
National Assessment Report for DENMARK

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1. Emissions

Most Danish sources have been under regulation since the early 1970s, from the mid-1980s also according to the requirements of the UNECE/CLRTAP protocols. As a consequence Danish emission reductions targets have, as shown in Tables 1 and 2, been more than attained and have in some cases also met some future targets.

Table 1. The Danish emission targets according to UNECE-CLRTAP protocols and the actual emission reductions.

UNECE- CLRTAP protocols	Base year	Target year	Target Reduction %	Reduction attained in target year %
SO₂	1980	2000	80	94
NO_x	1987	1994	0	10
VOC	1985	1999	30	33

According to the sulphur protocol Denmark was obliged to reduce the SO₂ emission by 80% from 1980 to 2000. In 2000 the emission was only 27504 tonnes (table 2) and the reduction 94% (table 1). This means that the obligation is more than fulfilled. Also the targets in the NO_x- and VOC-protocols were reached.

The emissions for SO₂, NO_x, NMVOC and NH₃ for the most important sectors in 1980 – 2000 are shown in Fig. 1.a-b.

SO₂

The main part of the SO₂ emissions originate from combustion of fossil fuels – mainly coal and oil – on public power and district heating plants. The large reductions in this sector are mainly due to installation of desulphurization plants and use of fuels with lower content of sulphur. Despite that these plants make up about half of the total emission. Also emissions from industrial combustion plants, non-industrial combustion plants and other mobile sources are important. National sea traffic contributes with about 70% of the SO₂ emissions from other mobile sources. This is due to the use of residual oil with high content of sulphur. From 1980 to 2000 the total SO₂ emission has decreased by 94%.

NO_x

The three largest sources - almost equal in size - are combustion in energy industry (mainly public power and district heating plants), road transport and other mobile sources. The transport sector is dominating with a contribution in 2000 of 63% from road transport and other mobile sources. National sea traffic contributes with about 33% of the NO_x-emissions from other mobile sources. The emissions from public power plants have decreased by 32% from 1985 to 2000. For non-industrial combustion plants the main sources are combustion of gas oil, natural gas and wood in residential plants. The reductions are due to increasing use of catalyst cars and installation of low-NO_x-burners and de-NO_x-units on power and district heating plants. From 1985 to 2000 the total NO_x emission has decreased by 30%, mostly in the late 1990s.

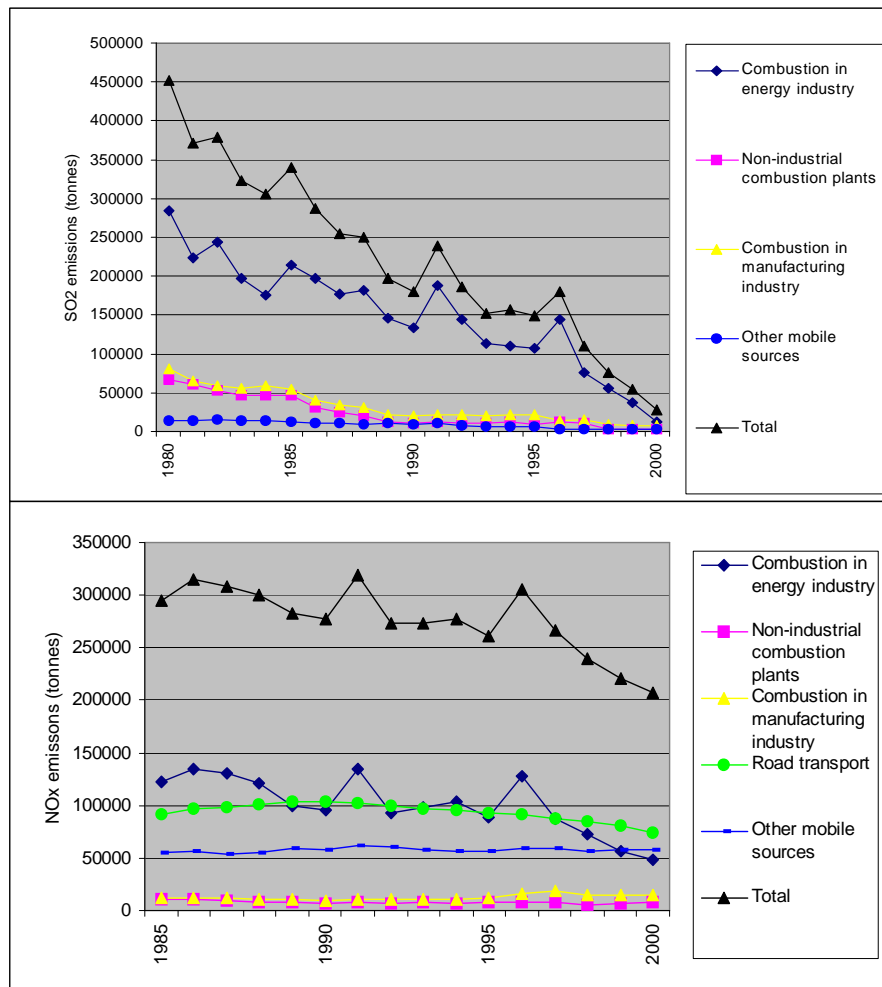


Figure 1a. Danish SO₂ and NO_x emissions.

NM VOC

The emissions of NMVOC originate from many different sources – both anthropogenic and natural – and can be divided into two main groups: Incomplete combustion and evaporation. The main sources to NMVOC emissions from incomplete combustion processes are road vehicles even though the emissions have declined since the introduction of catalyst cars in 1990, but other mobile sources such as sea vessels and off-road machinery also contribute. The evaporative emissions have decreased, mainly due to reduced emissions from use of solvents, whereas emissions from forestry have remained constant. The total anthropogenic emissions have decreased by 33% from 1985 to 2000.

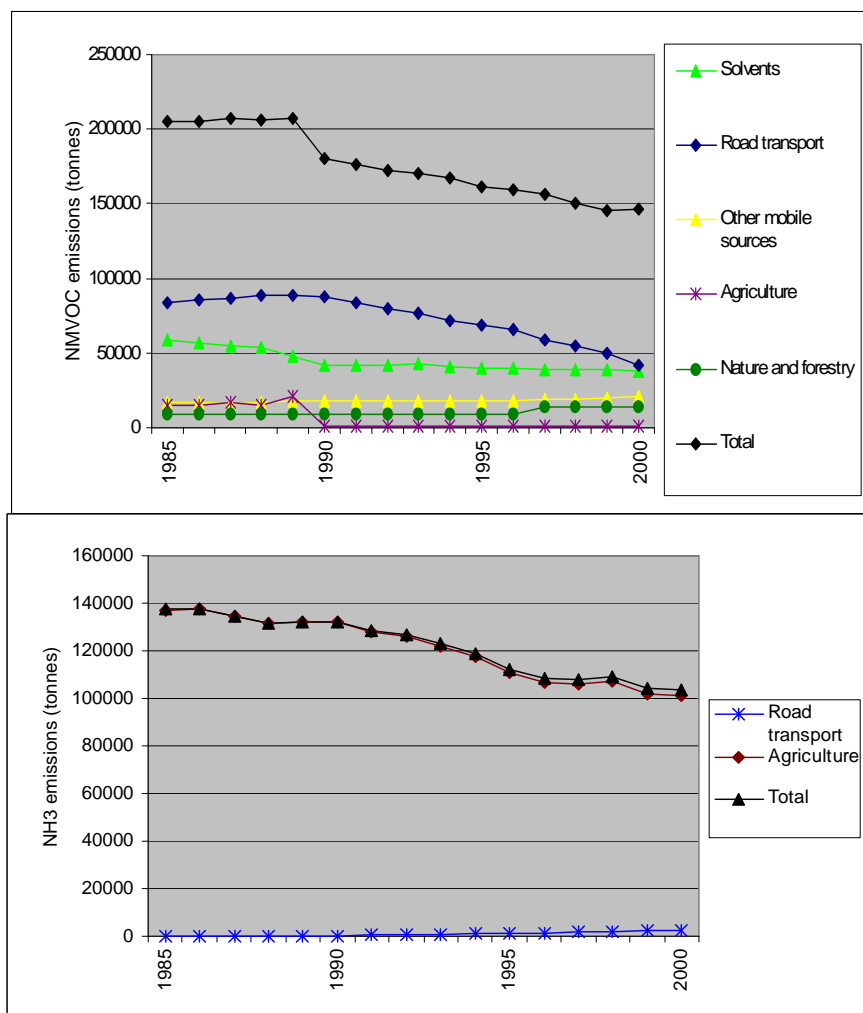


Figure 1b. Danish NMVOC and NH₃ emissions.

NH₃

Almost all atmospheric emissions of NH₃, 98% result from agricultural activities. The major part of the agricultural emissions stem from livestock manure (78%) and the biggest losses of ammonia occur during handling of the manure in stables and spreading on fields. Other contributions come from crops (13%), artificial fertilisers (7%) and ammonia used for straw treatment (2%). The reduction is primarily connected to improved manure management in spite of increasing animal production in the same period. The main reason for the fall in the emission is due to improved food utilisation resulting in less nitrogen excreted per produced unit. The increasing use of catalyst cars is the cause for the very small increase of 2% in emissions that originate from road transport. The total ammonia emission has decreased by 25% from 1985 to 2000.

Future targets

The new EMEP protocol – the Gothenburg Protocol – contains as a new principle prescribed emission ceilings, identical to those prescribed by EU. Table 2 shows the emission ceilings for Denmark in 2010. These targets also include most of the emissions of NH₃.

Table 2. Danish emissions in tonnes in 1990 and 2000 along with the Danish emissions ceilings according to the Gothenburg protocol.

Component	1990	2000	Ceilings 2010
SO₂	180617	27504	55000
NO_x	276930	207757	127000
NM VOC ^{a)}	170528	131994	85000
Total NH₃	132189	103621	
Regulated NH₃ ^{b)}	106038	87452	69000

a) Anthropogenic emissions

b) Excluding emissions from crops and straw treatment with NH₃

The reduction in the SO₂ emissions already attained are so large that the emission in 2000 has been reduced below the emission ceiling in 2010. For the other pollutants continued reductions are necessary.

2. Monitoring Programme

Station network and data quality

Surveillance of the air quality in rural areas of Denmark has been carried out since 1978 and is now operated by DMU – The National Environmental Research Institute under the national Background Air Quality Monitoring Programme.

The Danish EMEP stations *Tange*, *Keldsnor* and *Anholt* are located as shown on the map in Fig. 2 and at all three stations continuous measurements of both air and precipitation pollutants have taken place as shown in the table. However, special measurements such as O₃ have been carried out at the supplementary stations *Ulborg* and *Frederiksborg*.

Table 3. Measurement programme

Medium	Type	Sampling time	Components
Air	Gas	24 h 1 h	SO ₂ , ^a NH ₃ , ^b HNO ₃ , NO ₂ O ₃
	Particles	24 h	SO ₄ ²⁻ , ^a NH ₄ ⁺ , ^b NO ₃ ⁻ Cr, Mn, Fe, Ni, Cu, Zn, As, Cd, Pb
Precipitation	Ions	½ Month	SO ₄ ²⁻ , NH ₄ ⁺ , NO ₃ ⁻ , Na ⁺ , Mg ²⁺ , Cl ⁻ , K ⁺ , Ca ²⁺ , pH, Amount, conductivity
	Heavy metals	Month	Cr, Fe, Ni, Cu, Zn, As, Cd, Pb

Notes ^a Reported to EMEP as Tot-N_{red}= (NH₃ + NH₄⁺)-N (total ammonium)

^b and as Tot-N_{ox}= (HNO₃ + NO₃⁻)-N (total nitrate).

The measurement programme, which is shown in Table 3, is designed to meet both national needs and international obligations. The analytical methods are those described in the EMEP manual (available at <http://www.emep.int/>). However, the elements in aerosols are analysed by PIXE¹, a sensitive and well-tested method. In the annual EMEP analytical intercalibrations the Danish results usually deviate by less than 10% from theoretical values.

¹ PIXE – Proton Induced X-ray Emission spectroscopy

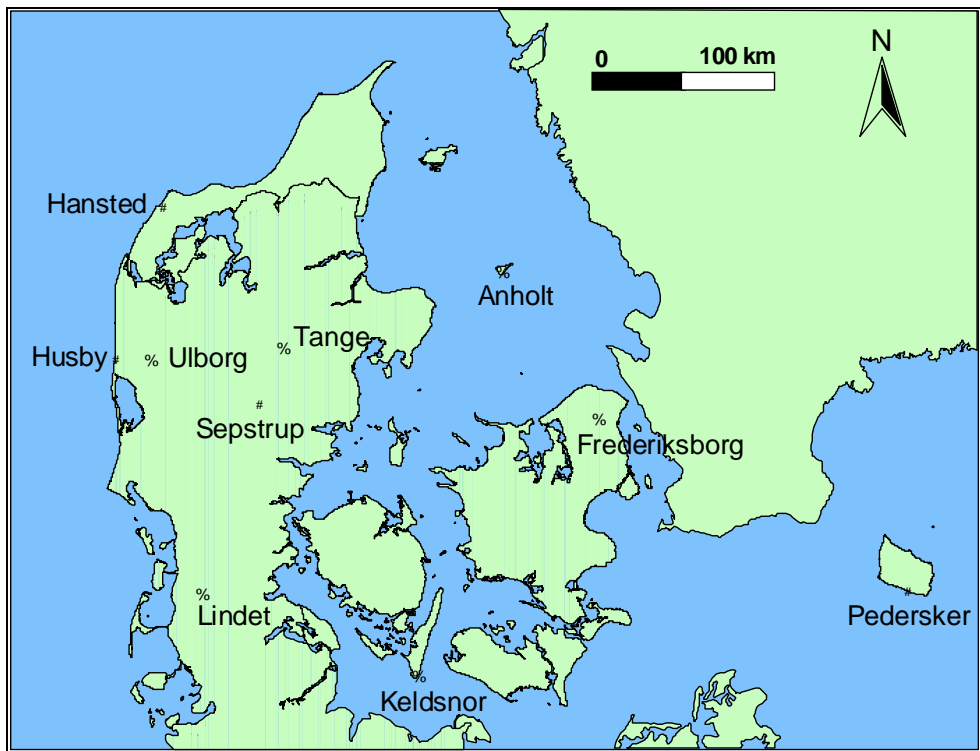


Figure 2. Danish monitoring stations

3. Atmospheric pollutants

Concentrations

For many pollutants the ambient concentrations have since the late 1970s decreased by factors of 2-5 or more, reflecting the changes in emissions in Europe. This is demonstrated in Table 4 which shows triple-year mean values of data from all 3 EMEP stations from the late 1970s, 1980s, and 1990s.

Table 4. Triple-year national mean concentrations in $\mu\text{g}\cdot\text{m}^{-3}$

Component	1978-1980	1988-1990	1998-2000
SO ₂ -S	5.56	2.30	0.61
SO ₄ -S	2.83	1.69	0.92
NH ₃ -N	.	0.87	0.68
NH ₄ -N	3.12	2.43	1.49
TNH ₄ -N	.	3.20	2.14
TNO ₃ -N	.	1.21	0.96

Trends

The more detailed temporal developments of the concentrations of selected pollutants are illustrated in Fig. 3. In these figures the thin jagged line shows the monthly medians of the measured

concentrations, the smooth curve delineating the shaded area represents a moving average over 12 months, and the full straight line is a linear regression line representing the long term trend.

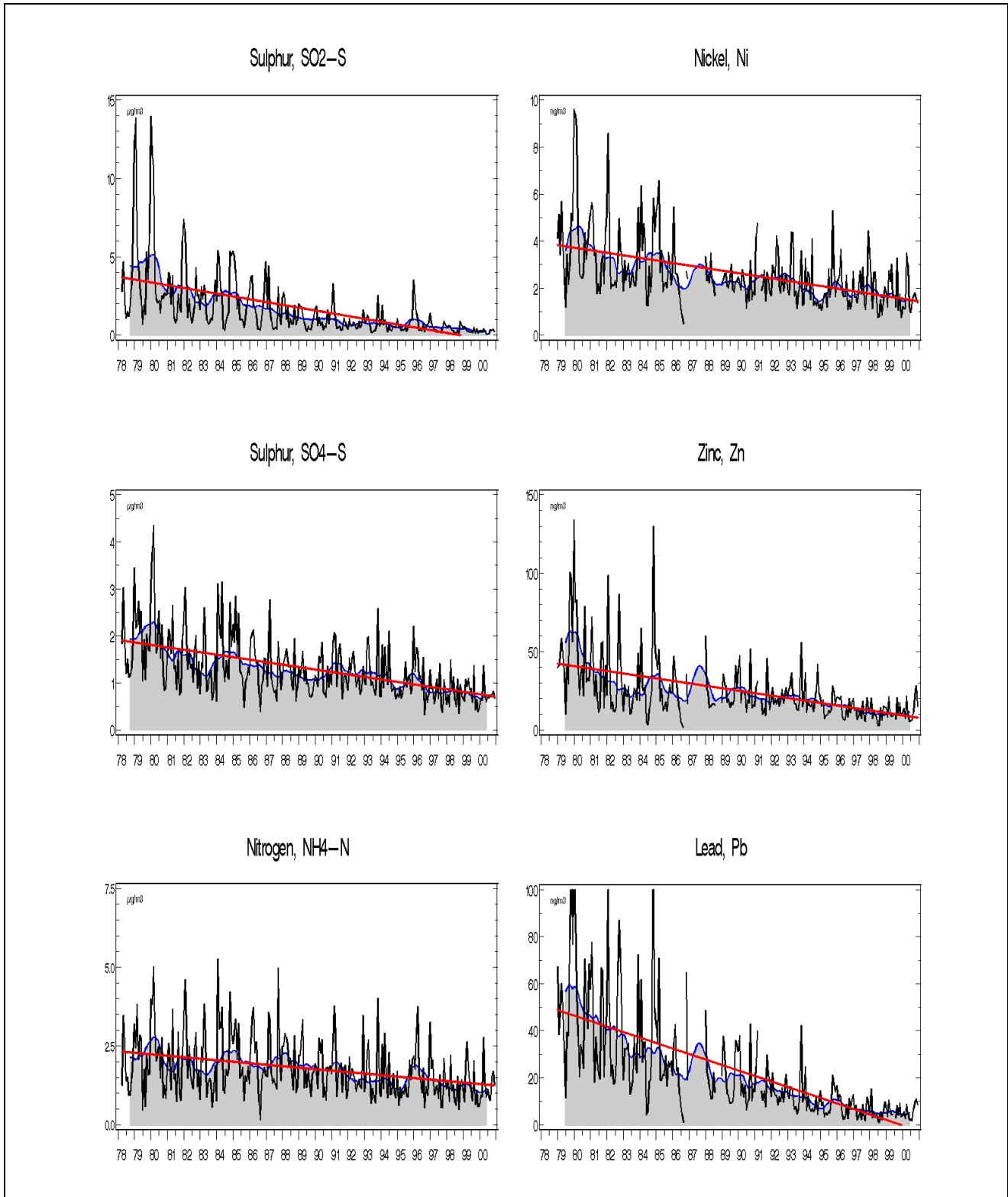


Figure 3. Trends for monthly median atmospheric concentrations 1978 – 2000. Major pollutants from Tange (left) and trace contaminants from Keldsnor (right).

It is evident that a turning point was reached in the late 1970s where the growth in concentrations of both sulphur and heavy metals was halted and concentrations started to fall steadily in the following years.

The decrease for both gaseous and particulate sulphur since around 1980 must be seen as the result of the widespread international effort to curb emissions through introduction of stack exhaust cleaning technologies and use of cleaner fuels, to a large extent induced by the CLTRAP protocols.

Similar results have been found at all Danish EMEP stations and for most other compounds (Heidam, 2000). An overview of the trends is shown in Table 5. The trends are given in percentage of the grand mean median over the whole period. Trend uncertainties are given as relative standard deviations in the range [0, 1] and if they are larger than 0.5 the trends are not considered significant and are not presented.

For ammonium, NH_4^+ it should be noted that neutralisation of atmospheric sulphuric acid by ammonia, which is abundant in Denmark, in combination with the decreasing concentrations of sulphate may be one of the reasons for the observed decrease of ammonium. Conversely, less sulphate may contribute to the lack of any trend in ammonia concentrations.

Table 5. Significant trends of monthly medians of air concentrations. Trend values are average annual percentage changes relative to the grand means of the monthly medians, measured in $\mu\text{g}\cdot\text{m}^{-3}$ for the sulphur and nitrogen compounds and in $\text{ng}\cdot\text{m}^{-3}$ for the elements.

COMPONENT	TANGE 1978 - 2000			KELDSNOR 1978 - 2000			EMISSIONS in EMEP
	Grand-mean Median	Trend Pct per year	Std. dev. relative	Grand-mean Median	Trend Pct per year	Std. dev. relative	Trend Pct per year
SO₂ -S	1,67	-10,7	0,09	2,42	-8,9	0,08	-4,20
S	1,31	-4,0	0,10	1,69	-3,7	0,10	-
NH₄⁺-N	1,79	-2,6	0,17	2,21	-2,1	0,19	-
NH₃ -N^a	1,38	-	-	0,90	-	-	-2,15
TNO₃-N^a	0,80	-	-	1,14	-4,3	0,34	(-1,8)
Ni	1,99	-5,9	0,09	2,65	-4,1	0,11	-
Zn	20,54	-5,7	0,11	24,87	-6,3	0,10	-
Pb	19,01	-11,0	0,05	22,86	-10,2	0,07	-

a. For the period 1978-1997 only.

For the oxidised nitrogen compounds, Tot-N_{ox} and NO₂, that derive mainly from combustion processes in power plants and in motor vehicles, the development with time is less decisive, the trends are either negative, absent or even positive. That is illustrated in Fig. 4 for NO₂ in the 1990s from the two stations *Anholt* and *Ulborg*. However that may be an effect of the limited time period used. Both components have been observed to decrease in the late 1990s and early 2000s (Ellermann et al. 2001; 2002).

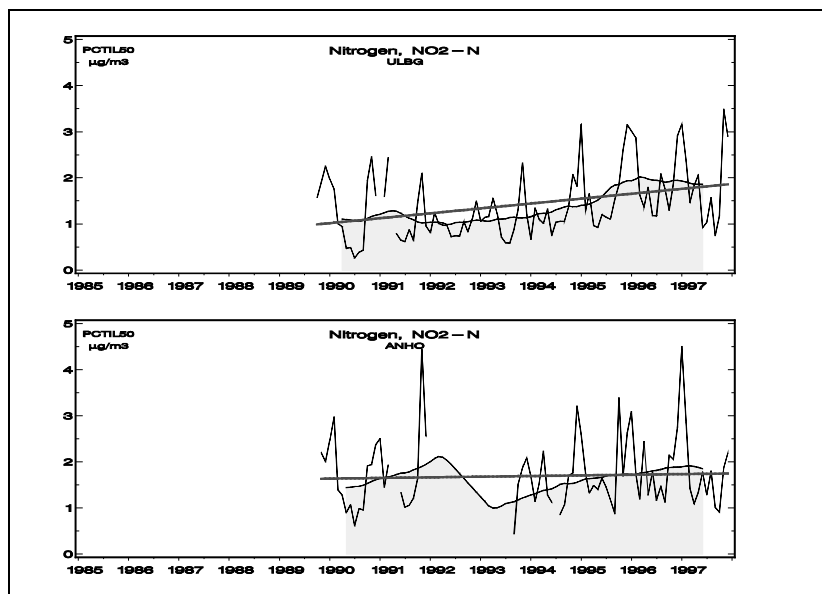


Figure 4. Trends for monthly median concentrations of NO₂ during the 1990s.

Emission restrictions of NO_x were internationally agreed upon in the first NO_x-protocol, which was introduced in 1988 under CLRTAP and entered into force in 1991. The protocol has advanced the process of installation of catalytic converters in petrol cars all over Europe. So specific emissions of NO have undoubtedly gone down but that may have been offset by the growth in road traffic. It is evident from Fig. 1 that by 1997, the end of the period considered for this component, Danish emissions of NO_x had not decreased by any decisive amount. But since O₃ concentrations in background areas usually are less than 100 ppb, ozone-limited oxidation of NO to NO₂ is certainly also a possibility for the lack of decreases in NO₂ concentrations. The only significant negative trend has been found for total nitrate from *Keldsnor*. This station, where incidentally the highest concentrations occur, is under quite pronounced influence from sources on the European continent, indicating that the NO_x -protocol has had some effect.

Episodes and Exceedances

Episodes that lead to a nation-wide build-up of high concentrations of atmospheric pollutants occur 3-8 times a year. In the background areas they are most often observed in midwinter and they are usually also observed in urban air. Episodes may occur if conditions are either stagnant or stable and coupled to a steady flow from southern directions. A number of severe episodes since 1985 have been observed and reported in various reports from DMU.

The frequency and severity of episodes have been decreasing over the years in step with the steadily diminishing concentrations. This is illustrated in Fig. 5 where the occurrence of all episodes at *Tange* and *Keldsnor* of lead and zinc is shown. Episodes have been selected among the upper 5% of data that span at least 4 consecutive days and contain at most two consecutive non-episodic results.

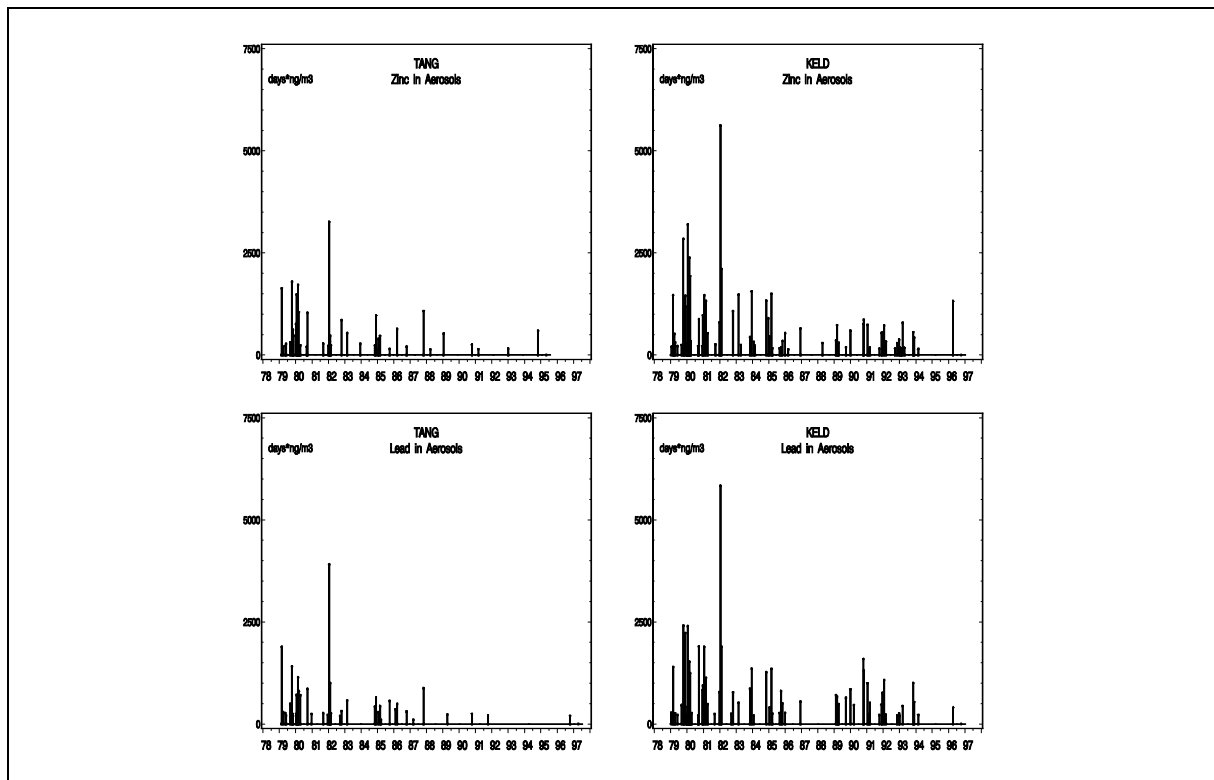


Figure 5. Episodes of lead and zinc at Tange (left) and Keldsnor (right), 1978 - 1997.

The episode severity is shown vertically as the sum of episode concentrations.

The frequency of episodes have fallen from about 7 per year in the early 1980s to about 3 per year in the period 1991-1997 but it remains higher at the more LRTAP-exposed southerly station *Keldsnor*. The severities of the episodes, defined as the sum of concentrations over the episode, have as can be seen also fallen considerably. However, this improvement may also have a climatological component since severe winters have become less frequent in the last decennia.

For ozone high concentration episodes usually occur in the summer period and may be aggravated by constant sunshine and stagnant weather or constant atmospheric transport from Central Europe. In these and other quite frequent instances critical levels may be exceeded at the Danish stations. The annual number of exceedances of the Danish critical levels for vegetation is shown in Table 6 at two Danish stations for each year since 1985. The limit on the daily mean value is being transgressed 2 -6 times a week as an average for the summer season where exceedances usually occur. These high ozone levels may cause substantial losses of crop yield but unfortunately it is quite a normal situation at most European ozone stations. On the other hand, the limit on the hourly values is only rarely exceeded, it has only been observed to happen 16 times.

Table 6. Annual number of exceedances of ozone limits: 1 hour maximum of 200 µg/m³ (100 ppb) and 24 hour mean of 65 µg/m³ (32.5 ppb).

SITE	ppb	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
FRBG	32,5				14	100	28	40	94	60	70	60	85	66
	100					6			3					
KELD	32,5											131	141	200
	100													
ULBG	32,5	22	102	96	99	99	40	148	149	143	156	172	97	65
	100						2		5					

Wind sector dependence

Air pollutants measured at a given location originate from a number of different sources. Since many air pollutants have a lifetime of several days they can travel considerable distances in the atmosphere. The sources may therefore be from a few kilometres to several hundred and even up to a thousand kilometres away. Thus the sources for air pollution measured in *e.g.* Denmark may be located anywhere in Europe. However, the main transport parameter is the wind and the direction of this wind may be a clue to the origin of the pollution.

The air pollution concentrations are based on sampling through 24 hours so use of the wind direction can only be meaningfully applied if the wind has a fairly constant direction over this time period. When the directions of the transporting wind during the particular day fulfil some predefined criteria for constancy of direction it is possible to assign a daily wind direction, say one of eight 45⁰-sectors, to a measuring site. In all other cases, when the wind is highly variable in direction or if there is little or no wind, the wind direction must be classified as indeterminate.

For an extended measuring period the average concentrations in each sector can illustrate which wind directions bring the highest concentrations to the site.

Results of such an analysis are shown in Fig. 6 for sulphur dioxide SO₂, particulate S and total ammonium Tot-N_{red}. The data are from the period 1991-1997 at the two EMEP-sites, Tange and Keldsnor. Similar results are found for many other components, *e.g.* Nickel, Zinc, and Lead (Heidam, 2000). The analysis shows that Denmark is highly exposed to transboundary pollution. For most pollutants the highest concentrations are found when the transport is from the south to the south-east, *i.e.* when the air comes from the European continent, notably Germany and the East European countries.

The results in Fig. 7 show how important the various wind directions are for the level of transboundary air pollution in Denmark. The data are the same as in Fig. 6 but the sector-means have been multiplied by the frequencies of occurrence of wind from the various directions. The resulting values are in fact equal to the sector's contribution to the overall annual mean concentrations. Since the maximum values have now shifted to south-west these figures show that the directional contributions to the annual mean concentrations are dominated by winds arriving in Denmark from southerly to westerly directions, *i.e.* from Western Europe, even though the highest concentrations occur in winds from the southeasterly directions.

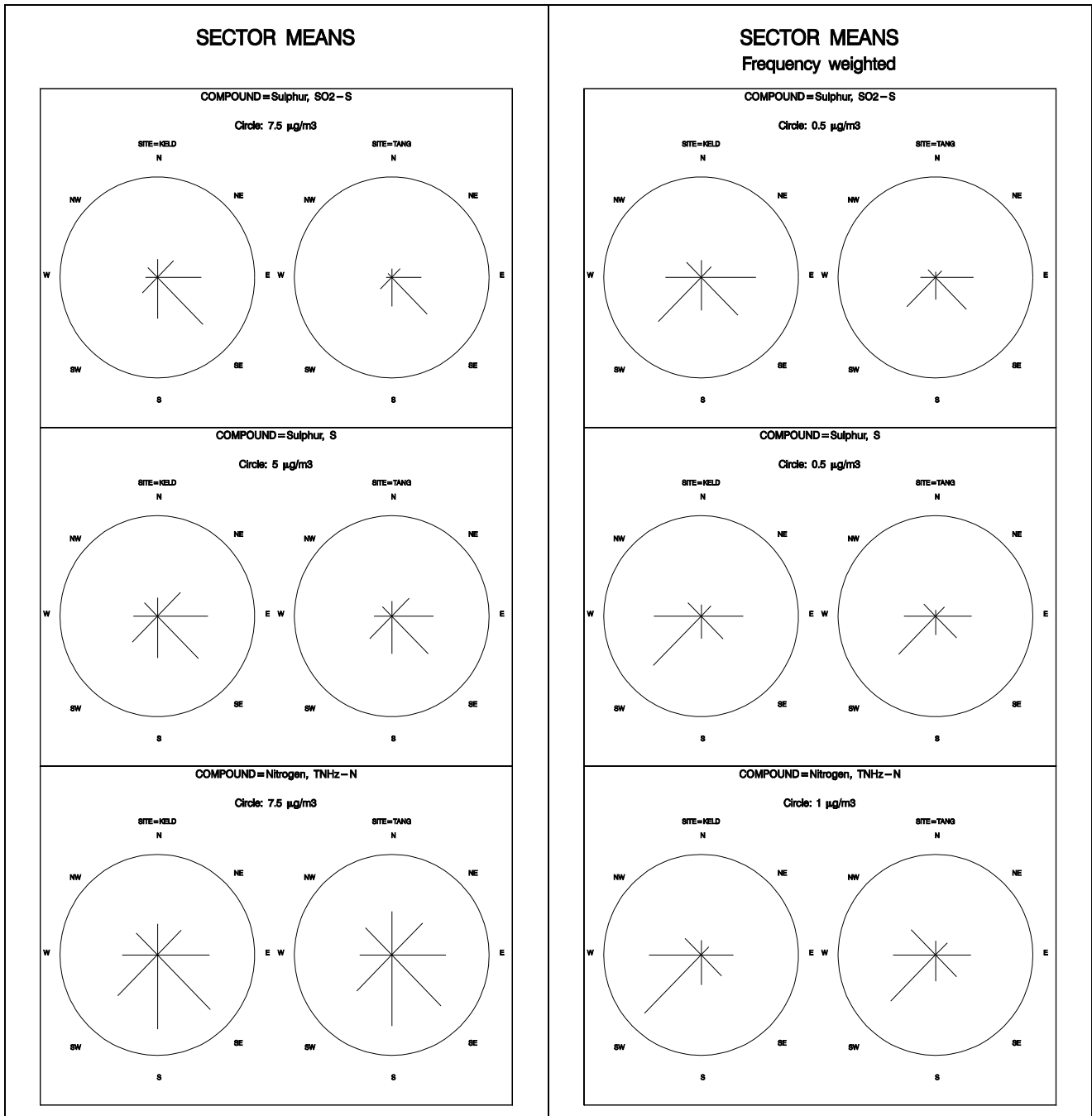


Figure 6. Mean concentrations of SO₂, S and Tot-N_{red} in 8 wind sectors at Keldsnor (left) and Tange (right). 1991 – 1997.

Figure 7. Wind frequency weighted mean concentrations of SO₂, S and Tot-N_{red} at Keldsnor (left) and Tange (right). 1991 – 1997.

For each compound the radius of the circumscribing circle gives the scale.

4. Precipitation

Concentrations

For many pollutants the measured concentrations in precipitation have since the late 1970s decreased by factors of 2-5 or more, reflecting the changes in emissions in Europe. This is shown in Table 7 which shows triple-year mean values of data from all 3 EMEP stations from the late 1970s, 1980s, and 1990s.

Table 7. Triple-year national mean^a concentrations in mg·l⁻¹

Component	1978-1980	1988-1990	1998-2000
NO3-N	0.59	0.53	0.51
SO4-S	2.20	1.17	0.67
NH4-N	0.91	0.66	0.49
pH	2.68	4.40	4.76
Na	.	3.62	2.59
Mg	.	0.43	0.32
K	.	0.20	0.18
Ca	.	0.34	0.26

^a. precipitation weighted

However, the tendencies are weakest for the nitrogen components, ammonium and nitrate, in particular at the inland station *Tange*. At this station which is always under some influence from road traffic or agriculture in the area, the nitrate concentration levels seem unchanged since the late 1970s.

Wet depositions

The development with time of quarterly wet depositions is shown in Fig. 8. Each figure contains three curves that are, respectively, the measured quarterly wet deposition (jagged line), a moving 4-quarter average (delineating the shaded area) and a trend (straight line) calculated as a regression line.

The wet depositions have decreased considerably in much the same way as observed for concentrations. The decreases are most pronounced for sulphur and acidity and less so for the nitrogen compounds. These findings are also reflected the percentage land area where critical loads of acidification and eutrophication are exceeded (EMEP 1999).

Estimates of significant deposition trends are presented in Table 8. The trends are given in percentage of the grand mean deposition over the whole period. All the trends are negative, but they are numerically smaller and more uncertain for the nitrogen compounds. For NO₃⁻ at *Tange* the trend is so small and uncertain that it is not significant.

A notable case is that of the base cation Calcium, which as the only dominantly natural component has been found to have a significant negative trend at the inland station *Tange*. The decreasing Ca depositions may reduce the neutralisation of the precipitation and thereby offset the benefits from reduced sulphur emissions. The phenomenon may arise from the increasing agricultural practice of green winter fields to prevent terrestrial eutrophication,

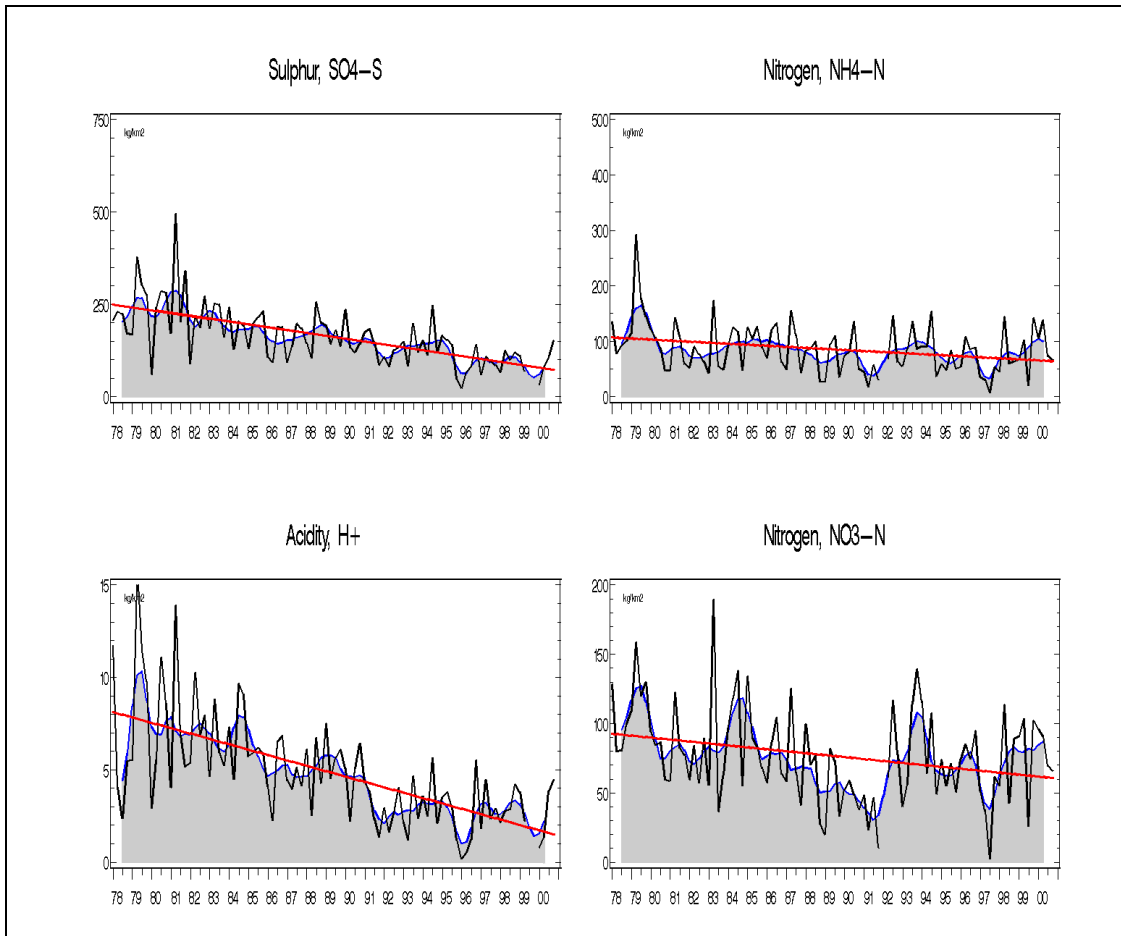


Figure 8. Trends for quarterly wet depositions 1978 – 2000.

Depositions of sulphate and acidity at Tange (left) and of ammonium and nitrate at Keldsnor (right).

Table 8. Trends in quarterly wet-only depositions for the period 1978- 2000. Trend values are average annual percentage changes relative to the grand mean deposition, measured in $\text{kg}\cdot\text{km}^{-2}$.

COMPONENT	TANGE 1978 - 2000				KELDSNOR 1978 – 2000			
	Grand Mean Deposition	Trend per Year	Pct.	Relative Std_Dev	Grand Mean Deposition	Trend per Year	Pct.	Relative Std_Dev
SO4-S	164,16	-4,7		0,12	163,61	-6,6		0,21
NH4-N	117,95	-2,8		0,29	86,30	-2,2		0,35
NO3-N	78,61	-		-	77,29	-1,8		0,36
H+	4,89	-5,9		0,12	3,97	-5,7		0,17
Ca	36,45	-8,9		0,22	45,44	-		-

Acidifying and Eutrophying Depositions

Sulphur

Model calculations both by EMEP and by DMU show that the deposition of sulphur, which is environmentally important for land areas only, has decreased markedly. According to calculations by the Danish model ACDEP the deposition of sulphur is dominated by equal amounts of dry deposition of SO_2 and of wet deposition of SO_4^{2-} (Heidam, 2000, Ellermann et al. 2001; 2002). On the average the annual deposition has fallen from about $1650 \text{ kg S}\cdot\text{km}^{-2}$ in the 1980s to $800\text{-}900 \text{ kg S}\cdot\text{km}^{-2}$ in the 1990s (Ellerman et al. 2001; EMEP 1998). However, critical acidifying loads are still exceeded in about 2% of the country, mostly the southern part where the largest depositions occur, indicating a considerable LRTAP-component.

Nitrogen

Similar model calculations for the total deposition of nitrogen to land and sea agree with the observations that trends are small or absent. The ensuing acidification and eutrophication problems are therefore of a long-term nature.

It is a major national environmental problem that the injection of nutrients to Danish waters from all sources regularly lead to algae blooms, severe oxygen depletion and fish deaths. It is therefore also a major problem that the annual atmospheric fluxes of nitrogen to Danish waters, illustrated in Fig. 9, are so large. It is estimated that the average flux is $1300 \text{ kg N}\cdot\text{km}^{-2}$ and that the total atmospheric deposition amounts to 140 kt N (Ellerman et al. 2001), which corresponds to almost 50% of the controllable supply from run-off and riverine and atmospheric input (Svendsen et al. 2001).

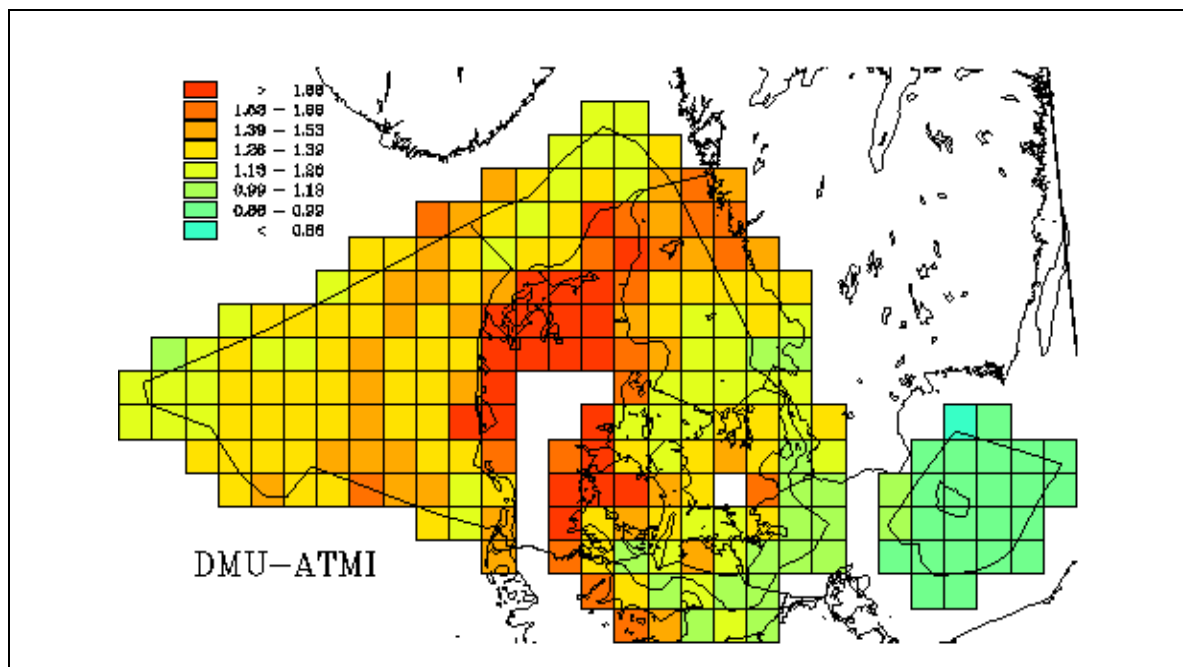


Figure 9. Deposition fluxes of total nitrogen to Danish Waters in 2000 as calculated by the ACDEP model. Units in tonnes N/km², grid length 30 km.
(http://www.dmu.dk/1_viden/2_Miljoe-tilstand/3_luft/4_spredningsmodeller/5_ACDEP/default.asp)

The annual depositions of nitrogen compounds to water surfaces vary considerably from low values in the open (North) sea, about 1000 kg N·km⁻², to depositions as high as 1700 kg N·km⁻² in the inner waters, notably the fjords and lakes (Ellerman et al. 2001).

In 2000 about 44 % of the nitrogen deposition to sea surfaces are in reduced form and 56 % in oxidised form. Both these contributions are dominated by nitrogen originating from foreign sources, so in total more than 80% of the nitrogen deposited from the atmosphere to Danish waters are of foreign origin (*ibid.*). Since reduced ammonium is almost exclusively arising in the agricultural sector these calculations show that about 10% of the marine deposition is caused by the domestic agricultural sector.

Depositions to land areas vary less and are largest in the south. The deposition flux to Danish land areas in 2000 is estimated at 2100 kg N·km⁻². That amounts to a total deposition of 92 kt N (*ibid.*), which is close to EMEP's estimate for 1985 (EMEP 1998, tables 3.6 and 3.7).

Transboundary air pollution

In general the atmospheric depositions of nitrogen from domestic sources amount to about 40% of the total deposition to terrestrial surfaces and about 17% of the total deposition to marine surfaces (Ellermann et al. 2002). The remaining depositions constitute a considerable import caused transboundary transport and depositions from abroad, and so Denmark is indeed a country, which is highly exposed to LRTAP.

But the country also exports a very large fraction of its emissions to neighbouring countries and seas, partly due to the small size of the country. The exports are in fact almost all larger than the imports so Denmark is a net exporter of pollution. For sulphur it has been estimated that the net export amounts to almost 60% of emissions from Danish sources and the similar figure for the sum of reduced and oxidised nitrogen is 61% (Heidam 2000).

5. Conclusions

Emissions from most Danish source types have been regulated since the early 1970s, and the targets set up by the EMEP protocols have been more than reached. To achieve the future emission ceilings in 2010 further reductions are required except for SO₂.

For most airborne pollutants the long-term trends show that the concentrations have fallen dramatically and continuously by factors of 3-10 over the last 20 years. These changes have been brought about by co-ordinated international efforts to reduce emissions in Europe and they have reduced not only the average but also the maximally occurring concentrations. There is however no trend in the concentrations of NH₃, and TNO₃ appears to have decreased only in eastern Denmark. For NO₂ trends are either absent or positive although emissions on a European scale have dropped by almost 2% per year in the last 10 years. As expected no trends can be seen for ozone and it has consistently maintained a broad summer maximum that leads to frequent exceedances of limit values. These exceedances may cause substantial losses in crop yield.

A wind sector analysis shows that Denmark is highly exposed to transboundary pollution.

For most pollutants the highest concentrations are found when the transport is from the south to the south-east, *i.e.* from Eastern Europe.

But the directional contributions to the annual mean concentrations are dominated by winds arriving in Denmark from southerly to westerly directions, *i.e.* from Western Europe.

In precipitation the concentrations of anthropogenic pollutants have since the early 1980s fallen considerably. The main exceptions are the nitrate concentrations that cannot be seen to have changed decisively.

The depositions of anthropogenic components have, with some reservation for nitrate, decreased markedly in the two decades, often by factors of 2-5. This decrease is most pronounced for sulphate and acidity and is without doubt caused by the internationally agreed restrictions on emissions. For the nitrogen compounds the decreases are smaller and more uncertain, in particular for nitrate. The major decrease in the wet-only depositions occurred in the 1980s.

Critical acidifying loads of sulphur are still exceeded in the southern part of the country where the largest depositions occur, indicating a considerable LRTAP-component.

It is a major environmental problem that the atmospheric deposition of nitrogen constitutes almost 50% of the 'controllable' supply of nutrients to Danish waters where eutrophication regularly leads to algae blooms, severe oxygen depletion and fish deaths. Most of these depositions have large LRTAP-components with no decisive negative trends. Therefore the ensuing eutrophication problems in Danish waters are of a long-term character and can only be solved by continued international co-operation on emission reductions.

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² All DMU reports are available as pdf-files at the web-address:
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