**Interactions of Tropical Precipitation with Atmospheric Circulation and Energy Transport**

Our canonical understanding of how tropical precipitation impacts broad scale atmospheric circulation and energy transport relies on simplified models of the zonal mean. In this view, low-level convergence drives tropical convection and helps the atmosphere respond to radiative imbalances. However, this simplified view fails to explain the vertical longitudinal variability in precipitation events, as well as their impact on energy fluxes and circulation patterns (Boos and Korty, 2015; Biasutti et al, 2018). This project aims to improve our understanding of the structure of regional rainfall patterns – how they vary both spatially and vertically – and how they contribute to energy fluxes in the atmosphere.

We are aiming to tackle the following key questions:

1. What are the dominant modes of energy flux from precipitation events?
2. How do these vary spatially and temporally?
3. How do these modes interact with broader circulation dynamics and atmospheric energy fluxes?

We will work with a combination of in situ rawinsonde profiles and satellite precipitation data to constrain the different modes of precipitation and their impact vertical energy convergence and divergence. From both datasets we will use the derived latent heating profiles to characterize rainfall events based on their energy implications. Using clustering methods, we will determine the dominant modes of precipitation in terms of their energy footprint, giving us a better sense of how precipitation contributes to atmospheric energy budgets. Diagnosing the energy profiles separately from the sondes, which provide direct, but limited measurements, and satellite data, which rely on algorithms and cloud resolving models to diagnose latent heating (Tao et al, 2016), will allow us to evaluate the robustness of the data products, and explore possible sources of discrepancy between the two.

After identifying energy modes of precipitation, we will explore the statistical patterns of the modes spatially and temporally. With a better sense of where precipitation is driving energy converging and diverging regionally, we can explore how that fits into the broad scale circulation patterns and atmospheric energy budgets. We will directly compare climatological means of latent heating from precipitation modes to observations of atmospheric energy flux, developing insight as to how the two are related. Through this lens, we will also look at the variability of precipitation energy modes across timescales, with the hope of exposing links with circulation and energy transport variability in the atmosphere.

This work will directly improve our understanding of the role of precipitation in redistributing energy, how it interfaces with broad scale atmosphere circulations, and the connection to atmospheric energy transport. This insight is immediately relevant to our understanding of regional variability in precipitation and circulation patterns and to our ability to project future changes in response to greenhouse gas forcing.

Biasutti, M. and Coauthors, 2018: Global energetics and local physics as drivers of past, present, and future monsoons. *Nature Geoscience*, **11**, 392-400.

Boos, W. and R. Korty, 2016: Regional energy budget control of the intertropical convergence zone and application to mid-Holocene rainfall. *Nature Geoscience*, **9**, 892-897

Tao, W.-K. and Coauthors, 2016: TRMM Latent Heating Retrieval: Applications and Comparisons with Field Campaigns and Large-Scale Analyses. *Meteorological Monographs*, **56**, 2.1-2.34