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Monitoring Oil Spill Hotspots, Contamination Probability Modeling and Assessment of Coastal Impacts in the Caspian Sea using Sentinel-1, Landsat-8, Radarsat, Envisat and Ers Satellite Sensors

Emil Bayramov
Technical University of Berlin, Germany

Oil and gas development in the Caspian region is associated with pollution risks. This research aimed to better understand those risks by using satellite data to characterize the spatial and temporal distribution of anthropogenic and naturally occurring oil slicks in the Azerbaijani portion of the Caspian Sea performing stochastic modelling of the risk that the oil spills pose to water quality and shoreline ecosystems and validating model predictions using satellite images. Over 411 satellite images acquired by SENTINEL-1, LANDSAT-8, RADARSAT, ENVISAT and ERS sensors between 1996 and 2017 were used for the semi-automatic detection and discrimination of oil spills and natural seepage slicks using object-based classification and visual interpretation. Anthropogenic oil pollution, natural seepage slicks and 'hotspots' or areas frequently covered by oil slicks were identified. Anthropogenic hotspots were observed at Oil Rocks Settlement, Chilov and Pirallahi Islands, three of the area's oldest oil platforms, with oil spill rates of up to 1264 m3 per day. The contamination probability of more than 50% was primarily located in the shoreline range of 464–508 km with the existence of high rank environmental and social sensitivities. The highest maximum accumulated emulsion mass (tonnes) was also observed in the shoreline range of 464–508 km with high contamination probability > 50% and with the existence of high rank environmental and social sensitivities. This research demonstrates how remote sensing data can be used to identify oil pollution hotspots and to quantitatively assess the risk to shoreline areas with high environmental value.

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