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The spatial and temporal variability of the seasonal mean sea level cycle in the South China Sea

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The seasonal cycle is the most energetic component of mean sea level variability and changes in either its amplitude or phase can seriously impact the risk of coastal flooding. Here, tide gauge records and satellite altimetry observations, along with steric and meteorological data are used to investigate the spatial and temporal variability of the seasonal cycle in the South China Sea (SCS) and its forcing mechanisms. The coastal annual amplitude varies significantly from region to region with values ranging from 2 cm to 24 cm, and generally peaks between July and January. The coastal semi-annual amplitude has maximum values of 7 cm, and it peaks between March and June. Along the coast, the seasonal cycle accounts on average for 60% with maximum values of up to 92% of the mean monthly sea level variability. Atmospheric pressure fluctuations explain a significant portion of the seasonal cycle with dominant annual signals in the northern SCS, the Gulf of Thailand and the north-western Philippines Sea. The wind forcing is dominant on the shelf areas of the SCS and the Gulf of Thailand where a simple barotropic model forced by local wind shows amplitudes of up to 27 cm. In the deep basin of the SCS, the Philippines Sea and the shallow Malacca Strait, the steric component is the major contributor with maximum annual amplitudes of up to 15 cm. Significant variability in the annual and semi-annual cycle is found on a year-to-year basis. The annual and semi-annual amplitudes vary by up to 63% and 45% of the maximum values, 15 cm and 11 cm, respectively. On average, stepwise regression analysis of contribution of different forcing factors accounts for 69% of the temporal variability of the annual cycle. The zonal wind and the cross-shore wind were found to exert considerable influence in the Malacca Strait and the northern SCS respectively.