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Spectral descriptions of submesoscale surface circulation in a coastal region off the East Coast of Korea

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The spectral characteristics of hourly and 1-km resolution coastal surface currents obtained from an array of high-frequency radars of a coastal region off the East Coast of Korea are described in the frequency and wavenumber domains. The primary variance of the observed surface currents for a period of one year appears in the low-frequency (longer than 2 days), diurnal, and near-inertial frequency bands. The low-frequency surface currents exhibit more consistent variability with the regional geostrophic currents in summer than those in winter because of the relatively weaker wind conditions and a shallower mixed layer during summer. The diurnal surface circulation contains components that are coherent with diurnal land-sea breezes because of the development of the diurnal marine boundary layer. Clockwise near-inertial surface currents present decreasing amplitudes and spatially consistent on-shore phase propagations represented as a coastal inhibition, which is caused by coastal boundary effects on the near-inertial currents. The kinetic energy spectra of the surface currents in the wavenumber domain have decay slopes between k^{-2} and k^{-3}, and their seasonal decay slopes are slightly steeper in winter than in summer. These findings can be interpreted that the submesoscale processes in this region can be related to both surface frontogenesis caused by regional mesoscale eddies with weak seasonality and baroclinic instability associated with the seasonal mixed layer and vertical fluctuations modulated by its harmonic frequencies.