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TIME SERIES MONITORING OF THE 2020 MAURITIUS OIL SPILL WITH SYNTHETIC APERTURE RADAR SATELLITE IMAGERY

Abstract

A tanker ran aground on a coral reef South-East of Mauritius in the Indian ocean on July 25th, 2020. The vessel was carrying 4000 tons of fuel oil of which an estimated 1000 tons leaked out into the lagoon. The coral reef near the coast of Mauritius is known to be a hotspot of biodiversity and unique wildlife with reefs, lagoons, seagrass and mangroves. This human-made disaster heavily impacted the natural environment and large scale cleanup efforts are still ongoing 6 months later.

To quantitatively evaluate the extent of the oil spill, we acquired both satellite images and local data including weather data and ground truth images of the oil spill and cleanup activities. The satellite images are high resolution Synthetic Aperture Radar (SAR) from ICEYE that are uniquely suited to detect the oil layer on the ocean and do not suffer from the cloud cover or illumination condition limitations of optical satellite images

We implemented and compared two analysis approaches: unsupervised and supervised learning. Unsupervised learning is based on heuristic feature selection using Grey Level Co-occurrence Matrix and Haralick textures which can differentiate between the specific oil texture and the surrounding ocean and land textures. The supervised learning approach is a semantic segmentation model with a U-Net architecture. Both approaches are applied to the SAR images which are obtained on different days in August, during the evolution of the oil spill. This output is then compared with local data to validate the models.

Each approach shows high accuracy for the estimation of the area covered by oil. The robustness of the supervised learning model is confirmed in a wide range of wind and wave conditions and over various SAR data acquisition modes such as resolution, look angle, and Signal to Noise Ratio. We show the evolution of the oil spill from the vessel to the seashore and along the coast of the South-East Mauritius island.

In conclusion, this paper presents a unique combination of high resolution SAR data time series analysis coupled with ground data and applied to a significant oil spill event. Our aim is to receive feedback from the community on the methods and results presented in this paper. We strive to be able to use these methods for timely response to the next oil spill to help emergency management and cleanup efforts protect biodiversity.