University of California, Los Angeles

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Department of

Atmospheric and Oceanic Sciences

Seminar

AOS270

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“Tropical Energetic and Precipitation Responses to Sea Surface Temperature Perturbations: Zonal Mean and the African Sahel”

ABSTRACT:

Tropical precipitation is linked through the moist static energy (MSE) budget to the global distribution of sea surface temperatures (SSTs), and large deviations from the present-day SST distribution have been inferred for past climates and projected for global warming. We use idealized SST perturbation experiments in multiple atmospheric general circulation models (AGCMs) to examine the hydrologic and energetic responses in the zonal mean and in the African Sahel to SST perturbations. We also use observational data to assess the prospects for emergent constraints on future rainfall in the Sahel.

The tropical zonal mean anomalous MSE fluxes in the NOAA Geophysical Fluid Dynamics Laboratory (GFDL) AM2.1 AGCM due to SST anomalies caused by either historical greenhouse gas or aerosol forcing primarily occur through the time-mean, zonal mean (Hadley) circulation. Away from the Intertropical Convergence Zone (ITCZ), this largely stems from altered efficiency of the Hadley circulation energy transport, i.e. the gross moist stability (GMS). A thermodynamic scaling-based estimate that relates GMS change to the local climatological moisture and temperature change relative to the ITCZ captures most of the qualitative GMS responses. It also yields a heuristic explanation for the well known correlation between low-latitude MSE fluxes and the ITCZ latitude.

Severe Sahelian drying with uniform SST warming in AM2.1 is eliminated when the default convective parameterization is replaced with an alternate. The drying is commensurate with MSE convergence due to suppressed ascent balanced by MSE divergence due to increased dry advection from the Sahara. These qualitative energetic responses to uniform warming are shared by five other GFDL models and ten CMIP5 models, although they do not translate into quantitative predictors of the Sahel rainfall response. Climatological values and interannual variability in observations and reanalyses suggest that drying in AM2.1 is exacerbated by an overly top-heavy ascent profile and positive feedbacks through cloud radiative properties.

Wednesday, October 5, 2016

3:30 PM to 4:30PM

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