The shortwave to longwave ratio in contrail radiative forcing as evident in two radiation schemes used for global GCMs

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The Radiation Schemes

- **ECHAM4 (Roeckner et al., 1996)**
  - 3 spectral bands
  - for contrail forcing, 6 spectral bands, no scattering by clouds usually, but here averaged for global mean radiative forcing, according to Mayer and Mayer, (2002)

- **ECHAM5 (Roeckner et al., 2003)**
  - also used in EMAC (Jöckel et al., 2006)
  - 4 spectral bands, effectiveness approach to correct for non-homogeneous clouds

- **see part: Forouzan and Bonnel (1980)**
  - 2 spectral bands

The **Myhre Benchmark Test** to Evaluate the Performance of Radiation Schemes for Thin Cirrus (Contrails)

The benchmark framework introduced by Myhre et al. (2005) has been designed to test the uncertainties in the net radiative forcing for thin cirrus clouds. The optical properties of the contrail clouds are chosen similar to those of contrails. A 1% cirrus increase is prescribed all over the globe at 10 to 11 km (200 hPa) altitude. The single scattering albedo is 0.8, and the asymmetry parameter is prescribed as 0.8 without any dependence on wavelength.

Compensation between Shortwave and Longwave Forcing (Dependence on Latitude and Season)

In the ECHAM4 radiation scheme the amount of the daily mean shortwave forcing is smaller compared to the longwave forcing at almost all latitudes and seasons (MHR). The compensation is most effective at polar latitudes in summer (up to 80%) in the ECHAM4 radiation scheme. The compensation is obviously different over (dark) water and (bright) ice, although this effect is partially masked by the presence of natural background clouds. Mind that those are different in ECHAM4 and ECHAM5!

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### Conclusions

- **GM beam radiation schemes yield radiative forcing for thin cirrus that are in the range of respective calculations with more sophisticated radiative transfer models.**
  - Different GCM radiation schemes give substantially different estimates, even for prescribed coverage and optical properties.
  - Making a decision on the superiority of one scheme is not straightforward.

### References