Oil Spill Detection: Feature Extraction

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1 Abstract

This paper addresses oil spill detection from SAR images. SAR observations led to a significant improvement in sea oil slick observation since they allow distinguishing oil slicks from a broad class of lookalikes. In particular, it focuses on the automatic features extraction of regions of interest (ROIs) in two classes, namely oil spills or look-alikes. ROIs have been manually selected from SAR images. From each ROIs, a set of features has been extracted. Three kind of features were indentified: Geometrical, Backscatter and Texture features. In addition, a fourth group related to the image was considerated: ancillary features. Then, these features have been used to populate a Dataset.

2 Introduction

It is worldwide recognized that a large amount of oil is yearly discharged into the marine environment due to vessel operations, land-based sources, etc. and that coastal environments suffer from petroleum pollutants. The topic is very relevant and it includes the different sources of sea oil spills, how they are affected by weathering and other physical processes, i.e. evaporation, dispersion, emulsification, and what are the effects of oil discharged into the sea on marine ecosystems. Oil sources can be classified into four categories: natural oil seeps, petroleum extraction, petroleum transportation, and petroleum consumption. The different tools to detect and monitor oil spills are vessels, airplanes, and satellites. Vessels, especially if equipped with specialised radars, can detect oil at sea but they can cover a very limited area. The vessel, however, remains necessary in case oil sampling is required. The main systems to monitor sea-based oil pollution are the use of airplanes and satellites equipped with Synthetic Aperture Radar (SAR). SAR is an active microwave sensor, which captures two dimensional images. The brightness of the captured image is a reflection of the properties of the target-surface. The possibility of detecting an oil spill in a SAR image relies on the fact that the oil film decreases the backscattering of the sea surface resulting in a dark formation that contrasts with the brightness of the surrounding spill-free sea. Spaceborne SAR sensors are extensively used for the detection of oil spills in the marine environment, as they are independent

from sun light, they are not affected by cloudiness, they cover large areas and are more cost-effective than air patrolling. Usually, for oil spill detection, large swath widths are chosen at the expense of lower resolution. This approach is adopted because it is in our interest to cover as much area as possible even if very small oil spills can not be detected.

In the following sections we are going to give a brief overview about the features extracted then, how we worked about features extraction from setting workspace to dataset's creation.

2.1 SAR imaging of oil spills

Oil films decrease the backscattering of the sea surface resulting in a dark formation on SAR images.

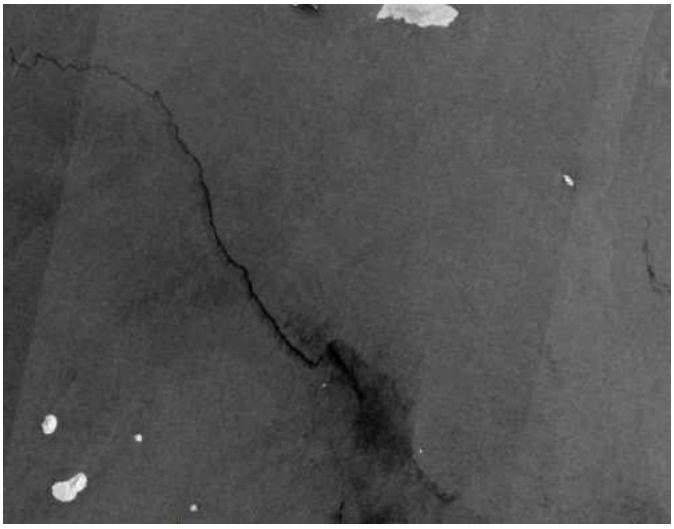

Figure 1: Oil dark patch in the sea

Although SAR-based solutions are really powerful for oil spill detection from space, mainly due to their all-weather and all-day detection capabilities, they have well known limitations. For example, the difficulty in detecting oil spills for high wind speeds (¿6 m/s), which exposes to the possibility of missing true oil spills, or, when the wind speed is low (¡1.5 m/s), to that of generating too many false alarms, i.e. alerts indicating supposed oil spills which could reveal to be look-alikes, after in situ verification. Since the latter is very expensive, there is a need for keeping the number of false alarms as small as possible, while trying not to miss any true oil spill case. Thus, there is a need for alternative or complementary solutions. This suggests the possibility of exploiting optical data, which, up to now, have been little used for oil spill detection applications

3 Conclusion

"I always thought something was fundamentally wrong with the universe" [1]

References

[1] D. Adams. *The Hitchhiker's Guide to the Galaxy.* San Val, 1995.