

OIL SPILL MONITORING USING ICEYE

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ICEYE SATELLITE CONSTELLATION OVERVIEW

ICEYE operates a constellation of small satellites equipped with Synthetic Aperture Radar (SAR). These satellites offer versatile imaging capabilities for applications like oil spill monitoring.

- **Orbit:** Each ICEYE satellite is in a sun-synchronous orbit with a ground track repeat cycle ranging from 1 to 22 days, depending on the satellite. There are 15 imaging orbits per day.
- **Unique Orbit Timing:** Unlike conventional sun-synchronous orbits, IceYE satellites are phased to observe a location at different times of the day, allowing for more flexible monitoring.
- **Band :** ICEYE's radar use X-band part of the spectrum.
- **Resolution :** The radars resolution depends on the mode used. The ground resolution can go up to 50cm in dwell mode, while the scene size can go up to 840km*150km in scan mode.

CHALLENGES :

- Difficult to detect small oil spills (they represent 80% of the total amount globally)
- determine the extent of the oil spill and be able to track its movement in near real-time
- difficult to detect oil spills caused by drilling operations far from the coast
- differentiate the natural surfactant oil film from biological processes and the mineral oil

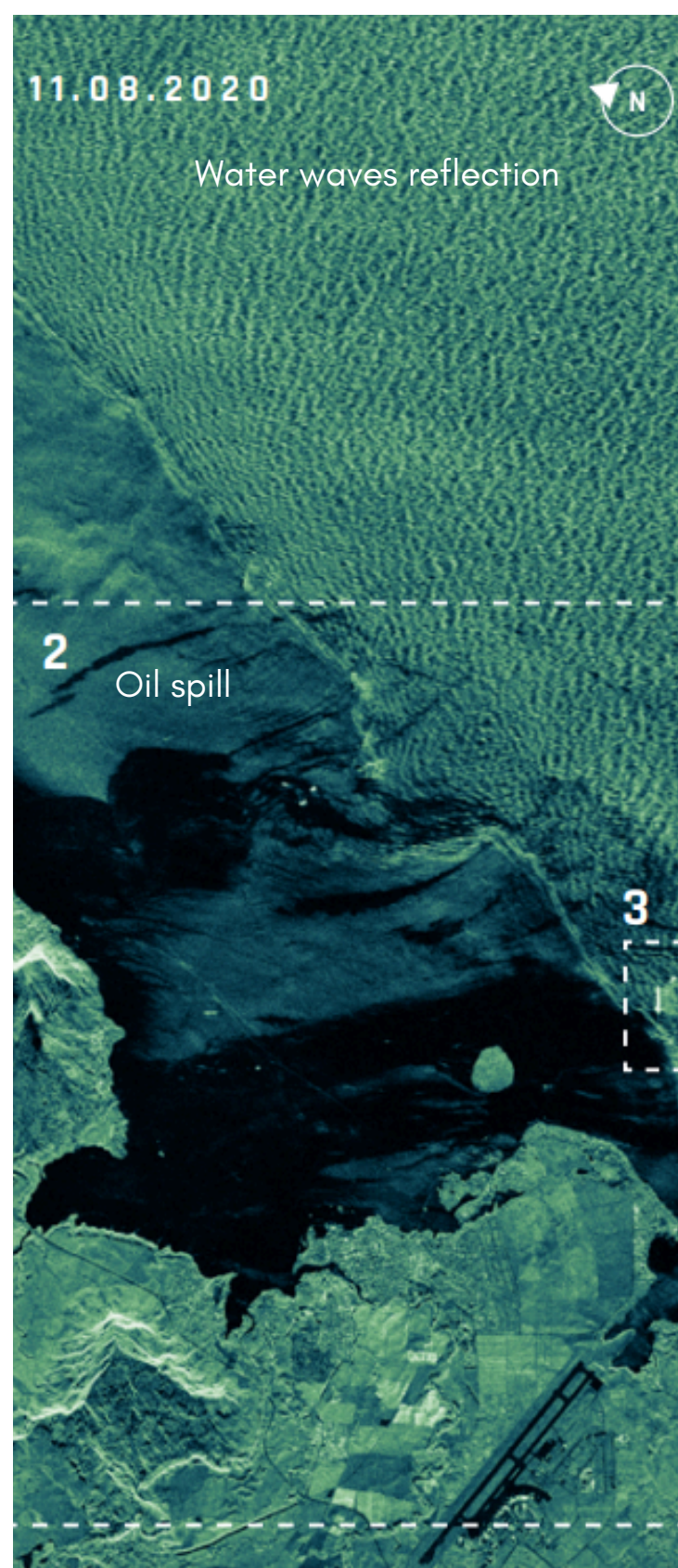
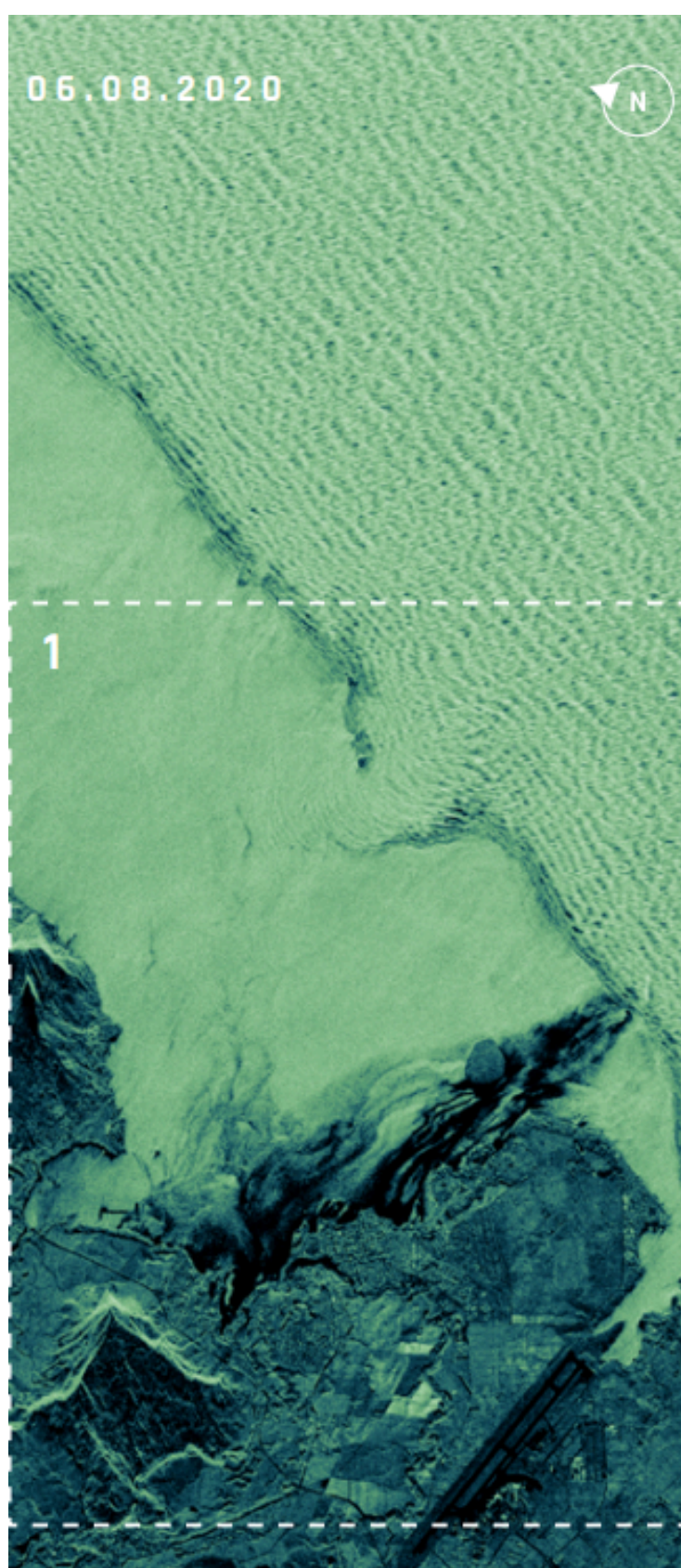
HOW DOES THE SENSOR FIT THEM

Operating Band:

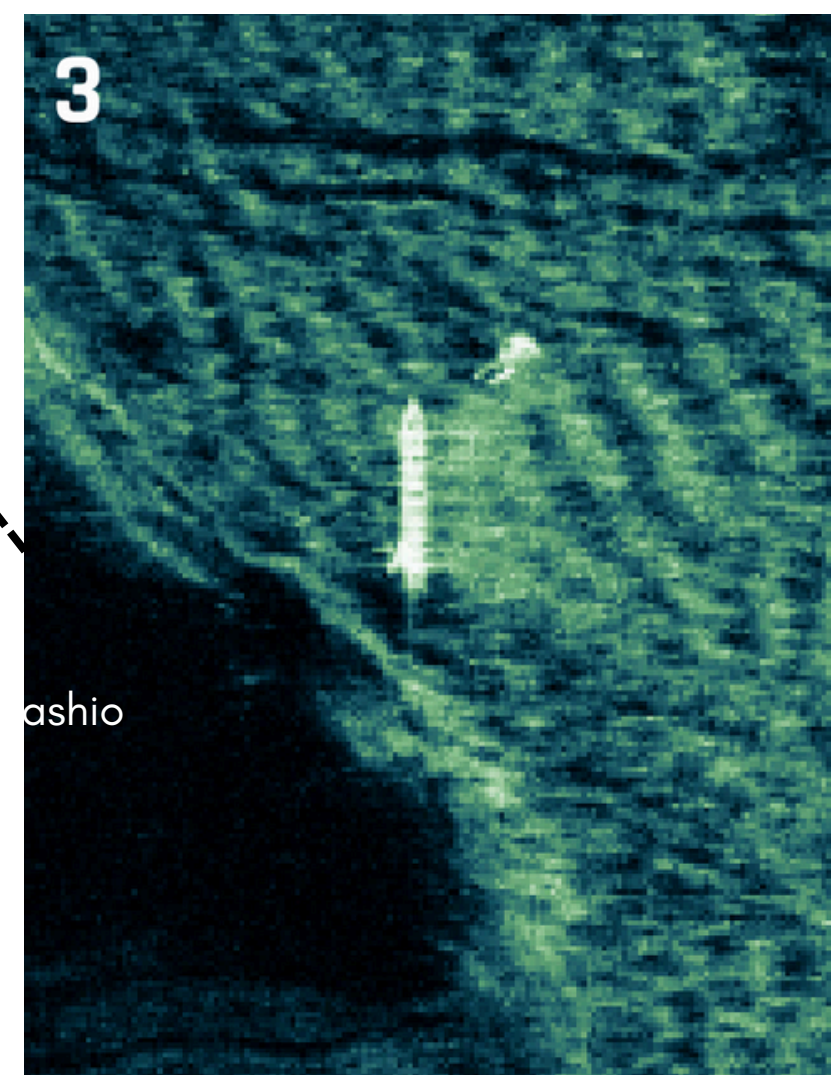
- X-band radars are more sensitive and can detect smaller particles compared to radar bands at smaller wavelength (thus higher frequencies): Once an oil spill is detected, they can zoom in at even higher fidelity and collect images with a resolution of up to 25 cm
- Damping ratio - a measure of the difference in spectral energy density of the ocean surface waves between oil-free and oil-covered surfaces - increases at higher frequencies, so the contrast between oil spills and clean sea is reported to be highest in X-band.
- Damping behaviors of plant oil (biogenic) and mineral oil slicks differ the most in band X : the mineral oil slicks generally cause stronger damping on backscattering coefficients at X-band

Large SAR satellite constellation:

- Sub-daily information delivery on any point on the globe
- collect imagery of areas up to 10'000 square kilometer in size
- penetrate clouds, rain, fog, and smoke allows data acquisition day and night



Picture : X-ray backscattering images : oil spill detection on Mauritius's costs



EXAMPLES

- 24/7 monitoring costs of a country
- Shows a week-long period progression (direction) of an oil spill in Mauritius (2020) from 3 km² (1) to 10 times extent (2). Night detection shows the importance of SAR and the responsible vessel MV Wakashio could be identified (3).

Sources:

- [iceye.com](https://www.iceye.com)
- https://www.iceye.com/hubfs/Downloadables/ICEYE_Application_Study_Oil_Spill_Monitoring_Mauritius_112022.pdf?hsLang=en
- <https://earth.esa.int/eogateway/missions/iceye>