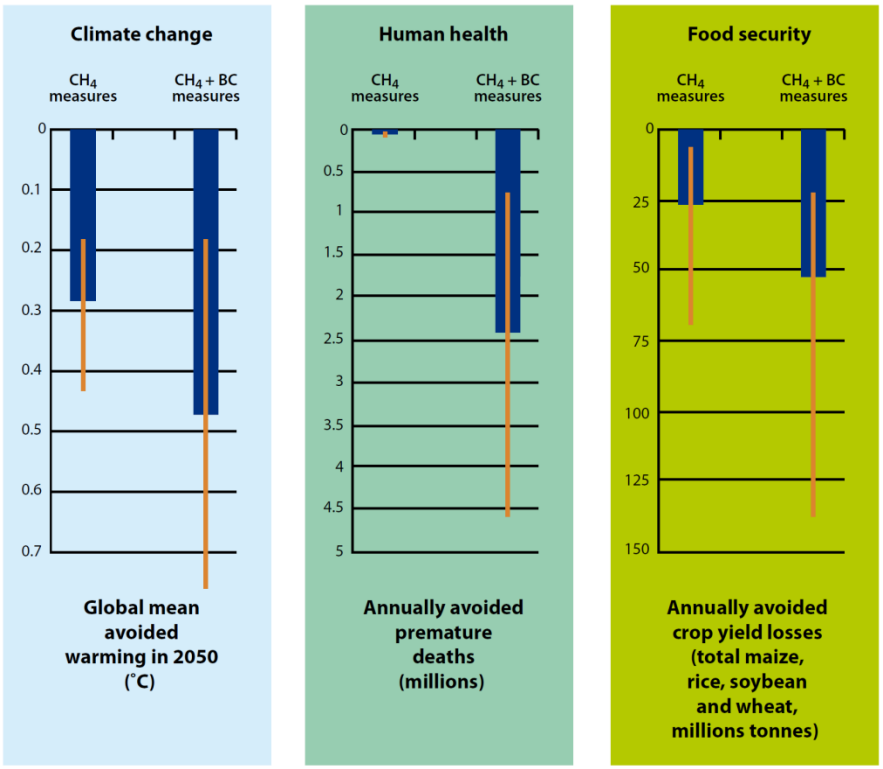
European Commission

Support to the review of the Thematic Strategy on Air Pollution: JRC's contribution to the 2nd Stakeholder Meeting, January 2012.

A. Borowiak, S. Galmarini, J. Hjorth, P. Thunis, R. Van Dingenen and F. Dentener.



EUR 25283 EN - 2012

Joint Research Centre

The mission of the JRC-IES is to provide scientific-technical support to the European Union's policies for the protection and sustainable development of the European and global environment.

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Contact information
Frank Dentener
Address: TP 290, Via E. Fermi 2749, I-21027 Ispra (VA)
E-mail: frank.dentener@jrc.ec.europa.eu
Tel.: +390332786392
Fax: +390332785837

http://ies.jrc.ec.europa.eu/
http://www.jrc.ec.europa.eu/

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Support to the review of the Thematic Strategy on Air Pollution: JRC's contribution to the 2nd Stakeholder Meeting, January 2012.

A. Borowiak, S. Galmarini, J. Hjorth, P. Thunis, R. Van Dingenen and F. Dentener.

EC Joint Research Centre (JRC), Inst. Environment & Sustainbility, Via Fermi, 2749, 21027 Ispra, ITALY

April 2012

Table of contents

1. Introduction

The efforts of the EU to reduce air pollution have led to important reductions of emissions within the Member States. However, millions of people are still exposed to air pollutants at concentration levels that may endanger their health and air pollution is still causing relevant damage to crops and ecosystems. in spite of reduced precursor emissions, the concentrations of particulate matter are only slowly decreasing in Europe and ozone has not even shown a clear downwards trend over the last decade.

The need to address these outstanding problems is part of the background for the decision of the EU Commission to review its air quality policy. In addition, new issues have come up that should be considered when defining a strategy for the fight against air pollution. Among these issues are the links between Climate Change and Air Quality that encompass both the fact that some air pollutants appear to have a relevant influence on the radiative balance of the Earth and the notion that changing climatic conditions can have an impact on emissions, processing and transport of air pollutants.

In January 2011 the College of Commissioners supported the proposal of commissioner Potocnick to review the Thematic Strategy for Air Pollution (TSAP) by 2013 at latest, and do this through a consultation process, led by DG ENV, with a broad group of stakeholders. In this group are found members from the national administrations of the Member States, Candidate Countries and third countries as well as associations (e.g. industry, agriculture, network of cities,…), NGOs, EU bodies and international organisations. The scientific inputs to the review process are particularly coming from WHO, EEA, EMEP, IIASA and other DG ENV contractors, DG RI research projects and from the JRC.

A first stakeholder meeting held in June 2011aimed at presenting to the stakeholders an outline of the approach that DG ENV will follow in the review. This approach will build on the experiences obtained in this mature area of policy making, but anyway use the most recent advances in integrated assessment of air pollutions and its links to climate change, noise and biodiversity. Emerging issues, such as “new” pollutants (black carbon aerosol, methane, ...), “new” sectors (agriculture, domestic, shipping, ...), “new” impacts (climate, biodiversity,...) will receive special attention. At the second Stakeholder Expert Group (SEG) meeting, held in January 2012, several inputs from stakeholder experts to the review were presented and discussed.

In addition to the review process within the SEG the Commission has carried out an on-line public consultation with three questionnaires, one for the general public, one for experts and practitioners dealing with air pollution issues and one for members of the SEG. The results of this exercise are presently being analysed. Among the preliminary conclusions from the response of the SEG members were that more attention should be paid to the health relevant PM fractions and that models should be more extensively used, but harmonized and quality assured.

The JRC’s Air and Climate Unit has a particular engagement in research related to air pollution and with its commitment to provide scientific support to EU policy making it has naturally become strongly involved in supporting DG ENV in this review process. The presentations and abstracts included in this document are those made by JRC representatives at the second SEG meeting. They give a flavour of the contribution and support to the review process provided by the JRC, which reflects an involvement in air pollution monitoring programs, harmonisation and quality control of models as well as research efforts in the emerging fields of climate-air quality interactions and hemispheric transport of air pollutants. A regular update of this document is foreseen.

2. Integrated assessment of Air Pollution and Climate Change: looking for win-win air pollution policies

R. Van Dingenen (JRC)

Feedbacks of climate policies on air quality (co-benefits as well as trade-offs) are now being recognized and introduced in optimization schemes for air quality policy development, e.g. with the GAINS model. However, also air quality policies can have consequences for climate. Many “classical” air pollutants (NOx, CO, BC) have the same source as CO_2: combustion of fossil fuels. Some pollutants are contributing to warming (BC, O_3), others are cooling (SO_4, NO_3, organic carbon). Air quality policies are commonly designed without taking into account possible feedbacks on climate, although there is a potential for smart air quality policies that lead to a win-win situation for both climate and air quality.

This issue was addressed in the recently published UNEP-WMO reports (Integrated Assessment of Black Carbon and Troposphere Ozone” and “Near-Term Climate Protection and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcers”). The assessment proposes a limited portfolio of 16 climate-friendly air quality measures, and evaluates the benefits resulting from a hypothetical 100% implementation. These measures go beyond the baseline of current legislation (including current European air quality policies like EURO6/VI standards, and the climate & energy package). A first group of measures addresses the reduction of CH_4 emissions (with associated benefits for reduced background ozone), a second group targets BC (with additional benefits for O_3 for those sectors where NOx and NMVOC are co-emitted species). The reports conclude that potentially a temperature benefit of 0.5K in the coming decades can be achieved, along with significant reductions in premature mortality worldwide following reduced PM2.5 concentrations. The reduction of O_3 also leads to benefits for crop production.

The portfolio of measures proposed in the UNEP assessments was designed in order to give a maximal climate benefit worldwide, and the outcome was presented for 5 large world regions where Europe, Russia and North America are aggregated in one region. For the current presentation we have calculated what the 16 measures would mean for EU27 in terms of specific control measures and resulting benefits. This was done with the TM5-FASST tool, a global source-receptor model developed at JRC which calculates impacts from emissions from 56 source regions. EU27 is represented by 15 regions, aggregating smaller countries to one FASST region.

The series of bar plots (slide #7-#12) show some of the evaluated impacts. The upper panel shows the result for the EU17 as a whole, along with USA, the BRIC countries and the African continent, and the lower panel shows the result for individual EU27 regions within TM5-FASST.

- PM2.5: the most relevant measure for Europe from the UNEP portfolio is “replacing residential wood burning with efficient pellet stoves and boilers”. The EU27 benefit remains limited compared to developing countries where other specific measures would apply. This is a consequence of the fact that promising BC reducing measures are already part of the European baseline through past and current air quality policies.
- Crop benefits: all measures (both from the CH_4 package and the BC package) contribute to some extend to O_3 reduction and crop yield increase. For Europe, the main benefits are from CH_4 reduction measures, hence from a reduction of background (hemispheric) ozone, whereas developing countries gain mostly from the implementation of EURO6/VI standard – assuming that the standard fully yields the foreseen NOx reductions.
- The global climate benefit of the full set of measures can be expressed as a reduction by 10.3 GTonnes of GWP100 based CO_2 equivalent (CO_{2e}). The share of Europe can be compared with the

real CO_2 reduction effort required under the Climate & Energy package (10%), however the CO_{2e} from the short-lived air pollutant measures should not be confused with real CO2 reduction.

- Deposition of BC to the Arctic is a relevant metric for “saving the Arctic”. Here the benefit from European measures (together with China and Russia) clearly jumps out, in contrast to the PM2.5 measures.

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Integrated assessment of Air Pollution and Climate Change
looking for win-win air pollution policies

Rita Van Dingenen, Frank Dentener, Frank Raes, Elisabetta Vignati, Greet Maenhout
Joint Research Centre – European Commission
Ispra, Italy

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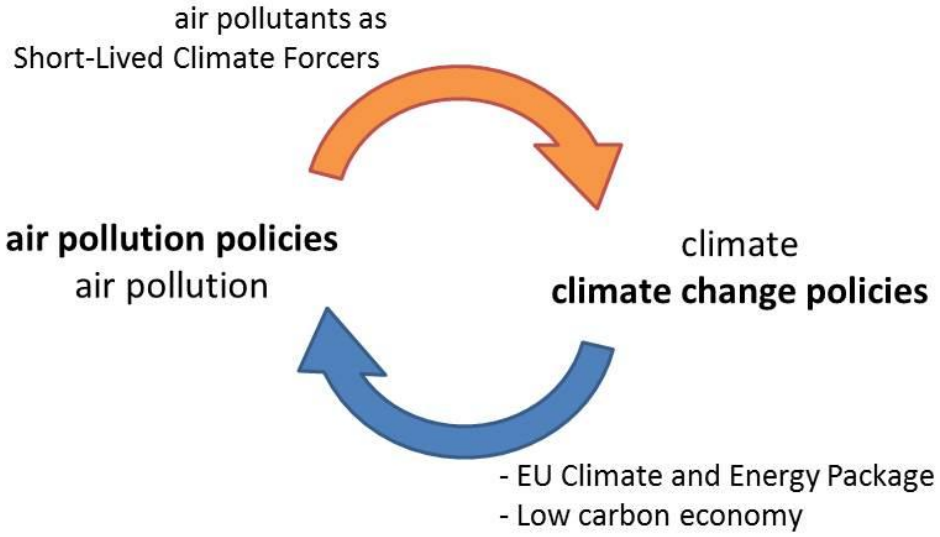

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Three groups of promising measures (UNEP, 2011) based on IIASA/GAINS emissions for 2005 + GWP100s from literature

"CH_4" measures

1. Recovery of coal mine gas
2. Production of crude oil and natural gas
3. Gas leakages at pipelines and distribution nets
4. Waste recycling
5. Wastewater treatment
6. Farm-scale anaerobic digestion
7. Aeration of rice paddies

Technical "BC" measures

1. Modern coke ovens
2. Modern brick kilns
3. Diesel particle filters
4. Briquettes instead of coal for heating
5. Improved biomass cook stoves
6. Pellets stoves and boilers (in industrialized countries)

Non-technical measures

1. Ban of high-emitting vehicles
2. Ban of open burning of agricultural waste
3. Elimination of biomass cook stoves

130 measures (out of 2000) reduce warming, the selected 16 reduce 90% of it.
A 100% implementation of the measures is assumed in the study

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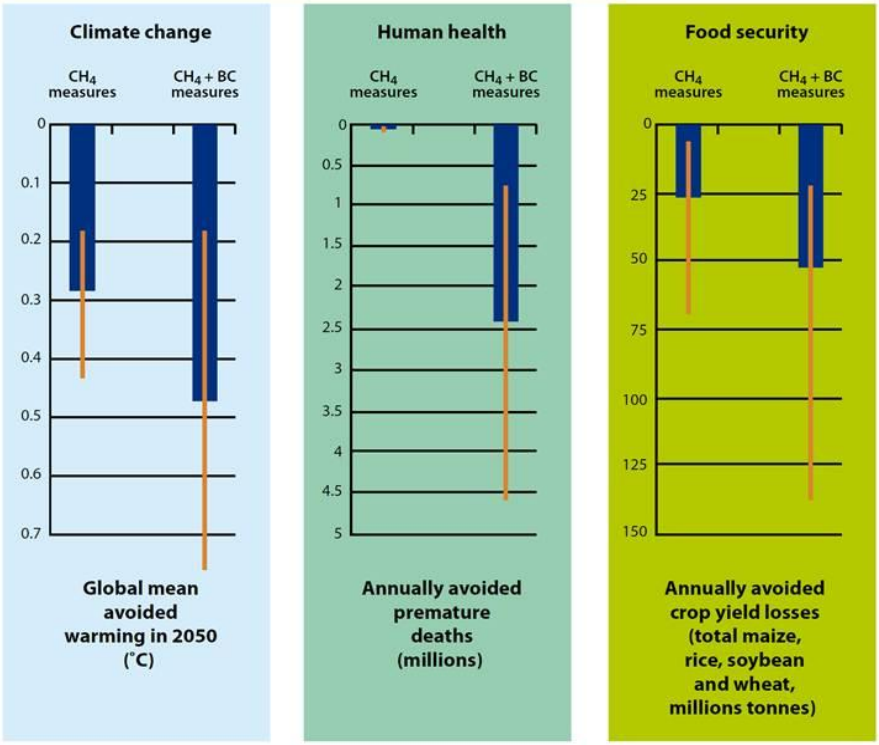
Global benefits of 16 selected CH4 – O3 – BC control measures



UNEP, 2011

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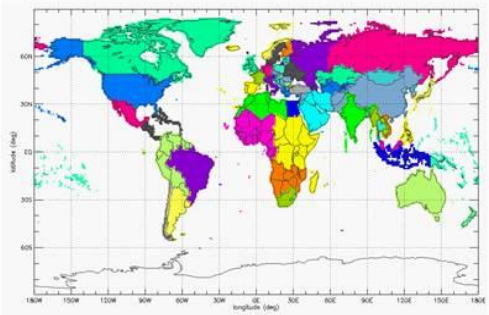
the FAst Scenario Screening Tool TM5-FASST



- Based on global **linear source receptor relationships** calculated with the global chemical transport model TM5-CTM
- 56 source regions + international shipping
- EU27: 15 FASST regions

Calculates the effect of an emission change in each source region, on various impacts in all regions

- **Emissions considered:**
  SO_2, NO_x, NH_3, Black Carbon, Primary Organic Matter, PM2.5, CH_4
- **Impacts considered:**
  $PM_{2.5}$ impacts on human health,
  O_3 and O_3 metrics, impacts on agriculture
  Radiative forcing
  CO_{2e} based on GWP and GTP
  BC deposition to Arctic

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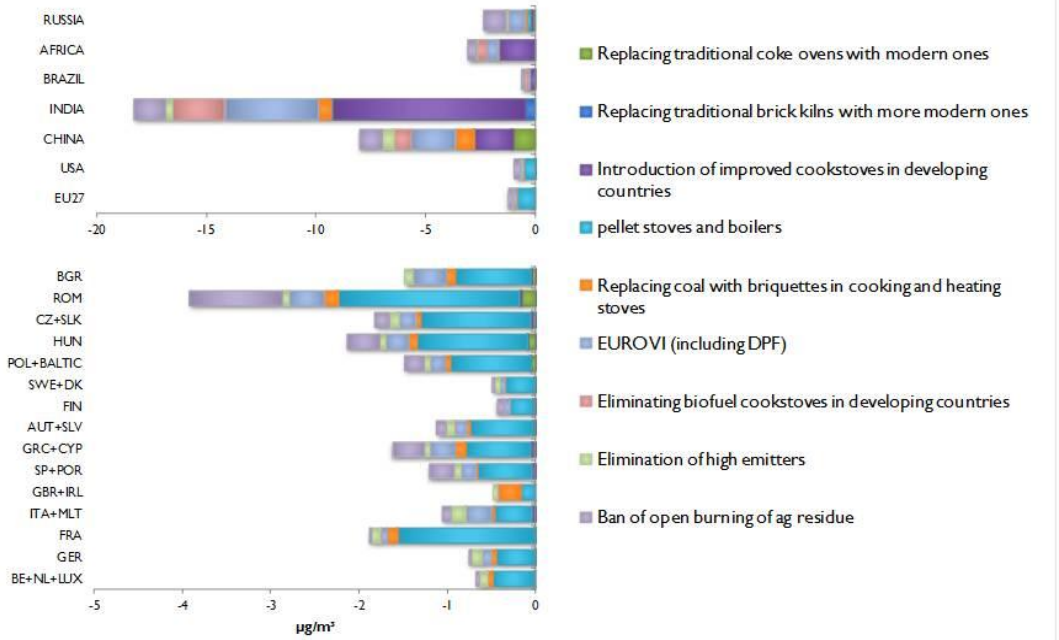
UNEP outcome applied to EU27

Benefits: PM2.5 reduction



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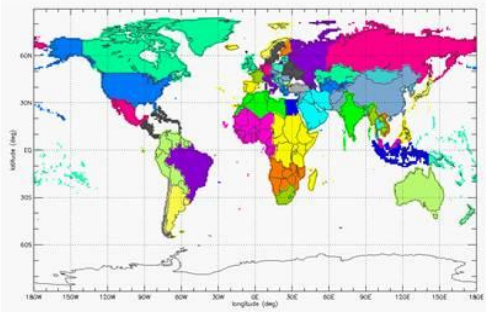

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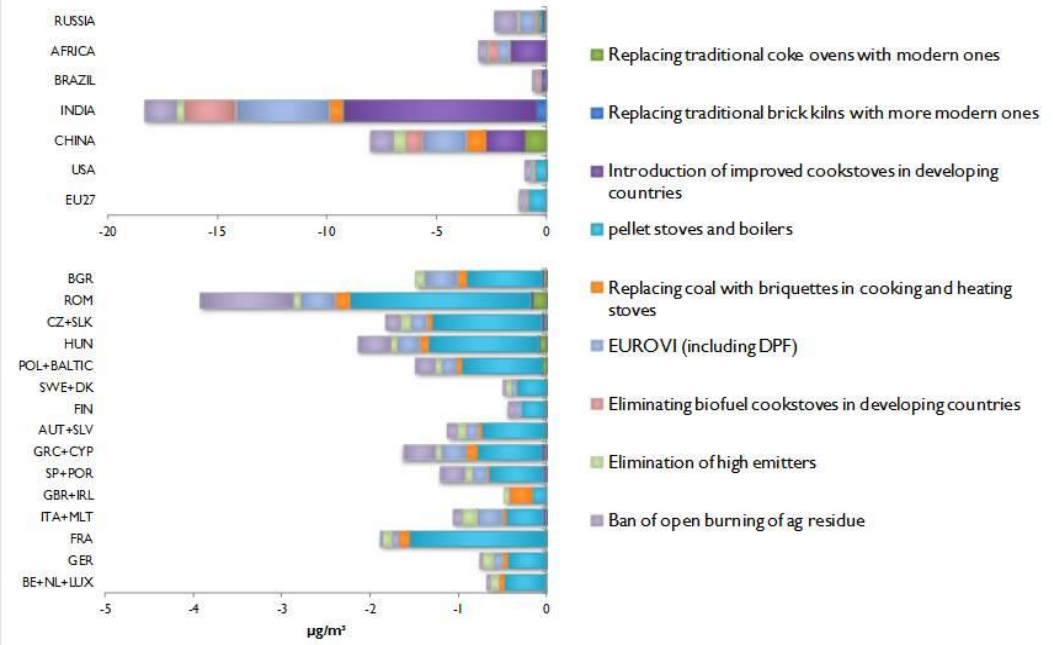

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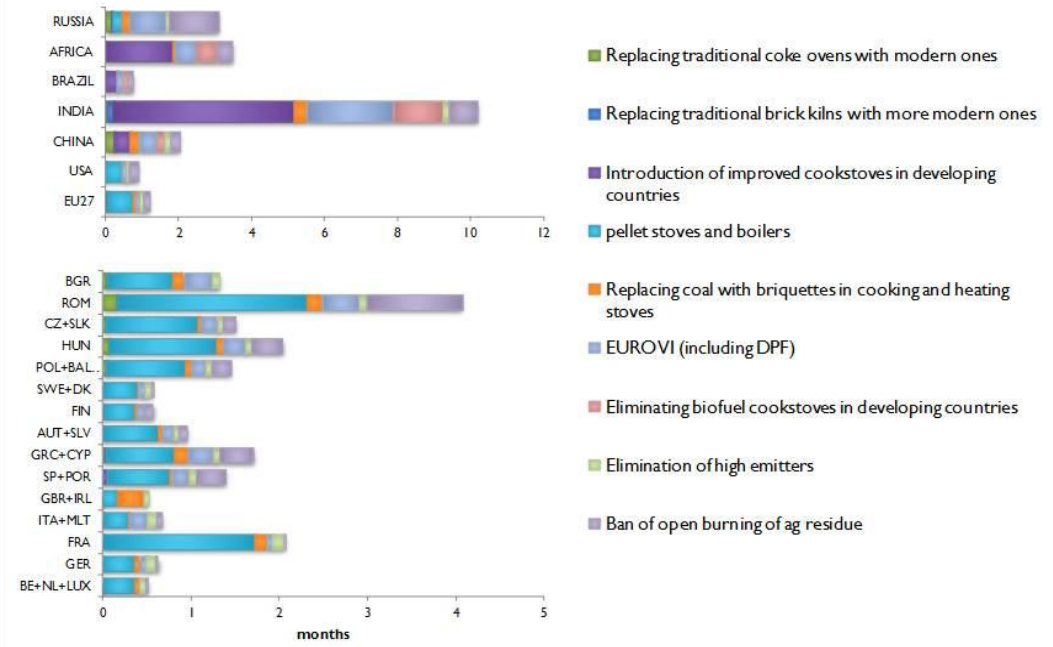
UNEP outcome applied to EU27

Benefits: increase in life expectancy



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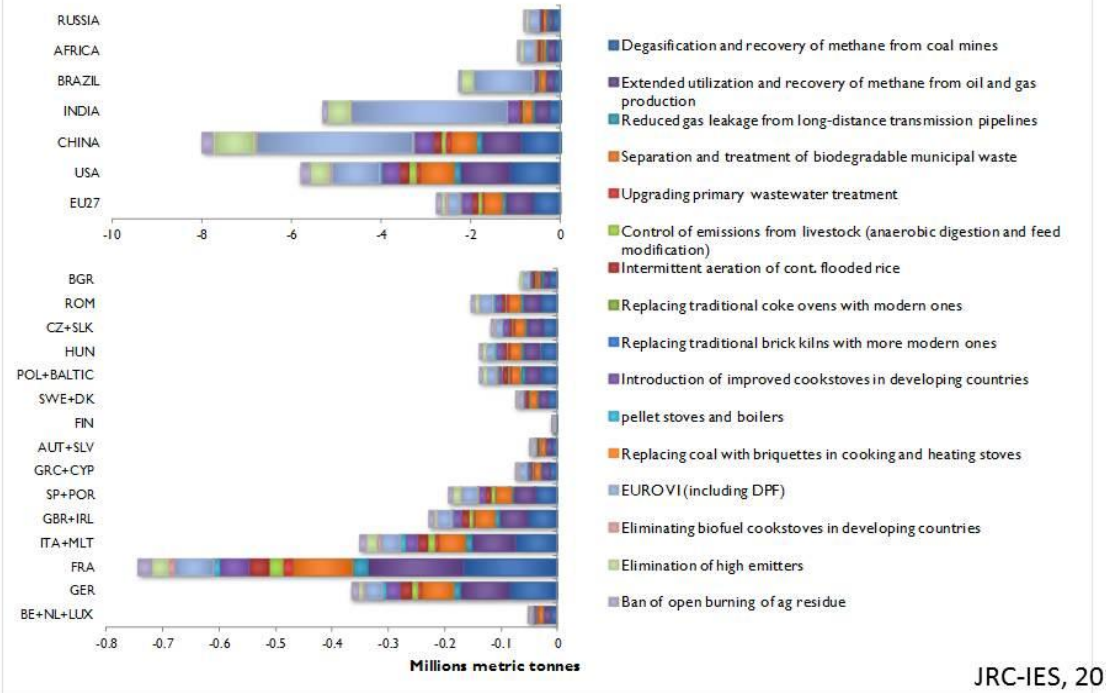
UNEP outcome applied to EU27

Benefits: reduced crop yield losses from O_3 (wheat, maize, rice, soybean)



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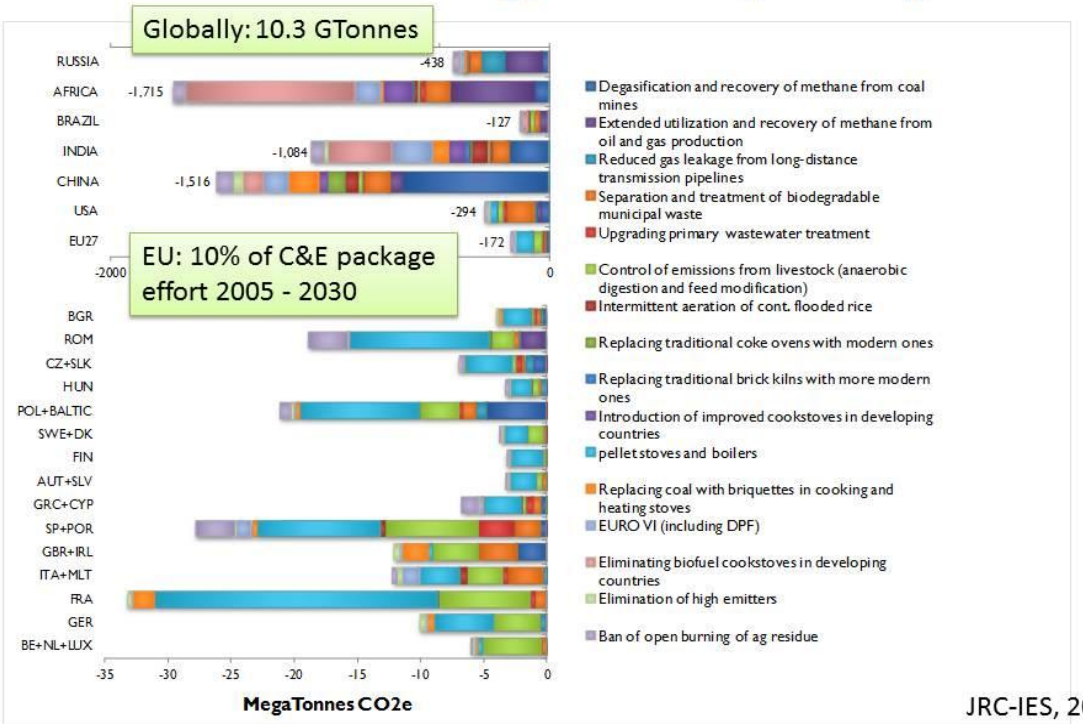
UNEP outcome applied to EU27

Benefits: short-term cooling (GWP100 CO2eq per country)



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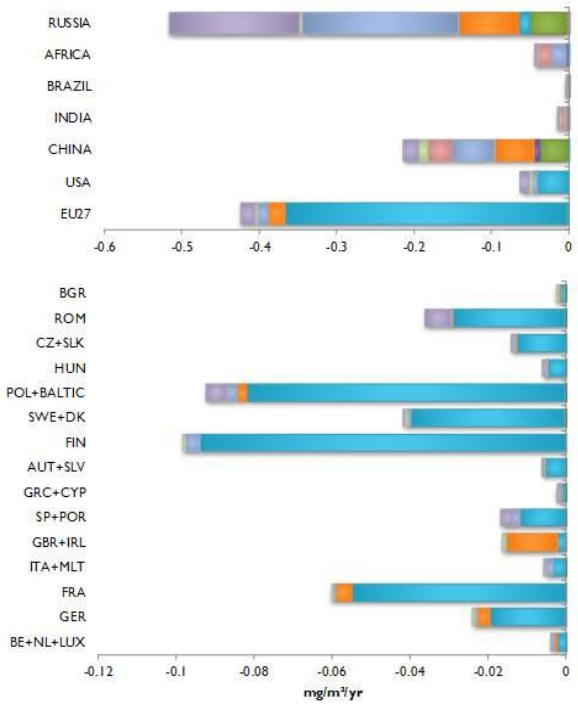
UNEP outcome applied to EU27

Benefits: deposition of BC to Arctic



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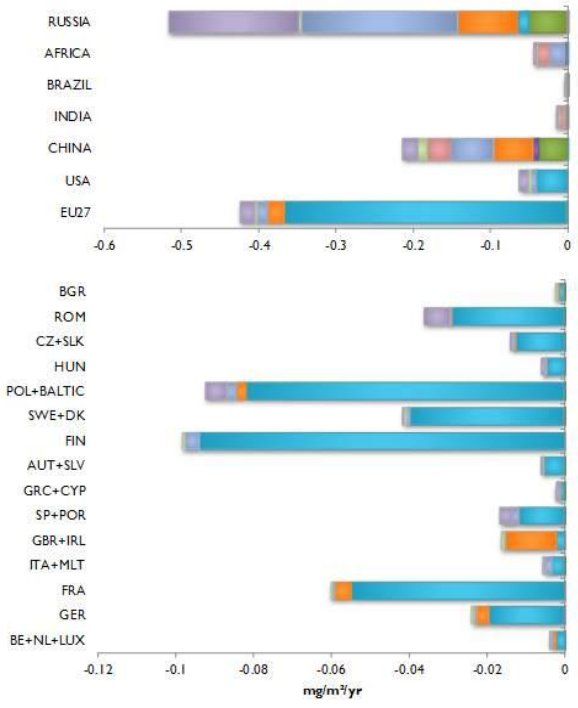
UNEP outcome applied to EU27

Benefits: deposition of BC to Arctic



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conclusions

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•Worldwide implementation of 16 measures will have a relatively rapid impact on global mean temperature (GMT) : 0.5° C (80% of expected GMT within 20 yrs!).

•Reductions in short-lived forcers CO_2e account for about 10% of the EU25 CO2e reduction effort according to the Climate & Energy Package BUT should not be used as exchange in long-lived GHG emission reductions.

•Relevant European measures:
- •Pellet stoves and boilers in residential sector
- •Treatment of biodegradable waste
- •Anaerobic digestion of manure + feed modification
- •Room for finetuning European measures?

•Known climate friendly PM measures (wood pellets, diesel particulate filter, coal brickets) constitute only 10-20% of PM reduction potential

• Ozone reduction measures, especially through CH_4, are an absolute no- regret policy for air pollution and climate. $CH_4 - O_3$ benefits in crop yields occur at hemispheric scale.

•Take-home messages:
- •Revision: treat BC as separate pollutant
- •Consider opportunities of AQ policies for benefit of climate in impact assessments

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Acknowledgements:

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•NASA Goddard Institute for Space Studies, USA
•Stockholm Environment Institute, York, UK
•Scripps Institute, Univ. of California, USA
•IIASA, Laxenburg, Austria
•Kings College, London, UK
•US EPA
• JRC Ispra
And others

JRC contributions

Frank Raes	Vice Chair
Greet Janssens – Maenhout	Emissions & gridding
Elisabetta Vignati	Climate model
Rita Van Dingenen	AQ and crop impacts

3. Linking global scale and European scale modelling: Hemispheric Transport of Air pollution

F. Dentener (JRC), A. Zuber (DG-ENV), T. Keating (US EPA)

Transport of air pollutants across the Northern Hemisphere, can influence the levels of ozone (O_3), particulate matter (PM), heavy metals including mercury (Hg) and persistent organic pollutants (POPs) in Europe. This issue was recognized by policy makers, leading to the establishment of the Task Force on Hemispheric Transport of Air Pollution in 2004, under the umbrella of the United Nations Economic commission for Europe, and co-chaired by the European Commission and the US EPA. The Task Force aims to examine the transports of air pollution across the Northern Hemisphere; assess the potential emission mitigation options available inside and outside the UNECE region; assess their impacts on regional and global air quality, public health, ecosystems, and near-term climate change; endorse the collaboration with other groups both inside and outside the LRTAP Convention and enhance the creation of common knowledge basis for future air pollution policies.

In the presentation I show examples of increasing O_3 at Europe's boundaries, initial work from the Task Force showing the increasing importance of extra-regional air pollutant emissions and CH_4 in determining O_3 trends in Europe. Furthermore extra-regional influences differ per pollutant (e.g. smaller for particles than for O_3 but still substantial, larger for climate impacts than for surface pollution). Future work within the Task Force and dedicated work addressing the needs of the review of the air quality directives, will inter-alia focus on improving the robustness of the model results, improving policy-relevant estimates of impacts on vegetation and human health (using coupled global/regional models) and exploring mitigation options of global and regional importance.

JRC is contributing to this process by own analysis, as well as supporting the scientific community to address these issues.

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Linking global scale and European scale modelling:

Hemispheric Transport of Air pollution

Frank Dentener
JRC

Andre Zuber
ENV

Terry Keating
US EPA

and HTAP authors/contributors

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EUROPEAN COMMISSION
Dentener, Brussels, January 2012

LRTAP
Long-range Transboundary Air Pollution

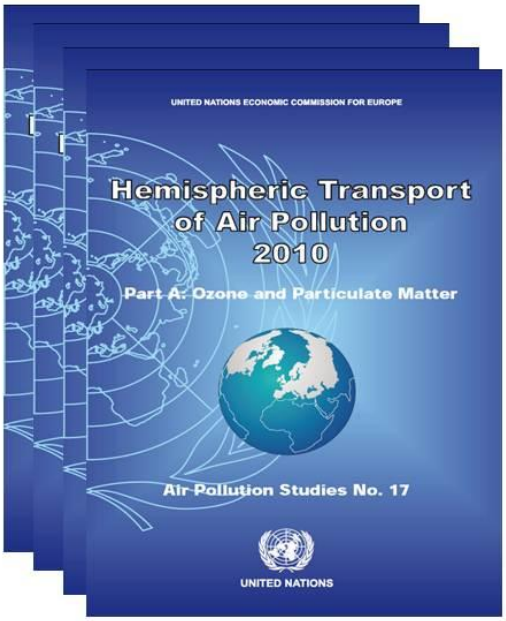
Task Force Hemispheric Transport of Air Pollution (TF HTAP)

Established in 2004 by UNECE
Interim report 2007
HTAP Assessment report 2010

Mandate:

- **Examine the transport of air pollution across the Northern Hemisphere, ozone and its precursors and PM and its components (including black carbon)**
- **Assess potential emission mitigation options available inside and outside the UNECE region**
- **Assess their impacts on regional and global air quality, public health, ecosystems, near-term climate change**
- **Collaboration with other groups both inside and outside the Convention.**

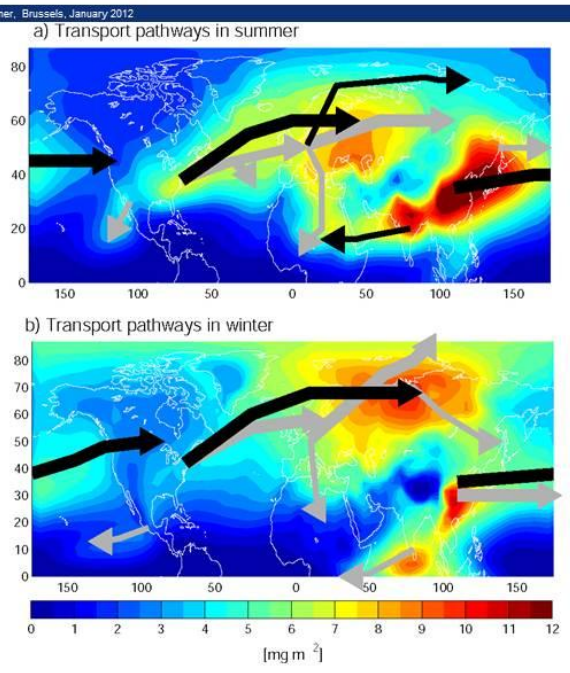
Task Force on Hemispheric Transport of Air Pollution



HTAP 2010 Report

- 4 volumes, 826 pages, 178 contributors
- Covers O_3, PM, Hg, POPs
- Contents addresses:
  - Conceptual Models
  - Observed Spatial & Temporal Trends
  - Emissions Inventories & Projections
  - Global & Regional Modeling of Pollution Transport
  - Impacts to Health, Ecosystems, & Climate
- Available electronically at www.htap.org
  Available in print on request

Pathways of hemispheric pollution transport



CO passive tracer

Lower troposphere

Mid-upper troposphere

Flexpart, A. Stohl et al, 2004

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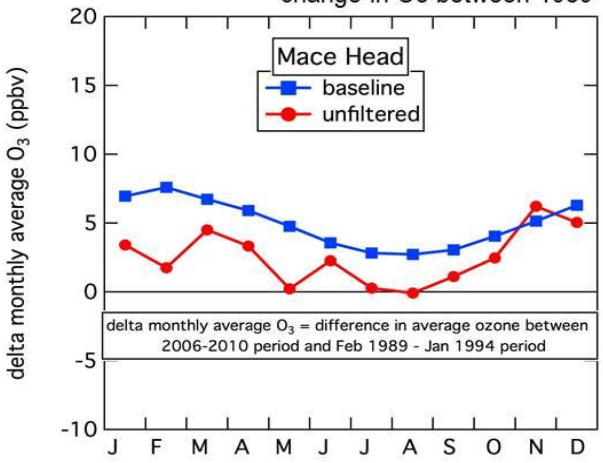
change in O3 between 1989-1994 and 2006-2010



Change in global baseline O3?

Change in meteorological conditions?

Is this happening everywhere along the borders of Europe?

How does this impact air quality in Europe?

Courtesy D. Derwent, K. Law

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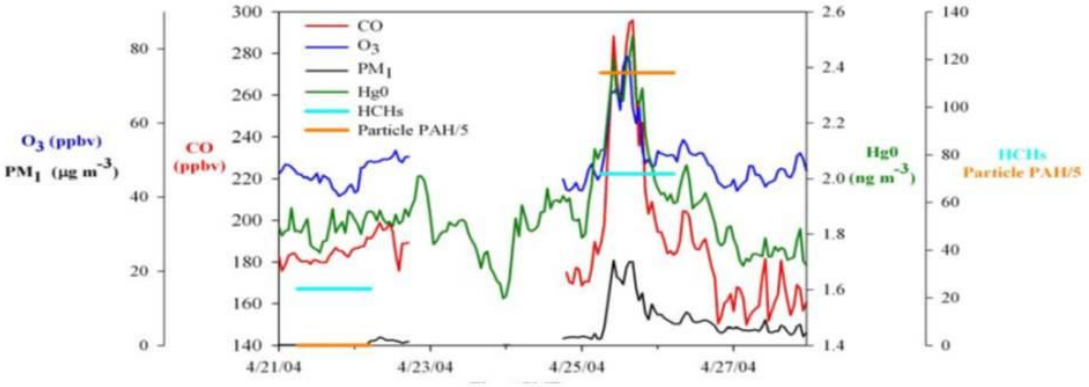
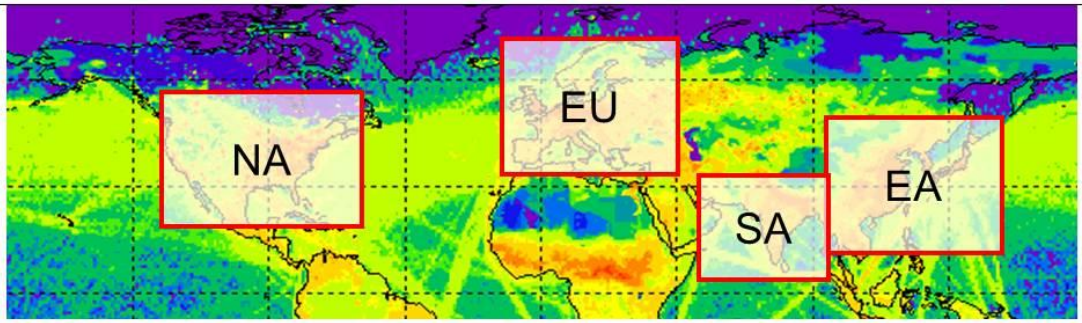
Measurements at Mount Batchelor, US West Coast

Dentener, Brussels, January 2012 6



- Several surface stations and satellite analysis show intercontinental transport
- Plume transport versus 'diffusive' background transport
- the magnitude and importance of these transports from combination of models and measurements

HTAP: Design of Multi-Model Experiments



Source-Receptor Sensitivity Simulations:

- Base Year 2001
- >20 global models
- Decrease emissions of precursors in each region by 20%
- Precursors emission include
  - NO_X, VOC, CO, NO_X+VOC+CO,
  - NO_X+VOC+CO+PM
  - Hg, POPs
  - CH_4 concentration

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HTAP policy relevant metric

RELATIVE ANNUAL INTERCONTINENTAL RESPONSE

$$RAIR = \frac{\Sigma R(foreign\_regions)}{\Sigma R(all\_regions)}$$

R= annual average response to emission perturbation

Under current conditions: if everywhere in the world the same emission reductions were applied, what would be in the EU the relative contribution of pollution from abroad?

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RAIR for air pollution, climate and ecosystem metrics

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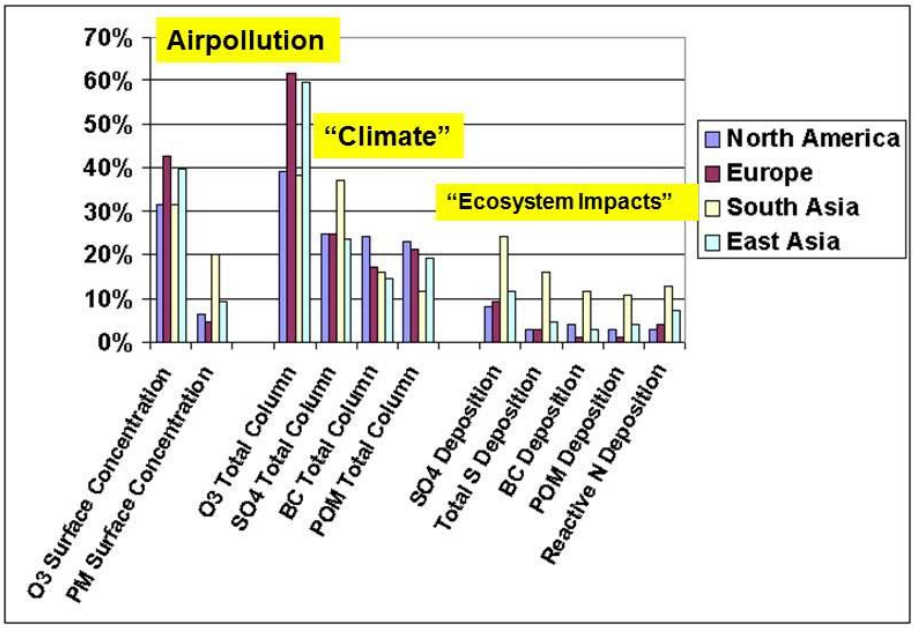

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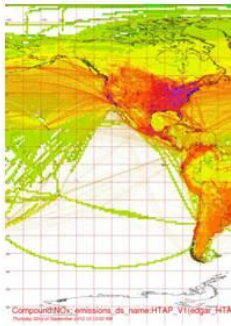

- National and
- Policy consis
- Consistent hi

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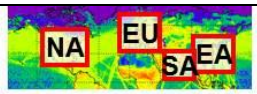
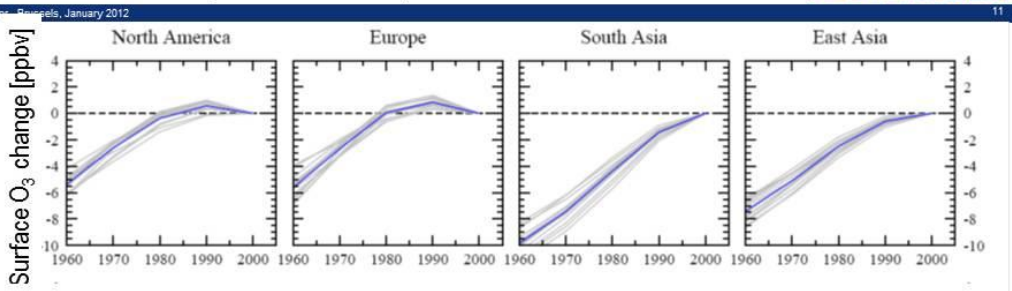
HTAP reconstruction of regional ozone changes: period 1960-2000; attribution of drivers.





- Source Receptor relationships from ca. 10 global models
- Global emissions trends of precursors (1960-2000)
- Reconstruction of the past O_3 trends
- Source attribution

O. Wild et al., ACPD, 2011

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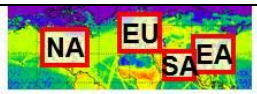
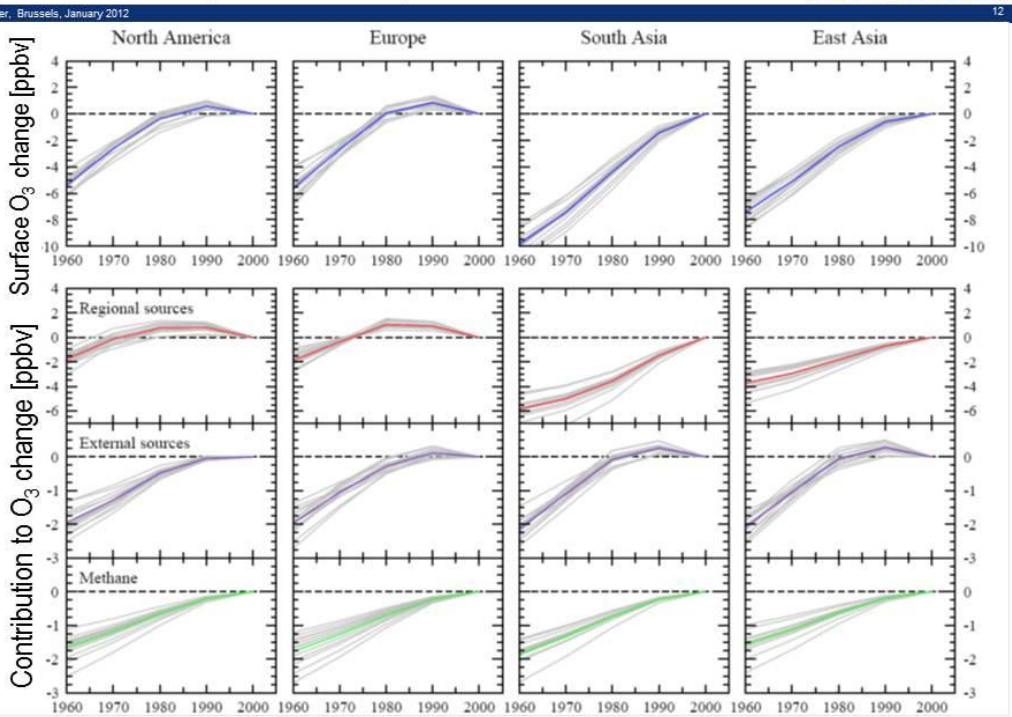
HTAP reconstruction of regional ozone changes: period 1960-2000; attribution of drivers.





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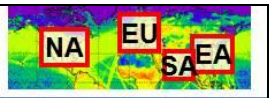
HTAP reconstruction of O3 changes in EU: attribution of drivers.



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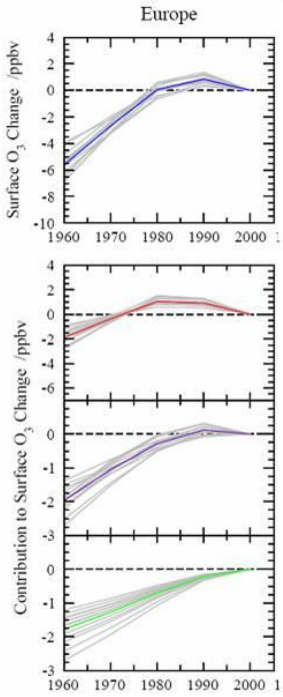
Total change

Within EU

Outside of EU

Methane



- Annual average - large region
- Small reductions in O_3 during 1980-2000, largest changes (6 ppbv) happened before.
- O_3 reductions attributable to EU emissions partly compensated by increasing emissions elsewhere
- Important role for (global) CH_4 30-50 %

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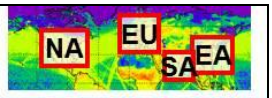
HTAP reconstruction of O3 changes in EU: attribution of drivers.



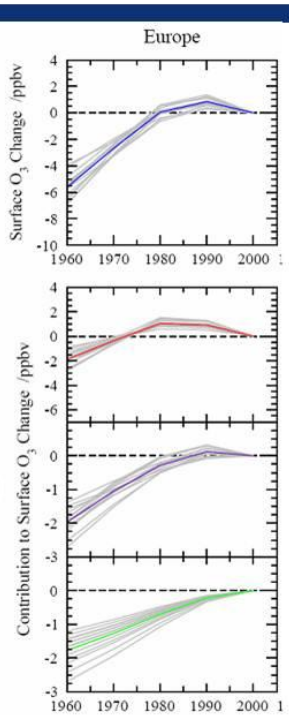
Dentener, Brussels, January 2012 14

Total change

Within EU

Outside of EU

Methane



- Annual average - large region
- Small reductions in O_3 during 1980-2000, largest changes (6 ppbv) happened before.
- O_3 reductions attributable to EU emissions partly compensated by increasing emissions elsewhere
- Important role for (global) CH_4 30-50 %
- Taken together changes in O_3 from outside EU and CH_4 are larger than within EU (60-70 %)
- External O_3 becomes more important when 'local' source are more regulated.
- More important at 'lower' concentrations

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TF HTAP Future Directions

1. **Deliver Policy Relevant Information to the LRTAP Convention, Other Multi-Lateral Forums, and National Governments and EU**
   a. Fraction of air pollution concentrations attributable to emission within region compared to extra-regional.
   b. Impacts on human health (Global Burden of Disease), ecosystems (WGE) and climate change (IPCC)
   c. Sensitivity to changes in specific sources (e.g. ships)
   d. Change of impacts and fractions under expected air pollution abatement efforts or climate change: scenarios and control options: focus on Black Carbon, Methane, Mercury
   e. Comparison of the availability, costs and impacts of additional emission abatement options across different regions
2. **Improve Our Scientific Understanding of Air Pollution at the Global to Hemispheric Scale**
   a. Emissions: EDGAR HTAP
   b. Various source apportionment methods
   c. Linking of global and regional models
   d. Model-Observation Evaluation and Process Diagnosis
3. **Build a Common Understanding by Engaging Experts Inside and Outside the LRTAP Convention**

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EC ENV contract on Hemispheric Transport

- Model simulations in the frame of TF HTAP, but focus on EU and review
- Contractor: MetNo, IIASA, FZ Julich, assisted by JRC
- Timeframe: 11/2011-11/2013
- Emission scenarios and control options
- Contribute to multi-model analysis and evaluation in TF HTAP
- Provide dedicated information on the impact of past and future changes in boundary conditions on EU Air Quality

Linking the European scale modeling with urban and street scales

P. Thunis (JRC), M. Amann (IIASA), B. Bessagnet (INERIS), C. Heyes (IIASA), G. Kiesewetter (IIASA), L. Rouil (INERIS), K. Cuvelier (JRC), W. Schoepp (IIASA), E. Terrenoire (INERIS)

Current integrated assessment studies at the European scale mostly rely on the GAINS methodology developed at IIASA. This approach is based on the atmospheric EMEP modelling to establish relations between emission changes and changes in concentration levels, however with a spatial resolution of 50x50 km^2, urban scale and street scale impacts cannot be captured adequately. With the CityDelta modelling exercise (2003) parameterisations to address these urban scale effects have been developed (for PM2.5) and implemented in regional scale models.

The objectives of this work, done in collaboration with IIASA and INERIS, are to review the existing urban parameterisations, to generalize them to other pollutants (NO_2, PM10 and O_3) and develop new parameterisations at the street level to address compliance issues related to the number of exceedances over the Air Quality Directive threshold values at hot spot locations.

To achieve these objectives, a two-step methodology has been put in place:

1) Urban Background increment: The CHIMERE model (developed at INERIS) is used over all Europe to calculate concentration levels for key pollutants with both the 50 and 7 km spatial resolutions. The concentration difference between the two simulations is calculated and related to the difference in emissions. These relationships are then implemented in the EMEP-GAINS system.
2) Street level increment: AIRBASE stations characterised by a high number of exceedances are analysed with a specific approach (i.e. simple box model) to establish a link between emissions, meteorology and concentrations levels. The derived street increment relationships are then implemented in GAINS-EMEP on top of the urban background increment (point 1)

In this presentation, the results of the comparison between the 50 and the 7km resolution simulations are shown (point 1). The importance of having accurate quality control on the input data but also on monitoring data is stressed. The added value of having a finer resolution is highlighted in terms of pollutant and geographical areas. Finally strengths and weaknesses of the approach are discussed.

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ies Institute for Environment and Sustainability

Institute for Environment and Sustainability

Linking the European scale modelling with urban and street scales

P. Thunis[1], M. Amann[2], B. Bessagnet[3], C. Heyes[2], G. Kiesewetter[2], L. Rouil[3], K. Cuvelier[1], W. Schoepp[2], E.Terrenoire[3]

(1) JRC-IES ; (2) IIASA; (3) INERIS

http://ies.jrc.ec.europa.eu/
http://www.jrc.ec.europa.eu/

IIASA INERIS

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Background & Objectives

IIASA INERIS

Background: Air quality modelling (CAFE) is currently based on:

- GAINS - EMEP at 50 km resolution to capture rural background concentrations
- Urban scale effects are parameterized with the CityDelta relationships

Objectives:

- Improve current PM2.5 population exposure assessment (based on CityDelta)
- Estimate compliance with AQ limit values for PM10, NO2, O3 for future Europe-wide emission control scenarios in GAINS (new compared to CAFE)

Approach:

- Step 1: Urban background → CHIMERE 7*7 km over Europe
  - Concentrations delta (7 km – 50 km) are related to differences in low level emission sources.
  - Relationships are implemented in GAINS/EMEP 50 km runs
- Step 2: Urban traffic hot spots
  - Determine measured increments for NO2 and PM10 from traffic emissions, from AIRBASE traffic stations
  - For future scenarios: scale increments with changes in traffic emissions
  - Add these increments to the urban background, to estimate compliance with AQ limit values for PM10 and NO2

In this presentation:

- Model evaluation performed on 30 EU cities
- Analysis of the concentration deltas across the airbase station classifications (Regional – Urban – Traffic)

Meteorology

- ECMWF-IFS (25km) meteorology, Lower wind speed in urban areas (surface roughness)

Emissions

- National gridded EMEP emissions downscaled to 7km
- Updated height profiles, NO/NO2 ratios, temporal emission patterns for domestic heating

Boundary conditions

- Saharan dust and wild fires from FIRE

Monitoring data

- AIRBASE data for 2006 and 2009 (~800 stations)

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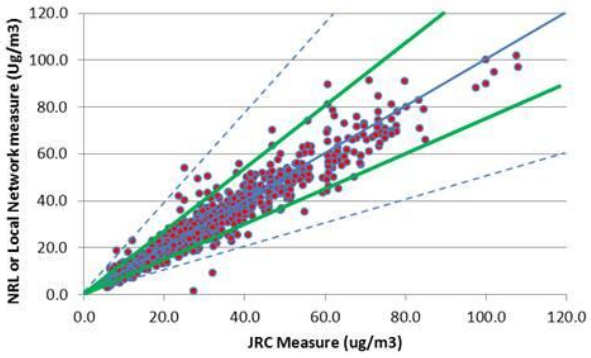
Model evaluation (I): Quality of monitoring/emission data

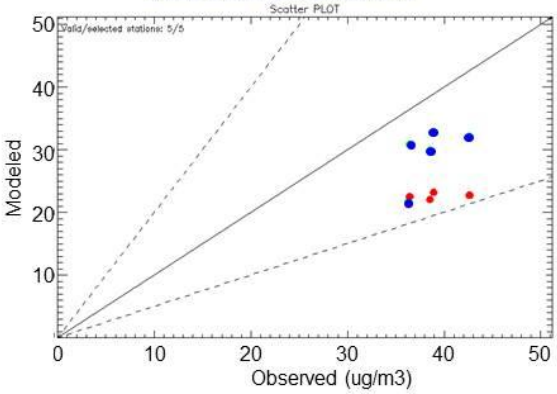
IIASA INERIS

Stakeholder meeting January 2012 5

PM10: Observation uncertainty – Results from local networks vs. JRC reference instruments



PM10 Urban concentrations Results from two different emission inventories



Significant uncertainties related to measurements (Ref: AQUILA publication [EUR 24851, JRC])

- Spatial disaggregation: EMEP
- Spatial disaggregation: MACC

National Sectoral totals kept identical

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Model evaluation (II): FAIRMODE quality criteria

IIASA INERIS

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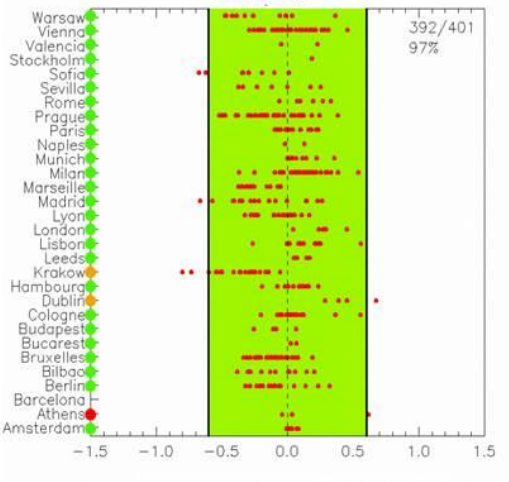
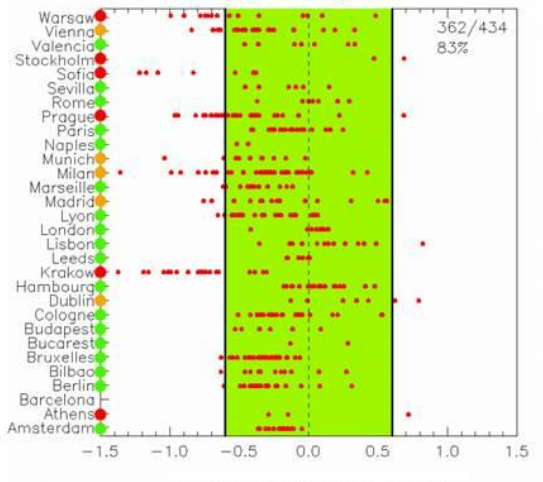
PM10 computed with CHIMERE 7km

Entire year



Fulfilled for 97% of stations

January

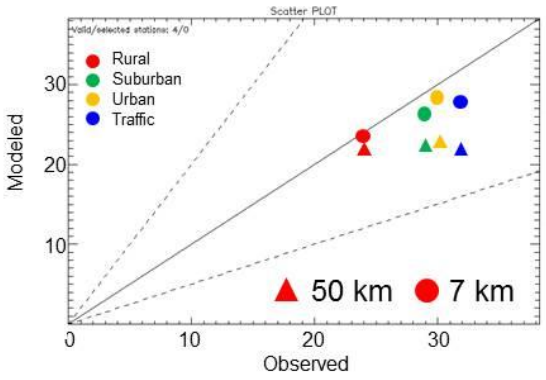


Fulfilled for 83% of stations

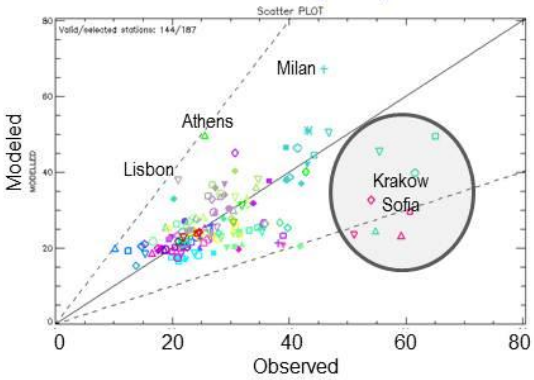
FAIRMODE criterion: Mean fractional bias $\mathrm{MFB} = 2 * \sum_i (\mathrm{M}_i - O_i)/(\mathrm{M}_i + O_i)$ (green range = suitable for policy analysis

Model evaluation (III): PM10 annual mean

PM10 average (2009)
300 AIRBASE stations



CHIMERE 7 km resolution
AIRBASE urban/suburban/rural stations in 30 cities (2009)

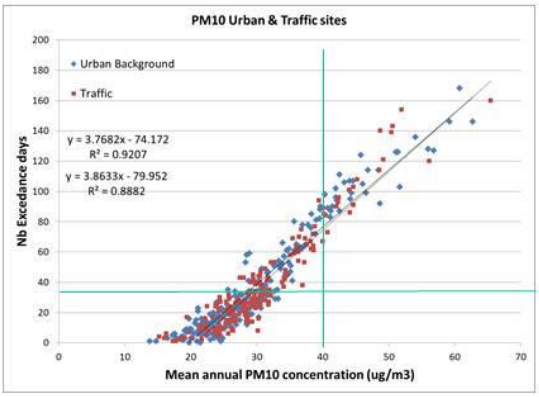


- Good fit for all station types with 7km resolution
- Rural background can be modelled with 50km model
- Clear improvement from 7 to 50km for urban/suburban and traffic stations
- Clear underestimate in Eastern countries, overestimate in some stations (e.g. Milan, Athens)

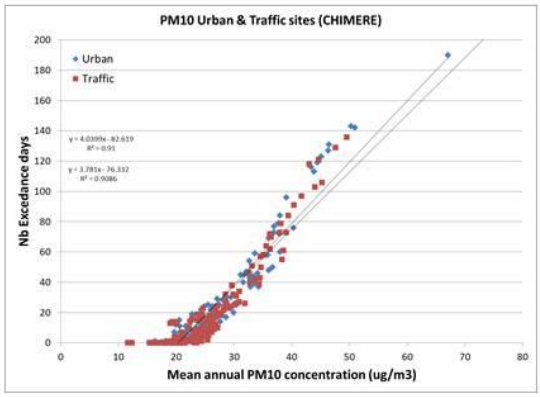
Model evaluation (IV): PM10 Exceedance days

Relation between PM10 annual mean and exceedance days > 50 micrograms

Observations



7 km model



- The limit value for exceedance days is more stringent than the one for annual mean PM10
- Strong correlation found between annual mean and number of days exceeding 50 µg/m3
- Relation holds for both Airbase traffic & urban background stations and model

Model evaluation (VI): NO2 and O3

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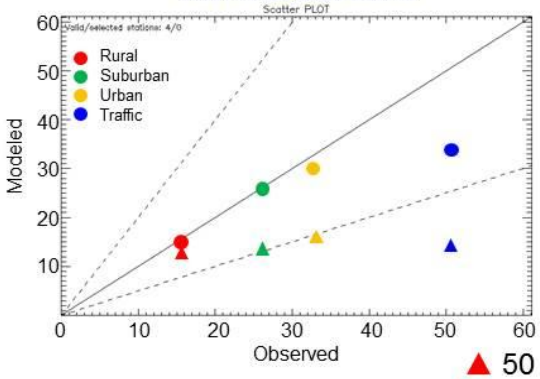
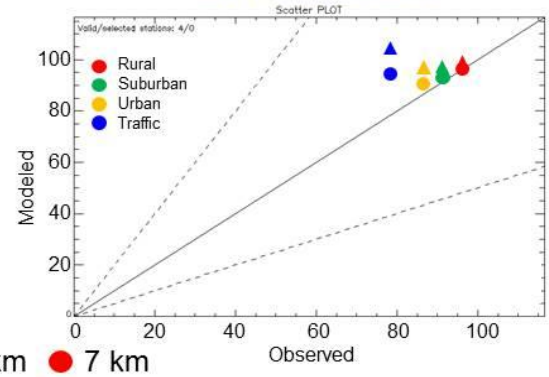
NO2 average (2009)
380 AIRBASE stations



O3 8h daily max average (2009)
250 AIRBASE stations



▲ 50 km ● 7 km

- Rural background can be modelled with 50km model
- Clear improvement for urban and suburban stations with 7 km
- 7 km resolution is not sufficient for traffic stations: need for a specific approach

- Rural and suburban background accurately modelled with 50km resolution
- Improvement for urban stations with 7 km
- Clear but insufficient improvement at traffic sites.

Conclusions

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- **New input data and finer-scale models have led to improvements in estimating exceedance of air quality limit values at the European scale.**
- **A specific approach is currently developed to address NO2 at traffic sites.**
- **Improved post-processing and QA/QC of input/monitoring data have improved model performance. Diagnostic FAIRMODE tools are useful in highlighting problematic areas**
- **New methodology will be implemented in GAINS and applied to all stations where exceedances have been reported**
- **Limitations:**
  - **Quality of monitoring data (link to AQUILA)**
  - **Accuracy of gridded emission data (esp. for domestic sources → MACC)**
  - **Inter-annual meteorological variability**
- **Next steps:**
  - **Workshop to present results in detail and compare with other approaches (March 8-9, Paris)**
  - **Multi-model assessment exercise: *'What is the contribution of local/national/regional sources to the exceedence of air quality limit value?'* – *draft results by September 2012***

AQUILA contribution to EU air policy review

A. Borowiak (JRC)

The AQUILA Network was founded in 2001 and is composed of the National Air Quality Reference Laboratories of the EU Member States. Accession Countries are participating as observers and other organisations are involved as associated members, like the World Health Organisation Collaborating Centre, the European Environmental Agency and its Topic Centre on Air Quality. The chair is elected every 4 years among the Member States representatives, and is supported by permanent co-chairs from DG ENV and the Joint Research Centre. More information, meeting minutes, recommendations and other useful documents can be found at
http://ies.jrc.ec.europa.eu/aquila-homepage.html

Based on its competence in the fields of measurements, metrology and the role of reference laboratories, the AQUILA Network identified 17 items where in current air policy clarification and improvement is wished. The list of 17 items was discussed during the 17th AQUILA meeting in October 2011 and comprises the following:

- clarify procedure and impact of quality assurance programs organized at EU level,
- facilitate recognition of type approval of measurement devices,
- improve definition of roles and responsibilities of National Reference Laboratories,
- review of data quality (uncertainty, etc) for all air pollutants,
- review rural background measurements: inconsistencies between AQD and EMEP,
- advise on improved siting criteria/classification/representativeness of monitoring stations,
- how to perform or improve measurements of ozone precursors, mercury, PAH and NH_3,
- advise on deposition measurements of PAH and metals.

The AQUILA Network has planned to discuss a first draft proposal of all 17 discussion items and to agree on a final draft during its next meeting in March 2012. The Stakeholder Expert Group, consulted by DG ENV for the review of air policy, shall receive in due time the final draft positions of AQUILA for further discussions.

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Contribution from AQUILA to Air Policy Review

AQUILA - Network of Air Quality Reference Laboratories

Annette Borowiak

Joint Research Centre (JRC)

Institute for Environment and Sustainability (IES)

Air & Climate Unit

annette.borowiak@jrc.ec.europa.eu

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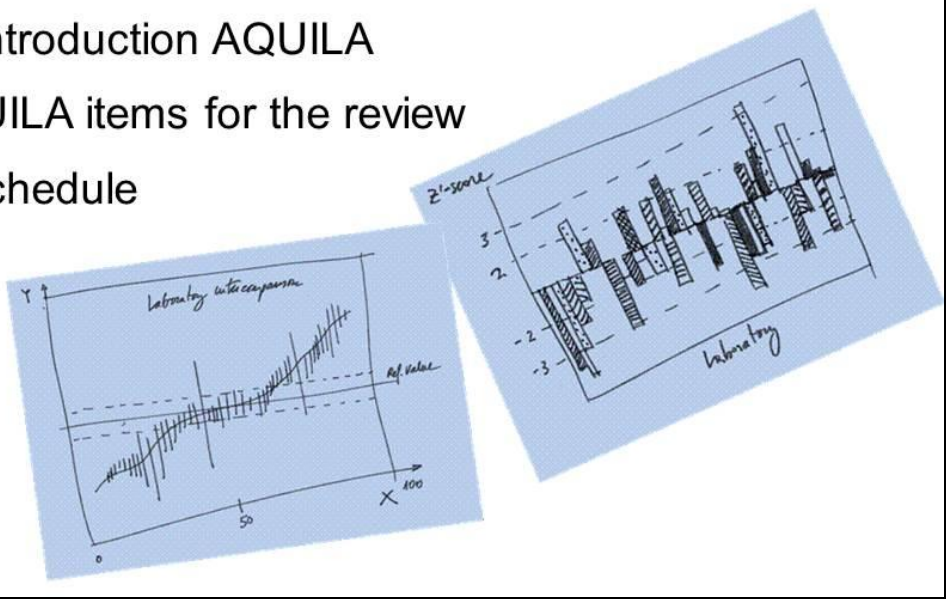
Structure of presentation

- Short introduction AQUILA
- 17 AQUILA items for the review
- Time schedule



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SEG Meeting 19+20 January 2012 3

AQUILA

Air Quality Reference Laboratories

Network Members:
37 National Reference Laboratories from the 27 Member States & CH, NO, IS

Observers : Croatia, Macedonia, Serbia and Turkey
Associated Members: WHO CC, EEA and EEA-ETC ACC

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AQUILA: meetings

1st meeting: December 2001

⬇

18th meeting: March 2012

focussing on, e.g.:

- **Accreditation of NRL's**
- **Common PM equivalence tests**
- **Development of CRM**
- **Training on measurement uncertainty**
- **PM2.5 measurement uncertainties**

17th and 18th meeting dedicated to input for review of Air Policy: **measurements & metrological aspects**

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17 AQUILA items: 1 - 5

1) "Quality assurance programmes organised by the Commission" (Article 3, Annex I C.)
- Intercomparison exercises at JRC's European Reference Laboratory for Air Pollution (ERLAP).
- Directive text needs clarification (definition of "active participation", impact of failure).
- Link with ISO 17025 and other Directive's requirements.

2) "Approval of measurement systems" (Article 3 and Annex VI E.)
- Mutual acceptance of type approvals: Advise on review of Annex VI E.
- Propose setting up of acceptance criteria/check list.
- Validity of "old" instrumentation if European Norms outdated?

3) Roles and responsibilities of "competent authorities and bodies" (Article 3)
- Provide recommendations for review of definitions in Article 3 of 2008/50/EC + Annex.
- Advise on possibility/responsibility for National Reference Laboratories to check regional networks.

4) Data quality all pollutants **(2008/50: Annex I, 2004/107: Annex IV)**
- Measurement quality of historical data (AIRBASE) compliant?
- Provide support to revision of Data Quality Objectives (like uncertainty).

5) Terms and definitions (Article 2 and beyond)
- Advise on reviewing certain definitions e.g. data capture, time coverage, individual measurement, representativeness, objective estimation, natural sources, etc.

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17 AQUILA items: 6 - 9

6) Measurements at rural background stations (Article 6-5., Annex IV): Ions
- Highlight differences between Directive and EMEP, eliminate inconsistencies where possible and suggest harmonised approach.

7) Elemental Carbon/Organic Carbon (Article 6-5., Annex IV, "Whereas" (8))
- CEN awaiting mandate from Commission for validating standard method.
- Current monitoring situation Black Carbon/Elemental Carbon in EU?
- Summarise results of inter-comparison exercises EUSAAR (FP 6) and AQUILA.
- Suggest how to eliminate inconsistencies in sampling for Directive and EMEP.
- Advise on definition of pollutant.

8) Classification (Article 7/10, Annex III/VIII)
- Recommend clarifications on definitions of station classifications (traffic, urban, etc).
- Give advice on siting for the measurement of Average Exposure Indicator.

9) Representativeness/classification (Annex III/VIII)
- Suggest clearer macro/microscale siting criteria.
- Representativeness important issue for model validation.
- Link to FAIRMODE (modelling) & GMES.

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17 AQUILA items: 10 - 13

10) Ozone precursors (Annex X, Article 11.2)
- Give an opinion on a reviewed list of ozone precursor compounds.
- Advise on reference measurement technique(s).

11) Average Exposure Indicator (Article 15)
- Discuss establishment of uncertainty of AEI.
-Can an exposure reduction be measured with current PM2.5 measurement uncertainties?
- Check with IPR: number of monitoring stations,more advise on averaging/weighting?
- Recommend on accounting for moving or closing sites.

12) EN standards use & impact of revision of EN standards (Article 8, Annex VI)
- Guide for Demonstration of Equivalence & EN standard & IPR.

13) Guidance on Natural Sources (PM and other pollutants) (Article 20)
- Guidance document sufficient?
- Give an opinion on definition of natural sources.

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17 AQUILA items: 14 - 17

14) Mercury (2004/107/EC)
- Review currently performed measurements (in PM, gaseous Hg, speciation of Hg).
- Advise on monitoring places/siting.
- Recommend monitoring techniques (EN for gaseous Hg) and reference materials.

15) Deposition measurements (2004/107/EC)
- Feedback on current EN standards (Hg, HM, PAH deposition).
- Advise on sampling equipment.
- Establish synergies with EMEP monitoring.

16) Polycyclic Aromatic Hydrocarbons (PAH) (2004/107/EC)
- Limit value needs decimal (1,0 ng/m^3).
- Clarify reference method: sampling with or without scrubber?
- Suggest revised data quality objectives in Annex IV.

17) NH3 (g) measurements
- State of the art measurement techniques.

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AQUILA: timing

- Draft outline by November 2011 to all involved AQUILA members.
- The full "paper" (1 – 3 pages) shall be submitted for all 17 points to all AQUILA by end February.
- At the next AQUILA meeting in March 2012 draft proposal should be produced.
- Final draft to be circulated to the *next* Stakeholder Expert Group.

AQUILA Air Quality Reference Laboratories

FAIRMODE

S.Galmarini (JRC)

Within the review of the Air Quality Directive (AQD), the Joint Research Centre (JRC) and the European Environment Agency (EEA) were asked to put together a joint task aiming at identifying the role of models in the current AQD, how the current legislation was interpreted and used, what aspects needed to be improved and how models could better be used in support to regulatory applications. (Slide #1).

Air quality models have long demonstrated to have reached a level of maturity that can be used to assist with the assessment of compliance with air quality standards and planning of measures to improve critical situations (Slide #2).

The EEA (/European Topic Centres), contribution consisted in the compilation of technical reports in which the current legislation was analysed and interpreted from the point of view of AQ model users (see slide #8). These relate to specific AQD pollutants as well as outlining unclear points in the current legislation.

The JRC contribution to the actions was mainly related to exploring what the research activities performed since the issuing of the current legislation have produced and how the latter can serve in filling the gaps currently present in the directive. In particular four aspects where analysed. The JRC other than coordinating the working group contributed to the source apportionment subgroup, the definition of new air quality objectives and model benchmarking procedure development.

The draft recommendations (slide #4) presented aimed at increasing the role of models in support to regulatory applications requested by EU legislation and toward a better determination of human and ecosystem exposure. Three main aspects were indicated as needing improvement provided that other two are considered as well. Namely:

- The necessity of better specifying in the AQD when and how a model should be used. In support to this recommendation the EEA report "The application of models under the European Union's Air Quality Directive: A technical reference guide" represents an important FAIRMODE contribution. There in all unclear elements regarding this issue are clearly spelled out.

- The second aspect of the recommendations is that it should also be made clear whether models should be used mandatorily or not. This is a critical point that requires the specification that models would not be used in substitution of measurements but as complement. It is recognized that a very relevant added value can be obtained by the use of model in terms of space and time representation of exceedances, thus identifying, for example, areas in which they could be more severe although not observed. The combined use of model and monitoring should be more exploited.

- Whether the use of models is mandatory or not (third aspect), better model quality objectives should be specified and most of all they should be agreed upon and used by all member states (MS). Toward this scope the JRC has developed a new set of model quality objectives, clear in their formulation and comprehensive in their scope. They can be proposed as a common gauge for all MS against which all models can be compared. The new QOs have been organised in a model quality report that allows the presentation of a model performance in a concise and comprehensive way. Further to that, a model benchmarking procedure has also been devised (slide #7) that would, if applied, allow a centralised production of the abovementioned report and periodic model inter comparison activities. In such an activity all EU regulatory model users could come together to work on a common case and have a multi national comparison with other modelling groups. Such an activity will produce rapid improvements towards a harmonised use of models and comparable quality standards in model performance from country to country.

- The recommendations include also the fact that no model can be quality checked unless a comparable level of quality is guaranteed for emission inventories and efforts are made to harmonize the information and clarify the representativeness of monitoring networks for model evaluations. Examples of pitfalls were given for the two issues (slide #5 and #6).

Forum for Air quality Modelling
FAIRMODE
http://fairmode.ew.eea.europa.eu/

Joint response action of the European Environment Agency (EEA)
and the
European Commission Joint Research Centre (JRC):

- to bring together air quality modelers and users
- to promote and support the harmonised use of models by EU member states, with emphasis on their application to the European Air Quality Directive.

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European Environment Agency
SEG meeting, Brussels, 19-20/01/12 – Stefano Galmarini
FAIRMODE Forum for air quality modelling in Europe

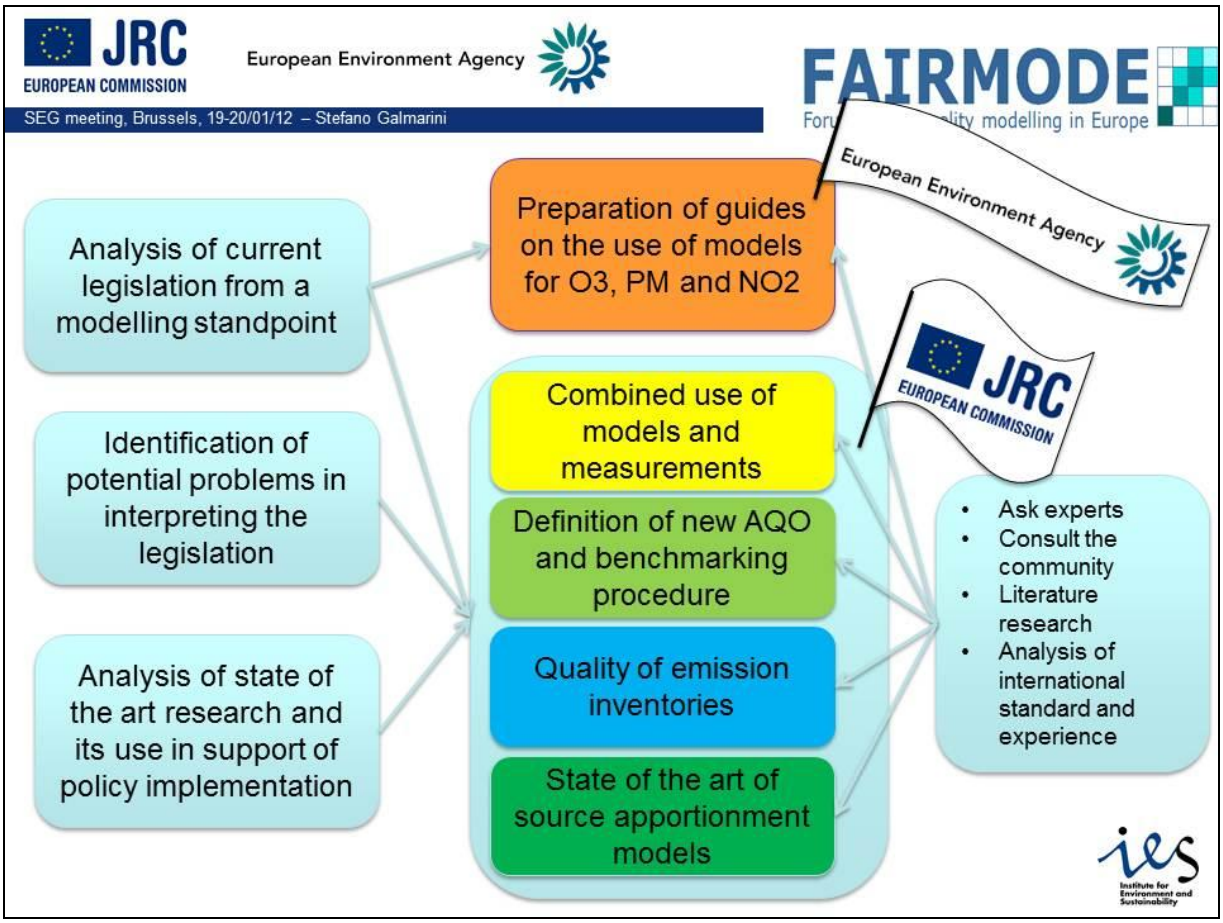
Activities

Application 1 (APP1):
Assessment of air quality levels to establish the extent of exceedances and establish the population exposure

Application 2 (APP2):
Forecasting air quality levels for short term mitigation and public information and warnings

Application 3 (APP3):
Source allocation to determine of the origin of exceedances and provide a knowledge basis for planning strategies

Application 4 (APP4):
Assessment of plans and measures to control AQ exceedances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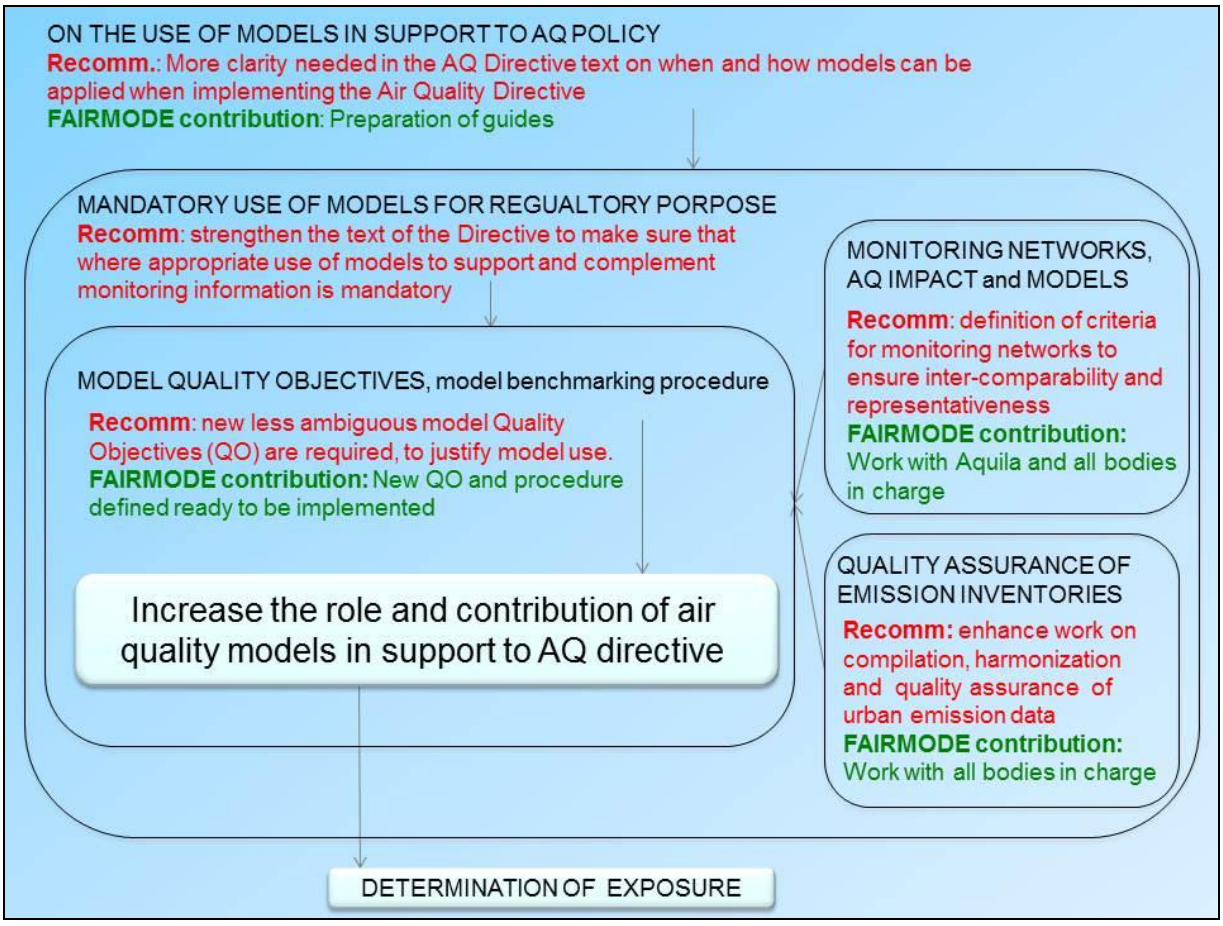
European Environment Agency
SEG meeting, Brussels, 19-20/01/12 – Stefano Galmarini
FAIRMODE
Analysis of current legislation from a modelling standpoint
Identification of potential problems in interpreting the legislation
Analysis of state of the art research and its use in support of policy implementation
Preparation of guides on the use of models for O3, PM and NO2
Combined use of models and measurements
Definition of new AQO and benchmarking procedure
Quality of emission inventories
State of the art of source apportionment models
Ask experts
Consult the community
Literature research
Analysis of international standard and experience


ON THE USE OF MODELS IN SUPPORT TO AQ POLICY
Recomm.: More clarity needed in the AQ Directive text on when and how models can be applied when implementing the Air Quality Directive
FAIRMODE contribution: Preparation of guides
MANDATORY USE OF MODELS FOR REGUALTORY PORPOSE
Recomm: strengthen the text of the Directive to make sure that where appropriate use of models to support and complement monitoring information is mandatory
MODEL QUALITY OBJECTIVES, model benchmarking procedure
Recomm: new less ambiguous model Quality Objectives (QO) are required, to justify model use.
FAIRMODE contribution: New QO and procedure defined ready to be implemented
Increase the role and contribution of air quality models in support to AQ directive
MONITORING NETWORKS, AQ IMPACT and MODELS
Recomm: definition of criteria for monitoring networks to ensure inter-comparability and representativeness
FAIRMODE contribution: Work with Aquila and all bodies in charge
QUALITY ASSURANCE OF EMISSION INVENTORIES
Recomm: enhance work on compilation, harmonization and quality assurance of urban emission data
FAIRMODE contribution: Work with all bodies in charge
DETERMINATION OF EXPOSURE

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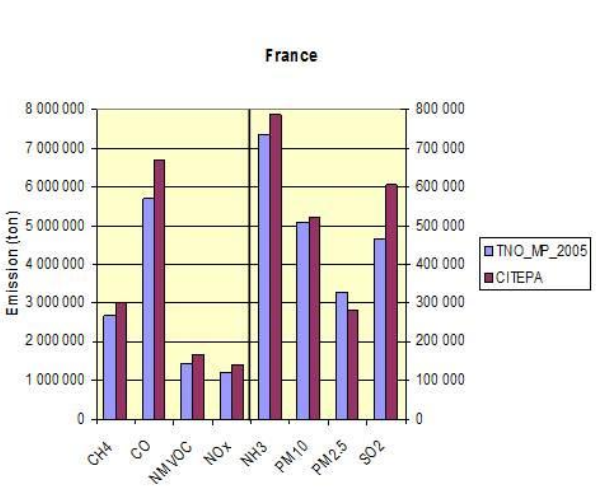
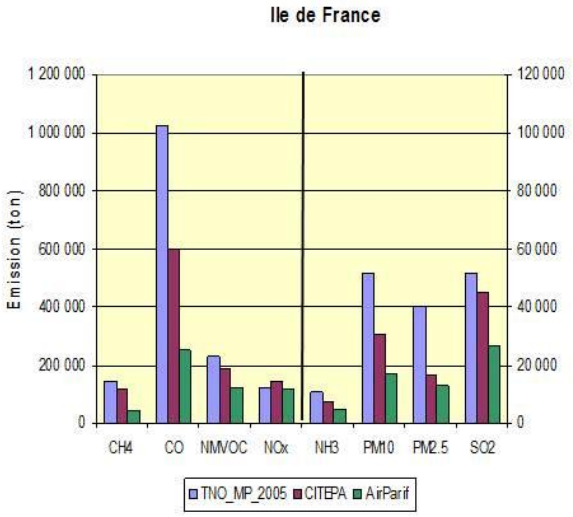
QUALITY ASSURANCE OF EMISSION INVENTORIES

(in)consistencies across scales of emission inventories (EIs)

Example: case study France (left) – Paris (right) *Y-axis)*





Hugo Denier van der Gon (TNO)

Megacity & regional emissions – Results of FP7 MEGAPOLI

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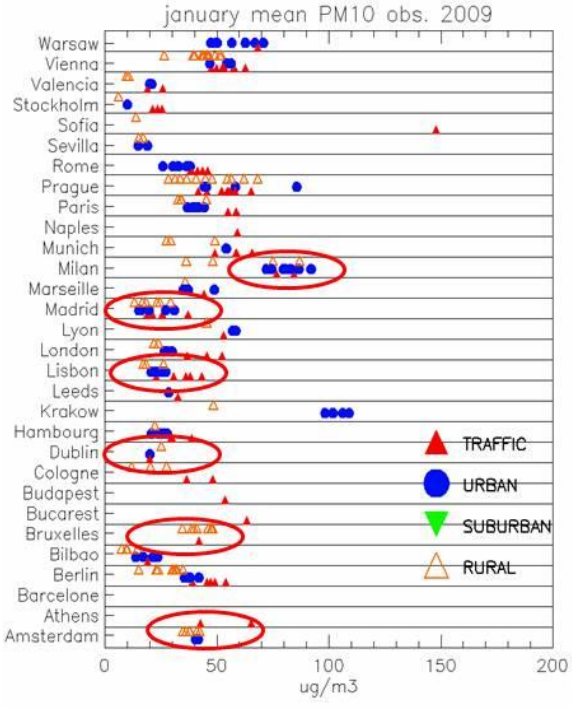
MONITORING NETWORKS, AQ IMPACT and MODELS



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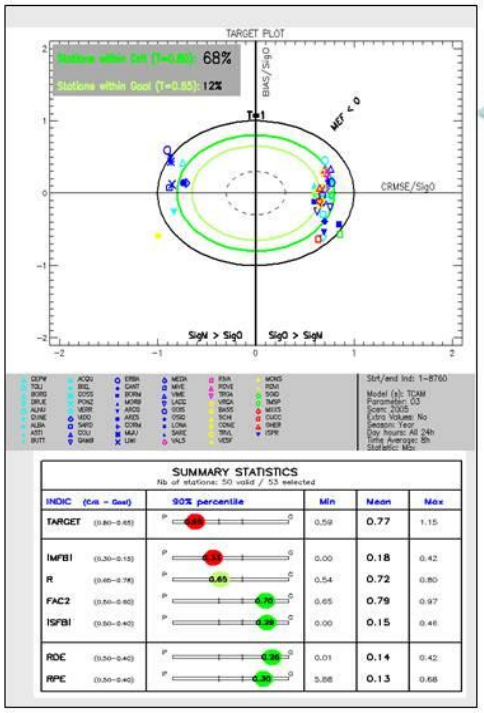
MODEL QUALITY OBJECTIVES & Model benchmarking procedure



- New Quantitative AQ objectives defined
- A standardised comprehensive summary of individual model performance
- A common quality scale that can be used in all MS
- Stand alone software reporting tool (DELTA Tool)
- Standard procedure:

- where member states can submit model data and generate an "official" model quality report.

- allows model evaluation studies on common case study by all MS using the JRC ENSEMBLE model evaluation platform

ENSEMBLE

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The FAIRMODE Guides

Input to current recommendations

EEA Technical Report in 2011 "The application of models under the European Union's Air Quality Directive: A technical reference guide"
http://www.eea.europa.eu/publications/fairmode

ETC/ACM Technical Paper in 2011 "Modelling of Nitrogen Dioxide (NO_2) for air quality assessment and planning relevant to the European Air Quality Directive"

Future input

ETC/ACM working papers on modelling PM and reporting modelling results under the AQ Directives in 2012

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SEG meeting, Brussels, 19-20/01

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List of abbreviations

AQD: Air Quality Directive

TSAP: Thematic Strategy for Air Pollution

DG ENV: The Directorate-General for Environment of the European Commission

DG RI: The Directorate-General for Research and Innovation of the European Commission

NGO: Non-governmental organization

WHO: World Health Organization

EEA: European Environmental Agency

IIASA: International Institute for Applied Systems Analysis

PM: Particulate Matter

SEG: Stakeholder Expert Group

BC: Black Carbon

UNEP: United Nations Environment Programme

WMO: World Health Organization

EMEP: European Monitoring and Evaluation Programme

POP: Persistent Organic Pollutant

US-EPA: US Environmental Protection Agency

UNECE: United Nations Economic Commission for Europe

LRTAP Convention: Convention on Long-range Transboundary Air Pollution

INERIS: French National Institute for Industrial Environment and Risks

QO: Quality Objective

PAH: Policyclic Aromatic Hydrocarbons

European Commission

EUR 25283 EN– Joint Research Centre – Institute for Environment and Sustainability

Title: Support to the review of the Thematic Strategy on Air Pollution: JRCs contribution to the 2nd Stakeholder meeting January 2012

Author(s): A. Borowiak, S. Galmarini, J. Hjorth, P. Thunis, R. Van Dingenen and F. Dentener

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Abstract

Although efforts of the EU to reduce air pollution have led to important reductions of emissions within the Member States, millions of people are still exposed to air pollutants at concentration levels that may endanger their health and air pollution is still causing relevant damage to crops and ecosystems. On this background, the European Commission has decided to review its Thematic Strategy for Air Pollution (TSAP) by 2013 at latest, and do this through a consultation process, led by DG ENV, with a broad group of stakeholders. The present report contains the presentations made by JRC staff at the second Stakeholder Meeting, held in January 2012.

The presentation by R. Van Dingenen discusses the possibilities of designing air pollution policies that also helps to mitigate climate change. Such policies are possible because many air pollutants, llike CO_2, are emitted by the burning of fossil fuels and some air pollutants have an important warming effect on climate.

F. Dentener presents an analysis of the impact of hemispheric transport of air pollutants, particularly for the case of tropospheric ozone. It is found that emissions outside of the European region have increasing influence on ozone trends in Europe.

The talk by P.Thunis links the European scale modelling with urban and street scale. The advantages of having high spatial resolution of models and emission inventories are discussed and the importance of good quality monitoring data is stressed.

A. Borowiak tells about the AQUILA network and its planned contributions to the review. The AQUILA Network was founded in 2001 and is composed of the National Air Quality Reference Laboratories of the EU Member States.

The Forum for Air Quality Modelling (FAIRMODE) is a joint action of the JRC and the Euorpean Environmental Agency. S. Galmarini illustrates the work of this body that aims at bringing together air quality modellers and users and promote the use of harmonized models within the EU.

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