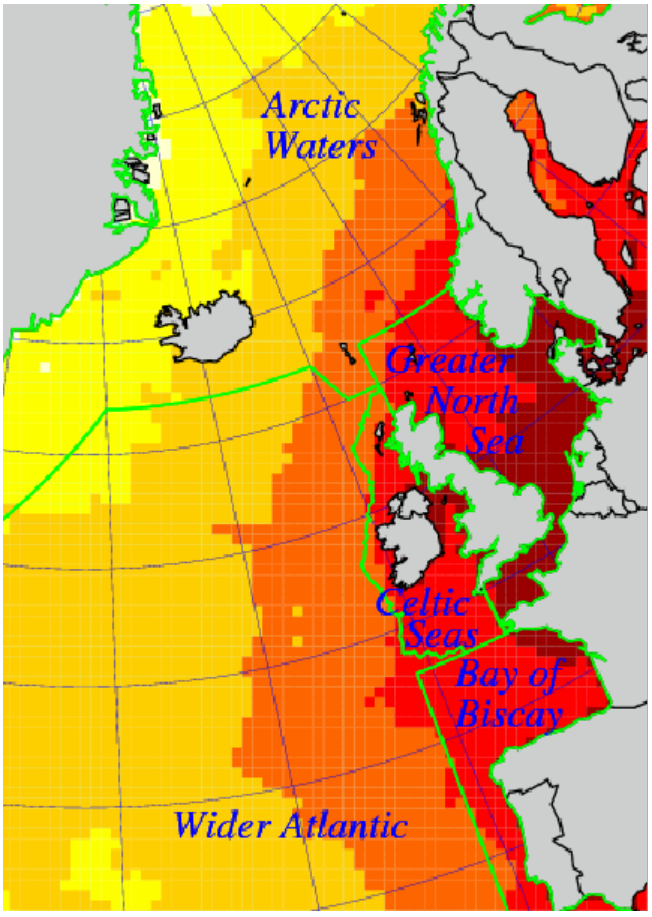
OSPAR COMMISSION

Trends in atmospheric concentrations and deposition of nitrogen and selected hazardous substances to the OSPAR maritime area



Monitoring and Assessment Series

2009

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l'Espagne.

Front page picture: EMEP map of modelled total annual nitrogen deposition to the OSPAR maritime area in 2006.

Acknowledgement

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Model based deposition calculations and data products have been prepared at the request of the OSPAR Commission by the Meteorological Synthesizing Centre East (heavy metals and POPs) and Meteorological Synthesizing Centre West (nitrogen) of the Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP):

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EMEP retains all rights on the data measured under the EMEP Programme and modelled for this report, and related data products (tables and figures). This work has been supported and financed by the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention).

Contents

Executive summary

Model calculations largely suggest that atmospheric deposition of selected heavy metals and organic contaminants (lindane and polychlorinated biphenyls) and of nitrogen substantially declined in the period 1990 – 2006 in the OSPAR maritime area. For the heavy metals cadmium, lead and mercury, most of the reductions in measured concentrations in precipitation and air and in modelled deposition were achieved in the 1990s. However, the rate of reduction has slowed since 1998. Model calculations suggest that atmospheric deposition of nitrogen has decreased in the Greater North Sea over the period 1995 – 2006 but stagnated or increased in the other OSPAR Regions. This is broadly supported by measurements of nitrogen in precipitation and air.

Reductions in deposition of cadmium, lead and mercury have stagnated in recent years with combustion in power plants, industry and industrial processes the key contributing sector

Atmospheric emissions based on national inventories have overall decreased in 1990 – 2006 for cadmium, lead and mercury, but much of the reductions have been achieved in the 1990s and overall emissions to air have been at relatively constant levels since 2000. More than 1000 tonnes of lead and around 40 tonnes each of cadmium and mercury were released by OSPAR countries to the atmosphere in 2006. Emission sources from Poland and Russia, with emissions in 2006 of around 900 tonnes for lead, 100 tonnes for cadmium and 35 tonnes for mercury, were also taken into account in model calculations. Long-range transport of emissions from sources in other parts of the world also contribute to the total deposition of the heavy metals in the OSPAR area. The hemispheric emissions of mercury for example are dominated by contributions from emission sources in Asia.

Emission based model calculations suggest that atmospheric deposition of all three metals has decreased over the period 1990 – 2006, but reductions have slowed since 1998 and stagnated in recent years. This is broadly confirmed by measurements of the three metals in air and precipitation. While slightly increasing measurements of mercury in air at selected stations in the OSPAR area may be influenced by meteorological factors, the increase is sufficient reason to keep a close eye on these measurements in the future.

Depositions of lead and cadmium show a clear gradient over the regions, with the highest deposition close to the coasts and largely decreasing towards the open sea. Depositions for mercury show an opposite pattern with highest deposition in the open sea as would be expected, given the large hemispheric background of mercury and the large re-emissions of mercury from the sea itself.

Model calculations suggest that combustion sources are the key contributors to heavy metal deposition to the OSPAR area; they contributing 70% – 90% to the total deposition of heavy metals in the five OSPAR Regions in 2005. Despite significant reductions achieved in lead emissions from road traffic, transport still contributes substantially to atmospheric deposition of lead in the Arctic Waters (Region I) (20%), Greater North Sea (Region II) (17%) and the Celtic Seas (Region III) (12%) and around 8% in the Bay of Biscay/Iberian coast (Region IV) and the Wider Atlantic (Region V). Waste is the second largest source contributing to deposition of mercury to the OSPAR area, with contributions ranging between 11% and 17% in the five OSPAR Regions.

Bearing in mind that not all sources of inputs to the sea are taken into account, a comparison of modelled atmospheric deposition with riverine inputs and direct discharges indicates that atmospheric inputs are the dominant pathway for heavy metals to Regions I, IV and V. In Regions II and III both pathways are equally important.

Atmospheric deposition of PCB-153 and lindane have continuously decreased in 1990 – 2006

Atmospheric deposition of persistent organic pollutants (POPs) is a global issue. Long-range transport of emissions from sources outside the OSPAR area contribute to atmospheric inputs to the North-East Atlantic.

Polychlorinated biphenyls have been banned in Europe since the 1980s and lindane was phased out in OSPAR countries by 2000. However, emissions still occur, for example lindane from stockpiles and imported products, and PCBs from wastes and as a by-product of combustion.

Emissions of PCB-153 and lindane have been significantly and continuously decreasing in the period 1990 – 2006. With the phase out of lindane, emission inventories have been discontinued in most countries and few data are available for 2001 – 2006. Taking account of high uncertainties in model calculations introduced through re-emissions of POPs from the sea and the incomplete data for lindane, models suggest that net atmospheric deposition significantly decreased in 1998 – 2006 for PCB-153 between 60% and 70% and for lindane between 70% and 85% in the five OSPAR Regions. Estimates based on CAMP observations confirm a sharp decline in lindane depositions in the late 1990s which continues more gently today; atmospheric deposition of lindane is still above background levels in the North Sea and deposition continues across the OSPAR area.

Agriculture, combustion and transport are the main contributors to atmospheric deposition of nitrogen to the OSPAR area, with contributions from international shipping increasing

While atmospheric emissions based on national inventories of OSPAR countries have overall decreased from land based sources since 1998 by roughly 20% for oxidised nitrogen and 10% for reduced nitrogen (mainly from agriculture) to around 2300 kt N each in 2006, emissions from shipping have increased by 21% in that period to 1830 kt NO_x (equivalent to 560 kt N) in 2006. Emissions from Italy, Poland and Russia, amounting to almost 2000 kt N in 2006, also contributed to atmospheric inputs of nitrogen to the OSPAR area and were taken into account in model calculations.

Emission based model calculations suggest that the OSPAR area has received more than 1500 kt N of airborne nitrogen inputs in 2006. Atmospheric deposition of total nitrogen on the Greater North Sea (Region II) has decreased over the period 1995 – 2006 but stagnated or increased in the other OSPAR Regions. Depositions show a clear gradient over the regions, with the highest deposition close to the coasts and largely decreasing towards the open sea.

The CAMP measurements of the concentrations of nitrogen components in precipitation and air roughly show the same overall trends but with statistically significant increases in ammonium and nitrate concentrations in air in Regions I and II and in nitrate in precipitation in Regions II and IV. Modelled depositions for Region II are contrasted by measurement based estimates of deposition of nitrogen suggesting that reductions have stagnated in recent years or deposition even slightly increased.

Model based calculations suggest that agriculture, combustion and transport (including shipping) each contribute 25% – 30% to the deposition of total nitrogen in Regions I and V. Agriculture is the main contributor (40%) to atmospheric deposition of total nitrogen in Regions II, III and IV; combustion and transport each contribute 20% – 25% in these Regions.

Bearing in mind that not all sources of inputs to the sea are taken into account, a comparison of modelled atmospheric deposition with riverine inputs and direct discharges indicates that atmospheric inputs are the dominant pathway for nitrogen to Regions I, IV and V. In Regions II and III riverine inputs and direct discharges are the dominant pathway for nitrogen to the sea.

Récapitulatif

Les calculs des modèles suggèrent dans l'ensemble que les retombées atmosphériques de métaux lourds sélectionnés et de contaminants organiques (lindane et biphényls polychlorés) et d'azote ont diminué substantiellement entre 1990 et 2006 dans la zone maritime OSPAR. Dans le cas des métaux lourds cadmium, plomb et mercure, la plupart des réductions relevées dans les teneurs analysées dans les précipitations et l'air et les retombées modélisées ont été obtenues dans les années 1990. Le taux de réduction a cependant diminué depuis 1998. Les calculs des modèles suggèrent que les retombées atmosphériques d'azote ont diminué dans la mer du Nord au sens large entre 1995 et 2006 mais se sont maintenues ou ont augmenté dans les autres régions OSPAR. Les mesures des teneurs d'azote dans l'air et les précipitations confirment en général la tendance d'ensemble de toutes les régions OSPAR dans le cadre du Programme exhaustif de surveillance de l'atmosphère (CAMP). Ceci est, en général, confirmé par les teneurs de l'azote analysées dans les précipitations et l'air.

Les réductions des retombées de cadmium, de plomb et de mercure ont stagné au cours de ces dernières années, la combustion dans les centrales électriques, l'industrie et les processus industriels représentant les principaux contributeurs

Selon les inventaires nationaux, les émissions atmosphériques de cadmium, de plomb et de mercure ont baissé dans l'ensemble, entre 1990 et 2006, mais la plupart des réductions ont été obtenues dans les années 1990 et dans l'ensemble les émissions atmosphériques se sont maintenues à un niveau relativement constant depuis 2000. Les apports atmosphériques des pays OSPAR en 2006 s'élèvent à plus de 1000 tonnes de plomb et à environ 40 tonnes de cadmium et de mercure. Les calculs des modèles ont également tenu compte des sources d'émission situées en Pologne et en Russie, leurs émissions s'élevant en 2006 à 900 tonnes de plomb, 100 tonnes de cadmium et 35 tonnes de mercure. Le transport à longue distance des émissions provenant de sources situées dans d'autres pays contribue également aux retombées totales de métaux lourds dans la zone OSPAR. Les émissions hémisphériques de mercure par exemple sont dominées par les contributions provenant de sources situées en Asie.

Les calculs des modèles se fondant sur les émissions suggèrent que les retombées atmosphériques de ces trois métaux ont diminué entre 1990 et 2006 mais les réductions ont ralenti depuis 1998 et stagné ces dernières années. Ceci est confirmé dans l'ensemble par les mesures des trois métaux dans l'air et les précipitations. Tandis qu'une légère augmentation des émissions atmosphériques de mercure relevées dans des stations sélectionnées de la zone OSPAR pourrait être influencée par des facteurs météorologiques, cette augmentation justifie un examen soutenu de ces mesures à l'avenir.

Les retombées de plomb et de cadmium suivent un gradient net selon les régions, les plus élevées se situant à proximité du littoral et les plus faibles en pleine mer. Les retombées de mercure suivent une tendance inverse, les plus élevées se situant en pleine mer comme on pourrait s'y attendre étant donné le contexte hémisphérique important du mercure et ses réémissions importantes provenant de la mer elle-même.

Les calculs des modèles suggèrent que les sources de combustion sont les principaux contributeurs aux retombées de métaux lourds dans la zone OSPAR; elles ont contribué de 70 à 90% aux retombées totales de métaux lourds dans les cinq régions OSPAR en 2005. La contribution du transport aux retombées atmosphériques de plomb dans les eaux arctiques (Région I) (20%), la mer du Nord au large (Région II) (17%), les mers celtiques (Région III) (12%) et le Golf de Gascogne/côte ibérique (Région IV) et l'Atlantique au large (Région V) (environ 8%) est encore substantielle bien que les émissions de plomb provenant de la circulation routière aient diminué de manière significative. Les

déchets représentent la deuxième source contribuant aux retombées de mercure dans la zone OSPAR, leur contribution se situant entre 11 et 17% dans les cinq régions OSPAR.

Une comparaison des retombées atmosphériques modélisées et des apports fluviaux et rejets directs indique que les apports atmosphériques représentent les principales voies de pénétration des métaux lourds dans les Régions I, IV et V, tout en se souvenant que l'on ne tient pas compte de toutes les sources d'apport à la mer. Dans les Régions II et III ces deux voies de pénétration ont la même importance.

Les retombées atmosphériques de PCB-153 et de lindane ont constamment diminué entre 1990 et 2006

Les retombées atmosphériques de polluants organiques persistants (POP) représentent un problème mondial. Le transport à longue distance des émissions provenant de sources situées en dehors de la zone OSPAR contribue aux apports atmosphériques dans l'Atlantique du Nord-est.

Les biphényls polychlorés sont interdits en Europe depuis les années 1980 et les pays OSPAR ont progressivement supprimé le lindane jusqu'en 2000. Cependant des émissions se produisent encore, il s'agit par exemple de lindane provenant de réserves et de produits importés et de PCB provenant de déchets et dérivé de la combustion.

Les émissions de PCB-153 et de lindane ont diminué continuellement et de manière significative entre 1990 et 2006. Les inventaires des émissions ont été suspendus dans la plupart des pays, lorsque le lindane a été supprimé et très peu de données sont disponibles de 2001 à 2006. En tenant compte des incertitudes importantes que présentent les calculs des modèles dues aux réémissions de POP provenant de la mer et des données incomplètes sur les émissions de lindane, à l'exception des émissions de lindane en Espagne qui révèlent une augmentation significative entre 1998 – 2006, les calculs des modèles suggèrent que les retombées atmosphériques nettes ont diminué de manière significative entre 1998 et 2006, de 60% à 70% pour le PCB-153 et de 70% à 85% pour le lindane dans les cinq Régions OSPAR.

Les estimations se fondant sur les observations CAMP confirment un déclin net des retombées de lindane vers la fin des années 1990 qui se poursuit dans une moindre mesure actuellement; les retombées atmosphériques de lindane sont encore supérieures aux teneurs ambiantes dans la mer du Nord et les retombées se poursuivent dans l'ensemble de la zone OSPAR.

L'agriculture, la combustion et le transport sont les principaux contributeurs aux retombées atmosphériques d'azote dans la zone OSPAR, la contribution de la navigation internationale étant en hausse

Selon les inventaires nationaux des pays OSPAR, les émissions atmosphériques provenant de sources telluriques ont baissé depuis 1998 dans l'ensemble d'environ 20% pour l'oxyde d'azote et 10% pour l'azote réduit (provenant essentiellement de l'agriculture) chacun s'élevant maintenant à environ 2300 kt de N en 2006, tandis que les émissions provenant de la navigation sont passées à 1830 kt de NO_x ce qui représente une augmentation de 21% durant la même période (équivalent à 560 kt de N) en 2006. Les émissions de l'Italie, de la Pologne et de la Russie, s'élevant à environ 2000 kt de N en 2006, ont contribué également aux apports atmosphériques à la zone OSPAR et ont été prises en compte dans les calculs des modèles.

Les calculs des modèles se fondant sur les émissions suggèrent que les apports atmosphériques d'azote à la zone OSPAR ont été supérieurs à 1500 kt en 2006. Les retombées atmosphériques d'azote total dans la mer du Nord au sens large (Région II) ont diminué entre 1995 et 2006 mais se sont maintenues ou ont augmenté dans les autres régions OSPAR. Les retombées suivent un

gradient net selon les régions, les plus élevées se situant à proximité du littoral et les plus faibles en pleine mer.

Les mesures CAMP des teneurs des composantes d'azote dans les précipitations et l'atmosphère révèlent dans l'ensemble les mêmes tendances, des augmentations statistiquement significatives des teneurs atmosphériques d'ammonium et de nitrate étant relevées dans les Régions I et II et de nitrate dans les précipitations dans les Régions II et IV. Les retombées modélisées pour la Région II sont en contraste avec les estimations fondées sur les mesures des retombées d'azote, ce qui suggère que les réductions ont stagné au cours de ces dernières années ou que les retombées ont même légèrement augmenté.

Les calculs fondés sur les modèles suggèrent que l'agriculture, la combustion et le transport (y compris la navigation) contribuent chacun de 25 à 30% aux retombées d'azote total dans les Régions I et V, l'agriculture étant le principal contributeur (40%) dans les Régions II, III et IV. La combustion et le transport contribuent chacun de 20 à 25% dans ces régions.

Une comparaison des retombées atmosphériques modélisées et des apports fluviaux et rejets directs indique que les apports atmosphériques constituent la principale voie de pénétration de l'azote dans les Régions I, IV et V, tout en se souvenant que l'on ne tient pas compte de toutes les sources d'apport à la mer. Dans les Régions II et III les apports fluviaux et les rejets directs constituent la principale voie de pénétration dans la mer.

Extended Executive Summary

What is the problem?

Atmospheric inputs of nitrogen and hazardous substances may contribute to eutrophication and chemical contamination and their associated adverse effects on the marine ecosystem. The most important anthropogenic sources of emissions to air are industrial and combustion processes, transport (including shipping), and agriculture. Once in the air the substances can be transported over longer distances and deposit in the marine environment.

What has been done?

OSPAR's objectives under its Eutrophication Strategy and Hazardous Substances Strategy are to achieve a healthy and clean marine environment by continuously reducing releases of hazardous substances and nutrients to the environment. Cadmium, lead, mercury, lindane (γ-HCH) and polychlorinated biphenyls (PCBs) have been identified by OSPAR as hazardous substances for priority action and every effort should be made to move towards ceasing releases by 2020. Releases of nitrogen should be reduced by 50% compared to input levels in 1985 in areas where their input can contribute to eutrophication problems.

Measures by OSPAR, the European Union, the United Nations system and other international instruments target air emissions of hazardous substances and nitrogen. Contracting Parties have applied national pollution control measures under those regimes. This includes for example the EU Integrated Pollution Prevention Control Directive (2008/1/EC), the EU National Emission Ceilings Directive (2001/18/EC), the UN-ECE Convention on Long-Range Transboundary Air Pollution and the UNEP Stockholm Convention on Persistent Organic Pollutants (POPs). Under the umbrella of the International Maritime Organization, the MARPOL Convention addresses the reduction of emissions of pollutants from ships. Indirectly, measures taken to combat climate change will also lead to reductions in emissions of nitrogen oxides.

What does atmospheric monitoring and modelling tell us?

Long-term monitoring of atmospheric concentrations in air and precipitation allows tracking atmospheric inputs of pollutants to the sea and provides an indication of whether the implemented measures are working. Under the OSPAR Comprehensive Atmospheric Monitoring Programme (CAMP) Contracting Parties monitor and report annually concentrations of nitrogen and selected contaminants (including cadmium, lead, mercury and lindane) in precipitation and air. The objective of the monitoring programme is to assess, as accurately as appropriate, the atmospheric inputs of pollutants, to determine long-term trends in atmospheric inputs, and to provide measurements for validating atmospheric transport models used for assessments of atmospheric inputs to the OSPAR maritime area. The current assessment is the second periodic trend assessment of CAMP data.

Model calculations of atmospheric deposition of cadmium, lead, mercury, lindane and PCBs (using the congener PCB-153 as indicator) and nitrogen to the OSPAR maritime area for the period 1990 – 2006 has been prepared by the Co-operative Programme for Monitoring and Evaluation of the Long Range Transport of Air Pollutants in Europe (EMEP) and augment observations from CAMP measurements.

Data coverage and uncertainties in measurements under the CAMP Programme

CAMP measurements for 1987 – 2006 were analysed for trends in concentrations in precipitation and in air with a focus on the developments since 1998 (cut-off date for the Quality Status Report 2000). Data coverage in the OSPAR maritime area is best for the Greater North Sea (OSPAR Region II). For all other Regions, data are sparse and the trend analysis is very limited. In general the data availability

is better for concentrations in precipitation than for concentrations in air. The trend analysis therefore is largely based on precipitation data.

In general, the nitrogen observations tend to have less uncertainty than those for the heavy metals. The scale of errors in nitrogen data would be expected to tend more towards 10% than 50%. Depending on the implementation of the monitoring programme, metal measurements can be of similar quality. However, some countries may observe errors leading to higher concentrations. Detailed evaluations of data quality are reported in the annual OSPAR CAMP data reports http://www.ospar.org.

Data coverage and uncertainties in model calculations of deposition

EMEP calculations based on atmospheric transport and deposition models were used for the assessment of atmospheric deposition of nutrients in 1995 – 2006 and heavy metals and organic contaminants in 1990 – 2006. They were also used for identifying the relative contributions of emissions of Contracting Parties and most relevant emission sectors to atmospheric inputs to the OSPAR Regions. With the model calculations a complete coverage of the deposition over the regions is obtained. Inputs to the models are emissions to the atmosphere (officially reported data complemented by expert estimates) and meteorological data.

The overall uncertainty for the deposition of heavy metals and nitrogen into the OSPAR area is typically 30% – 50%. In comparison with measurements for the Greater North Sea, the heavy metal model shows an underestimation of the wet deposition of lead and cadmium of about 30% and 50%, respectively. For reduced nitrogen and oxidized nitrogen an underestimation by the model is calculated with respectively 20% and 40% based on a comparison to European monitoring data including CAMP data.

Have our measures been working?

Most CAMP measurements of hazardous substances in air and precipitation show downward trends in the period 1998 – 2006, while some nitrogen concentrations are increasing

Limitations in coverage of measurements meant that trend analysis of observed concentrations in precipitation and air are mostly limited to Regions I, II and IV (Table 0.1).

Concentrations of heavy metals in precipitation have generally fallen in Regions I and II with statistically significant decreases of cadmium and lead in the Greater North Sea (Region II). No measurements of heavy metals in precipitation for other regions were available for assessment. Overall, the aerosol data for heavy metals also show a decrease in Regions II and the Bay of Biscay and Iberian coasts (Region IV) but only the trend for lead in Region II was statistically significant. An increase of concentrations of lead and mercury in air has been found for Region I although this is not statistically significant.

The measurements of the lindane concentration in precipitation for the Regions I and II show clear downward trends.

Concentrations of nitrogen in precipitation have decreased at most CAMP stations in Region II but increased in Region I, while in both Regions the aerosol concentrations of nitrate and ammonium have increased. In Region IV, the picture is mixed with nitrate concentrations in precipitation and aerosol increasing and concentrations of ammonium decreasing. However, most of the changes in Region IV are not statistically significant. A small decrease in the NO_2 concentrations in air has been found in Regions I, II and IV with the only statistically significant trend in Region II; concentrations have increased in Region III although the increase is not statistically significant.

***Table 0.1**: Summary of trends in concentrations of pollutants in precipitation (top) and air/aerosol (bottom) measured at CAMP stations in the period 1998 – 2006. Values are the mean % change of all monitoring stations in a Region. Trends in grey cells are statistically not significant; coloured cells show statistically significant trends:*

upward trend; downward trend; mean trend is upward but more stations showed a downward trend.

Concentration in precipitation	Nitrate (NO_3)	Ammonium (NH_4)	Lead	Cadmium	Mercury	Lindane
Region I	0.8 ↑	2.2 ↑	-4.5 ↓	--	--	-13.2 ↓
Region II	1.0 ↑	-8.1 ↓	-8.3 ↓	-10.4 ↓	-2.0 ↓	-28.2 ↓
Region III	-2.1 ↓	0.9 ↑	--	--	--	--
Region IV	15.7 ↑	-8.7 ↓	--	--	--	--
Region V	24.9 ↑	--	--	--	--	--

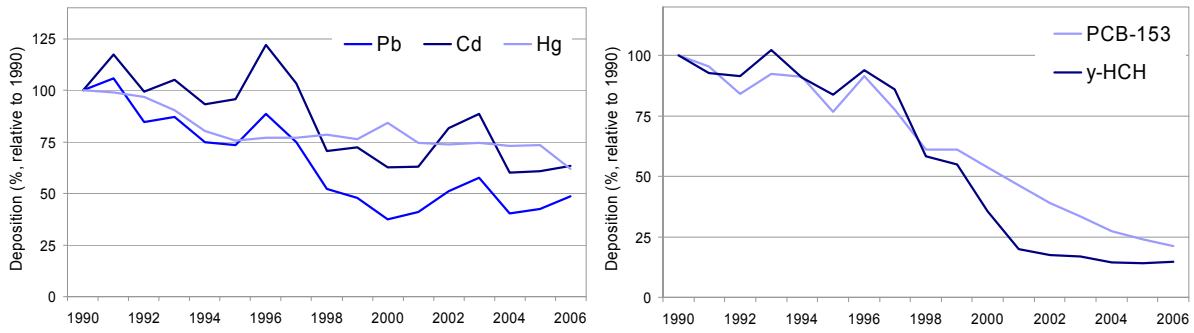
Concentration in air/aerosol	Nitrogen dioxide (NO_2)	sNO_3^*	sNH_4^{**}	Lead	Cadmium	Mercury
Region I	-0.8 ↓	25.1 ↑	30.7 ↑	4.7 ↑	-8.0 ↓	8.1 ↑
Region II	-2.5 ↓	12.9 ↑	11.6 ↑	-4.4 ↓	-4.5 ↓	-1.8 ↓
Region III	5.2 ↑	--	--	--	--	--
Region IV	-0.9 ↓	6.6 ↑	-4.4 ↓	-3.9 ↓	-5.7 ↓	--
Region V	--	--	--	--	--	--

* sum of nitrate and nitric acid; ** sum of ammonia and ammonium

Modelled atmospheric deposition of heavy metals (lead, cadmium and mercury) and organic contaminants (lindane, PCB-153) decreased substantially over the period 1990 – 2006. This is confirmed by the decreasing trends in CAMP measurements of heavy metals and lindane. However, since 1998 the decrease in modelled deposition of heavy metals has slowed, or input levels have stagnated.

Modelled atmospheric deposition of the heavy metals (lead, cadmium and mercury) and organic contaminants (lindane, PCB-153,) has decreased substantially over the period 1990 – 2006 (Figure 0.1) following emission reductions in Europe and the phase out of lindane and PCBs. The rate of decrease was more significant in the early 1990s when substantial reductions in emissions of heavy metals had been achieved in European countries as a consequence of the ban on leaded fuels for cars, the use of cleaner production technologies, as well as economic contraction and industrial restructuring in Eastern European countries. Since 1998, however, model calculations suggest that levels of atmospheric deposition of heavy metals have stagnated.

This is largely confirmed by CAMP measurement data which show a limited decrease of concentrations of the assessed heavy metals in precipitation in Regions I and II. No measurements in precipitation for other regions were available for an assessment. The aerosol data also show general downward trends. An exception is an upward trend for mercury, found at both stations in Region I.

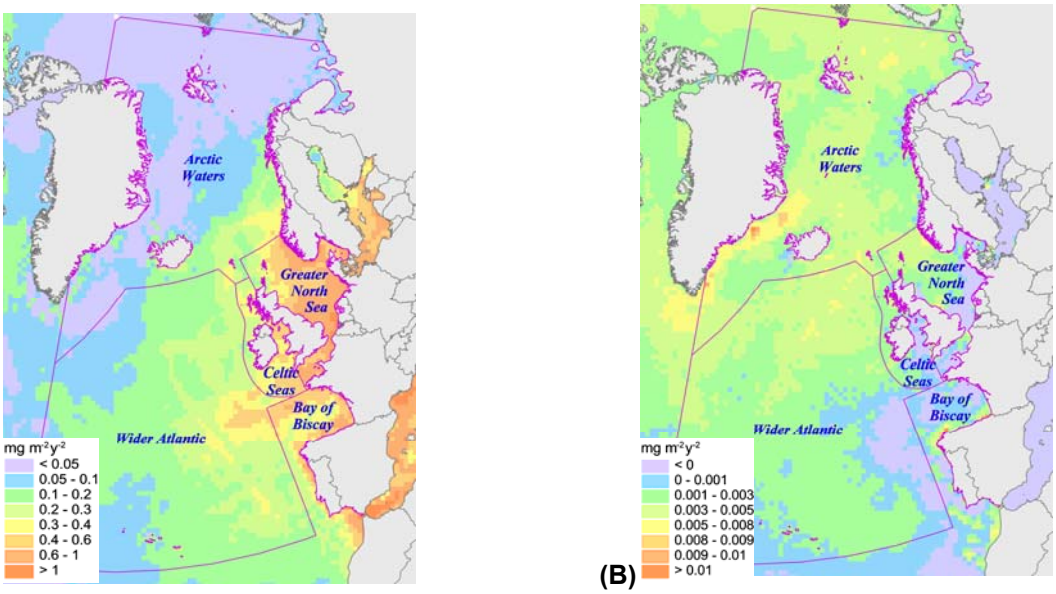


(A) **(B)**

***Figure 0.1**: Percentage change in modelled total deposition of the metals lead, cadmium and mercury (A) and of the organic contaminants PCB-153 and lindane (γ-HCH) (B) to the OSPAR area in 1990 - 2006.*

Modelled depositions of cadmium, lead, lindane and PCB-153 show a clear geographical gradient over the Regions with the largest values close to land areas and largely decreasing towards the open sea. The deposition of mercury shows a different pattern with highest deposition on the open sea.

The modelled deposition of lead (Figure 0.2 (A)), cadmium, lindane and PCB-153 show steep geographical gradients with the largest values close to land areas, and largely decreasing towards the open sea. The deposition density close to land areas is about an order of magnitude higher than the values for the open sea. This can be explained by the significant influence of European emission sources on the coastal areas. The deposition of mercury, however, shows a different pattern (Figure 0.2(B)) because of the large hemispheric background of mercury and the large re-emissions of mercury from the sea itself. The model calculations show the largest values of the deposition for the open sea in Regions I and V. In the coastal areas, the calculated deposition can even be negative. This indicates a re-emission of mercury from sea surfaces as opposed to deposition.



(A) **(B)**

***Figure 0.2**: Spatial distribution of the annual net deposition in 2006 of lead (A) and mercury (B) to the OSPAR area and its Regions. Unit is in mg/m^2/yr.*

Combustion in power plants and industry and industrial processes is the dominant contributor to modelled deposition of heavy metals to the OSPAR Regions.

The most important contributor to the deposition of lead, cadmium and mercury to the OSPAR area is the source category 'Combustion in power plants and in industry and industrial processes' (Figure 0.3). Model calculations suggest that the contribution of these combustion sources to total depositions in the five OSPAR Regions ranges between 70 - 90%. Calculations suggest that the second most important contributors to the deposition are 'Transport' for lead, 'Commercial, residential and other combustion' for cadmium, and 'Waste' for mercury.

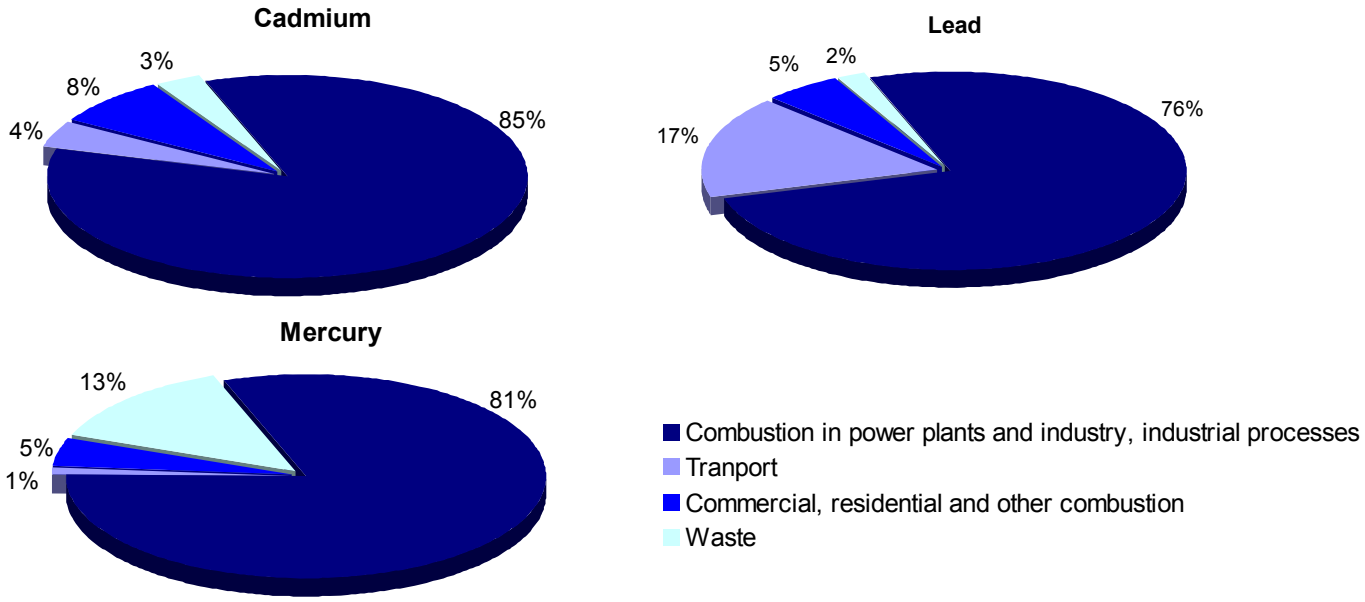


***Figure 0.3**: Relative contribution of different emission source categories to atmospheric deposition of cadmium, mercury and lead to the OSPAR area in 2005.*

The most important contributors to modelled deposition of heavy metals to the Regions are United Kingdom, France and Spain.

When examining the contribution of countries' emissions to total atmospheric inputs of contaminants to the OSPAR area, the geographical location and degree of industrial activity need to be borne in mind. For example, the geographical location of the UK means that the prevailing winds take emissions in the direction of Regions II and III, resulting in a relatively large contribution per emitted quantity.

The most significant contribution to the atmospheric deposition of the heavy metals lead, cadmium and mercury, and the organic contaminants lindane and PCB-153 to OSPAR Regions I, II and III is from the United Kingdom. The second most significant contributors are France and Spain. Significant contributions come also from Poland. For Regions IV and V the most significant contributors are Spain, Portugal, France and United Kingdom (Table 0.2).

***Table 0.2**: Most important countries contributing to the atmospheric deposition of contaminants to the OSPAR Regions in 2006. The percentages are given in relation to the sum of the deposition from emission sources in OSPAR countries plus Poland, Russia and Italy. Biocidal and pesticidal applications of lindane have ceased in all Contracting Parties and emission data for 2006 from diffuse sources such as imported goods are available only from Belgium, Spain and the UK.*

OSPAR Regions	Cadmium	Lead	Mercury	PCB-153
Region I	UK(18%), PL(30%)	UK(22%), PL(19%)	UK(32%), PL(19%)	UK(33%), FR(23%)
Region II	UK(31%), PL(18%)	UK(33%)	UK(48%)	UK(42%), FR(25%)
Region III	UK(30%), ES(26%)	UK(30%)	UK(56%)	UK(48%), FR(22%)
Region IV	ES(62%), PT(27%)	ES(49%), PT(35%)	ES(57%), PT(23%)	ES(48%), FR(32%)
Region V	ES(42%), PT(23%)	ES(30%), PT(30%)	ES(28%), UK(23%)	FR(28%), ES(24%)

Modelled atmospheric deposition of nitrogen on the Greater North Sea (Region II) has decreased over the period 1995 – 2006 but stagnated or increased in the other OSPAR Regions since 2000. The CAMP measurements of concentrations of nitrogen components roughly show the same trends over this period.

Modelled atmospheric deposition of nitrogen has decreased in Region II over the period 1995 – 2006, but stagnated or increased in the other OSPAR Regions since 2000 (Figure 0.4). The CAMP measurements of the concentrations of nitrogen components roughly show the same trends over this period. The emission reduction of nitrogen oxides in major contributing countries like UK and Germany is the reason for a decreasing deposition in Region II, whereas the increasing emissions from the ship traffic are responsible for increased depositions in Region V.

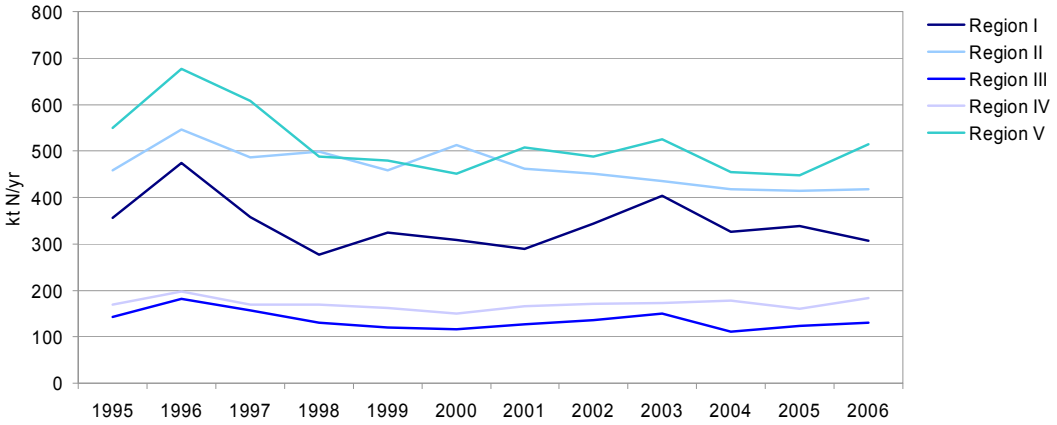


***Figure 0.4**: Time series of total nitrogen deposition to the OSPAR Regions for the period 1995 – 2006 (unit: kt N/yr).*

Modelled deposition of nitrogen shows a clear geographical gradient over the Regions, with the highest deposition close to land areas and largely decreasing towards the open sea.

The deposition of total nitrogen (oxidized and reduced nitrogen) shows a clear geographical gradient over the Regions, with the largest values close to land areas and largely decreasing towards the open sea (Figure 0.5). The deposition density close to land areas is about an order of magnitude higher than the values for the open sea. However, in the open sea there is also a higher level of deposition due to model boundary conditions. These boundary conditions reflect the global transport of nitrogen from sources such as emissions in the USA.

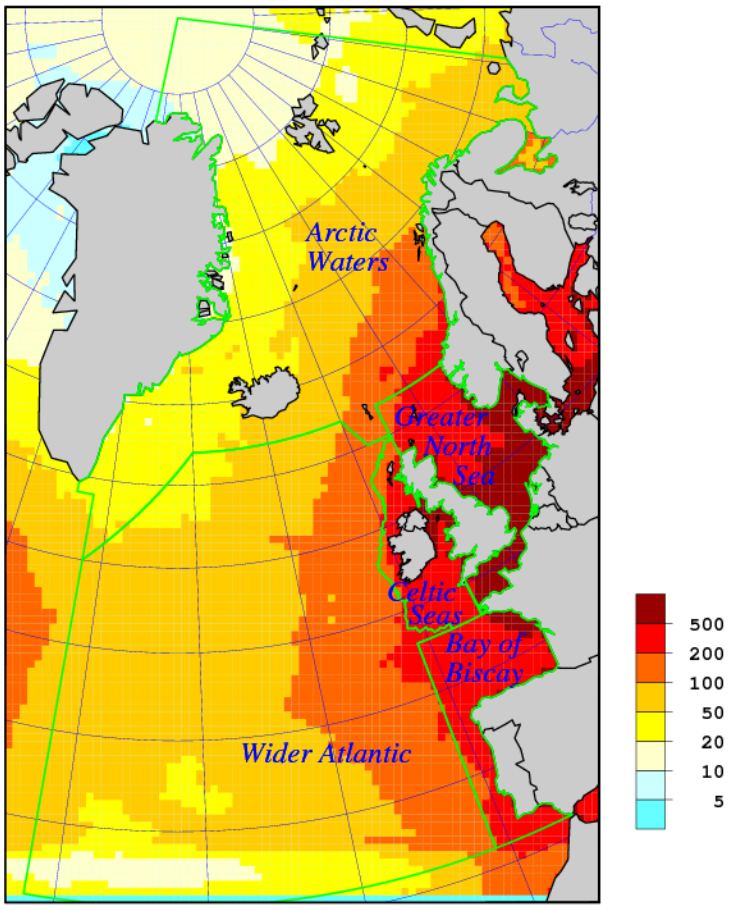


***Figure 0.5**: Modelled spatial distribution of total nitrogen deposition to the OSPAR area and its Regions in 2006 (unit: t N/yr/grid).*

Model calculations suggest that the UK is an important contributor to the deposition of nitrogen to all Regions except Region IV (Bay of Biscay and Iberian coast). All other countries contribute to a lesser extent to the deposition. In Region IV the deposition of nitrogen is dominated by emissions from France and Spain.

The modelled deposition of nitrogen is the sum of the deposition of oxidized nitrogen and reduced nitrogen. In general the oxidized nitrogen originates from the source categories combustion and transportation whilst the reduced nitrogen originates from agricultural activities. The country contributions to oxidized and reduced nitrogen depositions are from slightly different sources. For all Regions, five major contributors account for more than 50% of total oxidized nitrogen deposition. For three out of five regions emissions from the UK are the major contribution (24 – 30%). Nitrogen oxides emissions from international ship traffic on the Atlantic Ocean and on the North Sea contribute together 16 – 28% and are one of the major contributors to total oxidised nitrogen depositions in the OSPAR area (Figure 0.6).

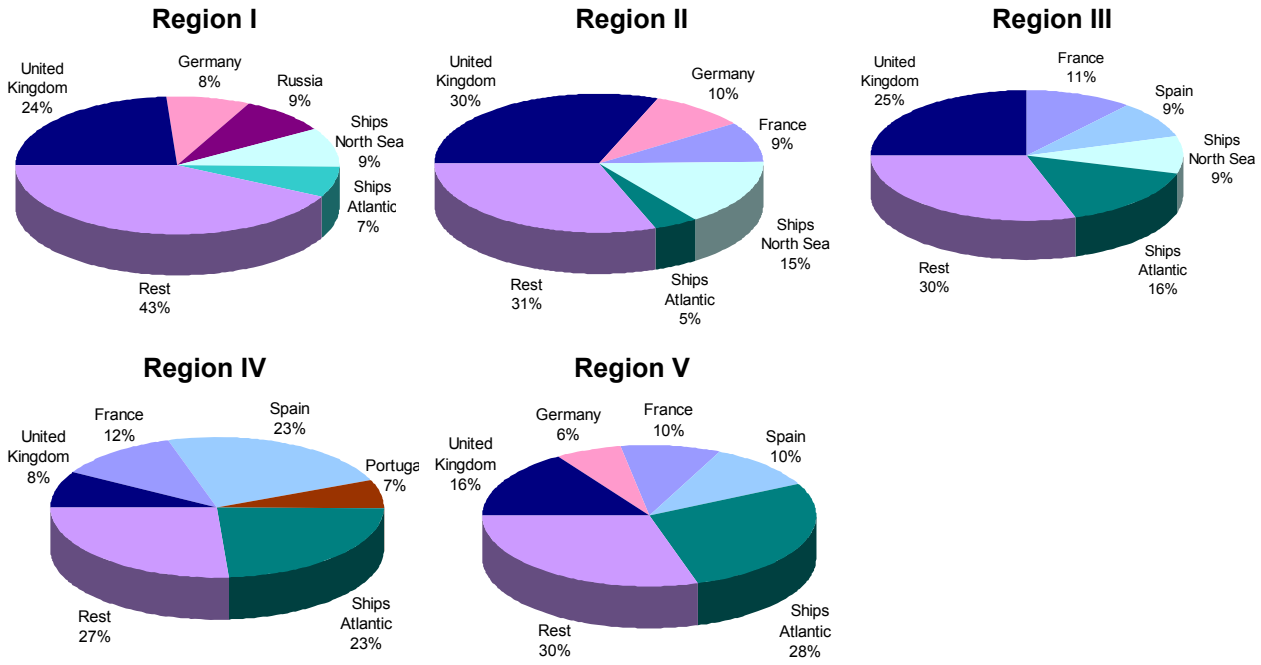


***Figure. 0.6**: Main contributors to oxidized nitrogen deposition to the OSPAR Regions in 2006. Contribution of international shipping on the North Sea and the Atlantic is presented as "Ships North Sea" and "Ships Atlantic", respectively.*

In the case of reduced nitrogen deposition, the UK and France are the major contributors to all Regions. Emissions from Spain contribute significantly to the deposition in Regions IV and V (Figure 0.7).

The UK is an important contributor to the deposition of total nitrogen to all Regions except Region IV, where the emissions from the international ship traffic on the Atlantic Ocean are the main contributor (16%). All other countries contribute to a lesser extent to the deposition. In Region IV the deposition is dominated by emissions from France and Spain. The five major contributors account for more than 90% of the total reduced nitrogen deposition in Regions III, IV and V.

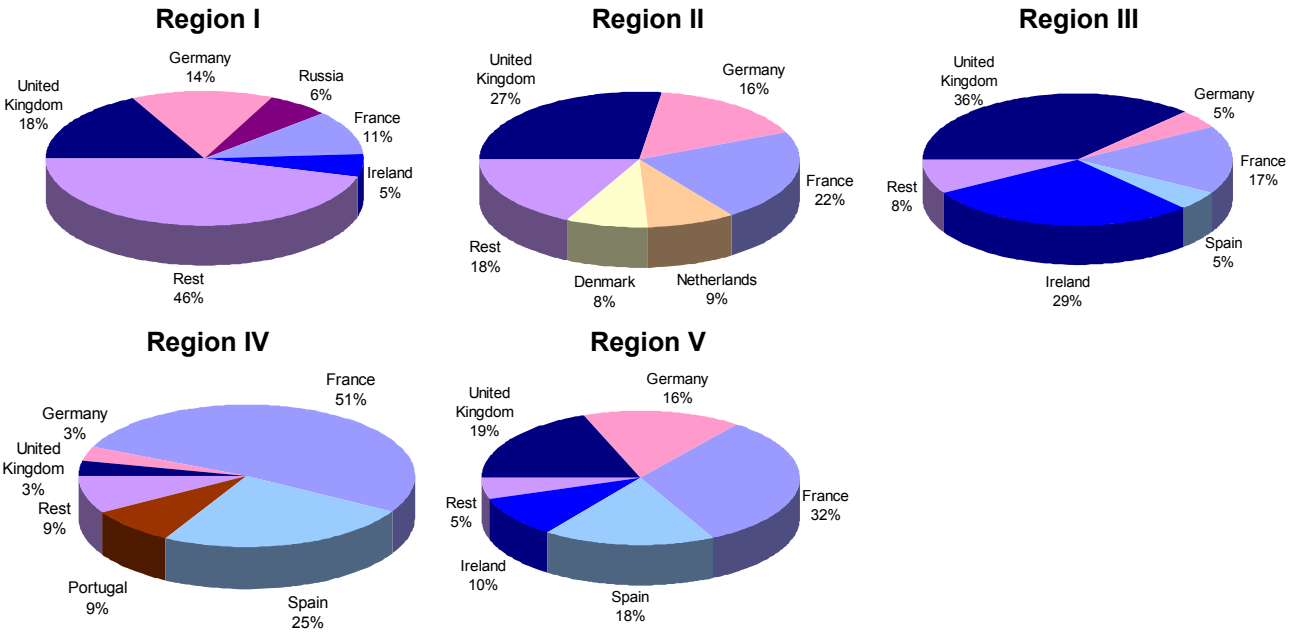


***Figure 0.7**: Main contributors to reduced nitrogen deposition to the OSPAR Regions in 2006.*

Models suggest that emissions from combustion (in power plants and industry), transport (including ship traffic) and agriculture are the main contributors to the deposition of nitrogen to the OSPAR Regions.

Models suggest that for Regions I and V the main emission sources contributing to nitrogen deposition are a) combustion for energy production and industry, b) transportation including ship traffic and c) agriculture. They contribute each about 25 – 30% to the deposition of nitrogen. In Regions II, III and IV, combustion for energy production and industry on one hand, and transportation including ship traffic on the other hand, contribute each about 20 – 25%; agriculture contributes about 40% to the deposition in these Regions (Figure 0.8).

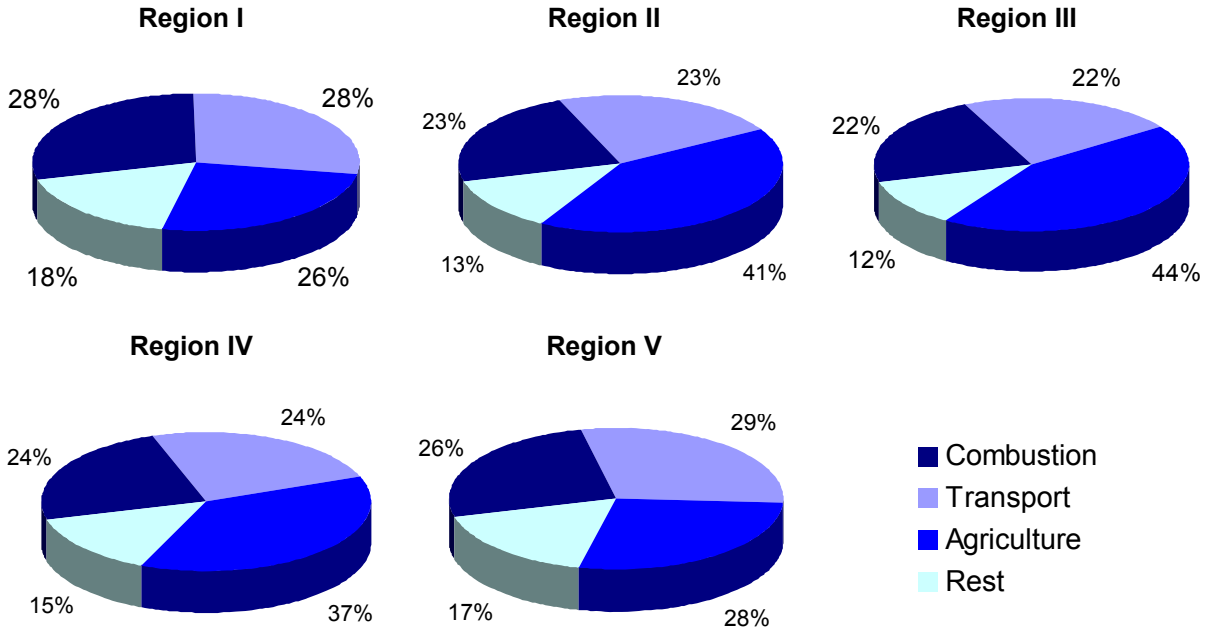


***Figure 0.8**: Main emission sources (as defined by the EMEP Selected Nomenclature for reporting of Air Pollutants (SNAP)) contributing to total nitrogen deposition to the OSPAR Regions in 2006. "Combustion" comprises combustion from stationary sources relating to the energy and transformation industries (SNAP 1), non-industrial combustion plants (SNAP 2) and manufacturing industries (SNAP 3). "Transport" comprises road transport (SNAP 7) and other mobile sources and machinery (SNAP 8) (including emissions from shipping). "Agriculture" refers to SNAP emission category 10. "Rest" refers to remaining SNAP emission categories.*

How do loads of atmospheric inputs compare to riverine inputs and direct discharges in the OSPAR Regions?

Bearing in mind that not all sources of inputs to the sea are taken into account, a comparison of modelled atmospheric deposition with riverine inputs and direct discharges indicates that atmospheric inputs are the dominant pathway for nitrogen and heavy metals to Regions I and V. In Regions II and III riverine inputs and direct discharges are the dominant pathway for nitrogen to the sea. For heavy metals there is no dominant pathway pattern in Regions II and III. In Region IV atmospheric deposition is the dominant pathway for both nitrogen and heavy metals.

What is the outlook?

More efforts may be needed for both heavy metals and nitrogen to further progress towards OSPAR's objectives under the Eutrophication and Hazardous Substances Strategies. A prediction of future trends is difficult to make keeping in mind differences in scenarios, uncertainties in estimates, the delay in time for ecosystems to respond to measures and the possible influence of climatic factors on airborne pathways.

1. Introduction

Atmospheric deposition is a relevant pathway for pollutants to the marine environment of the North-East Atlantic. Once emitted to air, pollutants may travel short or long distances with air currents from emission sources in Europe and industrialized areas in North-America and Asia before they enter the sea via atmospheric deposition.

Under the OSPAR Comprehensive Atmospheric Monitoring Programme (CAMP), Contracting Parties are monitoring and reporting annually (since 1987) concentrations of selected pollutants – heavy metals, organic contaminants and nitrogen species – in air and precipitation to allow the evaluation of the trends in loads of atmospheric inputs of those pollutants to the OSPAR area. The objectives of the monitoring programme are set out in the CAMP Principles (OSPAR reference number 2001-7) as follows:

- to assess, as accurately as appropriate, the atmospheric input of the selected contaminants to the maritime area and regions thereof on an annual basis;
- to determine long-term trends in atmospheric inputs;
- their use in relation to modelling activities, specifically to validate atmospheric transport models used for assessments of atmospheric inputs to the maritime area.

This report has been prepared under the OSPAR Joint Assessment and Monitoring Programme and presents the second comprehensive scientific assessment of OSPAR atmospheric monitoring data for selected pollutants and their atmospheric inputs to the OSPAR area. It follows the first comprehensive trend assessment in 2005 (OSPAR, 2005) and is complemented by model based calculations of atmospheric deposition prepared by the Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmissions of Air Pollutants in Europe (EMEP).

The assessment is a contribution to the overall evaluation of the status and trends of marine pollution and the Quality Status Report 2010 (Box 1). It provides supporting evidence for conclusions on progress towards the specific targets of the OSPAR Hazardous Substances Strategy and Eutrophication Strategy to reduce emissions and associated inputs of contaminants and nitrogen to the North-East Atlantic.

Box 1.1

Electronic navigator to complementary QSR assessments and documentation

QSR assessments

- Trends in waterborne inputs (OSPAR, 2009a)
- Trends and concentrations in marine sediments and biota (OSPAR, 2009b)
- Status and trends of marine pollution (OSPAR, 2009c)
- Towards the cessation target for priority chemicals (OSPAR, 2008a)
- Eutrophication status of the OSPAR area (OSPAR, 2008b)

Complementary documentation

- CAMP Principles (agreement 2001-7)
- Annual CAMP data reports. Latest report taken into account: CAMP 2007 data report (OSPAR, 2009d)
- 2005 CAMP data assessment (OSPAR, 2005)
- Atmospheric deposition of heavy metals and POPs (OSPAR, 2008c)
- Atmospheric nitrogen in the OSPAR Convention area in 1990 – 2004 (OSPAR, 2007a)

2. Assessment procedure

The assessment is based on the following data:

- *Measurements* from the OSPAR CAMP monitoring programme. The CAMP measurements yield values for *concentrations* of contaminants in precipitation and in air and are used to detect trends of airborne pollutants.
- *Emission inventories*. EMEP emission data are used to detect trends in atmospheric emissions of OSPAR countries and other main European contributors to atmospheric emissions, and as the basis for model calculations of atmospheric deposition.
- Results from *model calculations* carried out with chemical transport models from EMEP Meteorological Synthesizing Centre West and East. From the model calculations the *deposition* of contaminants over the OSPAR maritime area are obtained.

The assessment covers the following pollutants:

- Nitrogen: reduced nitrogen, oxidized nitrogen;
- Heavy metals: mercury, cadmium, lead, arsenic, chromium, copper, nickel, zinc. Main focus is given to the three OSPAR priority chemicals mercury, cadmium and lead (OSPAR, 2004).
- Organic contaminants: lindane, PAHs and PCB-153. For PCB-153 no measurements are available, while for PAHs no model calculations are available. All three (groups of) hazardous substances have been identified by OSPAR for priority action (OSPAR, 2004).

The assessment presents trends and conclusions for each of the five OSPAR Regions. Trends for concentrations and depositions of nitrogen and the selected contaminants are presented for CAMP data for the period 1987 – 2006, and for EMEP model calculations for a period from 1990 for heavy metals and POPs and from 1995 for nitrogen up to 2006. The focus of the assessment is the presentation of trends since 1998 to allow evaluation of progress made since the OSPAR Quality Status Report 2000 (which took account of data up to 1998).

2.1 Regions

For assessment purposes, the OSPAR area is divided into five OSPAR Regions (Figure 2.1, left panel):

Region I: Arctic Waters (5.5×10^6 km^2)
Region II: Greater North Sea (7.6×10^5 km^2)
Region III: Celtic Seas (3.6×10^5 km^2)
Region IV: Bay of Biscay and Iberian Coast (5.3×10^5 km^2)
Region V: Wider Atlantic (6.3×10^6 km^2)

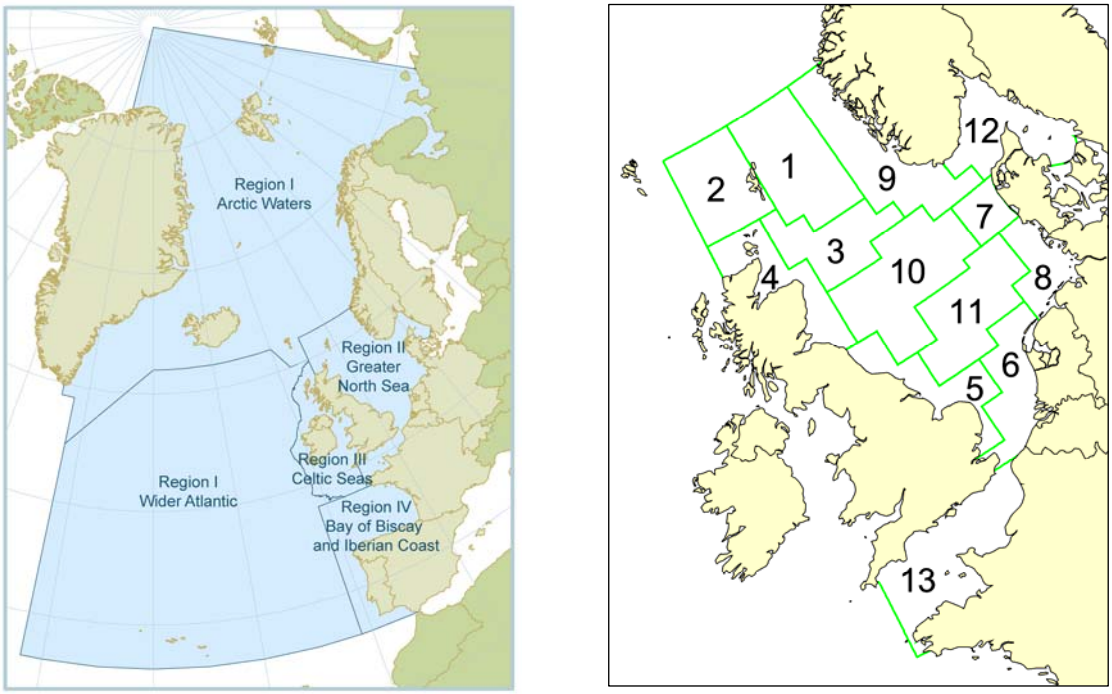


***Figure 2.1**: The OSPAR area and its five Regions (left panel), and the 13 sub-areas of the Greater North Sea used for the EMEP model calculations (right panel).*

In addition, for the EMEP calculated depositions, the Greater North Sea has been sub-divided into 13 sub-areas, as shown in the right panel of Figure 2.1. The size of the different sub-areas of Region II – which link to so-called ICES Boxes – are listed below:

Sub-area 1:	ICES Box 1	– 8.1×10^4 km^2
Sub-area 2:	ICES Box 2a	– 6.0×10^4 km^2
Sub-area 3:	ICES Box 2b	– 5.2×10^4 km^2
Sub-area 4:	ICES Box 3a	– 4.7×10^4 km^2
Sub-area 5:	ICES Box 3b	– 4.0×10^4 km^2
Sub-area 6:	ICES Box 4	– 4.9×10^4 km^2
Sub-area 7:	ICES Box 5a	– 1.8×10^4 km^2
Sub-area 8:	ICES Box 5b	– 3.4×10^4 km^2
Sub-area 9:	ICES Box 6	– 8.5×10^4 km^2
Sub-area 10:	ICES Box 7a	– 9.5×10^4 km^2
Sub-area 11:	ICES Box 7b	– 6.8×10^4 km^2
Sub-area 12:	ICES Box 8	– 6.0×10^4 km^2
Sub-area 13:	ICES Box 9	– 8.0×10^4 km^2

2.2 Data used in the assessment

2.2.1 Coverage and treatment of CAMP measurement data

The CAMP programme calls for mandatory monitoring of a range of heavy metals, organic contaminants and nitrogen species in precipitation and air, and encourages the monitoring on a voluntary basis of additional contaminants (OSPAR, 2001). The CAMP monitoring network has been operational since 1987. Each OSPAR country bordering the maritime area should have at least one monitoring station in the joint monitoring programme. A monitoring station should in principle be located not more than 10 km from the coastline. At the stations the measurement of the chemical composition of precipitation and air are to be performed.

Data collected at the CAMP monitoring stations are submitted by OSPAR Contracting Parties to the Norwegian Institute for Air Research (NILU) which acts as OSPAR CAMP data centre and maintains a CAMP database (http://www.nilu.no/camp). Submitted data are quality controlled and validated by Contracting Parties.

The measurement data used in this assessment have been extracted from the CAMP database which contains all available data for the period 1987 – 2006 for each monitoring station. Since 1987 the number and location of monitoring stations have varied. Figure 2.2 and Table 2.1 give an overview of all monitoring stations which have been selected for this report. In order to construct Table 2.1, information has been used from the 2005 CAMP assessment (OSPAR, 2005) and the CAMP 2005 data report (OSPAR, 2007).

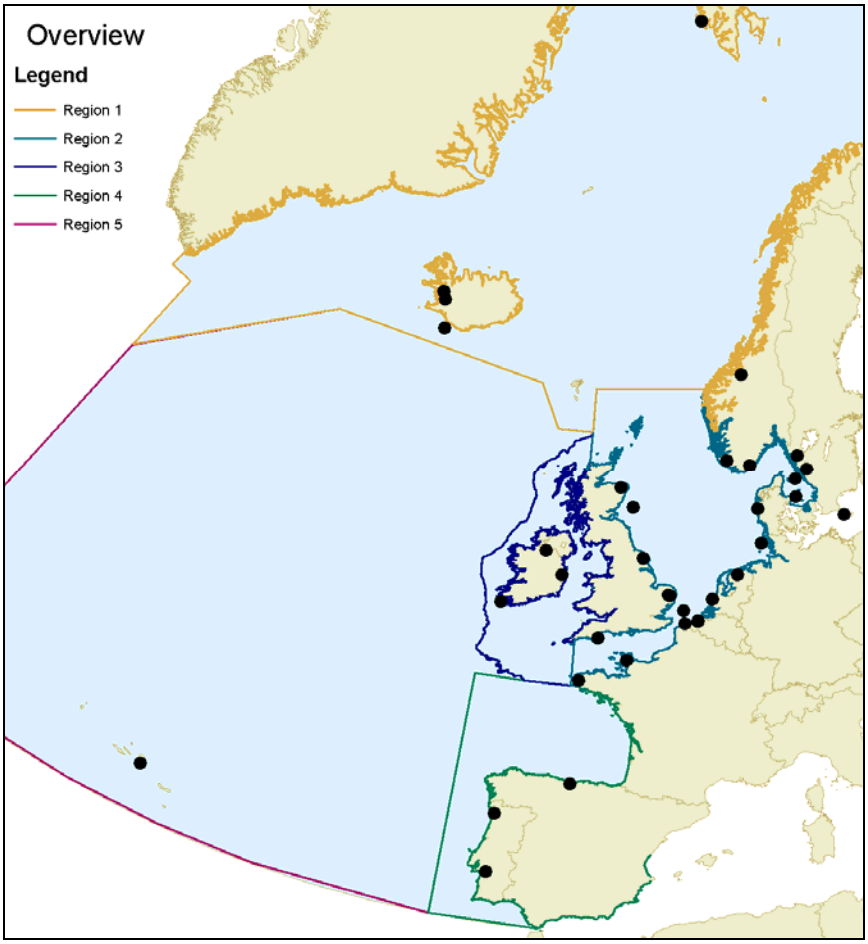


***Figure 2.2**: Geographical position of the CAMP monitoring stations used in this report.*

***Table 2.1**: CAMP monitoring stations used in this report (see also Figure 2.2)*

Code	Name	Latitude	Longitude	Altitude (m)	Distance to sea (km)
BE0004R	Knokke	51.21	3.20E	0	1
BE0011R	Moerkerke	51.15	3.21E	0	9
BE0013R	Houtem	51.1	2.35E	2	12
BE0014R	Koksijde	51.7	2.30E	7	1.5
DE0001R	Westerland	54.56	8.19E	12	0.09
DK0008R	Anholt	56.43	11.31E	40	0.5
DK0020R	Pedersker	55.1	14.57E	5	
DK0031R	Ulborg	56.17	8.26E	40	20
ES0008R	Niembro	43.44	4.85W	115	0.5
FR0005R	Le Hague	49.37	1.50W	133	
FR0090R	Porspoder	48.30	4.46W	30	0.5
GB0006R	Lough Navar	54.26	7.54W	130	28
GB0013R	Yarner wood	50.36	3.43W	119	16
GB0014R	High Muffles	54.20	0.48W	265	22
GB0016R	Glen Dye	56.58	2.59W	85	24
GB0017R	Heigham Holmes	52.43	1.37E	0	4.4
GB0090R	East Ruston	52.48	1.28E	5	8
GB0091R	Banchory	57.5	2.32W	130	26.5
IE0001R	Valentia Island	51.56	10.15W	9	0
IE0002R	Turlough Hill	53.2	6.24W	420	19
IS0002R	Irafoss	64.5	21.1W	65	
IS0090R	Reykjavik	64.8	21.54W	61	1
IS0091R	Storhofdi	63.24	20.17W	118	0.5
NL0009R	Kollumerwaard	53.20	6.17E	1	7.5
NL0091R	De Zilk	52.18	4.31E	4	2.5
NO0001R	Birkenes	58.23	8.15E	190	20
NO0039R	Karvatn	62.47	8.53E	210	70
NO0042G	Zepellinfjell	78.54	11.53E	474	2
NO0057R	Ny Alesund	78.55	11.55E	8	0.3
NO0099R	Lista	58.6	6.34E	13	0.1
PT0003R	Viana do Castelo	41.42	8.48W	16	4
PT0004R	Monte Velho	38.5	8.48W	43	1.5
PT0010R	Angra do Heroismo	38.40	27.13E	74	1
SE0002R	Rorvik	57.25	11.56E	10	0.65
SE0014R	Rao	57.24	11.55E		
SE0097R	Gaardsjoen	58.3	12.1E	113	12
SE0098R	Svartedalen	57.59	12.6E	120	16

Table 2.2 gives an overview of the CAMP parameters which are measured on a mandatory basis (M) and on a voluntary basis (V), for both precipitation and air/aerosol.

Heavy metals are directly analysed in both precipitation and air/aerosol. Nitrogen is analysed separately for reduced and oxidized components. Reduced nitrogen includes ammonia (NH_3) in air/aerosol and ammonium (NH_4^+) in precipitation, oxidized nitrogen includes nitrate (NO_3^{2-}) in precipitation and nitrogen dioxide (NO_2), nitric acid (HNO_3) and nitrogen monoxide (NO) in air/aerosol.

A trend analysis has been performed on both precipitation and air measurement data. For this purpose, annual mean concentrations of heavy metals and nitrogen have been used over the assessment period. This is 1987 – 2006 and 1998 – 2006 for nitrogen and 1998 – 2006 for heavy metals (and for lindane in precipitation). Trends are reported with a focus on the period 1998 – 2006.

For the assessment period 1998 – 2006, only time series have been selected from the CAMP database which have more than *five years of valid data* in the period 1998 – 2006 and include *at least one year* in the period 2003 – 2006. The first criterion was chosen in order to make a trend analysis which is representative for the period. The second criterion was selected to ensure that the more recent years are covered, as the previous CAMP assessment covered CAMP data up to 2002 (OSPAR, 2005).

***Table 2.2**: List of contaminants measured under CAMP programme on a mandatory (M) and voluntary (V) basis.*

	CAMP parameters	Precipitation	Air/Aerosol
Heavy metals	Arsenic (As)	M	V
	Cadmium (Cd)	M	V
	Chromium (Cr)	M	V
	Copper (Cu)	M	V
	Lead (Pb)	M	V
	Mercury (Hg)	M	V
	Nickel (Ni)	M	V
	Zinc (Zn)	M	V
Nutrients	Ammonium (NH_4^+)	M	M
	Nitrate (NO_3^-)	M	M
	Nitrogen Dioxide (NO_2)		M
	Nitric Acid (HNO_3)		M
	Ammonia (NH_3)		M
	Nitrogen monoxide (NO)		V
Persistent organic pollutants	Lindane (γ-HCH)	M	V
	PCB-congeners[1]	V	V
	PAHs[2]	V	V

[1] The PCB congeners 28, 52, 101, 118, 138, 153 and 180

[2] The PAHs phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[a]pyrene, benzo[ghi]perylene, indeno[1,2,3-cd]pyrene

2.2.2 EMEP emission data

Data from emission inventories are assessed in this report for cadmium, lead, mercury, lindane and PCB-153 for the period 1990 – 2006, and for reduced and oxidised nitrogen for the period 1995 – 2006. Data used are emission data used in EMEP models which are publicly available through the EMEP web database (WebDab) (*http://www.ceip.at/emission-data-webdab/emissions-used-in-emep-models/*). These data are based on the emissions officially reported by countries under the UNECE Convention on Long-Range Transport of Air Pollutants to EMEP, but some of these data have been corrected and gaps filled through estimates to provide complete time series for model calculations. A description of EMEP emission data used in models is given in OSPAR (2007a) and OSPAR (2008c). A general description of the data is given on the WebDab website (*http://www.ceip.at/emission-data-webdab/user-guide-to-webdab/*).

The emission data used in this report are at Annexes 1 and 2, based on Bartnicki and Fagerli (OSPAR, 2007a) and Gusev *et al*. (OSPAR, 2008c) and are updated with the years 2005 – 2006 for nitrogen and 2006 for heavy metals and POPs.

The emission data for nitrogen are given in the EMEP WebDab database as Gg NO_x and Gg NH_3. For the assessment and model calculations, data have been converted to Gg N and are presented as kilo tonnes (kt). The conversion factors for N are NO_x x 14/46 and NH_3 x 14/17.

2.2.3 Data from atmospheric transport model calculations

In the assessment the deposition to the OSPAR Regions was obtained from calculations using chemical atmospheric transport models. The models calculate the total deposition fluxes to the OSPAR area for oxidized, reduced and total nitrogen for the period 1995 – 2006, and for lead, cadmium, mercury, lindane and PCB-153 for the period 1990 – 2006. Inputs to the models consisted of EMEP emission data (as described in section 2.2.2 above) for the relevant countries and main emission sectors, and meteorological data.

For source-receptor matrix calculations, emission data were used for main source groups as defined by the EMEP/CORINAIR Selected Nomenclature for reporting of Air Pollutants (SNAP) relating to combustion (SNAP 1, 2, 3), transport (SNAP 7, 8), waste (SNAP 9) and agriculture (SNAP 10). The SNAP sectors and their coverage used for the model calculations are described in the 2007 update of the EMEP/EEA air pollutant emission inventory guidebook (EMEP/EEA, 2007). For contaminants the source classification of the inventory of the Netherlands Organisation for Applied Scientific Research (TNO) were used, which are mostly based on EMEP/CORINAIR SNAP. This is further described in OSPAR (2008c).

The model calculations were carried out in 2007 and 2008, respectively, by the Meteorological Synthesizing Centres West (MSC-W) for nitrogen and East (MSC-E) for heavy metals and POPs of the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmissions of Air Pollutants in Europe, EMEP. The calculations update the latest deposition reports prepared by EMEP for the OSPAR Commission through Bartnicki and Fagerli (OSPAR, 2007a) and Gusev *et al*. (OSPAR, 2008c). Those reports give a full description of the models used and model calculations. Discrepancies in data presented in those reports (1990 – 2004 for nitrogen and 1990 – 2005 for contaminants) compared to those in the current assessment relate to the following factors:

- C hange in meteorological forcing used for the MSC-E heavy metals and POPs models in the calculations for 2006 (compared to 1990 – 2005), although the influence of these changes are considered low and within meteorological variability;

- recalculation of nitrogen deposition for the whole period 1990 – 2006, using the latest available version of the EMEP Unified Model developed in 2008. The results for reduced nitrogen remained on similar levels, but those calculated for oxidised nitrogen are considerably lower (15 – 20%) compared to previous calculations. This is due to the differences in the changes in chemical reactions involving nitrogen in the latest version of the EMEP model. While annual totals of ammonia emissions in 1995 – 2004 as described in the previous EMEP report have not much changed, the spatial distribution of national emissions within the model grid system used in the latest model runs is slightly different.

2.3 Assessment methods

2.3.1 Calculation of annual mean concentrations from CAMP data

Calculations follow the CAMP Principles (OSPAR, 2001). The annual mean concentration in **precipitation** $\overline{C}$ was estimated by precipitation amount weighted averaging of the concentrations for each of the sampling periods:

$$\overline{C} = \sum_{i=1}^{N} P_i \cdot C_i \Big/ \sum_{i=1}^{N} P_i \ .$$

Where *N* is the number of sampling periods in one year, P_i is the amount precipitation in mm in period i and C_i is the concentration in period i. The method used in the OSPAR assessment in 2005 was followed by judging an annual mean to be valid when temporal coverage is more than 75%. About 8% of the precipitation data is lost due to the use of EMEP flags for validity of the precipitation data in the CAMP database. In this current assessment only data with the flags 0.000, 0.780 and 0.781 and 0.999 – those explicitly mentioned in the CAMP Principles – were considered. These flags stand for valid (0.000) and invalid (0.780, 0.781 and 0.999) values for the concentration respectively.

The calculation of the yearly averaged values for **air/aerosol** was performed as described in the CAMP Principles. First the *monthly* averaged concentration in air/aerosol $\overline{C}_m$ was calculated by the averaging of the concentrations C_i. Each concentration C_i is weighted by its associated time interval t_i, for all sampling periods, such that:

$$\overline{C}_m = \sum_{i=1}^{N} C_i \times t_i \Big/ \sum_{i=1}^{N} t_i$$

where N is the number of *valid* sampling periods. This monthly averaged concentration in air/aerosol $\overline{C}_m$ was considered *valid* when α is larger than 0.50. The parameter α is defined as:

$$\alpha = \sum_{i=1}^{N} t_i \Big/ \sum_{i=1}^{M} t_i$$

where the first sum is over the *N valid* sampling periods and the second sum is over all sampling periods, *M in total*. Finally the *annual* average $\overline{C}_a$ is calculated as:

$$\overline{C}_a = \frac{1}{K} \sum_{m=1}^{K} \overline{C}_m$$

where *K* is the number of valid monthly averages. At least nine monthly values had to be available ($K \geq 9$) in order for an annual average to be valid.

For all data in this assessment we considered the data as invalid when it was either missing or below the limit of detection. Furthermore, the data had to satisfy the criteria of temporal coverage as explained above. Data which did not satisfy these criteria are marked red in the data tables presented in the Annexes 5 to 9, while valid data are marked yellow.

2.3.2 Calculation of trend curves

Trend analyses have been undertaken for both long-term data series (except for emissions) and for the period since 1998. The presentation of the trend results in this report focuses on 1998 – 2006. The long-term assessment periods are:

- 1987 – 2006 for nitrogen CAMP data;
- 1987 – 2002 for heavy metal CAMP data; these are the results of the trend analysis of the previous CAMP assessment (OSPAR, 2005) brought forward into this report;
- 1995 – 2006 for nitrogen EMEP deposition;
- 1990 – 2006 for contaminant EMEP deposition.

The trends in concentrations in air and precipitation are calculated using the software package RTrend (OSPAR, 2003). RTrend has been developed for trend assessments of riverine inputs. The statistical methods which are available within the software package can however also be used for the trend analysis of concentrations in air and precipitation. The results of the statistical calculations presented in this report are based on the Theil slopes to quantify the linear trend in the concentrations. Furthermore a Mann-Kendal test is performed to check whether the sign of the trend is significant.

The nomenclature of the statistical analysis is as follows:

Theil slope: From the slope of the linear function the relative change of value per year is deduced. It is the difference between the value at the end and the beginning of the time series, divided by the number of years. It is related to the value at the beginning of the period.

Estimated change of the level: This is the relative change of the value during the whole investigated time period. It is calculated as the difference between the corresponding Theil trend of the last and first year, related to the first year. Because the estimated change of the level is based on the Theil slope the decrease can be lower than -100.0%.

For trends of emissions and depositions from the EMEP model calculations, the slope and Mann-Kendall test have been performed using the Excel template *MakeSense* (Salmi *et al.*, 2002).

For both concentrations and emission/deposition a trend is considered significant if the confidence interval is >90% (which is equivalent to a p-value of <0.1).

2.4 Quality of the data

2.4.1 CAMP measurement results

The trend analysis of the air/aerosol measurements was hampered by incomplete reporting and by the invalidity of data according to the selection criteria described in the previous section.

The precipitation data is covering a large part of the OSPAR area and assessment period. However, incomplete reporting and a lack of valid data made trend analysis difficult to achieve for all monitoring stations. For some stations there are double sets of measurements data which do not match.

The CAMP Principles (OSPAR, 2001) recommend the use of four flags for valid and invalid values of concentrations (see section 2.3.1 above). However, there were a number of stations for which additional EMEP flags have been used in the time series. In this report data with EMEP flags were omitted from the procedure for calculating annual mean values for concentrations.

Data coverage is in general good for the Greater North Sea. All other Regions lack (data from) stations and the combination of these measurement results did not give a representative situation for the respective Regions. For example, in the Wider Atlantic, the largest area of the five OSPAR Regions, there is only one monitoring station (see Figure 2.2).

2.4.2 EMEP emission data

There are relevant uncertainties in the emissions of nitrogen. The ship emissions contribute significantly to the nitrogen depositions in the OSPAR maritime area, and their magnitude, distribution and trends are not very well known (OSPAR, 2007a).

Completeness and uncertainties of officially reported heavy metal emission data is an issue of significant concern within the LRTAP Convention. Estimates of the uncertainty associated with reported heavy metal emission data are very scarce. Available uncertainty estimates performed by national experts vary from 25% (Finland) to 260% (Denmark) (OSPAR, 2008c).

With the phase out of lindane in the OSPAR area, emission reporting has been discontinued by some countries, others confirmed no application of lindane (OSPAR, 2008c). From 2001 to 2006 only three countries continued to report emission data. In the cases of no reported information, the information compiled by Pacyna *et al.* (1999) on γ-HCH usage in the period 1990 – 1996 and expert estimates of γ-HCH emission for 2000 (Denier van der Gon *et al*., 2005) were used for model calculations. The estimates of γ-HCH emissions to the atmosphere and their spatial distribution are subject to significant uncertainties by a factor which can range from 2 to 5 (OSPAR, 2008c).

There are significant uncertainties associated with PCB-153 emission data. For model calculations three emission scenarios were used to account for this. The range of uncertainties of obtained PCB emission values is about one order of magnitude (OSPAR, 2008c).

EMEP annual inventory reviews provide insight into reporting patterns and shortcomings of emission data (for the last year of the assessed time series of emissions see Vestreng *et al*., 2006).

2.4.3 Chemical transport model results from EMEP MSC-W and MSC-E

A full account of the uncertainties associated with the model calculations are given in OSPAR (2007a) and OSPAR (2008c). The quality of the model calculations can be estimated by comparing the calculations with the CAMP measurements. The agreement between model calculations and measurements does not only depend on the model performance and the quality of the input parameters (emissions, meteorological data) but also on the quality of the CAMP measurement data (see 2.4.1 above).

For the calculations of nitrogen fluxes, there was in general an underestimation of the wet deposition. For reduced nitrogen and oxidized nitrogen, an underestimation by the model is calculated with respectively 20% and 40%, based on a comparison to European monitoring data including CAMP data.

For the calculations of the heavy metals lead, cadmium and mercury, the difference between modelled and measured depositions was commonly found to be within the ±50% range for Danish, German, Netherlands and Icelandic stations, but there were also cases where the difference between modelled and observed values was significantly larger (OSPAR, 2008c). In comparison with measurements for the Greater North Sea, the heavy metal model shows an underestimation of the wet deposition of lead and cadmium of about 30% and 50%, respectively.

The uncertainty of computed POPs deposition due to the variation of pollutant-specific and environmental parameters can reach 50% – 70% in remote regions.

In general, for all model calculations there was good agreement between observations and model results for stations in Region II. Regions near the boundary of the grid model, especially the Arctic Waters and the Wider Atlantic, were sensitive to the choice of the boundary conditions. Hence, the results for Regions I and V are expected to have a much larger uncertainty.

3. Emissions to the atmosphere

In this chapter the trend in national emissions of nitrogen, heavy metals, and P-153 and lindane are presented for each OSPAR country and selected relevant contributing countries. By summing up the emissions from countries bordering the OSPAR maritime area for each separate OSPAR Region, a quantitative comparison can be made between emissions in 1998 and 2006 for each Region. In the calculations the following countries were considered to influence the OSPAR Regions:

- Region I: Iceland, Norway and the Russian Federation;
- Region II: Norway, Sweden, Denmark, Germany, Netherlands, Belgium, France and UK;
- Region III: UK and Ireland;
- Region IV: France, Spain and Portugal;
- Region V: Iceland, Ireland, France, Spain and Portugal.

3.1 Nitrogen compounds

The emission data of nitrogen oxides (NO_x) and ammonia (NH_3) of OSPAR countries plus Italy, Poland and Russia for the period 1990 – 2006 are presented at Annex 1. Table 3.1 shows the results of the statistical trend analysis for all assessed countries and parameters for the period 1998 – 2006.

Overall, ***oxidised nitrogen (NO_x)*** emissions to the atmosphere from the assessed countries were lower in 2006 compared to 1990, except for Spain and Portugal which had an increase of NO_x emissions over this period (see Figure A1.1 in Annex 1). Emission levels in 2006 compared to 1990 for Luxembourg, Russia, Norway, Iceland and Ireland show no clear pattern. In the period 1998 – 2006, there was an overall downward trend in NO_x emissions except for Spain and Russia with upward trends; there is no statistically significant trend in emissions for Portugal.

The decrease in NO_x emissions can be linked to a) a reduction in the emissions from road transport by introducing emission EU standards for vehicles (EURO II, III, IV, V) and b) a reduction in the emissions of large combustion plants controlled under the EU Large Combustion Plant Directive (2001/80/EC) and EU Integrated Pollution and Prevention Control (IPPC) Directive (2008/1/EC).

An additional source of NO_x emissions for the OSPAR maritime area comes from international ship traffic. The total contribution from international ship traffic shows a steady rise over the period 1990 – 2006 and a statistically significant increase of 21% in 1998 – 2006 to 1826 kt NO_x (equivalent to 560 kt N) in 2006.

Figure 3.1 shows the sum of the NO_x emissions from neighbouring countries to each Region over the period 1998 – 2006. Comparing the emissions in 1998 and 2006 the following relative changes are observed. Region I showed an increase (+19%), while all other regions indicated a decrease; Region II -19%, Region III -20%, Region IV -6% and Region V -6%. The increase in Region I is due to Russia, that is among the three countries showing an increase in nitrogen emissions to the atmosphere of 22%.

Emissions of ***reduced nitrogen (NH_3)*** are shown in Figure A1.2 at Annex 1 for all 18 countries relevant for the OSPAR maritime area. In 1990 – 2006, there has been no clear change in emissions in most countries, except in the Netherlands, Denmark, Russia, Belgium, United Kingdom and Poland where annual emissions have fallen. For 1998 – 2006, Table 3.1 shows significant downward trends for many of the relevant countries but a clear increase in emissions in Spain. No trend was detectable in emissions in Norway and Portugal.

Figure 3.2 shows the sum of the NH_3 emissions from neighbouring countries to each Region over the period 1998 – 2006. Comparing the emissions in 2006 with respect to 1998 a decrease in emissions was observed for all Regions; Region -12%, Region II -9%, Region III -13%, Region IV -8% and Region V -9%. The decrease in Region I was due to the decrease in NH_3 emission to the atmosphere by Russia.

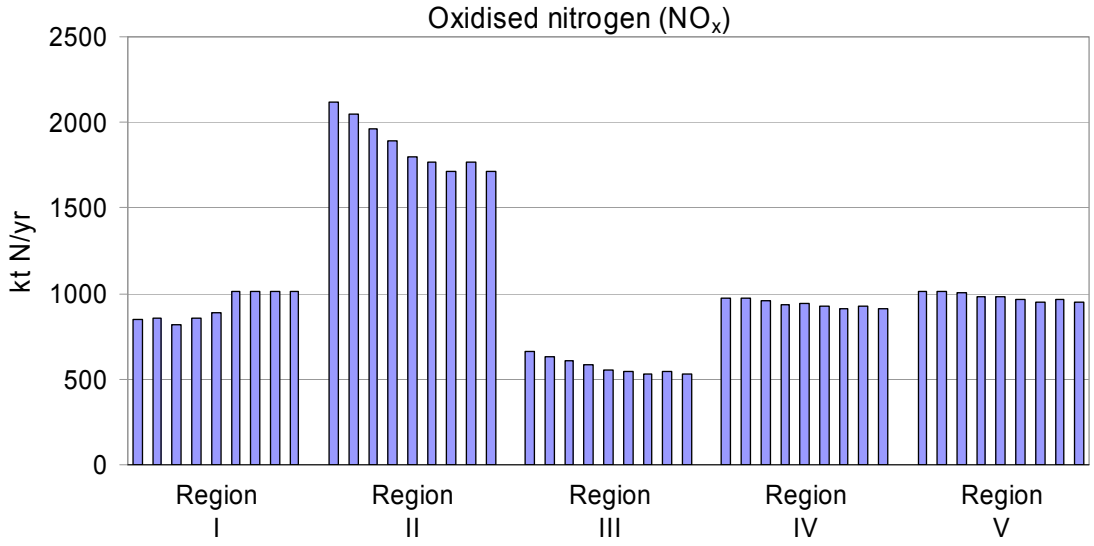


***Figure 3.1**: Sum of NO_x emissions of countries bordering each OSPAR Region for the period 1998 – 2006.*

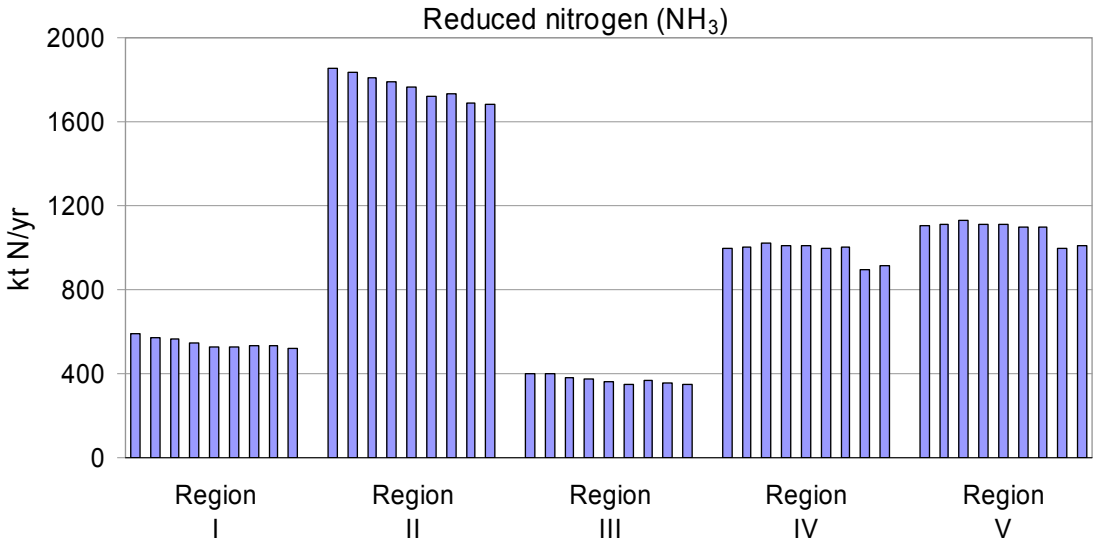


***Figure 3.2**: Sum of NH_3 emissions of countries bordering each OSPAR Region for the period 1998 – 2006.*

***Table 3.1**: Trend analysis of emissions over the period 1998 – 2006, presented as % increase (+, arrow up) or decrease (-, arrow down). Statistically significant trends (90% confidence interval) are indicated by the coloured cells (upward = red; downward = green). Grey cells: change is statistically not significant. Trend is given as Sen slope of MAKESENSE (Salmi* et al., *2002). Empty cells: no data.*

	Reduced nitrogen (NH_3)		Oxidised nitrogen (NO_x)		Lead		Cadmium		Mercury		γ-HCH		PCB-153	
Belgium	-22	↓	-15	↓	-61	↓	-57	↓	-34	↓	No trend		-35	↓
Denmark	-18	↓	-16	↓	-18	↓	No trend		-26	↓			-89	↓
Finland	No trend		-19	↓	-13	↓	No trend		+103	↑			-57	↓
France	-12	↓	-22	↓	-81	↓	-68	↓	-53	↓	-115*	↓	-71	↓
Germany	+6	↑	-23	↓	+14	↑	+7	↑	+8	↑			-86	↓
Iceland	No trend		No trend		No trend		No trend		No trend				No trend	
Ireland	-15	↓	-10	↓	-78	↓	-53	↓	No trend		No trend		-24	↓
Luxembourg	No trend		-11	↓	No trend		-67	↓	No trend		No trend		No trend	
Netherlands	-25	↓	-13	↓	No trend		+62	↑	+39	↑			-73	↓
Norway	No trend		-11	↓	-14	↓	-50	↓	-21	↓			-73	↓
Portugal	No trend		-5	↓	-48	↓	-7	↓	-15	↓	-114*	↓	No trend	
Spain	+16	↑	+7	↑	-74	↓	-17	↓	-15	↓	6	↑	-73	↓
Sweden	-13	↓	-17	↓	-31	↓	No trend		-24	↓			-42	↓
Switzerland	-8	↓	-24	↓	-63	↓	-57	↓	-83	↓			-80	↓
UK	-14	↓	-24	↓	-50	↓	-51	↓	-19	↓	-79	↓	-81	↓
Italy	-3	↓	-19	↓										
Poland	-12	↓	-15	↓	-28	↓	-23	↓	-36	↓				
Russia	-12	↓	+31	↑	-56	↓	+22	↑	+48	↑				
Shipping			+21	↑										

*The linear trend on the data gives negative emissions in 2006

3.2 Heavy Metals

The data on atmospheric emissions of cadmium, lead and mercury for the 15 OSPAR countries plus Russia and Poland used in this assessment are presented at Annex 2 for the period 1990 – 2006. Table 3.1 shows the results of the statistical trend analysis for all assessed countries for the period 1998 – 2006.

For lead the main emission sources contributing to atmospheric deposition in OSPAR countries and Russia and Poland are combustion in power plants and industry and industrial processes (76%) and transport (17%). For cadmium the main contributing sectors are combustion in power plants and industry and industrial processes (85%) and commercial, residential and other combustion (8%). For mercury combustion in power plants and industry and industrial processes (81%) and waste (13%) are the dominant sources (Figure 0.4).

The emissions of ***lead*** to the atmosphere have strongly declined in all countries over the period 1990 – 2006 (see Figure A2.1 in Annex 2). This is mainly due to the ban on leaded petrol. While there are statistically significant downward trends in most assessed countries in 1998 – 2006, most of the decrease in lead emissions has taken place before 2000 and emission levels have stagnated since. Figure 3.3 compares the sum of the emissions from the countries bordering the five OSPAR Regions in 1998 and 2006. This confirms a decrease for all Regions for lead emissions; Region I -84%, Region II -78%, Region III -86%, Region IV -76% and Region V: -76%.

The emissions of ***cadmium*** to the atmosphere have declined in most countries since 1990 with significant decreases in 1998 – 2006. However, emission levels have clearly stagnated since 2000 (see Figure A2.2 in Annex 2). Figure 3.3 presents the sum of cadmium emissions for the countries bordering the five OSPAR Regions for the years 1998 and 2006. It shows an increase in cadmium emissions for the Region I (+20%), and a decrease for the other Regions; Region II -46%, Region III -42%, Region IV -33% and Region V -34%. The increase in Region I is due to the increase of cadmium emissions from Russia.

In general, the atmospheric emissions of ***mercury*** show different patterns in 1990 – 2006. For Iceland, Luxembourg and Russia mercury emissions have increased while in Finland, Switzerland, France, Belgium, Ireland, UK and the Netherlands the emissions have declined (see Figure A2.3 in Annex 2). In 1998 – 2006, there was no statistically significant trend in a third of the assessed countries and a statistically significant increase of emissions in Finland, Germany, Netherlands and Russia. Figure 3.3 shows the sum of the emissions for the countries bordering the five OSPAR Regions for 1998 and 2006. Differences in atmospheric emissions of mercury between these two years show an increase for Region I (+42%), but a decrease for the other Regions; Region II -35%, Region III -30%, Region IV -34% and Region V -34%. The increase in Region I is due to the steady increase of atmospheric mercury emissions in Russia.

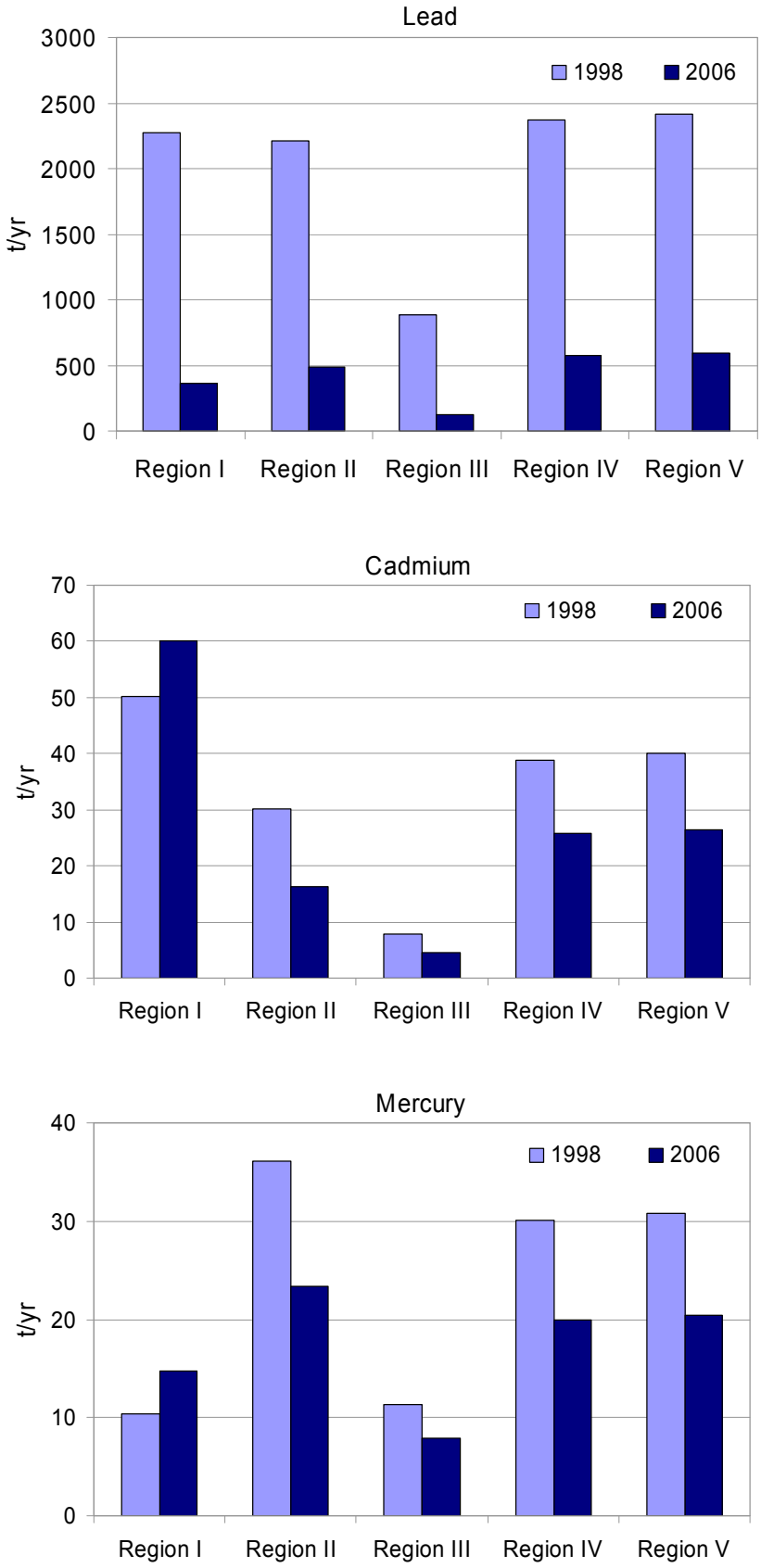


***Figure 3.3**: Comparison of the total atmospheric emissions of lead, cadmium and mercury to the five OSPAR Regions for the years 1998 and 2006.*

3.3 Organic contaminants

The data on atmospheric emissions are presented for nine countries for lindane (Figure A2.4) and 15 countries for PCB-153 (Figure 2.5) at Annex 2 for the period 1990 - 2006. Table 3.1 shows the results of the statistical trend analysis for the period 1998 – 2006.

Reported emissions of lindane have decreased in 1990 – 2006. With the phase out of lindane, emission reporting has been discontinued by some countries, others confirmed no application of lindane. In 2001 – 2006, emission data were available only for Belgium, Spain and the UK. Based on the limited data, there has been a statistically significant downward trend in lindane emissions in 1998 – 2006 in France and the UK and a significant upward trend in Spain. Figure 3.4 presents the sum of the lindane emissions for the countries bordering the five OSPAR Regions for the years 1998 and 2006. It shows a decrease in emissions as follows; Regions II -90%, Region III -72%, Region IV -76% and Region V -89%. For Region I zero emissions were reported for 1998 and 2006. The large reductions in most areas were the result of reductions of emissions in the United Kingdom and, prior to 2000, in France.

Atmospheric PCB-153 emissions have decreased in all countries in 1990 – 2006. Significant downward trends continued over the period 1998 – 2006 for most countries. Figure 3.5 sums up the emissions from the countries bordering the five OSPAR Regions for 1998 and 2006. There was a decrease in all Regions as follows: Region I -50%, Region II -66%, Region III -70%, Region IV -67% and Region V -66%.

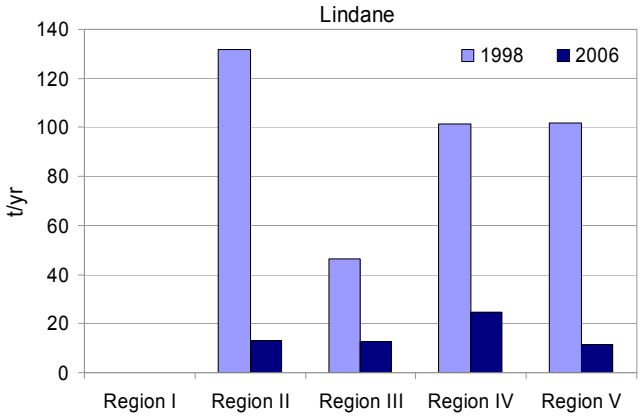


***Figure 3.4**: Comparison of the total atmospheric emissions of lindane to the different OSPAR Regions for the years 1998 and 2006.*

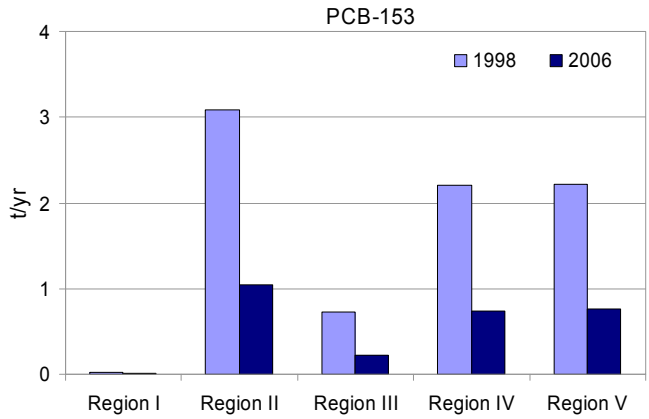


***Figure 3.5**: Comparison of the total atmospheric emissions of PCB-153 to the five OSPAR Regions for the years 1998 and 2006.*

3.4 Regional summary of trends in atmospheric emissions

While emissions from land based sources have decreased overall since 1998 by roughly 20% for oxidised nitrogen (to around 2300 kt N in 2006) and 10% for reduced nitrogen (also to 2300 kt N in 2006), emissions from shipping have increased by 21% in that period to 556 kt N in 2006. Emission reductions have slowed since 1998. Emission sources from Italy, Poland and Russia have together reached almost 2000 kt N in 2006 which also contribute to atmospheric inputs of nitrogen to the OSPAR area.

Atmospheric emissions of cadmium, lead and mercury have overall decreased in 1990 – 2006 but much of the reductions have been achieved in the 1990s and overall emissions to air have been relatively constant since 2000. More than 1000 tonnes of lead and around 40 tonnes each of cadmium and mercury were released by OSPAR countries to the atmosphere in 2006. Poland and Russia together emitted to air around 900 tonnes of lead, 100 tonnes of cadmium and 35 tonnes of mercury in 2006. Emissions from other parts of the world also contribute to deposition in the OSPAR area. The hemispheric emissions of mercury, for example, are dominated by emission sources in Asia (OSPAR, 2008c).

Emissions of PCB-153 and lindane have been continuously decreasing throughout the period 1990 – 2006 as a result of the ban of PCBs and the phase out of lindane. However, emissions have still occurred, for example lindane from stockpiles and imported products, and PCBs from wastes and as by-product of combustion. Long-range transport of emissions of PCBs and lindane from sources outside OSPAR also contribute to pressures on the OSPAR area.

At the level of OSPAR Regions, emissions of nitrogen, heavy metals and PCB-153 were lower in 2006 than in 1998, except for oxidised nitrogen, cadmium and mercury in Region I which were higher than in 1998 (Table 3.2).

***Table 3.2**: Comparison of the total atmospheric emissions of nitrogen and contaminants from countries bordering each of the five OSPAR Regions for the years 1998 and 2006 (in %).*

	NO_x	NH_3	Cadmium	Lead	Mercury	γ-HCH	PCB-153
Region I	+20	-12	+20	-84	+42	-	-50
Region II	-19	-9	-46	-78	-35	-90	-66
Region III	-20	-13	-42	-86	-30	-72	-70
Region IV	-6	-8	-33	-76	-34	-76	-67
Region V	-6	-9	-34	-76	-34	-89	-66

4. Measured concentrations in precipitation

The annual mean of measured concentrations of nitrogen, heavy metals and lindane in precipitation were calculated as described in section 2.3.1. The results are listed in Annexes 5, 6 and 9. Subsequently the statistical software package RTrend was used to calculate the trend lines of the time series. The most robust statistical method was chosen from this statistical software package, which calculates the Theil slope and checks the significance of an upward or downward trend via a Mann-Kendall test. The criteria are defined in section 2.3.2 were applied.

In order to place the detected trends for 1998 – 2006 in perspective, an overview of the trends since the beginning of the monitoring period in 1987 is given. In the case of nitrogen, a trend analysis has been performed on data for 1987 – 2006 for those stations which have been selected for trend analysis for the period 1998 – 2006. For the heavy metals the results of the trend analysis performed in the 2005 CAMP data assessment covering the period 1987 – 2002 (OSPAR, 2005) are summarised.

4.1 Nitrogen in precipitation

Ammonium (NH_4) and nitrate (NO_3) are the nitrogen components analysed in precipitation on a mandatory basis. The only Region which has been monitored to a large extent is Region II. The other Regions lack monitoring stations or do not have sufficient valid data to allow for a consistent trend analysis (see Annex 5).

Table 4.1 (ammonium) and Table 4.2 (nitrate) show the results of the respective trend analysis, with the analysis for the total period at the top (a) and the period 1998 – 2006 at the bottom (b). Values presented in bold indicate that the calculated trend curve is statistically significant (above the statistical 90% significance level), the lower limit in the previous OSPAR assessment report (OSPAR, 2005). Values in italics indicate situations where a visual trend could be observed, but significance was below the 90% confidence. In the tables the Theil slope is coloured green for downward trends, and red when the trend is upward, irrespective of the p-value. Figures 4.1 and 4.2 summarise the trend analysis for ammonium and nitrate. Section 4.5 summarises the trend analysis of nitrogen for each OSPAR Region.

***Table 4.1a**: Trend analysis of ammonium in precipitation over the entire monitoring period (1987 – 2006). Values in bold are statistically significant, i.e. above the 90% confidence level. Values in italics indicate a visual but statistically non-significant trend. The Theil slope is shown in green for downward trends, and red for upward trends.*

Region	Station	Period	P-value Mann-Kendall test	Theil slope	Estimated change of the level
Region I	IS0090	1999-2006	0.108	4.4%	**31.0%**
	NO0039	1987-2006	0.581	0.8%	**15.6%**
	NO0057	1992-2006	0.373	-3.0%	**-42.2%**
Region II	DE0001	1987-2005	0.162	-1.3%	**-22.9%**
	DK0008	1999-2006	0.260	-2.0%	**-14.1%**
	DK0020	1998-2006	0.707	-2.8%	**-22.7%**
	FR0090	**1993-2006**	**0.002**	**-9.5%**	**-123.3%**
	GB0013	2001-2006	0.133	19.9%	**99.6%**
	GB0014	**1987-2006**	**0.092**	**-1.6%**	**-30.3%**
	NL0009	**1994-2005**	**0.020**	**-4.2%**	**-46.0%**
	NL0091	**1996-2006**	**0.020**	**-5.3%**	**-26.4%**
	NO0001	**1987-2006**	**0.001**	**-2.2%**	**-41.4%**
	NO0099	1988-2003	0.224	1.8%	**26.5%**
	SE0014	2002-2006	0.806	1.2%	**4.7%**
	SE0098	1999-2005	0.548	-3.1%	**-18.4%**
Region III	**GB0006**	**1987-2006**	**0.048**	**-2.1%**	**-39.4%**
Region IV	ES0008	2002-2006	0.221	-8.7%	**-34.7%**

***Table 4.1b**: Trend analysis of ammonium in precipitation over the period 1998 – 2006; see Table 4.1a for details.*

Region	Station	Period	P-value Mann-Kendall test	Theil slope	Estimated change of the level
Region I	*IS0090*	*1999-2006*	*0.108*	*4.4%*	*31.0%*
	NO0039	1998-2006	0.466	1.9%	15.4%
	NO0057	1998-2006	1.000	0.3%	1.4%
Region II	DE0001	1998-2005	0.536	1.8%	12.5%
	DK0008	*1999-2006*	*0.260*	*-2.0%*	*-14.l%*
	DK0020	1998-2006	0.707	-2.8%	-22.7%
	FR0090	**1999-2006**	**0.072**	**-14.3%**	**-100.3%**
	GB0013	*2001-2006*	*0.133*	*19.9%*	*99.6%*
	GB0014	2000-2006	1.000	0.7%	4.3%
	NL0009	1998-2005	0.548	-1.6%	-11.1%
	NL0091	**1998-2006**	**0.076**	**-1.8%**	**-14.1%**
	NO0001	1998-2006	0.917	-0.2%	-1.7%
	NO0099	*1998-2003*	*0.133*	*19.9%*	*99.3%*
	SE0014	2002-2006	0.806	1.2%	4.7%
	SE0098	1999-2005	0.548	-3.1%	-18.4%
Region III	GB0006	2001-2006	1.000	0.9%	4.3%
Region IV	*ES0008*	*2002-2006*	*0.221*	*-8.7%*	*-34.7%*

***Table 4.2a**: Trend analysis of nitrate in precipitation over the entire monitoring period 1987 – 2006; see Table 4.1a for details.*

Region	Station	Period	P-value Mann-Kendall test	Theil slope	Estimated change of the level
Region I	IS0090	1994-2006	0.533	1.4%	**16.4%**
	NO0039	1987-2006	0.889	0.3%	**5.5%**
	NO0057	1987-2005	0.649	0.6%	**11.3%**
Region II	**DE0001**	**1987-2005**	**0.004**	**-1.7%**	**-30.2%**
	DK0008	1990-2006	0.244	-0.8%	**-13.5%**
	DK0020	1998-2006	0.707	2.1%	**16.5%**
	FR0090	1993-2006	0.283	-2.9%	**-37.2%**
	GB0013	2001-2006	0.452	5.8%	**28.8%**
	GB0014	**1987-2006**	**0.013**	**-1.4%**	**-25.7%**
	NL0009	**1994-2005**	**0.043**	**-3.1%**	**-33.9%**
	NL0091	**1996-2006**	**0.020**	**-5.9%**	**-29.4%**
	NO0001	**1987-2006**	**0.002**	**-1.7%**	**-32.3%**
	NO0099	1987-2003	0.822	0.2%	**3.1%**
	SE0014	**2002-2006**	**0.086**	**-4.1%**	**-16.3%**
	SE0098	1999-2005	0.548	-1.7%	**-10.1%**
Region III	IE0001	1987-2006	0.107	-1.9%	**-36.6%**
	GB0006	**1993-2006**	**0.063**	**-4.0%**	**-51.5%**
Region IV	**ES0008**	**1999-2006**	**0.063**	**15.7%**	**110.3%**
	PT0003	1994-2004	0.764	1.6%	**16.4%**
Region V	PT0010	1999-2003	0.462	24.9%	**99.8%**

***Table 4.2b**: Trend analysis of nitrate in precipitation over the period 1998 – 2006.*

Region	Station	Period	P-value Mann-Kendall test	Theil slope	Estimated change of the level
Region I	IS0090	1999-2006	0.902	-0.6%	**-4.4%**
	NO0039	*1998-2006*	*0.174*	*5.6%*	***44.4%***
	NO0057	1998-2005	0.902	-2.5%	**-17.3%**
Region II	DE0001	1998-2005	0.536	-2.0%	**-14.4%**
	DK0008	**1999-2006**	**0.035**	**-3.0%**	**-21.1%**
	DK0020	1998-2006	0.707	2.1%	**16.5%**
	FR0090	1999-2006	0.548	5.5%	**38.5%**
	GB0013	2001-2006	0.452	5.8%	**28.8%**
	GB0014	2000-2006	0.452	-1.6%	**-9.8%**
	NL0009	1998-2005	0.764	-1.4%	**-9.7%**
	NL0091	**1998-2006**	**0.076**	**-2.1%**	**-17.0%**
	NO0001	1998-2006	0.917	-0.2%	**-1.6%**
	NO0099	**1999-2003**	**0.086**	**13.0%**	**52.0%**
	SE0014	**2002-2006**	**0.086**	**-4.1%**	**-16.3%**
	SE0098	1999-2005	0.548	-1.7%	**-10.1%**
Region III	IE0001	2001-2006	1.000	-1.1%	**-5.5%**
	GB0006	2001-2006	0.452	-3.0%	**-14.8%**
Region IV	**ES0008**	**1999-2006**	**0.063**	**15.7%**	**110.3%**
	PT0003	2000-2004	1.000	12.9%	**51.6%**
Region V	PT0010	1999-2003	0.462	24.9%	**99.8%**

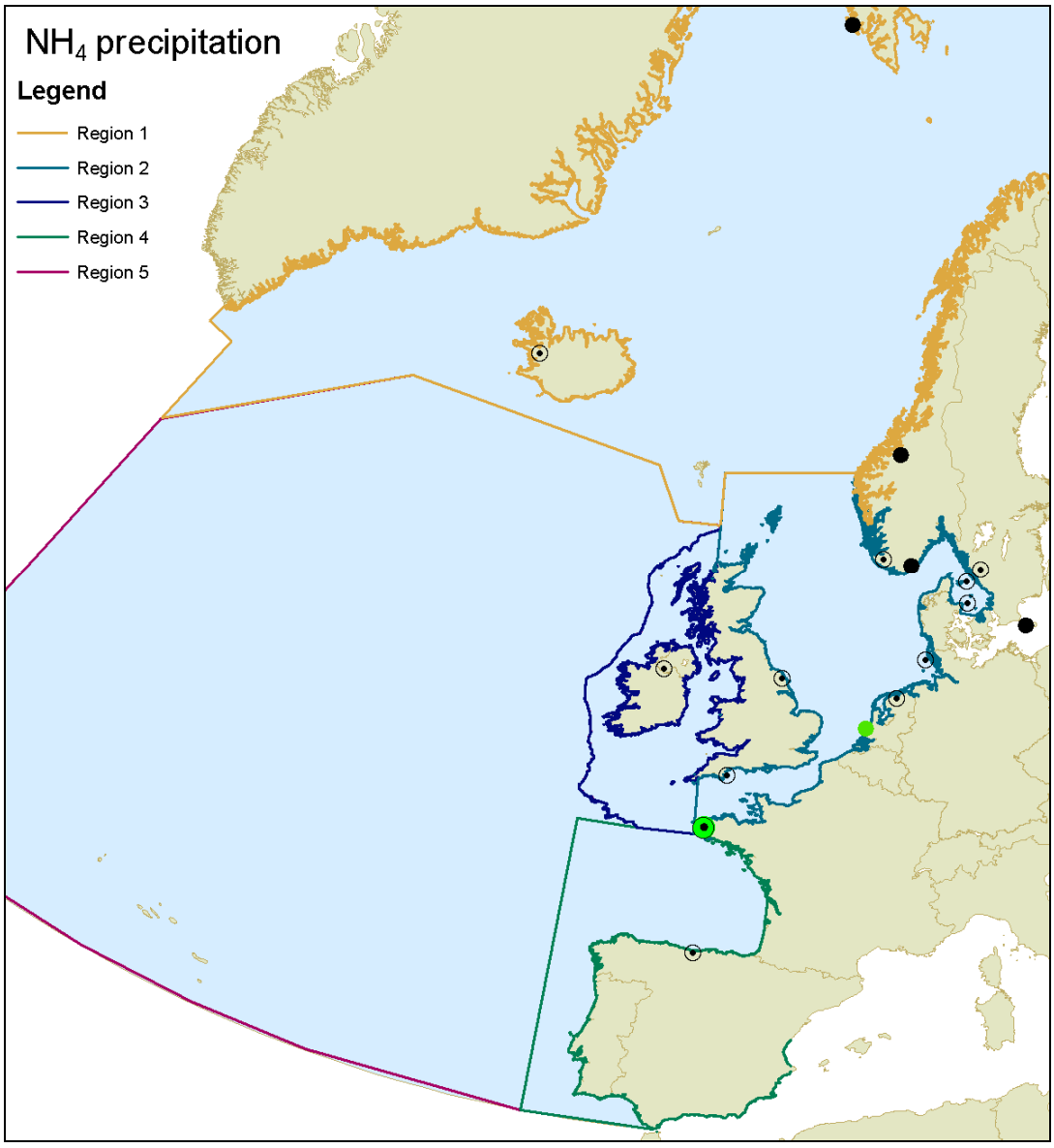


***Figure 4.1**: Geographical distribution of results from trend analysis for ammonium in precipitation. Green dots indicate statistically significant downward trends, red dots statistically significant upward trends and black dots indicate no trends above the 90% significance level. A black circle around the dots indicates that the period 1998 – 2006 was not fully covered. There are potentially 3 sizes for the dots. Small size: the slope is less than 10%; medium size: the slope is between 10% and 20%; and large size: the slope is above 20%. In this graph only small and medium size dots are depicted.*

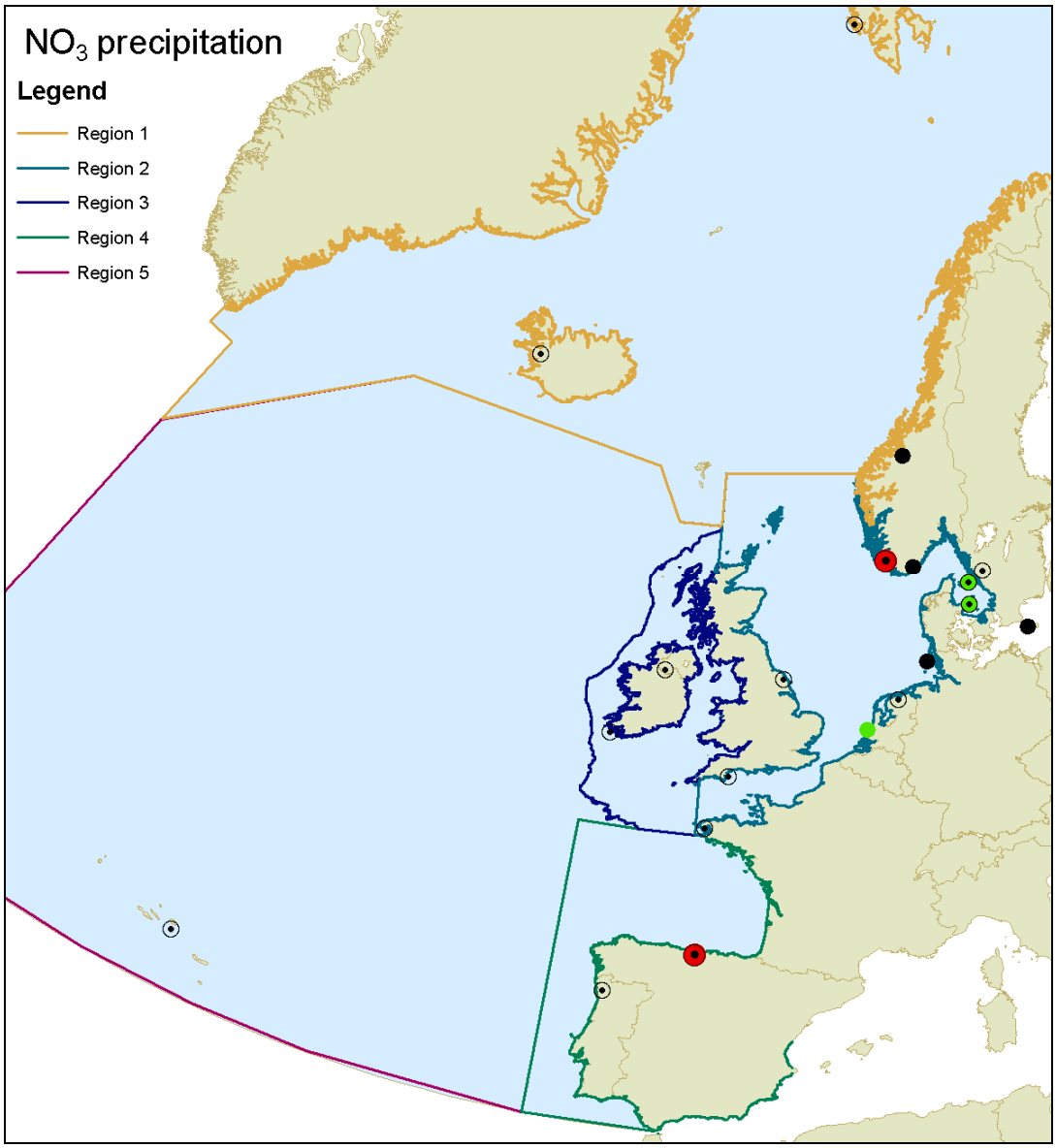


***Figure 4.2**: Geographical distribution of results from the trend analysis for nitrate in precipitation. For explanation see Figure 4.1. In this graph only small and medium size dots are depicted.*

4.2 Heavy metals in precipitation

The results of the trend analysis for the selected heavy metals lead, cadmium and mercury from the previous CAMP assessment (OSPAR, 2005) covering the period 1987 – 2002 are summarised in Table 4.3a. The results of the trend analysis for the period 1998 – 2006 are shown in Table 4.3b. The presentation in the tables is in a similar style as for the nitrogen components. For the CAMP data see Annex 6.

The only Regions which are sufficiently covered for trend analysis of heavy metals in precipitation are the Regions I and II. The other Regions lack either stations or do not have sufficient valid data for the period 1998 – 2006. Figures 4.3 and 4.4 summarise the trend analysis of lead and cadmium. Section 4.5 summarises the trend analysis of the heavy metals for each Region.

***Table 4.3a**: Results of the previous assessment (1987 – 2002) for Region II of the trend analysis of the heavy metals in precipitation. See Table 4.1a for details.*

Component	Station	Period	P-value Mann-Kendall	Slope
Lead	**BE0004**	**1996-2002**	**0.05**	**-9%**
	DE0001	**1990-2002**	**0.05**	
	DK0031	**1989-2002**	**0.001**	**-16%**
	FR0090	**1989-2002**	**0.05**	
	GB0090	**1989-2002**	**0.001**	**-14%**
	GB0091	**1990-2002**	**0.05**	
	NO0001	**1990-2002**	**0.001**	**-13%**
	SE0097	**1996-2002**	**0.05**	**-14%**
Cadmium	**DK0031**	**1989-2002**	**0.05**	**-7%**
	GB0090	**1990-2000**	**0.05**	
	NL0091	**1989-2002**	**0.05**	
	NO0001	**1987-2002**	**0.01**	**-8%**
	NO0099	**1990-2002**	**0.10**	
	SE0097	**1996-2002**	**0.05**	
	SE0098	**1987-1994**	**0.05**	
Mercury	**NL0091**	**1990-2001**	**0.001**	
	SE0002	**1991-2002**	**0.01**	**-12%**

***Table 4.3b**: Trend analysis of heavy metals in precipitation for the period 1998 – 2006; see Table 4.1a for details.*

Component and Region	Station	Period	P-value Mann-Kendall	Theil slope	Estimated change of the level
Lead					
Region I	*IS0090*	*1998-2006*	*0.175*	*-6.4%*	*-51.1%*
	IS0091	2002-2006	0.806	-2.5%	-9.9%
Region II	*DE0001*	*1998-2006*	*0.118*	*-5.2%*	*-41.7%*
	DK0008	**1999-2006**	**0.009**	**-9.1%**	**-64.1%**
	DK0020	2000-2006	0.452	-5.6%	-33.5%
	DK0031	*1998-2005*	*0.133*	*-4.5%*	*-31.6%*
	FR0090	**1999-2006**	**0.007**	**-13.0%**	**-90.7%**
	GB0091	1998-2004	0.221	6.0%	35.7%
	NL0009	1998-2006	1.000	-0.2%	-1.6%
	NL0091	**1998-2006**	**0.048**	**-3.6%**	**-28.4%**
	NO0001	*1998-2006*	*0.118*	*-3.6%*	*-29.0%*
	NO0099	1998-2003	1.000	4.5%	22.7%
	SE0097	**1998-2006**	**0.016**	**-7.6%**	**-60.6%**
Cadmium					
Region II	**DE0001**	**1998-2006**	**0.009**	**-11.1%**	**-89.2%**
	DK0008	1999-2006	0.536	-4.7%	-33.1%
	DK0020	2000-2006	0.26	-10.8	-64.9%
	DK0031	*1998-2005*	*0.133*	*-5.6%*	*-39.4%*
	FR0090	1999-2006	0.230	20.4%	142.9%
	GB0091	1998-2004	0.806	-6.7%	-40.5
	NL0091	**1998-2006**	**0.072**	**-9.7%**	**-38.6%**
	SE0097	1998-2006	0.348	-3.3%	-26.1%
Mercury					
Region II	DE0001	1998-2006	0.348	-1.7%	-13.9%
	NL0091	1998-2006	0.348	-2.3%	-18.4%

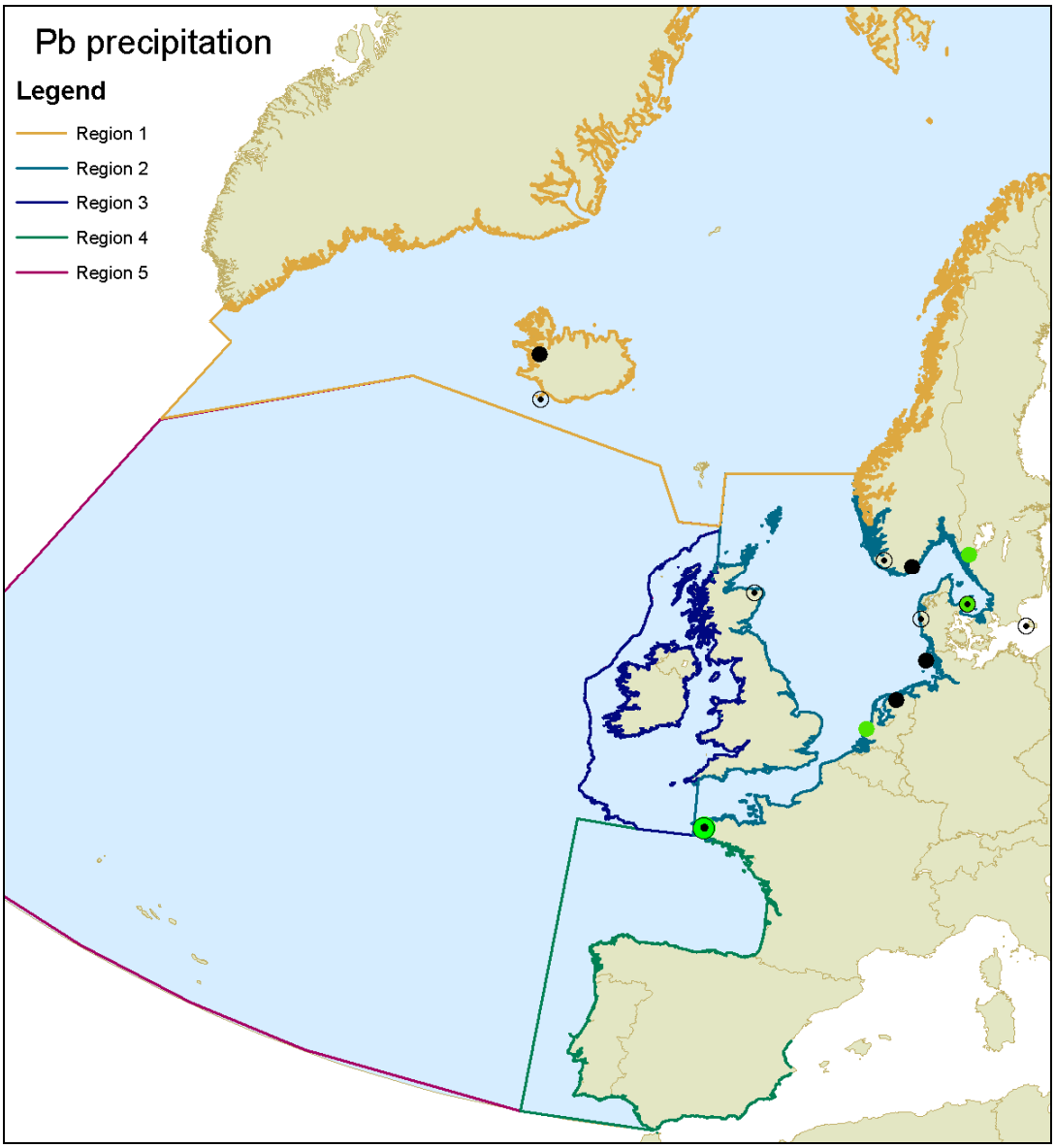


***Figure 4.3**: Geographical distribution of results from trend analysis for lead in precipitation. See Figure 4.1 for details. In this graph only small and medium size dots are depicted.*

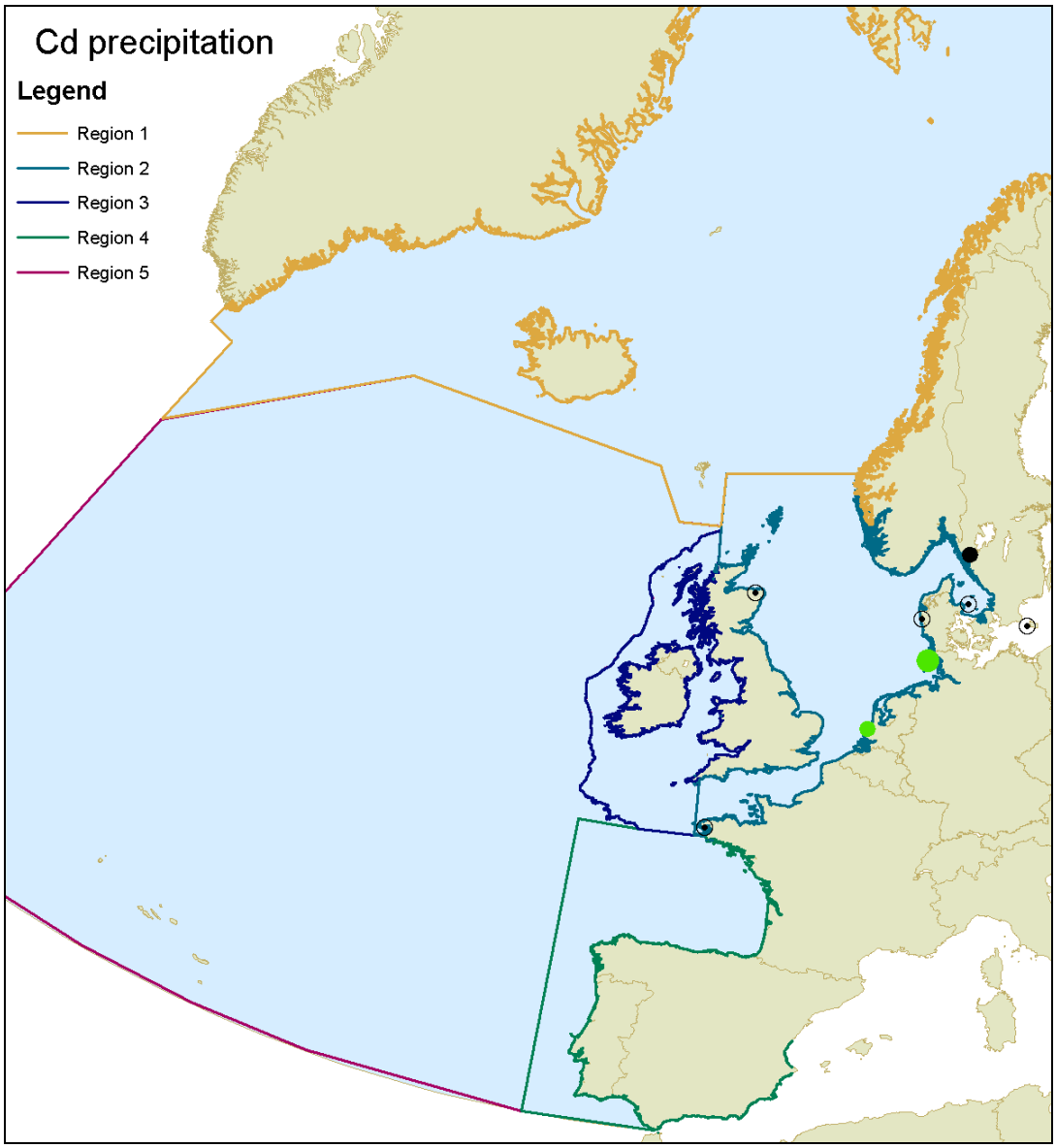


***Figure 4.4**: Geographical distribution of results from trend analysis for cadmium in precipitation. See Figure 4.1 for details. In this graph only small and medium size dots are depicted.*

4.3 Trend analysis of other heavy metals in precipitation

The annual mean concentrations in precipitation of the other heavy metals, *i.e.* arsenic, chromium, copper, nickel and zinc have been calculated (Annex 6). Table 4.4 summarises the results of the trend calculations for these analytes. Most trends are downward but only a few are statistically significant (above the 90% significance level).

***Table 4.4**: Trend analysis of other heavy metals in precipitation for the period 1998 – 2006; see Table 4.1a for details.*

Component and Region	Station	Period	P-value Mann-Kendall test	Theil slope	Estimated change of the level
Arsenic					
Region II	DE0001	1998-2006	0.348	-2.8%	**-22.5%**
	DK0008	**1999-2006**	**0.019**	**-7.4%**	**-51.7%**
	DK0020	2000-2006	0.260	-5.6%	**-33.2%**
	DK0031	*1998-2005*	*0.133*	*-7.7%*	***-54.0%***
	FR0090	1999-2005	0.260	41.2%	**247.4%**
Chromium					
Region II	*DE0001*	*1998-2006*	*0.175*	*-3.3%*	***-26.3%***
	DK0008	1999-2006	0.386	-3.1%	**-21.8%**
	DK0020	2000-2006	0.707	14.8%	**88.5%**
	DK0031	1998-2005	0.548	-0.6%	**-4.3%**
	FR0090	1999-2006	0.230	-1.6%	**-11.3%**
	GB0091	*1998-2004*	*0.221*	*-21.3%*	***-127.7%***
Copper					
Region I	IS0090	1998-2006	0.917	0.7%	**5.9%**
	IS0091	2002-2006	0.806	-0.8%	**-3.1%**
Region II	*DE0001*	*1998-2006*	*0.118*	*-13.4%*	***-107.4%***
	DK0008	1999-2006	0.536	-4.5%	**-31.6%**
	DK0020	2000-2006	1.000	-7.5%	**-44.7%**
	DK0031	1998-2005	0.452	46.9%	**164.1%**
	FR0090	1999-2006	0.230	-3.8%	**-26.9%**
	GB0091	1998-2004	0.462	-8.5%	**-51.3%**
	NL0009	1998-2006	0.707	3.1%	**25.2%**
	NL0091	1998-2006	1.000	-1.0%	**-8.0%**
	NO0099	1998-2003	0.452	3.6%	**18.1%**
	SE0097	1998-2006	0.230	-17.4%	**-69.8%**

***Table 4.4**: Trend analysis of other heavy metals in precipitation (continued)*

Component and Region	Station	Period	P-value Mann-Kendall	Theil slope	Estimated change of the level
Nickel					
Region I	IS0090	1998-2006	0.452	12.2%	**48.9%**
Region II	**DE0001**	**1998-2006**	**0.076**	**-12.6%**	**-100.6%**
	DK0008	1999-2006	0.536	-1.7%	**-12.2%**
	DK0020	2000-2006	0.707	4.1%	**24.5%**
	DK0031	1998-2005	0.368	7.9%	**55.5%**
	FR0090	1999-2006	0.548	-6.7%	**-47.0%**
	GB0091	1998-2004	0.806	3.6%	**21.7%**
	SE0097	1998-2006	0.266	9.9%	**78.9%**
Zinc					
Region I	IS0090	1998-2006	0.251	-9.3%	**-74.5%**
	IS0091	2002-2006	0.806	3.8%	**15.0%**
Region II	**DE0001**	**1998-2006**	**0.048**	**-11.4%**	**-91.3%**
	DK0008	1999-2006	0.711	-0.3%	**-2.0%**
	DK0020	2000-2006	0.452	-4.6%	**-27.8%**
	DK0031	1998-2005	1.000	-0.4%	**-2.9%**
	FR0090	1999-2006	1.000	-1.5%	**-10.6%**
	GB0091	1998-2004	0.806	-6.2%	**-37.5%**
	NL0009	1998-2006	0.462	-3.2%	**-25.9%**
	NO0001	1998-2006	0.917	0.5%	**3.8%**
	NO0099	1998-2003	1.000	0.0%	**0.0%**
	SE0097	**1998-2006**	**0.048**	**-12.1%**	**-96.5%**
Region III	*IE0001*	*1998-2006*	*0.108*	*-10.6%*	***-84.9%***
Region IV	PT0003	2000-2006	0.462	35.0%	**105.0%**
	PT0004	2000-2005	0.462	-13.3%	**-33.3%**

4.4 Lindane in precipitation

The annual mean concentrations in precipitation of lindane are summarised in Annex 9. A trend analysis could be undertaken for a few stations only. The results are summarised in Table 4.5. All trends are downward and statistically significant.

***Table 4.5**: Trend analysis of lindane in precipitation; for details see Table 4.1a.*

Region	Station	Period	P-value Mann-Kendall	Theil slope	Estimated change of the level
Region I	**IS0091**	**1999-2006**	**0.009**	**-13.2%**	**-92.7%**
Region II	**DE0001** **NO0099**	**1998-2006** **1998-2003**	**0.003** **0.027**	**-13.8%** **-42.6%**	**-110.3%** **-106.5%**

4.5 Regional summary of pollutant concentrations in precipitation

The results of the trend analysis for concentrations of pollutants in precipitation, summarised per Region over the period 1998 – 2006, are presented in Table 4.6b. Similarly, in Table 4.6a the summary for the entire monitoring period (1987 – 2006) is given.

For the Regions, where trend analysis could be performed, it is clear that the concentrations of heavy metals and lindane have decreased over the past decade (1998 – 2006). For the nitrogen compounds, there has been a slight increase (non-significant) in Region I, a decreasing trend for most stations in Region II and a substantial increase of nitrate in precipitations in the Regions IV (significant) and V (non-significant). For ammonium considerable decreasing trends were observed for the Region II (significant) and Region IV (non-significant).

***Table 4.6**: Regional summary of the mean % trend in concentrations of pollutants in precipitation at CAMP monitoring stations (a) in the period 1987 – 2006 for nitrogen and 1987 – 2002 for heavy metals, and (b) in the period 1998 – 2006.*

statistically significant upward trend; statistically significant downward trend; while mean trend is upward, more stations showed a downward trend.

Table 4.6a	1987 – 2006		1987 – 2002		
	NO_3	NH_4	Pb	Cd	Hg
Region I	+0.8	+0.7	--	--	--
Region II	-3.0	-4.6	-13.2	-7.5	-12.0
Region III	-4.0	-2.1	--	--	--
Region IV	+15.7	-8.7	--	--	--
Region V	+24.9	--	--	--	--

Table 4.6b	1998 – 2006					
	NO_3	NH_4	Pb	Cd	Hg	γ-HCH
Region I	+0.8	+2.2	-4.5	--	--	-13.2
Region II	+1.0	-8.1	-8.3	-10.4	-2.0	-28.2
Region III	-2.1	+0.9	--	--	--	--
Region IV	+15.7	-8.7	--	--	--	--
Region V	+24.9	--	--	--	--	--

5. Measured concentrations in air

The annual mean concentrations of nitrogen and heavy metals in air/aerosol were calculated as described in section 2.3.1. The results are listed in Annexes 7 and 8. Subsequently the statistical software package RTrend was used to calculate the trend curves of the time series of nitrogen and heavy metals concentrations. As for the trend assessment for concentrations in precipitation (section 4), the most robust statistical method was selected from this statistical software package, which calculates the Theil slope and checks the significance of upward or downward trends using a Mann-Kendall test.

The selection criteria for data time series given in section 2.2.1 were applied. The focus was on the trend analysis of the period 1998 – 2006. For nitrogen, a trend analysis was also performed for the whole monitoring period 1987 – 2006 for those monitoring stations that were selected for the trend analysis for the period 1998 – 2006. For heavy metals, a summary of the trend analysis results of the previous CAMP assessment (OSPAR, 2005) for the period 1987 – 2002 is presented.

5.1 Nitrogen in air/aerosol

The annual mean concentrations of nitrogen compounds were calculated for nitrogen dioxide (NO_2), the sum of ammonia and ammonium (sNH_4) and the sum of nitric acid and nitrate (sNO_3), see Annex 7. Region II is the only OSPAR Region which was monitored to a large extent. The other Regions lack monitoring stations or do not have sufficient valid data to allow for a sound trend analysis for the period 1998 – 2006.

Table 5.1a shows the results of the trend analysis for the entire monitoring period (1987 – 2006). Table 5.1b presents the trend analysis results for the period 1998 – 2006. Values presented in bold indicate that the calculated trend curve was statistically significant (above the above 90% significance level). Values in italics indicate that a trend could be observed visually, but this trend was not significant. Theil slope data are shown in green for downward trends, and red for upward trends, irrespective of the p-value. The Figures 5.1 to 5.3 summarise the results of the trend analysis of the nitrogen components. Section 5.3 summarises the trend analysis for each OSPAR Region.

***Table 5.1a**: Trend analysis of nitrogen compounds in air/aerosol for the period 1987 – 2006; values in bold are statistically significant (above 90% confidence level); values in italics indicate a visual but statistically non-significant trend; the Theil slope is in green for downward trends, and red for upward trends.*

Component and Region	Station	Period	P-value Mann-Kendall	Theil slope	Estimated change of the level
NO_2					
Region I	NO0039	1987-2006	0.144	-1.3%	**-24.0%**
Region II	BE0011	1990-2006	0.434	-0.2%	**-3.8%**
	BE0013	1990-2006	0.837	0.2%	**3.8%**
	DE0001	1987-2005	0.124	-0.8%	**-15.1%**
	NL0009	**1994-2005**	**0.002**	**-2.4%**	**-26.3%**
	NL0091	**1996-2006**	**0.043**	**-2.8%**	**-27.5%**
	NO0001	**1987-2006**	**<0.001**	**-3.9%**	**-74.9%**
	SE0014	2002-2006	0.462	2.2%	**8.6%**
Region III	IE0001	1987-2006	0.537	0.6%	**10.7%**
Region IV	ES0008	1999-2006	0.536	-0.9%	**-6.5%**
sNH_4					
Region I	**NO0039**	**1988-2006**	**0.002**	**4.5%**	**81.2%**
	NO0042	**1991-2006**	**<0.001**	**11.1%**	**382.7%**
Region II	**DK0008**	**1989-2006**	**<0.001**	**-2.9%**	**-49.7%**
	NO0001	1987-2006	0.496	-0.4%	**-7.5%**
	SE0014	2002-2006	0.806	-2.6%	**-10.5%**
Region IV	ES0008	1999-2006	0.902	-4.4%	**-31.2%**
sNO_3					
Region I	**NO0039**	**1988-2006**	**0.100**	**2.4%**	**53.3%**
	NO0042	1991-2006	0.276	3.8%	**75.2%**
Region II	**DK0008**	**1989-2006**	**0.003**	**-1.8%**	**-26.2%**
	DK0031	**1990-2006**	**0.020**	**-3.0%**	**-38.7%**
	NO0001	1987-2006	0.721	-0.2%	**-4.2%**
	SE0014	2002-2006	0.806	-3.4%	**-13.5%**
Region IV	ES0008	1998-2006	0.108	6.6%	**46.5%**

***Table 5.1b**: Trend analysis of nitrogen compounds in air/aerosol for the period 1998 – 2006; see Table 5.1a for details.*

Component and Region	Station	Period	P-value Mann-Kendall	Theil slope	Estimated change of the level
NO_2					
Region I	NO0039	1998-2006	0.466	-0.8%	-6.2%
Region II	*BE0011*	*1998-2006*	*0.118*	*-1.6%*	*-13.0%*
	BE0013	1998-2006	0.754	-0.6%	-4.9%
	DE0001	1998-2006	0.602	1.0%	8.3%
	NL0009	**1998-2006**	**0.035**	**-2.5%**	**-20.4%**
	NL0091	1999-2006	0.902	-0.3%	-2.1%
	NO0001	*1998-2006*	*0.118*	*-2.4%*	*-19.3%*
	SE0014	2002-2006	0.462	2.2%	8.6%
Region III	IE0001	2001-2006	0.452	5.2%	26.1%
Region IV	ES0008	1999-2006	0.536	-0.9%	-6.5%
sNH_4					
Region I	**NO0039**	**1998-2006**	**0.029**	**17.7%**	**141.4%**
	NO0042	**1998-2006**	**0.009**	**43.6%**	**349.0%**
Region II	*DK0008*	*1998-2006*	*0.266*	*-1.4%*	*-11.1%*
	NO0001	**1998-2006**	**0.009**	**11.6%**	**92.6%**
	SE0014	2002-2006	0.806	-2.6%	-10.5%
Region IV	ES0008	1999-2006	0.902	-4.4%	-31.2%
sNO_3					
Region I	**NO0039**	**1998-2006**	**0.003**	**31.4%**	**251.1%**
	NO0042	**1998-2006**	**0.063**	**18.7%**	**295.2%**
Region II	DK0008	1998-2006	0.917	0.2%	1.9%
	DK0031	1999-2006	1.000	0.3%	2.4%
	NO0001	**1998-2006**	**0.001**	**12.9%**	**103.5%**
	SE0014	2002-2006	0.806	-3.4%	-13.5%
Region IV	*ES0008*	*1998-2006*	*0.108*	*6.6%*	*46.5%*

5.2 Heavy metals in air/aerosol

The annual mean concentrations of heavy metals in air/aerosol were calculated for cadmium, lead and mercury (see Annex 8). Monitoring in Region II is generally good and allows a trend analysis for several monitoring stations. Other stations for which trend analysis could be performed include IS0091 from Iceland (Region I) and the Spanish station ES0008 (Region IV). For the other Regions, various factors hampered a sound trend analysis for the period 1998 – 2006: stations are lacking, valid data are insufficient or monitoring is not continuous. Table 5.2a summarises the trend analysis results of the 2005 CAMP data assessment covering the period 1987 – 2002 (OSPAR, 2005), and Table 5.2b summarises the results of trend analysis for 1998 – 2006.

***Table 5.2a**: Results of the trend analysis carried out for the previous assessment (1987 – 2002) for heavy metals in air/aerosol (all in Region II); for details see Table 5.1a.*

Component	Station	Period	P-value Mann-Kendall	Slope
Lead	**DE0001**	**1987-2000**	**0.001**	**-22%**
	DK0008	**1996-2002**	**0.05**	**-11%**
	DK0031	**1990-2002**	**0.001**	**-28%**
	GB0014	**1994-2002**	**0.05**	**-13%**
	GB0090	**1989-2002**	**0.01**	**-12%**
	GB0091	**1989-2002**	**0.001**	**-21%**
	NL0009	**1990-2002**	**0.001**	**-27%**
Cadmium	**DE0001**	**1987-2001**	**0.01**	**-12%**
	GB0091	**1989-2002**	**0.1**	**-9%**
	NL0009	**1994-2002**	**0.05**	**-11%**

***Table 5.2b**: Results of the trend analysis for the period 1998 – 2006 for heavy metals in air/aerosol; for details see Table 5.1a.*

Component and Region	Station	Period	P-value Mann-Kendall	Theil slope	Estimated change of the level
Cadmium					
Region I	IS0091	1998-2006	0.348	-8.0%	-64.2%
Region II	DE0001	1998-2006	0.266	-4.5%	-34.7%
Region IV	ES0008	2001-2006	0.133	-5.7%	-28.6%
Lead					
Region I	IS0091	1998-2006	0.754	10.1%	81.0%
	NO0042	1998-2006	0.917	-0.7%	-6.0%
Region II	**DE0001**	**1998-2006**	**0.076**	**-4.4%**	**-35.1%**
	DK0008	*1998-2006*	*0.118*	*-2.8%*	*-22.5%*
	DK0031	*1998-2006*	*0.118*	*-6.7%*	*-53.8%*
	GB0091	1998-2006	0.602	2.4%	19.1%
	NO0099	1998-2003	1.000	-0.4%	-2.2%
Region IV	ES0008	2001-2006	0.452	-3.9%	-19.7%
Mercury					
Region I	IS0091	1998-2006	0.602	14.3%	114.8%
	NO0042	1998-2005	0.230	1.8%	16.8%
Region II	SE0014	2002-2006	0.221	-1.8%	-7.0%

5.3 Regional summary of pollutant concentrations in air/aerosol

The results of the trend analysis for the concentration of pollutants in air/aerosol is summarised for each Region for the period 1998 – 2006 in Tables 5.3a and for 1987 – 2006 for nitrogen and 1987 – 2002 for heavy metals in Table 5.3b.

For the Regions where trend analysis could be performed, it is clear that in Regions I and II there are significantly increasing trends for sNO_3 and sNH_4; NO_2 is slightly decreasing in the Regions I and IV (but increasing in Region III), and significantly decreasing in Region II by 2.5%. The heavy metal concentrations in air decreased over the past decade in Regions II and IV, as was cadmium in Region I. In the latter Region lead and mercury showed increasing trends. Only the downward trend of lead in Region II was statistically significant in the period 1998 – 2006.

***Table 5.3**: Regional summary of the mean % trend in concentrations of pollutants in air/aerosol (a) in the period 1987 – 2006 for nitrogen and 1987 – 2002 for heavy metals, and (b) in the period 1998 – 2006.*

statistically significant upward trend; statistically significant downward trend; while mean trend is upward, more stations showed a downward trend.

Table 5.3a	1987 – 2006			1987 – 2002		
	NO_2	sNO_3	sNH_4	Pb	Cd	Hg
Region I	-1.3	+2.4	+7.8	--	--	--
Region II	-3.0	-2.4	-2.9	-19	-11	--
Region III	+0.6	--	--	--	--	--
Region IV	-0.9	+6.6	-4.4	--	--	--
Region V	--	--	--	--	--	--

Table 5.3b	1998 – 2006					
	NO_2	sNO_3	sNH_4	Pb	Cd	Hg
Region I	-0.8	+25.1	+30.7	+4.7	-8.0	+8.1
Region II	-2.5	+12.9	+11.6	-4.4	-4.5	-1.8
Region III	+5.2	--	--	--	--	--
Region IV	-0.9	+6.6	-4.4	-3.9	-5.7	--
Region V	--	--	--	--	--	--

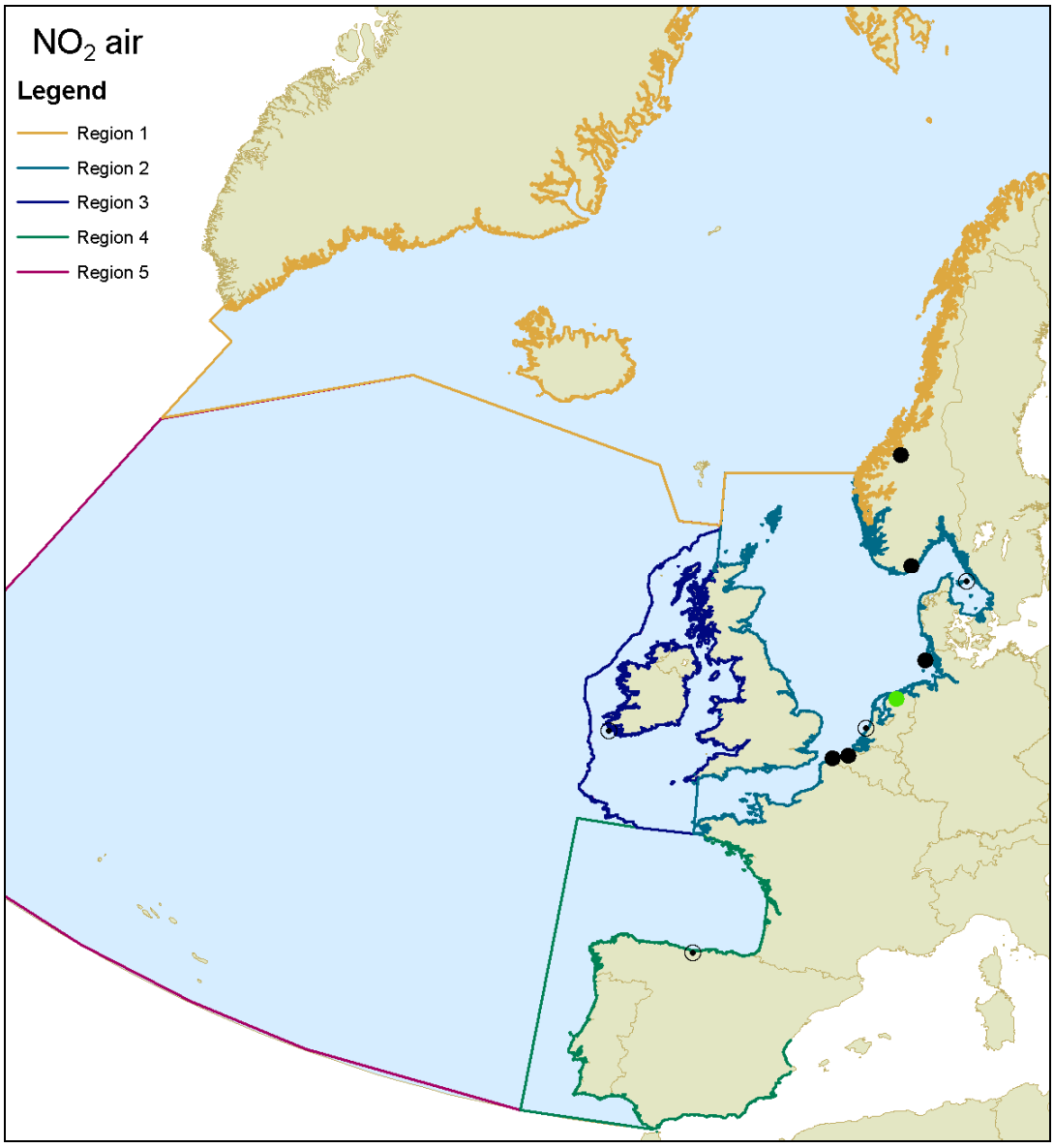


***Figure 5.1**: Geographical distribution of results from the trend analysis for nitrogen dioxide in air. Green dots indicate declining trends, red dots upward trends and black dots indicate no trends above the 90% significance level. A black circle around the dots indicates that the period 1998 – 2006 is not fully covered. There are 3 sizes for the dots: small size: the slope is less than 10%, medium size: the slope is in between 10% and 20% and large size: the slope is above 20%. In this graph only small size dots are depicted.*

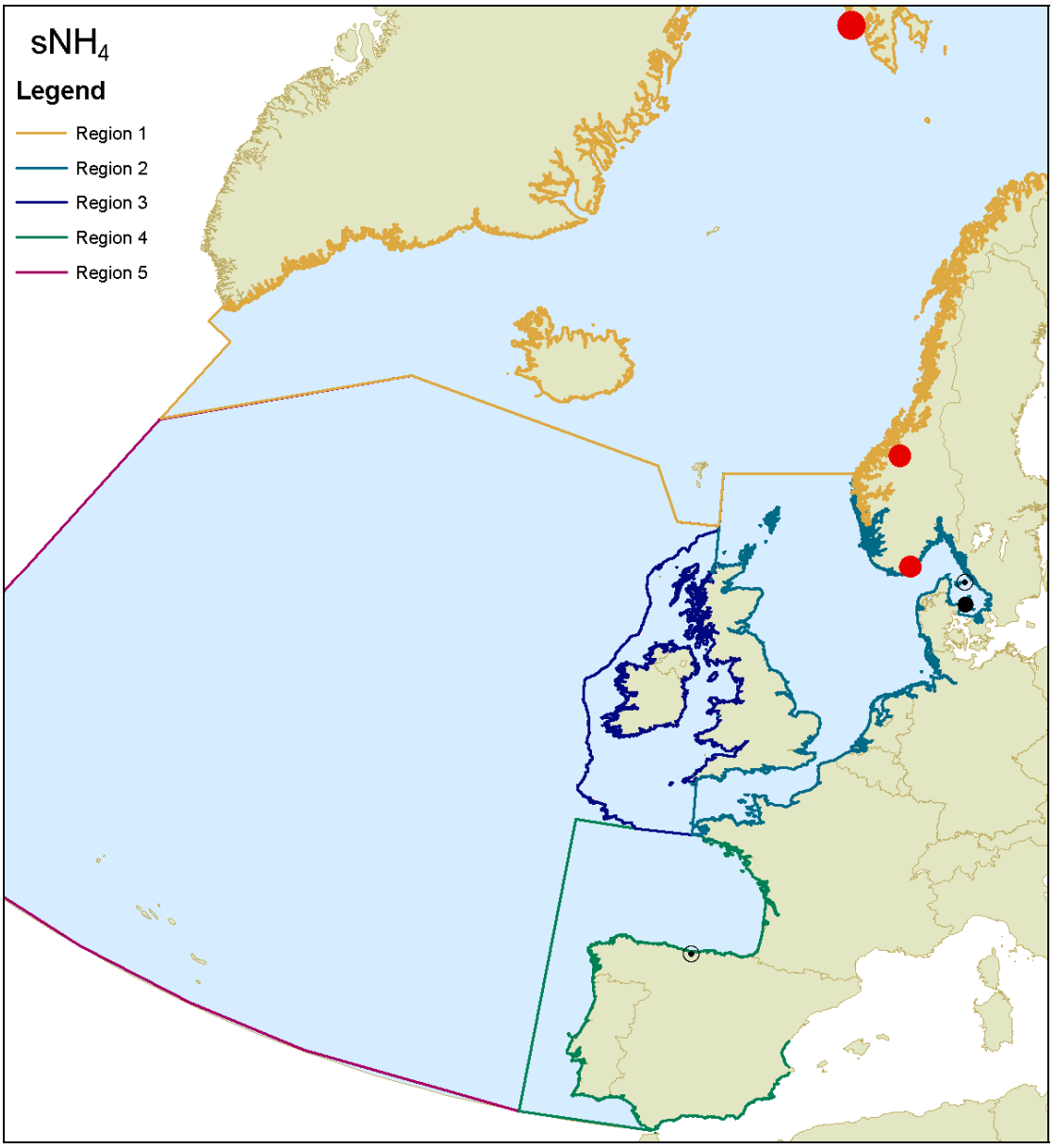


***Figure 5.2**: Geographical distribution of results from the trend analysis for sNH_4 in air. Explanation as for Figure 5.1*

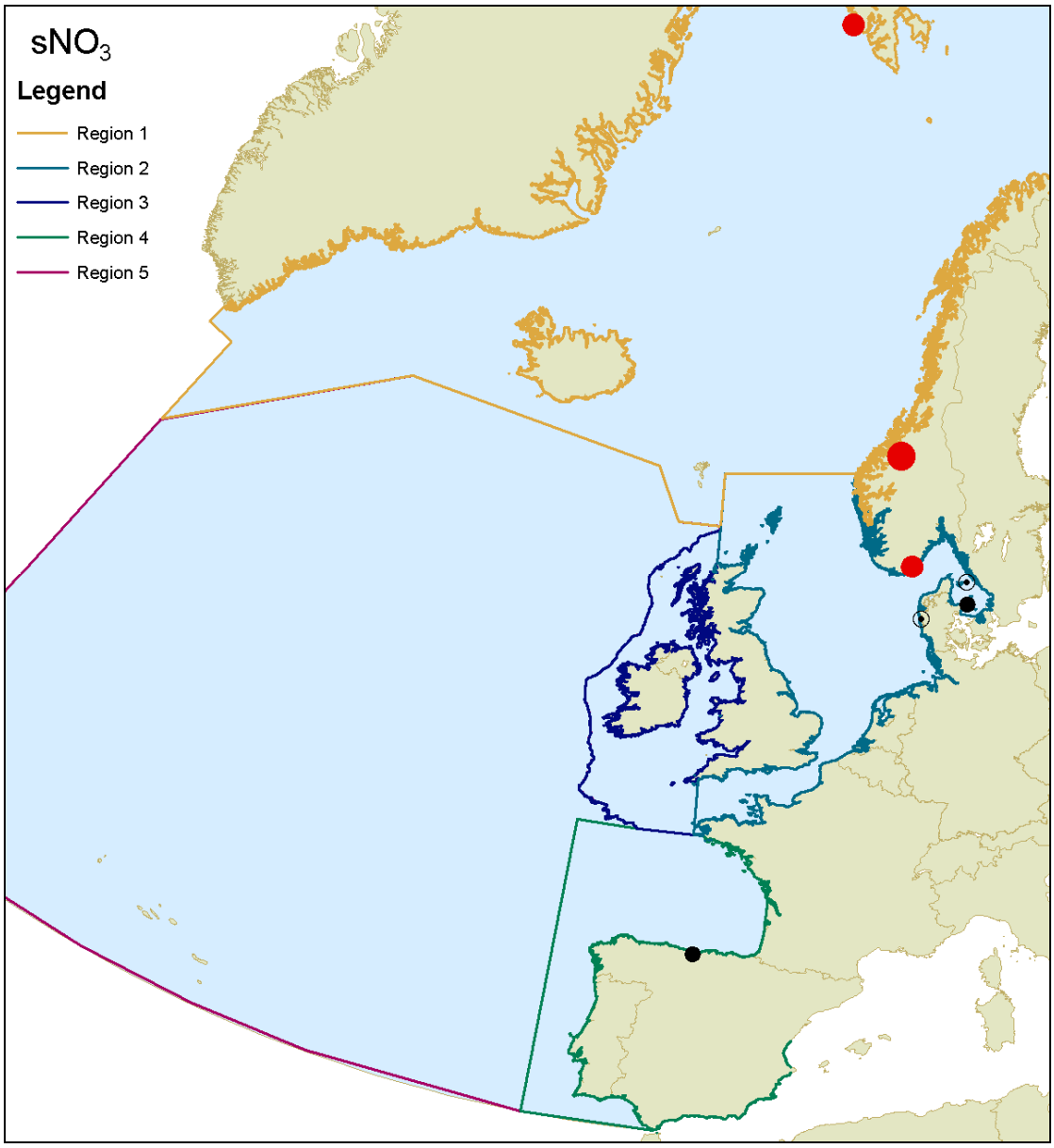


***Figure 5.3**: Geographical distribution of results from the trend analysis for sNO_3 in air. Explanation as for Figure 5.1*

6. Modelled deposition to the OSPAR maritime area

6.1 Modelled deposition of nitrogen

The atmospheric nitrogen deposition to the OSPAR maritime area has been calculated by EMEP MSC-W with the EMEP Unified Eulerian model system, a chemical transport model (Annex 3). The calculations were performed for the period 1995 – 2006. Deposition calculations took into account emission contributions from sources outside the OSPAR area in Italy, Poland and Russia. Calculations are made for total nitrogen, oxidised nitrogen and reduced nitrogen.

6.1.1 Total nitrogen deposition

Figure 6.1 shows the modelled total (oxidized and reduced) annual nitrogen deposition to the five OSPAR Regions in 2006. It shows that the highest depositions occur near the coastal areas of Western Europe and have maximum values in the Greater North Sea (Region II). Furthermore a clear gradient of deposition towards the open seas is observed.

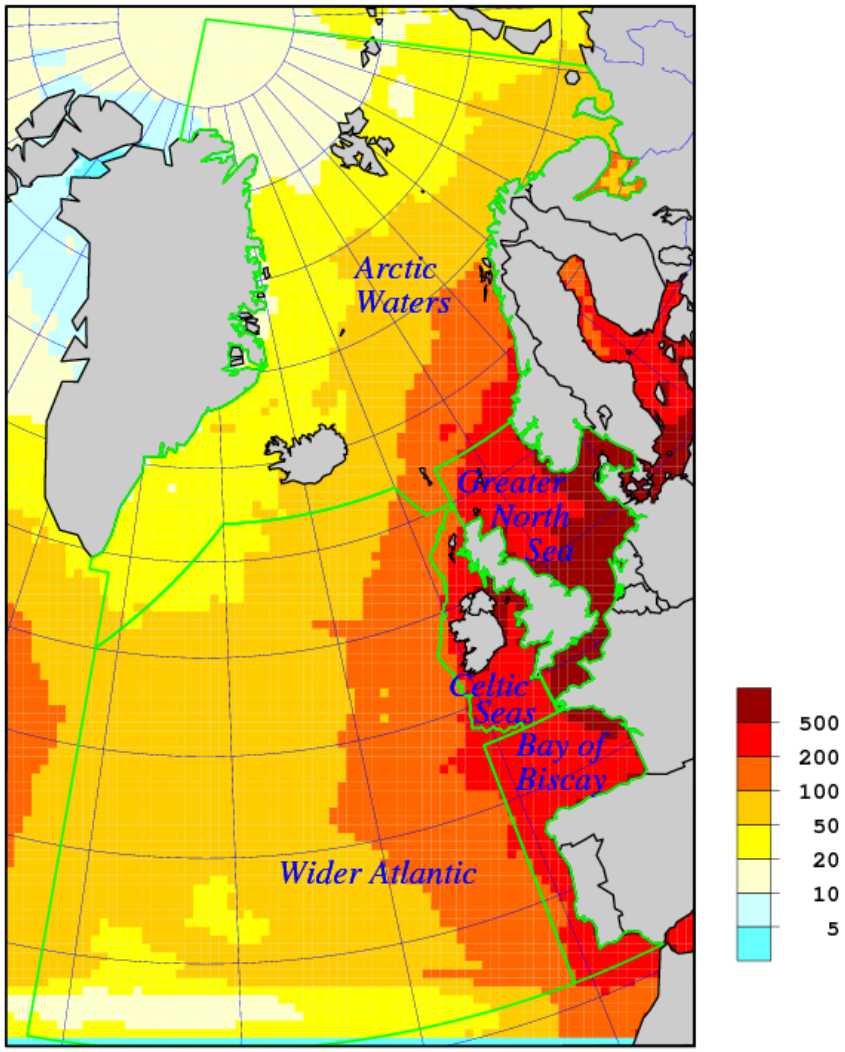


***Figure 6.1**: Map of EMEP modelled total annual nitrogen (oxidized and reduced) deposition to the five OSPAR Regions in 2006. Units are in mg N/m^2 per year.*

Figure 6.2 gives the relative contribution of individual countries to the annual deposition of total nitrogen in 2006 (data in Table A3.9 at Annex 3). Contributions from international ship traffic on the North Sea and the Atlantic are included in the labels “Ships North Sea” and “Ships Atlantic”, respectively.

Figure 6.2 suggests that the UK is an important contributor to the deposition of nitrogen to all Regions except Region IV (Bay of Biscay and Iberian coast). All other countries contribute to a lesser extent to the deposition. In Region IV the deposition of nitrogen is dominated by emissions from France and Spain.

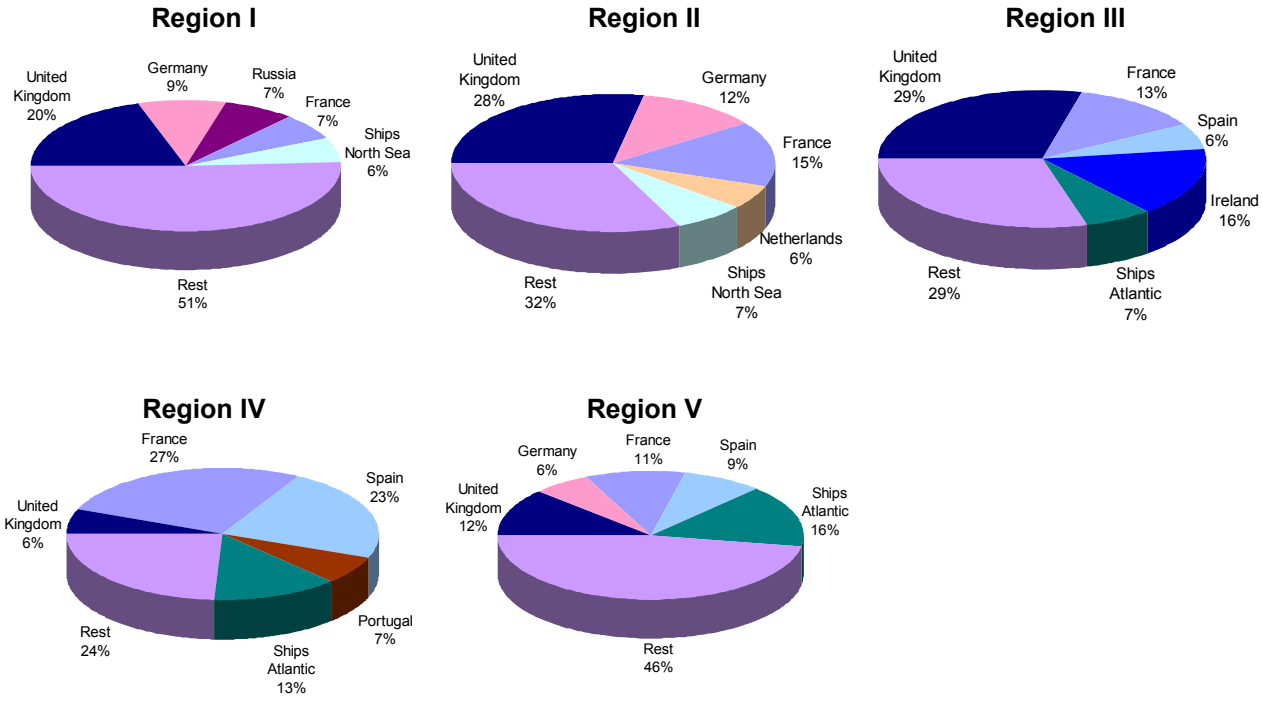


***Figure 6.2**: Contribution of individual countries to the total annual nitrogen (oxidized and reduced) deposition to the OSPAR Regions in 2006.*

Figure 6.3 gives the relative contributions from the most important emission sectors to the annual deposition of total nitrogen deposition in 2006 (data in Tables A3.12 at Annex 3).

Figure 6.3 suggests that for Regions I and V the main emission sources contributing to nitrogen deposition are a) combustion for energy production and industry, b) transportation including ship traffic and c) agriculture. They contribute each about 25 – 30% to the deposition of nitrogen.

In Regions II, III and IV combustion for energy production and industry on one hand, and transportation including ship traffic on the other hand contribute each about 20 – 25%; agriculture contributes about 40% to the deposition in these Regions (Figure 0.8).

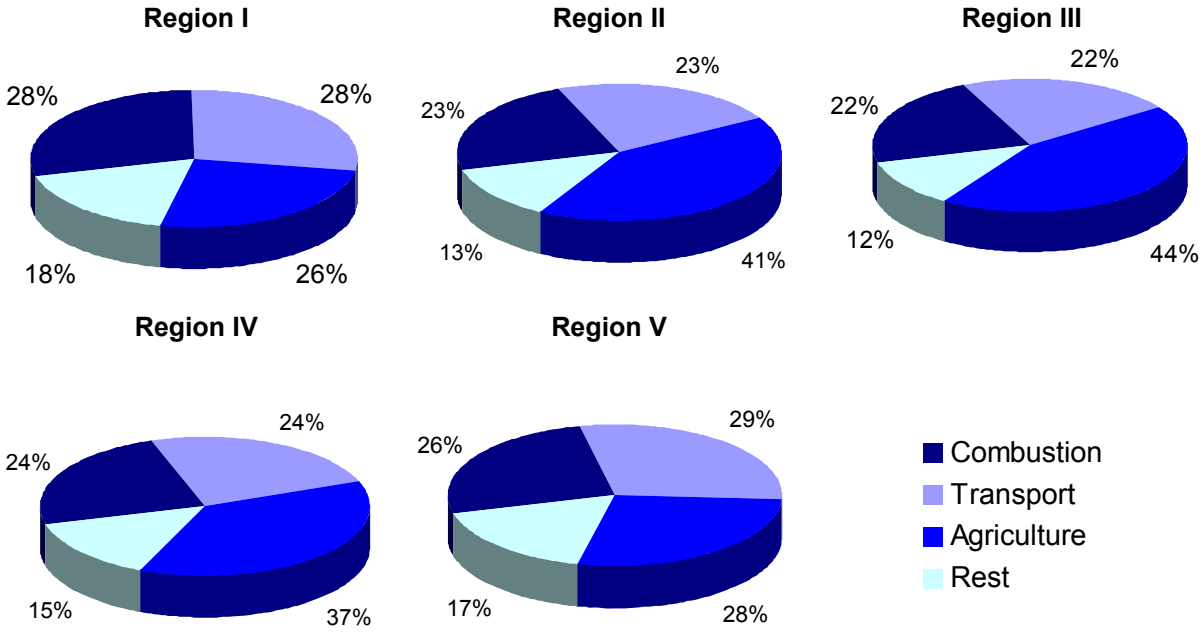


***Figure 6.3**: Contribution of sectors (as defined by the EMEP Selected Nomenclature for reporting of Air Pollutants (SNAP)) to the total annual nitrogen (oxidized and reduced) deposition to the OSPAR Regions in 2006. Combustion includes SNAP 1 (combustion in energy and transformation industry), SNAP 2 (non-industrial combustion plants) and SNAP 3 (combustion in manufacturing industry). Transport includes SNAR 7 (road transport) and SNAP 8 (other mobile sources and machinery, including international shipping). SNAP 10 is the basis for agricultural data.*

Time series of the EMEP modelled total annual nitrogen depositions to the five Regions over the period 1995 – 2006 are shown in Figure 6.4 (data in Table A3.5 of Annex 3). Performing a Mann-Kendall test over these time series for the period 1998 – 2006, a statistically significant downward trend could be detected only in Region II. Deposition levels stagnated or even increased in the other OSPAR Regions.

Figure 6.5 shows the time series of the deposition of total nitrogen to the 13 sub-areas of the Greater North Sea (data in Table A3.6 of Annex 3). A Mann-Kendall test was performed on these series for the period 1998 – 2006. In 8 out of the 13 sub-areas a significant downward trend was observed.

The downward trend of the models are largely supported by calculations for the North Sea based on concentrations in precipitation. However, these trends are often not significant and data for recent years suggest stagnation of reduction efforts (see Box 6.1).

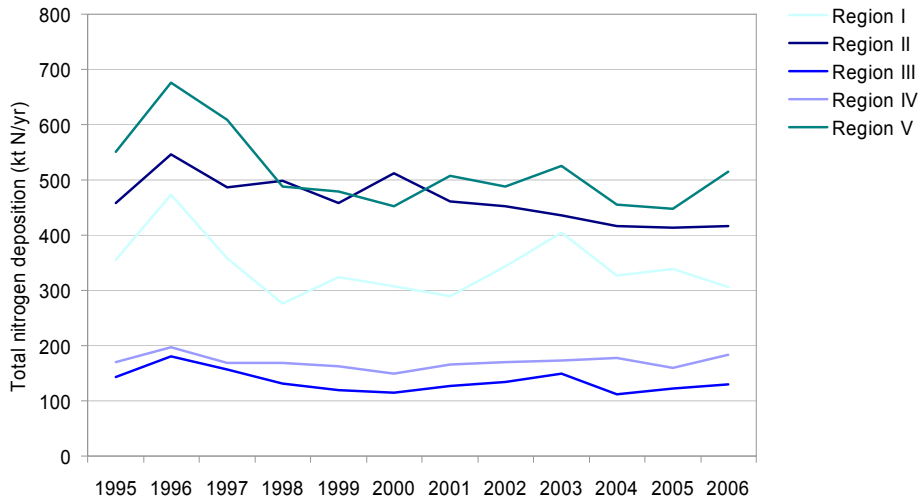


***Figure 6.4**: Time series of EMEP modelled total annual nitrogen (oxidized and reduced) deposition to the OSPAR Regions. Units in kt N/yr.*

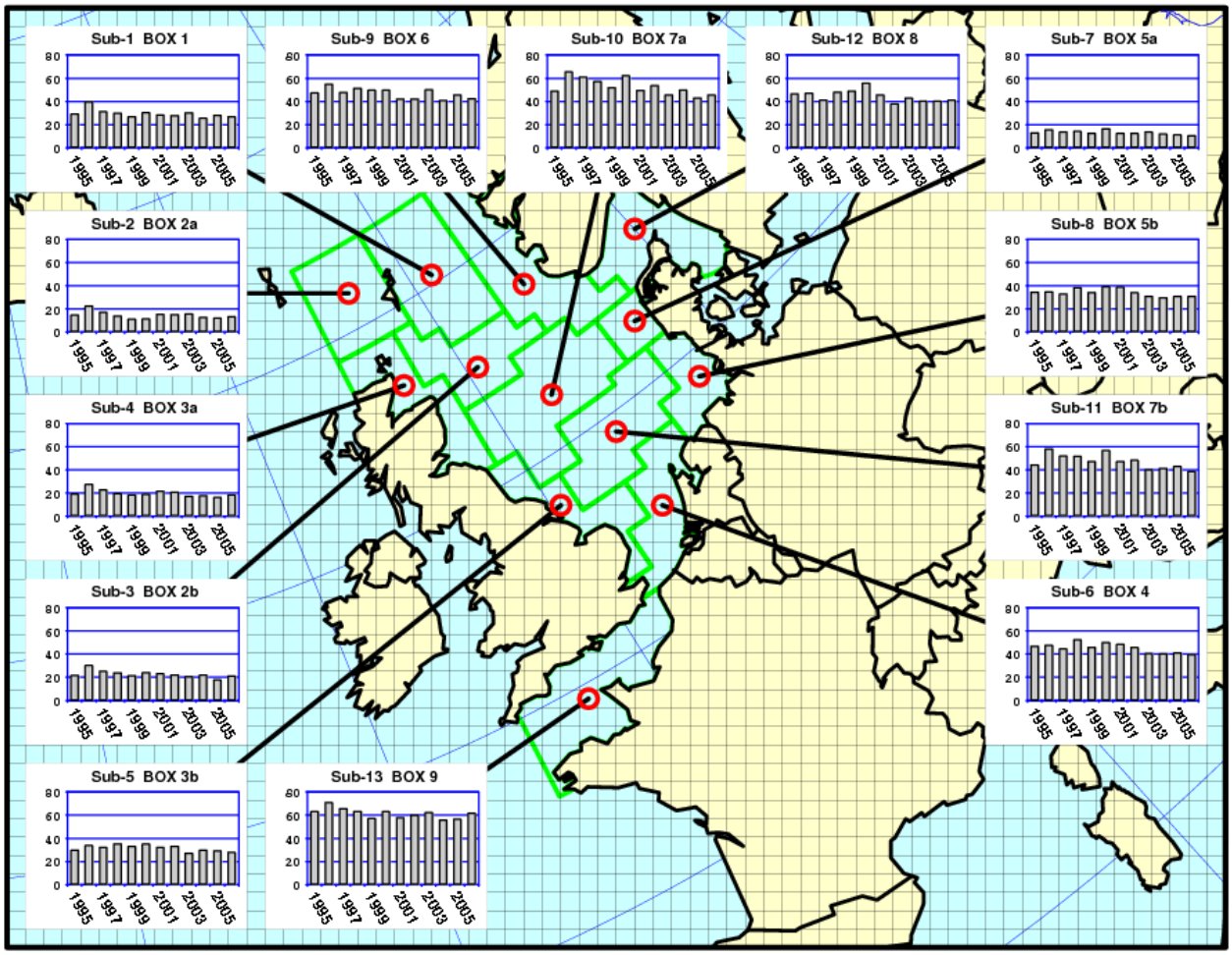


***Figure 6.5**: Map with time series of EMEP modelled total annual nitrogen (oxidized and reduced) deposition to the 13 sub-areas of Region II. Units in kt N/yr.*

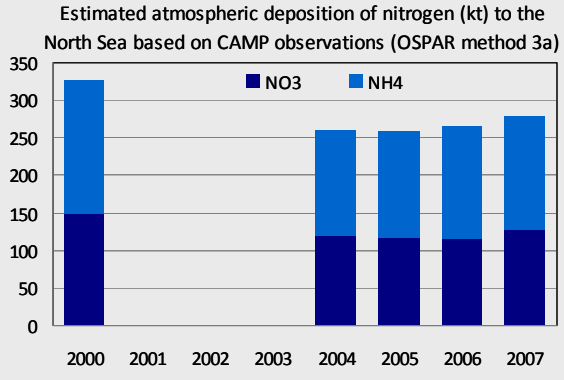
Box 6.1

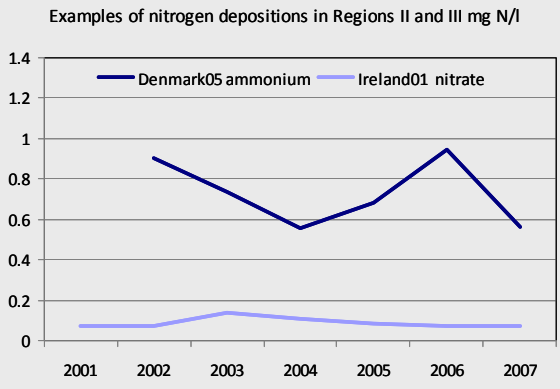
Estimated total depositions of nitrogen to the North Sea based on CAMP measurements

Whilst negotiated international agreements aim to deliver notable reductions in the emissions of nitrogen to the atmosphere, progress has been slower than originally wished for. Although calculated nitrogen emission estimates provided by European countries do largely point downwards, recent evaluations suggest that many countries may not attain targets.

CAMP data offer the opportunity for an independent assessment of progress in reducing nitrogen emissions, given that reductions in final depositions are the desired outcome of the emission reduction policies. Indeed, the CAMP review of monitoring station data does reveal that only a minority of stations are reporting a significant downward trend in nitrogen depositions, even though model calculations suggested a significant downward trend in nitrogen for the North Sea, where most stations are located. When the observations are used to drive independent deposition estimates the position becomes more equivocal. The OSPAR Method 3a is essentially an extrapolation technique weighting the multi-station combined series of coastal observations each year according to estimated over-sea deposition patterns. The figure (below left) suggests that although there may have been a decline since 2000 in total nitrogen depositions to the North Sea, in the past four years depositions have been largely unchanged, with even a hint of an increase.

Looking at observations from individual monitoring stations provides a variable picture. In the figure (below right) the background nitrate depositions which occur on OSPAR's western coasts is illustrated from Ireland, representing an amalgamation of Europe's influence on the Wider Atlantic, with the general hemispheric influence on OSPAR waters. Largely unchanged concentrations on the far coastal margin further suggest that any changes in nitrate deposition that have occurred can be expected to have been quite localised. This fact is illustrated by the Danish record of ammonium deposition on the southern North Sea coast, which shows dramatic inter-annual variations. These higher concentrations result from station proximity to emission sources and the shorter transport distances of ammonium compared to nitrate. Although meteorological variations will play a significant role here, as far as depositions experienced by the North Sea are concerned once again no marked downward trend is seen.





6.1.2 Deposition of oxidized nitrogen

Figure 6.6 shows the time series for oxidized nitrogen deposition to the OSPAR Regions (data in Table A3.1 in Annex 3). A Mann-Kendall test for the period 1998 – 2006 showed that a significant downward trend was only observed for Region II. In Figure 6.7 the relative contribution of the dominant contributing countries to the annual deposition of oxidized nitrogen is displayed for 2006 (data in Table A3.7 in Annex 3). Contributions from international ship traffic on the North Sea and the Atlantic are included in the labels "Ships North Sea" and "Ships Atlantic", respectively. Figure 6.8 gives the relative contributions from the different sectors to the annual deposition of oxidized nitrogen in 2006 (data in Table A3.10 in Annex 3).

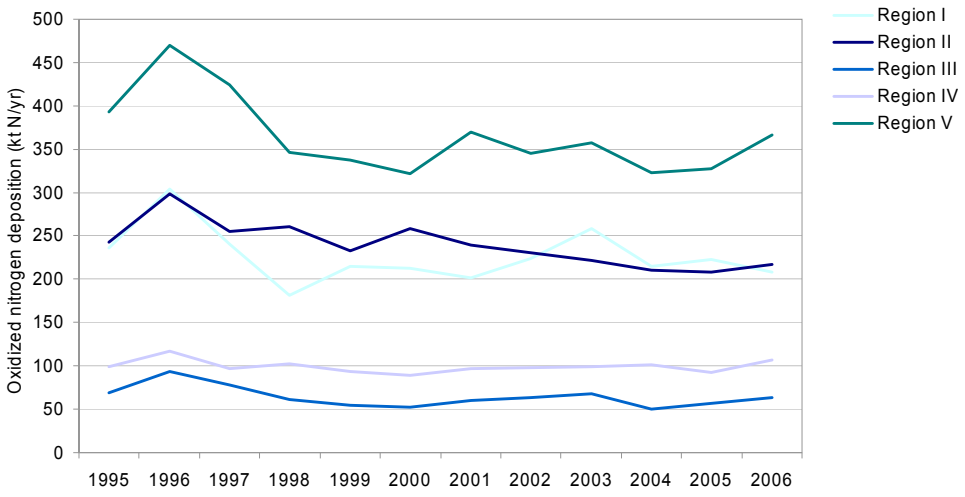


***Figure 6.6**: Time series of EMEP modelled oxidized annual nitrogen deposition to the OSPAR Regions. Units are in kt N/yr.*

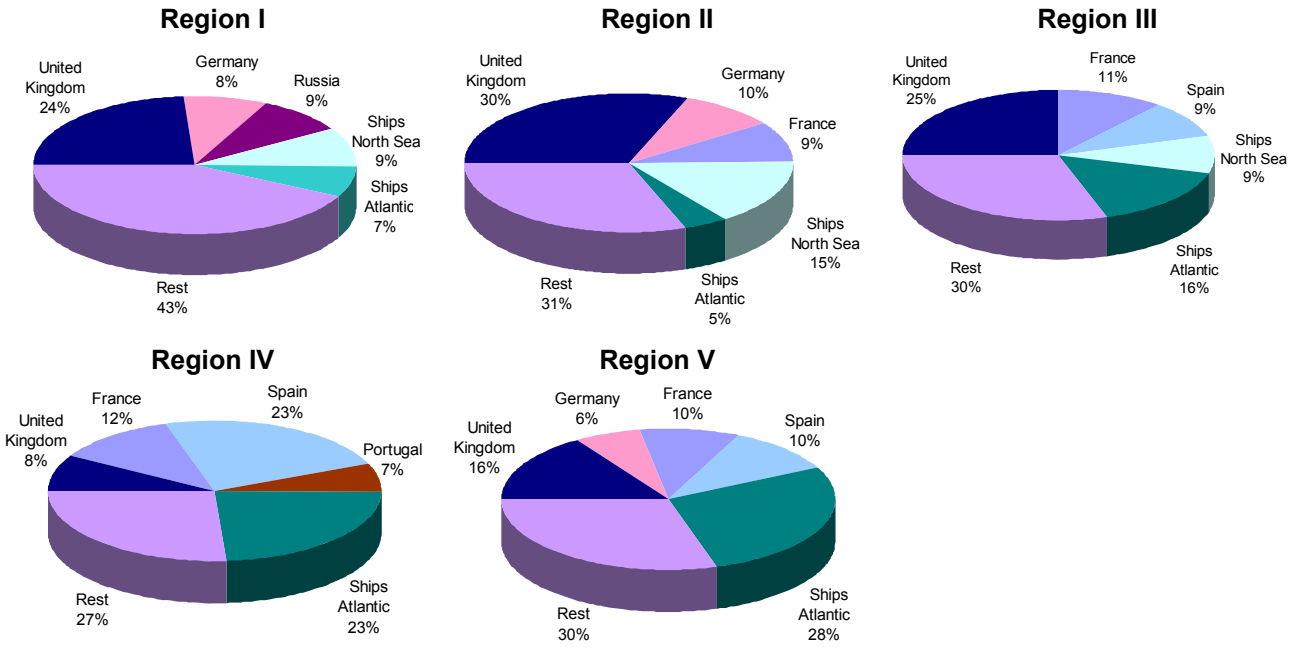


***Figure 6.7**: Contribution of major individual countries to the annual deposition of oxidized nitrogen to the OSPAR Regions in 2006. The contribution of international shipping on the North Sea and the Atlantic Ocean is presented as "Ships North Sea" and "Ships Atlantic" respectively.*

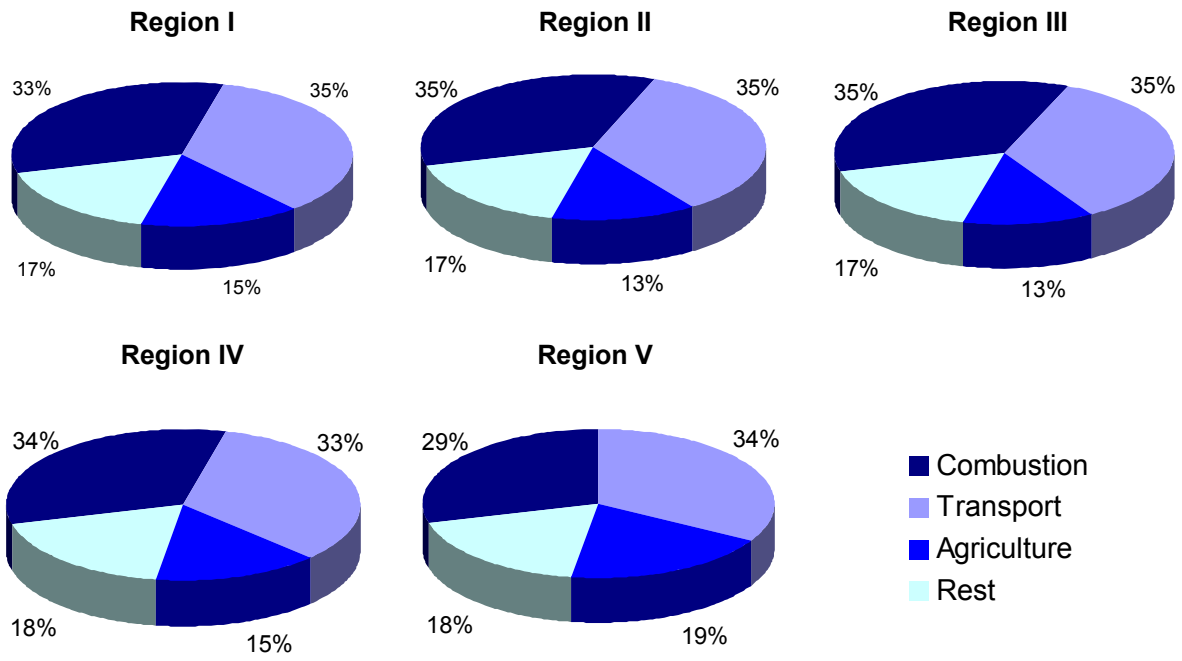


***Figure 6.8**: Contribution of major sectors to the annual deposition of oxidized nitrogen to the OSPAR Regions in 2006. Sectors as for Figure 6.3.*

6.1.2 Deposition of reduced nitrogen

Figure 6.9 shows the time series for reduced nitrogen deposition to the OSPAR Regions (data in Table A3.3 at Annex 3). A Mann-Kendall test for the period 1998 – 2006 detected a significant downward trend for Region II and a significant upward trend for Region IV. Figure 6.10 presents the relative contribution of the most important individual countries to the annual deposition of reduced nitrogen in 2006 (data in Table 3.8 at Annex 3). In Figure 6.11 the relative contributions from the different sectors to the annual deposition in 2006 of reduced nitrogen are displayed (data in Table 3.11 at Annex 3). Finally, Figure 6.12 provides the modelled reduced and oxidized nitrogen deposition to the five OSPAR Regions for the period 1998 – 2006.

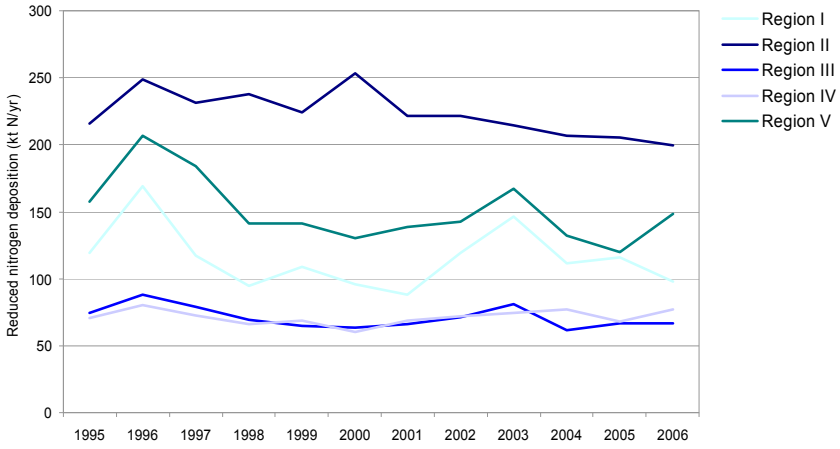


***Figure 6.9**: Time series of EMEP modelled annual deposition of reduced nitrogen to the OSPAR Regions. Units in kt N/yr.*

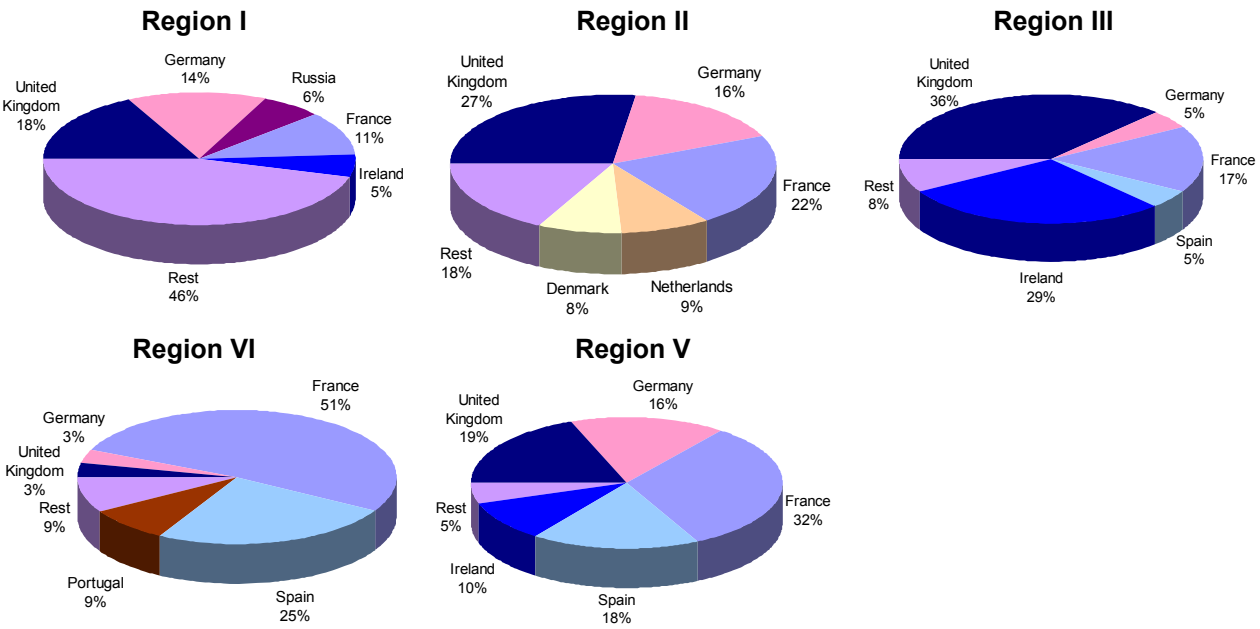


***Figure 6.10**: Contribution of major individual countries to the annual deposition of reduced nitrogen to the OSPAR Regions in 2006.*

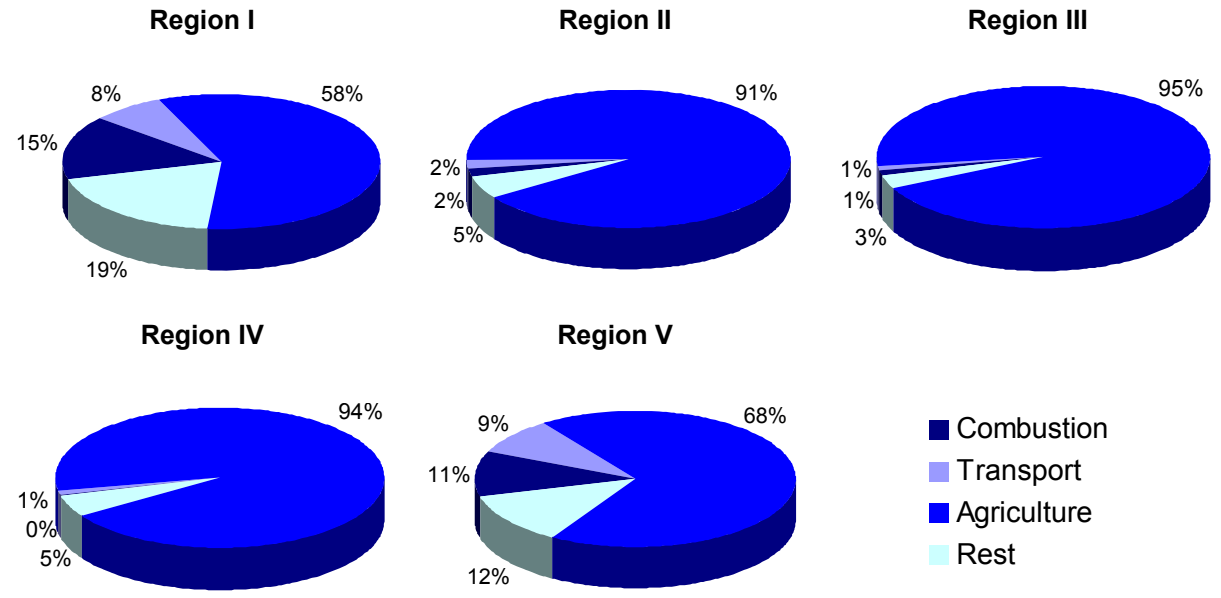


***Figure 6.11**: Contribution of sectors to the annual deposition of reduced nitrogen to the OSPAR Regions in 2006 (Sectors as for Figure 6.3).*

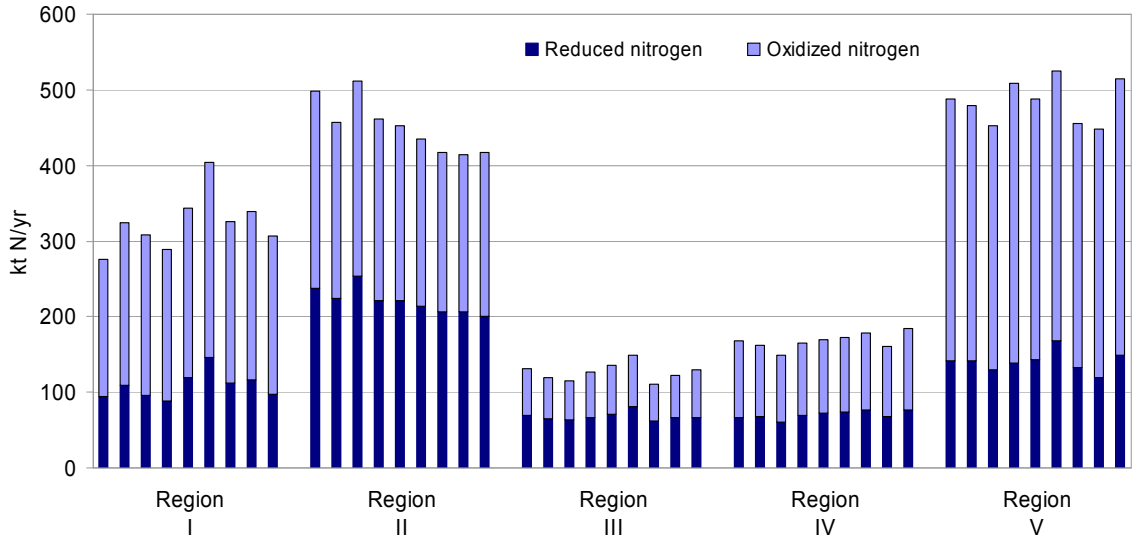


***Figure 6.12**: Annual deposition of oxidized and reduced nitrogen to each of the OSPAR Regions for the period 1998 – 2006.*

6.2 Modelled deposition of heavy metals

The atmospheric inputs of lead, cadmium and mercury to the OSPAR maritime area were calculated by EMEP/MSC-E using the chemical transport model MSCE-HM (Annex 4). The calculations were performed for the period 1990 – 2006, taking into account emissions from outside the OSPAR area (Poland and Russian).

In general, atmospheric depositions of heavy metals are accompanied by re-emission of these contaminants: mercury can be easily reduced in seawater to the dissolved elemental form which can evaporate back into the atmosphere. Lead and cadmium can also be re-suspended from the ocean surface with salt spray. In order to evaluate net atmospheric input of heavy metals to the OSPAR maritime area, the *net deposition* fluxes represent the difference between total deposition and estimated re-emission. Net deposition is the most appropriate quantity for this assessment, however, since re-emission is an uncertain parameter in the model calculations, the total deposition is presented as well.

The contribution to the deposition is given for the four key source sectors:

Sector 1: Combustion in power plants and industry and industrial processes;

Sector 2: Transport;

Sector 3: Commercial, residential and other combustion;

Sector 4: Waste.

6.2.1 Lead

Figure 6.13 shows the modelled total and net deposition fluxes of lead in 2006 to the OSPAR Regions. The highest values occur in Regions II, III and IV. Regions I and V have the lowest deposition fluxes.

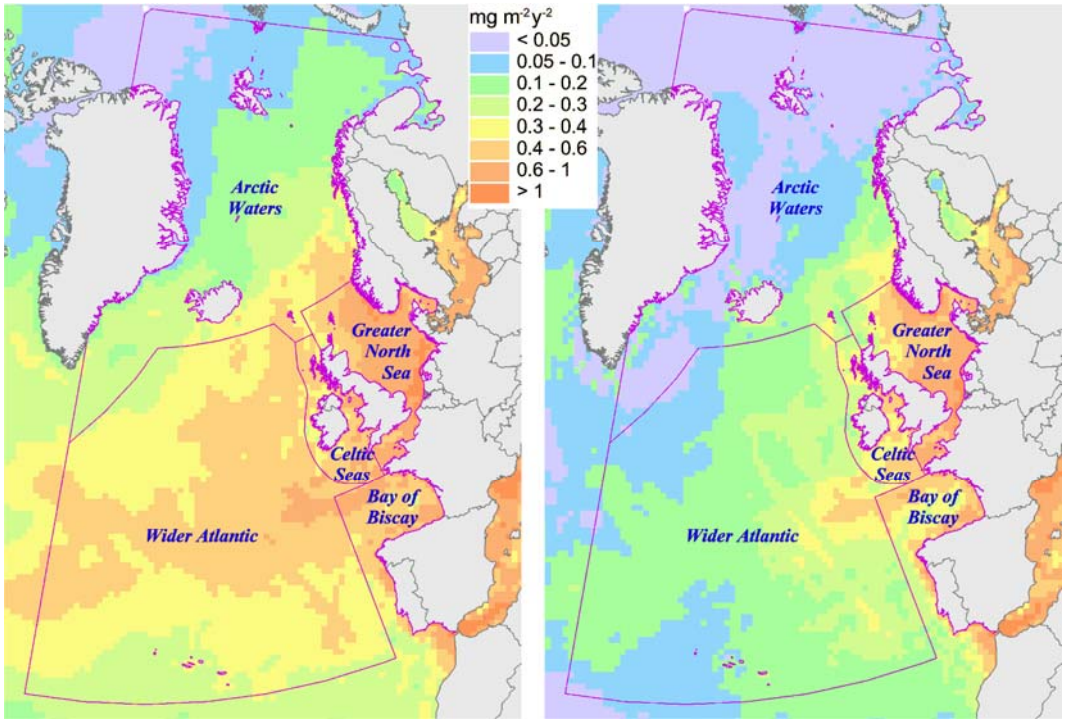


***Figure 6.13**: Map of modelled total deposition (left panel) and net deposition (right panel) of lead (mg/m^2/yr) to the OSPAR Regions in 2006; units are in mg/m^2 per year.*

Figure 6.14 displays the contribution of individual countries to the annual deposition of lead to the five OSPAR Regions in 2006. For Regions IV and V, the largest part of the deposition originates from two countries (Portugal and Spain). For Regions II and III, the dominant input contribution is from the UK and other contributions more equally distributed across the bordering countries.

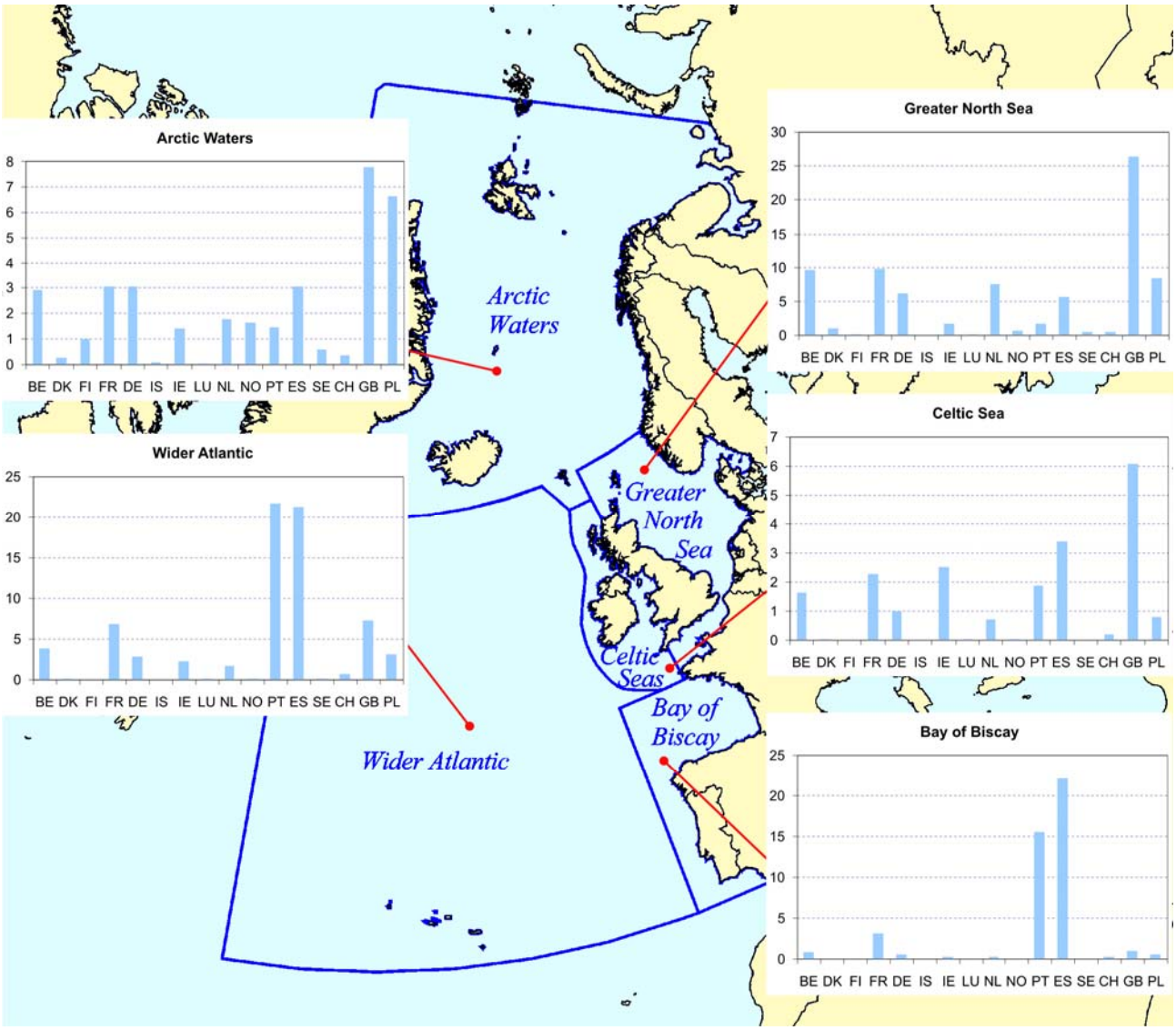


***Figure 6.14**: Contribution of individual countries to the modelled annual deposition of lead to the OSPAR Regions for 2006. Units are in t//yr.*

Figure 6.15 shows the relative contribution from the most important source sectors to the annual deposition in 2005; combustion processes (Sector 1) are considered the most dominant source.

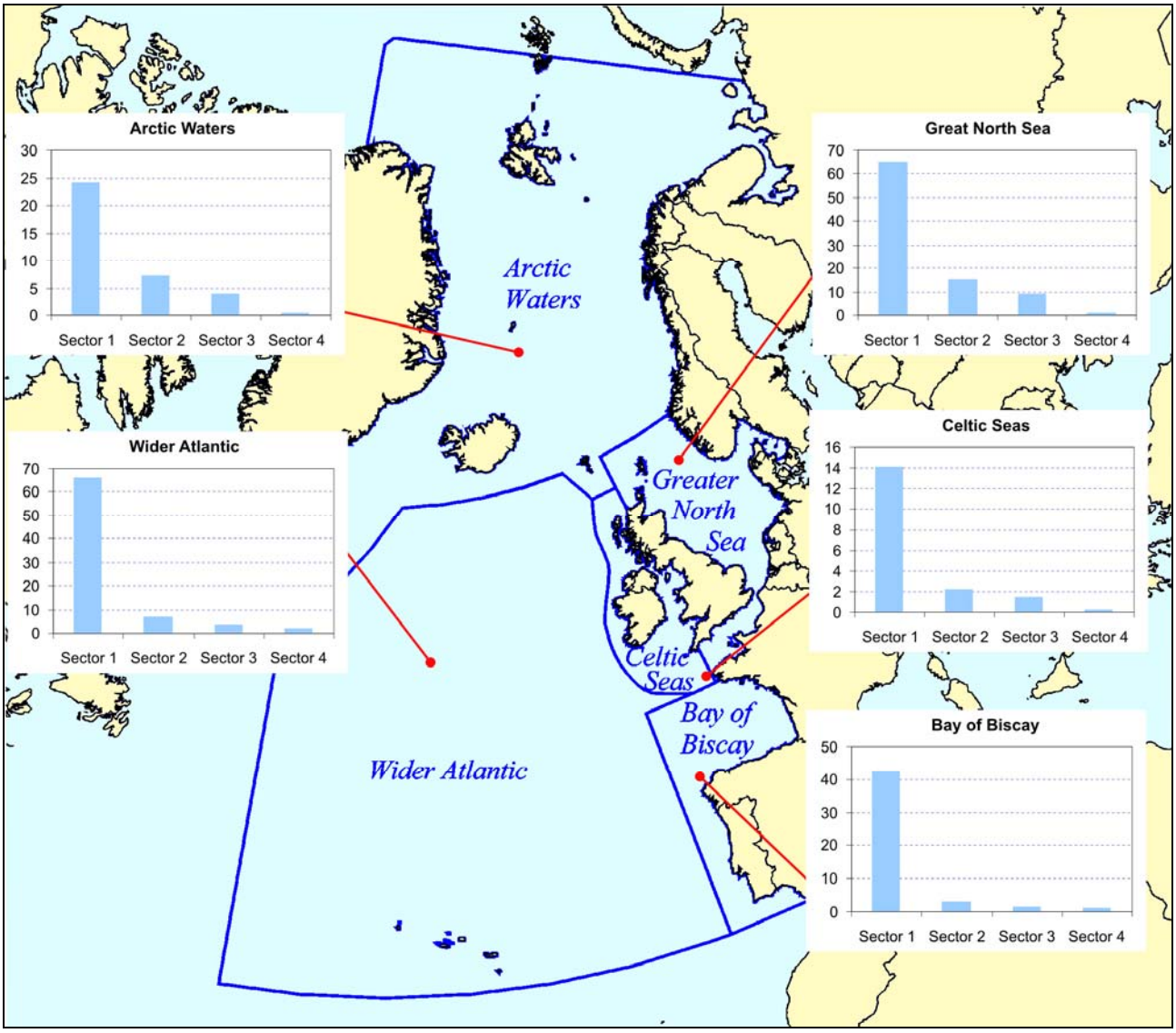


***Figure 6.15**: Contribution of four key source categories to the lead depositions to the OSPAR Regions in 2005; units are in t//yr.*

Figure 6.16 shows the time series of the total and net deposition fluxes of lead for the period 1990 – 2006 to the five OSPAR Regions, and Figure 6.17 shows the same for the 13 sub-areas of the Greater North Sea..

Statistical trend analysis has been performed for all time series presented in the Figures 6.16 and 6.17 (Mann-Kendall test). The analysis shows that all atmospheric deposition has significantly declined in the period 1990 – 2006. The same analysis performed for the period 1998 – 2006 shows that the decline in deposition seemed to have stagnated in the most recent years. Only for Region IV a significant downward trend has been observed.

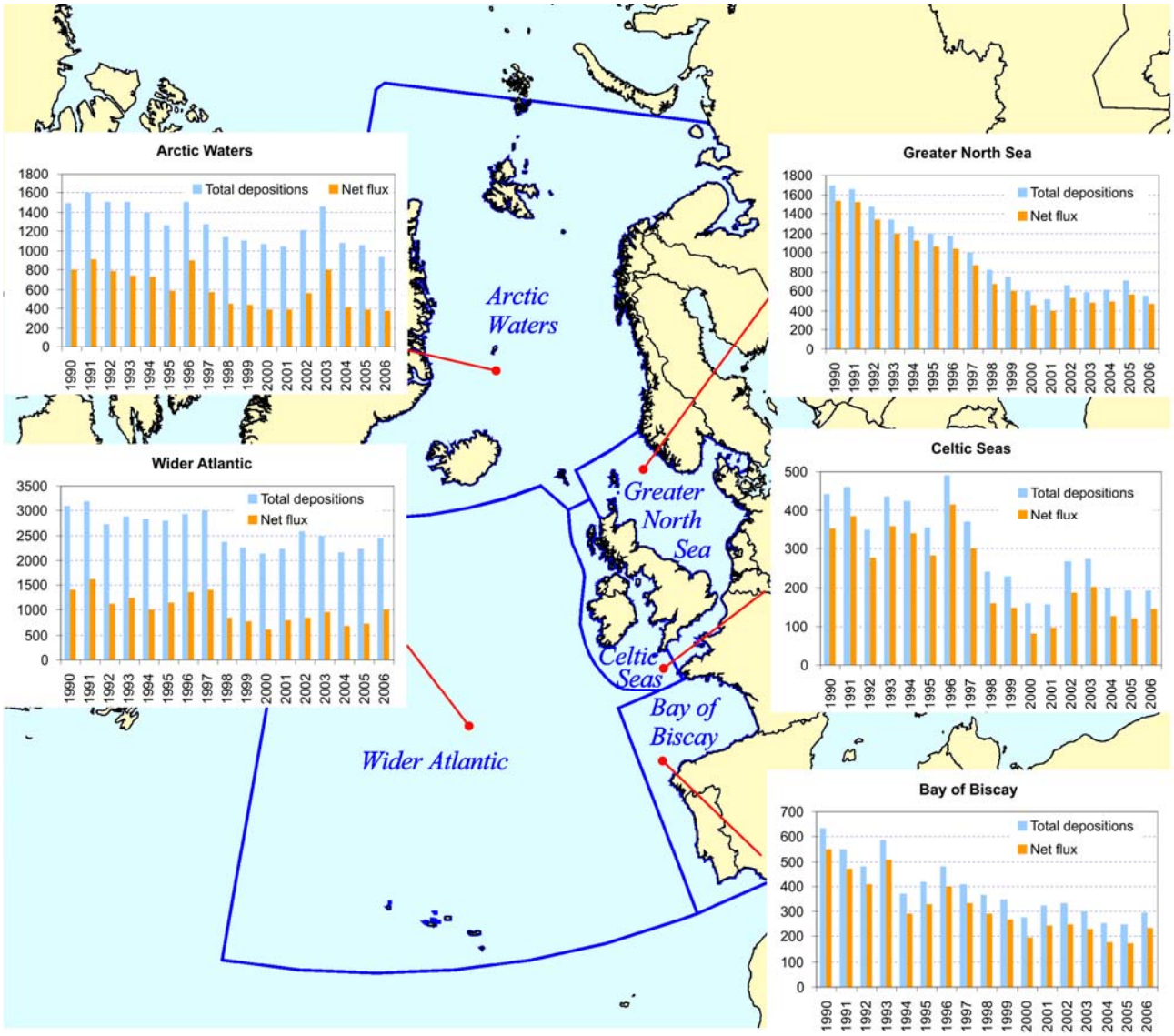


***Figure 6.16**: Time series of modelled total and net deposition fluxes of lead to the OSPAR Regions for the period 1990 – 2006; units are in t//yr.*

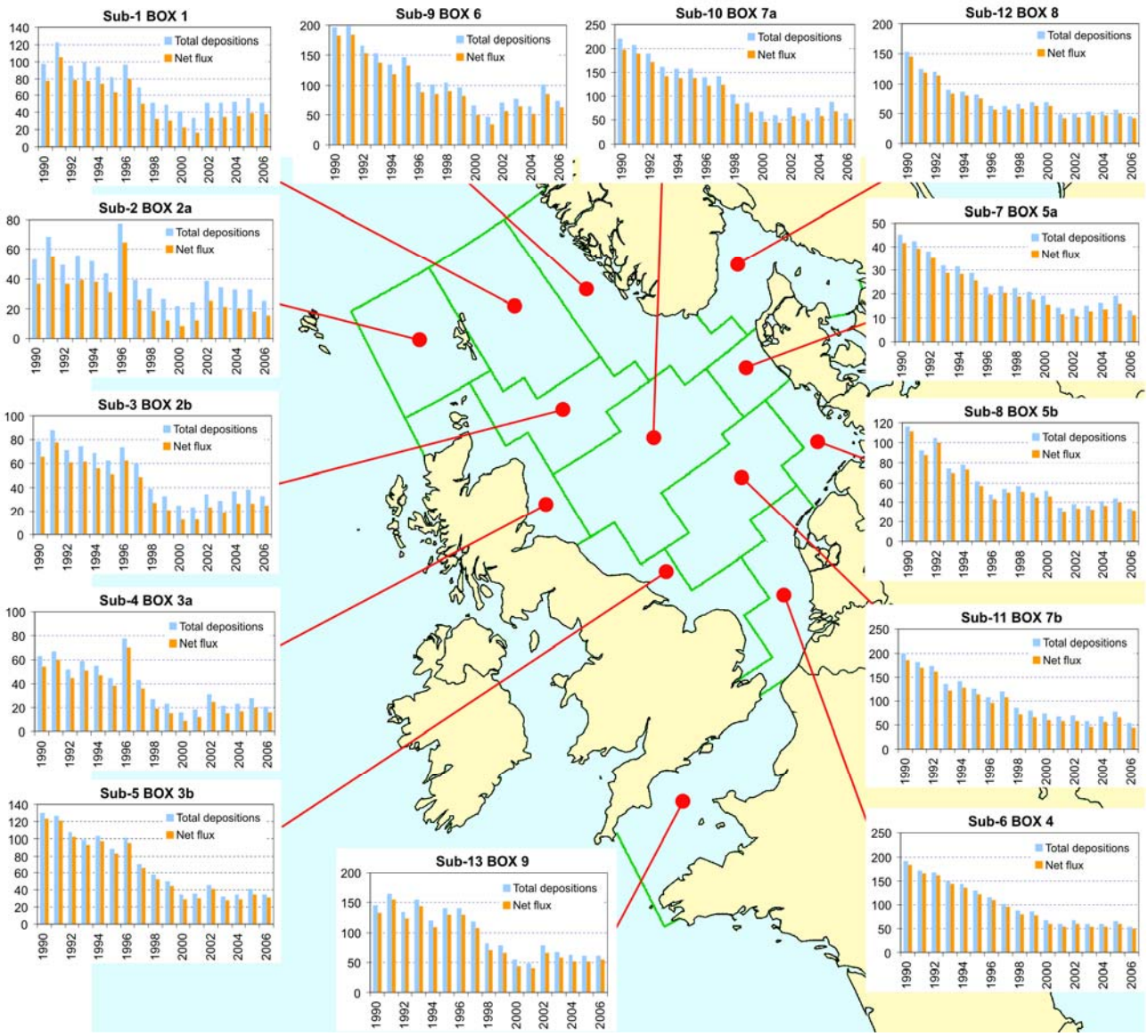


***Figure 6.17**: Time series of modelled total and net deposition fluxes of lead to the 13 sub-areas of the Greater North Sea for the period 1990 – 2006; units are in t//yr.*

6.2.2 Cadmium

Figure 6.18 shows the modelled spatial distribution of the deposition of cadmium in 2006. Regions I and V both have low values for the net deposition, while the highest values occur near the coastal areas.

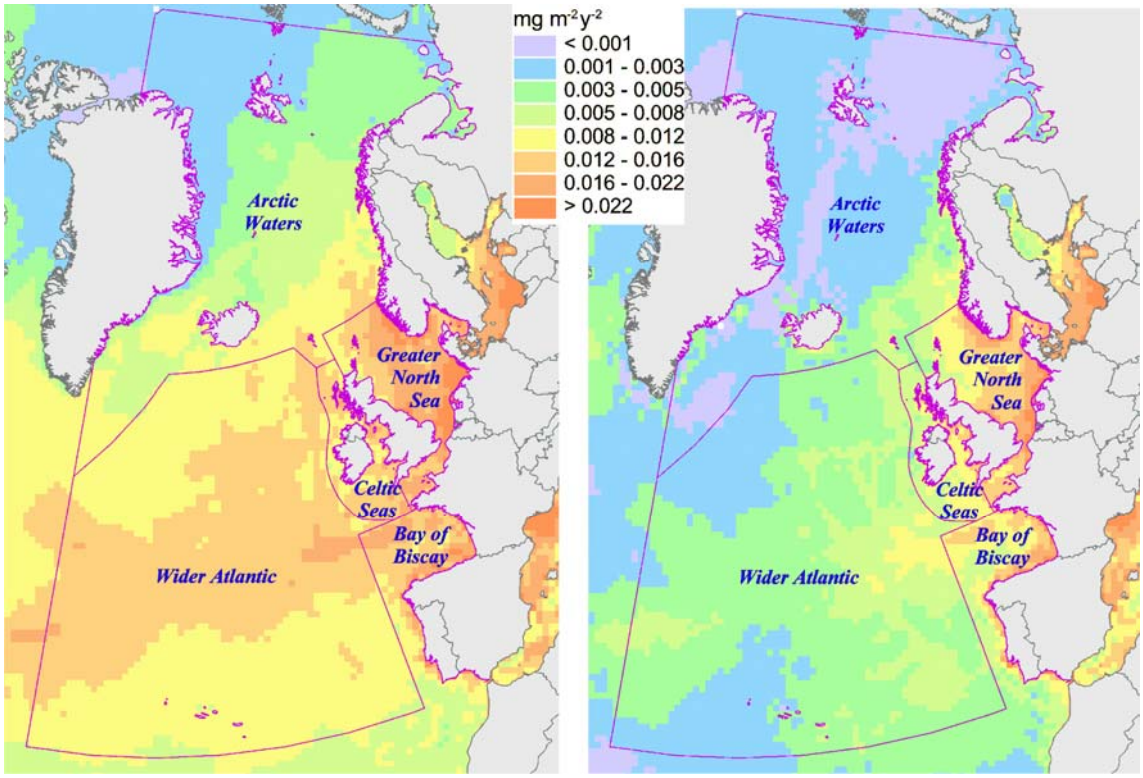


***Figure 6.18**: Total (left panel) and net (right panel) deposition fluxes for cadmium to the OSPAR Regions in 2006; units are in mg/m^2 per year.*

Figure 6.19 shows the modelled contribution of individual countries to the annual deposition of cadmium to the OSPAR Regions in 2006. In all Regions, the largest part of the deposition typically comes from two (nearby) countries (Table A4.11 at Annex 4).

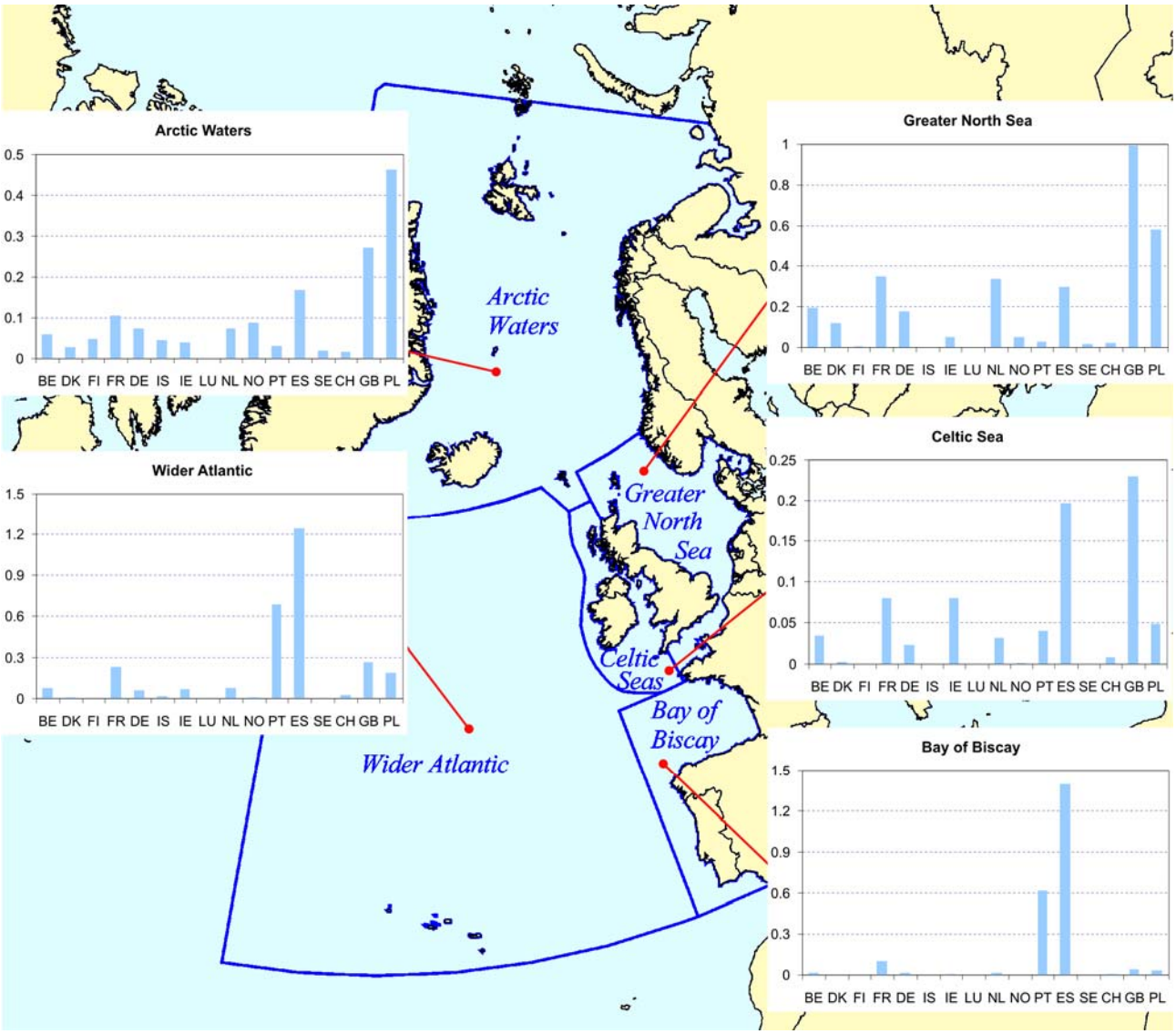


***Figure 6.19**: Contribution of individual countries to the modelled annual depositions of cadmium to the OSPAR Regions for 2006; units are in t//yr.*

Figure 6.20 shows the relative contribution from the most important emission sectors to the annual deposition in 2005, with combustion processes (sector 1) as the dominant source in all regions (Table A4.12 at Annex 4).

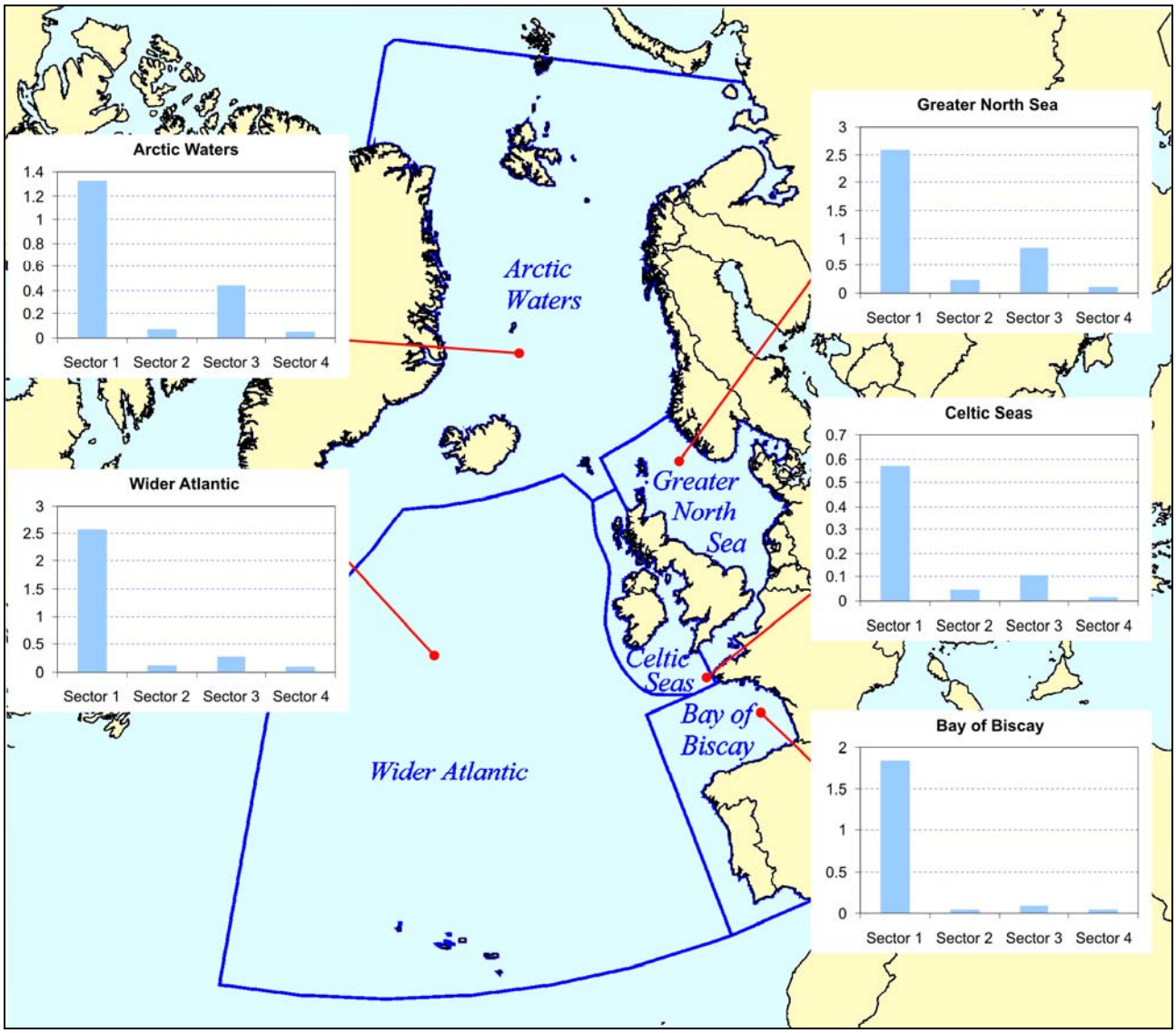


***Figure 6.20**: Contribution of four key source sectors to the cadmium deposition to the OSPAR Regions in 2005; units are in t//yr.*

In Figure 6.21 the time series (1990 – 2006) of total and net cadmium deposition to the OSPAR Regions is displayed. Data are given in Tables A4.7 and A.4 9 at Annex 4. The trend analysis by Mann-Kendall test showed significant declining trends for all five Regions. When this test was applied for the more recent period 1998 – 2006 only, the time series showed no significant declining trends for any of the Regions, indicating that the trends are stagnating.

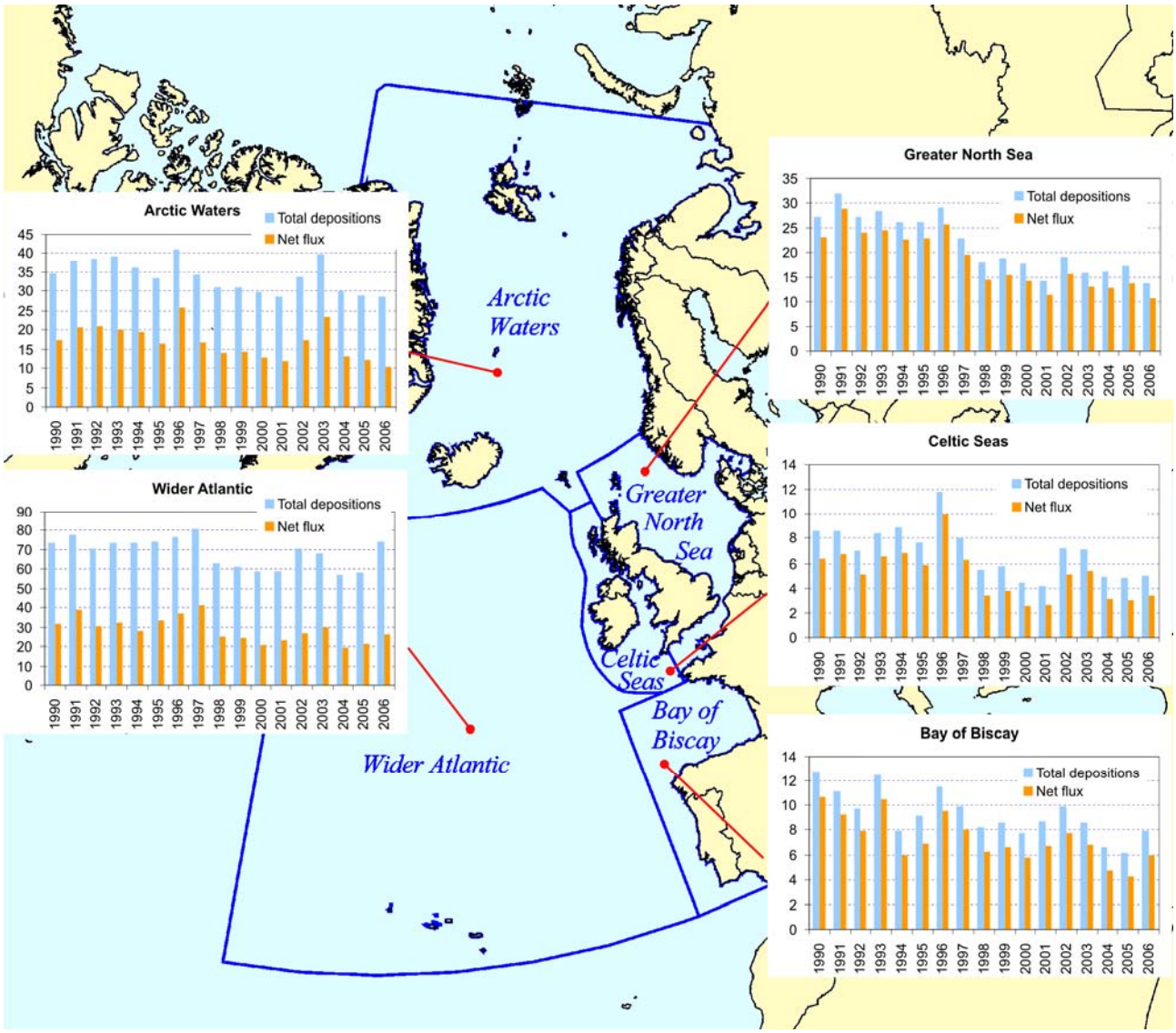


***Figure 6.21**: Time series (1990 – 2006) of modelled total and net deposition fluxes of cadmium to the OSPAR Regions; units are in t//yr.*

Figure 6.22 shows the time series of cadmium deposition from 1990 – 2006 for the 13 sub-areas of Region II (Tables A4.8 and A4.10 at Annex 4). The Mann-Kendall test for this period revealed a significant decreasing trend for all areas. When performed for the more recent period (1998 – 2006) again stagnation of the decline was shown as none of the time series showed significant declining trends.

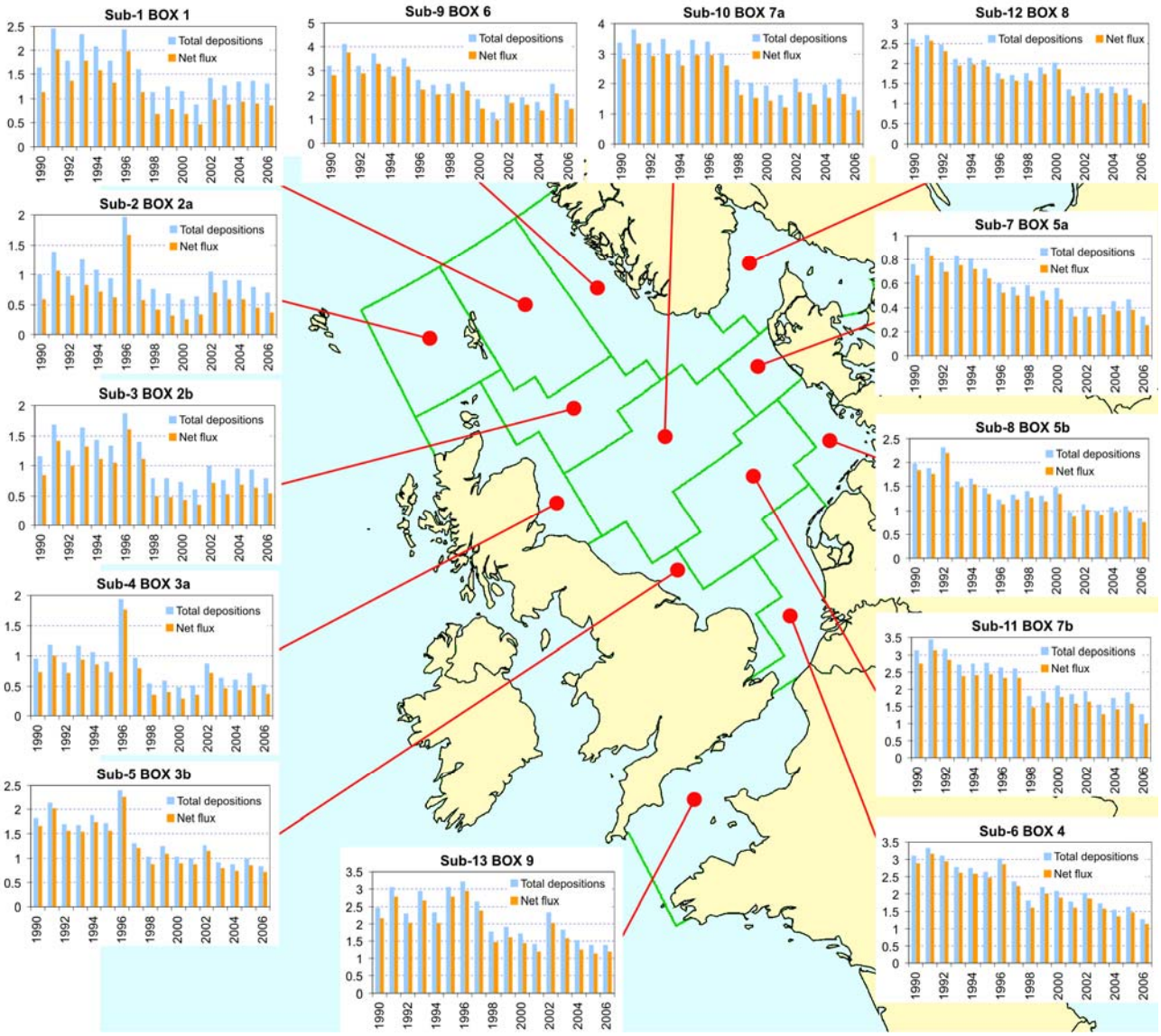


***Figure 6.22**: Time series (1990 – 2006) of modelled total and net deposition fluxes of cadmium to the 13 sub-areas of the Greater North Sea; units are in t//yr.*

6.2.3 Mercury

Figure 6.23 shows the modelled spatial distribution of total and net mercury deposition to the OSPAR maritime area in 2006. In contrast to lead and cadmium deposition, the open sea Regions I and V have the highest values for the net deposition fluxes. Also in total deposition, these Regions show high values for the deposition fluxes. The coastal areas show in general lower net deposition fluxes, indicating a balance between the deposition and the re-emission of mercury.

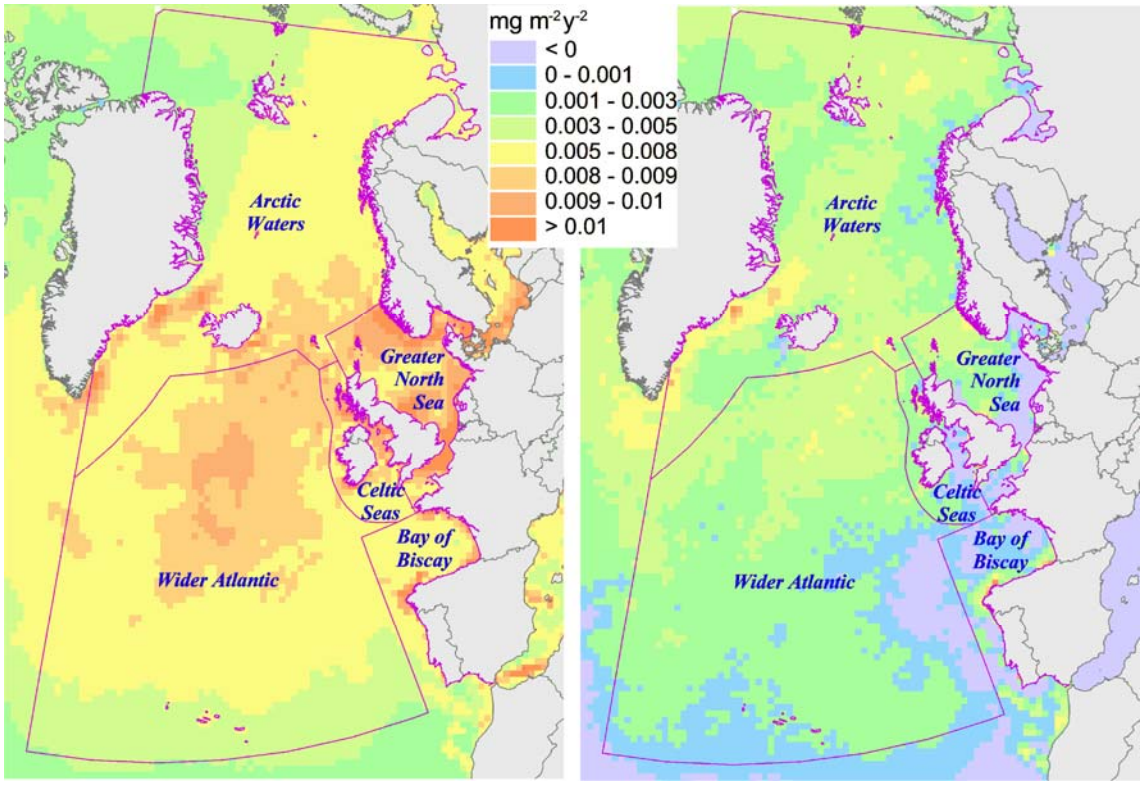


***Figure 6.23**: Total (left panel) and net (right panel) modelled deposition fluxes for mercury (mg/m^2/yr) to the OSPAR Regions in 2006; units are in mg/m^2 per year.*

Figure 6.24 shows the contribution of individual countries to the annual deposition of mercury to the five OSPAR Regions in 2006 (Table A4.17 at Annex 4). In each region there are typically few countries that contribute most to mercury deposition.

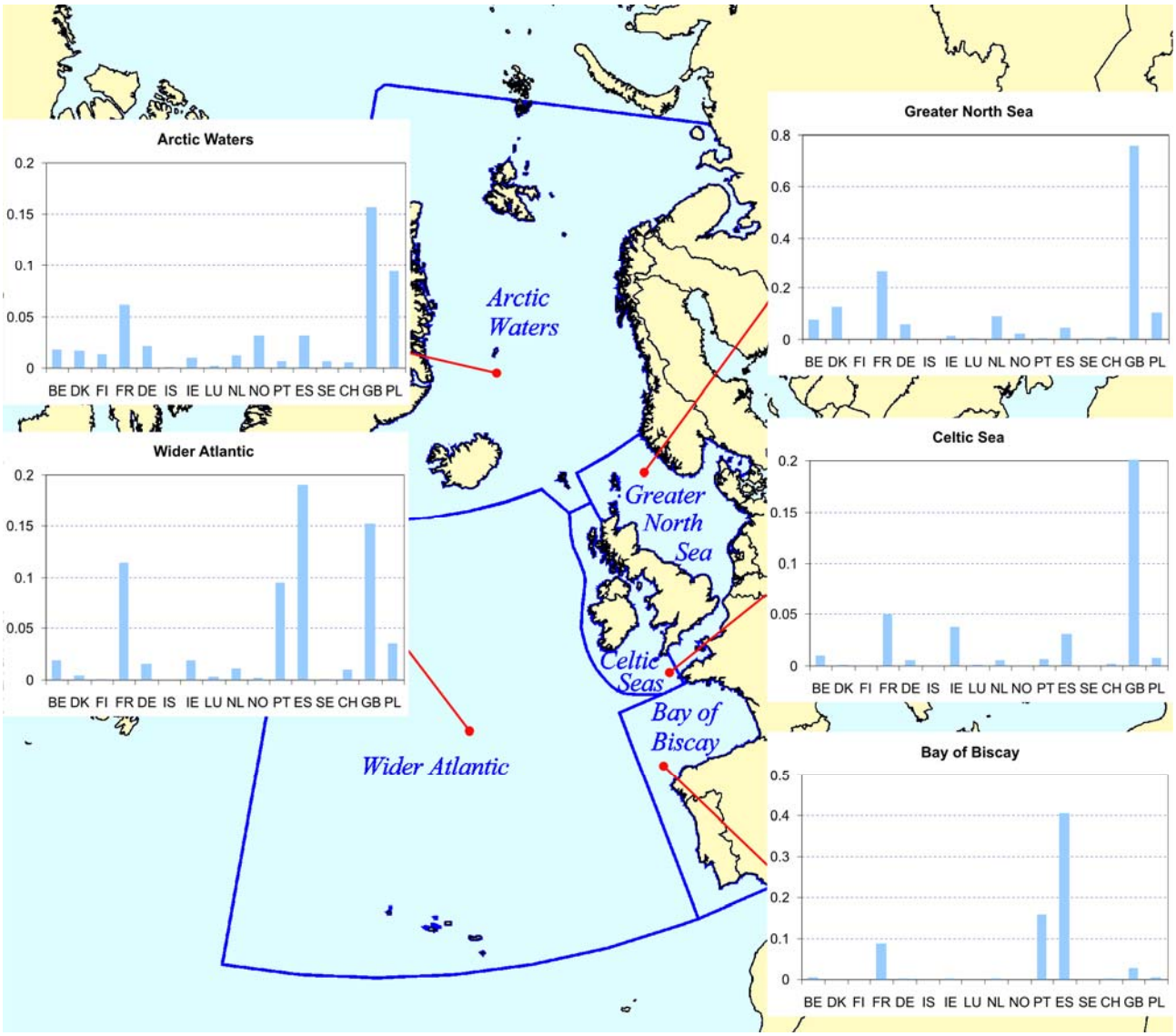


***Figure 6.24**: Contribution of individual countries to the annual depositions of mercury to the OSPAR Regions for 2006; units are in t//yr.*

In Figure 6.25, the relative contribution from the most important emission sectors to the annual deposition of mercury in 2005 is presented; combustion processes (sector 1) is the dominant source (Table A4.18 at Annex 4).

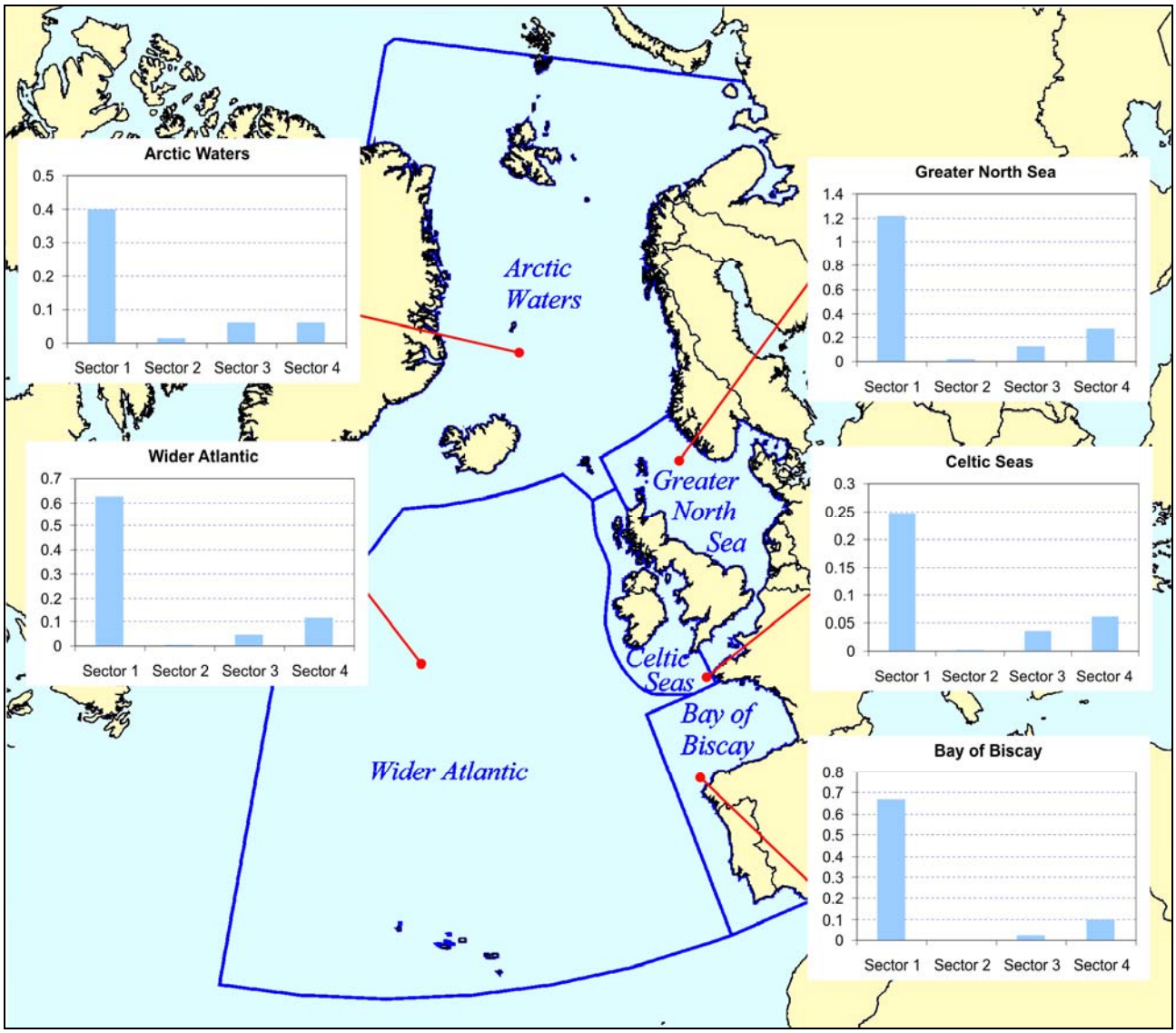


***Figure 6.25**: Contribution of four key source sectors to mercury deposition to the OSPAR Regions in 2005; units are in t//yr.*

Figure 6.26 shows the time series of mercury deposition to the five Regions (1990 – 2006). The values are given in Tables A4.13 and A4.15 in Annex 4. The Mann-Kendall test has been applied to this full set of data and revealed statistically significant downward trends for all Regions, except for the net deposition in Region I which showed no significant trend. The trend analysis applied to the more recent period of 1998 – 2006 revealed that not all trends in the five Regions were declining significantly. This indicates that the deposition levels have stagnated recently. This is broadly supported by CAMP data on mercury in wet deposition and in the air (see Box 6.2).

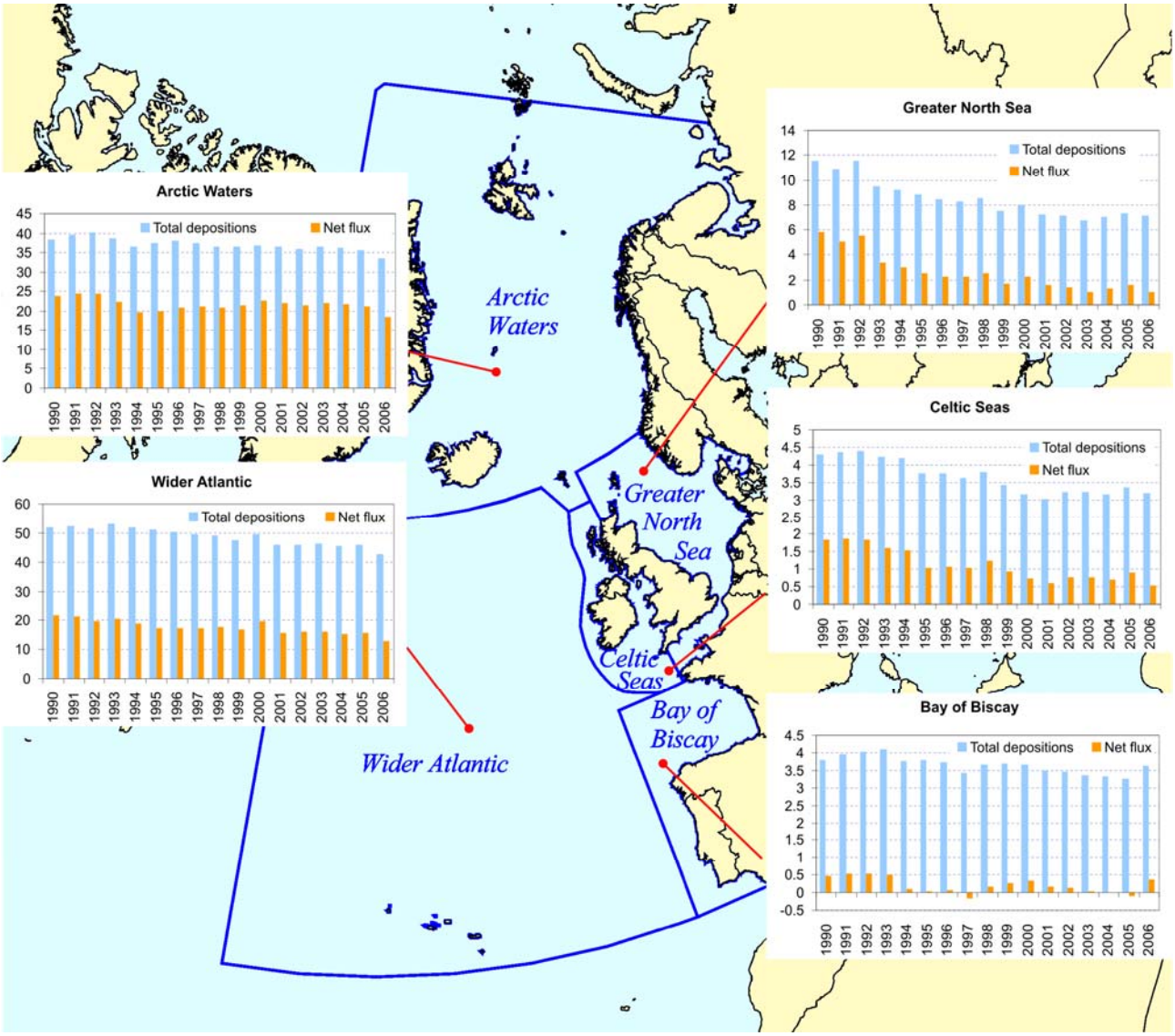


***Figure 6.26**: Time series of modelled total and net deposition fluxes of mercury to the OSPAR Regions (1990 – 2006); units are in t/yr.*

Figure 6.27 shows the time series of mercury deposition from 1990 – 2006 for the 13 sub-areas of Region II (Tables A4.14 and A4.16 at Annex 4). Performing the Mann-Kendall test for trends over this period revealed significantly declining deposition trends for all areas. The analysis performed for the period 1998 – 2006 resulted in none of the 13 different sub-areas having a significant decline anymore. Once again this indicates that the deposition levels have stagnated.

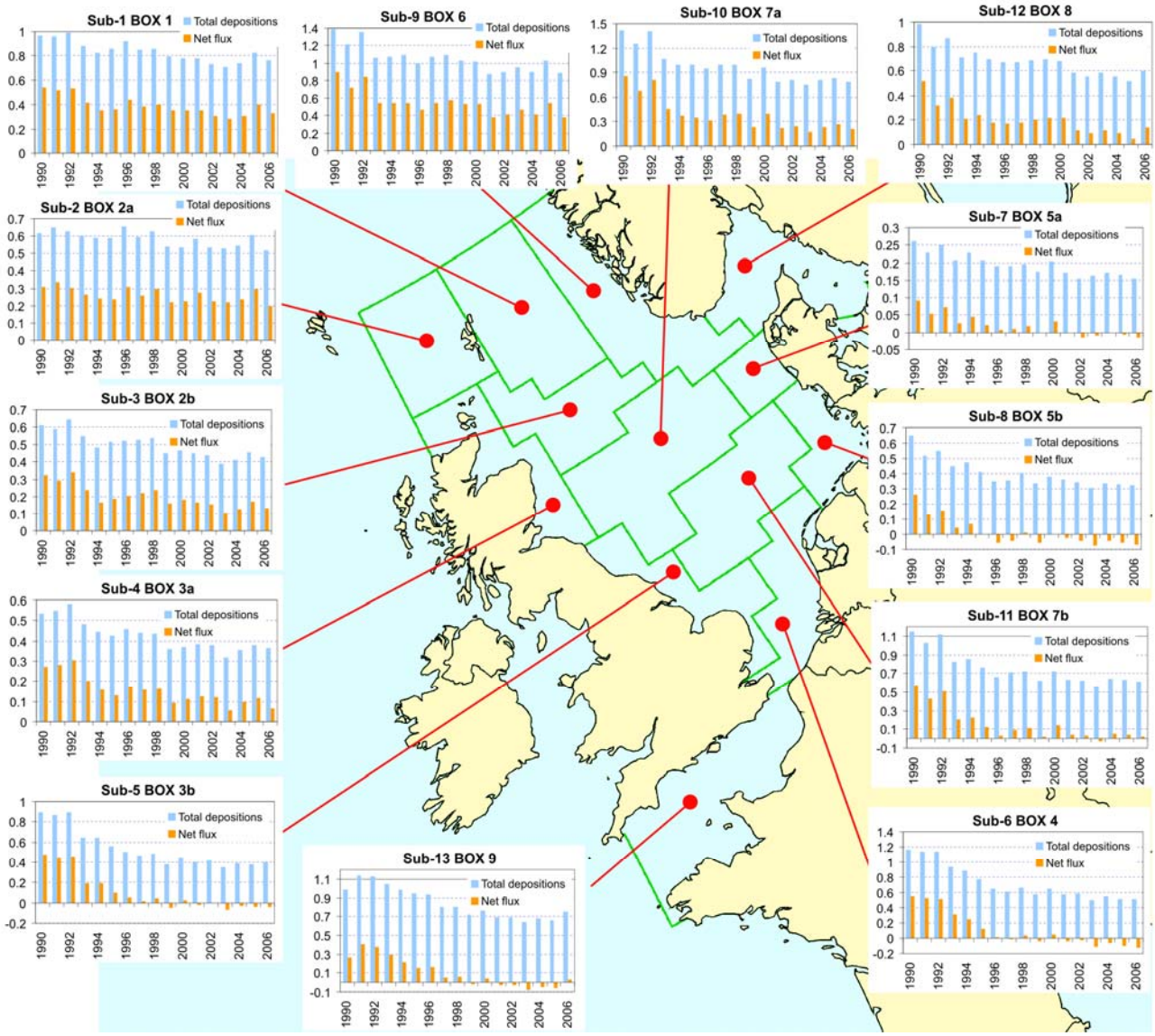


***Figure 6.27**: Time series of modelled total and net deposition fluxes of mercury into the 13 sub-regions of the Greater North Sea. Units are in t//yr.*

Box 6.2

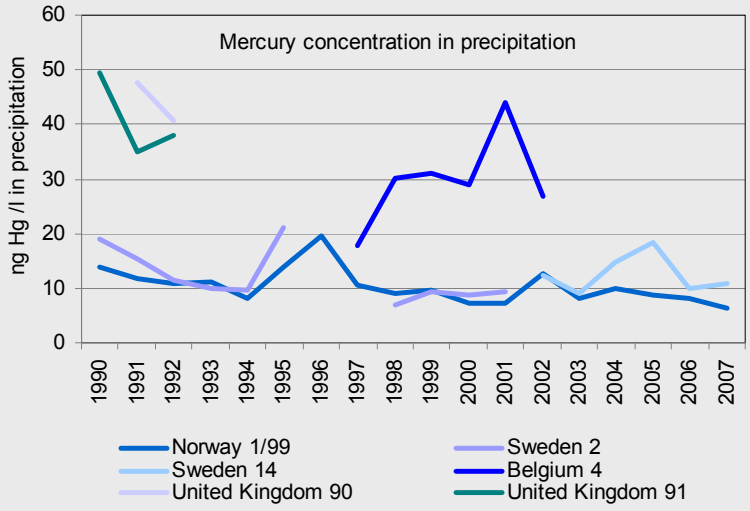
Mercury in coastal precipitation and in the air

Observations under the CAMP programme of mercury in precipitation and in the air around the coasts has special relevance now that UNEP has decided to press forward with a global mercury agreement (UNEP Governing Council, February 2009), and that the European Union is moving forward with its own mercury policy. These records provide a view of past changes and current state which can inform these policy initiatives and which can provide a benchmark.

All monitoring sites have seen a decline in the mercury content to precipitation, changes being greater nearer to Europe's continental heartland. With annual precipitation up to approximately 1400 mm, depositions in precipitation are now currently mostly under 10 mg Hg /m^2.

Observations of the concentrations of mercury found in precipitation provide the longest records held by CAMP monitoring. Indeed, for Birkenes/Lista on the southern tip of Norway CAMP monitoring holds a continuous record stretching nearly two decades. The reliability of these observations is evidenced by comparable concentrations being observed on the Swedish coast. The CAMP record also indicates the more localised changes which have been seen closer to source regions. Records from Belgium and the United Kingdom reveal much higher concentrations in the beginning and middle of the period, the latter station in 2007 having seen a five-fold fall in precipitation concentrations from its 1990 peak. Scandinavian sites have seen a halving of concentrations, all coastal locations now reporting under 10 ng/l mercury in precipitation (see Figure below).

Observations of mercury in air have only recently been reported under the CAMP, giving a short record over recent years. Observations at some sites suggest that whilst concentrations are low, they may have nevertheless crept upwards over the past four years at single locations. It is not possible to exclude meteorological factors as a reason for this, but observations of rising mercury air concentrations on OSPAR's coasts does provide a measure to watch carefully in the future.



6.3 Modelled deposition of organic contaminants

The atmospheric inputs of lindane and PCB-153 into the OSPAR maritime areas were calculated by EMEP/MSC-E (Gusev *et al*., 2008c) using the chemical transport model MSCE-POP. The calculations were performed for the period 1990 – 2006. In general, atmospheric depositions of persistent organic pollutants (POPs) are, like for heavy metals, accompanied by re-emission of these contaminants back to the atmosphere. The net atmospheric input of POPs to the OSPAR maritime area, the *net deposition* fluxes, represent the difference between the total deposition and estimated re-emission. Model calculations take into account the intercontinental transport of PCB-153 and lindane.

6.3.1 Lindane

Figure 6.28 shows the spatial distribution of the total and net deposition fluxes of lindane in 2006. The highest values for deposition occur in the Regions II and IV. In contrast to the Baltic Sea, there is no large re-emission of lindane over the OSPAR area, leading to a net deposition similar to total deposition. This means that lindane deposition is mainly from anthropogenic inputs. The contribution from individual countries to the deposition of lindane is shown in Figure 6.29 (data in Table A4.23 at Annex 4).

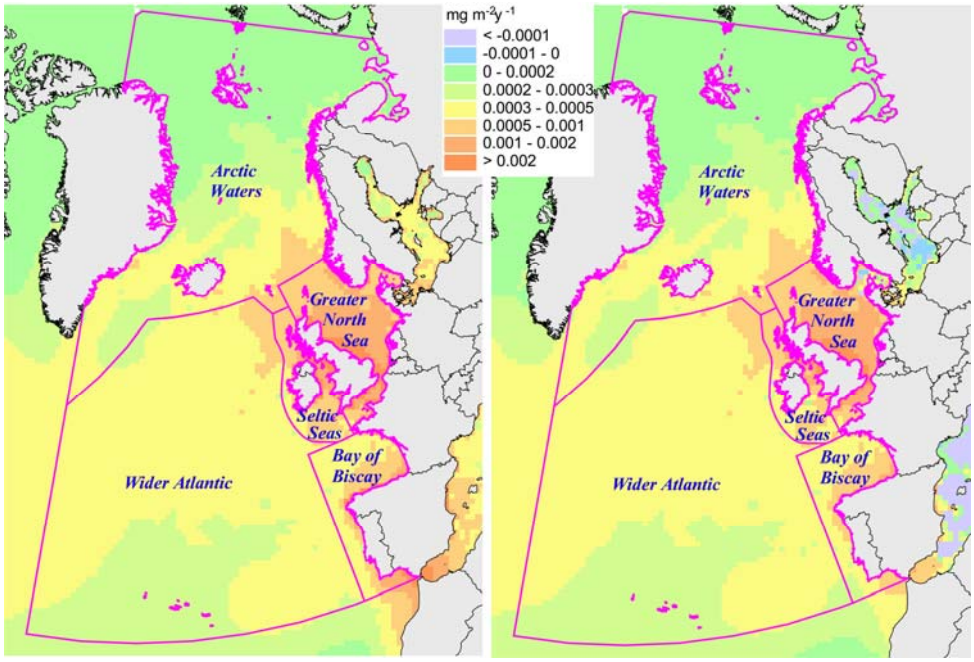


***Figure 6.28**: Total (left panel) and net (right panel) modelled deposition fluxes of lindane to the OSPAR Regions in 2006; units are in mg/m^2 per year.*

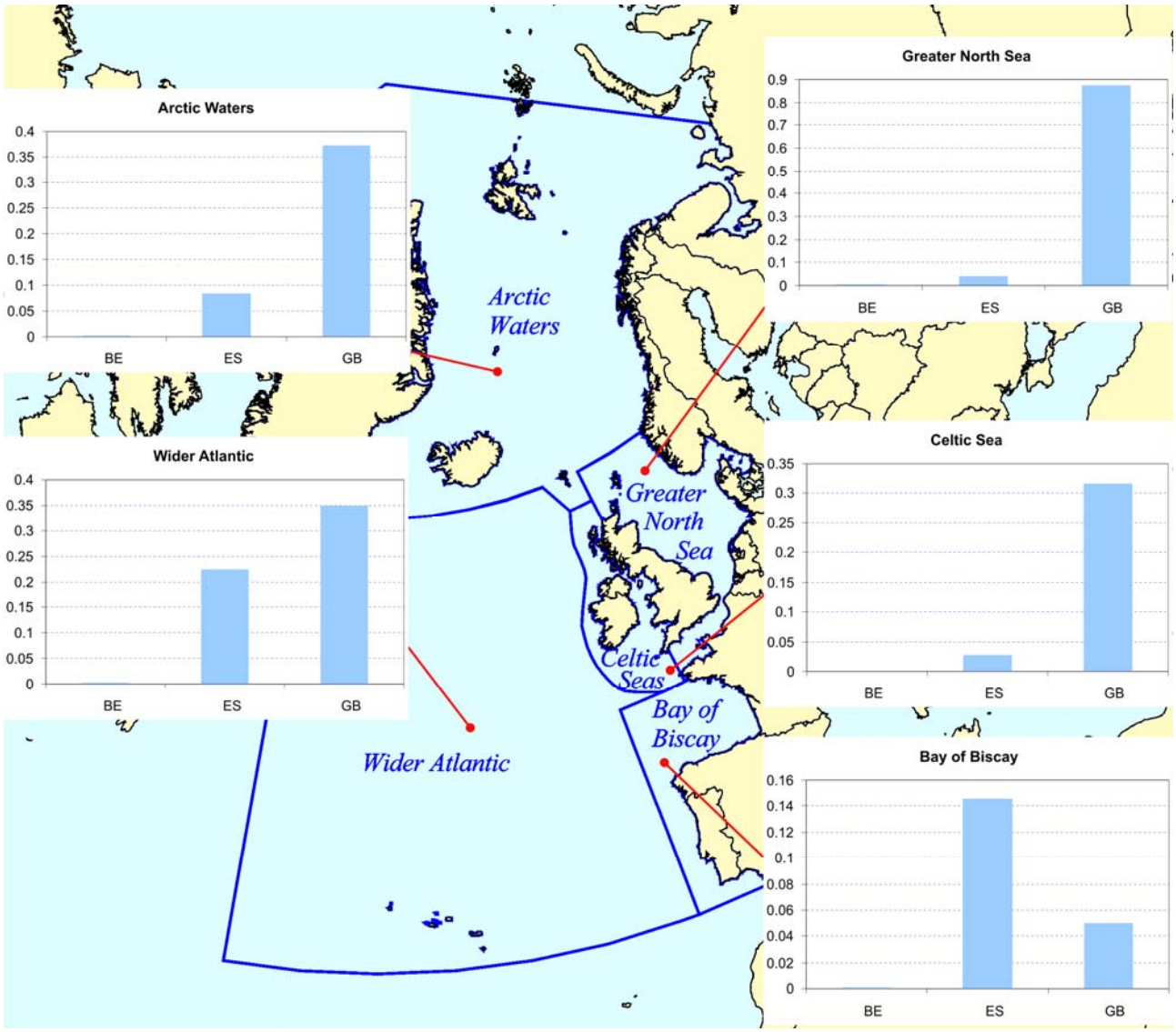


***Figure 6.29**: Contribution of individual countries to the annual deposition of lindane to the OSPAR Regions for 2006, based on available data; units are in t//yr.*

Figure 6.30 shows the time series of lindane deposition (1990 – 2006) for the five OSPAR Regions. Data are given in Tables A4.19 and A4.21 in Annex 4. A Mann-Kendall test was performed over these time series which shows significant downward trends for all five Regions, both for the period 1990 – 2006 and the more recent period 1998 – 2006.

Estimates based on CAMP observations confirm a sharp decline in lindane depositions in the late 1990s which continues more gently today. Despite the phase out of lindane, atmospheric deposition is still above background levels in the North Sea and deposition continues across the OSPAR area (see Box 6.3).

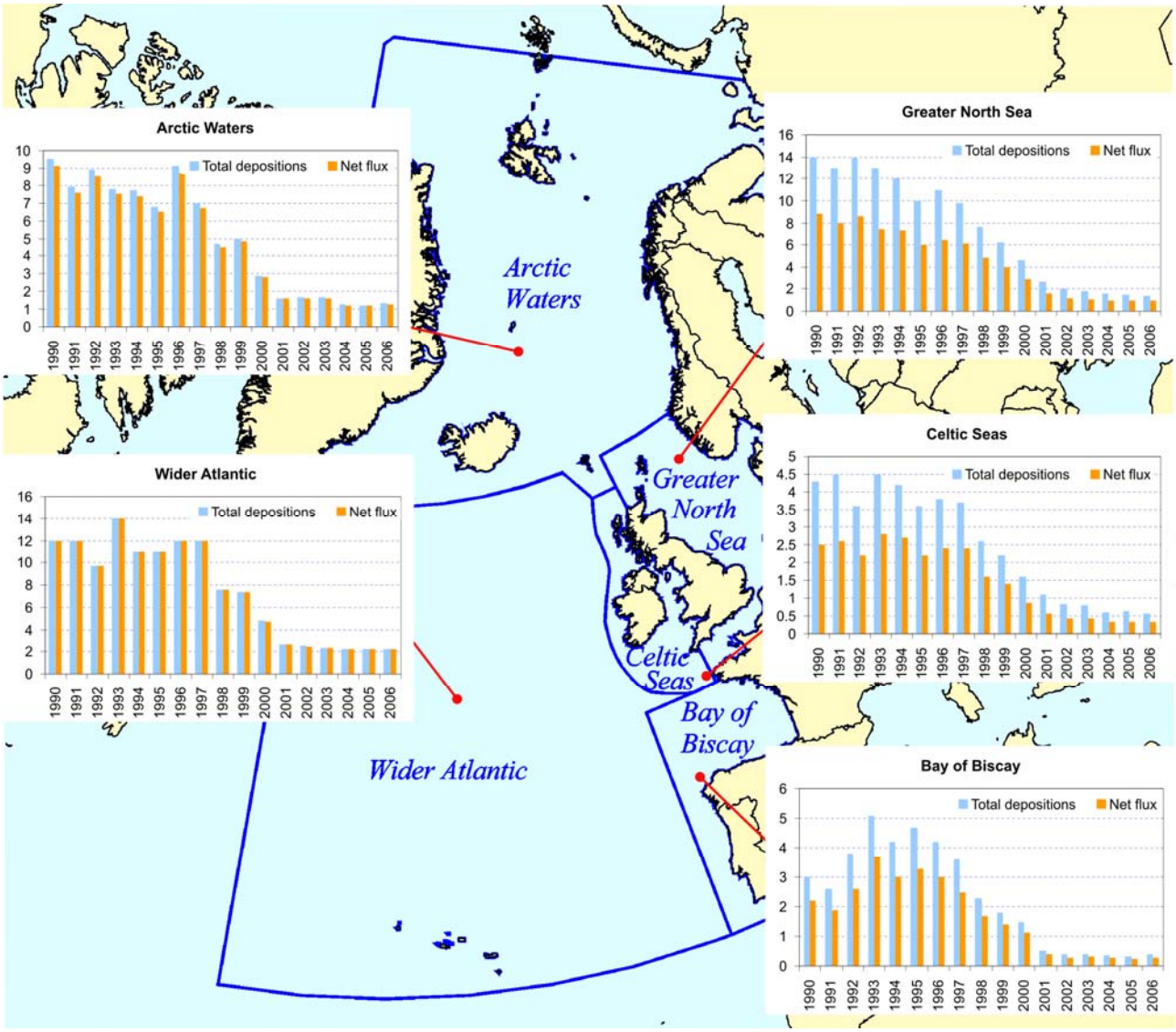


***Figure 6.30**: Time series (1990 – 2006) of modelled total and net deposition fluxes of lindane to the OSPAR Regions; units are in t//yr.*

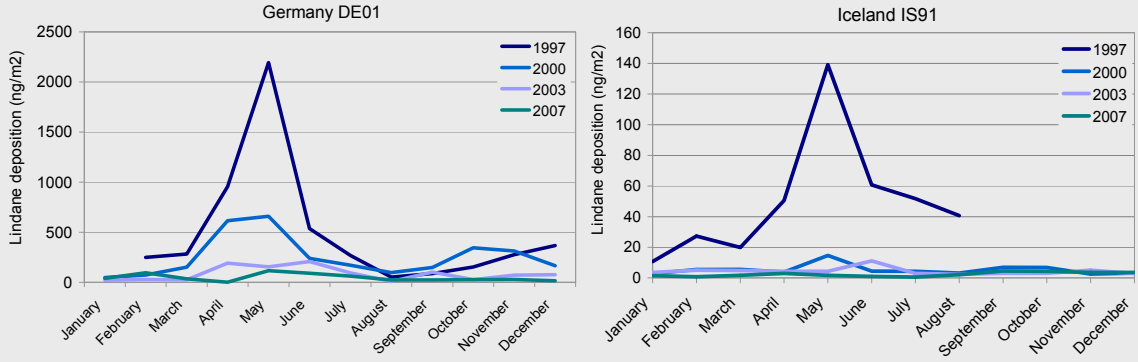
Box 6.3
Lindane has still not entirely gone

Lindane is an example of a biocide which has been phased out in Europe, and for which levels now being deposited to the seas have fallen dramatically. The improvement, however, has taken a period of time to be fully evident. OSPAR's Comprehensive Atmospheric Monitoring Programme has been able to track these changes independently of the official expectations.

In the late 1990s lindane was phased out across Europe, France completing the process in 1999. Observations made by CAMP show a dramatic decrease in the quantities being deposited to the coasts in precipitation at this time, yet lindane continued to be observed for several years. Moreover, a clear seasonal pattern persisted with a spring peak of depositions each year. This suggests that lindane was still being used after 1999, for example as stockpiles were rundown.

Although a decline has been seen in all regions there is a clear decrease in observed depositions of lindane with distance from mainland Europe. By 2007, approximately a decade after the peak, observed depositions in the southern North Sea had fallen by a factor of up to 50, as they had also done on the coasts of Iceland. However, during this decade the southern North Sea depositions have only just fallen to the levels seen in Iceland at the peak ten years ago and are still clearly above background levels (see the figures below).

Lindane is still found in the atmosphere. Some continued European use is one explanation, as is continental-scale transport from as far away as Asia where use continues. Re-release from the environment also occurs, one potential pathway with current topical interest being release as ice melts in the high Arctic.



6.3.2 PCB-153

Figure 6.31 shows the spatial distribution of the modelled deposition of PCB-153 in 2006. The highest values occur in the Regions II and IV. Figure 6.32 shows the contribution from individual countries to the deposition in 2006 (Table 4.28 at Annex 4).

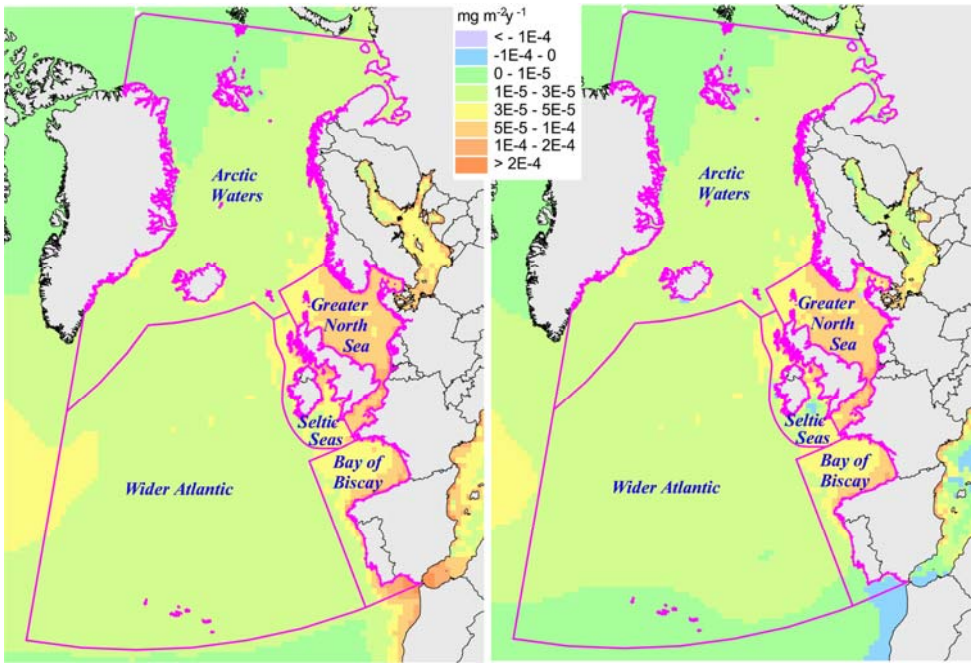


***Figure 6.31**: Total (left panel) and net (right panel) modelled deposition fluxes of PCB-153 to the OSPAR Regions in 2006; units are in mg/m^2 per year.*

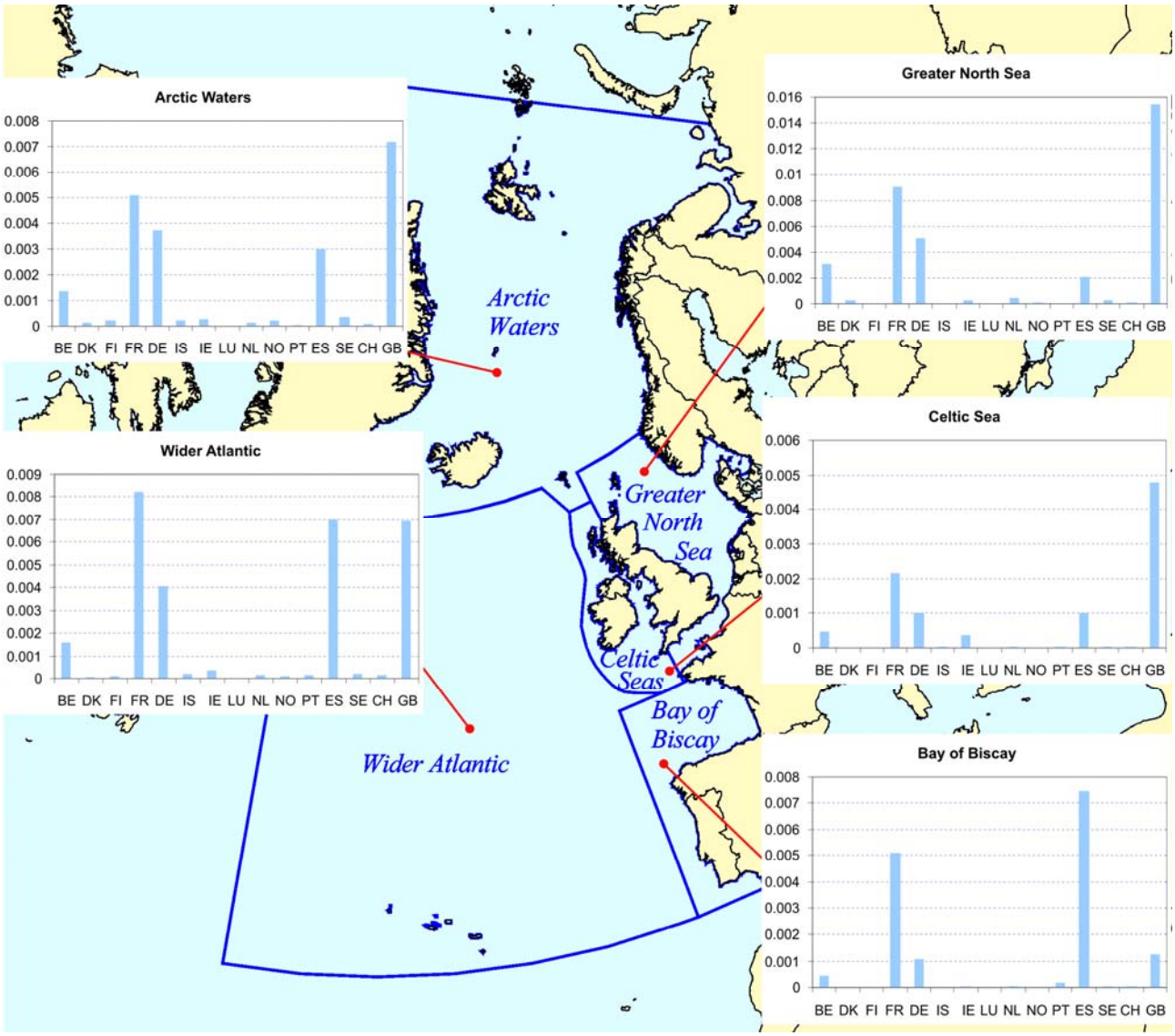


***Figure 6.32**: Contribution of individual countries to the modelled annual deposition of PCB-153 to the OSPAR Regions for 2006; units are in t//yr.*

In Figure 6.33, the time series (1990 – 2006) of PCB-153 deposition over the five Regions of the OSPAR maritime area are depicted. Data are given in Table A4.24 and A4.26 in Annex 4. The Mann-Kendall test showed significant downward trends for all five Regions, both for the period 1990 – 2006 and the more recent period 1998 – 2006 with one exception. This is the net deposition of PCB-153 to Region III which showed a non-significant downward trend.

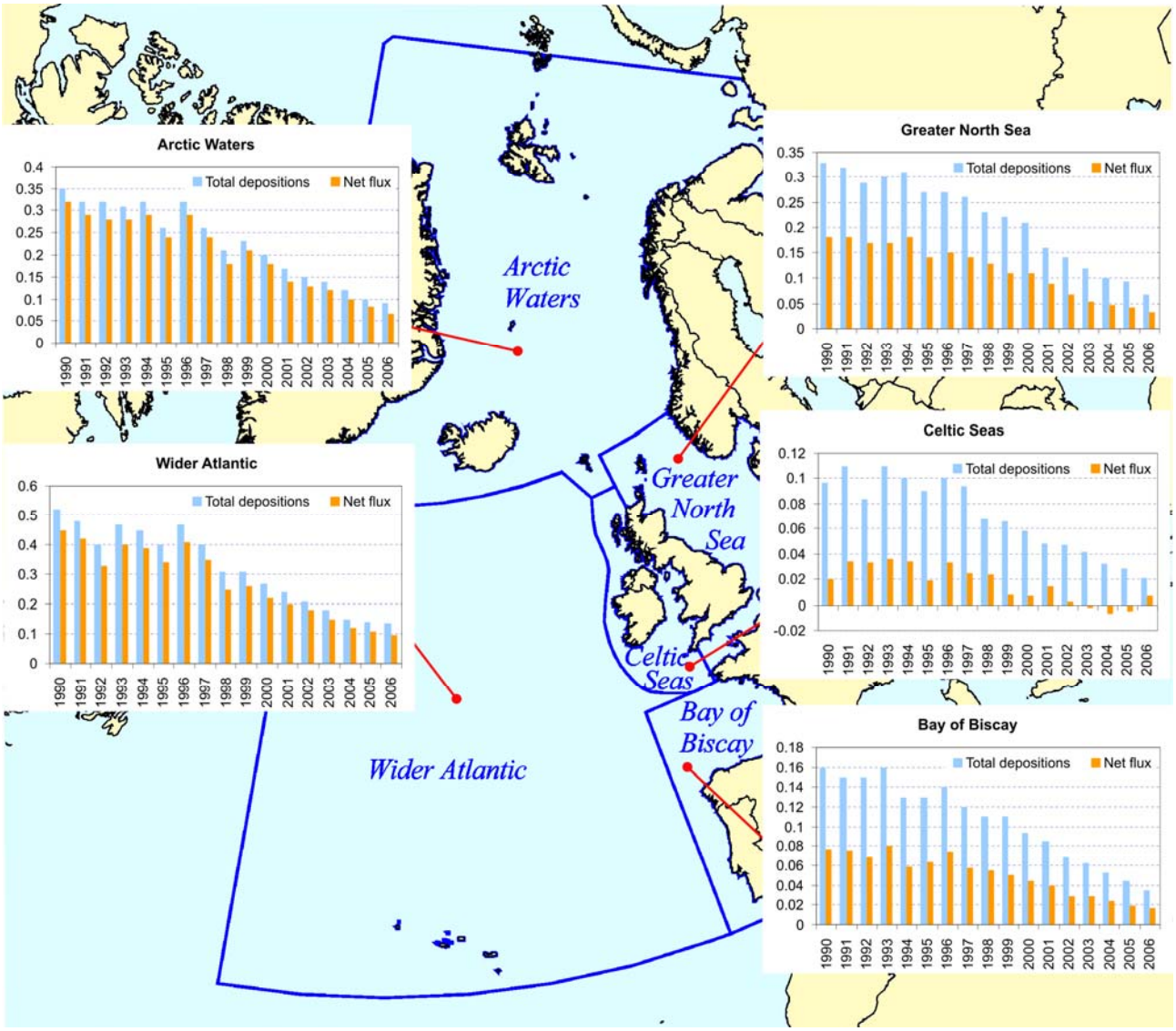


***Figure 6.33**: Time series (1990 – 2006) of modelled total and net deposition fluxes of PCB-153 to the OSPAR Regions; units are in t//yr.*

6.4 Regional summary of modelled deposition to the Regions

The results of trend analysis of atmospheric deposition in 1998 – 2006 of nitrogen (oxidized, reduced and total), heavy metals (lead, cadmium and mercury) and the organic contaminants lindane and PCB-153 are presented in Table 6.1 per Region. The values presented are the % difference over the period for net deposition.

It becomes clear from the model calculations that nitrogen compounds show an upward trend in the deposition in most Regions, albeit most trends are not statistically significant (except for reduced nitrogen in Region IV). In contrast, all nitrogen compounds show a significant downward trend in Region II. For Region III reduced and total nitrogen give (non-significant) downward trends.

For heavy metals most trends of modelled net deposition are downward, but only mercury in Regions II and V, and lead in Region IV are statistically significant. Lead and cadmium in Region V and mercury in Region IV have (non-significant) upward trends. Finally, all trends for lindane and PCB-153 for all five Regions are significant and declining.

***Table 6.1**: Regional summary of the trends (in %) for the EMEP modelled (net) deposition of pollutants for the period 1998 – 2006. Coloured cells are statistically significant trends: downward (green) and upward (red).*

	NO_x	N_{red}	N_{tot}	Pb	Cd	Hg	Lindane	PCB-153
Region I	+15	+3	+11	-16	-27	-11	-72	-62
Region II	-17	-16	-16	-30	-25	-58	-80	-74
Region III	+3	-3	-1	-10	-1	-55	-79	-70
Region IV	+5	+16	+9	-18	-4	+113	-84	-70
Region V	+6	+5	+6	+20	+5	-28	-71	-61

7. Comparison of atmospheric and waterborne inputs

Under the OSPAR Comprehensive Study of Riverine Inputs and Direct Discharges, the RID monitoring programme, OSPAR countries monitor and report annually since 1990 inputs of nutrients and selected contaminants via rivers and via direct discharges (for example sewage and industrial effluents and more recently aquaculture) to the sea. Periodic assessments of the RID data determine trends in waterborne inputs of nutrients and contaminants to the sea. The latest regional assessment of waterborne inputs was published in 2009 for the period 1990 – 2006 (OSPAR, 2009a).

This section compares the observation data for waterborne inputs under the RID monitoring programme with the model calculations of atmospheric deposition for total nitrogen, lead, cadmium and mercury into the OSPAR area. The purpose is to give an indication of the relative magnitude of waterborne and airborne pathways of assessed pollutants to the OSPAR area. The comparison has been carried out for Regions I to IV; as Region V consists of an open sea area without rivers or direct discharges (with the exception of the Azores) this Region is not considered.

Detailed comparisons of time series of inputs for each Region and parameter over the assessment periods are given in Annex 10 together with data descriptions and associated uncertainties. In the following sections a summary of uncertainties and the results of the detailed comparison at Annex 10 is presented for nitrogen and for heavy metals. The percentage contribution of each pathway is presented as average across the time series. As such and given the uncertainties associated with waterborne data and airborne calculations, this is intended as an indication of magnitudes and not as precise quantification.

7.1 Uncertainties affecting the comparison

For the calculations of atmospheric deposition of nitrogen there is in general an underestimation of the wet deposition fluxes. Although calculated and measured wet deposition match well, a typical value of uncertainty is 30% (EMEP, 2002), but in some cases differences between measured and calculated depositions can be much larger. In general, modelled wet deposition for stations situated in the sub-areas of the Greater North Sea follow observations better than modelled wet deposition for stations representing the OSPAR Regions (OSPAR, 2007a).

For the heavy metals lead, cadmium and mercury the difference between modelled and measured depositions is commonly within the ±50% range for Danish, German, Dutch and Icelandic stations, but there are cases where the difference between modelled and observed values are significantly larger (OSPAR, 2008c).

RID input data should be treated with caution given the identified uncertainties and incompleteness of reporting (see OSPAR, 2009a). Results and their interpretation for most Regions and rivers give solely an indication of the magnitude of waterborne inputs. Main uncertainties in RID data and the associated assessment results include the following:

- In general, determinants in direct discharges (especially for nutrients) are less well reported than those in riverine inputs. There are significant gaps in the reporting of heavy metals for both riverine inputs and direct discharges, especially for mercury.
- Riverine flow rates have a greater or lesser influence on the level of riverine inputs, depending upon the substance concerned. Generally, flow adjustment (especially for nitrogen) suppresses

the variability between adjacent years which results in far more statistically significant trends compared to the assessment of unadjusted data.

- OSPAR Region II, especially the main body of the North Sea, is the maritime area that is the best covered in terms of completeness of reporting, although also here there are considerable gaps in reporting and completeness of data. There are major gaps in data for Region IV, especially for metals, which made it impossible to perform any proper trend analysis for that Region.
- There are large variations in the way that direct discharges to water are accounted for in the Contracting Parties' annual RID data reports. Some Contracting Parties report on direct discharges from sewage treatment plants, industries and fish farming, others do not report any direct discharges at all. Given that large cities are located along the shores of the marine coastline for all relevant OSPAR countries, the reported discharges may have been seriously underestimated. Direct discharges appear to be relatively less important than riverine inputs. This may be reasonable for areas where large cities are located upstream and along major rivers, but the issue of whether discharges from coastal urban areas are properly accounted for remains unresolved.
- Limits of detection (LoD) for river water analysis may vary considerably within a country, when different laboratories perform the analysis, and between countries. Different analytical methods may have been applied (for example because of analytical developments over time) and contribute to uncertainties in the trend analysis.

7.2 Nitrogen

For nitrogen a comparison is made for the period 1995 – 2006, since there are no EMEP modelled deposition values prior to 1995. Waterborne inputs of nitrogen in Region I are incomplete as these are based on Norwegian main river and discharge data only. Similarly, data coverage and quality in Region IV are associated with high uncertainty. With this in mind, a comparison of the RID and EMEP model based inputs suggests that waterborne inputs are the dominant source (up to two thirds) of total nitrogen inputs to the OSPAR area in Regions II and III. Airborne inputs are the dominant source in Region IV and in particular in Region I (Figure 7.1).

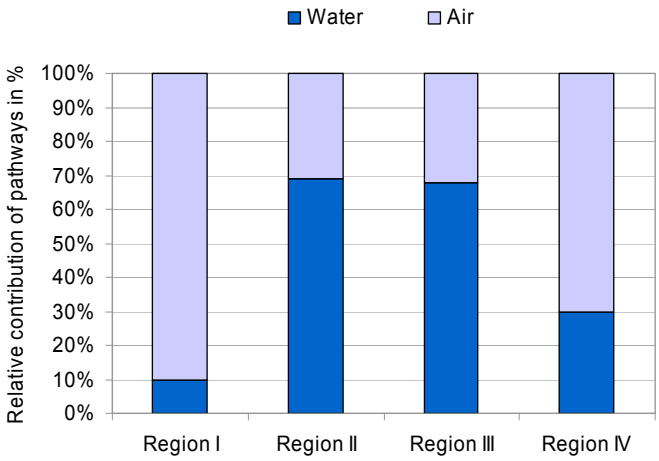


***Figure 7.1**: Total nitrogen inputs to OSPAR Regions I – IV via direct discharges to water and riverine inputs (RID monitoring) and total atmospheric deposition (EMEP model calculations) averaged over the period 1995 - 2006. Waterborne inputs in Region I are based on Norwegian data only.*

7.3 Heavy metals

Furthermore, in Region IV RID data is only available from 1997 onwards. For mercury there was no sufficient data in Region IV to perform an adequate RID assessment. Hence the comparison is carried out for four pollutants only. Waterborne inputs in Region I are based on Norwegian data for main rivers and discharges only.

Atmospheric deposition is the dominant pathway of heavy metals to Region I. There is no clear overall dominant pattern in Regions II and III with waterborne contributions ranging between around 50% and 70%, except for mercury with more than 80% in Region II. However, uncertainty of mercury RID data and modelled atmospheric deposition is high. In Region IV atmospheric deposition is the dominant pathway for cadmium and lead to the sea.

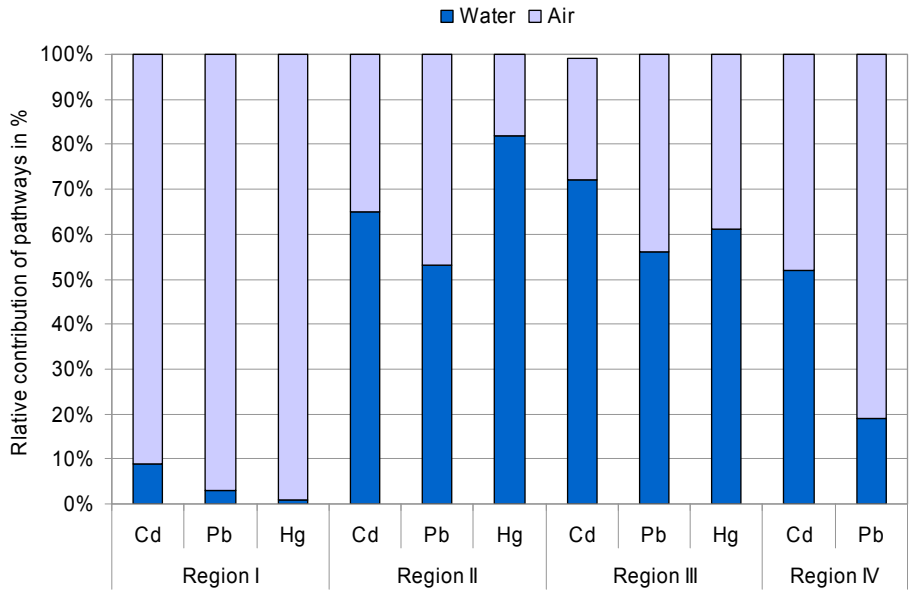


***Figure 7.1**: Total inputs of cadmium (d), lead (Pb) and mercury (Hg) to OSPAR Regions I – IV via direct discharges to water and riverine inputs (RID monitoring) and total atmospheric deposition (EMEP model calculations) averaged over the period 1990 - 2006. Waterborne inputs for Region IV are for 1997 – 2006 and inputs of mercury are insufficient to allow an assessment. Waterborne inputs for Region I are based on Norwegian data only.*

8. Conclusions and recommendations

8.1 Conclusions

In this report an assessment of atmospheric concentrations and deposition of nitrogen, heavy metals (lead, cadmium and mercury) and persistent organic pollutants (lindane and PCB-153) is presented. The emphasis of the report is on the trends over the period 1998 – 2006, i.e. changes since the QSR 2000.

In general very few monitoring data are available for Regions I, III, IV and V. The conclusions on trends for these Regions should therefore be considered as indicative. If no information is given on trends in a certain Region no data was available.

Emissions to air

A comparison of emissions in 1998 and 2006 of the countries bordering the OSPAR Regions shows a general decrease for all assessed pollutants for Regions II to V. Also for Region I emissions decreased for ammonia (NH_3), lead and PCB-153. In contrast, emissions increased for Region I for nitrogen oxides (NO_x, +20%), Cd (+20%) and Hg (+42%). These increases are all attributed to emissions from Russia.

For NO_x the sum of emissions of the countries bordering Regions II and III decreased by about 20%, and for the Regions IV and V by 6%. An additional source of nitrogen oxide emissions for the OSPAR maritime area is international ship traffic; the total contribution increased from 1515 kt N/yr in 1998 to 1826 kt N/yr in 2006 (+21%). Decrease of ammonia emissions (NH_3) ranged between 8% – 13% for all Regions.

The sum of trace metal emissions from the countries bordering the Regions showed a decreasing trend for lead (-76% to -86%) for all Regions, and decreasing trends for Regions II to V for cadmium (-33% to -46%) and mercury (-30% to -35%).

The sum of the lindane emissions from the countries bordering Region I is nil. For Regions III and IV the emissions show a decrease of around -75%, and reductions reach even -90% for Regions II and V. PCB-153 emissions decreased by -50% (Region I) and decrease ranged between -66% and -70% for the other Regions.

Measurement of concentrations in precipitation and air

The results of the measurements of nitrogen compounds in precipitation and air over the period 1998 – 2006 showed that nitrate concentrations in precipitation in Regions I and II were both increasing and decreasing at different stations. For Region III, a decrease in nitrate concentrations in precipitation was observed, while there was an increase in concentrations in Regions IV and V. Nitrate in aerosol increased in Regions I and II and in Region IV. Ammonium concentrations also increased in Regions I and II, but with some stations in Region II having a decreasing trend. NO_2 concentrations decreased in Regions I, II and (slightly) in IV, but increased in Region III. For ammonium, in precipitation and aerosol, concentrations increased in Regions I and III, and decreased in Regions II and IV. Only in Region II the decrease is statistically significant. For Region V only data for nitrate were available.

The measurements of lead and cadmium in precipitation showed in general a downward trend for Regions I (lead and cadmium) and II (cadmium). Lead and cadmium concentrations in aerosol were decreasing in Region II. For Region I the concentration in aerosol decreased for cadmium, but increased for lead. Mercury concentrations in precipitation and aerosol show a downward trend for Region II. For Region I an increase of the mercury concentration in aerosol was found. For lindane in precipitation, downward trends for Regions I and II were found.

Modelled atmospheric depositions

The deposition of substances calculated by EMEP for the different Regions for the period 1998 – 2006 shows an increase of nitrogen depositions in Regions I, IV and V, no change in Region III, and a decrease in Region II. For the trace metals, a decrease was calculated for all Regions except for an increase in mercury deposition in Region IV, and small increases in the deposition of lead and cadmium in Region V. A decrease of the organic compounds lindane and PCB-153 was observed for all Regions.

The deposition of nitrogen is the sum of the deposition of oxidised and reduced nitrogen. In general, the oxidised nitrogen originates from combustion and transport (including maritime shipping) whilst the reduced nitrogen originates mainly from agricultural activities. The contribution of reduced nitrogen to total nitrogen depositions varies between the Regions, and accounts for about one third in Region I, 50% in Region II, over 50% in Region III, about 40% in Region IV and about 30% in Region V.

The deposition of nitrogen and the trace metals shows a clear gradient over the Regions, with the largest values close to land and largely decreasing towards the open sea. The deposition density close to land areas is about an order of magnitude higher than the values in the open sea. The deposition of mercury shows a different pattern, however, because of the large hemispheric background of mercury and the re-emissions of mercury from the sea itself. The calculations show the largest values of mercury deposition in the open sea of the Arctic Waters and the Wider Atlantic.

The main contributors to the atmospheric deposition of nitrogen and trace metals are usually the countries directly bordering the Regions. However, other sources also contribute. Poland is an important source of lead to Region I and of cadmium and mercury to Regions I and II; international shipping on the Atlantic Ocean is an important source of nitrogen to Region V. Based on limited data, the main contributors to the deposition of lindane to all Regions are the UK and Spain. The deposition of PCB-153 to the Regions is dominated by the emissions from four countries: UK, Spain, Germany and France.

The main source categories contributing to the atmospheric deposition of nitrogen to all Regions are combustion for energy production and industry and transportation including ship traffic (each roughly 25% – 30%) and agriculture (25% – 30% for Regions I and V, about 40% – 45% for the other Regions). For trace metals the major source category is for all Regions the combustion in power plants and industry and industrial processes (ranging between 70% – 90% for all metals and Regions). The second most important sector is transport for lead, commercial, residential and other combustion for cadmium and waste for mercury.

Comparison atmospheric deposition and riverine input and direct discharges

A comparison of the estimates of atmospheric depositions (EMEP calculations) and riverine input and the direct discharges (RID data) was made. The contribution of the atmospheric input to the total (atmospheric plus waterborne) input to each Region was calculated as averages for the total time period. Based on this the magnitude of contributions of atmospheric deposition to total inputs is as follows:

Contribution of atmospheric inputs to total inputs				
	Nitrogen	Lead	Cadmium	Mercury
Region I	90%	97%	92%	99%
Region II	31%	47%	35%	18%
Region III	32%	44%	27%	39%
Region IV	70%	81%	48%	No estimate

8.2 Recommendations

NILU submits a report to INPUT annually, with an overview of the CAMP data. In that report aggregated data as needed for the assessment are presented. It is recommended that these data are stored in a database so that they can be used for the assessment.

The deposition estimates are obtained via model calculations by EMEP. Modelling of the deposition is the only way in which Region-wide deposition estimates can be obtained. It is recommended that the current deposition calculations are updated annually by taking this up in the work programme for the regular yearly calculation activities of EMEP. This would require limited resources for OSPAR and guarantees the availability of deposition data.

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Annex 1. Atmospheric emissions of nitrogen

EMEP emission data based on countries' officially reported emissions and EMEP complementary expert estimates.

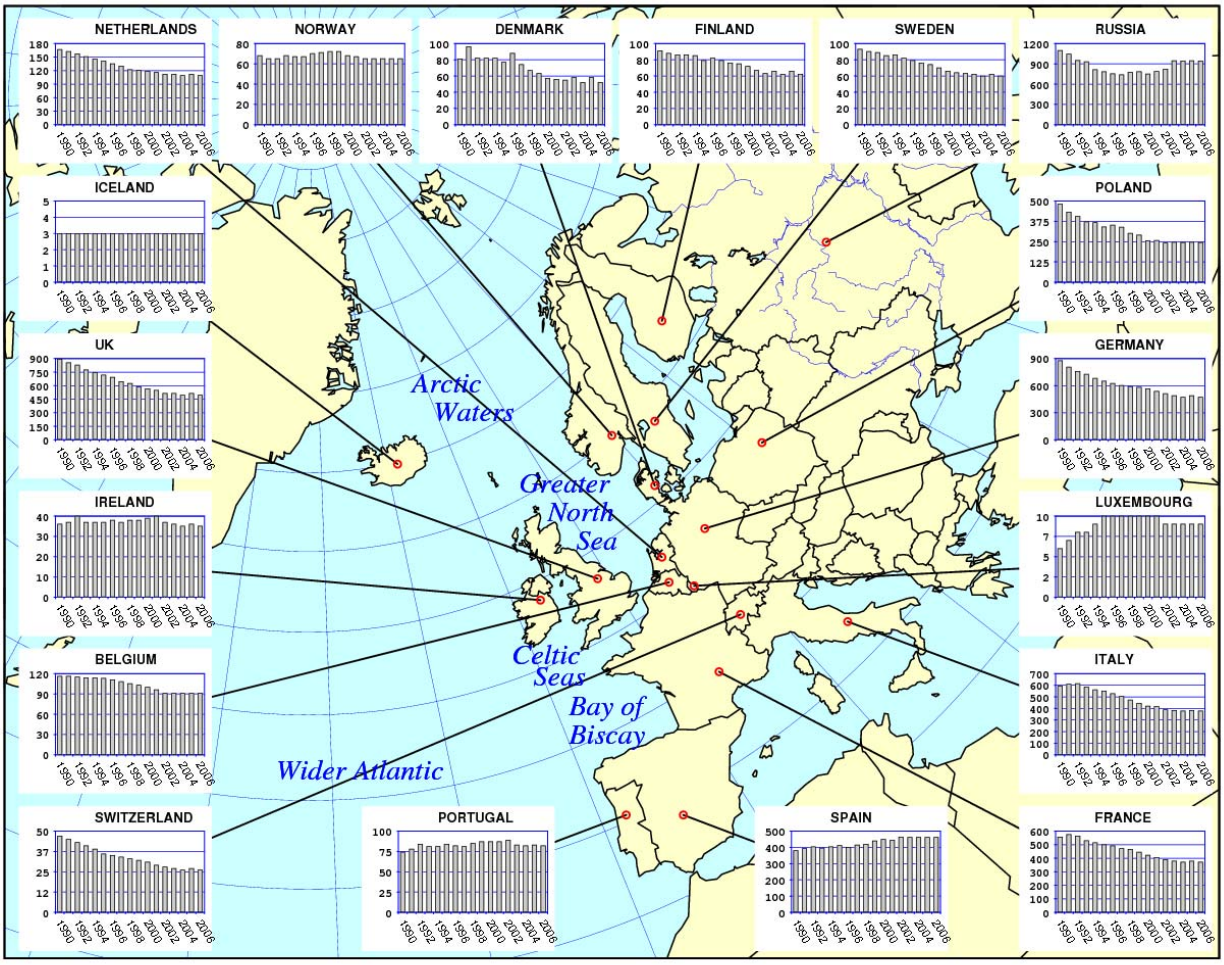

***Figure A1.1**: Annual nitrogen oxides (NO_x) emissions from the OSPAR Contracting Parties, Russia, Poland and Italy. Units are in kt N/yr.*

***Table A1.1a**: Annual nitrogen oxides emissions (as NO_2) of OSPAR Contracting Parties and three main contributors to deposition. Unit: kt N/yr*

	Year																
Country	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Belgium	116	116	115	114	114	113	111	108	105	103	100	96	91	91	91	89	85
Denmark	81	96	82	82	82	77	88	74	67	63	57	56	55	58	52	57	56
Finland	91	88	86	86	85	79	82	79	76	75	72	67	63	66	62	54	59
France	557	575	564	529	515	500	492	472	466	445	423	406	390	378	371	367	411
Germany	876	806	758	725	680	649	624	601	590	583	564	537	510	488	473	439	424
Iceland	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
Ireland	36	37	40	37	37	37	38	37	38	38	39	40	37	36	35	35	36
Luxembourg	6	7	8	8	9	10	10	10	10	10	10	10	9	9	9	9	9
Netherlands	167	162	157	151	146	141	135	130	122	121	118	116	112	112	109	105	95
Norway	68	65	65	68	67	67	70	71	72	72	68	67	65	65	65	60	58
Portugal	74	78	84	81	81	84	82	81	85	87	87	87	89	83	82	84	81
Spain	380	393	403	396	404	411	401	415	419	440	449	444	463	462	462	428	414
Sweden	93	90	89	85	86	82	79	76	74	70	66	64	63	62	60	62	53
Switzerland	47	45	43	41	39	36	35	34	33	32	31	29	28	27	26	26	25
UK	892	853	828	775	747	717	693	645	625	589	565	547	515	513	493	495	485
Italy	592	609	614	584	560	550	527	503	472	443	419	416	388	383	379	357	348
Poland	481	432	405	372	367	341	352	339	302	290	255	258	242	246	245	247	271
Russia	1,096	1,045	950	929	812	782	754	737	774	784	748	786	821	945	941	941	1020

***Table A1.1b**: Annual nitrogen oxides emissions (as NO_x) for international shipping on the North Sea, Atlantic within EMEP domain (ATL) and outside (EMEP-ext). Unit: kt NO_x/yr*

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
North Sea*	508	521	534	547	561	575	590	605	620	636	652	668	685	703	721	739	747
ATL*	565	579	593	608	624	639	655	672	689	706	724	742	760	779	799	819	828
EMEP-ext*	169	174	178	182	187	192	197	202	207	212	217	223	228	234	240	246	251
Total ship*	1242	1273	1305	1338	1372	1406	1442	1478	1515	1553	1593	1633	1674	1716	1759	1804	1826

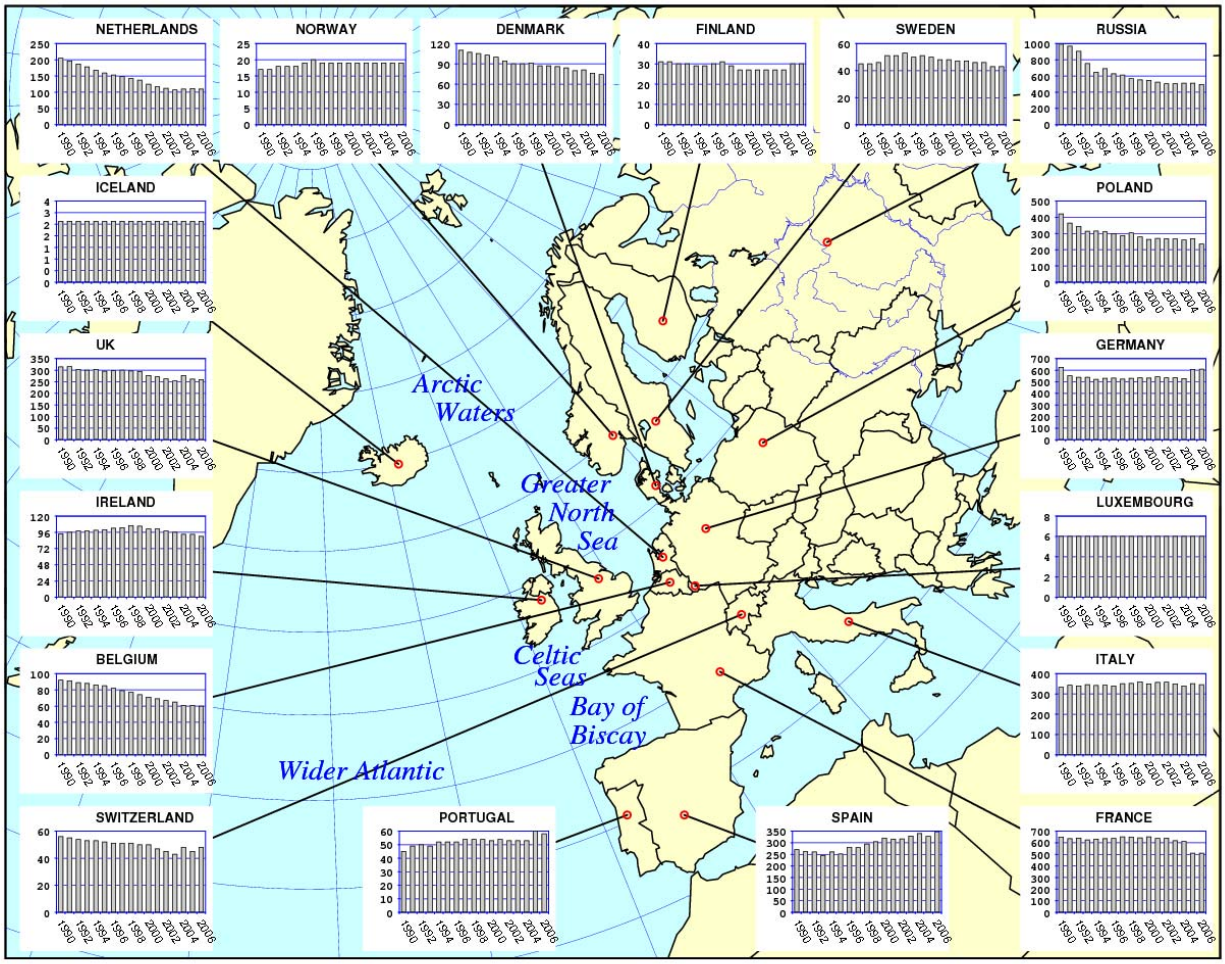

***Figure A1.2**: Annual ammonia (NH_3) emissions from the OSPAR Contracting Parties, Russia, Poland and Italy. Units are in kt N/yr.*

***Table A1.2**: Annual reduced nitrogen emissions (NH3) of OSPAR Contracting Parties and three main contributors to deposition. Unit: kt N/yr*

Country	Year																
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	92	91	89	88	86	85	82	79	77	74	71	69	67	65	61	61	60
Denmark	110	107	105	103	100	94	90	90	91	87	87	86	84	80	81	76	74
Finland	31	31	30	30	29	29	30	31	29	27	27	27	27	27	27	30	30
France	648	636	640	624	631	636	638	650	649	642	650	638	640	618	611	510	511
Germany	624	552	538	538	521	529	531	524	530	535	532	543	535	534	528	606	609
Iceland	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Ireland	94	96	98	98	99	100	102	103	106	105	101	101	98	96	93	93	90
Luxembourg	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Netherlands	205	196	187	178	168	159	153	148	142	137	125	117	112	107	110	111	110
Norway	17	17	18	18	18	19	20	19	19	19	19	19	19	19	19	19	19
Portugal	45	49	50	49	52	52	52	54	54	54	53	54	53	53	53	60	58
Spain	271	262	260	245	261	252	280	279	295	305	320	316	317	329	340	328	347
Sweden	45	45	46	51	51	53	50	51	50	48	48	47	47	46	46	43	43
Switzerland	56	55	54	53	53	52	51	51	51	50	50	47	45	43	48	45	48
UK	314	315	303	300	303	296	298	300	297	295	277	272	263	254	277	262	259
Italy	333	343	339	346	342	343	339	351	352	359	349	357	358	349	339	351	345
Poland	421	364	343	314	315	311	299	287	304	280	264	270	268	266	261	269	236
Russia	992	967	903	754	646	689	628	612	567	552	546	525	505	505	511	511	496

Annex 2. Atmospheric emissions of heavy metals and organic contaminants

EMEP emission data based on countries' officially reported emissions and EMEP complementary expert estimates.

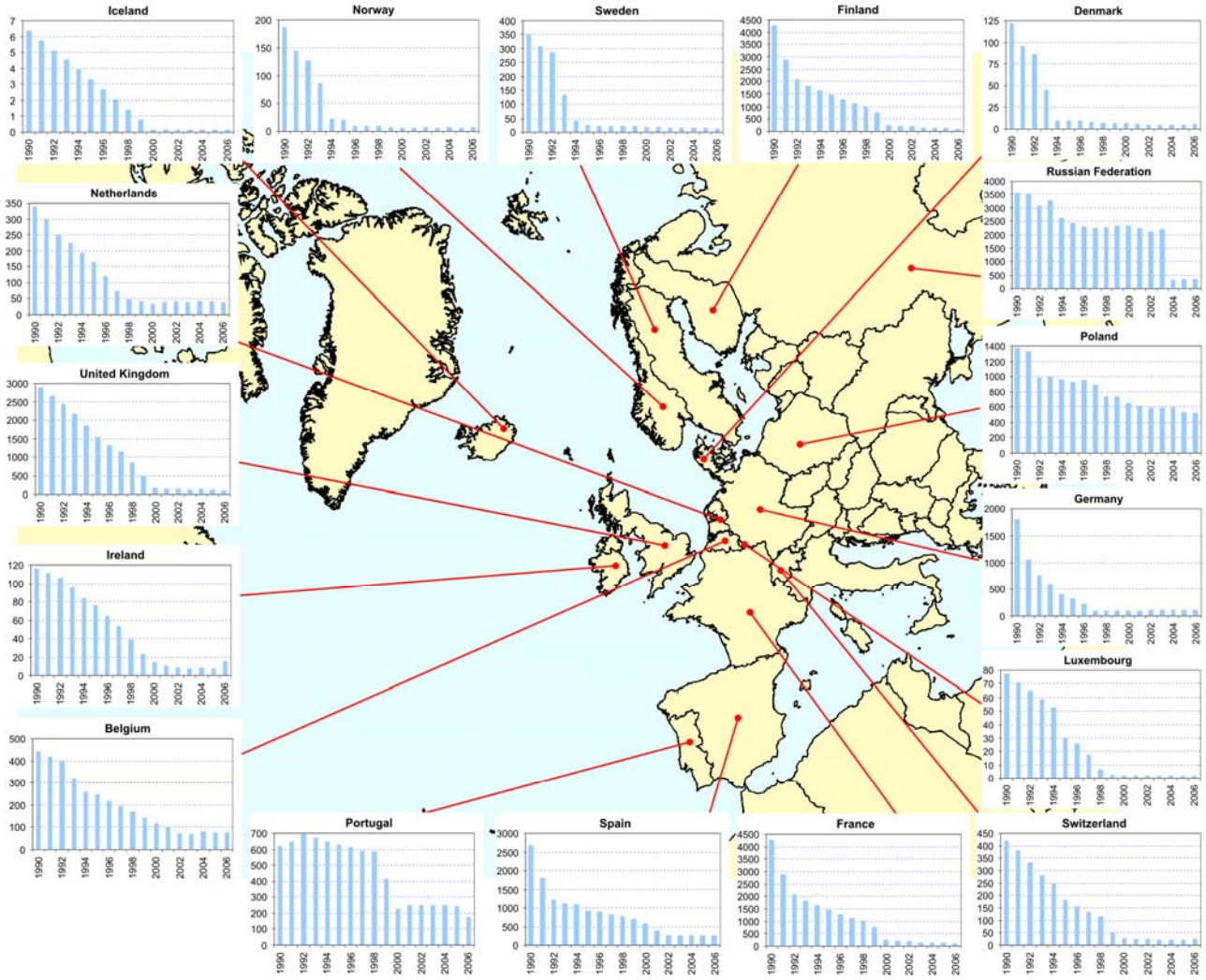

***Figure A2.1**: Atmospheric emission of lead in tonnes per year.*

***Table A2.1**: Annual **lead** emissions of OSPAR Contracting Parties and two main contributors to deposition. Unit: t/yr*

Country	Year																
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Belgium	442	418	397	320	259	247	221	195	169	144	118	102	72	68	81	78	76
Denmark	122	95	86	44	11	10	10	8	7	7	7	6	5	5	5	6	6
Finland	326	247	175	100	60	57	35	19	20	14	38	38	40	34	27	24	25
France	4283	2876	2090	1833	1630	1450	1276	1127	1010	776	250	213	206	145	135	134	128
Germany	1801	1055	761	606	405	330	222	96	94	96	102	105	106	107	109	107	108
Iceland	6	6	5	5	4	3	3	2	1	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Ireland	116	111	107	96	84	76	65	54	39	24	15	11	9	8	8	8	16
Luxembourg	77	71	65	59	53	30	26	18	7	2	2	2	2	2	2	2	2
Netherlands	340	299	251	225	193	164	120	73	50	42	35	39	43	40	44	44	39
Norway	187	144	127	87	24	22	10	9	9	9	7	6	8	7	8	6	8
Portugal	621	646	694	674	649	631	615	591	586	417	228	250	253	248	252	244	177
Spain	2681	1809	1220	1115	1104	932	902	839	779	709	589	389	268	265	261	266	270
Sweden	352	307	287	135	41	27	23	24	23	21	19	19	17	18	18	17	14
Switzerland	420	380	335	281	247	184	156	137	117	52	30	27	24	21	20	20	24
UK	2912	2657	2434	2159	1859	1549	1314	1151	849	495	165	156	143	130	134	118	106
OSPAR, kt	**14.7**	**11.1**	**9**	**7.7**	**6.6**	**5.7**	**5**	**4.3**	**3.8**	**2.8**	**1.6**	**1.4**	**1.2**	**1.1**	**1.1**	**1.1**	**1.0**
Poland	1372	1336	986	997	966	937	960	896	736	745	647	610	588	596	600	536	524
Russia	3591	3553	3095	3276	2643	2426	2304	2247	2262	2339	2352	2235	2118	2207	330	355	355
EMEP, kt	**35**	**29.2**	**24.4**	**22.5**	**19.9**	**17.7**	**16.1**	**14.6**	**13.3**	**11.8**	**9.7**	**8.7**	**7.1**	**6.9**	**4.9**	**4.7**	**4.3**
ReNat *, kt	**2.7**	**2.5**	**2.6**	**2.7**	**2.8**	**2.6**	**2.5**	**2.6**	**2.5**	**2.5**	**2.5**	**2.4**	**2.7**	**2.4**	**2.4**	**2.5**	**2.2**

* - Total re-emission and natural emission from the OSPAR maritime area

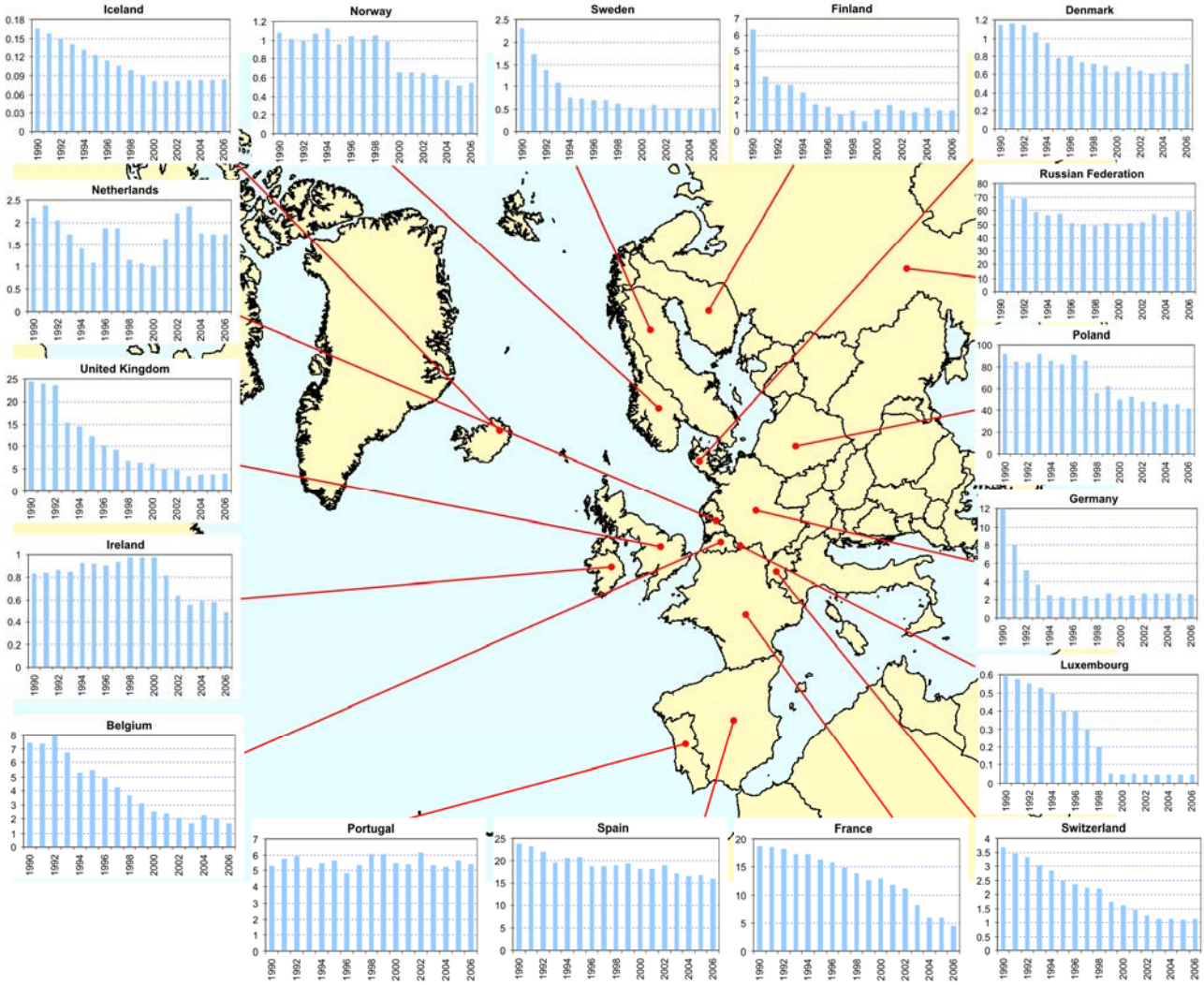

***Figure A2.2**: Atmospheric emission of cadmium in tonnes per year.*

***Table A2.2**: Annual **cadmium** emissions of OSPAR Contracting Parties and two main contributors to deposition. Unit: t/yr*

Country	Year																
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	7.4	7.3	7.9	6.7	5.3	5.5	4.9	4.3	3.7	3.1	2.5	2.4	2.1	1.7	2.3	2.0	1.7
Denmark	1.1	1.2	1.1	1.1	1.0	0.8	0.8	0.7	0.7	0.7	0.6	0.7	0.6	0.6	0.6	0.6	0.7
Finland	6.3	3.4	2.9	2.9	2.4	1.7	1.5	1.1	1.3	0.6	1.4	1.6	1.3	1.2	1.5	1.3	1.3
France	18.8	18.5	18.2	17.3	17.2	16.3	15.8	14.8	13.9	12.6	12.9	11.7	11.2	8.2	6.0	5.9	4.6
Germany	12.0	8.0	5.2	3.7	2.6	2.3	2.2	2.4	2.2	2.7	2.4	2.6	2.7	2.7	2.7	2.7	2.7
Iceland	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ireland	0.8	0.8	0.9	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	0.8	0.6	0.6	0.6	0.6	0.5
Luxembourg	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.3	0.2	0.1	0.1	0.1	0.05	0.05	0.05	0.05	0.05
Netherlands	2.1	2.4	2.1	1.7	1.4	1.1	1.9	1.9	1.2	1.1	1.0	1.6	2.2	2.4	1.8	1.7	1.7
Norway	1.1	1.0	1.0	1.1	1.1	1.0	1.0	1.0	1.1	1.0	0.7	0.7	0.7	0.6	0.6	0.5	0.5
Portugal	5.3	5.8	5.9	5.2	5.5	5.7	4.9	5.3	6.0	6.0	5.5	5.4	6.1	5.4	5.3	5.7	5.4
Spain	23.8	23.2	22.0	19.7	20.7	20.7	18.8	18.7	19.0	19.3	18.2	18.2	18.9	17.2	16.6	16.7	15.9
Sweden	2.3	1.7	1.4	1.1	0.8	0.7	0.7	0.7	0.6	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5
Switzerland	3.7	3.5	3.3	3.0	2.8	2.5	2.4	2.2	2.2	1.8	1.6	1.5	1.3	1.1	1.1	1.1	1.1
UK	24.3	24.0	23.6	15.4	14.4	12.2	10.3	9.2	6.8	6.5	6.3	5.0	4.8	3.4	3.7	3.8	4.0
OSPAR, t	**110**	**102**	**96**	**80**	**77**	**72**	**67**	**64**	**60**	**57**	**55**	**53**	**53**	**46**	**43**	**43**	**41**
Poland	91.6	85.0	84.1	91.9	85.8	82.6	91.2	85.8	55.4	61.7	50.4	52.5	48.7	48.5	46.0	46.0	42.2
Russia	79.4	68.2	68.8	59.0	56.6	57.4	51.0	50.4	49.0	50.9	50.5	51.0	51.5	57.3	55.4	59.4	59.4
EMEP, t	**484**	**449**	**429**	**399**	**375**	**361**	**351**	**338**	**295**	**293**	**269**	**264**	**250**	**276**	**242**	**244**	**241**
ReNat (*), t	**68**	**63**	**65**	**68**	**70**	**65**	**62**	**64**	**63**	**61**	**63**	**59**	**67**	**61**	**61**	**61**	**73**

(*) Total re-emission and natural emission from the OSPAR maritime area

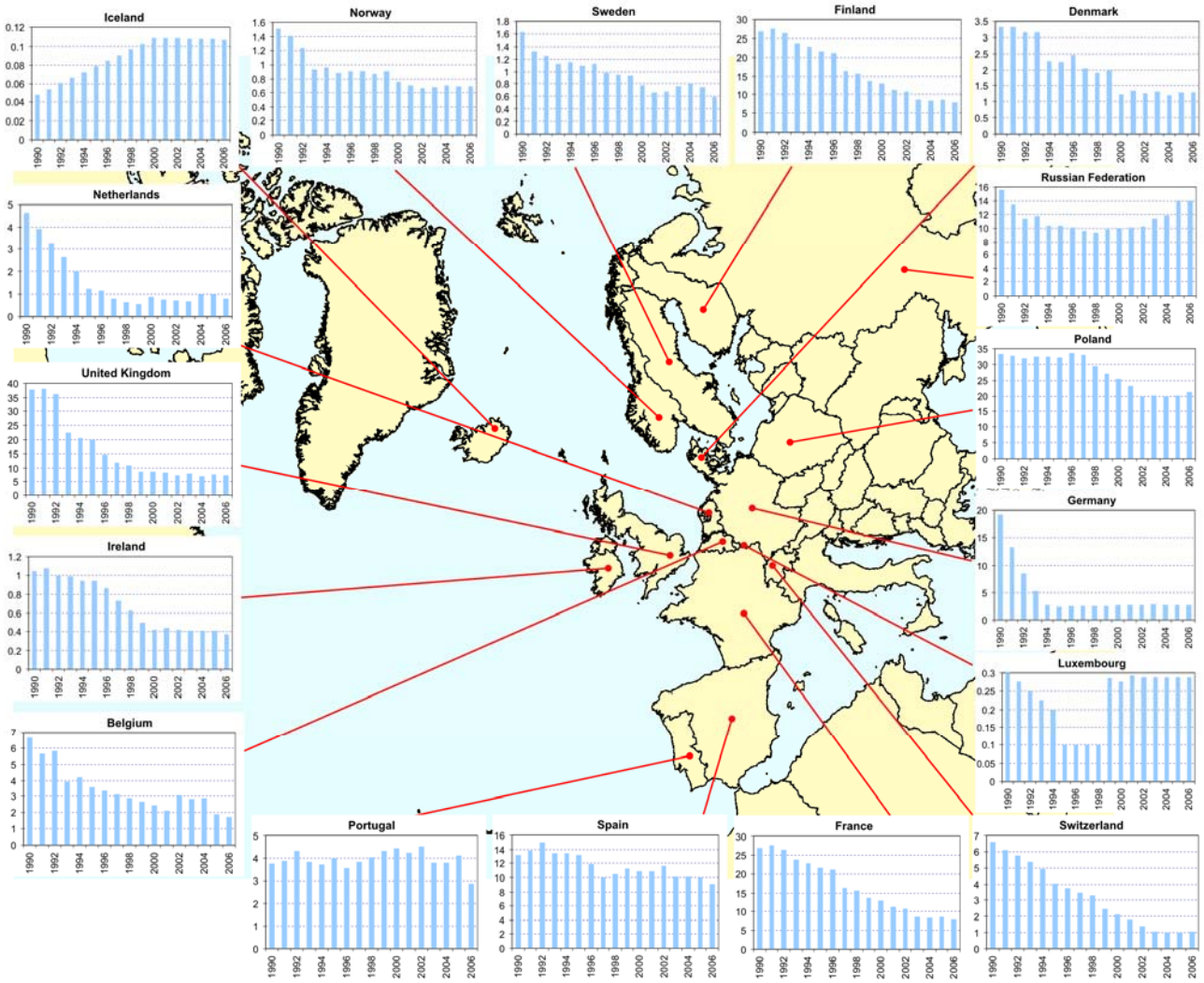

***Figure A2.3**: Atmospheric emission of mercury in tonnes per year.*

***Table A2.3**: Annual **mercury** emissions of OSPAR Contracting Parties and two main contributors to deposition. Unit: t/yr*

Country	Year																
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Belgium	6.6	5.7	5.8	3.9	4.2	3.6	3.4	3.2	2.9	2.7	2.5	2.1	3.1	2.8	2.9	1.9	1.8
Denmark	3.3	3.3	3.2	3.2	2.3	2.2	2.5	2.0	1.9	2.0	1.2	1.4	1.3	1.3	1.2	1.3	1.3
Finland	1.1	0.9	0.8	0.6	0.7	0.7	0.8	0.6	0.5	0.4	0.6	0.7	0.7	0.8	0.7	0.9	1.0
France	27.0	27.5	26.4	23.8	22.8	21.6	21.0	16.3	15.6	13.7	13.0	11.4	10.8	8.7	8.5	8.6	7.9
Germany	19.2	13.3	8.4	5.3	2.8	2.4	2.6	2.5	2.6	2.5	2.7	2.7	2.7	2.9	2.8	2.7	2.8
Iceland	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ireland	1.0	1.1	1.0	1.0	0.9	0.9	0.9	0.7	0.6	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Luxembourg	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Netherlands	4.7	3.9	3.3	2.6	2.0	1.2	1.2	0.8	0.6	0.5	0.9	0.7	0.7	0.7	1.0	1.0	0.8
Norway	1.5	1.4	1.2	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.7
Portugal	3.8	3.9	4.3	3.9	3.7	4.0	3.6	3.9	4.1	4.3	4.4	4.2	4.5	3.8	3.8	4.1	2.9
Spain	13.2	13.9	15.0	13.5	13.4	13.2	11.9	9.9	10.4	11.3	10.9	10.9	11.6	10.1	10.1	10.0	9.1
Sweden	1.6	1.3	1.3	1.1	1.1	1.1	1.1	1.0	0.9	0.9	0.8	0.7	0.7	0.8	0.8	0.7	0.6
Switzerland	6.6	6.1	5.8	5.4	4.9	4.1	3.8	3.5	3.3	2.4	2.1	1.8	1.4	1.0	1.0	1.0	1.1
UK	37.7	37.9	36.1	22.2	20.6	19.7	14.7	11.8	10.7	8.6	8.7	8.4	7.4	8.1	7.0	7.6	7.5
OSPAR, t	**128**	**120**	**113**	**88**	**81**	**76**	**68**	**57**	**55**	**51**	**49**	**47**	**46**	**42**	**41**	**41**	**38**
Poland	33.3	32.7	31.9	32.5	32.4	32.3	33.6	33.0	29.5	27.1	25.6	23.2	19.8	20.2	19.8	20.1	21.3
Russia	15.6	13.4	11.4	11.8	10.4	10.4	10.1	9.6	9.4	9.9	10.0	10.1	10.2	11.4	11.9	14.0	14.0
EMEP, t	**334**	**317**	**299**	**269**	**255**	**249**	**236**	**222**	**215**	**204**	**202**	**196**	**172**	**194**	**170**	**172**	**179**
ReNat (*), t	**57**	**56**	**54**	**53**	**52**	**50**	**52**	**53**	**54**	**56**	**57**	**55**	**57**	**57**	**58**	**57**	**56**

(*) Total re-emission and natural emission from the OSPAR maritime area

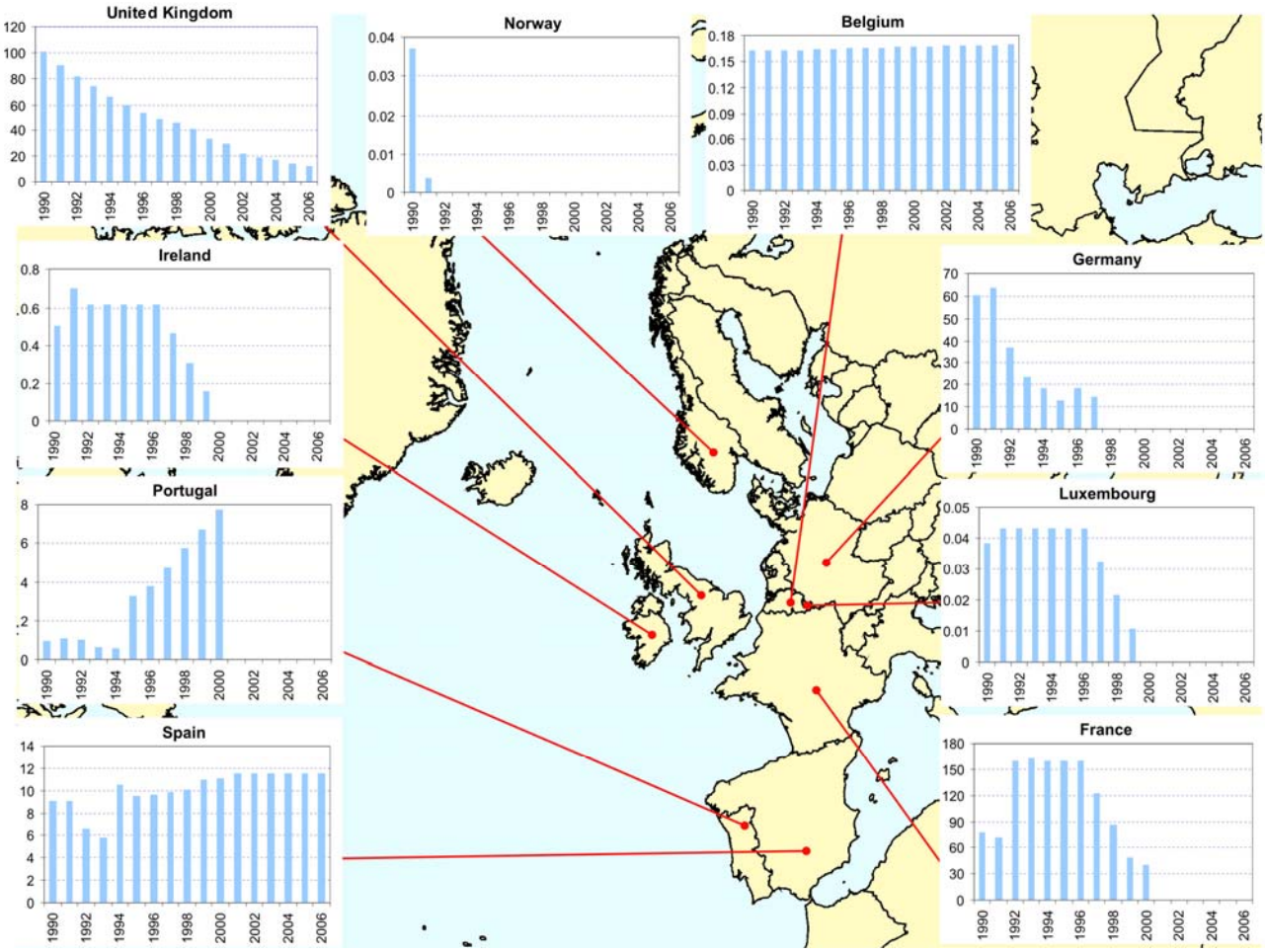

***Figure A2.4**: Atmospheric emissions of lindane in tonnes per year.*

***Table A2.4**: Annual γ-HCH emissions for the OSPAR Contracting Parties and two main contributors to deposition. Unit: t/yr*

Country	Year																
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Denmark	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Finland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
France	77.3	72.3	160.0	162.9	160.0	160.0	160.0	122.8	85.7	48.5	39.8	0.00	0.00	0.00	0.00	0.00	0.00
Germany	60.20	63.70	36.90	23.50	18.50	13.10	18.50	14.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iceland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ireland	0.51	0.70	0.62	0.62	0.62	0.62	0.62	0.46	0.31	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Luxembourg	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Netherlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Norway	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Portugal	0.97	1.09	1.01	0.61	0.56	3.27	3.77	4.76	5.75	6.74	7.73	0.00	0.00	0.00	0.00	0.00	0.00
Spain	9.11	9.11	6.65	5.83	10.6	9.48	9.66	9.84	10.1	11.0	11.1	11.6	11.5	11.5	11.5	11.5	11.58
Sweden	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Switzerland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UK	100.4	90.7	81.3	73.6	66.1	59.4	54.2	49.2	46.1	41.6	33.2	29.3	22.3	19.4	16.9	14.6	12.87
OSPAR	**249**	**238**	**287**	**267**	**257**	**246**	**247**	**202**	**148**	**108**	**92**	**41**	**34**	**31**	**29**	**26**	**25**
Other	213	180	163	79	75	58	47	15	17	21	26	4	4	1	1	1	1
EMEP	**462**	**418**	**449**	**346**	**332**	**304**	**294**	**217**	**165**	**129**	**118**	**45**	**38**	**32**	**29**	**27**	**27**

POPCycling Baltic usage data, emission factor 0.1
TNO
Official data

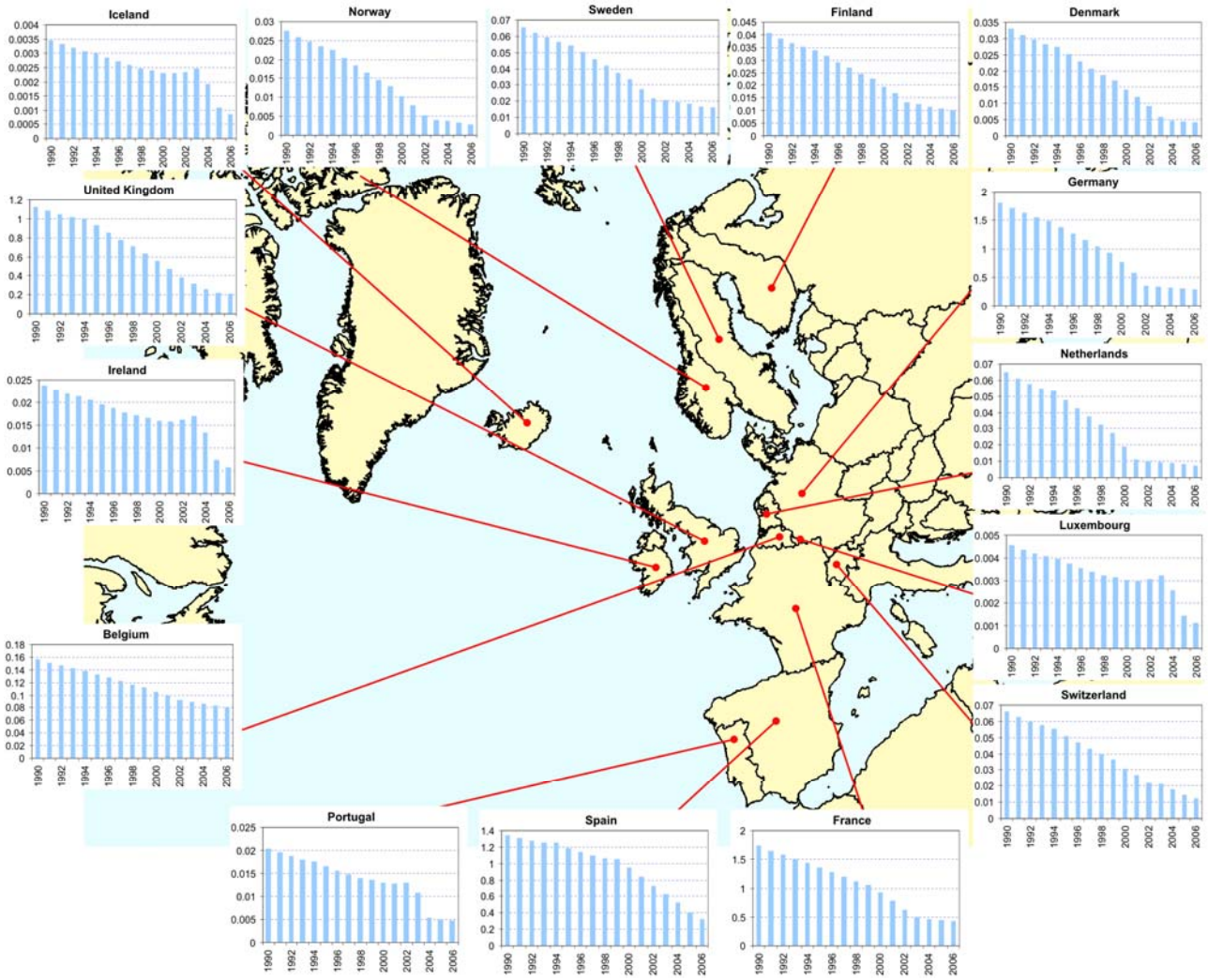

***Figure A2.5**: Atmospheric emission of PCB-153 in tonnes per year.*

***Table A2.5**: Annual **PCB-153** emissions of OSPAR Contracting Parties and two main contributors to deposition. Unit: t/yr*

Country	Year																
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Belgium	0.16	0.15	0.15	0.14	0.14	0.13	0.13	0.12	0.12	0.11	0.11	0.10	0.09	0.09	0.09	0.08	0.08
Denmark	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.005	0.004	0.004
Finland	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
France	1.74	1.66	1.58	1.51	1.45	1.36	1.28	1.20	1.12	1.06	0.93	0.79	0.62	0.50	0.47	0.45	0.43
Germany	1.81	1.72	1.63	1.55	1.49	1.37	1.26	1.15	1.04	0.93	0.77	0.58	0.35	0.34	0.32	0.30	0.29
Iceland	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001
Ireland	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Luxembourg	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.001	0.001
Netherlands	0.06	0.06	0.06	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Norway	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.004	0.004	0.003	0.003
Portugal	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.005
Spain	1.35	1.31	1.28	1.26	1.25	1.19	1.14	1.10	1.07	1.05	0.95	0.84	0.73	0.62	0.53	0.41	0.32
Sweden	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Switzerland	0.07	0.06	0.06	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01
UK	1.13	1.08	1.04	1.02	1.00	0.93	0.85	0.78	0.71	0.63	0.55	0.47	0.38	0.32	0.26	0.22	0.21
OSPAR	**6.5**	**6.2**	**6.0**	**5.8**	**5.6**	**5.3**	**4.9**	**4.6**	**4.3**	**4.0**	**3.5**	**2.9**	**2.3**	**2.0**	**1.7**	**1.5**	**1.4**
Other	3.1	3.0	2.8	2.7	2.5	2.4	2.2	2.0	1.9	1.8	1.7	1.6	1.4	1.3	1.2	1.1	1.0
EMEP	**9.7**	**9.2**	**8.8**	**8.5**	**8.2**	**7.6**	**7.1**	**6.6**	**6.2**	**5.8**	**5.1**	**4.5**	**3.7**	**3.3**	**2.9**	**2.6**	**2.4**

Annex 3. EMEP modelled deposition of nitrogen to the OSPAR Regions

***Table A3.1**: Modelled annual oxidized nitrogen deposition in the main regions of the OSPAR maritime area. Unit: t N/yr*

Year	Region I	Region II	Region III	Region IV	Region V
1995	235 737	242 365	69 111	99 109	392 723
1996	303 793	298 328	93 004	116 831	470 051
1997	240 108	254 488	77 683	96 438	424 336
1998	181 531	260 076	61 758	102 011	346 449
1999	214 801	233 154	54 563	93 819	337 764
2000	212 600	258 594	52 191	89 020	321 671
2001	201 181	239 666	59 802	96 338	369 531
2002	223 843	230 681	63 817	97 901	345 646
2003	257 858	221 103	68 419	98 780	357 371
2004	214 821	210 051	49 624	101 086	322 712
2005	222 340	208 422	56 277	92 330	327 550
2006	208 712	217 041	63 315	106 644	366 288

***Table A3.2**: Modelled annual oxidized nitrogen deposition in the sub-regions of OSPAR Region II (Greater North Sea) of the OSPAR maritime area. Unit: t N/yr*

Year	Sub-regions of OSPAR Region II Greater North Sea												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1995	19123	9396	13378	9571	14050	21099	7102	15118	29084	29482	25820	23659	25574
1996	24906	13965	18585	14896	17497	21830	8357	15120	33914	40175	34394	24260	30409
1997	20594	11138	15673	11918	15137	19142	7215	13495	29160	36372	29479	20414	24742
1998	19029	8689	14618	9669	16550	24000	7528	16183	31435	34607	30299	23760	23620
1999	16793	7024	12474	8785	14927	20144	6871	14413	29633	30262	26678	24758	20280
2000	19535	7437	14689	9384	16068	21445	8478	15253	30193	36418	31087	26727	21766
2001	18192	9743	14200	11210	15290	21815	6494	16130	26246	29755	26750	22748	21027
2002	18329	9937	13675	10910	15286	18661	6123	13084	26057	31902	26478	19177	21035
2003	18950	9792	12545	8741	12461	16281	7149	11732	30684	27485	22350	21819	21120
2004	16042	7819	12799	8528	13158	17431	6162	11913	24454	28817	22742	19704	20448
2005	17760	7428	10554	7895	13201	17791	5728	12018	27775	24763	23231	20225	20014
2006	17321	8599	12800	9278	12533	17010	5912	12588	27197	27422	22104	21040	23249

***Table A3.3**: Modelled annual reduced nitrogen (NH_3-N + NH_4^+-N) deposition in the main regions of the OSPAR maritime area. Unit: t N/yr*

Year	Region I	Region II	Region III	Region IV	Region V
1995	119 390	215 694	74 265	70 509	157 473
1996	169 421	248 590	87 845	80 620	206 469
1997	117 458	231 447	78 860	72 857	184 255
1998	94 782	237 759	69 062	66 385	141 291
1999	109 131	224 377	65 073	68 535	141 083
2000	95 580	253 384	63 254	60 291	130 174
2001	88 151	221 793	66 358	68 897	138 343
2002	119 266	221 291	71 153	72 188	142 799
2003	146 205	214 165	81 169	74 386	167 364
2004	111 362	206 860	61 640	76 930	132 383
2005	116 079	205 711	66 563	68 070	120 126
2006	97 938	199 852	66 841	77 334	148 490

***Table A3.4**: Modelled annual reduced nitrogen deposition in the sub-regions of OSPAR Region II (Greater North Sea) of the OSPAR maritime area. Unit: t N/yr*

Year	Sub-regions of OSPAR Region II Greater North Sea												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1995	10039	5311	8321	9531	15809	25562	5863	19260	18277	19375	18280	22889	37438
1996	14818	8529	11543	12667	16275	25572	7145	19544	20896	25223	23457	22856	40256
1997	10592	6037	9392	10774	16948	25307	6488	19353	18506	24568	22402	20661	40674
1998	10733	5145	9131	9677	18688	28291	6687	22038	19808	22572	21332	24186	39496
1999	9985	3980	8936	9611	18003	25718	5618	19725	19985	21527	20442	24128	36769
2000	10712	3883	9307	9518	18966	28324	7894	23796	19611	25690	25534	29008	41179
2001	10055	5474	8779	10331	16778	26571	5976	22519	15892	19752	20393	22669	36721
2002	9485	5132	8347	9723	17741	27000	6287	20851	16013	21657	21760	18719	38749
2003	11231	5769	7804	8363	14529	24135	6451	19033	19300	18123	17802	21004	40961
2004	9450	4727	9185	9302	16527	22632	5650	17665	16369	21022	18571	20631	35237
2005	10311	4606	7073	8466	16060	23167	5453	18858	17794	18098	19682	19906	36386

***Table A3.5**: Modelled total annual (NO_x-N + NH_4-N) nitrogen deposition in the main regions of the OSPAR maritime area. Unit: t N/yr*

Year	Region I	Region II	Region III	Region IV	Region V
1995	355 127	458 060	143 375	169 618	550 197
1996	473 214	546 918	180 849	197 451	676 520
1997	357 566	485 935	156 543	169 295	608 591
1998	276 313	497 834	130 820	168 396	487 740
1999	323 932	457 530	119 636	162 354	478 847
2000	308 180	511 978	115 444	149 311	451 845
2001	289 333	461 459	126 160	165 235	507 874
2002	343 109	451 972	134 970	170 090	488 446
2003	404 063	435 268	149 589	173 166	524 735
2004	326 183	416 910	111 265	178 015	455 095
2005	338 419	414 133	122 840	160 400	447 676
2006	306 650	416 893	130 156	183 978	514 778

***Table A3.6**: Modelled total annual nitrogen deposition in the sub-regions of OSPAR Region II (Greater North Sea) of the OSPAR maritime area. Unit: t N/yr*

Year	Sub-regions of OSPAR Region II Greater North Sea												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1995	29161	14707	21699	19102	29859	46661	12966	34377	47361	48858	44100	46548	63012
1996	39725	22494	30128	27564	33772	47402	15502	34664	54811	65398	57851	47115	70664
1997	31186	17175	25066	22692	32084	44449	13703	32848	47666	60940	51882	41075	65415
1998	29761	13834	23748	19346	35237	52291	14215	38221	51243	57179	51631	47946	63116
1999	26778	11004	21411	18396	32930	45862	12489	34138	49618	51789	47120	48886	57048
2000	30247	11320	23996	18902	35034	49769	16372	39049	49804	62108	56621	55735	62945
2001	28247	15217	22980	21541	32068	48386	12470	38649	42138	49507	47143	45417	57748
2002	27813	15069	22022	20633	33027	45661	12411	33935	42069	53559	48238	37896	59784
2003	30181	15561	20348	17104	26991	40416	13600	30765	49984	45608	40151	42823	62080
2004	25492	12546	21984	17830	29686	40063	11812	29578	40823	49839	41313	40335	55685
2005	28071	12034	17627	16362	29261	40958	11181	30875	45569	42861	42913	40131	56400
2006	26805	13298	21046	18294	27850	39589	10560	30850	42329	45424	38632	40963	61436

***Table A3.7**: Contribution of emitter countries (15 OSPAR Contracting Parties plus the three largest outside contributors plus ship traffic on the North Sea and on the Atlantic Ocean) to annual oxidized nitrogen deposition in the main OSPAR Regions in the year 2006. Unit: t N/yr*

Source	Main OSPAR Regions					
	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
Belgium	4553	5584	1720	1681	6356	19895
Denmark	4570	3841	358	317	1719	10805
Finland	5934	811	131	42	428	7345
France	11658	19469	6315	12289	28391	78122
Germany	16409	19483	4022	5564	18280	63759
Iceland	880	89	35	22	464	1489
Ireland	4016	3886	2502	865	5479	16748
Luxembourg	332	356	121	171	592	1571
Netherlands	6561	6045	1434	1518	7217	22775
Norway	9600	4314	393	219	2102	16628
Portugal	990	1013	901	6764	10222	19891
Spain	5617	8514	4992	23950	30017	73090
Switzerland	509	498	100	367	790	2264
Sweden	4553	2135	228	157	911	7983
UK	47342	63150	13866	8561	46224	179144
Italy	2030	2510	600	1983	3325	10449
Poland	6255	6293	995	645	1271	15460
Russia	17243	1996	430	106	659	20433
North Sea	18088	30890	5098	3846	14714	72637
Atlantic	14404	9354	8710	24017	80726	137210

***Table A3.8**: Contribution of emitter countries (15 OSPAR Contracting Parties plus the three largest outside contributors plus ship traffic on the North Sea and on the Atlantic Ocean) to annual reduced nitrogen deposition in the main OSPAR Regions in the year 2006. Unit: t N/yr*

Source	Main OSPAR Regions					
	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
Belgium	1710	8105	872	626	2361	13674
Denmark	2517	16645	230	118	799	20309
Finland	1949	153	54	17	221	2394
France	8709	43464	10522	37532	25766	125994
Germany	11649	31524	2901	2348	12913	61336
Iceland	1547	33	17	3	347	1946
Ireland	4359	5723	18246	1038	7934	37300
Luxembourg	129	241	54	49	238	712
Netherlands	3033	17407	1062	665	3200	25367
Norway	3526	2099	39	19	272	5955
Portugal	627	406	406	6194	4048	11681
Spain	4011	4245	2922	17983	14113	43274
Switzerland	495	646	116	338	799	2394
Sweden	1768	2089	100	45	396	4399
UK	14260	53988	23700	2463	15283	109694
Italy	1300	2045	405	779	1896	6427
Poland	4337	3296	567	429	2860	11489
Russia	5131	533	194	109	1361	7327
North Sea	0	0	0	0	0	0
Atlantic	0	0	0	0	0	0

***Table A3.9**: Contribution of emitter countries (15 OSPAR Contracting Parties plus the three largest outside contributors plus ship traffic on the North Sea and on the Atlantic Ocean) to total annual nitrogen deposition in the main OSPAR Regions in the year 2006. Unit: t N/yr*

Source	Main OSPAR Regions					
	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
Belgium	6264	13689	2593	2306	8717	33569
Denmark	7087	20486	588	435	2518	31114
Finland	7883	964	184	58	649	9739
France	20367	62933	16837	49822	54157	204115
Germany	28058	51008	6924	7912	31194	125096
Iceland	2427	122	51	25	811	3436
Ireland	8375	9608	20748	1903	13414	54048
Luxembourg	462	596	175	220	830	2283
Netherlands	9594	23452	2496	2182	10417	48141
Norway	13126	6413	432	238	2373	22583
Portugal	1617	1419	1307	12958	14270	31571
Spain	9628	12759	7915	41932	44130	116364
Switzerland	1004	1144	216	705	1589	4658
Sweden	6321	4224	328	202	1307	12381
UK	61603	117138	37566	11024	61507	288838
Italy	3331	4556	1005	2763	5221	16875
Poland	10592	9589	1563	1074	4132	26949
Russia	22374	2528	624	215	2020	27760
North Sea	18088	30890	5098	3846	14714	72637
Atlantic	14404	9354	8710	24017	80726	137210

***Table A3.10**: Contribution of selected groups of emission sectors to annual oxidized nitrogen deposition in the main OSPAR Regions in the year 2006. Unit: t N/yr*

Sectors	Main OSPAR Regions					
	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
S1 + S2 + S3	111072	124632	36160	64500	158667	495032
S7 + S8	115489	122683	35929	65373	182711	522186
S10	51439	47626	12977	30359	104169	246571
Rest	56852	60610	17217	35665	100249	270593

***Table A3.11**: Contribution of selected groups of emission sectors to annual reduced nitrogen deposition in the main OSPAR Regions in the year 2006. Unit: t N/yr*

Sectors	Main OSPAR Regions					
	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
S1 + S2 + S3	16265	4156	688	192	12890	34191
S7 + S8	7982	3777	737	611	10211	23317
S10	61212	183408	60004	70383	80869	455876
Rest	20569	10725	1966	3754	14490	51504

***Table A3.12**: Contribution of selected groups of emission sectors to total annual nitrogen deposition in the main OSPAR Regions in the year 2006. Unit: t N/yr*

Sectors	Main OSPAR Regions					
	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
S1 + S2 + S3	127338	128788	36849	64692	171557	529223
S7 + S8	123471	126460	36667	65984	192922	545504
S10	112651	231034	72981	100742	185038	702447
Rest	77421	71335	19183	39419	114739	322097

Annex 4. EMEP modelled deposition of heavy metals, PCB-153 and lindane

***Table A4.1**: Annual modelled **lead** total depositions to the main regions of the OSPAR maritime area. Unit: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	1491	1689	442	633	3111	7366
1991	1608	1656	460	548	3183	7455
1992	1506	1468	350	480	2725	6529
1993	1509	1338	436	587	2900	6770
1994	1398	1265	424	373	2813	6273
1995	1265	1195	355	417	2801	6033
1996	1514	1171	490	480	2946	6601
1997	1272	1005	371	408	3000	6056
1998	1140	817	242	368	2382	4949
1999	1111	747	228	348	2256	4690
2000	1068	609	159	279	2149	4264
2001	1043	516	156	322	2228	4265
2002	1217	666	268	335	2589	5075
2003	1457	595	273	303	2486	5114
2004	1081	622	199	255	2164	4321
2005	1060	710	193	248	2224	4435
2006	936	561	194	295	2449	4435

***Table A4.2**: Annual modelled **lead** total deposition to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Unit: t/yr*

Year	Sub-regions of OSPAR Region II												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1990	98.0	52.8	78.5	63.1	130.1	192.7	45.0	116.6	197.4	220.6	200.9	152.9	145.5
1991	122.2	68.2	88.0	67.1	126.4	171.7	42.5	91.8	198.2	208.8	183.0	124.9	165.2
1992	95.5	49.2	71.2	51.8	107.5	168.8	38.2	104.5	166.9	189.0	174.3	119.5	134.5
1993	99.3	55.9	74.3	59.6	99.0	149.8	32.1	74.1	153.5	161.7	135.6	89.5	154.4
1994	93.6	52.1	68.6	55.1	103.5	143.7	31.7	77.9	133.7	157.9	141.4	86.1	120.1
1995	82.2	43.8	62.1	45.1	88.9	129.5	28.8	61.8	147.9	157.4	126.8	82.3	140.5
1996	96.9	77.4	73.3	77.7	101.3	116.6	22.8	47.5	103.7	140.2	108.8	62.5	141.6
1997	69.7	39.3	60.1	43.0	71.0	102.6	23.4	53.7	100.7	142.1	119.5	62.1	117.8
1998	51.5	33.0	39.3	27.1	58.3	88.2	22.6	56.5	104.6	104.3	85.6	65.3	82.2
1999	49.6	26.5	32.8	23.5	50.7	85.3	20.8	49.9	96.6	85.5	79.6	69.5	78.1
2000	41.1	21.6	25.0	16.2	34.4	68.5	19.4	51.7	65.6	67.0	74.7	69.2	54.7
2001	33.2	24.2	22.8	18.6	35.5	60.8	14.5	34.7	47.0	60.3	68.7	47.6	48.7
2002	51.4	38.5	34.6	31.5	46.5	67.4	14.0	38.1	70.0	75.6	70.4	49.6	78.8
2003	51.1	34.0	29.2	21.6	32.4	59.9	15.3	36.2	76.4	63.6	57.0	52.2	67.2
2004	52.5	32.6	36.6	23.4	34.5	60.6	16.6	41.0	64.6	76.2	68.4	53.1	62.5
2005	57.4	32.5	38.5	28.2	40.9	66.6	19.2	44.6	100.1	88.4	78.9	56.1	60.8
2006	51.4	25.2	32.5	20.8	34.2	53.2	13.3	33.9	73.2	64.8	53.6	44.7	61.2

***Table A4.3**: Annual modelled **lead** net atmospheric input to the main regions of the OSPAR maritime area. Unit: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	800	1533	352	550	1421	4656
1991	916	1526	385	471	1622	4920
1992	795	1339	277	408	1117	3936
1993	747	1191	358	507	1249	4052
1994	728	1120	340	291	1004	3483
1995	579	1058	284	329	1162	3412
1996	900	1039	417	400	1370	4126
1997	566	875	300	332	1417	3490
1998	455	671	161	289	851	2427
1999	443	603	147	270	771	2234
2000	385	465	81	199	615	1745
2001	384	396	96	243	791	1910
2002	555	532	187	249	854	2377
2003	801	479	203	230	967	2680
2004	408	493	126	180	674	1881
2005	385	570	121	175	730	1981
2006	382	471	145	237	1019	2254

***Table A4.4**: Annual modelled **lead** net atmospheric input to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Unit: t/yr*

Year	Sub-regions of OSPAR Region II												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1990	77.5	36.5	65.6	54.4	123.4	184.0	41.4	111.2	181.7	198.5	185.3	145.5	132.6
1991	104.8	55.2	77.3	60.2	121.1	165.2	39.4	87.4	184.0	190.4	170.5	118.7	154.7
1992	78.6	36.2	60.7	44.7	102.3	162.2	35.1	99.7	153.2	171.1	161.7	113.0	124.0
1993	77.5	39.1	61.5	51.2	93.5	143.2	28.8	69.5	136.8	141.8	122.7	82.5	143.6
1994	74.0	37.7	56.2	47.0	97.7	136.3	28.4	73.0	118.0	137.6	127.7	79.4	108.1
1995	64.1	31.0	51.0	38.3	83.0	121.9	25.5	57.0	133.0	138.1	113.3	75.5	128.9
1996	79.3	64.9	62.3	70.7	95.6	109.8	19.6	43.1	88.6	121.6	96.1	56.7	130.1
1997	50.3	25.5	49.0	36.1	66.6	96.9	20.3	49.5	84.7	124.8	108.3	55.9	107.4
1998	32.8	18.7	27.1	19.4	52.2	80.4	18.9	51.3	89.0	83.6	71.3	57.9	69.9
1999	30.6	12.0	20.5	15.4	44.5	77.4	17.4	45.0	81.9	65.3	65.7	62.6	65.6
2000	22.3	8.2	13.0	8.7	28.8	60.8	15.5	46.0	49.7	46.8	60.6	61.9	43.2
2001	16.7	11.9	12.8	12.2	30.6	54.5	11.6	30.4	33.9	44.0	57.4	41.2	39.2
2002	33.5	25.0	23.5	24.7	41.3	60.3	10.8	33.4	55.9	57.6	57.8	43.3	65.8
2003	35.0	21.2	19.4	14.9	27.6	54.3	12.7	32.5	63.7	47.9	46.7	46.7	57.4
2004	35.4	20.1	26.0	16.7	29.0	53.5	13.4	36.5	50.8	58.2	55.7	46.7	51.2
2005	38.8	18.2	26.3	20.3	35.0	59.7	15.9	39.9	84.8	68.0	65.4	49.5	50.4
2006	37.7	15.0	24.6	15.9	31.0	49.1	11.1	31.3	62.7	52.1	44.9	41.8	55.0

***Table A4.5**: Contribution of the OSPAR Contracting Parties and one other selected country (Poland) to **lead** anthropogenic depositions to the five OSPAR Regions in 2006. Units: t/yr*

Country	OSPAR Region				
	Region I	Region II	Region III	Region IV	Region V
Belgium	2.93	9.68	1.64	0.91	3.92
Denmark	0.26	1.03	0.02	0.02	0.09
Finland	1.01	0.1	0.01	0	0.06
France	3.05	9.85	2.27	3.18	6.82
Germany	3.08	6.22	0.99	0.63	2.84
Iceland	0.1	0	0	0	0.03
Ireland	1.4	1.69	2.52	0.25	2.23
Luxembourg	0.05	0.1	0.03	0.02	0.08
Netherlands	1.79	7.56	0.71	0.35	1.76
Norway	1.62	0.65	0.02	0.01	0.12
Portugal	1.48	1.7	1.88	15.64	21.72
Spain	3.07	5.63	3.42	22.16	21.32
Sweden	0.61	0.46	0.02	0.01	0.07
Switzerland	0.39	0.53	0.19	0.25	0.7
UK	7.78	26.42	6.08	1.04	7.24
Poland	6.63	8.33	0.81	0.55	3.1

***Table A4.6**: Annual modelled **lead** depositions from individual emission sectors to the main regions of the OSPAR maritime area in 2005. Units: t/yr*

OSPAR Region	Emission sectors			
	Combustion in power plants and industry & industrial processes	Transport	Commercial, residential and other combustion	Waste
Region I	24.1	7.2	4.0	0.6
Region II	64.9	15.3	9.0	1.1
Region III	14.1	2.2	1.5	0.2
Region IV	42.7	3.2	1.7	1.2
Region V	66.4	7.0	4.0	2.0

***Table A4.7**: Annual modelled **cadmium** total depositions to the main regions of the OSPAR maritime area. Unit: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	34.6	27.2	8.6	12.8	73.7	156.9
1991	38.1	32.0	8.6	11.2	77.8	167.8
1992	38.7	27.3	7.0	9.7	70.7	153.4
1993	39.1	28.3	8.4	12.5	73.3	161.6
1994	36.2	26.3	8.9	8.0	73.3	152.7
1995	33.5	26.4	7.6	9.1	74.2	150.8
1996	41.2	29.2	11.8	11.5	76.7	170.4
1997	34.2	22.9	8.0	10.0	81.1	156.1
1998	31.0	18.0	5.5	8.2	63.3	126.0
1999	31.1	19.0	5.8	8.6	61.5	126.0
2000	29.9	17.8	4.5	7.8	58.9	118.9
2001	28.5	14.3	4.2	8.7	59.2	114.9
2002	33.7	19.0	7.1	10.0	70.4	140.3
2003	39.9	16.0	7.1	8.6	68.1	139.7
2004	30.0	16.1	5.0	6.6	56.9	114.5
2005	28.9	17.2	4.8	6.1	58.4	115.5
2006	28.7	13.7	5.0	7.9	74.0	129.3

***Table A4.8**: Annual modelled **cadmium** total deposition to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Unit: t/yr*

Year	Sub-regions of OSPAR Region II												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1990	1.64	1.00	1.16	0.95	1.83	3.11	0.76	1.99	3.21	3.37	3.14	2.62	2.48
1991	2.46	1.38	1.68	1.18	2.15	3.33	0.91	1.88	4.12	3.80	3.44	2.72	3.05
1992	1.79	0.97	1.26	0.89	1.70	3.10	0.78	2.33	3.23	3.38	3.17	2.48	2.30
1993	2.34	1.25	1.64	1.15	1.68	2.78	0.83	1.61	3.73	3.50	2.72	2.12	2.95
1994	2.08	1.07	1.43	1.06	1.88	2.76	0.81	1.67	3.16	3.13	2.75	2.14	2.33
1995	1.78	0.94	1.33	0.90	1.72	2.65	0.72	1.46	3.55	3.45	2.78	2.09	3.06
1996	2.43	1.97	1.87	1.94	2.40	3.02	0.60	1.24	2.61	3.41	2.64	1.77	3.23
1997	1.61	0.91	1.39	0.96	1.31	2.35	0.58	1.33	2.41	3.03	2.61	1.73	2.65
1998	1.14	0.77	0.80	0.54	1.03	1.80	0.58	1.40	2.47	2.13	1.82	1.77	1.77
1999	1.26	0.68	0.79	0.59	1.25	2.20	0.54	1.31	2.54	2.04	1.95	1.91	1.93
2000	1.15	0.59	0.73	0.47	1.03	2.09	0.56	1.49	1.83	1.95	2.12	2.03	1.74
2001	0.87	0.64	0.61	0.50	0.99	1.77	0.40	0.97	1.28	1.63	1.87	1.36	1.42
2002	1.43	1.04	1.00	0.88	1.27	2.03	0.41	1.12	2.00	2.16	1.96	1.43	2.34
2003	1.28	0.91	0.77	0.63	0.92	1.71	0.40	1.00	1.92	1.68	1.55	1.39	1.82
2004	1.35	0.90	0.95	0.60	0.86	1.54	0.45	1.08	1.70	1.97	1.74	1.42	1.52
2005	1.36	0.80	0.94	0.71	0.99	1.64	0.47	1.08	2.45	2.17	1.91	1.38	1.39
2006	1.31	0.70	0.80	0.53	0.83	1.28	0.33	0.84	1.79	1.54	1.28	1.10	1.40

***Table A4.9**: Annual modelled **cadmium** net atmospheric input to the main regions of the OSPAR maritime area. Unit: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	17.3	23.3	6.3	10.7	31.5	89.1
1991	20.8	28.8	6.8	9.2	38.8	104.5
1992	21.0	24.1	5.1	7.9	30.5	88.6
1993	20.0	24.6	6.5	10.5	32.0	93.6
1994	19.5	22.6	6.8	5.9	28.1	82.9
1995	16.3	23.0	5.9	7.0	33.2	85.3
1996	25.8	25.9	10.0	9.5	37.3	108.6
1997	16.6	19.6	6.2	8.1	41.5	92.0
1998	13.9	14.3	3.4	6.2	25.1	63.0
1999	14.4	15.4	3.8	6.7	24.4	64.6
2000	12.9	14.2	2.5	5.8	20.6	55.9
2001	12.0	11.3	2.7	6.7	23.3	56.0
2002	17.2	15.7	5.1	7.8	27.0	72.8
2003	23.5	13.0	5.4	6.8	30.1	78.8
2004	13.2	12.8	3.1	4.8	19.6	53.5
2005	12.0	13.7	3.0	4.3	21.0	54.1
2006	10.2	10.7	3.4	6.0	26.3	56.6

***Table A4.10**: Annual modelled **cadmium** net atmospheric input to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Unit: t/yr*

Year	Sub-regions of OSPAR Region II												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1990	1.13	0.59	0.84	0.73	1.66	2.89	0.67	1.85	2.82	2.82	2.75	2.44	2.16
1991	2.02	1.06	1.41	1.00	2.02	3.17	0.83	1.77	3.77	3.34	3.13	2.56	2.78
1992	1.36	0.64	1.00	0.71	1.57	2.93	0.70	2.21	2.89	2.93	2.86	2.32	2.04
1993	1.79	0.83	1.32	0.94	1.54	2.62	0.75	1.49	3.31	3.00	2.40	1.94	2.68
1994	1.59	0.71	1.12	0.86	1.74	2.58	0.72	1.55	2.76	2.62	2.41	1.97	2.03
1995	1.33	0.62	1.05	0.73	1.57	2.46	0.64	1.34	3.17	2.96	2.44	1.92	2.77
1996	1.99	1.66	1.60	1.77	2.26	2.85	0.52	1.13	2.23	2.94	2.32	1.62	2.94
1997	1.12	0.57	1.12	0.79	1.20	2.21	0.50	1.23	2.01	2.59	2.33	1.57	2.40
1998	0.67	0.41	0.50	0.35	0.88	1.61	0.49	1.27	2.08	1.62	1.46	1.58	1.46
1999	0.78	0.32	0.48	0.39	1.09	2.00	0.46	1.19	2.18	1.54	1.61	1.74	1.62
2000	0.68	0.25	0.43	0.28	0.89	1.90	0.46	1.35	1.43	1.44	1.77	1.85	1.45
2001	0.46	0.33	0.35	0.34	0.86	1.62	0.32	0.86	0.95	1.22	1.58	1.20	1.18
2002	0.98	0.70	0.72	0.71	1.15	1.86	0.33	1.01	1.65	1.71	1.64	1.27	2.02
2003	0.87	0.59	0.52	0.46	0.80	1.57	0.34	0.91	1.60	1.29	1.29	1.25	1.57
2004	0.93	0.58	0.68	0.44	0.73	1.37	0.37	0.97	1.35	1.52	1.42	1.26	1.24
2005	0.90	0.44	0.64	0.51	0.84	1.47	0.38	0.97	2.07	1.66	1.57	1.21	1.13
2006	0.85	0.36	0.53	0.37	0.72	1.14	0.25	0.75	1.44	1.12	1.00	1.00	1.19

***Table A4.11**: Contribution of the OSPAR Contracting Parties and one other selected country (Poland) to **cadmium** anthropogenic depositions to the five OSPAR Regions in 2006. Units: t/yr*

Country	OSPAR Region				
	Region I	Region II	Region III	Region IV	Region V
Belgium	0.06	0.19	0.03	0.02	0.08
Denmark	0.03	0.12	0.002	0.002	0.01
Finland	0.05	0.004	0.0005	0.0002	0.003
France	0.11	0.35	0.08	0.10	0.23
Germany	0.07	0.17	0.02	0.01	0.06
Iceland	0.05	0.001	0.001	0.0001	0.01
Ireland	0.04	0.05	0.08	0.01	0.07
Luxembourg	0.001	0.002	0.001	0.001	0.002
Netherlands	0.07	0.34	0.03	0.02	0.08
Norway	0.09	0.05	0.002	0.001	0.01
Portugal	0.03	0.03	0.04	0.61	0.68
Spain	0.17	0.30	0.20	1.40	1.24
Sweden	0.02	0.01	0.001	0.0004	0.002
Switzerland	0.02	0.02	0.01	0.01	0.03
UK	0.27	0.99	0.23	0.04	0.27
Poland	0.46	0.58	0.05	0.03	0.19

***Table A4.12**: Annual modelled **cadmium** depositions from individual emission sectors to the main regions of the OSPAR maritime area in 2005. Units: t/yr*

OSPAR Region	Emission sectors			
	Combustion in power plants and industry & industrial processes	Transport	Commercial, residential and other combustion	Waste
Region I	1.33	0.08	0.44	0.05
Region II	2.59	0.23	0.84	0.12
Region III	0.57	0.05	0.11	0.02
Region IV	1.84	0.05	0.09	0.05
Region V	2.56	0.11	0.29	0.08

***Table A4.13**: Annual modelled **mercury** total depositions to the main regions of the OSPAR maritime area. Unit: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	38.41	11.59	4.29	3.80	51.86	109.94
1991	39.51	10.92	4.36	3.95	52.17	110.91
1992	40.09	11.53	4.38	4.02	51.42	111.44
1993	38.77	9.45	4.22	4.10	52.97	109.51
1994	36.49	9.23	4.20	3.76	51.98	105.67
1995	37.49	8.84	3.75	3.78	50.99	104.85
1996	37.95	8.47	3.75	3.72	50.21	104.09
1997	37.52	8.30	3.64	3.42	49.54	102.42
1998	36.53	8.51	3.78	3.67	49.15	101.64
1999	36.64	7.49	3.42	3.70	47.58	98.82
2000	36.98	7.99	3.17	3.67	49.63	101.45
2001	36.64	7.27	3.04	3.50	45.71	96.15
2002	35.87	7.16	3.22	3.46	46.02	95.72
2003	36.46	6.74	3.21	3.36	46.35	96.11
2004	36.20	7.08	3.16	3.32	45.59	95.34
2005	35.75	7.31	3.35	3.25	45.93	95.59
2006	33.52	7.10	3.18	3.63	42.86	90.29

***Table A4.14**: Annual modelled **mercury** total deposition to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Unit: t/yr*

Year	Sub-regions of OSPAR Region II												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1990	0.97	0.62	0.61	0.53	0.89	1.16	0.26	0.65	1.38	1.42	1.15	0.98	0.98
1991	0.96	0.65	0.59	0.55	0.87	1.14	0.23	0.52	1.22	1.26	1.02	0.79	1.14
1992	0.99	0.63	0.64	0.58	0.90	1.14	0.25	0.55	1.35	1.40	1.11	0.87	1.13
1993	0.88	0.60	0.55	0.48	0.64	0.94	0.21	0.45	1.07	1.06	0.82	0.71	1.05
1994	0.83	0.59	0.49	0.45	0.64	0.89	0.23	0.48	1.08	1.00	0.85	0.75	0.98
1995	0.86	0.59	0.52	0.43	0.56	0.78	0.21	0.41	1.09	1.00	0.77	0.69	0.94
1996	0.92	0.65	0.52	0.46	0.50	0.66	0.19	0.35	1.00	0.95	0.66	0.67	0.93
1997	0.85	0.59	0.53	0.44	0.46	0.62	0.19	0.36	1.07	1.00	0.72	0.67	0.81
1998	0.86	0.63	0.54	0.44	0.48	0.66	0.20	0.41	1.09	1.00	0.72	0.69	0.81
1999	0.80	0.54	0.45	0.36	0.38	0.58	0.17	0.34	1.03	0.82	0.62	0.70	0.72
2000	0.78	0.53	0.47	0.37	0.45	0.65	0.20	0.38	1.02	0.96	0.73	0.68	0.76
2001	0.78	0.58	0.45	0.38	0.40	0.57	0.17	0.36	0.87	0.79	0.63	0.58	0.69
2002	0.73	0.53	0.44	0.38	0.42	0.58	0.16	0.35	0.90	0.81	0.62	0.56	0.69
2003	0.71	0.53	0.39	0.32	0.35	0.50	0.16	0.31	0.95	0.75	0.56	0.58	0.64
2004	0.74	0.54	0.42	0.36	0.39	0.55	0.17	0.34	0.90	0.81	0.64	0.56	0.68
2005	0.83	0.60	0.46	0.38	0.38	0.51	0.17	0.33	1.03	0.84	0.63	0.52	0.67
2006	0.76	0.52	0.43	0.36	0.40	0.51	0.16	0.32	0.89	0.78	0.61	0.60	0.76

***Table A4.15**: Annual modelled **mercury** net atmospheric input to the main regions of the OSPAR maritime area. Unit: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	23.95	5.87	1.85	0.47	21.76	53.90
1991	24.41	5.08	1.87	0.54	21.35	53.25
1992	24.35	5.57	1.83	0.53	19.89	52.17
1993	22.40	3.37	1.61	0.52	20.73	48.63
1994	19.48	3.03	1.53	0.10	19.02	43.17
1995	19.84	2.51	1.03	0.04	17.31	40.74
1996	20.93	2.27	1.09	0.06	17.25	41.60
1997	21.15	2.22	1.03	-0.16	17.30	41.54
1998	20.80	2.55	1.23	0.17	17.62	42.37
1999	21.54	1.65	0.93	0.28	16.76	41.17
2000	22.53	2.27	0.73	0.34	19.53	45.40
2001	22.18	1.55	0.60	0.17	15.61	40.11
2002	21.41	1.44	0.78	0.12	15.92	39.68
2003	22.00	1.02	0.78	0.03	16.25	40.07
2004	21.74	1.36	0.72	-0.01	15.49	39.30
2005	21.29	1.60	0.92	-0.08	15.84	39.55
2006	18.54	1.07	0.55	0.37	12.76	33.29

***Table A4.16**: Annual modelled **mercury** net atmospheric input to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Unit: t/yr*

Year	Sub-regions of OSPAR Region II												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1990	0.54	0.31	0.33	0.27	0.47	0.55	0.09	0.26	0.90	0.86	0.57	0.51	0.26
1991	0.52	0.33	0.29	0.28	0.44	0.52	0.05	0.13	0.72	0.68	0.42	0.32	0.41
1992	0.54	0.30	0.34	0.31	0.46	0.52	0.07	0.15	0.84	0.80	0.50	0.38	0.38
1993	0.41	0.26	0.24	0.20	0.20	0.31	0.03	0.05	0.54	0.45	0.20	0.21	0.29
1994	0.35	0.24	0.17	0.16	0.19	0.25	0.05	0.07	0.54	0.37	0.22	0.24	0.21
1995	0.37	0.24	0.19	0.13	0.10	0.13	0.02	-0.001	0.55	0.36	0.12	0.18	0.16
1996	0.44	0.31	0.20	0.17	0.05	0.01	0.01	-0.06	0.47	0.32	0.03	0.17	0.16
1997	0.39	0.26	0.22	0.16	0.02	-0.02	0.01	-0.05	0.55	0.39	0.10	0.18	0.05
1998	0.41	0.30	0.24	0.16	0.05	0.04	0.02	0.01	0.58	0.40	0.11	0.21	0.06
1999	0.36	0.22	0.16	0.09	-0.05	-0.04	0.00	-0.05	0.53	0.24	0.02	0.22	-0.02
2000	0.36	0.23	0.18	0.11	0.03	0.05	0.03	0.00	0.53	0.40	0.14	0.22	0.04
2001	0.36	0.28	0.16	0.12	-0.02	-0.03	0.00	-0.02	0.38	0.22	0.04	0.11	-0.03
2002	0.30	0.23	0.15	0.12	-0.01	-0.02	-0.02	-0.04	0.41	0.25	0.03	0.09	-0.03
2003	0.28	0.22	0.11	0.06	-0.07	-0.11	-0.01	-0.08	0.47	0.18	-0.03	0.12	-0.08
2004	0.31	0.24	0.13	0.10	-0.03	-0.06	0.00	-0.05	0.42	0.24	0.05	0.09	-0.04
2005	0.40	0.30	0.17	0.12	-0.04	-0.10	-0.01	-0.06	0.55	0.27	0.04	0.05	-0.06
2006	0.33	0.20	0.14	0.07	-0.04	-0.13	-0.01	-0.07	0.31	0.21	0.03	0.14	0.04

***Table A4.17**: Contribution of the OSPAR Contracting Parties and one other selected country (Poland) to **mercury** anthropogenic depositions to the 5 OSPAR Regions in 2006. Units: t/yr*

Country	OSPAR Region				
	Region I	Region II	Region III	Region IV	Region V
Belgium	0.018	0.077	0.010	0.006	0.019
Denmark	0.017	0.129	0.001	0.001	0.005
Finland	0.014	0.001	0.0002	0.0001	0.001
France	0.062	0.265	0.050	0.089	0.115
Germany	0.022	0.061	0.006	0.004	0.016
Iceland	0.001	0.0001	0.000	0.000	0.0005
Ireland	0.010	0.014	0.037	0.002	0.020
Luxembourg	0.003	0.005	0.001	0.001	0.003
Netherlands	0.013	0.091	0.005	0.003	0.011
Norway	0.032	0.021	0.001	0.0002	0.003
Portugal	0.006	0.006	0.006	0.160	0.094
Spain	0.031	0.046	0.030	0.407	0.190
Sweden	0.007	0.005	0.0002	0.0001	0.001
Switzerland	0.006	0.008	0.003	0.004	0.010
UK	0.157	0.761	0.201	0.028	0.152
Poland	0.095	0.106	0.008	0.005	0.035

***Table A4.18**: Annual modelled **mercury** depositions from individual emission sectors to the main regions of the OSPAR maritime area in 2005. Units: t/yr*

OSPAR Region	Emission sectors			
	Combustion in power plants and industry & industrial processes	Transport	Commercial, residential and other combustion	Waste
Region I	0.40	0.01	0.06	0.06
Region II	1.21	0.02	0.13	0.27
Region III	0.25	0.00	0.04	0.06
Region IV	0.67	0.00	0.03	0.10
Region V	0.63	0.00	0.05	0.12

***Table A4.19**: Annual modelled γ-**HCH** total depositions to the main regions of the OSPAR maritime area. Units: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	9.5	14.0	4.3	3.0	12.0	42.8
1991	7.9	13.0	4.5	2.6	12.0	40.0
1992	8.9	14.0	3.6	3.8	9.7	40.0
1993	7.8	13.0	4.5	5.1	14.0	44.4
1994	7.7	12.0	4.2	4.2	11.0	39.1
1995	6.8	10.0	3.6	4.7	11.0	36.1
1996	9.1	11.0	3.8	4.2	12.0	40.1
1997	7.0	9.8	3.7	3.6	12.0	36.1
1998	4.7	7.6	2.6	2.3	7.6	24.8
1999	5.0	6.2	2.2	1.8	7.4	22.6
2000	2.9	4.6	1.6	1.5	4.8	15.4
2001	1.6	2.7	1.1	0.5	2.7	8.6
2002	1.7	2.0	0.8	0.4	2.6	7.6
2003	1.7	1.8	0.8	0.4	2.4	7.1
2004	1.3	1.6	0.6	0.4	2.2	6.1
2005	1.2	1.5	0.6	0.3	2.2	5.9
2006	1.3	1.4	0.6	0.4	2.2	5.9

***Table A4.20**: Annual modelled γ-**HCH** total deposition to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Units: t/yr*

Year	Sub-regions of OSPAR Region II												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1990	0.62	0.40	0.56	2.00	1.90	1.00	0.21	0.96	1.10	1.10	0.80	0.71	2.30
1991	0.54	0.34	0.48	1.80	1.80	1.00	0.18	0.96	0.96	0.93	0.75	0.56	2.60
1992	0.55	0.37	0.48	1.60	1.60	1.30	0.18	0.81	1.00	0.93	0.82	0.63	3.40
1993	0.39	0.29	0.36	1.60	1.60	1.20	0.12	0.65	0.58	0.72	0.65	0.40	3.80
1994	0.42	0.31	0.37	1.30	1.40	1.00	0.14	0.62	0.76	0.72	0.61	0.48	3.70
1995	0.36	0.24	0.33	1.20	1.10	0.90	0.13	0.48	0.64	0.63	0.51	0.39	3.20
1996	0.44	0.38	0.35	1.20	1.20	0.88	0.12	0.52	0.61	0.66	0.55	0.37	3.30
1997	0.38	0.25	0.34	1.00	1.10	0.85	0.13	0.50	0.58	0.69	0.57	0.37	2.90
1998	0.28	0.18	0.27	0.96	1.00	0.76	0.10	0.32	0.47	0.55	0.45	0.30	1.90
1999	0.28	0.18	0.25	0.85	0.80	0.51	0.08	0.25	0.47	0.46	0.38	0.28	1.30
2000	0.18	0.11	0.16	0.40	0.66	0.48	0.07	0.19	0.30	0.42	0.32	0.21	1.10
2001	0.11	0.07	0.09	0.28	0.46	0.26	0.04	0.13	0.18	0.20	0.18	0.14	0.55
2002	0.09	0.06	0.07	0.23	0.35	0.18	0.03	0.08	0.17	0.17	0.12	0.09	0.37
2003	0.09	0.06	0.08	0.20	0.29	0.14	0.03	0.07	0.18	0.18	0.11	0.10	0.30
2004	0.05	0.03	0.05	0.16	0.28	0.15	0.03	0.07	0.10	0.13	0.10	0.07	0.34
2005	0.09	0.05	0.06	0.15	0.24	0.12	0.02	0.06	0.13	0.14	0.09	0.06	0.29
2006	0.07	0.04	0.06	0.14	0.23	0.13	0.02	0.05	0.10	0.13	0.10	0.07	0.26

***Table A4.21**: Annual modelled γ-HCH net atmospheric input to the main regions of the OSPAR maritime area. Units: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	9.1	8.8	2.5	2.2	12.0	34.6
1991	7.6	8.0	2.6	1.9	12.0	32.1
1992	8.5	8.6	2.2	2.6	9.7	31.6
1993	7.5	7.4	2.8	3.7	14.0	35.4
1994	7.4	7.3	2.7	3.0	11.0	31.4
1995	6.5	6.0	2.2	3.3	11.0	29.0
1996	8.7	6.4	2.4	3.0	12.0	32.5
1997	6.7	6.1	2.4	2.5	12.0	29.7
1998	4.5	4.8	1.6	1.7	7.6	20.2
1999	4.8	4.0	1.4	1.4	7.4	19.0
2000	2.8	2.9	0.9	1.1	4.7	12.4
2001	1.6	1.6	0.6	0.4	2.7	6.9
2002	1.6	1.2	0.5	0.3	2.5	6.1
2003	1.6	1.1	0.4	0.3	2.4	5.8
2004	1.2	0.9	0.3	0.3	2.2	4.9
2005	1.2	0.9	0.3	0.3	2.2	4.9
2006	1.3	1.0	0.3	0.3	2.2	5.0

***Table A4.22**: Annual modelled γ-HCH net atmospheric input to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Units: t/yr*

Year	Sub-regions of OSPAR Region II												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1990	0.62	0.39	0.56	0.92	0.99	0.65	0.16	0.55	0.89	1.10	0.80	0.38	0.71
1991	0.54	0.34	0.48	0.83	0.91	0.65	0.13	0.52	0.79	0.93	0.75	0.24	0.87
1992	0.55	0.37	0.48	0.76	0.89	0.86	0.14	0.49	0.83	0.93	0.81	0.32	1.20
1993	0.39	0.29	0.36	0.72	0.86	0.82	0.09	0.38	0.45	0.72	0.64	0.15	1.50
1994	0.42	0.30	0.37	0.61	0.74	0.68	0.11	0.38	0.61	0.72	0.61	0.21	1.50
1995	0.36	0.24	0.33	0.52	0.58	0.58	0.10	0.30	0.51	0.63	0.51	0.16	1.10
1996	0.44	0.38	0.35	0.60	0.64	0.54	0.09	0.29	0.48	0.66	0.54	0.14	1.20
1997	0.38	0.25	0.34	0.49	0.60	0.55	0.10	0.30	0.47	0.69	0.57	0.17	1.10
1998	0.28	0.18	0.27	0.46	0.56	0.52	0.07	0.21	0.37	0.55	0.45	0.11	0.76
1999	0.28	0.17	0.25	0.40	0.43	0.34	0.06	0.16	0.39	0.46	0.38	0.11	0.51
2000	0.18	0.11	0.16	0.19	0.36	0.31	0.05	0.12	0.24	0.42	0.31	0.07	0.41
2001	0.10	0.07	0.09	0.12	0.24	0.16	0.03	0.08	0.14	0.20	0.17	0.03	0.17
2002	0.09	0.06	0.07	0.11	0.18	0.11	0.02	0.05	0.13	0.17	0.12	0.00	0.12
2003	0.09	0.06	0.08	0.09	0.15	0.08	0.02	0.04	0.14	0.18	0.11	0.01	0.10
2004	0.05	0.03	0.05	0.07	0.14	0.09	0.02	0.05	0.08	0.13	0.10	0.01	0.11
2005	0.09	0.04	0.06	0.07	0.13	0.07	0.01	0.03	0.10	0.14	0.09	0.00	0.10
2006	0.07	0.04	0.06	0.07	0.14	0.08	0.02	0.04	0.08	0.13	0.10	0.03	0.11

***Table A4.23**: Contribution of OSPAR Contracting Parties to the annual depositions of **γ-HCH** to the five OSPAR Regions for 2006. Units: t/yr*

Country	OSPAR Region				
	Region I	Region II	Region III	Region IV	Region V
Belgium	0.0024	0.0039	0.0008	0.0006	0.0030
Spain	0.0845	0.0386	0.0274	0.1458	0.2242
United Kingdom	0.3717	0.8737	0.3161	0.0498	0.3493

***Table A4.24**: Annual modelled **PCB-153** total depositions to the main regions of the OSPAR maritime area. Units: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	0.35	0.33	0.10	0.16	0.52	1.46
1991	0.32	0.32	0.11	0.15	0.48	1.38
1992	0.32	0.29	0.08	0.15	0.40	1.24
1993	0.31	0.30	0.11	0.16	0.47	1.35
1994	0.32	0.31	0.10	0.13	0.45	1.31
1995	0.26	0.27	0.09	0.13	0.40	1.15
1996	0.32	0.27	0.10	0.14	0.47	1.30
1997	0.26	0.26	0.09	0.12	0.40	1.13
1998	0.21	0.23	0.07	0.11	0.31	0.93
1999	0.23	0.22	0.07	0.11	0.31	0.94
2000	0.20	0.21	0.06	0.09	0.27	0.83
2001	0.17	0.16	0.05	0.09	0.24	0.70
2002	0.15	0.14	0.05	0.07	0.21	0.62
2003	0.14	0.12	0.04	0.06	0.18	0.55
2004	0.12	0.10	0.03	0.05	0.15	0.46
2005	0.10	0.09	0.03	0.04	0.14	0.41
2006	0.09	0.07	0.02	0.04	0.14	0.35

***Table A4.25**: Annual modelled **PCB-153** total deposition to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Units: t/yr*

Year	Sub-regions of the OSPAR Region II												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1990	0.014	0.008	0.011	0.018	0.032	0.036	0.007	0.023	0.040	0.025	0.022	0.034	0.058
1991	0.014	0.009	0.011	0.019	0.034	0.039	0.006	0.018	0.034	0.025	0.020	0.027	0.064
1992	0.012	0.008	0.010	0.015	0.028	0.039	0.006	0.021	0.034	0.023	0.021	0.027	0.052
1993	0.013	0.008	0.010	0.017	0.030	0.039	0.006	0.020	0.030	0.023	0.021	0.025	0.061
1994	0.014	0.009	0.011	0.017	0.030	0.038	0.006	0.021	0.033	0.025	0.021	0.028	0.057
1995	0.011	0.007	0.008	0.015	0.026	0.032	0.006	0.018	0.029	0.019	0.017	0.025	0.056
1996	0.013	0.010	0.010	0.017	0.027	0.030	0.005	0.016	0.025	0.020	0.017	0.021	0.055
1997	0.012	0.007	0.010	0.015	0.026	0.030	0.005	0.016	0.026	0.021	0.018	0.022	0.054
1998	0.011	0.006	0.009	0.012	0.023	0.029	0.005	0.016	0.025	0.021	0.018	0.021	0.039
1999	0.010	0.005	0.007	0.011	0.021	0.026	0.005	0.015	0.025	0.016	0.014	0.023	0.040
2000	0.009	0.005	0.007	0.011	0.020	0.025	0.005	0.015	0.022	0.018	0.016	0.023	0.035
2001	0.007	0.004	0.006	0.009	0.016	0.020	0.004	0.011	0.017	0.013	0.013	0.016	0.030
2002	0.006	0.004	0.005	0.009	0.014	0.017	0.003	0.009	0.015	0.012	0.010	0.014	0.025
2003	0.006	0.003	0.004	0.007	0.011	0.014	0.002	0.007	0.014	0.009	0.007	0.012	0.024
2004	0.004	0.003	0.004	0.006	0.011	0.013	0.002	0.007	0.010	0.008	0.007	0.010	0.019
2005	0.004	0.002	0.003	0.005	0.009	0.011	0.002	0.006	0.011	0.007	0.007	0.009	0.018
2006	0.004	0.002	0.003	0.004	0.007	0.008	0.001	0.004	0.008	0.006	0.004	0.007	0.012

***Table A4.26**: Annual modelled **PCB-153** net atmospheric input to the main regions of the OSPAR maritime area. Units: t/yr*

Year	Region I	Region II	Region III	Region IV	Region V	OSPAR area total
1990	0.32	0.18	0.02	0.08	0.45	0.45
1991	0.29	0.18	0.03	0.08	0.42	0.42
1992	0.28	0.17	0.03	0.07	0.33	0.33
1993	0.28	0.17	0.04	0.08	0.40	0.40
1994	0.29	0.18	0.03	0.06	0.39	0.39
1995	0.24	0.14	0.02	0.06	0.34	0.34
1996	0.29	0.15	0.03	0.07	0.41	0.41
1997	0.24	0.14	0.03	0.06	0.35	0.35
1998	0.18	0.13	0.02	0.06	0.25	0.25
1999	0.21	0.11	0.01	0.05	0.26	0.26
2000	0.18	0.11	0.01	0.04	0.22	0.22
2001	0.14	0.09	0.02	0.04	0.20	0.20
2002	0.13	0.07	0.00	0.03	0.18	0.18
2003	0.12	0.05	0.00	0.03	0.15	0.15
2004	0.10	0.05	-0.01	0.02	0.12	0.12
2005	0.08	0.04	-0.01	0.02	0.11	0.11
2006	0.07	0.03	0.01	0.02	0.10	0.10

***Table A4.27**: Annual modelled **PCB-153** net atmospheric input to the sub-regions of Region II (Greater North Sea) of the OSPAR maritime area. Units: t/y*

Year	Sub-regions of OSPAR Region II												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1990	0.014	0.008	0.010	0.008	0.012	0.019	0.003	0.014	0.020	0.024	0.021	0.003	0.024
1991	0.013	0.008	0.010	0.009	0.015	0.022	0.002	0.011	0.017	0.024	0.020	0.001	0.031
1992	0.011	0.007	0.009	0.007	0.011	0.021	0.003	0.012	0.017	0.021	0.020	0.008	0.024
1993	0.012	0.007	0.009	0.008	0.012	0.022	0.003	0.012	0.014	0.022	0.021	0.001	0.028
1994	0.014	0.009	0.011	0.008	0.012	0.020	0.003	0.013	0.017	0.024	0.021	0.003	0.026
1995	0.011	0.006	0.007	0.007	0.009	0.016	0.002	0.010	0.014	0.018	0.017	0.001	0.025
1996	0.012	0.009	0.010	0.008	0.010	0.016	0.002	0.010	0.011	0.020	0.017	0.001	0.027
1997	0.012	0.006	0.009	0.007	0.010	0.016	0.002	0.009	0.012	0.020	0.018	-0.001	0.025
1998	0.010	0.005	0.009	0.005	0.008	0.015	0.003	0.009	0.012	0.020	0.016	0.005	0.017
1999	0.009	0.005	0.006	0.004	0.006	0.012	0.002	0.008	0.012	0.015	0.013	0.001	0.016
2000	0.008	0.005	0.006	0.005	0.007	0.013	0.003	0.009	0.010	0.017	0.015	0.003	0.015
2001	0.006	0.004	0.005	0.004	0.005	0.010	0.002	0.006	0.007	0.012	0.012	0.003	0.014
2002	0.006	0.003	0.005	0.003	0.004	0.008	0.001	0.005	0.005	0.011	0.010	-0.003	0.010
2003	0.005	0.003	0.004	0.002	0.002	0.006	0.001	0.004	0.005	0.008	0.007	-0.002	0.009
2004	0.004	0.002	0.003	0.002	0.003	0.006	0.001	0.003	0.003	0.008	0.007	-0.002	0.007
2005	0.004	0.002	0.003	0.001	0.002	0.005	0.000	0.003	0.004	0.007	0.006	-0.002	0.007
2006	0.003	0.002	0.002	0.001	0.003	0.004	0.000	0.001	0.003	0.004	0.003	0.002	0.004

***Table A4.28**: Contribution of OSPAR Contracting Parties to the annual depositions of **PCB-153** to the five OSPAR Regions for 2006. Units: t/yr*

Country	OSPAR Region				
	Region I	Region II	Region III	Region IV	Region V
Belgium	1.4E-03	3.1E-03	4.9E-04	4.6E-04	1.6E-03
Denmark	1.2E-04	2.7E-04	1.4E-05	1.2E-05	7.2E-05
Finland	2.1E-04	3.8E-05	1.3E-05	8.2E-06	9.5E-05
France	5.1E-03	9.0E-03	2.2E-03	5.1E-03	8.2E-03
Germany	3.7E-03	5.0E-03	1.0E-03	1.1E-03	4.1E-03
Iceland	2.2E-04	3.1E-05	1.9E-05	1.4E-05	2.0E-04
Ireland	2.7E-04	2.4E-04	3.7E-04	4.1E-05	3.4E-04
Luxembourg	1.2E-05	1.6E-05	4.7E-06	5.6E-06	1.8E-05
Netherlands	1.5E-04	4.4E-04	4.4E-05	3.8E-05	1.5E-04
Norway	2.2E-04	1.3E-04	1.5E-05	9.5E-06	8.3E-05
Portugal	5.8E-05	3.3E-05	1.8E-05	1.8E-04	1.8E-04
Spain	3.0E-03	2.1E-03	1.0E-03	7.5E-03	7.0E-03
Sweden	3.8E-04	3.1E-04	3.1E-05	2.5E-05	1.9E-04
Switzerland	8.4E-05	6.4E-05	2.6E-05	4.8E-05	1.5E-04
UK	7.2E-03	1.5E-02	4.8E-03	1.2E-03	6.9E-03

Annex 5. Observed concentrations of nitrogen in precipitation

Annual mean concentrations of nitrogen in precipitation (in mg/l) measured at CAMP monitoring stations. Precipitation is given in mm. Red indicates invalid data, yellow indicates valid data.

Station	Year	Precipitation (mm)	NH_4 (mg/l)	NO_3 (mg/l)
BE0014R	2001	467	0.280	0.301
BE0014R	2002	808	0.560	0.352
BE0014R	2003	535	0.610	0.410
BE0014R	2004	591	0.574	0.431
BE0014R	2005	627	0.703	0.509
BE0014R	2006	672	0.579	0.324
DE0001R	1987	686	0.700	0.769
DE0001R	1988	868	0.610	0.641
DE0001R	1989	479	0.848	0.789
DE0001R	1990	692	0.553	0.579
DE0001R	1991	571	0.649	0.660
DE0001R	1992	697	0.607	0.680
DE0001R	1993	670	0.555	0.598
DE0001R	1994	777	0.625	0.704
DE0001R	1995	519	0.480	0.571
DE0001R	1996	340	0.659	0.676
DE0001R	1997	494	0.559	0.607
DE0001R	1998	636	0.582	0.602
DE0001R	1999	744	0.441	0.551
DE0001R	2000	641	0.591	0.647
DE0001R	2001	641	0.439	0.438
DE0001R	2002	718	0.529	0.514
DE0001R	2003	586	0.729	0.621
DE0001R	2004	689	0.442	0.451
DE0001R	2005	593	0.664	0.528
DE0001R	2006	743		0.474
DK0008R	1990	538		0.501
DK0008R	1991	380		0.525
DK0008R	1992	531		0.501
DK0008R	1993	80		0.242
DK0008R	1995	382		0.592
DK0008R	1999	798	0.419	0.532
DK0008R	2000	711	0.441	0.596
DK0008R	2001	591		0.491
DK0008R	2002	712		0.474
DK0008R	2003	549	0.502	0.537
DK0008R	2004	510	0.406	0.452
DK0008R	2005	552	0.415	0.454
DK0008R	2006	687	0.277	0.424

Station	Year	Precipitation (mm)	NH_4 (mg/l)	NO_3 (mg/l)
DK0020R	1998	698	0.713	0.544
DK0020R	1999	643	0.917	0.563
DK0020R	2000	522	1.812	0.702
DK0020R	2001	585	1.369	0.521
DK0020R	2002	611	0.833	0.557
DK0020R	2006	510	0.681	0.638
ES0008R*	1998	351		
ES0008R*	1999	1084	0.33	0.59
ES0008R*	2000	661	0.27	0.42
ES0008R*	2001	556	0.46	1.09
ES0008R*	2002	625	0.48	0.64
ES0008R*	2003	674	0.56	0.68
ES0008R*	2004	662	0.57	1.68
ES0008R*	2005	604	0.48	1.73
ES0008R*	2006	373	0.41	0.81
FR0005R	1987	910	0.626	0.475
FR0005R	1988	888	0.396	0.557
FR0005R	1989	319	0.665	0.686
FR0005R	1990	220	0.643	0.518
FR0005R	1991	166	2.097	0.611
FR0005R	1992	480	0.835	0.363
FR0005R	1993	829	1.048	0.497
FR0005R	1994	987	0.646	0.361
FR0005R	1995	827	0.622	0.425
FR0005R	1996	752	0.412	0.444
FR0005R	1997	936	0.340	0.282
FR0005R	1998	1063	0.370	0.303
FR0005R	1999	964	0.306	0.263
FR0005R	2000	1133	0.308	0.242
FR0005R	2001	909	0.314	0.264
FR0005R	2002	976	0.235	0.206
FR0005R	2003	244	0.295	0.243
FR0090R	1993	684	0.573	0.520
FR0090R	1994	851	0.360	0.428
FR0090R	1995	790	0.466	0.378
FR0090R	1999	1088	0.225	0.284
FR0090R	2000	1322	0.309	1.368
FR0090R	2001	1168	0.195	0.220
FR0090R	2002	964	0.091	0.284
FR0090R	2004	1059	0.058	0.269
FR0090R	2005	900	0.100	0.348
FR0090R	2006	918	0.064	0.375

* The Spanish data have been corrected after trend analysis had been done. While changes to data were small, this may still have impact on the precise % change calculated.

Station	Year	Precipitation (mm)	NH_4 (mg/l)	NO_3 (mg/l)
GB0006R	1987	934	0.237	0.168
GB0006R	1988	1104	0.232	0.183
GB0006R	1989	944	0.177	0.113
GB0006R	1990	1371	0.183	0.134
GB0006R	1991	922	0.222	0.161
GB0006R	1992	1238	0.218	0.130
GB0006R	1993	1127	0.297	0.179
GB0006R	1994	1374	0.313	0.215
GB0006R	1995	1024	0.359	0.211
GB0006R	1996	460	0.463	0.250
GB0006R	1997	1099	0.241	0.157
GB0006R	1998	1407	0.167	0.136
GB0006R	1999	387	0.123	0.073
GB0006R	2001	983	0.156	0.122
GB0006R	2002	1362	0.164	0.115
GB0006R	2003	817	0.147	0.121
GB0006R	2004	957	0.132	0.112
GB0006R	2005	816	0.156	0.136
GB0006R	2006	1371	0.169	0.095
GB0013R	2001	1024	0.272	0.283
GB0013R	2002	1214	0.217	0.233
GB0013R	2003	592	0.247	0.224
GB0013R	2004	853	0.288	0.272
GB0013R	2005	658	0.401	0.436
GB0013R	2006	872	0.369	0.283
GB0014R	1987	690	0.714	0.570
GB0014R	1988	697	0.768	0.593
GB0014R	1989	454	0.703	0.535
GB0014R	1990	492	0.496	0.366
GB0014R	1991	290	0.772	0.561
GB0014R	1992	829	0.603	0.512
GB0014R	1993	539	0.489	0.474
GB0014R	1994	517	0.556	0.494
GB0014R	1995	610	1.127	0.549
GB0014R	1996	389	0.586	0.418
GB0014R	1997	680	0.535	0.433
GB0014R	1998	748	0.526	0.461
GB0014R	1999	860	0.485	0.402
GB0014R	2000	1155	0.504	0.443
GB0014R	2001	869	0.546	0.529
GB0014R	2002	882	0.472	0.428
GB0014R	2003	485	0.559	0.482
GB0014R	2004	654	0.528	0.444
GB0014R	2006	789	0.526	0.398

Station	Year	Precipitation (mm)	NH_4 (mg/l)	NO_3 (mg/l)
GB0016R	1989	659	0.387	0.433
GB0016R	1990	760	0.365	0.420
GB0016R	1992	749	0.304	0.394
GB0016R	1993	963	0.395	0.460
GB0016R	1994	627	0.459	0.595
GB0016R	1995	724	0.410	0.503
GB0016R	2000	1240	0.357	0.360
GB0016R	2004	822	0.379	0.415
GB0016R	2005	497	0.269	0.277
GB0016R	2006	703	0.682	0.531
IE0001R	1987	1349	0.218	0.148
IE0001R	1988	1570	0.247	0.099
IE0001R	1989	1363	0.089	0.097
IE0001R	1990	1327	0.124	0.119
IE0001R	1991	1373	0.158	0.144
IE0001R	1992	1414	0.110	0.145
IE0001R	1993	1470	0.575	0.304
IE0001R	1994	1804	0.246	0.157
IE0001R	1995	1540	1.112	0.155
IE0001R	1996	1566	0.251	0.108
IE0001R	1997	1410	0.795	0.202
IE0001R	2001	1235	0.198	0.078
IE0001R	2002	1783	0.143	0.067
IE0001R	2003	1372	0.416	0.135
IE0001R	2004	1474	0.218	0.116
IE0001R	2005	1498	0.168	0.083
IE0001R	2006	1757	0.139	0.074
IE0002R	1992	1127	0.665	0.337
IE0002R	1993	1443	0.403	0.315
IE0002R	1994	1413	0.316	0.234
IE0002R	1995	1284	0.225	0.180
IE0002R	1996	1970		0.307
IE0002R	1997	1683		0.301
IE0002R	1998	1922		0.190
IE0002R	1999	1744		0.183
IE0002R	2000	1907		0.192
IE0002R	2001	1434		0.205
IE0002R	2002	2277		0.208
IE0002R	2003	1516		

Station	Year	Precipitation (mm)	NH_4 (mg/l)	NO_3 (mg/l)
IS0090R	1994	744		0.091
IS0090R	1995	610		0.103
IS0090R	1996	782		0.078
IS0090R	1999	559	0.270	0.114
IS0090R	2000	690	0.271	0.072
IS0090R	2001	809	0.390	0.152
IS0090R	2002	831	0.302	0.102
IS0090R	2003	845	0.346	0.102
IS0090R	2004	971	0.319	0.131
IS0090R	2005	684	0.342	0.113
IS0090R	2006	888	0.376	0.097
IS0091R	2002	2243	1.359	0.890
IS0091R	2003	1770	0.624	0.135
IS0091R	2004	1607	0.168	0.281
IS0091R	2005	1493	1.195	0.096
IS0091R	2006	2502	1.882	0.752
NL0009R	1993	561	0.660	0.110
NL0009R	1994	585	0.979	0.521
NL0009R	1995	594	0.964	0.534
NL0009R	1996	191	1.427	0.815
NL0009R	1997	459	1.001	0.538
NL0009R	1998	815	0.797	0.477
NL0009R	1999	761	0.702	0.416
NL0009R	2000	713	0.791	0.510
NL0009R	2001	852	0.623	0.382
NL0009R	2002	829	0.667	0.385
NL0009R	2003	617	0.673	0.429
NL0009R	2004	762	0.645	0.388
NL0009R	2005	590	0.718	0.437
NL0009R	2006	755	0.790	0.402
NL0091R	1996	528	0.846	0.620
NL0091R	1997	412	0.666	0.481
NL0091R	1998	828	0.595	0.471
NL0091R	1999	994	0.544	0.493
NL0091R	2000	1011	0.520	0.451
NL0091R	2001	945	0.538	0.499
NL0091R	2002	842	0.536	0.487
NL0091R	2003	686	0.652	0.448
NL0091R	2004	720	0.503	0.433
NL0091R	2005	962	0.534	0.456
NL0091R	2006	924	0.430	0.332

Station	Year	Precipitation (mm)	NH_4 (mg/l)	NO_3 (mg/l)
NO0001R	1987	1575	0.507	0.450
NO0001R	1988	1921	0.595	0.563
NO0001R	1989	1159	0.661	0.746
NO0001R	1990	1858	0.463	0.481
NO0001R	1991	1247	0.537	0.588
NO0001R	1992	1344	0.487	0.527
NO0001R	1993	1245	0.535	0.550
NO0001R	1994	1396	0.560	0.549
NO0001R	1995	1393	0.398	0.472
NO0001R	1996	1187	0.488	0.523
NO0001R	1997	1243	0.459	0.498
NO0001R	1998	1491	0.422	0.458
NO0001R	1999	1717	0.355	0.415
NO0001R	2000	2328	0.341	0.434
NO0001R	2001	1605	0.404	0.428
NO0001R	2002	1569	0.339	0.341
NO0001R	2003	1306	0.498	0.523
NO0001R	2004	1701	0.347	0.364
NO0001R	2005	1243	0.430	0.480
NO0001R	2006	1838	0.345	0.426
NO0039R	1987	1464	0.119	0.112
NO0039R	1988	1488	0.106	0.073
NO0039R	1989	1537	0.120	0.064
NO0039R	1990	1520	0.069	0.047
NO0039R	1991	1620	0.105	0.063
NO0039R	1992	1619	0.060	0.068
NO0039R	1993	1448	0.119	0.061
NO0039R	1994	1474	0.097	0.079
NO0039R	1995	1660	0.065	0.047
NO0039R	1996	1170	0.100	0.069
NO0039R	1997	1843	0.114	0.060
NO0039R	1998	1417	0.121	0.059
NO0039R	1999	1242	0.077	0.073
NO0039R	2000	1169	0.102	0.054
NO0039R	2001	1521	0.085	0.059
NO0039R	2002	1288	0.129	0.084
NO0039R	2003	1664	0.130	0.089
NO0039R	2004	1948	0.081	0.053
NO0039R	2005	1733	0.082	0.066
NO0039R	2006	1218	0.137	0.079
NO0057R	1987	390		0.118
NO0057R	1988	307	0.299	0.069
NO0057R	1989	295	0.103	0.092
NO0057R	1990	410	0.090	0.087
NO0057R	1991	424	0.167	0.121
NO0057R	1992	272	0.138	0.104

Station	Year	Precipitation (mm)	NH_4 (mg/l)	NO_3 (mg/l)
NO0057R	1993	492	0.107	0.100
NO0057R	1994	279	0.274	0.075
NO0057R	1995	109	0.209	0.121
NO0057R	1996	504	0.321	0.126
NO0057R	1997	194	0.644	0.100
NO0057R	1998	139	0.180	0.139
NO0057R	1999	188	0.287	0.220
NO0057R	2000	419	0.118	0.079
NO0057R	2001	336	0.082	0.078
NO0057R	2002	173	0.090	0.085
NO0057R	2003	205	0.131	0.111
NO0057R	2004	253	0.119	0.118
NO0057R	2005	213	0.089	0.096
NO0057R	2006	342	0.191	0.099
NO0099R	1987	1169		0.554
NO0099R	1988	1585	0.570	0.665
NO0099R	1989	1053	0.549	0.870
NO0099R	1990	1565	0.418	0.548
NO0099R	1991	1031	0.596	0.818
NO0099R	1992	1376	0.407	0.605
NO0099R	1993	846	0.688	0.800
NO0099R	1994	1180	0.524	0.577
NO0099R	1995	895	0.621	0.736
NO0099R	1996	911	0.668	0.741
NO0099R	1997	1220	0.559	0.550
NO0099R	1998	1228	0.567	
NO0099R	1999	1212	0.498	0.563
NO0099R	2000	1503	0.494	0.632
NO0099R	2001	1429	0.583	0.601
NO0099R	2002	1130	0.714	0.714
NO0099R	2003	468	0.871	0.826
PT0003R	1991	1146	0.176	
PT0003R	1992	904	0.189	
PT0003R	1993	1151	0.216	
PT0003R	1994	1497	0.209	0.112
PT0003R	1995	1374	0.207	0.147
PT0003R	1996	1780	0.231	0.169
PT0003R	1997	1510	0.198	0.154
PT0003R	1998	888	0.251	0.196
PT0003R	1999	1496	0.196	0.170
PT0003R	2000	1891	0.184	0.123
PT0003R	2001	1850	0.128	0.120
PT0003R	2002	1730	0.144	0.178
PT0003R	2003	1577	0.211	0.270
PT0003R	2004	2233	0.186	0.103
PT0003R	2005	920	0.168	0.218
PT0003R	2006	1344	0.151	0.208

Station	Year	Precipitation (mm)	NH_4 (mg/l)	NO_3 (mg/l)
PT0004R	1991	429	0.194	
PT0004R	1992	294	0.296	
PT0004R	1993	553	3.132	2.063
PT0004R	1994	410	0.509	0.234
PT0004R	1995	490	0.110	0.197
PT0004R	1996	802	0.096	0.130
PT0004R	1997	794	0.313	0.140
PT0004R	1998	206	0.297	0.285
PT0004R	1999	560	0.318	0.173
PT0004R	2000	574	0.275	0.151
PT0004R	2001	501	0.214	0.160
PT0004R	2002	695	0.214	0.189
PT0004R	2003	576	0.143	0.197
PT0004R	2004	357	0.383	0.219
PT0004R	2005	427	0.096	0.164
PT0004R	2006	903	0.223	0.271
PT0010R	1995	834	0.141	0.103
PT0010R	1999	944	0.072	0.170
PT0010R	2000	933	0.086	0.197
PT0010R	2001	1228	0.072	0.153
PT0010R	2002	1065	0.102	0.190
PT0010R	2003	1121	0.065	0.413
PT0010R	2004	644	0.048	0.163
PT0010R	2005	1432	12.17	1.500
PT0010R	2006	1201	0.105	0.095
SE0002R	1987	734	0.632	0.593
SE0002R	1988	834	0.722	0.805
SE0002R	1989	591	0.729	0.798
SE0002R	1990	854	0.663	0.635
SE0002R	1991	648	0.644	0.699
SE0002R	1992	780	0.556	0.613
SE0002R	1993	652	0.571	0.595
SE0002R	1994	755	0.429	0.513
SE0002R	1995	615	0.518	0.554
SE0002R	1996	464	0.614	0.632
SE0002R	1997	584	0.582	0.617
SE0002R	1998	793	0.381	0.457
SE0002R	1999	849	0.481	0.503
SE0002R	2000	886	0.458	0.575
SE0002R	2001	598	0.472	0.497
SE0014R	2002	629	0.486	0.513
SE0014R	2003	601	0.479	0.493
SE0014R	2004	727	0.463	0.439
SE0014R	2005	596	0.482	0.451
SE0014R	2006	752	0.526	0.436

Station	Year	Precipitation (mm)	NH_4 (mg/l)	NO_3 (mg/l)
SE0098R	**1995**	**428**	**0.484**	**0.601**
SE0098R	**1999**	**1359**	**0.492**	**0.501**
SE0098R	**2000**	**741**	**0.573**	**0.508**
SE0098R	**2001**	**799**	**0.471**	**0.459**
SE0098R	**2002**	**1053**	**0.400**	**0.433**
SE0098R	**2003**	**1004**	**0.489**	**0.599**
SE0098R	**2004**	**1128**	**0.355**	**0.417**
SE0098R	**2005**	**494**	**0.493**	**0.468**

Annex 6. Observed concentrations of heavy metals in precipitation

Annual mean concentrations of heavy metals in precipitation (in µg/l, mercury in ng/l) measured at CAMP monitoring stations. Precipitation is given in mm. Red indicates invalid data, yellow indicates valid data.

Station	Year	Prec (mm)	As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (ng/l)	Ni (µg/l)	Zn (µg/l)
BE0004R	1996	604	2.44	0.47	7.11	7.42	44.14	483.3	6.25	192.8
BE0004R	1997	542	4.39	0.26	2.32	3.58	45.50	25.55	2.73	60.7
BE0004R	1998	984	0.72	0.25	5.87	2.81	33.14	30.17	2.29	49.2
BE0004R	1999	852		0.30	2.70	17.82	27.11	34.06	4.21	27.2
BE0004R	2002	767		0.66	1.53	10.59	6.38	38.35	2.38	59.8
BE0014R	2005	940		0.09	0.82	3.56	2.29	0.25	0.68	18.2
BE0014R	2006	686		0.09		2.67	1.61	11.61	0.97	17.2
DE0001R	1989	478	1.00		1.00	2.85	4.40		3.24	11.5
DE0001R	1990	692	0.31	0.15	0.49	1.05	2.43	1.92	0.71	11.5
DE0001R	1991	571								
DE0001R	1992	333	0.16	0.06	0.05	1.63	1.34	2.16	0.59	12.7
DE0001R	1993	440	0.23	0.07	0.06	1.01	3.29	13.73	0.44	6.1
DE0001R	1994	777	0.86	0.13	0.45	2.50	2.61		1.09	16.6
DE0001R	1995	657			0.49	2.31	1.65		0.94	14.1
DE0001R	1996	336	0.43	0.11	0.37	3.13	2.06	30.92	0.46	11.9
DE0001R	1997	402	0.32	0.06	0.41	1.96	1.86	17.54	0.64	10.5
DE0001R	1998	703	0.15	0.11	0.16	3.20	1.55	9.31	1.04	17.4
DE0001R	1999	764	0.11	0.06	0.15	2.50	1.09	12.72	0.84	16.8
DE0001R	2000	661	0.15	0.07	0.18		1.09	9.55	0.75	24.7
DE0001R	2001	657	0.12	0.03	0.15	1.45	1.00	6.34	0.28	6.6
DE0001R	2002	784	0.15	0.04	0.11	1.40	1.17	7.19	0.38	12.9
DE0001R	2003	623	0.14	0.04	0.14	0.79	1.17	9.08	0.24	7.2
DE0001R	2004	709	0.10	0.02	0.12	0.52	0.79	8.13	0.30	5.3
DE0001R	2005	581	0.12	0.03	0.16	1.08	0.94	8.70	0.35	7.5
DE0001R	2006	726	0.11	0.03	0.10	0.87	0.87	8.57	0.34	6.4
DK0008R	1999	760	0.24	0.05	0.24	1.48	1.80		0.36	11.8
DK0008R	2000	670	0.32	0.06	0.26	1.35	2.33		0.33	11.5
DK0008R	2001	569	0.31	0.06	0.23	0.95	1.40		0.30	8.6
DK0008R	2002	604	0.26	0.06	0.19	0.92	1.67		0.26	8.3
DK0008R	2003	552	0.22	0.10	0.22	1.20	1.29		0.33	8.5
DK0008R	2004	597	0.23	0.05	0.18	1.63	1.32		0.48	18.1
DK0008R	2005	522	0.19	0.03	0.18	1.38	1.01		0.32	12.5
DK0008R	2006	677	0.17	0.03	0.29	0.62	0.76		0.29	8.5

Station	Year	Prec (mm)	As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (ng/l)	Ni (µg/l)	Zn (µg/l)
DK0020R	2000	473	0.24	0.11	0.26	2.06	2.53		0.34	18.9
DK0020R	2001	579	0.20	0.09	0.15	1.24	1.28		0.29	13.1
DK0020R	2002	593	0.20	0.06	0.19	0.98	1.55		0.29	15.1
DK0020R	2003	329	0.15	0.08	0.14	1.59	2.16		0.42	11.4
DK0020R	2004	501	0.13	0.17	0.15	2.75	1.40		0.49	16.7
DK0020R	2005	433	0.15	0.05	0.22	1.45	1.59		0.40	15.1
DK0020R	2006	473	0.19	0.06	0.37	1.29	1.19		0.37	9.3
DK0031R	1989	732	0.45	0.12	0.48	1.30	4.16		0.46	15.9
DK0031R	1990	1063		0.10	0.28	0.99	2.73	11.53	0.50	9.1
DK0031R	1992	905		0.06	0.47	1.84	2.28		0.45	12.2
DK0031R	1993	819		0.06	0.46	1.22	2.09		0.38	10.0
DK0031R	1995	754		0.06	0.40	1.82	2.10		0.39	18.2
DK0031R	1996	660		0.08	0.37	1.30	1.92		0.46	15.8
DK0031R	1997	690		0.06	0.57	1.78	2.26		0.89	15.4
DK0031R	1998	941	0.17	0.04	0.32	0.93	1.14		0.31	10.1
DK0031R	1999	1067	0.08	0.03	0.10	0.62	0.89		0.22	6.9
DK0031R	2000	837	0.14	0.04	0.10	0.53	0.86		0.20	7.9
DK0031R	2001	1017	0.12	0.03	0.10	0.63	0.69		0.22	8.4
DK0031R	2002	987	0.11	0.03	0.14	0.59	0.75		0.24	6.8
DK0031R	2004	1016	0.10	0.03	0.10	3.71	0.70		0.43	7.8
DK0031R	2005	682	0.09	0.03	0.11	0.95	0.85		0.28	8.8
DK0031R	2006	630	0.08	0.02	0.25	0.40	0.60		0.25	6.0
ES0008R*	2004	1450	0.74	0.21	25.35	21.58	3.97		43.30	121.15
ES0008R*	2005	1117	0.30	0.11	46.55	21.60	7.21		37.67	65.50
ES0008R*	2006	863	0.20	0.07	85.49	14.72	3.01		28.19	82.05
FR0090R	1989	489	0.22	0.14	0.20	3.15	3.03		0.57	11.0
FR0090R	1990	685	0.10	0.04	0.10	0.60	1.53		0.46	4.8
FR0090R	1991	707	0.09	0.07	0.38	1.44	2.52		1.09	12.2
FR0090R	1992	650	0.12	0.02	0.11	0.58	1.15		0.43	4.1
FR0090R	1993	684	0.08	0.03	0.23	0.71	1.77		0.56	3.7
FR0090R	1994	851	0.11	0.02	0.08	0.49	1.14		0.35	2.4
FR0090R	1995	790	0.04	0.02	0.07	0.43	1.10		0.49	3.0
FR0090R	1999	1088	0.09	0.02	0.16	0.92	1.86		0.30	2.5
FR0090R	2000	1322	0.04	0.02	0.18	0.86	1.81		0.71	2.3
FR0090R	2001	1168	0.10	0.03	0.06	0.92	1.07		0.54	1.7
FR0090R	2002	964	0.43	0.03	0.15	0.68	1.02		0.42	2.8
FR0090R	2004	1059	0.28	0.02	0.17	1.44	0.57		0.55	2.0
FR0090R	2005	900	0.16	0.03	0.15	0.74	0.85		0.39	2.0
FR0090R	2006	918		0.05	0.06	0.66	0.21		0.30	2.5

* The Spanish data have been corrected after trend analysis had been done. While changes to data were small, this may still have impact on the precise % change calculated

Station	Year	Prec (mm)	As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (ng/l)	Ni (µg/l)	Zn (µg/l)
GB0006R	2004	1292	0.27	0.01	0.16	0.34	0.34		0.05	2.0
GB0006R	2005	1166	0.21	0.06	0.03		0.15		0.14	1.3
GB0006R	2006	453	0.17	0.00	0.11	0.18	0.18		0.25	1.2
GB0013R	1996	702	0.85	0.17	0.76	2.22	5.60		0.41	9.4
GB0013R	2004	1206	0.09	0.02	0.10	0.35	0.65		0.23	5.2
GB0013R	2005	1025	0.10	0.05	0.09	0.48	0.78	4.84	0.43	5.1
GB0013R	2006	1063	0.10	0.02	0.11	0.39	0.55	3.35	0.31	3.6
GB0014R	1993	908	0.25	0.07	0.20	1.17	3.32		0.60	9.9
GB0014R	1994	724	0.43	0.11	0.29	1.87	5.45		0.96	29.6
GB0014R	1995	610	0.32	0.33	0.64	2.88	4.73		1.28	16.6
GB0014R	1996	467	0.82	0.16	0.86	2.12	4.74		0.36	7.8
GB0014R	1997	791	0.33	0.05	0.16	1.32	3.85		0.18	28.3
GB0014R	1998	977	0.19	0.05	0.39	0.94	2.55		0.39	9.9
GB0014R	1999	949	0.24	0.07	0.21	1.42	2.46		0.31	5.1
GB0014R	2000	1155	0.14	0.05	0.18	1.13	2.58		0.30	9.6
GB0014R	2002	881	0.16	0.06	0.33	1.53	853.1		0.28	11.2
GB0017R	2005	461	0.15	0.04	0.10	1.00	1.42	6.96	0.34	6.4
GB0017R	2006	565	0.14	0.03	0.13	1.90	1.03	3.79	0.43	6.1
GB0090R	1987	660		0.42	1.10	2.25	13.31	78.68	1.31	9.1
GB0090R	1989	518	1.17	0.21	0.56	4.75	7.58	125.8	1.41	21.0
GB0090R	1990	530	0.48	0.40	0.75	2.00	4.93	60.00	1.46	16.8
GB0090R	1991	429	0.42	0.16	0.47	5.21	7.67	77.91	1.81	
GB0090R	1992	813	0.42	0.22	0.31	1.95	5.20	40.59	1.60	18.6
GB0090R	1993	822	0.28	0.26	0.17	1.64	4.15		2.34	13.2
GB0090R	1994	764	0.25	0.20	0.24	1.96	4.29		1.30	23.0
GB0090R	1995	663	0.36	0.11	0.38	1.74	4.43		1.61	12.9
GB0090R	1996	314	1.92	1.72	1.31	62.90	10.50		9.56	540.9
GB0090R	1997	634	0.27	0.06	0.47	3.35	3.85		0.50	9.8
GB0090R	1998	770	0.15	0.07	0.34	1.21	2.08		0.49	8.7
GB0090R	1999	831	0.13	0.04	0.29	1.28	1.89		0.35	5.5
GB0090R	2000	753	0.31	0.09	0.22	1.85	1.67		0.37	26.2
GB0090R	2002	663	0.10	0.10	0.11	1.25	1.47		0.52	18.0
GB0091R	1989	543	1.06	0.12	0.69	3.56	3.94	222.0	0.60	9.6
GB0091R	1990	693	0.41	0.13	0.27	1.93	3.04	315.1	0.74	9.0
GB0091R	1991	742	0.26	0.14	0.26	4.28	3.97	65.80	0.69	
GB0091R	1992	781	0.16	0.05	1.32	2.36	2.49	37.88	0.58	5.9
GB0091R	1993	942	0.21	0.11	0.26	1.84	2.46		0.48	11.6
GB0091R	1994	680	0.26	0.07	0.23	1.24	3.15		0.65	22.6
GB0091R	1995	948	0.14	0.07	0.69	4.86	1.99		0.76	9.8
GB0091R	1996	558	0.03	0.08	1.80	10.50	1.00		0.06	10.5
GB0091R	1997	885	0.31	0.25	0.30	1.15	2.78		0.20	5.2
GB0091R	1998	1038	0.09	0.05	0.60	0.86	0.90		0.19	11.4
GB0091R	1999	895	0.10	0.06	0.21	1.18	0.91		0.30	3.2

Station	Year	Prec (mm)	As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (ng/l)	Ni (µg/l)	Zn (µg/l)
GB0091R	2000	1060	0.07	0.04	0.25	1.60	0.90		0.36	9.3
GB0091R	2002	984	0.13	0.16	0.07	0.64	1.09		0.21	10.9
GB0091R	2004	792		0.03	0.11	0.48	1.16		0.25	6.1
GB0091R	2005	500	0.07	0.07	0.05		0.34	3.34	0.28	4.1
GB0091R	2006	272	0.18	0.04	0.19	0.69	1.88	3.69	0.43	5.9
IE0001R	1991	1377		0.51		12.15	8.00		11.00	29.9
IE0001R	1992	1224	0.20	0.34	0.50	3.98	1.26	100.0		22.1
IE0001R	1993	1471		0.19	0.28	5.97	1.66			15.4
IE0001R	1994	1808		0.09	0.75	3.03	18.38		0.90	11.5
IE0001R	1995	1542		0.31		4.16	1.96		1.95	14.8
IE0001R	1996	1568		0.23		7.10	1.38			13.8
IE0001R	1997	1406		0.15		5.15	6.76		1.50	21.7
IE0001R	1998	1782		0.30		5.10	1.92	100.0		59.3
IE0001R	1999	1776	0.60	0.07	0.60	0.85	0.68			15.0
IE0001R	2000	1769		0.07		5.78	1.00			32.6
IE0001R	2001	1261				2.28				37.9
IE0001R	2002	1919				3.00	2.00			43.0
IE0001R	2004	1367		0.27	2.40	8.74	3.24		11.62	31.8
IE0001R	2005	1498		0.40		9.43	2.82		3.10	13.4
IE0001R	2006	1757				2.78				8.6
IE0002R	1992	1127		0.12	0.75	10.19	2.24			10.5
IE0002R	1993	1443		0.08	0.51	3.81	1.13	60.00		9.7
IE0002R	1994	1413		0.37	0.48	6.50	1.62	118.3	1.40	10.7
IE0002R	1995	1284		0.31		9.89	1.22		3.53	12.8
IE0002R	1996	1970		0.15		2.85	1.62			20.0
IE0002R	1997	1683		0.09		1.56	1.77		1.29	17.0
IE0002R	1998	1922		0.09		0.98	1.16		1.00	2.6
IE0002R	1999	1744	0.60	0.08	0.50	0.95	0.95		0.53	4.4
IE0002R	2000	1907			1.17	9.14	1.16		0.79	10.5
IE0002R	2001	1434		0.13		13.48	1.81			8.9
IE0002R	2002	2277			3.46	3.27	2.00			7.8
IE0002R	2003	1516				2.00	2.55			11.3
IS0002R	1992	1706		0.27	0.47	6.16	5.07		0.60	15.9
IS0002R	1993	2199		0.08	0.77	1.90	1.36		0.70	28.9
IS0002R	1994	1640		0.80	0.18	1.68	2.55		4.40	17.8
IS0002R	1995	1155		0.24	0.10	3.63	0.90		3.88	14.8
IS0002R	1996	1842		0.20	0.29	1.54	1.85		1.13	16.4
IS0002R	1997	1784		0.12	0.25	1.49	1.70		1.70	18.9
IS0002R	1998	1671	0.07	0.06	1.20	3.62	1.15		0.95	159.4
IS0002R	1999	1218	0.09	0.03	0.79	1.54	1.40		0.41	11.6
IS0002R	2000	1519	0.06	0.03	1.12	1.00	0.54		0.54	17.4
IS0002R	2001	681	0.16	0.03		0.95	0.47		0.19	10.3

Station	Year	Prec (mm)	As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (ng/l)	Ni (µg/l)	Zn (µg/l)
IS0090R	1992	840		0.06	0.37	1.92	2.27		1.02	
IS0090R	1993	864		0.05	0.41	1.68			1.06	
IS0090R	1994	744		0.10	0.10	2.62	1.19		0.62	163.0
IS0090R	1995	610		0.06	0.21	2.95	1.05		1.20	183.7
IS0090R	1996	782		0.07	0.34	1.88			0.72	140.6
IS0090R	1997	838		0.19	0.71	1.67			0.78	130.9
IS0090R	1998	749	0.19	0.15	0.67	2.58	0.36		0.49	81.5
IS0090R	1999	605	0.10	0.02	0.52	2.29	0.74		1.44	11.1
IS0090R	2000	758	0.08	0.03	0.49	1.65	0.65		0.78	4.2
IS0090R	2001	836	0.24	0.03	0.39	2.71	0.55		0.79	6.6
IS0090R	2002	1025	0.25	0.03	1.18	2.02	0.61		1.64	5.5
IS0090R	2003	1097	0.21	0.02	0.41	1.84	0.49		0.63	4.7
IS0090R	2004	971	0.23	0.02	0.41	1.61	0.39		0.58	7.2
IS0090R	2005	732	0.20	0.02	0.41	3.87	0.37		0.97	7.6
IS0090R	2006	957	0.19	0.02	0.25	2.75	0.44		0.76	4.2
IS0091R	2002	1556		0.03	0.98	1.90	0.40		1.57	9.1
IS0091R	2003	1770		0.03	1.22	31.42	0.70		1.18	11.5
IS0091R	2004	1607		0.02	0.45	1.37	0.38		0.42	11.9
IS0091R	2005	1486	0.07	0.07	1.28	1.84	1.99		3.11	12.4
IS0091R	2006	2330	0.06	0.02	0.30	1.86	0.36		1.21	8.1
NL0009R	1990	698		0.21		2.73	3.90		0.75	15.1
NL0009R	1991	522		0.16		3.45	0.78		1.16	15.0
NL0009R	1992	729		0.13		1.79	2.76		0.92	10.3
NL0009R	1993	833		0.15		1.73	4.20			11.7
NL0009R	1994	793		0.12		2.87	3.11			14.3
NL0009R	1995	837		0.08		2.65	2.45			9.2
NL0009R	1996	492		0.24		1.83	2.04			15.2
NL0009R	1997	519		0.18		1.16	2.13			13.0
NL0009R	1998	946		0.12		1.19	2.03		0.55	10.6
NL0009R	1999	831	0.56	0.13		1.77	1.65		0.57	9.6
NL0009R	2000	643	0.28	0.08	0.54	2.05	2.14		0.52	7.8
NL0009R	2001	793	0.26	0.09		2.91	1.65			8.2
NL0009R	2002	984	0.22	0.06	0.53	1.50	1.28			6.0
NL0009R	2003	592	0.35	0.07	0.68	1.40	1.64		0.55	7.1
NL0009R	2004	762	0.30	0.06		1.03	1.23		0.47	6.6
NL0009R	2005	613	0.43	0.08	1.12	1.89	2.13		0.64	10.0
NL0009R	2006	755	0.45	0.07	0.78	1.63	1.66		0.65	7.9
NL0091R	1996	543	1.42	0.13	0.68	1.92	3.60	26.79	1.03	9.9
NL0091R	1997	638		0.11		1.73	3.23	17.40	1.41	10.9
NL0091R	1998	828		0.08		1.41	2.65	13.64	0.63	9.8
NL0091R	1999	994		0.07		1.50	2.70	11.10	0.53	7.2
NL0091R	2000	1026	0.22	0.06		1.70	3.06	10.64	0.65	6.2
NL0091R	2001	962	0.16	0.07		1.99	3.16	9.40	0.54	8.3
NL0091R	2002	855	0.17	0.06		1.60	3.06	9.32	0.46	6.8

Station	Year	Prec (mm)	As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (ng/l)	Ni (µg/l)	Zn (µg/l)
NL0091R	2003	552	0.20	0.06	0.66	1.99	2.38	8.64	0.64	7.4
NL0091R	2004	720	0.30	0.05		1.80	2.32	15.17	0.50	5.6
NL0091R	2005	965	0.18	0.06	0.61	1.10	2.19	15.06	0.55	6.0
NL0091R	2006	924	0.18	0.05	0.52	1.14	1.88	9.31	0.59	5.4
NO0001R	1987	1576		0.12						9.0
NO0001R	1990	1792		0.25			3.79			9.6
NO0001R	1991	1158		0.07			3.61			6.9
NO0001R	1992	1355		0.05			2.85			5.2
NO0001R	1993	1207		0.07			3.12			6.5
NO0001R	1994	1406		0.06			2.63			5.0
NO0001R	1995	883		0.05			2.52			6.6
NO0001R	1996	951		0.07			3.05			5.2
NO0001R	1997	1161		0.04			1.75			4.1
NO0001R	1998	1516		0.05			1.59			4.9
NO0001R	1999	1618		0.05			1.33			3.6
NO0001R	2000	1838		0.03			1.39			3.2
NO0001R	2001	1427		0.04			1.33			5.0
NO0001R	2002	1399		0.04			0.96			3.6
NO0001R	2003	1139		0.04			1.50			3.7
NO0001R	2004	1013	0.22	0.14		0.95	1.33	9.85	0.57	3.7
NO0001R	2005	958	0.36	0.12	2.59	1.15	1.24	8.85	2.24	5.8
NO0001R	2006	1816	0.25	0.19	0.76	0.85	0.89	8.08	0.78	3.4
NO0099R	1990	1565		0.32	1.36	5.75		13.75	2.10	7.6
NO0099R	1991	1031	2.28	0.06	0.76	2.46		11.83	1.16	14.2
NO0099R	1992	1376	0.33	0.07	2.97	1.80		10.93	1.00	7.9
NO0099R	1993	846	0.72	0.11	2.87	1.90	4.20	11.27	0.72	13.1
NO0099R	1994	1180	0.21	0.05	0.51	1.00		8.09	0.51	7.8
NO0099R	1995	895	0.36	0.06	0.96	1.06	2.35	13.95	0.54	8.5
NO0099R	1996	581	0.51	0.06	0.39	0.99	2.79	19.67	0.47	7.9
NO0099R	1997	1068	0.49	0.05	0.49	1.02	2.82	10.63	0.59	6.7
NO0099R	1998	1040	0.33	0.05	0.66	1.14	2.07	9.03	0.73	8.2
NO0099R	1999	1177	0.35	0.04	0.49	1.88	1.47	9.71	0.70	7.4
NO0099R	2000	1310	0.28	0.04	0.30	1.11	1.56	7.32	0.43	6.4
NO0099R	2001	1068	0.18	0.07	0.43	1.23	1.41	7.30	0.59	7.3
NO0099R	2002	874	0.31	0.04	0.36	1.32	2.32	12.81	0.62	7.4
NO0099R	2003	882	0.89	0.10	0.56	1.35	2.04	8.12	0.62	7.6
PT0003R	1988	1011		3.90		5.78	3.32		2.81	49.6
PT0003R	1989	1135				1.74	2.73		2.77	51.8
PT0003R	1990	782				2.47	2.05		2.75	37.7
PT0003R	1991	1146		4.27		2.92	5.03		2.44	19.2
PT0003R	1992	904				1.60	2.92		2.32	15.6
PT0003R	1993	1151		20.75		2.73	4.17		3.84	26.1
PT0003R	1994	1412				2.53	2.50		2.28	19.6
PT0003R	1995	1421				2.12	2.14		2.63	31.5
PT0003R	1996	1752		2.53		2.66	1.72		2.39	51.1

Station	Year	Prec (mm)	As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (ng/l)	Ni (µg/l)	Zn (µg/l)
PT0003R	1997	1510		1.41		2.32	2.40		2.59	33.3
PT0003R	1998	888		1.28		2.47	1.93		1.91	27.1
PT0003R	1999	1496		1.88		2.56	2.19		2.35	14.8
PT0003R	2000	1891		1.28		2.15	2.55		1.44	11.4
PT0003R	2001	1850				4.53	1.90		2.23	18.6
PT0003R	2002	1730				2.17			2.06	15.3
PT0003R	2003	1577				2.60	1.64		2.28	16.1
PT0003R	2004	2233		0.85		9.08	9.20		1.60	9.1
PT0003R	2005	920				2.42	3.22			13.1
PT0003R	2006	1344				3.63	5.09		3.64	46.3
PT0004R	1997	794		1.73		1.15	1.69		1.93	26.5
PT0004R	1998	206		3.03		1.45	1.38		1.84	16.8
PT0004R	1999	560		1.28		1.42	1.76		2.49	12.7
PT0004R	2000	574				1.37	1.67			8.6
PT0004R	2001	501				1.11			5.48	8.1
PT0004R	2002	695				1.26			2.49	5.7
PT0004R	2003	576				2.08			3.51	10.1
PT0004R	2004	357				1.79	7.65		8.43	7.7
PT0004R	2005	427				1.55				5.2
PT0004R	2006	903				2.06	6.64		3.57	25.6
PT0010R	1995	834				4.81			3.29	69.4
PT0010R	1999	944		2.03		2.04	3.59		4.58	59.9
PT0010R	2000	933				1.69	2.71			36.0
PT0010R	2001	1228				2.03	5.25		9.91	22.8
PT0010R	2002	1065				1.85	1.83		10.84	44.2
PT0010R	2003	1121				1.99	7.52		8.76	100.1
PT0010R	2004	644					2.04		12.85	24.7
PT0010R	2005	1432				27.74			38.30	59.0
PT0010R	2006	1201				2.82			2.51	44.9
SE0002R	1989	584						30.09		
SE0002R	1990	853						18.90		
SE0002R	1991	647						15.33		
SE0002R	1992	779						11.42		
SE0002R	1993	653						9.92		
SE0002R	1994	755						9.75		
SE0002R	1995	325						21.21		
SE0002R	1998	626						6.96		
SE0002R	1999	692						9.43		
SE0002R	2000	772						8.75		
SE0002R	2001	579						9.31		
SE0014R	2002	582						12.26		
SE0014R	2003	512						9.04		
SE0014R	2004	554						14.65		
SE0014R	2005	380						18.47		

Station	Year	Prec (mm)	As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (ng/l)	Ni (µg/l)	Zn (µg/l)
SE0097R	1995	961	0.23	0.07	0.15		2.40	12.04	0.29	11.7
SE0097R	1996	685	0.19	0.07	0.25		2.52		0.30	9.3
SE0097R	1997	906	0.22	0.06	0.33	4.56	2.00		0.27	9.5
SE0097R	1998	807	0.18	0.04	0.13	2.15	1.55		0.21	12.8
SE0097R	1999	1079	0.10	0.05	0.24		1.65		0.22	11.7
SE0097R	2000	1031	0.16	0.05	0.22	0.97	1.59		0.25	13.1
SE0097R	2001	676	0.17	0.04	0.21		1.36		0.27	11.5
SE0097R	2002	988	0.16	0.04	0.26	0.80	0.96		0.11	4.6
SE0097R	2003	754	0.24	0.05	0.69	1.21	1.13		0.22	5.0
SE0097R	2004	1091	0.18	0.03	0.21	0.57	0.91		0.31	4.3
SE0097R	2005	729	0.22	0.05	0.23	0.99	1.23		0.39	6.6
SE0097R	2006	1377	0.12	0.03	0.14	0.80	0.65		0.21	5.0
SE0098R	1987	782		0.10	0.15	1.92	2.63		0.52	8.9
SE0098R	1988	857	0.36	0.11	0.20	6.34	3.00		0.40	10.0
SE0098R	1989	614	0.33	0.13	0.16	1.21	2.86		0.46	11.1
SE0098R	1990	985	0.24	0.08	0.11	0.85	2.14		0.32	8.6
SE0098R	1991	736	0.26	0.07	0.30	1.12	2.93		0.35	8.2
SE0098R	1992	986	0.18	0.05	0.46	0.86	2.14		0.42	5.2
SE0098R	1993	896	0.24	0.06	0.23	3.24	2.77		0.27	7.1
SE0098R	1994	982	0.21	0.06	0.25	2.43	2.38		0.33	5.5
SE0098R	1995	428	0.22	0.05	0.22		2.13		0.28	7.5

Annex 7. Observed concentrations of nitrogen in air/aerosol

Annual mean concentrations of nitrogen in air/aerosol (in µg/m^3) measured at CAMP monitoring stations. Red indicates invalid data, yellow indicates valid data.

Station	Year	NO_2 (µg/m^3)	sNH_4 (µg/m^3)	sNO_3 (µg/m^3)
BE0011R	**1990**	**6.67**		
BE0011R	**1991**	**6.18**		
BE0011R	**1992**	**6.16**		
BE0011R	**1993**	**6.09**		
BE0011R	**1994**	**5.78**		
BE0011R	**1995**	**6.66**		
BE0011R	**1996**	**6.49**		
BE0011R	**1997**	**7.42**		
BE0011R	**1998**	**6.75**		
BE0011R	**1999**	**6.62**		
BE0011R	**2000**	**5.99**		
BE0011R	**2001**	**6.65**		
BE0011R	**2002**	**6.49**		
BE0011R	**2003**	**7.28**		
BE0011R	**2004**	**6.12**		
BE0011R	**2005**	**5.73**		
BE0011R	**2006**	**5.89**		
BE0013R	**1990**	**5.71**		
BE0013R	**1991**	**4.93**		
BE0013R	**1992**	**4.77**		
BE0013R	**1993**	**5.18**		
BE0013R	**1994**	**3.45**		
BE0013R	**1995**	**4.29**		
BE0013R	**1996**	**6.09**		
BE0013R	**1997**	**6.67**		
BE0013R	**1998**	**5.60**		
BE0013R	**1999**	**4.85**		
BE0013R	**2000**	**4.64**		
BE0013R	**2001**	**5.58**		
BE0013R	**2002**	**5.30**		
BE0013R	**2003**	**6.06**		
BE0013R	**2004**	**5.20**		
BE0013R	**2005**	**5.00**		
BE0013R	**2006**	**5.15**		
DE0001R	**1987**	**2.73**		
DE0001R	**1988**	**2.22**		
DE0001R	**1989**	**2.77**		

Station	Year	NO_2 ($\mu g/m^3$)	sNH_4 ($\mu g/m^3$)	sNO_3 ($\mu g/m^3$)
DE0001R	1990	2.58		
DE0001R	1991	2.81		
DE0001R	1992	2.50		
DE0001R	1993	2.59		
DE0001R	1994	2.55		
DE0001R	1995	2.61		
DE0001R	1996	3.06		
DE0001R	1997	2.84		
DE0001R	1998	2.48		
DE0001R	1999	2.12		
DE0001R	2000	2.12		
DE0001R	2001	2.03	2.32	0.95
DE0001R	2002	2.24	2.17	1.12
DE0001R	2003	2.65	3.05	1.63
DE0001R	2004	2.34	1.53	1.00
DE0001R	2005	2.33	2.04	1.06
DE0001R	2006	2.26	2.19	1.03
DK0008R	1989	2.40	1.81	0.97
DK0008R	1990	1.74	1.89	0.95
DK0008R	1991		2.08	1.08
DK0008R	1992		1.79	0.97
DK0008R	1993		1.80	1.00
DK0008R	1994		1.56	0.88
DK0008R	1995			
DK0008R	1996		1.67	0.93
DK0008R	1997		1.44	0.81
DK0008R	1998		1.16	0.69
DK0008R	1999		1.37	0.86
DK0008R	2000		1.29	0.87
DK0008R	2001	1.47	1.15	0.73
DK0008R	2002		1.21	0.73
DK0008R	2003	1.89	1.32	0.85
DK0008R	2004	1.57	1.05	0.70
DK0008R	2005	1.40		0.79
DK0008R	2006	1.48	1.15	0.84
DK0031R	1990	1.36		1.02
DK0031R	1991	1.59		1.15
DK0031R	1992	1.10	2.38	1.04
DK0031R	1993			1.02
DK0031R	1994			0.94
DK0031R	1995	2.00		1.11
DK0031R	1996			
DK0031R	1999		1.74	0.81
DK0031R	2000		1.53	0.70
DK0031R	2001			0.63
DK0031R	2005			0.74
DK0031R	2006		1.23	0.78

Station	Year	NO_2 ($\mu g/m^3$)	sNH_4 ($\mu g/m^3$)	sNO_3 ($\mu g/m^3$)
ES0008R*	1999	2.11	1.77	0.49
ES0008R*	2000	2.04	2.53	0.52
ES0008R*	2001	1.85	0.49	0.32
ES0008R*	2002	1.36	0.75	0.34
ES0008R*	2003	1.51	0.55	0.54
ES0008R*	2004	1.94.	0.32	0.47
ES0008R*	2005	2.01	1.80	0.54
ES0008R*	2006	1.92	1.99.	0.73
GB0014R	1989		1.44	0.65
GB0014R	1990		2.06	0.76
GB0014R	1991		2.58	1.06
GB0014R	1992		1.61	0.88
GB0014R	1993		1.81	0.91
GB0014R	1994		1.74	0.63
GB0014R	1995		1.77	0.66
GB0014R	1997		1.94	0.83
GB0014R	1998		1.59	0.68
GB0014R	1999		1.41	0.65
GB0014R	2002	1.56		
GB0014R	2003	4.06		
GB0014R	2004	10.06		
GB0014R	2005	2.28		
GB0014R	2006	2.35		
IE0001R	1988	1.15		
IE0001R	1989	0.82		
IE0001R	1990	0.61		
IE0001R	1991	0.89		
IE0001R	1992	0.62		
IE0001R	1993	0.73		
IE0001R	1994	0.54		
IE0001R	1995	0.70		
IE0001R	1996	0.88		
IE0001R	1997	0.79		
IE0001R	2001	0.75		
IE0001R	2002	0.64		
IE0001R	2003	0.82		
IE0001R	2004	0.49	0.75	0.24
IE0001R	2005	0.95	1.09	0.38
IE0001R	2006	0.88	0.90	0.27

* The Spanish data have been corrected after trend analysis had been done. While changes to data were small, this may still have impact on the precise % change calculated

Station	Year	NO_2 ($\mu g/m^3$)	sNH_4 ($\mu g/m^3$)	sNO_3 ($\mu g/m^3$)
NL0009R	1989	9.41		
NL0009R	1990	4.92		
NL0009R	1991	5.88		
NL0009R	1992	5.01		
NL0009R	1993	4.59		
NL0009R	1994	4.56		
NL0009R	1995	4.08		
NL0009R	1996	4.89		
NL0009R	1997	4.46		
NL0009R	1998	3.95		
NL0009R	1999	3.79		
NL0009R	2000	3.90		
NL0009R	2001	3.20		
NL0009R	2004	3.63		
NL0009R	2005	3.41		
NL0009R	2006	3.08		
NL0091R	1996	8.51		
NL0091R	1997	10.90		
NL0091R	1999	5.99		
NL0091R	2000	6.39		
NL0091R	2001	6.29		
NL0091R	2002	5.98		
NL0091R	2003	6.84		
NL0091R	2004	6.11		
NL0091R	2005	6.03		
NL0091R	2006	6.04		
NO0001R	1987	1.14	0.66	0.30
NO0001R	1988	1.39	0.63	0.29
NO0001R	1989	1.63	0.63	0.26
NO0001R	1990	1.81	0.77	0.27
NO0001R	1991	1.35	0.76	0.27
NO0001R	1992	1.36	0.53	0.24
NO0001R	1993	0.59	0.54	0.23
NO0001R	1994	0.65	0.65	0.29
NO0001R	1995	0.67	0.53	0.30
NO0001R	1996	0.68	0.58	0.29
NO0001R	1997	0.70	0.54	0.24
NO0001R	1998	0.62	0.41	0.19
NO0001R	1999	0.52	0.51	0.20
NO0001R	2000	0.58	0.43	0.20
NO0001R	2001	0.50	0.55	0.21
NO0001R	2002	0.46	0.62	0.27
NO0001R	2003	0.58	0.60	0.27
NO0001R	2004	0.46	0.54	0.25
NO0001R	2005	0.47	0.76	0.34
NO0001R	2006	0.47	0.77	0.40

Station	Year	NO_2 ($\mu g/m^3$)	sNH_4 ($\mu g/m^3$)	sNO_3 ($\mu g/m^3$)
NO0039R	1987	0.50	0.43	0.07
NO0039R	1988	0.60	0.44	0.07
NO0039R	1989	1.14	0.42	0.08
NO0039R	1990	0.40	0.35	0.06
NO0039R	1991	0.26	0.36	0.06
NO0039R	1992	0.19	0.38	0.06
NO0039R	1993	0.19	0.38	0.07
NO0039R	1994	0.22	0.47	0.10
NO0039R	1995	0.26	0.36	0.10
NO0039R	1996	0.24	0.50	0.09
NO0039R	1997	0.25	0.50	0.07
NO0039R	1998	0.26	0.34	0.05
NO0039R	1999	0.23	0.44	0.05
NO0039R	2000	0.33	0.55	0.05
NO0039R	2001	0.21	0.48	0.08
NO0039R	2002	0.26	0.78	0.09
NO0039R	2003	0.32	0.96	0.09
NO0039R	2004	0.23	0.48	0.07
NO0039R	2005	0.22	0.63	0.12
NO0039R	2006	0.25	0.87	0.14
NO0042G	1989			0.03
NO0042G	1990		0.10	0.04
NO0042G	1991		0.09	0.05
NO0042G	1992	0.05	0.08	0.04
NO0042G	1993		0.09	0.06
NO0042G	1994	0.07	0.09	0.06
NO0042G	1995		0.10	0.08
NO0042G	1996		0.11	0.08
NO0042G	1997		0.13	0.07
NO0042G	1998		0.13	0.04
NO0042G	1999		0.19	0.03
NO0042G	2000		0.11	0.03
NO0042G	2001		0.17	0.06
NO0042G	2002		0.24	0.05
NO0042G	2003		0.27	0.04
NO0042G	2004		0.24	0.08
NO0042G	2005		0.42	0.16
NO0042G	2006		0.42	0.11
SE0014R	2002	1.42	1.04	0.72
SE0014R	2003	1.72	1.16	0.76
SE0014R	2004	1.45	0.67	0.50
SE0014R	2005	1.49	0.94	0.63
SE0014R	2006	1.67	0.96	0.65

Annex 8. Observed concentrations of heavy metals in air/aerosol

Annual mean concentrations of heavy metals in air/aerosol (in ng/m^3) measured at CAMP monitoring stations. Red indicates invalid data, yellow indicates valid data.

Station	Year	As (ng/m^3)	Cd (ng/m^3)	Cr (ng/m^3)	Cu (ng/m^3)	Pb (ng/m^3)	Hg (ng/m^3)	Ni (ng/m^3)	Zn (ng/m^3)
BE0004R	1997				20.00	70.00		20.00	120.0
BE0004R	1998					55.00		20.00	132.5
BE0004R	1999				24.64	26.50		13.50	36.8
BE0004R	2000				21.00	42.00		22.82	74.5
BE0004R	2001				36.10	25.00		12.86	42.0
BE0004R	2002					16.89		17.89	42.5
BE0004R	2003				8.75	25.83		6.00	41.5
BE0014R	2005		0.33		4.80	11.40		4.60	39.8
BE0014R	2006	1.20	0.40	4.74	6.98	13.41	2.01	5.10	47.3
DE0001R	1987		0.37		2.55	23.33			
DE0001R	1988		0.39		3.35	23.25			
DE0001R	1989		0.41		2.64	19.55			
DE0001R	1990		0.30		3.13	17.33			
DE0001R	1991		0.36		1.53	18.03			
DE0001R	1992		0.25		2.16	11.88			
DE0001R	1993		0.20		2.26	12.72			
DE0001R	1994		0.16		1.89	9.92			
DE0001R	1995		0.18		1.91	8.77		1.42	
DE0001R	1996		0.25		1.61	9.63		1.35	
DE0001R	1997		0.20		1.53	8.04		1.24	
DE0001R	1998	0.63	0.15		1.31	6.68		1.06	
DE0001R	1999	0.54	0.18		1.84	5.25		1.06	
DE0001R	2000					6.47			
DE0001R	2001	0.89	0.15		2.23	7.35		1.53	
DE0001R	2002	0.61	0.16		2.55	6.18		1.31	
DE0001R	2003	0.71	0.18		2.18	6.22		1.32	
DE0001R	2004	0.88	0.08		1.65	3.85		1.33	9.8
DE0001R	2005	0.54	0.13		1.93	4.85			13.0
DE0001R	2006	0.49	0.12		2.14	4.43		1.56	13.6
DK0008R	1996				1.32	7.77		1.87	12.6
DK0008R	1997				1.28	5.48		1.63	10.3
DK0008R	1998				1.61	4.97		1.43	10.8
DK0008R	1999	0.45			1.41	5.36		1.57	10.2
DK0008R	2000	0.39		0.87	1.49	5.06		1.53	10.6
DK0008R	2001	0.46			1.08	4.47		1.64	10.1
DK0008R	2002	0.35		1.22	1.01	3.63		1.62	9.8
DK0008R	2003	0.50		0.76	1.16	4.46		1.76	10.3

Station	Year	As (ng/m^3)	Cd (ng/m^3)	Cr (ng/m^3)	Cu (ng/m^3)	Pb (ng/m^3)	Hg (ng/m^3)	Ni (ng/m^3)	Zn (ng/m^3)
DK0008R	2004	0.36		0.79	1.26	4.00		1.91	10.3
DK0008R	2005	0.51		0.82	1.30	4.47		2.15	11.6
DK0008R	2006	0.52		1.15	1.38	4.25		1.97	13.2
DK0031R	1990			1.48	1.62	17.40		1.68	24.0
DK0031R	1991			2.63	2.18	17.33		1.98	23.3
DK0031R	1992	1.99		1.45	1.91	13.42		1.81	22.1
DK0031R	1993	2.12		1.45	1.56	11.89		1.61	19.8
DK0031R	1994			1.90	1.65			1.54	18.1
DK0031R	1995	2.03			1.90	9.33		1.72	17.6
DK0031R	1996	1.43		1.09	1.36	7.28		1.45	14.9
DK0031R	1997	0.59			1.26	6.14		1.32	12.2
DK0031R	1998	0.54			1.50	6.63		1.16	12.9
DK0031R	1999	0.51		1.15	1.38	5.19		1.15	11.9
DK0031R	2000	0.39		1.02	1.52	4.79		1.02	10.5
DK0031R	2001	0.39		0.95	1.05	4.32		1.23	9.5
DK0031R	2002	0.30			0.91	2.99		0.91	8.7
DK0031R	2003	0.34		1.06	1.14	3.31		1.05	9.0
DK0031R	2004	0.33			1.36	3.22		1.10	9.1
DK0031R	2005	0.51		1.13	1.45	4.99		1.60	12.7
DK0031R	2006	0.54		1.17	1.33	4.14		1.37	12.7
ES0008R*	2001		0.14		37.84	8.45		1.20	
ES0008R*	2002		0.17		27.90.	12.93			
ES0008R*	2003		0.12		24.77	8.97			
ES0008R*	2004	0.31	0.09		21.70.	7.04		.	.
ES0008R*	2005		0.10		19.47	.6.96			
ES0008R*	2006	0.17	0.11		25.38	.6.92			
GB0013R	2004	0.56	0.17	1.21	2.11	4.45		1.51	14.3
GB0013R	2005	0.23	0.05	0.27	0.76	2.80	1.15	0.89	7.5
GB0013R	2006	0.60	0.11	0.75	1.87	4.99	1.53	1.53	21.1
GB0014R	1993	0.51	0.51	1.15	5.06	13.67		2.38	28.8
GB0014R	1994	0.44	0.15	0.69	2.94	11.03		1.86	20.1
GB0014R	1995	0.77	0.16	1.18	2.73	12.23		1.82	20.5
GB0014R	1996	0.75	0.15	1.01	2.98	7.67		1.56	25.7
GB0014R	1997	0.40	0.13	0.87	6.33	8.15		2.18	96.0
GB0014R	1998	0.40	0.10	0.55	4.00	5.40		1.10	33.8
GB0014R	1999	0.61	0.19	0.40	4.85	8.97		1.14	39.5
GB0014R	2000	0.54	0.23	1.29	3.21	6.32		2.50	58.8
GB0014R	2001	0.34	0.22	1.10	1.99	5.52		1.16	34.4
GB0014R	2002	0.69	0.27	1.71	1.45	5.39		1.18	48.9

* The Spanish data have been corrected after trend analysis had been done. While changes to data were small, this may still have impact on the precise % change calculated.

Station	Year	As (ng/m^3)	Cd (ng/m^3)	Cr (ng/m^3)	Cu (ng/m^3)	Pb (ng/m^3)	Hg (ng/m^3)	Ni (ng/m^3)	Zn (ng/m^3)
GB0017R	2003	1.12	0.22	1.96	2.49	8.92		1.80	27.5
GB0017R	2004	0.92	0.25	1.74	4.56	13.39	1.69	2.67	28.3
GB0017R	2005	0.21	0.06	0.32	1.60	4.44	1.34	1.29	7.4
GB0017R	2006	0.63	0.16	1.06	1.83	7.50	1.87	2.03	18.8
GB0090R	1989		0.40	0.80	3.72	28.30		2.21	26.1
GB0090R	1990		0.36	0.48	2.77	21.00		1.75	22.8
GB0090R	1991		0.66	0.72	3.36	26.14		3.27	73.9
GB0090R	1992	0.40	0.67	0.69	3.86	21.94		3.75	101.1
GB0090R	1993	0.51	0.30	1.91	4.16	11.36		4.17	50.7
GB0090R	1994	0.50	0.41	0.51	4.32	13.89		2.05	32.5
GB0090R	1995	0.87	0.23	0.79	4.18	15.01		2.00	38.1
GB0090R	1996	0.93	0.23	0.86	3.80	13.47		1.70	19.3
GB0090R	1997	0.64	0.17	0.51	2.43	11.70		1.58	11.0
GB0090R	1998	0.78	0.19	0.44	2.49	11.74		1.40	29.8
GB0090R	1999	1.13	0.30	1.20	3.49	16.83		1.47	18.5
GB0090R	2000	0.93	0.23	1.23	2.31	11.01		999.4	30.5
GB0090R	2001	0.63	0.24	0.96	2.24	8.22		10.87	38.8
GB0090R	2002	1.54	0.43	1.32	2.24	8.02		1.85	42.3
GB0091R	1989		0.13	0.33	1.29	7.64		0.74	7.5
GB0091R	1990		0.15	1.99	1.97	6.77		2.85	9.4
GB0091R	1991		0.13	0.29	1.75	7.46		0.80	11.8
GB0091R	1992	0.19	0.25	0.28	1.32	5.68		0.82	22.8
GB0091R	1993	0.25	0.46	1.23	2.24	4.60		2.77	15.8
GB0091R	1994	0.11	0.12	0.41	2.06	5.19		1.41	20.8
GB0091R	1995	0.46	0.40	6.30	10.75	4.92		10.32	25.9
GB0091R	1996	0.33	0.09	0.54	2.63	4.33		0.61	11.6
GB0091R	1997	0.44	0.06	0.40	2.73	3.45		0.95	27.0
GB0091R	1998	0.26	0.10	0.10	1.93	2.18		0.44	12.4
GB0091R	1999	0.26	0.09	0.82	1.19	2.23		0.30	15.3
GB0091R	2000	0.32	0.05	0.69		2.17		0.59	20.4
GB0091R	2001	0.37	0.13	0.47	0.76	2.35		0.47	13.5
GB0091R	2002	0.49	0.25	0.67	0.72	2.01		0.51	27.4
GB0091R	2003	0.48	0.17	1.48	1.96	4.27		1.09	20.3
GB0091R	2004	0.28		1.04	1.14	2.42	1.36	0.67	14.0
GB0091R	2005	0.10	0.04	0.89	0.52	1.13		0.92	4.0
GB0091R	2006	0.30	0.08	0.85	1.56	2.90	1.40	0.89	6.4
IS0091R	1995	0.27	0.03	3.67	1.43	0.96		3.41	6.3
IS0091R	1996	0.17	0.04	3.65	1.15	0.92		8.64	7.2
IS0091R	1997	0.24	0.04	6.39	1.65	0.95		14.58	8.6
IS0091R	1998	0.05	0.09	9.70	0.68	0.72	1.35	7.15	6.5
IS0091R	1999	0.08	0.19	7.22	1.11	1.00	0.53	11.21	16.5
IS0091R	2000	0.10	0.08	10.88	1.43	0.54	1.70	7.36	9.1
IS0091R	2001	0.05	0.04	6.42	0.52	0.36	4.79	3.68	2.7
IS0091R	2002	0.19	0.05	7.49	1.32	0.70	21.66	4.69	4.7

Station	Year	As (ng/m^3)	Cd (ng/m^3)	Cr (ng/m^3)	Cu (ng/m^3)	Pb (ng/m^3)	Hg (ng/m^3)	Ni (ng/m^3)	Zn (ng/m^3)
IS0091R	2003	0.15	0.02	5.73	0.64	0.51	0.80	3.72	5.8
IS0091R	2004	0.19	0.15	10.91	1.08	0.96	3.74	6.90	21.8
IS0091R	2005	0.17	0.05	9.68	1.54	0.60	2.60	6.56	7.4
IS0091R	2006	0.19	0.08	14.56	2.36	2.41	1.48	23.26	8.6
NL0009R	1990					31.63			
NL0009R	1991					38.96			
NL0009R	1992					29.25			
NL0009R	1993					27.82			
NL0009R	1994	2.98	0.39			17.39			51.2
NL0009R	1995	2.76	0.26			14.91			39.0
NL0009R	1996	1.52	0.40			14.34			49.1
NL0009R	1997	1.07	0.29			11.58			33.2
NL0009R	1998	0.78	0.30			9.64			29.6
NL0009R	1999	0.81	0.28			10.78			31.8
NL0009R	2000	0.62	0.20			8.38			32.4
NL0009R	2001	0.63	0.18			7.12			32.1
NL0009R	2002					6.41			
NL0009R	2003					6.65			
NL0009R	2004	0.54				6.98			
NL0009R	2005					6.81			
NL0009R	2006					5.01			
NO0001R	2004	0.24	0.05		1.01	1.72		0.65	4.0
NO0001R	2005	0.60	0.10	3.45	4.72	3.97	1.87	2.55	18.2
NO0001R	2006	0.33	0.07	3.60	1.81	2.15	1.72	0.85	6.0
NO0042G	1994	0.63			0.40	1.41	1.80	0.29	2.3
NO0042G	1995	0.17	0.03	0.34	0.54	0.84	1.60	0.28	1.5
NO0042G	1996	0.09	0.01		0.37	0.53	1.66	0.29	2.3
NO0042G	1997	0.32	0.03		0.46	0.77	1.18	0.36	2.2
NO0042G	1998	0.16	0.03	0.22	0.36	0.73	1.26	0.18	1.5
NO0042G	1999	0.09	0.02	0.13	0.28	0.55	1.74	0.14	1.4
NO0042G	2000	0.30	0.03	0.10	0.44	0.62	1.50	0.12	1.6
NO0042G	2001	0.40	0.02	0.07	0.32	0.51	1.56	0.08	1.3
NO0042G	2002	0.38	0.05	0.07	0.35	0.75	1.60	0.11	1.8
NO0042G	2003	0.17	0.04	0.20	0.36	0.67	1.60	0.14	2.5
NO0042G	2004	0.14	0.03	0.24	0.36	0.61	1.50	0.12	7.0
NO0042G	2005	0.17	0.20		1.06	0.97	1.58	0.26	5.8
NO0042G	2006	0.06	0.04		0.45	0.48	1.60	0.09	2.5
NO0099R	1991	0.77	0.06	1.86	0.80	2.69		0.59	4.4
NO0099R	1992	0.19	0.05	1.79	0.47	2.35	2.06	1.33	3.9
NO0099R	1993	0.41	0.07	3.70	0.85	3.67	1.84	0.81	7.0
NO0099R	1994	0.36	0.07	2.80	0.90	3.68	1.84	0.88	4.5
NO0099R	1995					1.01		0.25	2.4
NO0099R	1996			0.99	0.46	0.79		0.26	1.5
NO0099R	1997			0.68	0.72	0.71		0.23	2.2

Station	Year	As (ng/m^3)	Cd (ng/m^3)	Cr (ng/m^3)	Cu (ng/m^3)	Pb (ng/m^3)	Hg (ng/m^3)	Ni (ng/m^3)	Zn (ng/m^3)
NO0099R	**1998**				**0.41**	**0.62**		**0.43**	**3.3**
NO0099R	**1999**			**1.35**	**0.47**	**0.53**	**1.86**	**0.27**	**3.5**
NO0099R	**2000**			**0.69**	**0.37**	**0.52**	**1.77**	**0.10**	**1.8**
NO0099R	**2001**	**0.78**	**0.02**	**1.73**	**0.31**	**0.43**	**1.63**	**0.14**	**1.6**
NO0099R	**2002**	**0.06**	**0.01**	**1.57**	**0.44**	**0.55**	**1.70**	**0.14**	**1.8**
NO0099R	**2003**			**0.54**	**0.49**	**0.61**	**1.65**	**0.22**	**1.9**
SE0014R	**2002**						**1.69**		
SE0014R	**2003**						**1.78**		
SE0014R	**2004**						**1.62**		
SE0014R	**2005**						**1.68**		
SE0014R	**2006**						**1.60**		

Annex 9. Observed Concentrations of lindane in precipitation

Annual mean concentrations of lindane (γ-HCH) in precipitation (in ng/l) measured at CAMP monitoring stations. Precipitation in mm. Red indicates invalid data, yellow indicates valid data.

Station	Year	Prec (mm)	γ-HCH (ng/l)
BE0004R	1996	604	33.4
BE0004R	1997	542	104.9
BE0004R	1998	984	28.1
BE0004R	1999	852	26.8
BE0004R	2000	454	16.2
BE0004R	2001	376	24.4
BE0004R	2002	767	11.5
BE0004R	2003	281	9.9
BE0004R	2004	277	6.0
BE0014R	2006	1108	3.5
DE0001R	1996	325	10.7
DE0001R	1997	402	13.5
DE0001R	1998	740	6.0
DE0001R	1999	631	7.8*
DE0001R	2000	641	6.2*
DE0001R	2001	678	3.2*
DE0001R	2002	725	2.4*
DE0001R	2003	586	2.9
DE0001R	2004	560	1.7
DE0001R	2005	582	1.4
DE0001R	2006	722	1.0
IE0002R	1992	1127	
IE0002R	1993	1443	
IE0002R	1994	1413	
IE0002R	1995	1284	
IE0002R	1996	1970	
IE0002R	1997	1683	
IE0002R	1998	1922	
IE0002R	1999	1744	
IE0002R	2000	1907	
IE0002R	2001	1434	
IE0002R	2002	2277	0.8
IE0002R	2003	1516	
IS0091R	1995	1170	0.6
IS0091R	1996	1436	0.3
IS0091R	1997	1389	0.4

* Concentrations for DE00001R for 1999 – 2002 were determined with different method than in other years which may affect the results of the trend analysis.

Station	Year	Prec (mm)	γ-HCH (ng/l)
IS0091R	1998	1419	0.3
IS0091R	1999	708	0.1
IS0091R	2000	622	0.1
IS0091R	2001	718	0.2
IS0091R	2002	806	0.1
IS0091R	2003	739	0.1
IS0091R	2004	714	0.1
IS0091R	2005	640	0.1
IS0091R	2006	760	0.0
NL0091R	1996	598	28.1
NL0091R	1997	590	48.2
NL0091R	1998	828	48.7
NL0091R	1999	994	17.3
NL0091R	2000	638	65.9
NL0091R	2001	955	14.1
NL0091R	2002	885	20.0
NL0091R	2003	737	13.3
NL0091R	2004	931	11.0
NL0091R	2005	869	12.7
NL0091R	2006	811	3.3
NO0001R	2004	1404	0.9
NO0001R	2005	1167	0.7
NO0001R	2006	1798	0.5
NO0099R	1991	1031	4.1
NO0099R	1992	1376	5.0
NO0099R	1993	846	8.4
NO0099R	1994	1180	10.2
NO0099R	1995	895	5.2
NO0099R	1996	911	8.0
NO0099R	1997	1220	4.9
NO0099R	1998	1239	4.8
NO0099R	1999		
NO0099R	2000	1572	3.1
NO0099R	2001	1070	2.4
NO0099R	2002	1129	1.7
NO0099R	2003	1071	0.9

Annex 10. Comparison of EMEP modelled atmospheric deposition with measurements of waterborne inputs

Region 1

Data collected under the Comprehensive Study of Riverine Inputs and Directive Discharges (RID) for Region I consists solely of data from Norwegian rivers as the time series data for Icelandic rivers is too short. The identification of statistically significant trends should be interpreted with great caution since, in most cases, the changes are due to reasons other than 'real' input changes to Arctic Waters over time. The following should be noted in particular:

- For cadmium, lead and mercury, no firm conclusions on long-term changes can be drawn. Possible 'visual downward trends' are not necessarily explained by 'real' changes in loads. This is due to many sample values at or below LoD level, and to considerable changes in LOD values over the monitoring period. Thus, results and interpretations should be regarded with appropriate caution and should solely be used as an indication of the magnitude in loads/inputs;
- The sudden shift in level of direct discharges of nitrogen in the year 2000 and the detected statistically significant upward trend is the result of Norway starting in this year to report on the N and P losses from aquaculture.

For Region I tributary rivers play a significant role in the estimation of riverine inputs from Norway to Arctic Waters. These tributary rivers tend to have a low sampling frequency (once per year for 1990 – 2003 and four times per year for the period 2004 – 2006).

- A substantial part of the Norwegian drainage area of 81 290 km^2 is not included in the monitoring results;
- Norwegian direct inputs of cadmium, lead and mercury to the Barents Sea were not taken account of as data from 2004 – 2006 were missing.

The contributions of waterborne inputs to the sum of RID data and EMEP deposition in Region I were, averaged over the total period, for total nitrogen: 10%, for lead: 3%, for cadmium: 9% and for mercury: 1%. Note that the RID data only contained information from Norway.

The total inputs from direct discharges and riverine inputs (RID) and the total EMEP modelled atmospheric deposition to Region I are presented below for nitrogen (Figure A10.1), lead (Figure A10.2), cadmium (Figure A10.3) and mercury (Figure A10.4).

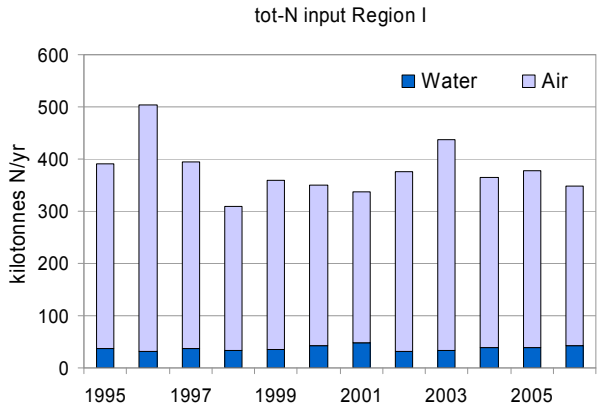

***Figure A10.1**: Total nitrogen inputs to Region I by direct discharges and riverine inputs (RID) and the total EMEP modelled atmospheric deposition (Note: RID data only for Norway).*

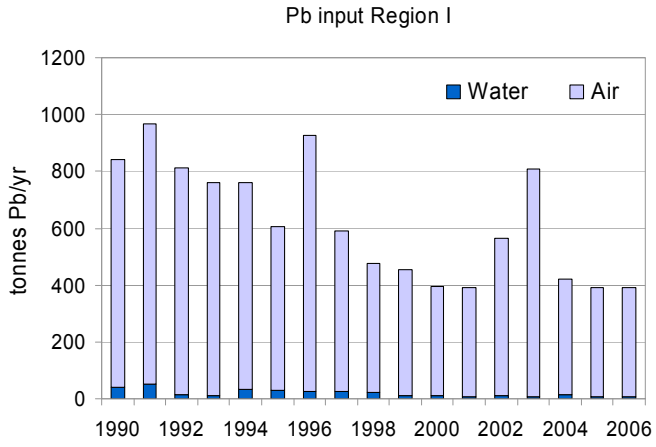

***Figure A10.2**: Total lead input to Region I by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition (Note: RID data only for Norway).*

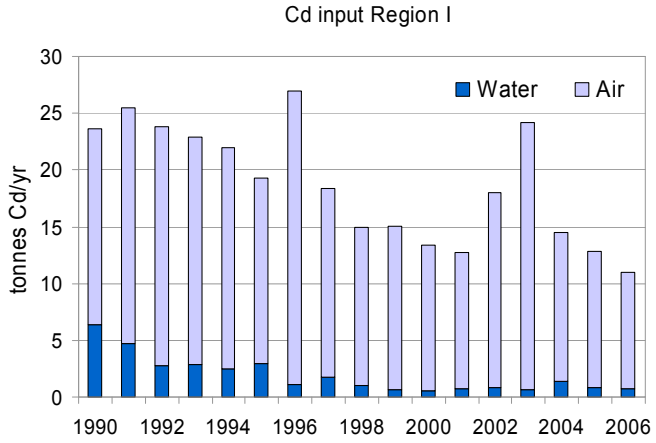

***Figure A10.3**: Total cadmium input to Region I by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition (Note: RID data only for Norway).*

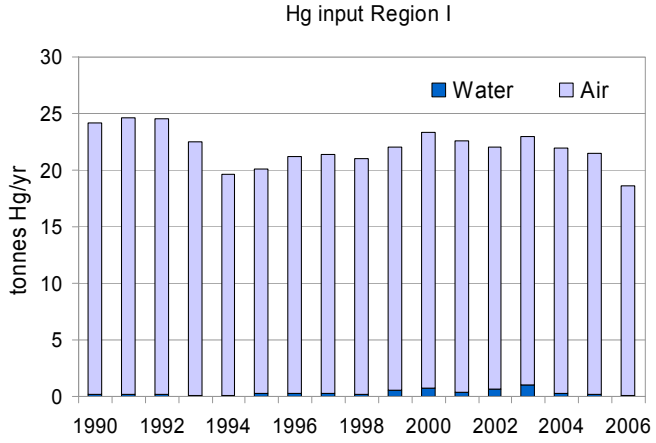

***Figure A10.4**: Total mercury input to Region I by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition.*

Region II

The following gaps in RID data should be noted

- There were no data on heavy metal inputs for Denmark. Since the late 1990s some heavy metals have been monitored in selected rivers and point sources. For rivers, most concentrations have been below the LoD and no total inputs to coastal waters have been estimated.
- There was no data from France on river inputs to the Channel except those for the river Seine.
- In Germany, data on metals were missing for the River Elbe for the period 1990 – 1991 (15% of the total drainage area).
- In the Netherlands, the monitoring system changed between the periods 1990 – 1992 and 1993 – 2006, notably for the number of rivers monitored and reported. In addition, in the Wadden Sea basin new sampling sites were introduced in 1997. Sewage and industrial effluents were reported again in 1995 after a gap in reporting for the period 1993 – 1994, and more data were available for 1995 than for the period 1990 – 1992.
- The direct discharges data from the Netherlands for the period 1990 – 1993 are incomplete. In 1994, no direct discharges from the Rhine area were reported, *i.e.* almost 20% of the total drainage area (Pijnenburg, personal communication).
- For many countries there has been a substantial change in LoD over the monitoring period 1990 – 2006 for cadmium, mercury and, to some extent, also for lead.
- In Sweden, riverine inputs of mercury in 1990 – 1994 were based on area-specific inputs from other monitored rivers; there was a change in chemical analytical method for cadmium and lead in 1995.

The contributions of waterborne inputs to the sum of RID data and EMEP deposition in Region II averaged over the total period were as follows. Total nitrogen: 69%; lead: 53%; cadmium: 65%; and mercury: 82%.

The total inputs from direct discharges and riverine inputs (RID) and the total EMEP modelled atmospheric deposition to Region II are presented below for nitrogen (Figure A10.5), lead (Figure A10.6), cadmium (Figure A10.7) and mercury (Figure A10.8).

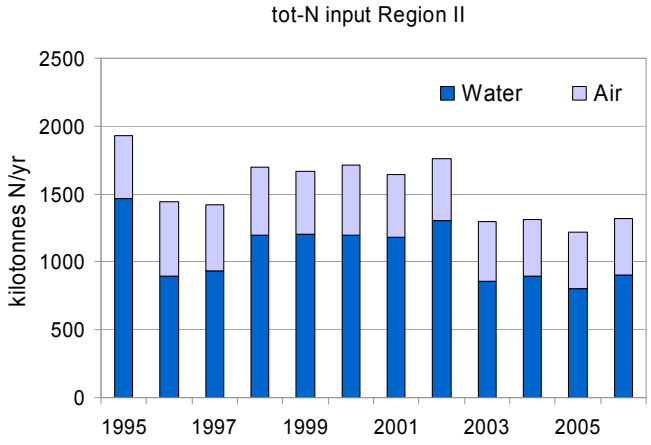

***Figure A10.5**: Total nitrogen load into Region II by direct discharges and riverine inputs (RID) and the total EMEP modelled atmospheric deposition. Units are in kt N/yr.*

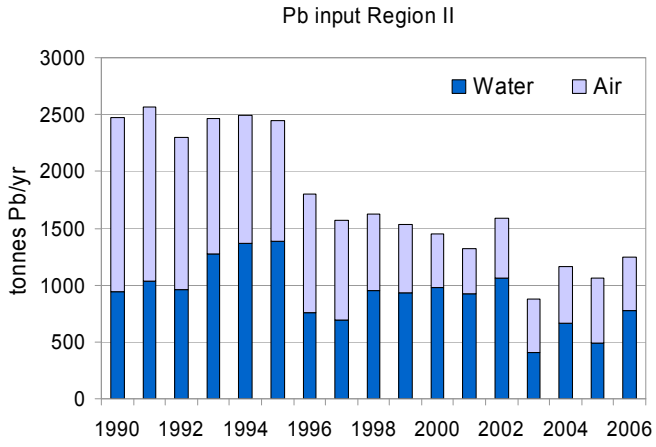

***Figure A10.6**: Total lead input to Region II by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition.*

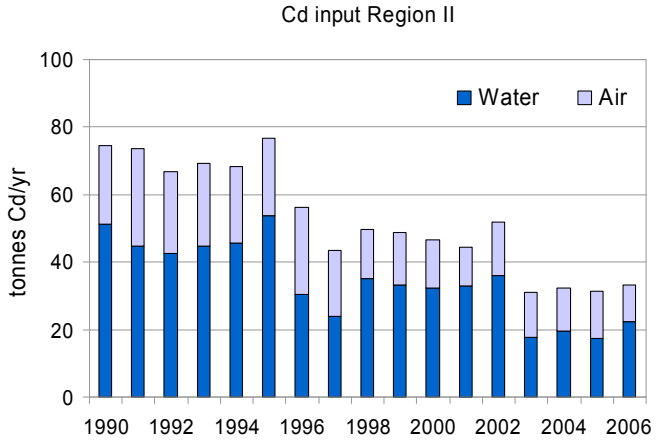

***Figure A10.7**: Total cadmium input to Region II by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition.*

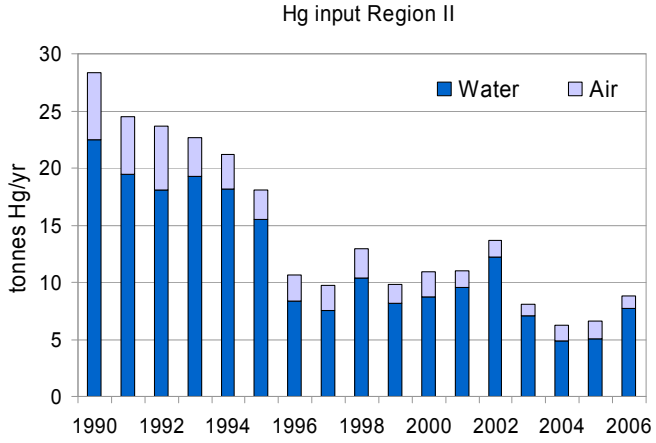

***Figure A10.8**: Total mercury inputs to Region II by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition.*

Region III

The RID inputs for Region III were based on data from rivers in Ireland and the UK. The identification of statistically significant trends should be interpreted with great caution since the changes were largely due to reasons other than 'real' input changes to the coastal areas. The following should be noted in particular:

- The direct discharges from Ireland reported in 1990 have been used for all the reporting years;
- No assessment of specific changes at river level can be made as the UK does not report on identified rivers but on 15 sampling regions in OSPAR Region III;
- For some of the Irish data, interpolations were necessary to allow for a consistent trend analysis (for example, Ireland lacked data for tot-N in the period 1997 – 2001);
- A change in the laboratory method for lead was made in Ireland.

The contributions of waterborne inputs to the sum of RID data and EMEP deposition in Region III averaged over the total period, were as follows. Total nitrogen: 68%; lead: 56; cadmium: 73%; and mercury: 61%.

The total inputs by direct discharges and riverine inputs (RID) and the total EMEP modelled atmospheric deposition to Region III are presented below for nitrogen (Figure A10.9), lead (Figure A10.10), cadmium (Figure A10.11) and mercury (Figure A10.12).

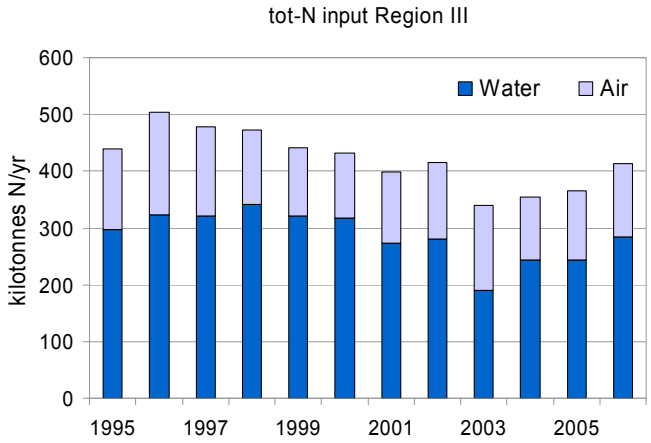

***Figure A10.9**: Total nitrogen inputs to Region III by direct discharges and riverine inputs (RID) and the total EMEP modelled atmospheric deposition.*

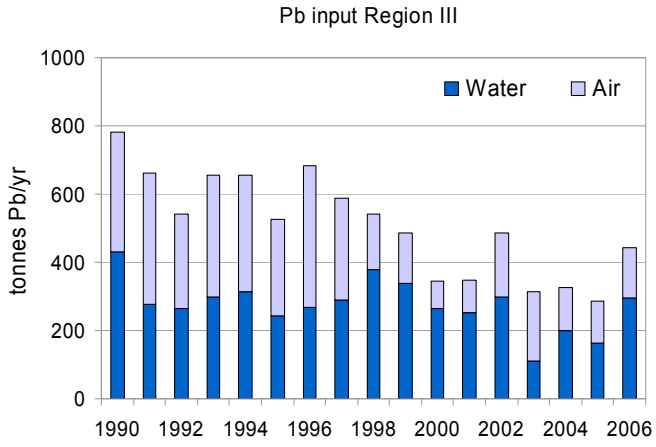

***Figure A10.10**: Total lead inputs to Region III by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition.*

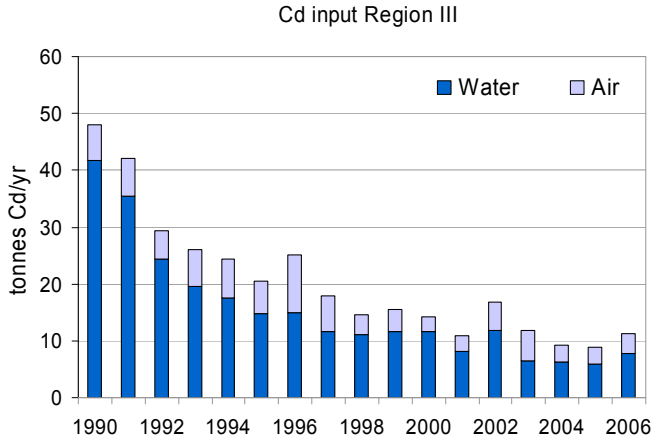

***Figure A10.11**: Total cadmium inputs to Region III by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition.*

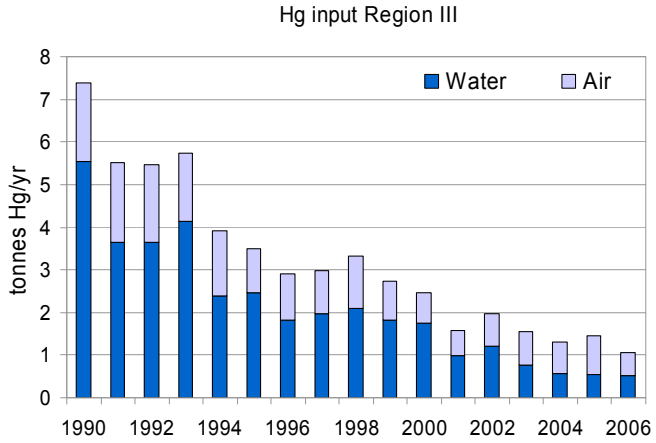

***Figure A10.12**: Total mercury inputs to Region III by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition.*

Region IV

For Region IV, RID input data and long-term trends have a higher degree of uncertainty in comparison to input data from OSPAR Regions I-III. The following should be noted in particular:

- Only the riverine inputs were considered as there was insufficient data on the direct discharges.
- The geographic coverage in the river basins was regarded as less than satisfactory as the reported values in some countries accounted for less than 40% of their area (for example, Portugal).
- The availability of data from France for riverine inputs of nitrogen and the heavy metals was too low to perform a suitable trend assessment.
- Four upstream tributaries of the River Tagus (Portugal) have been included in the reporting of the total riverine inputs, resulting in double counting; the reporting on these rivers varied between the years.
- Data for nutrients from Spain are only available from 1997 onwards, so no trend analysis covering the entire time period 1990 – 2006 could be undertaken. From 1999 – 2006 new rivers have gradually been added to the Spanish monitoring programme, but two rivers have also been excluded in 2005 and 2006 due to high natural background inputs of heavy metals.

The contributions of waterborne inputs to the sum of RID data and EMEP deposition in Region IV averaged over the total period were as follows. Total nitrogen: 30%; lead: 19%; and cadmium: 52%.

The total inputs by direct discharges and riverine inputs (RID) and the total EMEP modelled atmospheric deposition to Region III are presented below for nitrogen (Figure A10.13), lead (Figure A10.14) and cadmium (Figure A10.15).

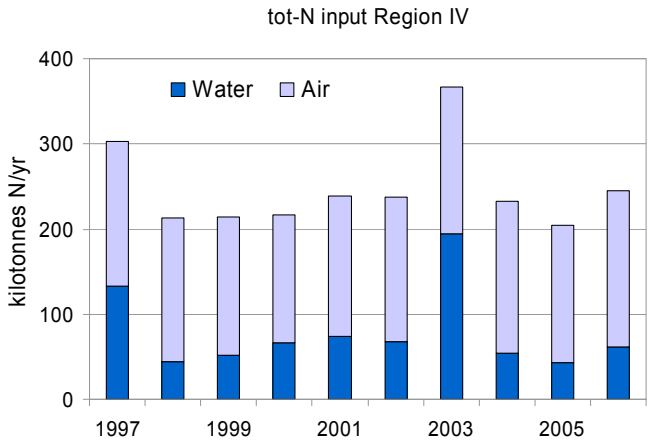

***Figure A10.13**: Total nitrogen inputs into Region IV by direct discharges and riverine inputs (RID) and the total EMEP modelled atmospheric deposition (Note: RID data for Spain and Portugal only).*

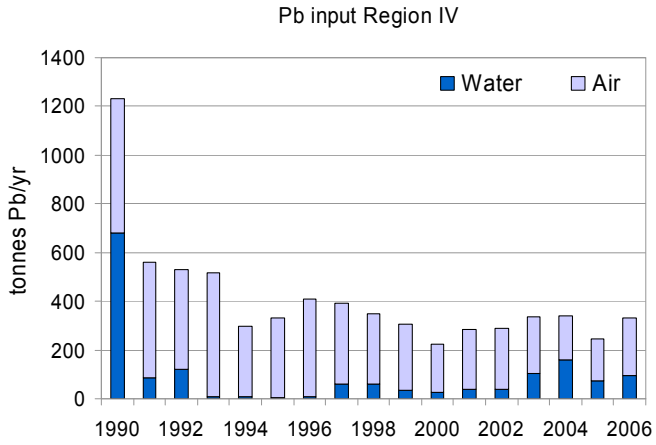

***Figure A10.14**: Total lead inputs to Region IV by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition (Note: RID data for Spain and Portugal only).*

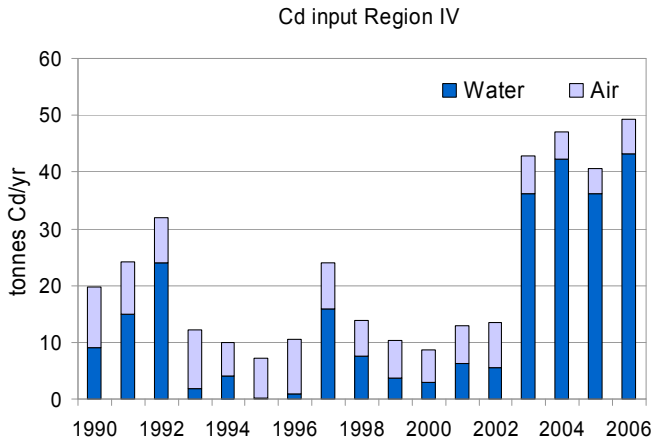

***Figure A10.15.** Total cadmium inputs to Region IV by direct discharges and riverine inputs (RID) and EMEP modelled atmospheric deposition (Note: RID data for Spain and Portugal only).*

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ISBN 978-1-906840-87-7
Publication Number: 447/2009

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