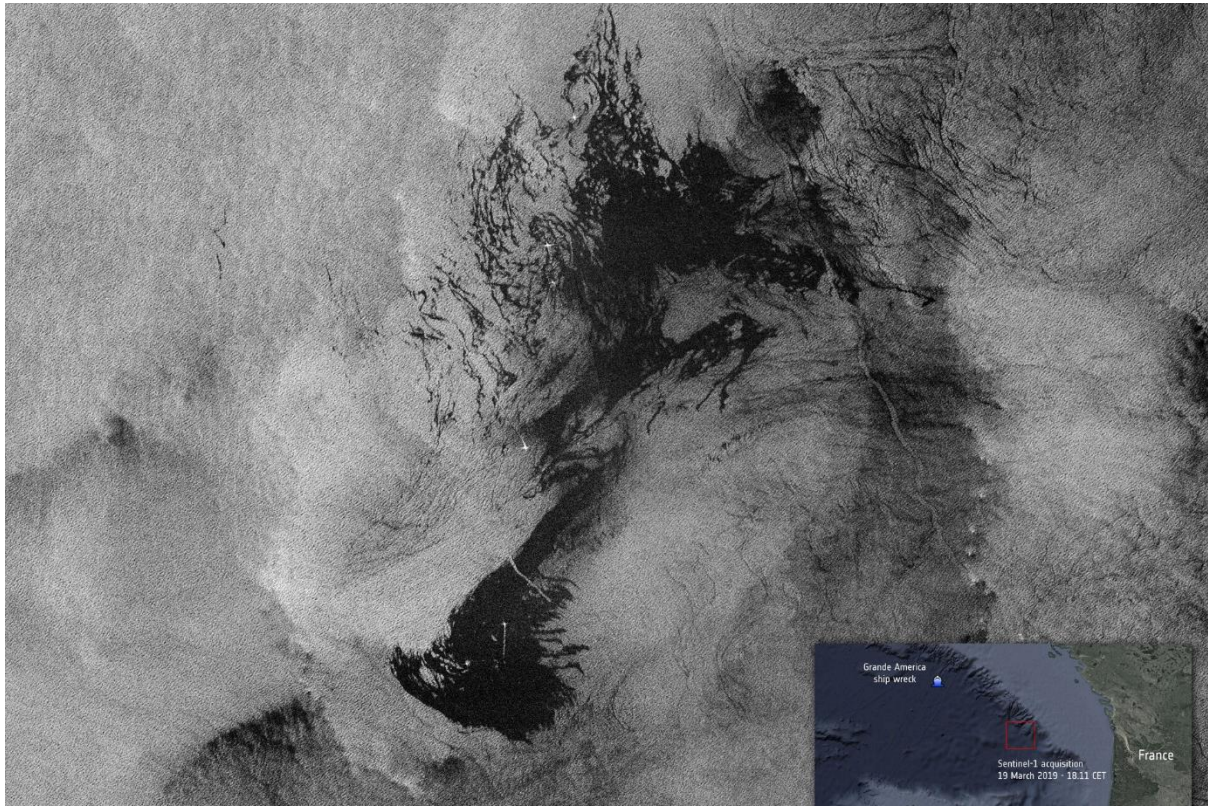## Oil Spill Detection

Copernicus Sentinel-1 acquired this radar image of the oil slick, the large, dark patch visible in the centre of the image, stretching about 50 km in Atlantic, about 300 km off the French coast on 12 March 2019 (Source: ESA)

Product Category

☐ Land Use   ☐ Natural Disaster   ☐ Coast Management   ☐ Earth's Surface Motion

☐ Land Cover   ☐ Climate Change   ■ Marine

Financial Domain(s)

☐ **Investment management**   ■ **Risk analysis**   ☐ **Insurance management**   ☐ **Green finance**

User requirements

UN39: Need to assess the potential impact of business activities or investments on ecosystems and biodiversity

Description

Satellite-based oil spill detection monitoring allows for the surveillance of significantly large areas while being much more cost-effective compared to using aircraft, drones, vessels, buoys, fluorescence sensors or platform radars for monitoring purposes. SAR imagery is preferred for oil spill detection and size determination due to its ability to capture images even in challenging conditions such as clouds, darkness, smoke, or other obstructions. This guarantees extensive coverage possibilities for any location worldwide. SAR images can detect oil spills on the water's surface as dark patches. Oil has a dampening effect on the water's surface, making it look smoother and less reflective in SAR images, creating a noticeable contrast with the surrounding water. In addition, SAR images can be used to track the expansion and movement of oil spills over time. Also, following an oil spill incident, SAR images serve for post-spill assessment, enabling the evaluation of the impacted area's extent and facilitating continuous monitoring of the recovery process.

Spatial Coverage Target

Seas and Oceans

Data Throughput

Rapid tasking   ■ High   ☐ Low

Data availability   ■ High   □ Low

Product specifications	
Main processing steps	The main processing steps for using Synthetic Aperture Radar (SAR) for oil spill detection include data acquisition from SAR satellites and pre-processing steps to improve the visibility of oil spills such as De-bursting, Radiometric calibration, multi-looking, Speckle filtering, Edge enhancement, Texture analysis, and shape analysis techniques. Then, oil spills on the water's surface can be observed as dark patches. Using AIS data to identify the locations of marine accidents can be useful information for oil spill detection. Moreover, emerging technologies like machine learning can be employed, with the limitation of requiring substantial amounts of data for training. However, they can prove beneficial in distinguishing oil spills from similar-looking substances or features on the water's surface.
Input data sources	Optical: N.A Radar: Sentinel-1, VHR images from different sources like ICEYE, Capella space, Umbra, and TerraSAR-X Supporting data: AIS
Accessibility	Sentinel-1: freely and publicly available from ESA. SAR VHR imagery: commercially available on demand from EO service providers.
Spatial resolution	Sentinel-1: 20 m SAR VHR: ≤ 3 m
Frequency (Temporal resolution)	Sentinel-1: 6 days SAR VHR: Daily
Latency	< 1 Day
Geographical scale coverage	Globally
Delivery/ output format	Data type: Raster File format: GeoTIFF
Accuracies	Thematic accuracy: 80-90% Spatial accuracy: 1.5-2 pixels of input data
Constraints and limitations	■ Radar detection of oil is difficult in low or high wind areas. Due to low difference between backscattering between oil and surrounding water in low wind conditions, and the strong backscatter of water's surface in high wind conditions overwhelming the weak signals from the oil spill. ■ Thin oil films may not produce strong enough signals to be easily distinguishable from the surrounding water. ■ SAR may have limitations in detecting small or localized oil spills, especially when the slick size is below the resolution capability of the radar
User's level of knowledge and skills to extract information and perform further analysis on the EO products.	Skills: Essential Knowledge: Ample
Similar Products	CleanSeaNet Service from European Maritime Safety Agency (EMSA) (Commercial) OIL SPILL DETECTION Service from Kongsberg Satellite Services (KSAT) (Commercial) OIL SPILL DETECTION Service from ICEYE (Commercial) Earth and Sea Observation System from Catapult (Commercial)