Extratropical Triggering of El Niño Events Through the Trade-Wind Charging Mechanism

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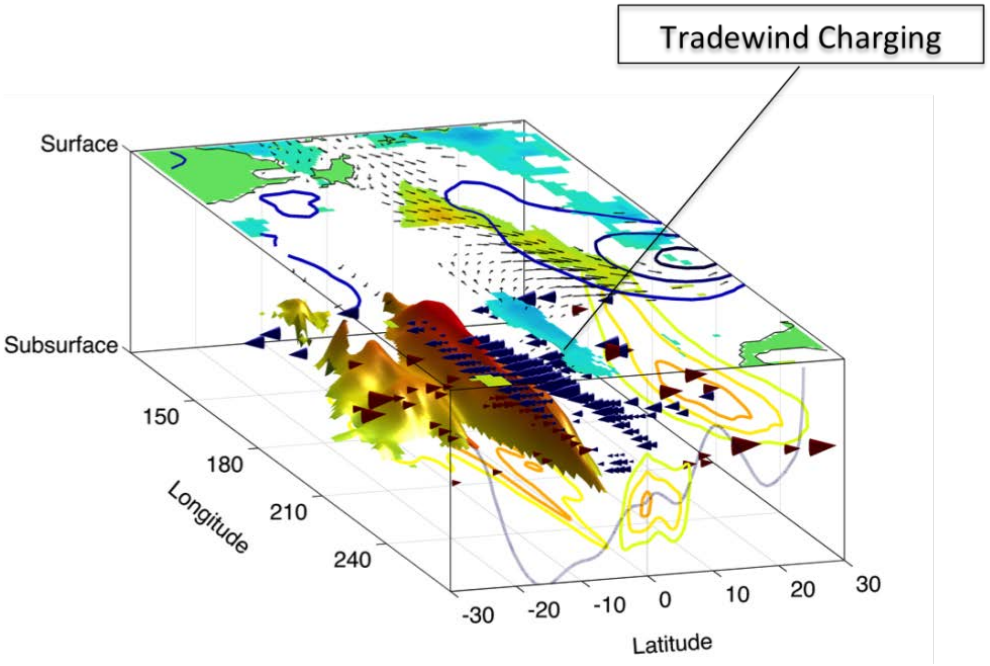
This project is a collaborative effort between AOML, Bruce Anderson (Boston University), Benjamin Giese (Texas A&M University). This work investigates the relationship between year-to-year variations in the extratropical atmosphere and their influence on the initiation and evolution of El Nino/Southern Oscillation (ENSO) events using data taken from observationally constrained reanalyses and numerical model experiments. Previous results indicate variations in subtropical North Pacific sea-level pressures (SLP) influence the state of the tropical Pacific 12-15 months prior to mature boreal-winter ENSO events. Research has also shown that these SLP anomalies associated with the southern lobe of the North Pacific Oscillation (NPO) and the accompanying changes in central Pacific trade winds modify sea surface temperatures (SST) across the tropical/subtropical North Pacific that subsequently shift equatorward via anomalous air-sea interactions. Less well understood is how these trade-wind changes modify subsurface temperatures across the tropical Pacific, despite the fact that temperature variations along the equatorial thermocline are a key initiator of ENSO events. For this project we will develop a numerical model framework designed to estimate the response of the ENSO system to observationally-constrained estimates of NPO-induced changes in the atmosphere. The oceanic response to these changes will be determined using an ocean-only model. The output from this model will be used to initialize a coupled ocean-atmosphere model, which will be integrated forward to determine the resulting evolution of the tropical Pacific, with a focus on the state of the ENSO approximately 12-15 months after the boreal winter NPO variations.



Schematic of surface and subsurface changes in the tropical Pacific linked to weakened North Pacific trade winds during Boreal Winter (Courtesy of B. Anderson). Black Vectors: Wind-stress anomalies. Surface Shading: Sea surface temperature anomalies. Subsurface Shading: Vertically-averaged temperature anomalies from 0-300m. Cones: Vertically-integrated meridional mass transport anomalies derived from the curl of the wind stress anomalies and vortex stretching. The cones represent the key feature of the Trade Wind Charging (TWC) mechanism linking the tradewind variations to the subsurface ocean temperatures.