Global Mean Sea Level Variations on Interannual-to-Decadal Timescales

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We investigate the impacts of the interannual climate oscillations on the global mean sea level (GMSL) with data derived from satellite radar altimeter observations since 1992. After removing numerically the long-term trend and seasonal variation, we conduct the cross-correlation and coherent spectrum analyses of GMSL with several climate oscillations represented by their respective meteorological indices, including El Niño-Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), Atlantic multidecadal oscillation (AMO), Arctic Oscillation (AO), Antarctic Oscillation (AAO). We find: (i) High correlation between GMSL and ENSO on timescales longer than 1.5 years, especially w.r.t. the Central-Pacific type of El Niño. The reasons might be related to changes in dynamics of the ocean mixed layer and in land-sea distribution of precipitation. (ii) Moderate correlations of MSL with PDO and AMO, respectively on timescales of over 4 years and 2-10 years, and AMO's peak correlation is 8 months earlier in phase than GMSL. (iii) Weak correlation of GMSL with AO even though the altimetry data do not include Arctic sea, implying exchanges of the Arctic water with other oceans. (iv) Practically no correlation between GMSL and AAO. Finally, we least-squares fit the above five indexes to GMSL to assess the relative contribution of each oscillation in causing the interannual GMSL variations, which would lead to a better understanding of the GMSL under the on-going climate changes.

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