

# Proceedings of an International Conference on Transport, Atmosphere and Climate (TAC)

Oxford, United Kingdom, 26<sup>th</sup> to 29<sup>th</sup> June 2006



Edited by

Robert Sausen, Anja Blum, David S. Lee and Claus Brüning



Department for  
**Transport**



<http://www.pa.op.dlr.de/tac/proceedings.html>

Edited by

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## Foreword

The "International Conference on Transport, Atmosphere and Climate (TAC)" held in Oxford (United Kingdom), 2006, was organised with the objective of updating our knowledge on the atmospheric impacts of transport, three years after the "European Conference on Aviation, Atmosphere and Climate (AAC)" in Friedrichshafen (Lake Constance, Germany).

While the AAC conference concentrated on aviation, the scope was widened to include all modes of transport in order to allow a equitable comparison of the impacts on the atmospheric composition and on climate. In particular, the conference covered the following topics:

- engine emissions (gaseous and particulate),
- emission scenarios and emission data bases,
- near field and plume processes, effective emissions,
- impact on the chemical composition of the atmosphere,
- impact on aerosols,
- contrails, contrail cirrus, ship tracks,
- indirect cloud effects (e.g., aerosol-cloud interaction),
- radiative forcing,
- impact on climate,
- metrics for measuring climate change and damage,
- mitigation of transport impacts by technological means, i.e., environmental impacts of modifications to vehicles and engines (e.g., low NO<sub>x</sub> engines, alternative fuels),
- mitigation of impacts by operational means (e.g., air traffic management, environmentally friendly flight and ship routing).

The conference was also a forum for dialogue of the QUANTIFY<sup>1</sup> project participants with the wider scientific community. At the same time, the conference marked the start of the EC funded project ATTICA<sup>2</sup>, which has the objective of providing a "European Assessment of Transport Impacts on Climate Change and Ozone Depletion".

The conference benefited from substantial financial support from the United Kingdom Department for Transport and the European Commission's DG Research, to whom the organizers are extremely grateful.

139 participants attended the TAC conference and there were 60 oral and 33 poster presentations. Extended abstracts of most of the presentations are included in this book of proceedings. After peer review, a subset of the papers will be published in a special issue of the journal *Meteorologische Zeitschrift*.

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<sup>1</sup> QUANTIFY is an EC funded Integrated Project entitled "Quantifying the Climate Impact of Global and European Transport Systems", see also <http://ip.quantify.eu>.

<sup>2</sup> <http://ssa-attica.eu/>

## **Program Committee**

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Dr. Karlheinz Haag, Lufthansa, Germany  
Dr. Dietrich Knörzer, EC  
Prof. David S. Lee, MMU, United Kingdom (chair Local Organising Committee)  
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Olivier Penanhoat, SNECMA, France  
Prof. Joyce Penner, University of Michigan, USA  
Prof. John Pyle, University of Cambridge, United Kingdom  
Dr. Claudia Stubenrauch, LMD, France  
Tim Wallington, Ford, USA

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### Engine emissions, emission inventories and scenarios

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## Conference Agenda

### Sunday, 25 June 2006

- 18:00 Registration  
20:00 End of Sunday registration time

### Monday, 26 June 2006

- 08:30 Registration

#### Opening ceremony

**Chair: Sausen**

- 09:45 The Right Honourable Douglas Alexander MP, Secretary of State for Transport, UK:  
*Opening Address*
- 10:05 Pierre Valette, Acting Director, European Commission, DG RTD I. Environment:  
*European Climate Research and Policy – the Role of Transport*
- 10:20 Prof Frank Kelly, Chief Scientist DfT, UK:  
*Transport and Climate – the UK Perspective*
- 10:35 Prof John Brooks, Vice Chancellor of Manchester Metropolitan University, UK:  
*Welcome Address*
- 10:40 Prof Ulrich Schumann, Deutsches Zentrum für Luft- und Raumfahrt e.V., Germany:  
*Welcome Address on Behalf of the Board of DLR*
- 10:45 Lee,  
*Introduction to Oxford*

#### Opening ceremony

**Chair: Lee**

- 10:50 *Coffee*
- 11:20 Sausen, *An introduction to QUANTIFY*

#### Engine emissions, emission inventories and scenarios

- 12:00 Wallington, *Light Duty Vehicle Emissions*
- 12:20 Delhayé, Ferry, Demirdjian, Ruiz, Penanhoat, Gouge, Suzanne, *Physico-chemical characterization of soot emitted by a commercial aircraft engine: morphology, size, structure, and elemental composition*
- 12:40 Yelvington, Herndon, Wood, Onasch, Miake-Lye, *Development of an emissions database to inform comparisons of various transportation modes*
- 13:00 *Lunch*
- 14:00 North, Noland, Ochieng, Polak, *Modelling of particulate matter mass emissions from a light-duty diesel vehicle*
- 14:20 Wey, Anderson, Howard, Kinsey, Miake-Lye, Whitefield, *An overview of the aircraft particle emissions experiment (APEX) series*
- 14:50 Baumgardner, Kok, Avallone, Kalnajs, Herman, Ross, Thompson, Toohey, *In-Situ Microphysical Measurements In Rocket Plumes With The Cloud And Aerosol Spectrometer (CAS)*
- 15:10 Peeters, Middel, *Historical and future development of air transport fuel efficiency*
- 15:30 Bows, Anderson, *Contracting UK carbon emissions: implications for UK aviation*

**Engine emissions, emission inventories and scenarios**

- 15:50 Tea **Chair: Wallington**
- 16:10 Pejovic, Noland, Williams, Toumi, *Calculating UK CO<sub>2</sub> emissions using real air traffic data*
- 16:30 Steller, Borken, *First validation of a global road transport emission inventory for the year 2000*
- 16:50 Schrooten, De Vlieger, Int Panis, Torfs, *Forecasted maritime shipping emissions for Belgium with an activity based emission model.*

**Near field and plume processes, effective emissions**

- 17:10 Kraai, Hensen, Duyzer, Hollander, *Measurement method for emissions from inland navigation*
- 17:30 Petzold, Weinzierl, Lichtenstern, Schlager, Gurk, Franke, Weingartner, Baltensperger, *Particle Emissions from Ship Engines: Emission Properties and Transformation in the Marine Boundary Layer*
- 17:50 Schlager, Arnold, Petzold, Rappenglueck, Gurk, *Aircraft measurements in primary European ship corridors*
- 18:10 *End of presentations*
- 18:20 *Ice breaker*

**Tuesday, 27 June 2006****Near field and plume processes, effective emissions****Chair: Schlager**

- 09:10 Miake-Lye, Herndon, Knighton, Onasch, Jayne, Northway, Wood, *Airport Emission Studies of Gaseous and Particulate Emissions*
- 09:30 Whitefield, Lobo, Hagen, *PM emissions from advected aircraft plumes at the Oakland International Airport*
- 09:50 Popovicheva, Starik, Persiantseva, Shonija, *Water-H<sub>2</sub>SO<sub>4</sub>-soot interaction in aircraft plume*
- 10:10 Paugam, Cariolle, Paoli, Cuenot, *Numerical Simulations of aircraft plumes using a meso scale code*
- 10:30 *Coffee* **Chair: Waitz**
- 11:00 Bauer, *Emissions of Gas Turbines and IC Engines*
- 11:40 Davison, Boardman, Whyatt, *Aerosol Evolution from a busy Road in North-West England*
- 12:00 Weimer, Mohr, Prévôt, Bach, Baltensperger, Lohmann, *Investigations of road traffic emissions in Switzerland using a mobile laboratory*

**Impact on atmospheric composition**

- 12:20 Dessens, Marizy, Simon, Grewe, Ramarosan, Pitari, Rogers, Pyle, *Results of the SCENIC project: impacts of supersonic aircraft emissions upon the atmosphere.*
- 12:40 Köhler, Dessens, Wild, Rogers, Pyle, *Changes in Ozone and Methane due to Aircraft NO<sub>x</sub>: Sensitivity to Cruise Altitude*

### Impact on atmospheric composition

- 13:00 *Lunch* **Chair: Penner**
- 14:00 Halenka, Huszar, Moldanova, *Ship emissions impact on atmospheric composition - case study*
- 14:20 Eyring, Stevenson, Lauer, Dentener, Butler, Collins, Ellingsen, Gauss, Hauglustaine, Lawrence, Rodriguez, Sanderson, Strahan, Sudo, van Noije, Wild, *Multi-model simulations of the impact of international shipping on atmospheric chemistry and climate in 2030*
- 14:40 Collins, Sanderson, *The impact of increasing ship emissions on air quality and deposition over Europe*
- 15:00 Introduction to posters I
- 15:30 *tea* **Chair: Grainger**
- 16:00 Poster Session I
- 17:00 Niemeier, Granier, *Simulation of future road and ship traffic impact on air pollution*

### Impact on clouds

- 17:20 Minnis, Duda, Nguyen, Palikonda, Sun-Mack, *Analysis of missing contrail effects during USA air traffic shutdown*
- 17:40 Eleftheratos, Zerefos, Tselioudis, *Natural versus man-made trends in cirrus clouds*
- 18:00 *End of presentations*
- 18:15 *Walking tour*

### Wednesday, 28 June 2006

#### Impact on clouds

**Chair: Eyring**

- 09:10 Mannstein, Krebs, *Contrail cirrus coverage and radiative forcing derived from satellite data*
- 09:30 Huebsch, Lewellen, *Sensitivity Study on Contrail Evolution*
- 09:50 Dedesh, Grigoryev, *Development of methods to research atmosphere contaminations, conditions of formation and composition of airplanes' condensation trails*
- 10:10 Fichter, *How to prepare your proceedings contribution*
- 10:30 *Coffee* **Chair: Schumann**
- 11:00 Shine, Metrics
- 11:40 Penner, Chen, *Effects of soot aerosols from aircraft on cirrus clouds*
- 12:00 Devasthale, Grassl, *Detection and quantification of impact of traffic emissions on clouds*
- 12:20 Schreier, Mannstein, Eyring, Bovensmann, *Global Distribution of ship tracks from one year of AATSR data*
- 12:40 Klima, Waitz, Baughcum, *Assessment of a Global Contrail Modeling Method*
- 13:00 *Lunch* **Chair: Fuglestedt**
- 14:00 Duda, Palikonda, Minnis, *Probabilistic Forecast of Contrails within Cirrus Coverage*

**Radiative forcing and impact on climate**

- 14:20 Stuber, Forster, Rädcl, Shine, *The importance of the diurnal and annual cycle of air traffic for contrail radiative forcing*
- 14:40 Grewe, Stenke, Ponater, Sausen, Pitari, Iachetti, Rogers, Dessens, Pyle, Isaksen, Gulstad, Marizy, Pascuillo, *Climate impact of supersonic air traffic: An approach to optimize a potential future supersonic fleet – Results from the SCENIC EU-project*
- 15:00 Introduction to posters II
- 15:30 *tea* **Chair: Moldanová**
- 16:00 Poster Session II
- 17:00 Fuglestedt, Berntsen, Myhre, Rypdal, Bieltvedt Skeie, *Climate Impacts of Transport Systems: Chemical responses and radiative forcing*
- 17:20 Rädcl, Shine, *Sensitivity of radiative forcing due to aircraft altitude*
- 17:40 Ponater, Pechtl, Grewe, Matthes, Sausen, Schumann, *Climate Sensitivity of Radiative Impacts from Transport Systems*
- 18:00 *End of presentations*
- 19:30 *Banquet*

**Thursday, 29 June 2006****Radiative forcing and impact on climate****Chair: Shine**

- 09:10 Olivié, Teyssèdre, Salas-Mélia, Cariolle, Royer, Karcher, *Results from pulse scenario experiments with the CNRM-CM3 global coupled model*
- 09:30 Lim, Lee, Sausen, *A climate response model for calculating aviation effects*
- 09:50 Lukachko, Waitz, Marais, *Valuing the Impact of Aviation on Climate*
- 10:10 Lee, Eyring, Lim, Sausen, *Radiative forcing and temperature response from global shipping emissions*
- 10:30 *Coffee* **Chair: Minnis**
- 11:00 Gierens, Contrails, contrail cirrus and ship tracks

**Mitigation by technical and operational means**

- 12:00 Noppel, Singh, Taylor, *Clean Exhaust Engine Concept*
- 12:20 Egelhofer, Marizy, Bickerstaff, *On how to consider the Earth's atmosphere in aircraft design*
- 12:40 Edwards, *The reduction of transport emissions in Jamaica through the manipulation of road network condition*
- 13:00 *Lunch* **Chair: Sausen**
- 14:00 Williams, Noland, Toumi, *Operational impacts of trajectory adjustments to avoid ice-supersaturated regions*

**Concluding Session**

- 14:20 *Summary, conclusions, awards, ...*
- 15:30 *tea*

## **LIST OF POSTERS**

### **Poster session 1**

#### **Engine emissions, emission inventories and scenarios**

- Anderson, Bows: *The neglect of international aviation and shipping emissions has led to serious flaws in the UK's climate change targets*
- Anderson, Winstead, Chen, Hudgins, Thornhill: *Concentrations and characteristics of particles within commercial aircraft exhaust plumes*
- Bewersdorff, Aulinger, Matthias: *The effect of temporal resolution of PAH emission data on transport and deposition patterns simulated with the Community Multiscale Air Quality Model (CMAQ)*
- Hagen, Lobo, Whitefield: *Physical Characterization of PM emissions from In-service Commercial Gas Turbine Engines – Projects APEX and JETS APEX2*
- Miake-Lye, Herndon, Knighton, Onasch, Jayne, Northway, Wood, Wormhoudt, Yelvington: *Aircraft Engine Emissions Characterization in APEX-series Measurement Studies*
- Middel, Berghof: *Quantification of Constrained Scenarios on Aviation and Emissions (CONSAVE 2050)*
- Owen, Lee, Lim: *New aviation scenarios for 2050*
- Petron, Miller, Frost, Peters, Bruhwiler, Tans: *Transportation and the Carbon Cycle*

#### **Near field and plume processes, effective emissions**

- Dotzek, Sausen: *SPIDER model process studies of aircraft plume dilution using simplified chemistry*
- Franke, Eyring, Sander, Lauer, Hendricks, Sausen, Bovensmann: *Ship emissions in the marine boundary layer: Ozone production and effective emissions*
- Moldanová, Schlager: *Ship plume chemistry – a model study*
- Paoli, Garnier, Mirabel, Cuenot: *Large-eddy simulation of a turbulent jet and wake vortex interaction: particle formation and evolution in the near-field of an aircraft*
- Velchev, Vignati, Hjorth, Dentener, Raes: *Measurements of ozone and Black Carbon along a Mediterranean cruise track during the winter season 2005-2006 ; comparison with TM5 model*

## Poster session 2

### Impact on clouds

Gierens, Kärcher, Mannstein, Mayer: *Aerodynamically induced condensation trails*

Guldberg: *Contrails in a global climate model – effect of reducing systematic errors*

Lim, Lee, Gierens, Ponater, Ismail, Grainger: *Comparison of cirrus cloud coverage from ECMWF and NCEP data compared with GRAPE data*

Palikonda, Minnis, Duda, Ayers, Garber: *Diurnal and Inter-annual variability of Contrail Coverage derived from AVHRR data over continental United States of America and surrounding areas.*

Samuelson, Davison, MacKenzie: *Seasonal and spatial variation in contrail cover over the UK (2001-2006)*

Unterstrasser, Gierens: *Initial conditions for contrail-to-cirrus transition*

### Impact on atmospheric composition

Meijer, Velthoven: *The importance of wet deposition for the different transport modes*

Pitari, Iachetti, Montanaro: *Homogeneous freezing of ice particles, including effects of aerosol size distribution in the University of L'Aquila CCM.*

### Radiative forcing and impact on climate

Meyer, Matheys, Van Mierlo, Macharis, Matthews, van Ypersele: *Aviation and the Belgian Climate Policy : Integration Options and Impacts - ABC Impacts*

Rodriguez de Leon, Lee: *Calculating contrail RF with the Edwards-Slingo radiative transfer code*

Teyssèdre, Olivié, Michou, Chéroux, Karcher, Cariolle: *On the coupling of the MOCAGE-Climat CTM with the CNRM climatic system*

### Mitigation by technical and operational means

Ishaque, Noland: *Pedestrian exposure to vehicle emissions: The role of traffic signal timings*

Lee, Wit: *Potential methods to include the full climate impact of aviation emissions into the European Emissions Trading Scheme and their scientific integrity*

Mannstein, Spichtinger, Gierens: *How to avoid contrail cirrus*

Ponater, Pechtl, Sausen, Schumann, Hüttig: *Climate Impact Reduction due to Cryoplane Introduction: A state-of-the-art assessment*

Salami, Idowu, Balogun: *West African weather Systems in the development of tropical cyclones*