High-rate radar altimeter waveform signatures of internal solitons in tropical marginal Seas

J.C.B. da Silva[1,2], J.M. Magalhaes[2], A.L.F. cerqueira[1] & E. Vieira[1]

[1] Department of Geoscience, Environment and Spatial Planning, Faculty of Science, University of Porto, Rua do Campo Alegre, 687, 4169-007 Porto, Portugal.

[2] CIIMAR, Centre of Marine and Environmental Research, Rua dos Bragas, 289; 4050-123 Porto, Portugal.

We report efforts for detection and recognition of short-period internal waves, also many times described in the literature as Internal Solitary Waves (ISWs), in high-rate along-track waveform records of the Jason-2/3 altimeters and SARAL Altika. A synergetic observation approach is developed for the identification of ISWs in altimeter data, based on validation with imaging radars and high-resolution optical sensors (measuring sun-glint patterns on the water surface). Geophysical parameters obtained from available SGDRs were processed and analyzed for regions of tropical marginal Seas where the existence of high-amplitude ISWs is known, namely: Andaman Sea, Sulu Sea, Celebes Sea, South China Sea, Red Sea, Northwest Australian Shelf, and Strait of Gibraltar. Evidence of modulation of several geophysical parameters is presented, namely: the "off-nadir-angle" available from the MLE4 retracking algorithm; sigma0 as retrieved from MLE4; significant wave height (SWH); and the differenced mean square slope calculated from the dual-band Jason-2/3 sigma0 measurements. The ISW signatures are sometimes recognized as parabolic-like shape sigma0 anomalies in the along-track radargram. These anomalies are mostly recognized as sigma0 positive anomalies which are related to short-event sigma0 blooms that have been reported in the literature (Mitchum et al., 2004; Tournadre et al., 2006; Dibarboure et al., 2014). On some occasions however, sigma0 negative anomalies with parabolic-like shape have also been observed back-to-back with the positive anomalies. We suggest that these consecutive negative/positive anomalies are associated to enhanced and decreased surface roughness produced by ISWs. This is consistent with some of our records of differenced mean square slope calculated from the dual-band Jason-2/3 altimeters. It is suggested that the improved MLE4 Brown model provides the capability to absorb the waveform distortion as ''off-nadir angle'' and sigma0, since the true pointing of Jason-2/3 is very good, so the retracked off-nadir angle is only apparent. With MLE4 the slope of the trailing-edge parameter and the sigma0 estimate are absorbing the bulk of the backscattering ISW event, for the case of pulse-limited altimeters, when the outer rings of the waveform footprint are affected. Hence, oceanography users interested in short-period internal wave signals may find useful information in 20-Hz rate Jason-2/3 current altimeter products. Development of better editing and postprocessing algorithms on the 20-Hz rate of current products is needed if we want to account for ISWs in coastal regions. New SARAL altimeter waveforms are compared with Jason-class high-rate altimeter waveforms related to ISWs.