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Oceanic response to the Madden-Julian Oscillation as observed by Argo

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Argo floats offer an unprecedented opportunity to study subsurface variability on various timescales. The Madden-Julian Oscillation (MJO) is the dominant mode of intraseasonal variability in the tropical atmosphere, with a typical timescale of 30-90 days. Using the Argo data set, we show that changes in atmospheric forcing associated with the MJO, i.e. anomalies in surface wind stress, surface heat flux, and precipitation/evaporation, induce changes in the upper ocean structure. Although changes in sea surface temperature (SST) are well documented, this is the first time that a significant effect of the MJO has been documented at depth in the ocean, and in salinity as well as temperature.

Temperature and salinity profiles from Argo floats in the Indian and Western Pacific Oceans from 2003 to 2005 inclusive were mapped to a regular weekly-mean grid with one-degree horizontal and five-metre vertical resolution. Composites of SST anomalies during MJO events show the well-known pattern in which SST variability lags atmospheric solar forcing by a quarter of a cycle. This signal extends to 50-100 m. Below that, an MJO-related signal is seen to a depth of 1000 m that is out of phase with the surface signal, because the thermocline is raised and lowered by propagating waves in response to the MJO. Composites of salinity show a less coherent pattern implying that advection may play a role in addition to surface forcing but nonetheless a statistically significant signal is seen in salinity to a depth of 100 m.