

ABSTRACT

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2) Processes and applications

Title

A computationally cheap atmosphere-ocean modelling system aimed at anticipating meteotsunami occurrence in Ciutadella harbour

Abstract

Ciutadella (Menorca, Spain) is well known for the large amplitude seiches of about 10.5 min period registered in its long narrow inlet, especially in the warm season. This phenomenon (locally referred to as “rissaga”) might reach extreme wave heights in the range 1.5 – 4 m with a recurrence of only a few years, leading to damaging consequences in the port activities and moored vessels. The provision of as accurate as possible predictions of the rissaga risk hours or days ahead appears as a crucial element in helping to mitigate these consequences. We devise a chain of atmospheric and oceanic numerical simulation components aimed at capturing with low computational cost the key physical processes conducive to the vast majority of rissagas: (i) the genesis of high amplitude atmospheric gravity waves upstream from the Balearic Islands that propagate in the SW-NE direction; these mesoscale waves are synthetically triggered using a 2D nonhydrostatic fully compressible model within a vertical environment provided by a representative sounding; (ii) the oceanic response to the concomitant pressure fluctuations along the Mallorca-Menorca channel, in the form of long oceanic waves subject to Proudman resonance; these processes are simulated with a shallow-water model applied over a 80-m depth channel; (iii) shelf amplification, which according to theory (Green’s law) accounts for a doubling of the wave amplitude; and (iv) harbour resonance within Ciutadella inlet, a crucial mechanism solved again with the shallow-water equations over an idealized 5-m deep channel. The prognostic system is successfully tested for the available set of 128 rissaga events and for a complementary set of 600 ordinary situations. Our approach discriminates fairly well non rissaga events from high-amplitude oscillations and tends to correctly categorize the meteotsunamis among weak, moderate or strong events. We now pursue the real time application of the method in a probabilistic context.

Key words

Meteotsunami; Rissaga; Ciutadella; Gravity Waves; Resonance; Numerical Model