

Listen to the ocean

Oil spill detection using radar satellite imagery

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and many colleagues**

Using Earth Observation for
Water Quality Monitoring
Workshop

13-14 October 2020

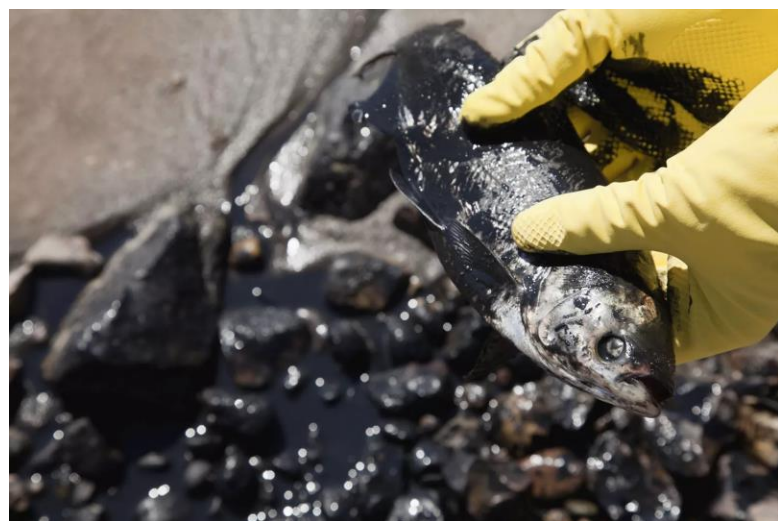


Impact of oil spills:

- Immediate and long-term environmental damage
- Beaches, marshes and wetlands become unsuitable for wildlife
- Damaging effects on fragile underwater ecosystems
- Damaging effect on birds, marine mammals and fish



<https://www.motherjones.com/environment/2019/04/deepwater-horizon-bp-oil-spill/>

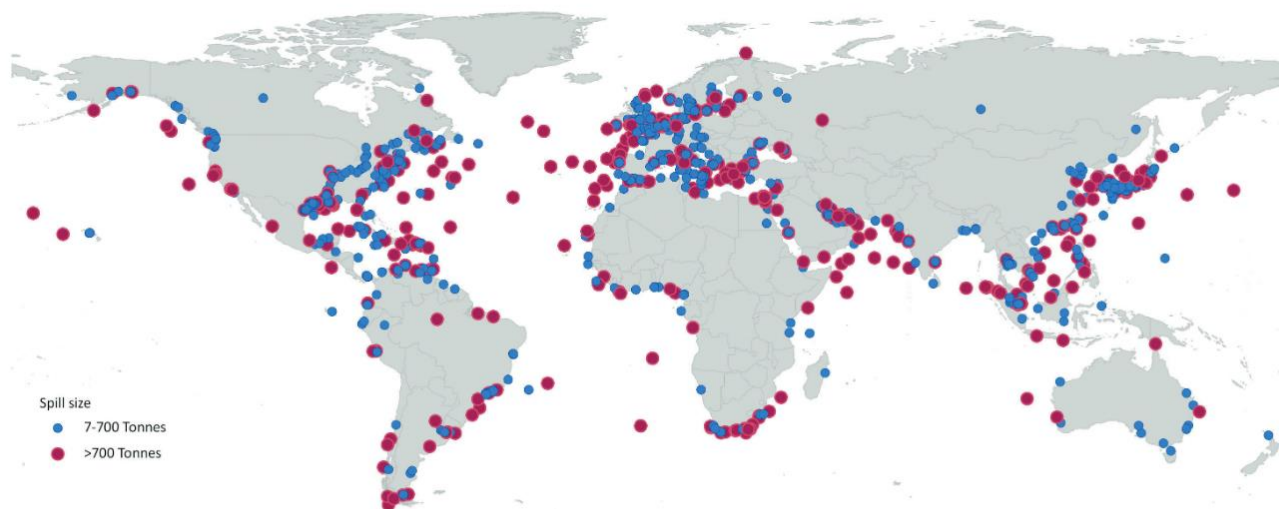


<https://www.thoughtco.com/environmental-consequences-of-oil-spills-1204088>

- Sea based sources:
 - discharge from ships and oil platforms
 - release of oily ballast water and tank washing residues
 - transportation accidents
- Natural oil seeps
- Runoff from land sources

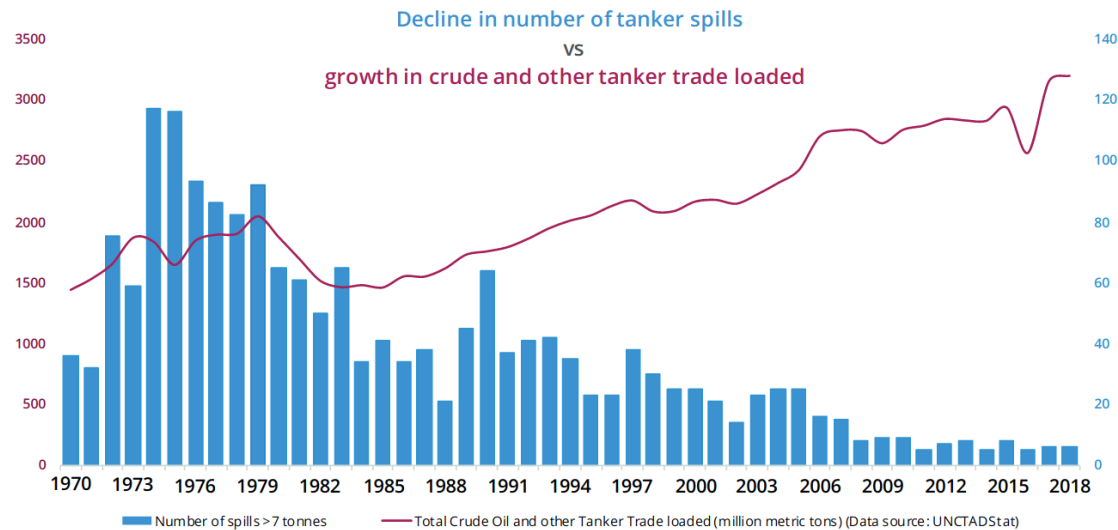
A map of oil spill accidents (spills >7 tonnes) from 1970–2019

([ITOPF Oil Tanker Spill Statistics 2019](#))

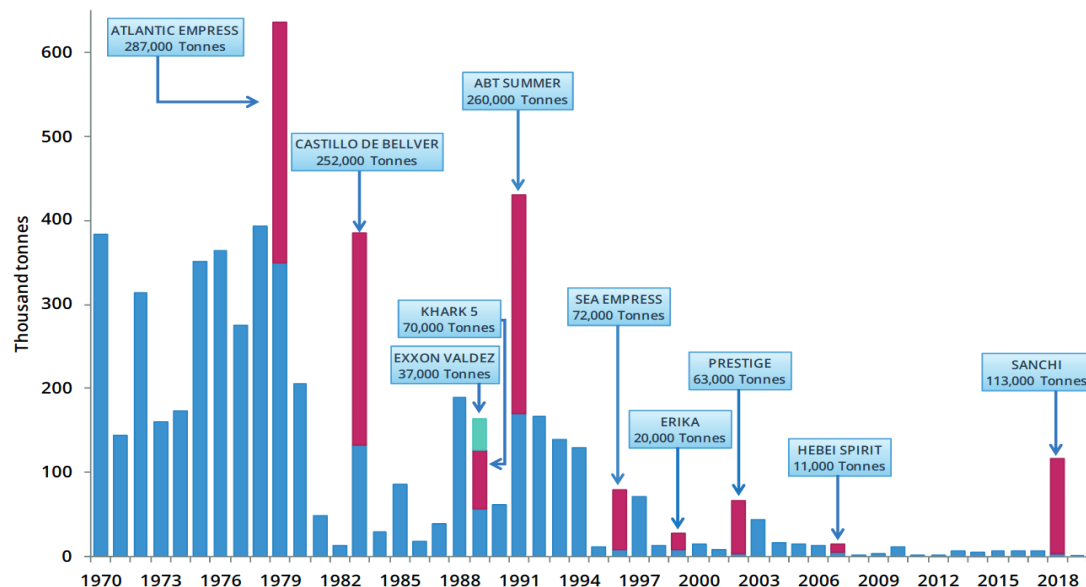


**This map represents nearly 90% of the spills (>7 tonnes) recorded in the ITOPF database. Records without specific location information have been omitted. Please note that approximate geographic coordinates have been used to map some records.*

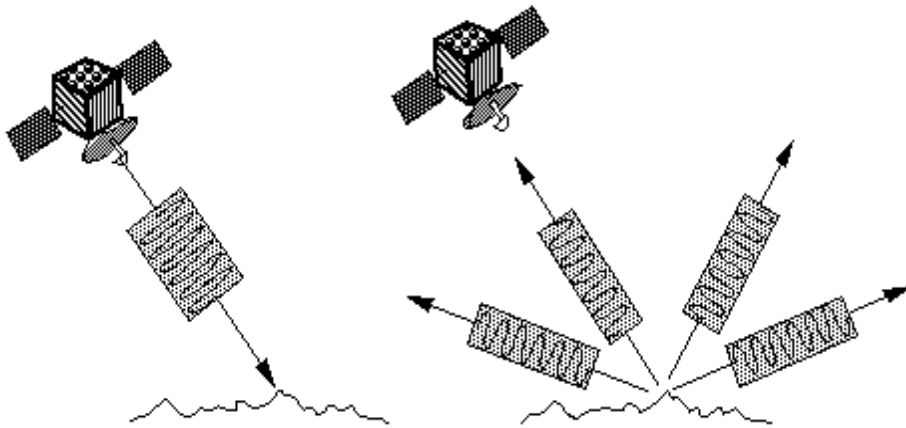
Oil Spills and Marine Pollution



Tanker spills vs
seaborne oil trade
([ITOPF Oil Tanker Spill Statistics 2019](#))



Quantities of oil spill
([ITOPF Oil Tanker Spill Statistics 2019](#))

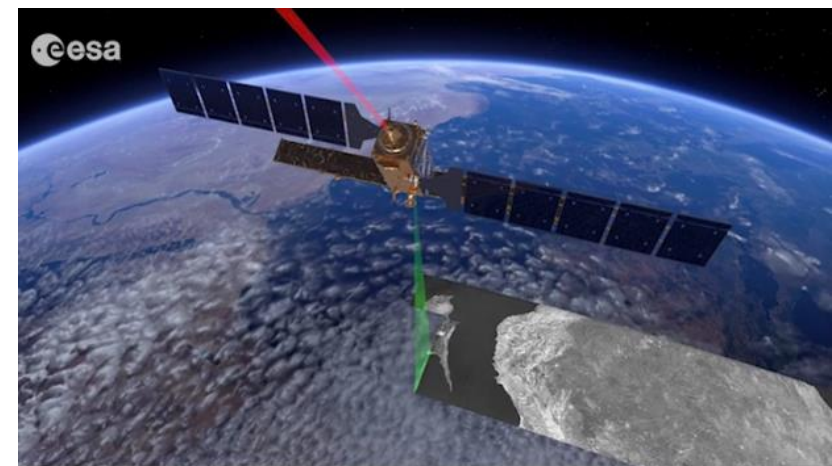


Synthetic Aperture Radar

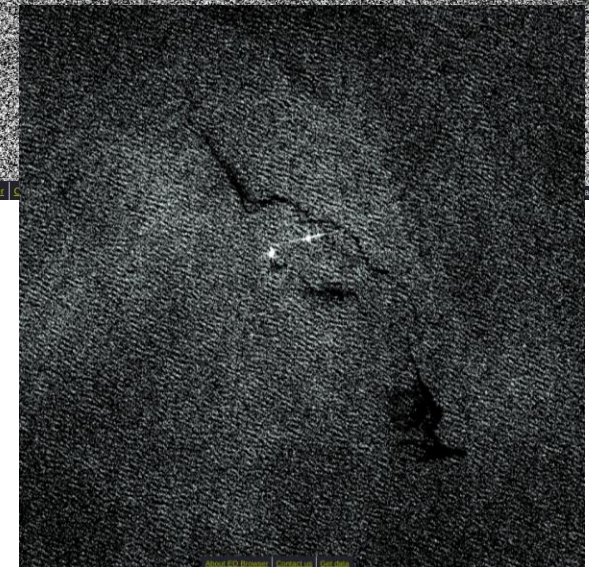
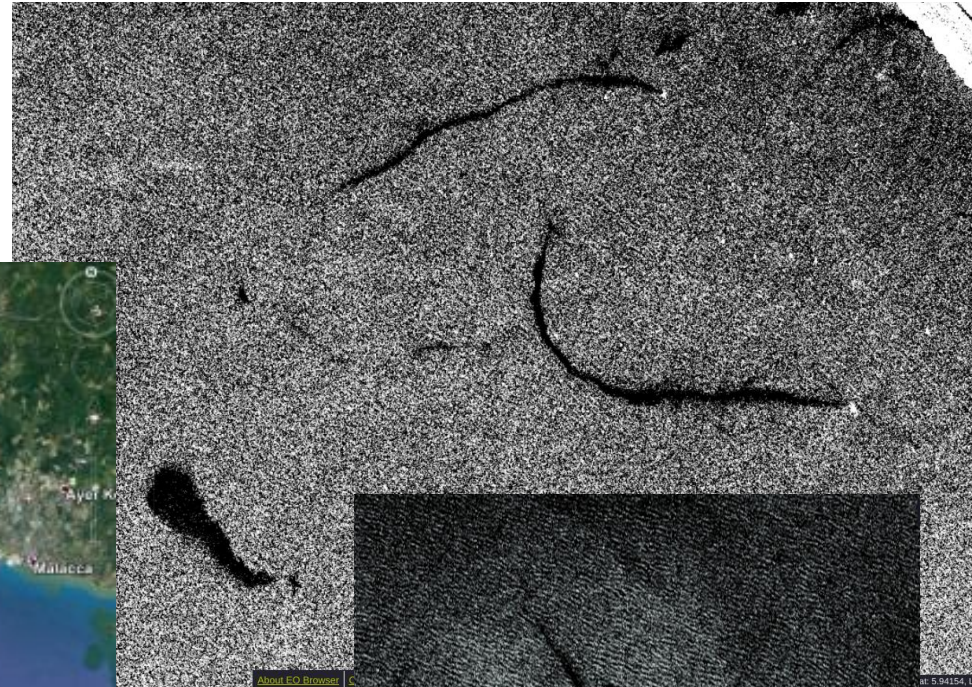
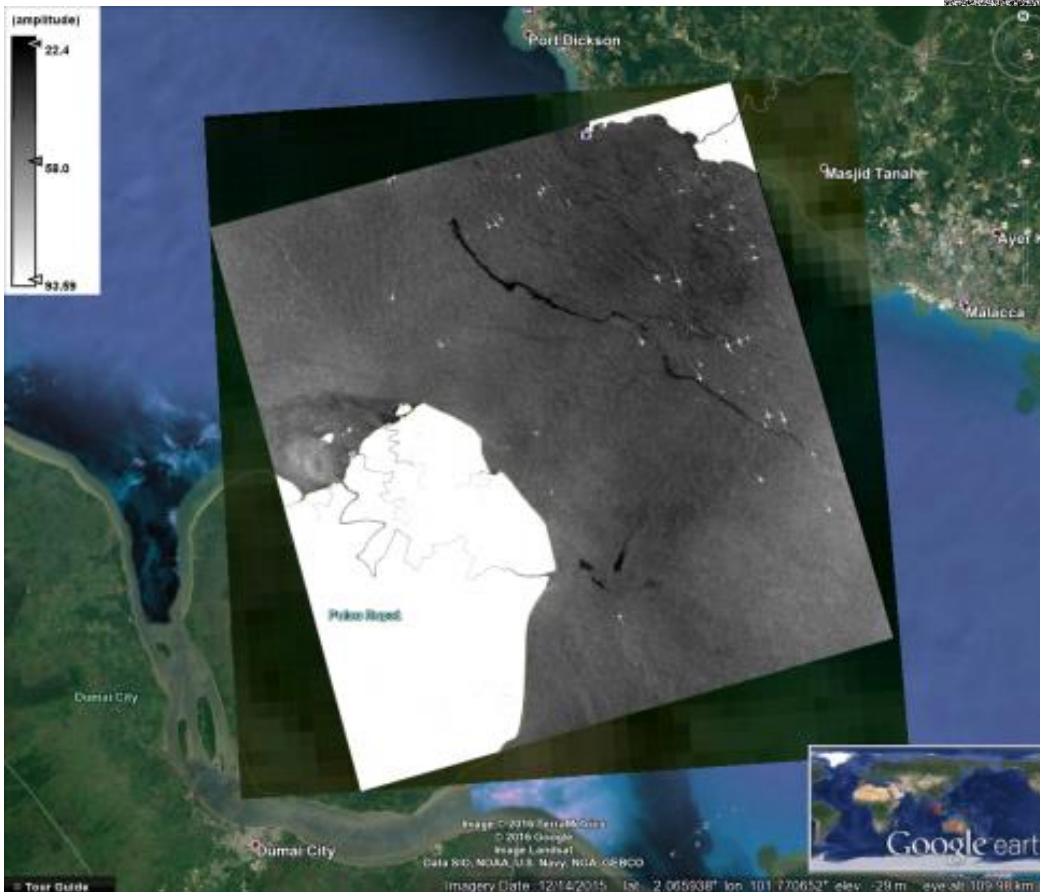
- an **active sensor**, can be used at day and night
- uses **microwaves** that penetrate through clouds, fog and precipitation

Sentinel-1 SAR mission, ESA

- Sentinel-1A and Sentinel-1B sensors
12-day revisit frequency
- C-band, HH + HV and VV + VH polarisations
- Resolution 5x5m, swath: < 400km



Examples of oil slicks in Sentinel-1 SAR images



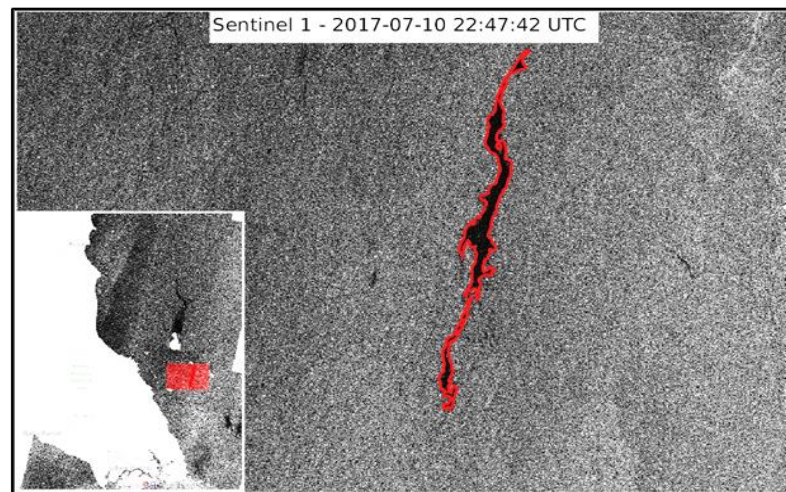
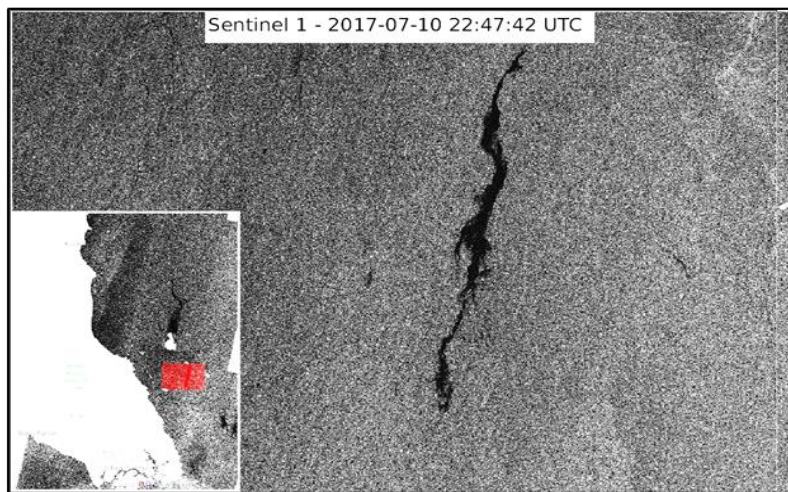
System Overview



Satellite oil detection

- Automated Satellite data delivery
- Oil detection algorithms

» *Spill location and extent*

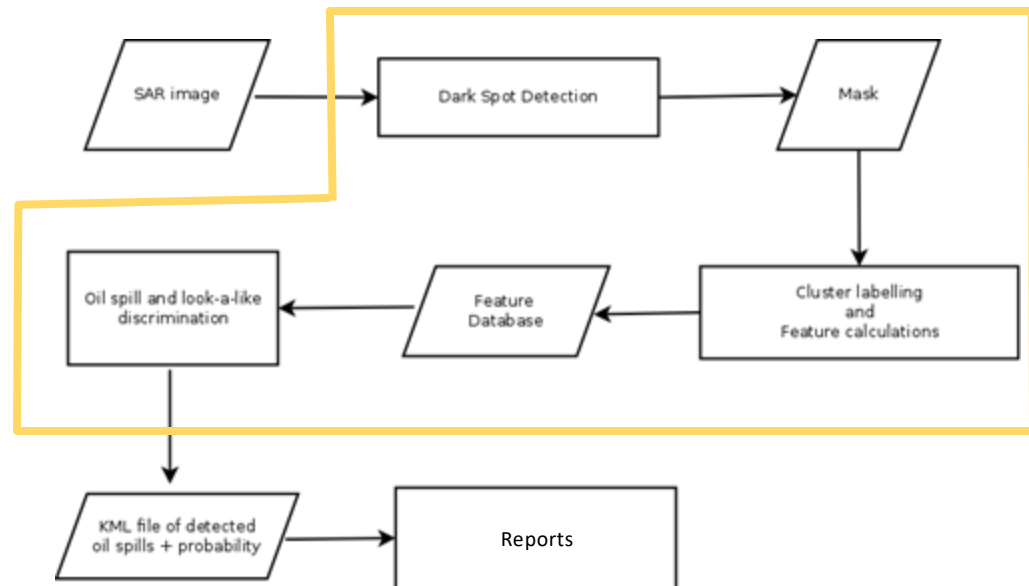


- Oil on surface dampens waves
- Causes dark patches to appear in SAR data
- Machine-learning based approach used to delineate potential oil slicks from 'lookalikes'

Oil Spill Detection Process

Oil spill detection:

- Multi-stage process.
- Automatic dark spot detection
- Machine learning method for discrimination into oil spills and look-alikes
- Training dataset includes:
more than 220 examples of oil slicks and 550 examples of look-alikes



Application Example:

Marine pollution in Mbao, Senegal in mid July 2020

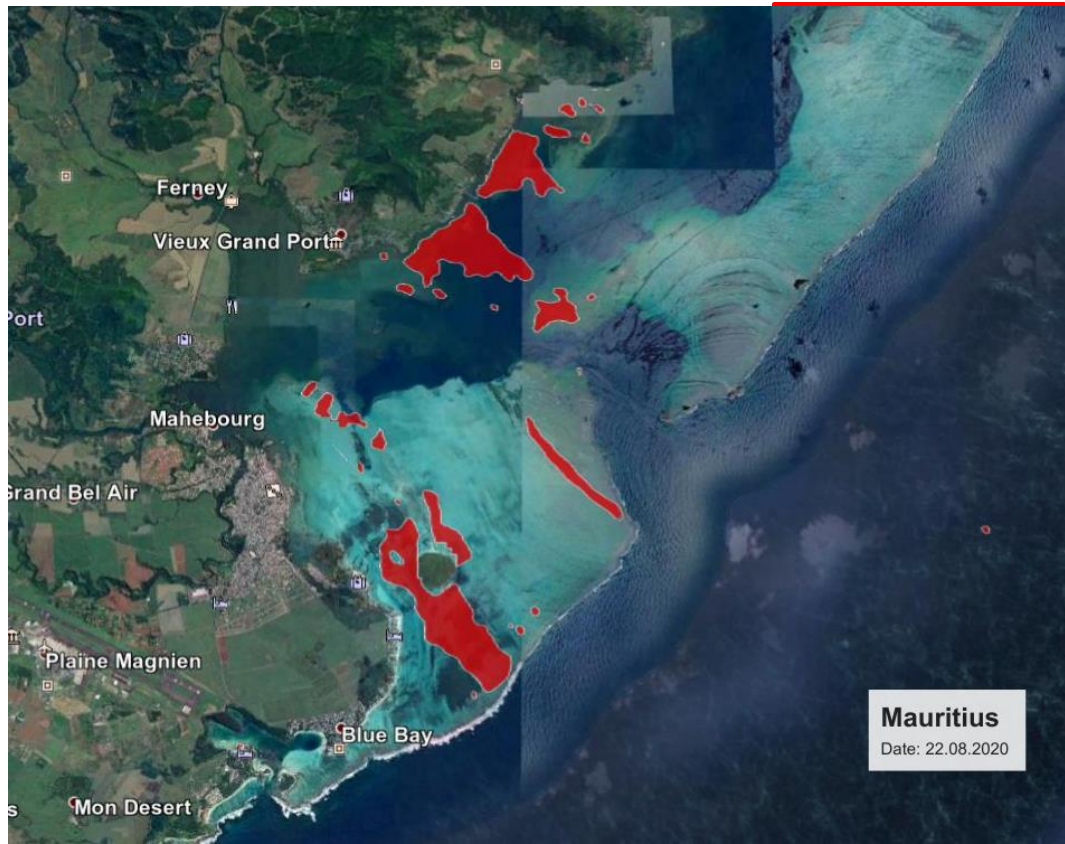
Reported by Mbao fishermen who noticed thick oil slicks scattered in the area from Big Mbao to Little Mbao

Location: The African Refining Company (SAR)



Application Example:

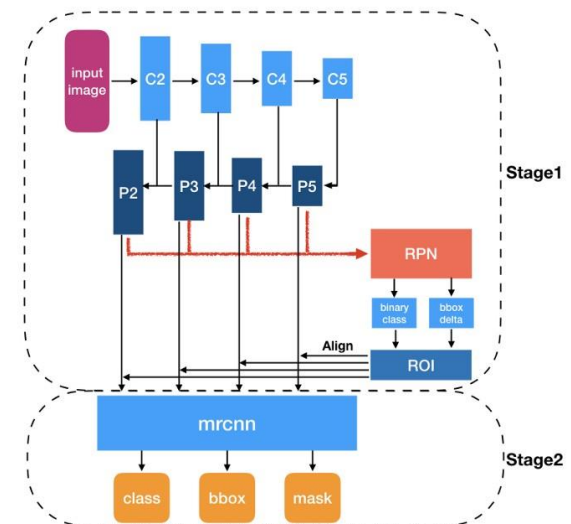
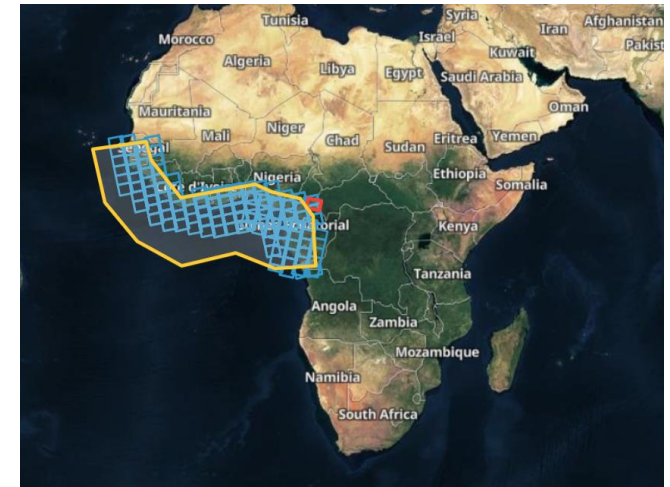
Mauritius Oil Spill Accident, 25 July 2020



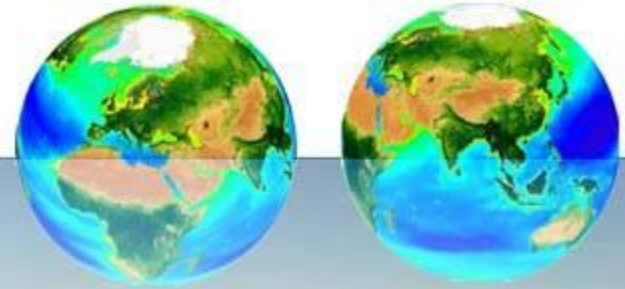
The **MV Wakashio** hit a coral reef, Pointe d'Esny, on **25 July** while carrying 4,000 tones of fuel oil.

Future Work

- Extending Oil Spill Monitoring service to new regions, including West Africa
- Updating PML database with new examples oil spills and look-alikes
- Integration with AIS and satellite vessel location data
- Application of Deep Learning Neural Network techniques for oil spill detection



Thank you



Questions?