Satellite Simulators for AeroCom

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Frascati

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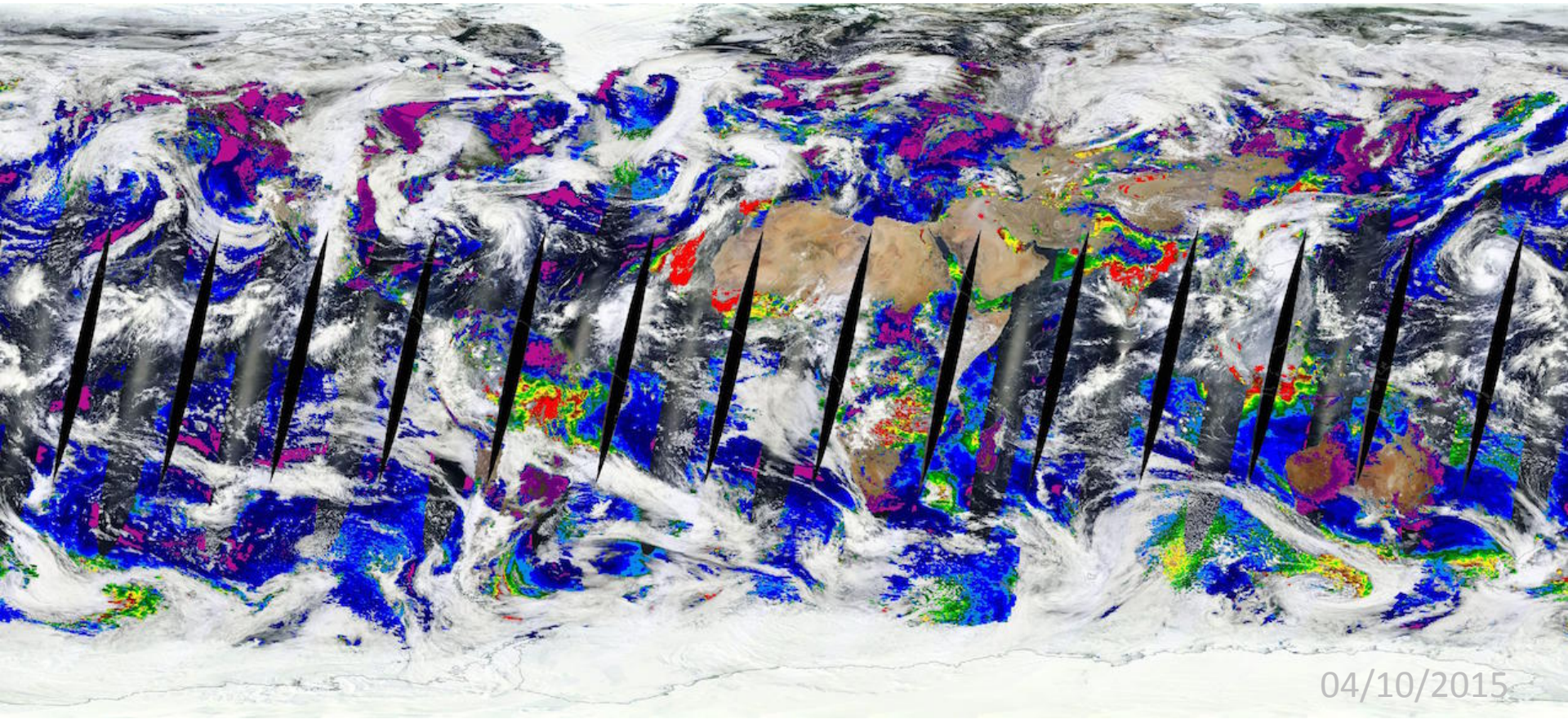
Why Satellite Simulators?

- Satellite retrievals can only retrieve aerosol for a (small) subset of all conditions

Satellite observations



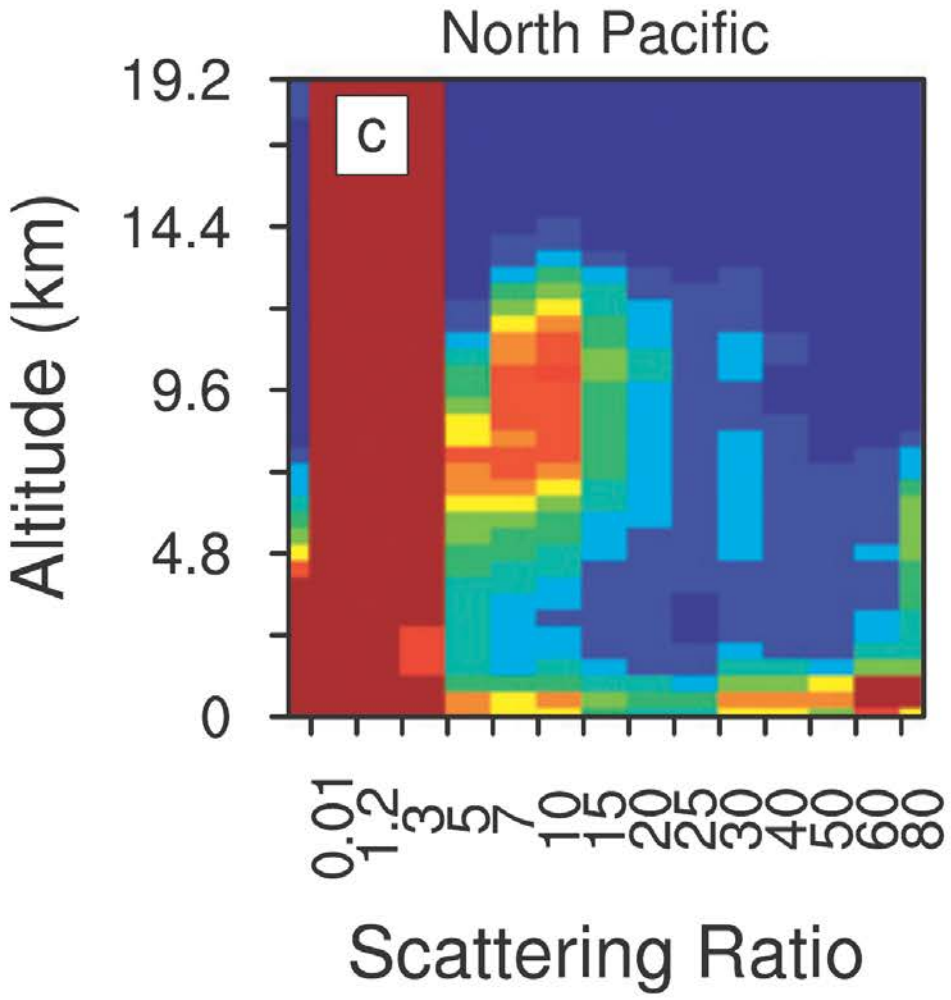
Visualisation of aerosol optical depth retrieval (coloured) on true colour image from MODIS satellite instrument (from https://earthdata.nasa.gov/labs/worldview/).

Why Satellite Simulators?

- Satellite retrievals can only retrieve aerosol for a (small) subset of all conditions
- Models always simulate and output aerosol properties
- This could introduce significant sampling biases in direct comparisons
- Satellite simulators aim to establish a like to like comparison

Considerations

- Aerosol simulator for CALIOP aerosol product (Po-Lun Ma, PNNL)
- Use of existing scattering ratio product in COSP: (Johannes Quaas, Leipzig)



Contoured frequency-by-altitude diagram (CFAD)

of CALIPSO scattering ratio
(attenuated backscatter /
molecular backscatter)

Widely used for cloud diagnostics in GCMs

Part of COSP

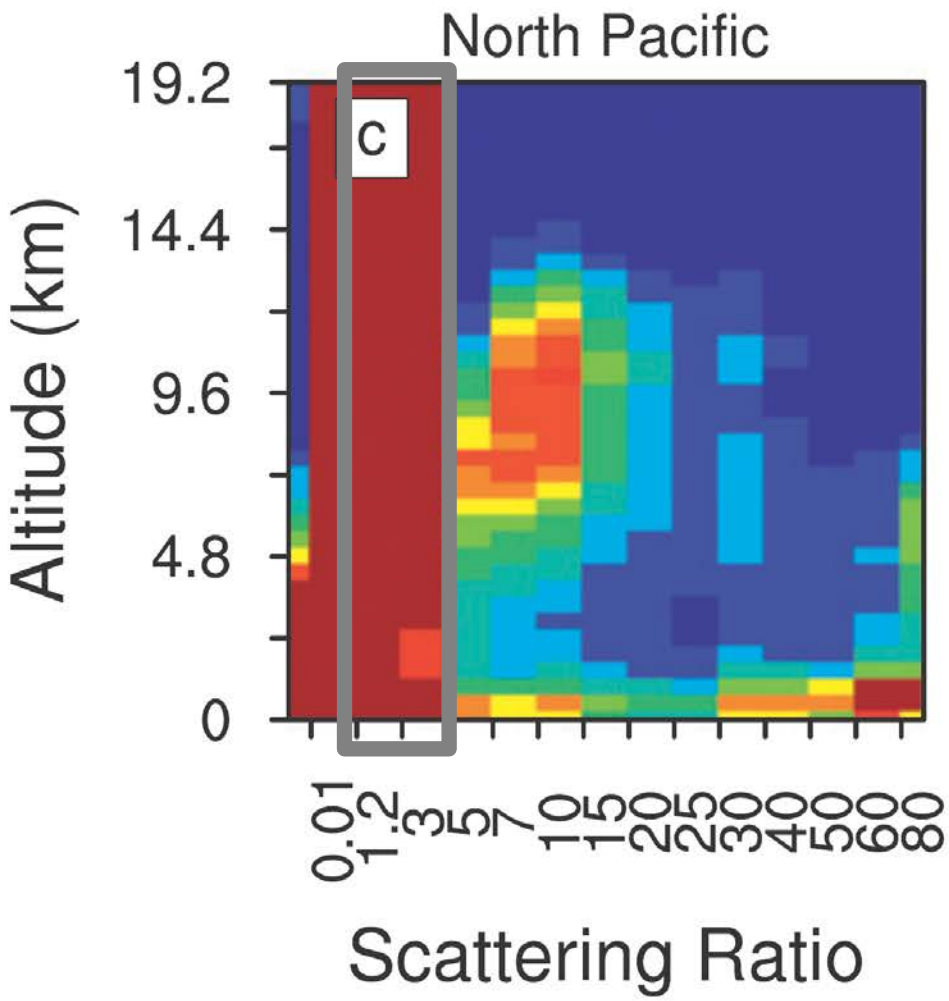
GCM-oriented CALIPSO cloud product (GOCCP) produced by LMD/Paris et al. and publicly available

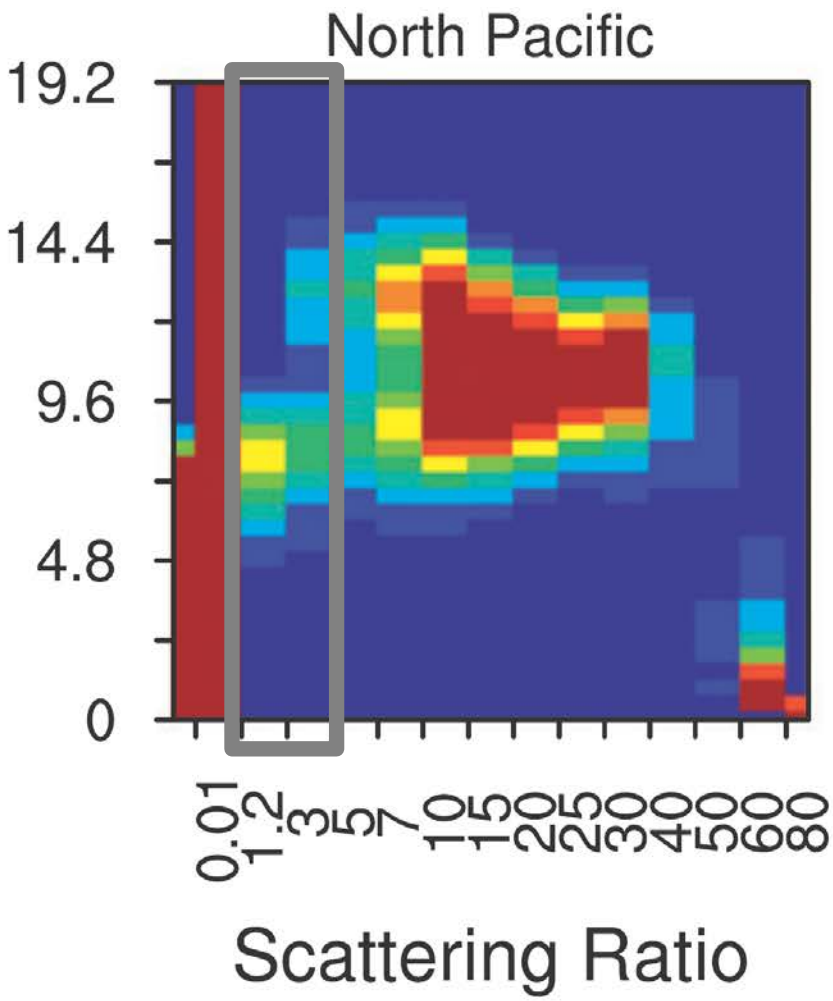
Threshold for cloudiness: SR > 5
above that SR metric for cloud optical thickness.

Nam and Quaas, J Climate 2012

GOCCP

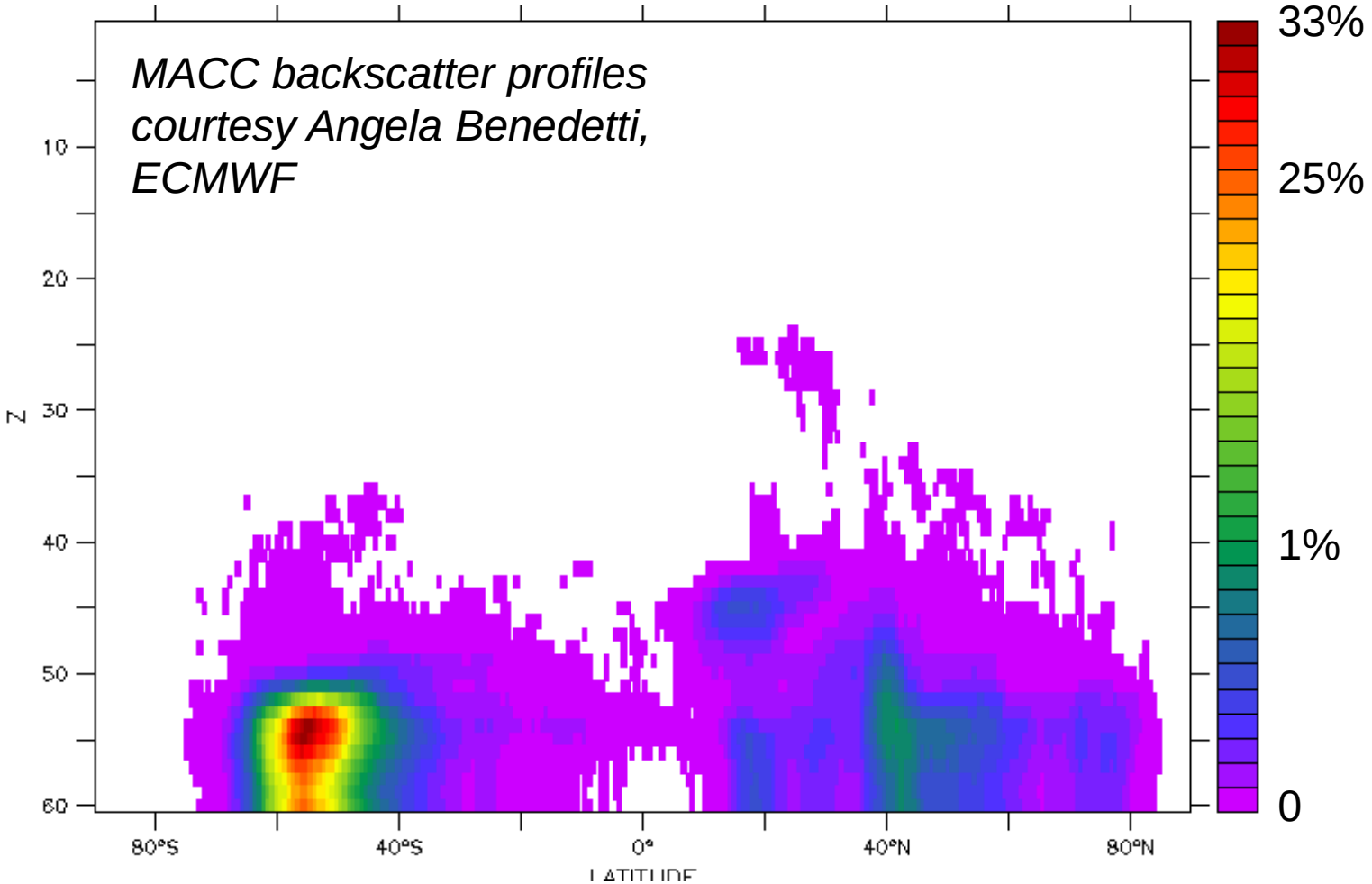
ECHAM clouds only





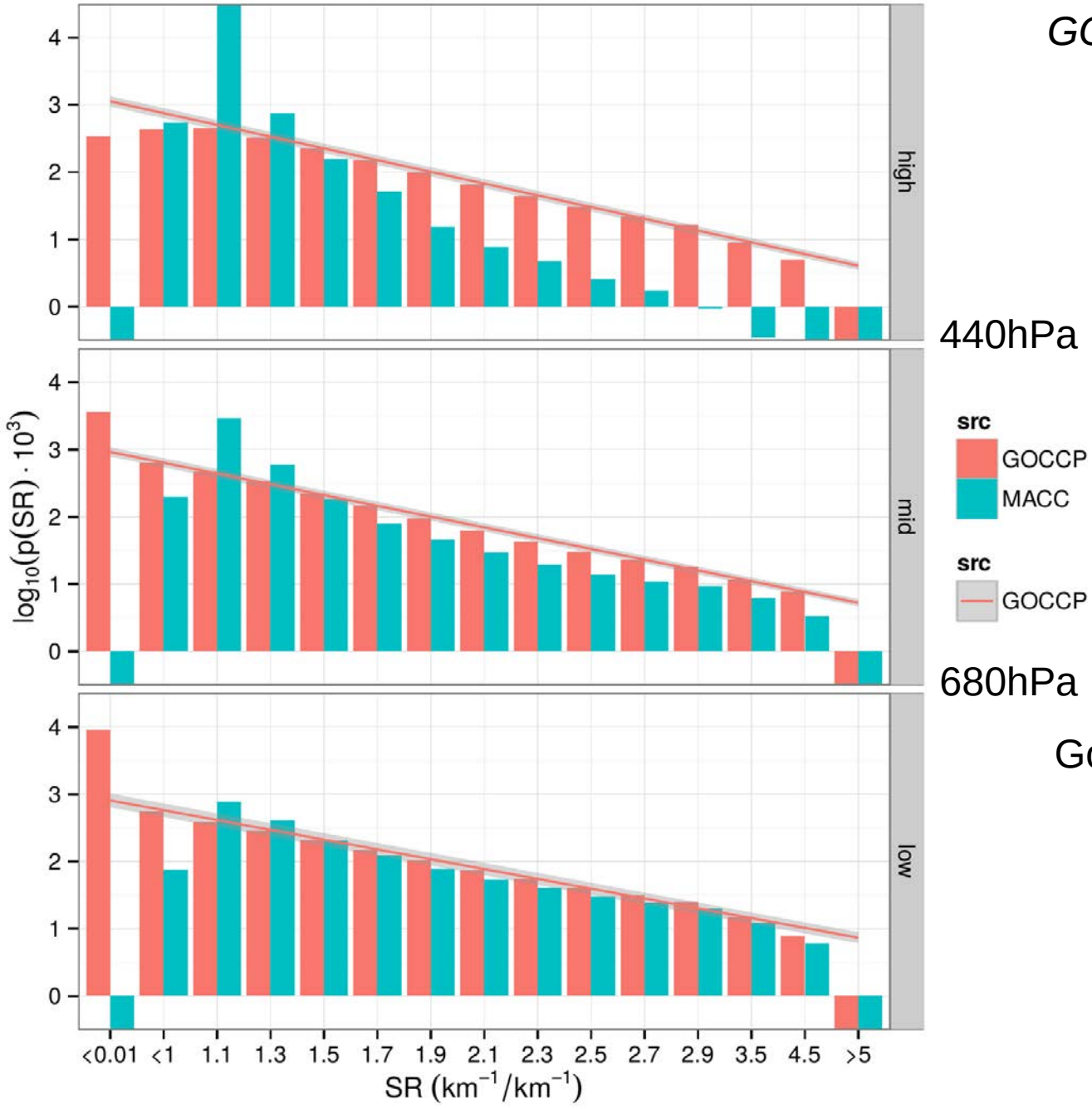
Small SR bins populated in data, not in model diagnostics → aerosol!

Nam and Quaas, J Climate 2012



MACC analysis

Frequency of occurrence of SR > 5 due to aerosol
October 2014, sampled at A-Train overpass



440hPa

680hPa

GOCCP data courtesy Patrick Raberanto / LMD Paris, Gregory Cesana, JPL

Global data
October 2014
Three levels

Good match between aerosol simulation and data
→ useful quantiative information about aerosol
→ misclassification of thin cirrus frequent in upper troposphere
→ but or feature!?

Results from Johannes Mülmenstädt, University of Leipzig

Arguments pro inclusion of aerosol backscatter in existing CFAD

1. GOCCP data exists and can readily be interpreted
→ no separate retrieval product necessary
→ in particular no distinction between aerosol and cloud retrieval
→ thresholds to be selected by user, ideal for aerosol-cloud interaction studies

2. Very easy to implement into existing code in GCMs
→ just add bins below SR 5 in CFAD
→ use grid-box average aerosol backscatter profiles, without subgrid sampling

Discussion

- How can we compare the different approaches?
- Can we still manage to include one or both into COSP for some of the MIPs?
- COSP (and approaches above) do not deal with spatio-temporal sampling for satellite overpass.
  Do we need to (and if, how can we) deal with this?