

# Evaluation of aerosol-cloud-radiation interactions in ESMs

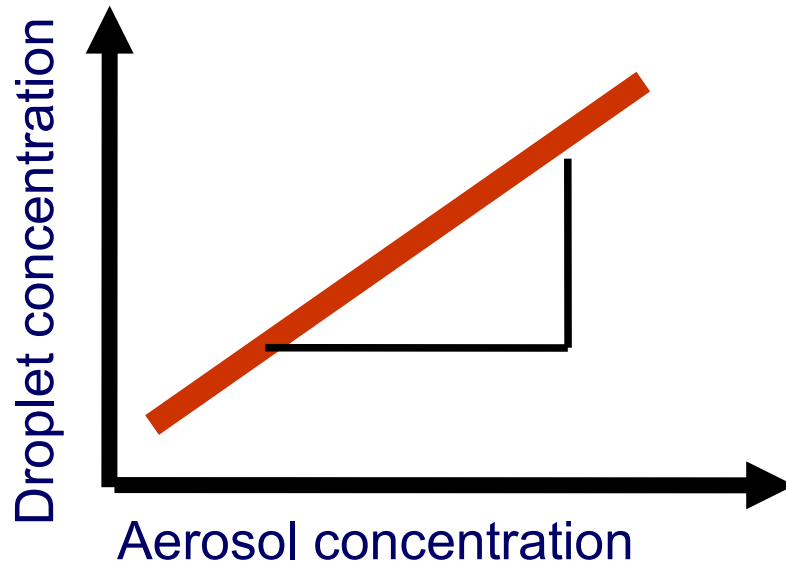
Johannes Quaas, MPI for Meteorology, Hamburg

- Cooperation with the AEROCOM initiative
- some of our ESMs participated to the study by Quaas et al. (Atmos. Chem. Phys. 2009)

Deliverable D2.2, month 30 (August 2012)



# Evaluation metric

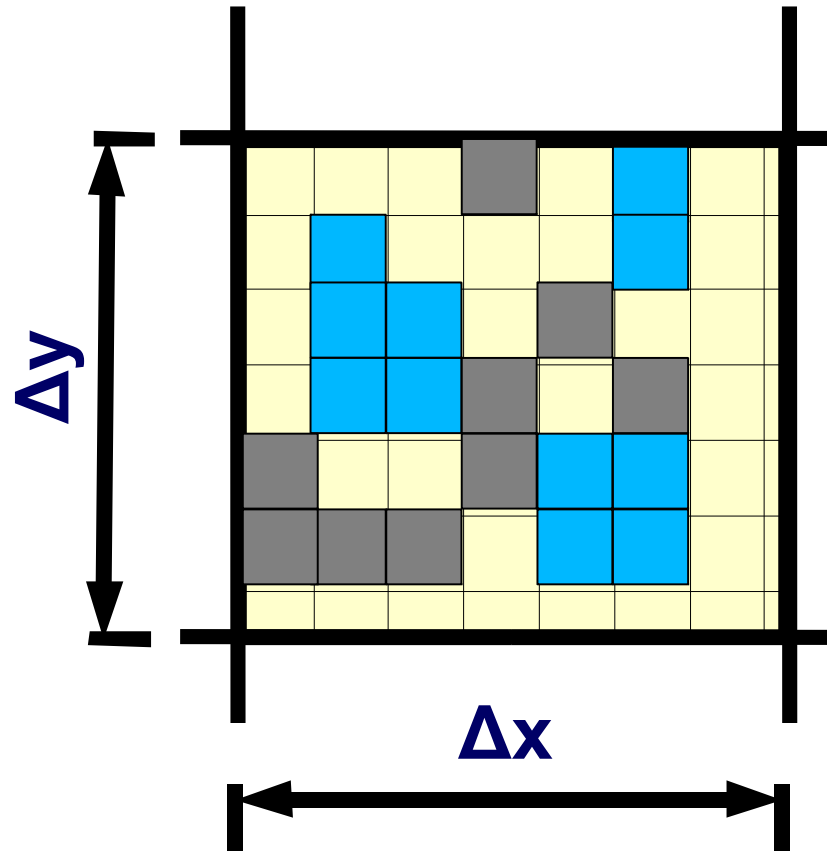





$$\frac{\Delta \ln N_d}{\Delta \ln \tau_a}$$

$N_d$  – cloud droplet number concentration (CDNC)

$\tau_a$  – aerosol optical depth (AOD)

# Evaluation metric



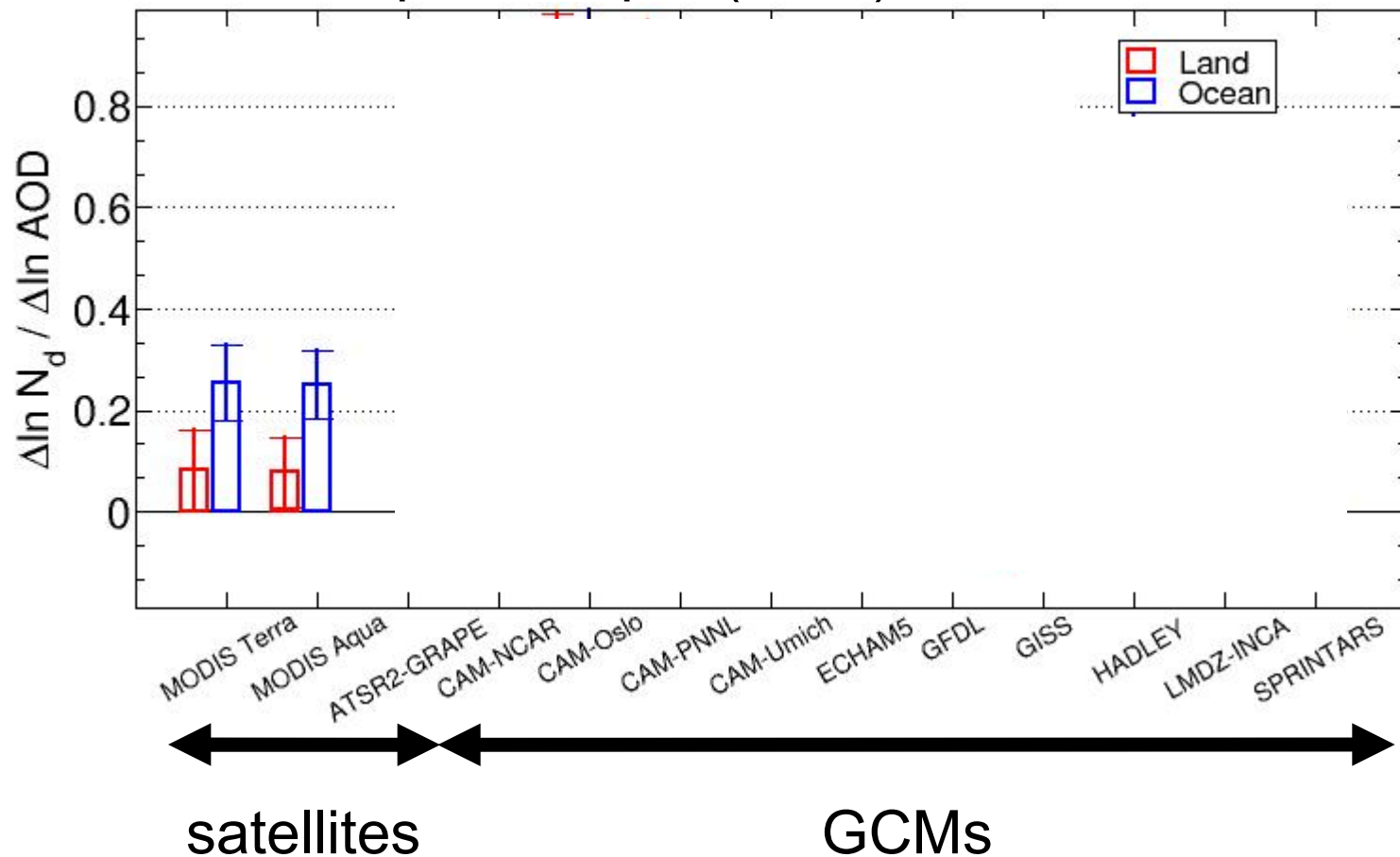
-  Aerosol measurements
-  Cloud measurements
-  No retrieval

**Method adopted:**  
relate aerosol and cloud quantities within a model gridbox (daily values)

$\Delta x / \Delta y$  : model resolution  
here:  $2.5^\circ \times 2.5^\circ$

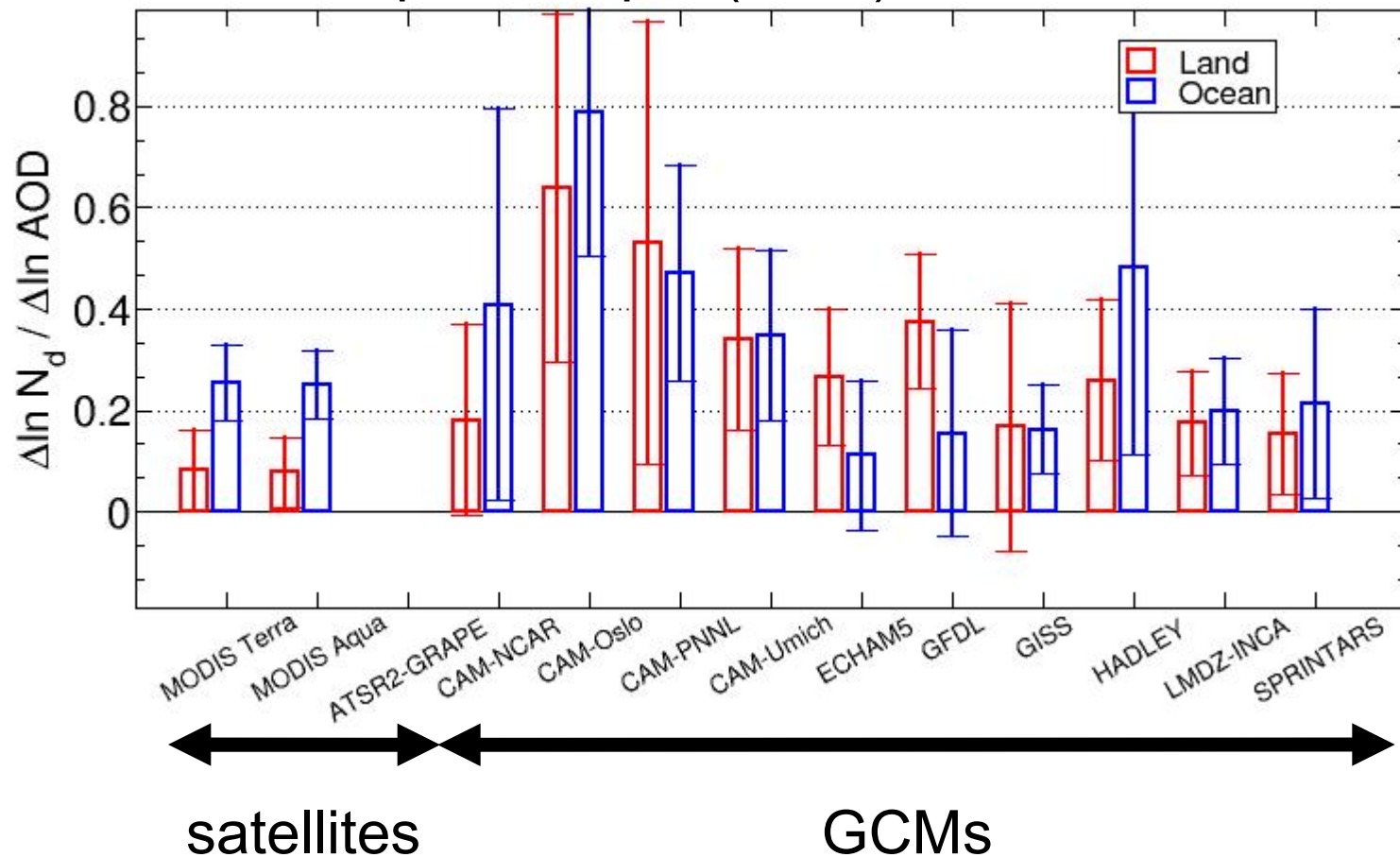
# Droplet number concentration vs. AOD

Cloud droplet number concentration ( $N_d$ ) vs. Aerosol optical depth (AOD)



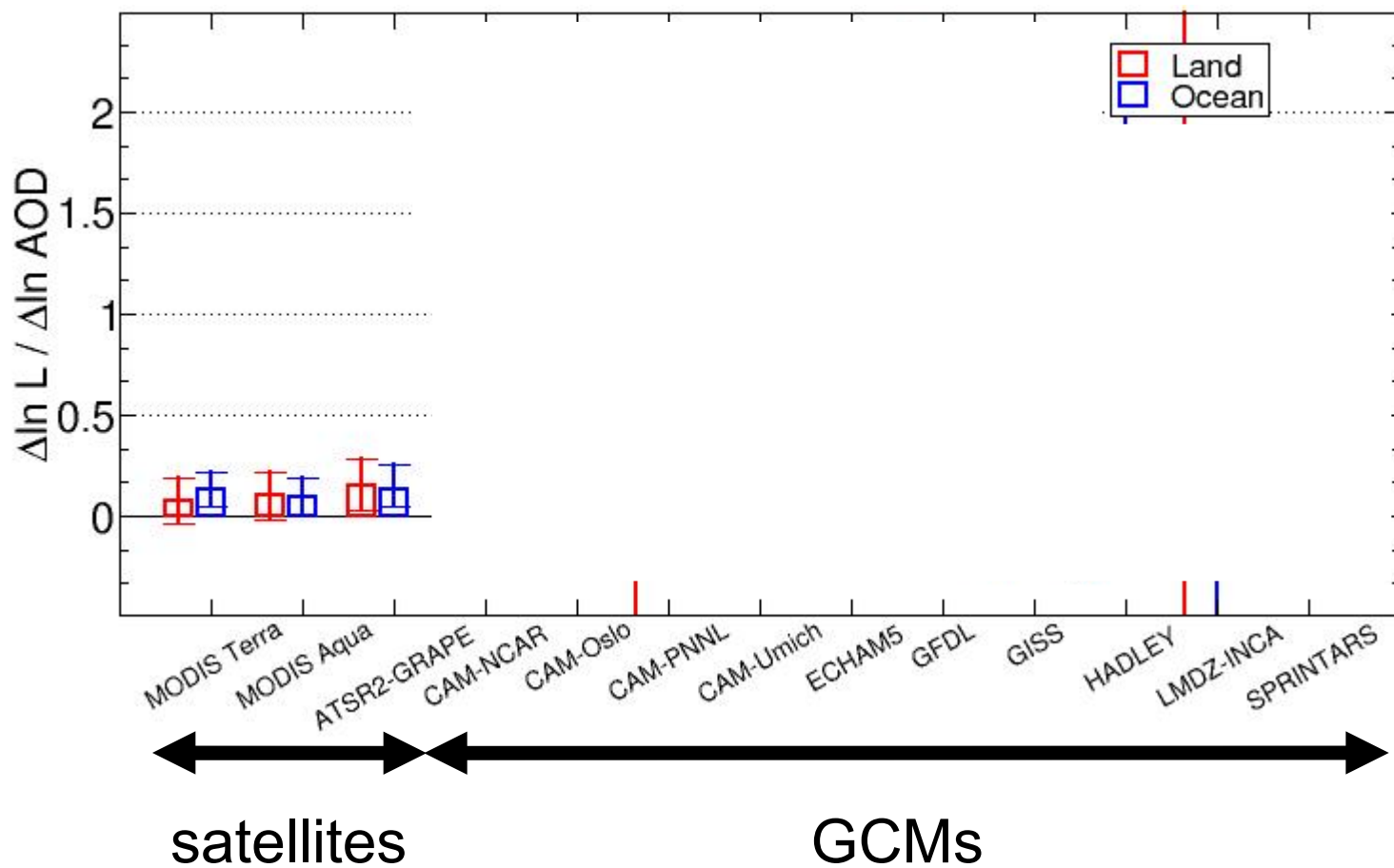
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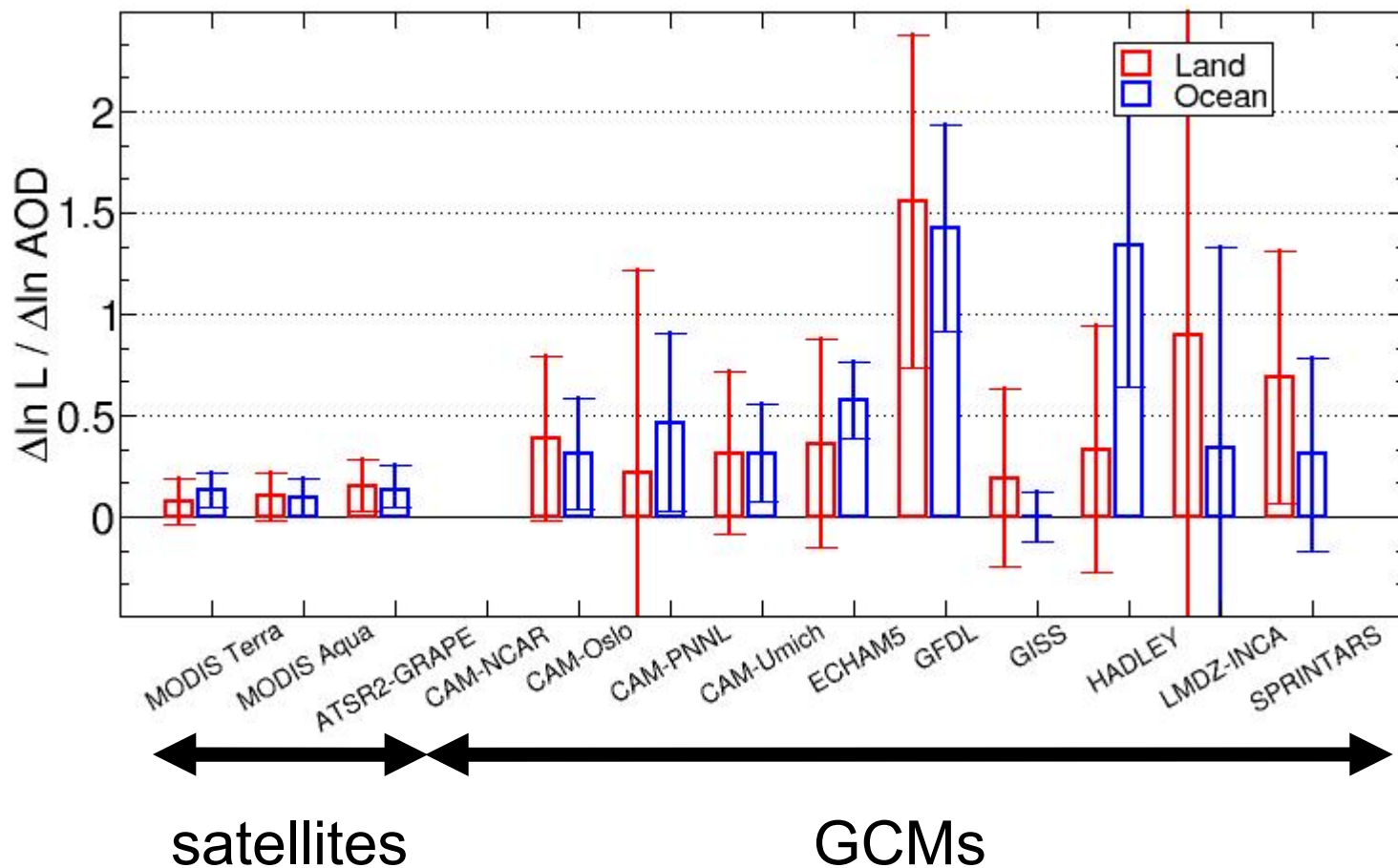
# Liquid water path vs. AOD

Liquid water path (L) vs. AOD



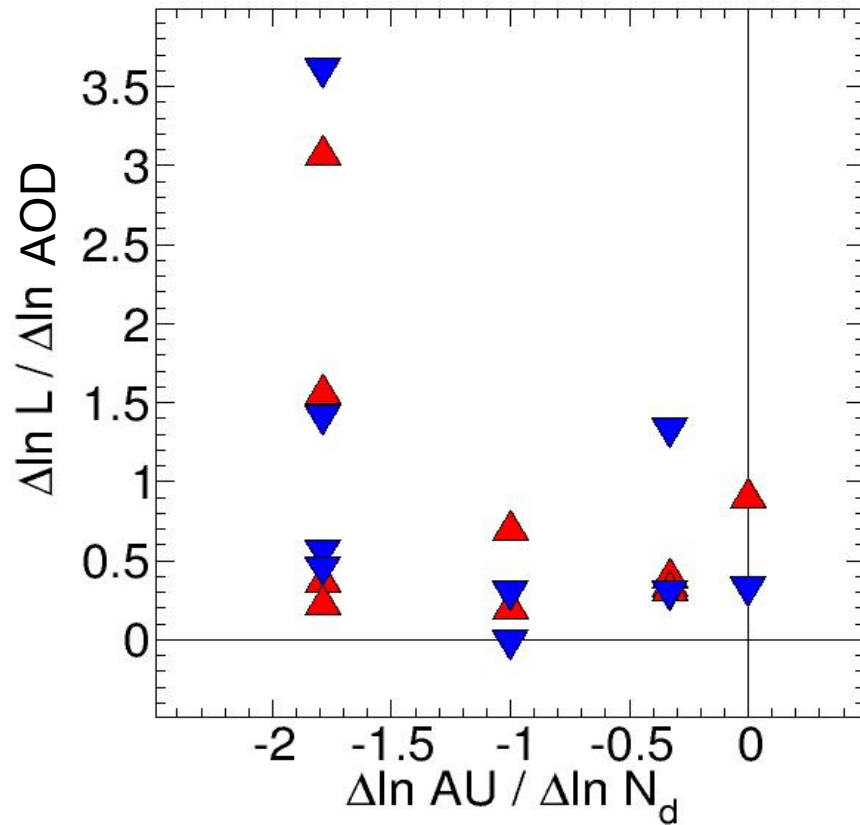
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# 2<sup>nd</sup> indirect effect

Second aerosol indirect effect implemented  
overly simplistic in GCMs



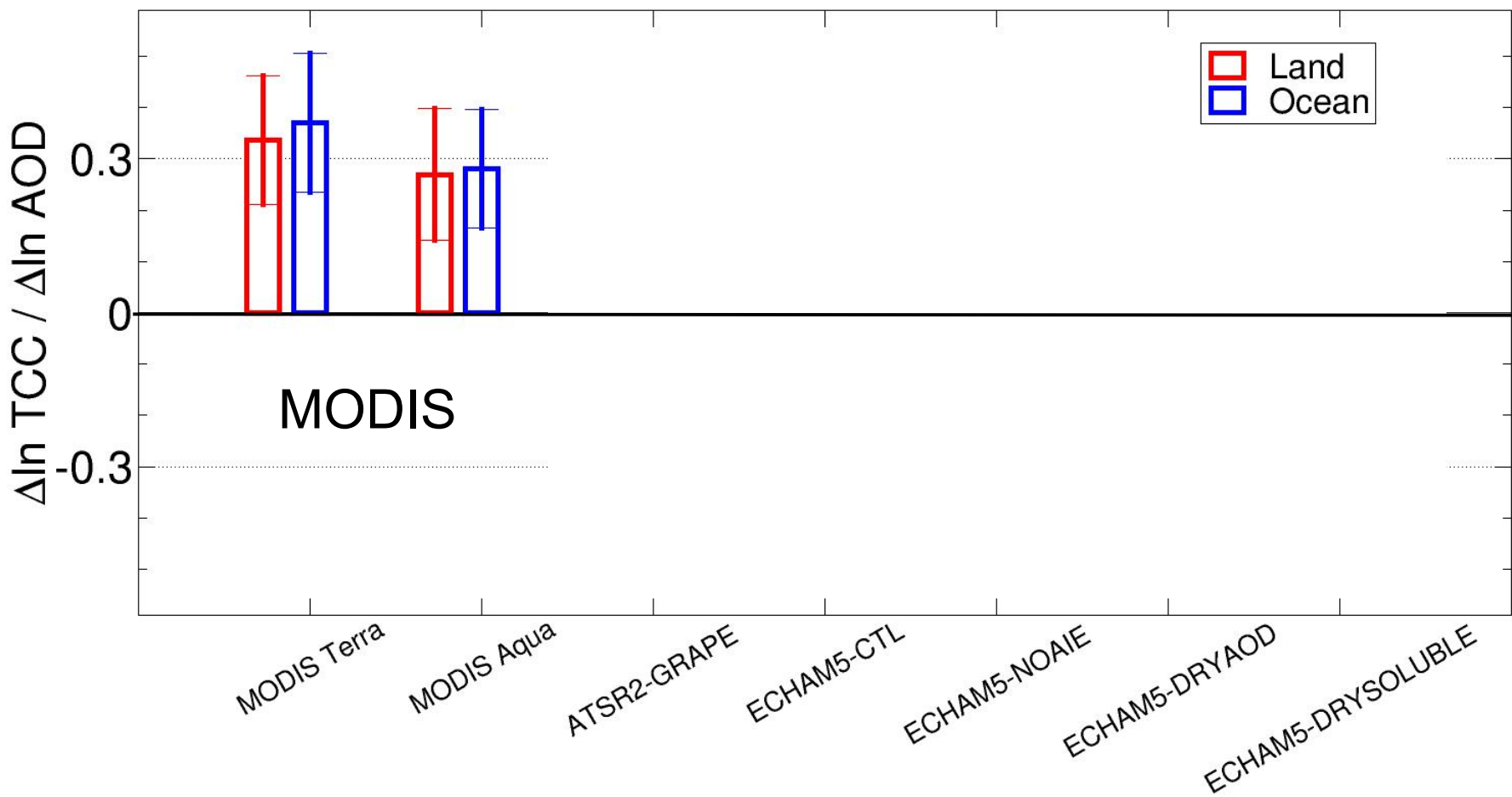
Precipitation by  
autoconversion (AU)  
depends on cloud droplet  
number concentration  $N_d$

$$AU \sim N_d^x$$

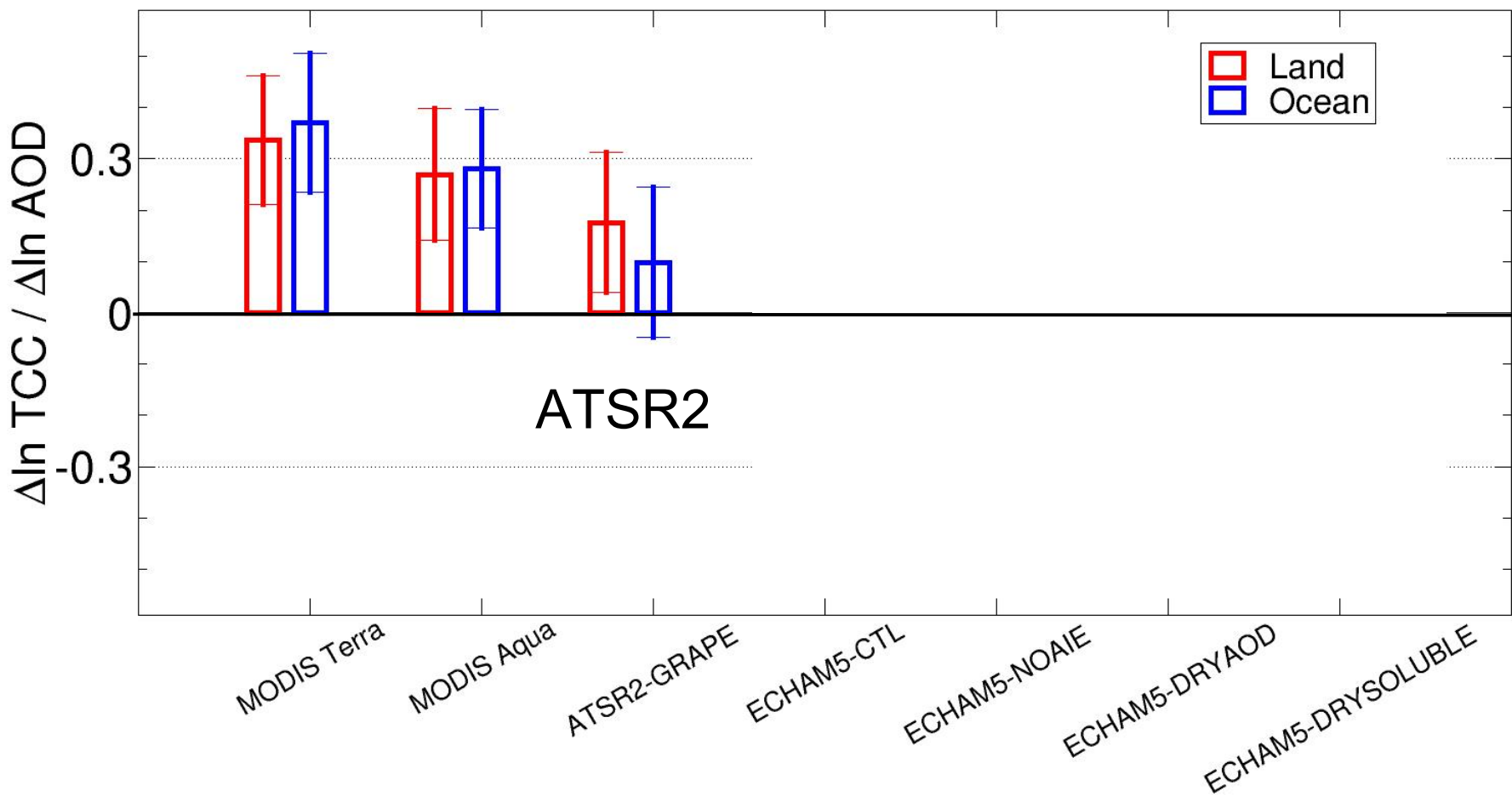
$$x \in \{-1.79, -1.0, -0.33, 0\}$$



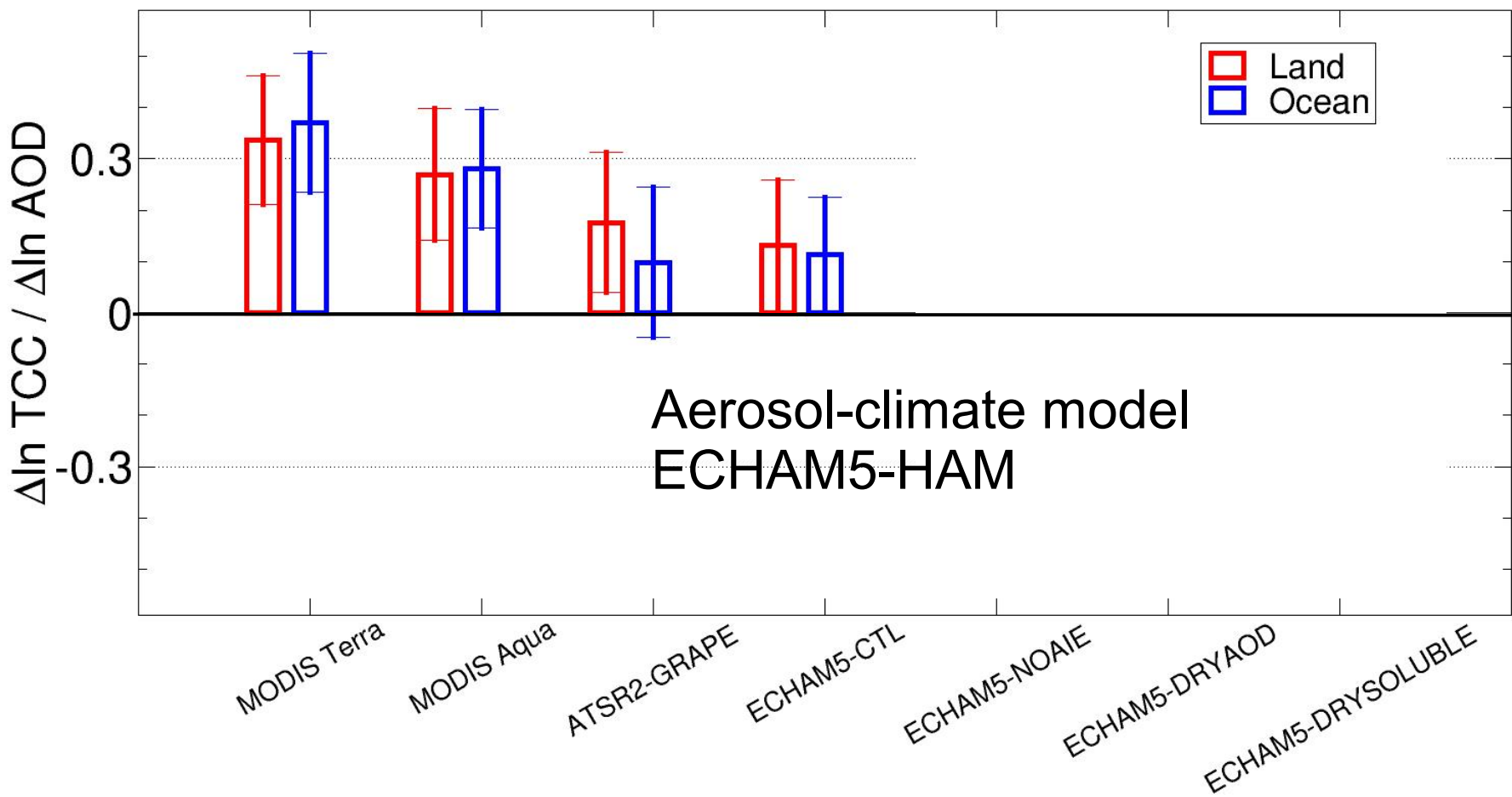
# Relationship total cloud cover (TCC) - AOD



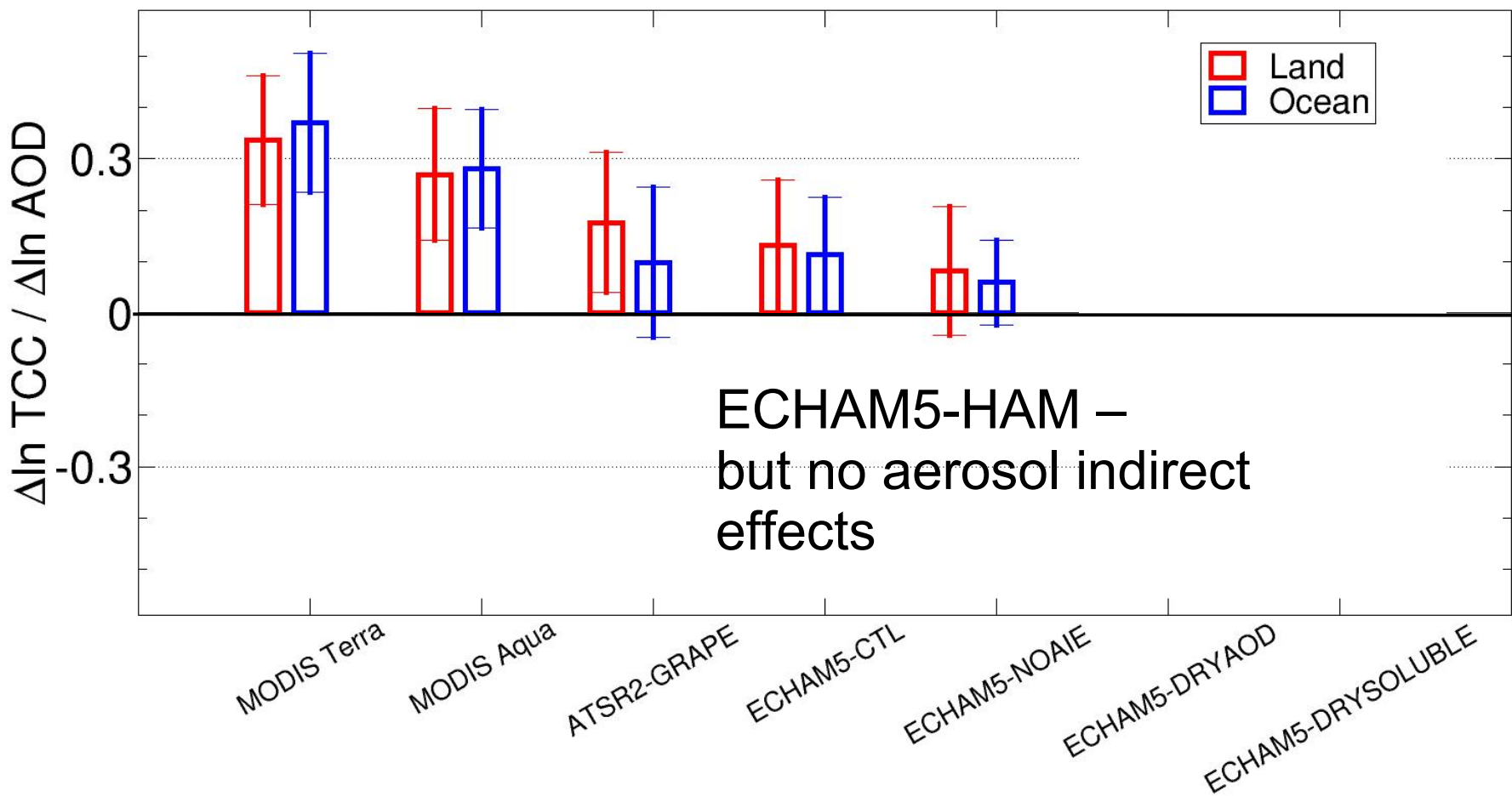
# Relationship total cloud cover (TCC) - AOD



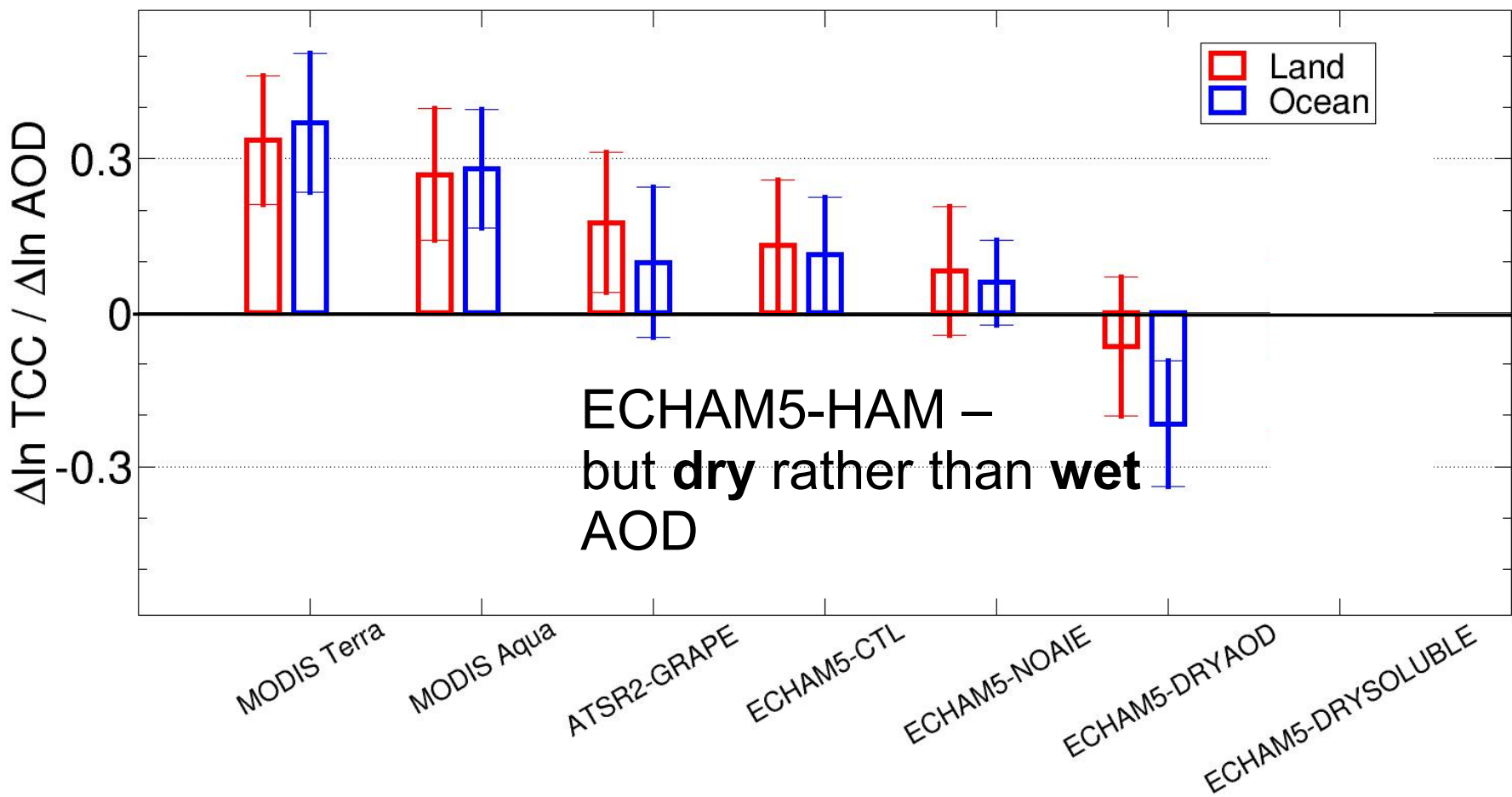
# Relationship total cloud cover (TCC) - AOD



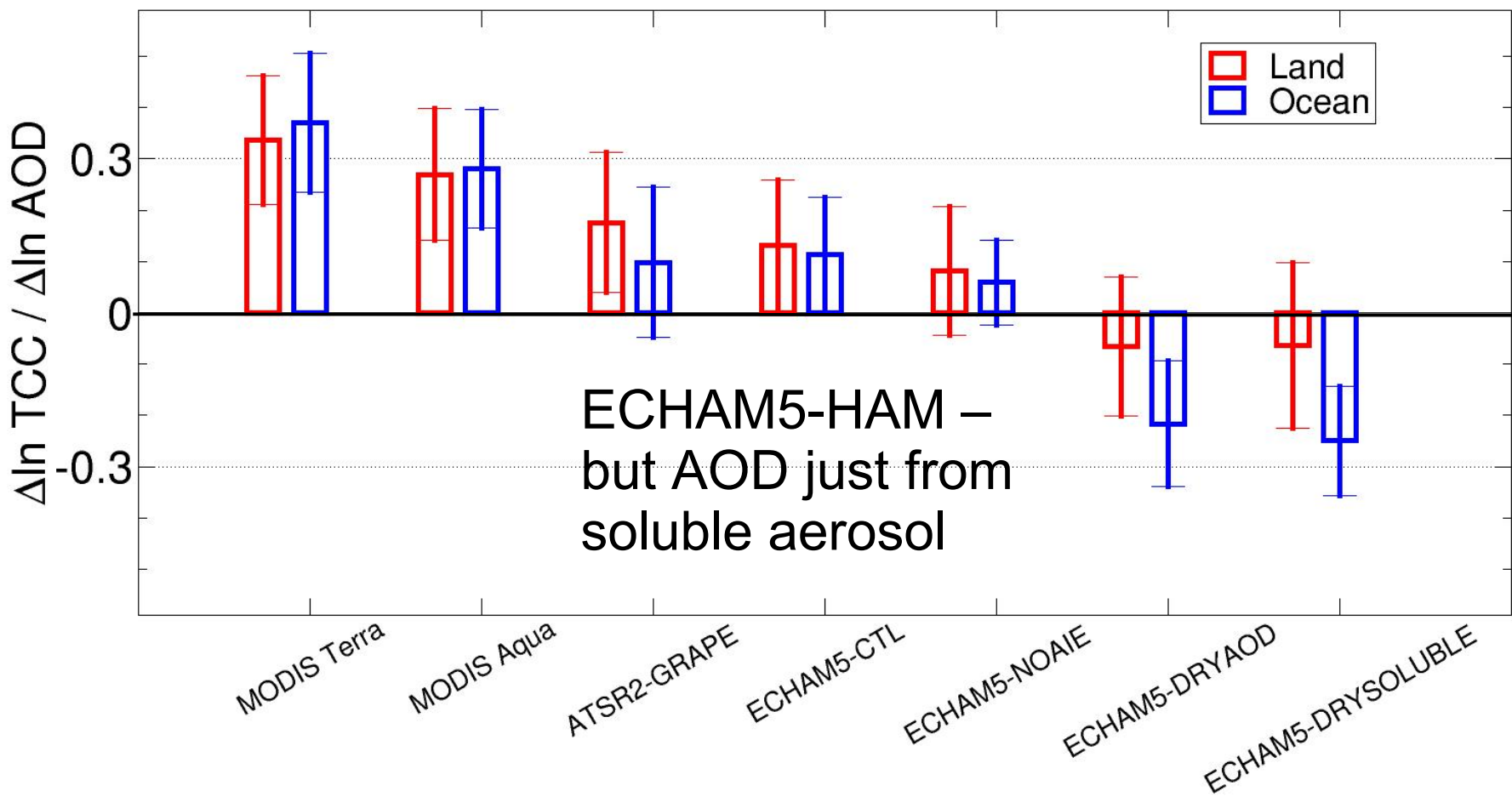
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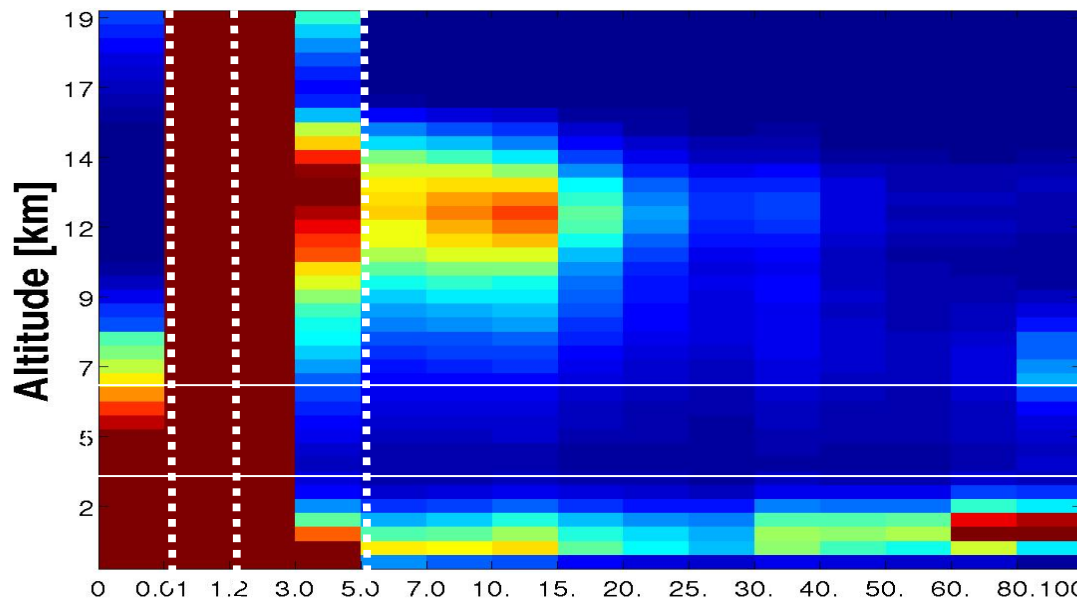


# Summary

- Aerosol-cloud interaction evaluation: suggest to be done in cooperation with AEROCOM
  - > results from preliminary study available
- Issues with vertical aerosol distribution and swelling
  - > aerosols in CALIPSO simulator?

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