
QUANTIFY

An overview on the QUANTIFY Integrated Project

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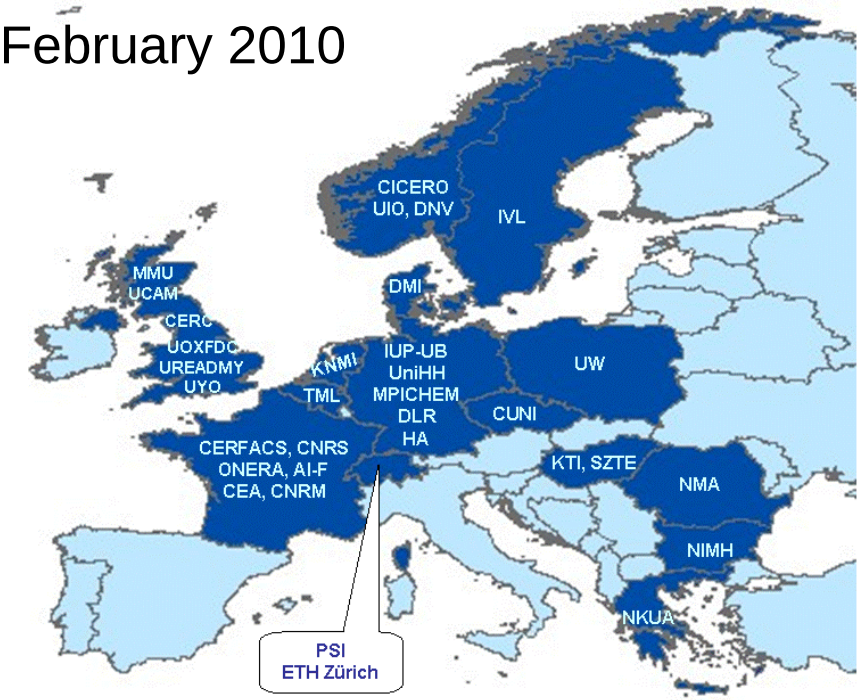
http://www.pa.op.dlr.de/quantify/

QUANTIFY

Quantifying the Climate Impact of global and European Transport Systems

Objective: To quantify the climate impact of the global and European transport systems for the present situation and for different scenarios of future development.

Co-ordinator: Sausen, DLR-IPA
Participants: 35 from 16 countries
Duration: March 2005 to February 2010
Funds: 8.0 M€
Total costs 12.0 M€



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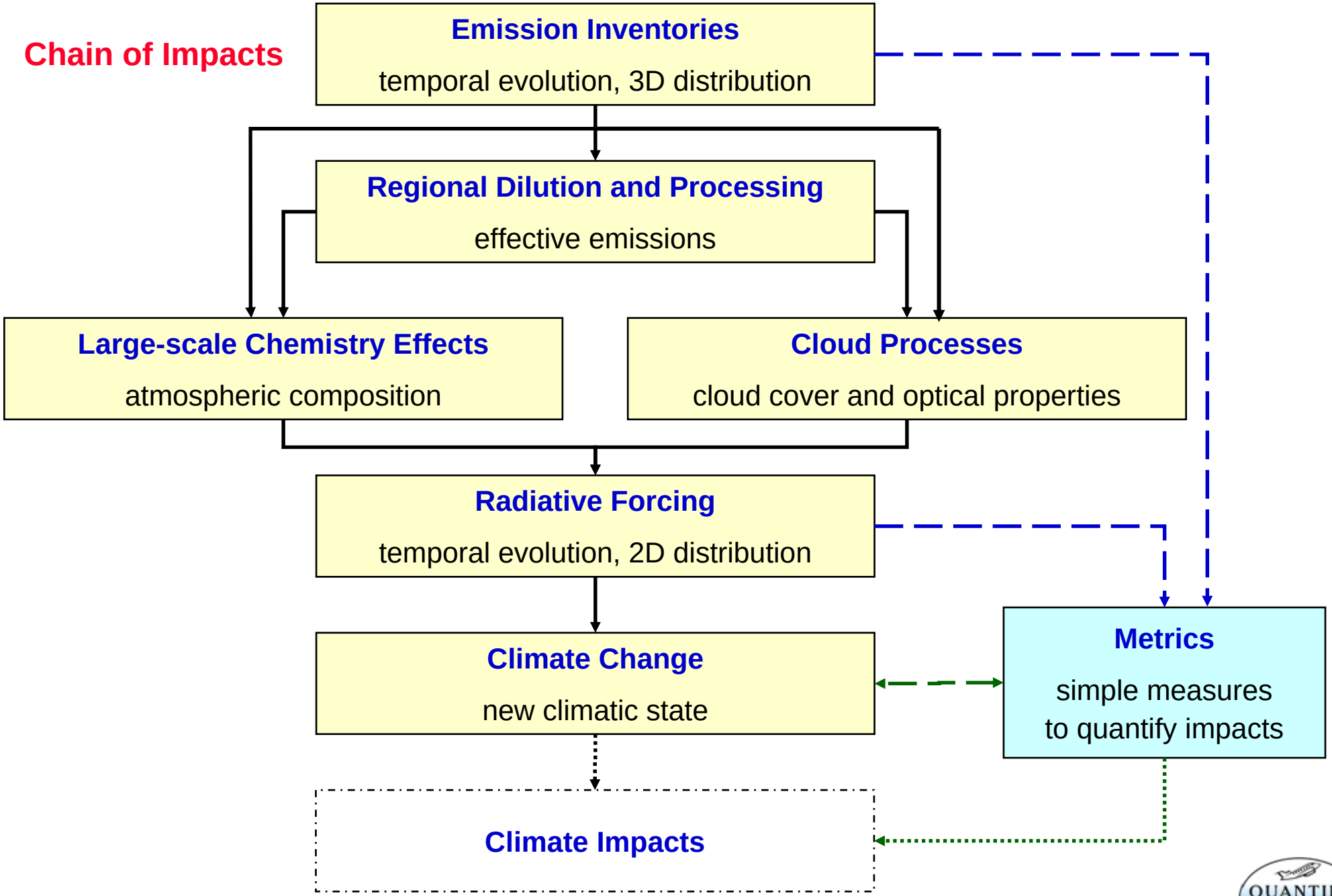
Impact of traffic emissions on climate

Change of the radiative forcing by

- the emission of greenhouse gases, including long-lived species like CO_2 and N_2O, but also of water vaour;
- the emission ozone precursors;
- the emission of particles and their precursors;
- triggering additional clouds (e.g., contrails contrail cirrus) and by modifying natural clouds (e.g., ship tracks).

Chain of Impacts



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Quantify

Structure

Activity 1
Emission Inventories

- **AC 1.1** Past & Pres. Transport
- **AC 1.2** Future Transport
- **AC 1.3** Validation Studies

Activity 2
Dilution & Processes

- **AC 2.1** Surface Transport
- **AC 2.2** Aircraft Plumes
- **AC 2.3** Ship Emissions
- **AC 2.4** Effective Emissions

Activity 3
Large-scale Chemistry

- **AC 3.1** Present Chem. Composition
- **AC 3.2** Model Improvement
- **AC 3.3** Future Chem. Composition

Activity 4
UTLS Data Sets

- **AC 4.1** Chem. Composition
- **AC 4.2** H_2O & O_3 Climatologies

Activity 5
Clouds

- **AC 5.1** Ship tracks
- **AC 5.2** Contrails and Contrail Cirrus
- **AC 5.3** Indirect Aerosol Effects

Activity 6
RF & Climate Change

- **AC 6.1** Radiative Forcing
- **AC 6.2** Climate Sensitivity
- **AC 6.3** Climate Modelling

Activity 7
Metrics

- **AC 7.1** Idealised GCM Integrations
- **AC 7.2** Climate Projections
- **AC 7.3** Metrics

Activity 8
Co-ord. & Synthesis

- **AC 8.1** Strategic Planning
- **AC 8.2** Synthesis
- **AC 8.3** Data Management
- **AC 8.4** Dissemination & Information

Activity 9
Management

- **AC 9.1** Project Office
- **AC 9.2** Administrative Management
- **AC 9.3** Training
- **AC 9.4** GAP

Activity 1: Transport Scenarios and Emission Inventories
(Gühnemann, Lee)

O1.1 To establish consistent global 3D/4D transport inventories of emissions for past and present, for different transport modes.

O1.2. To develop scenarios of emissions for future transport (by mode), which are consistent with IPCC SRES scenarios, and generate associated emission inventories.

O1.3 To evaluate the global top-down transport and emission inventories with regional bottom-up results for the European and the Asian regions, identify key factors, and quantify the uncertainties.

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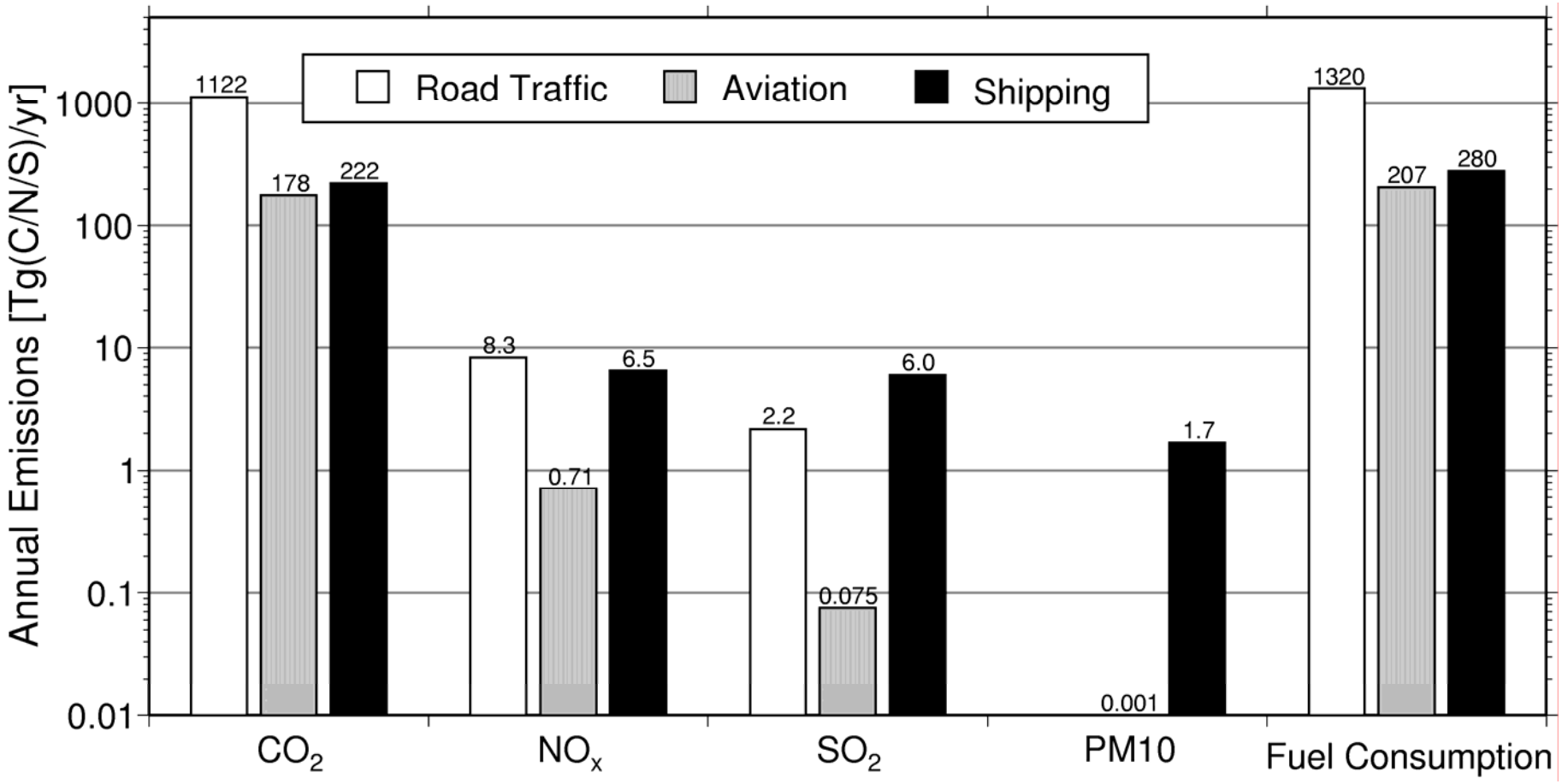
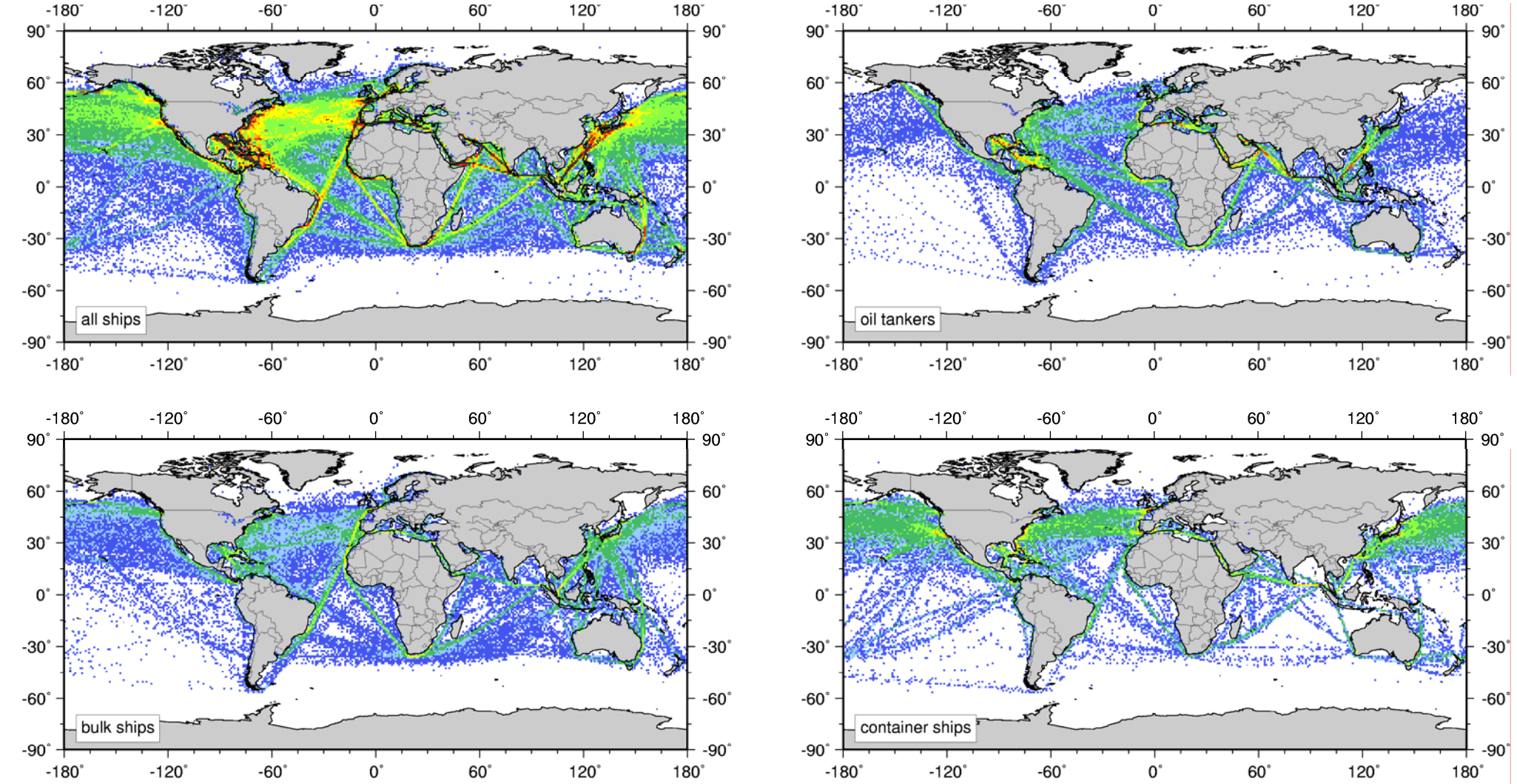
Emissions by different modes of transport



Eyring et al., 2005

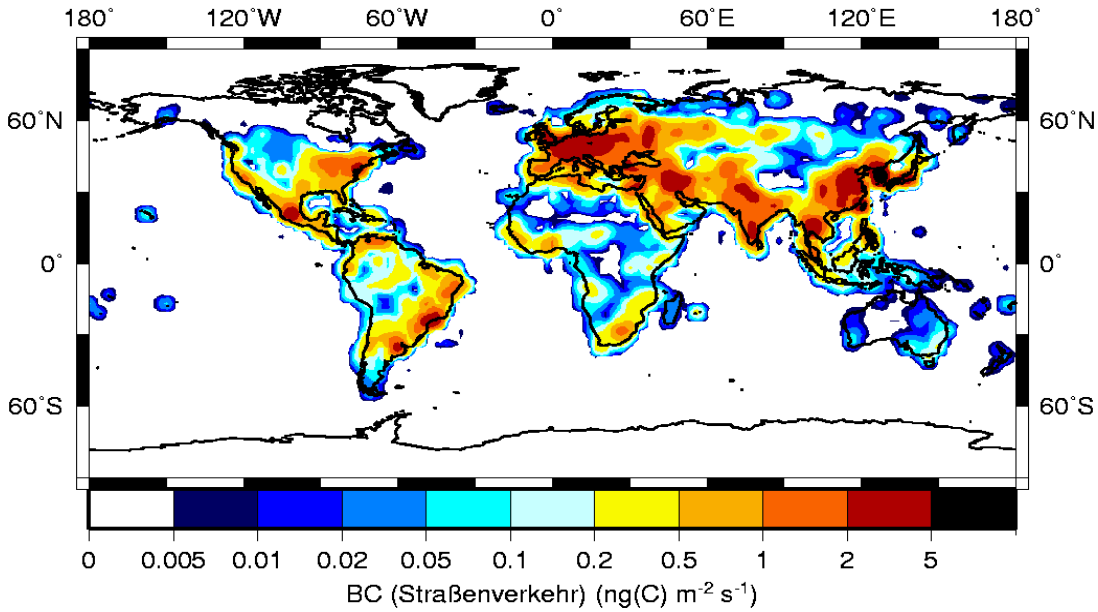
NO_x emissions by different types of ships in 2001



Eyring et al., 2005

BC emissions from road traffic

Horizontal distribution of surface emissions (T30)



Region	Source strength	Contribution
Europe	0.4 TgC/a	16%
North America	0.2 TgC/a	8%
Asia	0.9 TgC/a	38%
rest	0.9 TgC/a	38%
total	**2.4 TgC/a**	**100%**

Köhler et al., 2001

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Activity 2: Regional Dilution and Processing

(Cuenot, Halenka)

O2.1 To study in detail the dilution processes of the plumes and chemical transformations of pollutants generated by surface transport and aviation from the local scale to the scale of the global models.

O2.2 To calculate and propose parameterisations for "effective emission indices" linking emission inventories to the emissions to be used as input in large scale models.

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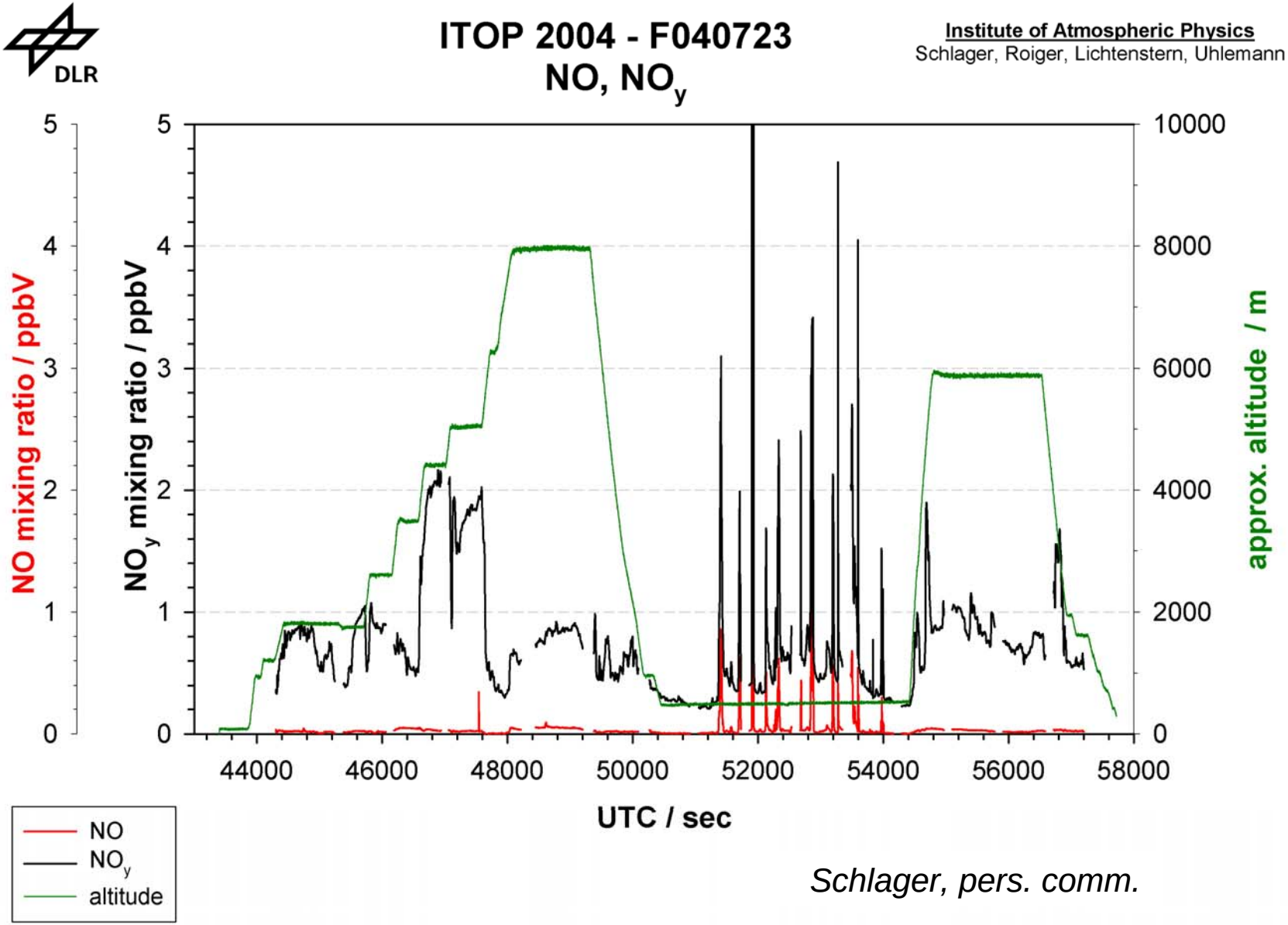
Airborne measurements of ship emissions



Schlager, pers. comm.

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Activity 3: Large-scale Chemistry Effects
(Isaksen, Van Velthoven)

O3.1 To prepare and apply global ACMs in atmospheric impact studies, with particular emphasis on processes in the UTLS region and the marine boundary layer.

O3.2 To estimate the current impact of the different transport sectors (aircraft, ships, land-based transport) on composition through global scale modelling and comparisons with observations.

O3.3 To estimate the future large scale effects from emissions from the transport sector.

O3.4 To investigate how undesirable effects can be reduced through control measures in different regions, and thereby to provide input for impact evaluation.

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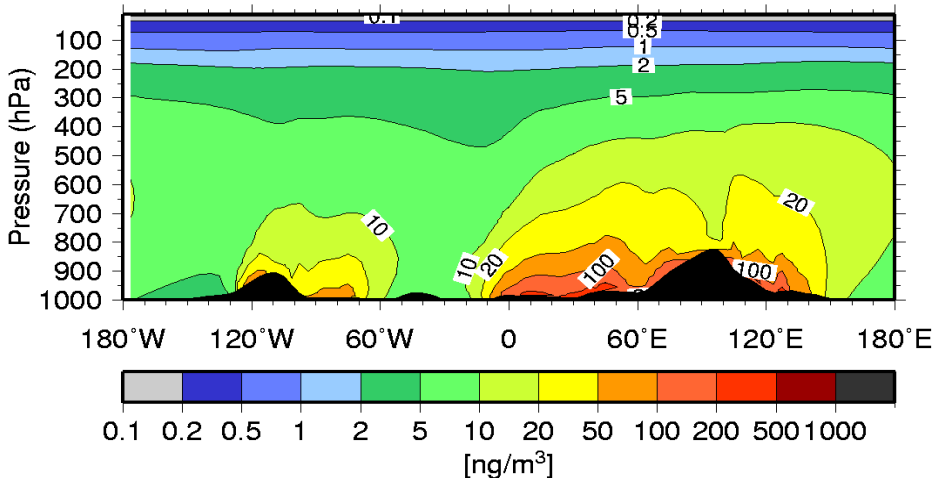
BC mass from road traffic

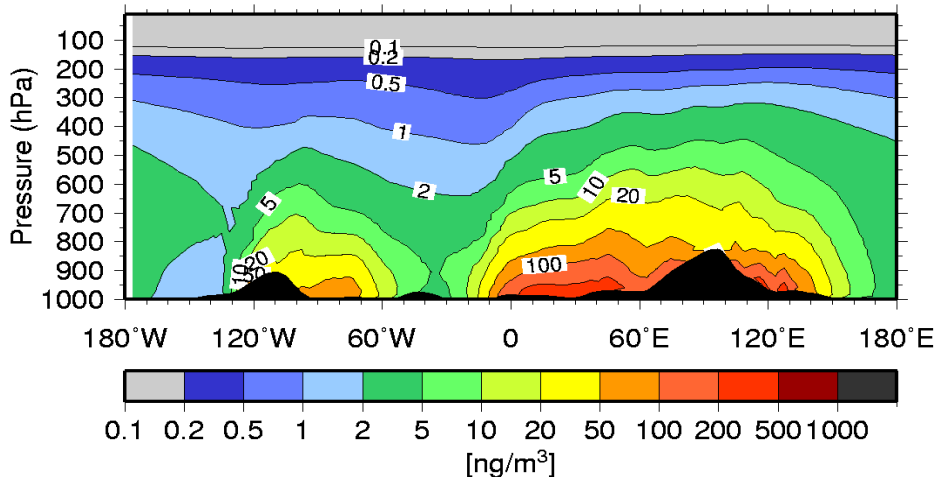
Meridional mean (30°N-70°N) of BC from road traffic

ECHAM4 with strongly simplified BC treatment



Köhler et al., 2001

ECHAM4/MADE (including aerosol dynamics)



Lauer et al., 2005

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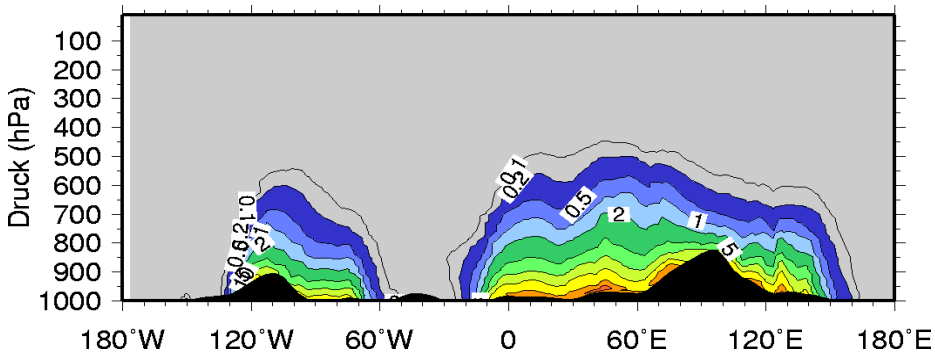
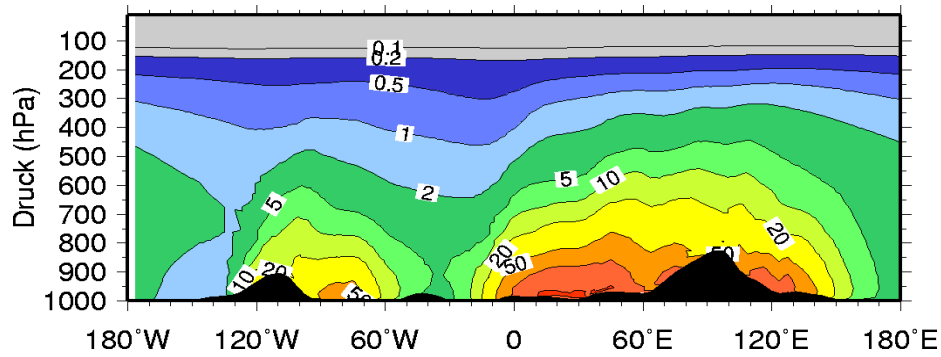
Size classes of BC particles from road traffic

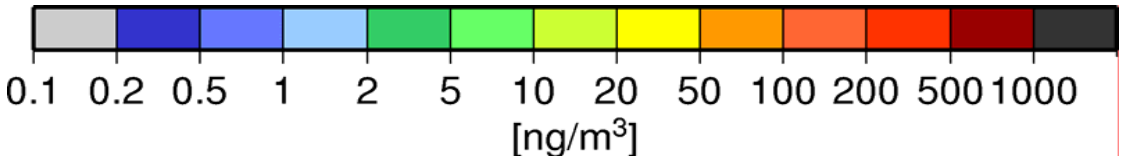
Meridional annual mean (30°N-70°N)

Aitken mode (< 0.1 μm)



accumulation mode (> 0.1 μm)





Lauer et al., 2005

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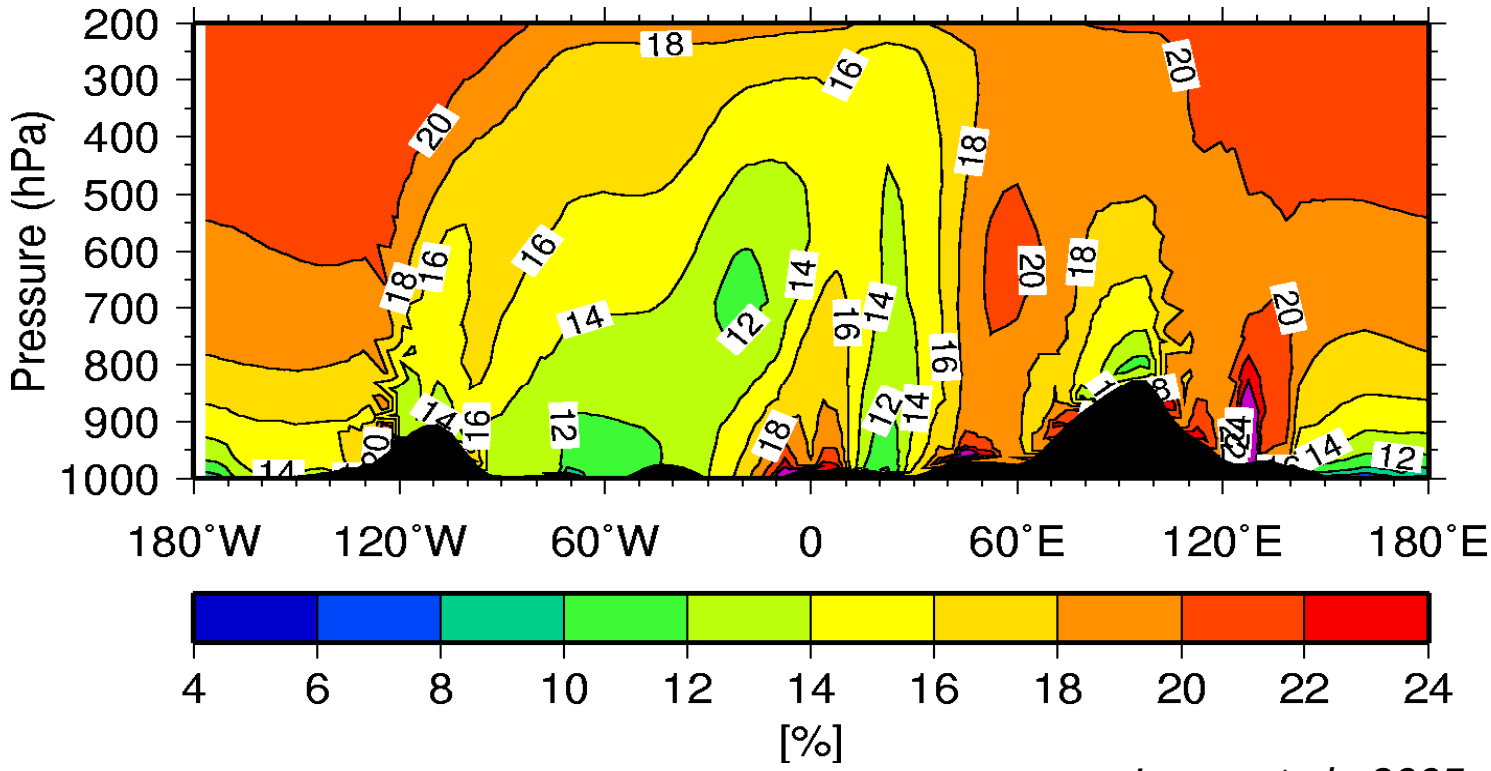
Contribution of road traffic BC emissions

Meridional annual mean (30°N-70°N)

$BC_{road\ traffic}/BC_{total}$



Lauer et al., 2005

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Activity 4: Long-term Data Sets of UTLS Compounds

(Lelieveld, Harris)

O4.1. To collect and analyse chemical measurement data, including water vapour, ozone, nitrogen oxides, carbon monoxide, carbonyls, halocarbons and hydrocarbons.

O4.2. To test chemistry-transport and climate models, with the goal of establishing a validated model-data system to perform emission scenario simulations.

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Activity 5: Aviation, Shipping and Clouds
(Zerefos, Gierens)

O.5.1 To determine the effects of emissions from shipping and aviation on cloud properties and cloud cover and to study their variability in space and time.

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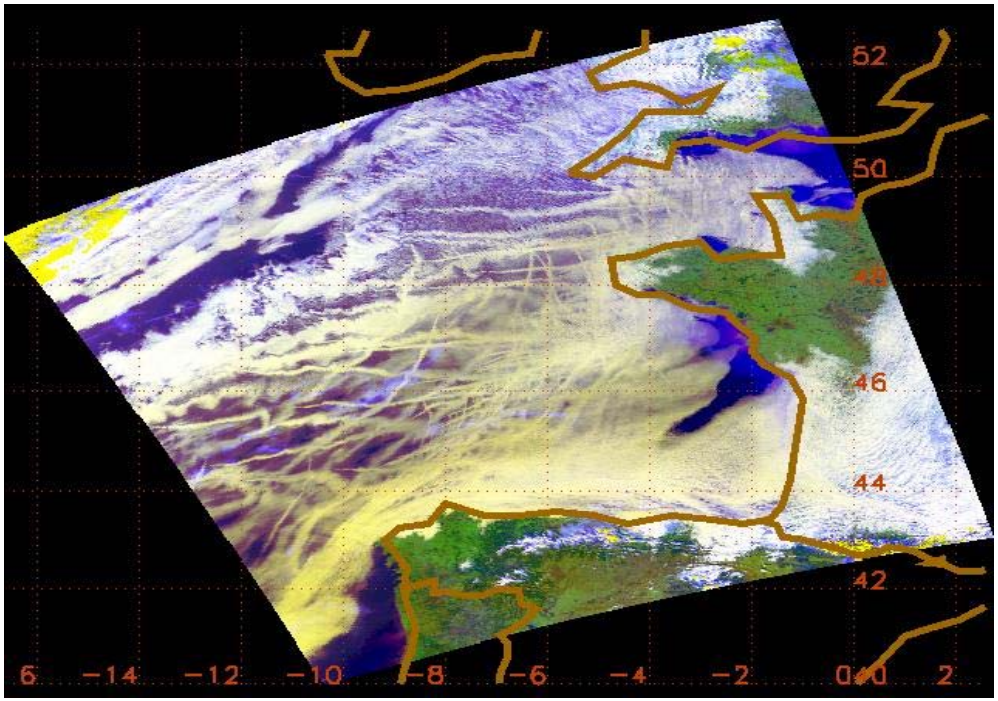
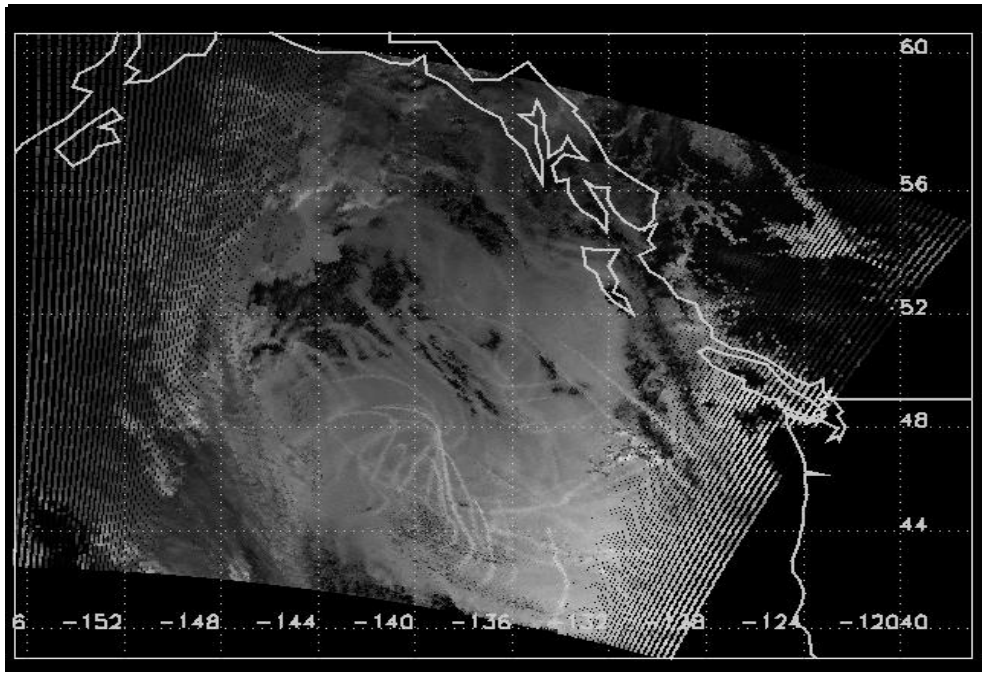
Shiptracks

Formation of new clouds



AVHRR (1, 2, 6), 2003/01/27, 13:30 UTC

Occurrence in stratiform clouds



MODIS (7), 2003/02/10, 20:25 UTC

Schreier, pers. comm.

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Activity 6: Radiative Forcing and Climate Change
(Shine, Cariolle)

O6.1 To determine the radiative forcing from traffic-induced changes in atmospheric (and surface) parameters including the separation of the contributions from different modes of trans-port; to estimate how this forcing has evolved over the past 100 years and how it may change over the next 100 years; to quantify the uncertainty in radiative forcing to poorly known parameters.

O6.2 To determine the spatial and temporal patterns of traffic-induced climate change over the past 100 years and how it may change over the next 100 years, and to determine if there is a specific climate fingerprint which is distinct from other causes of climate change.

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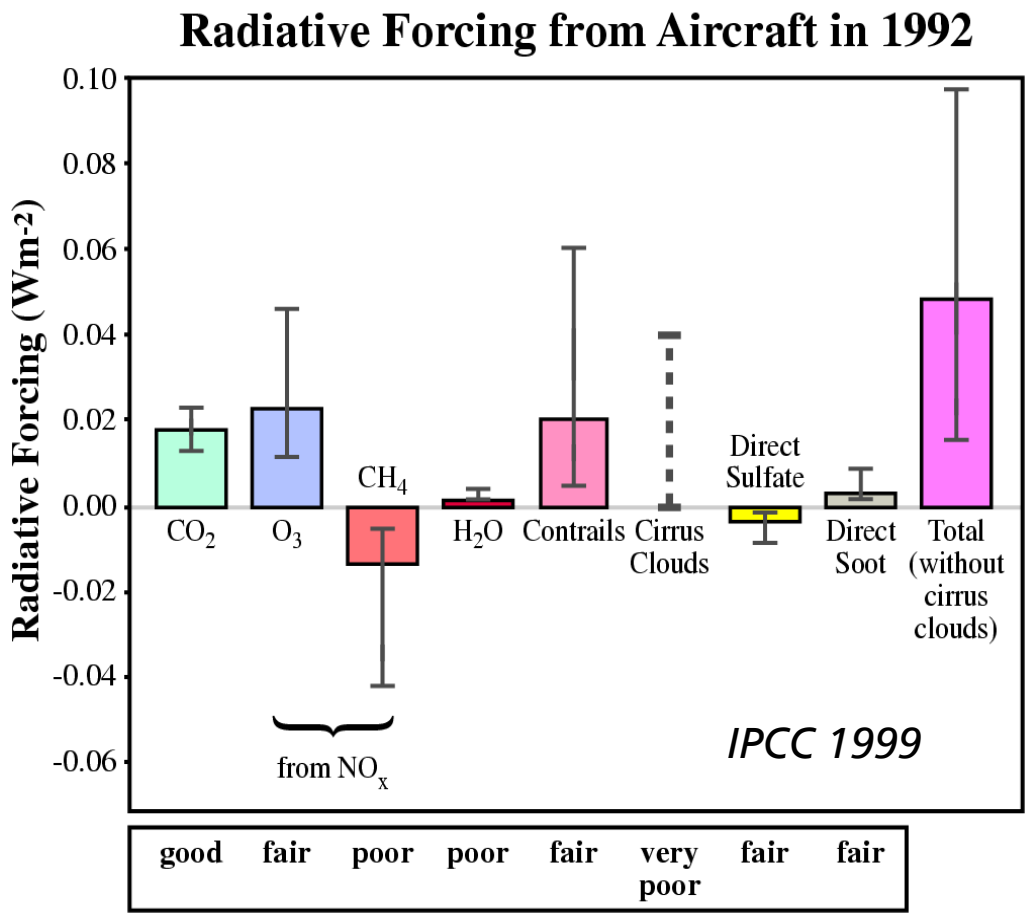
Radiative Forcing *RF* and Surface Temperature Change ΔT_s

IPCC: $\Delta T_s = \lambda\, RF$

climate sensitivity parameter: constant, i.e., independent of forcing, but model dependent



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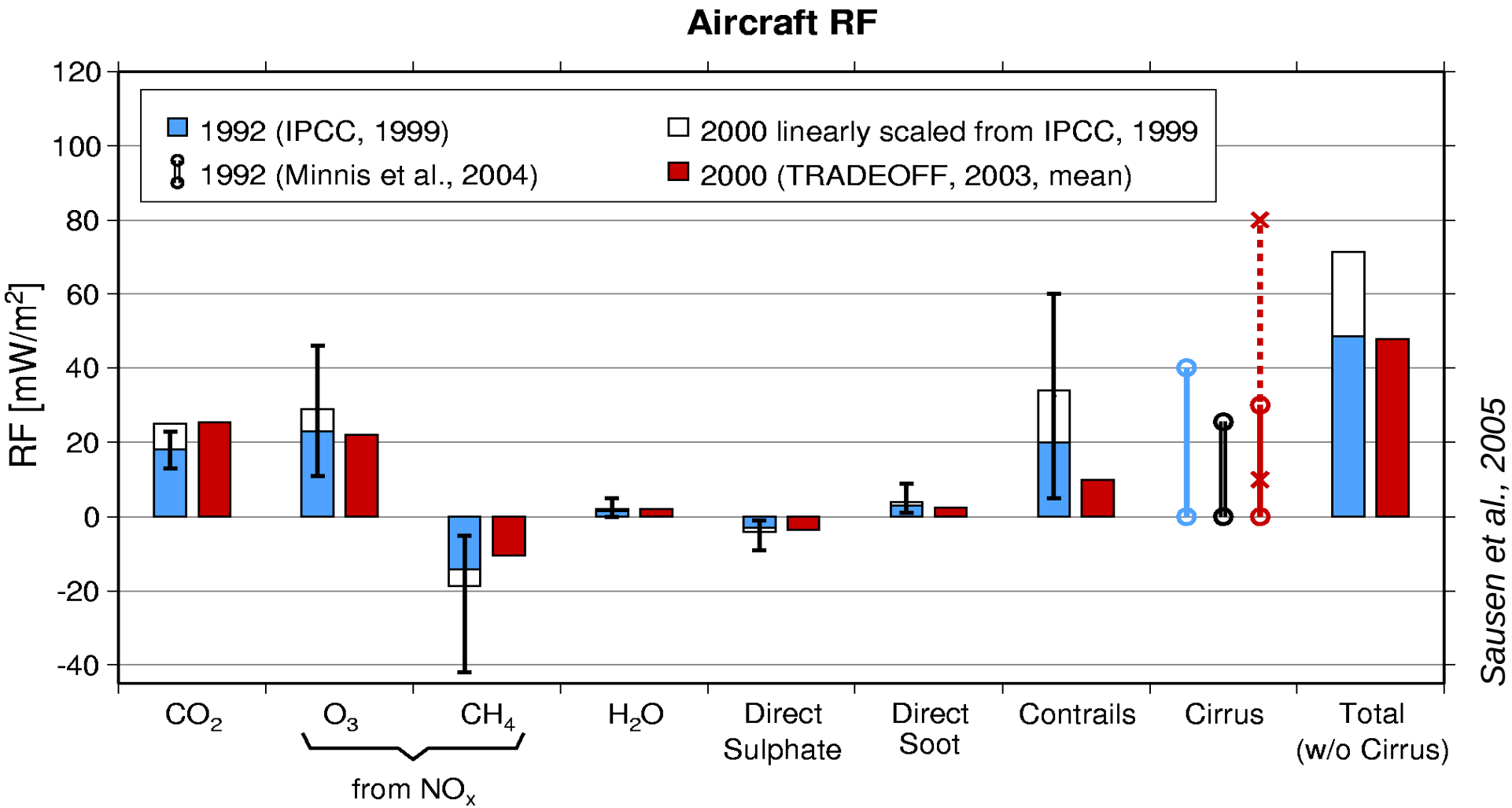
Updated Aviation Radiative Forcing for 2000



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Activity 7: Metrics

(Fuglestvedt, Makra)

O7.1. To calculate global and regional climate change throughout the 21st century for different assumptions about emissions from the transport sector.

O7.2. To build on the GCM calculations in Activity 6 to quantify and compare historical and fu-ture contributions to global temperature change from transport, but incorporating, in a com-mon framework, the impact of key uncertainties.

O7.3. To develop and evaluate policy relevant metrics that include all climate-relevant emissions, both long- and short-lived atmospheric constituents and homogeneous and inhomogeneous forcings of both signs. Regional variations in the global effects of emissions as well as varia-tions in the magnitude and nature of the regional responses will be taken into account.

O7.4 To apply metrics to compare the climate effects of different modes of transport and mitigation options.

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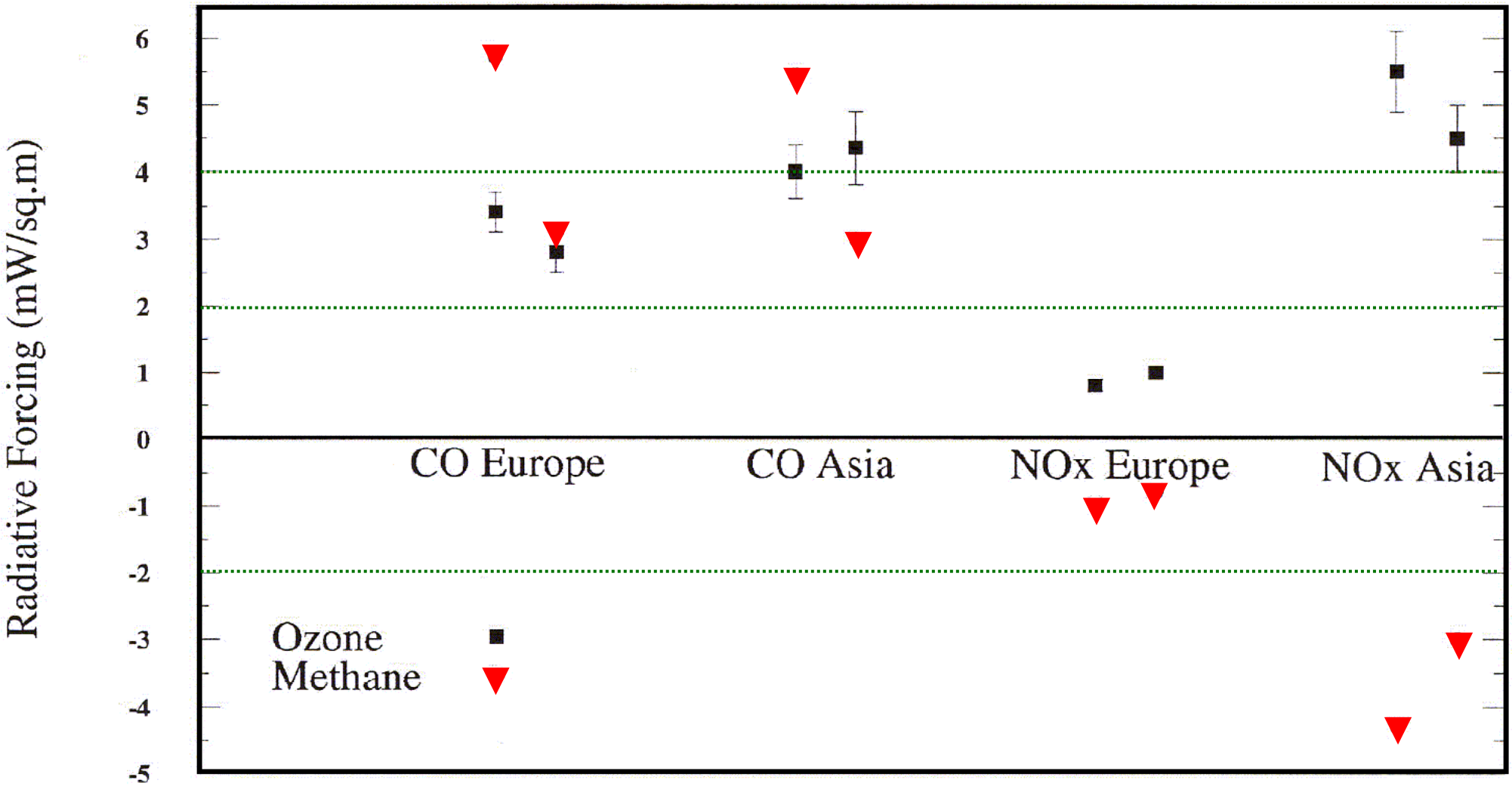
Radiative forcing from O_3 and CH_4 [mW/m^2], annual mean



Berntsen et al., 2004

Activity 8: Co-ordination and Synthesis

(Sausen, Dotzek)

O8.1 To ensure efficient organisation of QUANTIFY, timely exchange of information with the partners, the EC and relevant third parties (including knowledge management), and quality control

O8.2 To endorse an optimum decision making structure

O8.3 To enforce the QUANTIFY project by a strategic planning towards the main goal of the project

O8.4 To produce a QUANTIFY synthesis report and an assessment report on the climate effects of transport

O8.5 To collect and maintain common data in QUANTIFY data achieve

O8.6 To manage dissemination of public information

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Activity 9: Management
(Dotzek, Sausen)

AC 9.1 Project Office (Dotzek)

AC 9.2 Administrative management (Dreweck)

AC 9.3 Training (Uherek)

AC 9.4 Gender Action Plan (Highwood)

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Duration of project

Activity	year 1	year 2	year 3	year 4	year 5
A1 - A7					
A8 (Co-ordination)					
A9 (Management)					

Start of project: 1 March 2005

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Further information

http://www.pa.op.dlr.de/quantify/

(http://www.quantify.eu/)

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