Ocean Stratification and the Intensification of Tropical Cyclones

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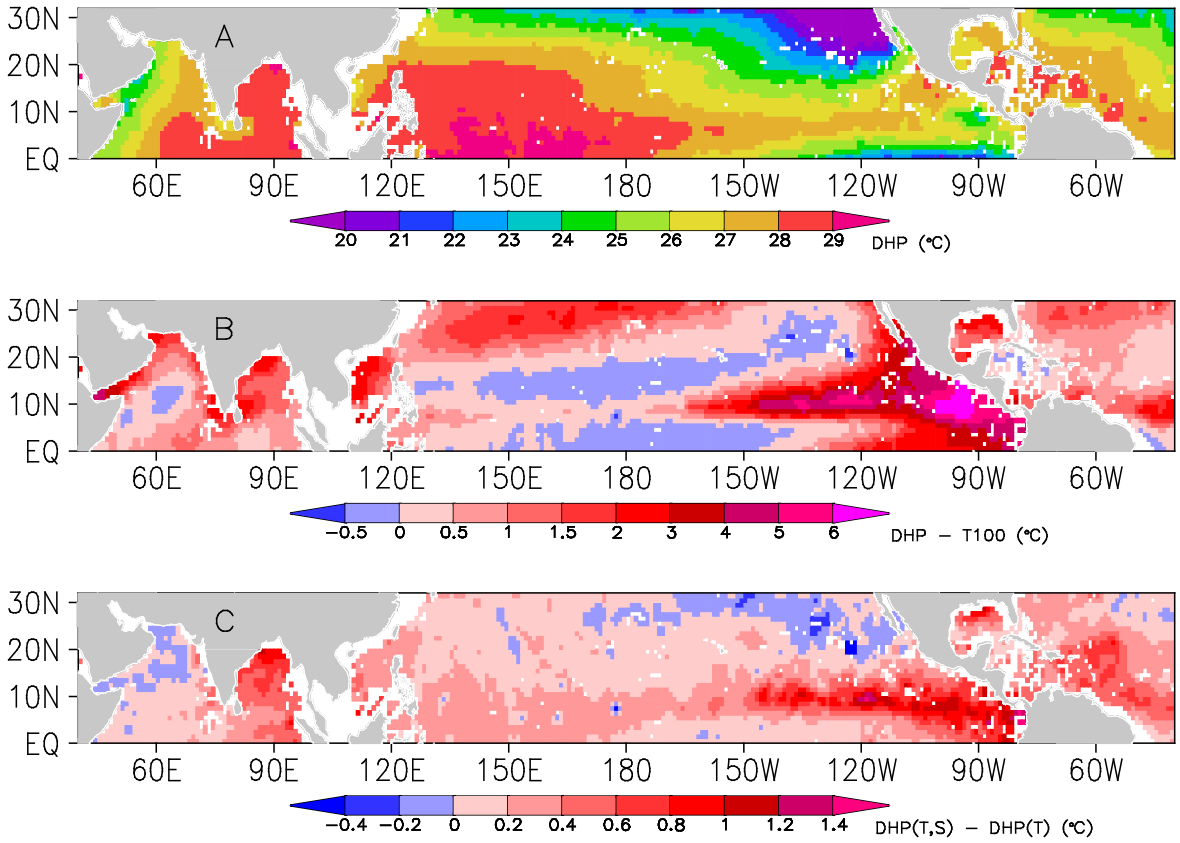
This project is in collaboration with scientists at Pacific Northwest National Laboratory. Traditional metrics of tropical cyclone heat potential are based on a vertical average or integral of temperature down to a fixed depth or isotherm, respectively. These static methods however do not accurately account for tropical cyclone-induced vertical mixing, which depends critically on the upper-ocean stratification and wind strength. In this project, a simple new "dynamic heat potential" was derived that is based on considerations of stratified fluid turbulence. An analysis of tropical cyclones for the 10-year period 2004-2013 and spanning the entire Northern hemisphere shows that while previous methods explain 0%-16% of the variance in tropical cyclone intensification rates, the dynamic heat potential explains 11%-32%. Furthermore, it was found that if salinity is removed from the dynamic heat potential the variance explained for major tropical cyclones decreases by as much as 7%. Future work will involve developing methods to obtain near-real-time subsurface temperature and salinity profiles from satellite-based surface temperature, salinity and sea level with the goal of introducing dynamic heat potential into operational tropical cyclone intensity forecasts.



(A) Dynamic heat potential, (B) comparison to traditional heat potential, and (C) contribution of salinity to dynamic heat potential.