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Drivers for seasonal variability in sea level around the China seas

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Globally variable ocean and atmospheric dynamics lead to spatially complex seasonal cycles in sea level. The China Seas, that is the Bohai, Yellow, East China and the South China seas, is a region with strong seasonal amplitudes, and straddles the transition between tropical and temperature zones, monsoonal and westerlies, shelf and deep ocean zones. Here we investigate the drivers for seasonal variability in sea level from tide gauge records, satellite altimetry along with output from the NEMO (Nucleus for European Modeling of the Ocean) model including sea surface height and ocean bottom pressure along with meteorological data in the China Seas. The seasonal cycle accounts for 37% - 94% of sea level variability in 81 tide gauge records, ranging from 18 to 59 cm. We divided the seasonal cycles into four types: 1) an asymmetric sinusoid; 2) a clearly defined peak on a flat background; 3) a relatively flat signal; 4) a symmetric co-sinusoid. Type 1 is found in northern China and Taiwan, Korea, Japan and The Philippines where Inverse Barometer (IB) effects dominates seasonality along with a steric contribution. The seasonal monsoon associated with barotropic response and freshwater exchange play important roles in type 2, (eastern and southern Chinese coasts), type 3 (East Malaysia) and type 4 (Vietnam and Gulf of Thailand). IB corrected seasonal cycle amplitudes are larger in continental shelf areas than the deep ocean, with a maximum in the Gulf of Thailand, and NEMO underestimates the seasonal amplitude along the coast by nearly 50%.