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Estimating ENSO influence on the global mean sea level during 1993-2010

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Interannual global mean sea level (GMSL) variations and El Nino-Southern Oscillation (ENSO) are highly correlated, with positive/negative GMSL anomalies during El Nino/La Nina events. In a previous study, we showed that interannual GMSL and global land water storage variations are quantitatively well correlated, with lower/higher than normal total water storage on land, and higher/lower GMSL during El Nino/La Nina,. Here, we investigate which oceanic regions (Atlantic, Indian and Pacific oceans) contribute to the interannual GMSL anomalies and focus on the 1993-2010 altimetry period including several El Nino and La Nina events. For each oceanic region, we compute the steric contribution (effect of temperature and salinity), and remove it from the mean sea level to estimate the mass component. We find that the tropical North tropical Pacific ocean (0°-30°N) mass is highly correlated with ENSO-related total land water storage. Analyses as a function of latitude/time and longitude/time show that tropical north Pacific mass excess is mostly confined within 10°N-20°N in the western half of the basin (120°E- 160°W). We computed the ocean-atmosphere water balance of the North Pacific and found that over the study period, the time derivative of the ocean mass component is well correlated with net P-E (precipitation minus evaporation). However during the 1997/1998 ENSO event, there is a temporary ocean mass increase, not compensated by the net P-E and likely due to an imbalance between the inflow/outflow entering/leaving the North Pacific. A qualitative analysis indicates that a significant reduction of the Makassar Strait transport, which accounts for 80% of the total Indonesian throughflow into the Indian Ocean, previously reported in the literature during the strong 1997/1998 El Nino event is consistent with the tropical North Pacific ocean mass excess.