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Spatiotemporal Variability of El Niño Southern Oscillation from Geodetic Satellites

Y.-H. Wu (1), D. García-García (2), and B. F. Chao (1)

(1) Institute of Geophysics, National Central University, Jhongli City, Taiwan (93622004@cc.ncu.edu.tw), (2) Department of Applied Mathematics, University of Alicante, Alicante, Spain (d.garcia@ua.es)

The global mean sea level rose at about 2.46 mm/year during 1930 and 2007. Many global change phenomena have been well observed and monitored, such as temperature rise in the polar region and large-scale ice melting, precipitation and ocean salinity changes, wind field and severe weather intensification, etc. The two main causes of the sea level variation (SLV) are thermal expansion and mass changes within oceans resulting from climate shift, but their relative share in the total SLV is still uncertain. We hereby study the SLV around tropical oceans in relation to El Niño Southern Oscillation (ENSO) and their variability in space-time. We employ the method of C/EOF (Complex/Empirical Orthogonal Function) to analyze various physical parameters in the region and their space-time variability. We find: (1) Using the satellite ocean altimeter data to study SLV in relation to ENSO variations revealed that from 1993 to 2007 the first mode's time series of Complex EOF suggests high correspondence to the SOI and Nino3.4 index; (2) We additionally extracted the spatial propagation with time evolution of ENSO SLV; (3) Time variable gravity (TVG) over the ENSO region obtained from GRACE satellite data suggests weaker mass migration signals than SLV, although larger uncertainty is expected from GRACE over low latitudes; (4) Using the GCM output (such as ECCO, and MERCATOR), e.g. salinity and temperature profiles with reference to the ocean altimeter and GRACE data revealed the characters of steric or mass-induced SLV during the ENSO events. Preliminary results show that both SLV and SST anomaly had a steady increase after the strongest 1997-98 ENSO event, but not present in the steric SLV conducted according to the GCMs, presumably due to the general underestimation in the latter.