1. Research Focus

Monthly variability in regional radiative diurnal cycles can influence the long term mean radiative balance by up to 7 W m⁻². In convectively active regions, such as the Amazon, the convective diurnal cycle is a major contributor to the radiative DCC.

-Radiative diurnal cycle variability is significantly related to anomalies in multiple atmospheric state variables (ASVs).

-Seasonal variability accounts for only 25% of the total COF variability. A similar (though opposite sign) dependence exists for DCCs.

2. Data/Methodology

We use conditional sampling of cloud properties observed by CloudSat based on time of day and three ASVs:

- Convective Tropospheric Stability (FTS, defined as 250 hPa equivalent potential temperature minus 850 hPa)
- Lower Tropospheric Stability (LTS, defined as 700 hPa equivalent potential temperature minus 850 hPa)
- 250 hPa relative humidity (RH250)

ASVs are provided by an average of the NCEP/NCAR Reanalysis, the ERA Interim, and MERRA.

Data are averaged monthly over 25°S to 0°, 50°W to 70°W, with seasonal cycle removed (denoted as (Var)), from June 2006 to March 2011.

Two types of clouds are examined:

- DCAs/DCCs: > 10 km tall, has a max. refl. of 5 dBZ, and a >5 dBZ reflectivity in the middle troposphere.
- DCA: cloud base > 5 km altitude, continguously attached to a DCC as observed by CloudSat.

3. Cloud Occurrence Frequency

CloudSat shows a tri-modal convective cloud structure (shallow CU, CUC congestus, and DCC/DCA), with additional cirrus and a mid-level cloud layer (5-7 km).

- Low level and near-tropopause clouds are more frequent during daytime, and upper troposphere clouds tend to be more frequent at night.
- Seasonal variability accounts for ~75% of the total COF variability. A similar (though opposite sign) dependence exists for DCCs.

4. Radar Reflectivity

- DCC refl. shows a distinctive double arc shape (caused by graupel/hail and snow in the upper cloud), a dark band near the freezing level, and attenuation by rain below the freezing level.
- Upper tropospheric reflectivity is higher during day (indicates stronger updrafts lofting large hydrometers), while nighttime reflectivity is higher in the lower troposphere (perhaps lighter rainfall) and near the tropopause.

- DCA CFADs show similar properties with DCCs above the freezing level, except with a single arc shape - the hail/graupel remains in the DCC, while the snow is detrained.

5. Conclusions

1) Daytime clouds are more frequent in the upper and lower troposphere than nighttime clouds. While the total cloud variability is mostly explained by seasonal variability, the variability in day/night contrast is related mostly to other factors. [describe DCC varb.]

2) There is an inverse relationship between the frequency and updraft intensity of DCCs. The day/night contrast in COF sensitivity to ASVs is mostly small, except for CU conv. to RH250, DCCs show a different reflectivity sensitivity to ASVs during night than day, indicating different physical processes affecting DCC microphysical structure.

5 dBZ

Covariability in the monthly mean convective and radiative diurnal cycles in the Amazon

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4. Radar Reflectivity

Selected References


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