Ph.D. Defense Announcement
Justin Whitaker
August 31, 2021 at 2:30 p.m.

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Ph.D. Defense

Tuesday, August 31, 2021
2:30 p.m.

Defense
ATS Large Classroom (101 ATS) or in Zoom (full information below)

Post Defense Meeting
Riehl Room (211 ACRC)

Committee:
Eric Maloney (Adviser)
Michael Bell
Kristen Rasmussen
Jeffrey Niemann (Civil and Environmental Engineering)

An Investigation of an East Pacific Easterly Wave Genesis Pathway and the Impact of the Papagayo and Tehuantepec Wind Jets on the East Pacific Mean State and Easterly Waves

Part one of this dissertation investigates the transition of a Panama Bight mesoscale convective system (MCS) into the easterly wave (EW) that became Hurricane Carlotta (2012). Reanalysis, observations, and a convective-permitting Weather Research and Forecasting (WRF) model simulation are used to analyze the processes contributing to EW genesis. A vorticity budget analysis shows that convective coupling and vortex stretching are very important to the transition in this case, while horizontal advection is mostly responsible for the propagation of the system. In the model, the disturbance is dominated by stratiform vertical motion profiles and a mid-level vortex, while the system is less top-heavy and is characterized by more prominent low-level vorticity later in the transition in reanalysis. The developing disturbance starts its evolution as a mesoscale convective system in the Bight of Panama. Leading up to MCS formation the Chocó jet intensifies, and during the MCS to EW transition the Papagayo jet strengthens. Differences in the vertical structure of the system between reanalysis and the model suggest that the relatively more bottom-heavy disturbance in reanalysis may have stronger interactions with the Papagayo jet. Field observations like those collected during the Organization of Tropical East Pacific Convection (OTREC) campaign are needed to further our understanding of this east Pacific EW genesis pathway and the factors that influence it, including the important role for the vertical structure of the developing disturbances in the context of the vorticity budget.

In parts two and three of this dissertation, the Weather Research and Forecasting (WRF) model is used to quantify the impact that the Papagayo and Tehuantepec wind jets have on the east Pacific mean state and east Pacific easterly waves. Specifically, a control run simulation is compared with a gaps filled simulation, where mountain gaps in the Central American mountains are "filled in" to block the Papagayo and Tehuantepec wind jets. In the absence of these wind jets, the northern half of the east Pacific mean state becomes drier, supporting a reduction in convective activity and precipitation there. Further, a 700 hPa positive vorticity feature that is linked to the Papagayo jet is reduced. An easterly wave tracking algorithm is developed and shows that easterly wave track density and genesis density are generally reduced in the eastern half of the basin for the gaps filled run. An eddy kinetic energy (EKE) budget is also calculated and highlights that EKE, barotropic conversion, and eddy available potential energy (EAPE) to EKE conversion all decrease for easterly waves when the wind jets are blocked. A composite analysis reveals that there are slight horizontal structural changes between waves in the simulations, while the waves have surprisingly similar strengths. Overall, the Papagayo and Tehuantepec wind jets are shown to be supportive influences on east Pacific easterly waves.

Topic: Ph.D. Defense: Justin Whitaker
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