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Relative contributions of sea surface salinity and temperature to density gradient and tropical instability waves: implications to eddy-mean flow interaction

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With their relatively uniform spatial and temporal sampling, satellite observations have revolutionized the estimates of the spatial derivative fields of various oceanic parameters that are not possible to derive from in-situ measurements on a global scale with sufficient spatial resolutions. For examples, the spatial gradients of sea surface height measurements from altimetry provide information about surface geostrophic currents; those of wind stress make possible the estimates of wind stress curl and divergence; those of sea surface temperature and salinity allow detections of thermal and haline fronts. These spatial derivatives fields are critical to the studies of ocean circulation and air-sea interaction. In particular, the spatial gradients of satellite-derived sea surface temperature and salinity (SST and SSS) have provided an unprecedented opportunity to study density gradient that is important to energy conversion between the background ocean state and the fluctuating flow field such as eddies and waves through baroclinic instability. In this study, we examine eddy-mean flow interaction in tropical oceans by studying the relations between background density gradient and tropical instability wave (TIW) variability using various satellite-derived SSS and SST products. In the equatorial Pacific and Atlantic Oceans, SSS is found to have equal or larger contribution to the background meridional density gradient. This has important consequence to the density variance associated with the TIWs (a proxy for the extraction of available potential energy from the background ocean state to the TIWs). Not accounting for salinity effect would under-estimate the TIW-related density variance by at least a factor of three.