How the Jet Stream Controls the Downstream Response to Recurving Tropical Cyclones: Insights from Idealized Simulations

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Recurving tropical cyclones (TCs) that interact with the jet stream and trigger Rossby wave packets can be a significant source of downstream forecast uncertainty. While several studies have attributed this downstream forecast uncertainty to the TC and its ability to phase with pre-existing Rossby waves, how much of the uncertainty is attributed to basic characteristics of zonal jet streams is less understood. This seminar will describe a set of idealized simulations from the COAMPS-TC® model in a channel domain configuration, which examine how the latitude and maximum wind speed of an initially zonal jet stream affect the downstream response to recurving TCs. Based on these simulations, we find that lower-latitude jet streams exhibit earlier jet streak formation and a stronger ridge immediately downstream of the TC than higher-latitude jets. This is due to the weaker Coriolis force at low latitudes, which reduces TC inertial stability and promotes negative PV advection by the irrotational outflow along the jet. Changing the speed of the jet does not noticeably affect the initial TC-jet interactions. But after several days, the highest-latitude and fastest jets, which have the largest baroclinic growth rates, tend to produce higher-amplitude Rossby waves several thousand kilometers downstream of the recurving TCs. Distinct areas of elevated standard deviation in surface pressure that form far downstream of the TCs reflect differences in the position and intensity of developing surface cyclones and anticyclones. Changing the speed of the jet explains more of the variance within these distinct areas than changing the jet latitude. In additional simulations that deactivate condensational heating in the model shortly after Rossby wave packets are triggered, the amplitude and variability of the flow pattern far downstream of the TCs are up to three times smaller than in the full-physics simulations. This result emphasizes the importance of moist diabatic processes within baroclinic waves for generating an amplified downstream response to recurving TCs on time scales of 7-10 days.

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Refreshments 3:15pm

NCAR-Foothills Laboratory, 3450 Mitchell Lane, FL2-1022, Large Auditorium

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