On the dependence of radar signatures of oceanic internal solitary waves on wind conditions and internal wave parameters

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ABSTRACT

On August 22, 1997, a large amplitude internal solitary wave was detected simultaneously by using in-situ and remote sensing observations south of the Strait of Messina, in the Mediterranean Sea. In-situ observations consisted of temperature and conductivity, hence salinity, measurements with a towed chain; remote sensing observations in radar backscatter measurements with a spaceborne synthetic aperture radar (SAR). A theoretical velocity field inferred from the observed density field associated with the internal solitary wave and the wind speed and direction measured during the experiment were inserted into a wave-current interaction model to calculate the spatially varying surface wave spectra over the internal solitary wave. Using a composite surface scattering model, the modulated wave spectra were converted into theoretical radar signatures. It is found that the observed and simulated variations of the normalized radar cross section (NRCS) agree quite well. This agreement results from an exceptionally accurate knowledge of the whole set of parameters which determine the theoretical radar signature of the internal solitary wave in the frame of the above mentioned radar imaging model suite. Several numerical simulations performed with the radar imaging model suite elucidate the dependence of the simulated radar signatures on wind conditions, namely wind speed and direction, and on internal wave parameters, namely wave amplitude, undisturbed interface depth, and relative density difference. It is found that the dependence of the modulation depth of the NRCS over internal waves on interior ocean parameters and on wind conditions over the ocean, which are, in general, not well known, is of the same order.