Geophysical Research Abstracts
Vol. 21, EGU2019-9013, 2019
EGU General Assembly 2019

Extratropical Cyclone Precipitation Life Cycles and Cloud Vertical Structure in Observations and Climate Models

James Booth (1), Catherine Naud (2), and Jeyavinoth Jeyaratnam (3)

(1) City University of New York, City College, New YorK, United States (jbooth.atmos@gmail.com), (2) Columbia University, United States, (3) The Graduate Center of the City University of New York, United States

This presentation will discuss recently published and new results based on cyclone-centered and front-centered analyses focused on satellite data and GCMs.The first analysis focuses on the relationship between the precipitation life cycle and dynamical strength life cycle in the cyclones. Based on reanalysis and satellite data, the precipitation maximum occurs prior to the dynamical strength maximum in 70% of the cyclones observed. The lag in timing between the two peaks is consistent with the difference in cyclone precipitable water vapor at the two peaks. Conditional subsetting of the cyclone composites shows that if the precipitable water vapor distribution is constrained to be equal throughout the composite life cycle, the precipitation peak occurs very near the time of the peak in cyclone dynamical strength. Thus, the boost in dynamical strength caused by latent heat associated with precipitation manifests itself with little to no time lag in observations. This life cycle analysis reveals slightly different behavior across the GCMs, however the models properly simulate the response of extratropical cyclone precipitation to changes in moisture and dynamical strength.

The second analysis compares satellite observations with modeled cloud cover in southern hemisphere extratropical cyclones in the GFDL model. Two model versions are used that differ only in terms of their parameterization of convection. Both model versions predict a realistic top-of-atmosphere cloud cover in the southern oceans, within 5% of the observations. However, compared to observations the models to overestimate high-level clouds (by differing amounts) and underestimate cloud cover at low-levels (again by differing amounts), and especially in the post-cold frontal (PCF) region. Focusing only on the models, their differences in high and mid-level clouds are consistent with their differences in convective activity and relative humidity (RH), but the same is not true for the PCF region. In this region, RH is higher in the model with less cloud fraction. These seemingly contradictory cloud and RH differences can be explained by differences stemming from the changes in the convection scheme.