Diurnal cycle of convection during GoAmazon: preliminary evaluation of cloud-resolving WRF simulations

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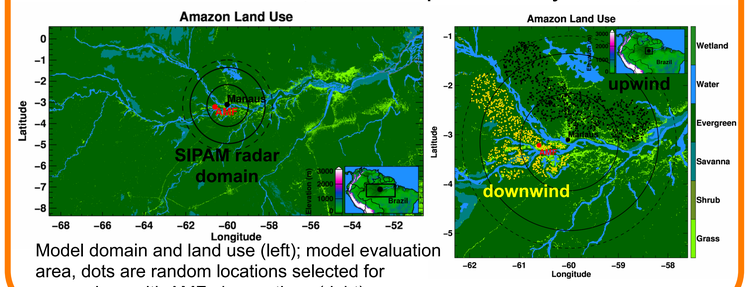
1. Introduction and Objective

- Diurnal cycle of convection in the Amazon is a complex phenomenon, influenced both by local land surface heterogeneity and large-scale advection, which strongly modulates convective clouds and precipitation, presenting significant challenges in model simulation at both global and regional scales
- **Goal:** use GoAmazon 2014/5 observations to evaluate high-resolution WRF simulations and use the model to understand mechanisms for the observed diurnal cycle of convection

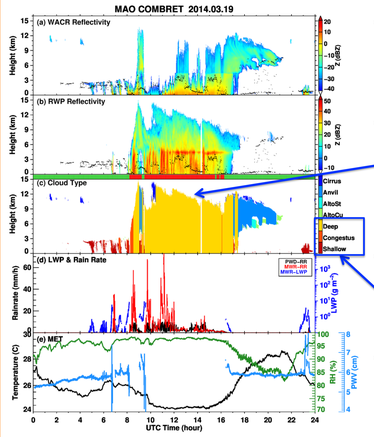
2. Model and Experiment

- Domain: 2000x1000km, Δx=1km, 40 levels
- Simulation period: Feb (wet), Aug (dry) 2014
- Boundary: GFS reanalysis
- PBL: MYJ, Land surface: NOAA, Microphysics: Thompson, Radiation: RRTM
- GPNR Soil moisture, land use provided by INPE, Brazil



Model domain and land use (left); model evaluation area, dots are random locations selected for comparison with AMF observations (right)

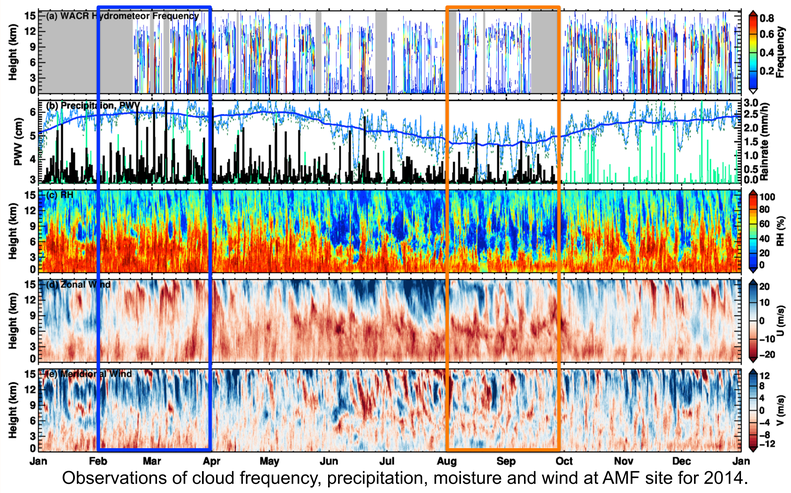
3. AMF and Brazil Radar Observations



Example of combined WACR+RWP for improved convective cloud profiles

- RWP profiles in moderate to heavy precipitation are combined with WACR
- Combined dataset improves detection of precipitating deep convection
- Shallow, congestus, deep clouds are classified as "convective" clouds
- Brazil SIPAM scanning radar (10cm) data is used to estimate areal (110km radius) precipitation characteristics

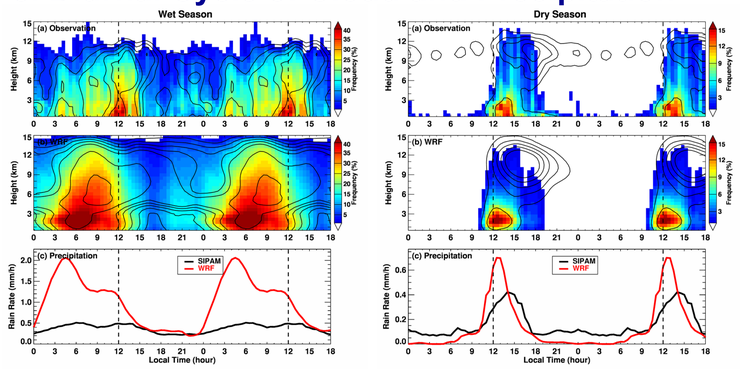
4. AMF Observations



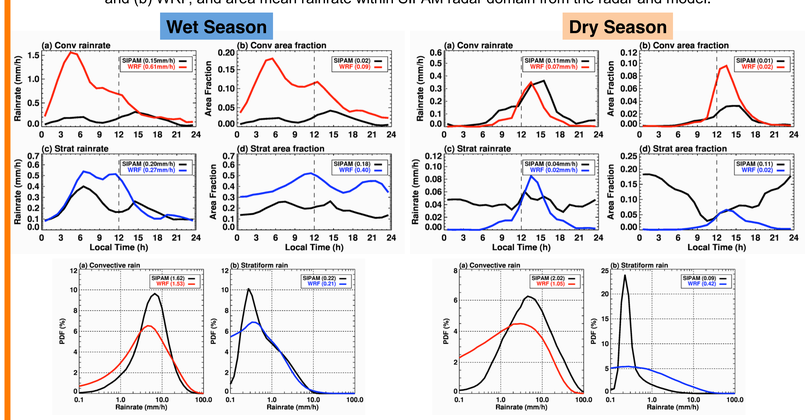
Observations of cloud frequency, precipitation, moisture and wind at AMF site for 2014.

- AMF observations from Feb-Mar and Aug-Sep are used to evaluate WRF simulations for the wet and dry seasons

5. Diurnal Cycle of Cloud and Precipitation



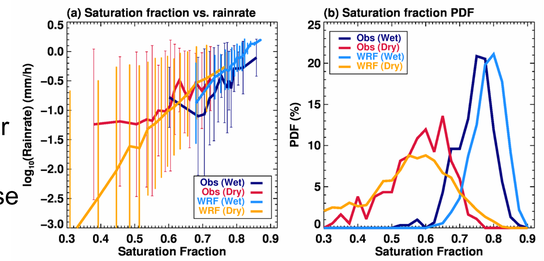
Composite diurnal cycle of convective (shaded) and total (contour) cloud frequency from (a) WACR+RWP and (b) WRF, and area mean rainrate within SIPAM radar domain from the radar and model.



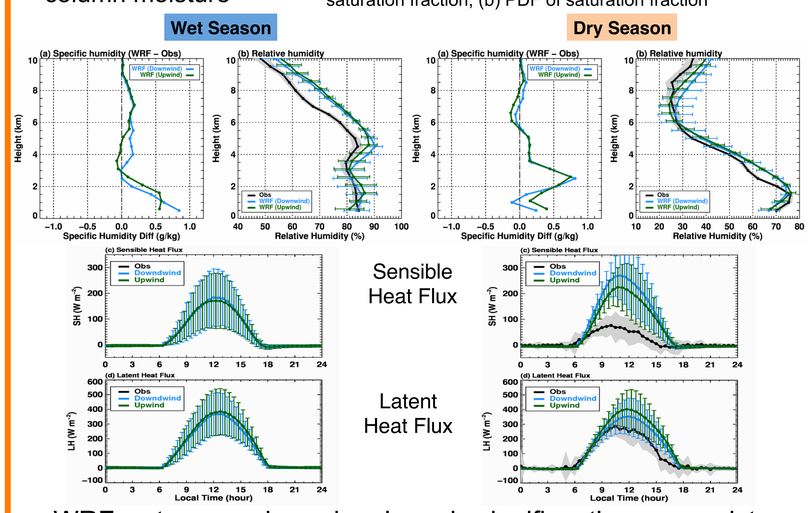
- Wet season precipitation bias are due to too frequent nocturnal convective rain, not convective rain intensity.
- Dry season convection peaks ~2h earlier than observed.

6. Sources of Precipitation Bias

- WRF wet season column moisture is biased high, precipitation response is stronger than obs.
- Dry season response is comparable to obs. in moderate column moisture



(a) Radar area mean rainrate as a function of column saturation fraction, (b) PDF of saturation fraction



- WRF wet season boundary layer is significantly more moist than observation, possibly related to bias in surface fluxes, but no flux observations are available at AMF in Feb, 2014
- WRF overestimates SH and LH flux in dry season by 200-300% and 30%, respectively. This is possibly due to underestimated shallow clouds, hence excessive incoming shortwave radiation and early triggering of convection

Summary and Future Work

- High-resolution WRF simulation during wet/dry season is evaluated using GoAmazon 2014/5 observations.
- WRF significantly overestimates nocturnal convective precipitation in the wet season, possibly due to moist biases in the boundary layer and stronger precipitation response to this moisture bias.
- Dry season simulation compares better with observations, although triggering of convection is earlier due to overestimated surface sensible heat flux.
- Future work will further investigate the sources of the moisture bias.

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