High resolution surface dynamics of the Algeciras Bay (Strait of Gibraltar) by Lagrangian particle tracking system

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The Algeciras Bay is one of the main crossroads for maritime traffic, commercial transport and tourism, worldwide. It is a reference base for exchanges between the Mediterranean Sea and the Atlantic Ocean, and the main gateway for people moving from Africa to the rest of Europe and vice-versa. It is located in the eastern side of the Strait of Gibraltar, possibly the most complex and energetic hotspots of the planet, from an oceanographic point of view. Its port handles about 250,000 containers, more than 350,000 passengers and nearly 80,000 vehicles every year, and is also a worldwide reference for interoceanic traffic bunkering, hosting one of the most important oil-refinery of the country. For all these reasons, the Algeciras Bay is continuously submitted to a high level of environmental risk and hence considered as a very sensible point from an ecological point of view. A reliable analysis system for oil-spill, debris distribution, and in general water quality assessment, is then highly demanded in this area. The new version of the widely validated very high resolution hydrodynamic model integrated in the Strait of Gibraltar forecast operational system by Puertos del Estado (SAMPA2), is used here in offline mode to simulate the advection of floating particles, as passive descriptors of the surface circulation patterns within the Bay. A classical 4^{th} order Runge-Kutta algorithm has been specifically adapted to the ununiform curvilinear model grid, and both the model writing frequency and the advection algorithm iteration interval have been optimized in order to provide a fast and reliable framework to this aim. The model, with its ~30 meters grid cell width, is capable of solve the inner structures of the complex Algeciras Port, and so describe the accumulation/dispersion of pollutant proxies (particles) all over the area. Several tests have been accomplished to analyze the high dependence of the circulation patterns by the semidiurnal tide, the tidal fortnightly modulation and the atmospheric forcing, and to provide water quality indicators, as residence and renewal time, for each single structure of the Algeciras Port.