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European Conference on Aviation, Atmosphere and Climate (AAC)

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Edited by

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The photograph for the AAC-Logo was provided by C. König (www.bvbk.de).

Foreword

The "European Conference on Aviation, Atmosphere and Climate (AAC)" in Friedrichshafen (Lake Constance, Germany) 2003 was initiated by the European Commission, Directorate General Research. The conference was organised with the objective of updating our knowledge on the atmospheric impact of aviation, four years after the publication of the 1999 IPCC Special Report "Aviation and the Global Atmosphere" and three years after the European workshop "Aviation, Aerosols, Contrails and Cirrus Clouds (A^2C^3) in Seeheim, Germany.

During the recent years many European projects (e.g. AEROCHEM-2, TRADEOFF, PARTEMIS, MOZAIC, AERO2K, SCENIC, INCA) and many national projects have been devoted to increase our knowledge with respect to the topic of the AAC conference. Significant scientific progress has been achieved: the aviation impact on the atmospheric concentrations of ozone and methane and their uncertainties have been better quantified; a consistent quantification of the radiative forcing from linear contrails has been provided; the interaction between aerosols emitted by aircraft and clouds is now better understood; first quantitative estimates of the radiative forcing from contrail cirrus are now available; and we learned about mitigation of aircraft effects on climate.

Despite the progress made, many open questions remain. For instance, how large is the radiative forcing index for aviation, now that first estimates of the effect from contrail cirrus are available? How large is the aviation impact on atmosphere and climate compared with other modes of transport?

115 participants attended the AAC conference and there were 50 oral and 27 poster presentations. Extended abstracts of most of the presentations are included in this book of proceedings. Many of the papers will be revised and after peer review be published in a special issue of the journal *Meteorologische Zeitschrift.*

I am confident that the outcome of this conference will be useful for scientific community and other stakeholders. Sincere thanks are due to my colleagues G. Amanatidis, C. Fichter and R. Sausen for organising this important event.

Anver Ghazi
Head, Global Change Unit
Research DG, European Commission
Brussels

Programme Committee

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Conference Agenda

Sunday, 29.06.2003

18:00 – 20:00 Registration

Monday, 30.06.2003

09:00 Registration

10:00 Sausen, R: Welcome and Information

Engine emissions and plume processes (1) **Chair: Paul Madden**

10:20 Gleitsmann G, Somnitz H, Zellner R: Novel rates of OH induced sulfur oxidation implications to the plume chemistry of jet aircraft

10:40 Wahl C, Kapernaum M, Krüger V, Rainer P, Aigner M: Determination of soot mass fraction soot density and soot fractal character in flame exhaust gases

11:00 Coffee break

11:20 Anderson B E, Winstead E L, Hudgins C H, Branham S, Plant J V, Thornhill K L: Overview of results from the NASA experiment to characterize aircraft volatile aerosol and trace species emissions (EXCAVATE)

12:00 Miake-Lye R C, Zaccardi V: SAE E-31 committee on aircraft exhaust emission measurements and an aerospace information report on the measurement of non-volatile Particle Emissions

12:20 Sorokin A, Katragkou E, Arnold F, Busen R, Schumann U: SO3 and H2SO4 in exhaust of an aircraft engine: Measurements and implications for fuel sulfur conversion to S(VI) and SO3 to H2SO4

12:40 Lunch break

Engine emissions and plume processes (2) **Chair: Ulrich Schumann**

14:00 Schumann U: Welcome, Aeronautic Research at DLR

Ghazi A: Welcome, Perspective EU, Environment and Aviation

14:40 Petzold A, Wilson C W, Arnold F, Baltensperger U, Fiebig M, Fritzsche L, Giebl H, Gysel M, Hitzenberger R, Hurley C D, Katragkou E, Kurtenbach R, Madden P, Nyeki S, Puxbaum H, Schumann U, Stein C, Vrchoticky S, Wahl C, Wiesen P: Particle emissions from aircraft engines - An overview of the european project PARTEMIS

15:20 Kurtenbach R, Kapernaum M, Lörzer J, Niedojadlo A, Petrea M, Wahl C, Wiesen P: Emission of non-methane volatile organic compounds (NMVOCs) from a jet engine combustor and a Hot End Simulator (HES) during the PARTEMIS project

15:40 Goos E, Braun-Unkhoff M, Slavinskaya N, Frank P: Modeling of soot precursor formation in laminar premixed flames with C1- C2- and C6-Fuels

16:00 Coffee break

Engine emissions and plume processes (3) **Chair: Karlheinz Haag**

16:20 Lee D S, Sun C-G, Cooper M, Snape C, Wilson C: Stable carbon isotope signatures of aircraft particles

16:40 Vancassel X, Sorokin A, Mirabel P: Modelling of volatile particles during PARTEMIS

17:00 Garnier F, Ferreira-Gago C, Brasseur A L, Uthéza F, Paoli R, Cuenot B: Growing and dispersion of particles in a turbulent exhaust plume

17:20 Plumb I, Randeniya L, Vohralik P, Baughcum S L: The effect of plume processes on aircraft impact

17:40 Wilson, C W: Aviation fuels - Where are we going and why?

18:00 Break

19:00 Ice-breaking reception in the Zeppelin museum

Tuesday, 01.07.2003

Transport and impact on chemical composition (1) Chair: David S. Lee

09:00 Crowther R, Law K, Pyle J, Nedelec P, Smit H, Volz-Thomas, A: NOy in the UT/LS: A source attribution study utilising MOZAIC measurements

09:20 Isaksen I S A: The TRADEOFF project: Goals and achievements

09:50 Brunner D, Staehelin J, Hauglustaine D, Jourdain L, Rogers H L, Koehler M O, Pyle J A, Berntsen T K, Gauss M, Meijer E, van Velthoven P, Grewe V, Sausen R, Pitari G, Mancini E, Isaksen I S A: On the quality of chemistry-transport simulations in the upper troposphere/lower stratosphere region

10:10 Grewe V: Lightning NOx emissions and the impact on the effect of aircraft emissions - Results from the EU-project TRADEOFF

10:30 Coffee break

Transport and impact on chemical composition (2) Chair: Georgios Amanatidis

10:50 Hauglustaine D, Stordal F, Myhre G, Gauss M, Berntsen T, Isaksen I: Impact of present-day and future subsonic aircraft emissions on tropospheric ozone and associated radiative forcing of climate

11:10 Gauss M, Köhler M, Grewe V: Impact of aircraft NO_x emissions: Effects of changing the flight altitude

11:30 Meijer E, Van Velthoven P, Bregman B, Seger A, Brunner D: Improved mass fluxes in a global chemistry-transport model: implications for upper tropospheric chemistry

11:50 Rodriguez J M, Logan J A, Rotman D A, Bergmann D, Baughcum S L, Friedl R R, Anderson D E: Activities of NASA's Global Modeling Initiative (GMI) in the assessment of subsonic aircraft impact

12:30 Lunch break

Transport and impact on chemical composition (3) Chair: Ivar Isaksen

13:50 Wuebbles D J, Dutta Mayurakshi P, Kenneth O, Baughcum S L: Parametric study of potential effects of aircraft emissions on stratospheric ozone

14:10 Baughcum S, Plumb I, Vohralik P: Stratospheric ozone sensitivity to aircraft cruise altitudes and NOx emissions

14:30 Stubenrauch C: Introduction to Poster Session 1

14:55 Poster Session 1 (Engine emissions and plume processes, Transport and impact on chemical composition)

17:20 Brenninkmeijer C, Slemr F, Zahn A, Fischer H, Hermann M, Heintzenberg J, Schlager H, Ziereis H: Investigating the global atmosphere by using commercial aircraft: CARIBIC and MOZAIC

17:40 Gossling S: The importance of aviation for tourism: Status and trends

18:00 end of sessions

Wednesday, 02.07.2003

Transport and impact on chemical composition (4) Chair: Philippe Mirabel

09:00 Dessens O, Rogers H, Pyle J,all SCENIC-project members: The SCENIC project: presentation and first results

09:20 Pitari G, Mancini E, Rogers H, Dessens O, Isaksen I, Rognerud B: A 3D model intercomparison of the effects of future supersonic aircraft on the chemical composition of the stratosphere

Particles and clouds (1) Chair: Philippe Mirabel

09:40 Kärcher B, Schumann U, Aigner M, Schurath U, Schrems O, Sausen R, Kruse H, Schiller C, Borrmann S, Arnold F, Feichter J, Lohmann U, Ström J, Rother T, Brinkop S, Busen R, Flentje H, Gierens K, Graf J, Haag W, Hendricks J, Mannstein H, Petzold A, Wendling P, Frank P, Gerlinger P, Noll B, Stricker W, Wahl C, Möhler O, Schaefers S, Stetzer S, Immler F, Döpelheuer A, Krämer M, Mangold A, Wollny A, Schneider J, Wilhelm S, Aufmhoff H, Timmreck C: Particles and cirrus clouds (PAZI) - Overview of results 2000-2003

10:20 Coffee break

10:40 Arnold F: Upper tropospheric aerosol formation inside and outside aircraft wakes: new findings from mass spectrometric measurements of gaseous and ionic aerosol precursors and very small aerosols

11:10 Baumgardner D, Kok G, Raga G, Diskin G, Sachse G: Single particle black carbon measurements in the UT/LS

11:30 Suzanne J, Ferry D, Popovicheva O B, Shonija N K: Ice-nucleating ability of soot particles in UT/LS

11:50 Möhler O, Schnaiter M, Wagner R, Schurath U, Mangold A, Krämer M: Experimental investigation of homogeneous and heterogeneous freezing processes at simulated UTLS conditions

12:10 Monier M, Wobrock W, Flossmann A: Detailed modelling of cirrus cloud - An intercomparison of different approaches for homogeneous nucleation

12:30 Lunch break

Particles and clouds (2) Chair: Corinne Marizy

13:50 Friedl R, WB-57 CRYSTAL-FACE science team: Overview of contrail and cirrus cloud measurements from the WB-57 aircraft in the CRYSTAL-FACE mission

14:10 Minnis P, Garber D P, Nguyen L, Duda D P, Palikonda R: Simulation of contrail coverage over the USA missed during the air traffic shutdown

14:40 Duda D P, Minnis P Costulis P K Palikonda R: CONUS contrail frequency estimated from RUC and flight track data

15:00 Danilin M Y, Baughcum S L, Read W G: Contrail properties derived from UARS MLS measurements

15:20 *Poster Session 2 (Particles and Clouds, Mitigation)*

16:30 Mannstein H: Observations of contrails and cirrus over Europe

17:00 Zerefos C, Eleftheratos K, Zanis P, Balis D, Stordal F, Myhre G: Updated perturbations on cirrus and contrail cirrus

17:20 Penner J, Liu X: Potential alteration of ice clouds by aircraft soot

17:40 *Break*

19:30 *boarding: Ship Cruise on Lake Constance with Dinner*

Thursday, 03.07.2003

Particles and clouds (3) **Chair: Winfried Dewes**

09:00 Hendricks J, Kärcher B, Döpelheuer A, Feichter J, Lohmann U: Potential impact of aviation-induced black carbon on cirrus clouds: Global model studies with the ECHAM GCM

09:20 Marquart S, Ponater M, Mager F, Sausen R: Future development of contrail cover optical depth and radiative forcing: Impacts of increasing air traffic and climate change

09:40 Guldberg A: A studie of contrails in a general circulation model

10:00 *Coffee break*

Mitigation **Chair: Winfried Dewes**

10:20 Ponater M, Marquart S, Ström L, Sausen R, Gierens K, Hüttig G: On the potential of the cryoplane option to reduce aircraft climate impact

10:40 Lee D S, Sausen R, Marquart S, Fichter C, Norman P: Tradeoffs in contrail and CO_2 radiative forcing by altered cruise altitudes

11:00 Noland R, Toumi R, Williams V: Policies for mitigating contrail formation from aircraft

11:20 Green, J: Greener by Design

11:50 *Lunch break*

Summary and Outlook **Chair: Robert Sausen**

13:30 Schumann, U: What did we learn?

14:10 Discussion

14:40 Sausen, R.: Homework and Good Bye

15:00 *end of conference*

Poster Sessions

1. Engine Emissions and Plume Processes/Transport and Impact on Chemical Composition

Hitzenberger R, Giebl H, Petzold A, Gysel M, Nyeki S, Weingartner E, Baltensperger U, Wilson C W: CCN activation of jet engine combustion particles during PARTEMIS

Worsnop D R, Miake-Lye R, Boudries H, Wormhoudt J, Anderson B: Gas and aerosol chemistry of commercial aircraft emissions measured in the NASA EXCAVATE experiment

Katragkou E, Wilhelm S, Arnold F, Wilson C W: Sulfur (VI) in the simulated internal flow of an aircraft gas turbine engine: first measurements during the PARTEMIS project

Fiebig M, Fritzsche L, Stein C, Nyeki S, Petzold A: Emission of volatile and non-volatile ultrafine particles from a combustion source during PARTEMIS

Sorokin A, Vancassel X, Mirabel P: Kinetics of binary nucleation in aircraft exhaust plume

Garber D P, Minnis P, Costulis P K: A USA commercial flight track database for upper tropospheric aircraft emission studies

Hayashi S, Yamada, H, Takazawa K, Makida M, Kurosawa Y: Interaction of NO and ice crystals produced from combustion generated water vapor in a simulated jet engine exhaust gas plume

Geigle K P, Schneider-Kühnle Y, Krüger V, Tsurikov M, Lückerath R, Braun-Unkhoff M, Slavinskaya N, Frank P, Stricker W, Aigner M: Validation of the kinetic soot model: An experimental and theoretical study on soot formation using LII and shifted vibrational CARS

Gysel M, Nyeki S, Weingartner E, Baltensperger U, Giebl H, Hitzenberger R, Petzold A, Wilson C W: Jet engine combustion particle hygroscopicity under subsaturated conditions during PARTEMIS

Bukovnik M, Kalivoda M: AvioMEET inventory tool and its applications

Leigh P, MacKenzie R, Borrman S: Air parcel trajectories in the south european UTLS: implications for the impact of air traffic emissions

Gauss M, Isaksen I, Lee D: The impact of aircraft on the chemical composition of the atmosphere and options for reducing the impact A 3D CTM model study

Köhler M O, Rogers H L, Pyle J A: Modelling the impact of subsonic aircraft emissions on ozone

Krämer M, Beuermann J, Schiller C, Grimm F, Arnold F, Peter T, Meilinger S, Meier A, Hendricks J, Petzold A, Schlager H: Uptake of nitric acid in cirrus clouds

Wuebbles D J, Dutta M, Jain A, Baughcum S L: Radiative forcing on climate from aircraft emissions in the stratosphere

Berntsen T, Gauss M, Grewe V, Hauglustaine D, Isaksen I, Mancini E, Meijer E, Pitari G, Sausen R: Sources of NOx at cruise altitudes, implications for predictions of ozone and methane perturbations due to NOx emissions from aircraft

2. Particles and Clouds/Mitigation

Minikin A, Petzold A, Fiebig M, Hendricks J, Schröder F: Aerosol properties measured in situ in the free troposphere and tropopause region at midlatitudes

Popovicheva O, Persiantseva N M, Shonia N K: Hygroscopicity and wetting of aircraft engine soot and its surrogates: CCN formation in UT

Mangold A, Büttner S, Ebert V, Giesemann C, Krämer M, Möhler O, Saathoff H, Schurath U, Stetzer O, Teichert H and Wagner R: Ice water content of cirrus clouds and its dependency on different types of aerosols

Nielsen J K: 3D simulation of cirrus formation from airplane contrails

Gierens K, Brinkop S: Heterogeneous nucleation effects on cirrus cloud coverage

Palikonda R, Phan D, Minnis P: Contrail coverage over the USA derived from MODIS and AVHRR data

Minnis P, Palikonda R, Ayers J K: Contrail coverage over the North Pacific from MODIS and AVHRR Data

Stubenrauch C, Meerkoetter R: Survey of cirrus properties from satellite retrievals using TOVS and AVHRR observations

Immler F, Schrems O: Comparison of cirrus cloud properties in the northern and southern hemisphere on the basis of lidar measurements

Tripathi S, Vancassel X, Grainger R, Rogers H: A Fast Stratospheric Aerosol Microphysical Model (SAMM)

Lee D S, Sausen R: Climate responses of aviation NO_x and CO_2 emissions scenarios

Extended Abstracts