Abstract View

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Internal Waves in the Strait of Messina Studied by a Numerical Model and Synthetic Aperture Radar Images from the *ERS 1/2* Satellites

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ABSTRACT

A new numerical two-layer model is presented, which describes the generation of internal tidal bores and their disintegration into internal solitary waves in the Strait of Messina. This model is used to explain observations made by the synthetic aperture radar (SAR) from the European Remote Sensing satellites *ERS 1* and *ERS 2*. The analysis of available *ERS 1/2* SAR data of the Strait of Messina and adjacent sea areas show that 1) northward as well as southward propagating internal waves are generated in the Strait of Messina, 2) southward propagating internal waves are observed more frequently than northward propagating internal waves, 3) sea surface manifestations of southward as well as northward propagating internal waves are stronger during periods where a strong seasonal thermocline is known to be present, 4) southward propagating internal bores are released from the sill between 1 and 5 hours after maximum northward tidal flow and northward propagating internal bores are released between 2 and 6 hours after maximum southward tidal flow, and 5) the spatial separation between the first two internal solitary waves of southward propagating wave trains is smaller in the period from July to September than in the period from October to June.

The numerical two-layer model is a composite of two models consisting of 1) a hydrostatic “generation model,” which describes the dynamics of the water masses in the region close to the strait’s sill, where internal bores are generated, and 2) a weakly nonhydrostatic “propagation model,” which describes the dynamics of the water masses outside of the sill region where internal bores may disintegrate into internal solitary waves. Due to a technique for movable lateral boundaries, the generation model is capable of simulating the dynamics of a lower layer that may intersect the bottom topography. The proposed generation–propagation model depends on one space variable only, but it retains several features of a fully three-dimensional model by including a realistic channel depth and a realistic channel width. It is driven by semidiurnal tidal oscillations of the sea level at the two open boundaries of the model domain.

Numerical simulations elucidate several observed characteristics of the internal wave field in the Strait of Messina,

such as north–south asymmetry, times of release of the internal bores from the strait's sill, propagation speeds, and spatial separations between the first two solitary waves of internal wave trains.

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