Easy Aerosols

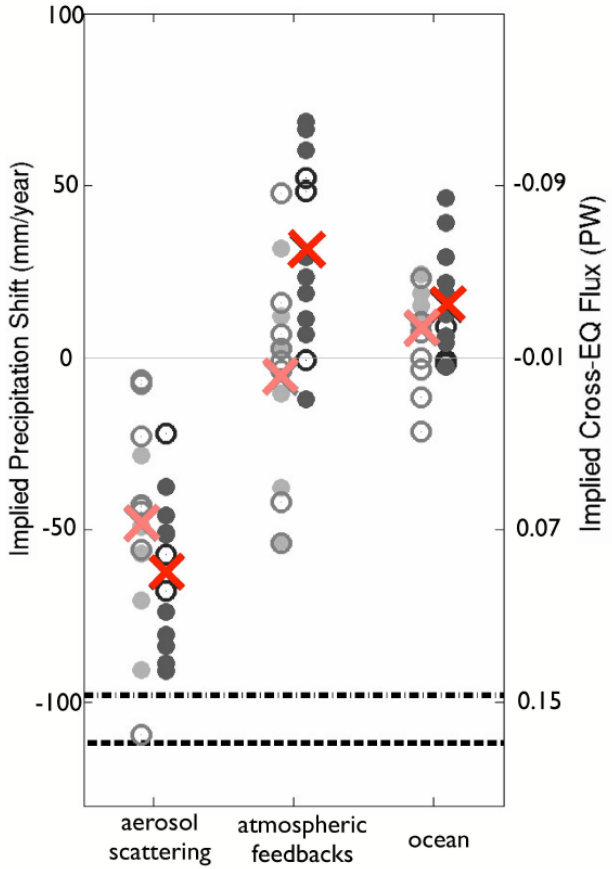
Identifying and studying robust aerosol effects on the general atmospheric circulation

Aiko Voigt, Bjorn Stevens, Sandrine Bony, Olivier Boucher

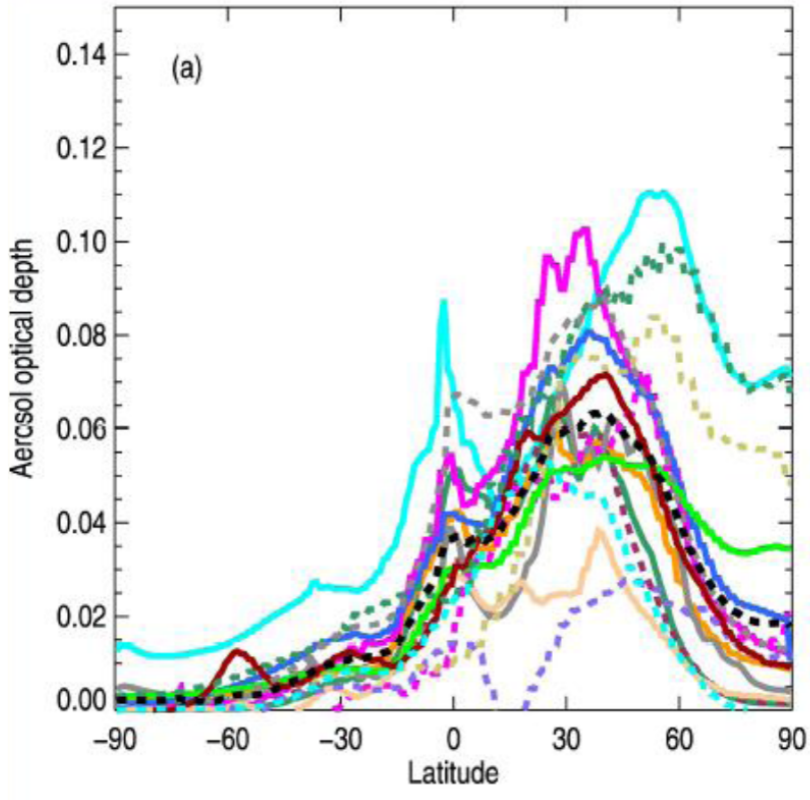
AEROCOM meeting, Hamburg, 23 September 2013

Changing patterns: anthropogenic aerosol

AEROCOM, WCRP, EUCLIPSE, PREDICT



Hwang et al. 2013



Myhre et al. 2013

Easy Aerosols in a nutshell

- *Are single-model results on aerosol-induced regional changes robust?*
- *Are differences in the magnitude of consistent changes explained by differences in the assumed anthropogenic aerosol?*
- Easy Aerosols challenges comprehensive models with the same anthropogenic aerosol forcing to test these questions.

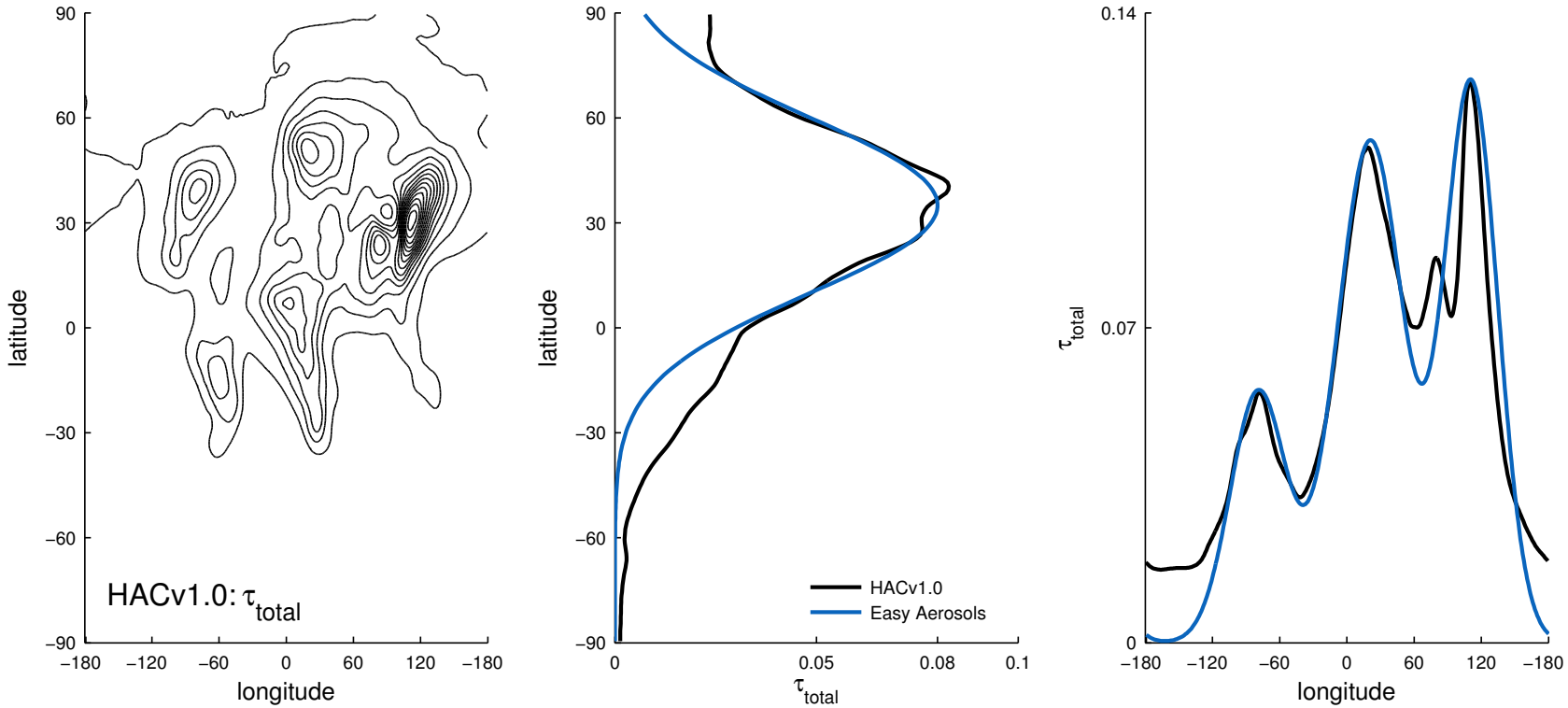
Easy Aerosols in a nutshell

- *Are single-model results on aerosol-induced regional changes robust?*
- *Are differences in the magnitude of consistent changes explained by differences in the assumed anthropogenic aerosol?*
- Easy Aerosols challenges comprehensive models with the same anthropogenic aerosol forcing to test these questions.

Easy Aerosols is easy because:

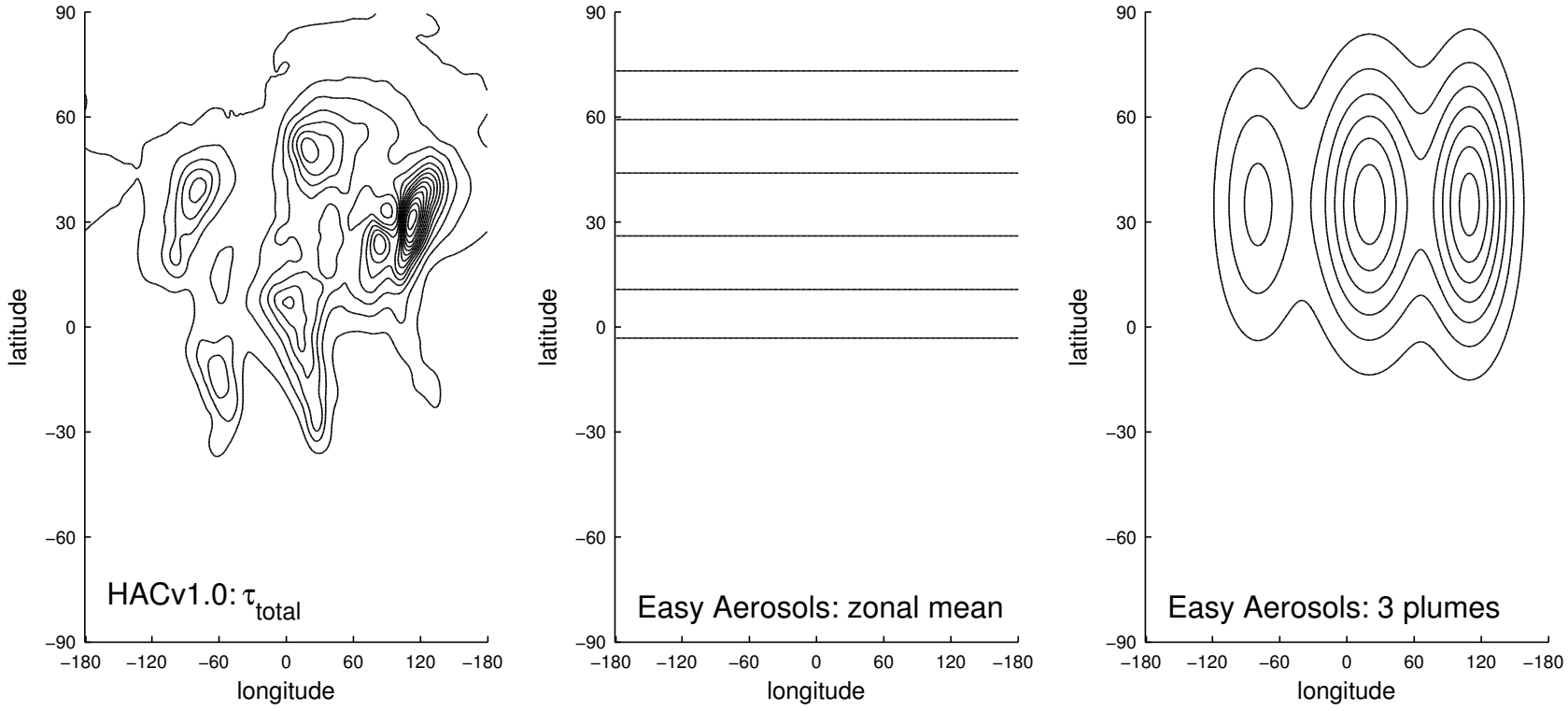
- it focuses on aerosol-radiation interaction, thereby emphasizing the role of aerosol as an agent of local diabatic heating
- it uses an idealized aerosol that captures the gravest mode of the anthropogenic aerosol

The Easy Aerosol in the horizontal



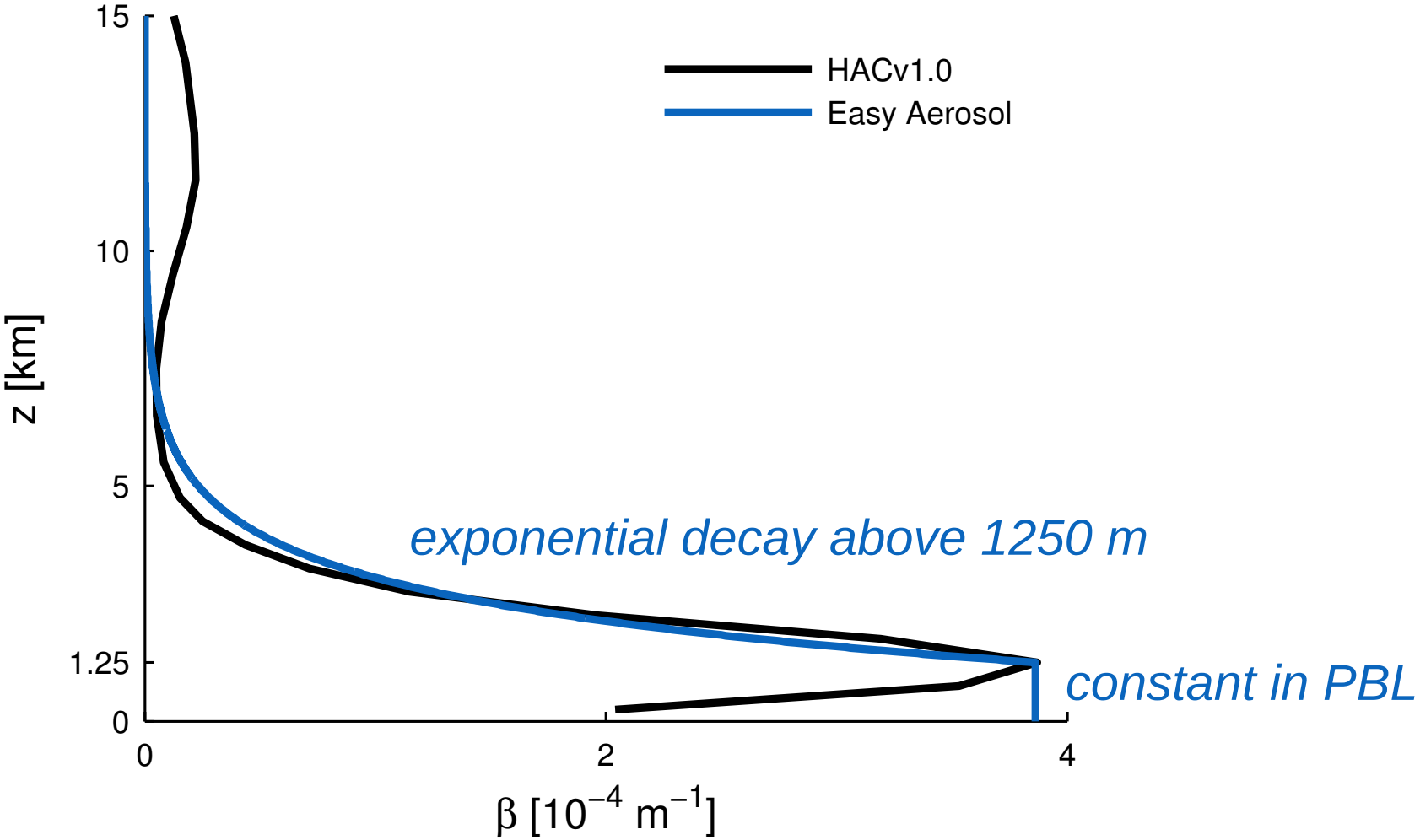
- based on global aerosol climatology HACv1.0 by Kinne et al. (2013)

The Easy Aerosol in the horizontal



- based on global aerosol climatology HACv1.0 by Kinne et al. (2013)
- zonally-symmetric case (middle) and case with three zonal plumes (right)

The Easy Aerosol in the vertical



Technical implementation of Easy Aerosol

Easy Aerosol is implemented through a Fortran90 module:

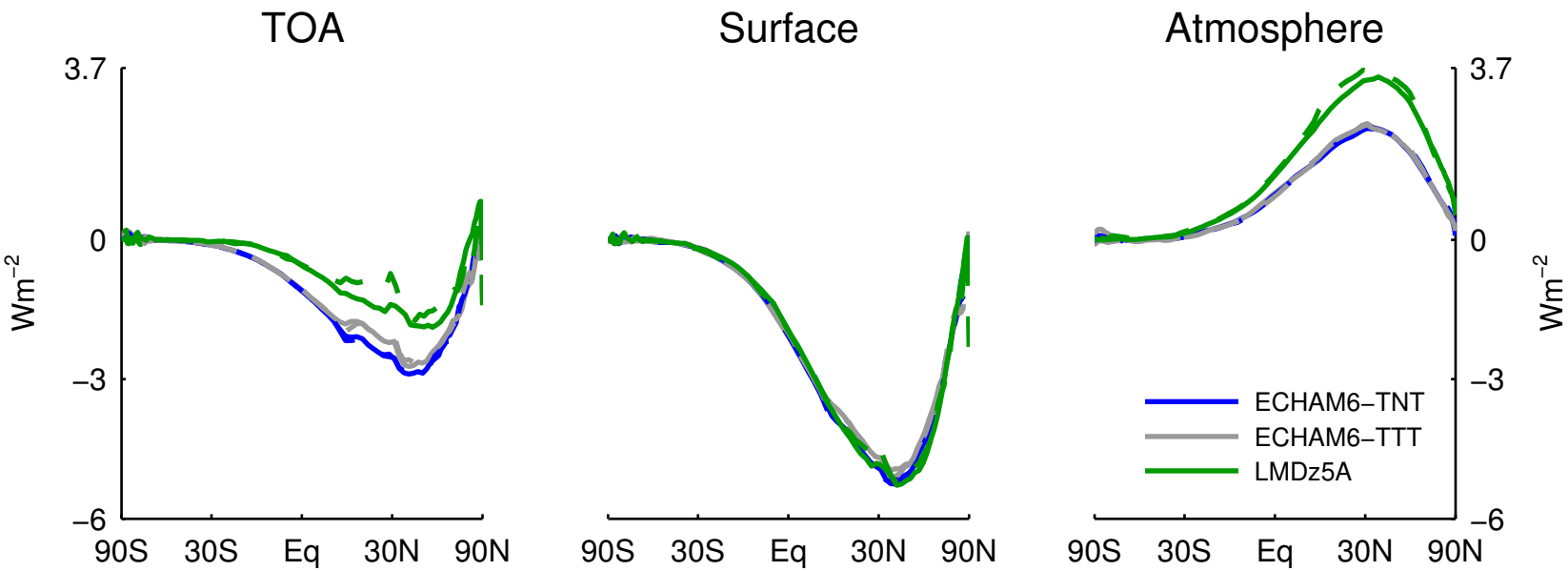
- Input: geographical location, altitude above sea-level, level thickness, frequency of shortwave bands
- Output: vertical profile of AOD, SSA, and ASY for each of the shortwave bands
- Based on the analytical expression given above and defined via namelist
- The module is currently implemented in ECHAM6 and LMDz, and is ready to be implemented in other models.

Easy Aerosol simulations

- AMIP simulations with zero aerosol and the Easy Aerosol
  - Do models see similar aerosol radiative forcing?
  - Which circulation changes are induced purely by absorption and land changes?

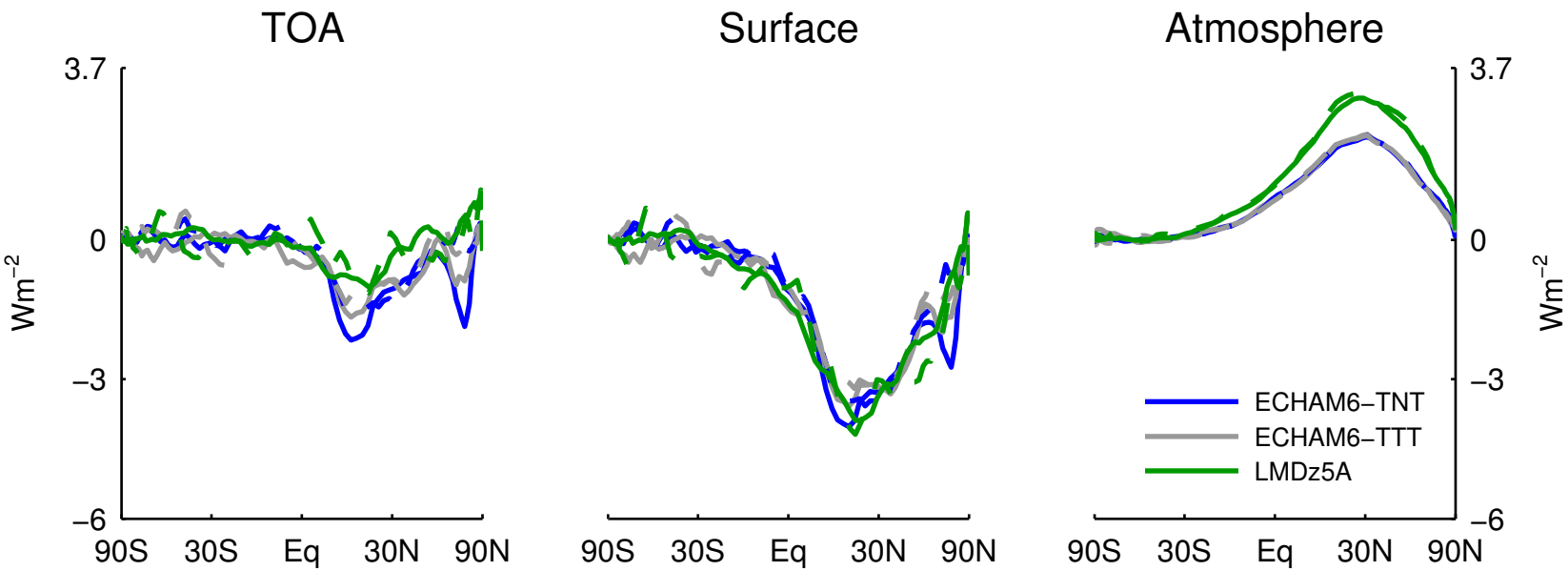
- "AMIP + ΔSST" simulations with the Easy Aerosol
  - Emulate aerosol surface cooling by SST perturbation derived from ECHAM6 slab ocean run.
  - If models agree on the aerosol radiative forcing, do they translate the forcing into consistent circulation responses?

AMIP Easy Aerosol with ECHAM6 and LMDz: net shortwave fluxes



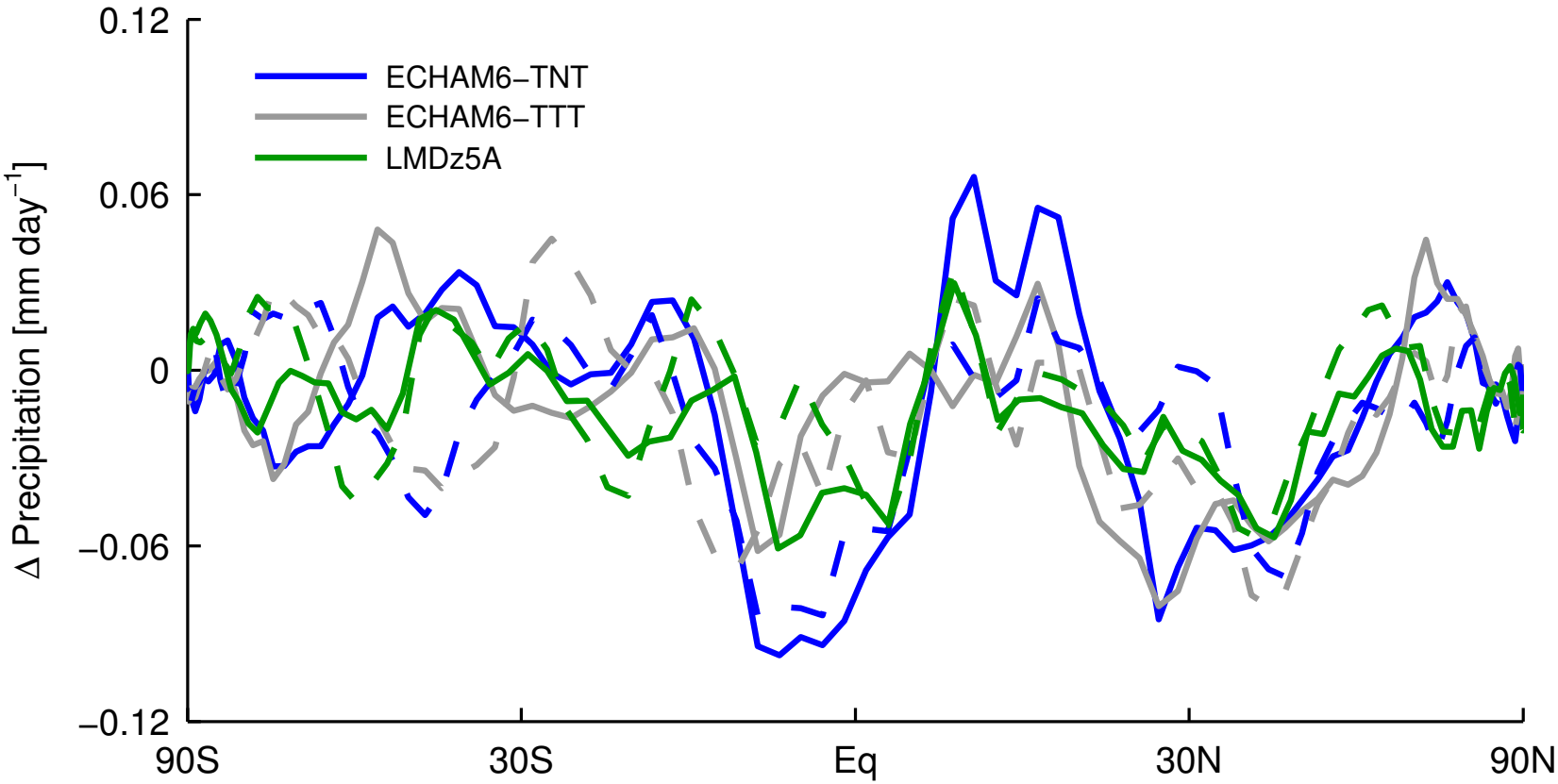
- Consistent quantitative decrease in surface flux
- 50 % difference in atmospheric absorption

AMIP Easy Aerosol with ECHAM6 and LMDz: net shortwave fluxes

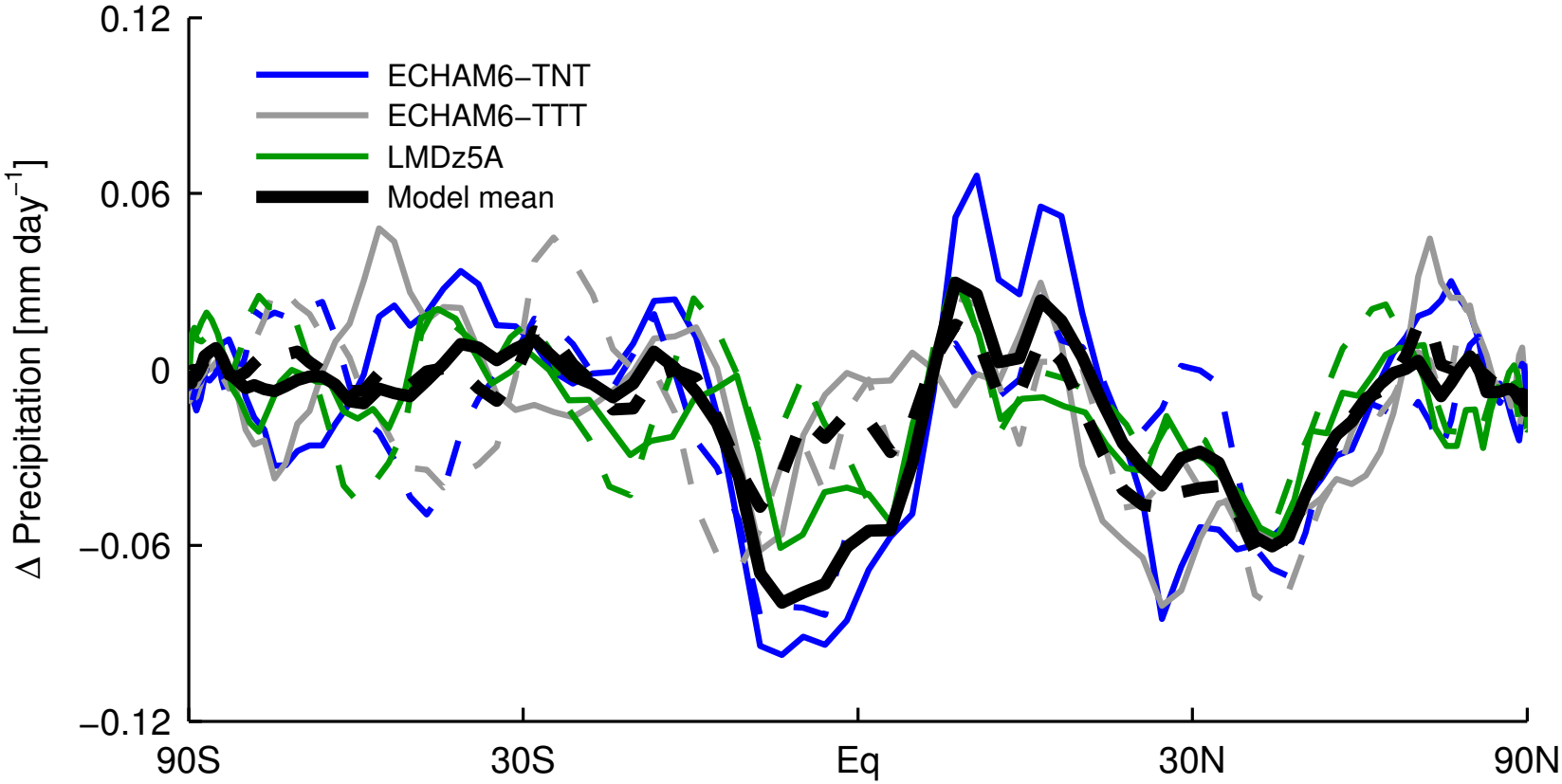


- Consistent quantitative decrease in surface flux
- 50 % difference in atmospheric absorption

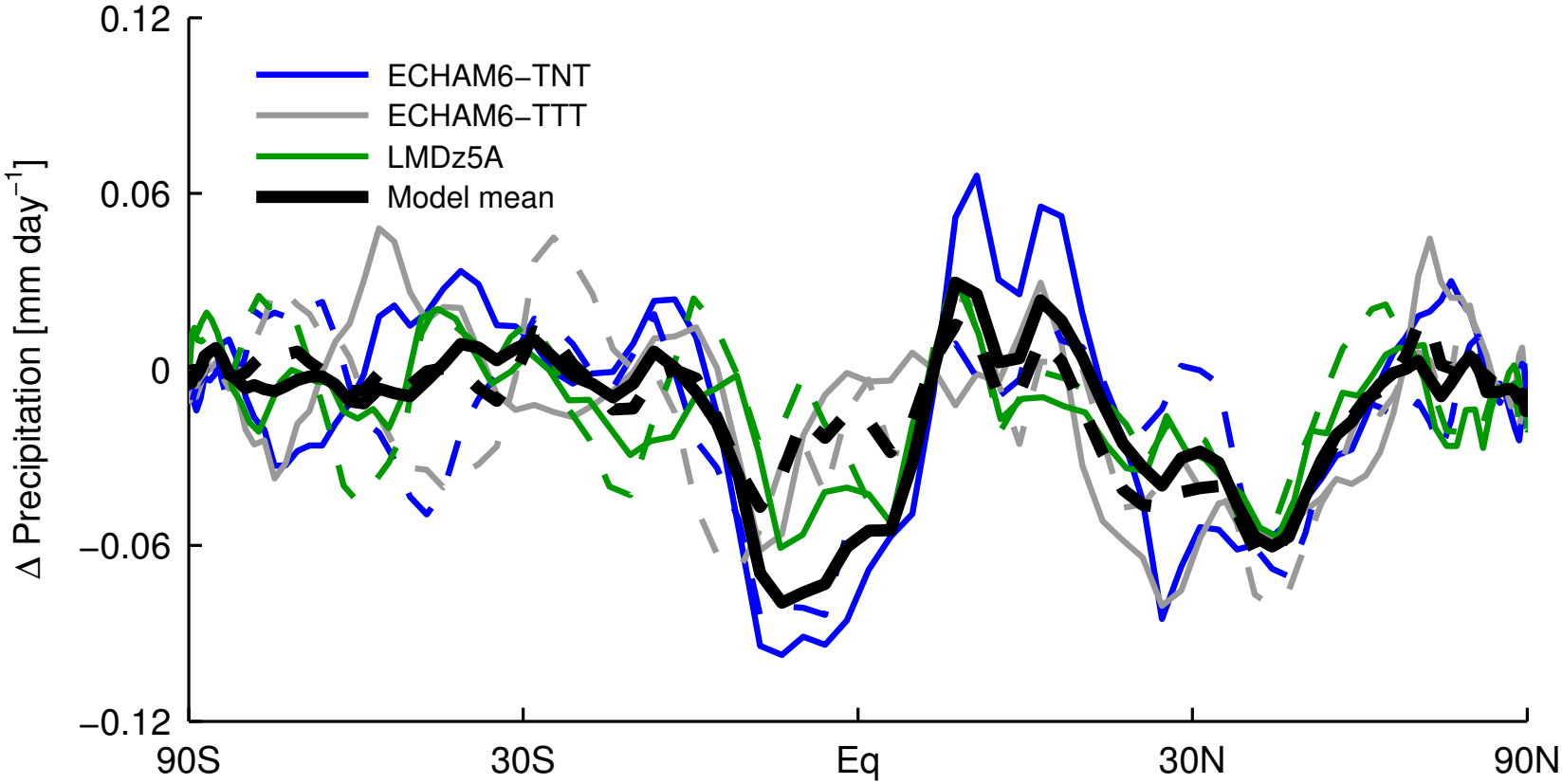
AMIP Easy Aerosol with ECHAM6 and LMDz: precipitation



AMIP Easy Aerosol with ECHAM6 and LMDz: precipitation

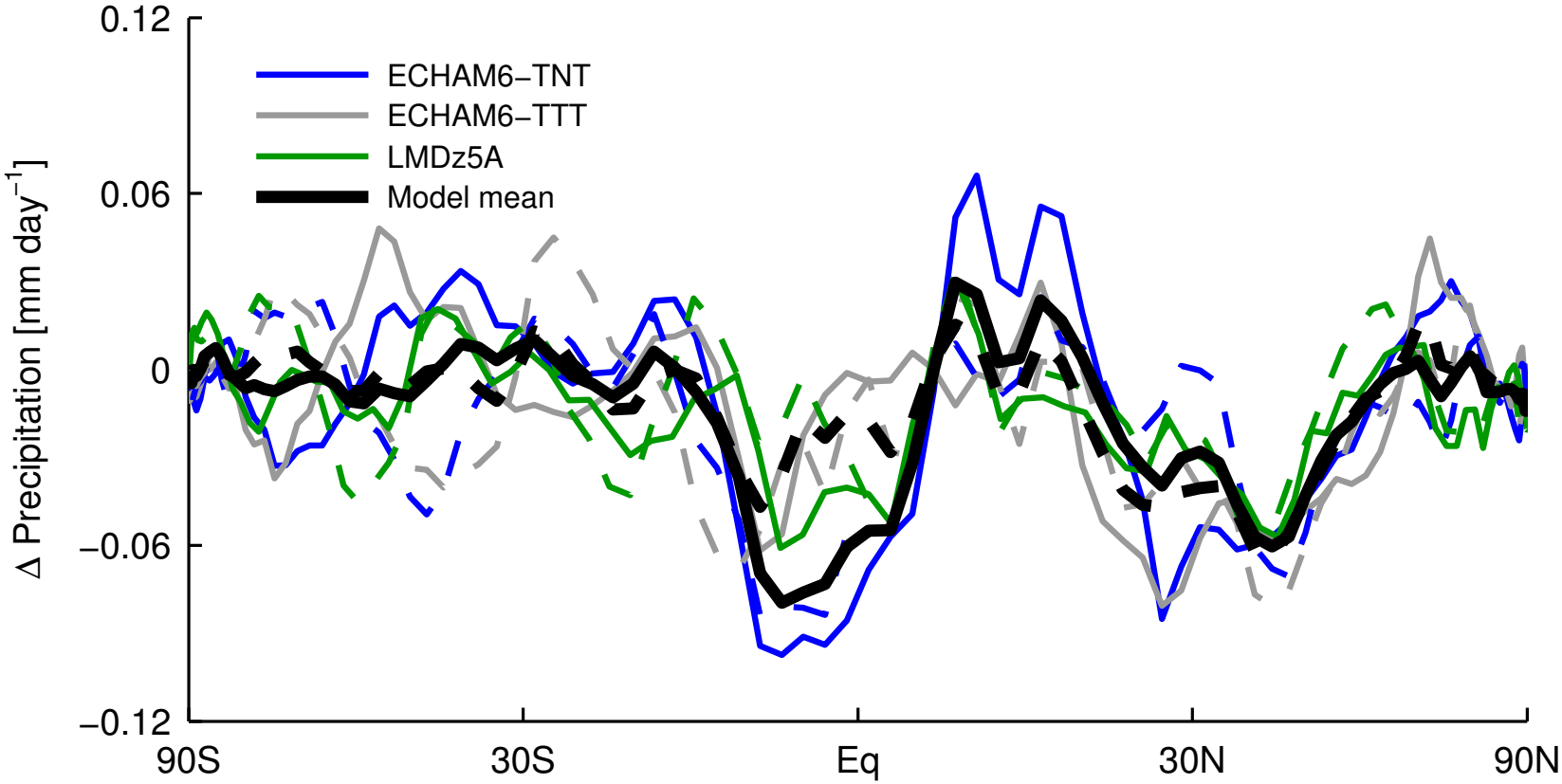


AMIP Easy Aerosol with ECHAM6 and LMDz: precipitation



- Less precipitation around center of aerosol plume

AMIP Easy Aerosol with ECHAM6 and LMDz: precipitation



- Less precipitation around center of aerosol plume
- Northward shift of tropical rain belt

Plus on est de fous, le plus on rit!*

- Contact person: Aiko Voigt, LMD Paris, aiko.voigt@lmd.jussieu.fr

* LMD speak: Join the Party!