	40	1	25	26	1	46	28	39	33	0	0	0	0	0	0	0	150	1277	BAS
NOS	11	2	0	474	1	6	8	0	5	1	2	3	0	0	0	0	0	0	0	183	1986	NOS
ATL	9	4	0	487	1	10	11	1	67	2	4	6	0	0	0	0	0	0	0	1317	3502	ATL
MED	1	7	57	21	79	10	80	9	12	0	1	3	38	0	0	0	0	0	0	601	2069	MED
BLS	0	0	136	1	4	13	347	14	170	0	1	2	0	0	0	0	0	0	0	218	1038	BLS
SUM	413	383	1609	3463	1211	1900	6536	338	9505	240	467	671	219	0	0	0	0	0	0	7341	70307	SUM
	SE	CH	TR	GB	YU	BY	UA	MD	RU	EE	LV	LT	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

Table C22 : Budget of Reduced Nitrogen in 1992 (Unit: 100 tonnes as N)

PROVISIONAL ESTIMATE

NOTE : For the year 1991 and later years East and West Germany are put together with the country code DE*

NOTE : For the year 1991 and later years SU are splitted up in 7 new countries (BY, UA, MD, RU, EE, LV, LT)

NOTE : For the year 1992 and later years YU are splitted up in 4 new countries (SI, HR, BA, YU*)

Emitters

Receivers	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	
AL	98	0	0	3	1	0	0	1	2	7	2	0	0	4	0	0	0	1	0	3	0	0	0	AL
AT	0	342	7	1	50	1	0	80	282	0	21	0	1	81	1	12	0	17	0	5	2	0	23	AT
BE	0	1	386	0	1	1	0	84	50	0	0	0	2	0	2	50	0	2	0	0	2	0	0	BE
BG	2	2	1	436	7	0	0	3	12	9	17	0	0	3	0	1	0	9	0	102	0	0	0	BG
CS	0	36	8	1	775	5	0	40	297	1	59	0	2	12	1	16	0	93	0	13	1	1	4	CS
DK	0	0	3	0	1	442	0	6	71	0	0	0	3	0	0	11	1	7	0	0	0	4	0	DK
FI	0	1	2	1	5	13	194	6	53	0	3	0	1	1	0	7	4	34	0	4	1	13	0	FI
FR	0	6	88	0	12	6	0	3692	222	0	5	0	15	62	6	55	0	12	4	2	75	1	25	FR
DE*	0	26	114	0	67	39	0	371	6018	0	9	0	16	36	10	330	1	89	1	4	10	2	51	DE*
GR	8	1	0	28	4	0	0	3	7	246	8	0	0	5	0	0	0	5	0	24	0	0	0	GR
HU	1	17	2	3	46	1	0	10	44	1	605	0	0	12	0	4	0	23	0	36	0	0	2	HU
IS	0	0	0	0	0	0	0	1	2	0	0	11	0	0	0	0	0	1	0	0	0	0	0	IS
IE	0	0	1	0	0	0	0	8	3	0	0	0	701	0	0	2	0	1	0	0	1	0	0	IE
IT	2	15	3	3	15	2	0	106	81	3	18	0	1	1700	0	4	0	17	1	7	15	0	25	IT
LU	0	0	2	0	0	0	0	8	3	0	0	0	0	0	18	0	0	0	0	0	0	0	0	LU
NL	0	0	57	0	2	2	0	39	119	0	0	0	4	0	0	861	0	3	0	0	1	0	0	NL
NO	0	1	6	0	6	34	2	13	72	0	3	0	12	0	0	19	160	16	0	1	1	11	0	NO
PL	0	9	18	2	102	38	1	54	556	1	26	0	7	8	1	48	2	2247	0	12	2	11	3	PL
PT	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	250	0	44	0	0	PT
RO	2	5	3	43	34	2	0	12	50	3	101	0	1	9	0	6	0	44	0	1401	0	1	1	RO
ES	0	1	7	0	3	1	0	120	36	0	3	0	5	12	0	8	0	4	72	1	1439	0	2	ES
SE	0	1	10	0	5	90	11	21	147	0	3	0	5	1	0	29	25	40	0	2	1	230	0	SE
CH	0	4	3	0	2	1	0	110	75	0	1	0	1	72	0	2	0	2	0	0	4	0	258	CH
TR	1	2	1	25	6	1	0	4	18	12	10	0	0	4	0	2	0	11	0	40	0	0	0	TR
GB	0	1	16	0	4	5	0	77	58	0	1	0	137	0	0	25	1	10	0	0	3	1	0	GB
BY	0	3	2	3	12	9	2	11	50	0	13	0	1	6	0	7	1	125	0	23	1	4	1	BY
UA	1	5	7	18	46	9	2	18	117	3	53	0	1	9	0	16	1	220	0	146	1	4	1	UA
MD	0	0	0	2	3	0	0	1	8	0	4	0	0	1	0	1	0	10	0	38	0	0	0	MD
RU	1	6	10	23	37	43	55	35	197	5	39	0	4	9	0	29	7	242	0	97	2	27	1	RU
EE	0	0	1	0	2	3	2	2	12	0	1	0	0	0	0	1	0	10	0	1	0	2	0	EE
LV	0	1	1	0	3	6	2	3	21	0	2	0	1	0	0	2	0	22	0	2	0	4	0	LV
LT	0	1	1	0	4	7	1	4	29	0	2	0	1	0	0	4	0	58	0	2	0	4	0	LT
SI	0	15	1	0	6	0	0	6	20	0	10	0	0	24	0	1	0	6	0	2	1	0	1	SI
HR	1	7	1	1	11	1	0	6	23	1	32	0	0	28	0	2	0	12	0	4	1	0	1	HR
BA	1	4	1	1	8	0	0	5	19	1	23	0	0	18	0	2	0	10	0	6	1	0	1	BA
YU*	14	5	1	27	14	1	0	8	31	10	52	0	0	16	0	3	0	12	0	40	1	0	1	YU*
REM	1	2	1	1	4	0	0	34	12	2	4	0	1	22	0	2	0	6	2	2	17	0	1	REM
BAS	0	2	14	0	11	166	24	37	388	0	5	0	7	1	1	47	6	144	0	6	1	61	1	BAS
NOS	0	3	79	0	14	118	1	327	394	0	4	0	77	2	1	219	20	43	1	1	6	11	1	NOS
ATL	0	3	29	0	14	29	13	441	195	0	4	7	354	4	1	55	31	46	52	2	135	9	4	ATL
MED	32	13	7	40	29	3	0	238	90	80	45	0	3	350	1	12	0	40	5	53	104	1	8	MED
BLS	1	2	2	27	10	2	0	5	31	4	16	0	0	4	0	4	0	30	0	83	0	1	1	BLS
SUM	165	544	895	690	1378	1078	314	6056	9913	387	1204	18	1365	2519	47	1901	261	3723	391	2165	1874	405	419	SUM
	AL	AT	BE	BG	CS	DK	FI	FR	DE*	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	

Emitters

Receivers	TR	GB	BY	UA	MD	RU	EE	LV	LT	SI	HR	BA	YU*	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	
AL	1	0	0	3	0	0	0	0	0	0	1	1	8	0	0	0	0	0	0	0	15	152	AL
AT	0	9	1	4	0	0	0	0	1	9	3	1	2	0	0	0	0	0	0	0	54	1009	AT
BE	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	618	BE
BG	6	1	5	48	7	7	0	0	1	0	2	2	26	0	0	0	0	0	0	0	55	765	BG
CS	0	11	6	23	1	2	0	1	1	2	3	1	4	0	0	0	0	0	0	0	62	1483	CS
DK	0	15	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	13	583	DK
FI	0	8	14	21	1	54	17	12	11	0	0	0	0	0	0	0	0	0	0	0	103	581	FI
FR	0	71	1	2	0	0	0	0	1	1	2	1	1	1	0	0	0	0	0	0	189	4559	FR
DE*	0	94	6	11	0	3	0	2	5	1	1	0	1	0	0	0	0	0	0	0	175	7497	DE*
GR	16	0	2	23	3	5	0	0	0	0	1	1	14	1	0	0	0	0	0	0	68	475	GR
HU	0	2	3	18	1	2	0	0	1	4	11	4	14	0	0	0	0	0	0	0	38	904	HU
IS	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	33	IS
IE	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	768	IE
IT	1	5	1	7	1	1	0	0	0	8	10	5	5	4	0	0	0	0	0	0	172	2237	IT
LU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	34	LU
NL	0	35	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	1146	NL
NO	0	53	1	3	0	3	1	1	2	0	0	0	0	0	0	0	0	0	0	0	122	546	NO
PL	0	35	52	69	1	16	1	5	19	1	2	1	3	0	0	0	0	0	0	0	159	3511	PL
PT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	319	PT
RO	3	3	15	167	31	18	0	1	3	1	4	3	26	0	0	0	0	0	0	0	103	2096	RO
ES	0	12	0	1	0	0	0	0	0	0	1	0	1	4	0	0	0	0	0	0	106	1842	ES
SE	0	33	6	7	0	11	4	6	7	0	0	0	1	0	0	0	0	0	0	0	124	820	SE
CH	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	571	CH
TR	1272	1	8	112	7	44	0	1	2	0	1	1	5	0	0	0	0	0	0	0	244	1836	TR
GB	0	2057	2	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	65	2466	GB
BY	1	7	1079	163	6	69	5	28	62	1	1	1	3	0	0	0	0	0	0	0	117	1815	BY
UA	19	10	187	4248	61	268	3	11	25	1	4	3	13	0	0	0	0	0	0	0	332	5860	UA
MD	1	1	6	80	155	5	0	0	1	0	0	0	1	0	0	0	0	0	0	0	17	337	MD
RU	211	28	362	1035	24	9469	52	96	100	1	4	3	13	0	0	0	0	0	0	0	2058	14333	RU
EE	0	2	5	5	0	8	105	13	6	0	0	0	0	0	0	0	0	0	0	0	19	203	EE
LV	0	4	19	9	0	18	13	212	32	0	0	0	0	0	0	0	0	0	0	0	33	409	LV
LT	0	5	28	9	0	11	3	23	332	0	0	0	0	0	0	0	0	0	0	0	37	569	LT
SI	0	1	0	1	0	0	0	0	0	69	6	1	1	0	0	0	0	0	0	0	17	193	SI
HR	0	1	1	5	0	0	0	0	0	6	126	15	6	1	0	0	0	0	0	0	33	325	HR
BA	0	1	1	5	0	0	0	0	0	2	20	135	16	1	0	0	0	0	0	0	32	314	BA
YU*	2	1	3	18	2	3	0	0	0	1	10	19	466	1	0	0	0	0	0	0	68	830	YU*
REM	2	2	0	2	0	0	0	0	0	1	1	1	1	176	0	0	0	0	0	0	233	533	REM
BAS	0	43	21	21	1	37	28	39	33	0	0	0	1	0	0	0	0	0	0	0	153	1302	BAS
NOS	0	564	5	6	0	2	1	2	3	0	1	0	0	0	0	0	0	0	0	0	198	2106	NOS
ATL	0	423	11	12	0	87	4	5	7	0	0	0	1	0	0	0	0	0	0	0	1341	3321	ATL
MED	84	12	7	69	7	14	0	1	2	6	25	16	33	42	0	0	0	0	0	0	667	2140	MED
BLS	170	2	20	380	21	148	1	2	5	0	2	1	6	0	0	0	0	0	0	0	243	1225	BLS
SUM	1784	3612	1882	6590	332	10306	240	465	664	118	244	217	675	232	0	0	0	0	0	0	7574	72647	SUM
	TR	GB	BY	UA	MD	RU	EE	LV	LT	SI	HR	BA	YU*	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM	

APPENDIX D.

GRIDDED EMISSIONS USED IN THE CALCULATIONS AVERAGED OVER THE YEARS : 1985, 1987, 1988, 1989, 1990, 1991 and 1992.

This appendix shows maps with numbers in EMEP grid squares for averaged emissions, and a table for the annual averaged total emissions in the different sub-domains of the calculation area, to which deposition contributions are allocated

Units are :

a) for gridded emissions :
   $cg(S)/m^2$ for oxidised sulphur
   $mg(N)/m^2$ for oxidised and reduced nitrogen..

b) for total emissions :
   kt(S)/a for oxidised sulphur
   $kt(NO_2)/a$ for oxidised nitrogen
   $kt(NH_3)/a$ for reduced nitrogen

Table D1 :

Emissions averaged over 1985,1987-1992
Unit:kt per annum. SO2 as S, NO2 as NO2 and NH3 as NH3

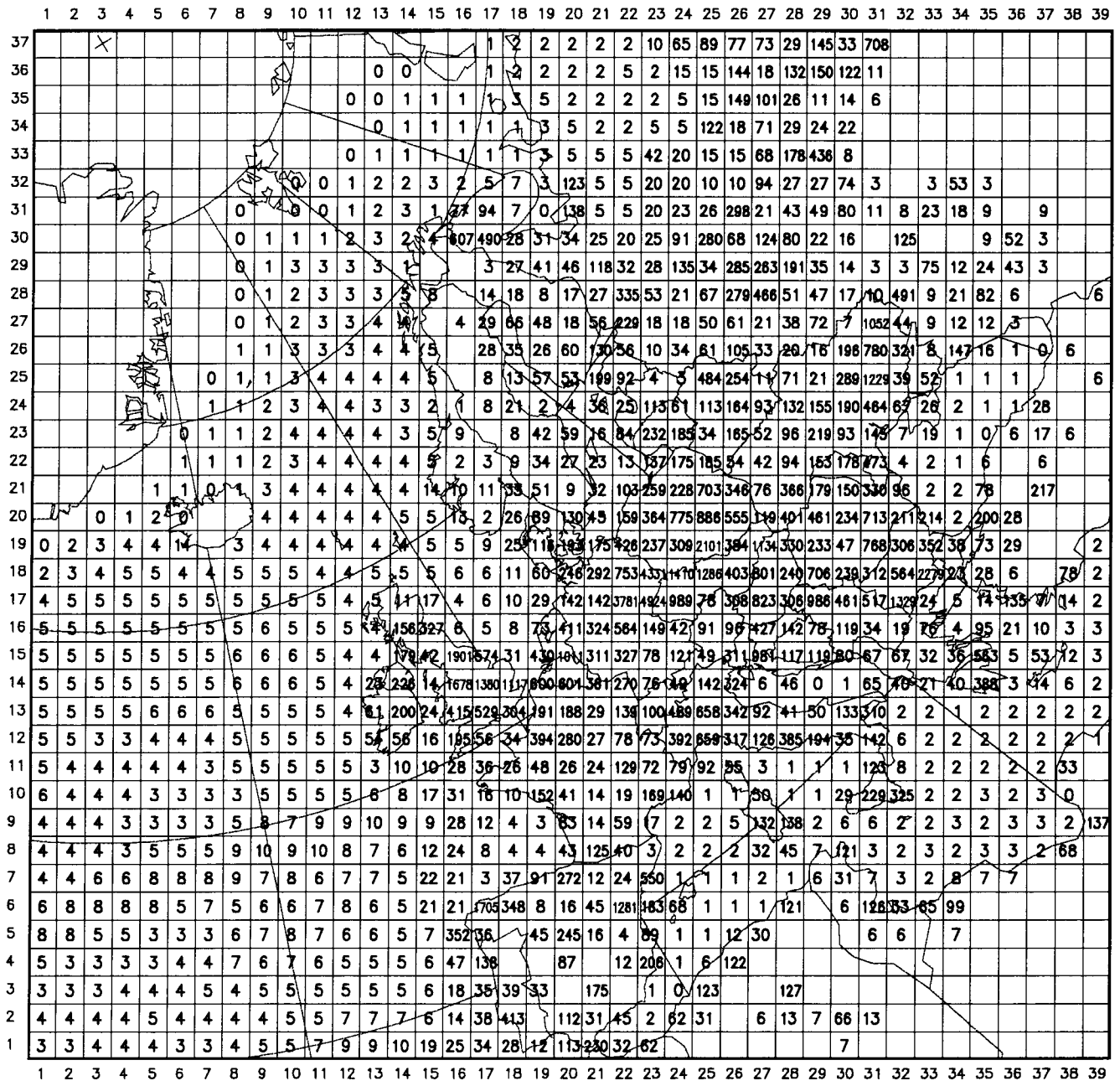
	SO2	NO2	NH3
Albania	25	9	30
Austria	58	225	85
Belgium	217	315	110
Bulgaria	1030	366	126
Czechoslovakia	1257	991	203
Denmark	121	287	143
Finland	135	282	42
France	665	1714	772
German Dem Rep.	2571	648	420
Germany, Fed. Rep.	670	2750	870
Greece	250	746	78
Hungary	573	251	170
Iceland	3	12	3
Ireland	84	121	168
Italy	1145	1727	410
Luxembourg	8	19	6
The Netherlands	120	550	243
Norway	32	227	36
Poland	1842	1392	538
Portugal	102	117	70
Romania	900	390	371
Spain	1138	839	342
Sweden	104	415	54
Switzerland	36	189	60
Turkey	174	175	415
Soviet	4529	4010	3113
United Kingdom	1891	2628	467
Yugoslavia	758	428	153
Remaining areas	256	100	56
The Baltic Sea	36	80	0
The North Sea	87	192	0
Rem. Atlantic Waters	158	349	0
The Mediteranian	6	13	0
The Black Sea	0	0	0
Biogenic sea emissions	362	0	0
TOTAL	**21345**	**22557**	**9611**

Subdivision of Soviet , Yugoslavia and Czechoslovakia

	SO2	NO2	NH3
Kola/Karelia	410	54	45
Leningrad/Novgorod-Psk.	185	123	122
Kaliningrad	23	4	5
Byelorussia	314	260	257
Ukraina	1490	1055	926
Moldovia	59	50	50
Rest of Russia	1830	2313	1527
Estonia	63	45	31
Latvia	43	37	61
Lithuania	112	69	89
Czechia	1052	850	137
Slovakia	207	141	66
Slovenia	128	77	20
Crotia	213	118	37
Bosnia & Hercegovina	74	52	36
Yugoslavia[1]	343	181	117

1. Former Yugoslavia excluding Slovenia, Croatia, Bosnia and Hercegovina.

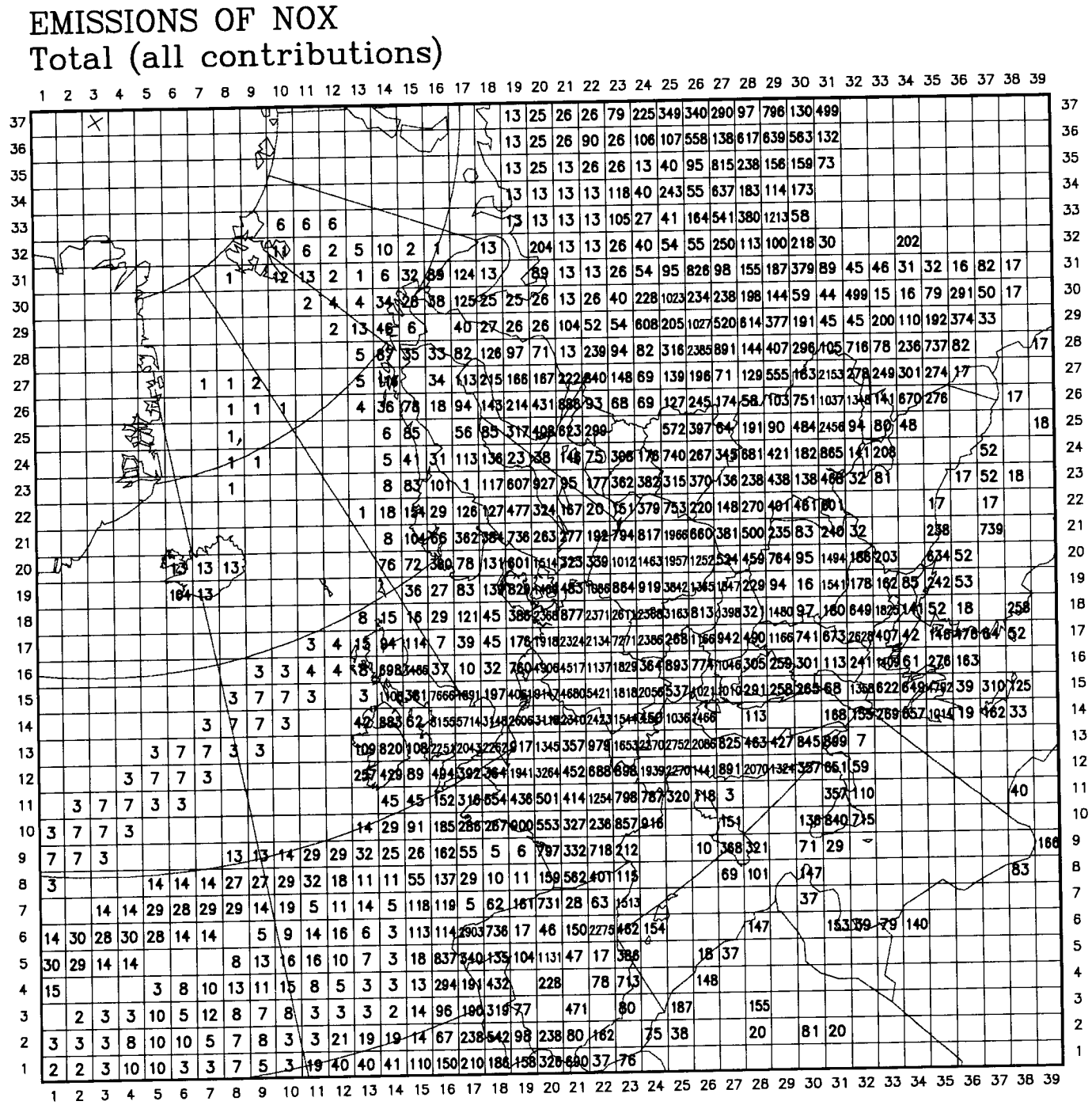
Figure D1 :



Average :
85/87/88/89/90/91/92

Unit :
cg/m2 as S

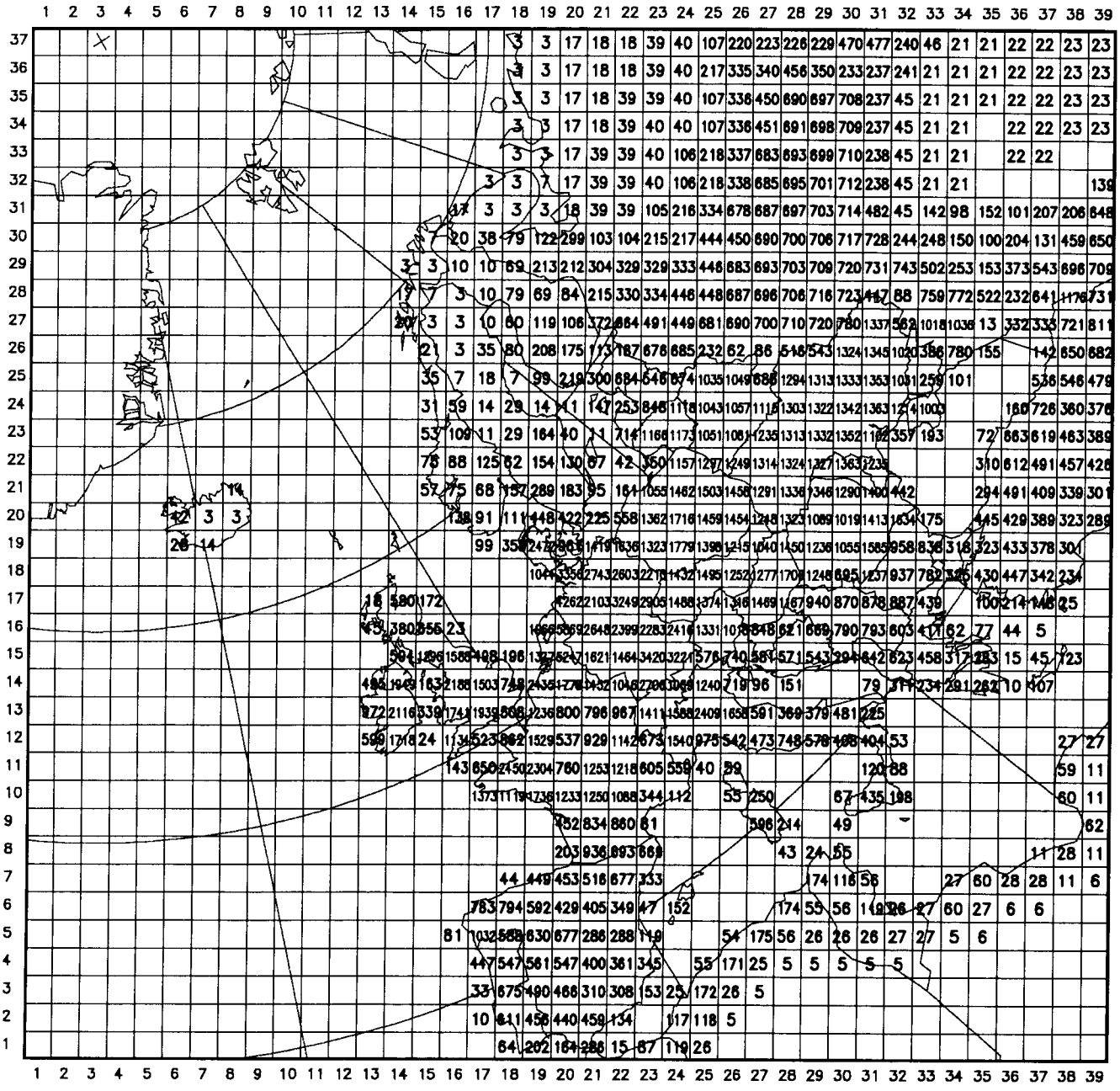
Figure D2 :



Average :
85/87/88/89/90/91/92

Unit :
mg/m2 as N

Figure D3 :



Average :
85/87/88/89/90/91/92

Unit :
mg/m2 as N

APPENDIX E.

COUNTRY ALLOCATED DEPOSITIONS OF OXIDISED SULPHUR AVERAGED OVER THE YEARS 1985, 1987, 1988, 1989, 1990, 1991 and 1992.

This appendix shows maps with numbers in EMEP grid squares of :

1) Total deposition of sulphur averaged over the years 85,87-92
2) The 5 percentile critical load of sulphur
3) Total excess deposition of sulphur
4) The sum of all attributable sulphur deposition contributions
5) The deposition of indeterminate contribution (IND)

6a) The part of IND originated from the free troposphere.

b) The part of IND originated from the trajectory initial concentrations

7) The sulphur deposition allocated to natural emissions
8) The deposition not responding to European control strategies (IND/3 + NAT)
9) The deposition from North American sources calculated with an Eulerian Hemispheric model.
10) Deposition allocated to emissions in the sub-domains defined in Table D1.

Units are $cg(S)/m^2$ for oxidised sulphur depositions.

Figure E1 :

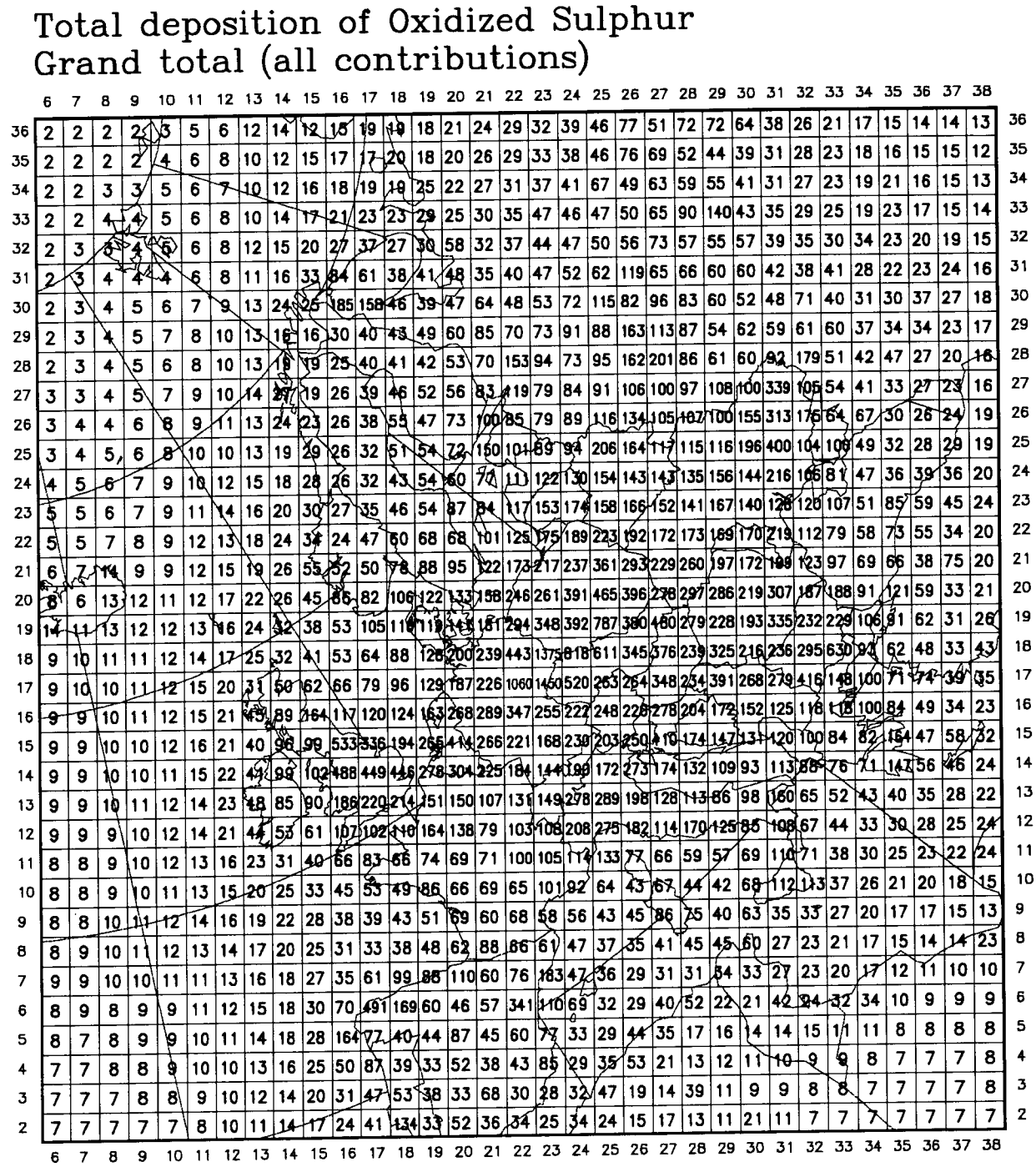

Total deposition of Oxidized Sulphur
Grand total (all contributions)
Average :
1985,1987–92
Unit: cg(S)/m2

Figure E2 :

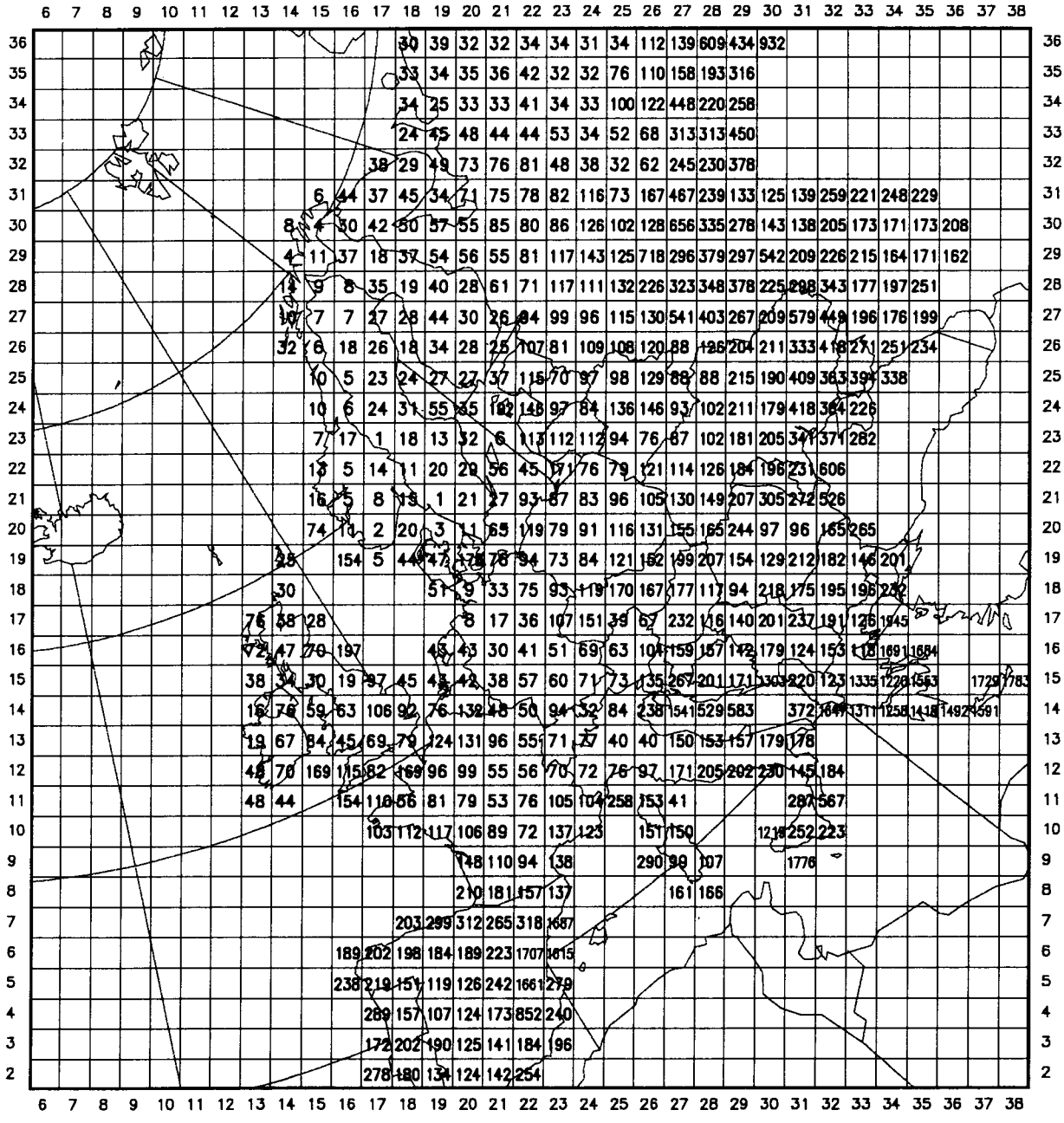
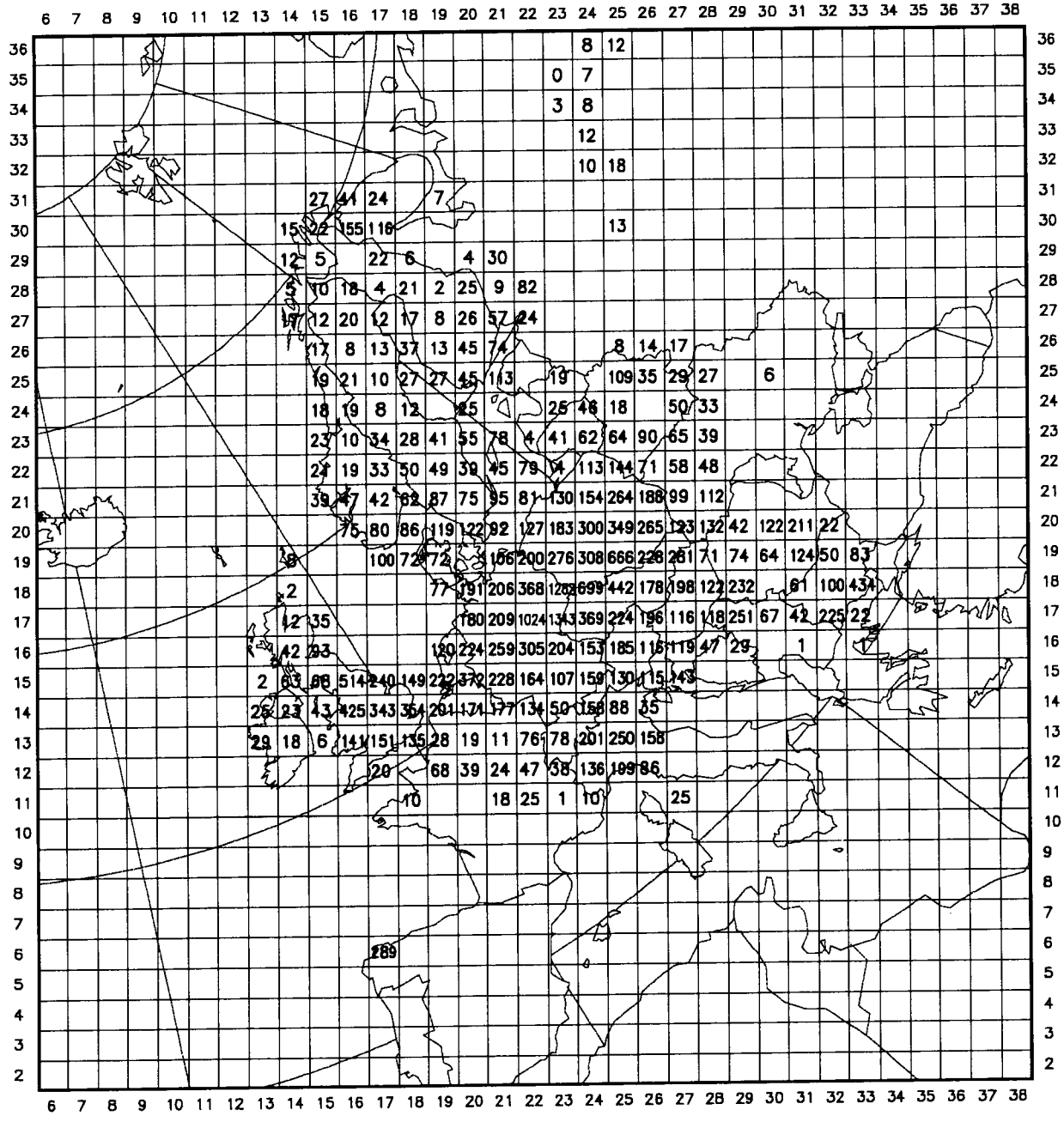

CRITICAL LOADS OF SULPHUR
5 percentile
Unit:
cg/m2 as S pr. year

Figure E3 :

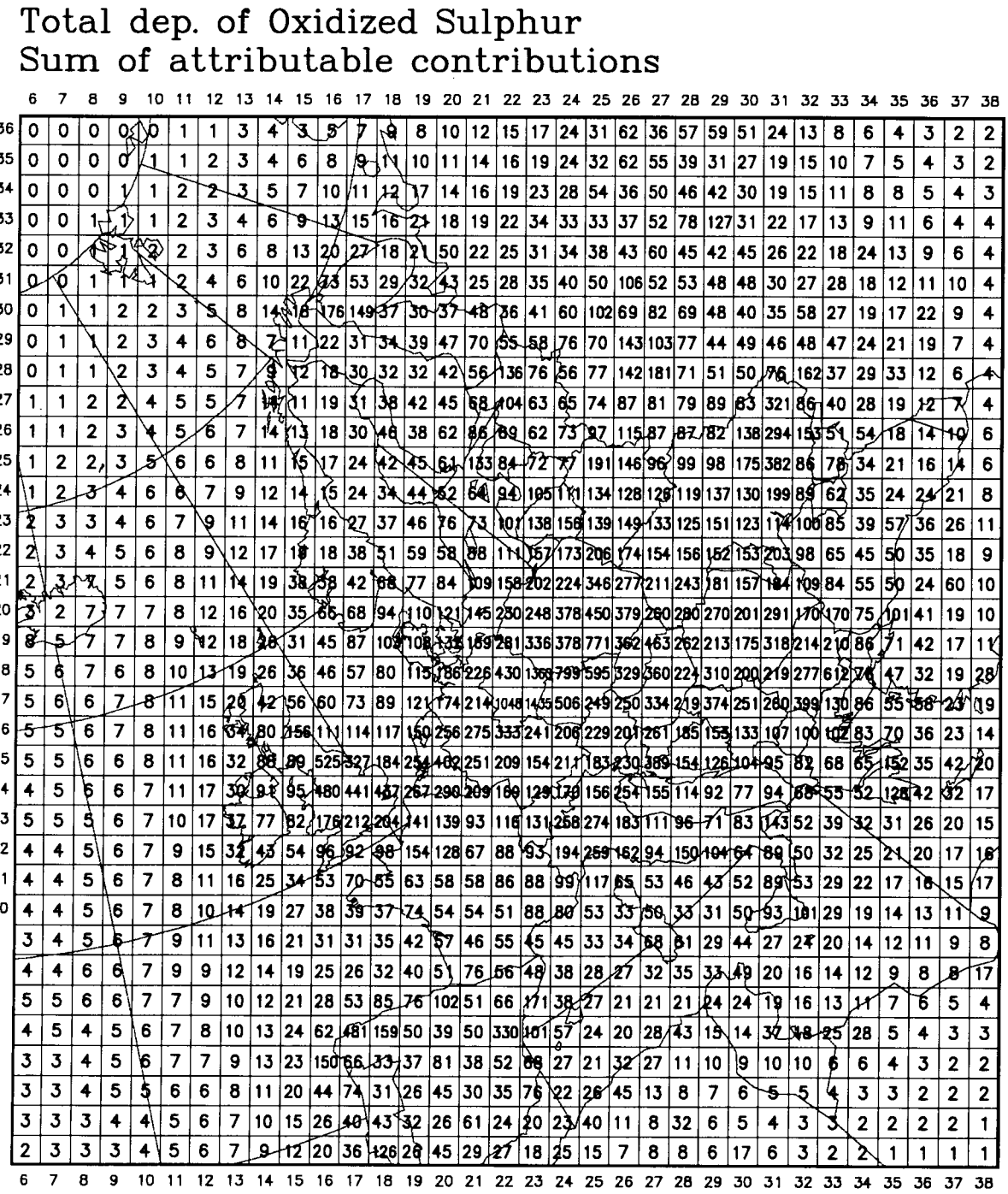


Average :
85/87/88/89/90/91/92

Unit :
cg/m2 as S

5 percentile

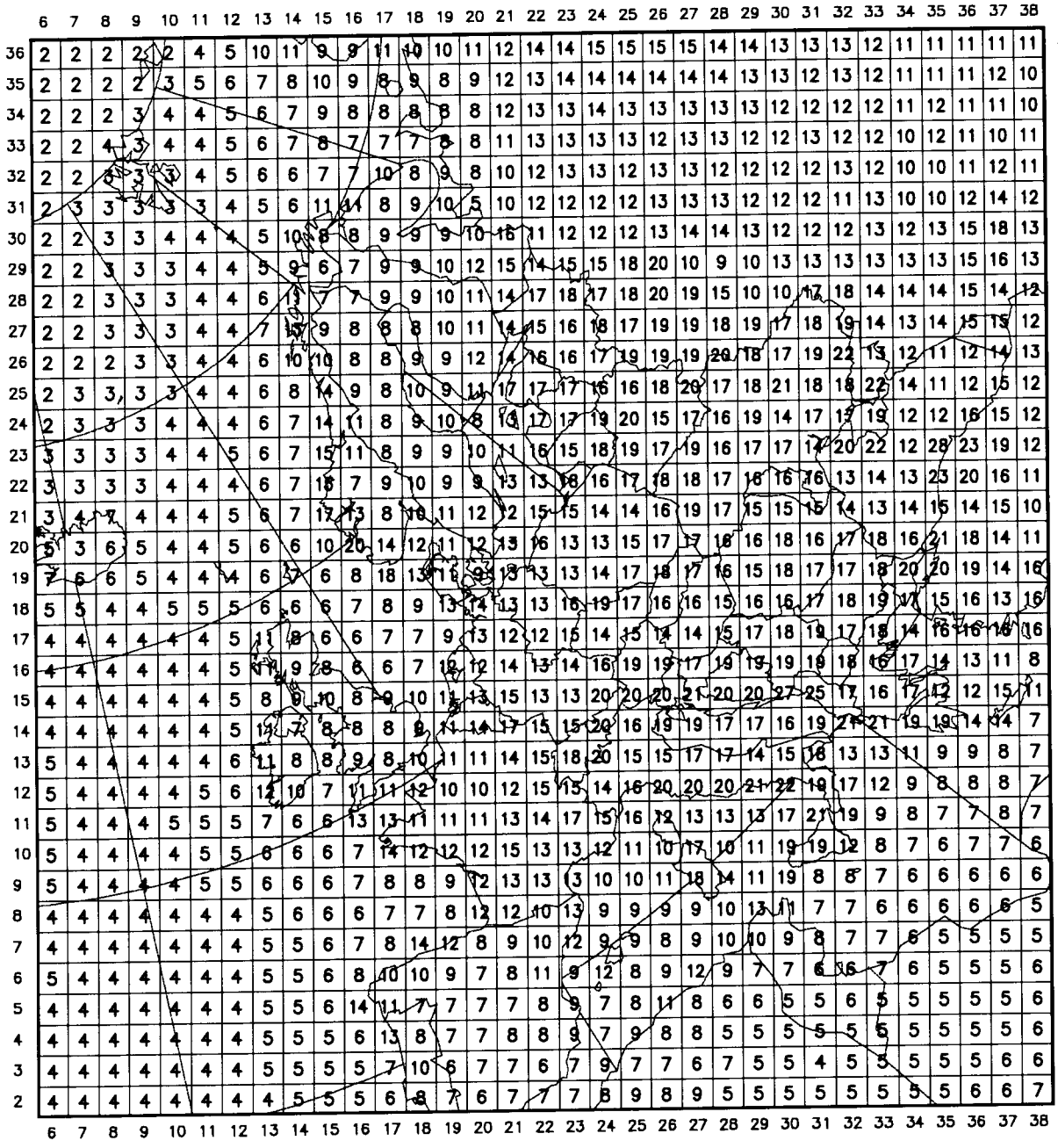
Figure E4 :



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

Figure E5 :

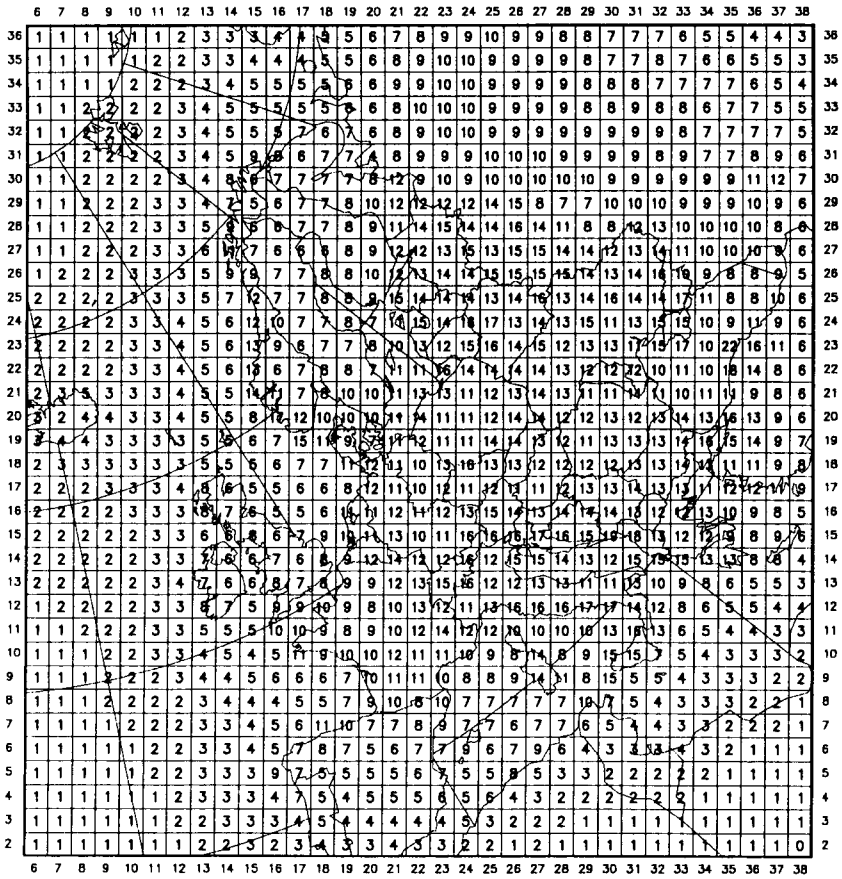


Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

Figure E6 :

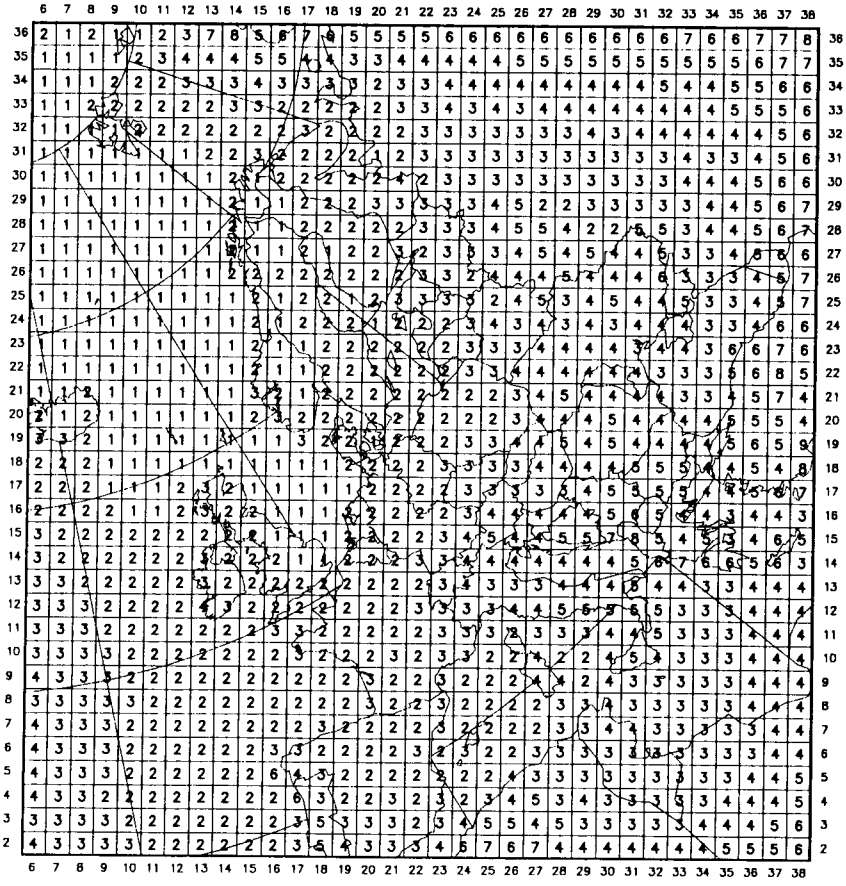
a) Total dep. of Oxidized Sulphur
Inattributable contributions from above



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

b) Total dep. of Oxidized Sulphur
Inattributable contributions from mix.l



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

Figure E7

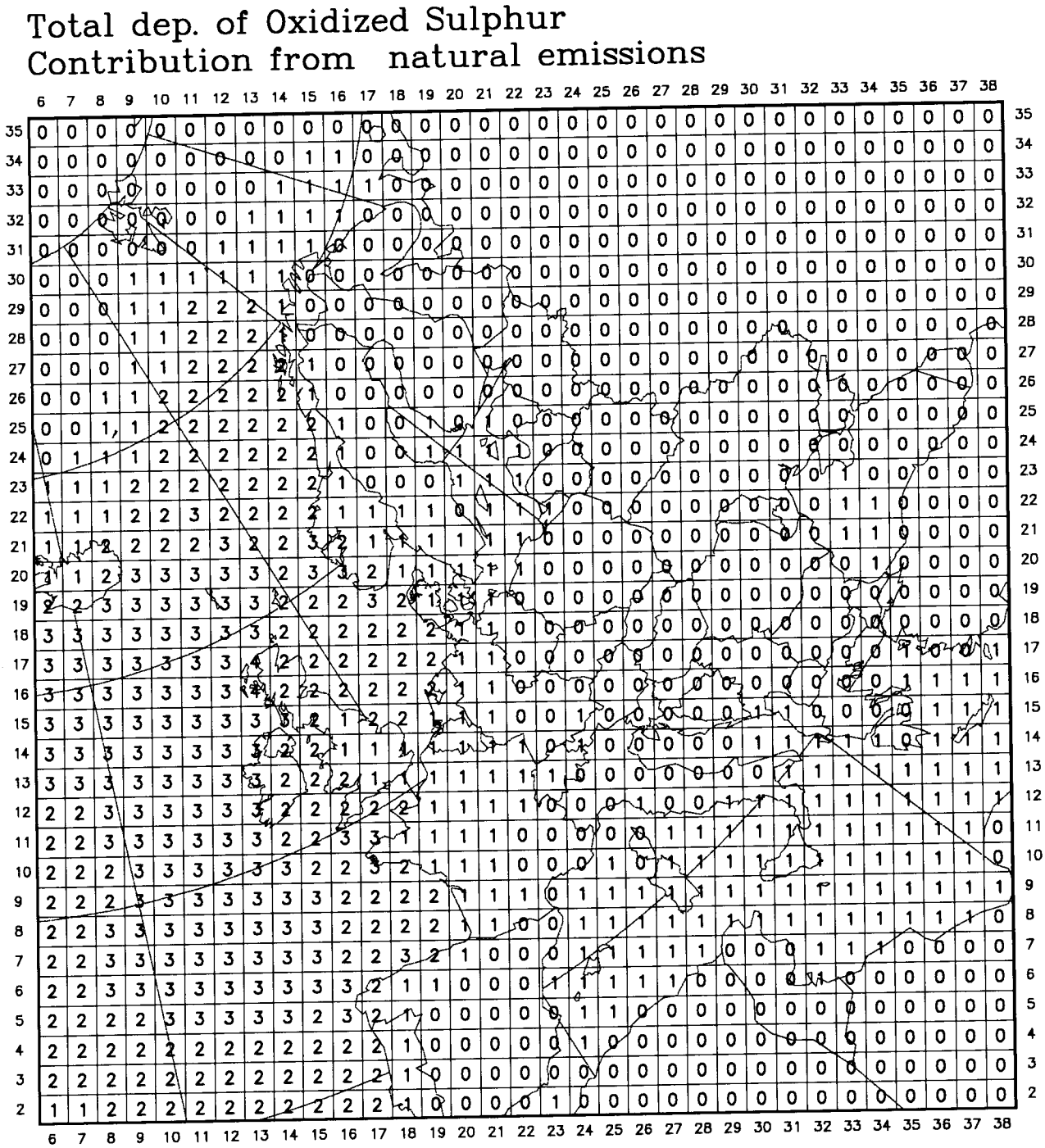
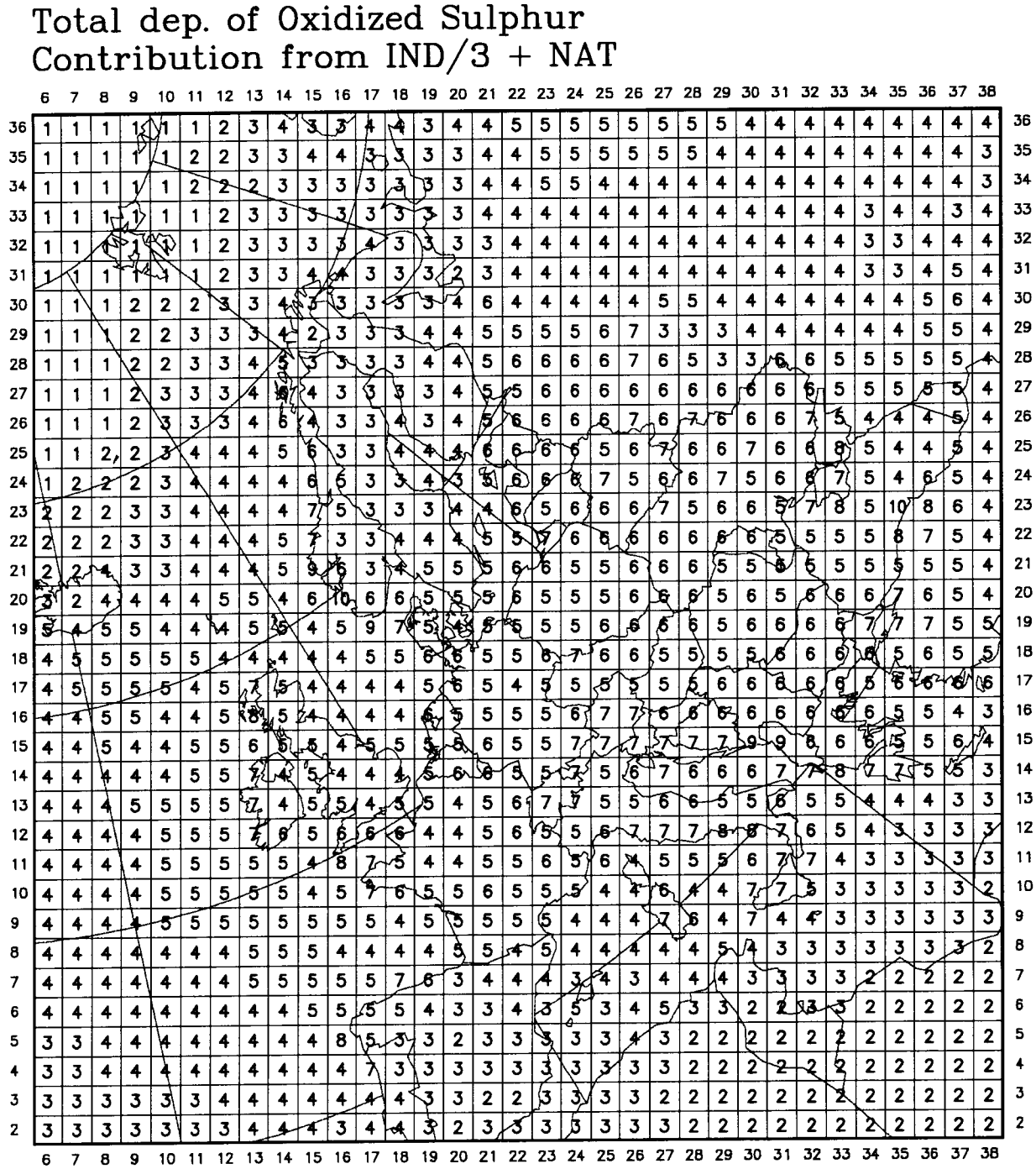

Total dep. of Oxidized Sulphur
Contribution from natural emissions
Average :
85/87/88/89/90/91/92
Unit : cg(S)/m2

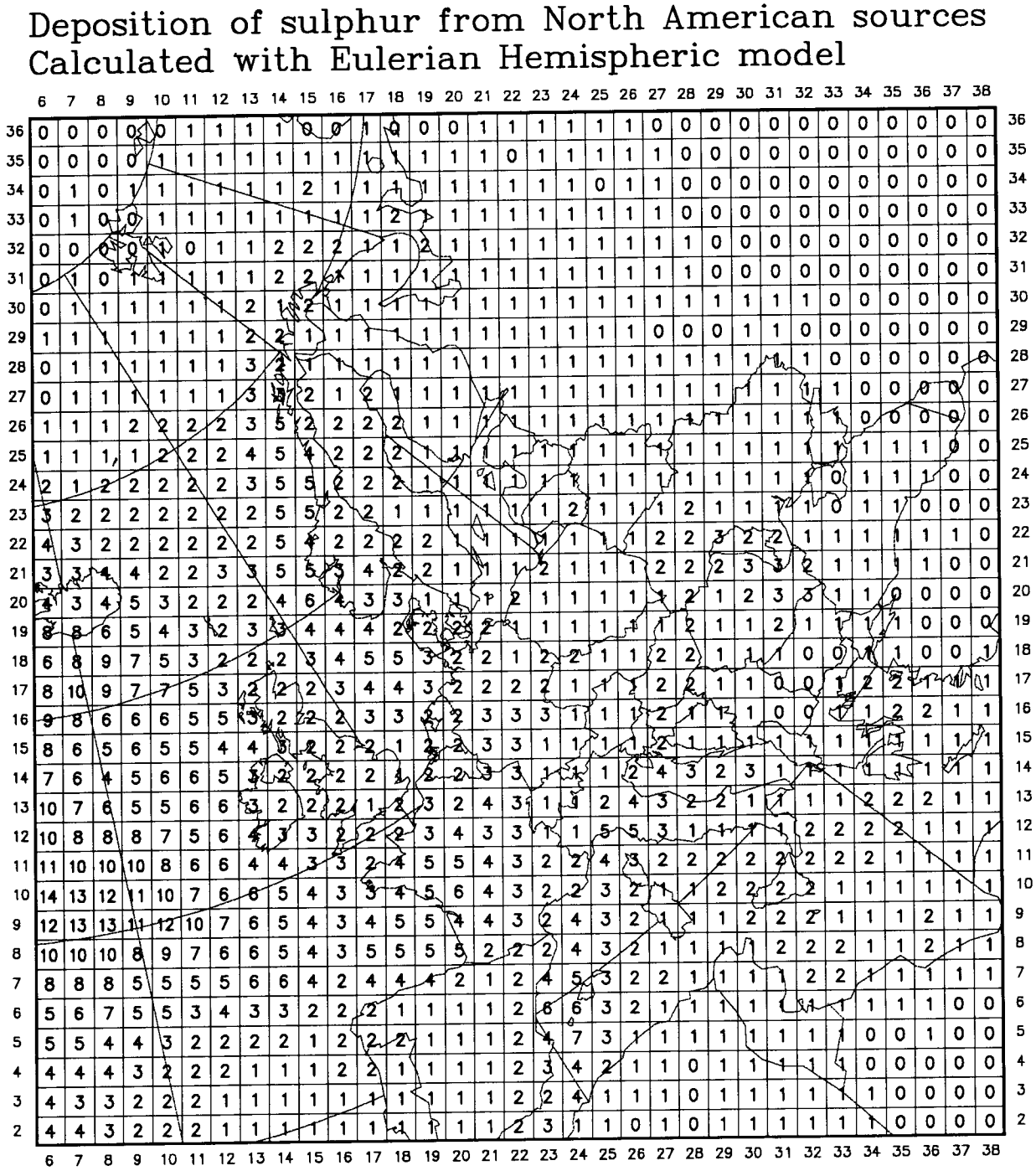
Figure E8 :



Average :
85,87–92

Unit : cg(S)/m2

Figure E9 :

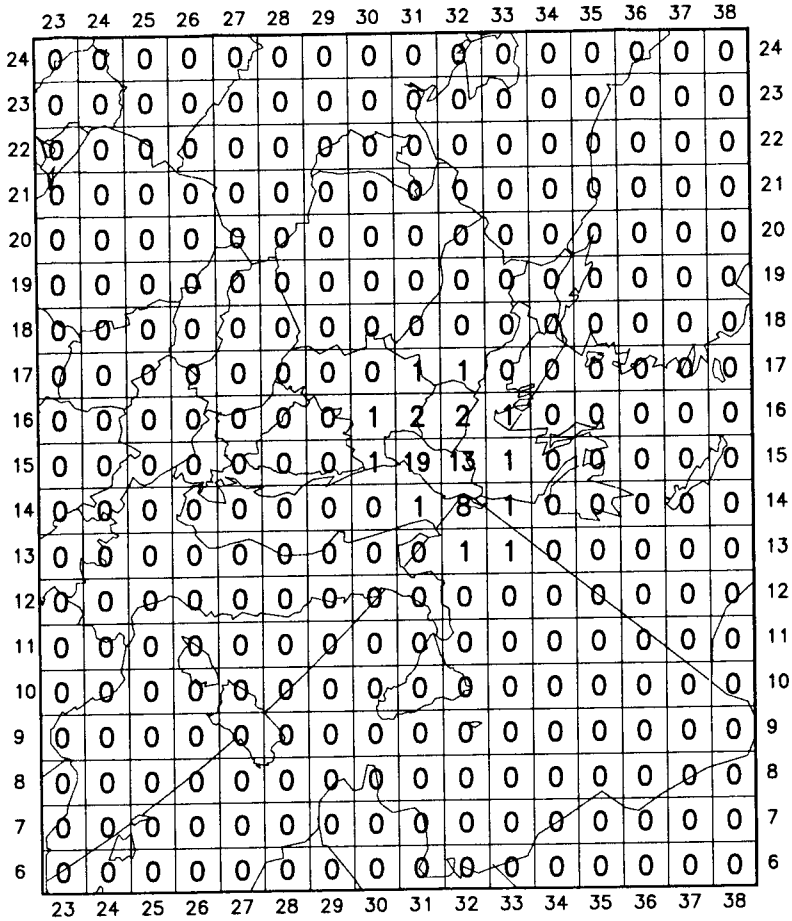


Unit: cg(S)/m2

Emission as
1985

Meteorology
as 1988

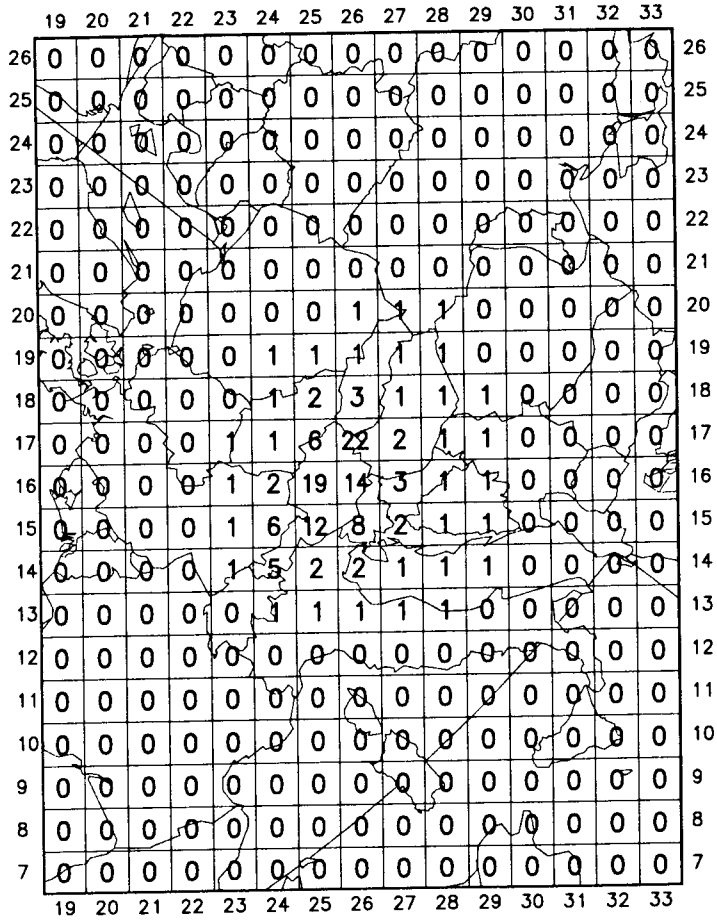
Total dep. of Oxidized Sulphur
Contribution from Albania



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

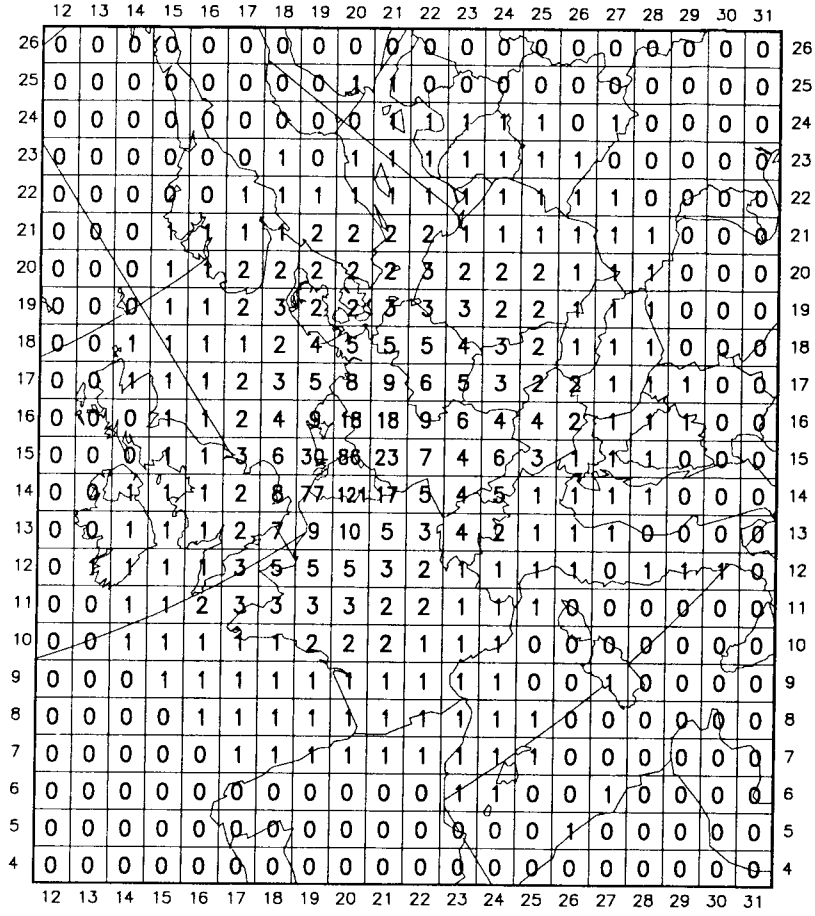
Total dep. of Oxidized Sulphur
Contribution from Austria



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

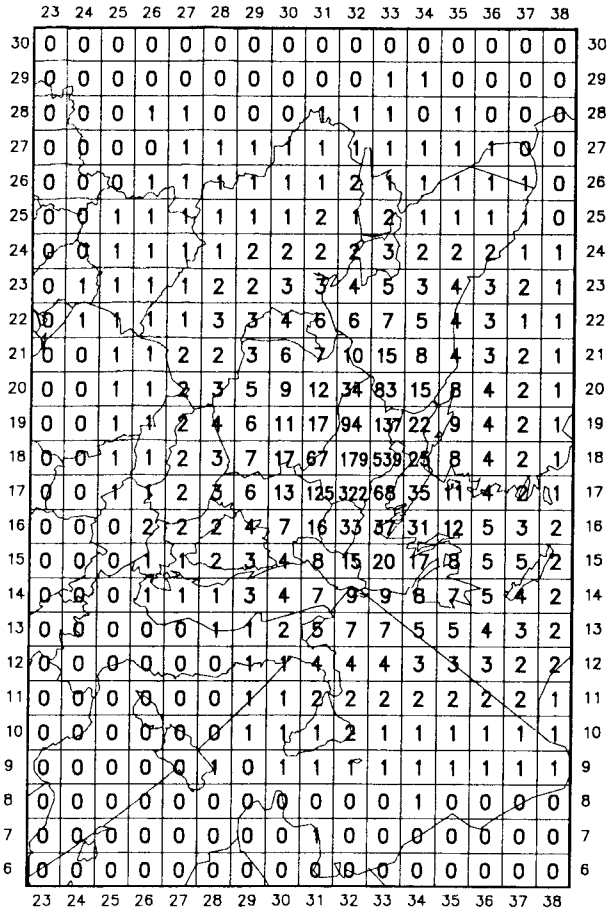
Total dep. of Oxidized Sulphur
Contribution from Belgium



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

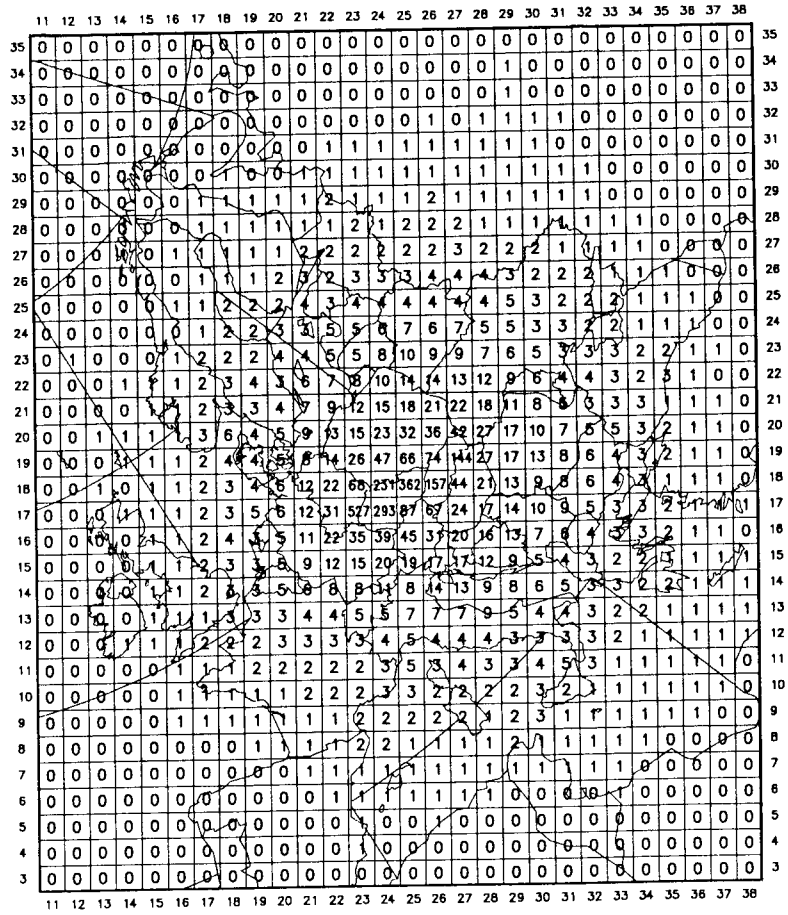
Total dep. of Oxidized Sulphur
Contribution from Bulgaria



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

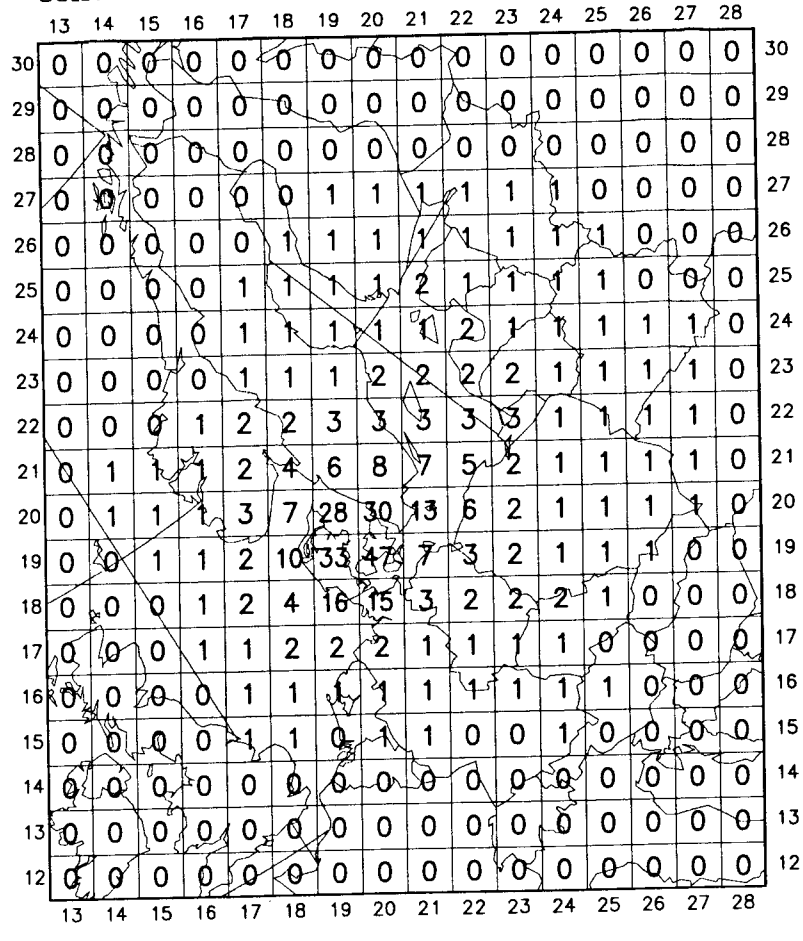
Total dep. of Oxidized Sulphur
Contribution from Czechoslovakia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

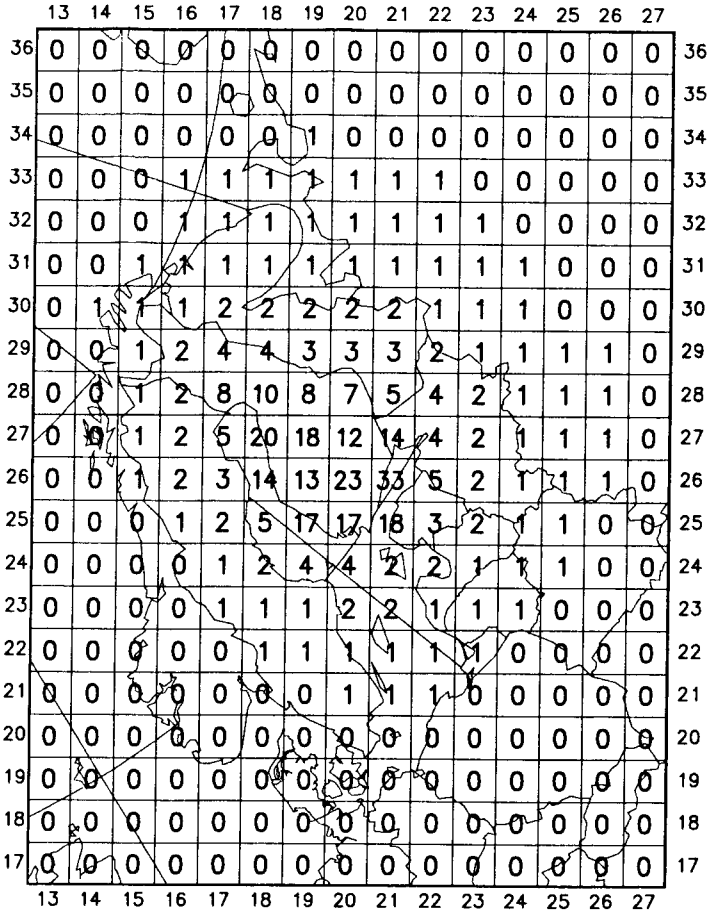
Total dep. of Oxidized Sulphur
Contribution from Denmark



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

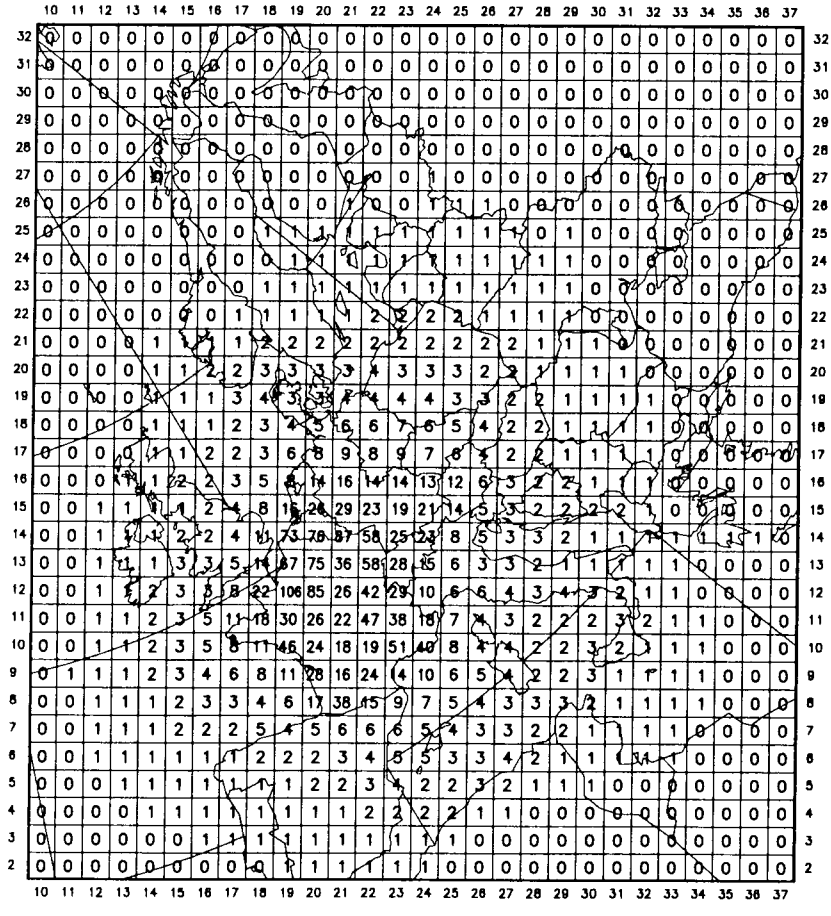
Total dep. of Oxidized Sulphur
Contribution from Finland



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

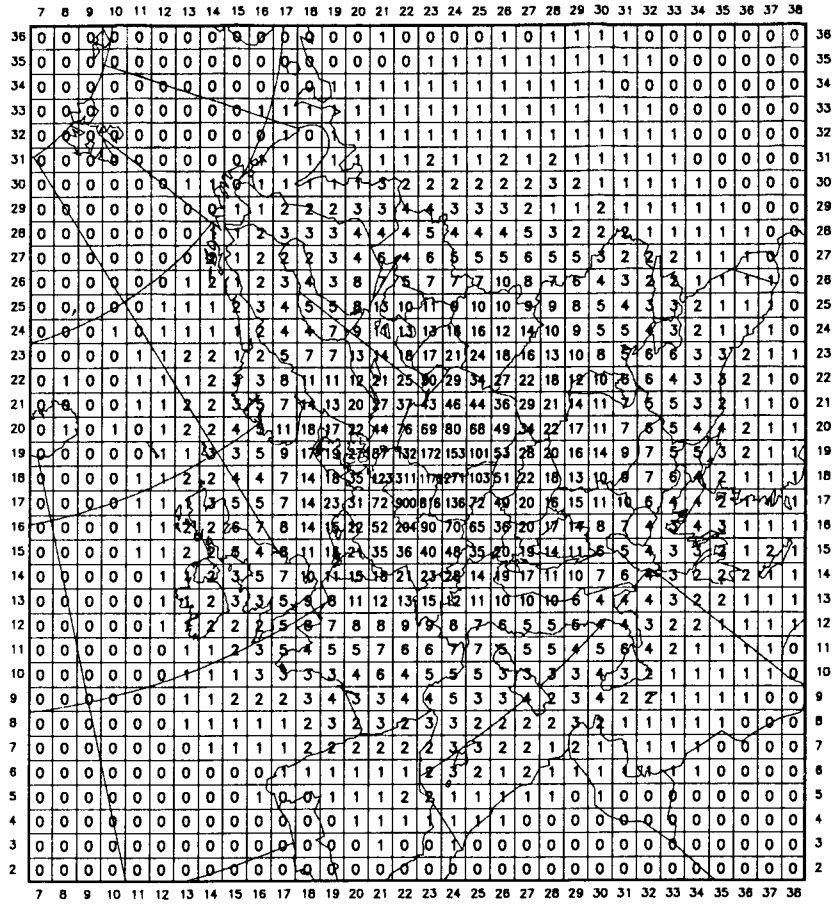
Total dep. of Oxidized Sulphur
Contribution from France



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

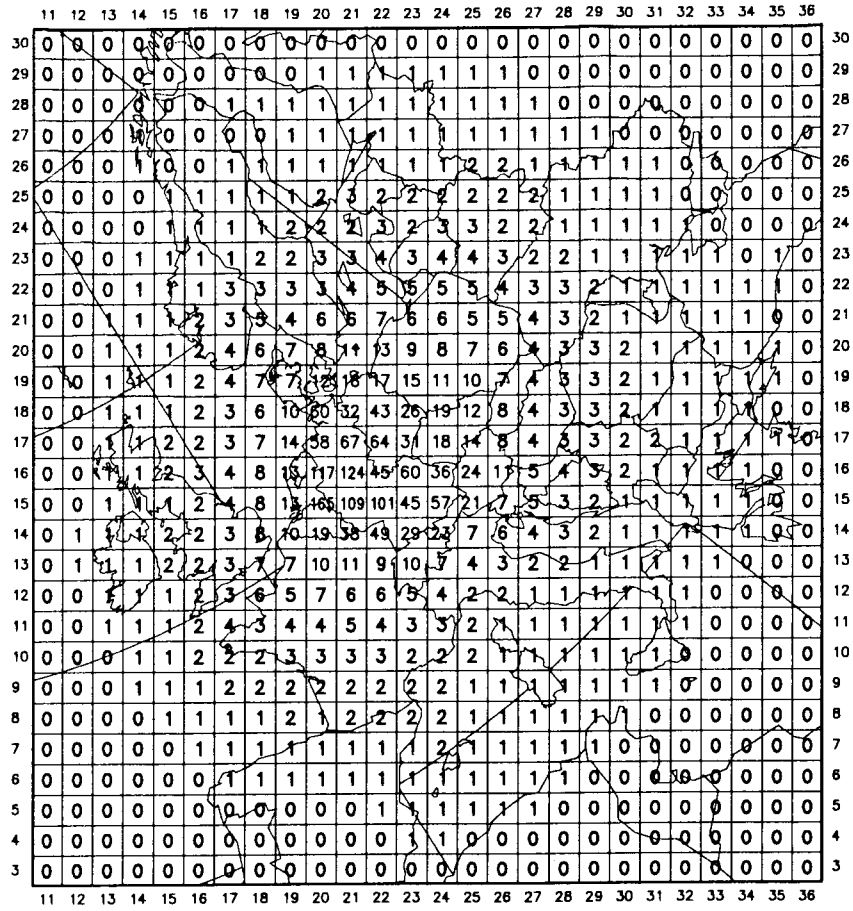
Total dep. of Oxidized Sulphur
Contribution from German Democratic Rep



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

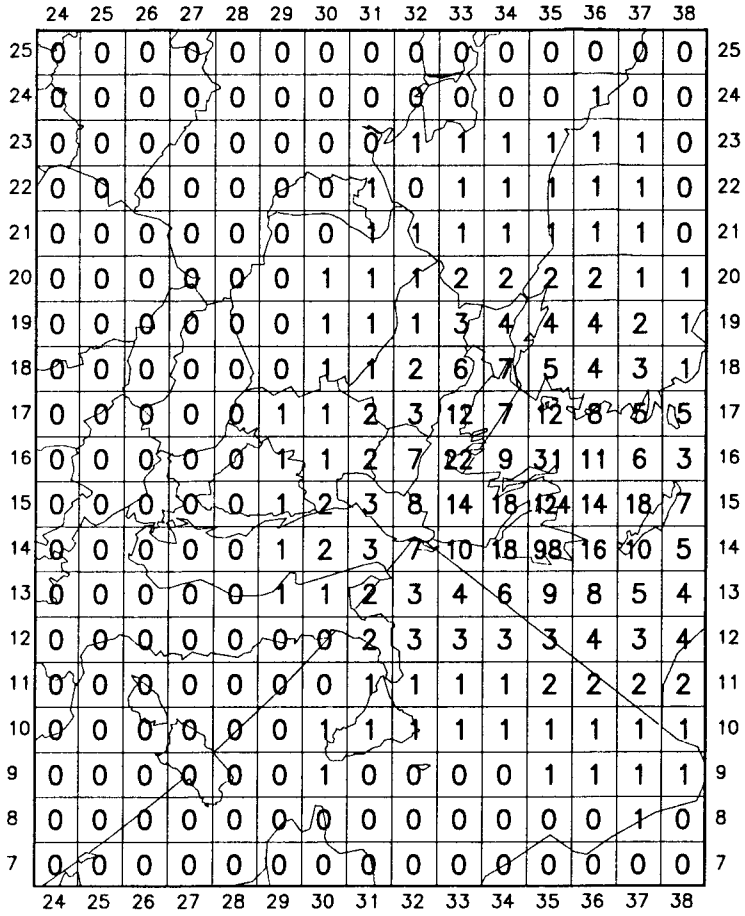
Total dep. of Oxidized Sulphur
Contribution from Germany, Federal Rep.



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

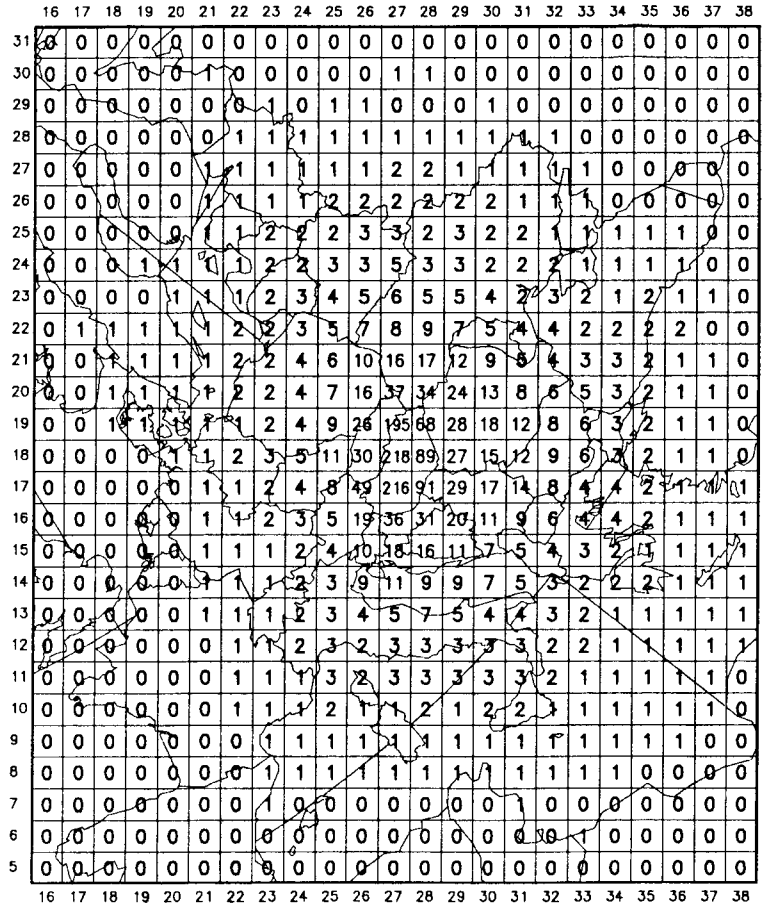
Total dep. of Oxidized Sulphur
Contribution from Greece



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

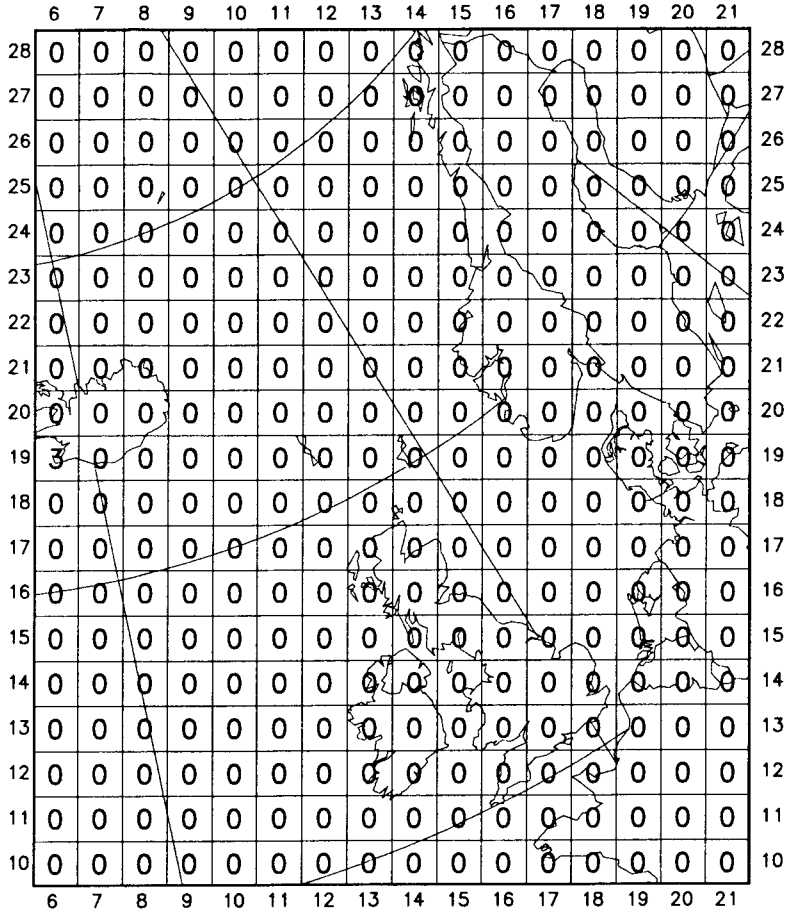
Total dep. of Oxidized Sulphur
Contribution from Hungary



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

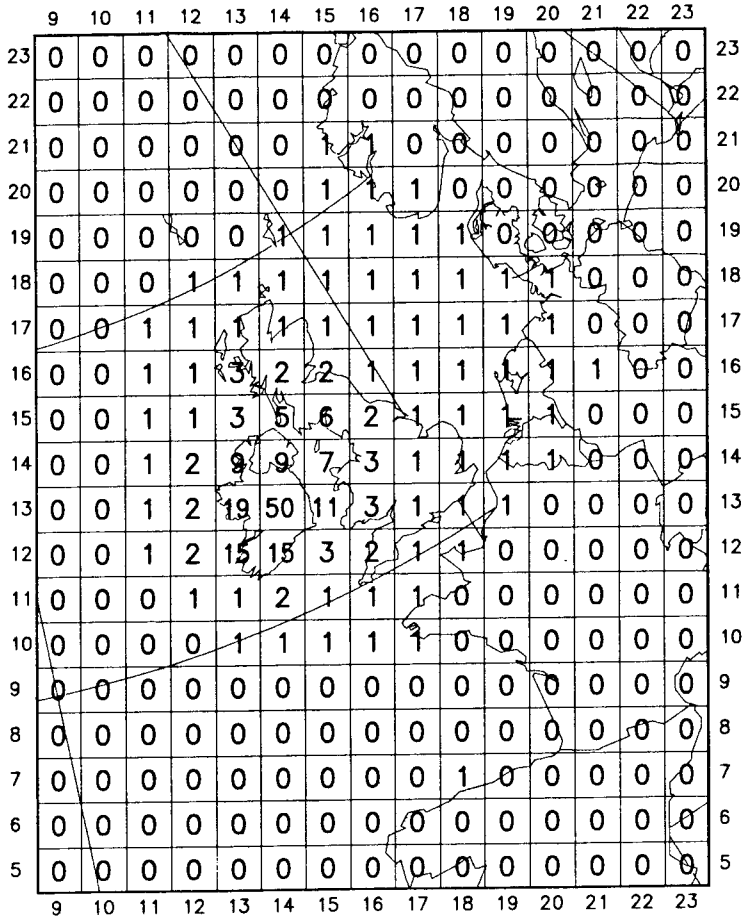
Total dep. of Oxidized Sulphur
Contribution from Iceland



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

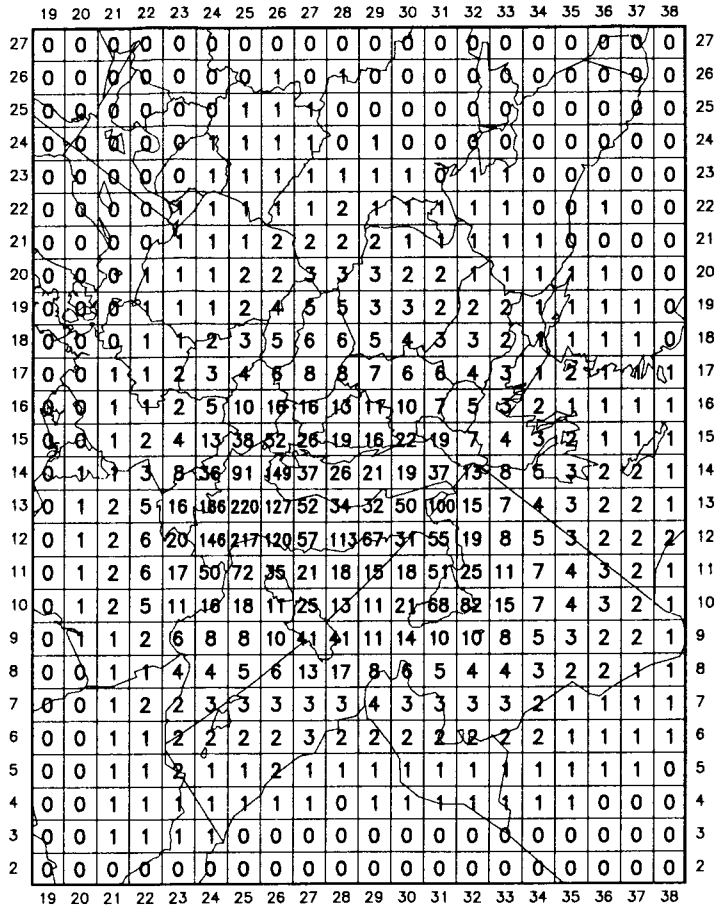
Total dep. of Oxidized Sulphur
Contribution from Ireland



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

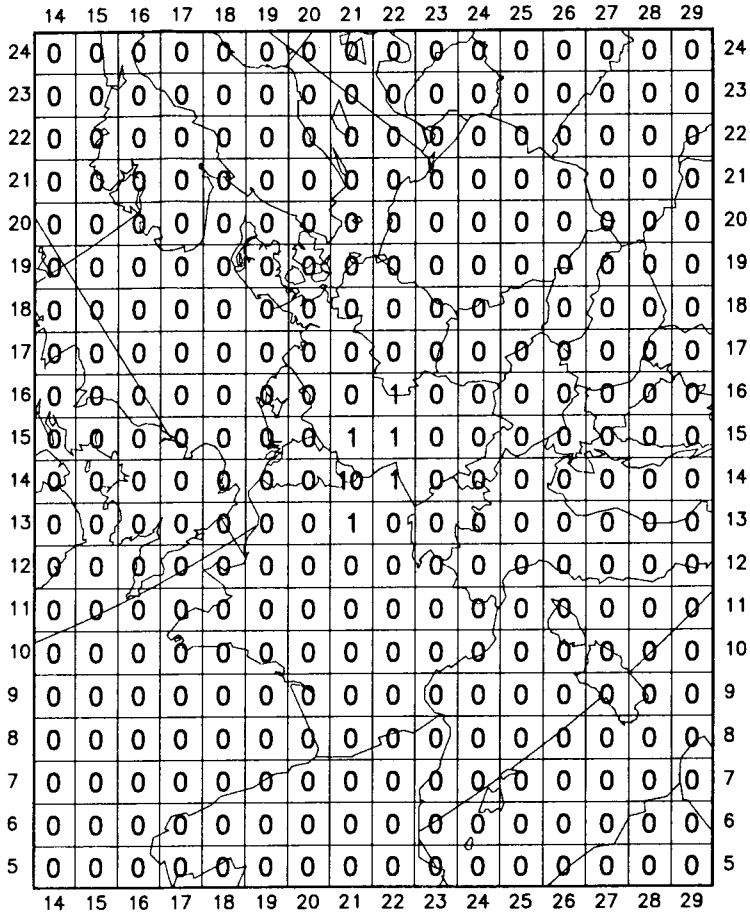
Total dep. of Oxidized Sulphur
Contribution from Italy



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

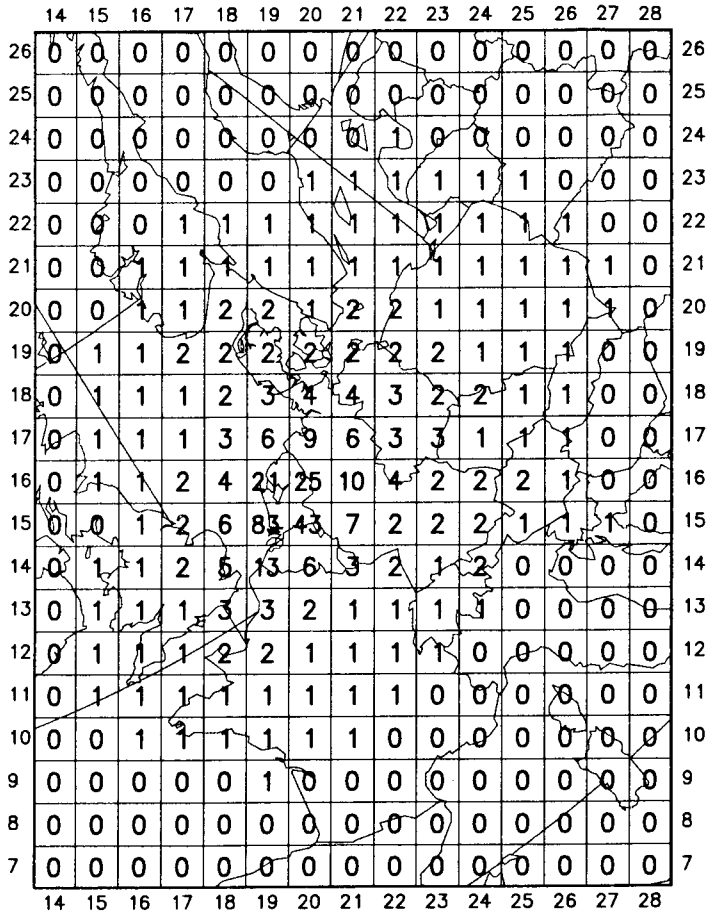
Total dep. of Oxidized Sulphur
Contribution from Luxembourg



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

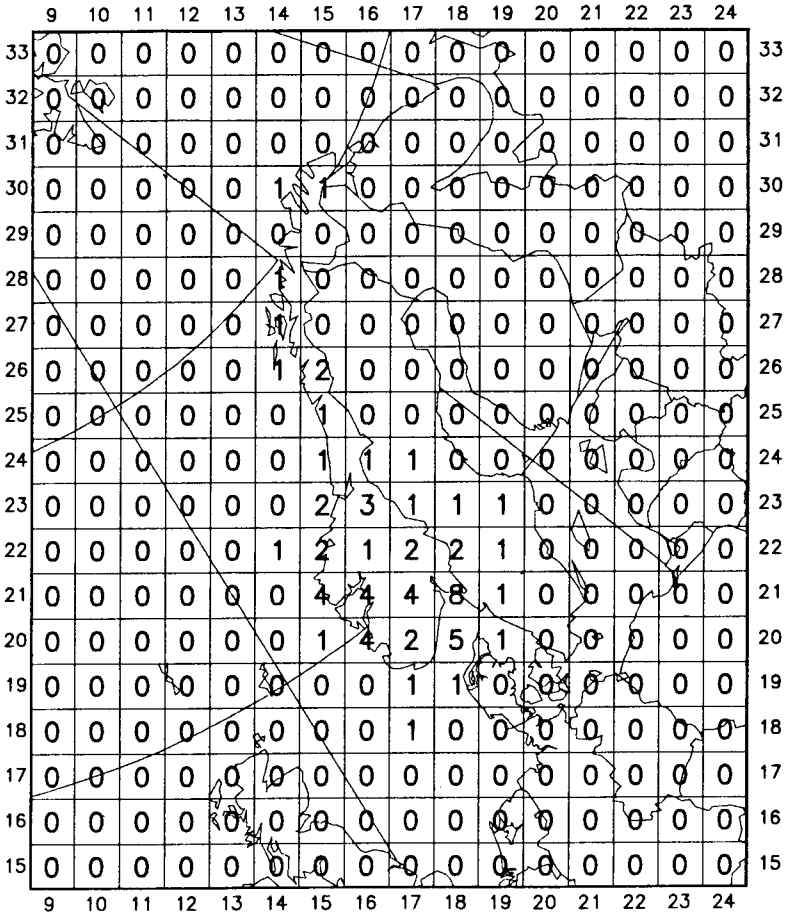
Total dep. of Oxidized Sulphur
Contribution from Netherlands



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

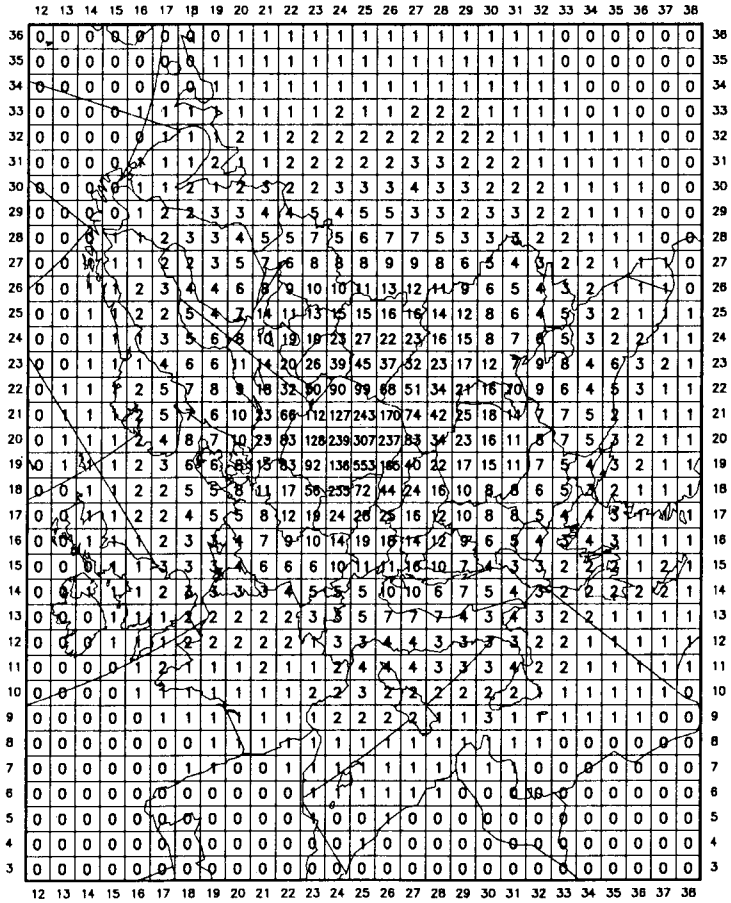
Total dep. of Oxidized Sulphur
Contribution from Norway



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

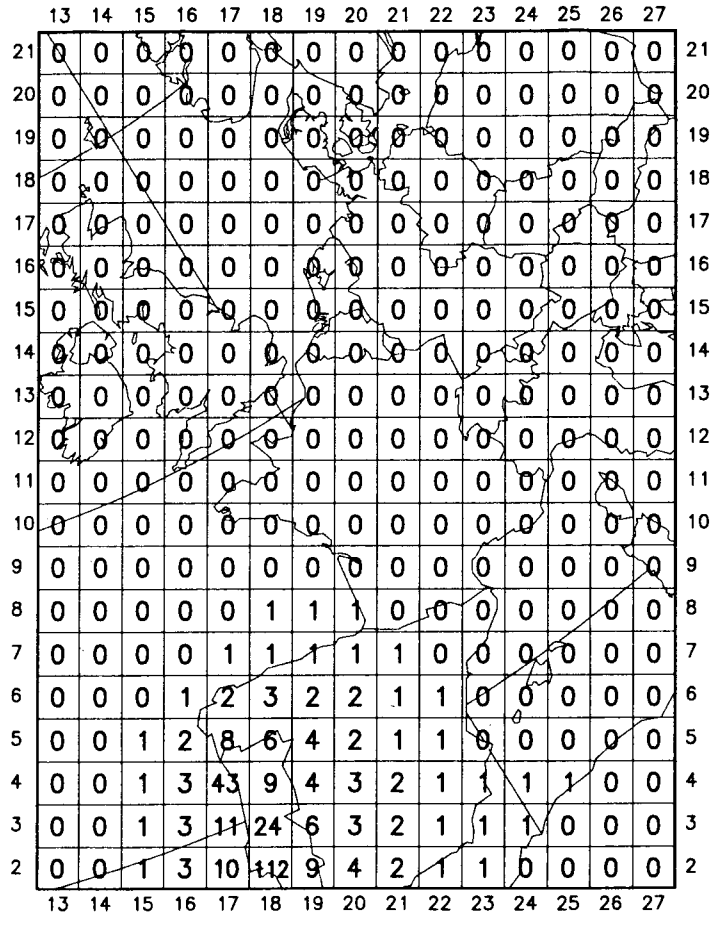
Total dep. of Oxidized Sulphur
Contribution from Poland



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

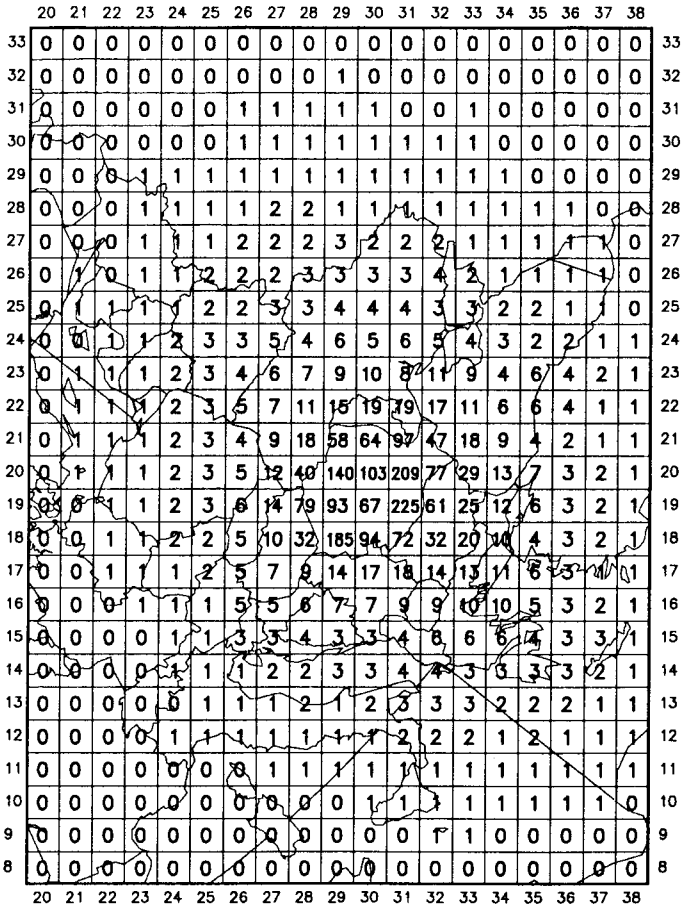
Total dep. of Oxidized Sulphur
Contribution from Portugal



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

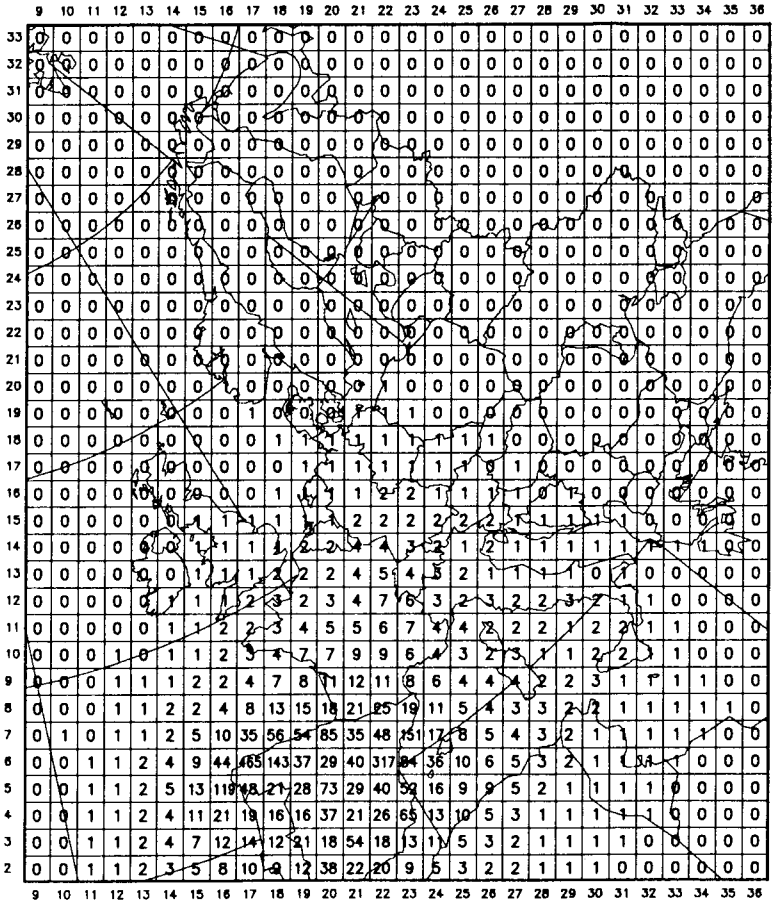
Total dep. of Oxidized Sulphur
Contribution from Romania



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

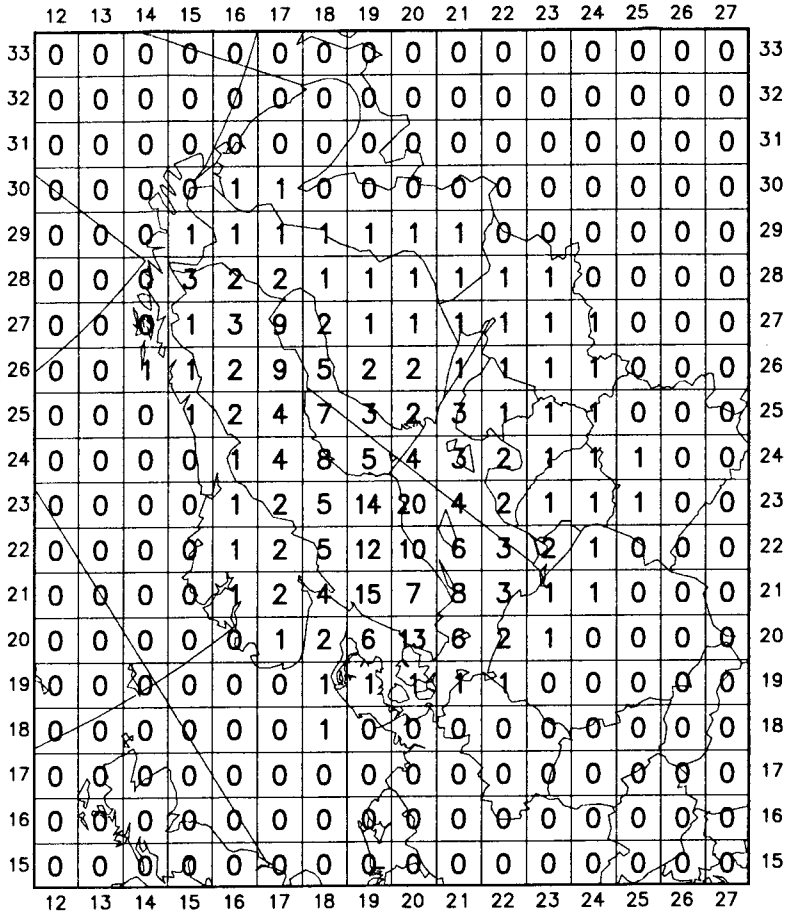
Total dep. of Oxidized Sulphur
Contribution from Spain



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

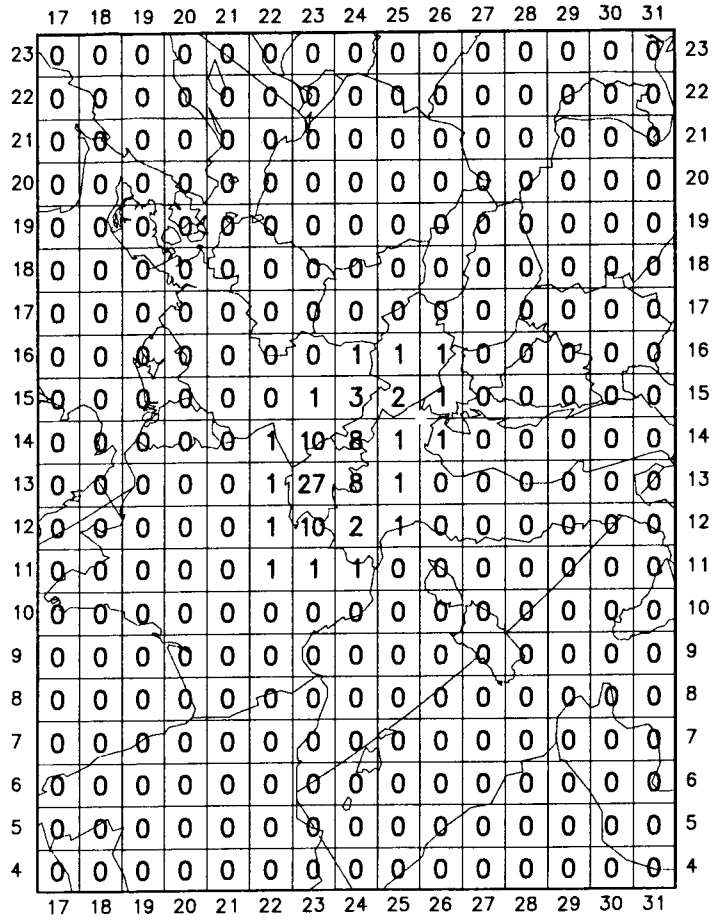
Total dep. of Oxidized Sulphur
Contribution from Sweden



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

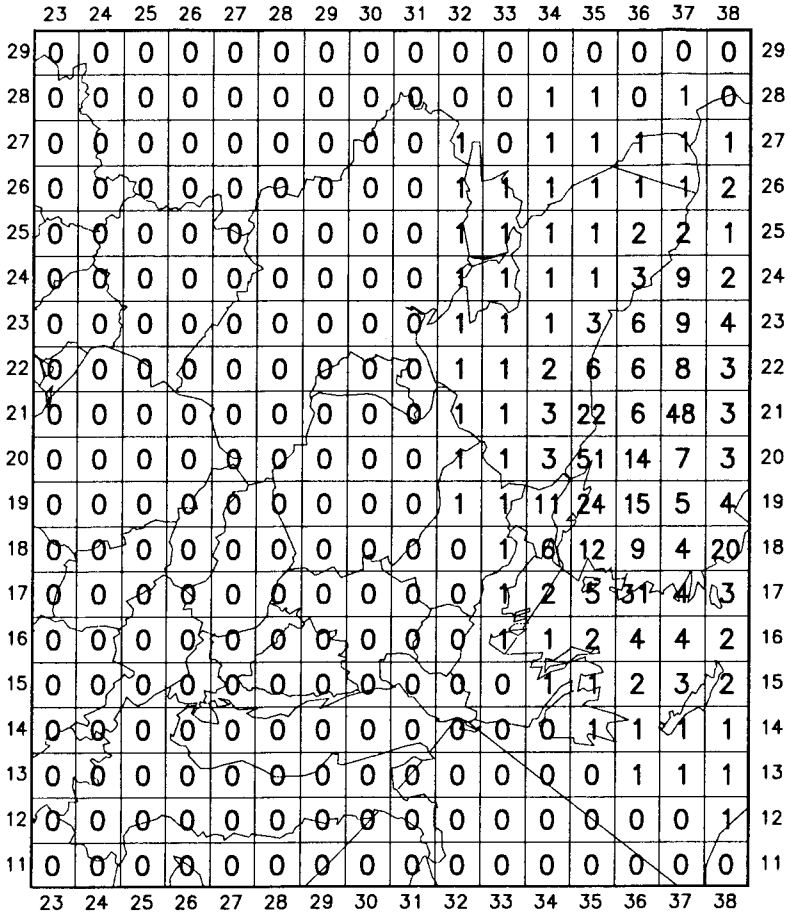
Total dep. of Oxidized Sulphur
Contribution from Switzerland



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

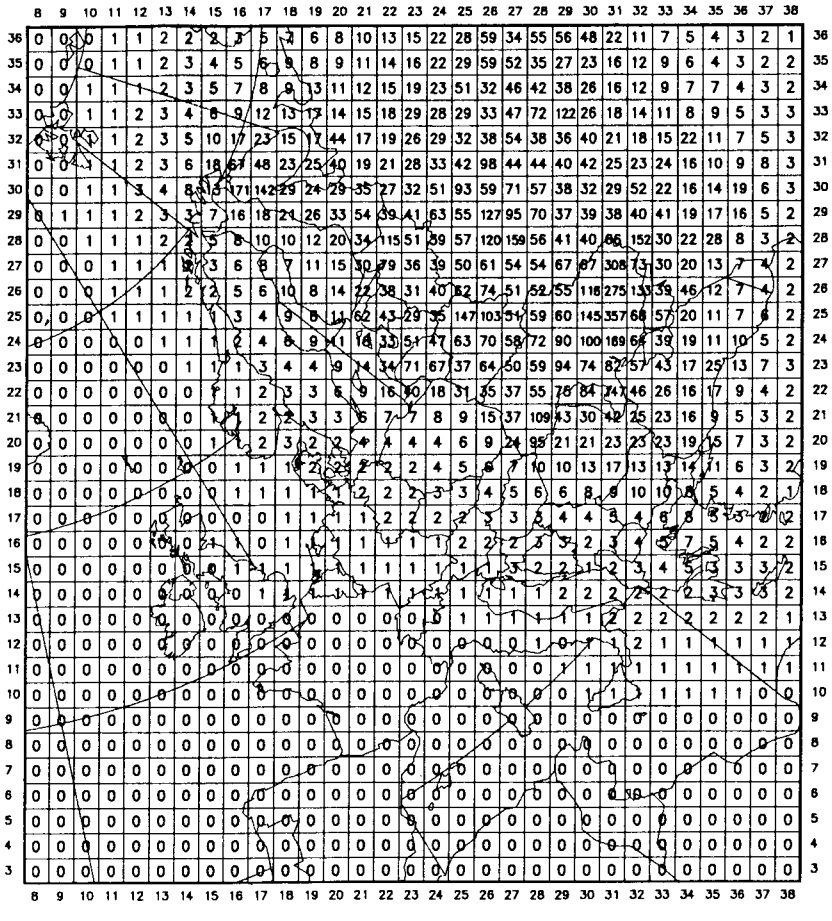
Total dep. of Oxidized Sulphur
Contribution from Turkey



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

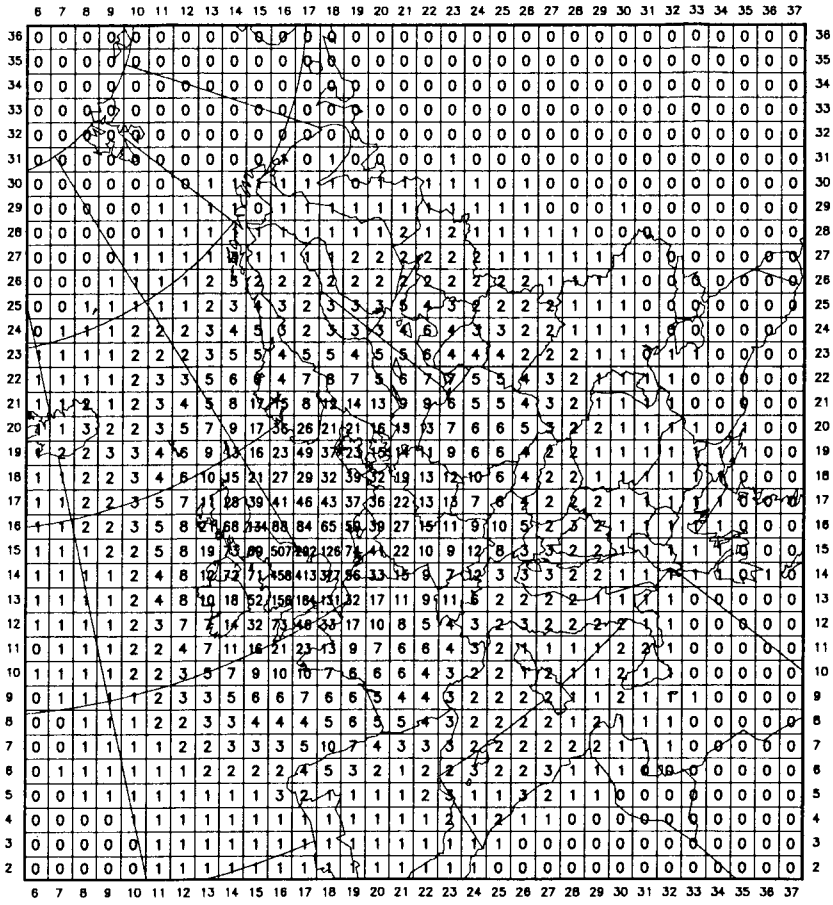
Total dep. of Oxidized Sulphur
Contribution from USSR (European)



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

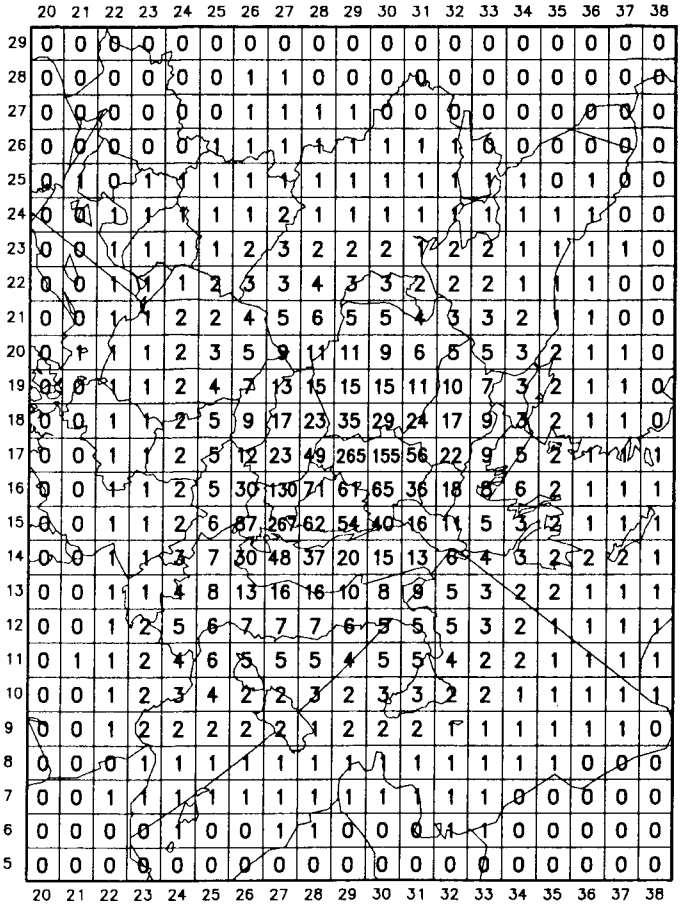
Total dep. of Oxidized Sulphur
Contribution from United Kingdom



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

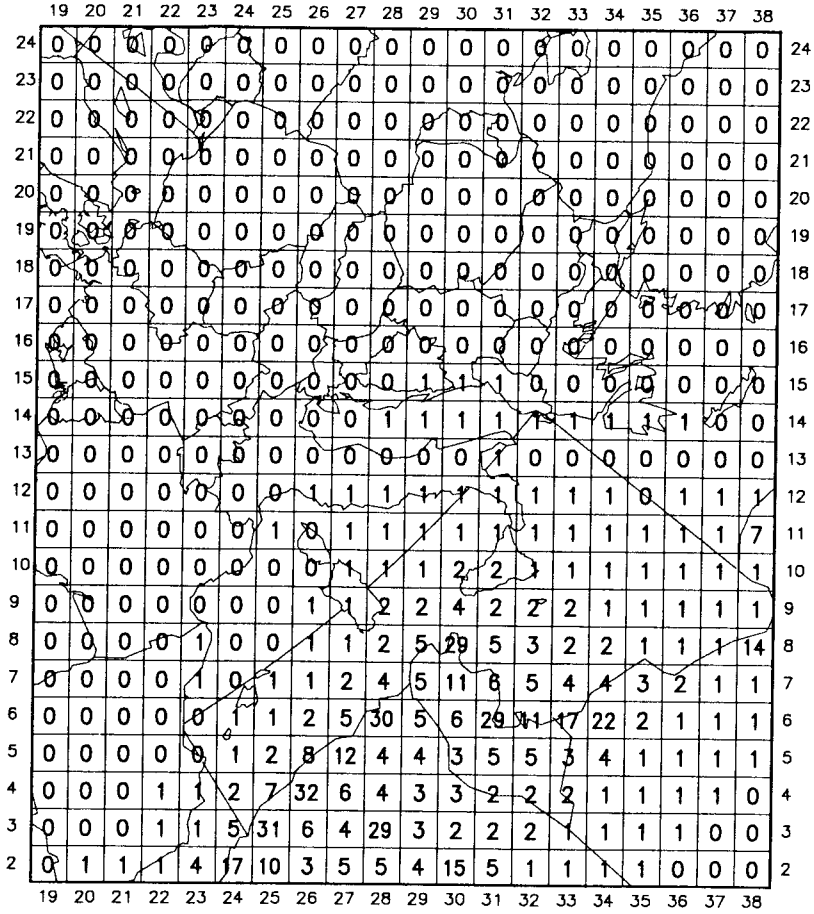
Total dep. of Oxidized Sulphur
Contribution from Yugoslavia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

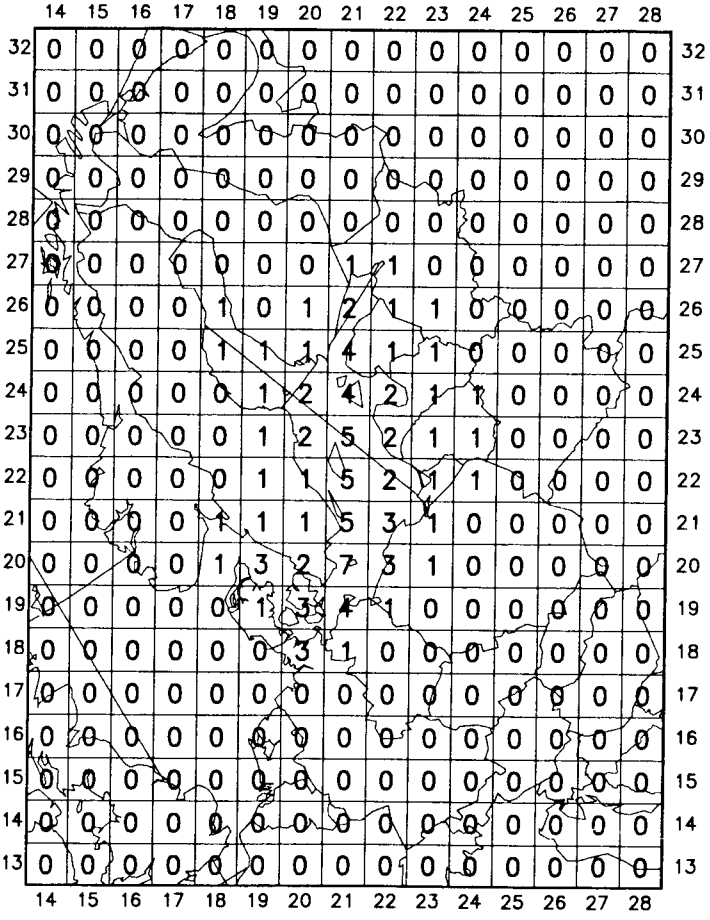
Total dep. of Oxidized Sulphur
Contribution from remaining land areas



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

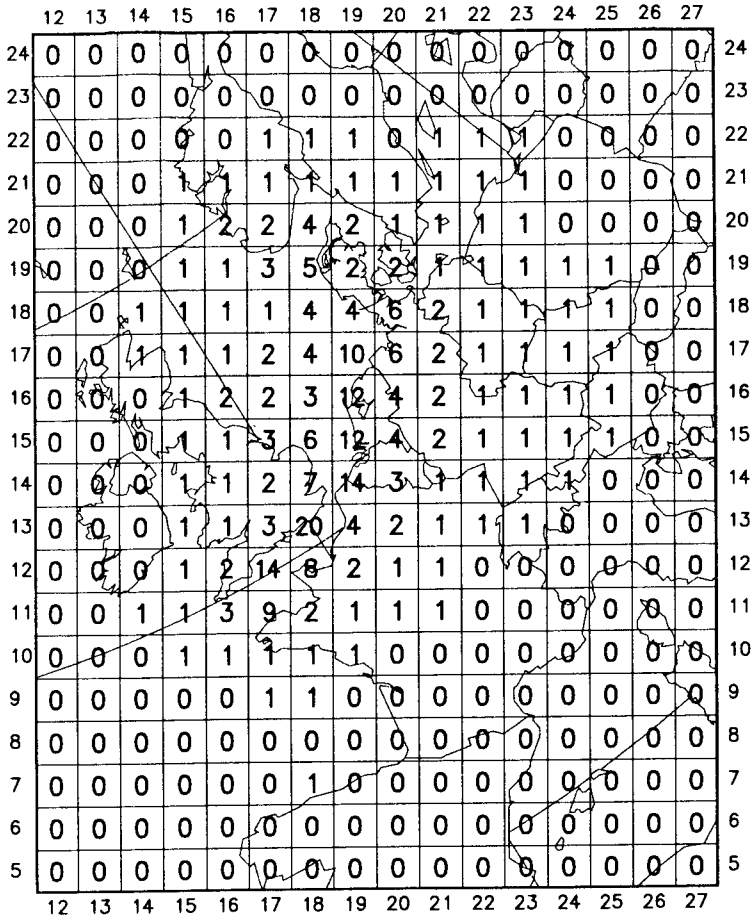
Total dep. of Oxidized Sulphur
Contribution from int. trade, Baltic sea



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

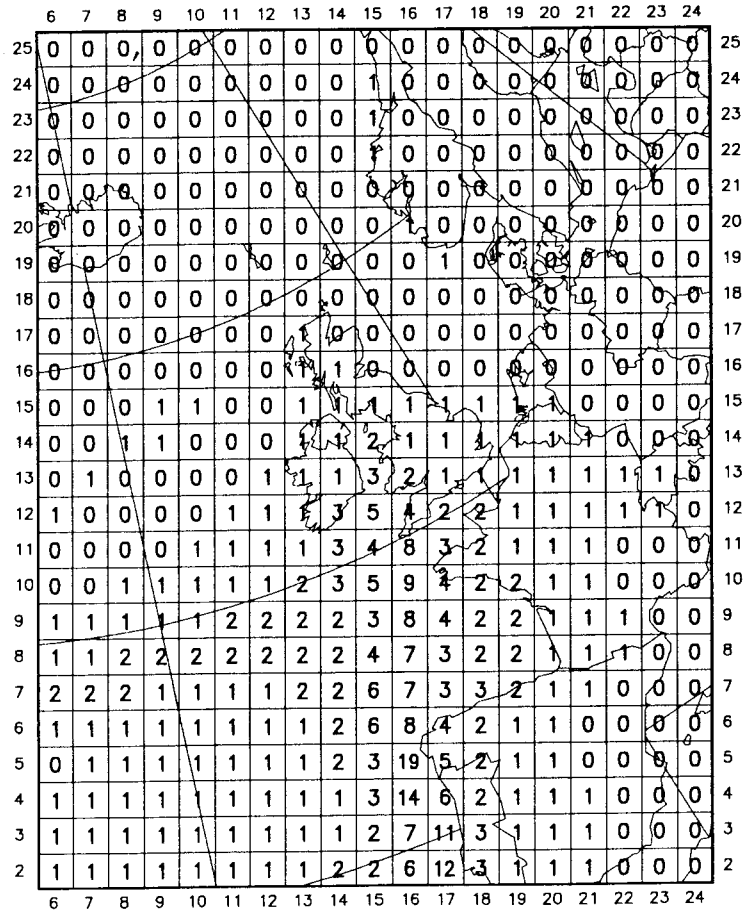
Total dep. of Oxidized Sulphur
Contribution from int. trade, North sea



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

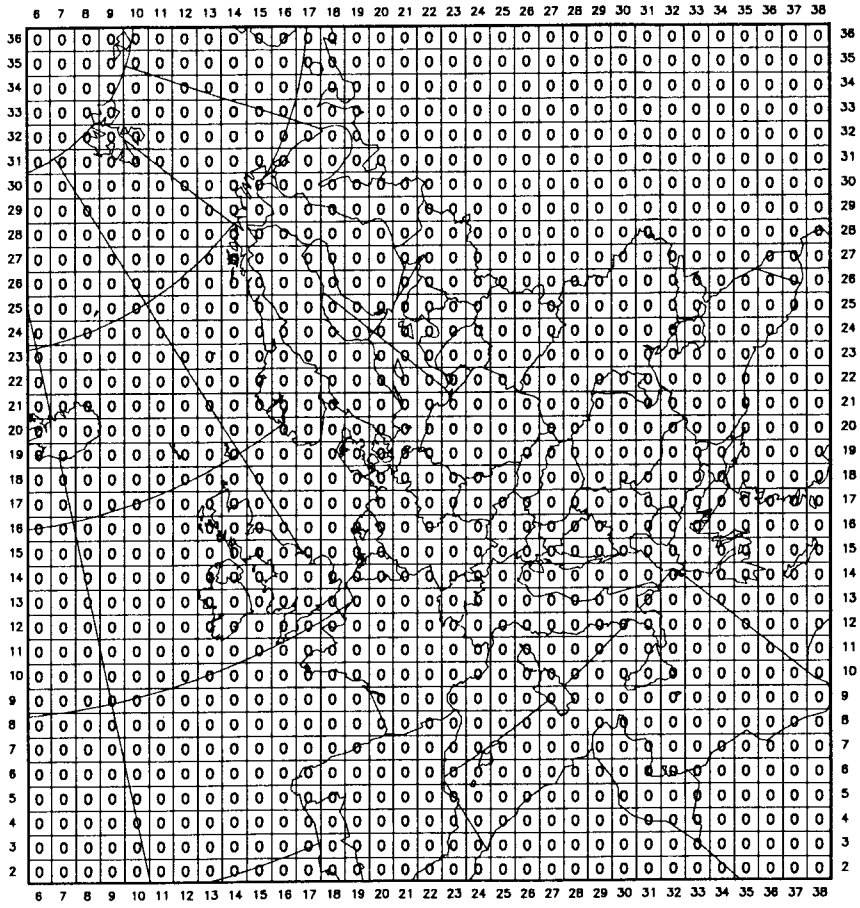
Total dep. of Oxidized Sulphur
Contribution from int. trade, rem. Atlantic waters



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

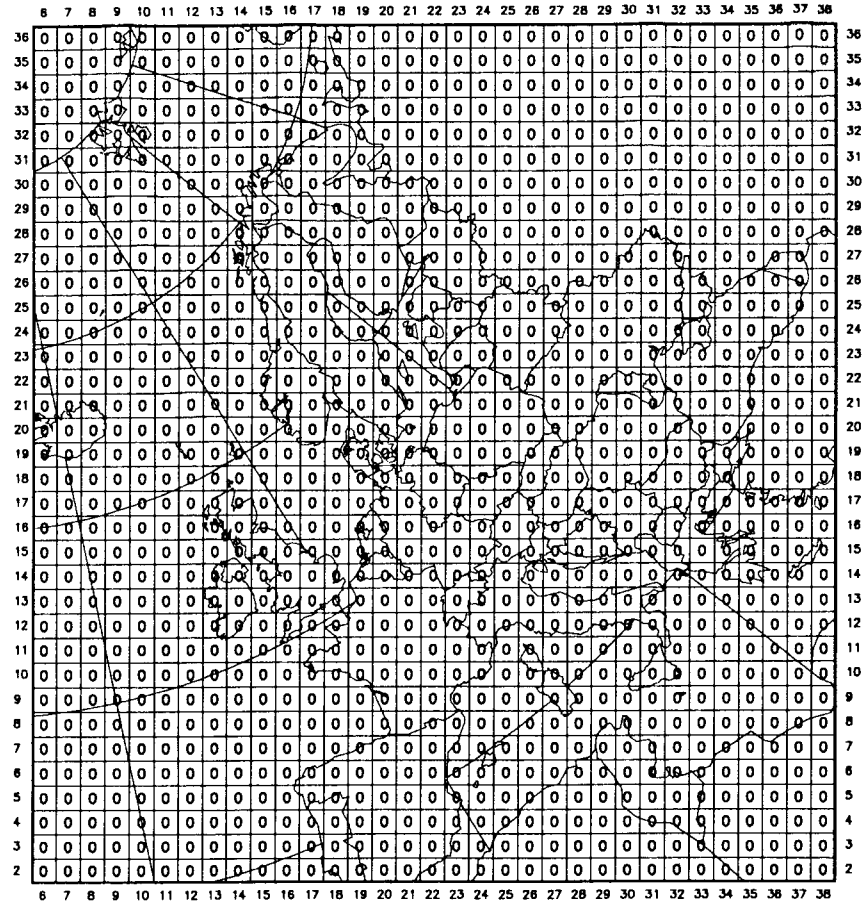
Total dep. of Oxidized Sulphur
Contribution from int. trade, Mediteranian Sea



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

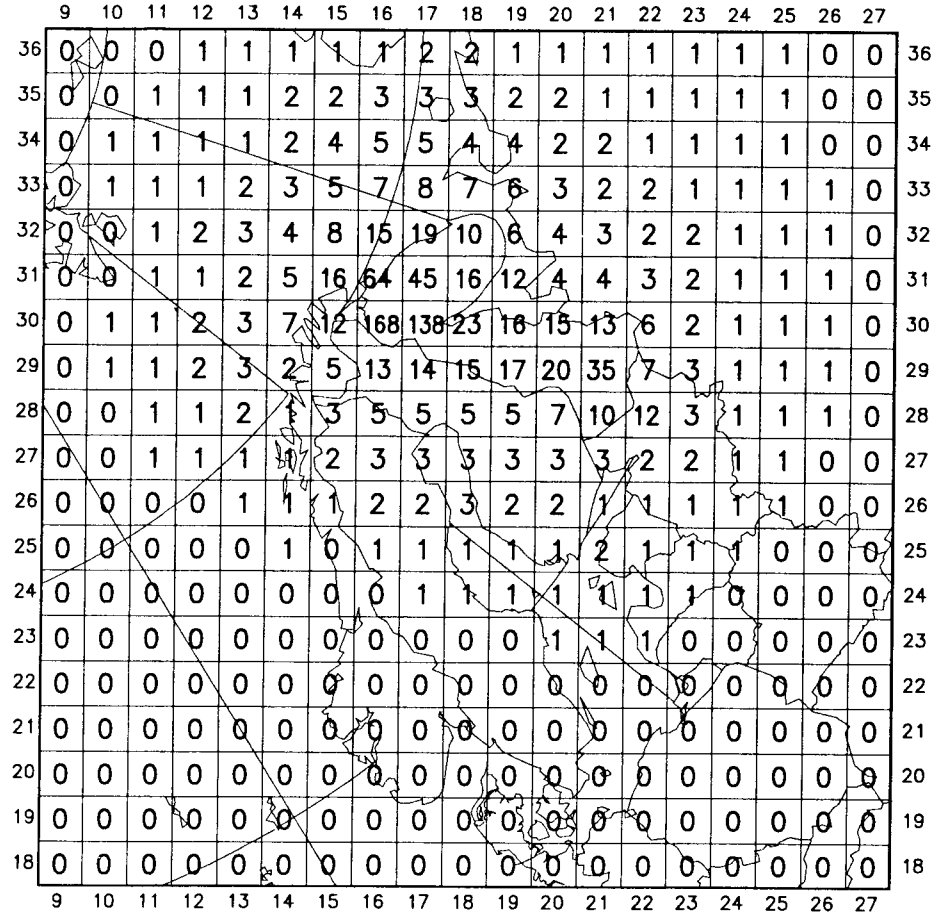
Total dep. of Oxidized Sulphur
Contribution from int. trade, Black sea



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

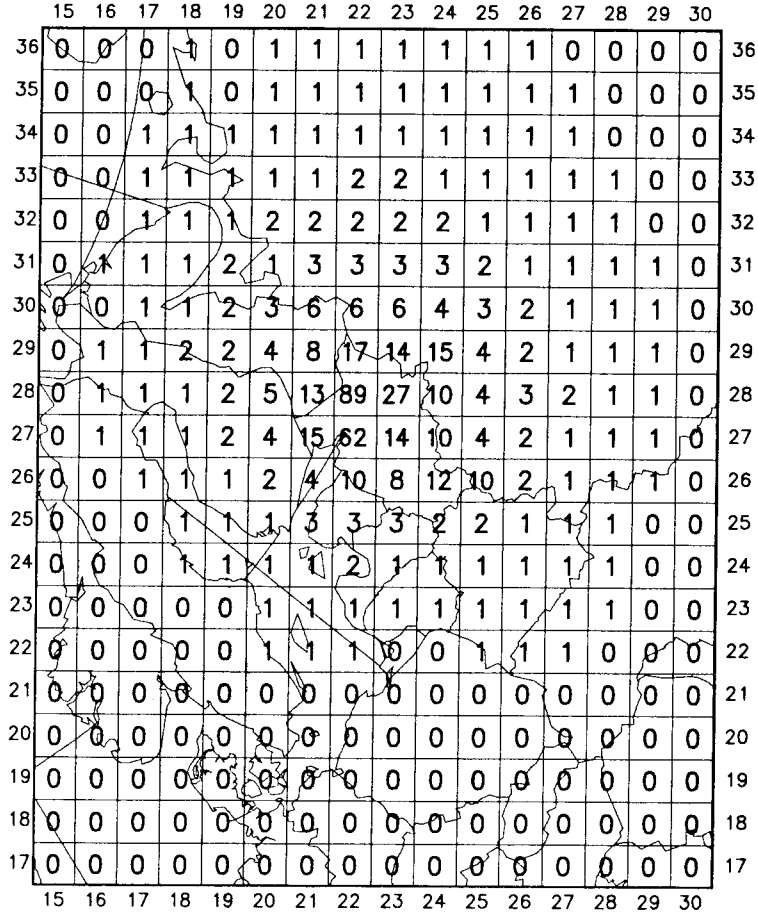
Total dep. of Oxidized Sulphur
Contribution from Kola / Karelia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

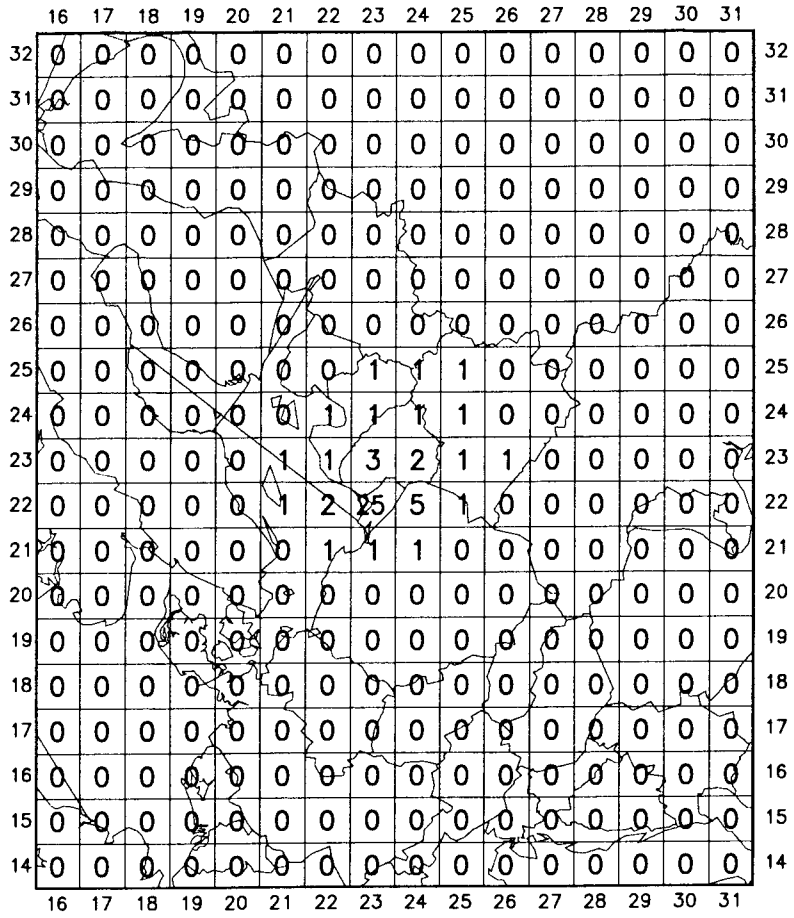
Total dep. of Oxidized Sulphur
Contribution from Leningrad / Novgorod–Pskov



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

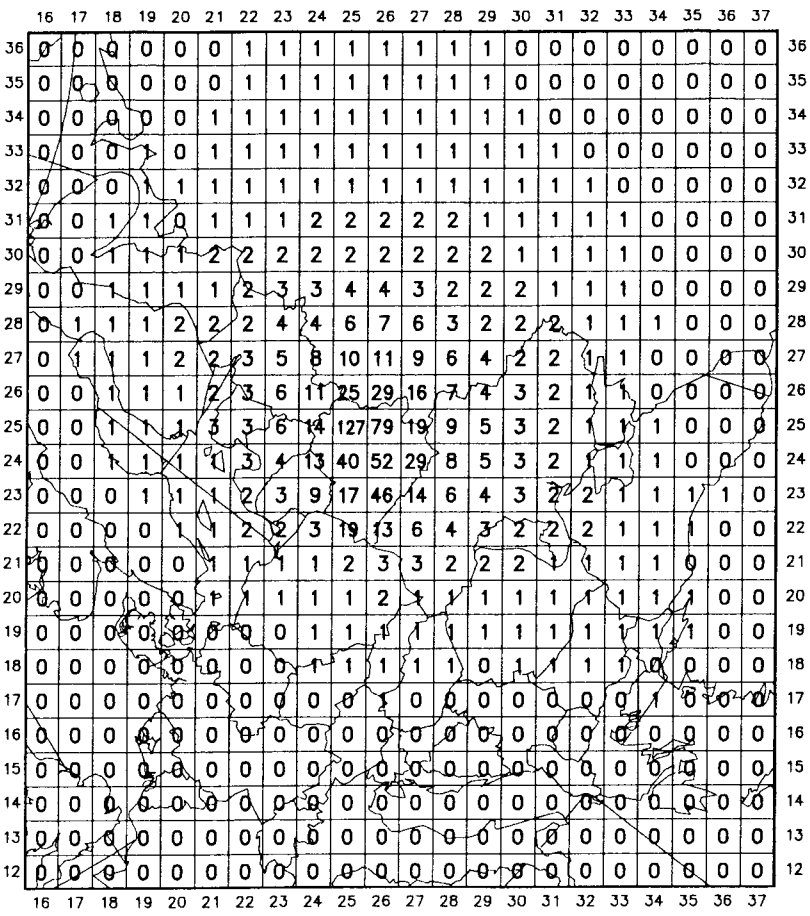
Total dep. of Oxidized Sulphur
Contribution from Kaliningrad



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

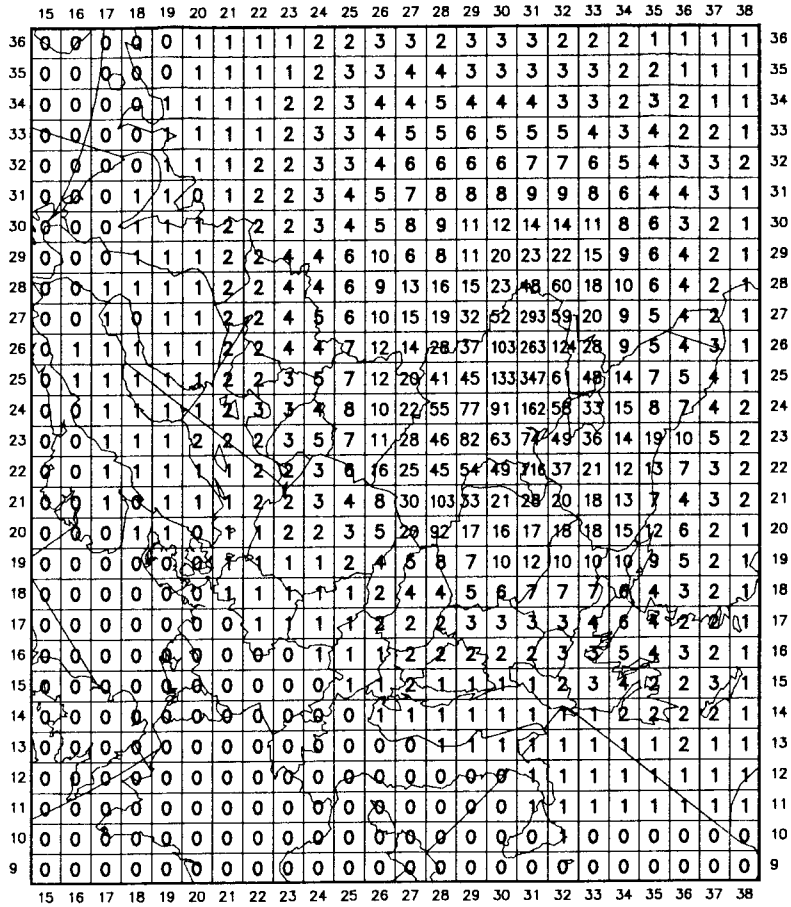
Total dep. of Oxidized Sulphur
Contribution from Byelorussia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

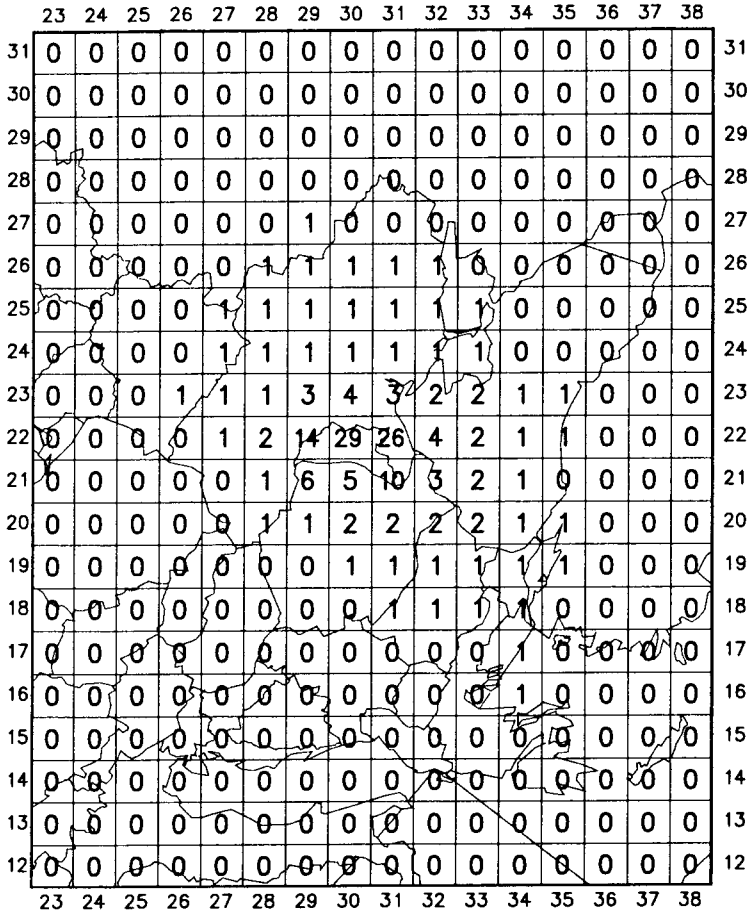
Total dep. of Oxidized Sulphur
Contribution from Ukraine



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

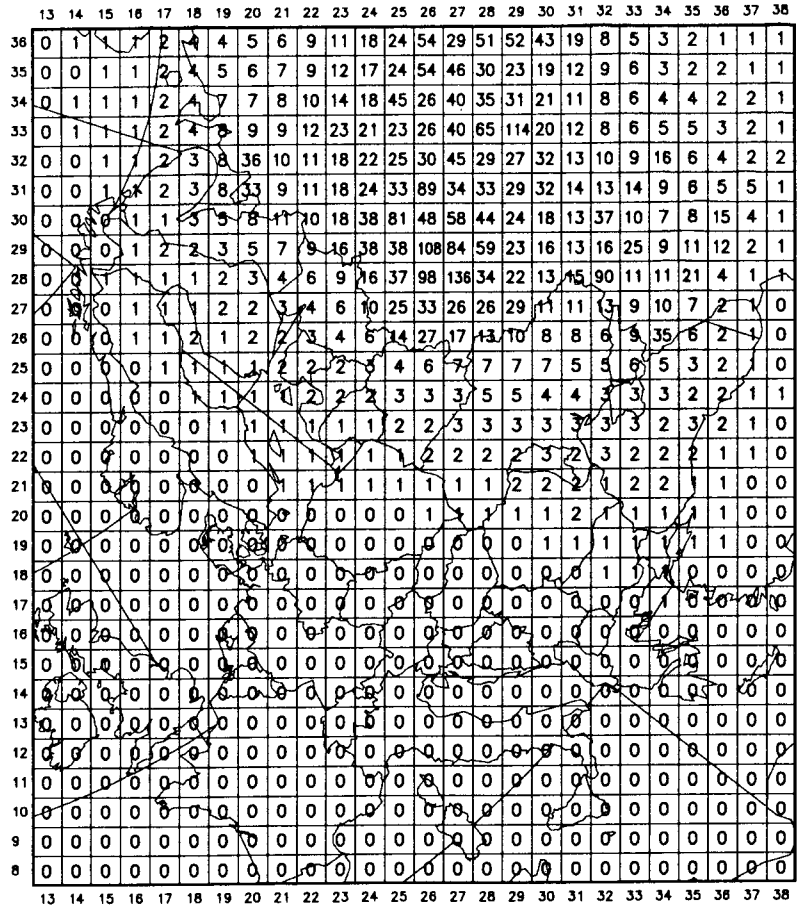
Total dep. of Oxidized Sulphur
Contribution from Moldavia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

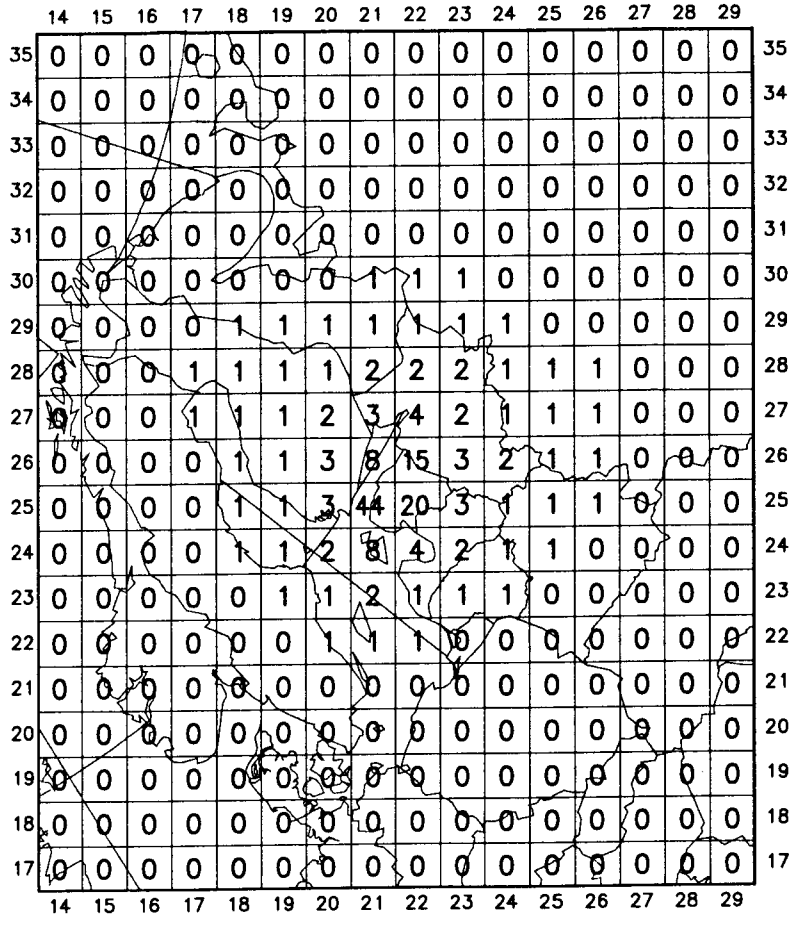
Total dep. of Oxidized Sulphur
Contribution from rest of Russia (European part)



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

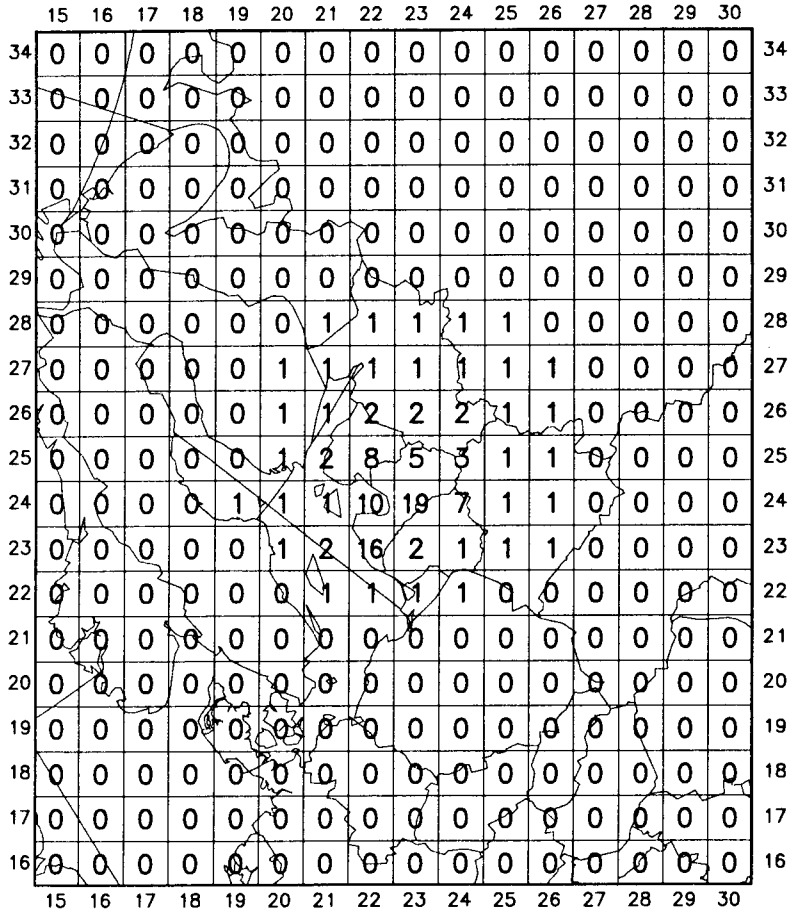
Total dep. of Oxidized Sulphur
Contribution from Estonia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

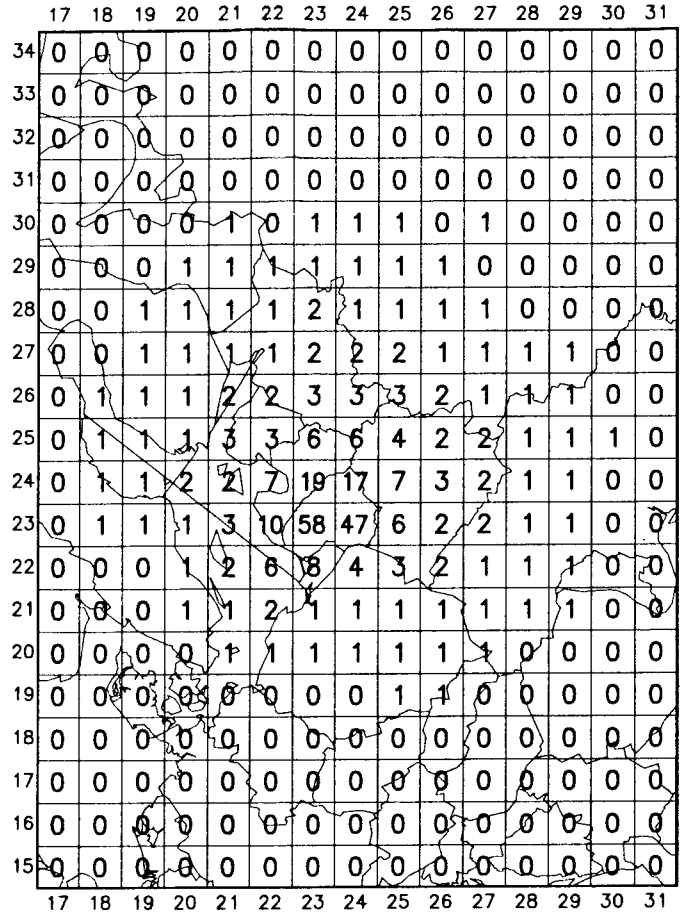
Total dep. of Oxidized Sulphur
Contribution from Latvia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

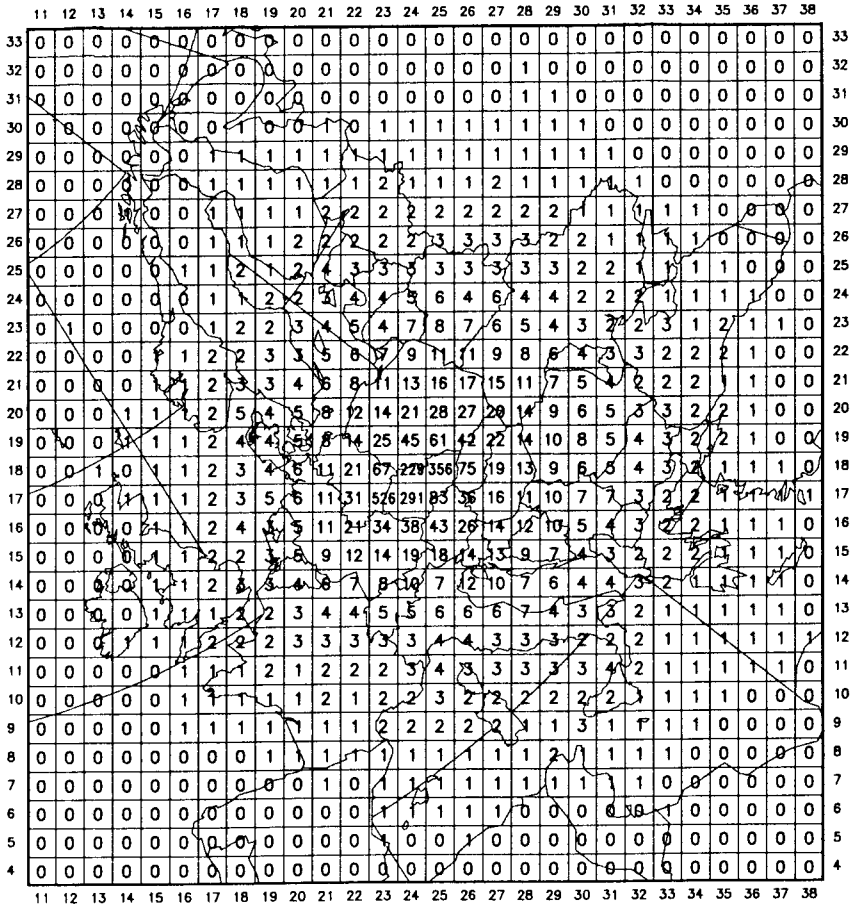
Total dep. of Oxidized Sulphur
Contribution from Lithuania



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

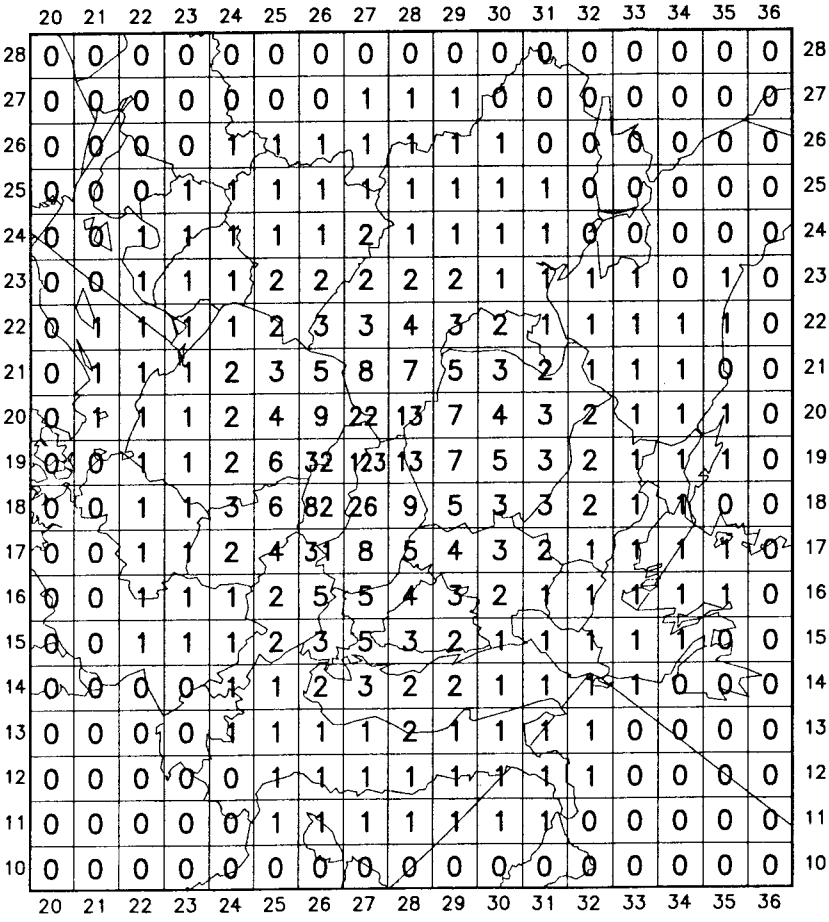
Total dep. of Oxidized Sulphur
Contribution from Czech Republic



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

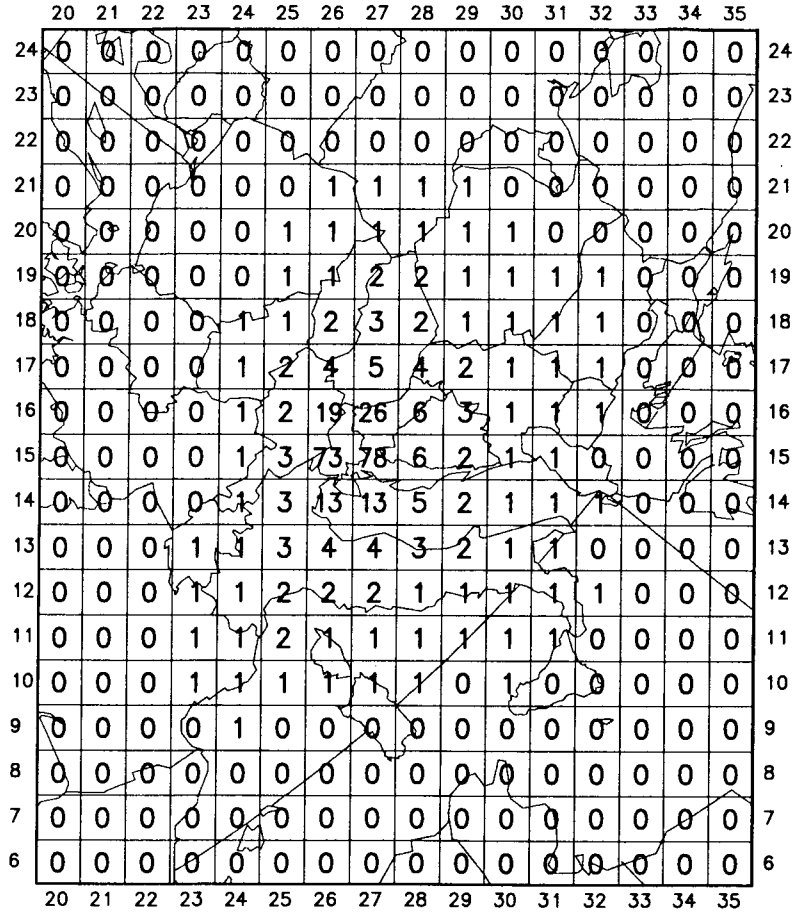
Total dep. of Oxidized Sulphur
Contribution from Slovakia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

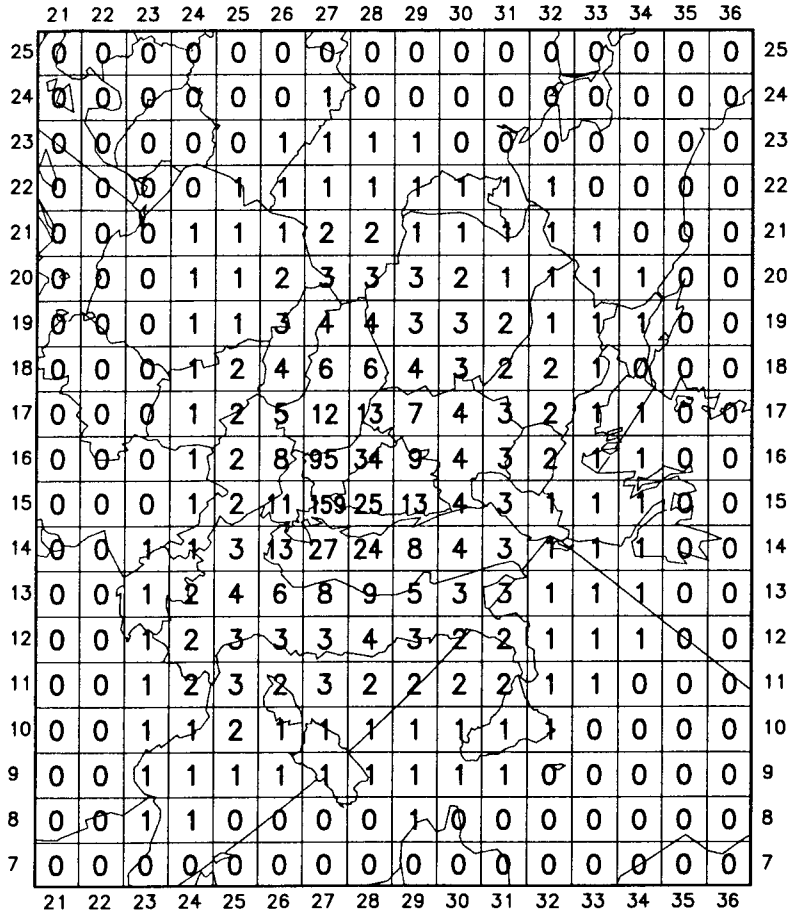
Total dep. of Oxidized Sulphur
Contribution from Slovenia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

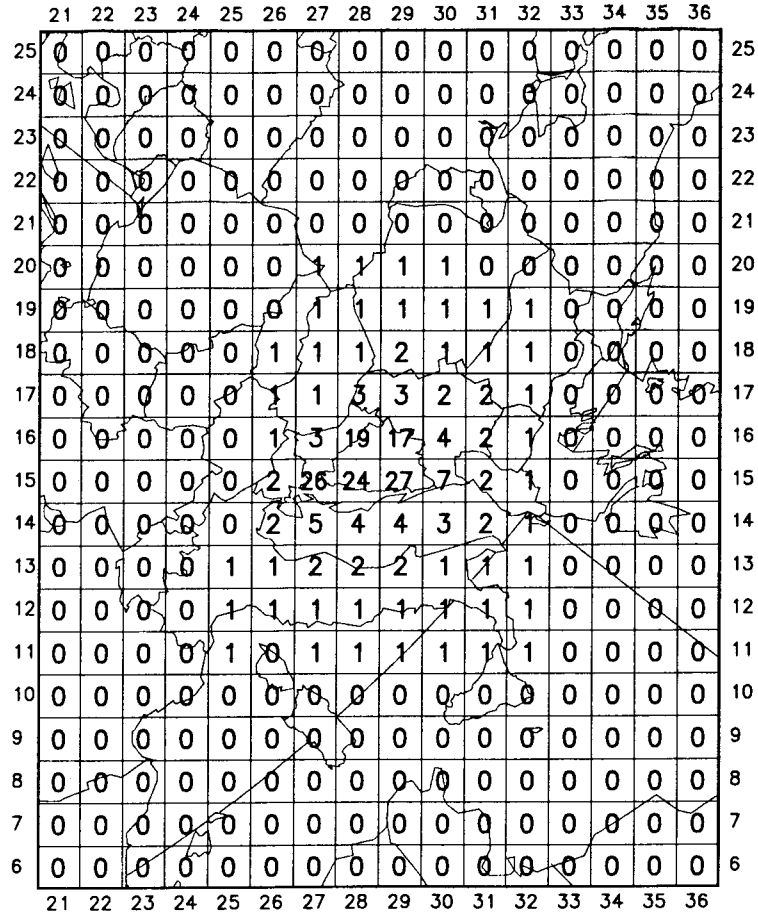
Total dep. of Oxidized Sulphur
Contribution from Croatia



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

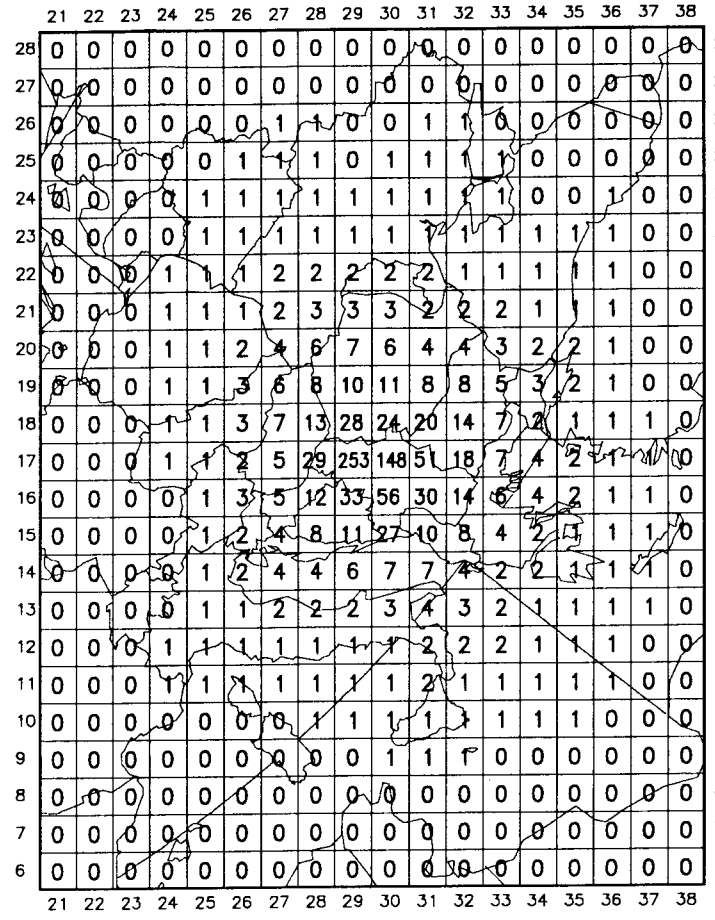
Total dep. of Oxidized Sulphur
Contribution from Bosnia & Hercegovina



Average :
85/87/88/89/90/91/92

Unit : cg(S)/m2

Total dep. of Oxidized Sulphur
Contribution from Yugoslavia*



Average :
85,87-92

Unit : cg(S)/m2

YU* Former Yugoslavia excluding Slovenia, Croatia, Bosnia and Hercegovina

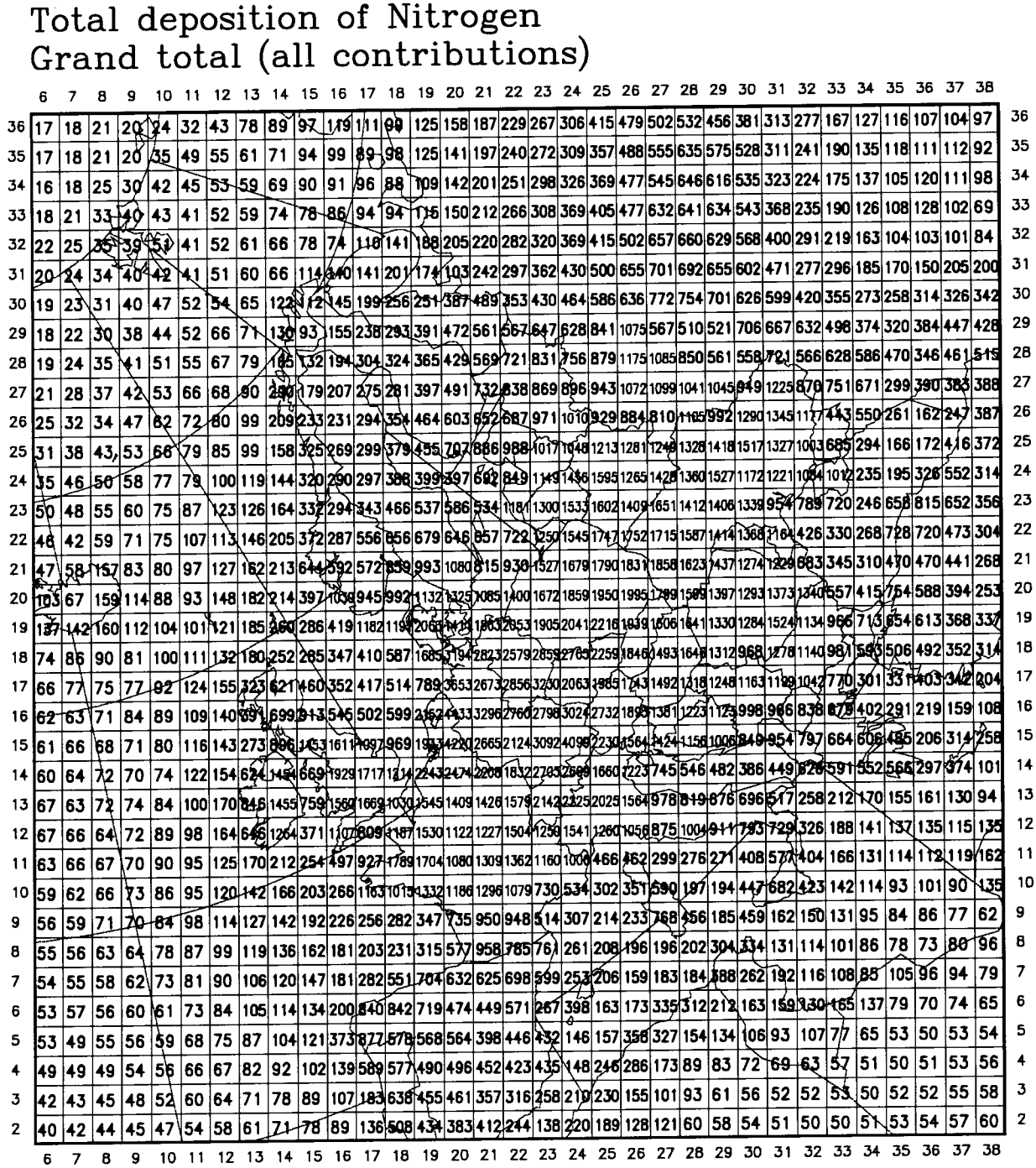
APPENDIX F.

COUNTRY ALLOCATED DEPOSITIONS OF OXIDISED AND REDUCED NITROGEN AVERAGED OVER THE YEARS 1985, 1987, 1988, 1989, 1990, 1991 and 1992.

This appendix shows maps with numbers in EMEP grid squares for deposition allocated to emissions in the sub-domains defined in Table D1.

Units are $mg(N)/m^2$ for oxidised and reduced nitrogen

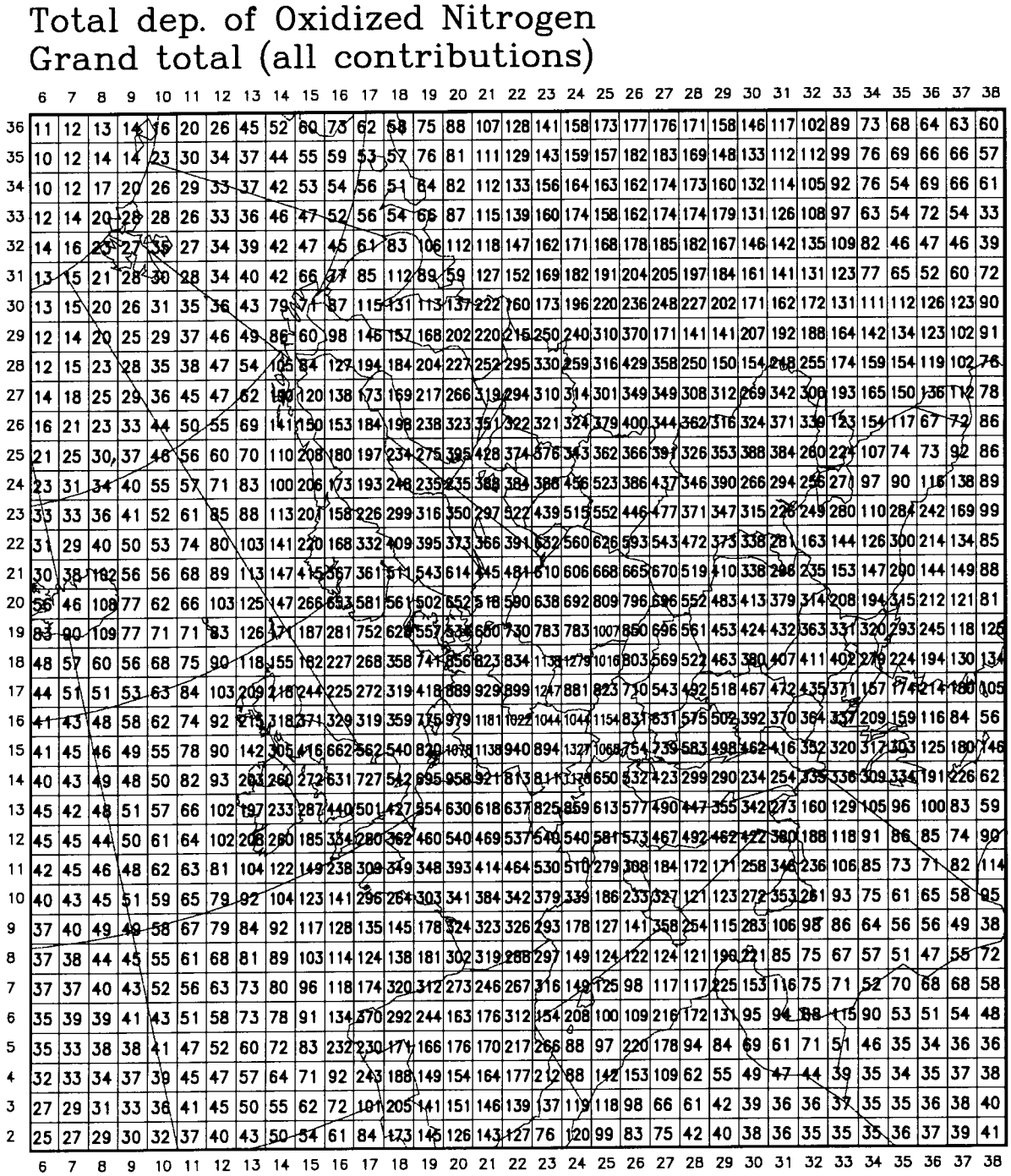
Figure F1 :



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

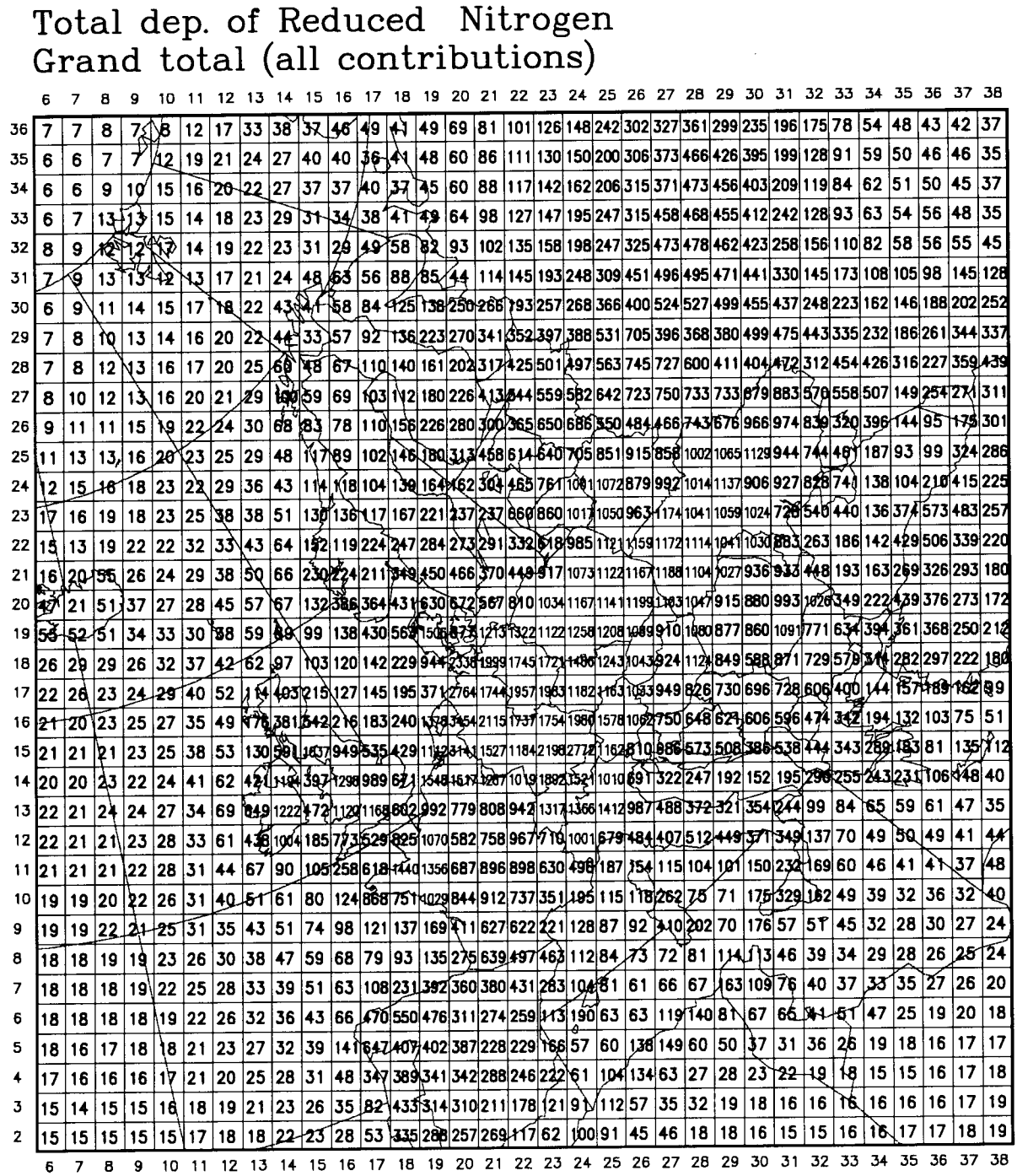
Figure F2 :



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

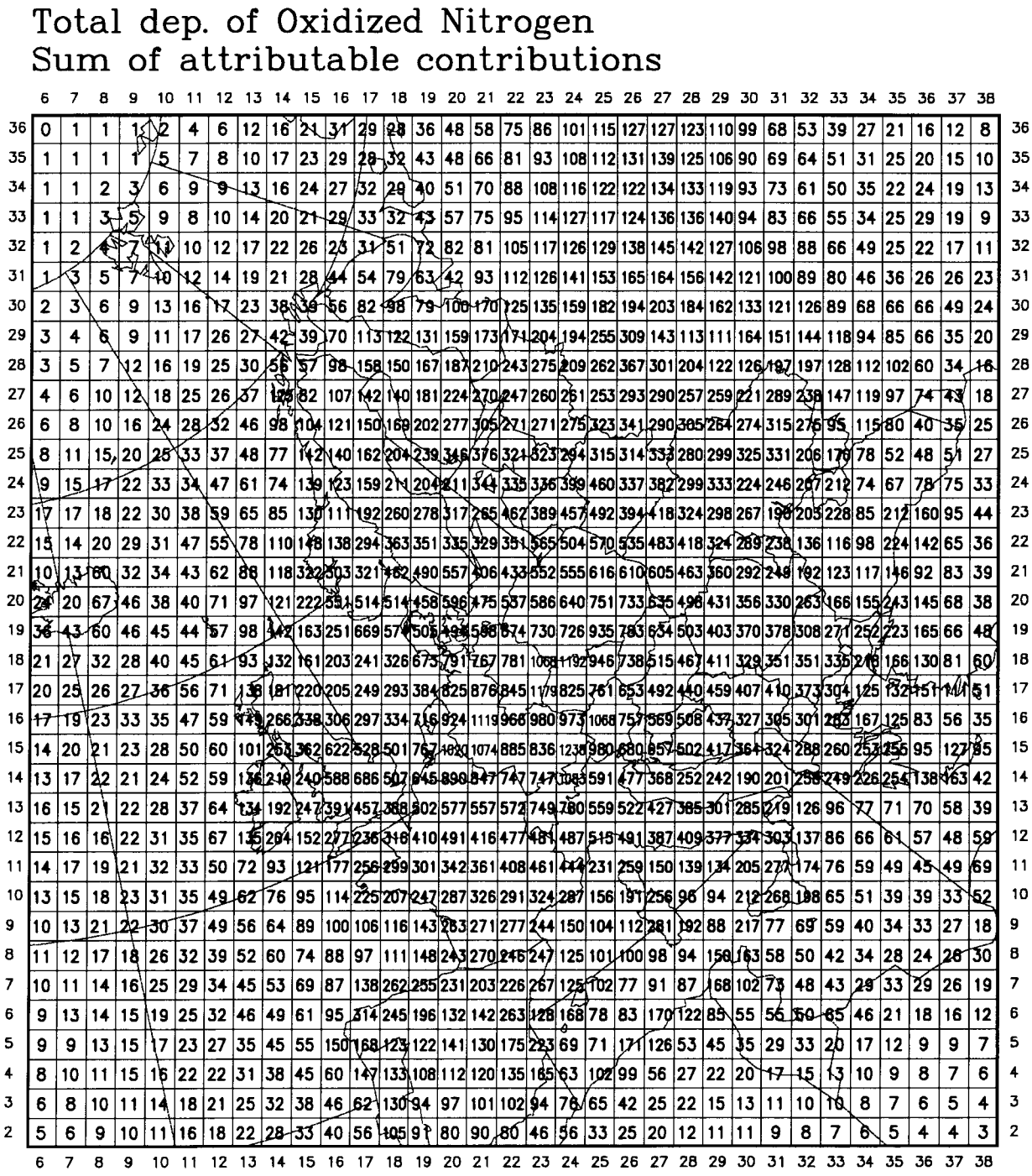
Figure F3 :



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

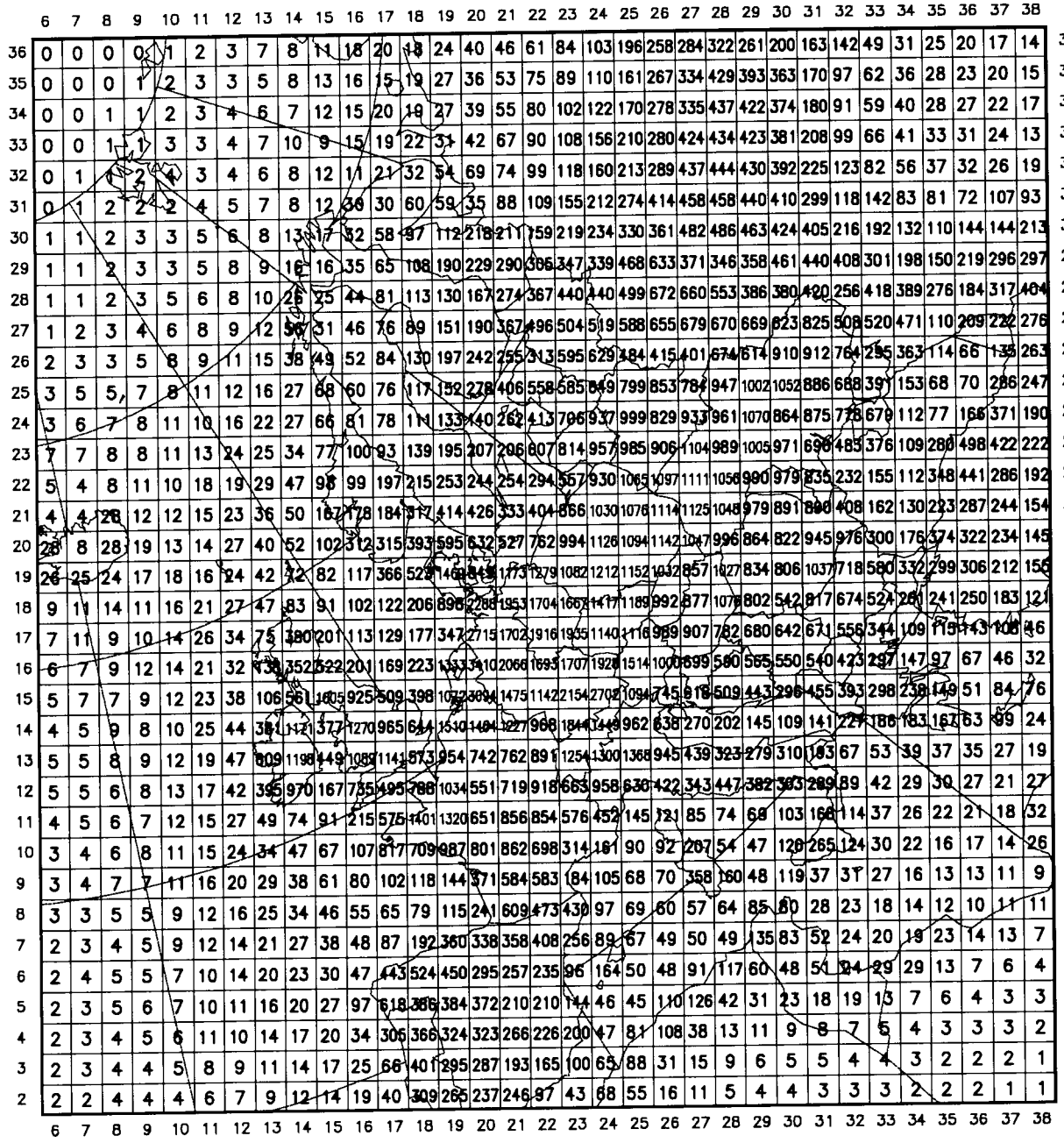
Figure F4 :



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

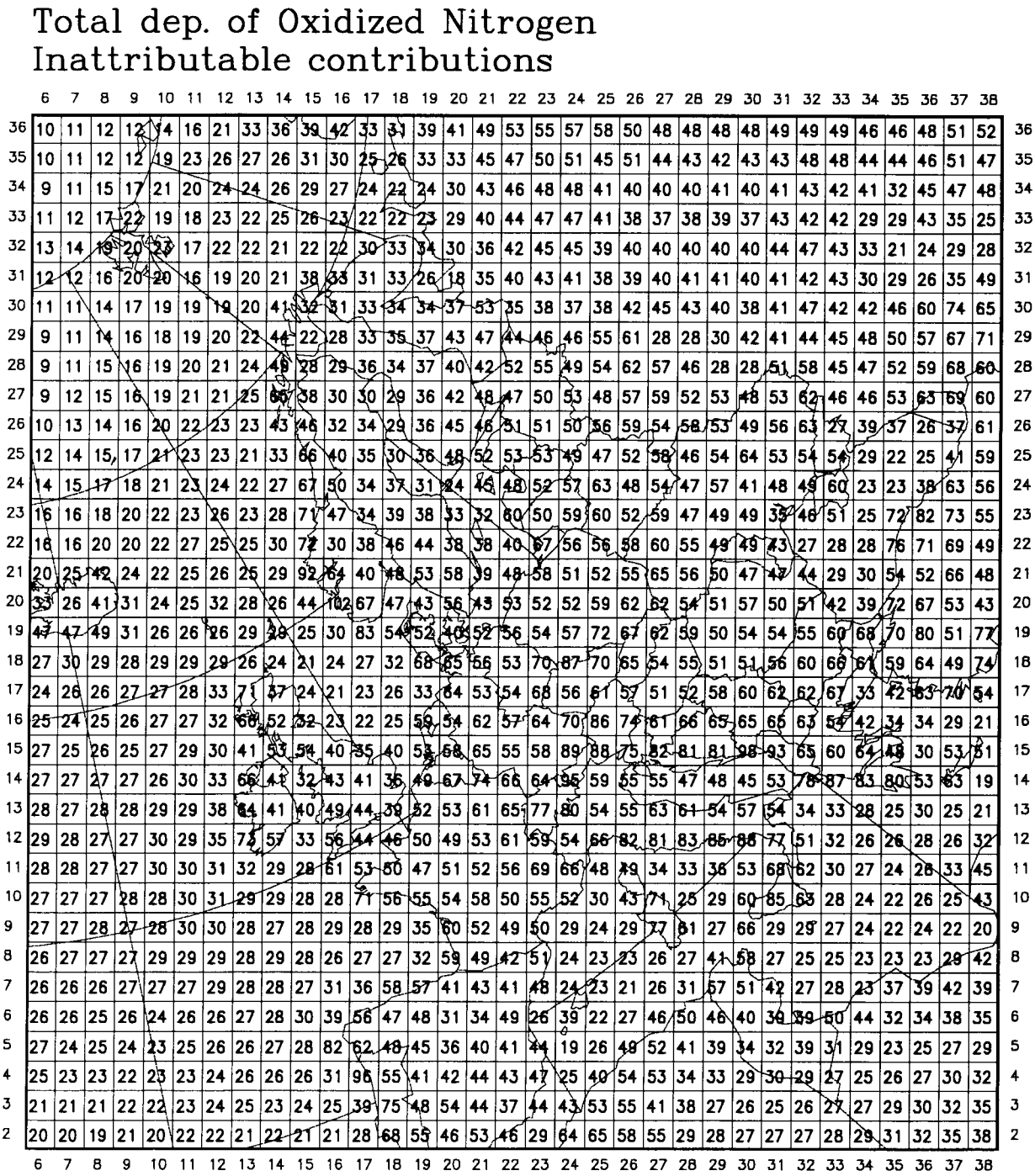
Figure F5 :



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

Figure F6 :



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

Figure F7

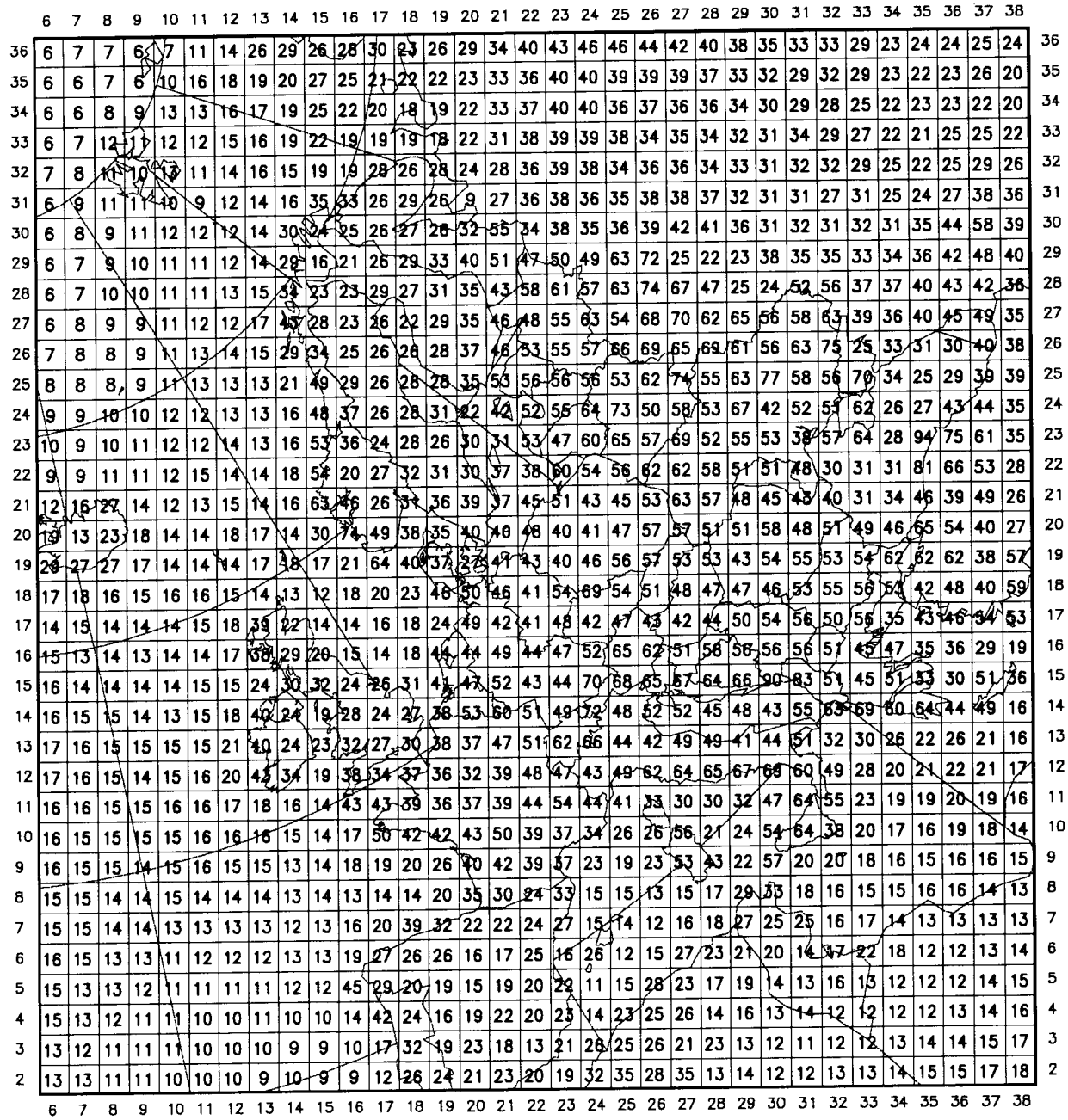
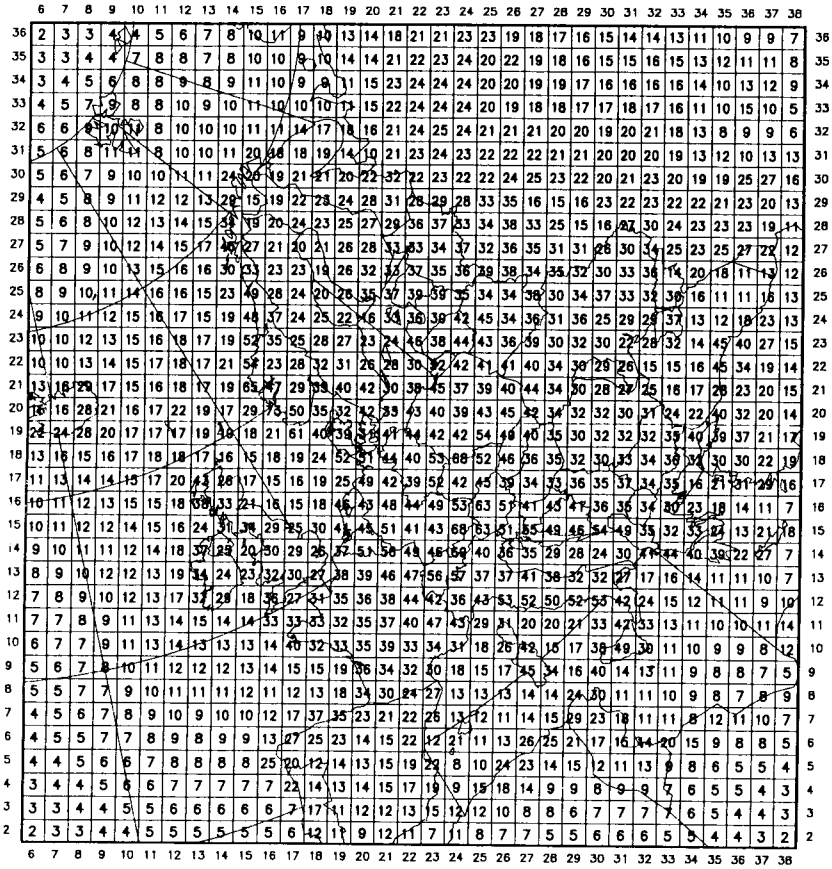

Total dep. of Reduced Nitrogen
Inattributable contributions
Average :
85/87/88/89/90/91/92
Unit : mg(N)/m2

Figure F8 :

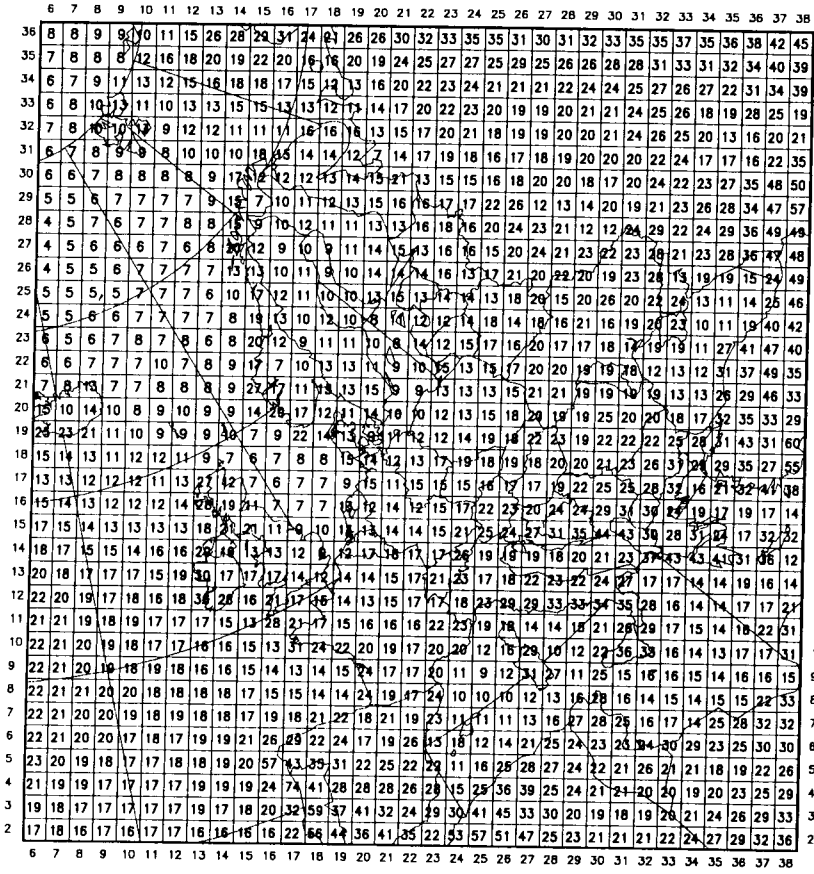
a) Total dep. of Oxidized Nitrogen
Inattributable contributions from above



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

b) Total dep. of Oxidized Nitrogen
Inattributable contributions from mix.l

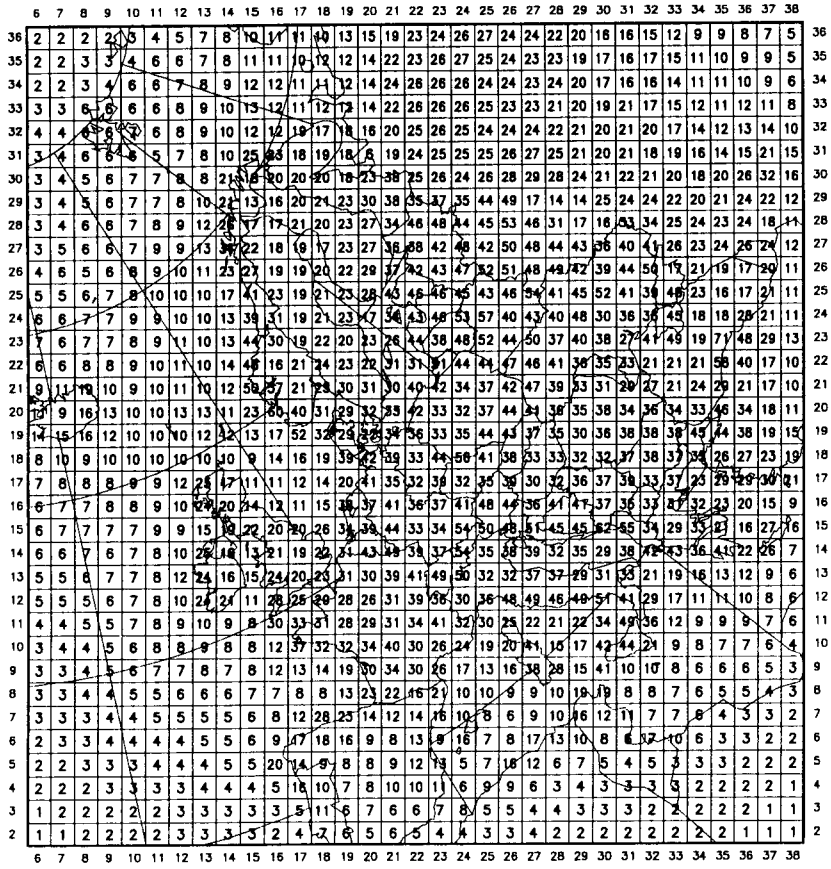


Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

Figure F9 :

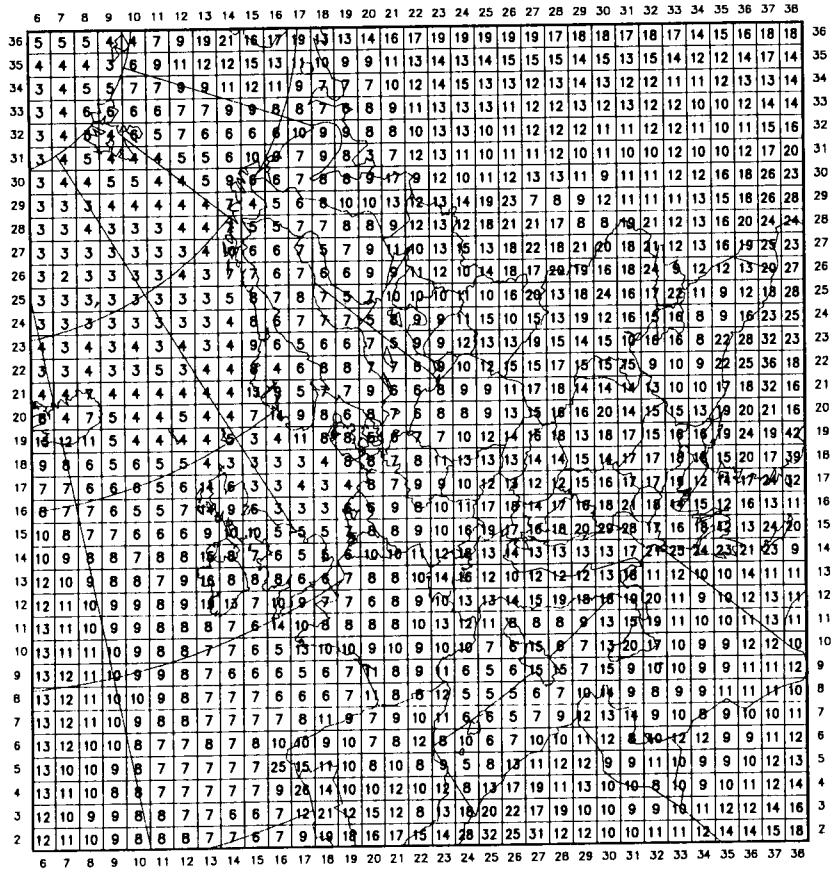
a) Total dep. of Reduced Nitrogen
Inattributable contributions from above



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

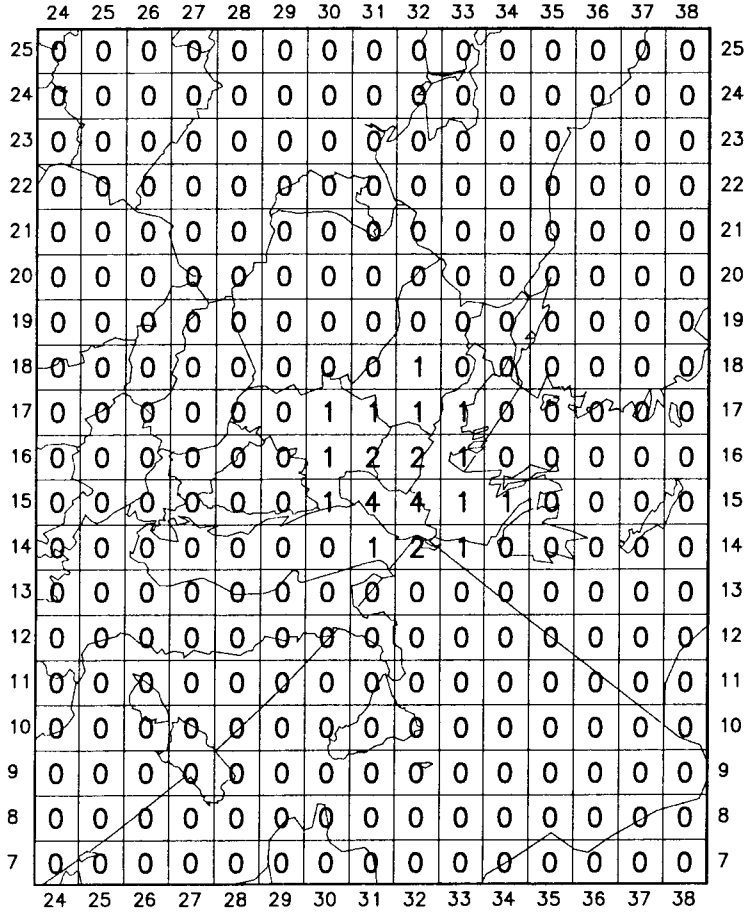
b) Total dep. of Reduced Nitrogen
Inattributable contributions from mix.l



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

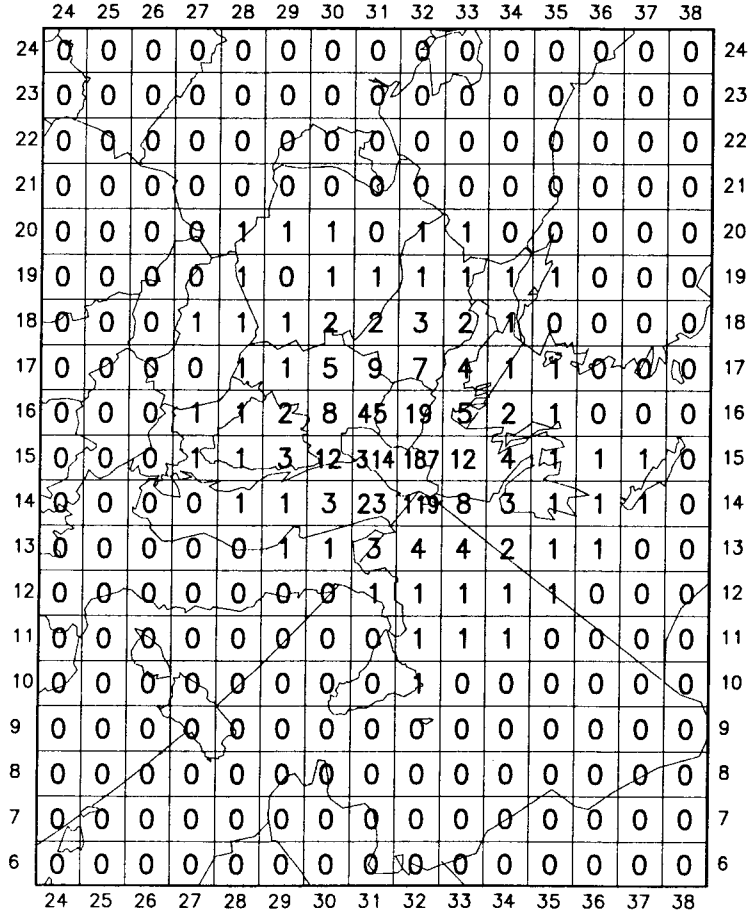
Total dep. of Oxidized Nitrogen
Contribution from Albania



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

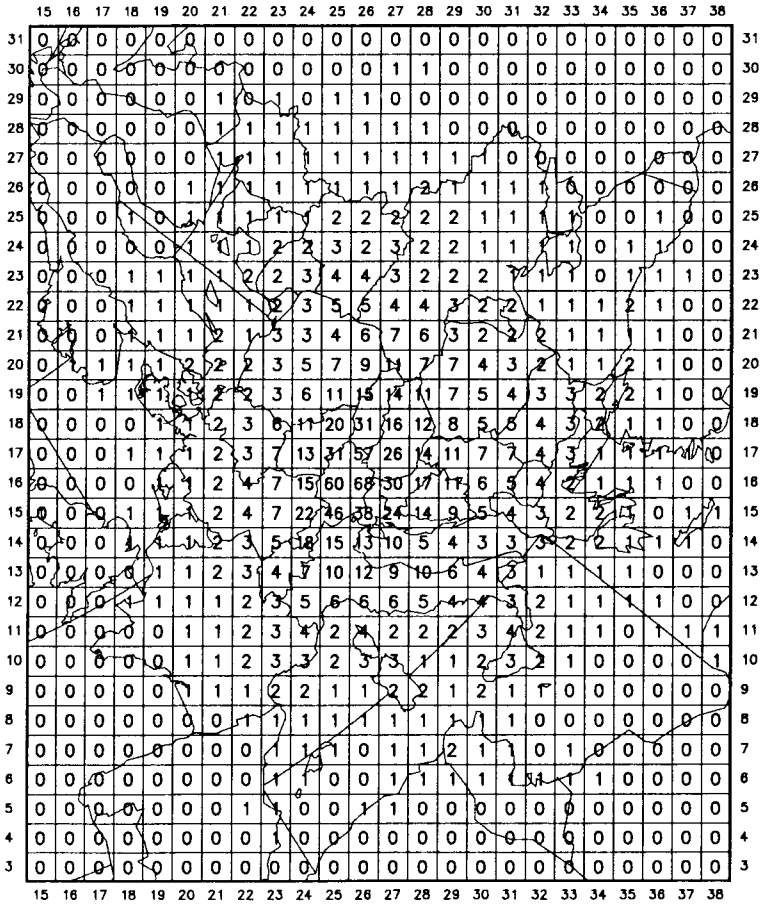
Total dep. of Reduced Nitrogen
Contribution from Albania



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

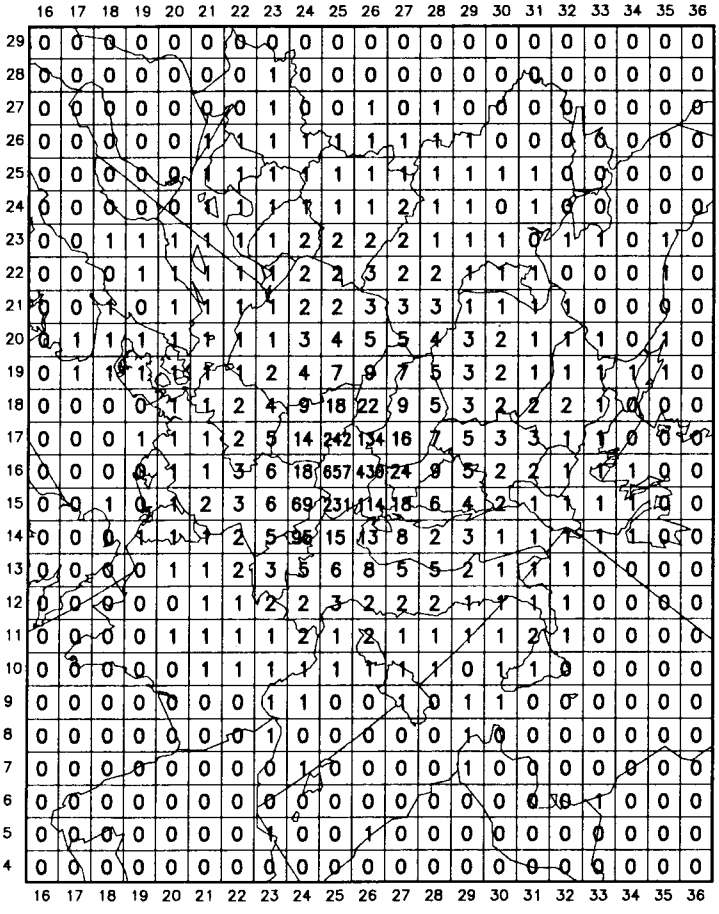
Total dep. of Oxidized Nitrogen
Contribution from Austria



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

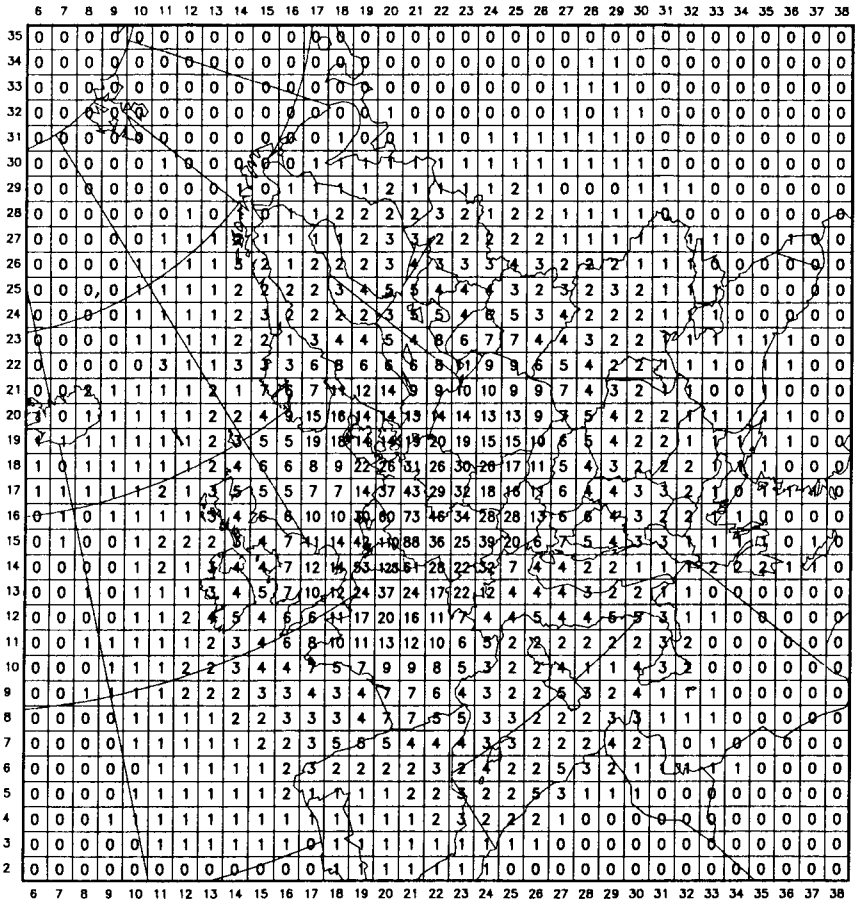
Total dep. of Reduced Nitrogen
Contribution from Austria



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

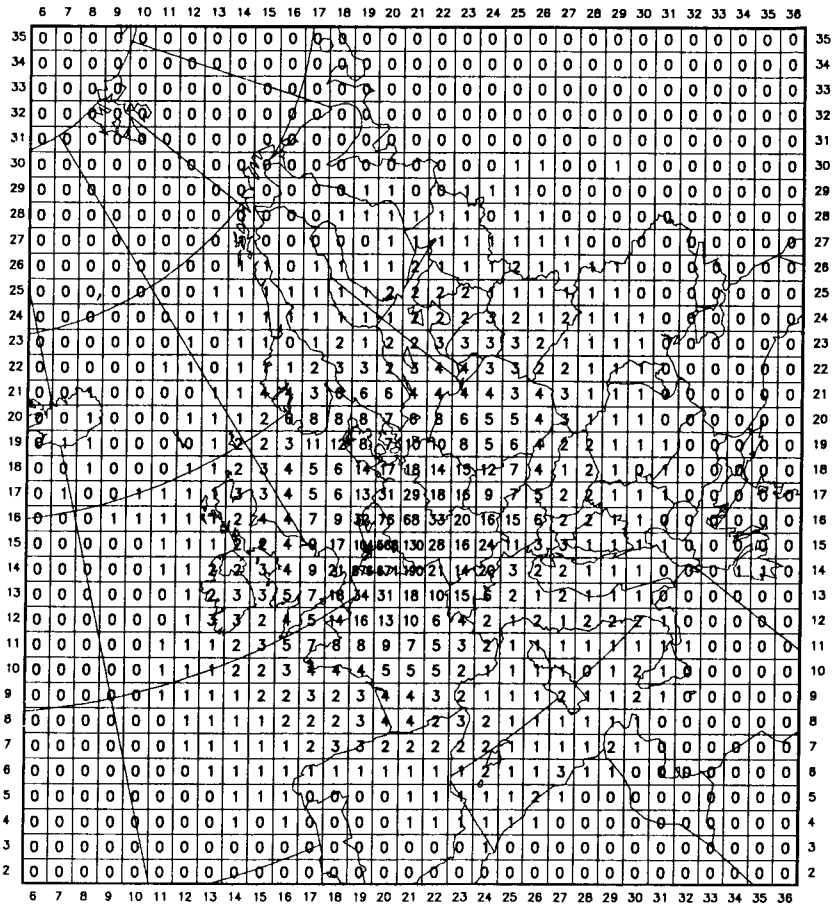
Total dep. of Oxidized Nitrogen
Contribution from Belgium



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

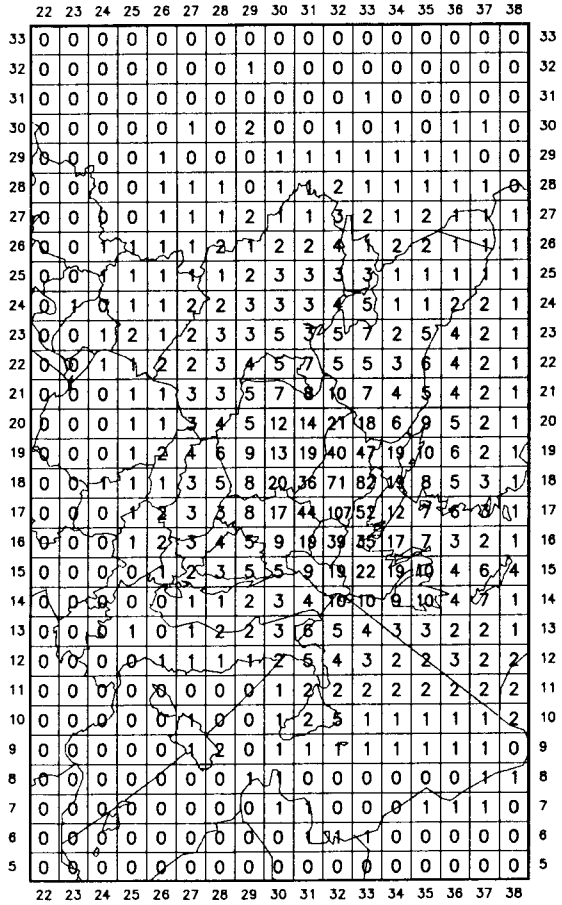
Total dep. of Reduced Nitrogen
Contribution from Belgium



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

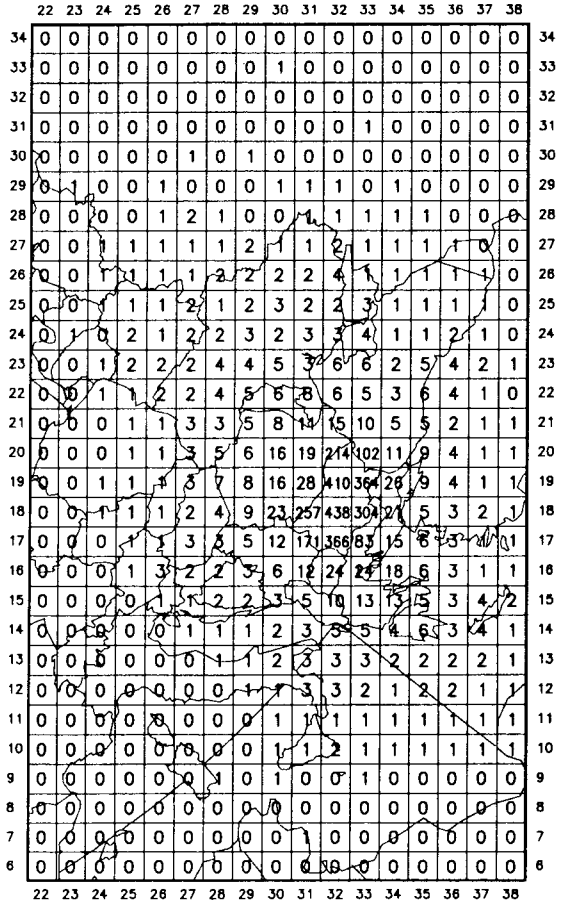
Total dep. of Oxidized Nitrogen
Contribution from Bulgaria



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

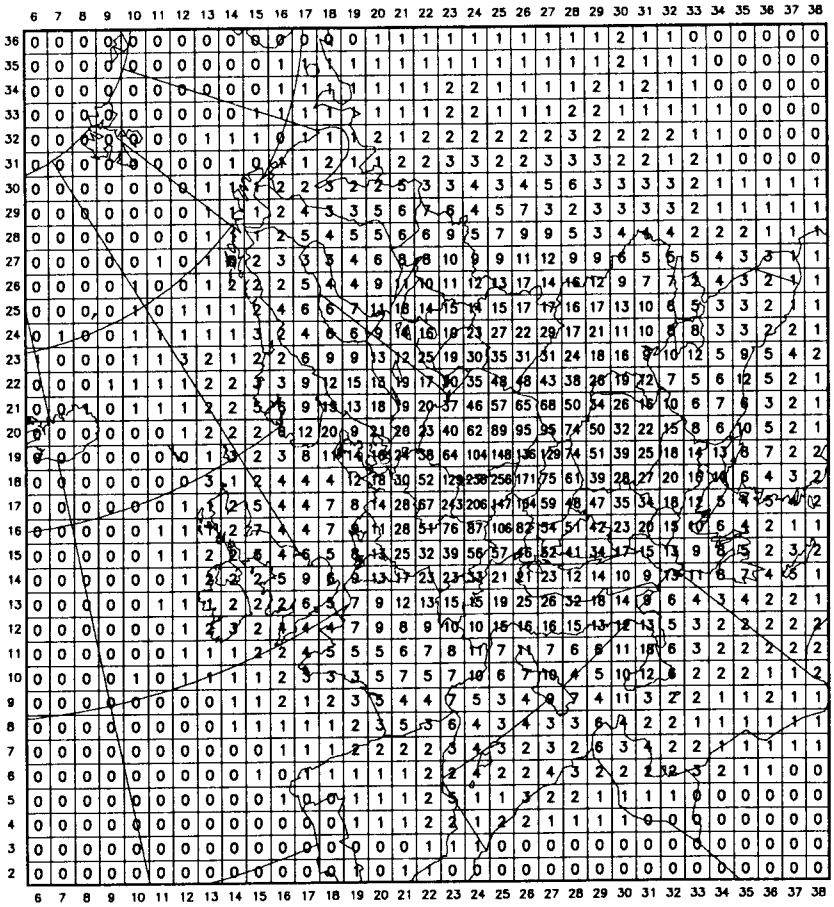
Total dep. of Reduced Nitrogen
Contribution from Bulgaria



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

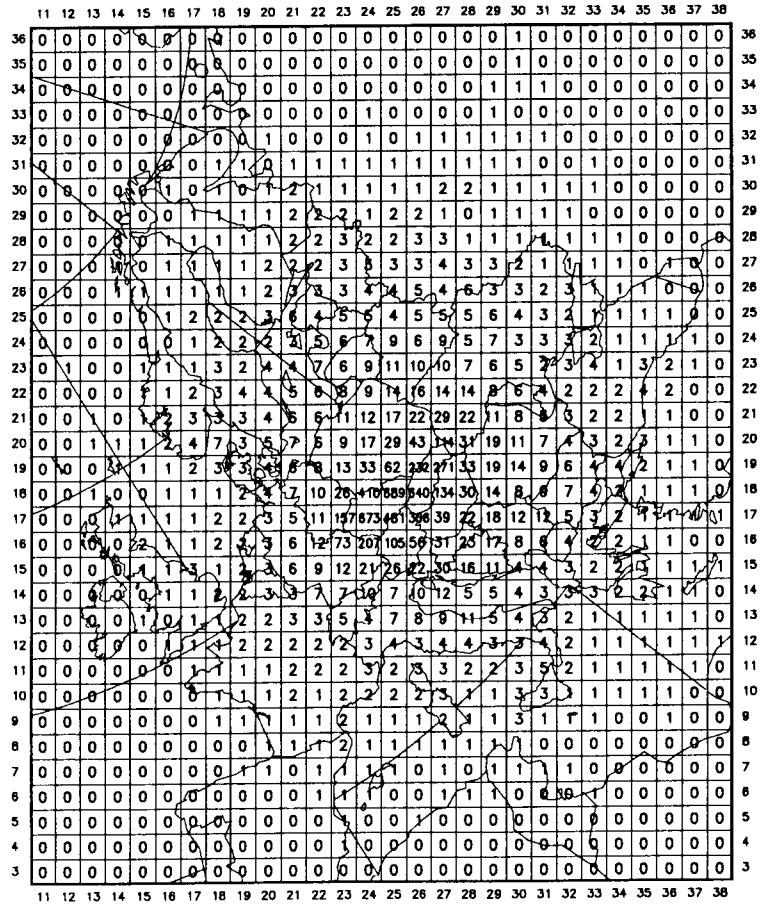
Total dep. of Oxidized Nitrogen
Contribution from Czechoslovakia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

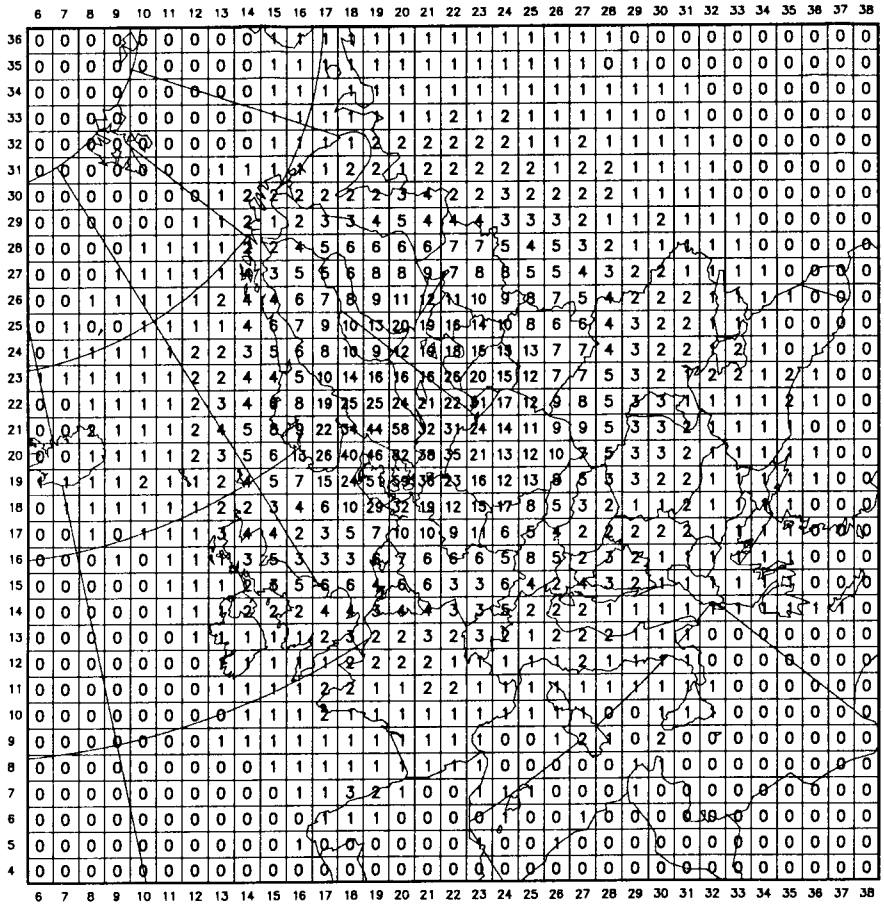
Total dep. of Reduced Nitrogen
Contribution from Czechoslovakia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

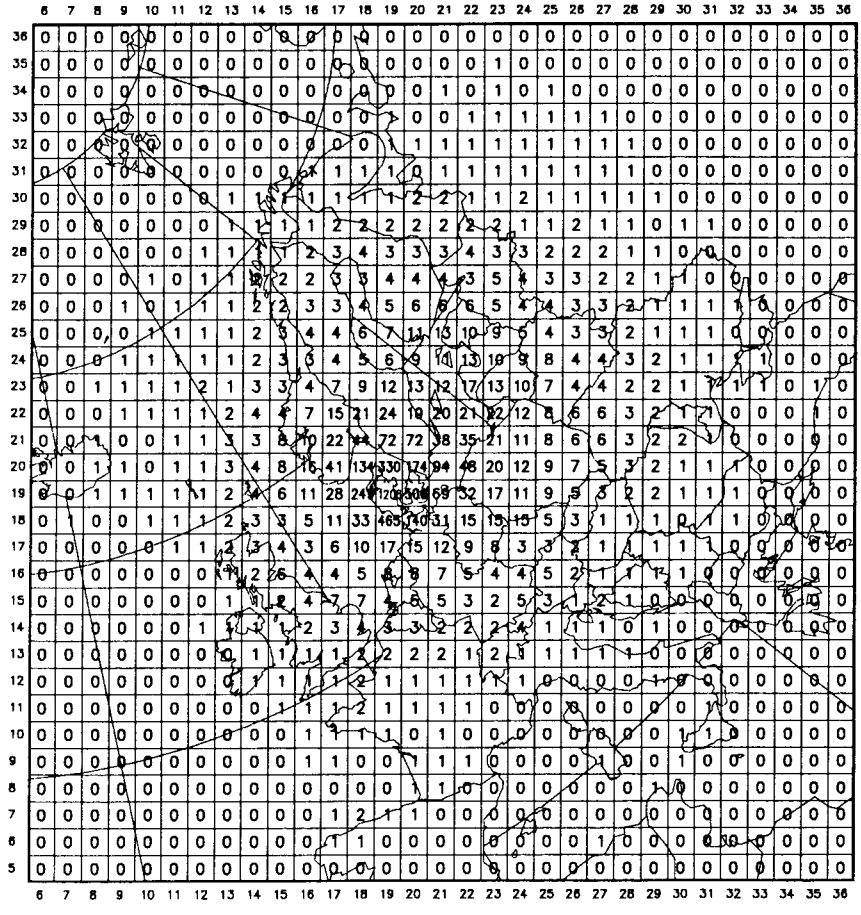
Total dep. of Oxidized Nitrogen
Contribution from Denmark



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

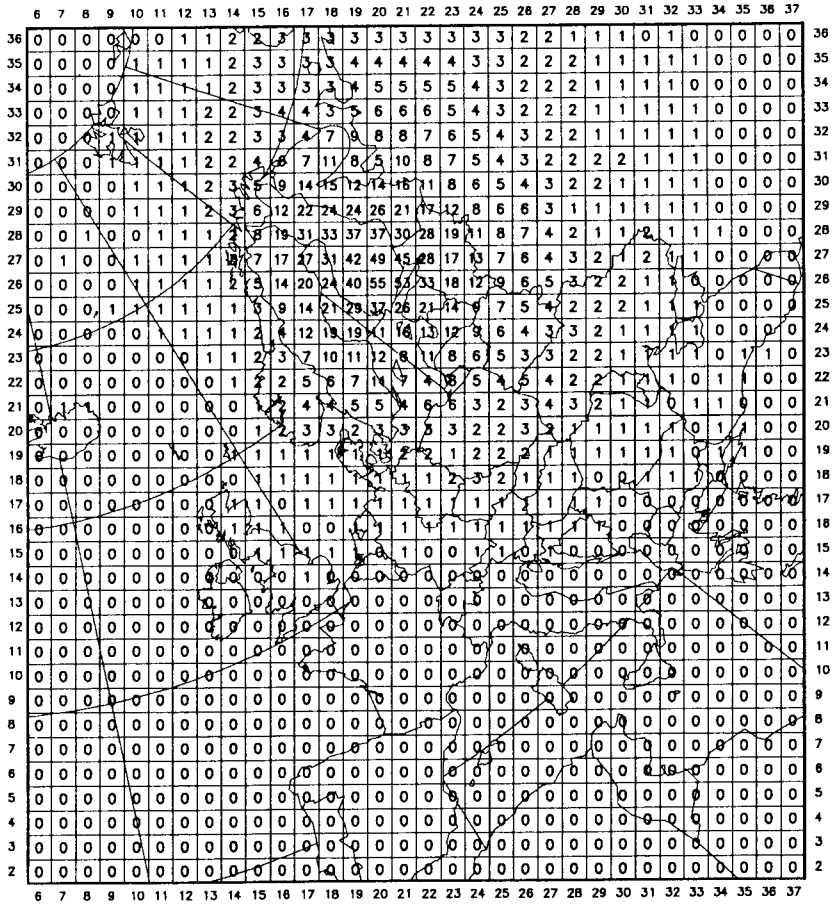
Total dep. of Reduced Nitrogen
Contribution from Denmark



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

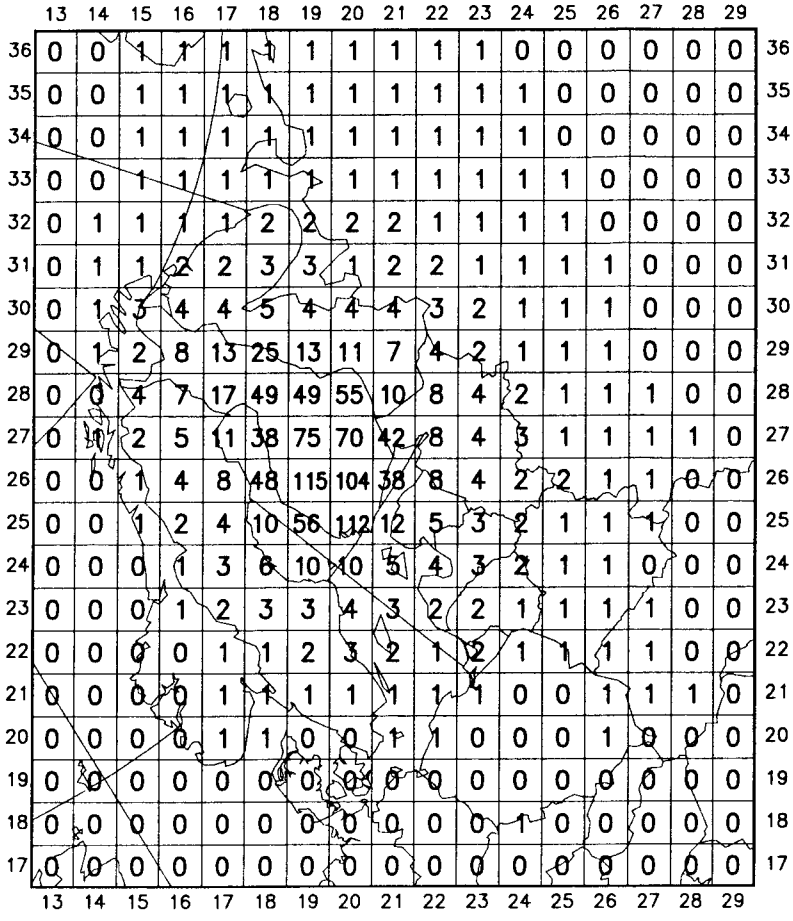
Total dep. of Oxidized Nitrogen
Contribution from Finland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

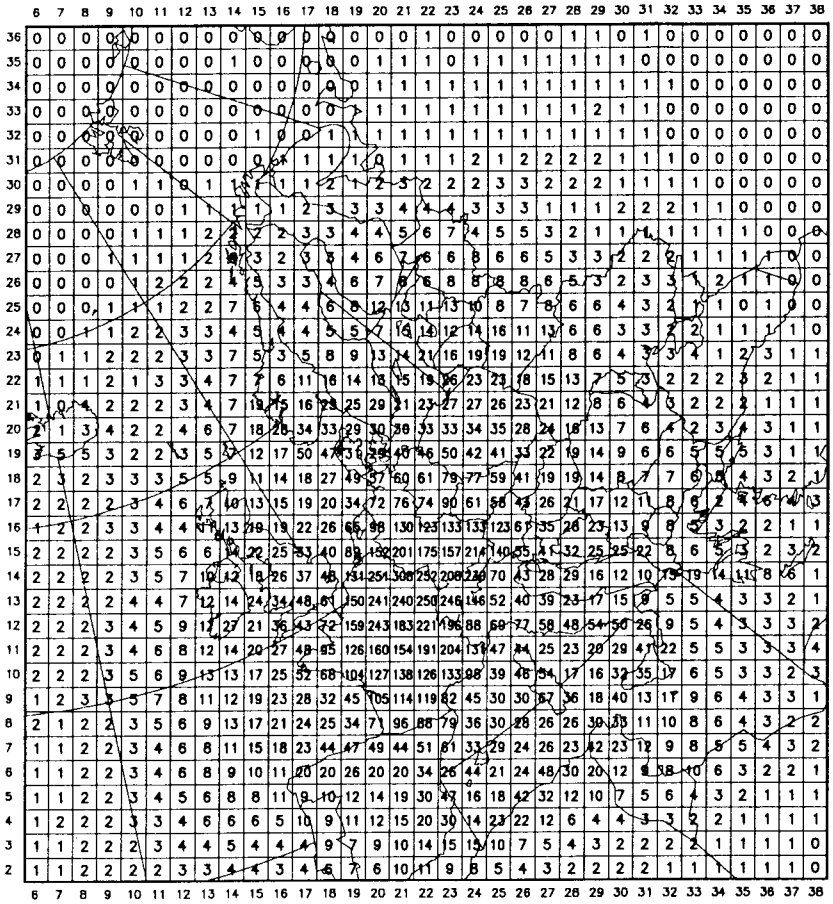
Total dep. of Reduced Nitrogen
Contribution from Finland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

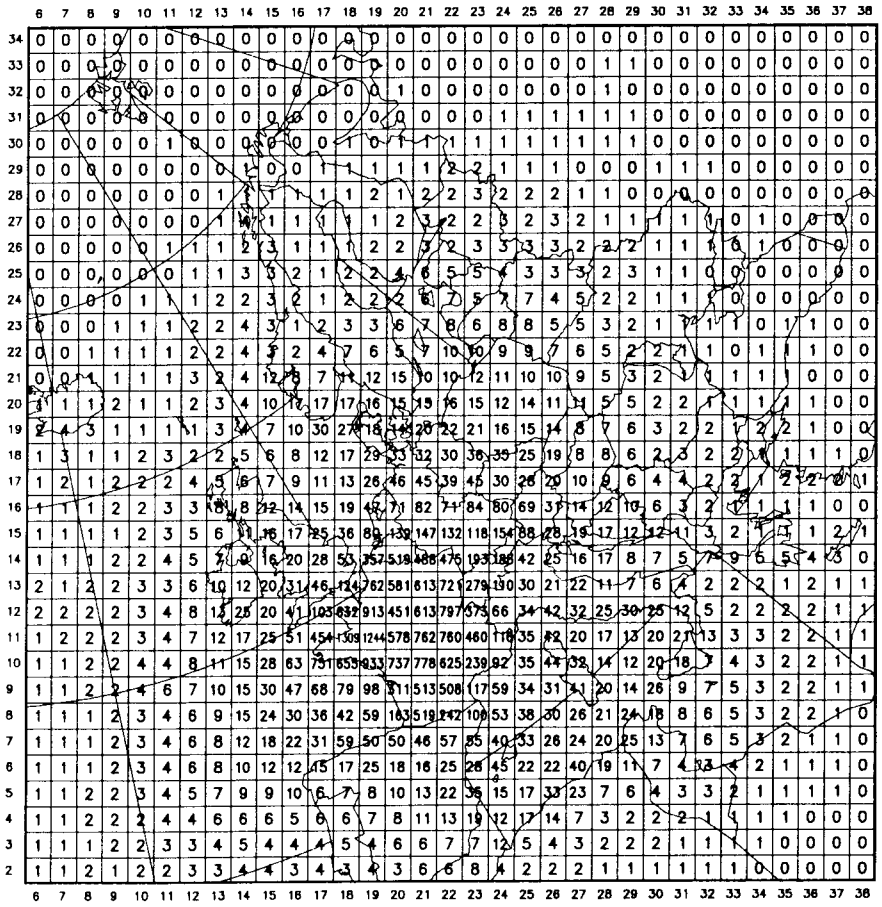
Total dep. of Oxidized Nitrogen
Contribution from France



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

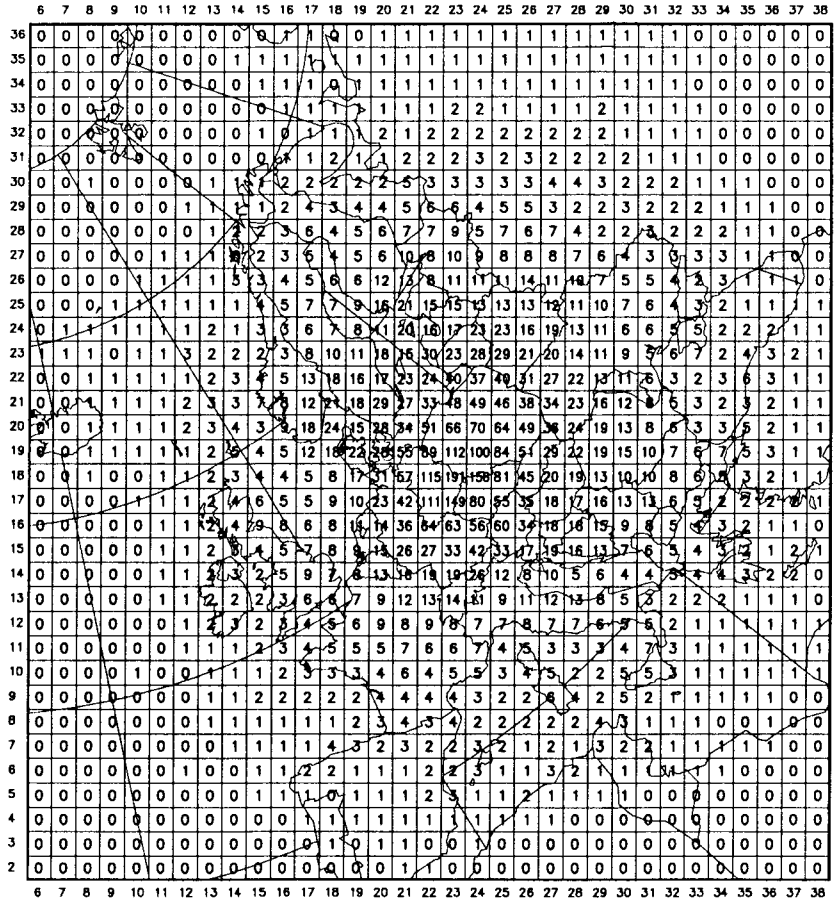
Total dep. of Reduced Nitrogen
Contribution from France



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

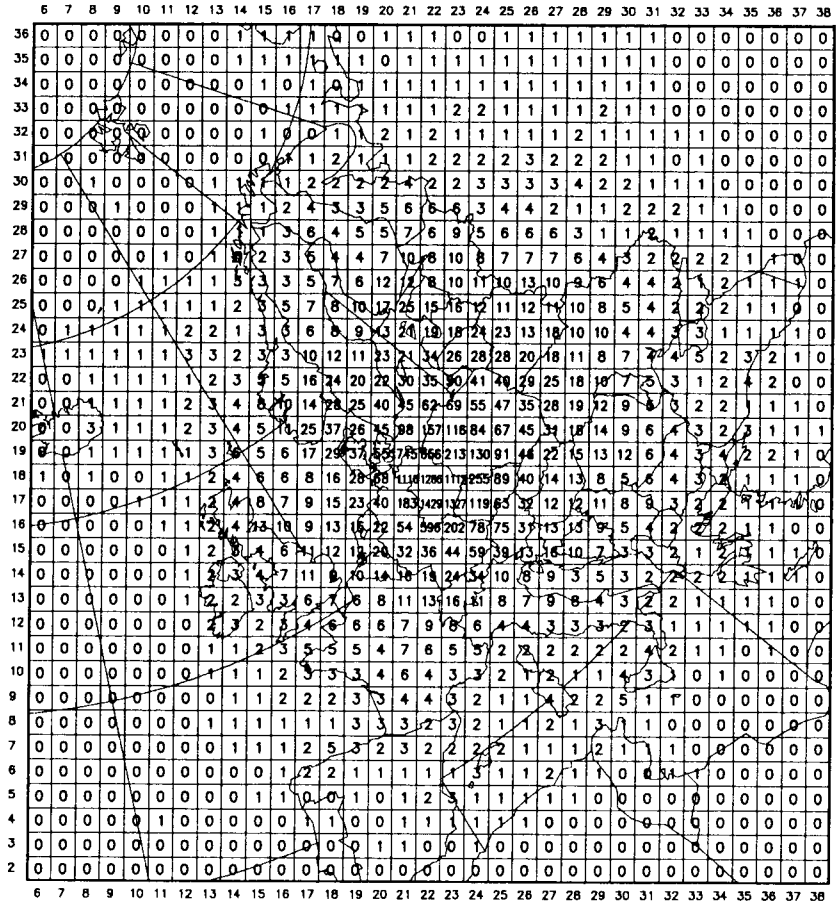
Total dep. of Oxidized Nitrogen
Contribution from German Democratic Rep



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

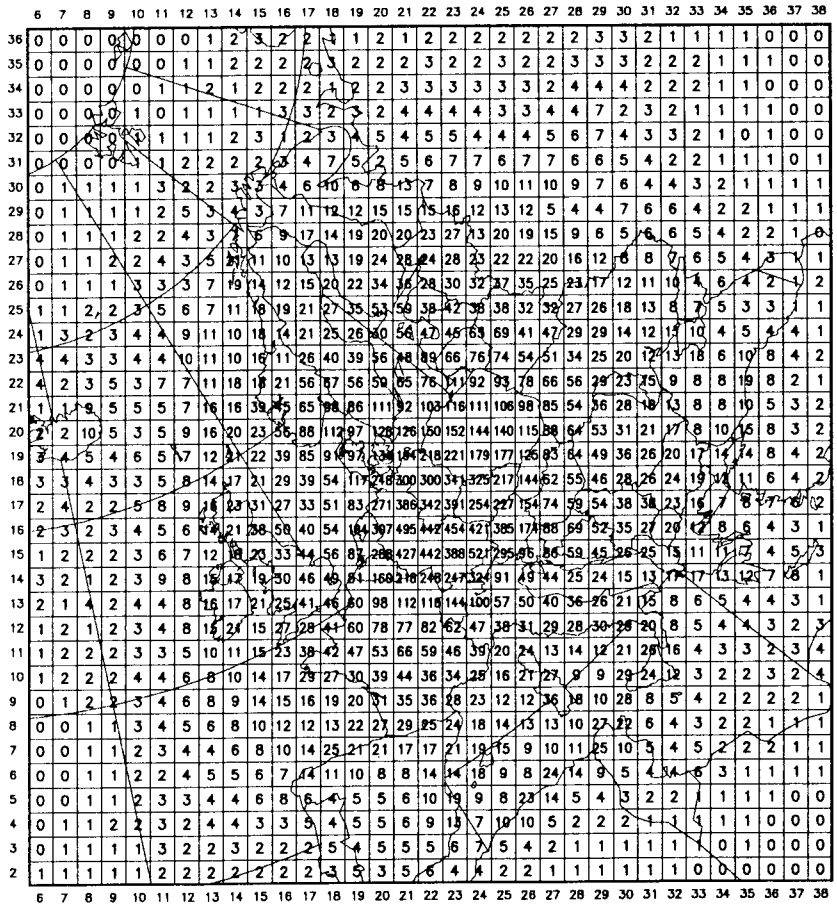
Total dep. of Reduced Nitrogen
Contribution from German Democratic Rep



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

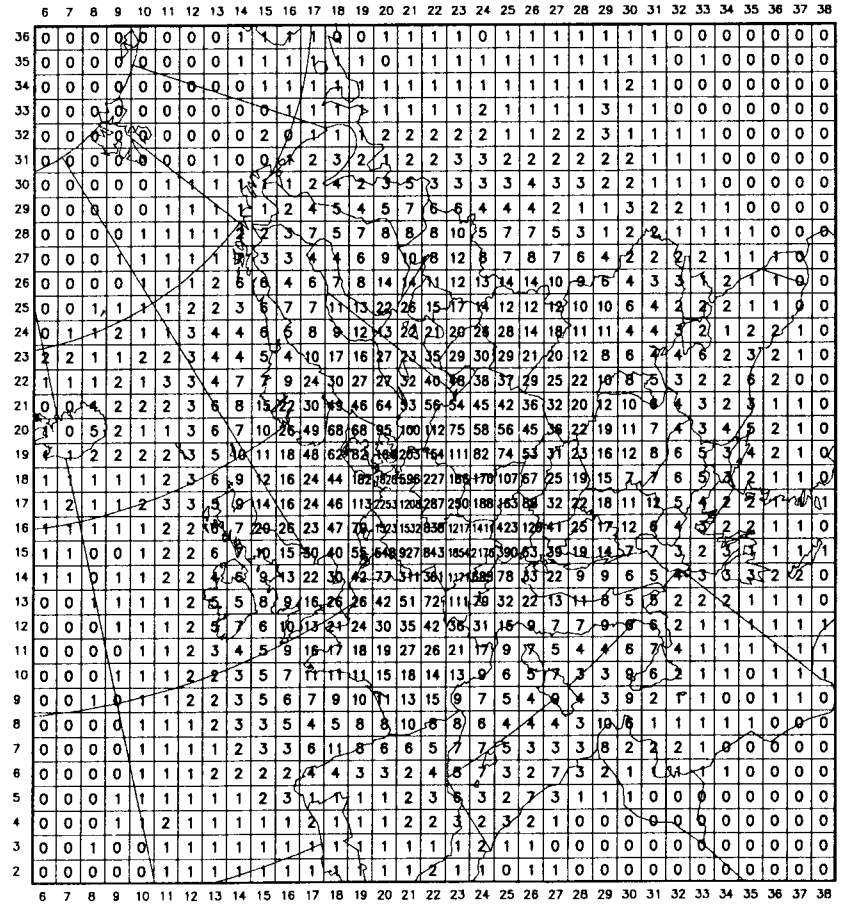
Total dep. of Oxidized Nitrogen
Contribution from Germany, Federal Rep.



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

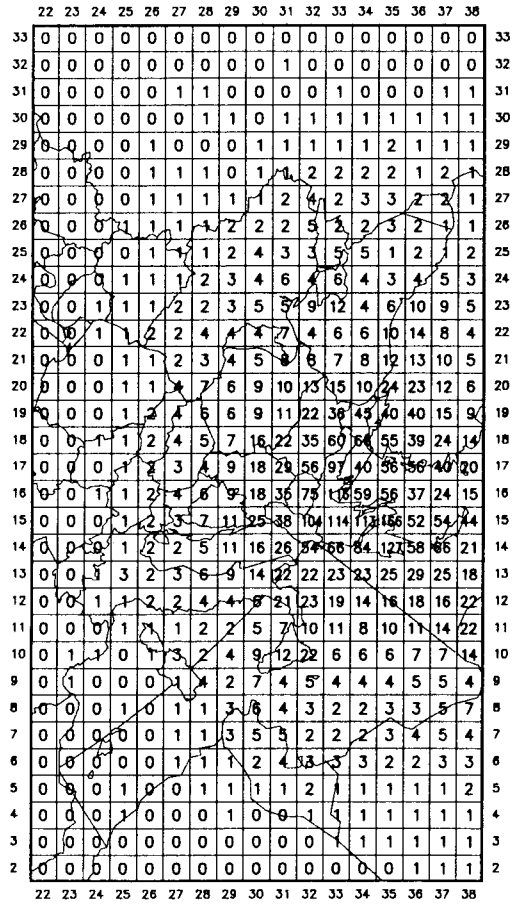
Total dep. of Reduced Nitrogen
Contribution from Germany, Federal Rep.



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

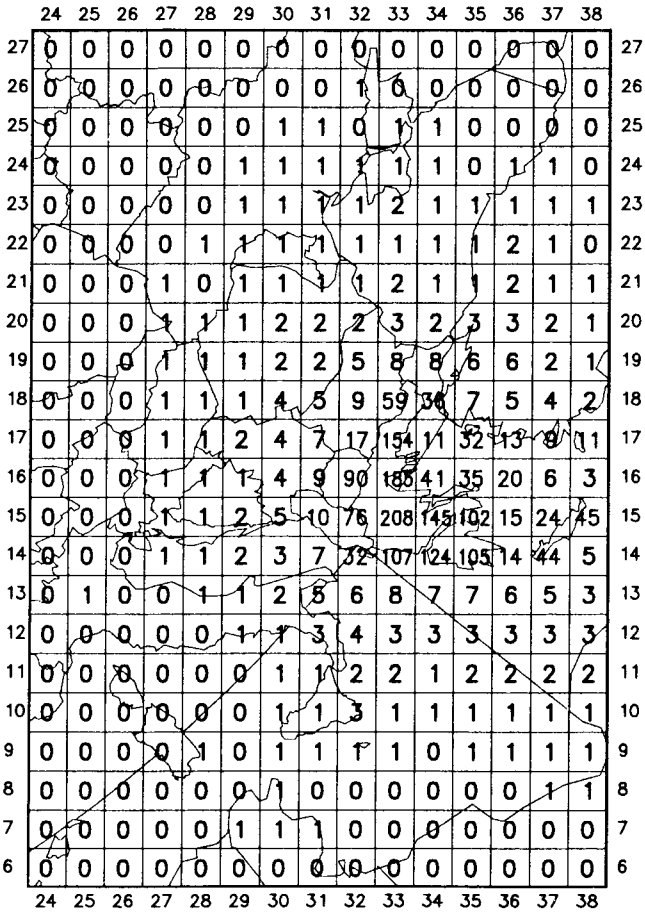
Total dep. of Oxidized Nitrogen
Contribution from Greece



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

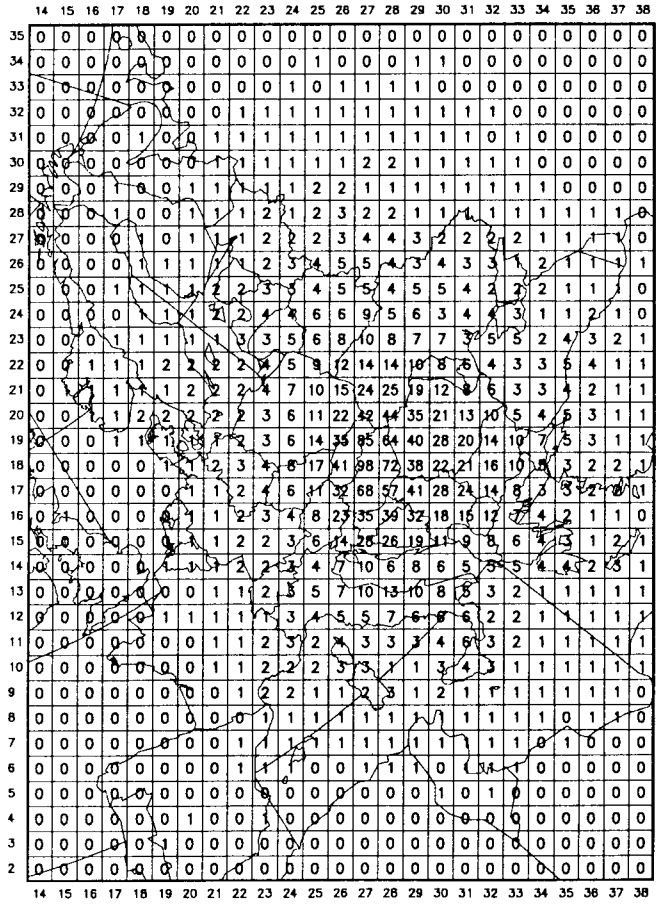
Total dep. of Reduced Nitrogen
Contribution from Greece



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

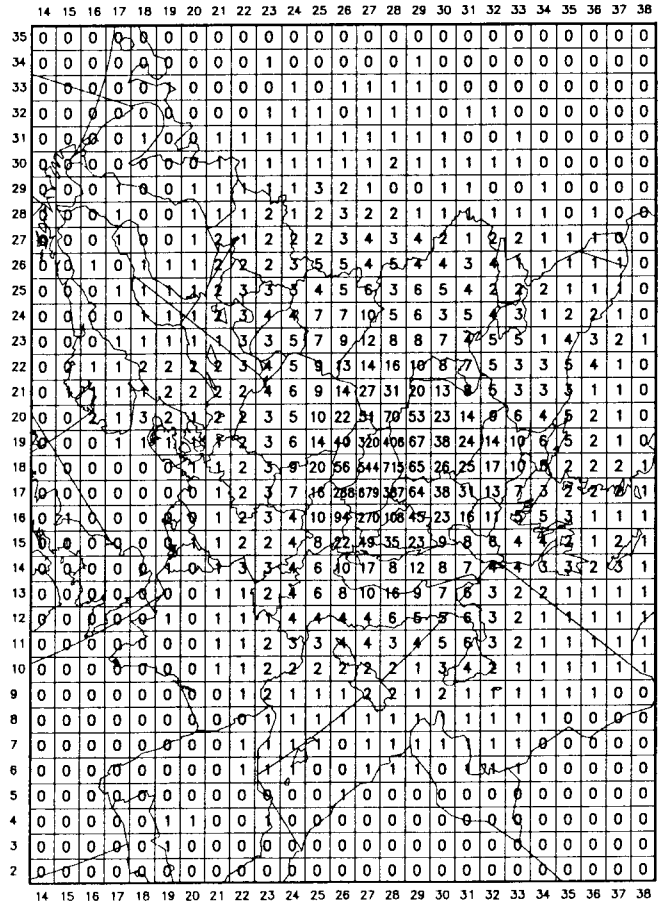
Total dep. of Oxidized Nitrogen
Contribution from Hungary



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

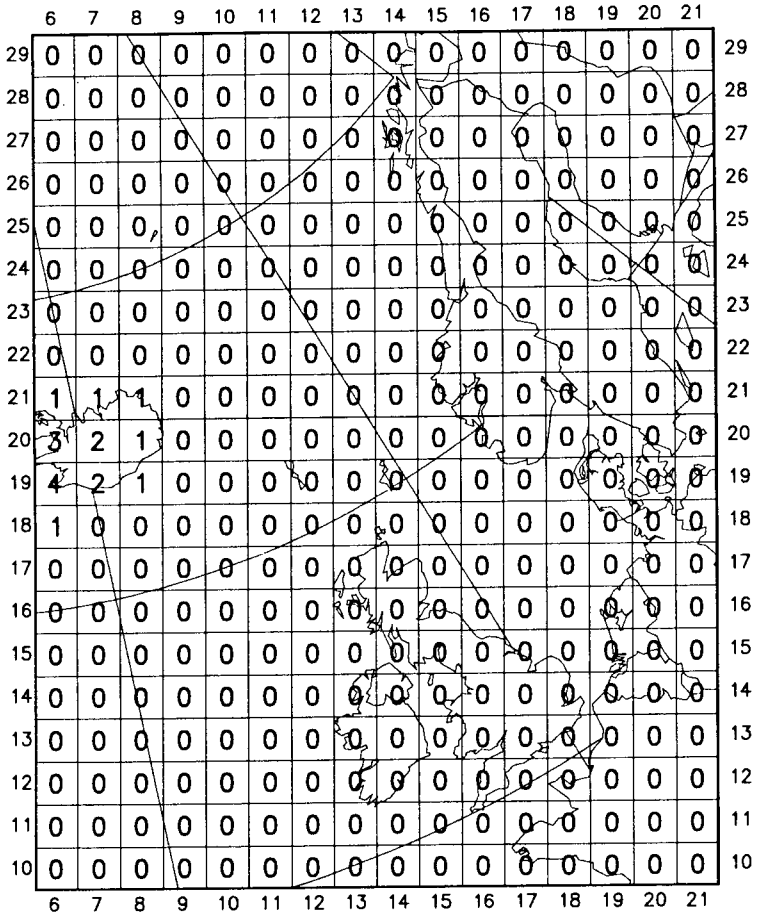
Total dep. of Reduced Nitrogen
Contribution from Hungary



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

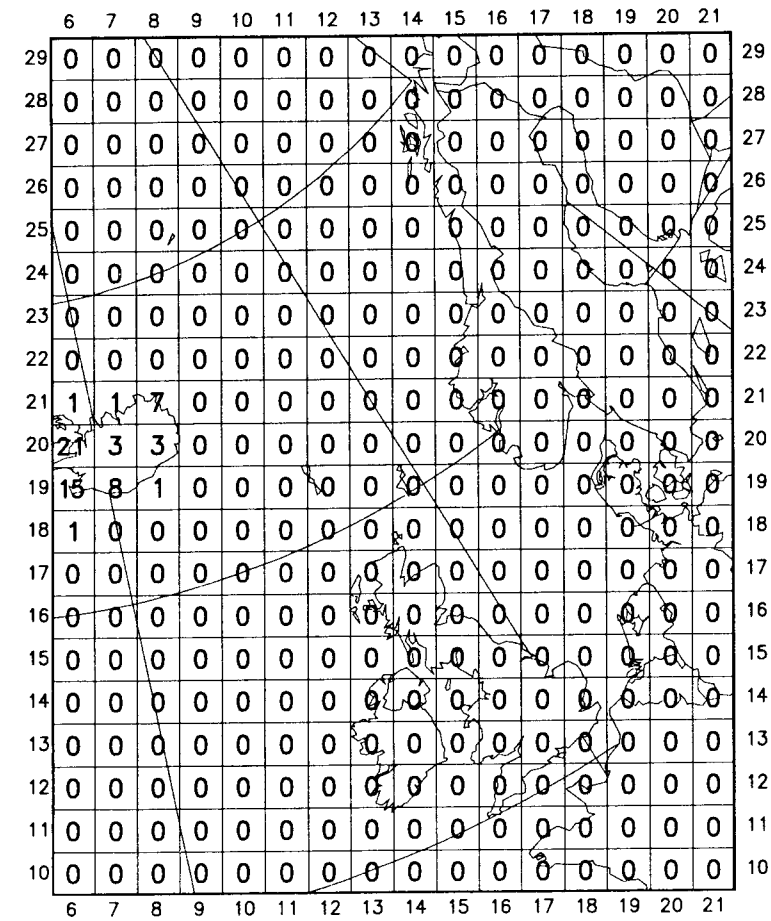
Total dep. of Oxidized Nitrogen
Contribution from Iceland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

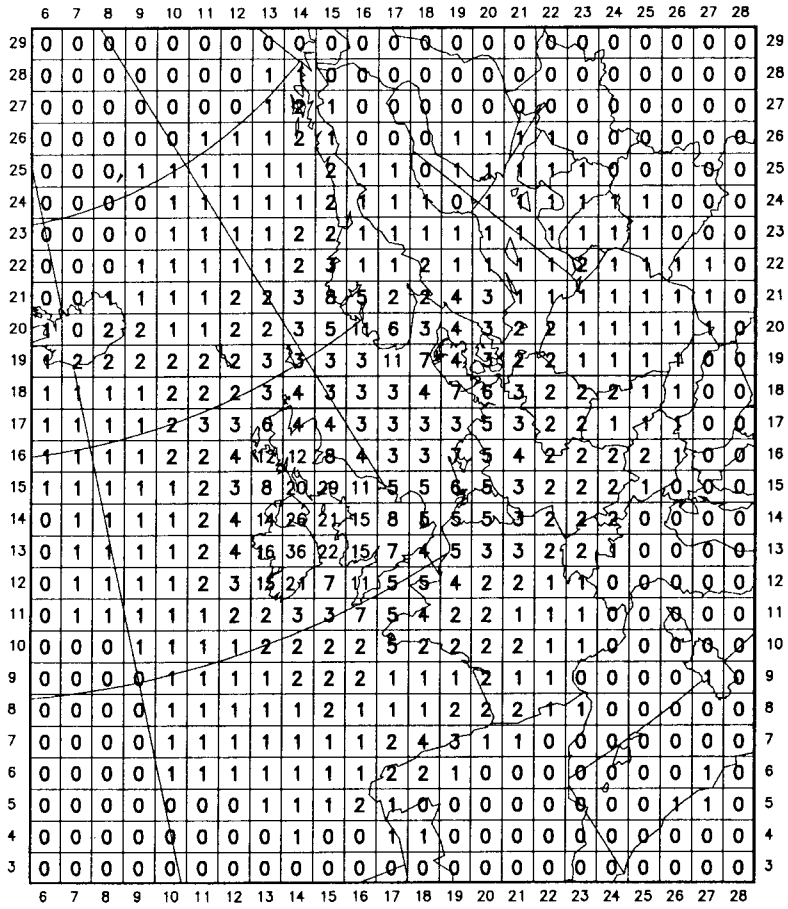
Total dep. of Reduced Nitrogen
Contribution from Iceland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

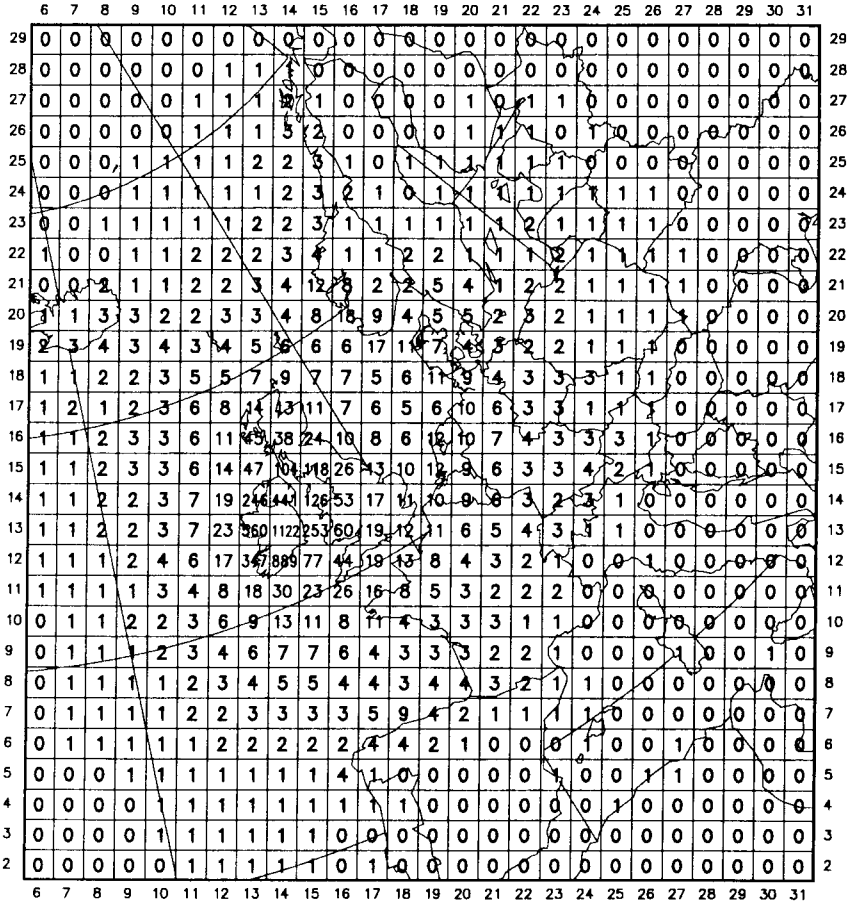
Total dep. of Oxidized Nitrogen
Contribution from Ireland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

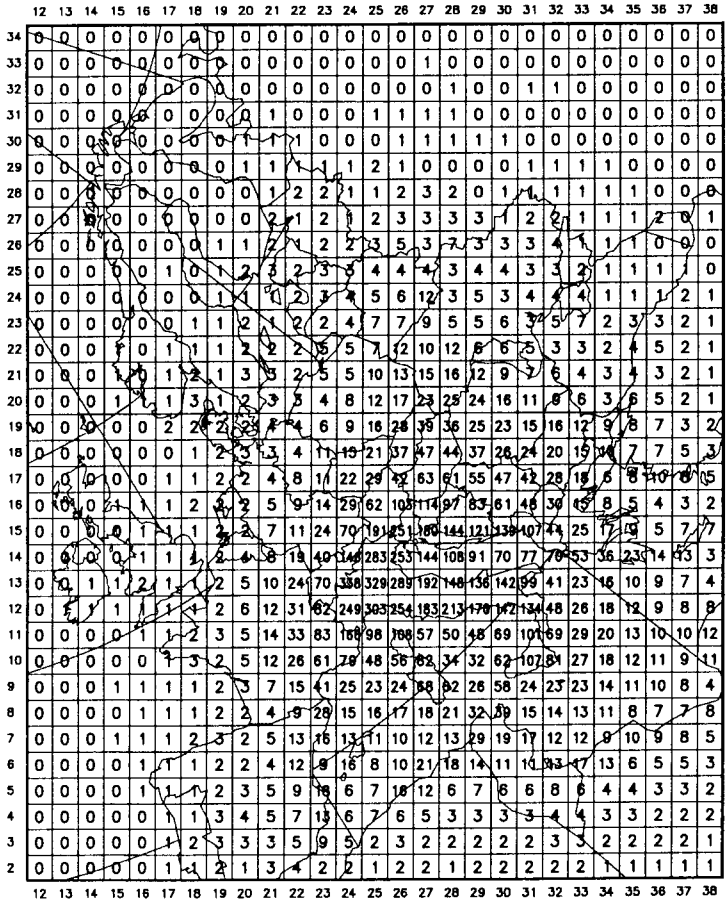
Total dep. of Reduced Nitrogen
Contribution from Ireland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

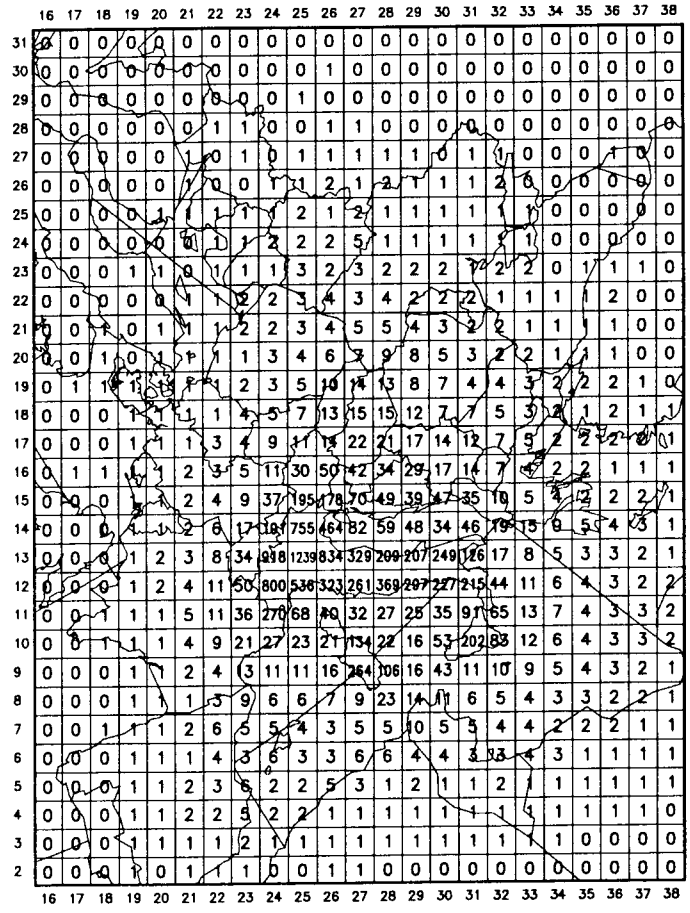
Total dep. of Oxidized Nitrogen
Contribution from Italy



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

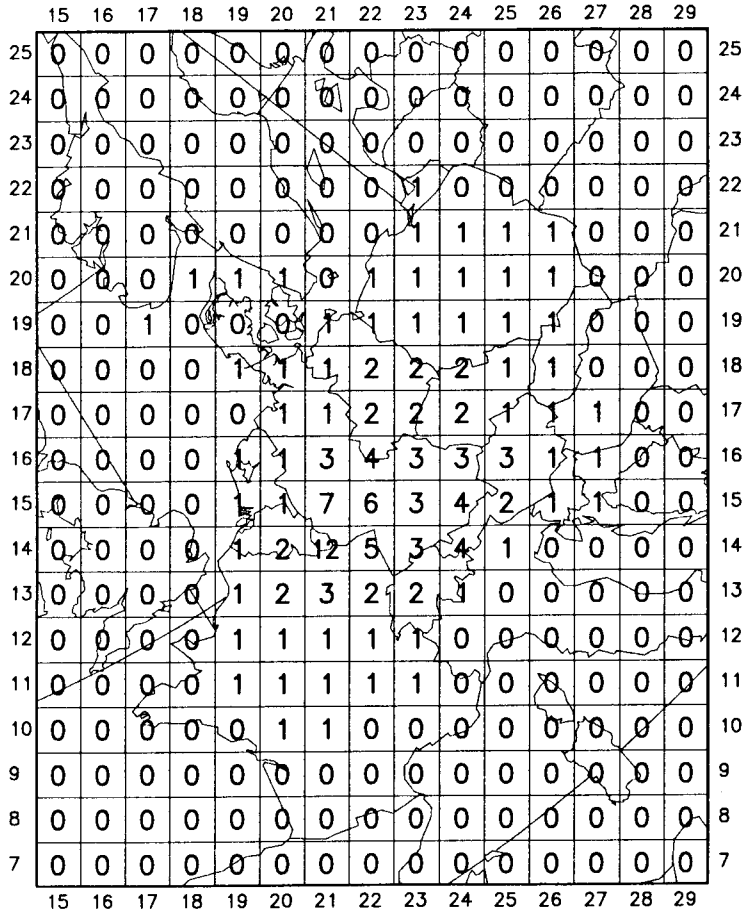
Total dep. of Reduced Nitrogen
Contribution from Italy



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

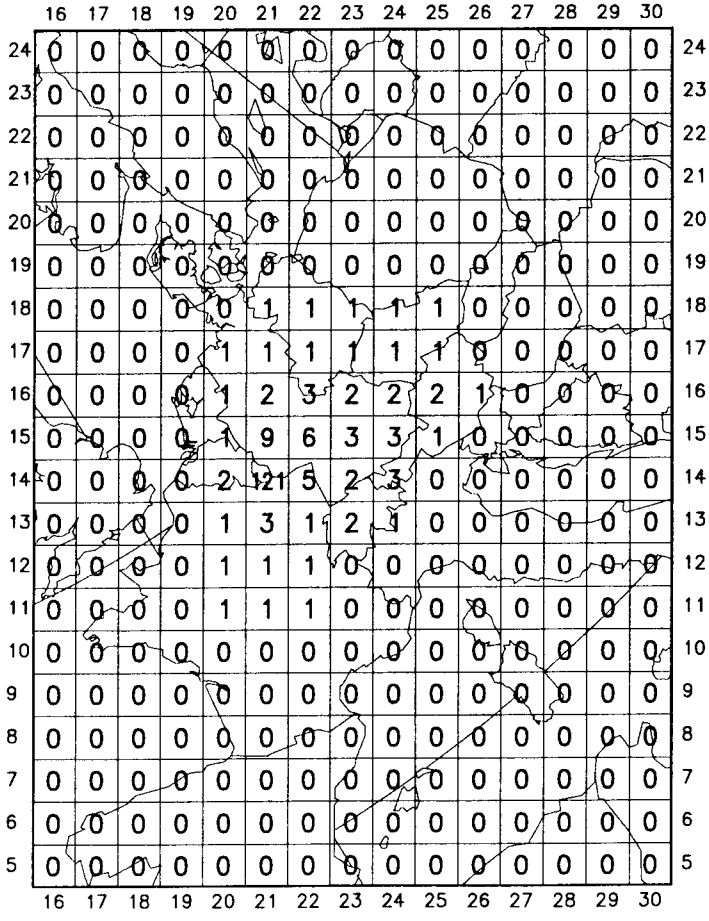
Total dep. of Oxidized Nitrogen
Contribution from Luxembourg



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

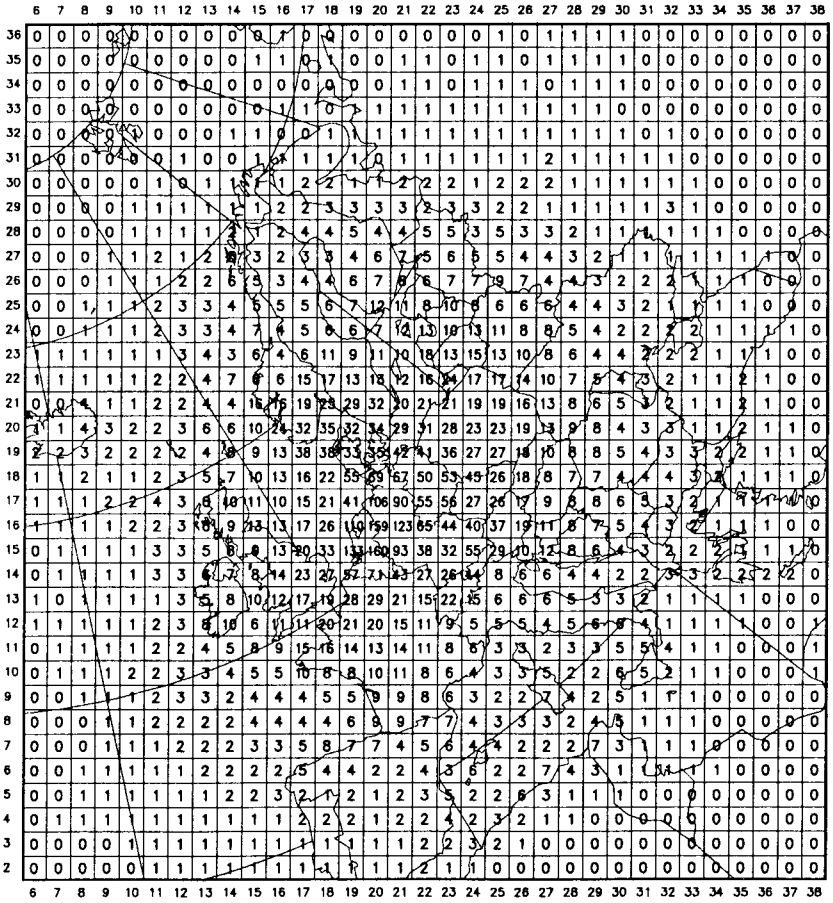
Total dep. of Reduced Nitrogen
Contribution from Luxembourg



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

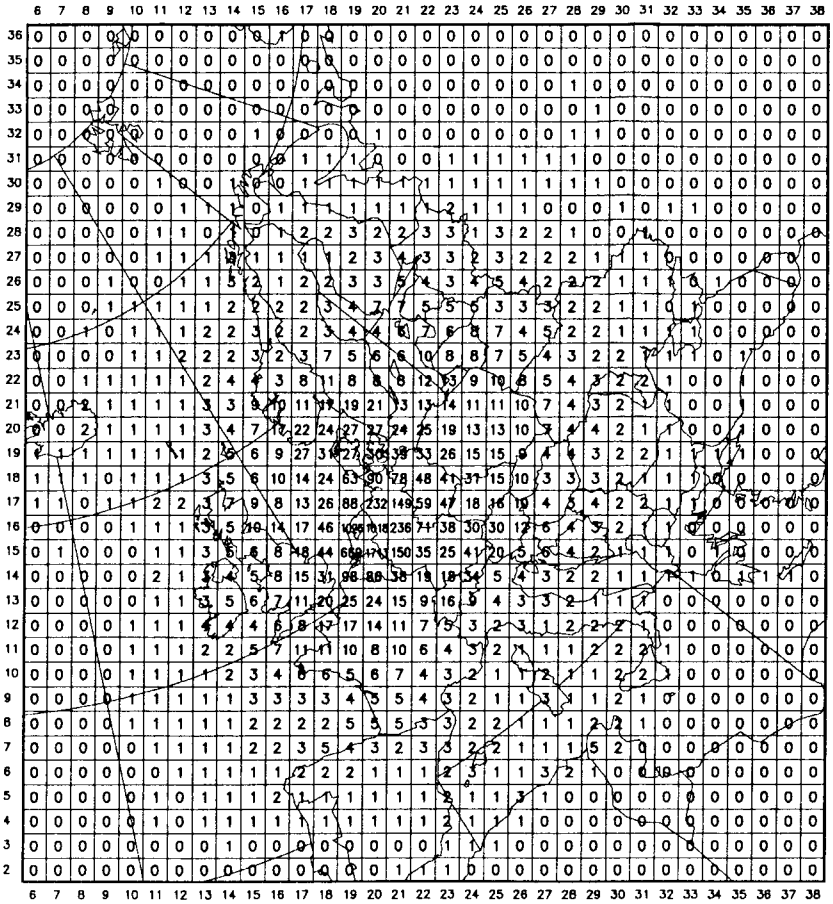
Total dep. of Oxidized Nitrogen
Contribution from Netherlands



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

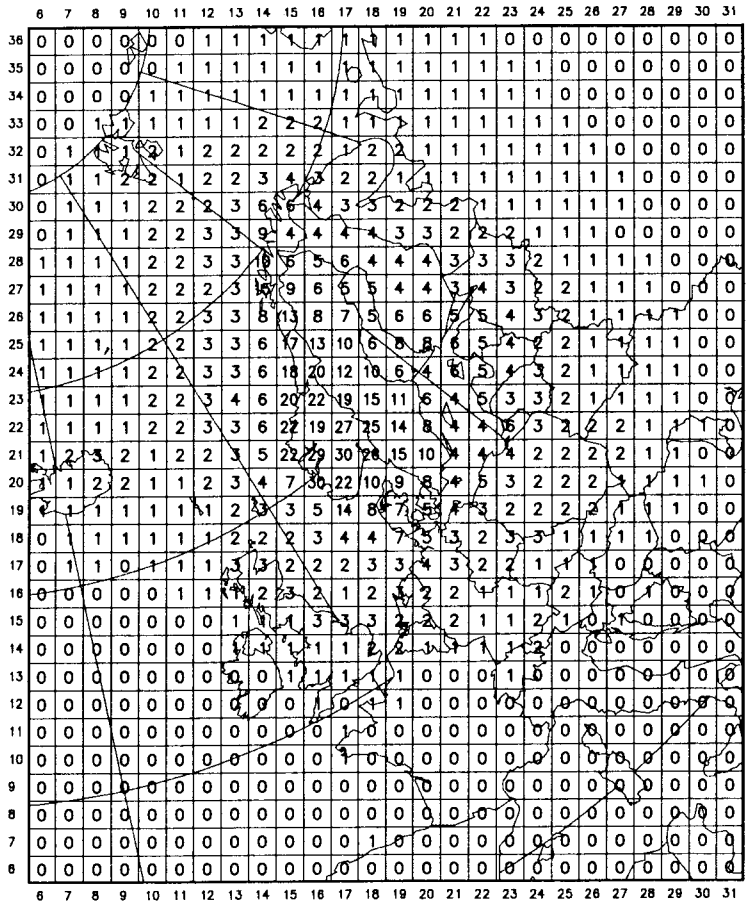
Total dep. of Reduced Nitrogen
Contribution from Netherlands



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

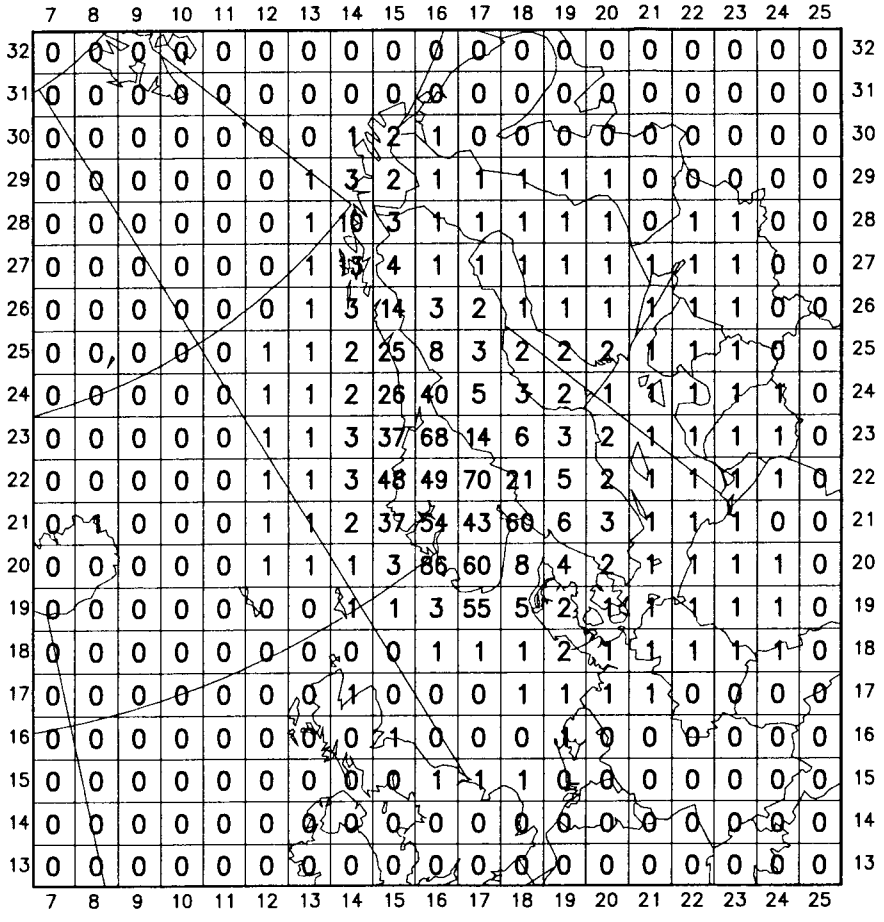
Total dep. of Oxidized Nitrogen
Contribution from Norway



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

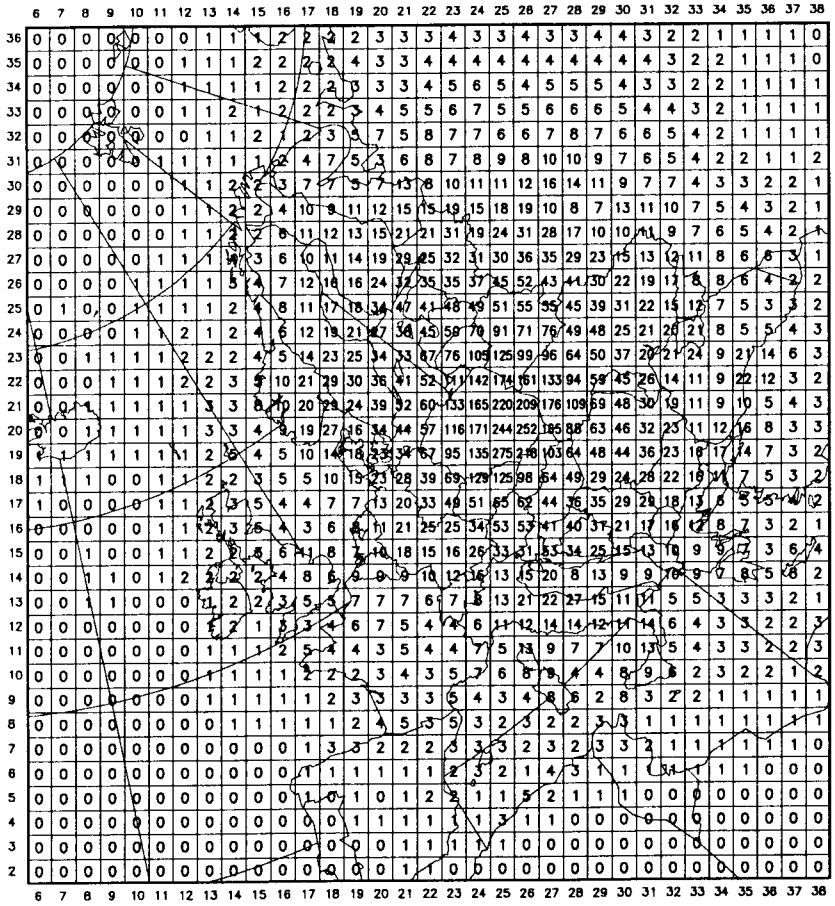
Total dep. of Reduced Nitrogen
Contribution from Norway



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

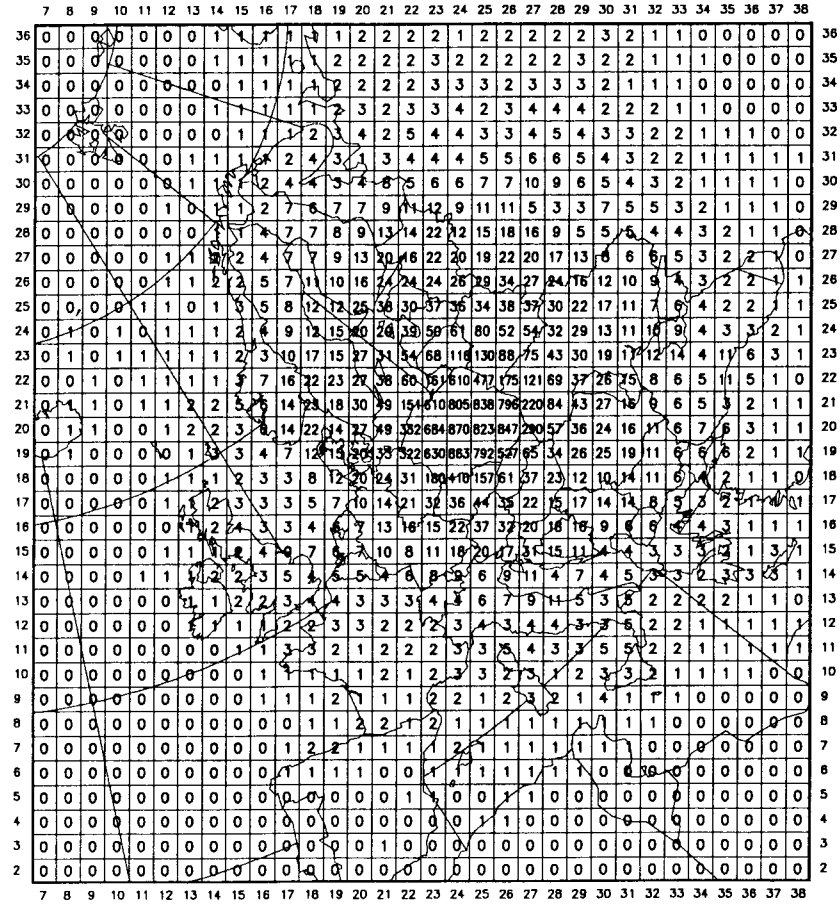
Total dep. of Oxidized Nitrogen
Contribution from Poland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

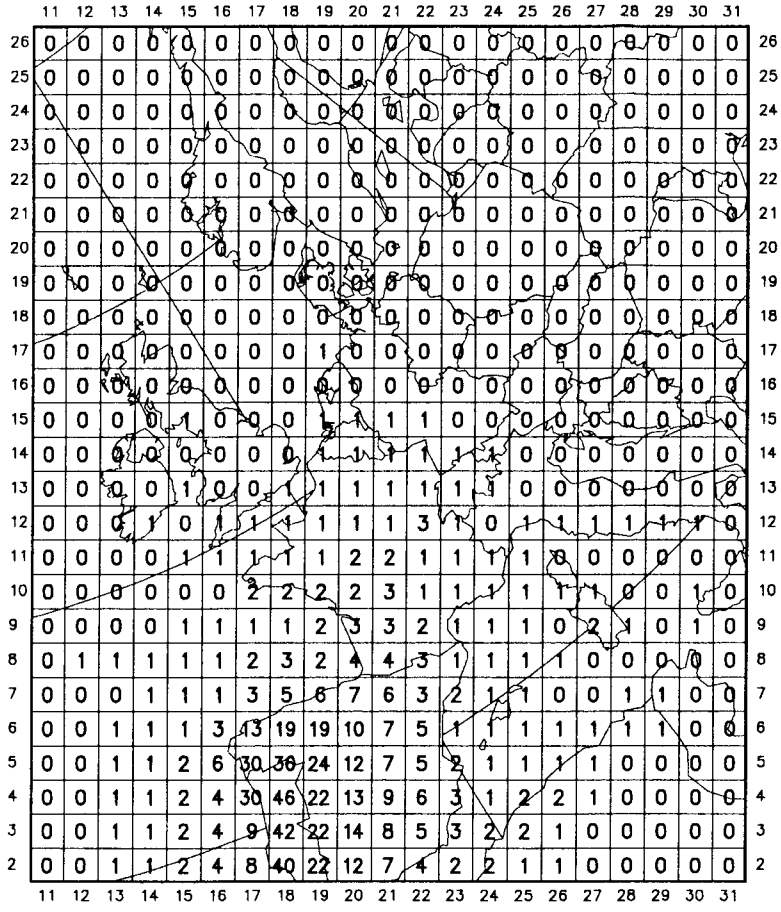
Total dep. of Reduced Nitrogen
Contribution from Poland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

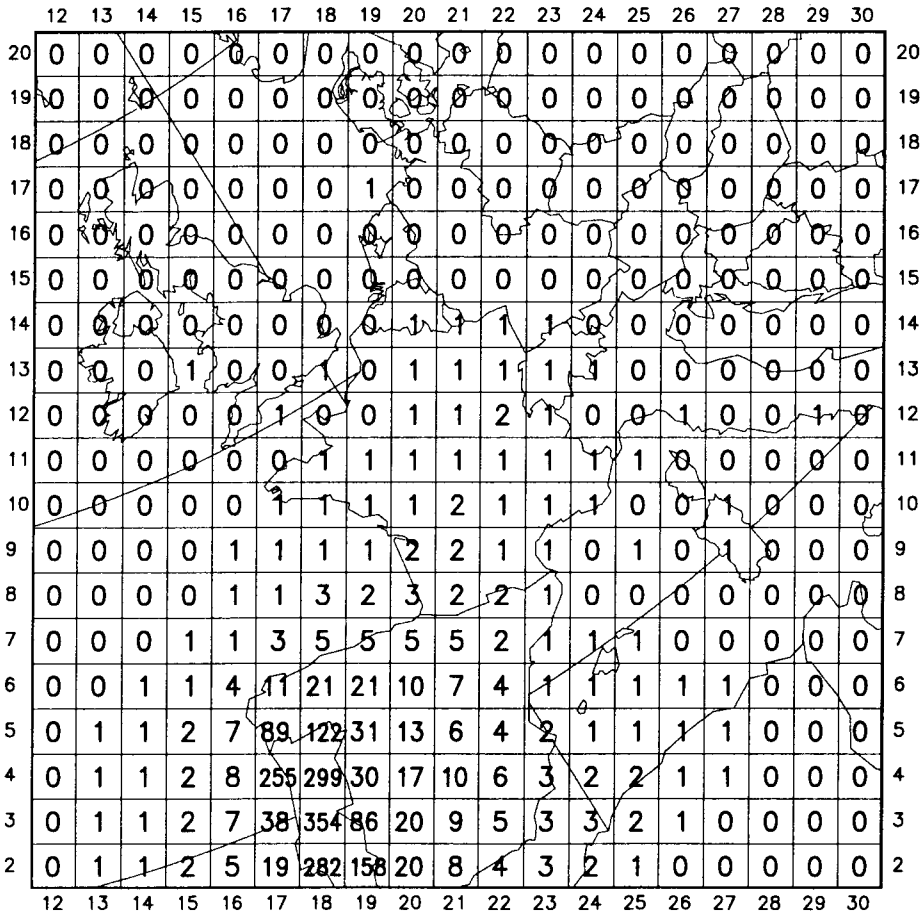
Total dep. of Oxidized Nitrogen
Contribution from Portugal



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

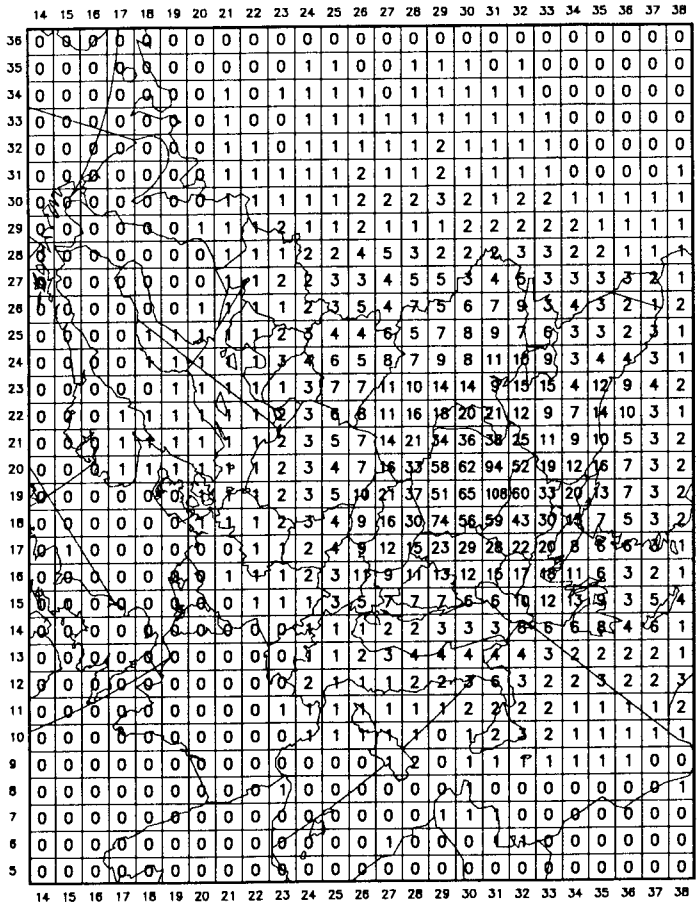
Total dep. of Reduced Nitrogen
Contribution from Portugal



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

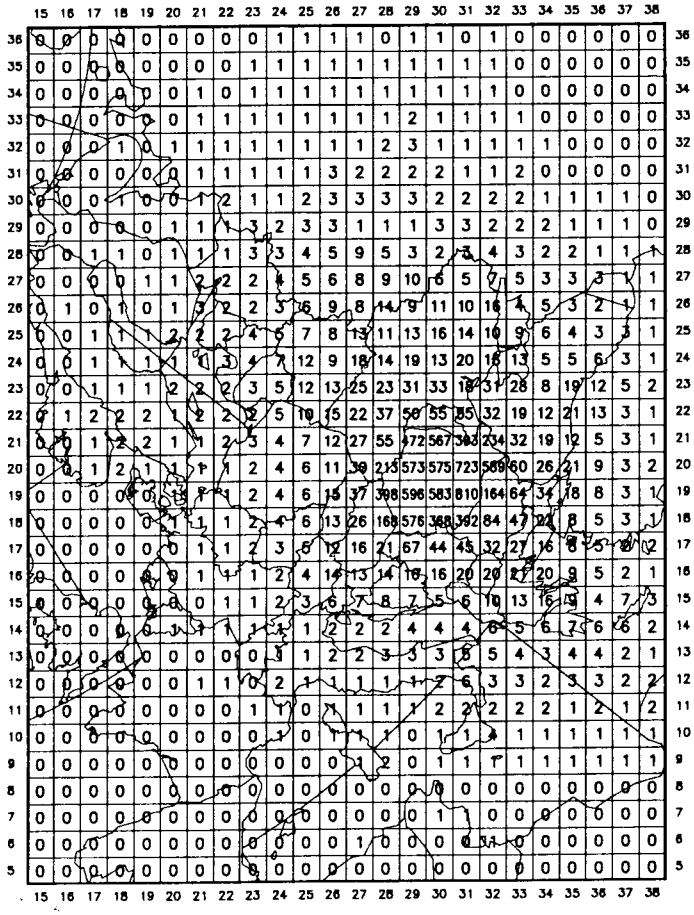
Total dep. of Oxidized Nitrogen
Contribution from Romania



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

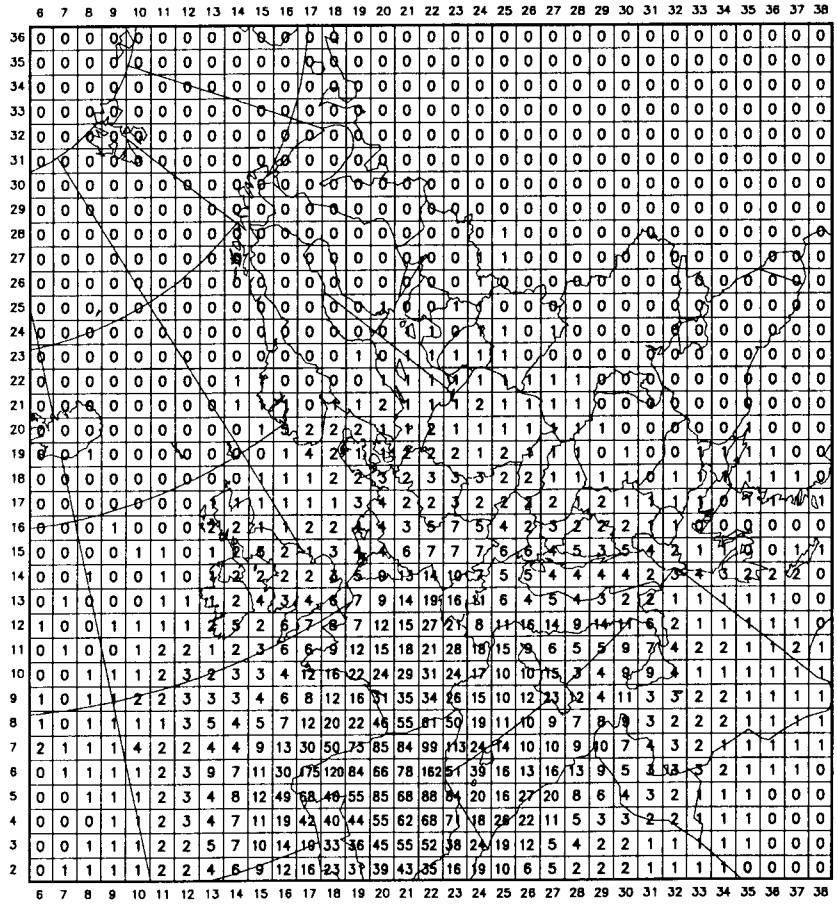
Total dep. of Reduced Nitrogen
Contribution from Romania



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

Total dep. of Oxidized Nitrogen
Contribution from Spain



Average :
85/87/88/89/90/91/92

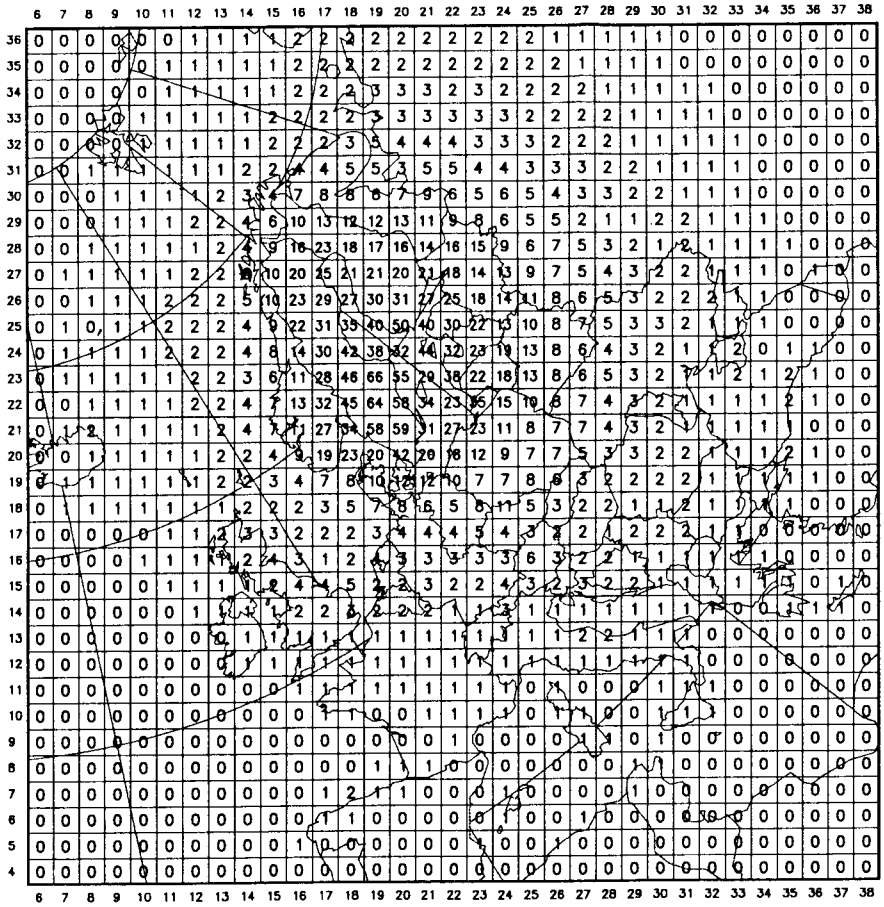
Unit : mg(N)/m2

Total dep. of Reduced Nitrogen
Contribution from Spain

Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

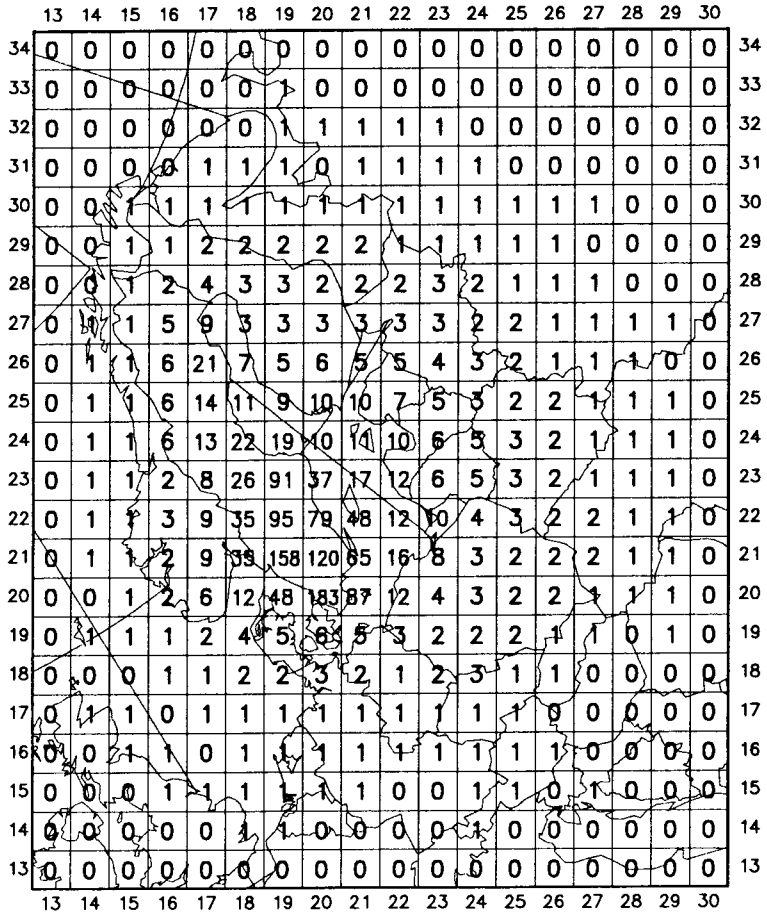
Total dep. of Oxidized Nitrogen
Contribution from Sweden



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

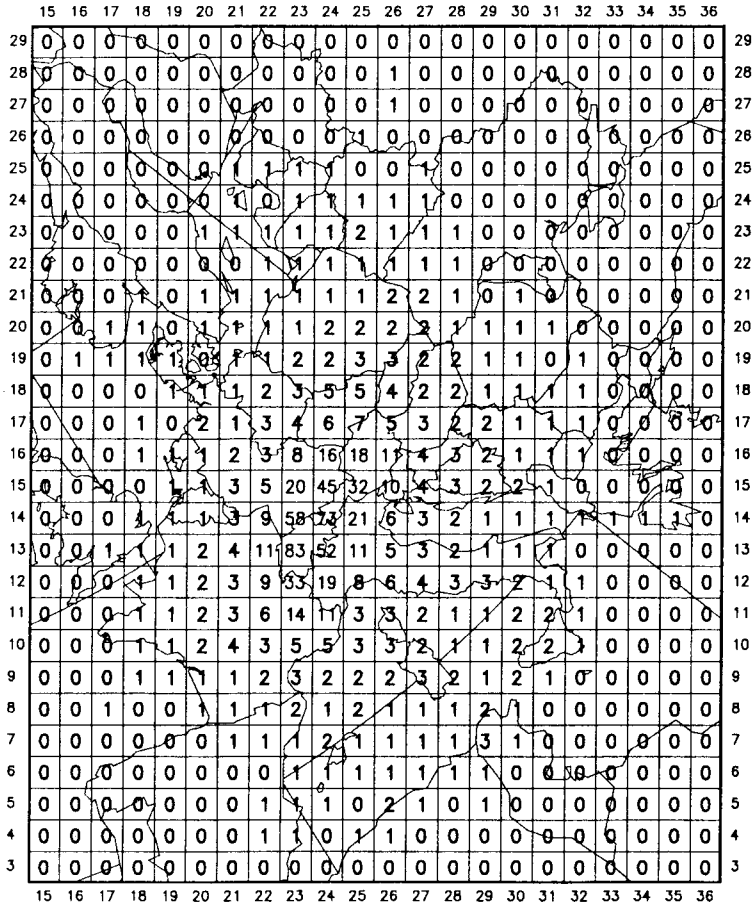
Total dep. of Reduced Nitrogen
Contribution from Sweden



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

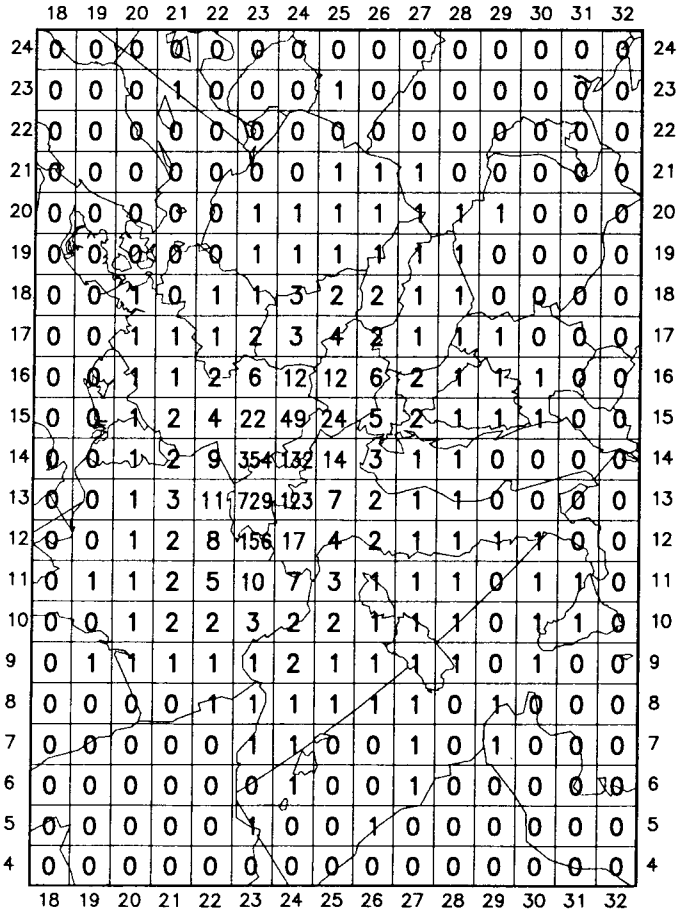
Total dep. of Oxidized Nitrogen
Contribution from Switzerland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

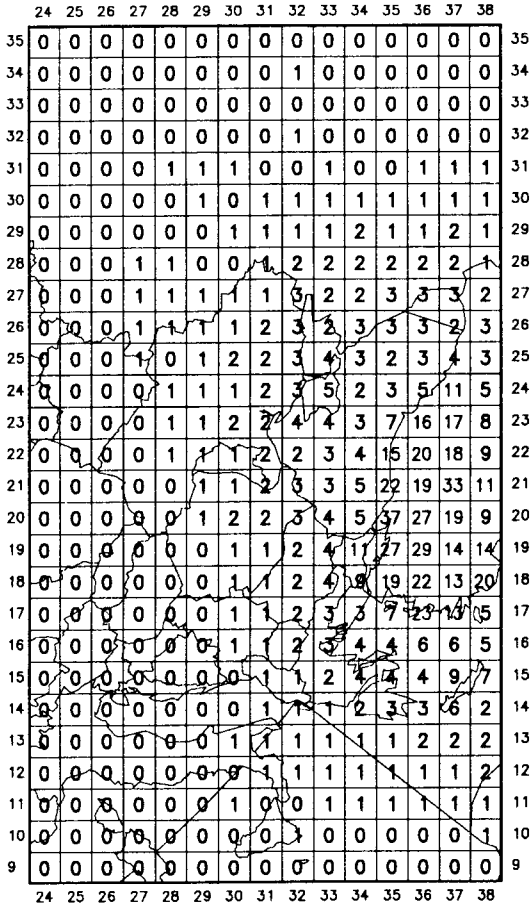
Total dep. of Reduced Nitrogen
Contribution from Switzerland



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

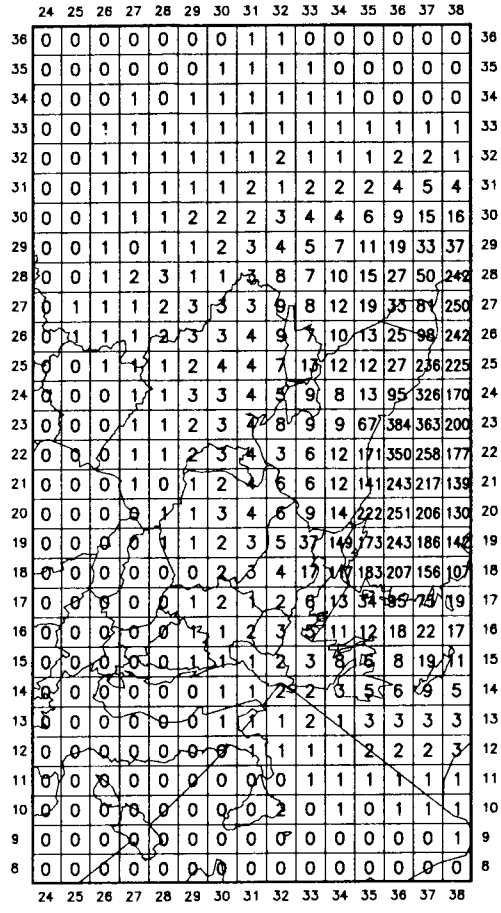
Total dep. of Oxidized Nitrogen
Contribution from Turkey



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

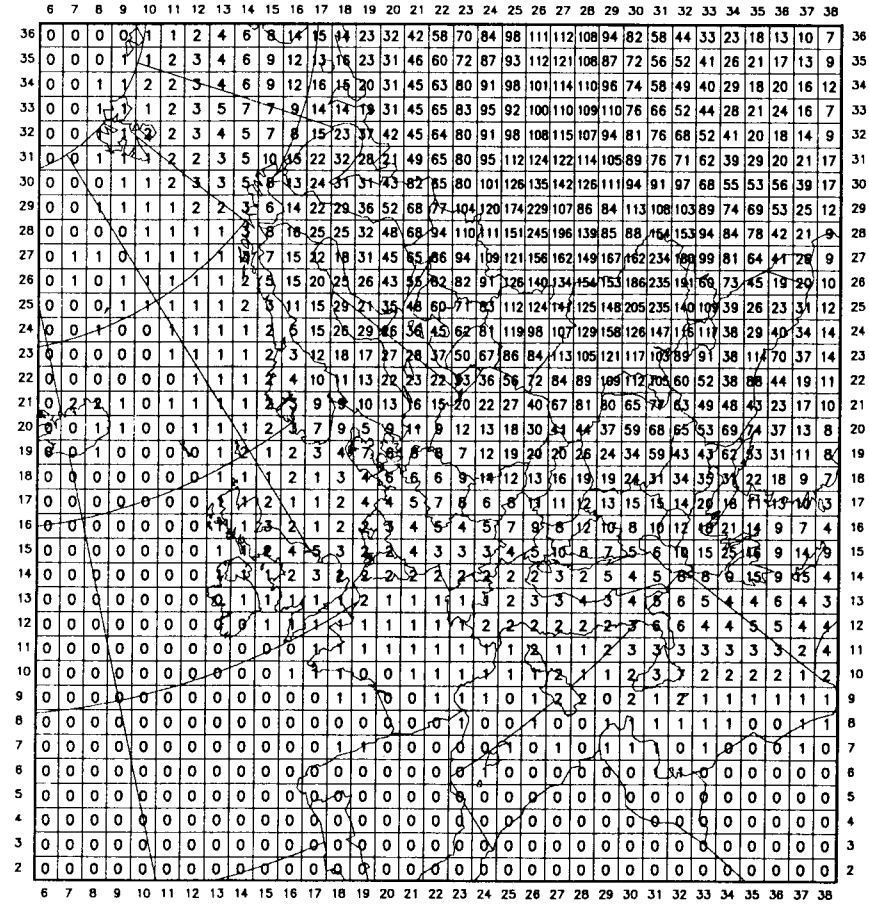
Total dep. of Reduced Nitrogen
Contribution from Turkey



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

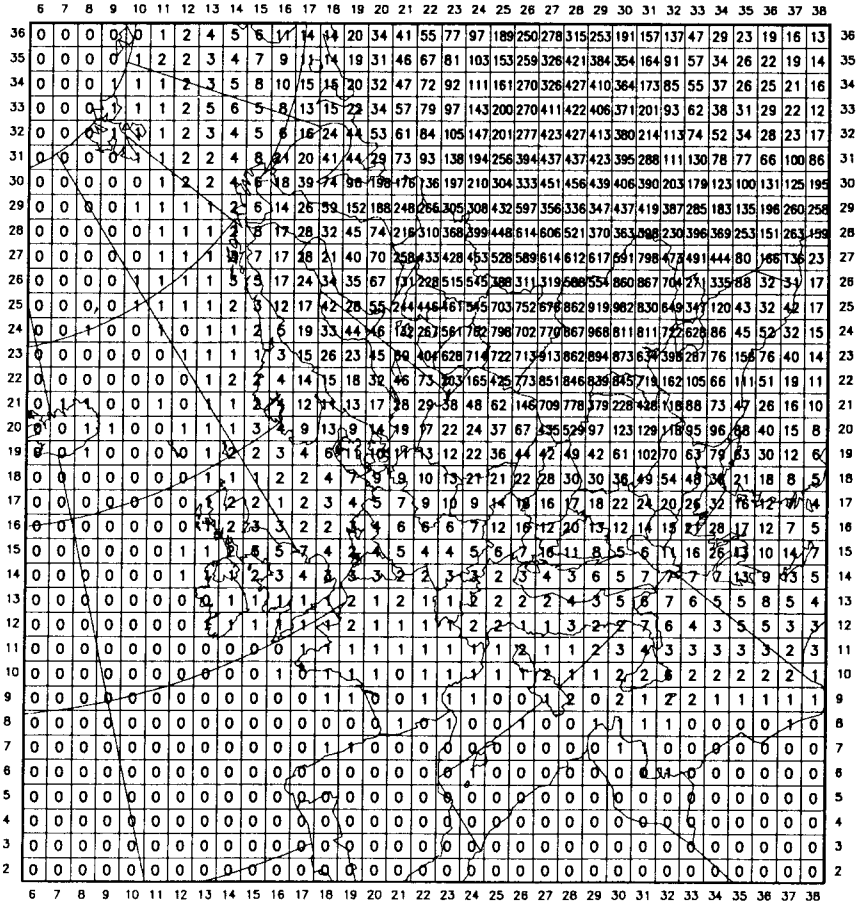
Total dep. of Oxidized Nitrogen
Contribution from USSR (European)



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

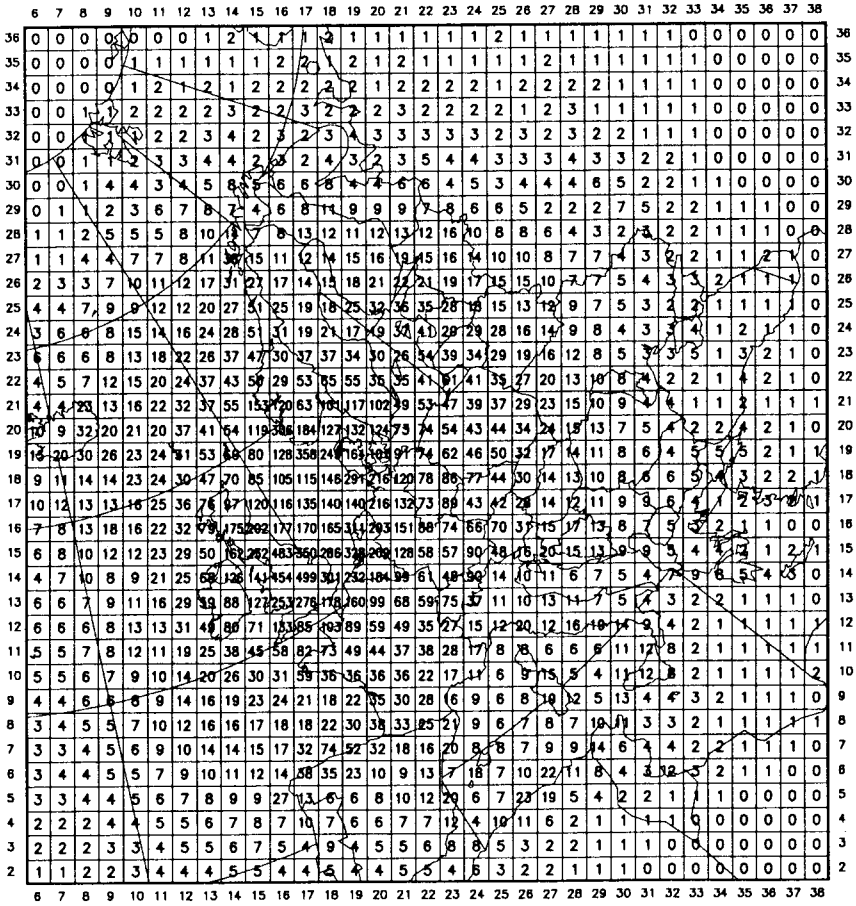
Total dep. of Reduced Nitrogen
Contribution from USSR (European)



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

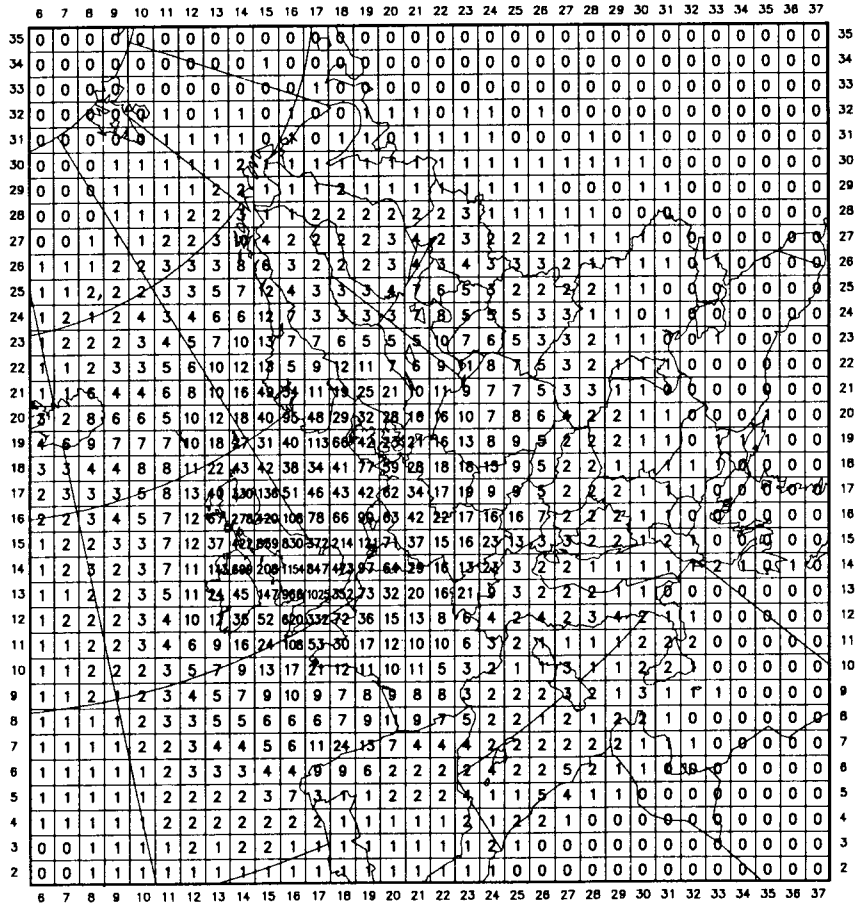
Total dep. of Oxidized Nitrogen
Contribution from United Kingdom



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

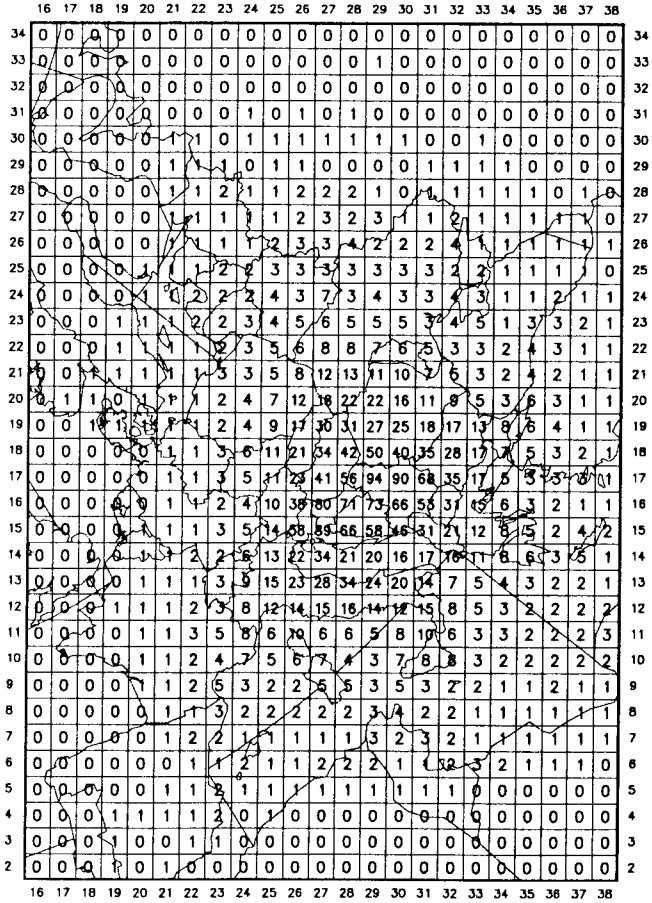
Total dep. of Reduced Nitrogen
Contribution from United Kingdom



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

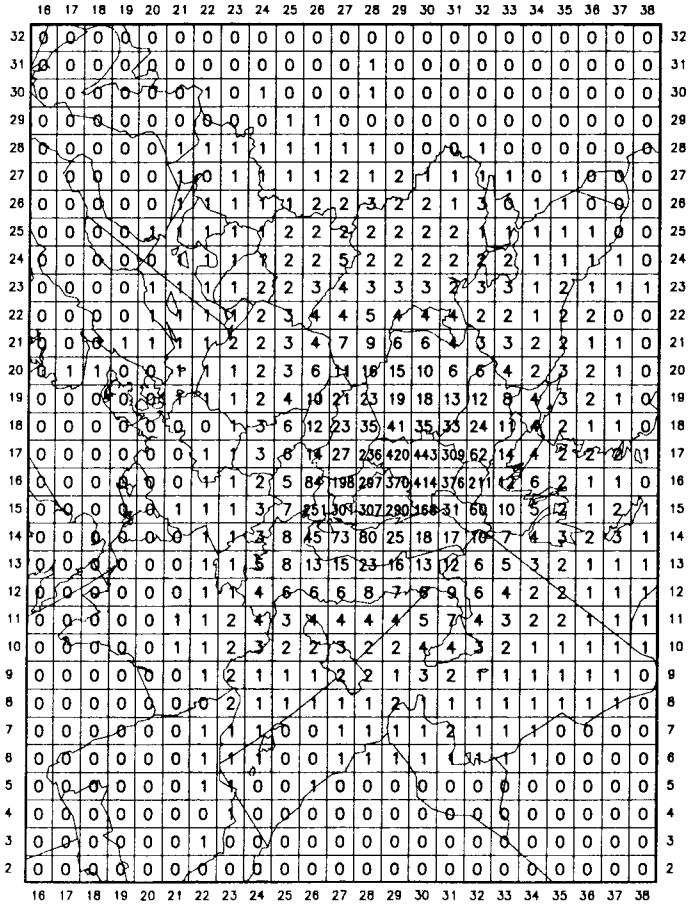
Total dep. of Oxidized Nitrogen
Contribution from Yugoslavia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

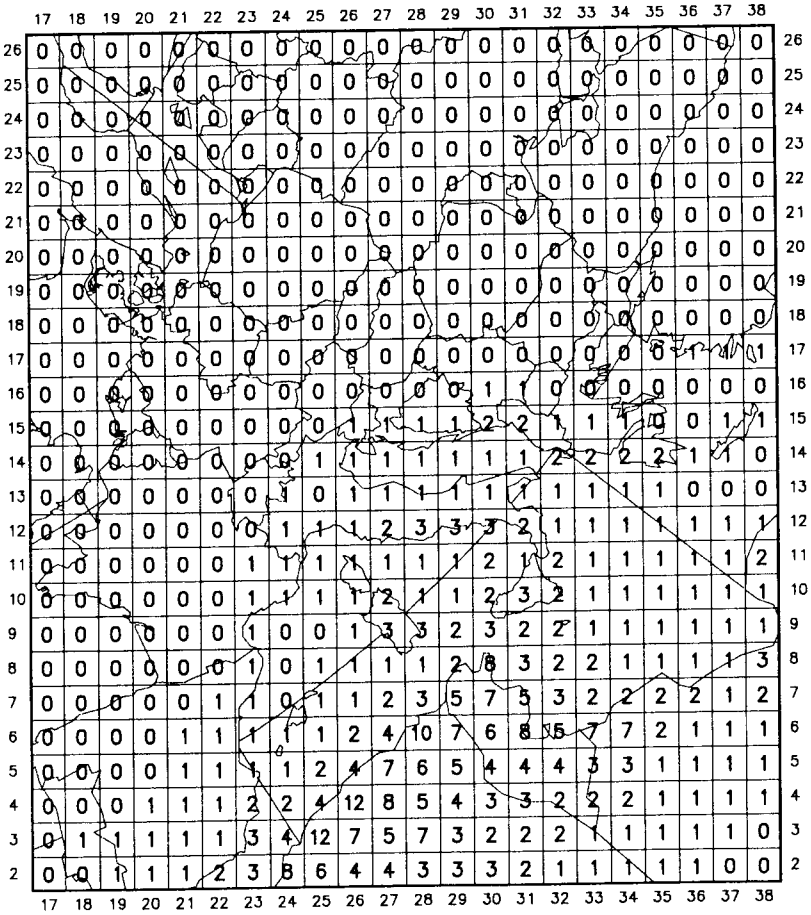
Total dep. of Reduced Nitrogen
Contribution from Yugoslavia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

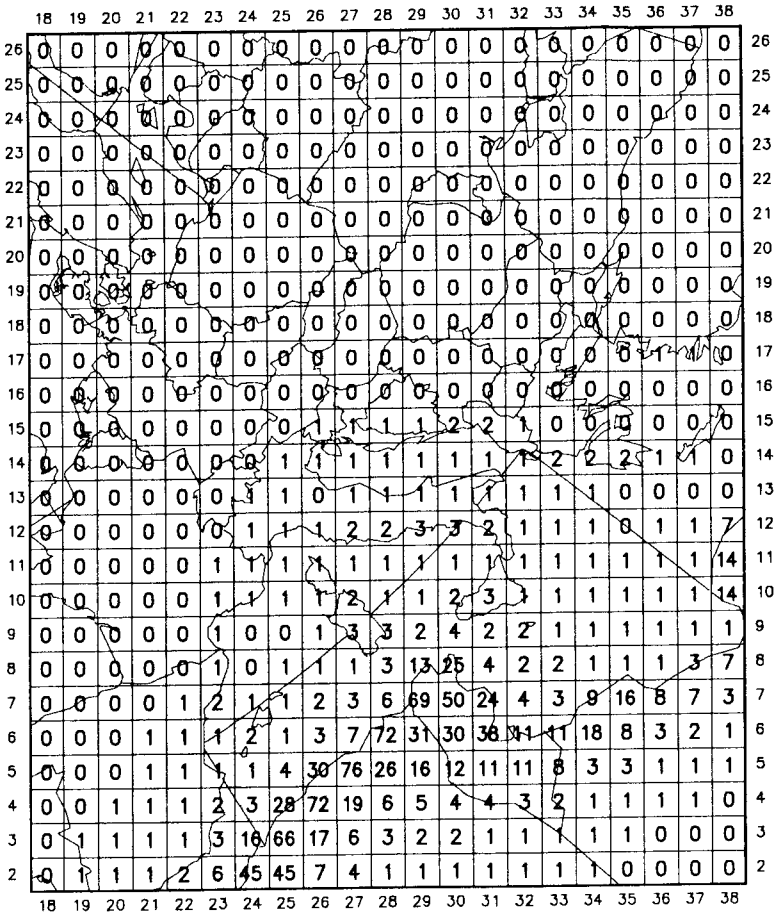
Total dep. of Oxidized Nitrogen
Contribution from remaining land areas



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

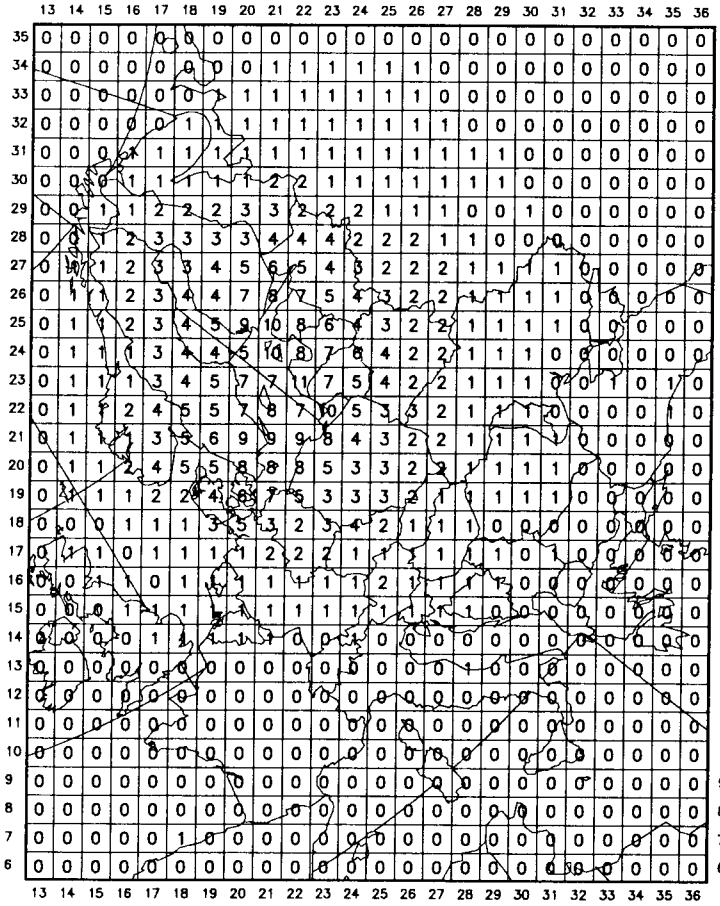
Total dep. of Reduced Nitrogen
Contribution from remaining land areas



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

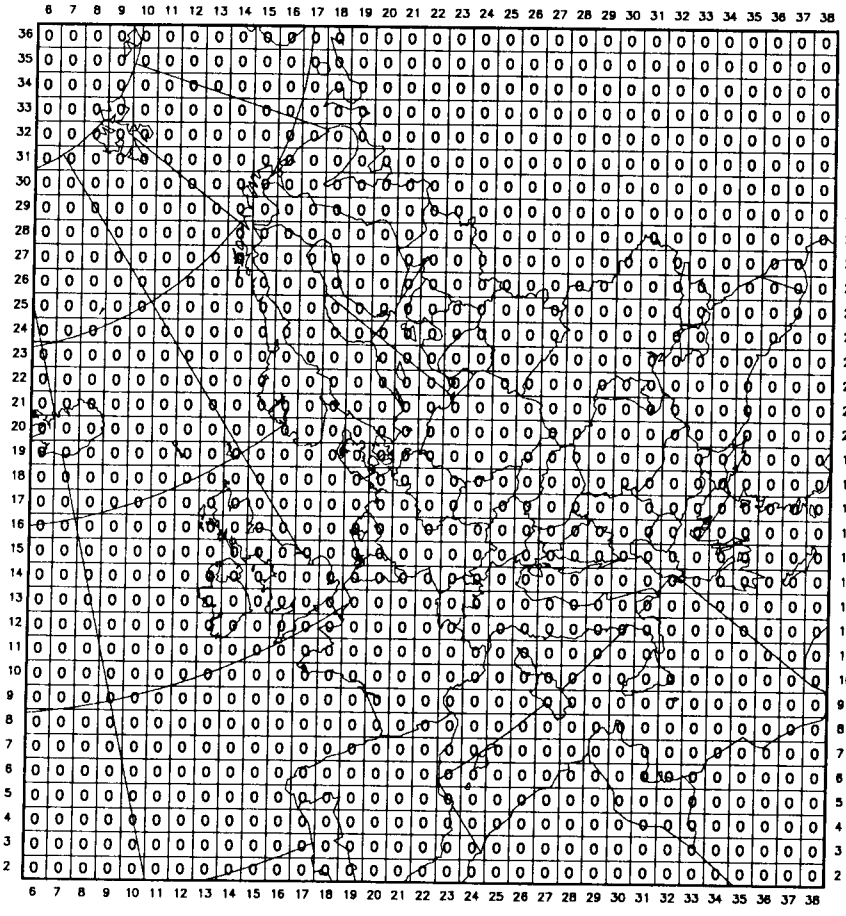
Total dep. of Oxidized Nitrogen
Contribution from int. trade, Baltic sea



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

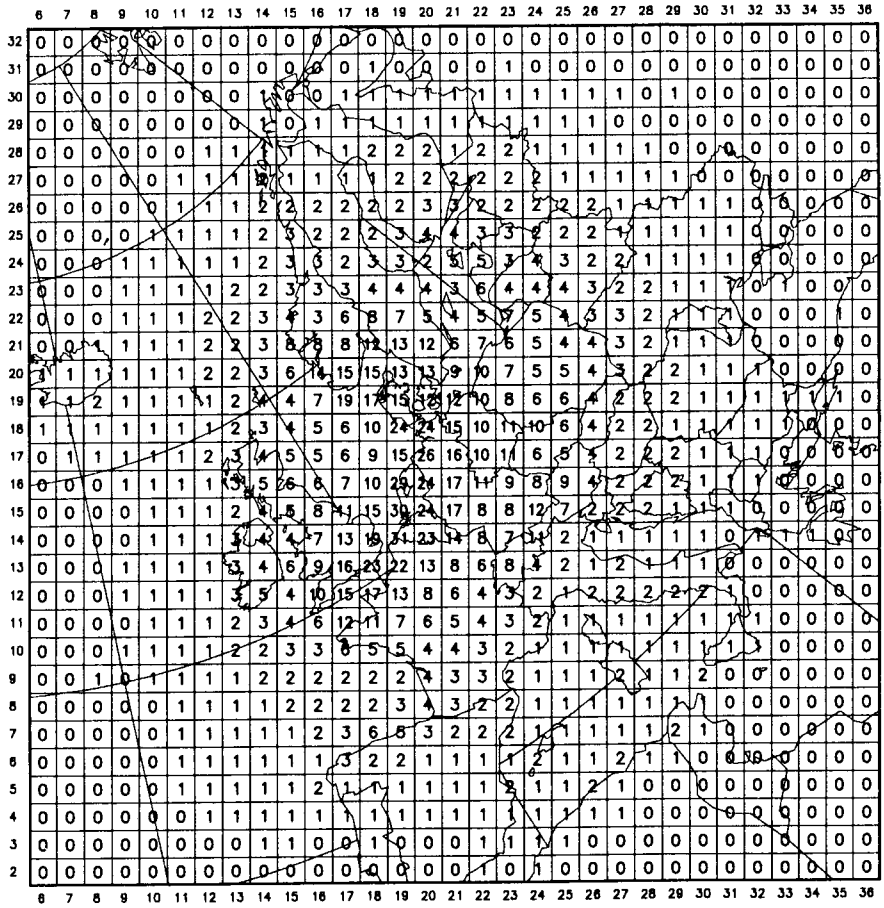
Total dep. of Reduced Nitrogen
Contribution from int. trade, Baltic sea



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

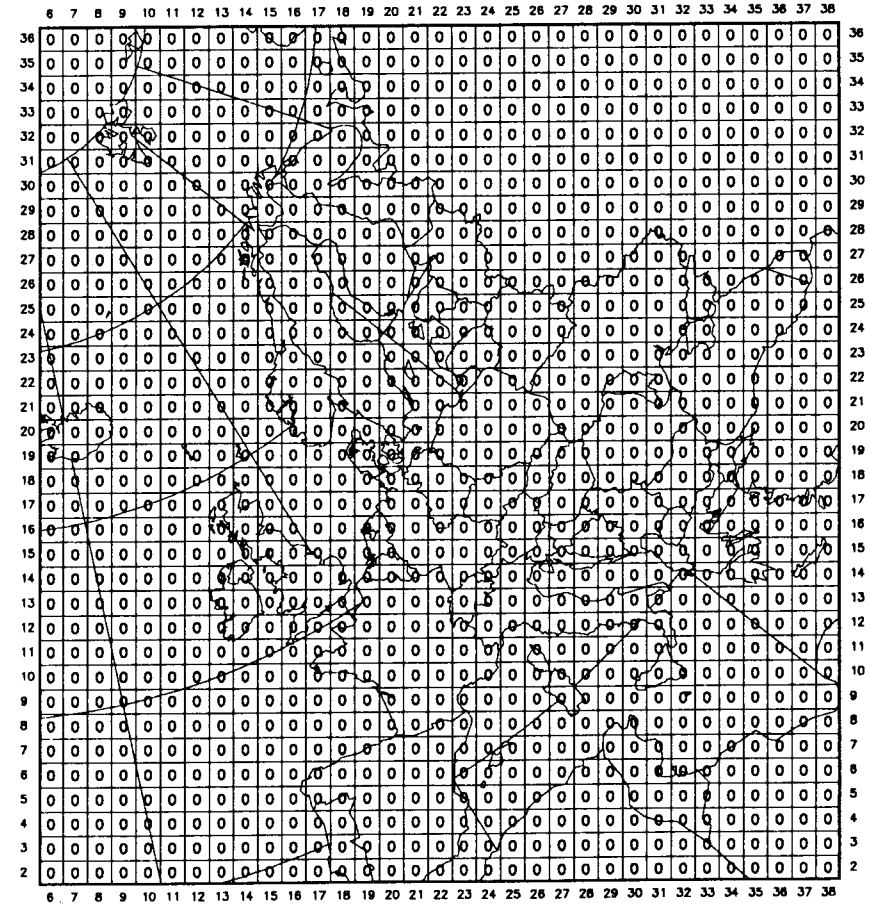
Total dep. of Oxidized Nitrogen
Contribution from int. trade, North sea



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

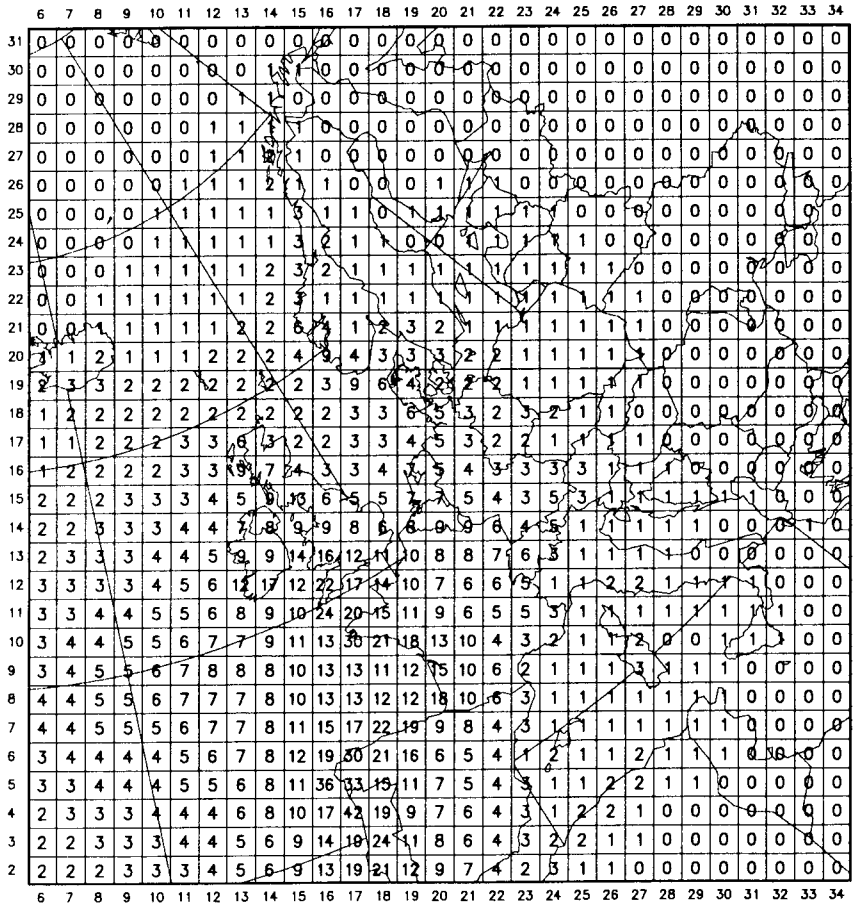
Total dep. of Reduced Nitrogen
Contribution from int. trade, North sea



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

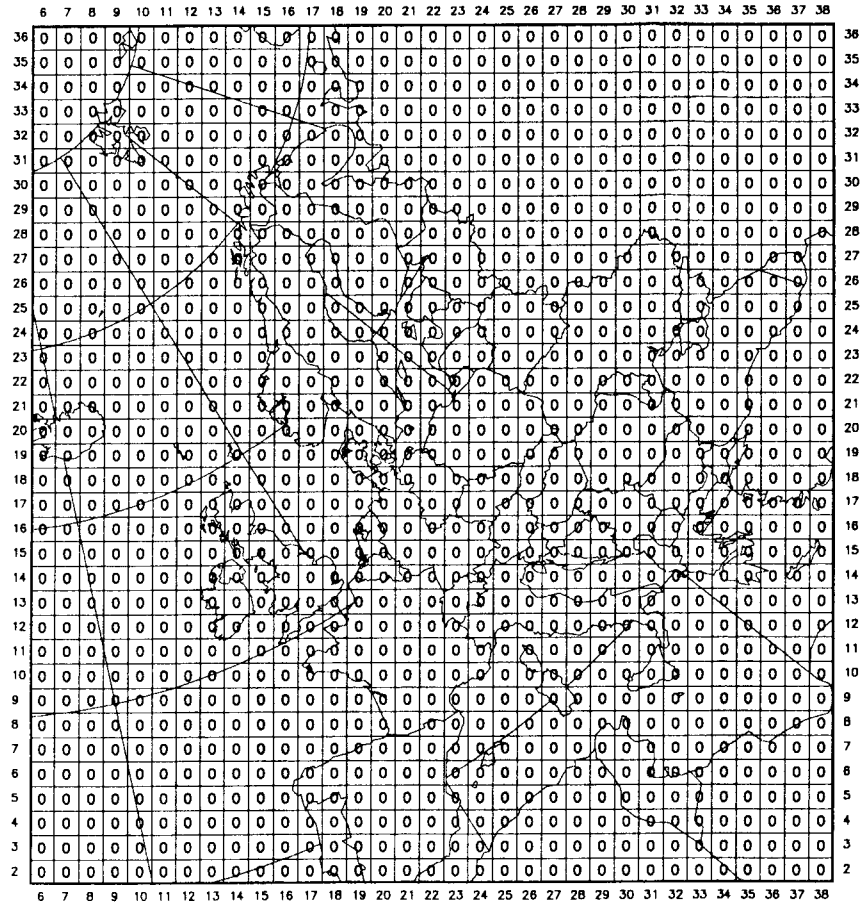
Total dep. of Oxidized Nitrogen
Contribution from int. trade, rem. Atlantic waters



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

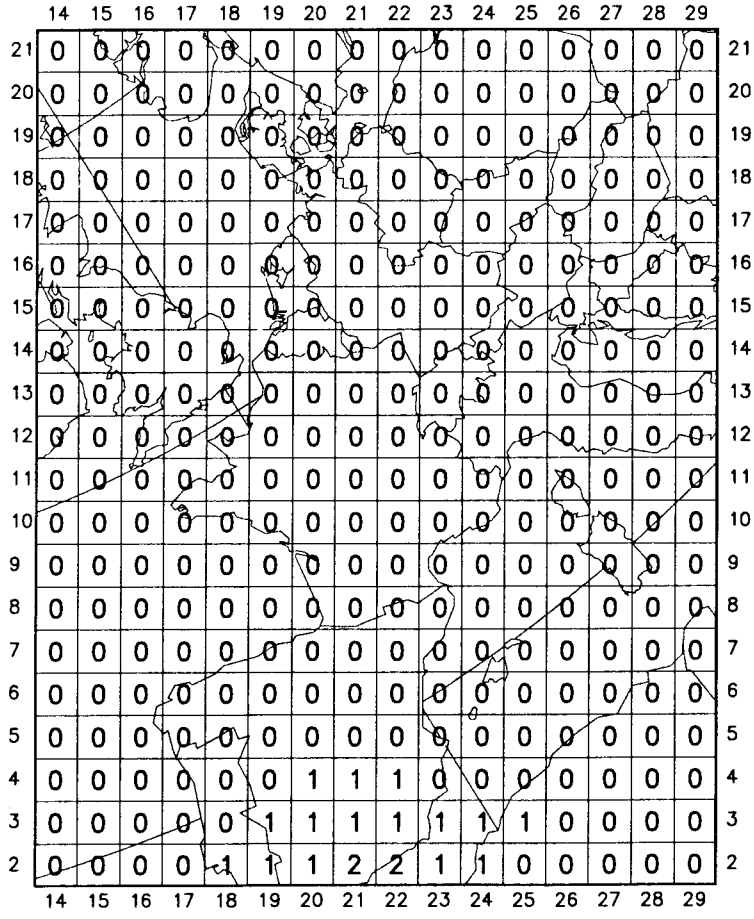
Total dep. of Reduced Nitrogen
Contribution from int. trade, rem. Atlantic waters



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

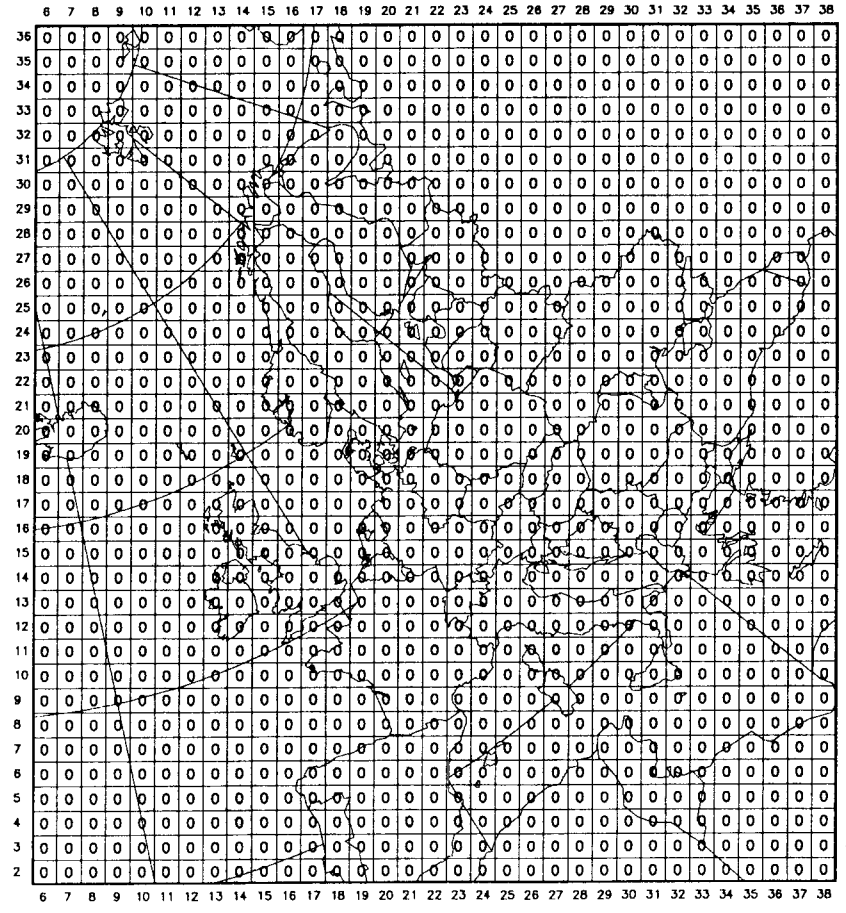
Total dep. of Oxidized Nitrogen
Contribution from int. trade, Mediteranian Sea



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

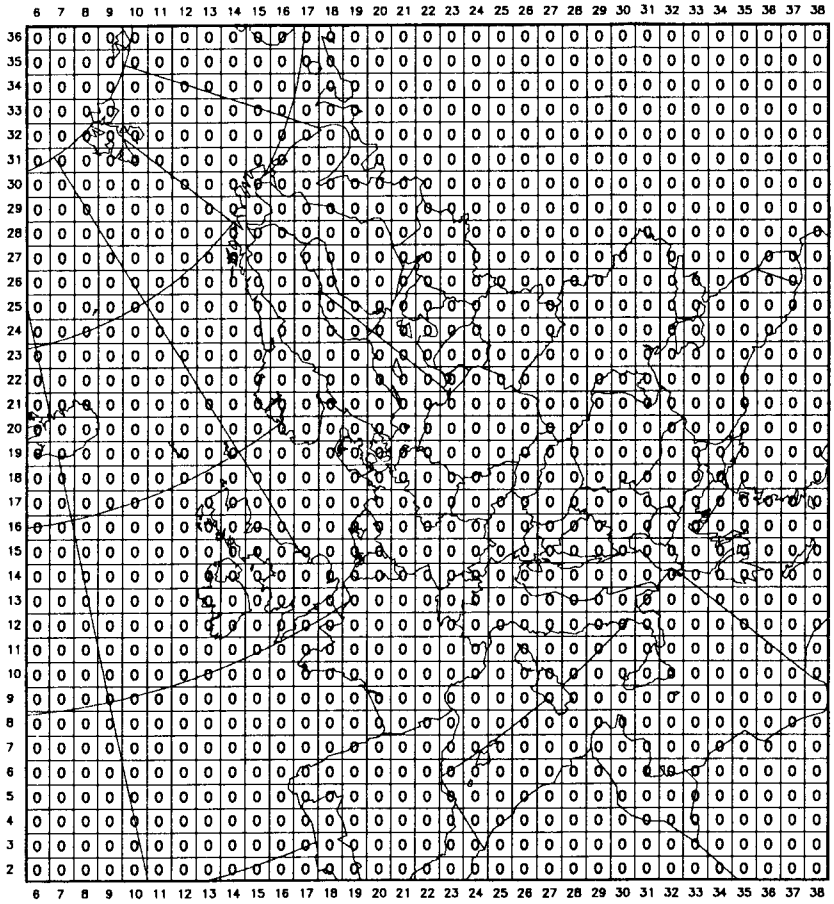
Total dep. of Reduced Nitrogen
Contribution from int. trade, Mediteranian Sea



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

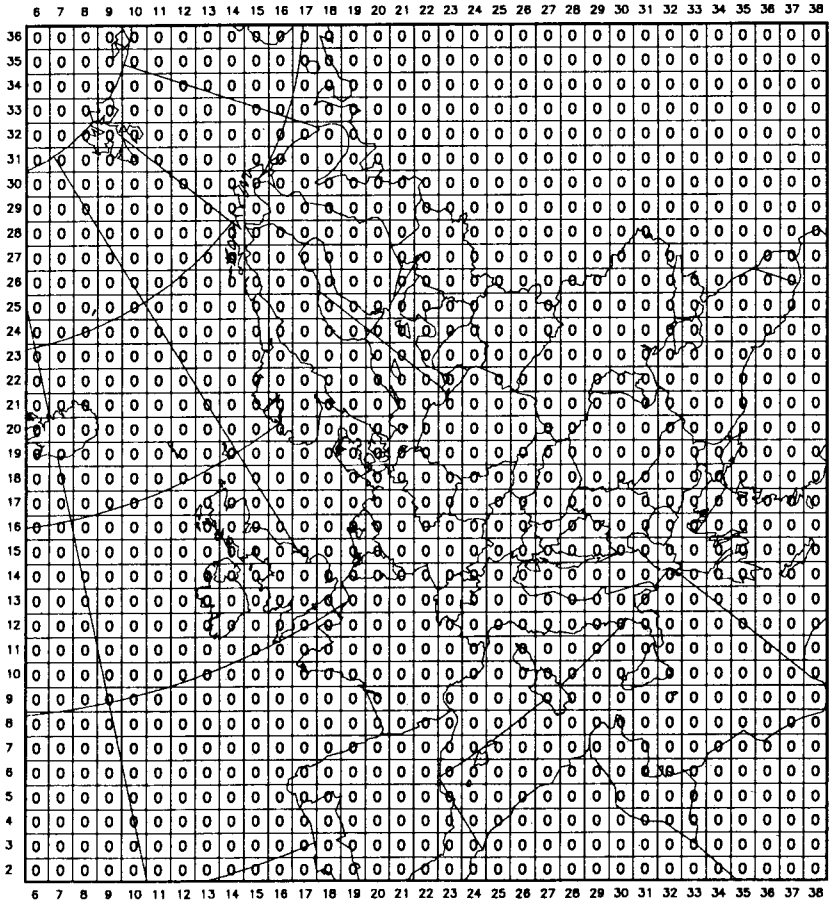
Total dep. of Oxidized Nitrogen
Contribution from int. trade, Black sea



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

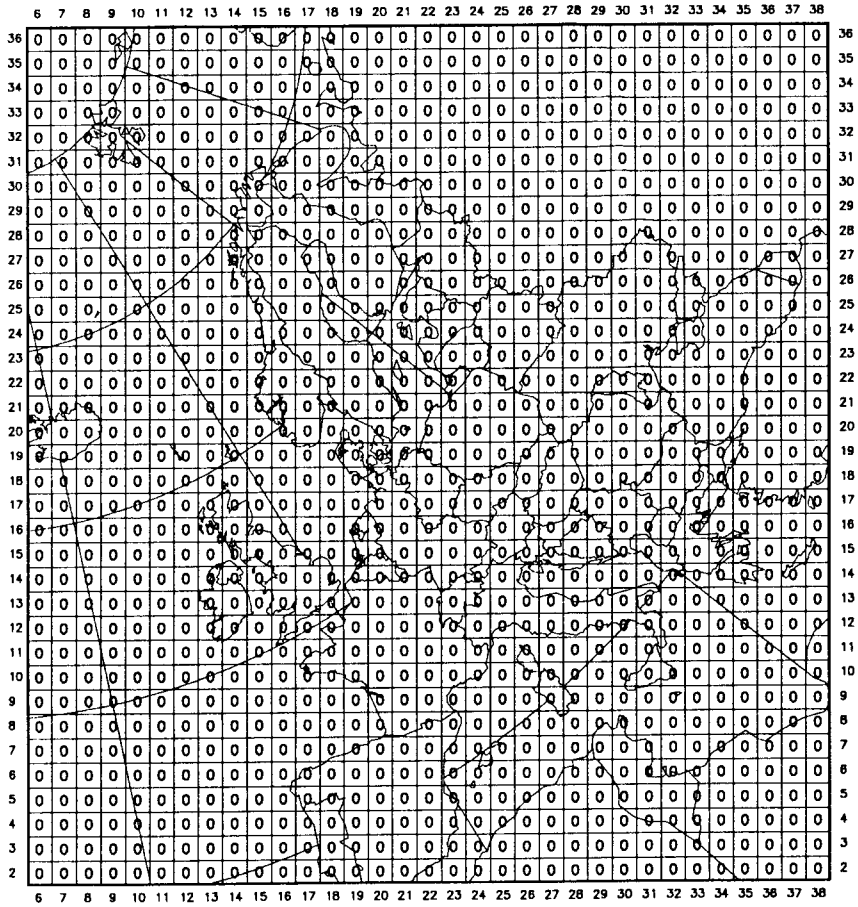
Total dep. of Reduced Nitrogen
Contribution from int. trade, Black sea



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

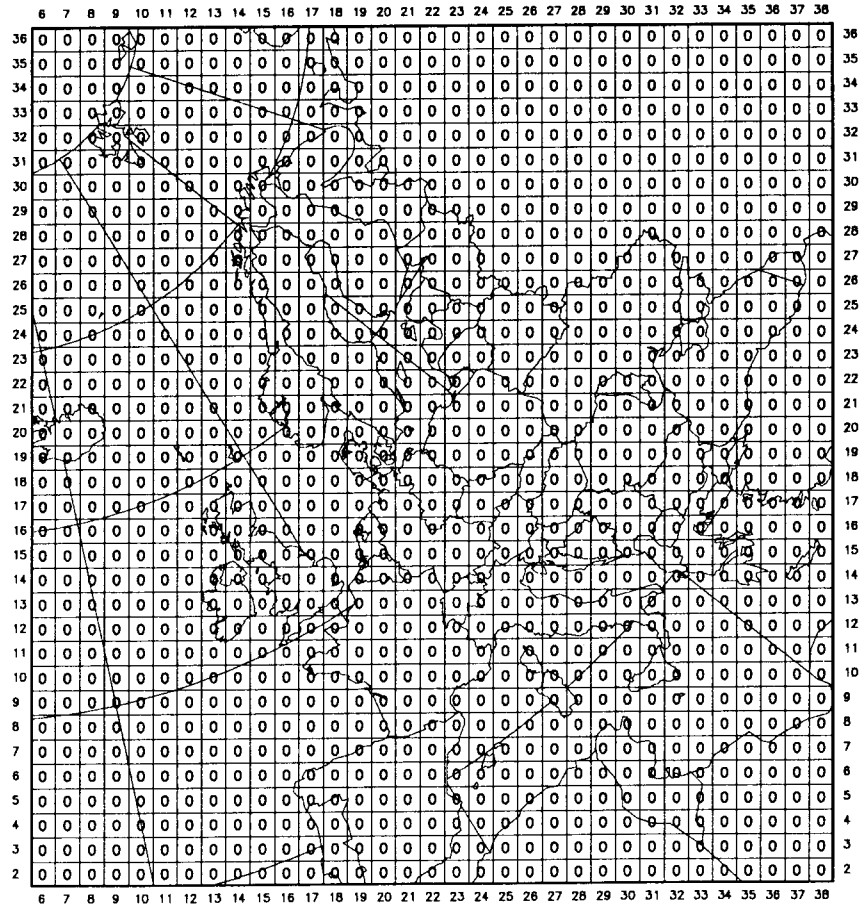
Total dep. of Oxidized Nitrogen
Contribution from natural emissions



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

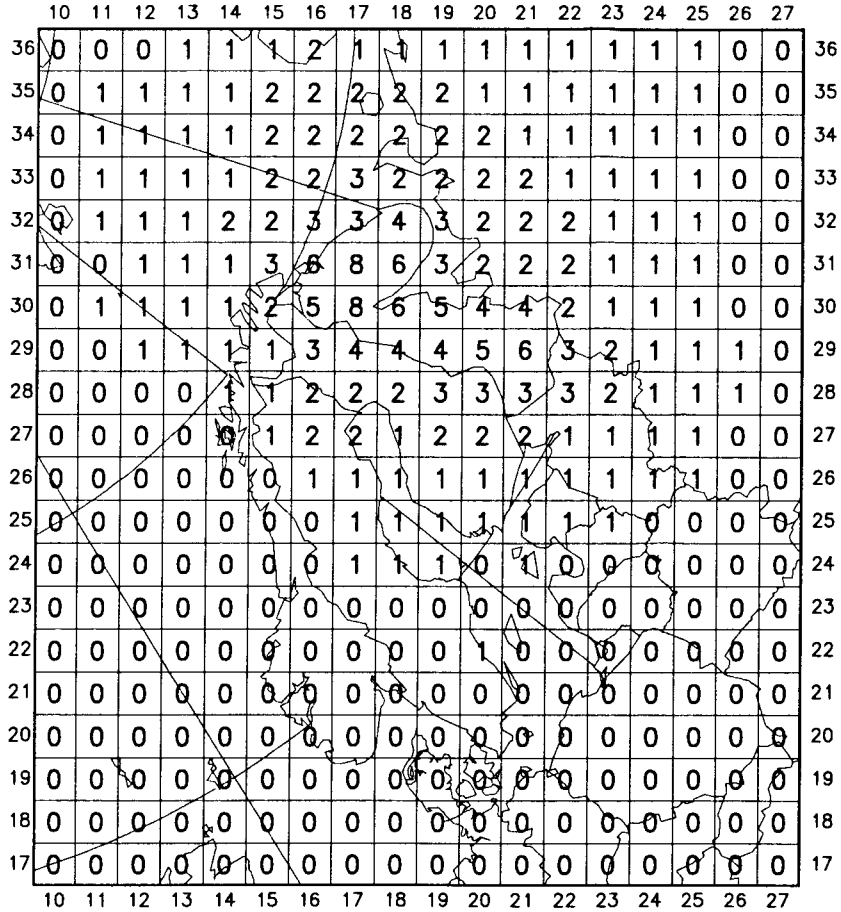
Total dep. of Reduced Nitrogen
Contribution from natural emissions



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

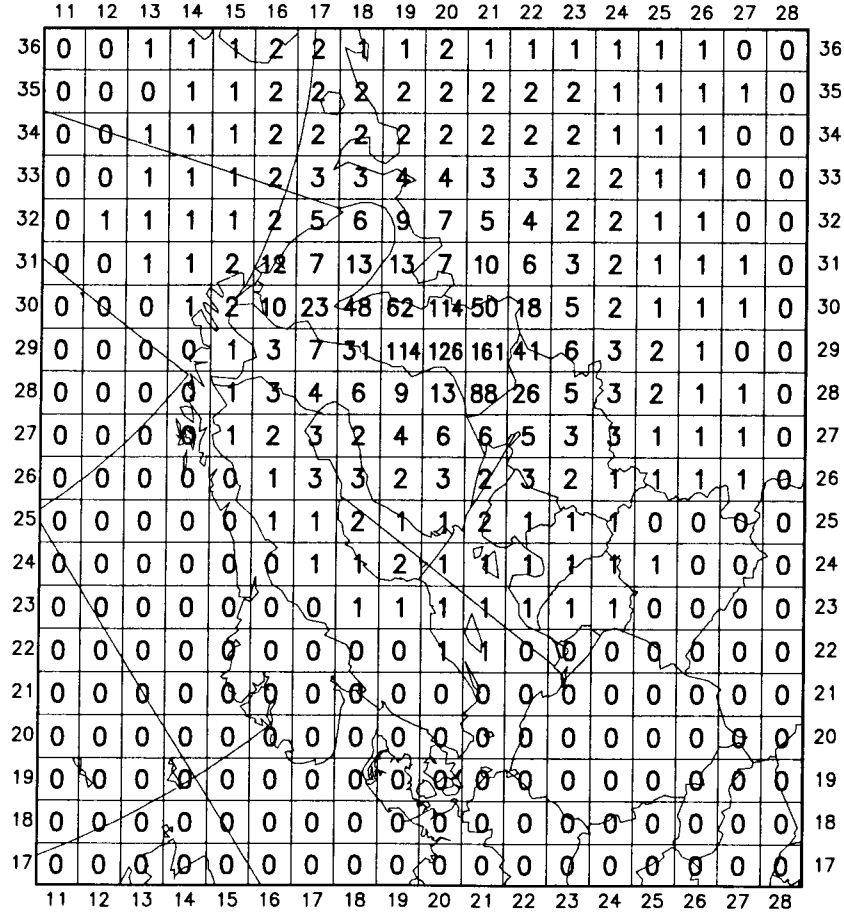
Total dep. of Oxidized Nitrogen
Contribution from Kola / Karelia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

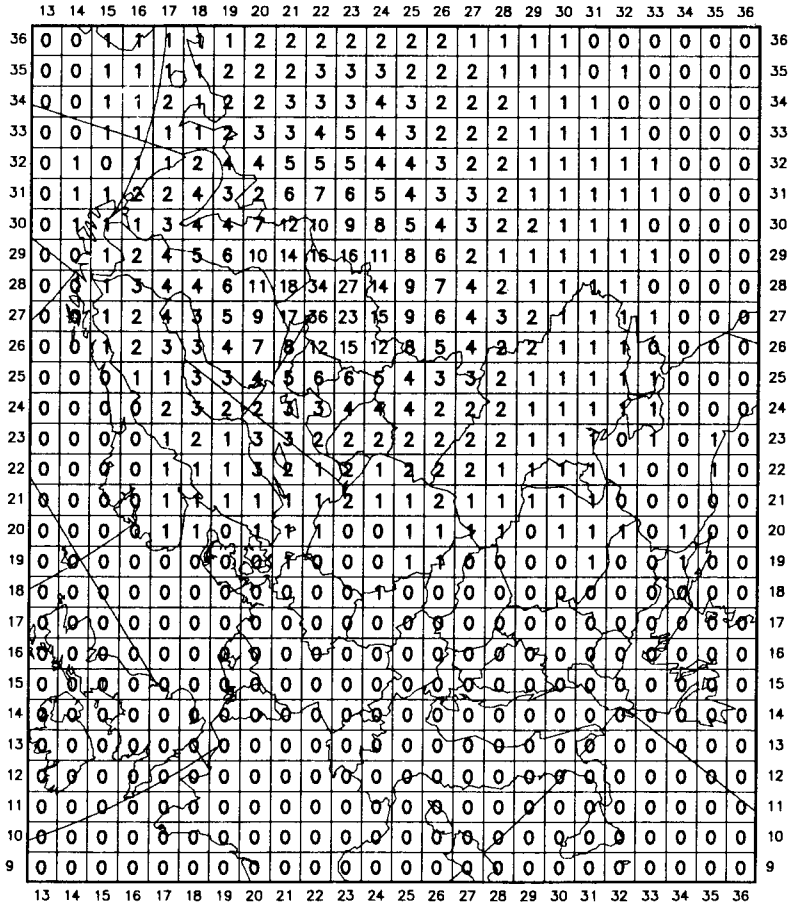
Total dep. of Reduced Nitrogen
Contribution from Kola / Karelia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

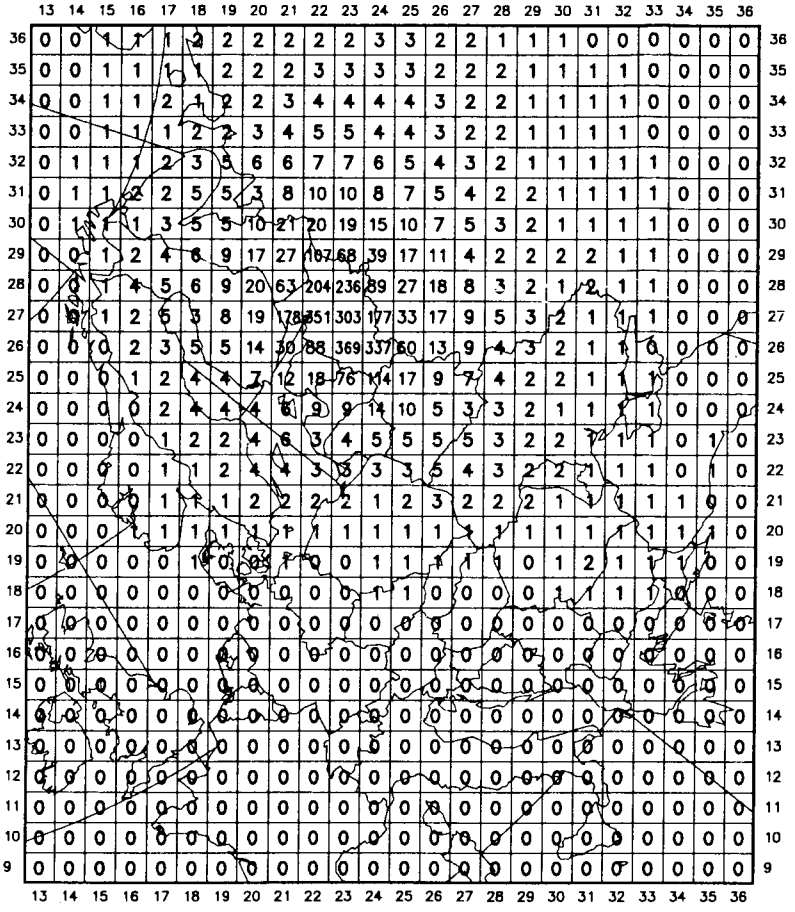
Total dep. of Oxidized Nitrogen
Contribution from Leningrad / Novgorod–Pskov



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

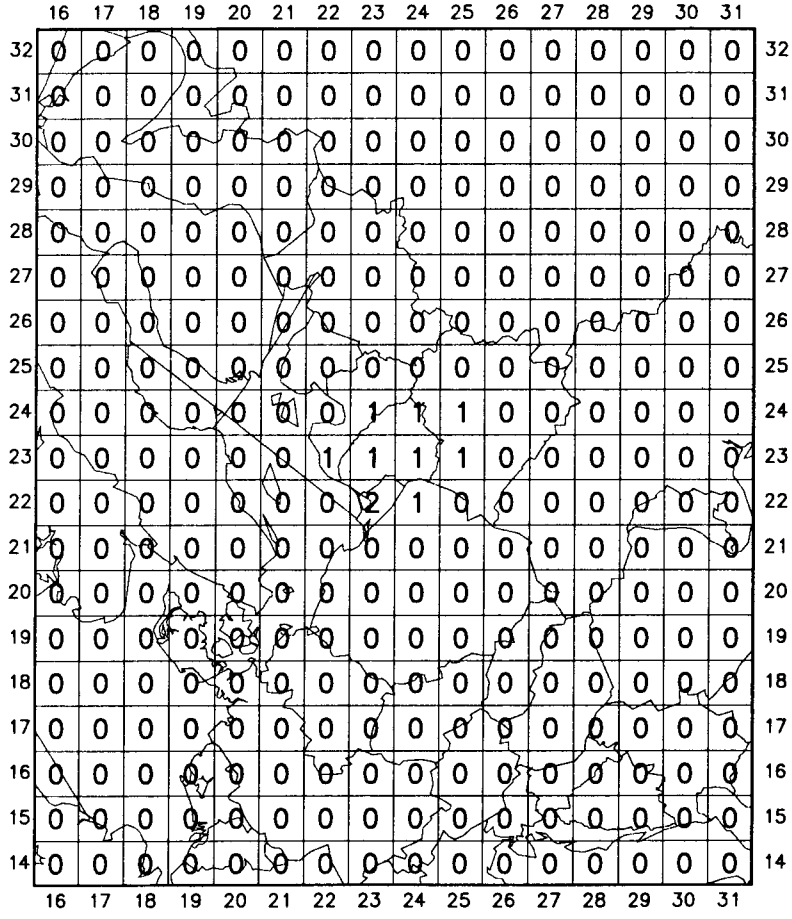
Total dep. of Reduced Nitrogen
Contribution from Leningrad / Novgorod–Pskov



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

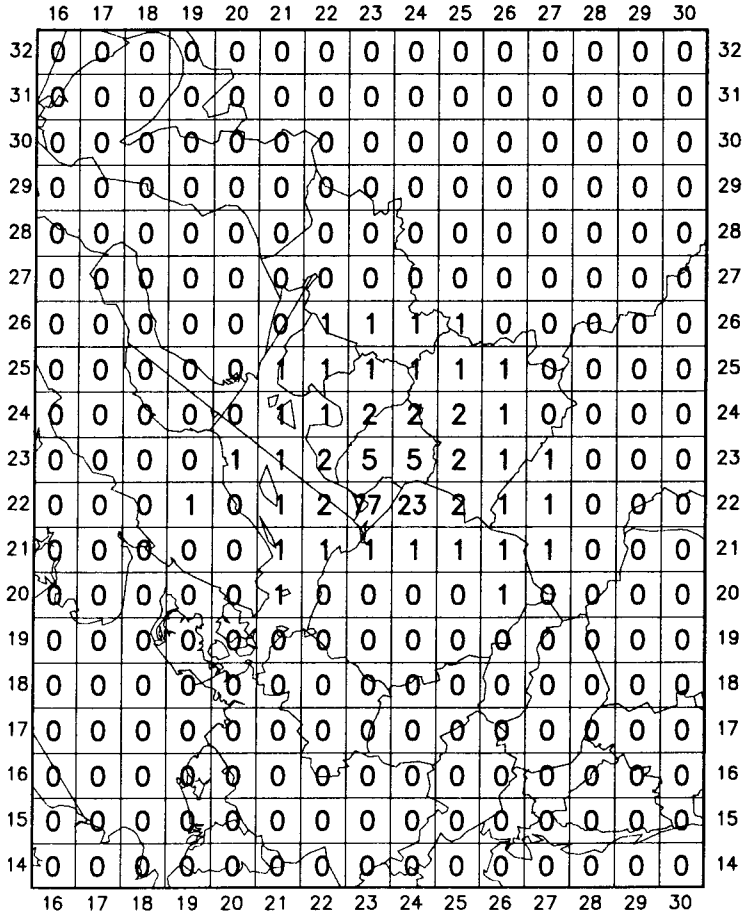
Total dep. of Oxidized Nitrogen
Contribution from Kaliningrad



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

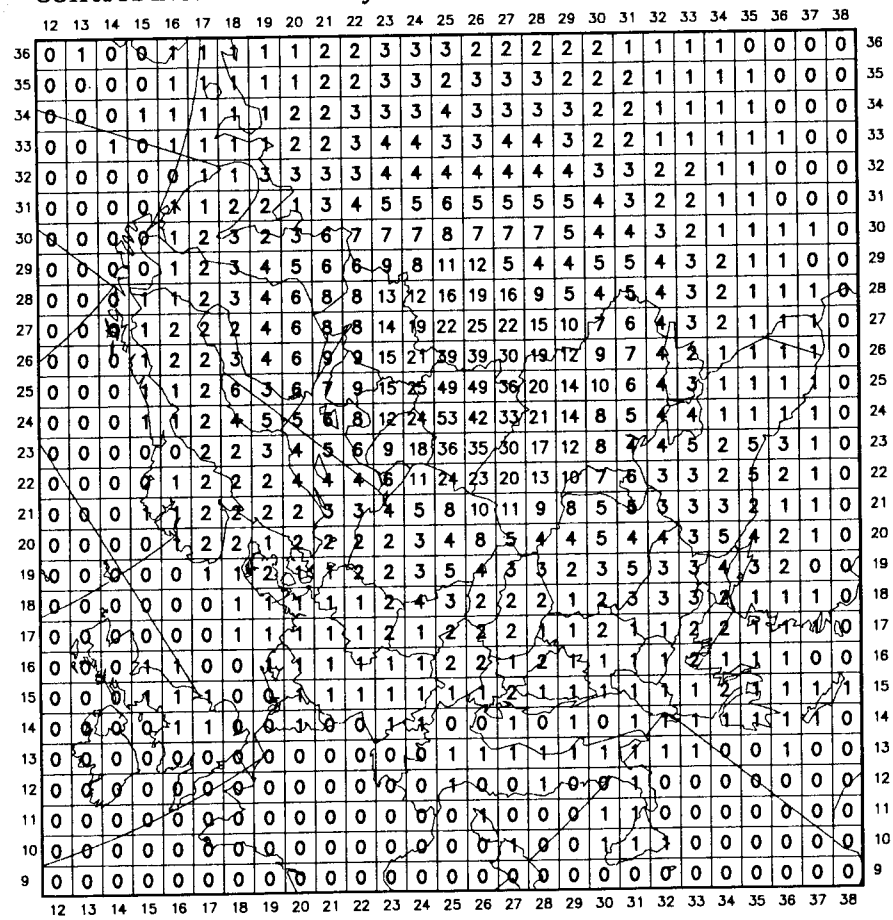
Total dep. of Reduced Nitrogen
Contribution from Kaliningrad



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

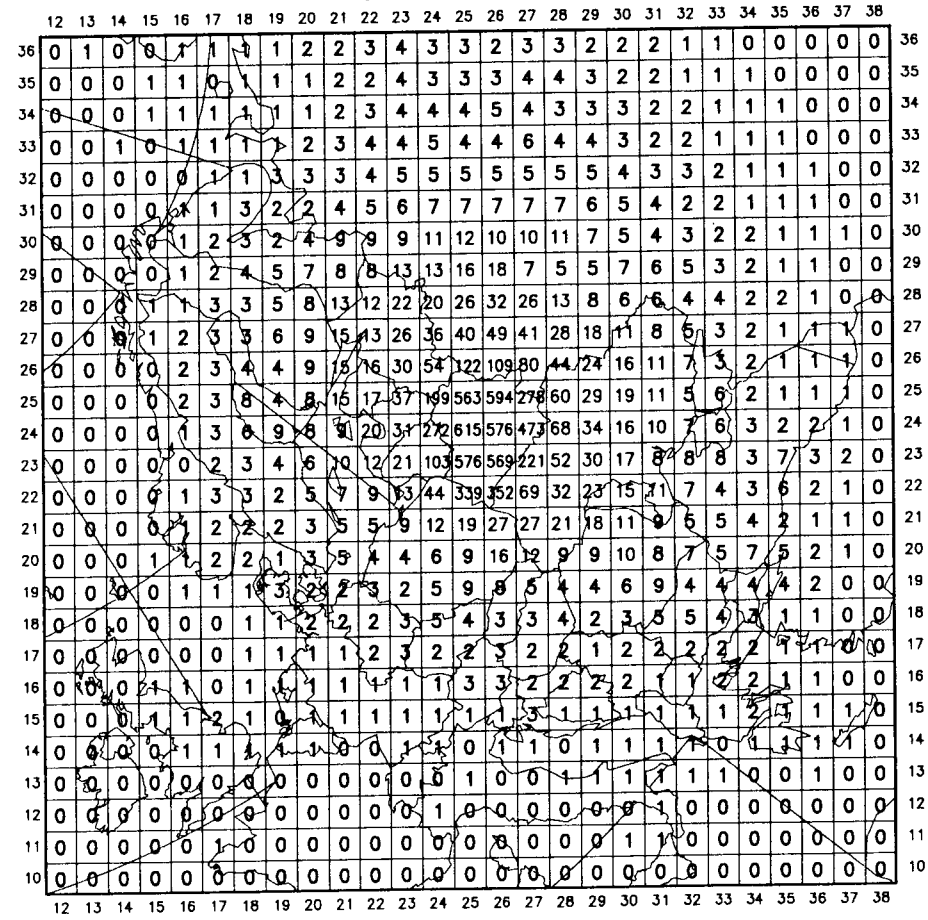
Total dep. of Oxidized Nitrogen
Contribution from Byelorussia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

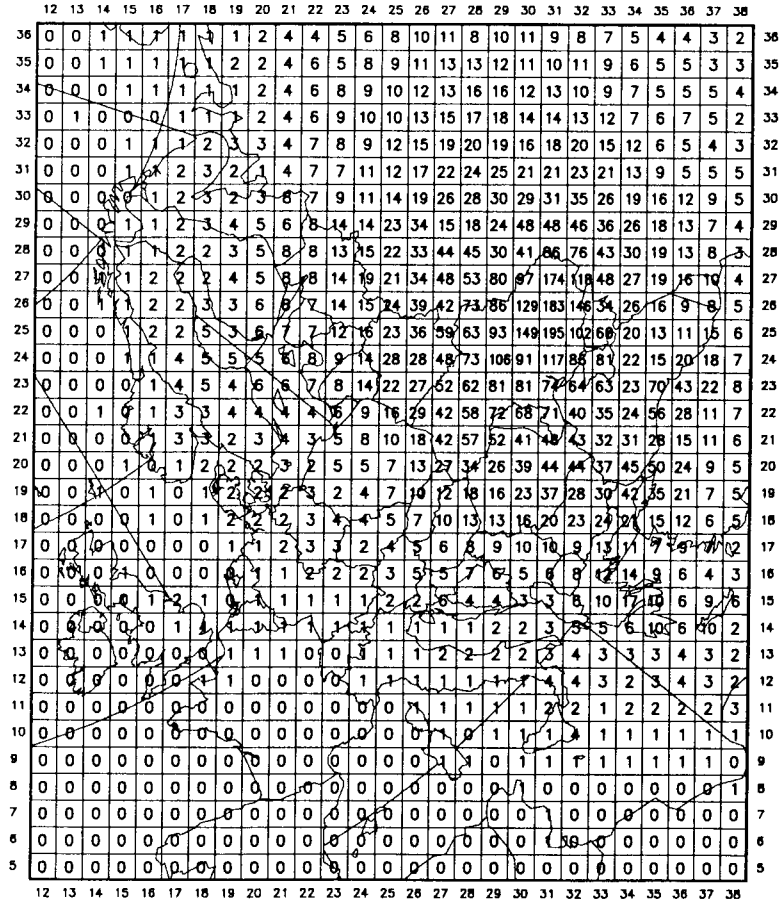
Total dep. of Reduced Nitrogen
Contribution from Byelorussia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

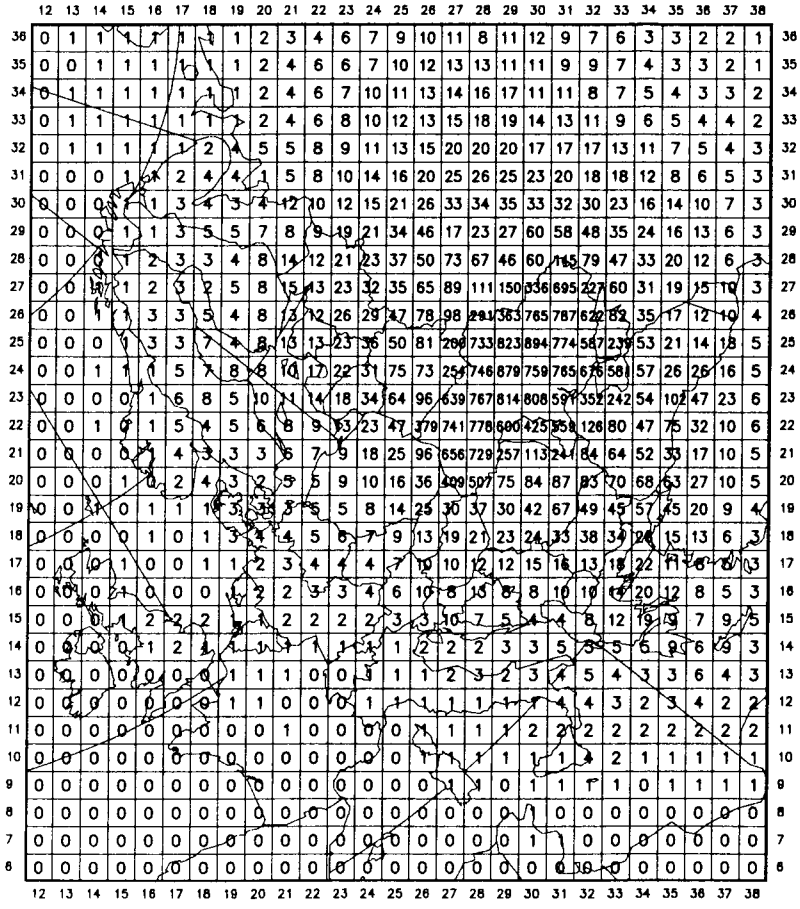
Total dep. of Oxidized Nitrogen
Contribution from Ukraine



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

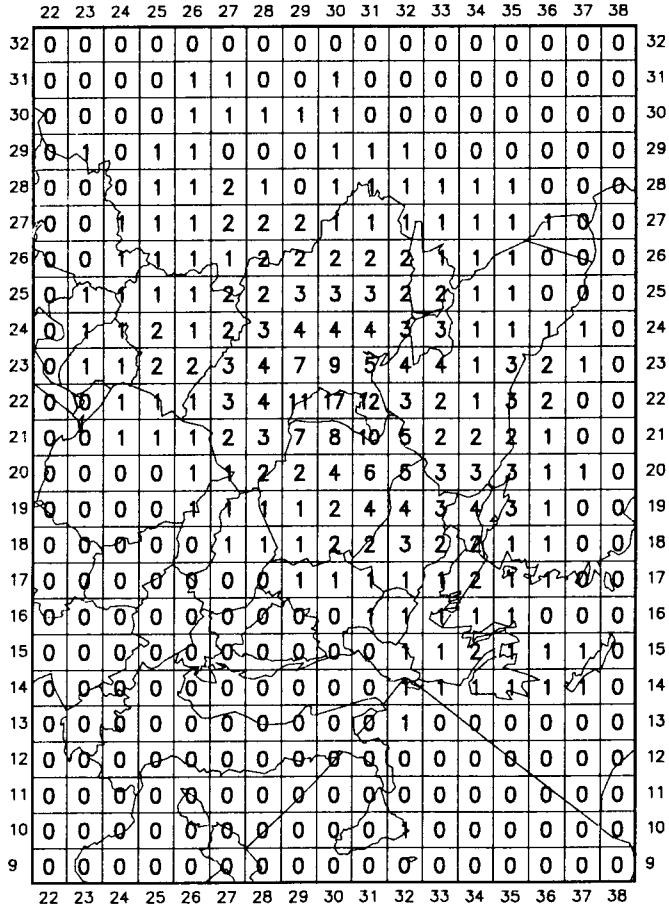
Total dep. of Reduced Nitrogen
Contribution from Ukraine



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

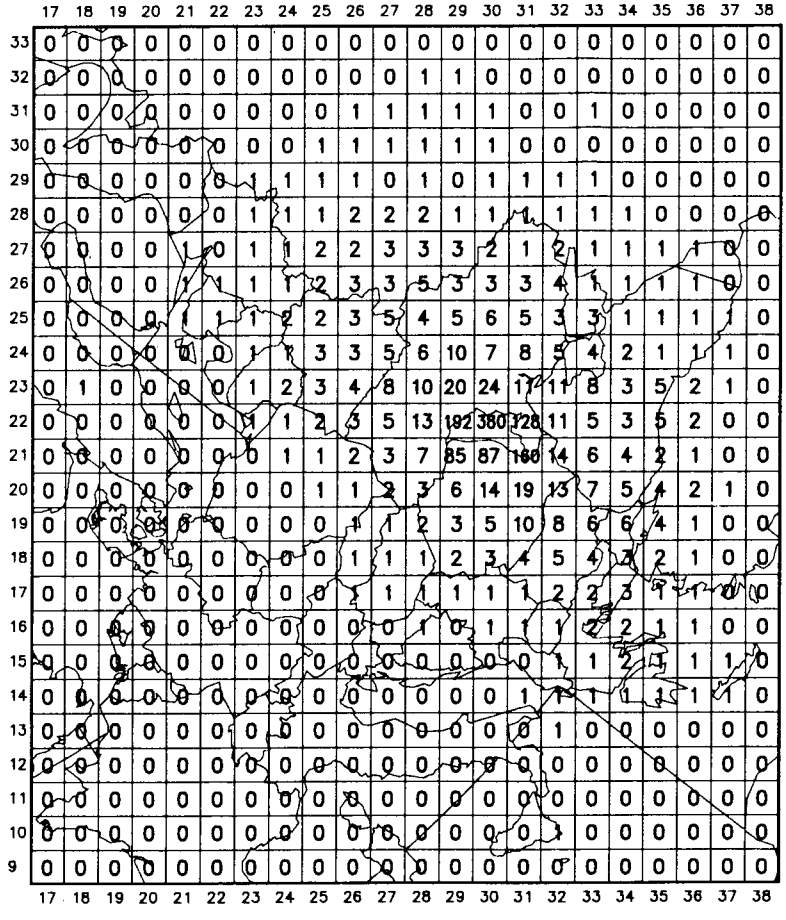
Total dep. of Oxidized Nitrogen
Contribution from Moldavia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

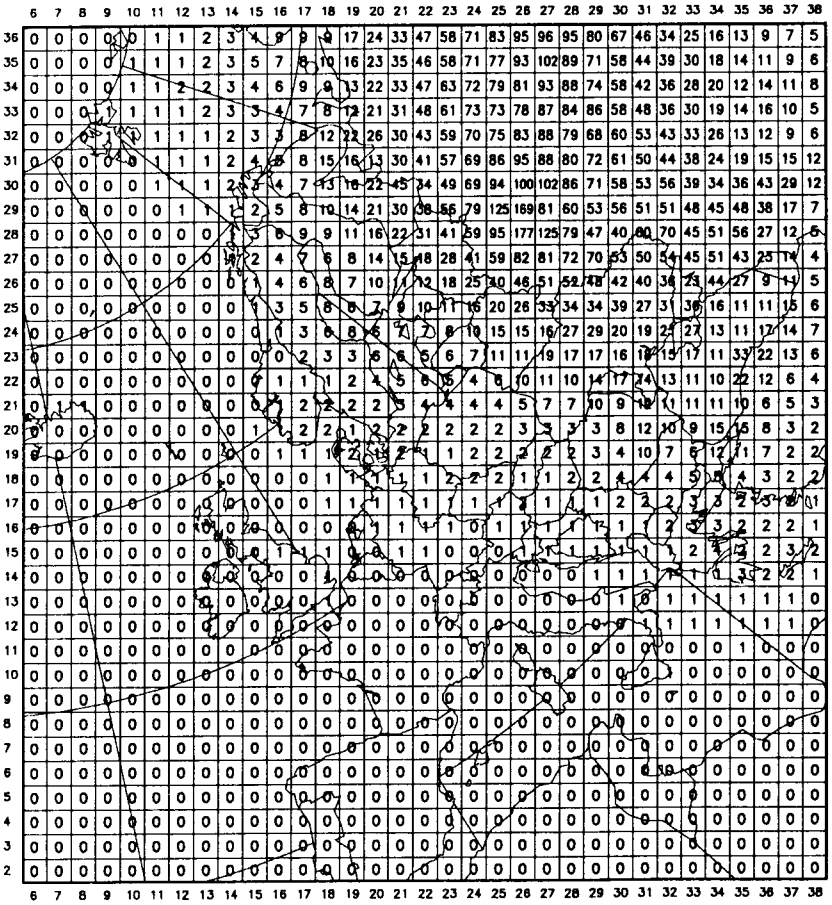
Total dep. of Reduced Nitrogen
Contribution from Moldavia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

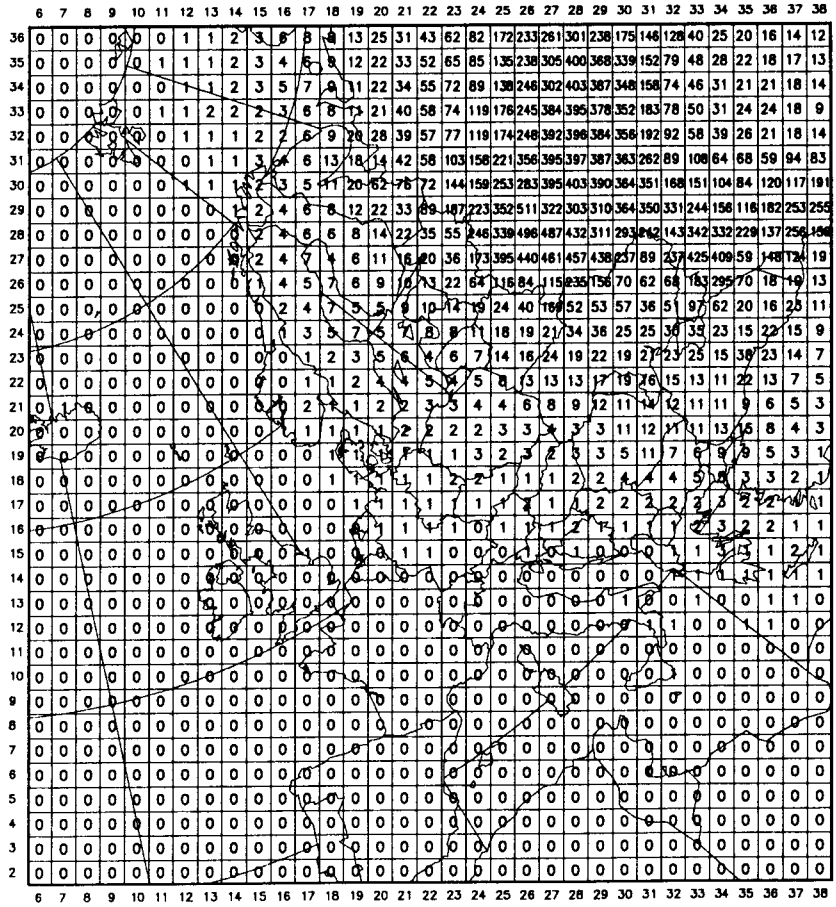
Total dep. of Oxidized Nitrogen
Contribution from rest of Russia (European part)



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

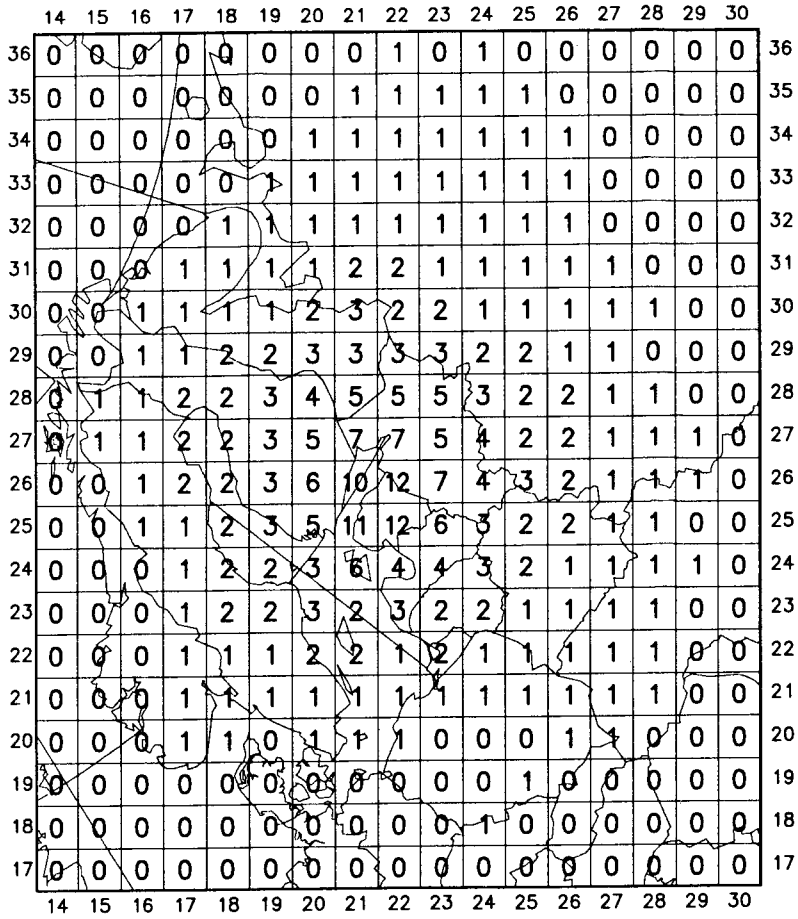
Total dep. of Reduced Nitrogen
Contribution from rest of Russia (European part)



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

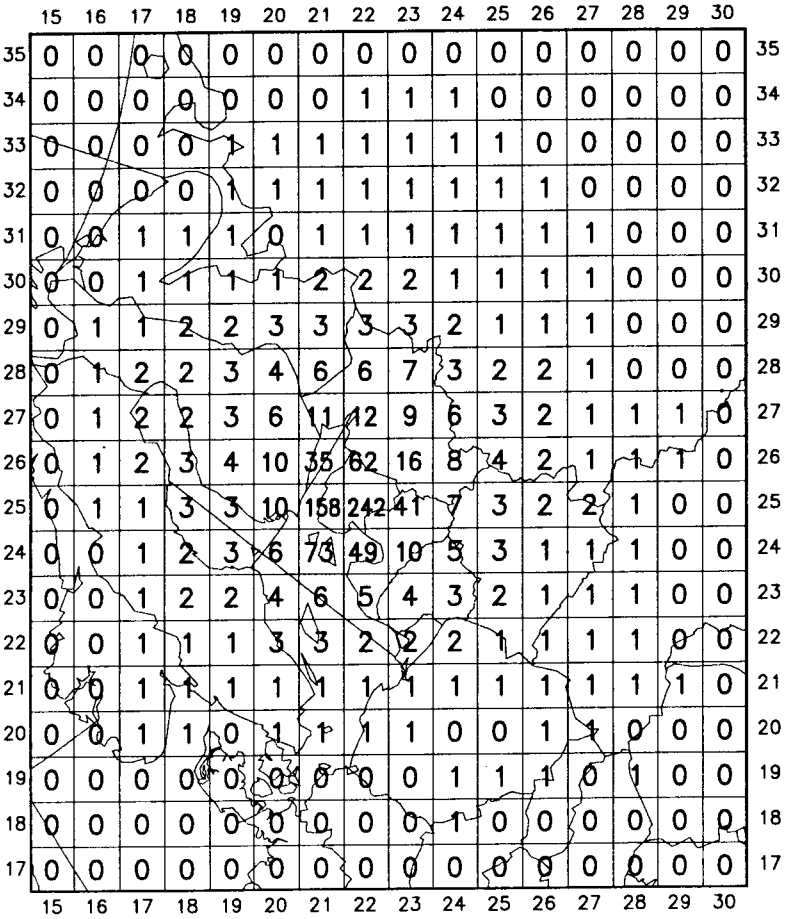
Total dep. of Oxidized Nitrogen
Contribution from Estonia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

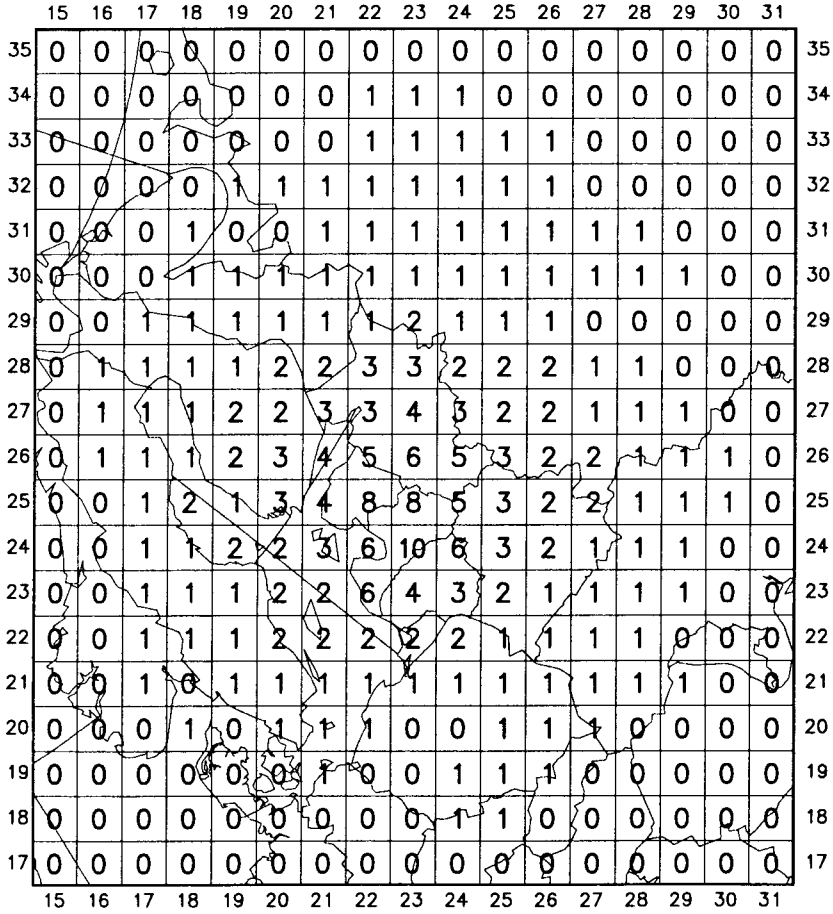
Total dep. of Reduced Nitrogen
Contribution from Estonia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

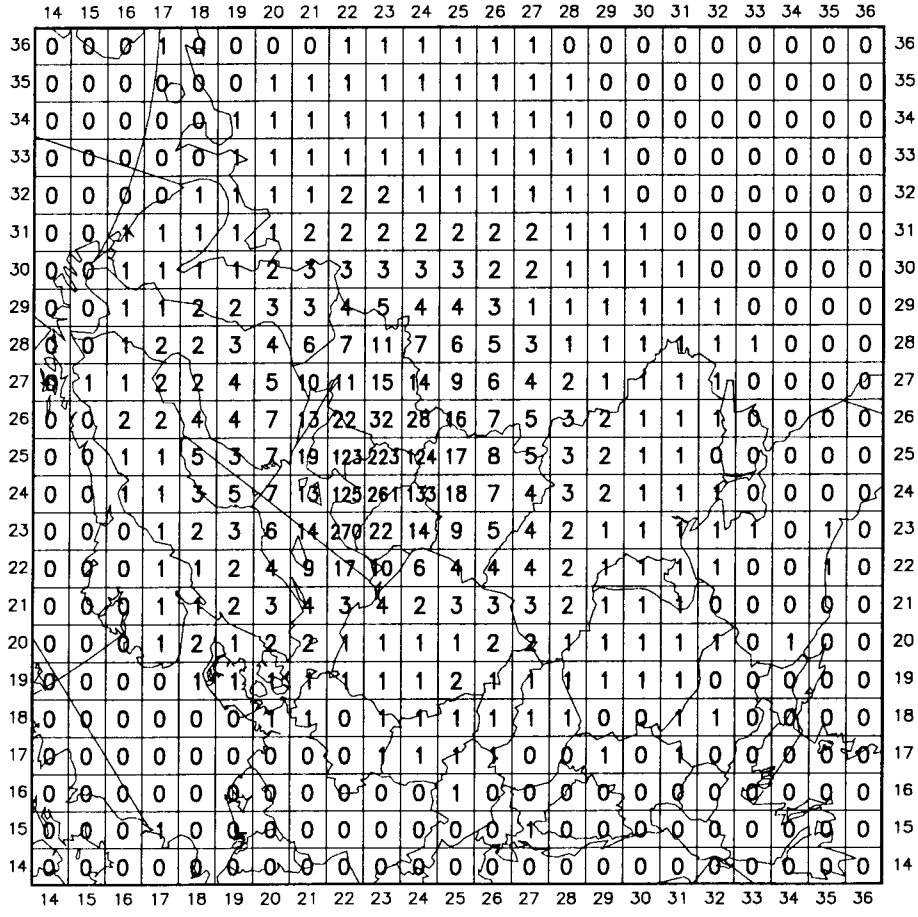
Total dep. of Oxidized Nitrogen
Contribution from Latvia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

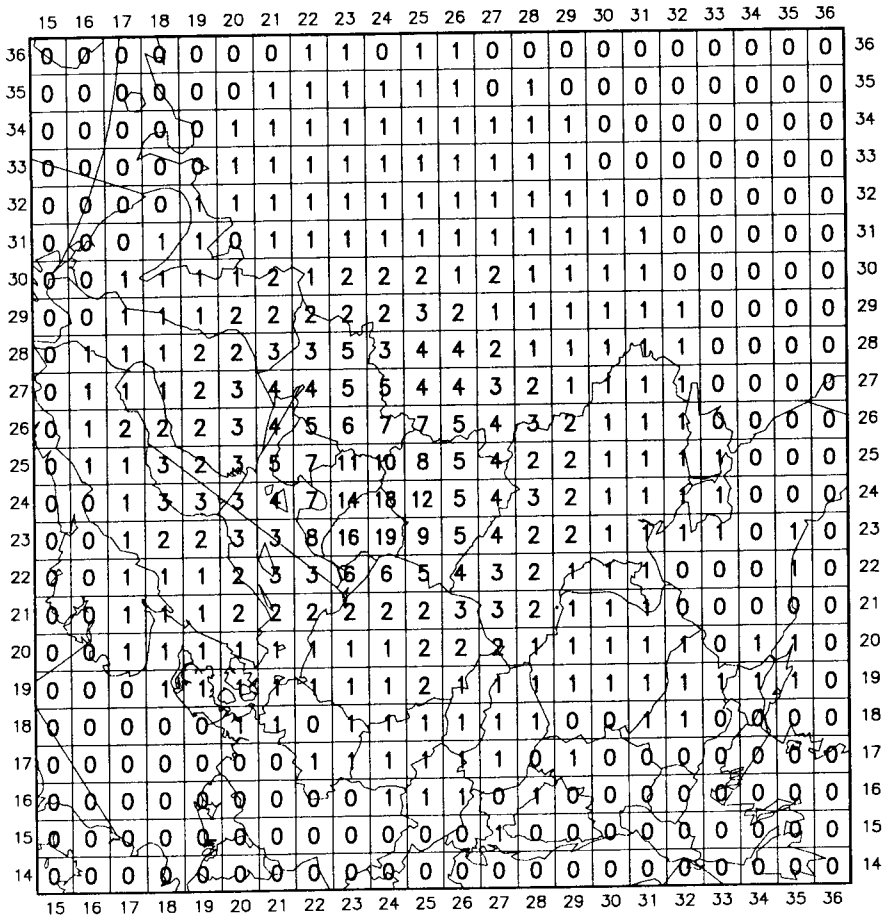
Total dep. of Reduced Nitrogen
Contribution from Latvia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

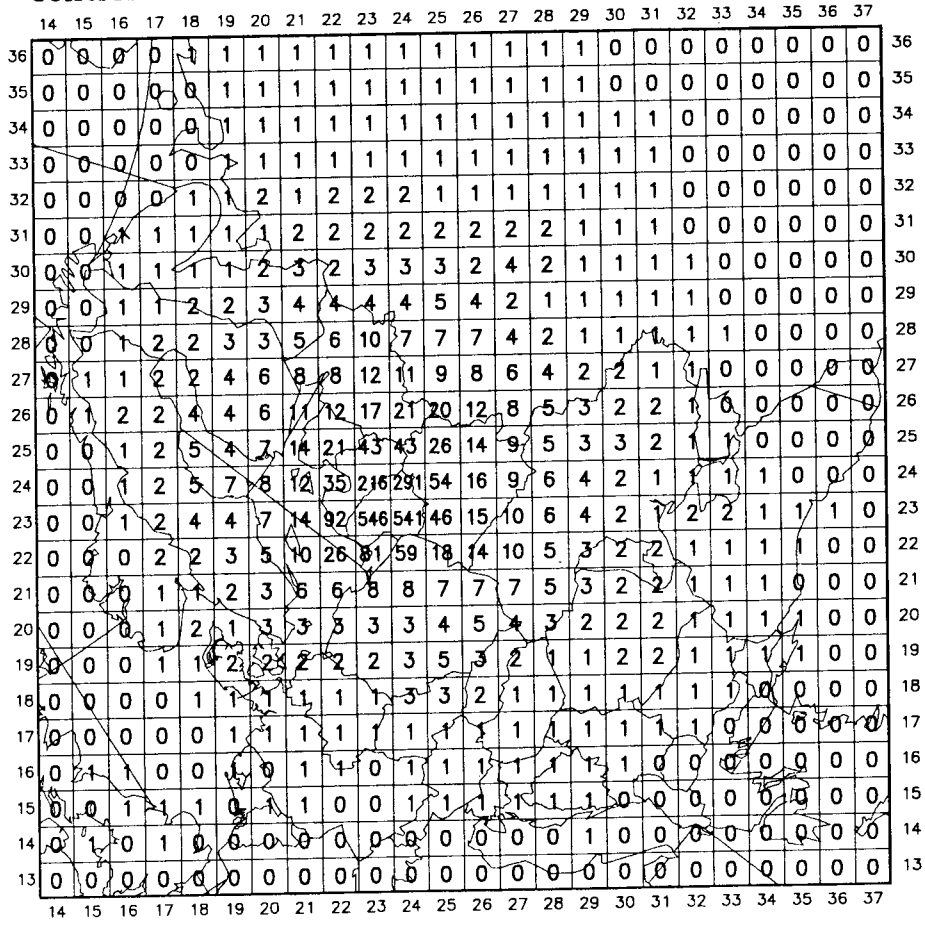
Total dep. of Oxidized Nitrogen
Contribution from Lithuania



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

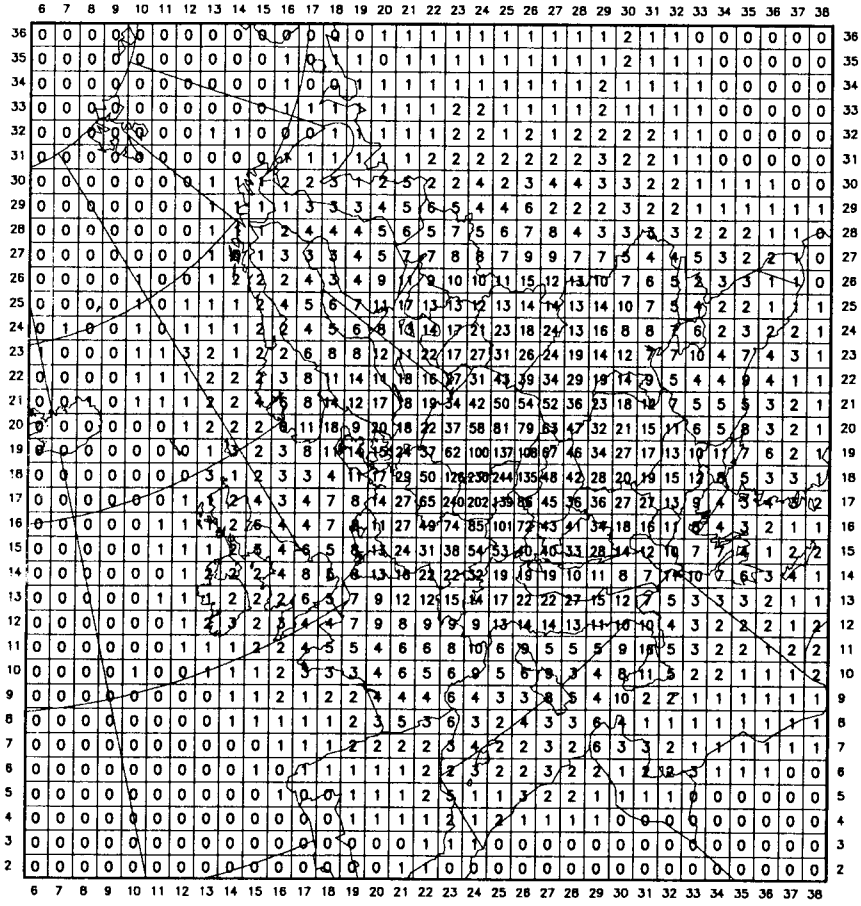
Total dep. of Reduced Nitrogen
Contribution from Lithuania



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

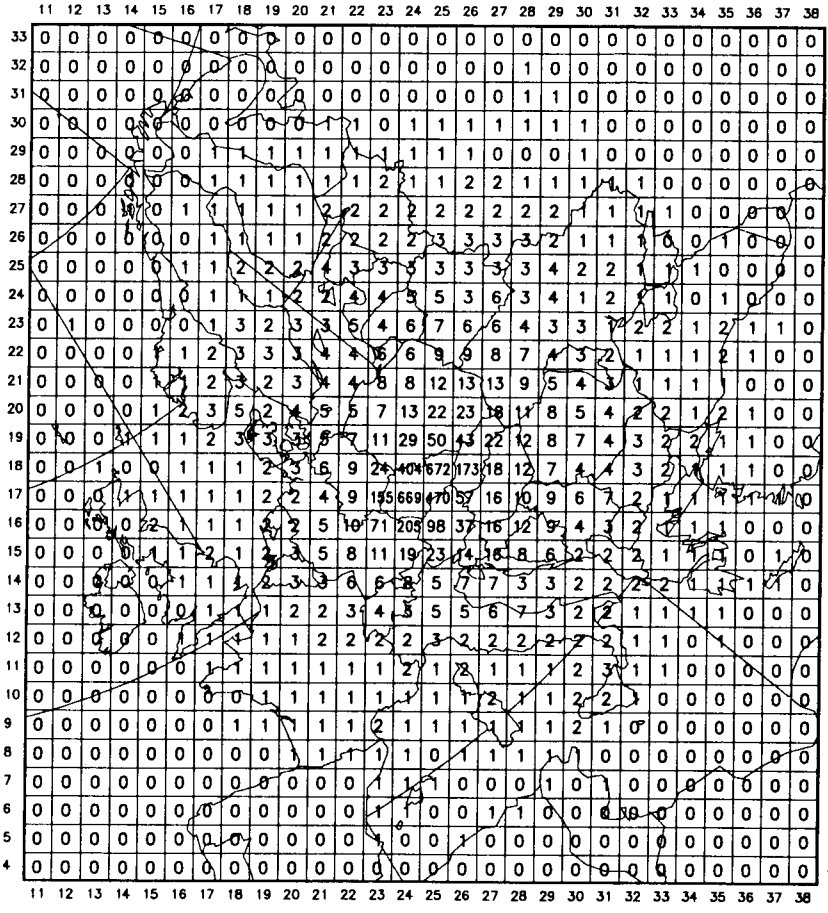
Total dep. of Oxidized Nitrogen
Contribution from Czech Republic



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

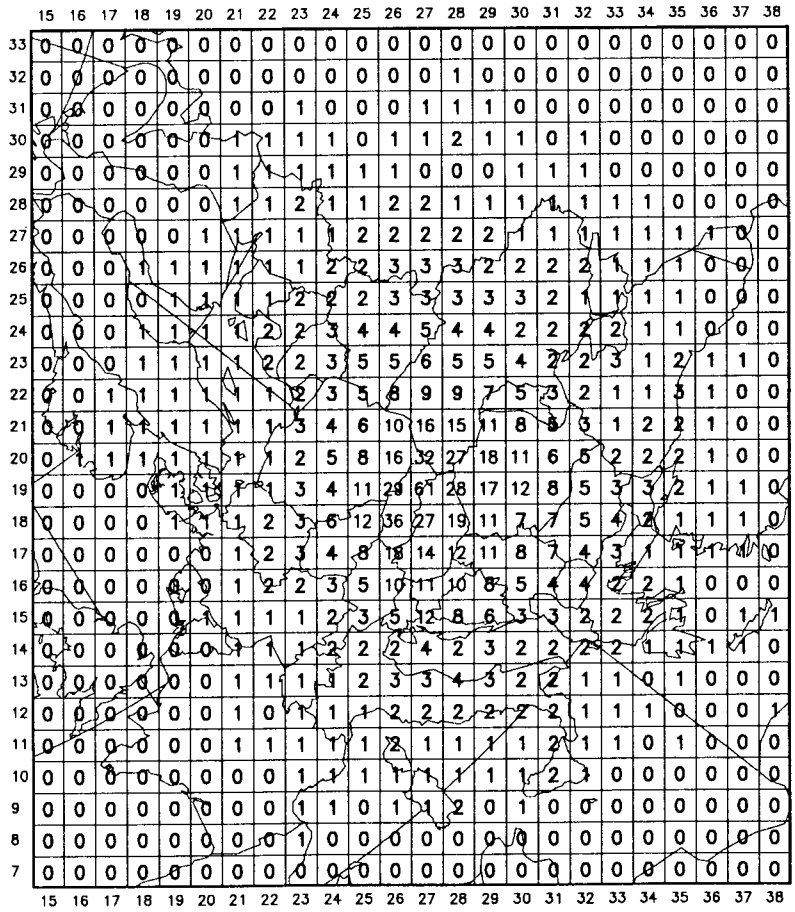
Total dep. of Reduced Nitrogen
Contribution from Czech Republic



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

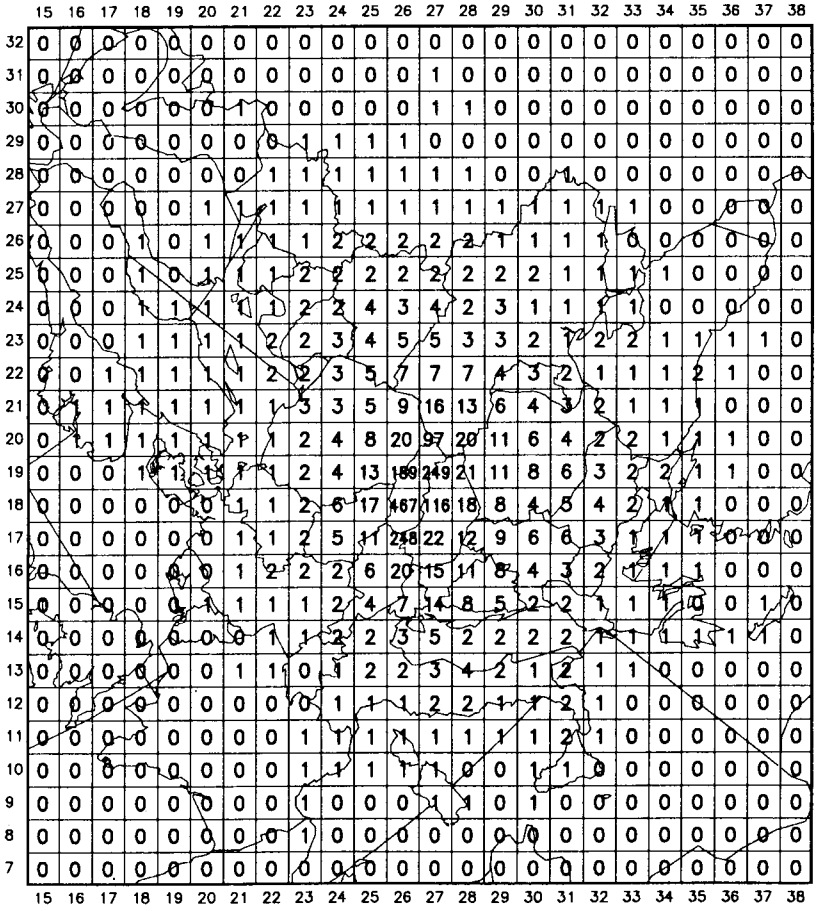
Total dep. of Oxidized Nitrogen
Contribution from Slovakia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

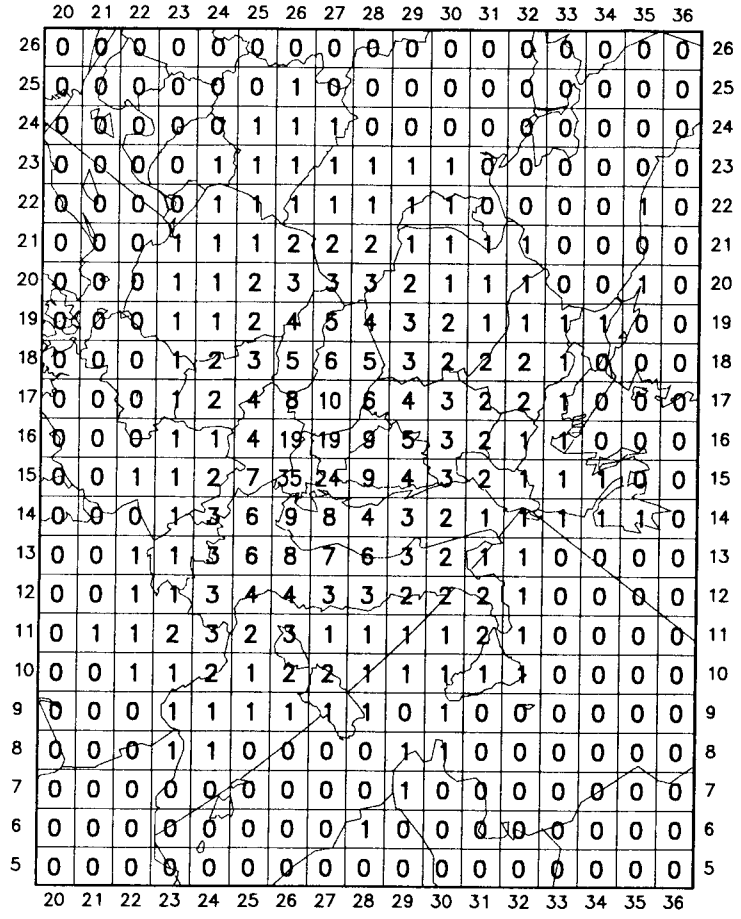
Total dep. of Reduced Nitrogen
Contribution from Slovakia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

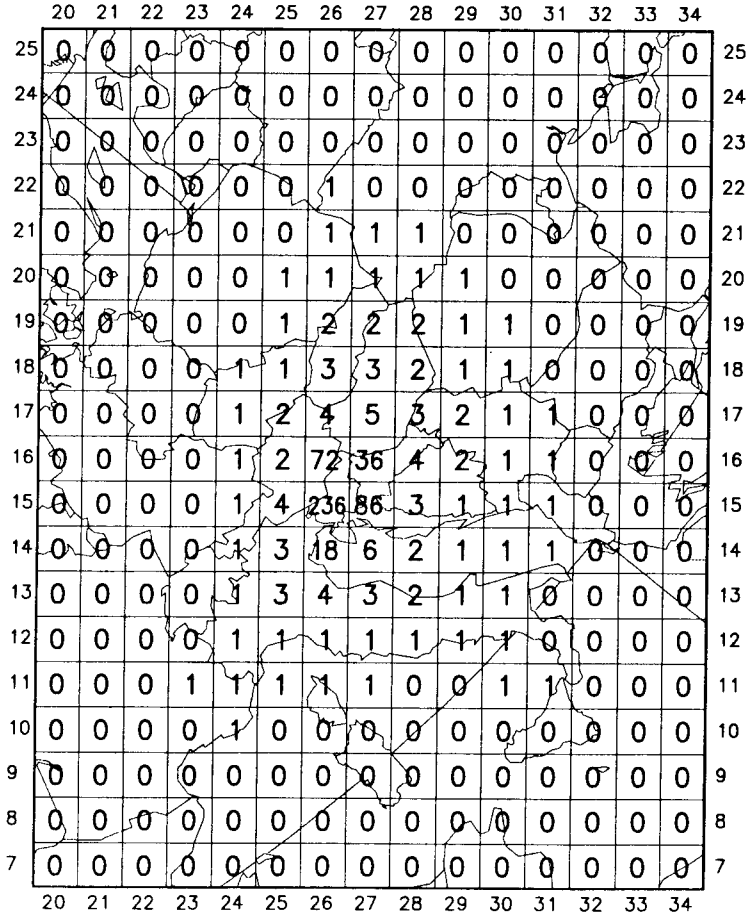
Total dep. of Oxidized Nitrogen
Contribution from Slovenia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

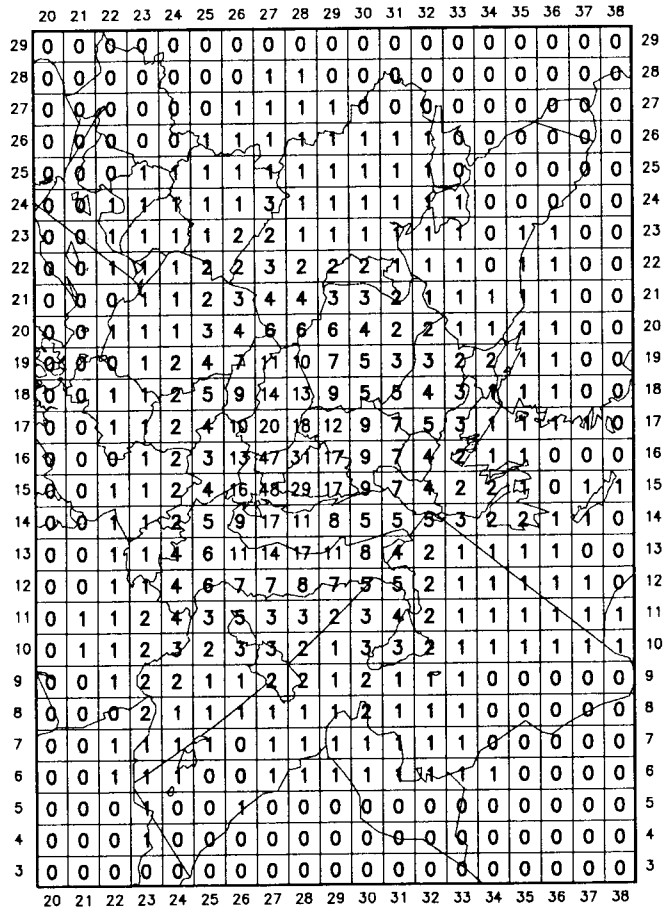
Total dep. of Reduced Nitrogen
Contribution from Slovenia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

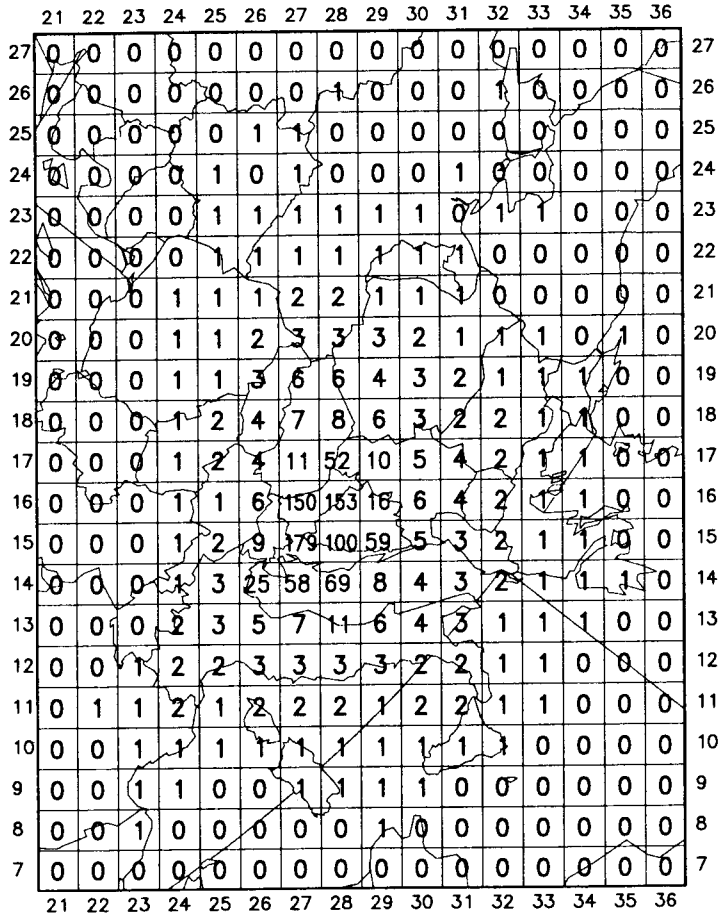
Total dep. of Oxidized Nitrogen
Contribution from Croatia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

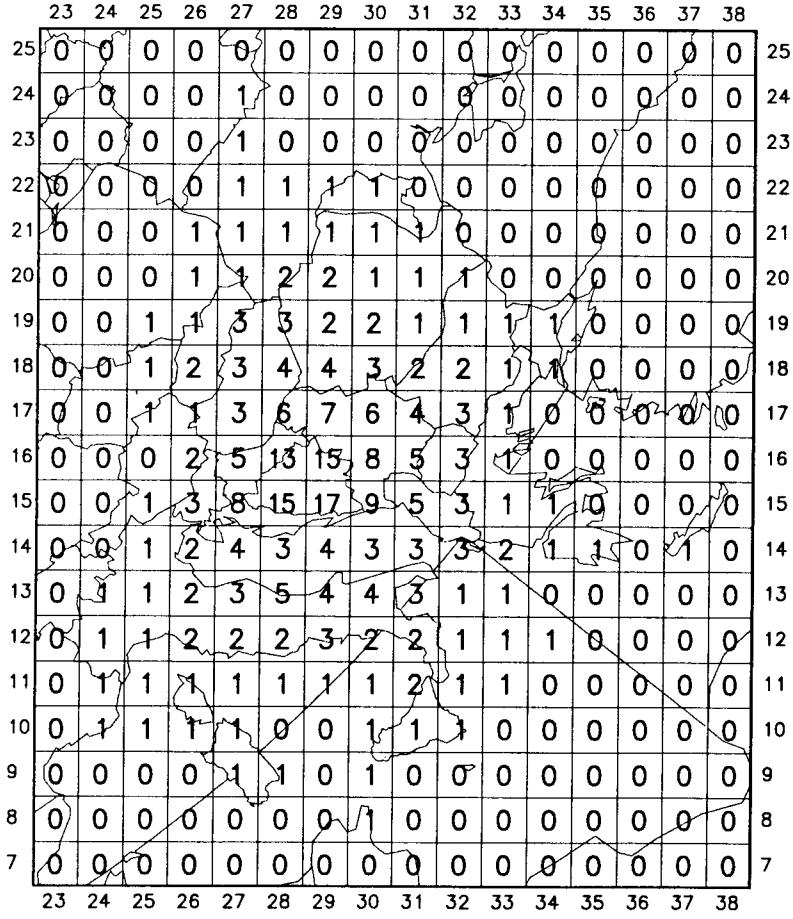
Total dep. of Reduced Nitrogen
Contribution from Croatia



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

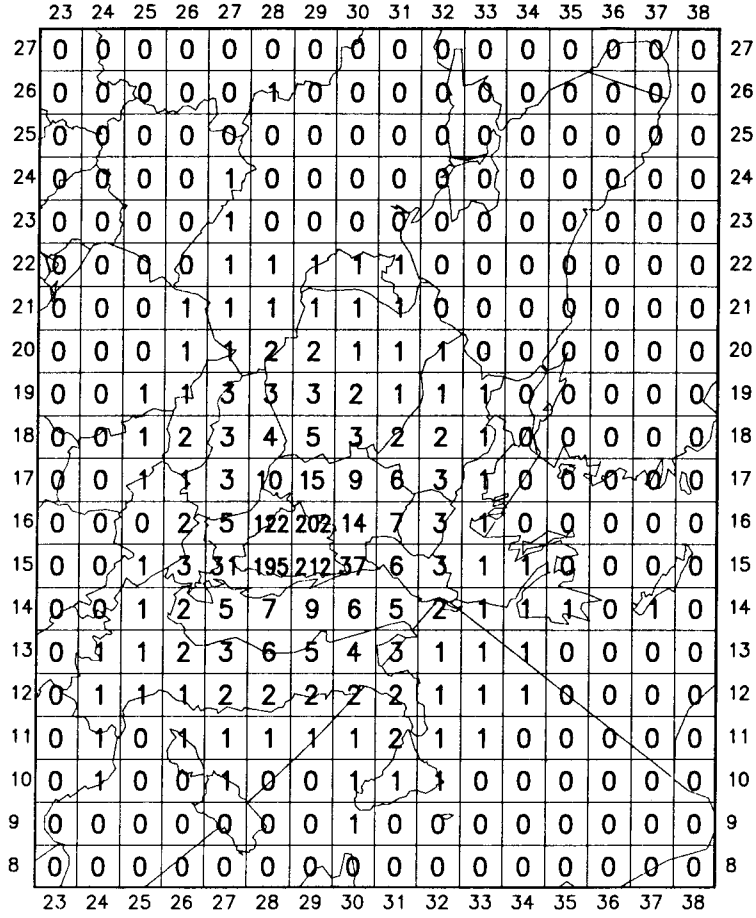
Total dep. of Oxidized Nitrogen
Contribution from Bosnia & Hercegovina



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

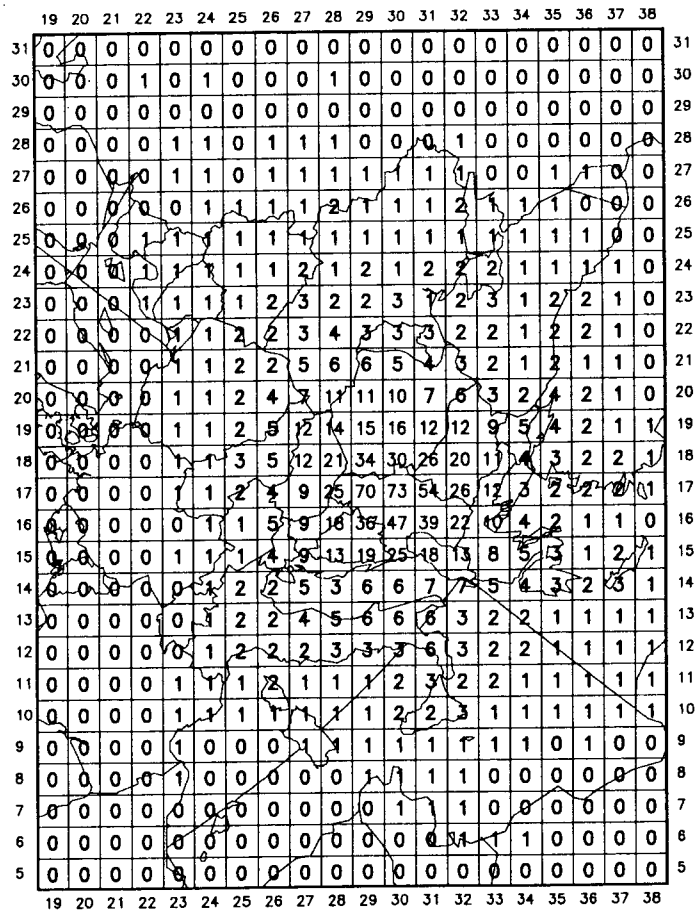
Total dep. of Reduced Nitrogen
Contribution from Bosnia & Hercegovina



Average :
85/87/88/89/90/91/92

Unit : mg(N)/m2

Total dep. of Oxidized Nitrogen
Contribution from Yugoslavia*

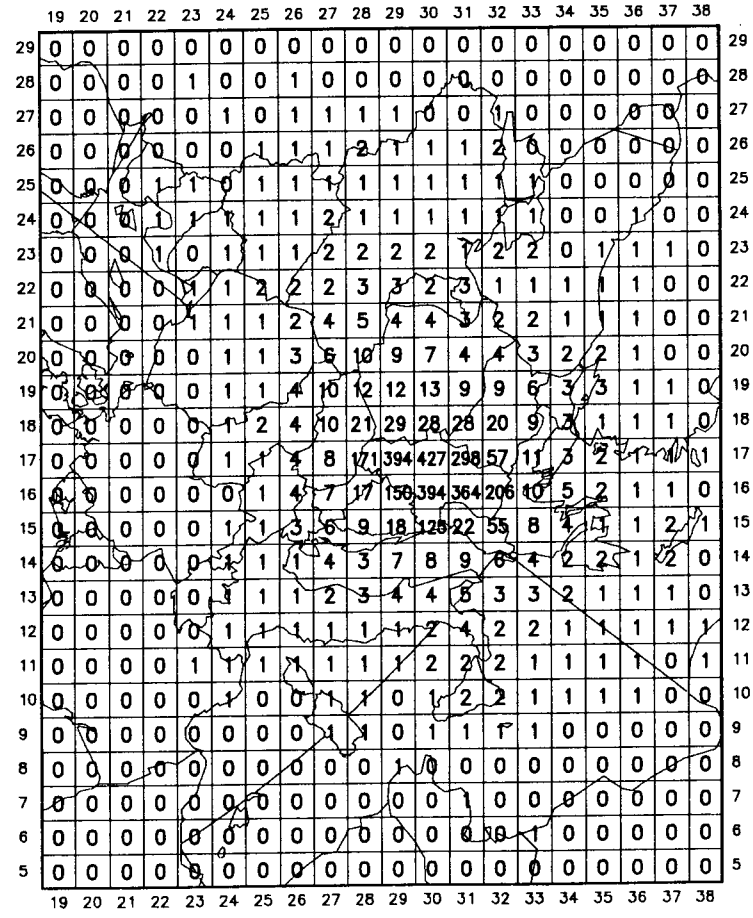


Average :
85,87-92

Unit : mg(N)/m2

YU* Former Yugoslavia excluding Slovenia, Croatia, Bosnia and Hercegovina

Total dep. of Reduced Nitrogen
Contribution from Yugoslavia*



Average :
85,87-92

Unit : mg(N)/m2

YU* Former Yugoslavia excluding Slovenia, Croatia, Bosnia and Hercegovina

APPENDIX G.

MAPS OF THE DEPOSITION OF INDETERMINATE ORIGIN FOR SULPHUR, OXIDISED AND REDUCED NITROGEN. AVERAGED OVER THE YEARS 1985, 1987, 1988, 1989, 1990, 1991 and 1992.

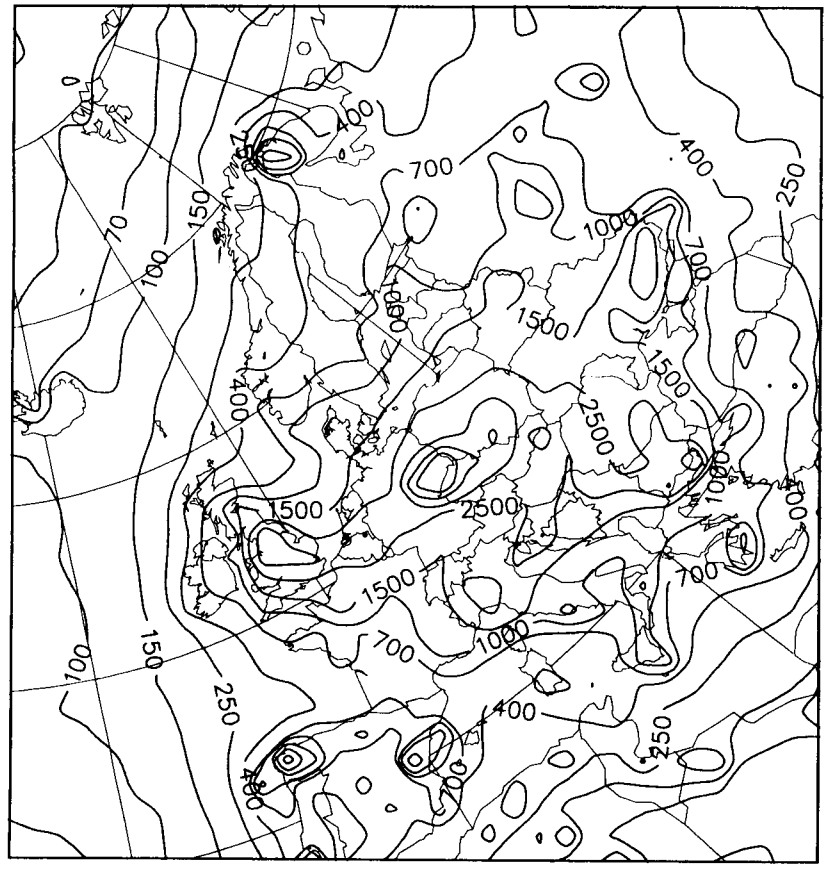
This appendix shows for oxidised sulphur, oxidised nitrogen and reduced nitrogen isoline maps of :

1) The Total deposition from all contributions (TOT).
2a) The deposition from inattributable contribution (IND).
b) The relative amount of IND as % of TOT.
3a) The deposition of the inattributable contributions originated from the free troposphere (INDA).
b) The relative amount of INDA as % of IND.
4a) The deposition of the inattributable contributions originated from the inital value at the trajectory start position (INDM) .
b) The relative amount of INDM as % of IND.

Units are $mg(S)/m^2$ for oxidised sulphur and $mg(N)/m^2$ for oxidised and reduced nitrogen

Figure G1 :

Total dep. of Oxidized Sulphur
Grand total (all contributions)

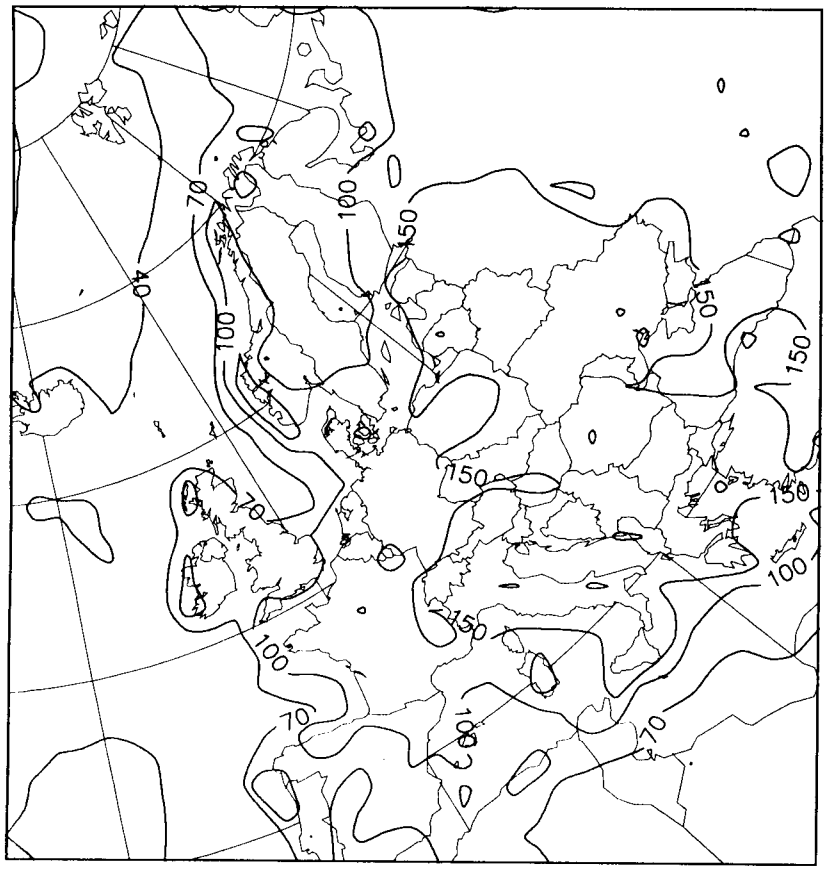


Average :
85,87-92

Unit : mg(S)/m2

Figure G2 :

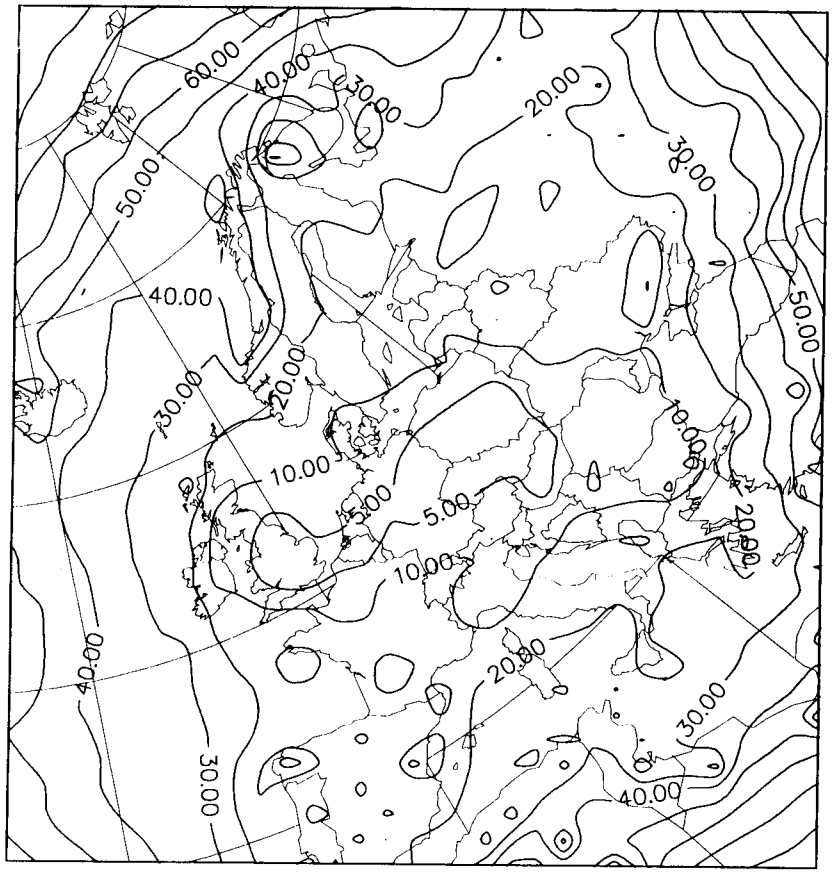
a) Total dep. of Oxidized Sulphur
Inattributable contributions



Average :
85,87–92

Unit : mg(S)/m2

b) Total dep. of Oxidized Sulphur
Inattributable contributions as % of total deposition

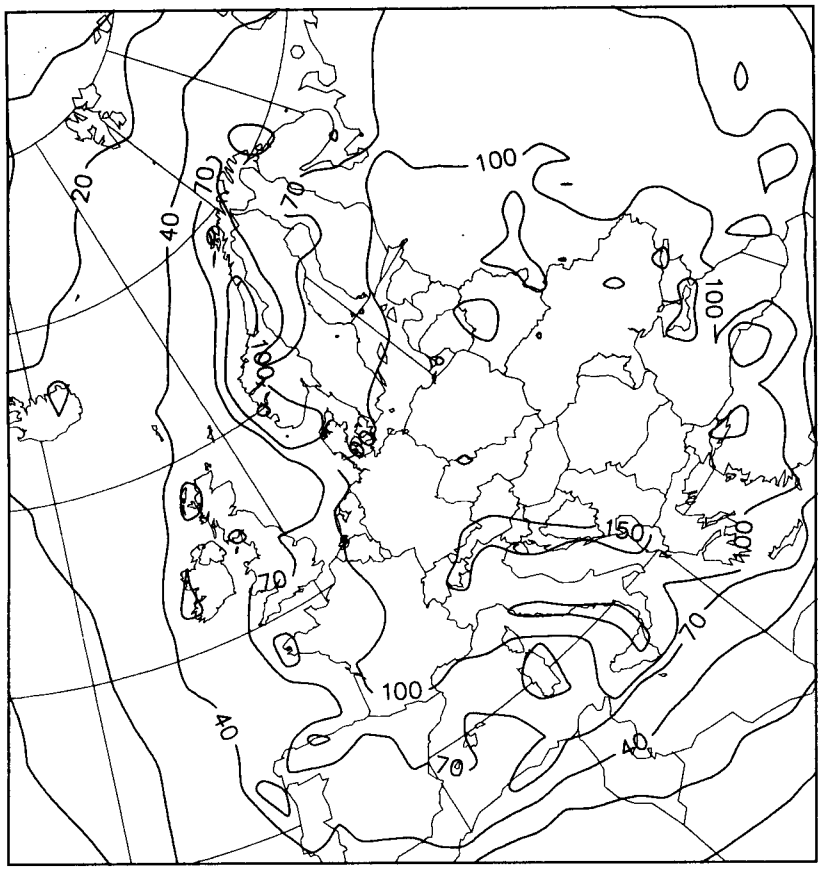


Average :
85/87/88/89/90/91/92

Unit : %

Figure G3 :

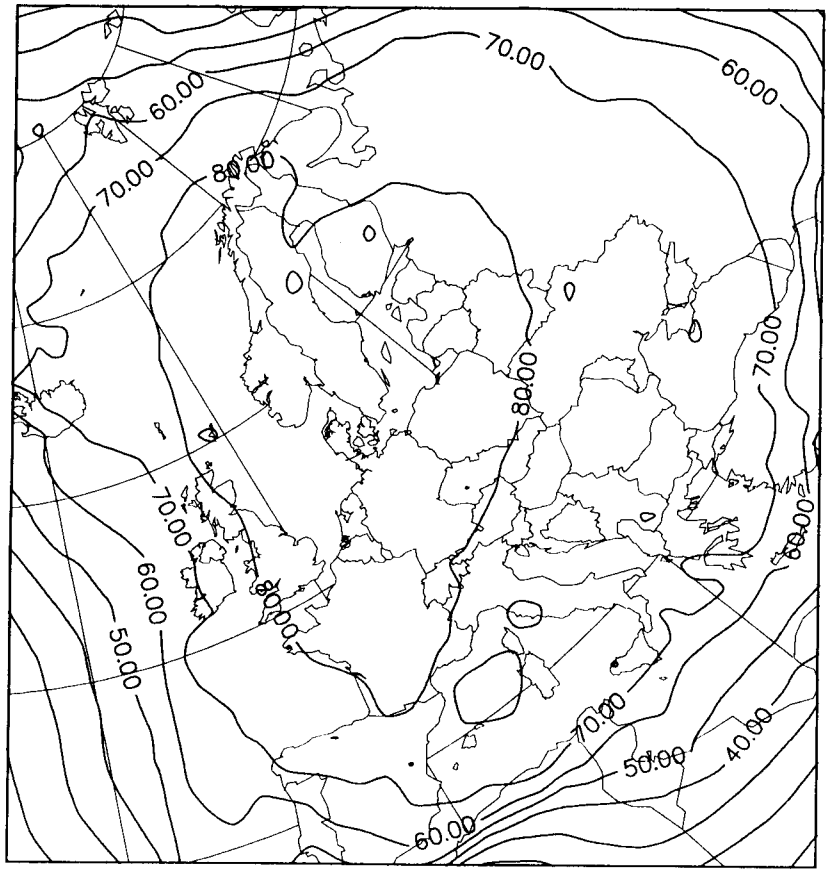
a) Total dep. of Oxidized Sulphur
Inattributable contributions from above



Average :
85,87-92

Unit : mg(S)/m2

b) Total dep. of Oxidized Sulphur
Inattributable contrib. from above as % of total ind.

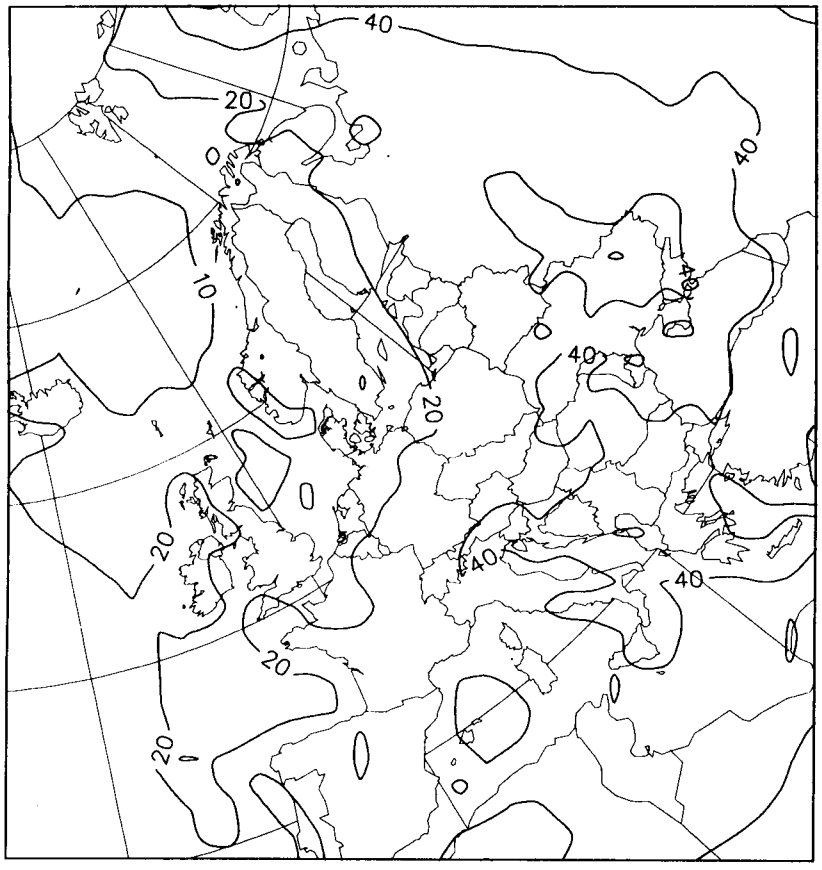


Average :
85/87/88/89/90/91/92

Unit : %

Figure G4 :

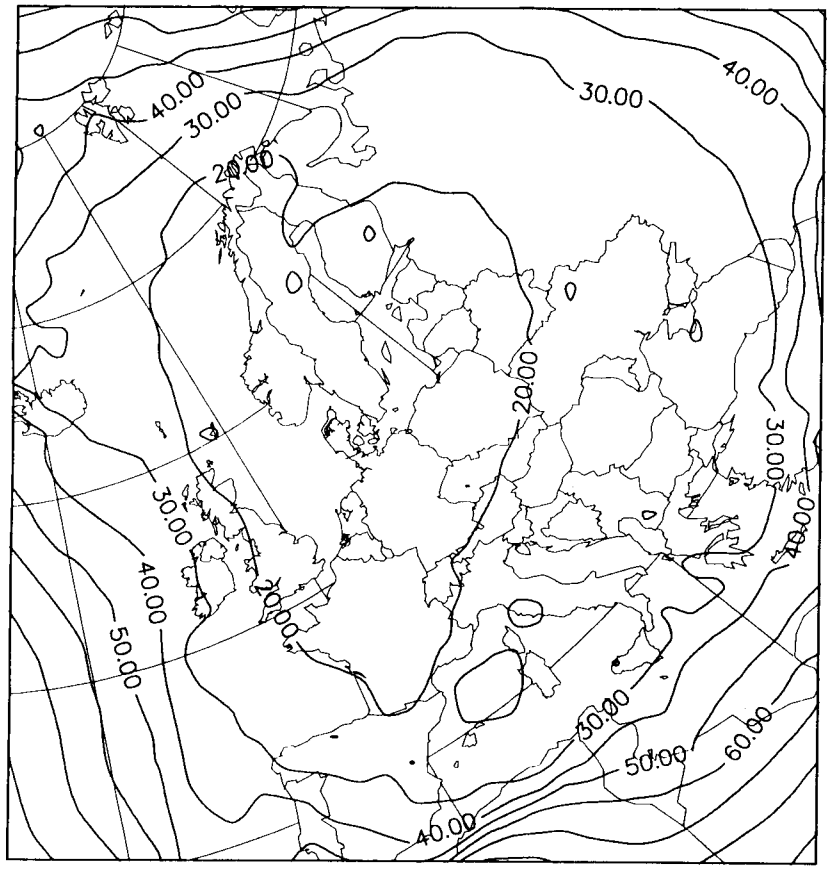
a) Total dep. of Oxidized Sulphur
Inattributable contributions from mix.l



Average :
85,87–92

Unit : mg(S)/m2

b) Total dep. of Oxidized Sulphur
Inattributable contrib. from mix.l. as % of total ind.

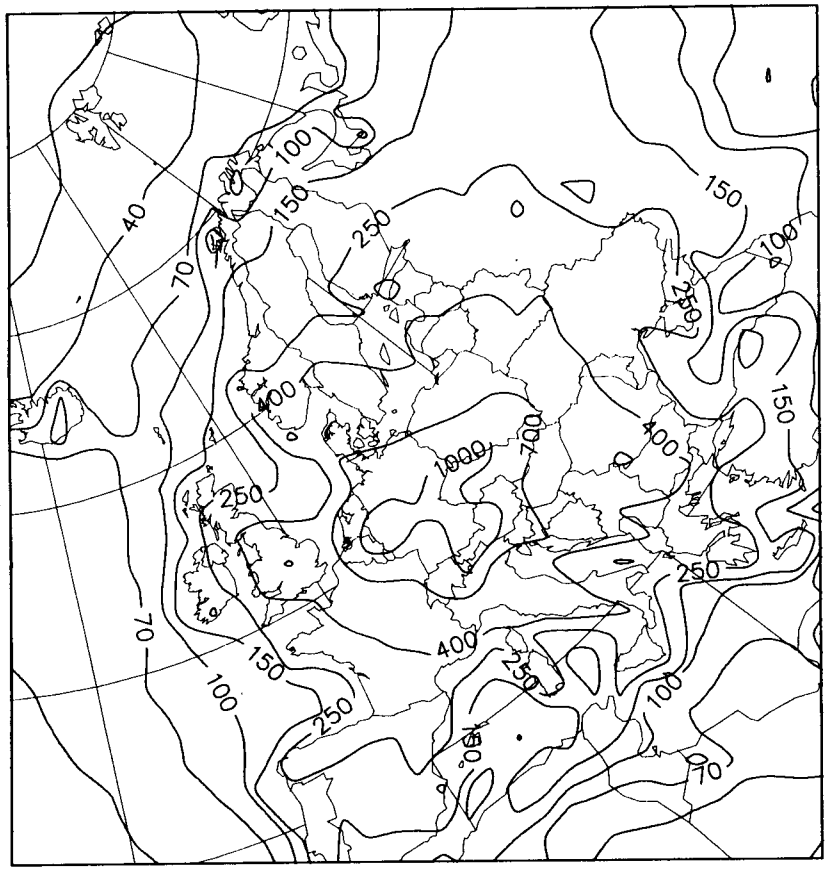


Average :
85/87/88/89/90/91/92

Unit : %

Figure G5 :

Total dep. of Oxidized Nitrogen
Grand total (all contributions)

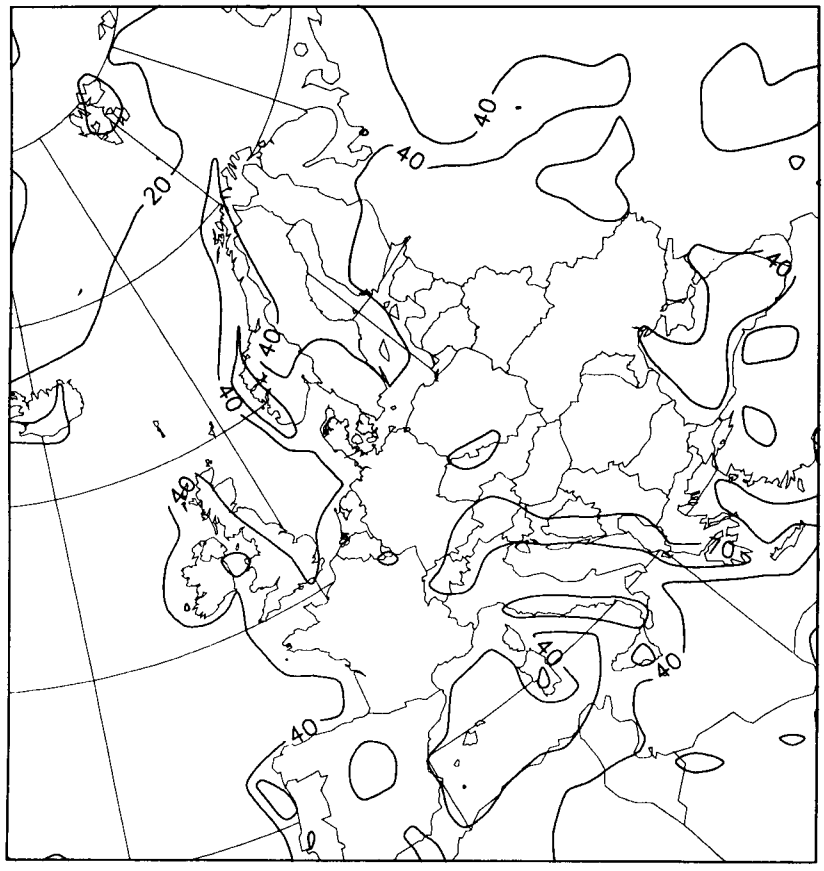


Average :
85,87-92

Unit : mg(N)/m2

Figure G6 :

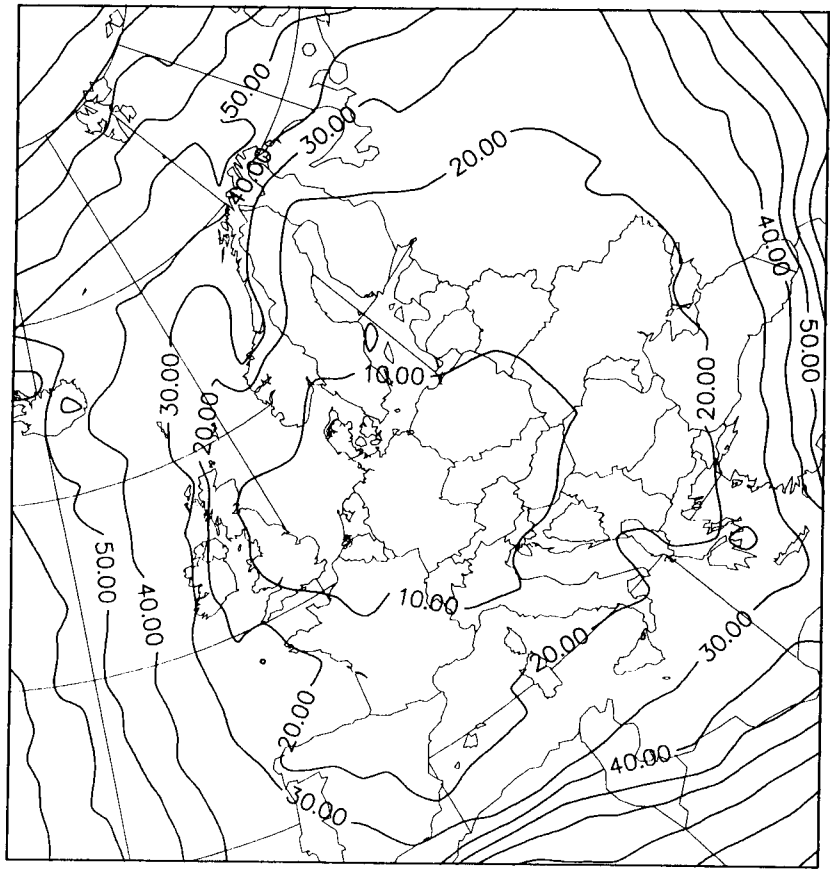
a) Total dep. of Oxidized Nitrogen
Inattributable contributions



Average :
85,87–92

Unit : mg(N)/m2

b) Total dep. of Oxidized Nitrogen
Inattributable contributions as % of total deposition

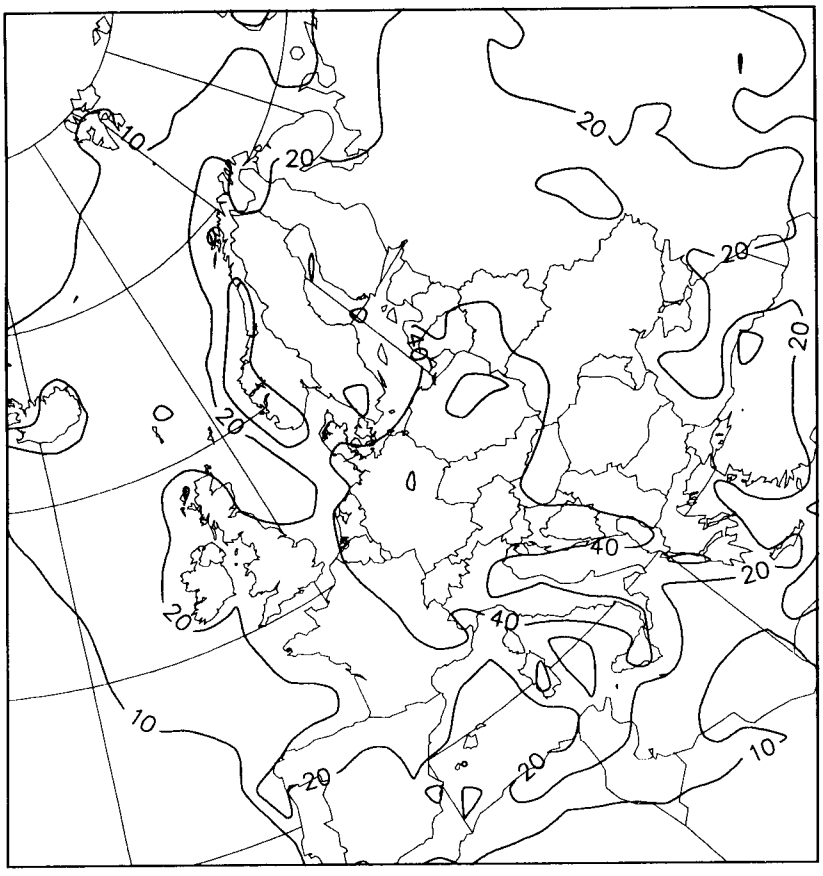


Average :
85/87/88/89/90/91/92

Unit : %

Figure G7 :

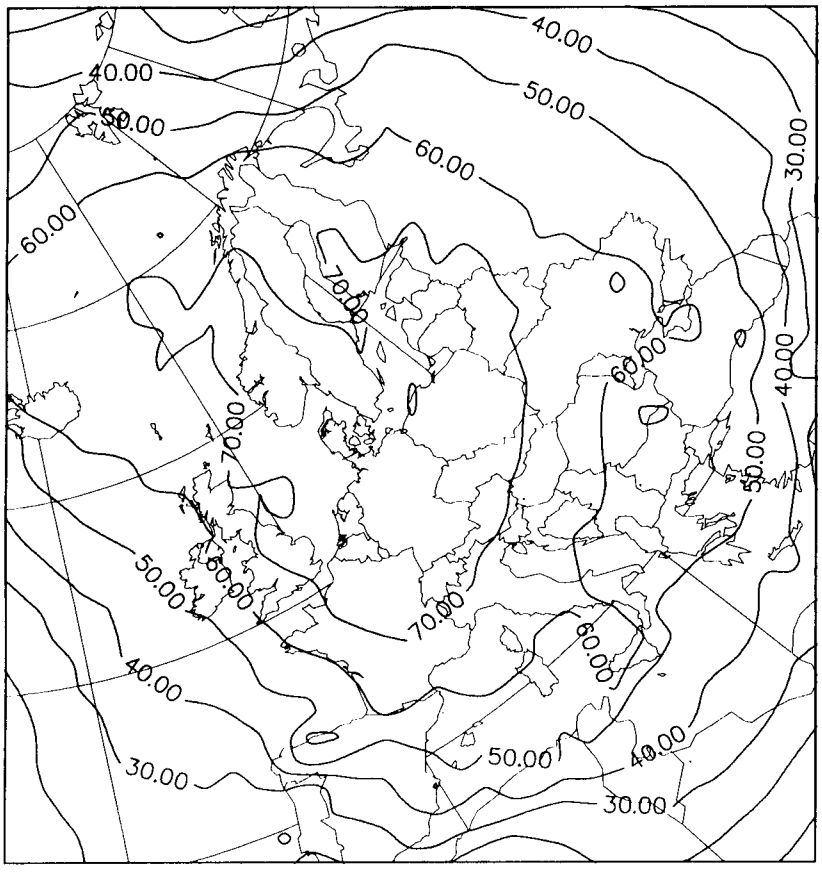
a) Total dep. of Oxidized Nitrogen
Inattributable contributions from above



Average :
85,87–92

Unit : mg(N)/m2

b) Total dep. of Oxidized Nitrogen
Inattributable contrib. from above as % of total ind.

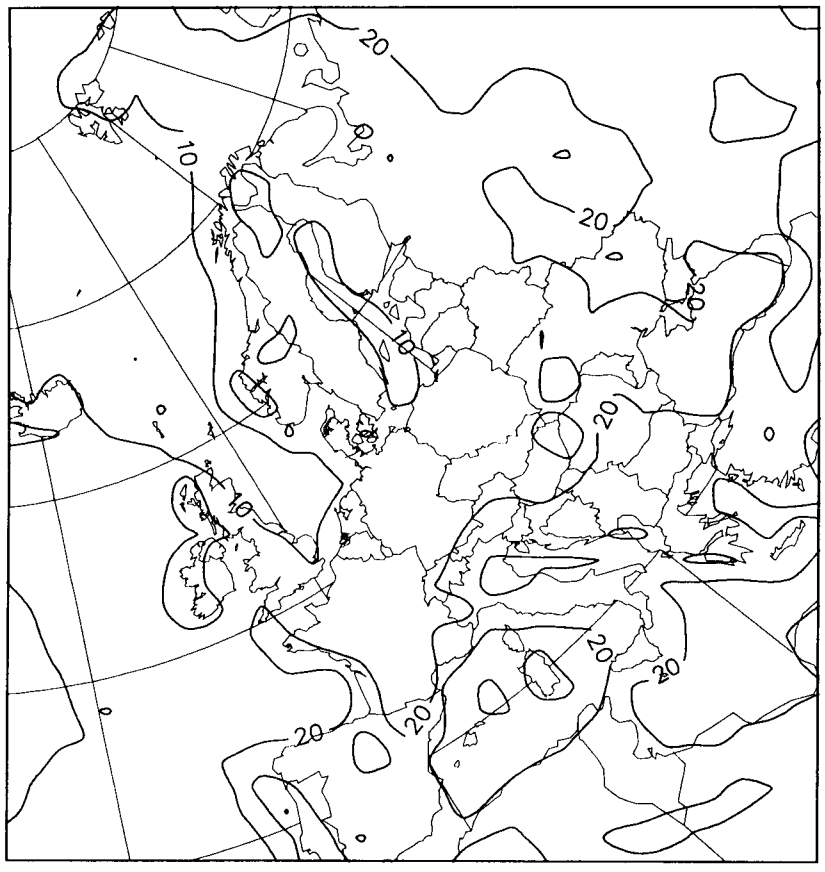


Average :
85/87/88/89/90/91/92

Unit : %

Figure G8 :

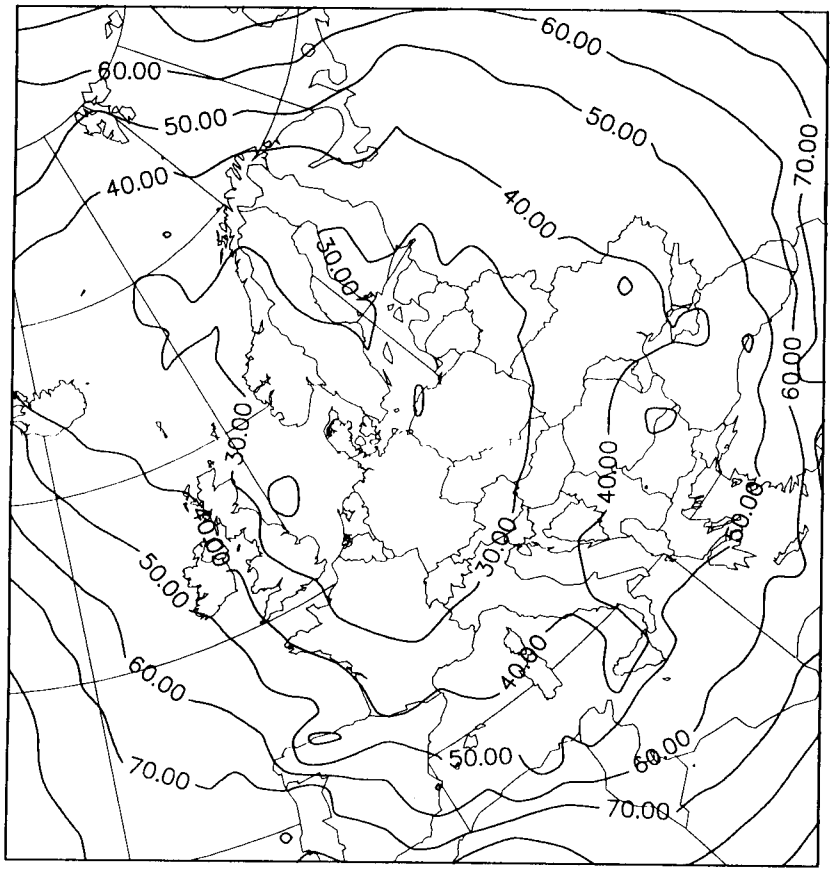
a) Total dep. of Oxidized Nitrogen
Inattributable contributions from mix.l



Average :
85,87–92

Unit : mg(N)/m2

b) Total dep. of Oxidized Nitrogen
Inattributable contrib. from mix.l. as % of total ind.

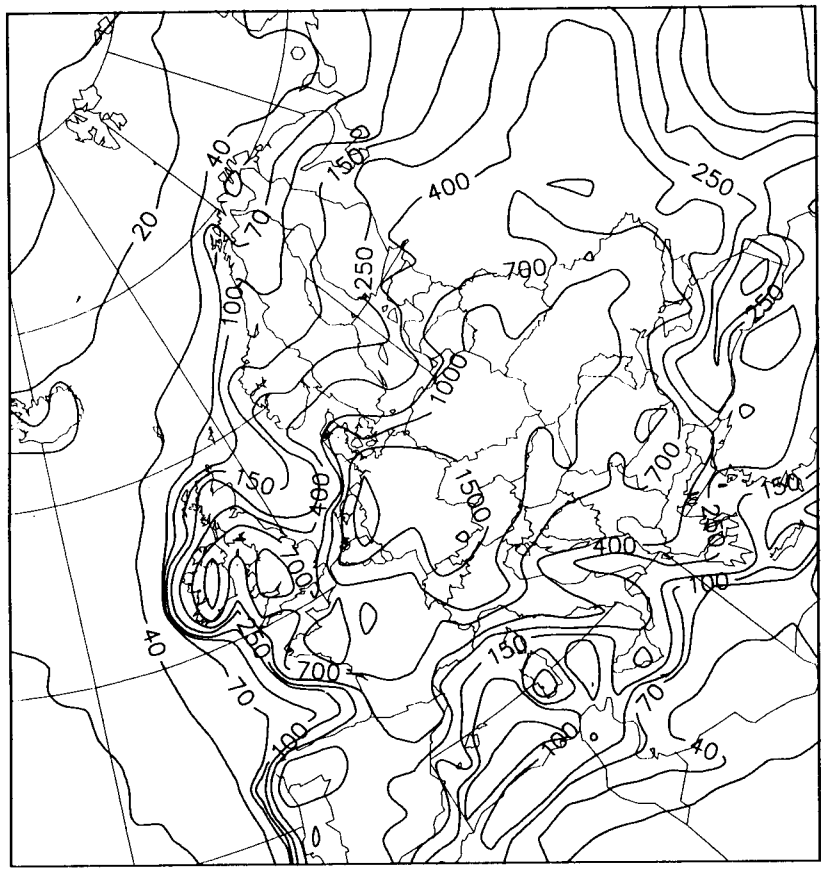


Average :
85/87/88/89/90/91/92

Unit : %

Figure G9 :

Total dep. of Reduced Nitrogen
Grand total (all contributions)

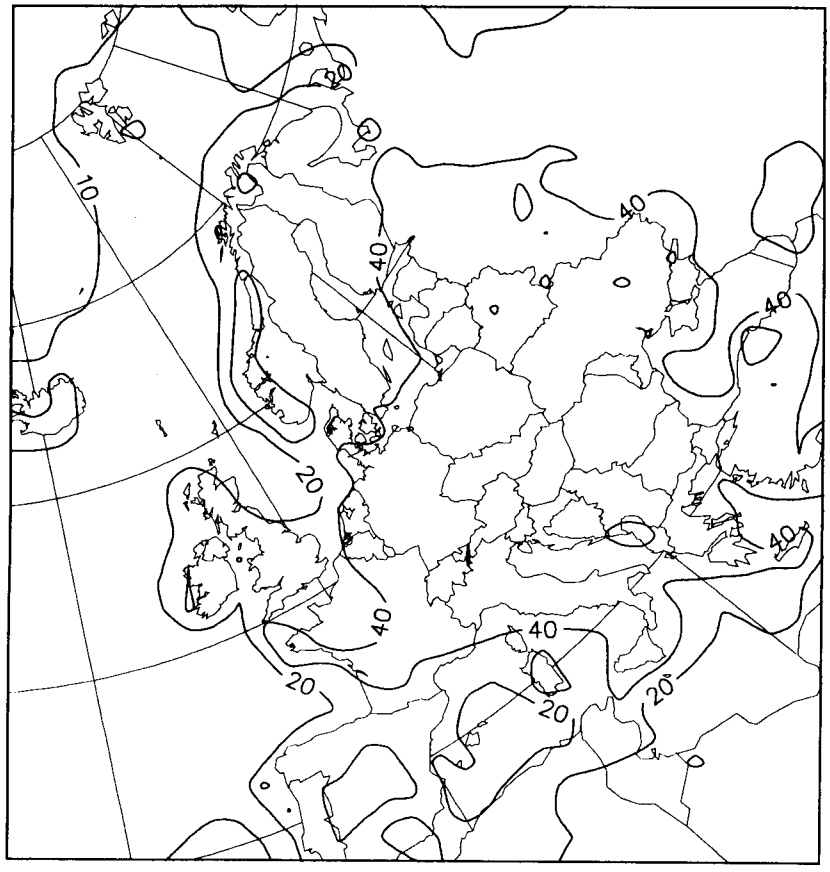


Average :
85,87–92

Unit : mg(N)/m2

Figure G10 :

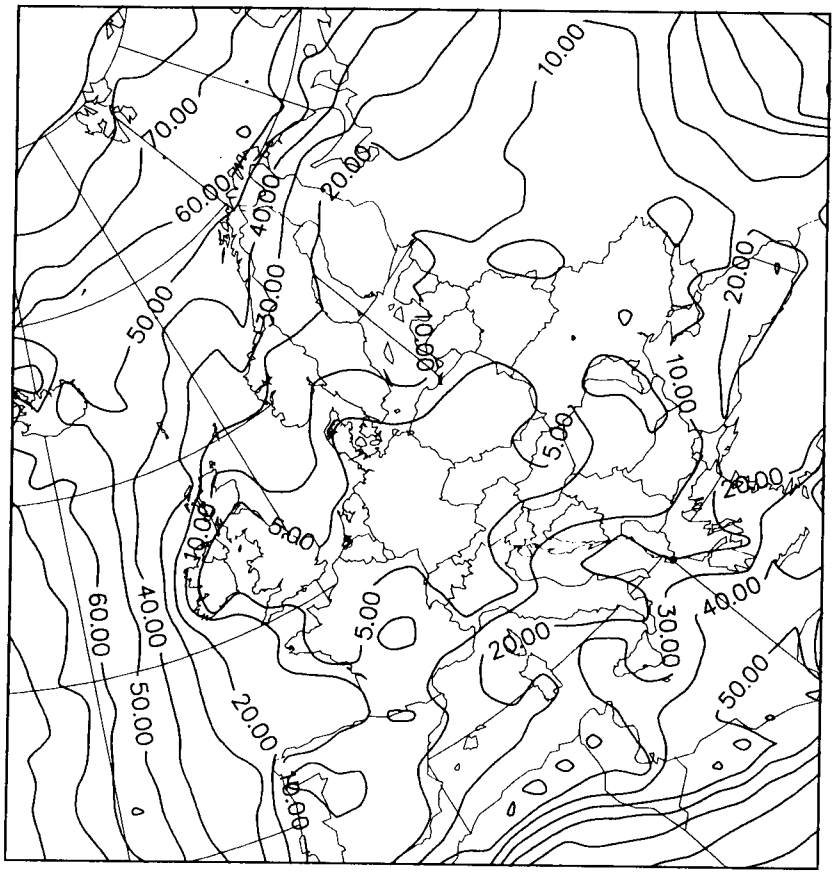
a) Total dep. of Reduced Nitrogen
Inattributable contributions



Average :
85,87–92

Unit : mg(N)/m2

b) Total dep. of Reduced Nitrogen
Inattributable contributions as % of total deposition

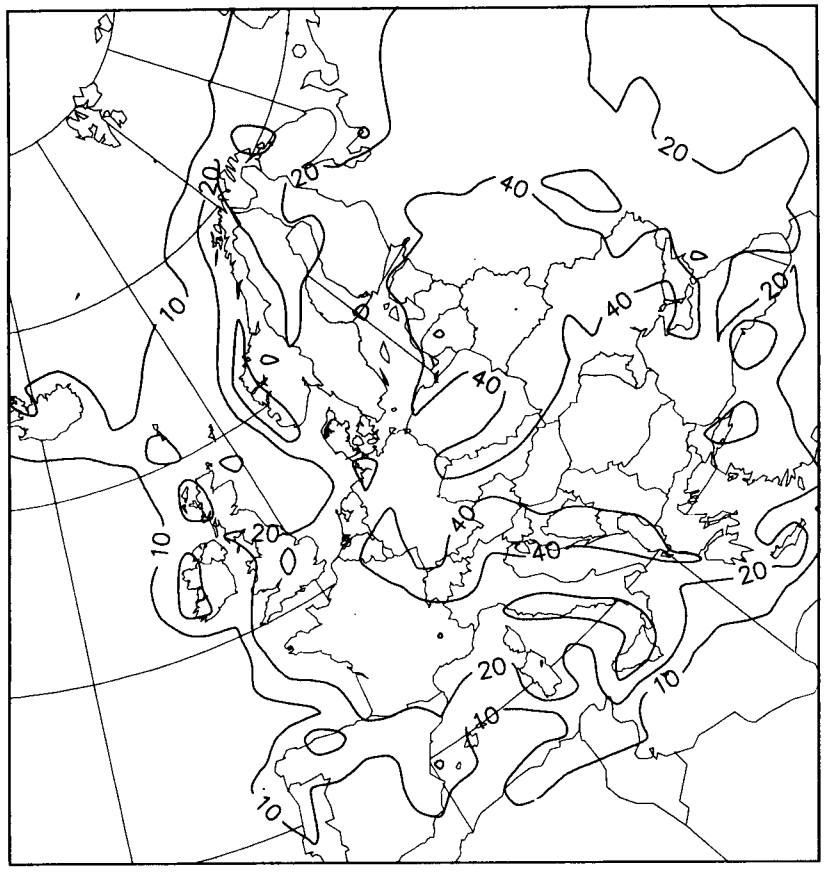


Average :
85/87/88/89/90/91/92

Unit : %

Figure G11 :

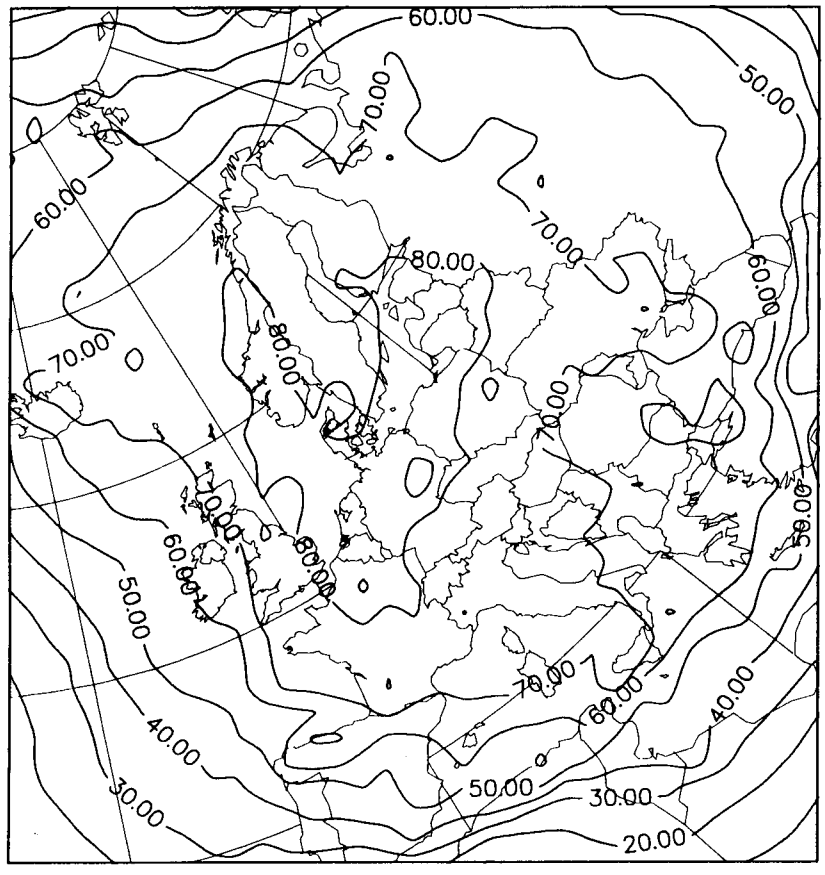
a) Total dep. of Reduced Nitrogen
Inattributable contributions from above



Average :
85,87–92

Unit : mg(N)/m2

b) Total dep. of Reduced Nitrogen
Inattributable contrib. from above as % of total ind.

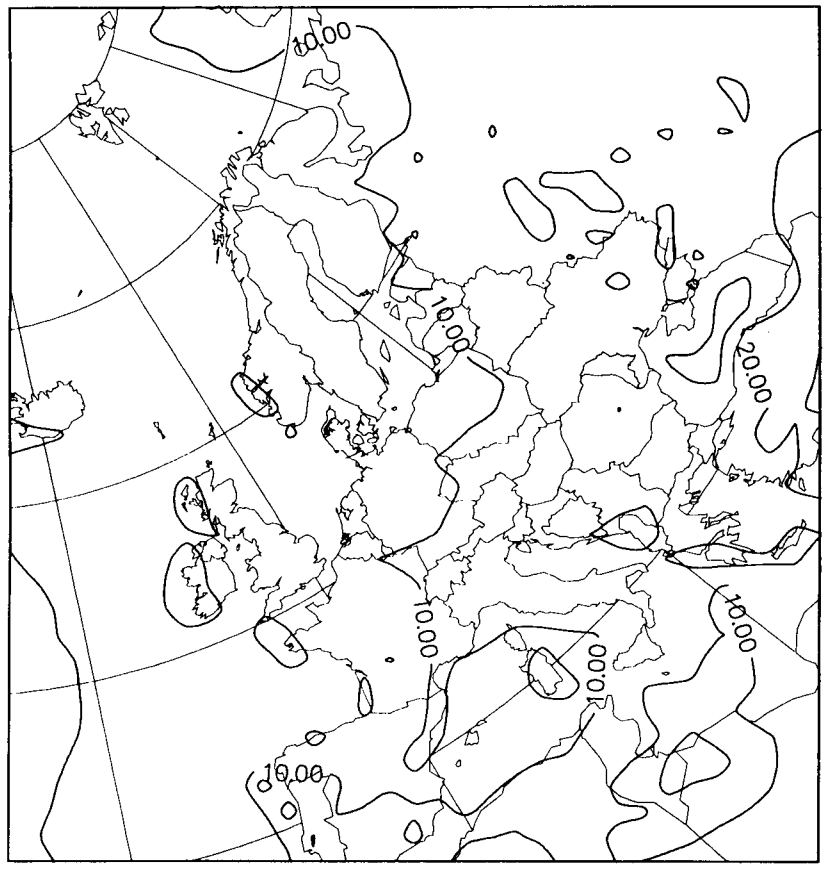


Average :
85/87/88/89/90/91/92

Unit : %

Figure G12 :

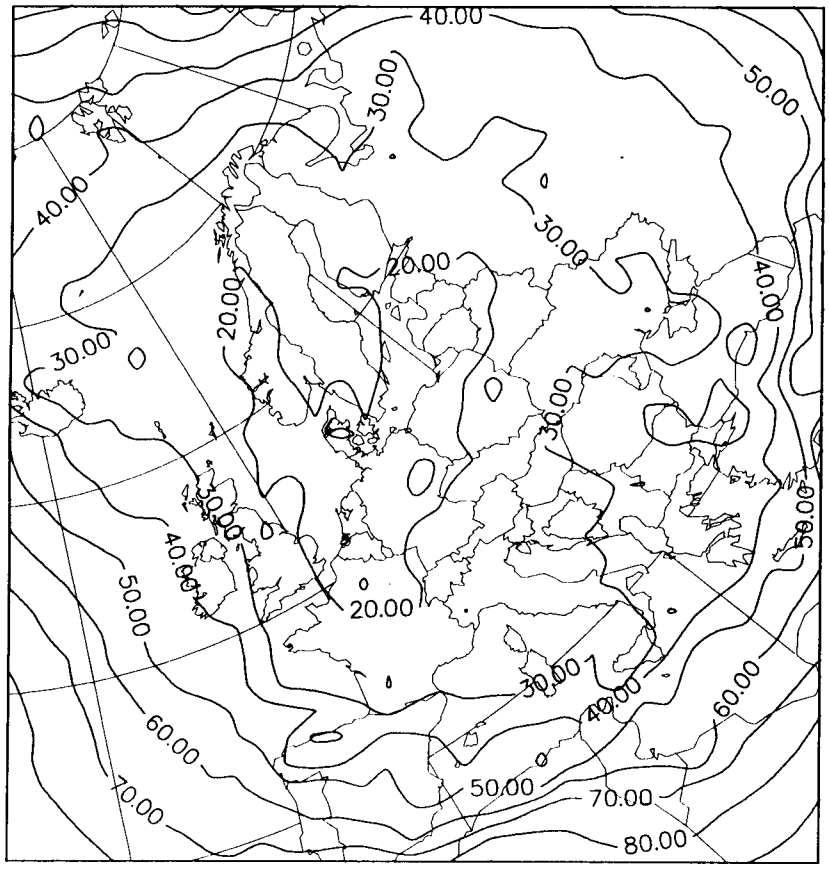
a) Total dep. of Reduced Nitrogen
Inattributable contributions from mix.l



Average :
85,87–92

Unit : mg(N)/m2

b) Total dep. of Reduced Nitrogen
Inattributable contrib. from mix.l. as % of total ind.



Average :
85/87/88/89/90/91/92

Unit : %