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Bands of alternating zonal mean currents and "too-fast" planetary wave propagation off California

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Lagged correlation of dynamic height from the gappy California Cooperative Oceanic Fisheries Investigation (CalCOFI) with monthly San Diego sea level for the period 1950-2001 shows that the dynamic height propagates westward at 4.10cm/sec, about double the speed of the large-scale low frequency Rossby wave (2.2cm/sec). TOPEX POSEIDON/Jason 1 along-track sea level height estimates since January 1993, filtered interannually, propagate westward at 4.3cm/sec, verifying that observed westward propagation is about double that expected. Including the effect of the mean California current on the Rossby wave propagation does not explain the discrepancy but rather slightly increases it. Standard theory therefore does not explain the observations.

Along-track satellite mean sea level estimates in the CalCOFI region suggest that the mean sea level has a large zonal scale but oscillates meridionally with an amplitude of a few cm and a comparatively short meridional wavelength of about 300 km. By geostrophy, these small meridional sea level oscillations correspond to bands of alternate weak zonal flows u bar and to a northward gradient of vorticity -u bar sub yy that is comparable to beta, the northward gradient of the Coriolis parameter. Theory shows that in the presence of such banded mean flow the interannual variability should propagate westward at approximately double the Rossby wave speed as observed. The theory also predicts that the interannual sea level amplitude can be approximated by the sum of a part independent of latitude and another part that is in phase with the mean sea level. Interannual satellite sea level observations confirm this structure.