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An automatic oil spill detection and early warning system in the Southeastern Mediterranean Sea

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Oil pollution is one of the most serious marine contamination; deliberate illegal discharges and tanker accidents pose threats to marine wildlife. The oil pollution “hotspots” are usually related to the regions with high marine traffic. One example would be the Eastern Mediterranean Sea as it offers the shortest shipping route from Asia to Europe and is regarded as an oil transit center. In addition, the discovery of oil and gas in the Levantine basin has led to an increasing number of oil and gas exploration and exploitation activities. However, there is no automated service exists for the region that provides early warning for oil spills along with projected forecast. This contributed to late reactions to an oil spill incident on February 2021, which caused a large ecological impact at the coast of Israel. This study aims to provide an automatic oil slick detection system and its integration to an early warning system for oil drift simulation in the Southeastern Mediterranean Sea. This can help with the estimation of oil contaminating region and the planning of oil combating response. The system includes both oil slick detection and oil drift simulation.

With the advantages of wide coverage and all-weather observations, Synthetic Aperture Radar (SAR) is applied for detecting oil spills. Sentinel-1 SAR Level-1 Ground Range Detected (GRD) products are downloaded from Copernicus Open Access Hub. The SAR products are then preprocessed with corrections including border noise removal, thermal noise removal, calibration, ellipsoid correction and conversion to decibels (dB) in a series of programs with the use of the Sentinel Application Platform (SNAP) Python API. Afterwards, a mosaic of showing the latest results from different preprocessed scenes in the study area is generated. A trained deep learning based You Only Look Once version 4 (YOLOv4) object detector is then used to detect oil spills on the mosaic results; the detector was trained on a total of 9768 manually inspected oil objects collect from 5930 Sentinel-1 images from 2015 to 2018. The extents of the detected oil slicks are defined by bounding boxes. Thus, the segmentation method is then applied to obtain the exact area covered by oil. The output oil slick masks are subsequently used for the simulations of oil slick trajectory by the MEDSLIK model, which uses daily forecasts of wind, circulation and wave to compute the propagation of the slick. An online interface is provided to perform simulations and visualize the results. In summary, the oil slick detection system notifies the decision makers of the existence of oil spills, and at the same time passes the generated oil slick masks to the early

warning system for simulating their trajectories in order to help with the planning of response. A prototype of the integration of automatic oil spill detection and early warning system will be shown in the presentation.