



Global modeling of contrail cirrus

Ulrike Burkhardt, DLR-IPA



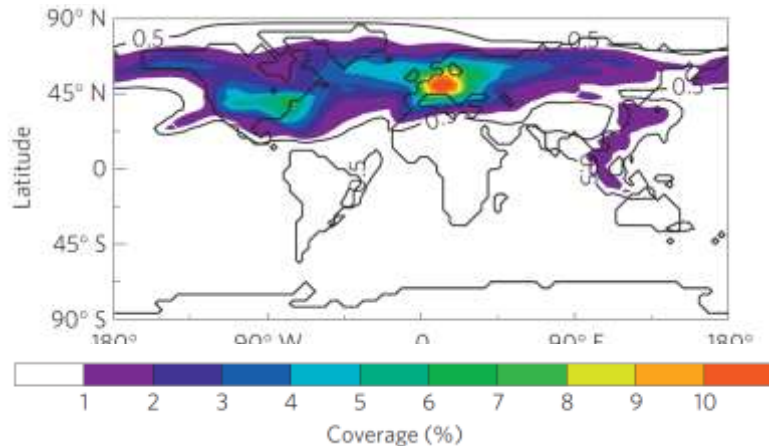
Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Institut für Physik der Atmosphäre

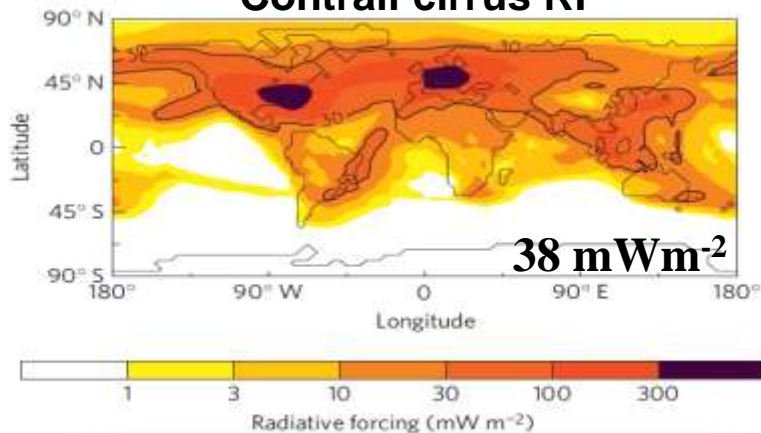
Washington, 18-19 July 2013

Contrail cirrus coverage and radiative forcing (RF) for current air fleet

Contrail cirrus coverage

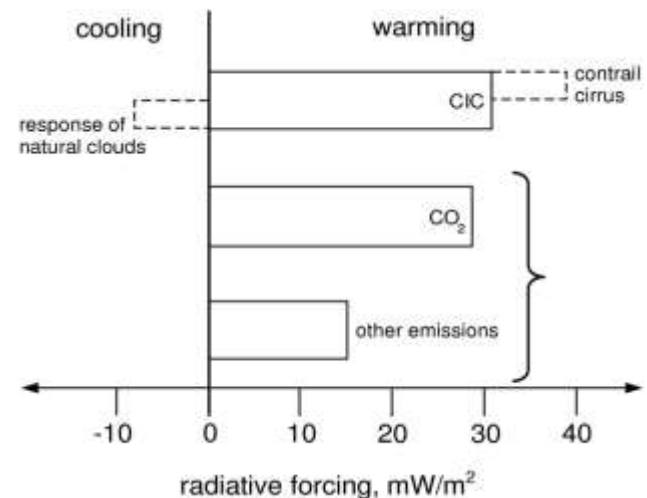


Contrail cirrus RF



New prognostic cloud class introduced in climate model that allows the simulation of the life cycle of contrail cirrus and their interaction with natural clouds.

Contrail cirrus cause a decrease in natural cirrus cloudiness limiting contrail cirrus RF.



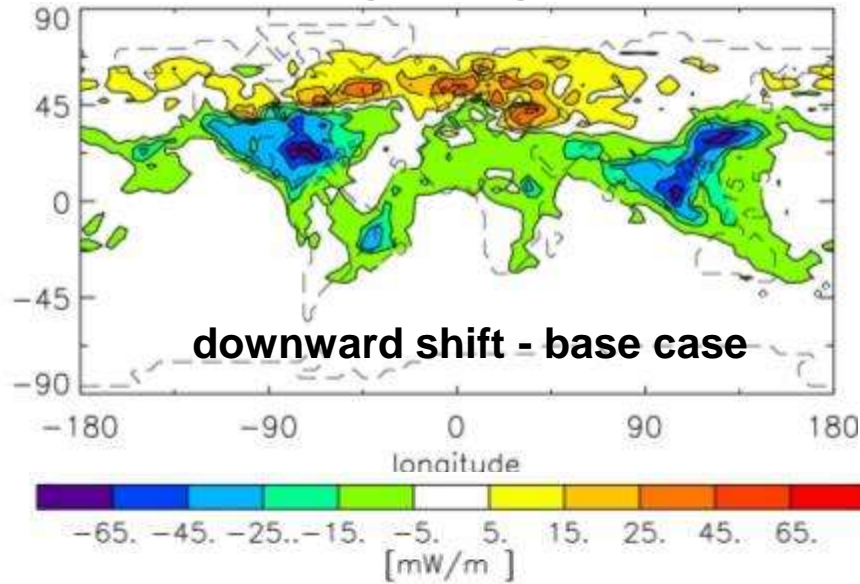
Burkhardt and Kärcher,
Nature Climate Change, 2011



Reducing Emissions from Aviation by Changing Trajectories for the benefit of Climate



Change in flight level



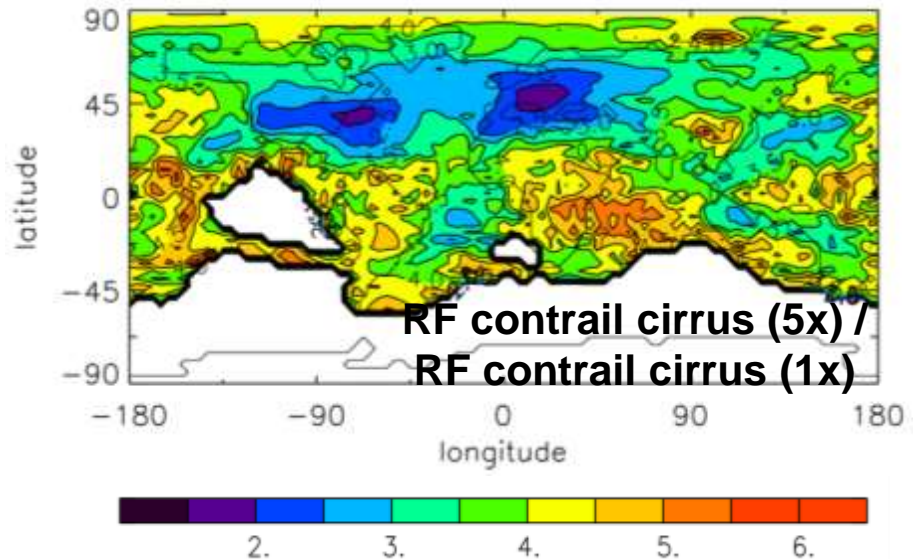
Downward (upward) shift of air traffic:

- increase (decrease) of RF in mid latitudes
- decrease (increase) in tropics/subtropics

Increase in air traffic:

- Strong saturation in contrail cirrus coverage and RF in main air traffic areas
- Increase of contrail cirrus RF in tropics depends on climate warming

Scaling of contrail cirrus climate impact

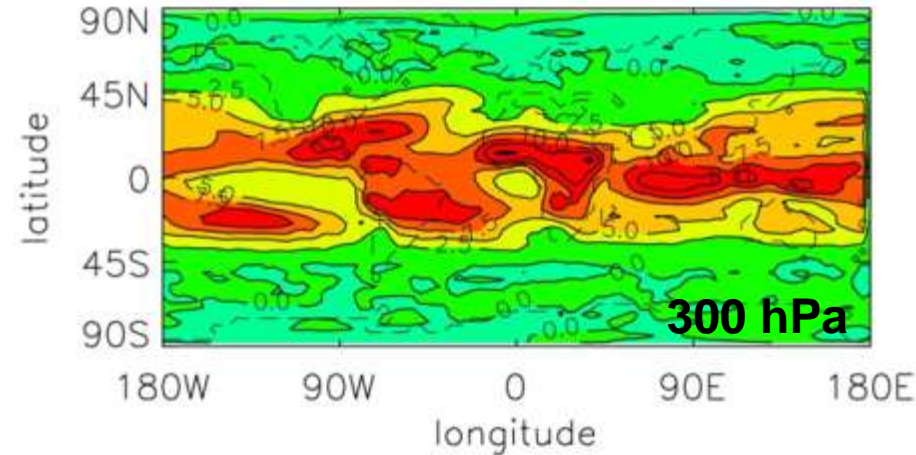


Alternative Fuels – LH2 and LNG

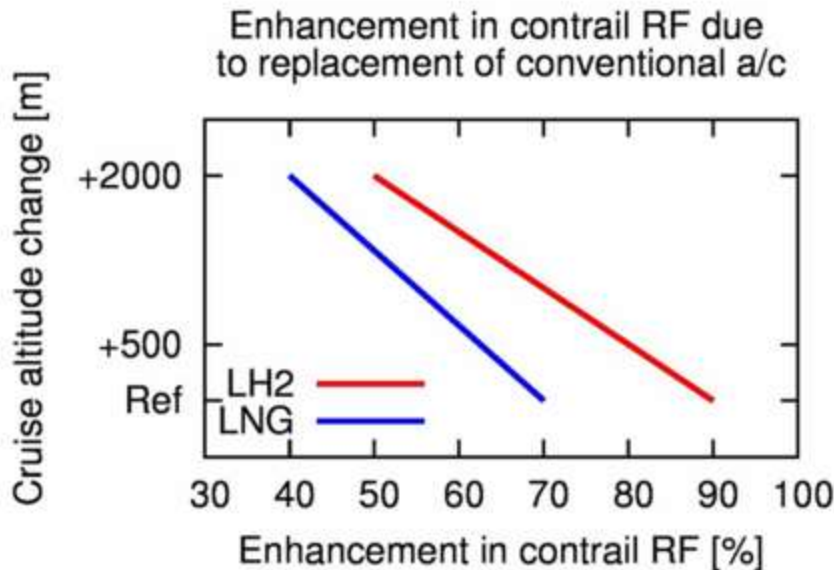
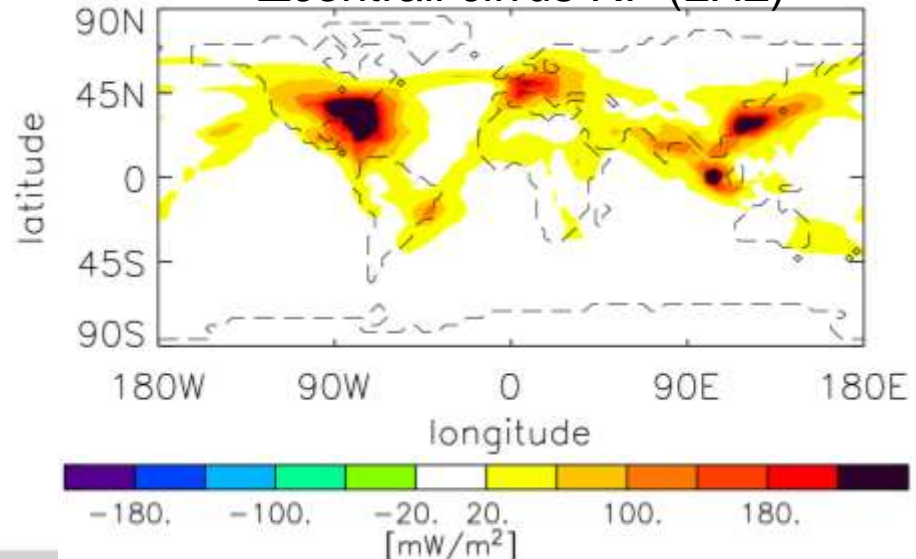
Changes in H₂O emissions, combustion heat and propulsion efficiency lead to a change in contrail formation probability and contrail cirrus coverage and RF.

Effect of change in aerosol number emissions on contrail cirrus optical properties and lifetime not yet resolved.

Δ contrail formation probability (LH2)

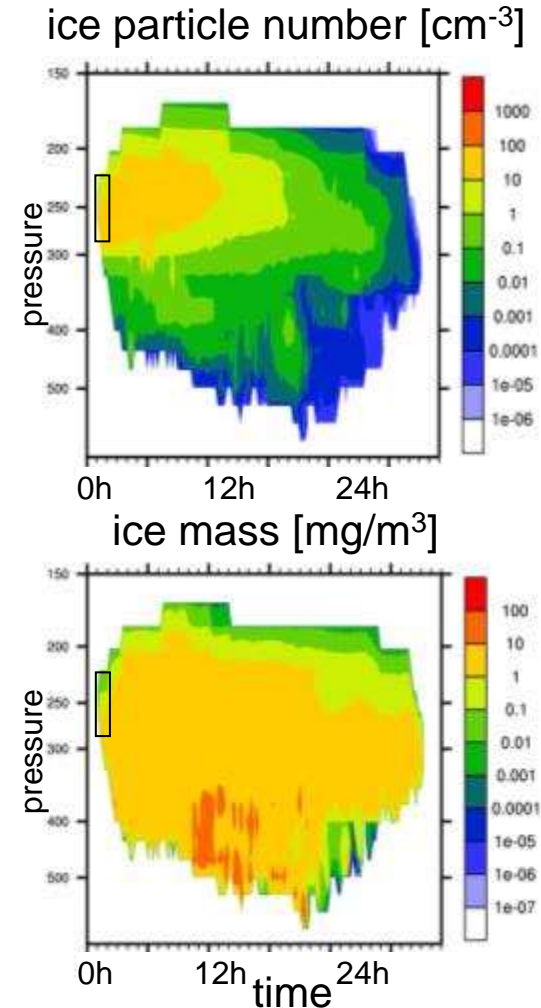


Δ contrail cirrus RF (LH2)



ECLIF: Global Modeling of Contrails and their Climate Impact

- Hypothesis: Contrail cirrus radiative forcing depends significantly on emitted particle number concentration due to a modification of contrail cirrus properties and life times.
- Strategy: Modeling of contrail cirrus as an independent cloud class in a climate model (ECHAM5-CCMod) based on an aircraft inventory modified for a global alternative fuel fleet.
 - Contrail cirrus with 2-moment microphysics (under development)
 - ice crystal formation dependent on particle emissions, aircraft parameters and atmospheric state



Lisa Bock