Improvement and Analysis of Tropical Ocean Climate Hindcasts Using a Global Ocean Data Assimilation System (HYCOM)

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A global ocean data assimilation system based on the HYbrid Coordinate Ocean Model (HYCOM) will be used in conjunction with satellite-derived SST and altimetry fields, along with other satellite and *in-situ* observations, to study tropical ocean climate variability and improve our capability to simulate this variability. The observations will be used to evaluate and improve the ocean model, and also for assimilation to improve tropical ocean hindcasts designed to resolve variability from seasonal to decadal timescales. Since global climate variability is strongly influenced by air-sea heat and mass exchanges over the tropical oceans, it is important that ocean models and the ocean component of global climate models properly reproduce the distribution and transport of heat in the tropical oceans plus the thermal exchanges with higher latitudes. The HYCOM assimilation system is particularly suited to this study for several reasons. The hybrid vertical coordinate system is quasi-optimal over a broad range of oceanographic conditions: isopycnic in the stratified ocean interior, level in the nearsurface mixed layer, and sigma over shallow water. The model presently contains one assimilation algorithm (optimum interpolation for use with satellite altimetry, SST, and XBT observations), while other state-of-the-art algorithms are being developed and tested. The model is equipped with multiple vertical mixing submodels, so the sensitivity of hindcasts to vertical mixing parameterization will be assessed. It is also equipped with multiple horizontal advection submodels. Satellite and *in-situ* observations will be employed (1) to generate the best possible forcing fields, (2) for model evaluation to guide the tuning and improvement of HYCOM subgrid-scale parameterizations, and (3) for assimilation into model hindcasts for scientific analysis. Full-basin and global HYCOM operational simulations with (at a minimum) satellite altimetry assimilation will provide initial and boundary conditions for the nested tropical ocean simulations proposed here. Process studies will be conducted in several tropical subdomains, both basin-wide and regional, using high-resolution nested simulations, increasing meridional over zonal resolution as necessary to properly resolve zonal currents. Process studies will focus on important climate phenomena such as the Pacific ENSO, the Atlantic Niño, the tropical Atlantic meridional SST gradient, the Western Hemisphere warm pool, and the Indian Ocean dipole. The contribution of different physical processes to tropical climate variability will be thoroughly analyzed.