Multi-scale variability of surface currents in the Gulf of Tonkin derived from HF radar observations

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The surface circulation in the Gulf of Tonkin (GoT) was analyzed using 2.5 year-long dataset from the High-Frequency radar (from April 2014 to October 2016). High temporal resolution of the measurements and large coverage from HFR dataset enable us to characterize the variability of surface circulation in the GoT in a wide range of scales: from tidal to annual scale. A number of techniques of data including rotary spectral analysis (RSA), principal component analysis (PCA), harmonic tidal analysis, coherent analysis, etc. were used to identify the dominant modes of variability. The tidal motions, accounting for approximately 62% of the total variability, revealed the dominance of diurnal components (K1 and O1) with 4 times larger magnitude than that of semi-diurnal constituent (M2). At seasonal scale, the monsoon wind plays an important role in driving the surface circulation in the GoT. This was supported by a tight correlation (0.7) between the wind stress and current velocities and by a large contribution (more than 50%) of the Ekman-driven component to the total variability of currents in the offshore area. Along the shore, large seasonal variability of circulation was highlighted. During the year, the seaward extension of the coastal current is primarily controlled by the cross-shore wind stress while the flow intensity is modulated by the Red River discharge.