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Scaling and diffusion of oil spills in the Ocean Surface

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The region of the Gulf of Lions at the northwestern Mediterranean Sea has been studied within a ten-year period from December 1996 until November 2006. More than 1000 synthetic aperture radar (SAR) images, which have been acquired by the Second European Remote Sensing Satellite (ERS 1/2) as well as from ENVISAT. We present statistical results of the structure of several features revealed by SAR such as oil spills and tensioactive slicks dynamic. We compare oil splils obtained from the projects Clean Seas,ENVA4/CT/0334, RC2003/005700, ESP2005/07551 and ESA/AO/IP2240. Since natural (caused by plankton, fish, etc.) slicks as well as man-made oil slicks dampen the small-scale surface waves, which are responsible for the radar backscattering from the ocean surface, both types of effects may be confused and give look/alike false oil spill detections.
The early SAR images were processed at a resolution of 1 pixel=200m and were provided by the RApid Information Dissemination System (RAIDS) SAR processing facility in West Freugh, UK. Recent ENVISAT images directly from ESA allow a higher resolution of 1 pixel = 26 m, improving the detected turbulent scaling range. The occurrence of marine oil pollution as well as several dynamic features near Barcelona (frames 8-10, 19, 20; 200 SAR images)is itself a random multi-scale process.
The use of different multifractal techniques, both using limits to the smallest and largest available scales, show that the scaling laws are very complex and depend strongly on intermittency of the assumed turbulent cascade, the shapes of the multifractal spectra functions are seen to deviate from an homogeneous multifractal and depend both on the initial conditions of the spill or slick, and on the transit time that the spill has been subjected to the local turbulence.