SESSION: (B1) Mechanisms of S2D predictability

(B1-11)

Oceanic and Atmospheric Sources of Seasonal Tropical Cyclone Predictability

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Tropical cyclones (TCs) are among the costliest and deadliest natural hazards. The goal of this research is to improve seasonal prediction and future projection of TC activity by understanding the physical relationships between TCs, modes of climate variability, and atmospheric internal variability using observations and ensembles of high-resolution climate model experiments. One major source of seasonal TC predictability is sea-surface temperature (SST) patterns, which can be predictable in advance of the hurricane season and can influence environmental favorability for TCs. We discovered that: 1) Atlantic and Pacific SST patterns drive compensating and constructive influences on Atlantic hurricane seasons, with concurrent La Niña and positive Atlantic Meridional Mode (AMM) conditions supporting the most active hurricane seasons, and strong concurrent El Niño and positive AMM driving near-average seasons; 2) The location of El Niño's SST warming plays a critical role in the degree of Atlantic TC suppression, with Central Pacific/Warm Pool El Niño substantially more effective at reducing Atlantic TCs than East Pacific/Cold Tongue El Niño, for equal warming intensity. This is physically explained by the strong zonal gradient in background tropical Pacific SST, together with the (climate-variant) SST threshold for deep convection. Less warming is needed in the Central Pacific to reach the SST threshold for deep convection, which is the key link to the teleconnected Atlantic vertical wind shear response; 3) Variability in the typical Atlantic TC precursor, African Easterly Waves (AEWs), provides little seasonal TC predictability, as suggested by mechanistic regional climate model simulations in which AEWs are prescribed or removed through the model's lateral boundary conditions; and 4) The tropical SST biases common to generations of coupled atmosphere-ocean climate models cause substantial errors in simulated TC activity, with an under-simulation of 50% in the Atlantic and over-simulation of 80% in the East Pacific. This work highlights key regions where reducing SST bias could improve predictions and projections of TC activity.