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RST analysis of thermal infrared satellite data for a continuous oil spill detection and monitoring

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Oil spills is one of the main sea pollution sources causing remarkable ecological impact on maritime and coastal environments. Oil spills can derive both from natural phenomena (hurricanes, landslides, earthquakes) and "human errors" (tankers collisions, shipwrecks, platform accidents), even if the main contribution to this kind of technological hazard comes from operational discharge from tankers (i.e. oil dumped during cleaning operations) representing 45% of total hydrocarbons marine pollution. Mainly for this reason, the developing of systems able to provide a high frequent sampling and observation of sea surface is fundamental.
Satellite remote sensing, thanks to global coverage and continuity of observations, might effectively contribute to mitigate oil spill environmental impact, provided that reliable and effective detection techniques are developed and that relevant information and products are timely delivered and made available.
In particular, satellite remote sensing by passive optical sensors on board meteorological satellites, thanks to their high temporal resolution (from a few hours to 15 minutes, depending on the characteristics of the platform/sensor), can give a significant opportunity in this field. Unfortunately, up to now, optical satellite data found a poor application in oil spill alert system mainly for the lack of data analysis techniques suitable for an automatic oil spill detection. The few methods up to now proposed are only able to manually and interactively localize the presence of an already known oil spill, mainly for "a posteriori" mapping purpose, often requiring the intervention of an expert operator. In particular, techniques based on Thermal Infrared (TIR) records exploit oil and water different thermal inertia in order to map spill sea pollution. Oil thermal inertia, in fact, is lower than sea water one, so that oil polluted areas usually show Brightness Temperature (BT) higher than sea water in TIR images collected in daytime while the opposite is true at night-time. Oil BT behaviour in night-time acquisitions makes more difficult oil detection in TIR satellite images collected because also clouds shows at this time BT lower than sea water, producing possible false identifications.
The Robust Satellite Techniques (RST) approach is a general strategy for multi-temporal satellite data analysis, applicable on whatever signal and independently from a specific satellite/sensor. This allowed us to apply it for an automatic oil spill detection and monitoring using single channel TIR diurnal data, as well as on a combination of two TIR channels (e.g. split window) to obtain a reliable oil spill detection also during night-time acquisitions. Results achieved using data acquired from both AVHRR (Advanced Very High Resolution Radiometer) and MODIS (Moderate Resolution Imaging Spectroradiometer) data, in different geographic areas and observational conditions, demonstrated the good performances of the proposed approach in the context of a h24 near real time oil spill disaster monitoring system. In this paper some of these results are shown and discussed, pointing out on the relevance that a system based on such an approach might have in reducing oil spill impact on marine ecosystem.