HYDROCARBON DISPERSAL IN THE GULF OF NAPLES: A PARAMETRIC STUDY

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Abstract
Surface current measurements provided by a HF radar system allowed to identify typical patterns of the circulation of the Gulf of Naples (Tyrrhenian Sea), and to associate them with the prevailing forcing conditions. Circulation data were then used as input for a model simulating the transport of particles released in ocean basins (GNOME - General NOAA Oil Modeling Environment). The results of this study highlight peculiar characteristics of the surface dynamics and transport processes in the Gulf of Naples, allowing an estimate of the residence times and the identification of potential particle aggregation and retention areas.
Keywords: Circulation, Tyrrhenian Se, Water Transport, Pollution

Historical reports on the circulation of the Gulf of Naples (GoN) highlight the occurrence of highly dynamic structures over the basin [1, 2]. As for other marginal and coastal basins, even in the GoN wind stress represents the most important local forcing, directly and indirectly affecting surface current fields [1, 2, 3, 4, 5]. Wind forcings display a typical seasonality [5] associated to the large-scale atmospheric circulation acting over the region; when such forcings are weak, as it often is the case in summer, a locally induced breeze regime can act as primary driver of sea surface circulation. The circulation of the GoN can also be remotely driven by the larger-scale circulation of Southern Tyrrhenian Sea [3], with which it is in direct communication. The resulting circulation structures allow the coexistence and mixing of different water masses [6], with characteristics ranging from those typical of oligotrophic environments [6] to that attributable to coastal systems [7]. In addition to its peculiar hydrographic and oceanographic features, the GoN holds a leading role among the marginal basins of Southern Tyrrhenian Sea for socio-economic reasons. A severe anthropic activity impinges on the system, ranging from urban settlements to tourism and maritime traffic, with potentially drastic consequences on ecosystem dynamics and water quality. The necessity of preserving and sustainably exploiting the environmental resources requires an accurate understanding and monitoring of the circulation and transport processes acting in the basin, by which forestalling or mitigating potentially hazardous events. In the last years, increasing awareness about the importance of operational oceanography systems has promoted the development of new techniques and instruments to investigate the real-time, multi-scale circulation patterns in a target area and their effects on transport and diffusion of pollutants, with a special emphasis to coastal zone management. The purpose of this work is to study the surface circulation patterns in the GoN as driven by typical local wind conditions and by Southern Tyrrhenian guidance, and to assess their effects on transport processes of passively buoyant particles. The synoptic, basin scale circulation of the GoN is reconstructed by means of a HF radar system (CODAR O. S. Ltd., USA) operating since October 2004. From the available dataset we selected four periods, each lasting 8 days, with typical forcing conditions for the investigated area. We first analysed the cross-correlation between wind stress and surface current components and directions, and afterwards we investigated the associated surface current velocity and vorticity fields. In addition we applied the GNOME (General NOAA Oil Modeling Environment, NOAA, USA) transport model to simulate the fate of passive conservative particles released in coastal sub-area (Bay of Naples). The results here presented indicate that each set of conditions determines peculiar, not easily foreseen circulation structures and transport processes, as the result of the superimposition of multiple co-occurring factors. Such an integrated approach, moreover, permits an evaluation of the renovation times of the water mass and the investigation of the exchange mechanisms between sub-basin areas.

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