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Barotropic standing-progressive Rossby waves

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Isopleths (Hovmoller Diagrams) of the sea-level variation on latitudinal or longitudinal sections demonstrate specific points in which the sea level is stationary (nearly zero values of the sea-level heights) for a time interval. A phase discontinuity of the sea-level variation takes place near such points, which results, because of the phase jump, in converting wave crests into troughs. In general, the wave movement pattern may be said to consist of standing-progressive waves, or more specifically, Rossby's, on accounting their spatial-temporal scales: wavelengths from several kilometers to thousands and periods from several days to several years.
A set of sea-level anomaly fields in the northwestern Pacific is taken from the AVISO site, and the seasonal alteration in them is eliminated by filtering out . Meanwhile, longitudinal isopleths drawn by the same data do not contain wave crests testifying of any wave movements. A similar conclusion is suggested by analysis of the wavelet-isopleths (spatial-temporal diagrams of wavelet coefficients for a certain variability scale), indicative of an expressed step-like change of sea level.
Indeed, these facts correspond to theory of the Rossby waves in closed basins; in other words, Rossby waves inside of a closed basin are of standing-progressive character [2, 3]. In the simplest case the barotropic standing-progressive waves of Rossby might be described as a zonal progressive wave, the amplitude of which is modulated along the meridian course. This kinematical model does rather correctly describe wave disturbances in the field of altimetry heights of sea surface. It is possible that such disturbances should satisfy to a system of hydrodynamic equations which describe wave movements of the type of gradient-vortex waves [1, 4].
In this model at zero moment, in the center of the rectangular cell bounded on all sides by fixed nodal lines there is a wave crest, and on the east and west there are wave troughs. Since a quarter of the cycle, this wave pattern is shifted westward, and a dipole appears, having a wave crest in the western part of the cell, and a trough in the eastern part; after a half of the cycle the cell center is entered by a trough, and the west and east are occupied by wave crests; and in three quarters of the cycle the extremes being translated to the west will create in the mid-pool a dipole of opposite sign. Thus, the mixed picture of the positive and negative sea level anomalies as observed on altimetric maps can be explained by the nature of standing-progressive Rossby waves.
In addition to the β-effect, physical mechanisms to determine the capture of wave energy, can include waveguides – either topographic (shelf, trench, ridge, etc.), shear or jet, and frontal ones. Concentration of wave energy in the waveguides is caused by the convergence of currents due to the dynamical or thermo-dynamical reasons.
Let us touch only on main regularities in the spatial distribution of amplitudes and phases of the $\frac{1}{2}$-year variation of the Northern Pacific Ocean water level. The cellular phase pattern may correspond to standing-progressive behavior of the $\frac{1}{2}$-year waves. The said regularities are particularly evident from wavelet isopleths in which a pronounced phase jump can be observed for the level fluctuations on a section along 35°N.
The analysis of the wavelet-based isopleths and of the altimetry data in general show that the presence of $\frac{1}{2}$-year cycling in the sea level variation in the Kuroshio Current system is caused by spread of the standing-progressive gradient-vortex waves. Thus, contrary to the prevailing opinion of the phenomenology of low-frequency wave dynamics, both the seas and the open ocean are dominated by not progressive, but standing-progressive gradient-eddy waves of the Rossby wave type.

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