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Wintertime Winds and Coastal Sea-Level Fluctuations in the Northeast China Sea. Part II: Numerical Model

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ABSTRACT

As a sequel to data analysis reported in Part I, a numerical model of the wintertime wind-driven circulation of the northeast China Sea is developed with the primary purpose of achieving an understanding of the underlying dynamics to several observed features of the coastal sea-level behavior. The model is linear and pertains to the vertically integrated balance of momentum and mass in a well mixed shallow ocean. The model bathymetry incorporates a realistic shelf embayment and an open-ocean region of a depth so limited that observed sea-level differences across open boundaries in the deep western Pacific do not result in unreasonably large model transports.

From results of model runs for the 1980/81 winter, it is found that 1) along the west coast of South Korea, sea-level setup to the south is a consequence chiefly of the presence, at the end of the Korean Peninsula, of relatively deep offshore water that is less responsive to wind forcing than the shallow shelf water, 2) pressure gradient force dominates in deep waters along the axis of the Yellow Sea embayment and contributes to an upwind (northward) flow that is particularly noticeable during relaxation when the north wind abates; 3) free, coastally trapped waves that travel counterclockwise around the basin dominate the relaxation response and are generated partly from the relaxation of coastal sea-level setups; 4) part of the free oscillations around 0.33 cpd detected in sea-level records along the west coast of South Korea appear to have originated from sea-level fluctuations generated along the western portion of the southern coast of the Korean Peninsula by the east-west wind component which exhibits a distinct spectral peak at that frequency; 5) the superposition of the mean of the wind-driven model circulation and the Kuroshio-driven steady state yields a northward flowing current similar to the observed Yellow Sea Warm Current and cyclonic gyres in the Yellow Sea and the East China Sea region southwest of Cheju that are long suspected from various oceanographic measurements.

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