OIL SPILL MONITORING USING X-BAND SAR DATA AND NEURAL NETWORKS

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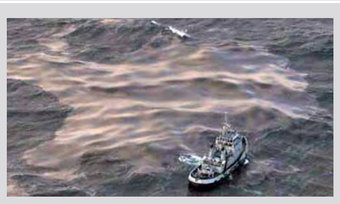
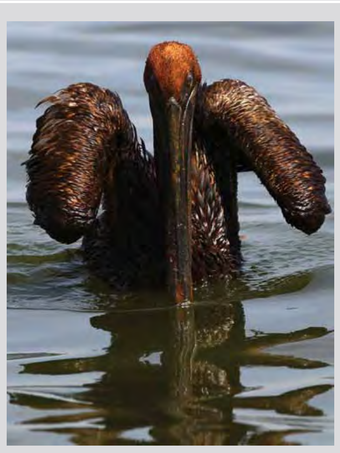
INTRODUCTION

An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially marine areas, due to human activity, and is a form of pollution.
An effective oil spill surveillance using active radar techniques is based on a correct discrimination between oil spills and look-alikes (natural phenomena that may cause a reduction of the radar backscattering and hence may appear as dark areas).

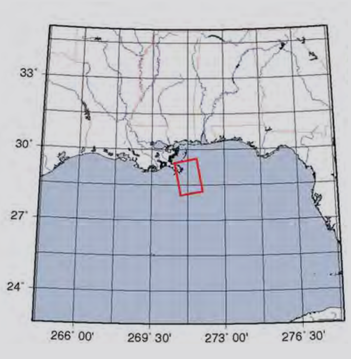


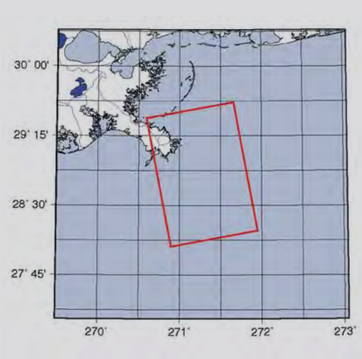



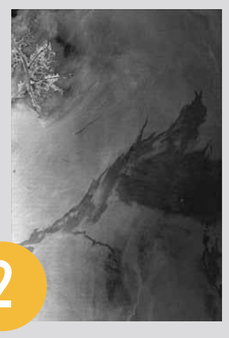
The increased amount of Synthetic Aperture Radar (SAR) images acquired over the ocean represents an extraordinary potential for improving oil spill detection activities. To this purpose, the use of artificial Neural Networks (NN) has already been demonstrated to be profitable
Neural Networks are widely used in inversion and classification problems, as they do not require the knowledge of the modeling process, therefore being appropriate for noisy data classification problems.

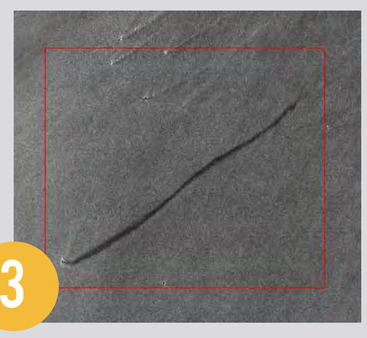
TECHNIQUE

After a first preprocessing step 1, 2 the user has to select a region of interest inside the image containing an oil spill candidate 3. Setting a threshold on the backscattering coefficient, the dark spot is highlighted and automatically segmented 4.

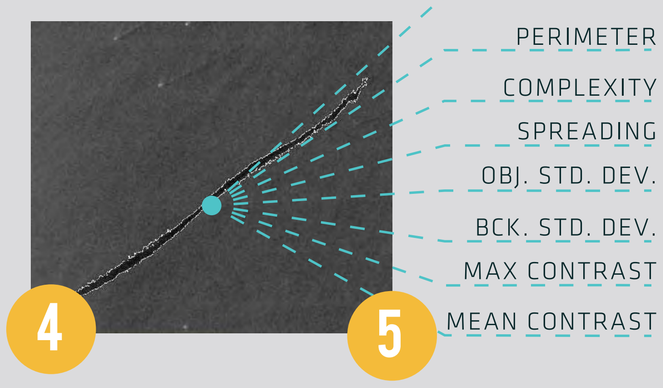


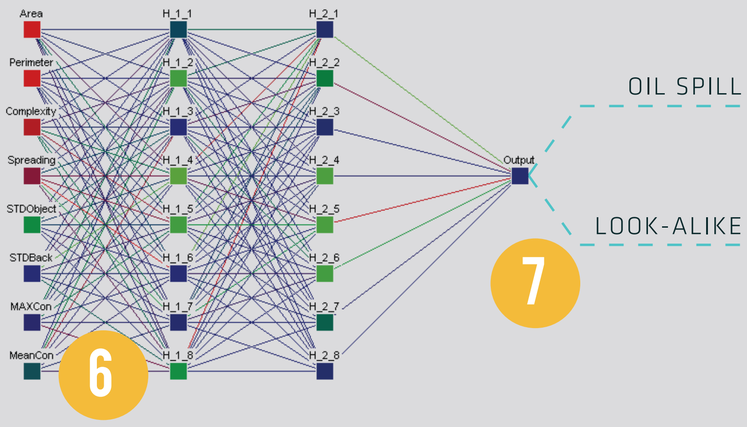






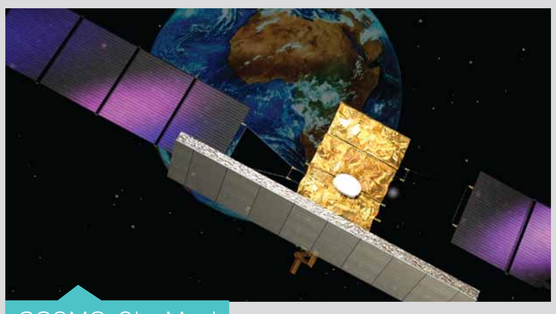
An automatic algorithm extracts a set of features 5, divided into Geometric (Area, Perimeter, Complexity and Spreading factor) and Radiometric (Object Standard Deviation, Background Standard Deviation, Maximun and Mean Constrast) ones.





The vector of features is passed as input to an Multi Layer Perceptron Neural Network 6, trained using a Backpropagation Algorithm. The Network Output represents the probability of the object being an oil spill 7.

DATASETS



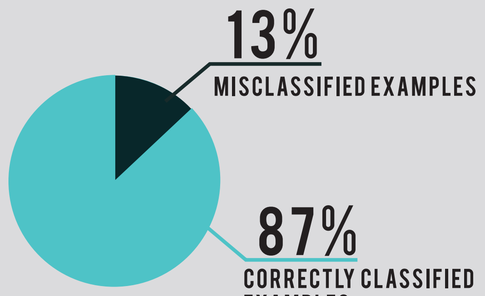
COSMO-SkyMed

60 IMAGES
WIDEREGION | 15 M | 100X100 KM
HUGEREGION | 45 M | 200X200 KM
188 EXAMPLES 46 VALIDATION

TerraSAR-X

47 IMAGES
STRIPMAP | 3,3 M | 30X50 KM
SCANSAR | 18,5 M | 100X150 KM
118 EXAMPLES 50 VALIDATION

RESULTS



CONCLUSIONS

The potentialities of X-band SAR data and NN algorithms for oil spill detection have been presented. The NNs have been trained with examples of both certified oil spills and well known look-alikes. Validation sets were employed to check the robustness of the classification algorithm. The networks were able to correctly recognise around 85% of validation examples. Additional informations about the border gradient of the dark object and the wind fields estimation should be taken into account in the future work in order to improve the overall performances.

ACKNOWLEDGEMENT

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