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Vortex detection by SAR and ASAR, Distribution and statistics in the NW Mediterranean

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The Synthetic Aperture Radar (SAR) is a useful tool that may be used to study both marine water dynamics and its pollution. It is demonstrated that useful information of a geometrical nature obtained by SAR satellite images may be used to estimate relevant dynamical parameters of coastal flows. The Synthetic Aperture Radar SAR and ASAR, its advanced version, are active radars which emit its energy in the centimetre frequencies range during a very short time period and it is able to receive the echoes. Due to the large orbital velocity of the satellite (7,5 km/s) approximately, its SAR antenna itself may be converted as a virtual antenna of a much larger size. The SAR instrument may be installed on a plane, on a helicopter or on board a satellite. The radar backscattering depends on the roughness of the small scale surface. When the surface is rougher (mostly due to capillary waves in the ocean surface) the intensity of the receiving signal is stronger due to Bragg resonant dispersion. In consequence a white zone is observed in the image when the surface is very rough. The dark areas are visible when there is a concentration of tensioactive products such as oil. Other phenomenon which has a strong significance in the use of the SAR images to monitor the sea surface is the Langmuir circulation. It is related to the surface particle concentration on the convergence zone between two vertical cells at sea. Algae, zoo-plankton, products of the marine life or waste from industries, spillage from tankers, hazardous waters, dregs at suspension, etc. accumulate on the convergence surface strips between cells. It is precisely there that they form the high concentration tensioactive wakes or strips which we can observe clearly in the SAR images. Due to this phenomenon, the SAR images may detect many different oceanic dynamic meso-scale processes, such as internal waves, marine surface currents, hydrographic fronts, vortices and bathymetric characteristics of the sea bottom at coastal areas. The meteorological phenomena as cyclones, atmospheric fronts, surface wind, atmospheric internal waves and rains are also detected by the SAR images due to their effect on the sea surface roughness. Oil spills and natural slicks may als be detected and processed with advanced computer techniques to reveal vortex dynamics and turbulence spectral characteristics of the complex eddy and current interaction in the ocean surface. In the framework of E.S.A. and E.U. project, more than 600 SAR images of the North-west Mediterranean Sea area taken between December 1996 and December 2006 were analyzed. Eddies can be detected under certain conditions and we analyzed statistically their appearance, size and position of vortices in the test area. It is shown that the maximum size of the eddies detected near the coast is limited by the Rossby deformation radius and that there is a decrease in size in the coastal waters in the direction of the Liguro-Provenzal current with the largest eddies occurring near the cape of Rosas in an anticyclonic rotation. The role of submarine canyons in the vortex generation is indicated by the asymmetry of their distribution with respect to the thalwegs.