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

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GES DISC

Multisensor Advanced Climatology Liquid Water Path Level 3 Data Products Released

The Multisensor Advanced Climatology of Liquid Water Path (MAC-LWP) data sets are now available through the GES DISC portal. These data sets provide monthly climatologies of liquid water path at various scales, including global, regional, and local scales.

Data Access and Documentation

The data sets are available for download from the GES DISC portal. The MAC-LWP data sets are organized into Level 3 data products, which provide monthly climatologies of liquid water path at various scales.

Additional information and documentation for these products are available on the data set landing pages:

- MACLWP: https://doi.org/10.5067/MEASURES/MACLWP
- MACTWIP: https://doi.org/10.5067/MEASURES/MACTWIP
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)
Current Day Climate

Nature

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

Autoconversion

Accretion
Constraining warm cloud physics

(Bennartz, et al., 2011b)
Constraining warm cloud physics

(Bennartz et al., 2011)
Constraining warm cloud physics

Bennartz et al., 2011
Cloud Ice

(Eliasson et al, 2011)
CloudeIce T Jacobians for a tropical atmosphere

CloudeIce T Jacobians for a subarctic–winter atmosphere

(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.