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Radar and in-situ observations to drive local coastal models in multipurpose applications: the case study of the Island of Giglio.

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Operational oceanography systems for sea state observation/forecasting at local/coastal scales have found increasing use in many situations of practical interest, such as the monitoring of storm surge impact on the shoreline, the verification of effectiveness of coastal protection interventions, and also the supporting practices for the emergency management (for example, Search and Rescue, planning of civil protection actions, etc.).
In particular, the recent disaster of the Costa Concordia ship near the Island of Giglio has motivated the implementation of a local scale observational and forecasting system, which is essential for the management of wreck removal operations and environmental monitoring. The observational component of this system includes some in-situ standard measurements for sea level, waves, currents and other ocean parameters, plus X-band radar observations of waves and currents, while the forecasting component is based on state-of-the-art numerical models for waves and ocean circulation, widely used by the scientific community. This strong very local concentration of different kinds of measurements represents a unique small laboratory of knowledge, and a major source of data for testing the present forecasting capabilities of waves and currents at such local scales.
In this work we show the results of a first period of sea state observations/predictions around the wreck and, in particular, the reliability of the forecasting models used at this local/coastal scale for supporting the emergency management. Models are used to predict waves (SWAN) and currents (ROMS) close to the coast, using atmospheric forcing (WRF) and boundary conditions from larger scale (2-3 km resolution) models. In particular the application of the X-band radar in high resolution configuration (<50 m) allows to highlight contributions to the wave spectrum due to wave refraction, diffraction and even reflection from the coast. These contributions can not be observed in large scale prediction models. This has motivated the adoption of a new phase-resolving wave model, operationally processed, that allows to take into account all these multiple shallow-water contributions. Ensemble-like wave simulations allow to minimize the initial choice of phases in the irregular wave patterns, and to assess the probability of local scales situations. In addition the calibration of such models require a careful calibration of wave dissipation parameters, due to the actual coastal and bathymetric features.
The coastline shape and bathymetry also greatly influence the observed currents, with observation of sub-mesoscale patterns that are challenging to reproduce by hydrodynamic models. The impact of this observation/forecasting system on the activities of wreck removal and marine monitoring appears to be very significant.
Similar monitoring activities, with the adoption of coastal radars, based on both HF- and X-band technologies, for hydrodynamic and morphodynamic observations of the sea conditions at local/coastal scales, are being implemented in other sites of the Tuscan coast, and some preliminary results will also be presented.