Observations for reducing air pollution:

EMEP – Quo Vadis?

- History/introduction
- Current policy drivers
- Monitoring strategy
  - Supersites (+ campaigns)

Kjetil Tørseth,
NILU/EMEP-CCC

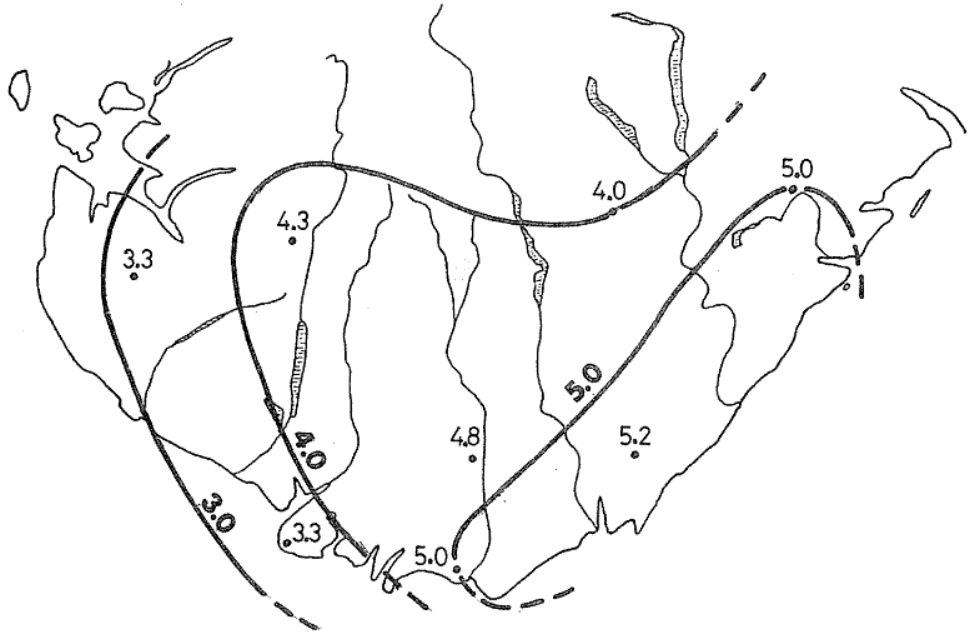
emep

Convention on Long-range Transboundary Air Pollution

emep Co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe

Concept of LRTAP established in the 1970ies:

Observations of precipitation chemistry -> data assessment revealed increasing acidity -> hypotesis of fresh water acidification and fish kills -> international attention -> OECD-project LRTAP (1972-1977) -> emission inventories + atmospheric chemistry tranport models -> scientific consensus -> CLRTAP + EMEP (1979)



Figur 4: Nedfall av sulfat hele 1972 (g/m²)
Precipitated sulphate 1972.

http://www.unece.org/env/lrtap/welcome.html

Protocols

Protocols to the Convention

The Convention has been extended by eight protocols:

The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 25 Parties. Entered into force on 17 May 2005. (Guidance documents to Protocol adopted by decision 1999/1, Revised guidance document on ammonia).

The 1998 Protocol on Persistent Organic Pollutants (POPs); 31 Parties. Entered into force on 23 October 2003.

The 1998 Protocol on Heavy Metals; 31 Parties. Entered into force on 29 December 2003.

The 1994 Protocol on Further Reduction of Sulphur Emissions; 29 Parties. Entered into force 5 August 1998.

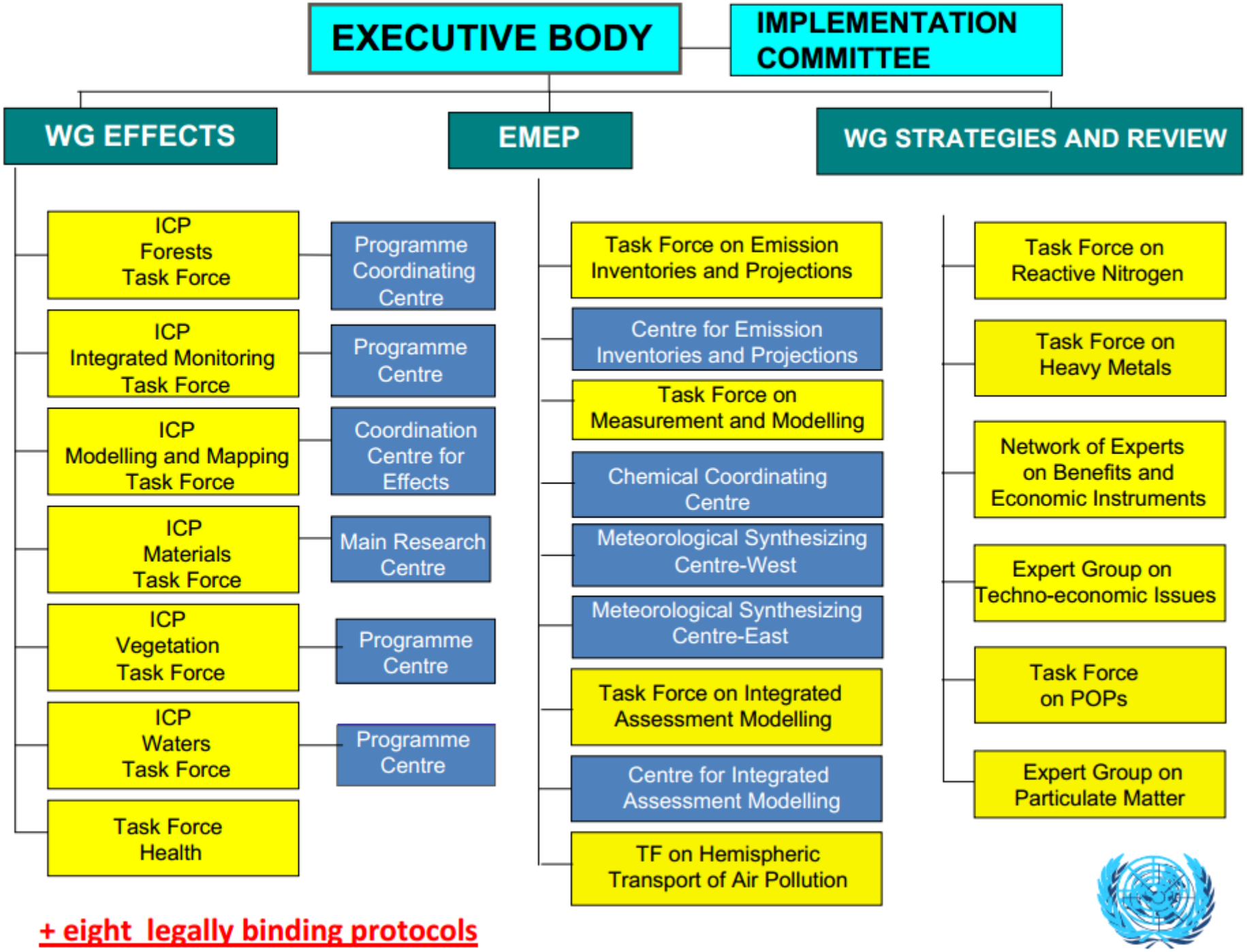
The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes; 24 Parties. Entered into force 29 September 1997.

The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes; 34 Parties. Entered into force 14 February 1991.

The 1985 Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent; 25 Parties. Entered into force 2 September 1987.

The 1984 Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP); 44 Parties. Entered into force 28 January 1988.

Status of ratification of the Convention and its Protocol


EXECUTIVE BODY
IMPLEMENTATION COMMITTEE
WG EFFECTS
EMEP
WG STRATEGIES AND REVIEW
ICP Forests Task Force
Programme Coordinating Centre
ICP Integrated Monitoring Task Force
Programme Centre
ICP Modelling and Mapping Task Force
Coordination Centre for Effects
ICP Materials Task Force
Main Research Centre
ICP Vegetation Task Force
Programme Centre
ICP Waters Task Force
Programme Centre
Task Force Health
Task Force on Emission Inventories and Projections
Centre for Emission Inventories and Projections
Task Force on Measurement and Modelling
Chemical Coordinating Centre
Meteorological Synthesizing Centre-West
Meteorological Synthesizing Centre-East
Task Force on Integrated Assessment Modelling
Centre for Integrated Assessment Modelling
TF on Hemispheric Transport of Air Pollution
Task Force on Reactive Nitrogen
Task Force on Heavy Metals
Network of Experts on Benefits and Economic Instruments
Expert Group on Techno-economic Issues
Task Force on POPs
Expert Group on Particulate Matter
+ eight legally binding protocols

Tasks of the EMEP Chemical Coordinating Centre

- **Develop and coordinate the observation activities required to assess air pollution across the EMEP geographical domain**
- **Secure and improve quality and representativeness of observations**
- **Quality assurance and quality control of data submitted by Parties**
- **Archival and dissemination of observation data and associated meta-data**.
- **Assessment of data and provide information to stakeholders about results from monitoring activities**
- **Serve the interest of EMEP monitoring activities with respect to relevant activities under other frameworks to ensure harmonization, efficient use of resources and multiple usage of data.**

Particulate matter/aerosols, Oxidants and precursors, Eutrophication, Acidification, Heavy metals, Persistent Organic Pollutants, Short-lived climate pollutants, tracers, (greenhouse gases)

Atmos. Chem. Phys., 12, 5447–5481, 2012
www.atmos-chem-phys.net/12/5447/2012/
doi:10.5194/acp-12-5447-2012

Atmospheric Chemistry and Physics

Introduction to the European Monitoring and Evaluation Programme (EMEP) and observed atmospheric composition change during 1972–2009

K. Tørseth, W. Aas, K. Breivik, A. M. Fjæraa, M. Fiebig, A. G. Hjellbrekke, C. Lund Myhre, S. Solberg, and K. E. Yttri

NILU – Norwegian Institute for Air Research, P.O. Box 100, 2027 Kjeller, Norway

http://www.atmos-chem-phys.net/12/5447/2012/acp-12-5447-2012.html

emep

Convention on Long-range Transboundary Air Pollution

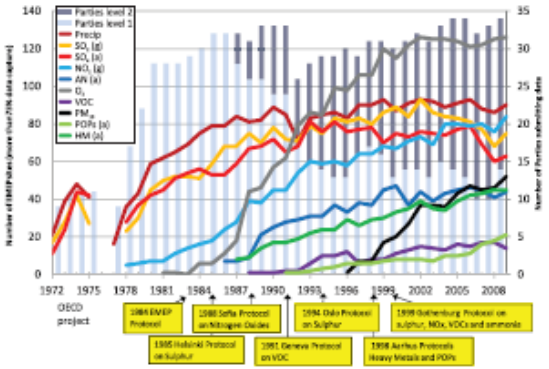
emep Co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe

Observed atmospheric composition change during 1972-2009

www.emep.int

The main objective of the European Monitoring and Evaluation Programme (EMEP) is to provide governments with information on the deposition and concentration of air pollutants, as well as the quantity and significance of the long-range transmission of air pollutants across boundaries.

A network of stations undertakes observations of chemical and physical variables linked to damage to human health and the environment, in particular acidification, eutrophication, photochemical oxidants, heavy metals, persistent organic pollutants and particulate matter. The information provided by EMEP is also fundamental for improving the knowledge of climate change and to assess rural and urban air quality. Supplemented with emission inventories, modelling of atmospheric chemistry and deposition, and integrated assessment modelling, the work of EMEP form the basis for legally binding emission reduction protocols under the UNECE Convention on Long-range Transboundary Air Pollution (*www.unece.org/env/lrtap*).



Development of the measurement programme. Bars represent the number of parties/countries submitting data according to the level-1 and level-2 monitoring requirements, respectively. Lines indicate the number of sites for which measurements of the various variables have been measured (g) = gaseous, (a) = aerosol, AN = NH_3+NH_4^+ and/or HNO_3+NO_3^-.

The Birkenes Observatory is located in southern Norway.

History

European harmonized monitoring of atmospheric composition was initiated in the early 1970s, when a project had been funded by the Organisation for Economic Co-operation and Development (OECD) to study long range transport of air pollutants. Political consensus was reached on the need for an international coordinated action and this subsequently led to the establishment of the Convention on Long Range Transboundary Air Pollution (CLRTAP) in 1979. The network of monitoring sites established for the OECD project was later continued under the European Monitoring and Evaluation Programme (EMEP), and the program was extended to include a wide range of substances which are subject to atmospheric transport across national boundaries.

Since the measurements need to be made in a comparable way at all sites and consistent in time to allow the assessment of temporal and spatial trends, the Chemical Coordinating Centre EMEP (EMEP-CCC) was established in 1977 to harmonize these efforts. The measurements are widely used by the scientific community, and have served as a basis for an extensive number of scientific studies during nearly 40 years.

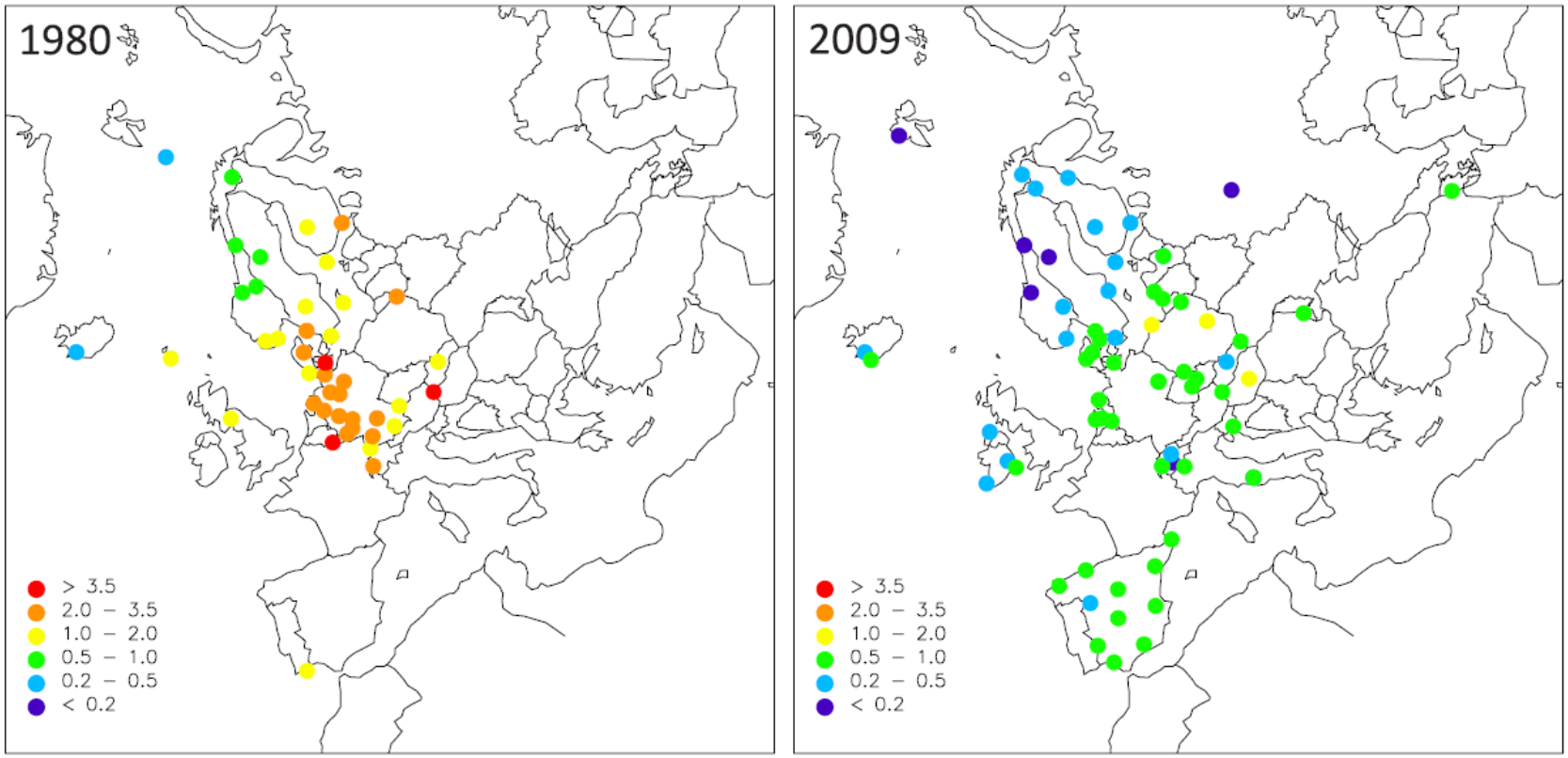
http://www.nilu.no/projects/ccc/emep_monitoring/EMEP-booklet_final.pdf

Sulphur

• Results from the EMEP monitoring show 70-90% reductions in ambient concentrations and deposition of sulphur species since 1980.

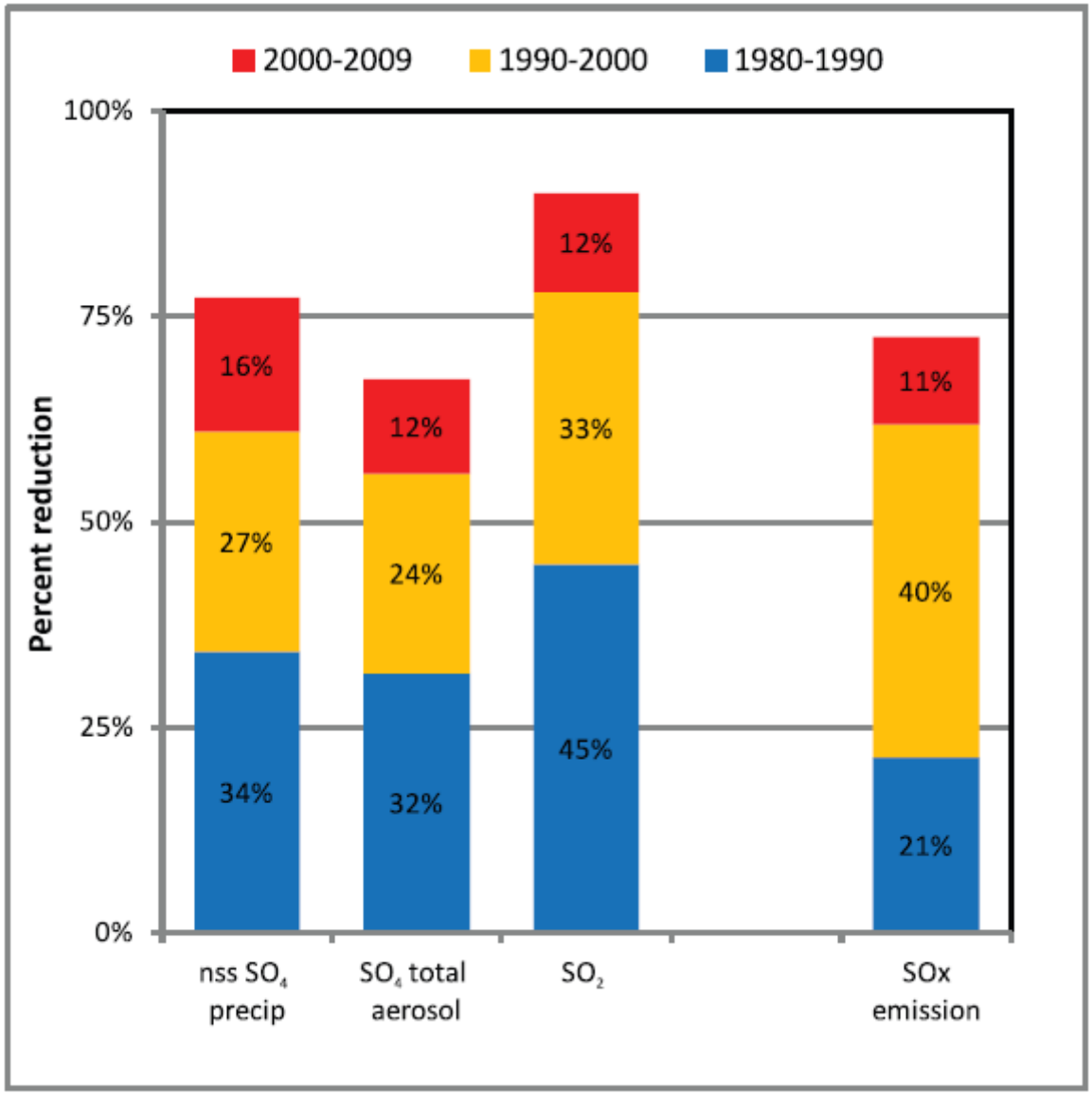
• As a result of the large reductions in sulphur concentrations, the acidity of precipitation has decreased across Europe.

• Despite these significant reductions, sulphate still remains one of the single most important compounds contributing to regional scale aerosol mass concentration.



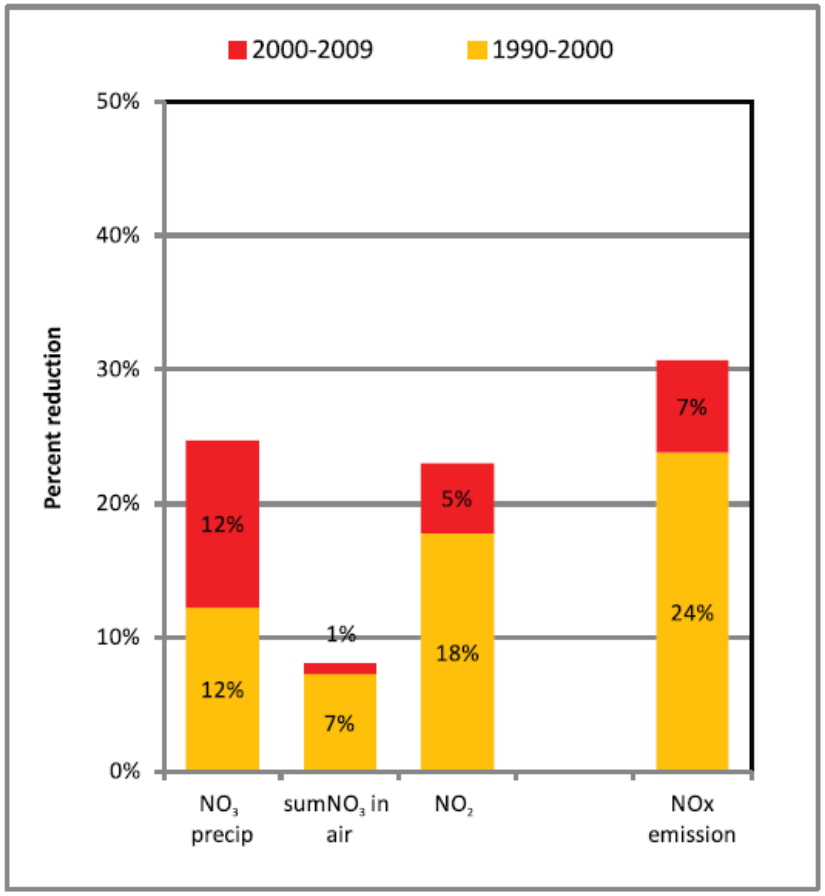
Annual mean concentrations of SO_4^{2-} in aerosols in 1980 and 2009. Unit: µg S m^{-3}.

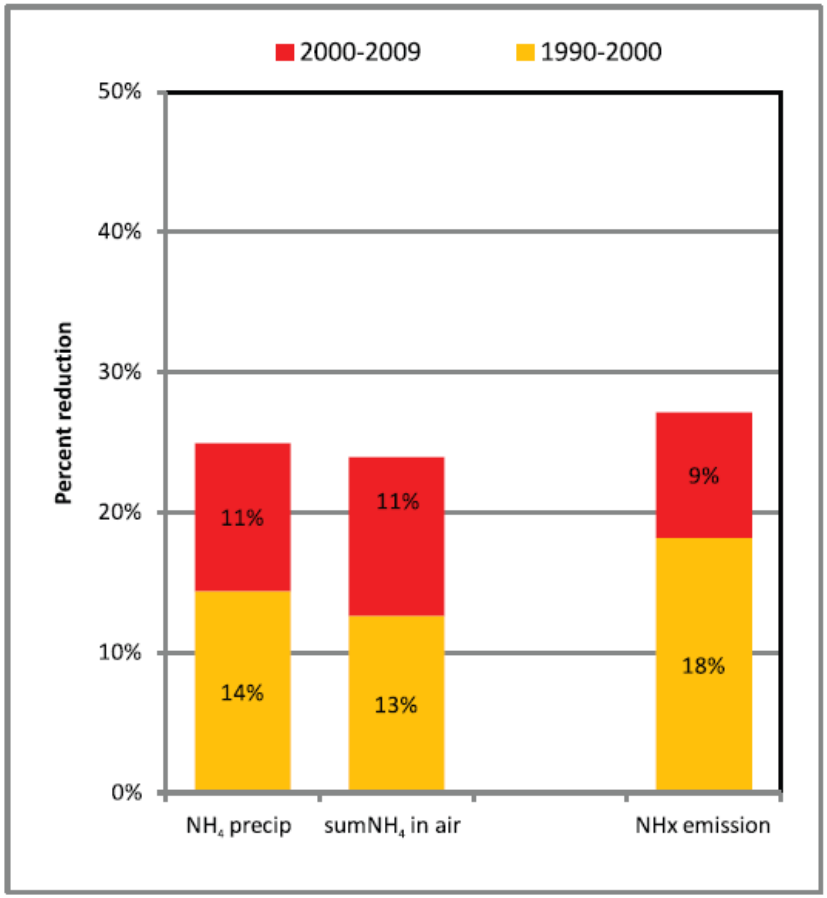
Observed sulphur trends at EMEP sites and emissions reductions



Nitrogen

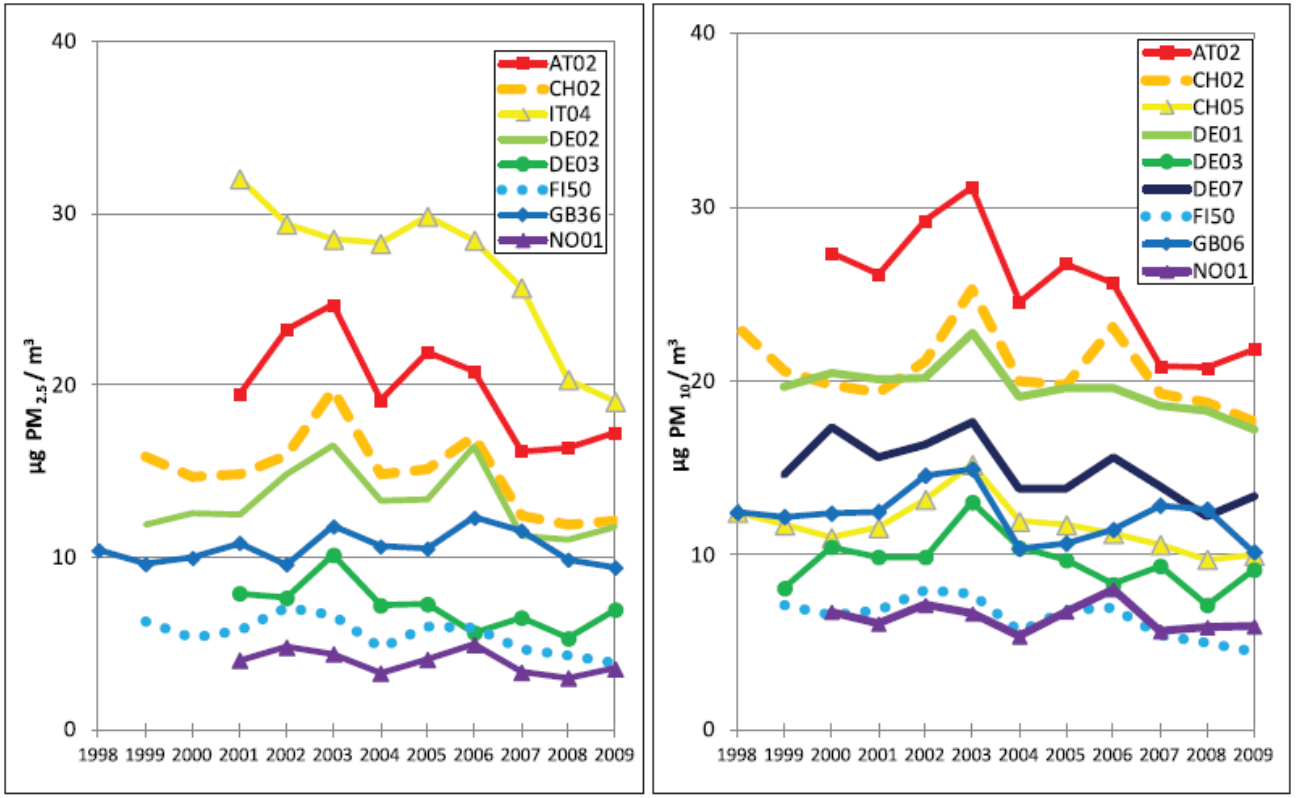
Also reduction in emissions of nitrogen oxides (NO_X) are reflected in the measurements, with an average decrease of nitrogen dioxide in air and nitrate in precipitation by about 23% and 25% respectively since 1990. Only minor reductions are however seen since the late 1990s. The concentration of total nitrate in air have decreased on average only by 8% since 1990, and few sites show a significant trend. A majority of the EMEP sites show a decreasing trend in reduced nitrogen both in air and precipitation on the order of 25% since 1990.





Particulate matter

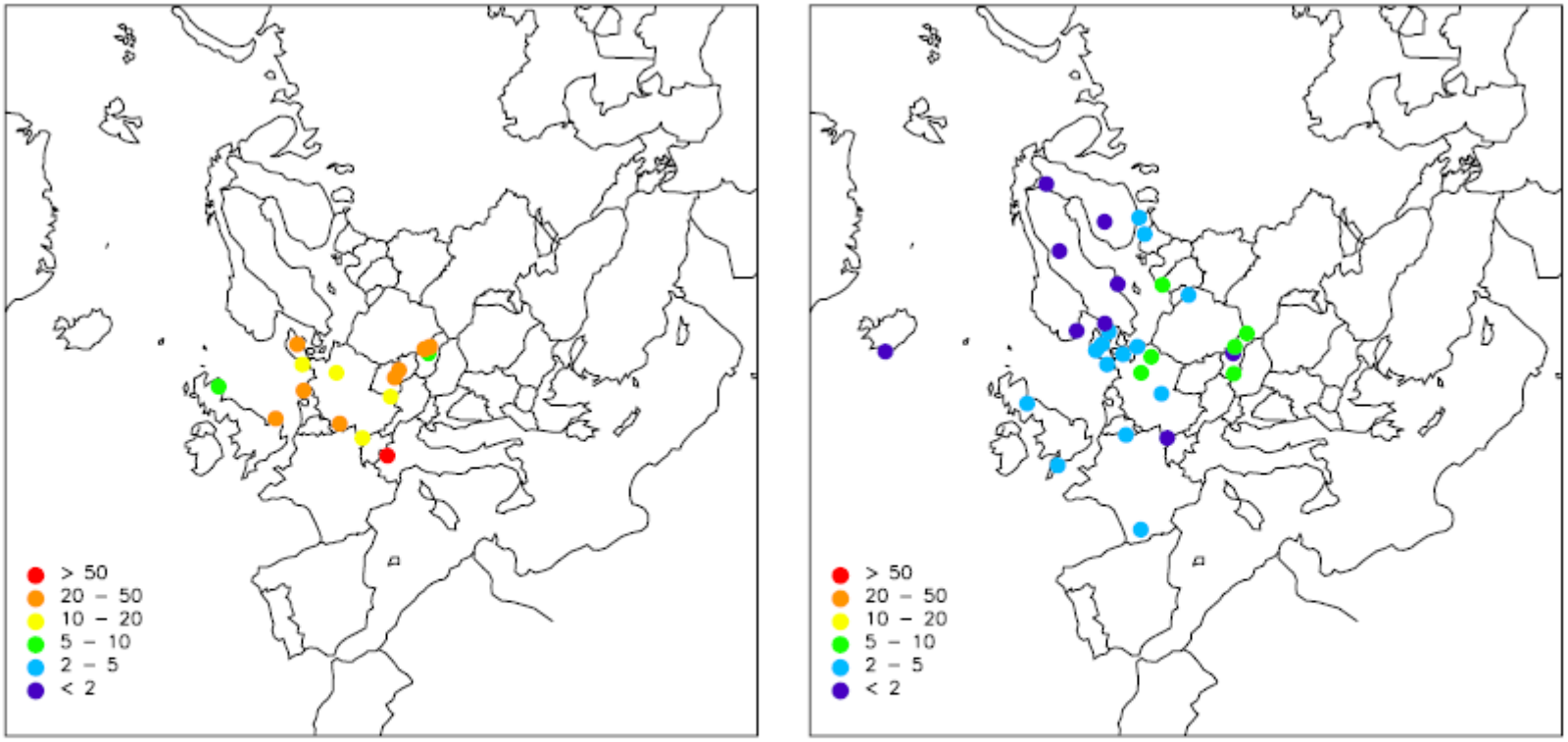
Measurements of particulate matter mass concentrations are generally only available after the year 2000. Large inter annual variations in the particulate matter (PM) mass concentrations reflect meteorological variability, but still there is a relatively clear overall decrease at several sites during the last decade. Based on observed chemical composition data extending back to the 1970s, results indicate an overall reduction of about 5 µg m^{-3} from sulphate alone.



Time series of $PM_{2.5}$ (left) and PM_{10} (right) at selected EMEP sites.

Heavy metals

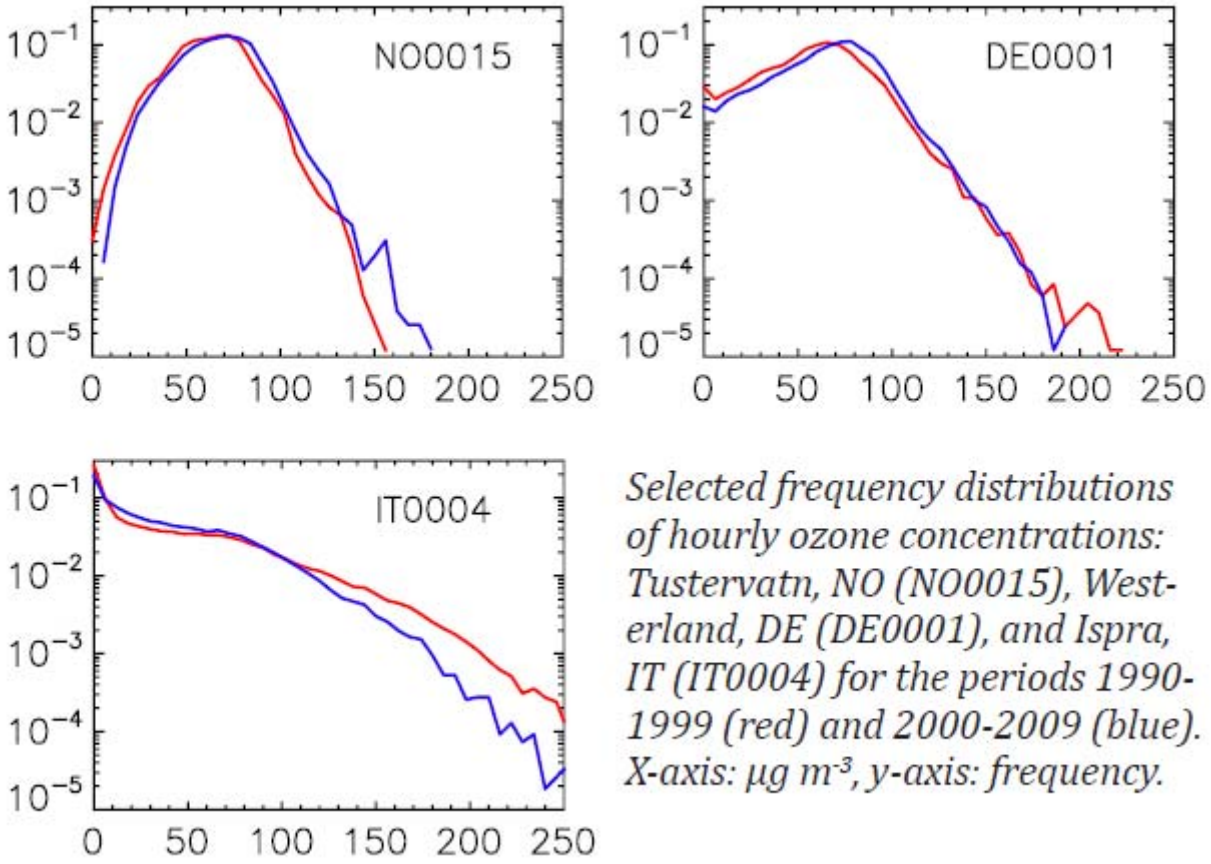
The reductions in heavy metal emissions within Europe have been extensive, and the observation data clearly reflect these changes. Concentrations of lead (Pb) and cadmium (Cd) have decreased in both air and precipitation during the last 20 years, with reductions in the order of 80-90 % for Pb and 64-84% for Cd (precipitation and air, respectively). The measurements of total gaseous mercury indicate a dramatic decrease in concentrations during 1980 to about 1993.



Average concentrations of Pb in aerosols in 1990 and 2009 (unit ng Pb m^{-3}).

Tropospheric ozone

Long-term ozone trends at EMEP sites show a mixed pattern. The year-to-year variability in ozone due to varying meteorological conditions is substantial, making it hard to separate the trends caused by emission change from other effects. Several sites show no significant trends. For the Nordic countries the data indicate a reduced occurrence of very low concentrations. The most pronounced change in the frequency distribution is seen at sites in the UK and the Netherlands, showing a reduction in the higher values.



Selected frequency distributions of hourly ozone concentrations: Tustervatn, NO (NO0015), Westerland, DE (DE0001), and Ispra, IT (IT0004) for the periods 1990-1999 (red) and 2000-2009 (blue). X-axis: µg m^{-3}, y-axis: frequency.

Relevance of EMEP observations in years to come

1.The monitoring activities originally developed to address acid rain have evolved to comprise a comprehensive and broad program relevant for assessing air pollution impacts on ecosystems, human health, materials and climate.

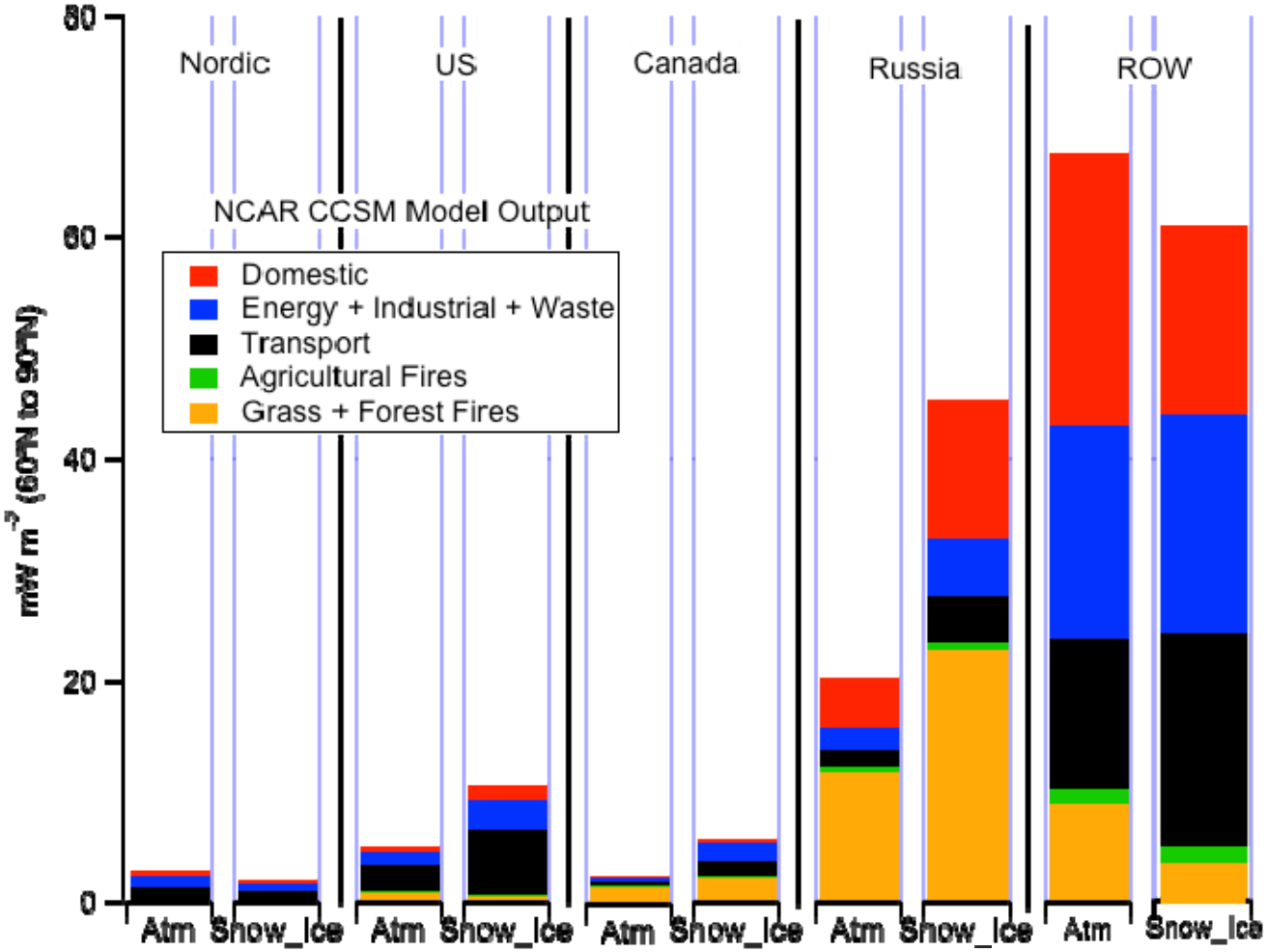
2.Of particular importance are EMEPs activities on **aerosols** and **ozone (including ozone precursors)** which are of growing interest due to their importance as **short-lived climate forcers**. **Inorganic substances and carbonaceous aerosols** (organic carbon and elemental/black carbon) lead to scattering and absorption of radiation, and affect climate indirectly through increased cloud formation and extended life time of clouds.

3.Particulate matter and surface ozone are also causing adverse air quality across Europe.

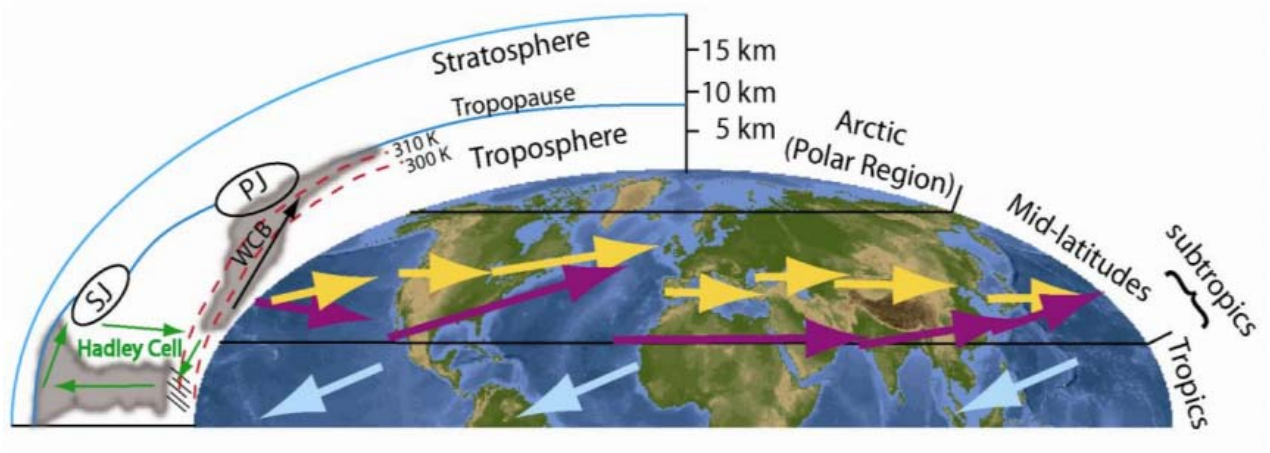
4.Nitrogen remains a major challenge, and the links between the nitrogen and carbon cycles call for a continued effort in monitoring the exchange between the atmosphere and ecosystems.

5.Mercury and POPs are addressed also by other global conventions but the monitoring program of EMEP is of key importance for the collection of comparable monitoring data within Europe as well as globally.

Absolute Level of Impact: Forcing due to BC + OC Mixture by Source Sector and Region within the Arctic Council Nations and ROW



Report of the AMAP Expert Group on Short-Lived Climate Forcers



The Task Force on Hemispheric Transport of Air Pollution (TF HTAP) is an international scientific cooperative effort to improve the understanding of the intercontinental transport of air pollution across the Northern Hemisphere. TF HTAP was organized in 2005 under the auspices of the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP Convention) and reports to the Convention's EMEP Steering Body. However, participation is open to all interested experts, both inside and outside the UNECE region.

TF HTAP organizes scientific cooperation in the areas of emissions inventories and projections, analysis of ambient monitoring and remote sensing, global and regional modeling, and impact assessment to understand the intercontinental flows of ozone and its precursors, fine particles and their components, mercury, and persistent organic pollutants (POPs). The main questions of interest to the TF HTAP relate to the benefits of international cooperation to decrease air pollution emissions:

- How do air pollution concentrations (or deposition) in one region of the world change as emissions change in other regions or the world?
- How do changes in emissions outside a region affect the health, ecosystem, and climate impacts of air pollution within a given region?
- How does the feasibility of further emissions control differ in different regions of the world?

In 2010, TF HTAP produced the first comprehensive assessment of the intercontinental transport of air pollution in the Northern Hemisphere. In 2012, TF HTAP launched a new phase of cooperative experiments and analysis that is intended to inform the LRTAP Convention and other multi-lateral cooperative efforts, as well as national actions to decrease air pollution and its impacts.

Table 3.2. The Relative Annual Intercontinental Response (RAIR) of pollutants to 20% emission decreases in four regions approximating North America, Europe, South Asia, and East Asia. The RAIR is the sum of the changes in the annual, regionally-averaged concentration within a region due to a 20% decrease in emissions in the three other regions divided by the sum of the changes in concentration within a region due to a 20% decrease in emissions in all four regions. Thus, the RAIR is a measure of how much benefit a region may receive from emission reductions in other regions when emission reductions are coordinated on an intercontinental scale.

		Receptor Region			
Scenario	**Pollutant/Parameter[a]**	**North America**	**Europe**	**South Asia**	**East Asia**
2001	O_3 Concentration	32%	43%	32%	40%
2001	O_3 Total Column Burden	39%	62%	38%	60%
2001	PM Concentration[b]	7%	5%	20%	9%
2001	SO_4 Deposition	8%	9%	24%	12%
2001	Black Carbon Deposition	4%	1%	12%	3%
2001	Reactive Nitrogen Deposition	3%	4%	13%	7%
2001	Aerosol Optical Depth[c]	17%	13%	25%	17%
2001	SO_4 Total Column Burden	25%	25%	37%	24%
2001	Hg Deposition	61%	35%	43%	10%
2001	α-HCH Deposition	82%	9%	6%	63%
2001	PCB-28 Deposition	9%	3%	48%	56%
2001	PCB-153 Deposition	11%	2%	32%	50%
2001	PCB-180 Deposition	11%	4%	36%	56%

”HTAP database”, surface observations

The importance of Supersites: EMEP + GAW joint supersites

- Concept developed through EMEP+GAW meetings, Eurotrac (2), ACCENT…

- EMEP Task Force on Measurements and Modeling
- GAW Scientific Advisory Groups (Aerosols, Reactive Gases, Greenhouse gases, precipitiation …
- Individual institutions and research groups wanting to do measurements

- Research Infrastructures
  - National funding opportunities
  - EU Infrastructures

- CREATE, EUSAAR, EARLINET, ACTRIS, InGOS…

ACTRIS
Aerosols, Clouds, and Trace gases Research Infrastructure Network

Type of funding scheme: Combination of Collaborative Projects and Coordination and Support Actions for Integrating Activities

Work programme topics addressed: FP7-INFRASTRUCTURES-2010-1

Support to existing research infrastructures

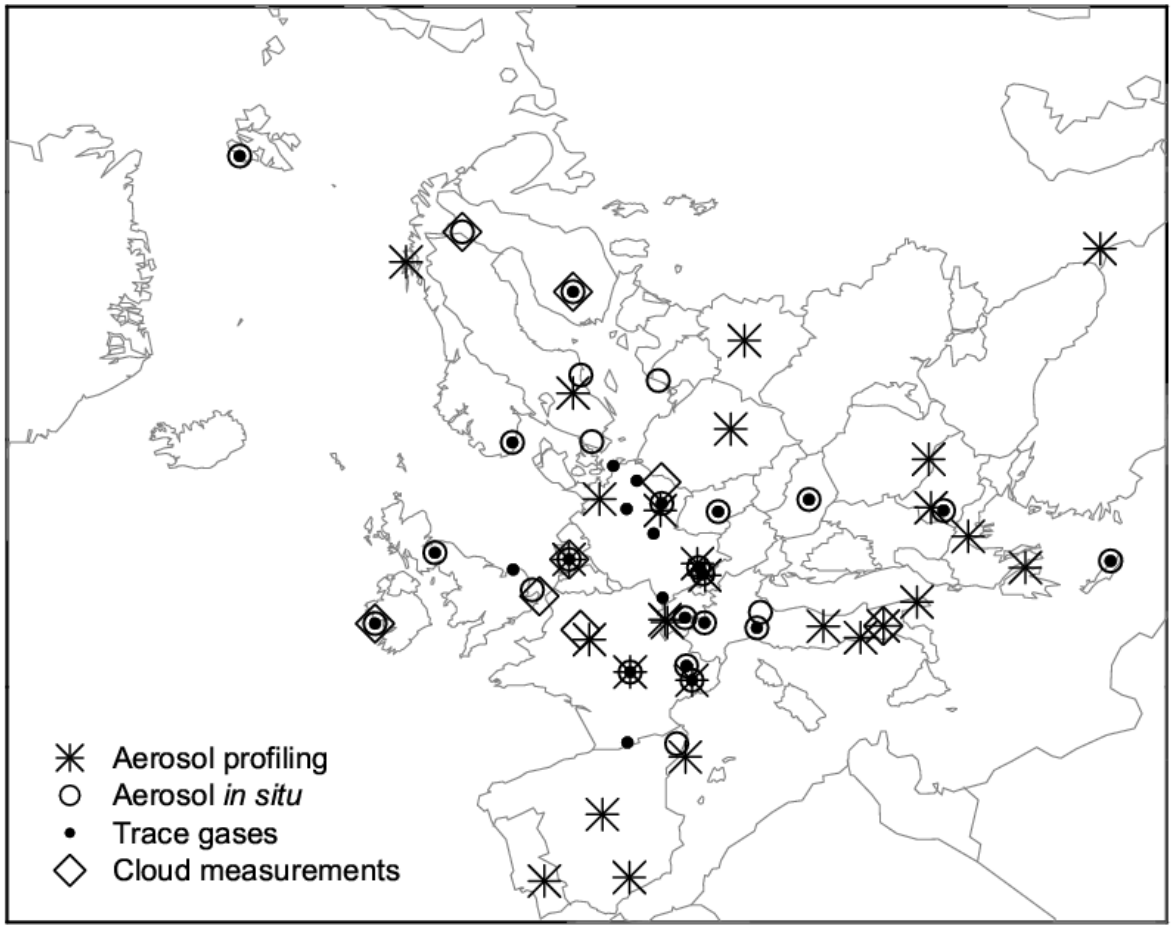
Integrating Activities

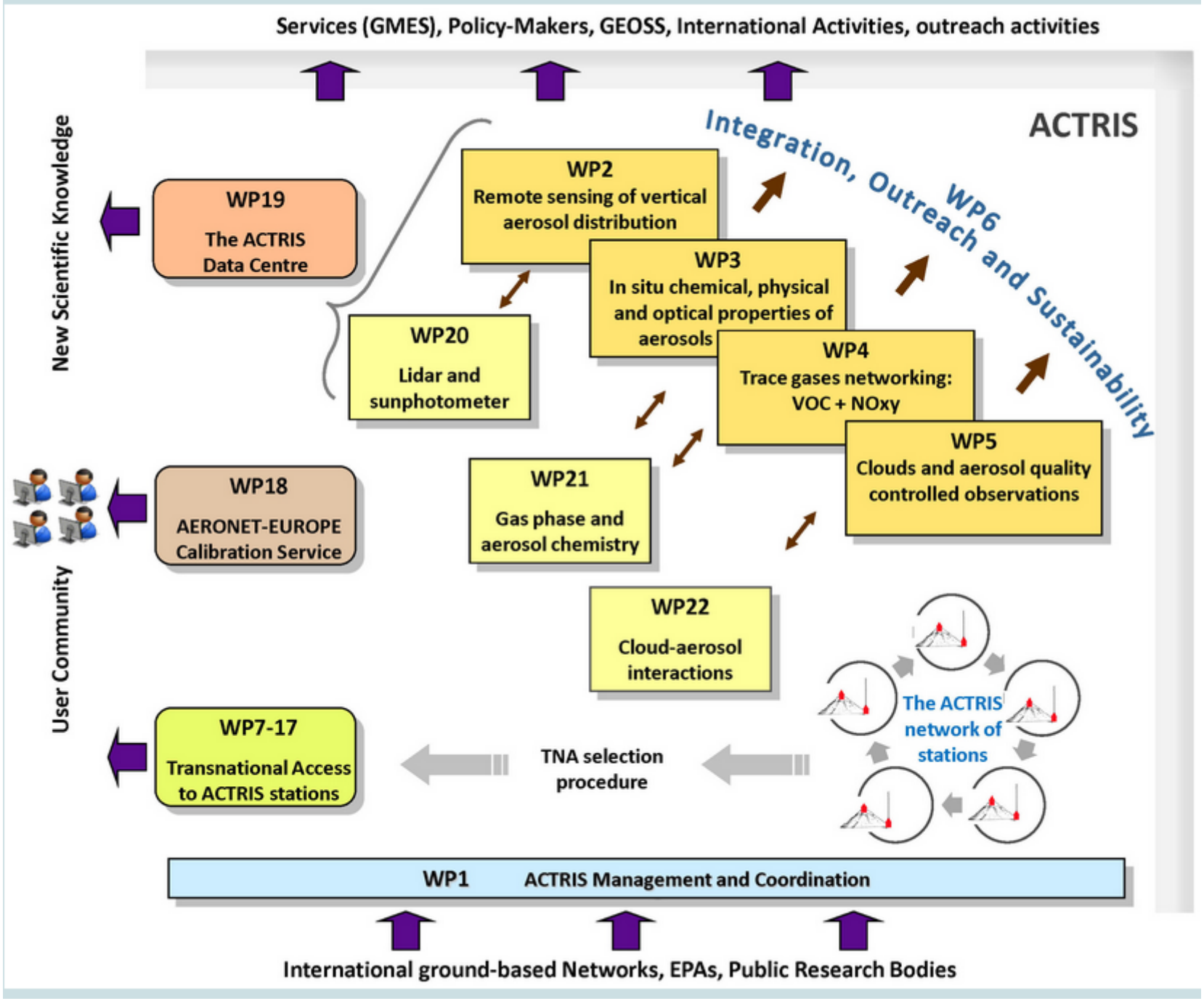
INFRA-2010-1-1.1.16: Research Infrastructures for Atmospheric Research

Integrating the key ground-based facilities for long-term observation of aerosols, cloud-aerosol interactions, and trace gases in Europe

IGACO-GMES
workshop, WMO,
Geneva, 18-19
December 2007

Map of measurement sites contributing to ACTRIS

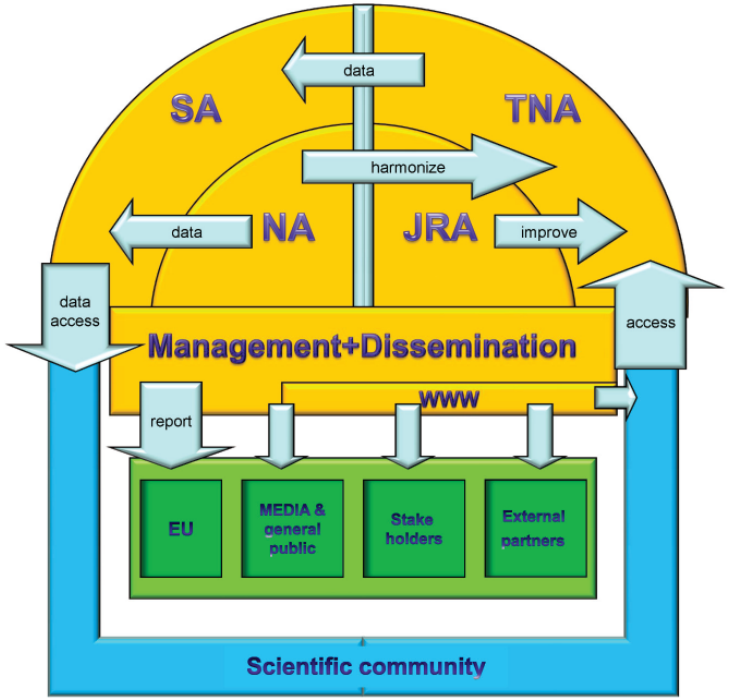


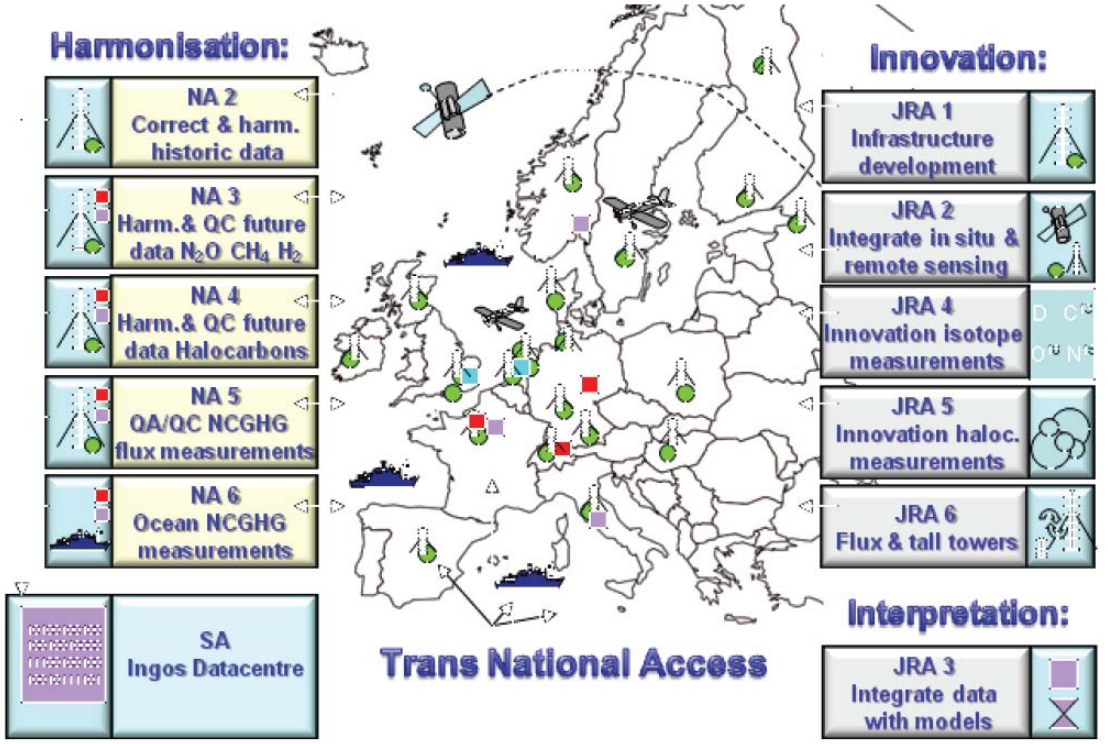

Services (GMES), Policy-Makers, GEOSS, International Activities, outreach activities
ACTRIS
Integration, Outreach and Sustainability
WP6
New Scientific Knowledge
WP19
The ACTRIS Data Centre
WP2
Remote sensing of vertical aerosol distribution
WP3
In situ chemical, physical and optical properties of aerosols
WP4
Trace gases networking: VOC + NOxy
WP5
Clouds and aerosol quality controlled observations
WP20
Lidar and sunphotometer
WP21
Gas phase and aerosol chemistry
WP22
Cloud-aerosol interactions
User Community
WP18
AERONET-EUROPE Calibration Service
WP7-17
Transnational Access to ACTRIS stations
TNA selection procedure
The ACTRIS network of stations
WP1 ACTRIS Management and Coordination
International ground-based Networks, EPAs, Public Research Bodies

Integrated non-CO_2 Greenhouse gas Observing System

Work programme topics addressed: INFRA-2011-1.1.11: Integrated non-CO_2 greenhouse gas Observing System; Integrating the key ground-based facilities for long-term observation of methane, nitrous oxide, SF_6, isotopes and halocarbons.

Name of the coordinating person: Alex Vermeulen





integrated carbon observation system

A European infrastructure dedicated to high precision monitoring of greenhouse gas fluxes

Home → Stations

RAMCES

UVSQ cea Institut Pierre Simon Laplace LSCE cnrs INSU

IMECC GEOmon ICOS Wiki ICOS Wiki RAMCES

Hot links

Main Menu

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- » Contact
- » Links

NRT

- » CO2 - 24H
- » CO2 - 15 days
- » CH4 - 15 days
- » Rn222 - 15 days

NRT stations

Click a station thumbnail to view data.


Trainou [TRN]


Biscarosse [BIS]


Hanle [HLE]


Puy-de-Dôme [PUY]


Hegyhatsal [HUN]


Ivittuut [IVI]


Lampedusa [LMP]


Lutjewad [LUT]


Cabauw [CBW]


Bialystok [BIK]


Egham [EGH]


Pallas [PAL]


Kasprowy Wierch [KAS]


Angus [TTA]


Ochsenkopf [OXK]


Gif-sur-Yvette [GIF]


Mace Head [MHD]


La Muela [LMU]


Lamto [LTO]


Guyaflux [GUY]


Ispra [ISP]


Jungfraujoch [JFJ]


Ascension [ASC]

Search

search...

Random Sites

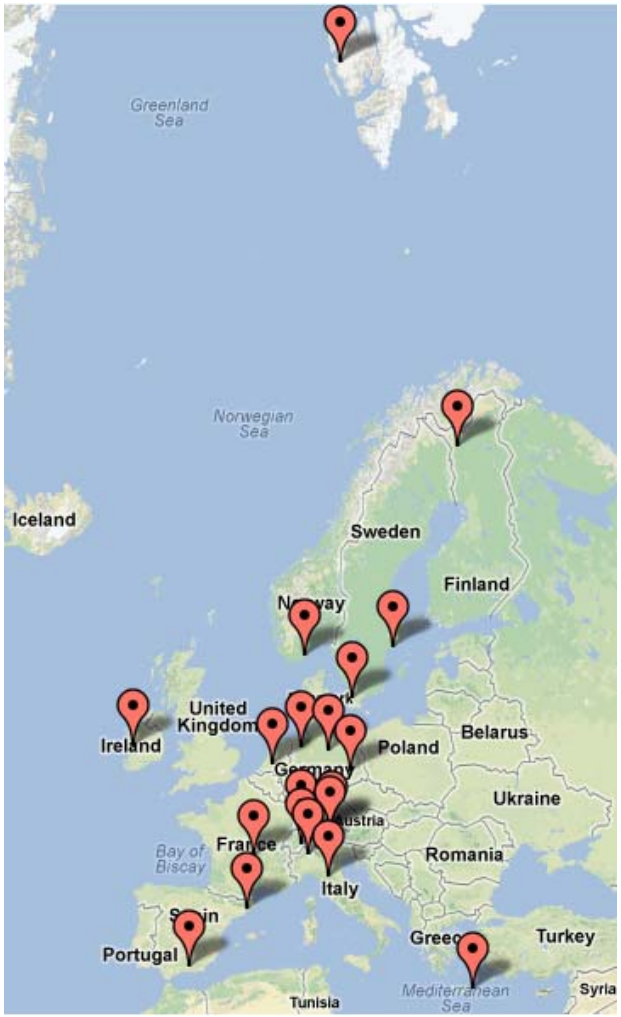
Near-real time

GAW-WDCA, NOAA, EMEP, EUSAAR, ACTRIS,

Aerosol _absorption_coefficient

Aerosol _extinction_coefficient

Aerosol _light_backscatter_coefficient



Aerosol _light_scattering_coefficient

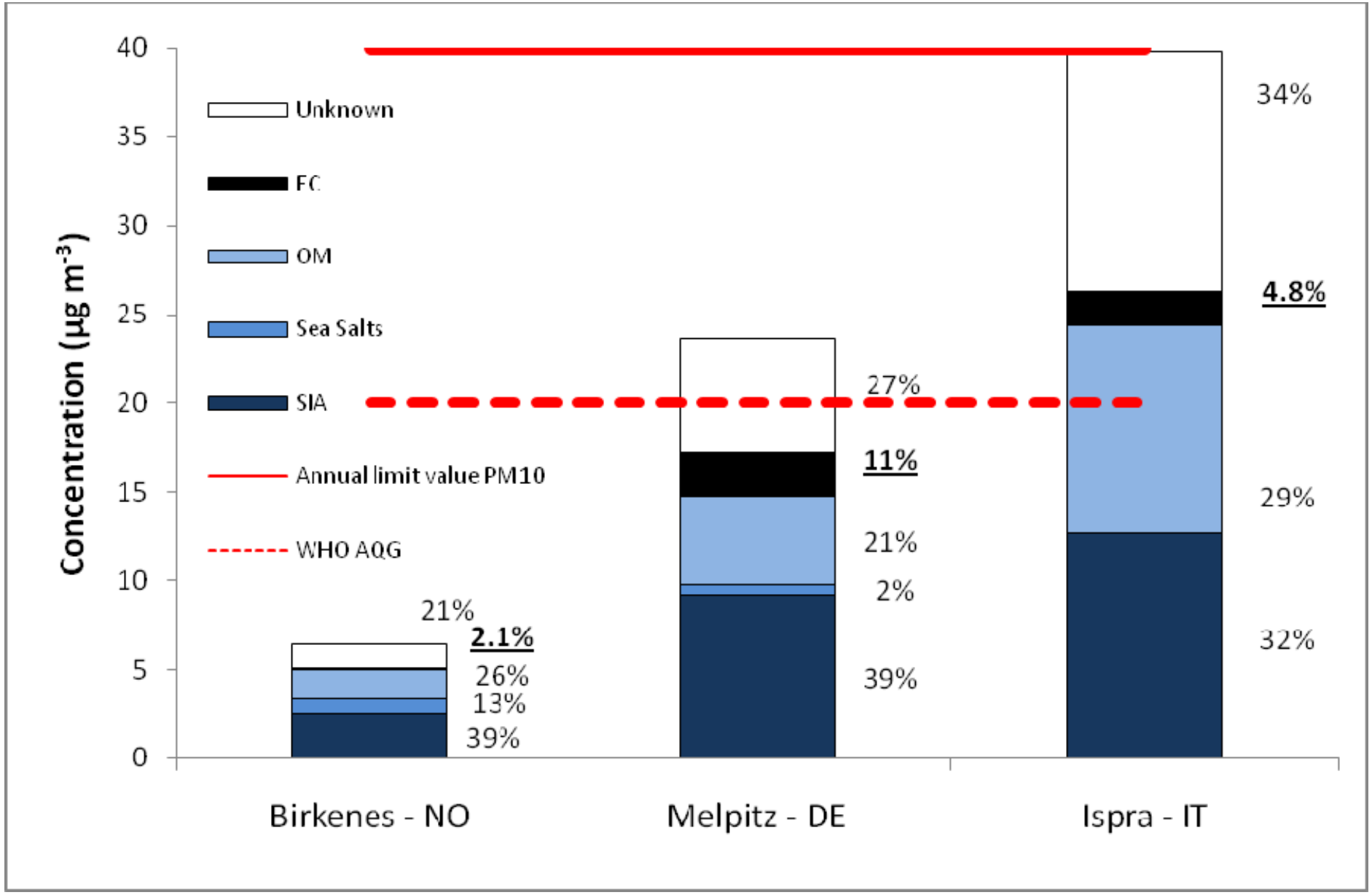
Aerosol _number_concentration

Aerosol _optical_depth

Black_carbon

Black_carbon_mass

Elemental_carbon


Concentration (µg m-3)
40
35
30
25
20
15
10
5
0
Unknown
EC
OM
Sea Salts
SIA
Annual limit value PM10
WHO AQG
21%
2.1%
26%
13%
39%
27%
11%
21%
2%
39%
34%
4.8%
29%
32%
Birkenes - NO
Melpitz - DE
Ispra - IT

CLRTAP revised Gothenburg Protocol, major changes:

After five years of negotiations, a revised Gothenburg Protocol was successfully finalized on 4 May 2012

The revised protocol specifies emission reduction commitments in terms of percentage reductions from base 2005 to 2020.

It has also been extended to cover one additional air pollutant, namely particulate matter ($PM_{2.5}$), and thereby also black carbon as a component of $PM_{2.5}$.

Between 2005 and 2020 the EU member states must jointly cut their emissions of:

- sulphur dioxide by 59%,
- nitrogen oxides by 42%,
- ammonia by 6%,
- volatile organic compounds by 28%
- primary particles by 22%.

Revised Gothenburg Protocol, specific changes:

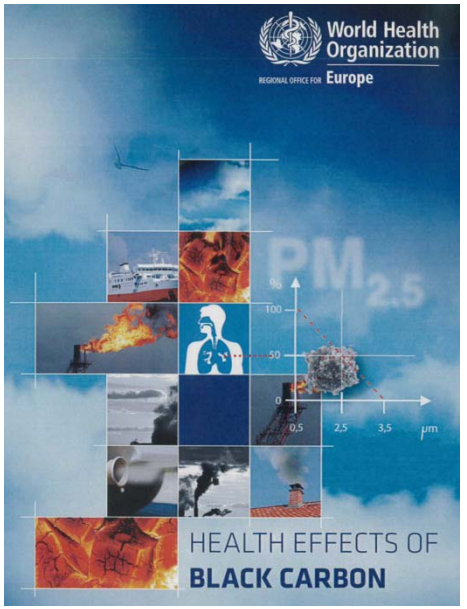
inclusion of **black carbon (soot)** as an important component of PM2.5 (air pollutant and at the same time an important short-lived climate forcer); new tasks and obligations with respect to BC include:

i) development of national emission inventories
ii) atmospheric monitoring and modelling
iii) monitoring of adverse health and environmental effects
iv) cost-benefit analysis
v) prioritizing PM2.5 mitigation measures with a focus on BC reductions

Collaboration between WHO and UNECE/LRTAP:

"Health Effects of Black Carbon" Report prepared by the Joint WHO/LRTAP Task Force on Health Aspects of Air Pollution ; April 2012 available at:

http://www.euro.who.int/en/what-we-publish/abstracts/health-effects-of-black-carbon



Conclusion

- Comprehensive, state-of-the-art monitoring at rural sites, integrating ALL variables relevant to assess atmospehric composition change, atmospheric processing and effects is fundamental.
- EMEP-GAW joint supersites have proven to represent a network capable of enabling such a capacity
- Links to global scale activities are well in place
- Regional implementation still inadequate, and long-term financing is of concern
- Links to local air quality and supersites addressing human exposure would be important to develop further