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Framing topographic Rossby waves in the Southern Adriatic Sea

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Topographic Rossby Waves (TRWs) are oscillatory phenomena associated with modulations induced by seabed morphology in the potential vorticity field. These features could be confined to a single layer or could involve the whole water column, and they are controlled by a combination of the bathymetric gradient and the uniform rotation in the same way as planetary Rossby waves are controlled by the meridional modulation of the Coriolis parameter. In terms of deep-sea circulation, TRWs provide a fundamental contribution by radiating large amounts of energy along and off a continental shelf. Under favorable conditions TRWs can be triggered by a number of factors, such as intense vorticity injections from the wind or the bathymetric perturbations - e.g., a promontory or a canyon crossing the path of a current.

In this work we combine observational data and numerical model fields for detecting the presence of TRWs along the Southern Adriatic Margin (SAM, Eastern Mediterranean Sea) and investigating their dynamics during an episode of dense water downflow in spring 2012. Starting from the observation of high-intensity velocity pulses with a period of approximately 2 days, we carry out a sequence of operations on the results of a high-resolution, ocean currents-waves coupled numerical modelling experiment aiming to reproduce dense water formation and migration in the Adriatic Sea in winter-spring 2012. First, we apply a wavelet analysis to modelled velocity time series at several locations off the Italian coast and along the SAM in order to identify the spatial and temporal extent of the pulsing episodes. Then, the properties of the oscillations are assessed via rotary analysis; the propagation of the band-filtered signal along the continental margin is characterized by extracting wave length and propagation velocity, therefore allowing the comparison against theoretical dispersion relations associated with the bathymetry of the SAM.

Our results show that the observed modulation was indeed related to a perturbation system propagating south-eastward along the Italian coast and amplified as a train of TRWs along the shelf break and on the continental slope, thus providing, to the best of our knowledge, the first evidence of the existence of such waves on the SAM. This work paves the way to further investigations of these waves and their implications on dense water dynamics and related impacts on the benthic environments.