Geophysical turbulent characteristics of the remotely-sensed submesoscale surface currents and chlorophyll concentrations

Sung Yong Kim*

Submesoscale maps of coastal surface currents and chlorophyll concentrations at hourly and $O(1)$-km resolutions, obtained from an array of high-frequency radars and geostationary ocean color imagery in a coastal region off the east coast of Korea over a period of at least one year to five years, are described in the frequency and wavenumber domains. The kinetic energy spectra of the surface currents in the wavenumber domain (k) become steeper at a scale of approximately 10 km from a slope of $k^{-5/3}$ to slopes between k^{-2} and k^{-3} at a length scale of 2 km. Moreover, the energy spectra of the chlorophyll exhibit anisotropy associated with bathymetric effects and regional circulation, and their decay slopes change from $k^{-5/3}$ to k^{-1} at $O(10)$ km scales and from k^{-1} to k^{-3} at $O(1)$ km scales, which is consistent with the two-dimensional quasi-geostrophic turbulence theory. The spectral decay slopes of these energy spectra show weak seasonality, which can be interpreted with the baroclinic instability in the weak seasonal mixed layer and the persistent and non-seasonal regional circulations.

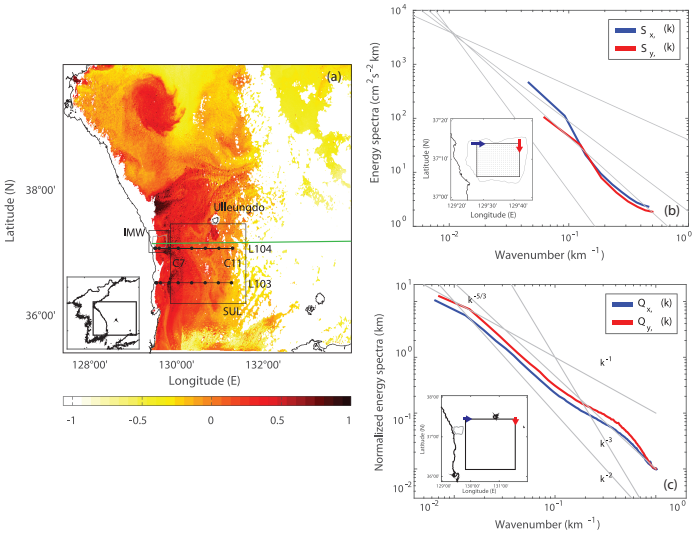

Figure 1: (a) An example of the remotely-sensed surface currents and chlorophyll concentrations ($\log_{10}$; μg L^{-1}) off the East/Japan Sea (EJS). (b) and (c): Wavenumber domain energy spectra of surface currents (S) and normalized chlorophyll concentrations (Q). The energy spectra of the data sampled on multiple one-dimensional cross-shore lines (x) are averaged in the along-shore direction (y) to estimate the wavenumber domain energy spectrum (S_x and Q_x) in the cross-shore direction. Four gray auxiliary lines of k^{-1}, $k^{-5/3}$, k^{-2}, and k^{-3} spectral decay slopes are overlaid.

*Department of Mechanical Engineering School of Mechanical and Aerospace Engineering Korea Advanced Institute of Science and Technology, Daejeon 34141, Republic of Korea