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GLOBAL**

ICAO: UNITING AVIATION ON CLIMATE CHANGE

ICAO Colloquium on Aviation and Climate Change

Climate optimized routing of flights

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on behalf of

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Robert Sausen, Klaus Gierens, Volker Grewe, Hermann Mannstein,
Sigrun Matthes, Vilmar Mollwitz, Martin Schaefer, Marco Weiss

Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)

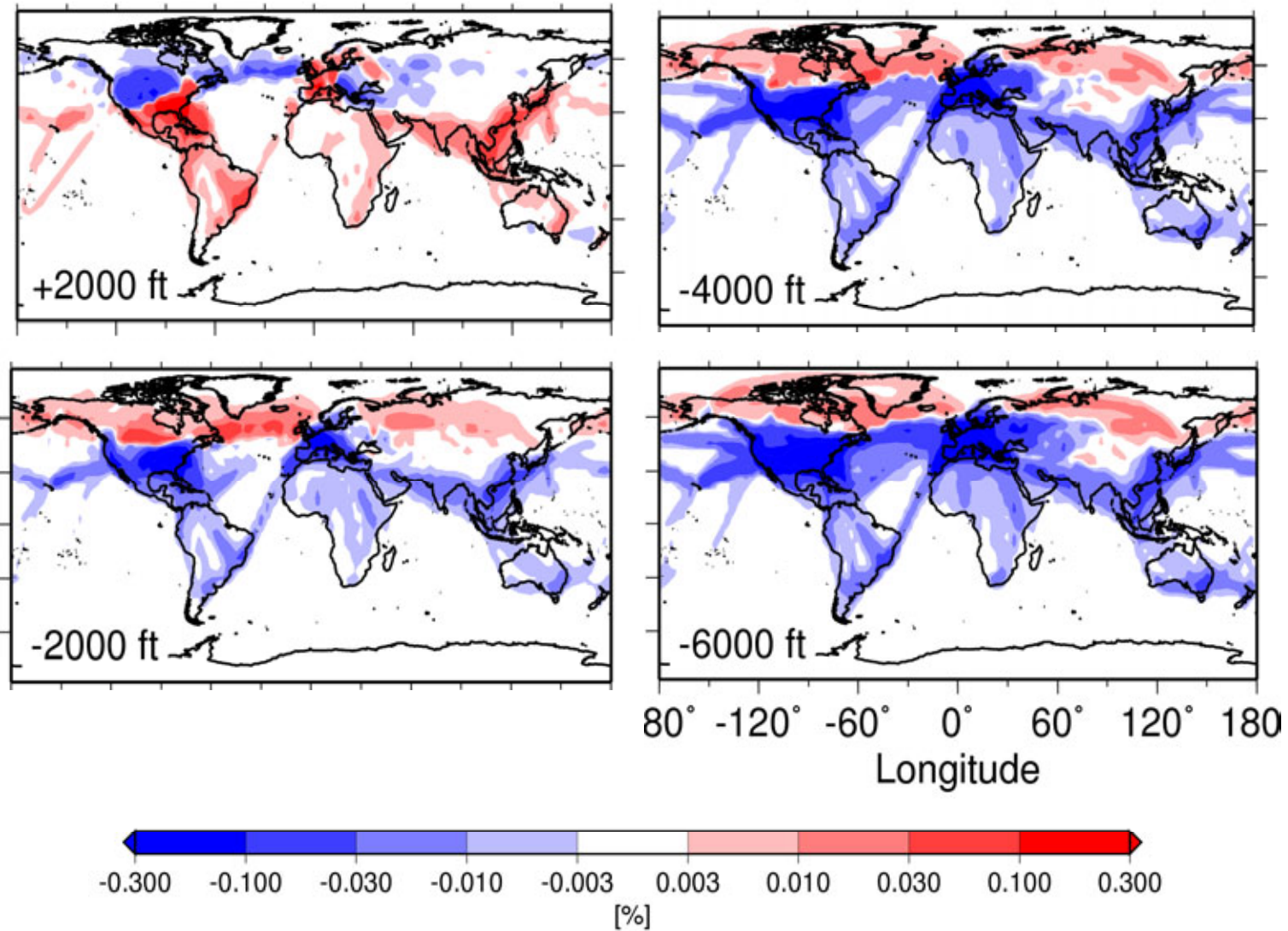
Workshop "Climate optimized routing of flights"

Berlin, 4 March 2010

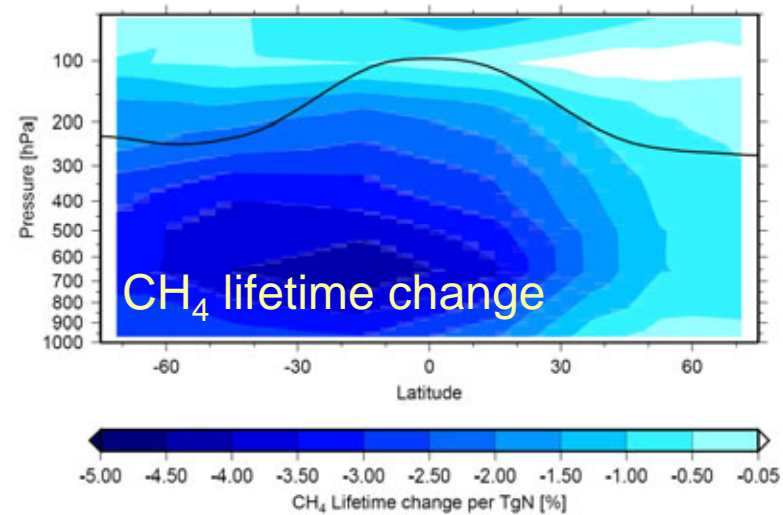
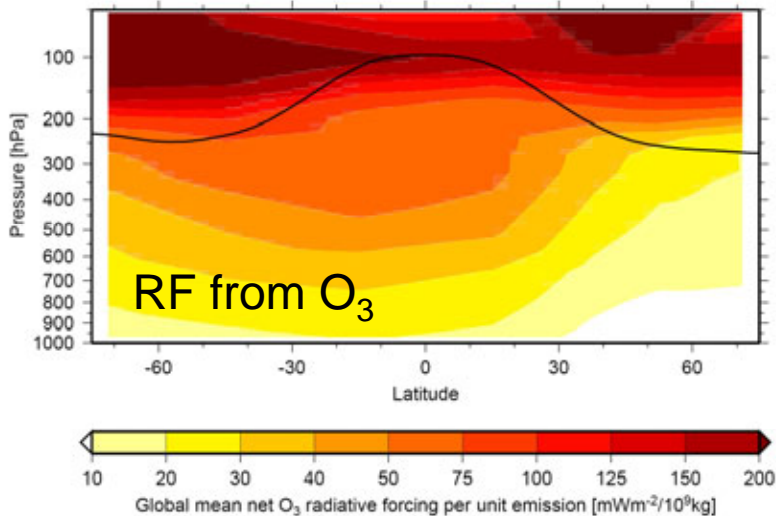
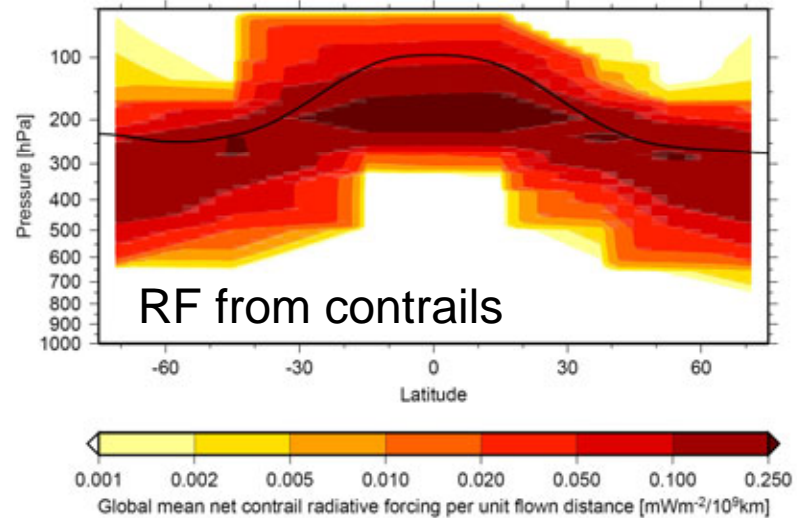
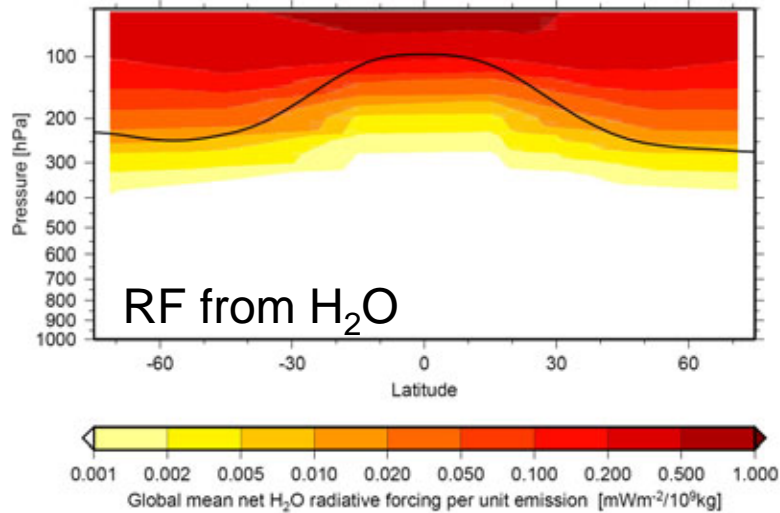


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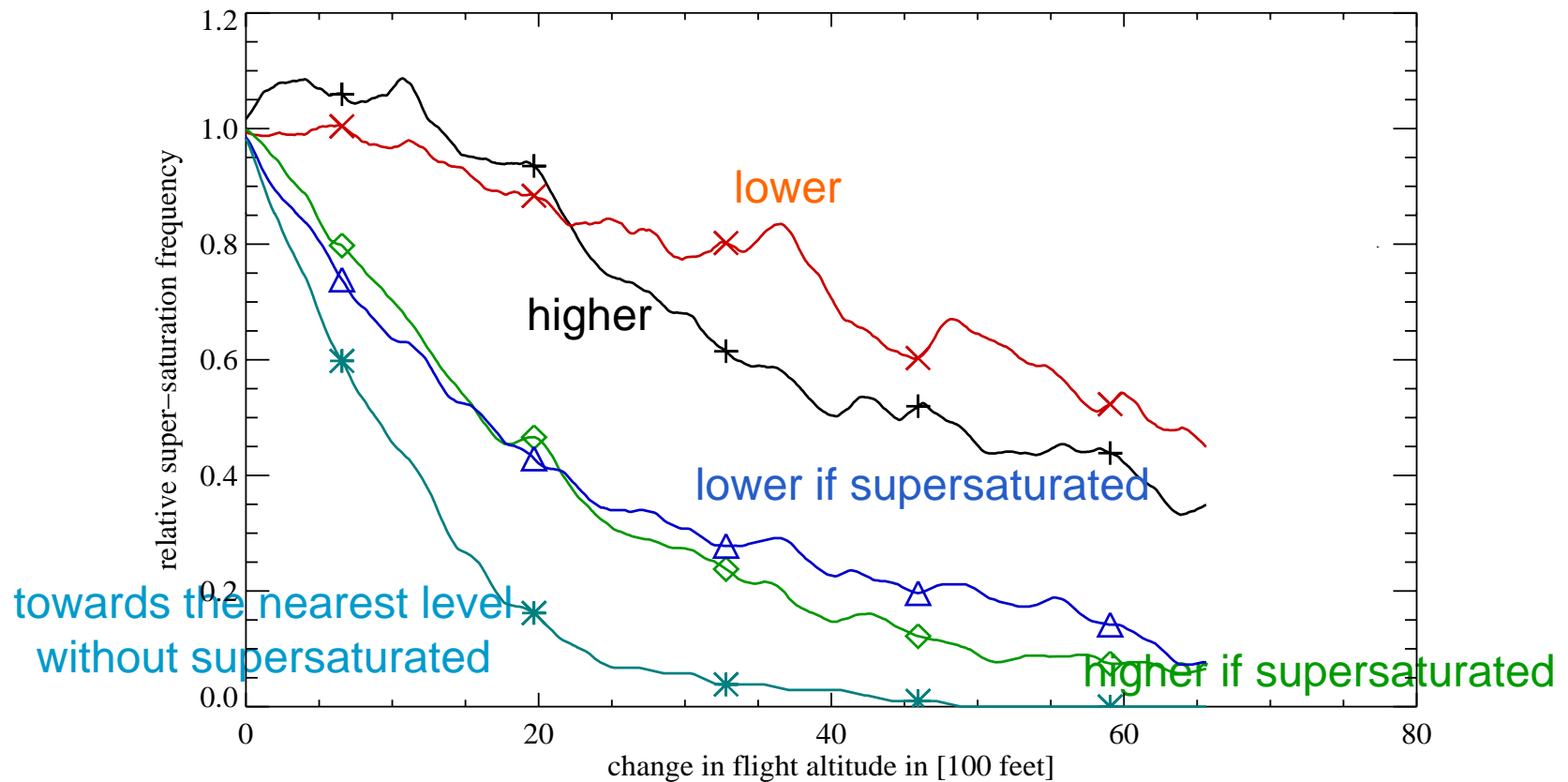
Impact of uniform flight altitude change on contrail cover



Impact of unit "emissions" as function of latitude and altitude



Change in frequency of contrails formation due to change of flight altitude



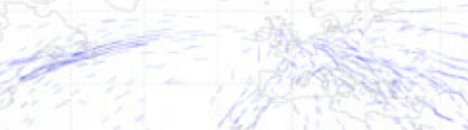
Contrail Cirrus Simulation and Prediction (CoCiP)

Input:
Aircraft
(BADA)



Movements
**(Eurocontrol,
OAD, DFS)**

00:00
00208

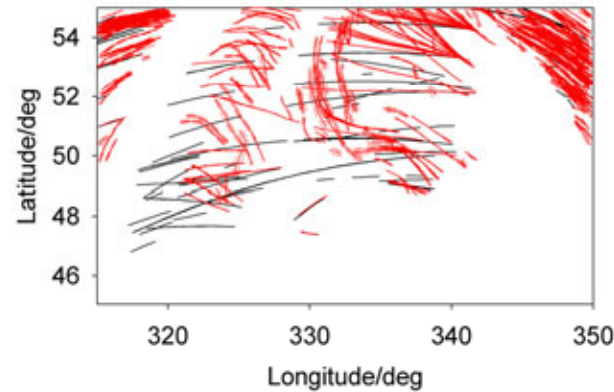


Meteorology
**(NWP results,
ECMWF, DWD)**



Contrail Cirrus Prediction Tool

NAR, 12. Aug 2005, 3-6 UTC



- From regional to global
- Comparable to observations

Output:
Contrail,
**life cycle,
cover, radiation**

Cirrus

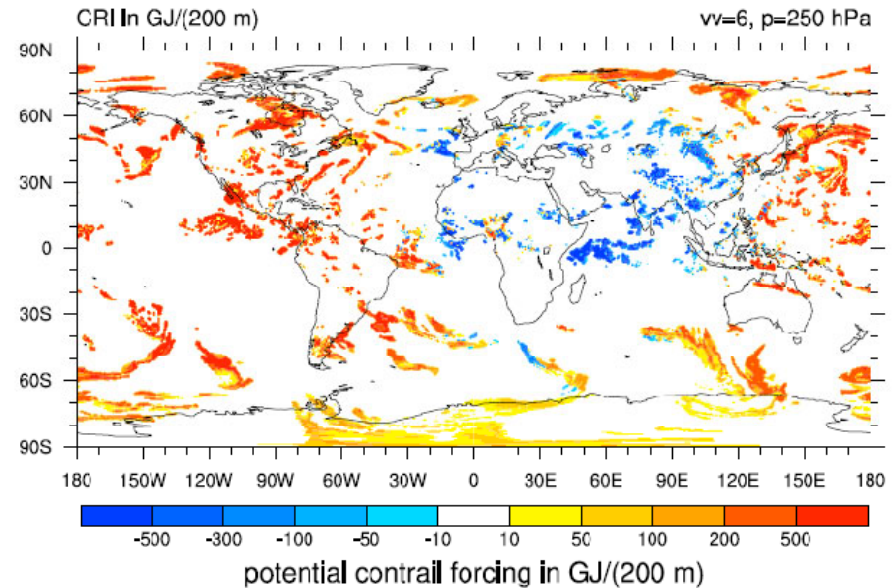
Simulation
**insitu, Lidar,
Satellite**

Sensitivity
studies

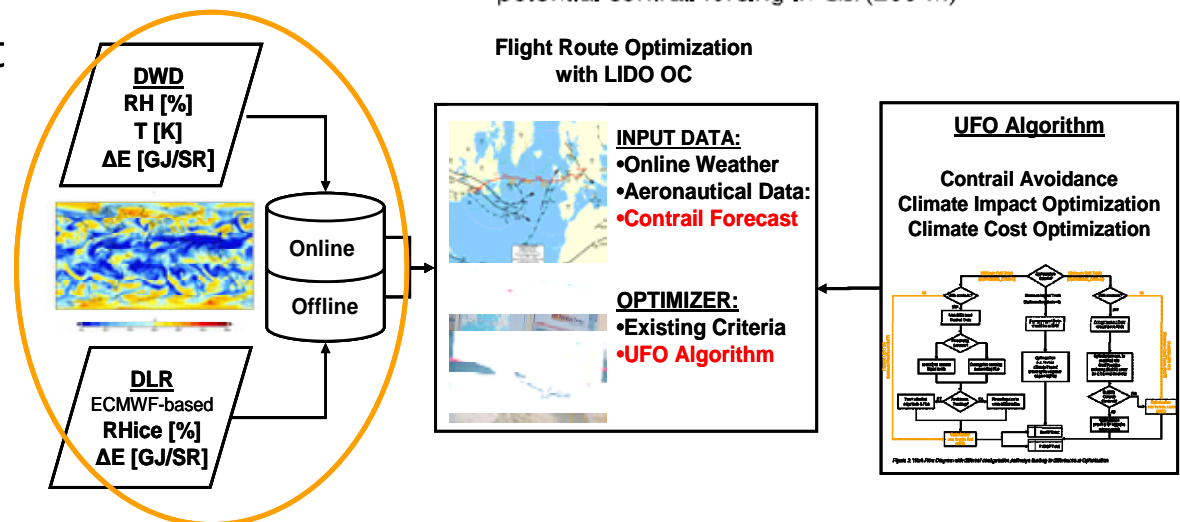
Prediction
Climate impact

A test-realisation for the contrail case (BMBF UFO project)

- ➔ Global weather forecast model of the German Weather Service (DWD): estimates the potential contrail forcing
- ➔ The LIDO-OC (operational flight planning tool of Lufthansa Systems) uses this as an add-on to the cost function in the flight route optimization.



DLR, DLH, DWD, DFS,
Mannstein et al. (2010)





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En-Route to Sustainability (ICAO) - Avoid:

The wrong place at the wrong time



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University of Sheffield / University of Leeds / University of Reading / University of Southampton / Loughborough University

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Conclusions

- The magnitude of the non-CO₂ effects depends on location, altitude and time of emission.
- Climate optimised flight planning opens the chance for a smaller climate impact of aviation.
- Climate optimised flight planning does not principally differ from traditional flight planning, only the cost function differs, the calculation of which requires additional meteorological and chemical information.
- A first test version of climate optimised flight planning (only contrails and fuel burn = CO₂) is already implemented within the Lufthansa Systems tools (UFO).
- A more comprehensive solution will be tested during the next few years (REACT4C).

Outlook

- ➔ A reliable forecast of the non-CO₂ aviation climate impacts arising from a single flight segment is required:
 - contrail cirrus,
 - chemical weather.
- ➔ The integration of climate cost functions in flight planning tools is necessary, e.g. based on incentives.
- ➔ Aircraft adapted to climate optimized flight routing should be developed.
- ➔ More on-board information should become available for the pilots.
- ➔ A realization of a climate optimised flight planning might be possible within a time frame of a decade.



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35 participants from aviation industry, politics, service providers and regulative authorities mainly from Germany, but also from France and the Netherlands attended the workshop.

Discussion:

Airspace congestion was the main argument against any deviation from the current procedures,

but the majority of participants agreed, that climate optimized flight planning is a viable option for reducing the climate impact of air traffic.



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