Ecophysiological controls on Amazonian precipitation seasonality and variability

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Abstract

The principal objective of this project is to address how vegetation influences climate variability and precipitation over Amazonian rainforests, with an emphasis on plant physiological controls on deep convection triggering along a geographical water stress gradient. To that end, we have begun development of a modeling framework using a high-resolution cloud resolving model (CRM). The CRM better simulates the seasonal and diurnal cycles of the hydrological cycle: we have found that the improvement can be attributed to the formation of a morning fog layer and variations in large-scale ascent. A morning fog layer present in the wet season but absent in the dry dramatically increases cloud albedo, and reduces evapotranspiration through its modulation of surface radiation energy budget. The temperature profile, warmer in the wet than in the dry season, mediates the seasonal transition of large-scale ascent, allowing precipitation to increase in the wet season.

Along with these CRM simulations, we have been analyzing atmospheric moisture variability from a network of GPS receivers situated in and around Manaus which provide high temporal resolution measurements of column water vapor (cwv). In particular, we have been focusing on the understanding the genesis of extremely dry conditions during the local dry season through application of FLEXPART, a Lagrangian parcel dispersion model. This is of interest given that current generation models frequently simulate too dry conditions during the Amazonian dry season.

To improve surface flux component of climate models, we have incorporated equations for SIF into a land surface model, the National Center for Atmospheric Research Community Land Model version 4 (NCAR CLM4) using existing theory and data. We demonstrate that our simulated fluorescence values are reasonable when compared with satellite (Greenhouse gases Observing SATellite; GOSAT) and *in situ* flux-tower measurements in the Netherlands. Our results overestimate GPP in tropical forests and thus indicate that maximum carboxylation rate (V_{max}) in CLM4 may be too high in tropical forests. The model and satellite fluorescence will be compared with in situ measurements in the Amazon. We have been testing all of the components of fluorescence measurements in the laboratory including software. The first installation will be at the K34 tower near Manaus in summer 2015.