Humidity in AeroCom Phase II

Comparisons to observations and implications for RF estimates

14th AeroCom Meeting, Frascati, October 2015

Bjørn H. Samset, Gunnar Myhre, J. Schwarz, AeroCom modellers, +++

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Further applications of the Phase II ensemble:

M.Sand

Aerosols at the poles

J.Schwarz

Measurements of black carbon (BC) vertical profiles

Introduction / motivation

G. Myhre et al.: Radiative forcing of the direct aerosol effect

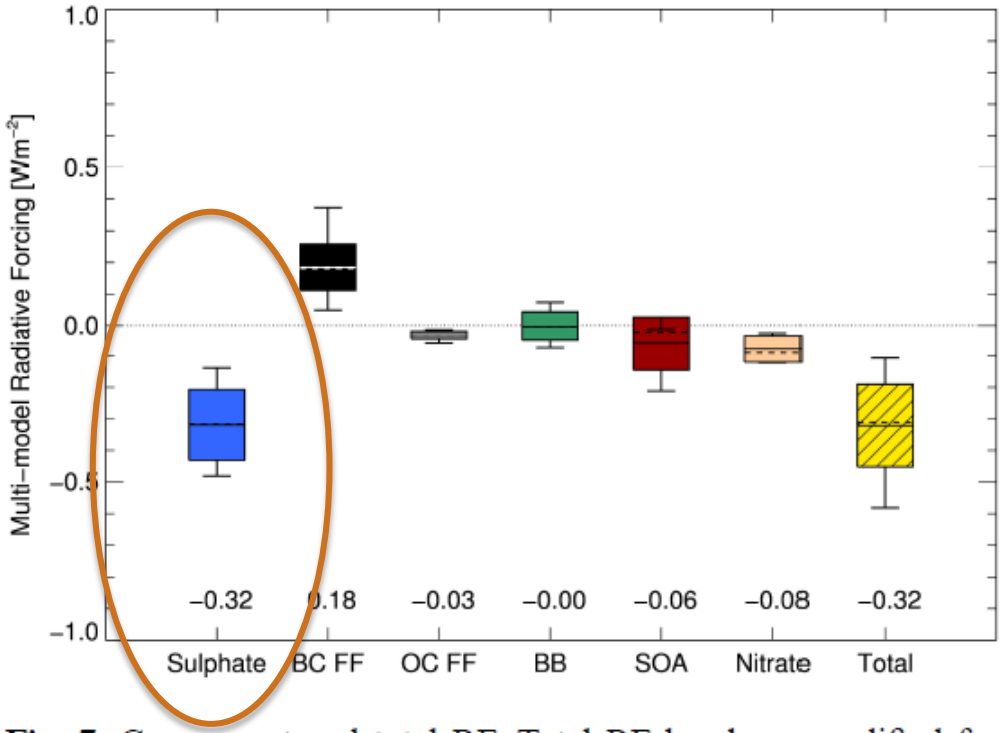
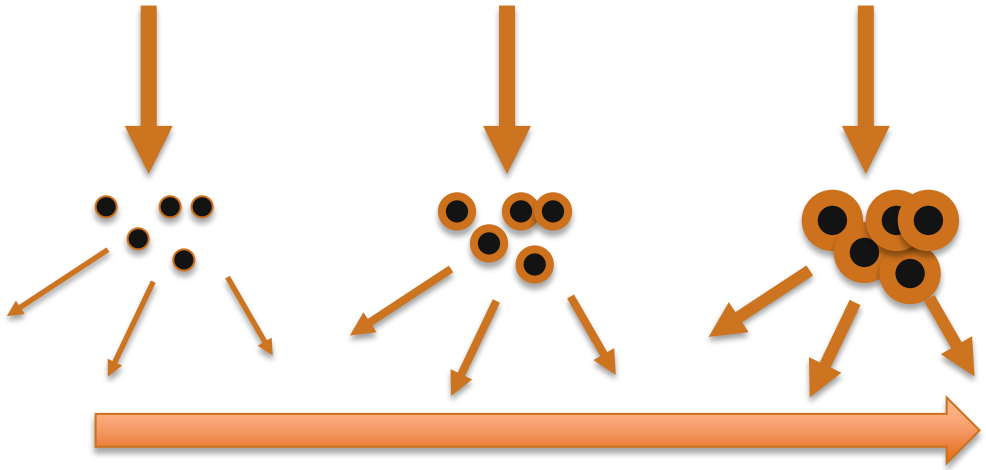


Fig. 7. Component and total RF. Total RF has been modified for missing components in individual models. Solid lines inside the boxes show the model mean, dashed lines show the median. The boxes indicate one standard deviation, while the whiskers indicate the max and min of the distribution.



Relative humidity

1. How similar/different are absolute and relative humidity fields in AeroCom models?
2. Is the model ensemble biased vs. observations?
3. Do intermodel differences influence calculated sulphate RF?

NB: Work in progress. Please give input!

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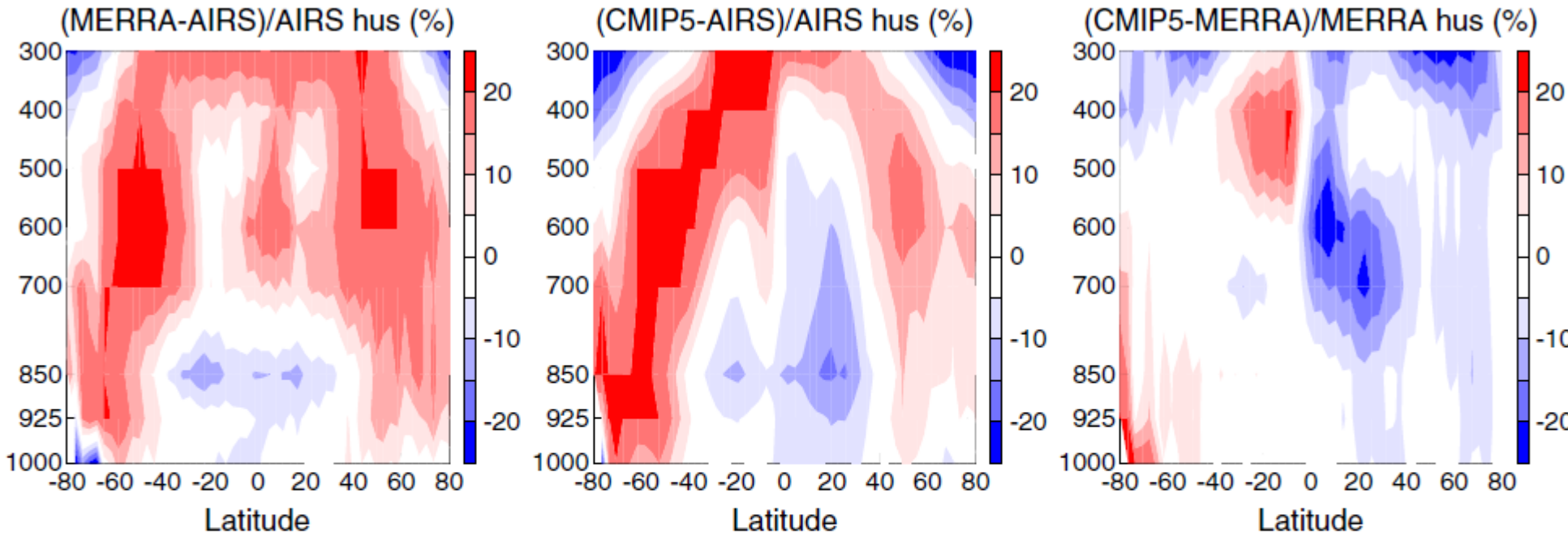
Evaluating CMIP5 models using AIRS tropospheric air temperature and specific humidity climatology

Baijun Tian,[1] Eric J. Fetzer,[1] Brian H. Kahn,[1] Joao Teixeira,[1] Evan Manning,[1] and Thomas Hearty[2]

Received 2 August 2012; revised 11 December 2012; accepted 13 December 2012; published 16 January 2013.

[1] This paper documents the climatological mean features of the Atmospheric Infrared Sounder (AIRS) monthly mean tropospheric air temperature (ta, K) and specific humidity (hus, kg/kg) products as part of the Obs4MIPs project and compares them to those from NASA's Modern Era Retrospective analysis for Research and Applications (MERRA) for validation and 16 models from the fifth phase of the Coupled Model Intercomparison Project (CMIP5) for CMIP5



Bjørn H. Samset | b.h.samset@cicero

Models, data and methodology

Specific humidity

Models:
- CAM4-Oslo
- CAM5.1
- GISS-modelE
- GISS-MATRIX
- GOCART
- OsloCTM2
- HadGEM2
- INCA
- SPRINTARS

Data / reanalysis:
- AIRS satellite data
- ECMWF reanalysis (OsloCTM2)
- HIPPO

NB: Monthly mean fields. Switching to daily fields makes little difference.

Relative humidity

Models:
- Same model set
- RH calculated from spec.hum. and temperature fields
- CMIP5

Data / reanalysis:
- AIRS satellite data
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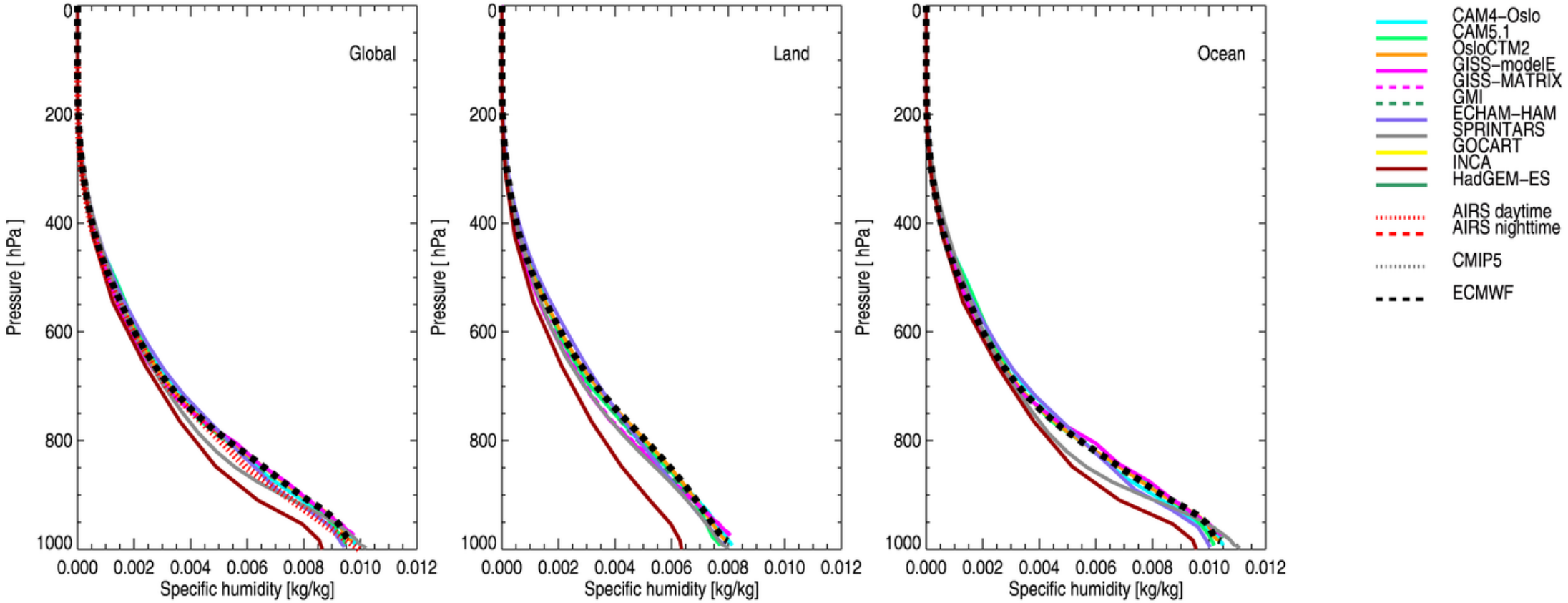
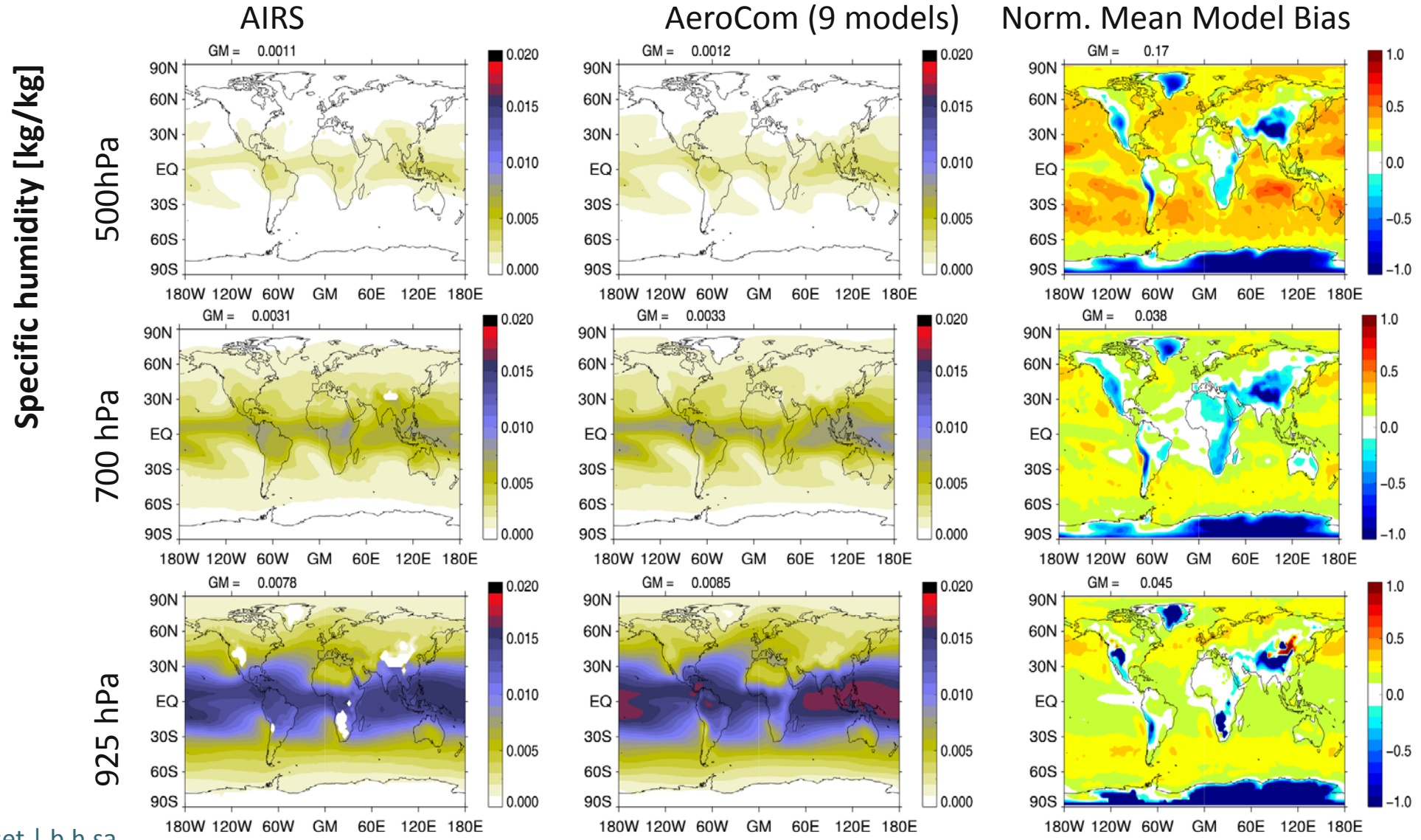
Radiative forcing

- Baseline: OsloCTM2 SO4 fields, disort 8-stream radiative transfer
- Hygroscopic growth parametrized following Fitzgerald (1975)
- Spec. hum and rel.hum from other models read into radiative transfer calculation, new RF calculated

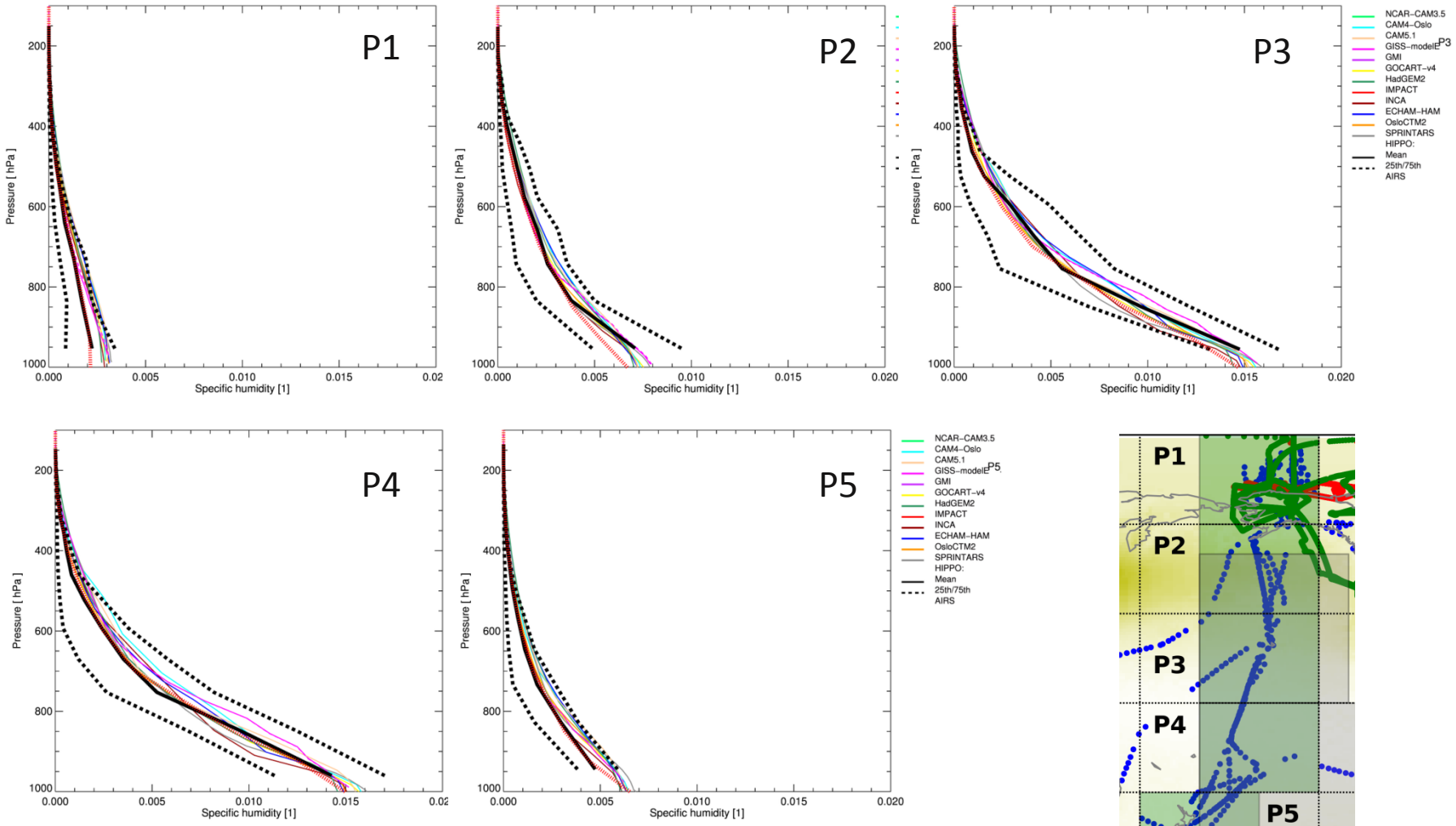
Specific humidity - global



Specific humidity - global



Specific humidity – Pacific - HIPPO



AeroCom: Based on *hus* field, mass fraction of water in air. Kg/kg. No conversion.
HIPPO: Based on measured mole fraction. Mult. by (18.01 / 28.94) to get from mole frac to mole mass, then 1e-6 to go from ppm to kg/kg.
AIRS: Water vapor mmr, daytime/ascending, AIRSX3STD v006, avg of 2009-2011.

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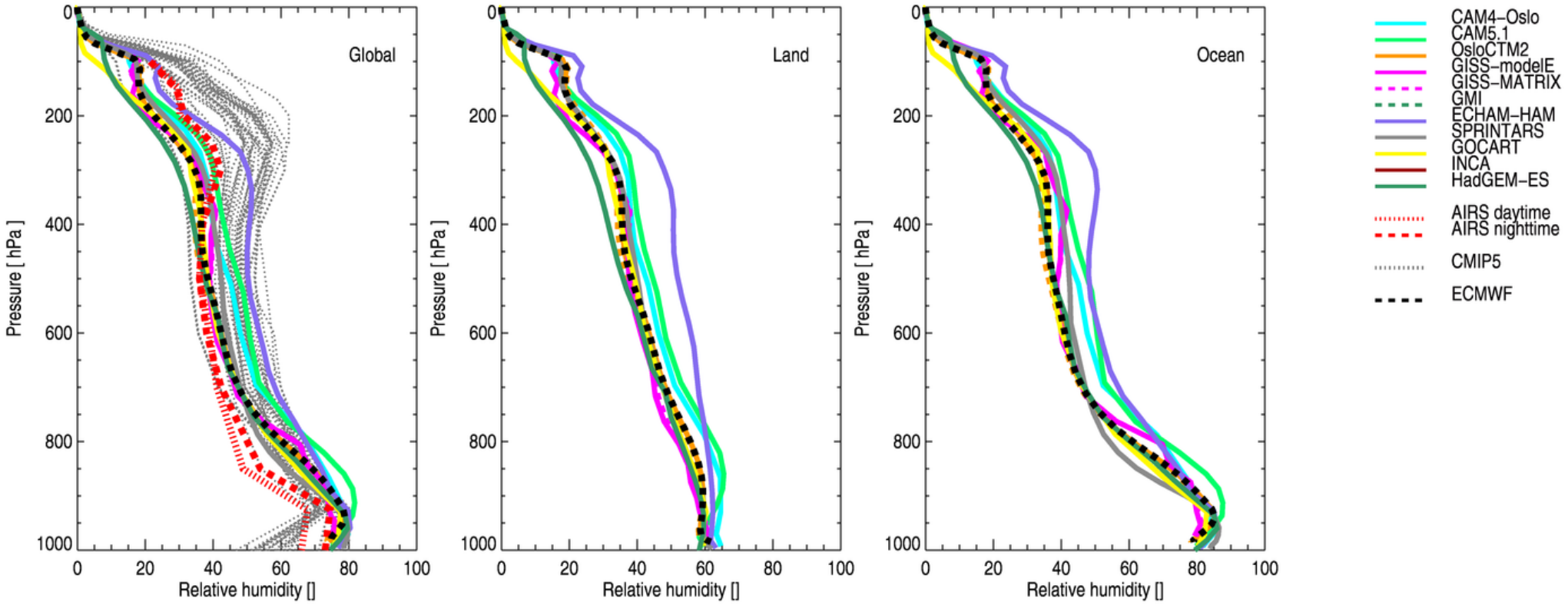

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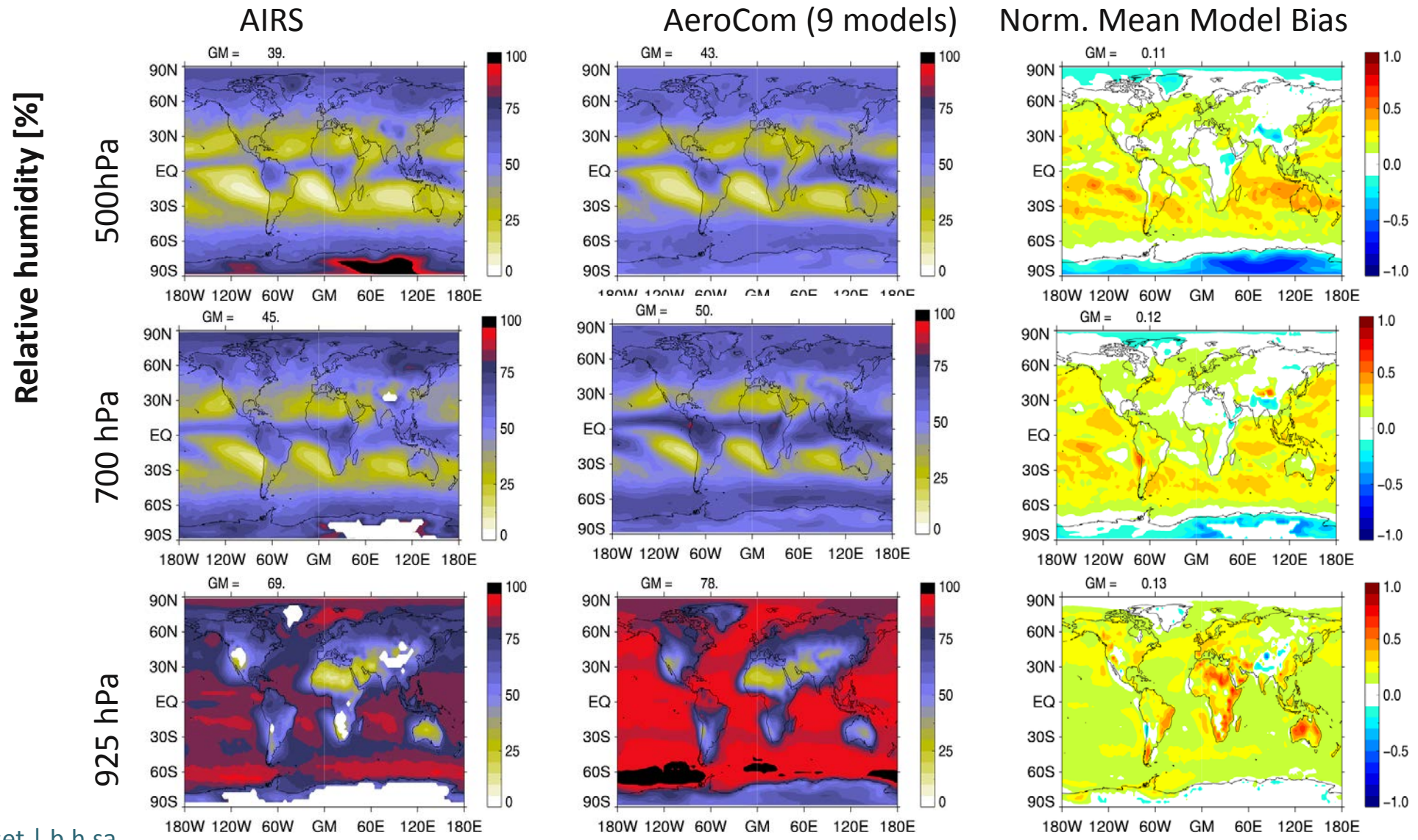
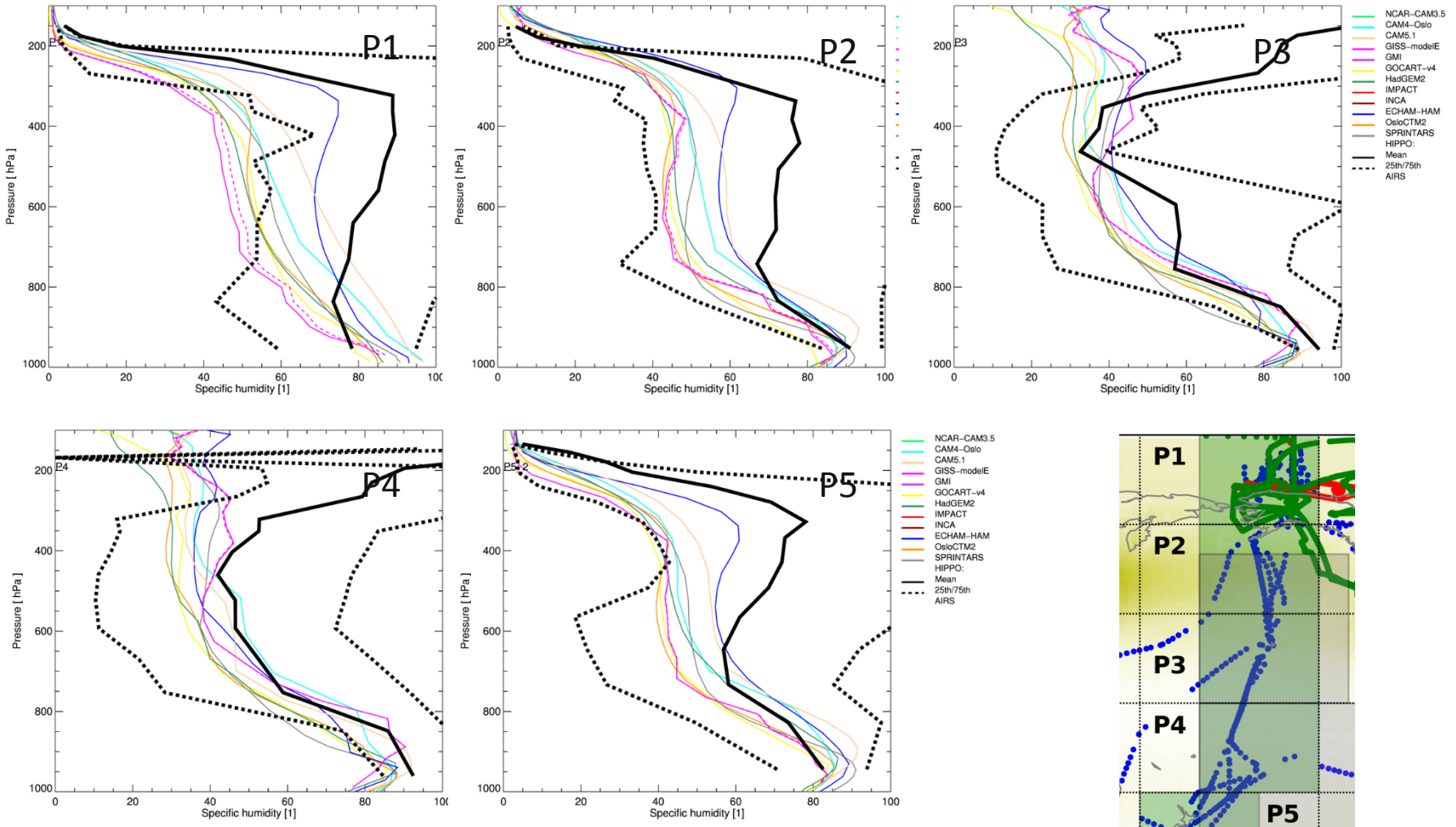


Relative humidity – Pacific - HIPPO



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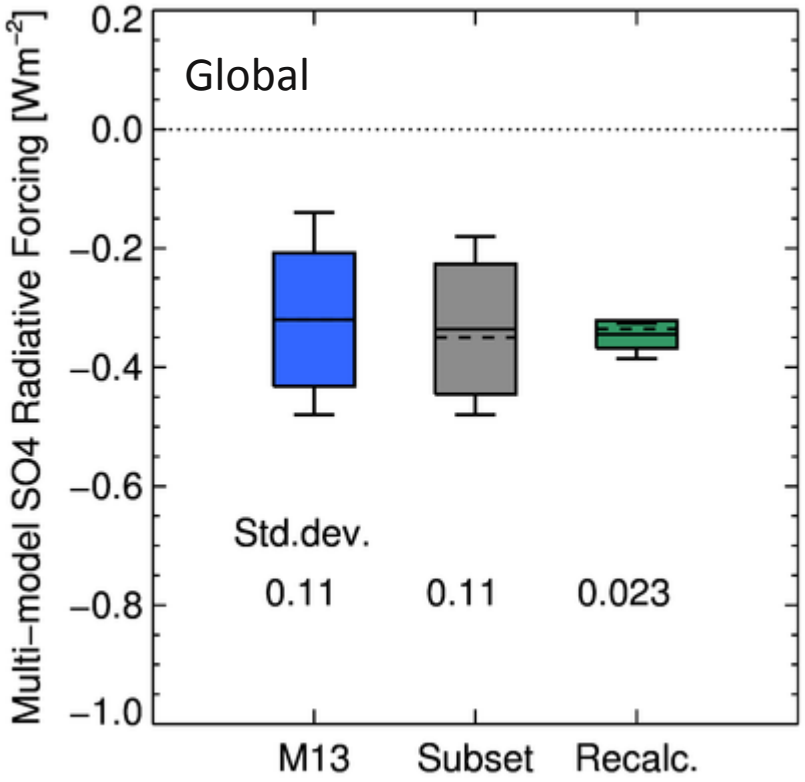
Sulfate radiative forcing:

Variability due to model differences in relative humidity…

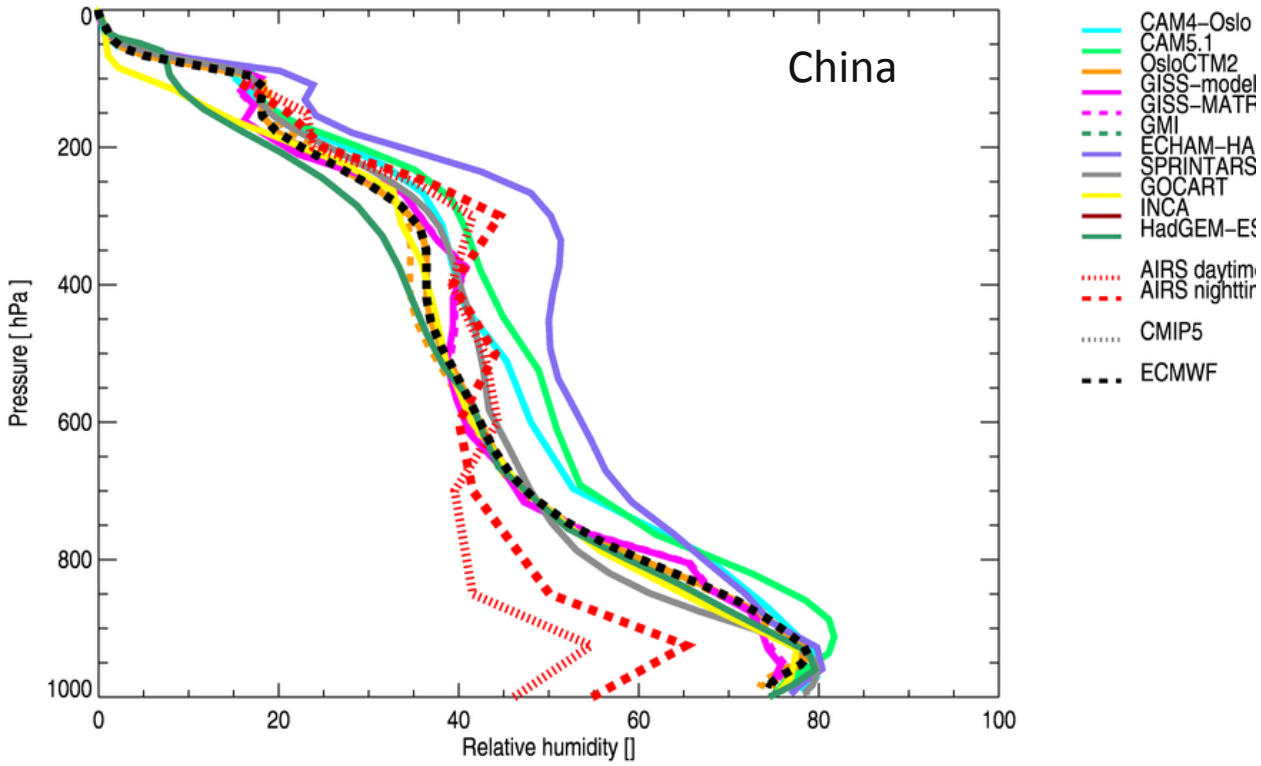
Global	Wm^{-2}
OsloCTM2 original	**-0.35**
OsloCTM2	-0.34
CAM4-Oslo	-0.39
CAM5.1	-0.36
GISS	-0.34
GOCART	-0.33
SPRINTARS	-0.33
Mean	**-0.35**
Std.dev	**0.02**
RH=0.0	-0.26

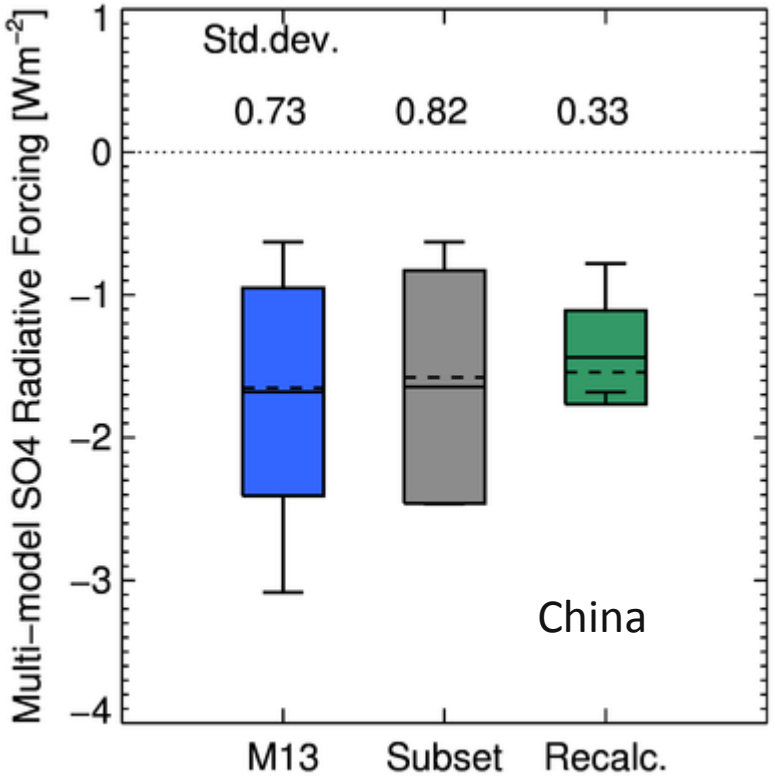


Sulfate radiative forcing:

Variability due to model differences in relative humidity…

«China» = (100E,130E) , (20N,45N)





Conclusions

1. **How similar/different are absolute and relative humidity fields in AeroCom models?**

   Specific humidity fields are in general quite similar.
   Relative humidity varies more, indicating that the modeled temperature fields differ more than humidity.

2. **Is the model ensemble biased vs. observations?**

   Specific humidity is in good shape, though with some intriguing land/ocean contrasts in mean model bias.
   Relative humidity shows same set of biases seen for CMIP5, though with differences to that ensemble esp. at high altitudes. Overestimation w.r.t. AIRS closer to the surface.

3. **Do intermodel differences influence calculated sulphate RF?**

   Globally? Meh. Not very strongly, at least.
   Regionally? Yes, in particular over the major China source region.

Plans: Add on more models, explore some additional regions and comparisons, then write up the analysis.