

Mixed-Layer Heat Budget Associated with ENSO, IOD, and PDO Inferred from Satellite Ocean Data Assimilation

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Abstract: El Nino Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), and Pacific Decadal Oscillation (PDO) are important modes of climate variability of the coupled ocean-atmospheric system on interannual and decadal time scales. The late 1990s features large events of ENSO, IOD, and phase switch of PDO. Satellite measurements of wind, sea level, and sea surface temperature have provided unprecedented capability to monitor such climate events. Mixed-layer heat budget associated with these events are studied using a satellite ocean data assimilation product. The assimilation is part of the ECCO Consortium effort (<http://www.ecco-group.org>) funded under the National Ocean Partnership Program and collaborated by JPL, SIO, and MIT. ECCO assimilation product is characterized by physical consistency in the evolution of the estimated state such that various physical budgets are closed. This presentation compares heat budget of ENSO, IOD, and phase switch of PDO, in particular, in terms of the relative contribution by air-sea interaction and oceanic processes

in mixed-layer temperature (MLT) balance. Oceanic advection plays a similarly important role to the three climate events in assisting the evolution of MLT. The role of air-sea heat flux marks a stark contrast among these events. Damping of MLT by air-sea heat flux is found for ENSO and IOD in the tropics, providing a necessary condition for negative feedback in the coupled ocean-atmosphere system. However, the same is not found in mid-latitude Pacific during the PDO phase switch. For ENSO, oceanic advection and mixing in the eastern equatorial Pacific cause a much larger amount of heat anomaly than the storage by oceanic mixed layer. This results in very large heat loss that affects equatorial zonal wind and in turn influences MLT through oceanic processes. For IOD, the pile-up of heat anomaly in the western equatorial Indian Ocean by oceanic processes is comparable to mixed-layer storage, suggesting that air-sea coupling associated with IOD is not as active as that for ENSO.