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Nature of Near-Inertial Motions in the Upper Ocean and a Possible Route towards HF Radar Probing of Seasonal Stratification

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Inertial band response of the upper ocean to changing wind is studied both theoretically and by analysis of observations in the Gulf of Lyons. The theoretical examination is carried out within the framework of the linearized Euler equations on the non-traditional f-plane. Due to the horizontal component of the Earth rotation for near-inertial waves with frequencies slightly below the local inertial frequency f there is a waveguide in the mixed layer confined from below by the pycnocline. When the stratification is shallow and strong these near-inertial motions are the ones most easily and strongly excited by the changing winds. The linear model predicts that in the presence of seasonal stratification the inertial band response of the upper ocean is dominated by these sub-inertial motions. These motions have been overlooked in the previous studies since they are absent under the traditional approximation. The in situ observations which employed buoys with thermistors, ADCPs, HF radars and SST data were carried out in the Gulf of Lyons in April-June 2006. The observations support the theoretical picture: a pronounced inertial band response occurs only in the presence of strong shallow stratification and is sharply localized near the surface. The surface signatures of these motions are easily captured by HF radars. The sensitivity of the inertial band response (as seen by HF radars) to the upper ocean stratification provides a possibility for developing HF radar probing of seasonal stratification. An analysis of continuous two year HF observations near the Porquerolle island confirms that the seasonal stratification is indeed the necessary condition for a strong inertial band response.