NEAR REAL TIME OIL SPILL DETECTION AND MONITORING USING SATELLITE OPTICAL DATA.

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ABSTRACT

The accidental release of oil into the oceans from tankers may have remarkable ecological impact on maritime and costal environments. However, the main contribution to oil pollution is not originated from ship accidents, but from systematic ship discharge (e.g. tank washing). In order to reduce the environmental impact of such kind of hazards, timely detection and continuously updated information are fundamental [1].
Satellite remote sensing can give a significant contribution in such a direction. Nowadays, SAR (Synthetic Aperture Radar) technology has been recognized as the most efficient for oil spill detection and description, thanks to the high spatial resolution and all-time/weather capability of the present operational sensors. Unfortunately, with a revisiting cycles which currently range from a few days up to 5 weeks (moving from polar to equatorial zones respectively), SAR systems cannot be profitably used for a timely detection and near real-time monitoring of these phenomena. Waiting for the complete deployment of COSMO-Skymed SAR constellation that will significantly improve time repetition of SAR systems, passive optical sensors on board meteorological satellites, with temporal resolution from few hours up to 15 minutes, could represent a suitable alternative for early detection and continuous monitoring of oil spills. Several techniques have been already proposed for oil spill mapping based on satellite data acquired in the optical band [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15]. Most of them are based on the analysis of satellite radiances in the Middle (MIR) and Thermal (TIR) Infrared spectral regions where the contrast between emittances of oil polluted and clean sea water is better appreciable [16] [17]. Due to its thermal inertia, in fact, lower than the sea water, oil polluted areas usually have higher brightness temperature in IR images collected in daytime, the opposite during the night [16]-[18]. Starting from these considerations, an innovative technique for near real time oil spill detection and monitoring has been proposed [19]. The technique is based on the more general RAT (Robust AVHRR Technique) approach [20] which exploits long-term multi-temporal satellite records in order to obtain a former characterization of the measured signal, in term of expected value and natural variability, providing a further identification of signal anomalies by an automatic, unsupervised change detection step. Results obtained in different geographic areas and observational conditions demonstrate excellent detection capabilities both in term of sensitivity (to the presence even of very thin/old oil films) and reliability (up to zero occurrence of false alarms). Exploiting its complete independence on the specific satellite platform, RAT approach (today named RST, Robust Satellite Technique, [21]) has been recently exported [22] to the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard Terra and Aqua EOS (Earth Observing System) satellites.
The main aim of this paper is to demonstrate the advantages coming from the application of RST approach to MODIS higher spatial resolution bands (250m in the VIS-NIR spectral range) in order to increase spatial accuracy of the description of oil spills detected by using IR MODIS (instead than or in combination with AVHRR) radiances.
Preliminary results achieved by coupling IR observations (each 3-6 hours from MODIS and AVHRR sensors) for timely oil spill detection, with the VIS-NIR ones (provided only during the day by MODIS) for accurate mapping, demonstrated the actual advantage of a monitoring systems based on the integration of different satellite sensors. Such an integration is particularly easy when a sensor-independent approach, like RST, is used for data analysis. Preliminary achievements obtained combining AVHRR and MODIS data will be shown in this paper, potential and limitations of the proposed

monitoring system - based on the integration of different satellite sensors, devoted to provide frequent (3-6 hours) and detailed (up to 250m) mapping of oil affected areas at the global scale - will be also discussed.

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