Geophysical Research Abstracts, Vol. 7, 06923, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06923

Baroclinic inertial oscillation in a semi-enclosed sea

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Strong inertial oscillations have been frequently observed by moored current meters in the semi-enclosed Japan/East Sea (e.g. Takematsu et al, 1999). The deep inertial oscillations appear to be coherent with the high-frequency wind stress. However, our barotropic model hardly simulates the inertial motions with hourly wind stress data. On the other hand, strong inertial oscillations are generated in a 1.5 layer, reduced-gravity model with the same forcing.

We interpret the inertial oscillation of the JES to be baroclinic rather than barotropic through an idealized two-layer model experiment. The top layer is uniformly driven by basin-wide wind stress as a form of step function in time, and generates pressure gradient according to the coastal boundary. The pressure gradient immediately pushes the bottom layer back in opposite to the surface movement. The horizontal velocity directions turn around with the Coriolis force, sustaining the out-of-phase relation between the top and bottom layers. The surface velocity amplitude of the oscillation turns out to be several times stronger than the deep oscillation in the JES simulation, which is consistent to the inertial variabilities of O(10cm/s) and O(1cm/s) reported by Park et al. (2004) and Mori et al. (2005) for the surface and deep layers, respectively. Xing and Davies (2004) simulated also the baroclinic inertial oscillation in another semi-enclosed region of the Balearic Sea.