EMEP Assessment Report: French national contribution

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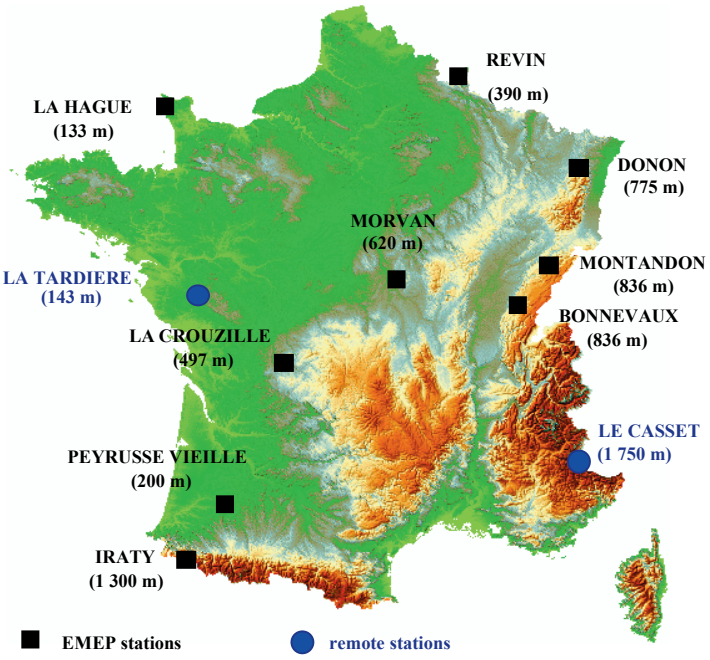
1°/ Precipitations, atmospheric concentrations and emissions:

1a/ Measurements:

French EMEP/MERA monitoring network description

The French contribution to the EMEP program includes 8 measurement stations integrated in a national monitoring network called MERA (MEsure des Retombées Atmosphériques). The map below shows their locations.



Equipment implemented at these stations allows getting information on a daily basis about precipitation amount, major ions in precipitation, sulphur dioxide and sulphate aerosols. Since 1998, EMEP/MERA stations (except La Crouzille and La Hague) have been equipped with ozone analysers and meteorological apparatus. Moreover, the measurement of volatile organic compounds (VOC) and carbonyls have been set up at Donon and Peyrusse-Vieille (EMEP super site) stations since 1992 and 1995 respectively.

The table below summarises the list of pollutants measured at each French EMEP station, and the date of first measurements:

Station	precipitation (1)	SO_2	S (part)	O_3	VOC	carbonyls	meteorology (2)
EMEP stations							
Bonnevaux (3)	01/1990	01/1990	01/1990	01/1995			
Donon	01/1990	01/1990	01/1990	09/1988	09/1992	06/1993	09/1988
Iraty	01/1990	01/1990	01/1990	03/1998			01/2000
La Crouzille	01/1978	01/1978	01/1978				
La Hague	01/1978	01/1978	01/1978				
Montandon	03/1998	03/1998	03/1998	04/1998			09/1998
Morvan	01/1990	01/1990	01/1990	01/1998			11/1998
Peyrusse-Vieille	01/1995	01/1995	01/1995	01/1995	07/1999	04/2000	02/1999
Revin	01/1990	01/1990	01/1990	01/1990			03/1999
Remote national stations							
Le Casset	01/1990	01/1990	01/1990	01/1997			09/1998
La Tardière	07/2001	07/2001	07/2001	07/2001	07/2001	06/2002	07/2001

(1) pH, conductivity, Cl^-, NO_3^-, SO_4^{2-}, Na^+, Ca^{2+}, K^+, NH_4^+, Mg^{2+}
(2) pressure, temperature, Humidity, precipitation amount, wind, solar radiation
(3) Stopped in 1998

Behaviour and trends of measured pollutants (precipitation, SO_2, S_{part}, VOC):

Sulphur compounds in air and aerosol

SO_2 in air

The concentrations of sulphur dioxide have significantly declined during the nineties, reflecting the decreasing of SO_2 emissions in France and in Europe. This significant trend is very similar for all French EMEP stations and more particularly for the two oldest stations La Hague and La Crouzille started in 1978.

The annual mean concentrations were between 2.5 – 8 $\mu g.m^{-3}$ in the eighties and dropped to 0.2 – 1 $\mu g.m^{-3}$ in the nineties. With the same sampling method it must be noted that the number of values below the analytical detection limit is increasing at most of the French sites. The maximum monthly mean concentrations were generally recorded in winter but some maximum values have been observed in spring or in summer.

The highest concentrations were observed in the Northeast of France. A study showed that these maxima occurred with air mass trajectories coming from central Europe for the eastern stations and South Europe for the southern stations.

Sulphate in aerosol

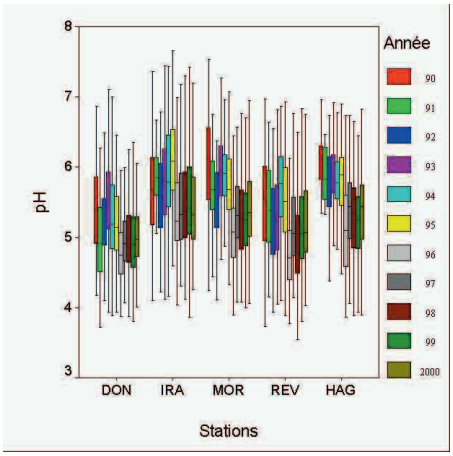
The concentrations of sulphate in aerosols declined in the nineties but not as significantly as that of SO_2. The annual mean concentration amounted to 1 – 1,2 $\mu g.m^{-3}$ at the beginning of nineties and to 0,4 – 0,6 $\mu g.m^{-3}$ at the end. The annual variations were not prominent.

The decrease in emissions of sulphur in Western Europe from 1980 onwards has resulted in much larger decreases in observed concentrations of SO_2 in ambient air compared to the decrease in ambient SO_4 aerosol concentrations. This result confirms the non-linearity between these two sulphur compounds identified by several authors.

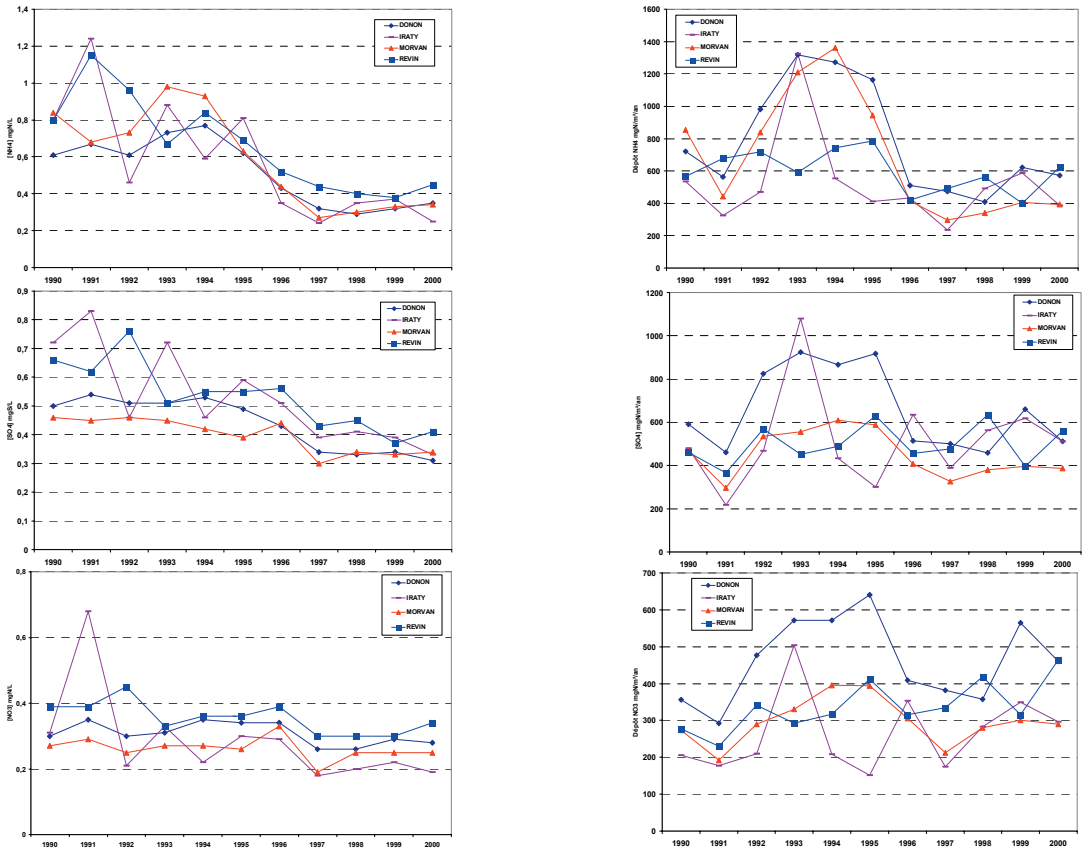
Precipitation

The annual amount of precipitation in France ranges between 600 and 2300 mm, the maximum heights are regularly recorded in the Northeast of France but the amounts and intensity of precipitation time and spatial variations play an important role.

The average pH for the nineties (see below) stood at 5.0 and the annual averages fluctuated between 4.7 and 5.5 according to the stations. The last five years of nineties were more acidic particularly in 1996 and 1998. The H^+ deposition was about 10 mg/m²/yr and fluctuated between 5 and 25 mg/m²/yr. Higher concentrations and deposition tended to occur in the East and the North of France. A slight increase of H^+ deposition (calculated for 100 mm rainwater) has been observed for the last five years of nineties and more particularly for the Northeast sites.



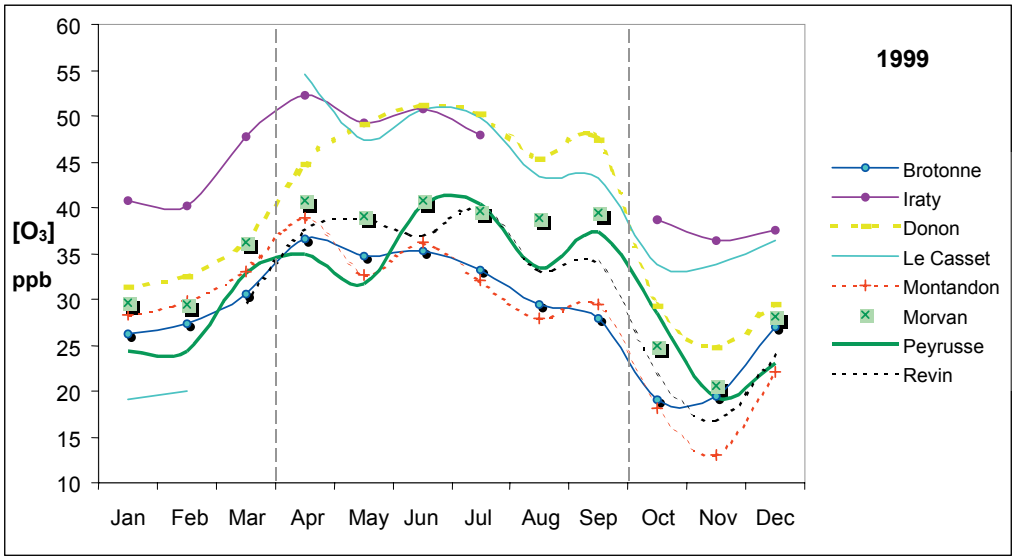
In rainwater, the nitrate concentrations did not vary strongly according the years, about 0.2-0.3 mgN/L. Nevertheless, a weak decrease was noted. Maximum concentrations and deposition (10 to 400 mgN/m²/year) were clearly situated in the North of France. The variations of ammonium concentrations were more pronounced, between 0.3 (at the present time) and 0.7 mgN/L (in the early nineties). The centre part of the North of France was also more exposed and deposition varied between 150 to 600 mgN/m²/year. About sulphates in precipitation, the concentrations have decreased slowly since the beginning of nineties (0.6 to 0.4 mgS/L). These concentrations have been very stable for 4-5 years like the emissions. As indicators of a marine influence, the sodium and chloride concentrations and deposition are higher near the sea. They were extremely variable depending on the site and the year. The indicators of terrestrial dust, calcium, magnesium and potassium did not vary according to longitude and latitude. No clear trend was shown either for annual concentrations or deposition. Nevertheless, a larger frequency of Saharan events that lead to calcium depositions was observed.



Concentration and deposition in four French sites since 1990 for NH_4, SO_4 and NO_3

Surface ozone

Most of EMEP rural stations have been equipped in 1998. The ozone concentrations did not show any trend, but the ozone measurements at Donon and Revin, located in the eastern of France and started in 1995, could give a good idea of temporal variation.



O_3 monthly mean concentration in 1999

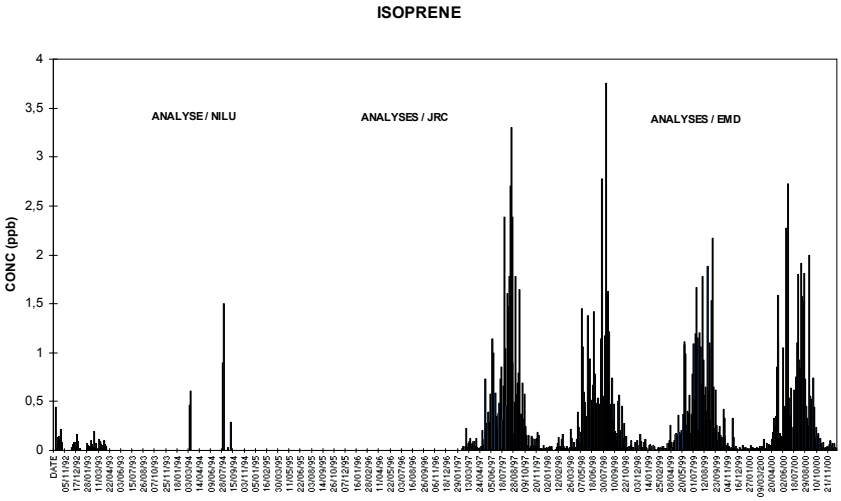
The annual mean concentrations were between 25 and 45 ppb. No concentration gradients were clearly identified from North to South. The highest values were observed in the mountainous sites (Iraty, Le Casset). Pollution roses established for all sites could not define any major direction of pollution episodes in France, as the typologies of the sites are all different and characteristic of meteorological influences. In most cases the daily maximum values (between 90 and 100 ppb) were observed in the sites situated in flat areas and during the summer period (June to August). The diurnal course of surface ozone levels were characterised by a minimum early in the morning and a maximum around 2 p.m. Some maximum values were observed during the night at the high altitude sites. This diurnal course is a function of site altitude.

The exceedances of the ambient air quality standard (55 ppb, 8 hours average) were rather frequent but the level requiring information to the public (90 ppb, one-hour average) has been exceeded only occasionally. No significant trends were observed at the French rural sites from the beginning of measurements. Inter-annual variability of ozone concentrations is assigned to the annual variation of photochemical activity.

Volatile organic and carbonyl compounds

VOCs started to be sampled in 1992 and the carbonyls in 1993 at Donon. The analyses were under the responsibility of NILU until 1996. Since 1997, the laboratory of the Ecole des Mines De Douai has carried out the analyses.
A new station in the southern part of France was started in 1997 and a third in 2001 in the western part of the country. The concentrations were higher in the Mediterranean site by one order of magnitude varying from tenths of ppb up to several ppb. Among the VOCs measured the average volumetric composition is the following: alkanes 55%, alkenes 12%, aromatics 13%, alkynes 5%, isoprene 12%. Monthly mean of concentrations were higher in winter for

all components except isoprene (see below), for which the maximum of concentrations are observed in summer. The average concentration, based on monthly median, was about 18 ppbC (13 ppbC in summer and 22 ppbC in winter).
The average volumetric composition of carbonyl compounds was the following: acetone 40%, formaldehyde 19%, acetaldehyde 14% and ethylmethylketone 14%. The average concentration was about 5 ppbC (2.5 ppbC in winter and 8 ppbC in summer).



1b/ Emissions in France: trends by pollutant:

SO_2 emissions

SO_2 emissions, 610 kt in 2001, fell by 54% between 1990 and 2001 (compared to -81% between 1980 and 2001). The reduction observed during the 1980s was due to a fall in fossil fuel use for energy production following implementation of the French nuclear energy programme and, to a lesser extent, energy conservation measures. More recently, this reduction has been the result of legislation being implemented with the aim of reducing the sulphur content of certain fossil fuels (heavy fuel oil, domestic heating fuel, diesel oil) combined with a switch from sulphur-intensive fuels to fuels with a low sulphur content or sulphur-free fuels, such as natural gas.

NOx emissions

NOx emissions, 1411 kt en 2001, fell by 26% between 1990 and 2001 (compared to -30% between 1980 and 2001), as a result of (i) catalytic converters being fitted to vehicles following the implementation of new vehicle standards, and (ii) developments in energy structure (implementation of the French nuclear energy programme) which occurred in other sectors for reasons similar to those explained in the above section dealing with SO_2.

NH_3 emissions

NH_3 emissions, 779 kt in 2001, have barely changed since 1980. However, emissions observed in recent years are situated in the upper range of values recorded over the last 20 years. Farming activities (livestock waste and fertiliser use) are the main sources of emission (95%).

NMVOC emissions

NMVOC emissions, amounting to 1674 kt in 2001, fell by 38% between 1988 and 2001. This downward trend is a result of (i) a 62% reduction in emissions from the transport sector between 1988 and 2001 due to vehicles being fitted with catalytic converters and to a gradual increase in diesel-engine cars on the road (which are low in VOC emissions), and (ii) a fall of nearly 14% in emissions from solvent use.

Heavy metals

Concerning those heavy metals covered by the 1998 Aarhus Protocol (Pb, Hg and Cd), there has been a fall in emissions since 1990. The trends recorded between 1990 and 2001 are as follows:

- ✓ -96% for **lead** as a result of the ban on the distribution of leaded petrol as of 2000 and, to a lesser extent in absolute terms, progress made in industrial processes.
- ✓ -49% for **mercury** as a result of a restriction on its use in various products and progress made in waste treatment processes (incineration).
- ✓ -34% for **cadmium** as a result of structural changes in energy consumption.

Persistent organic pollutants (POPs)

Concerning those persistent organic pollutants covered by the 1998 Aarhus Protocol (dioxins and furans, PAHs and HCBs), the trends recorded between 1990 and 2001 are as follows:

- ✓ -75% for **dioxins and furans**. This downward trend is due to efforts made mainly in three sectors: waste incineration, energy processes in industry and combustion in manufacturing industries.
- ✓ -14% for **HAPs** as a result of a significant fall in wood consumption in the residential sector due to structural effects of the equipment used.
- ✓ +7% for **HCBs**. This upward trend is a result of an increase in production by metallurgy industries over the last 10 years.

2°/ Trends analysis:

2a/ Influence of emissions reductions in the EMEP area on air quality in France

As shown in the previous section, the main trends for concentrations and deposition of acidifying and eutrophying compounds can be summarised as follow:

- ✓ A significant and regular decrease of sulphur compounds more pronounced for atmospheric data than for precipitation; however this trend has slowed down during the last years,
- ✓ This decrease is much less pronounced for nitrogen compounds. More precisely, fluctuations of nitrate concentrations and deposition, without a real decreasing trend are registered for the last 10 years. The situation is quite different for ammonium concentrations, which have diminished regularly during the last decade.

Such behaviours can be analysed looking at two main factors:

- ✓ The national regulations to reduce emissions of atmospheric pollutants,
- ✓ The import/export budget of atmospheric pollutants exchanges between France and other countries.

To point out these links, several results have been considered:

- ✓ French studies[1] based on source/receptor analysis
- ✓ Sector analysis allowed by backward trajectories running[2]
- ✓ Model results analysis.

Generally speaking, the simulations made with the EMEP lagrangian and eulerian models show that for the last twenty years:

1) More than 30% of SOx deposition come from national sulfur emissions,
2) About 30% of NOx deposition are explained by national emissions of nitrogen,
3) About 80% of reduced nitrogen is issued from national ammonia emissions.

To complete this analysis, acid rain events registered at six French stations scattered all over the country have been considered. Three of them (Morvan, Le Casset and Donon) have been precisely studied by the Ecole des Mines de Douai with a receptor-oriented model, applied to five years of meteorological data. The others have simply been analysed with sector analysis tools applied to the last decade.

- ✓ The results of this study for a station located in the middle of France (Morvan) determine five classes of backward trajectories associated with the precipitation: the fluxes from SW and WSW sectors contribute for 51,5% of events, the fluxes of NW and E contribute for 30,5 % of events but are the main responsible of high concentrations in sulphates, nitrate, ammonium and hydronium. Regions found to be responsible for rain events coincide with European regions known for their high anthropogenic emissions of SO_2 and NOx (Great Britain, Northern France, Belgium, The Netherlands and North Sea).
- ✓ The results for Iraty (Southwest of France) determines five classes of backward trajectories associated with the precipitation collected in this station: the fluxes from W sectors (NNW, NW, W and WSW) contribute for 71,3% of events, the flux of S (low wind) contributes for 28,7 % of events but is the main responsible of high concentrations in sulphate, nitrate, ammonium and calcium. The high concentrations of hydronium are identified from NNW sector.
- ✓ The results for Le Casset (Eastern mountainous region, not included in EMEP stations) determines four classes of backward trajectories associated with the precipitation collected in this station: the fluxes from W and WSW sectors contribute for 34,7% of events, the flux of SSW contributes for 43,3 % and the flux of SE for 22% of events. This last sector is the main responsible for high concentrations in sulphate, nitrate, ammonium and calcium. The concentrations measured in this station are nevertheless low. Regions found to be responsible for rain events coincide with southern and eastern areas known for their high anthropogenic emissions of SO_2 and NOx (North Africa, northern Italy and Yugoslavia).
- ✓ A station located in the west part of France and near the sea (La Hague) has revealed that the events are mainly associated with west sector fluxes, but the higher concentrations of sulphur compounds are explained by NEE fluxes. No sector appears clearly responsible for high concentrations of nitrate and ammonium.
- ✓ In the Northeast of France (Revin) the fluxes come mainly from west sectors (45.5%) and N-NE sectors (20%). Highest concentrations of sulphate, nitrate and ammonium clearly come from East sectors.
- ✓ For an eastern station (Donon) it should be noted that 56% of acid rains events are related to west fluxes while less than 10% are explained by east sectors fluxes. Once again, the highest concentrations of sulphate, nitrate and ammonium are associated with east sectors.

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[1] *Programme MERA : Etudes des relations sources/recepteurs influençant les retombées atmosphériques des stations du réseau MERA* ; A. Charron, P. Coddeville, H. Plaisance, rapport ADEME 9962063, oct 2000

[2] *Caractérisation des retombées atmosphériques acides en zones rurales :étude des realations sources/recepteurs et des moyens de mesure adaptés* ; rapport de thèse A. Charron

All these results show that the southern stations are not influenced by the same sources as the stations situated in the centre part of North. More precisely, these sites are less influenced by the high emissions of Central or North-western Europe. Only pH values seem under the influence of SO_2 and NO_x emissions from one of these areas. The Southern stations are very influenced by anthropogenic emissions and crustal sources around the Mediterranean Basin and North Africa. The relation between sulphate, nitrate and ammonium has been identified at several stations. This observation suggests that NH_4HSO_4, $(NH_4)_2SO_4$ and NH_4NO_3 are transported as aerosols.

The average source/receptor matrices computed by the EMEP models confirm these conclusions. SO_x and NO_x deposition in the northern part of France are largely influenced by emissions from Belgium, Germany and United Kingdom. In the southern part of the country, the pollutant levels are explained by emissions from Spain and Italy. The little part of imported reduced nitrogen could be assigned to ammonia emissions from Spain, Netherlands, Germany, Italy and UK.

As a consequence, it should be noted that:

- ✓ The relative stagnation of reduced nitrogen concentrations can be explained by the stagnation of national ammonia emissions,
- ✓ The sharp decrease of SO_x concentrations and deposition can be interpreted as a consequence of the general reduction of sulphur emissions in Europe,
- ✓ More questions arise for NO_x data. The decrease of the oxides of nitrogen levels is not so important compared to the emission reductions applied. National emissions have diminished particularly during the last decade, after a small increase at the beginning of the nineties. This scheme is exactly the same as in Italy. The neighbouring countries where NO_x emissions have increased or remain quite constant are Spain and Belgium. Elsewhere (Germany, UK, Netherlands) emissions have decreased.

2b/ Influence of French emissions reductions on air quality in the EMEP area

Similarly it could be very interesting to analyse the possible impact of emission reductions applied in France, to air pollutant concentration and deposition in the other countries of the EMEP area.
Considering the import/export budgets calculated by the MSC-W tools for the years 1996 and 1998, it should be confirmed that:

- 60 to 75 % of sulphate emitted in France are exported to the EMEP area,
- 65 to 80 % of nitrate are exported in oxidised form to the EMEP area,
- about 35% of reduced nitrogen is exported to the EMEP area.

The countries mainly concerned by this kind of pollution are neighbouring zones in the north (UK, Germany, Belgium), and in the Mediterranean region (Italy, Spain). All countries show a strong decrease of sulphate concentrations in air and precipitation pointing to the benefits of European and national regulations (the same as in France). Trends are not so clear for oxidised and reduced nitrogen. NO_x and NH_x concentrations in the above countries did not decrease since the beginning of the nineties. Although France is an obvious contributor, French NO_x emissions have been reduced by 25% during this period.

This short analysis associated to the one proposed in the previous chapter emphasises the questions arising with the disappointing results relative to nitrogen compounds in the environment. Gaseous chemistry, secondary aerosols formation and meteorology might be put forward obviously. Nevertheless it seems reasonable to consider potential other contributors who might be grouped in “boundary conditions”: marine inputs, transatlantic or

Asian pollution for instance. On this point of view it might be interesting to complete EMEP analysis with hemispheric considerations in a more systematic way.

2c/ Impact of measures on emission reduction

Different measures have been adopted and implemented at EU level to limit emissions of:

- ✓ **SO_2** (restricting the sulphur content of fuels, limiting emissions from large combustion plants,…),
- ✓ **NOx** (Auto-oil Programme, limiting emissions from large combustion plants,…),
- ✓ **NMVOCs** (Auto-oil Programme, restricting emissions from the storage and distribution of petrol and from solvent use,…),
- ✓ **Pb** (ban on the use of lead as an anti-detonating agent in petrol),
- ✓ **Dioxins and furans** (restricting emissions from incinerator plants).

French energy policy has also contributed to a fall in acid deposition. Implementation of the French nuclear energy programme in the 1970s and 1980s, combined with energy conservation measures, led to a fall in the consumption of fossil fuels for energy production. Further measures include those implemented by operators of industrial facilities, such as fuel switching (a reduction in the use of sulphur-containing fuels in favour of natural gas) and improved energy efficiency of plants.

This action has been supplemented by measures under national legislation such as the 1996 Clean Air and Rational Use of Energy Act and its implementing Decrees and Orders, including adoption and implementation of Air Protection Plans (PPA), Urban Transport Plans (PDU) and sector-specific Orders under legislation on Plants Classified for Environmental Protection Purposes (ICPE).

3°/ Environmental situation in France:

France participates to most of the International Cooperative Programmes (ICPs) managed by the Working Group on Effects (WGE). French research related to the estimation of critical loads is briefly described below.

National maps of nitrogen and acidic critical loads are available at a more accurate scale (1/1 000 000ème) than the EMEP grids used in Europe.

Acidity data are measured in France in some restricted geographic areas (Vosges, Ardennes, Massif Central). Thanks to the support from the Agency for the environment and energy Management (ADEME) and from the Ministry of environment, a critical load database has been elaborated from water and soil samplings issued from several years of field measurements. It is managed by the Laboratoire des Mécanismes de Transfert en Géologie (CNRS[3]/Université Paul Sabatier, Toulouse). Acidic critical loads maps have been established showing levels greater than 2 keq ha^{-1} an^{-1} on 60 % of the country area and lesser than 0.5 keq ha^{-1} an^{-1} on less than 10 % of the area. Comparing these results with deposition data has pointed out the fact that risk of critical load exceedances mainly concerns three sensible forest species (Scots pine, Norway Spruce, pedunculate oak) particularly in the Landes, the Vosges and the Ardennes regions. Total deposition maps modelled or measured show that risk of exceedance mainly exists at specific local situations and that acidic deposition is generally acceptable. However, atmospheric acidification must not be underestimated, particularly in the North of France.

[3] Centre National de Recherche Scientifique

Maps of nutrient nitrogen critical loads have been established in France in 2000 for forest and meadow ecosystems (0.2-0.5 keq N ha^{-1} yr^{-1} for 20% of the country and 0.5-2 keq N ha^{-1} yr^{-1} elsewhere). Potential exceedances are estimated everywhere in France, but more particularly in the Northeast, in the Ardennes and in the Vosges regions.

Concerning ozone, measurements issued from 80 sites have been used to compute maps which show clearly a strong exceedance of the critical load of 10 000 ppb.h. The areas most concerned are the Ile-de-France, the Southeast and Northeast regions. Other observations are devoted to identify indicators specific to ozone impact on forests and natural vegetation (In the Alpes-maritimes for instance).

The present state of the art does not allow mapping national heavy metal critical loads. The only maps available for heavy metal deposition originated from moss bio-monitoring network[4]. These data collected since 1996 have been integrated in the database managed by ADEME.

Finally, a first exposure map for materials was elaborated in 2001 for the Portland limestone in Ile de France.

4°/ further actions in the EMEP framework :

4a/ EMEP/MERA French monitoring network evolution

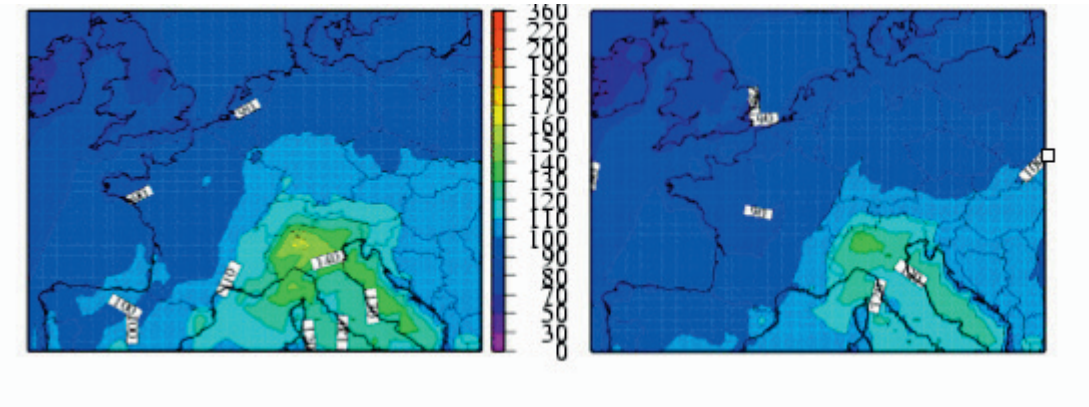
The EMEP/MERA network needs further developments to keep sampling and analysing equipment in accordance with the state of the art and with EMEP recommendations. For coming years, different developments are investigated. First, the current network will be improved, on the one hand by considering new locations for La Crouzille and La Hague stations to get better information satisfying EMEP criteria, and on the other hand by setting up a new station in the Mediterranean part of the country to record Mediterranean fluxes influence. In addition, the list of measured pollutants will be extended to heavy metals, PM10, POPs and nitrogen compounds.

4b/ Forecasting the 2010 horizon with the CHIMERE model

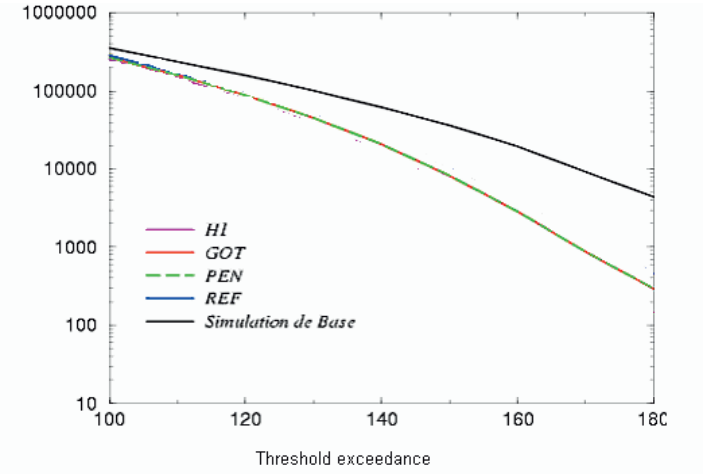
In France one of the main problems from the air quality point of view is related to secondary photochemical pollutants, and more precisely to ozone. In this framework it is interesting to evaluate the impact of NO_x and VOC 2010 emission regulations on ozone ground level. Several scenarios have been studied using the CHIMERE French continental model (CNRS/IPSL).

As an example, some simulations are presented below for the 2001 summer. The reference scenario is based on the 1998 emissions, while the GOT scenario assumes that the Gothenburg Protocol recommendations have been implemented. The results have been assessed for 220 European rural or peri-urban stations. Two indicators are plotted: maps of mean daily ozone concentrations and the number of exceedances as a function of the threshold.

[4] *Retombées atmosphériques de métaux en France : estimation par dosage dans des mousses – Campagne 1996* ; Galsomiès L, Savanne D, Letrouit M-A, Ayrault S, Charré B., ADEME Editions, France, 1999



Mean ozone concentrations for summer 2001;
base case (1998 emissions) on the left and Gotheburg protocole emissions on the right



Number of exceedances as a function of the threshold
for reference case and Gotheburg scenario

Air quality improvement obtained with the GOT scenario is obvious. Moreover it can be seen that the highest the thresholds, the greater the ozone concentrations decrease. This suggests that emissions regulations would influence peak ozone concentrations more than background concentrations. These results have to be refined considering other pollutants (NO_2 for example) and regional studies (City Delta project within the framework of CAFE[5] for example).

4c/ Recommendations for EMEP

Improving methodologies to estimate emissions

The new format of "emission reporting" (NFR) will enable modellers to have more harmonised information at their disposal within the UNECE. However, aggregating activities in accordance with this new format is much less transparent than the previous reporting system was, and raises problems in terms of public information. Furthermore, it is necessary to bear in mind the need to improve emissions data for certain sectors (agriculture, biotic emissions,…) or certain pollutants (particles, heavy metals, POPs, NH_3...) for which there are considerable uncertainties.

[5] CAFE : Clean Air For Europe

Taking these uncertainties into account
A system needs to be established enabling uncertainties, in terms of emissions and modelling, to be assessed. These uncertainties should be linked to modelling results so that they may be taken into account in policy-making.

Improving the monitoring strategy
Review or up-dating of criteria to define measurement sites should be proposed to take into account new pollutants specificities (POPs, heavy metals, ozone…).

Moreover an analysis resulting in concrete proposals could be develop around the site representativeness question in the EMEP framework. Some sites could be influenced by local pollution (eventually weak) which could induce bias for model comparison. Moreover this local aspect can only concern one kind of effect (acidification or photochemical pollutant for example). So it could be useful to define an indicator related to the site representativity as a function of the pollutant, to bring better determination of the measurements.
Finally, methods and equipment intercomparisons should be more regular and spread to each pollutant.

Improving model evaluation
Considering the importance of model results in the determination of efficient pollution control strategy, efforts must be kept for model evaluation. Comparing model results with field data is one step of evaluation (which can help to define monitoring strategy) but model intercomparison is another way which might be promoted to obtain such analysis. Transparency is necessary in this framework. For example source codes of numerical tools should be accessible to every parties.

5/ Conclusion

Monitoring activities, like modelling activities, undertaken under the EMEP Programme, meet the need to assess the impact of air pollution, as a prerequisite for developing and assessing policies. In pursuing these activities, it must be possible to monitor the impact of measures recently adopted or planned under the most recent UNECE protocols.

As a result of this work, it should also be possible to highlight environmental problems that could not be addressed by these measures. The impact of air pollution on human health, the persistence of pollution in emission-intensive areas (industry, road traffic, domestic heating) and trends in traffic-induced emissions (road and off-road) should be the focus of particular attention.

Policies to be considered for reducing these emissions should take into account the context of the European Union and its enlargement. This has an impact on the nature of emission abatement measures that each Member State may adopt. It appears that certain measures, the relevance of which has been established, can only be decided within a supranational framework. In this way, the EU directives adopted under the Auto-Oil Programme are proving an effective mean of reducing emissions from road traffic.

Today, it can be considered that setting emission ceilings for each Party fulfils a useful role in terms of objectives, as part of a global approach but that this objective cannot be deemed binding and that emission reductions must be envisaged according to a sectorial approach.