MW remote sensing of clouds. Climate context

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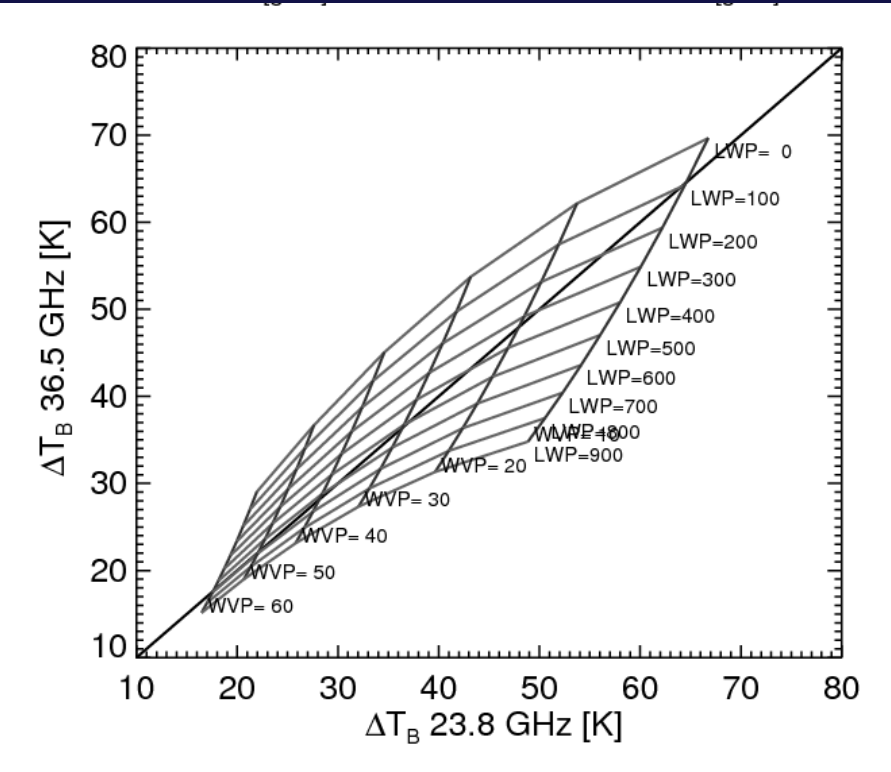
Outline

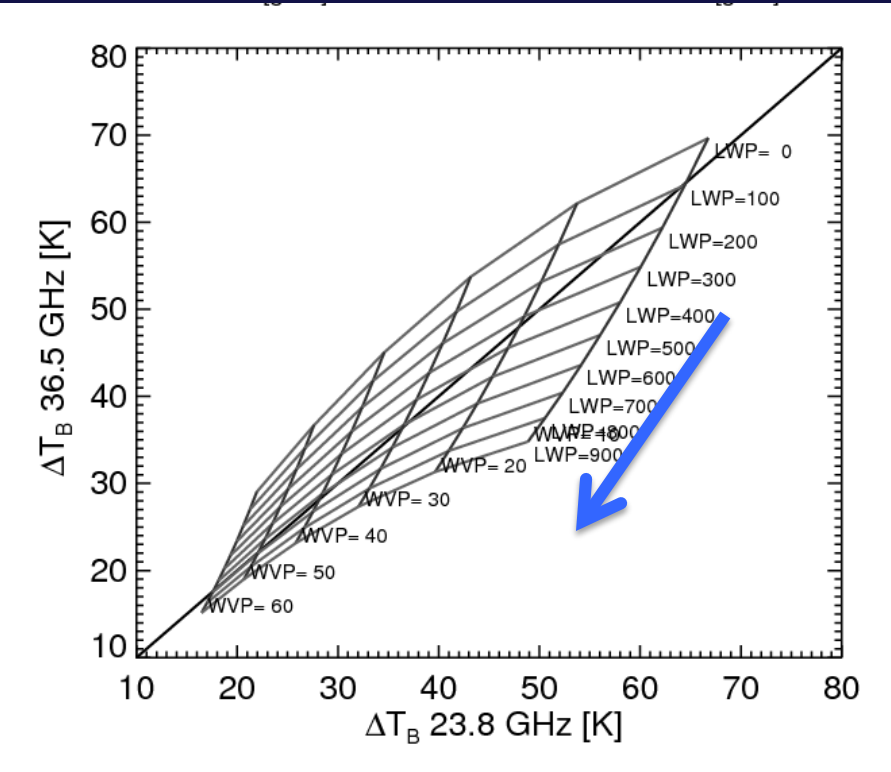
- Long-term climatologies of LWP
- Constraining climate models
- Ice clouds
- Conclusions/Outlook

MW: Principle of retrieval



- Use 2 channels and polarization difference to estimate WVP, LWP
- Also affected by rain water
- Separation of RWP/LWP critical.

MW: Principle of retrieval

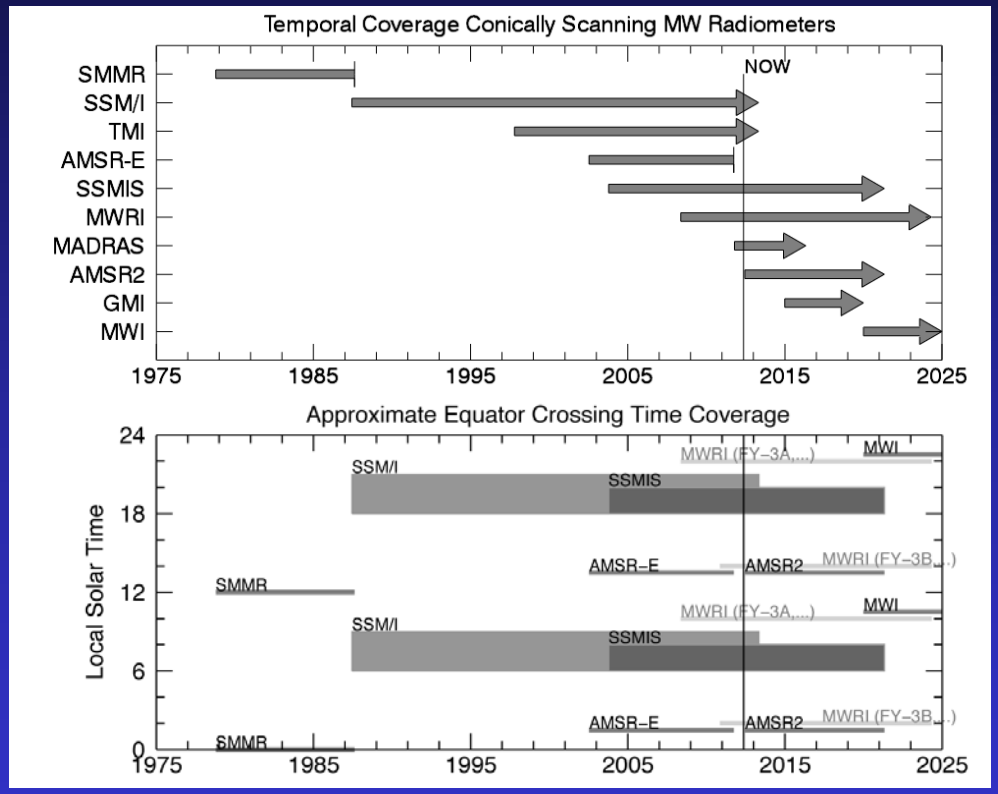


- Use 2 channels and polarization difference to estimate WVP, LWP
- Also affected by rain water, wind, cloud temperature
- Separation of RWP/LWP critical.

MW Cloud liquid water path climatology

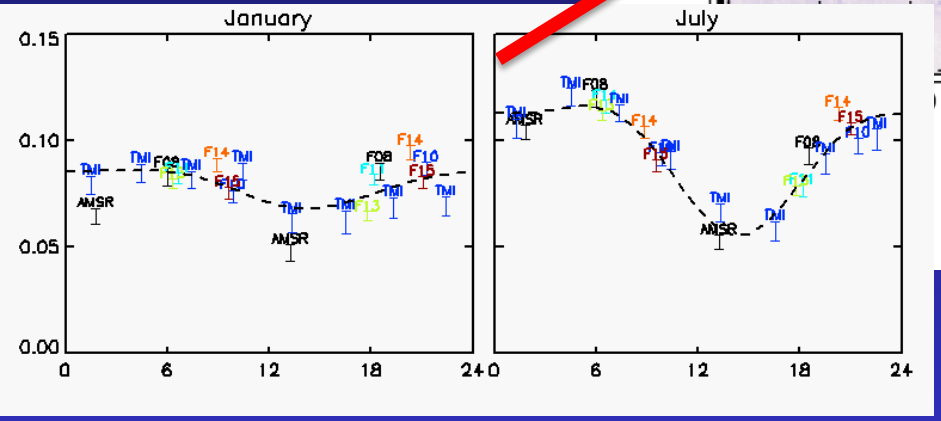
- Based on Wentz SSM/I since 1987, AMSR-E, and TMI
- Monthly diurnal mean liquid water path
- Climatological diurnal cycle
- O'Dell, Wentz, and Bennartz, J Climate, 2008,
- Elsasser et al., J Climate 2017
- Various limitations for high LWP (due to presence of rain), slight biases for low LWP
- NASA Measures project (2013-2018)

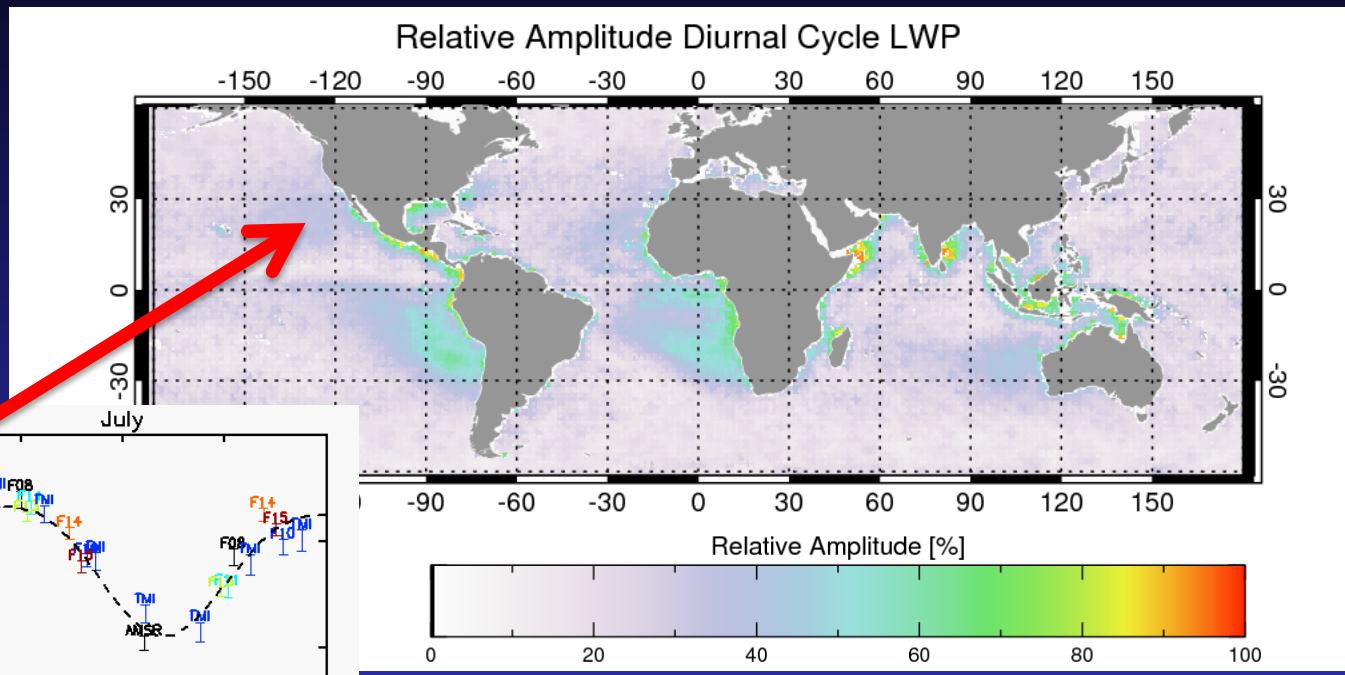
Data Record



- SSM/I, SSMIS Morning/Evening Coverage since 1987
- TRMM/GPM crisscrossing in LEXT since 1997 resp 2014
- AMSR-E/AMSR-2 13:30 LEXT
- MWI on EUMETSAT/ EPS-SG early afternoon orbit

The diurnal cycle of LWP





Long-term satellite studies of LWP must account for the diurnal cycle. Otherwise, satellite drifts will lead to an aliasing of the diurnal cycle onto trends of LWP.

Climatology available GES-DISC & J. Climate paper Dec. 2017

The Multisensor Advanced Climatology of Liquid Water Path (MAC-LWP)

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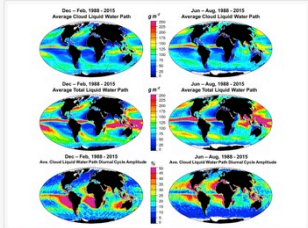
Multisensor Advanced Climatology Liquid Water Path Level 3 Data Products Released

by: James Acker - **Published:** Jun 20, 2017

The Goddard Earth Sciences Data and Information Services Center (GES DISC) is pleased to announce the release of the Multi-Sensor Advanced Climatology of Liquid Water Path (MAC-LWP) data sets. The three data sets include monthly 1.0° ocean-only estimates of cloud liquid water path (MACLWP_mean); total water path (MACTWP_mean), which includes both cloud and rain water; and monthly climatologies of cloud liquid water path diurnal cycle amplitudes and phases (MACLWP_diurnal).

The MAC-LWP algorithm uses as input the Remote Sensing Systems (RSS) Version 7 0.25°-resolution retrieval products, produced using the Special Sensor Microwave Imager (SSM/I), Advanced Microwave Scanning Radiometers (AMSR-E and AMSR-2), the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI), the Global Precipitation Measurement (GPM) Microwave Imager (GMI), the Special Sensor Microwave Imager/Sounder (SSMIS), and WindSat satellite sensors. It performs a bias correction on all input RSS cloud water path products based on AMSR-E matchups to clear-sky Moderate Resolution Spectroradiometer (MODIS) scenes. The MAC-LWP algorithm ensures that spurious trends and variability in the cloud fields arising from drifting satellite overpass times are mitigated by simultaneously solving for the monthly average cloud and total water paths and monthly-mean diurnal cycles.



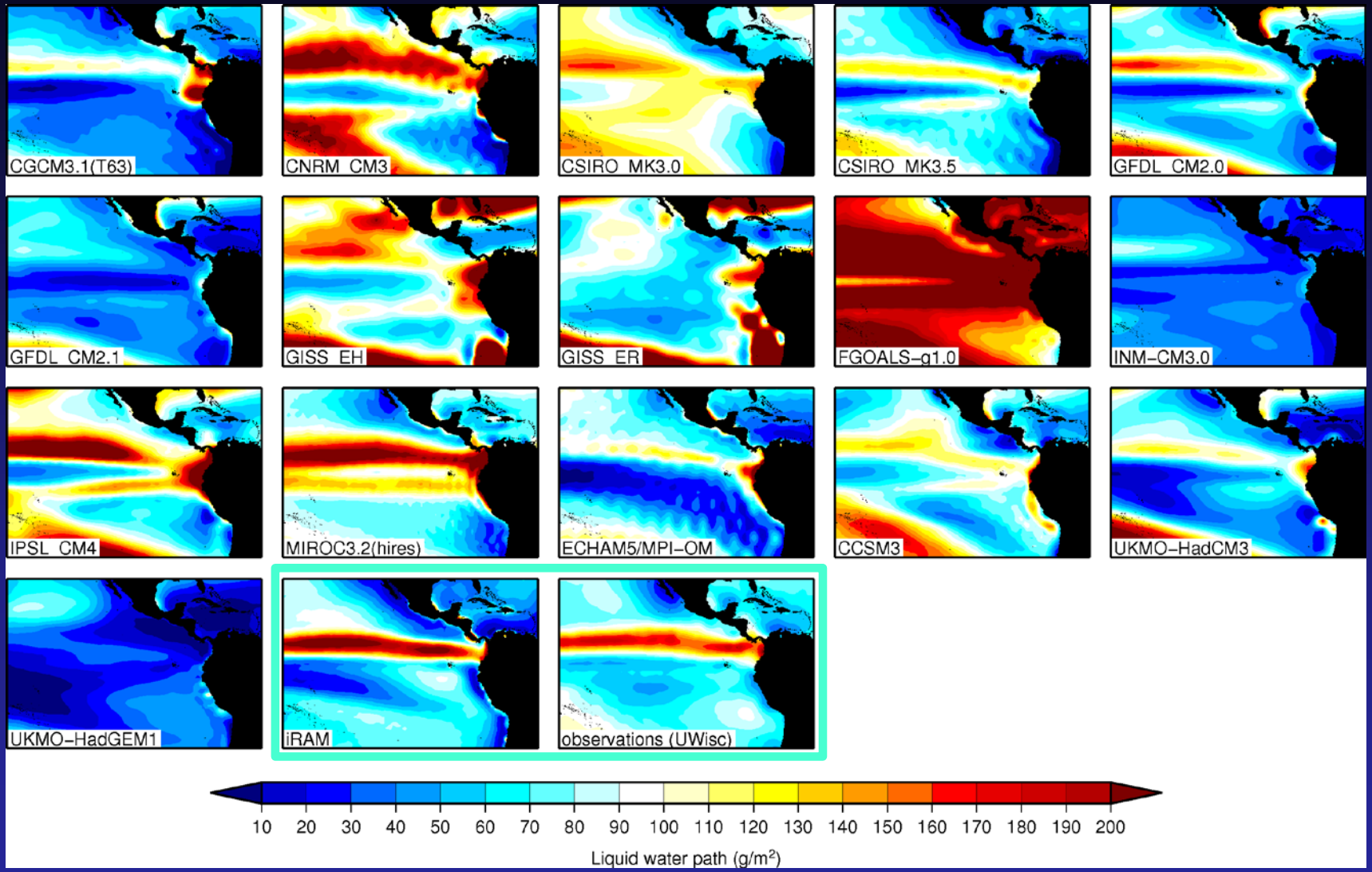
The sample images for the Multisensor Advanced Climatology Liquid Water Path (MAC-LWP) products display seasonal averages of the Cloud Liquid Water Path, the Total Liquid Water Path, and the Diurnal Cycle Amplitude.

Data Access and Documentation

Additional information on data access and documentation for these products is available on the data set landing pages.

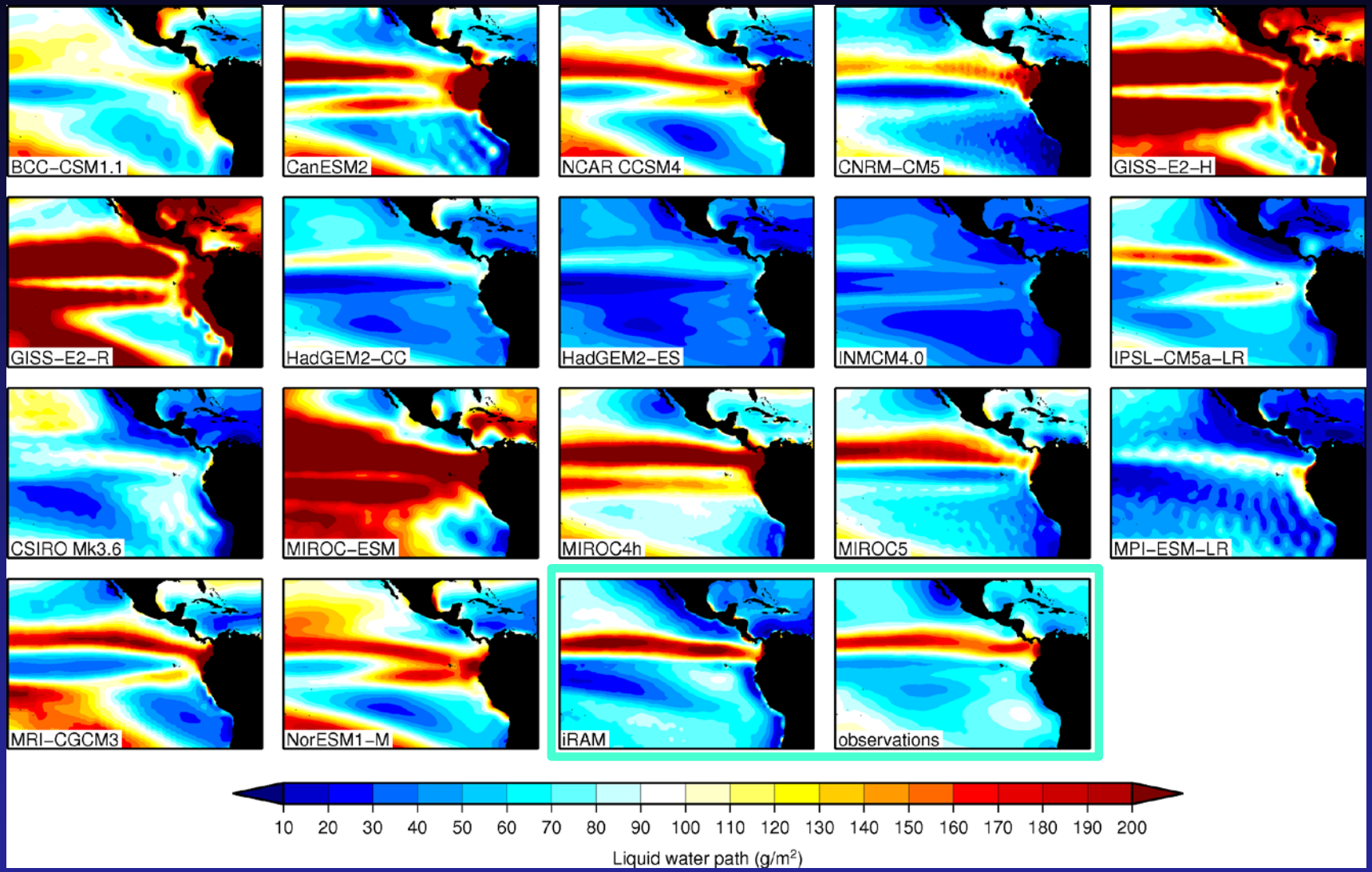
- MACLWP_mean: https://dx.doi.org/10.5067/MEASURES/MACLWPM
- MACTWP_mean: https://dx.doi.org/10.5067/MEASURES/MACTWPM

Liquid water path, observations versus IPCC AR-4 (CMIP-3)



Lauer et al. (2012)

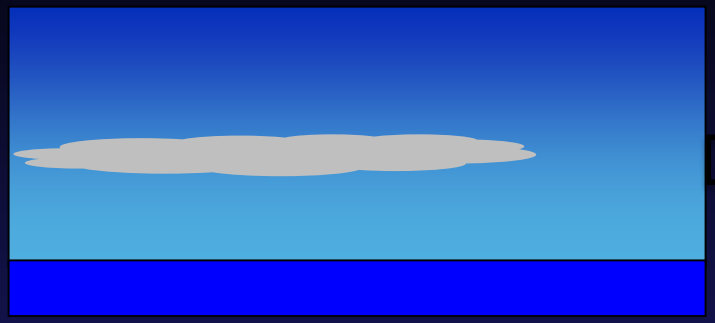
Liquid water path, observations versus IPCC AR-5 (CMIP-5)



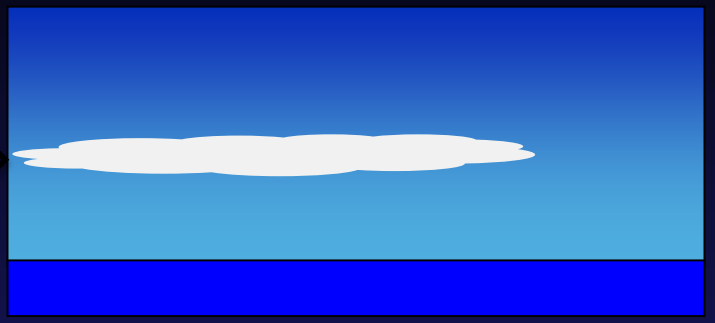
Lauer et al. (2012)

Nature

Current Day Climate



IAE will brighten up cloud

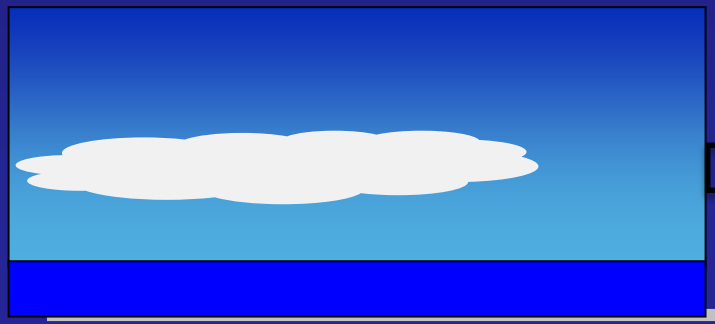


Models

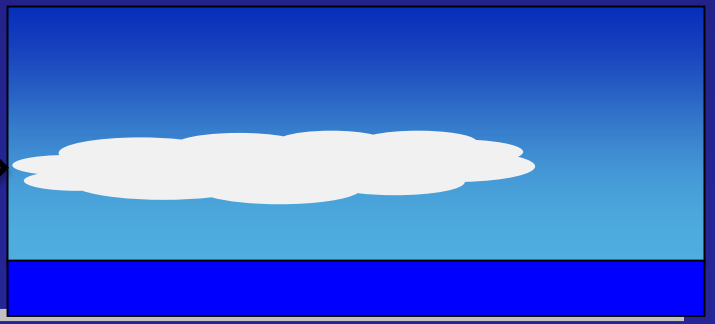
Model with too few clouds

IAE will be too weak (area)

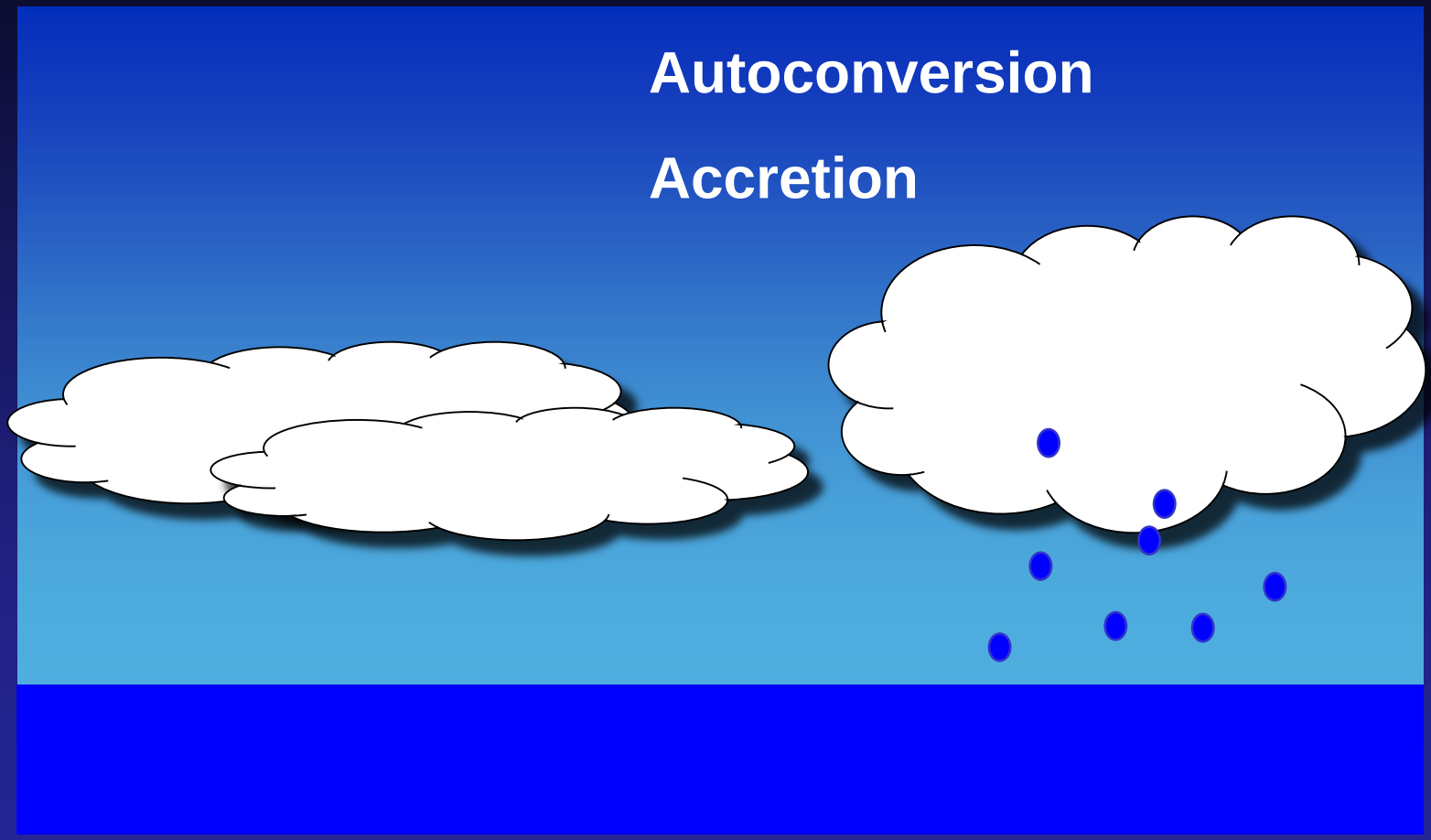
Model with too thick clouds



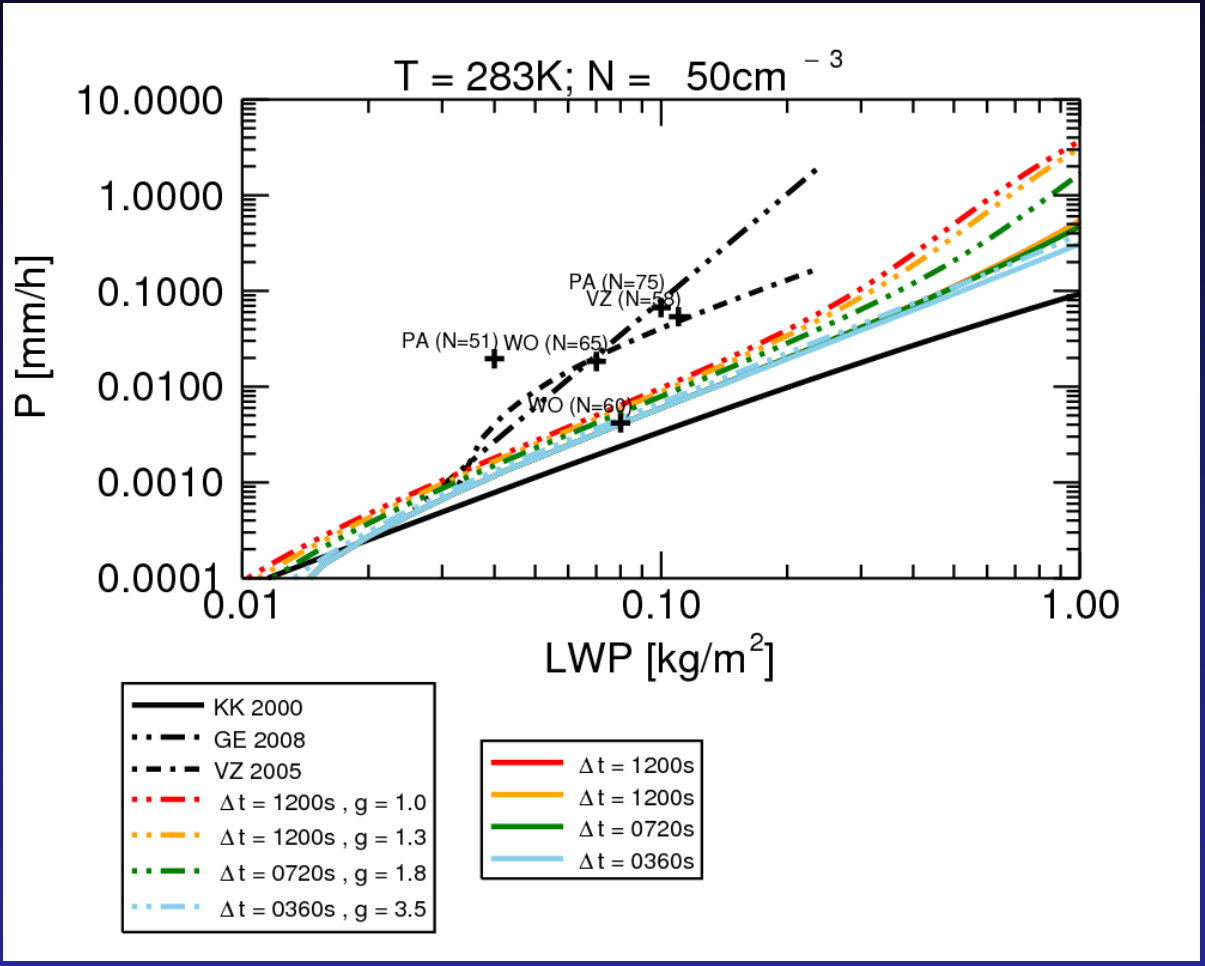
IAE will be too weak (saturation)



Precipitation processes



Constraining warm cloud physics



(Bennartz, et al. ,2011b)

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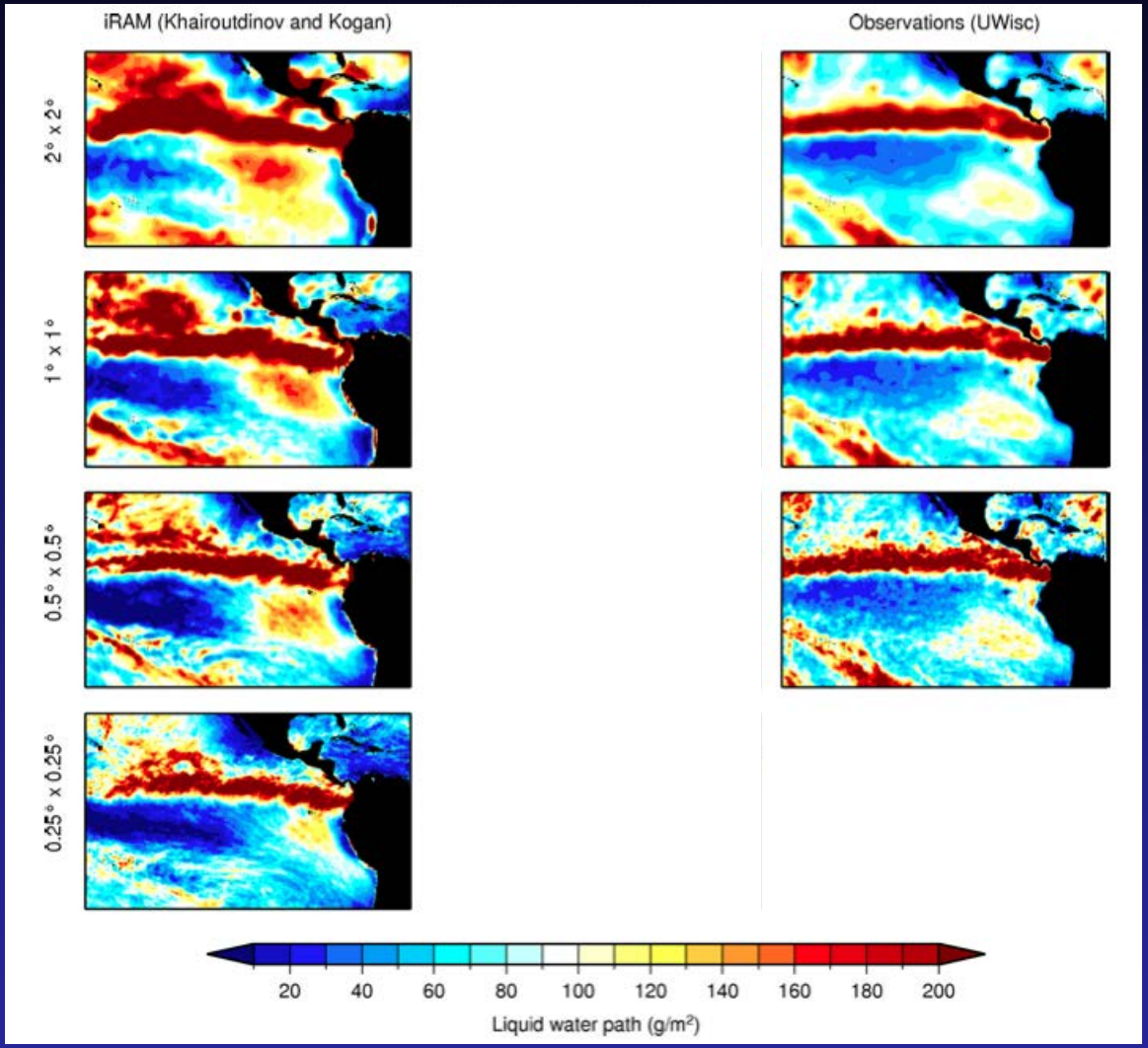
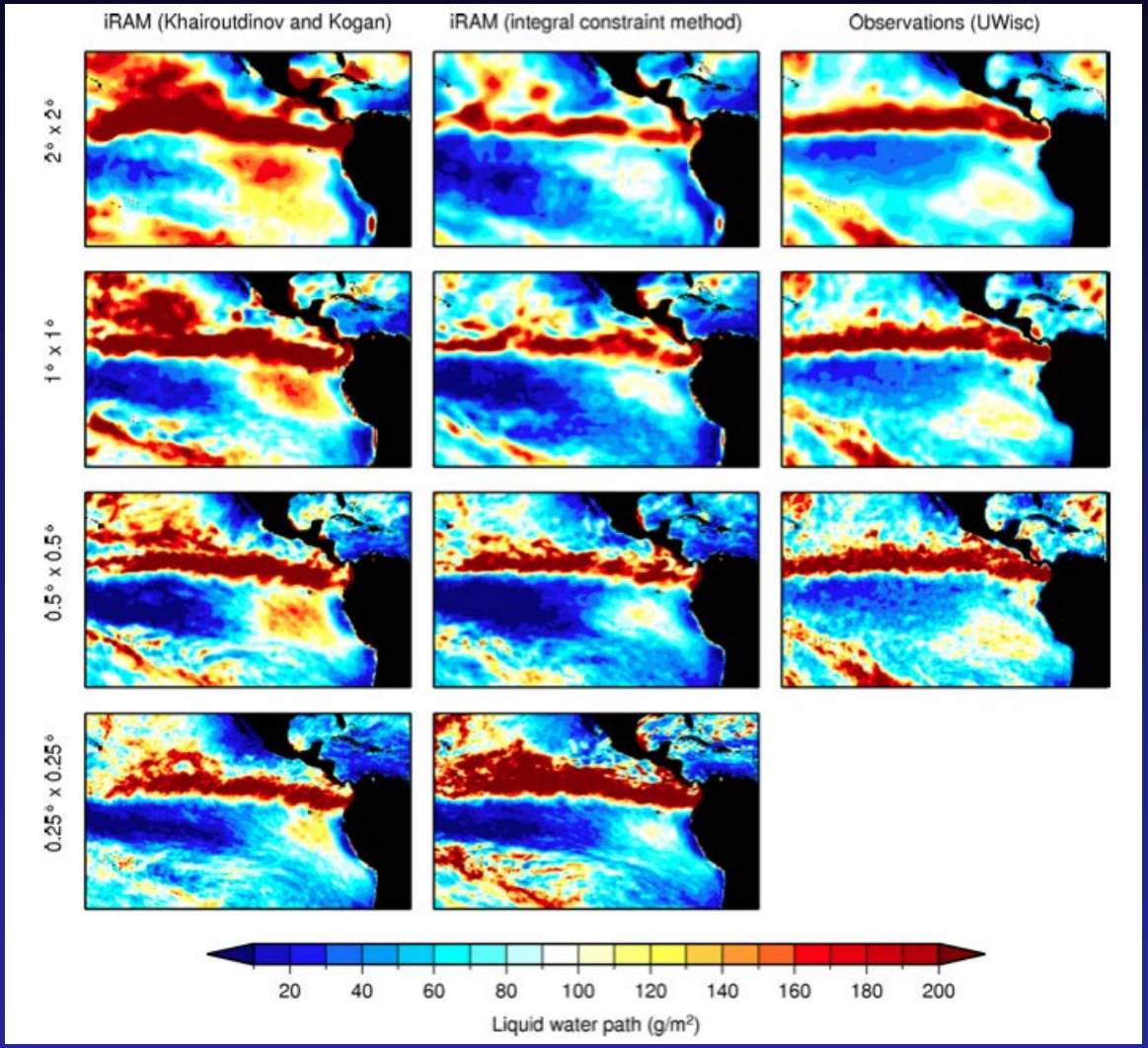


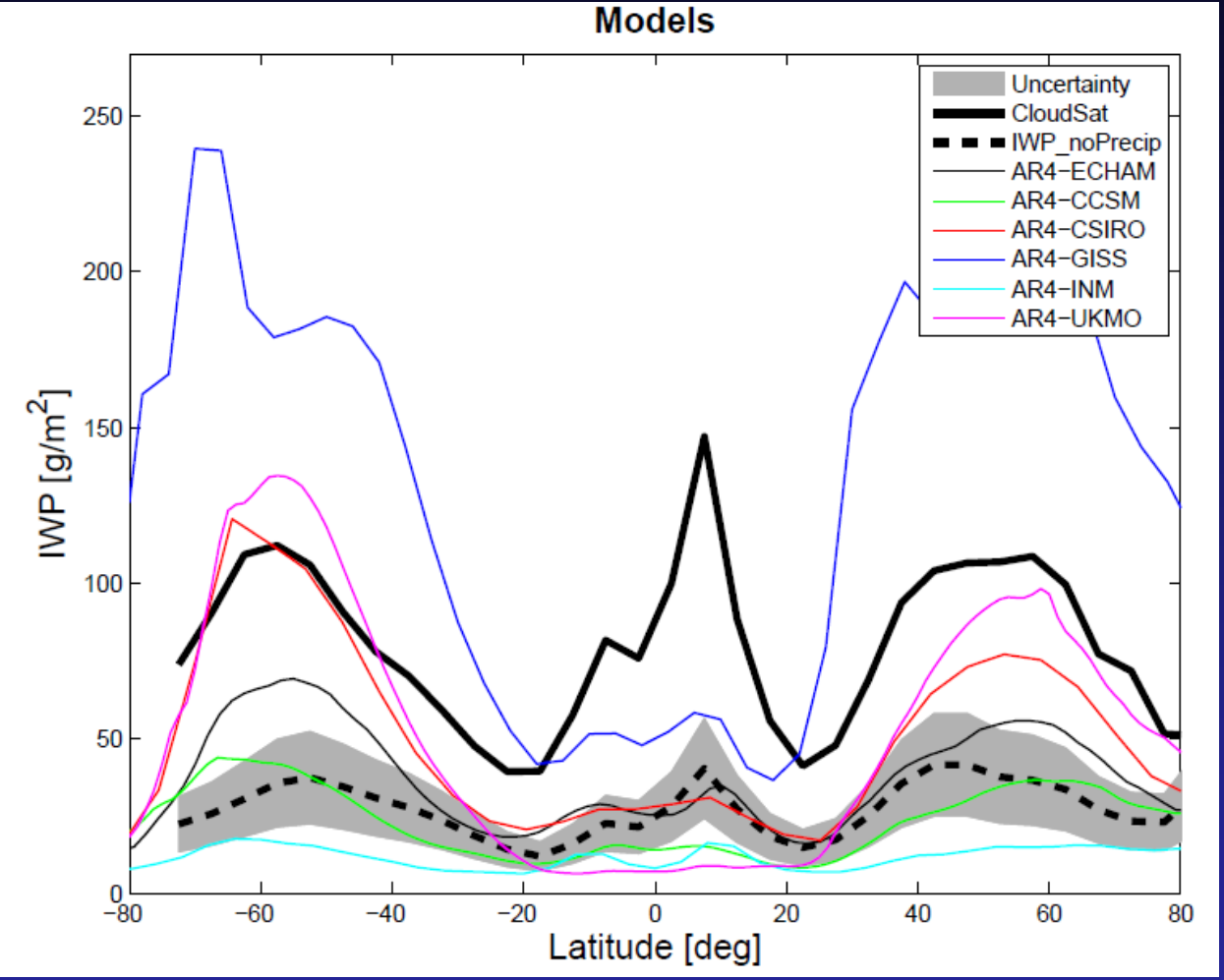
(Bennartz et al. ,2011)

Constraining warm cloud physics

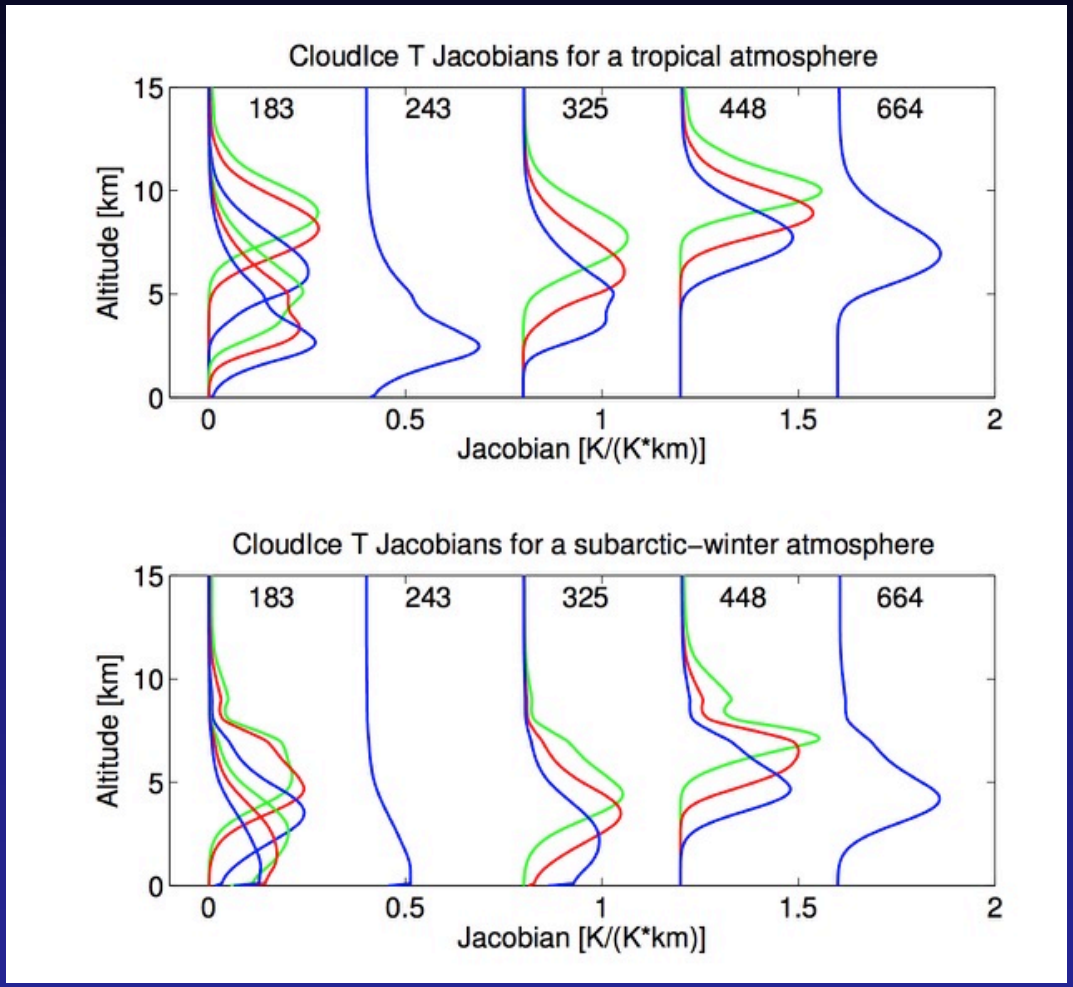


(Bennartz et al. ,2011)

Cloud Ice



(Eliasson et al, 2011)



(Buehler et al. 2012)

MW observations

- Highly valuable long-term dataset of cloud LWP over ocean based on conically scanning MW sensors (SSM/I heritage).
- Including a climatological diurnal cycle
- Continuation of this time series is highly desirable.
- Sub-millimeter will extend these capabilities to ice clouds. With ICI and other sub-mm sensors upcoming, community needs to prepare
- Synergy VIS/NIR/MW under-exploited.