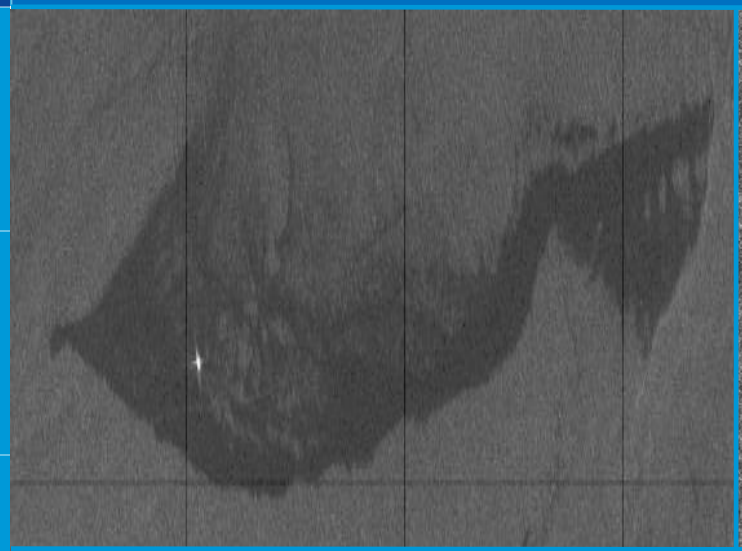
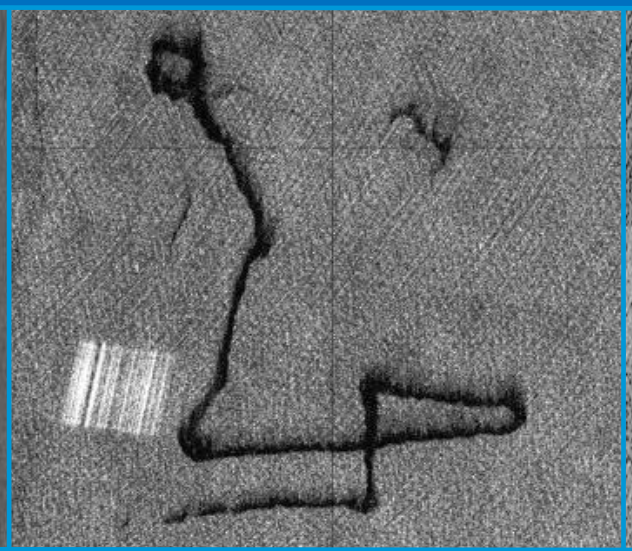
NOAA's Oil Spill Monitoring Program

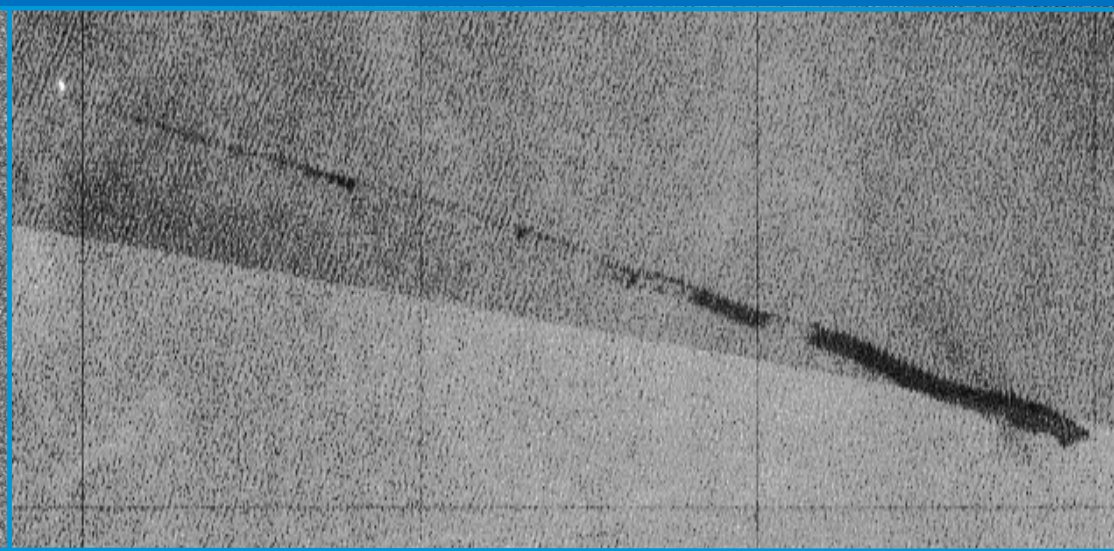
Juan Velasco, Program Lead & Ocean Remote Sensing Operations Officer

Satellite Analysis Branch

RRT-III | May 2021







The Satellite Analysis Branch

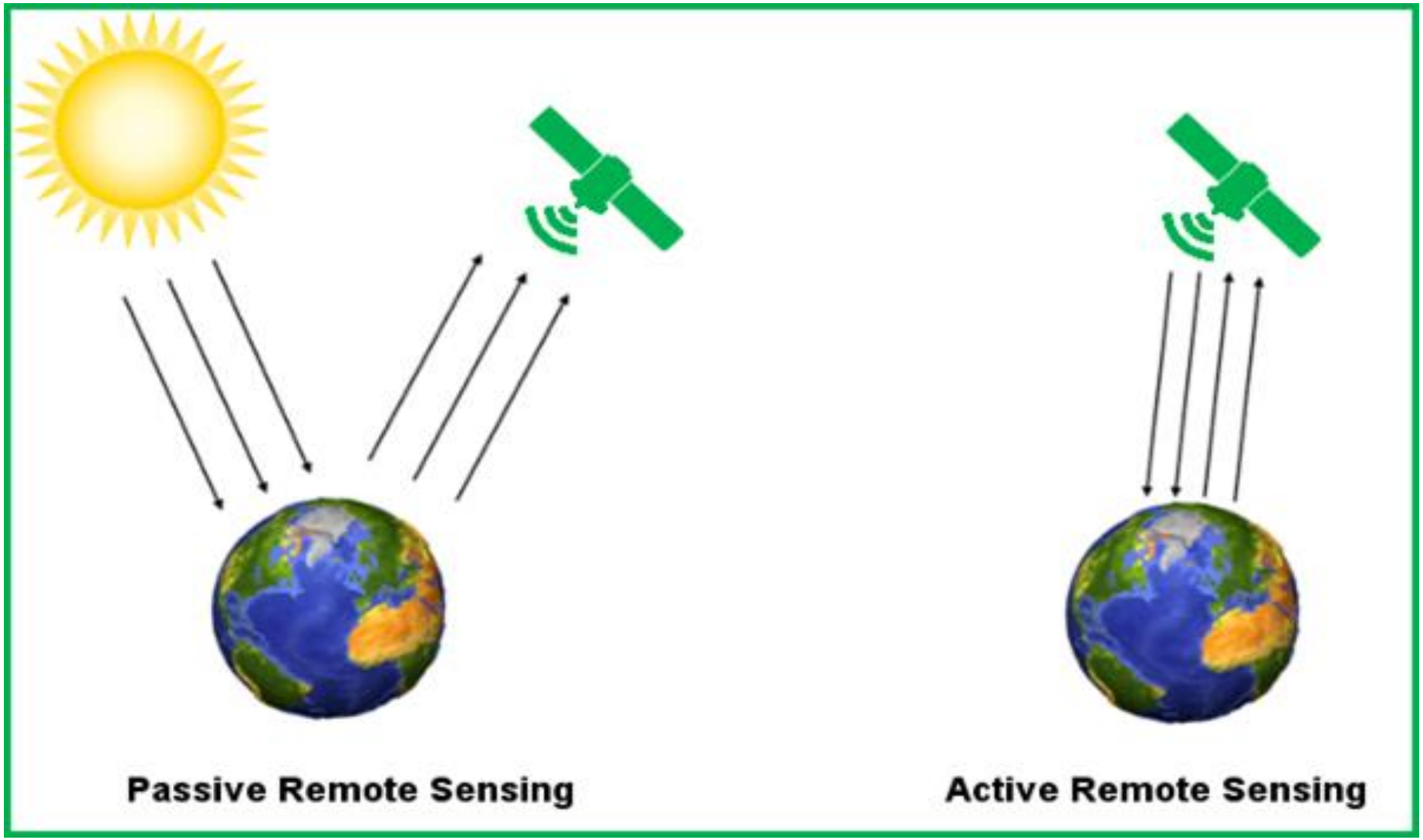
- Branch within NESDIS (National Environmental Satellite Data & Information Service)
- Satellite analysts with various backgrounds
- Marine pollution, fire/smoke, volcanic ash, and tropical cyclone analyses
- Operational 24/7
- Located in suburban Washington, DC

NOAA Center for Weather and Climate Prediction, College Park, Maryland, USA

Marine Pollution Program

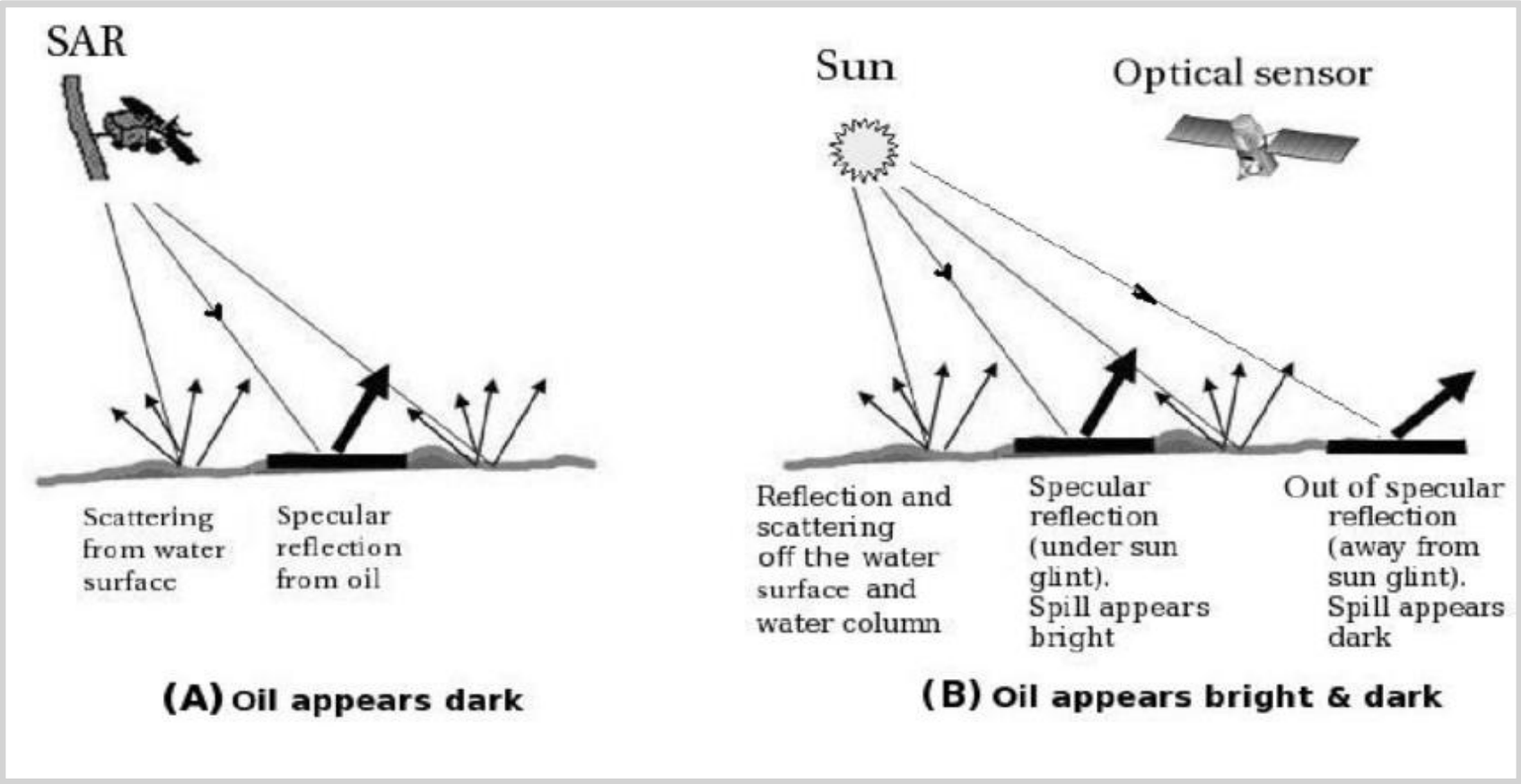
- First operational in 2011 to meet NOAA Emergency Response Division sat. monitoring needs
- Analyze satellite data & report unnatural oil-related marine anomalies in U.S. waters
- Users: NOAA ERD, U.S. Coast Guard, BSEE, BOEM, other federal & state agencies
- Reports (“Marine Pollution Surveillance Reports”) available on our website

Imaging Types Used for Oil Spill Monitoring



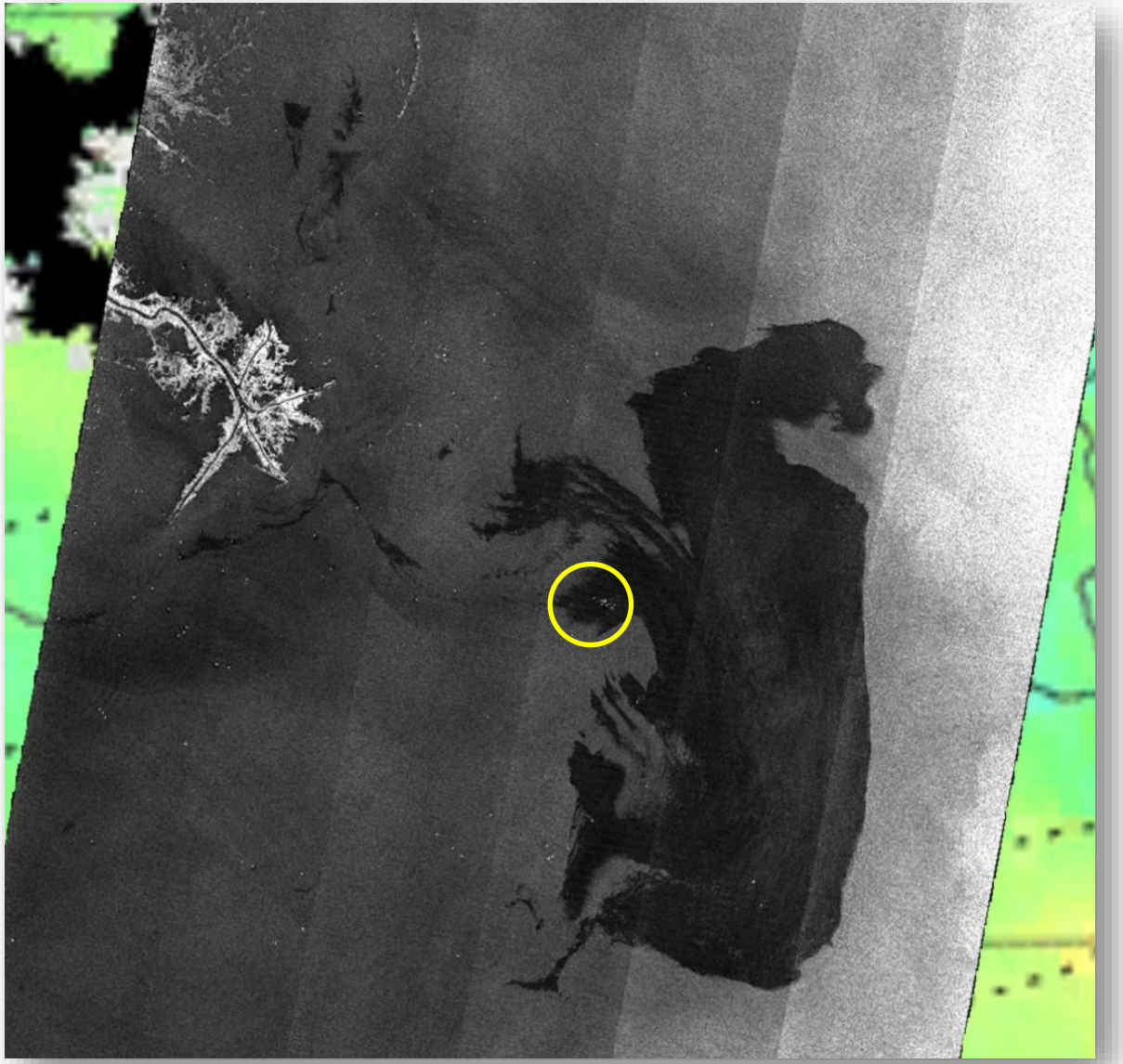
https://grindgis.com/remote-sensing/active-and-passive-remote-sensing

Electromagnetic Energy/Oil Interactions



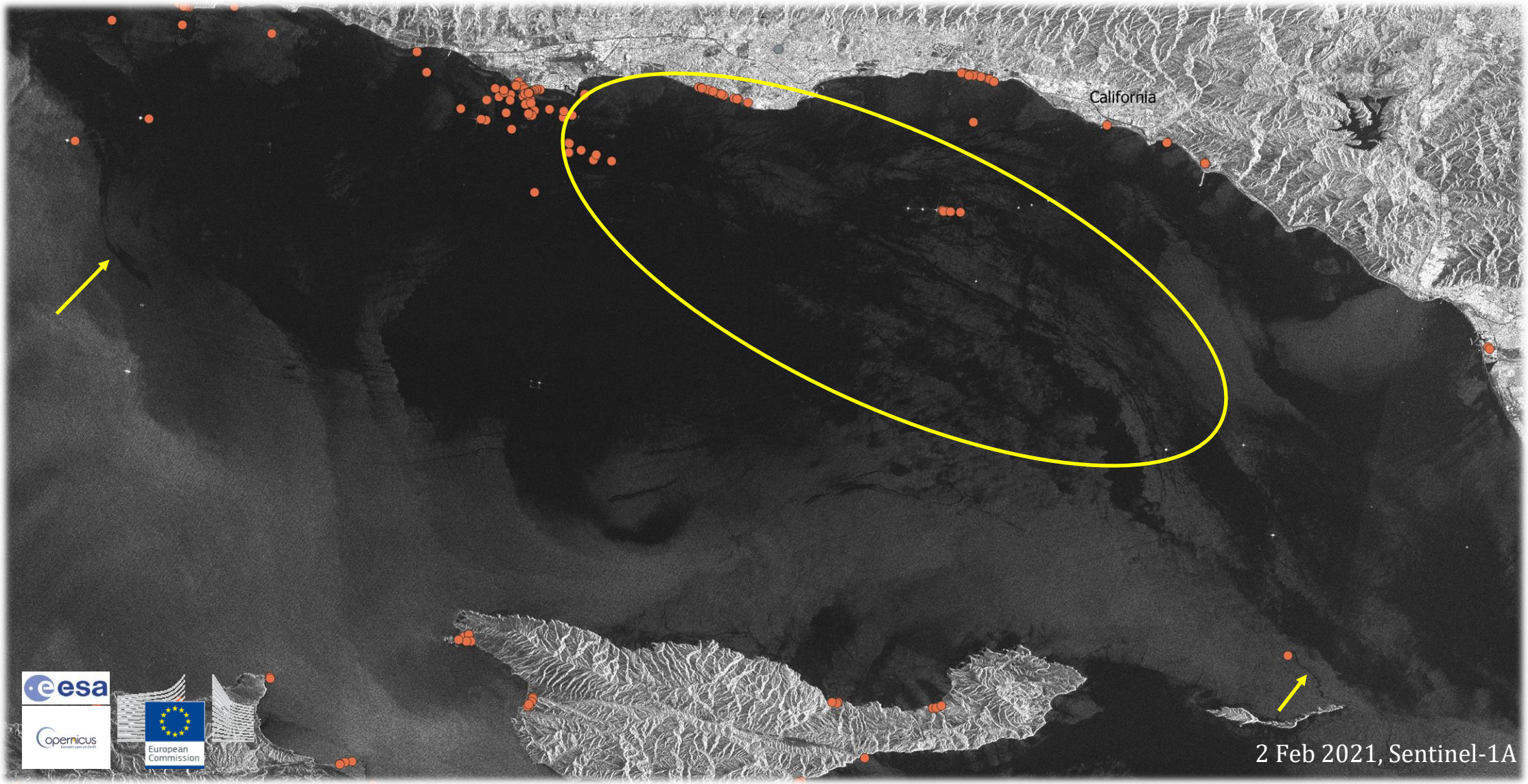
https://www.researchgate.net/figure/An-observation-comparison-between-the-A-SAR-and-B-optical-sensors-of-an-oil-spill_fig32_299463824

Oil Spill in SAR Data

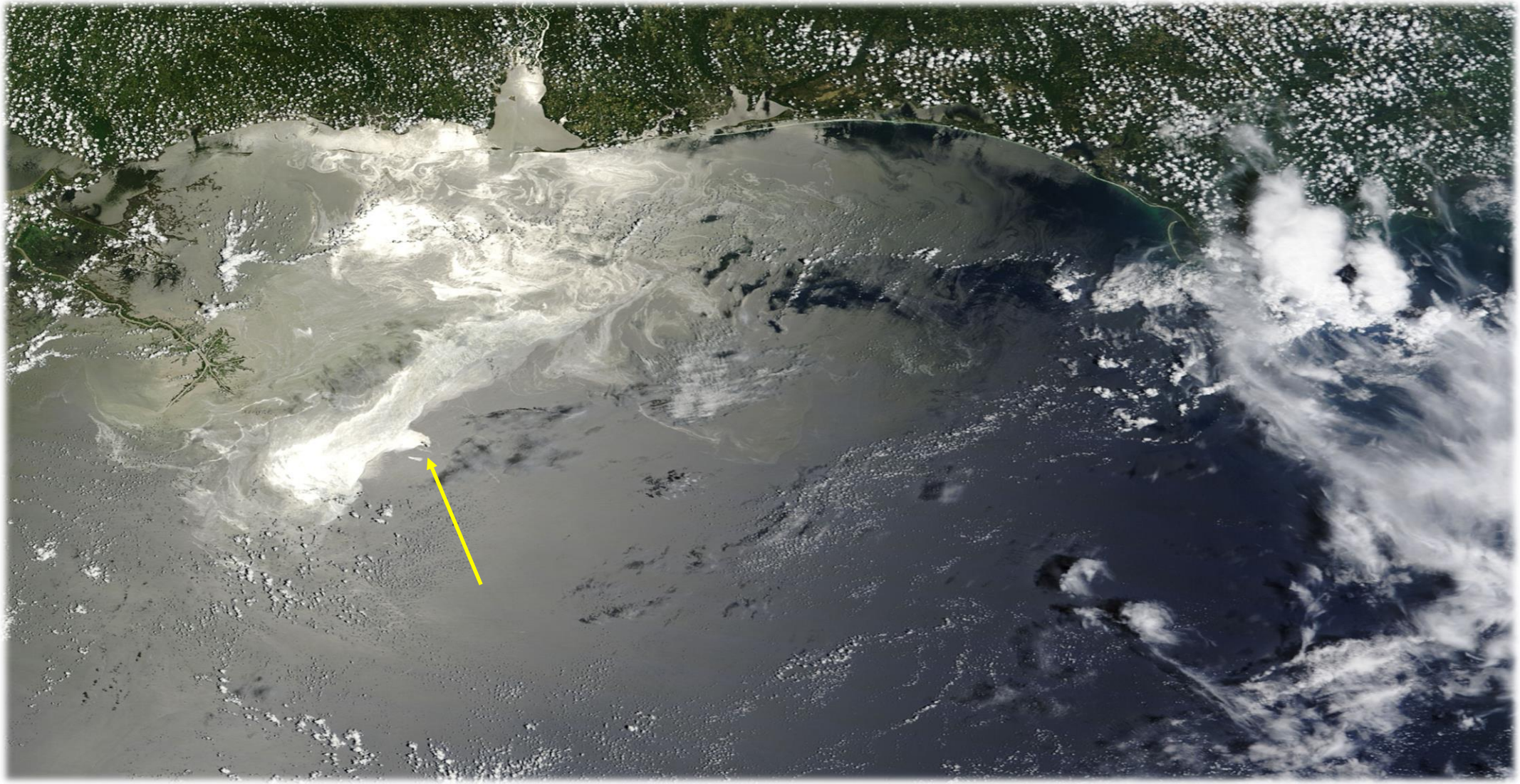


Cosmo-SkyMed 11 May 2020, https://www.esl.lsu.edu/static/pics/dwh-oil-spill/2010-05/100511.cosmo1.2357.jpg

More Oil Spills in SAR Data



Oil Spill in Multispectral Data



25 June 2010, MODIS (Terra)

Routine Satellite Data

Free, openly-available data

Passive sensor data (Multispectral)

- Landsat 7 & 8 (NASA)
- Sentinel-2A & 2B (ESA/Copernicus)
- ASTER on Terra (NASA)
- MODIS on Aqua & Terra (NASA)
- S-NPP and NOAA-20 VIIRS (NOAA)

Active sensor data (SAR)

- Sentinel-1A & 1B (ESA/Copernicus)

Commercial data

Passive sensor data (Multispectral)

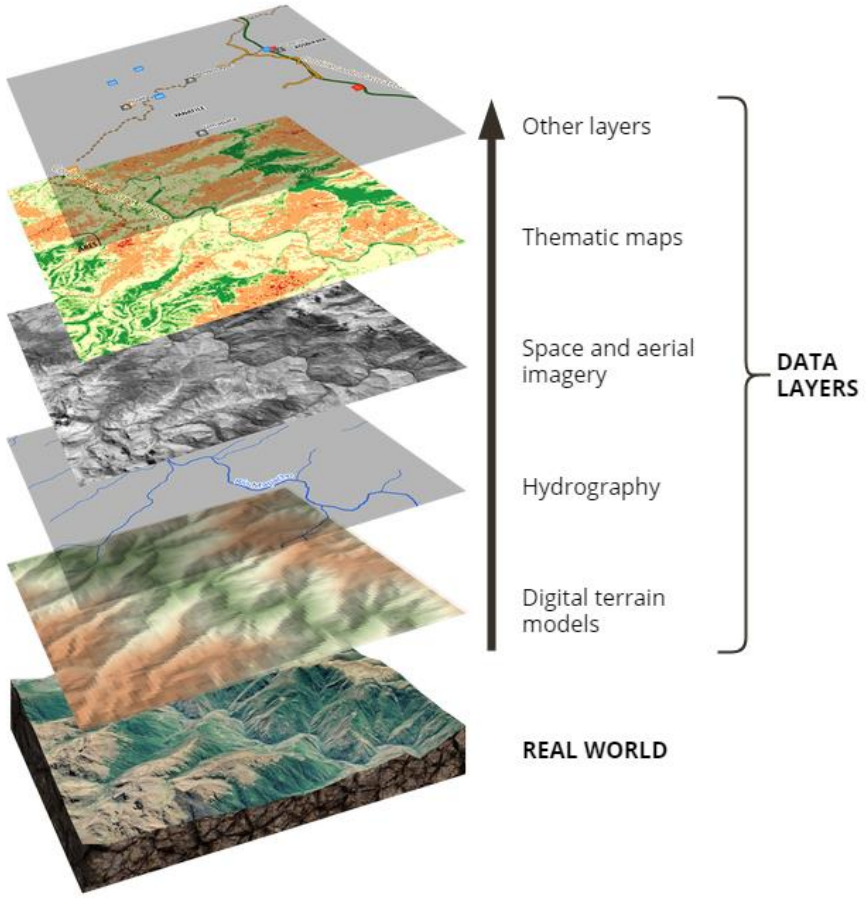
- PlanetScope (Planet Labs Inc.)
- Worldview-2 (MAXAR)
- Worldview-3 (MAXAR)
- Pleiades & others

Active sensor data (SAR)

- Radarsar-2 (MDA)
- TerraSAR-X (DLR)
- COSMO-SkyMed (ISA)
- ALOS-2, Kompsat-5 & others

Ancillary Data

- GIS data in US waters, such as…
  - Shipwrecks (ENC and RULET)
  - Natural oil seeps
  - Oil platforms & pipelines at the Federal and State level
  - Coastal bathymetry
- SAR and scatterometer wind products
- Chlorophyll products from MODIS-Aqua
- NOAA algal bloom bulletins for the Gulf of Mexico
- NOAA ocean current model data
- NOAA buoy data
- NOAA National Response Center (NRC) reports
- Other GIS data related to oceans and weather



SAR Imaging for Oil Spill Monitoring

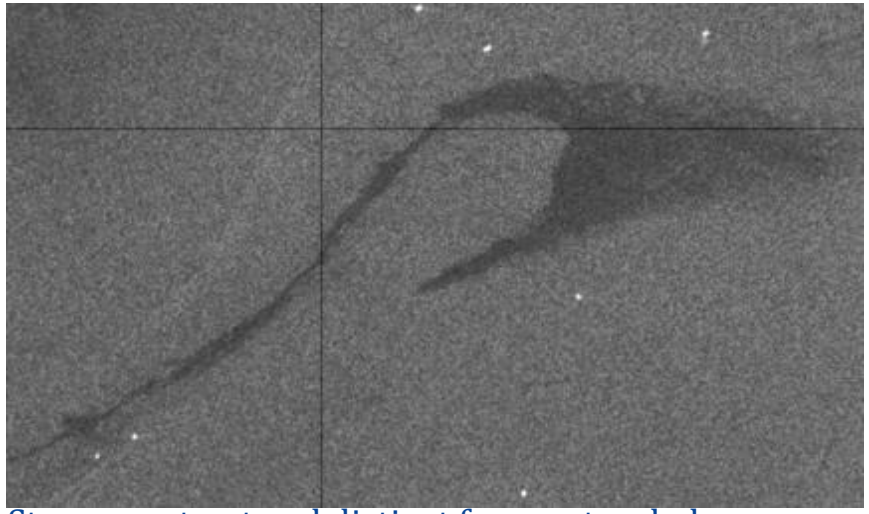
Advantages

- Not dependent on clear sky
- Day and night is both useful
- Minimal atmospheric effects
- Multiple imaging modes often available

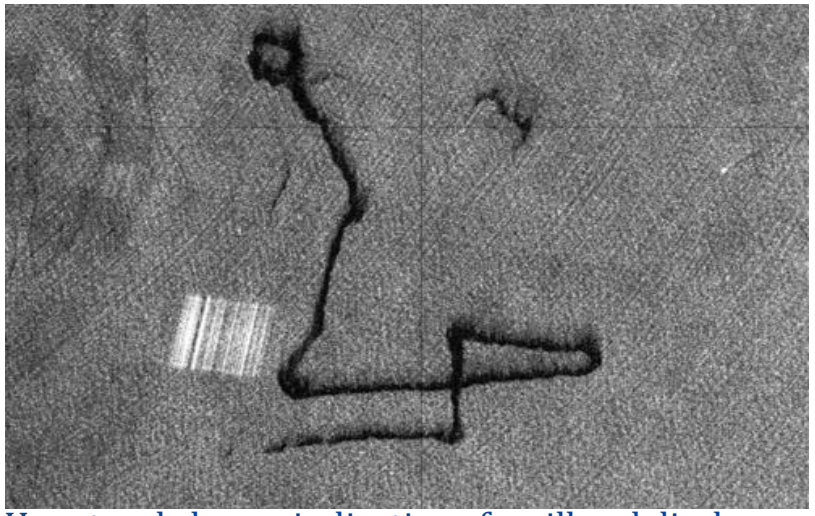
Disadvantage

- Oil spills are difficult to distinguish from false positives
  - Only one channel (wavelength)

Oil Spill Traits in SAR

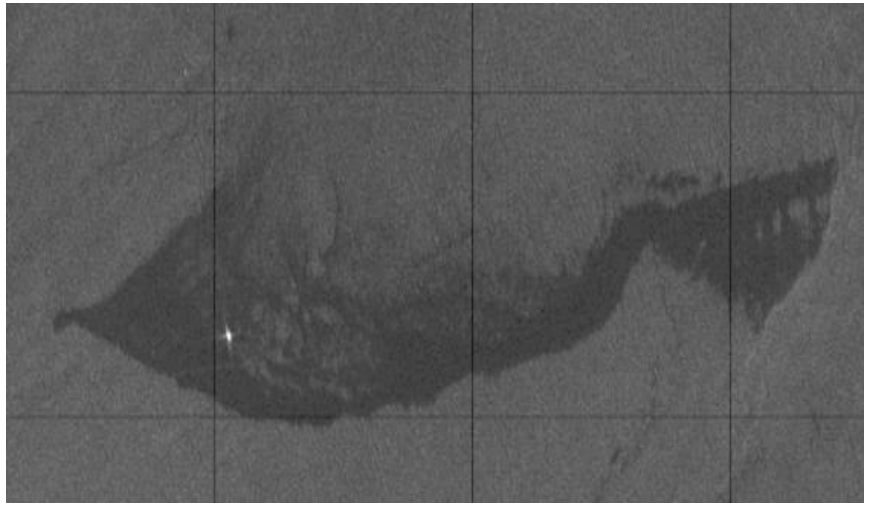


Strong contrast and distinct from natural phenomena

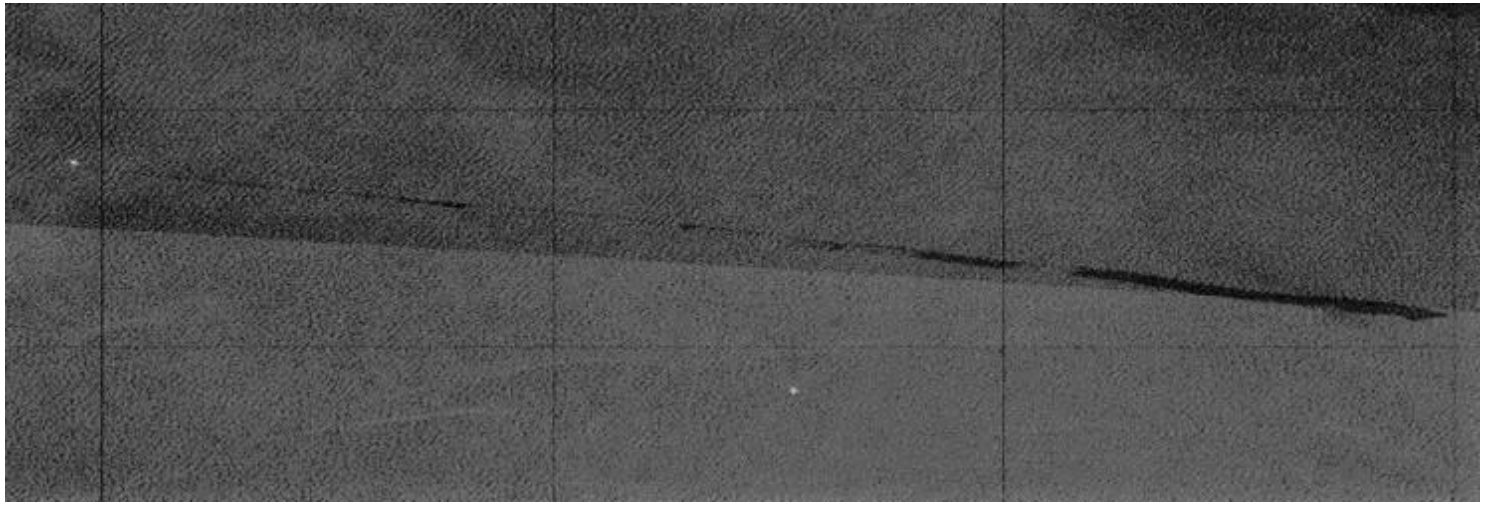


Unnatural shapes indicative of an illegal discharge

Widening with distance and connected to a vessel; possible illegal discharge



Well-defined borders/edges & strong contrast



Strong contrast, widens with distance, abrupt ending, discontinuity; signs of illegal discharge

MPSR of an Illegal Discharge

MARINE POLLUTION SURVEILLANCE REPORT

Analysis Provided by: The National Oceanic and Atmospheric Administration/National Environmental Satellite, Data and Information Service (NOAA/NESDIS)

REPORT DATE: FEBRUARY 27, 2018
REPORT TIME: 1350Z (0750 CST)
ANALYST: WHISNANT

DATA SOURCE: SENTINEL-1A
MODE: Interferometric Wide (IW) VV
RESOLUTION: 5 x 20 meter
IMAGE DATE/TIME: 2/27/2018 0008Z (2/26/2018 1808 CST)

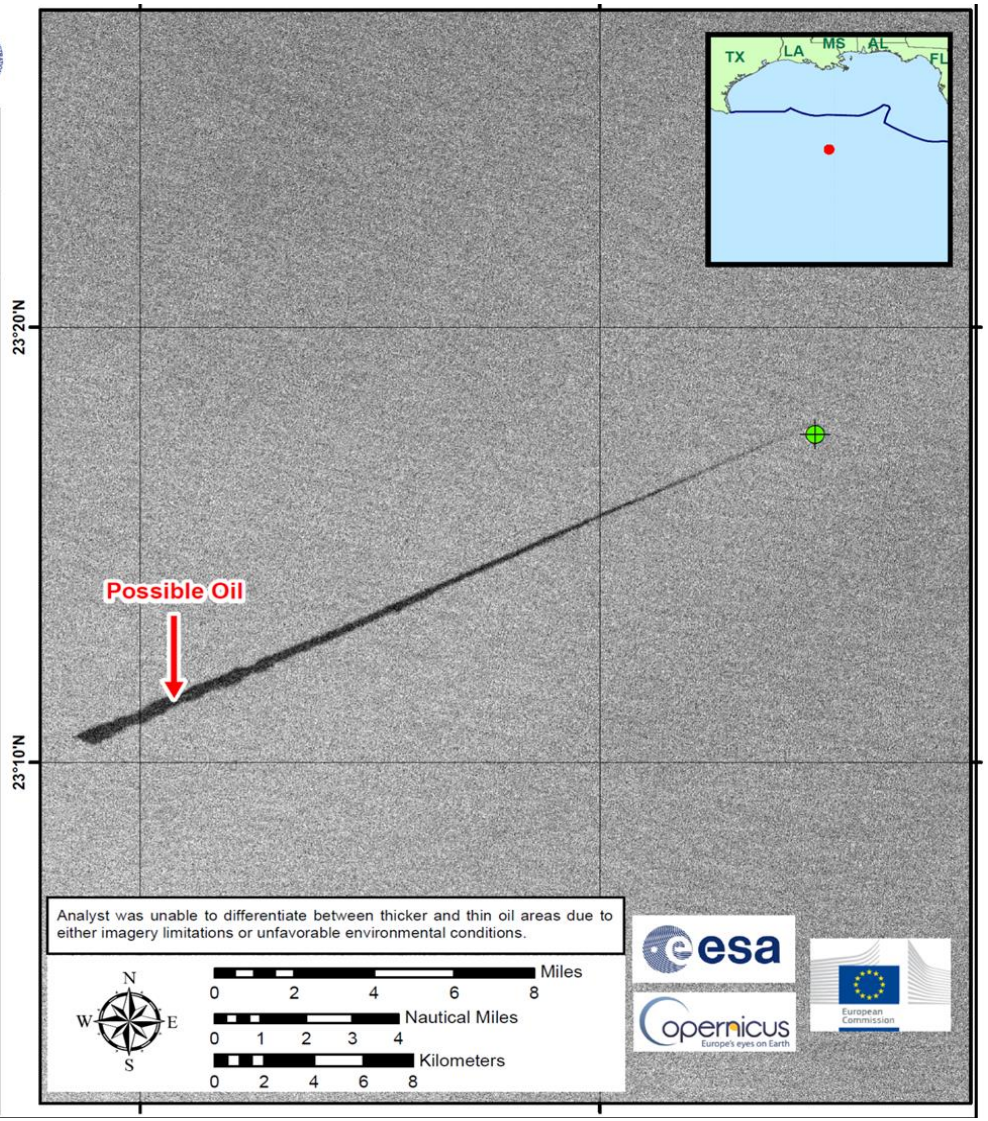
LEGEND

- Possible Oil
- Possible Thicker Oil
- Suspected Point Source: [23°17'32" N / 90°15'22" W]
- 11.9 km² — Area of Possible Oil
- False Positive (not oil)

CONFIDENCE: High

REMARKS:

Anomaly believed to be oil was observed in satellite imagery and was located 148.22 nautical miles south of the U.S. EEZ (moving toward it). The anomaly stretched a total of 16.20 nautical miles while widening with distance from the suspected point source. This is a known characteristic of a bilge dump. The edges were mostly well defined and showed good contrast with its background. The anomaly was not in the vicinity of natural seeps and certainly appeared out of place. Surface winds were out of the East at 10 knots around the time of the image. Confidence is deemed High given these characteristics are often associated with a bilge dump.



MPSR of an Accidental Oil Facility Spill

MARINE POLLUTION SURVEILLANCE REPORT

Analysis by: The National Oceanic and Atmospheric Administration, Satellite and Information Service (NOAA/NESDIS)

REPORT DATE/TIME: 7/9/2019 0130 (UTC)

DATA SOURCE: RADARSAT2
MODE: ScanSAR Narrow VV
RESOLUTION: 50 meter
IMAGE DATE/TIME: 7/09/2019 0000 (UTC)

Possible Oil

Possible Thicker Oil

Suspected Point Source: [28°51'56" N/89°16'41" W]

6.88 km² Total Area of Possible Oil

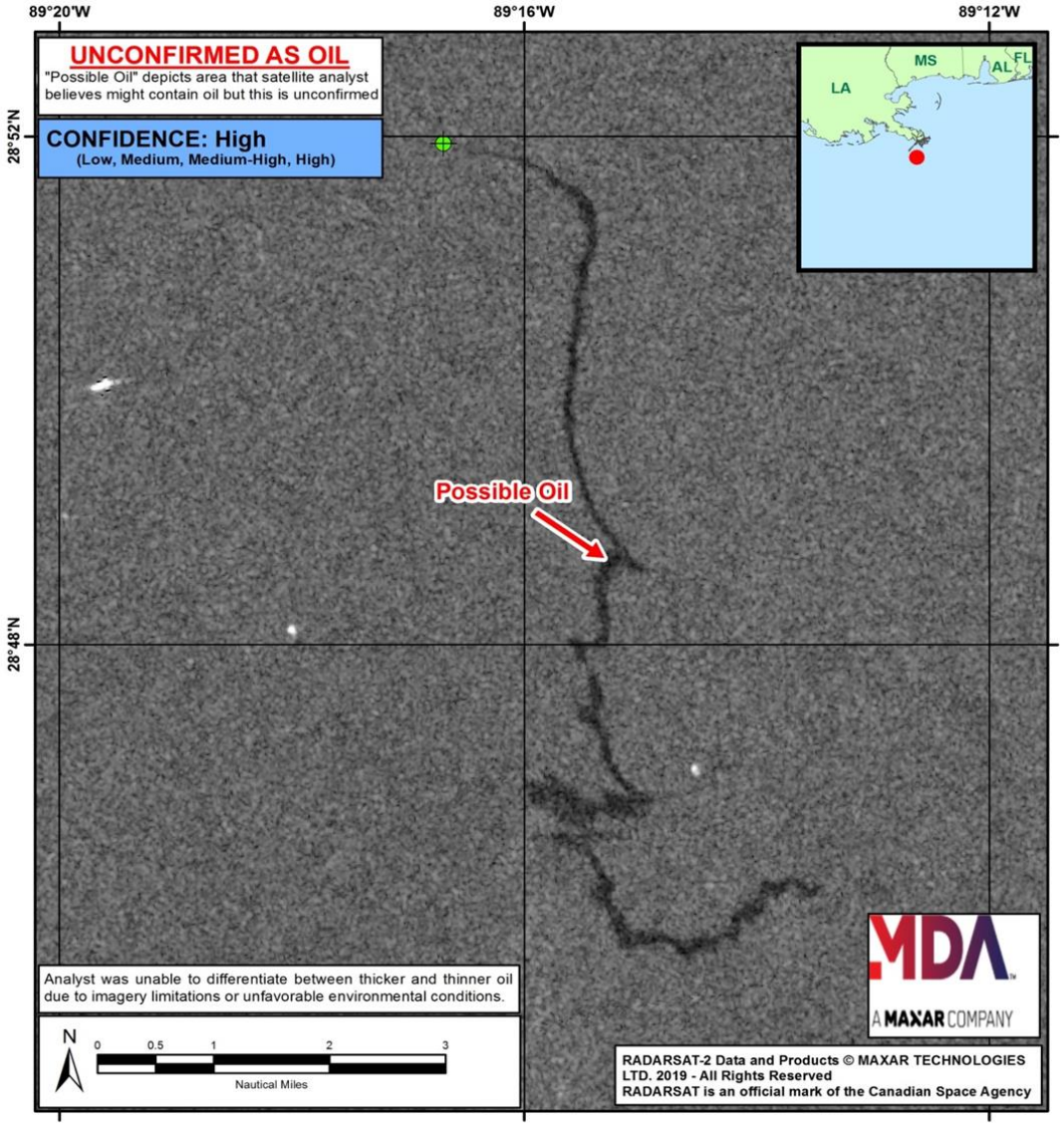
AREA/BLOCK: SOUTH PASS 55

REMARKS: Possible oil was observed in satellite imagery. This anomaly is unconfirmed as oil. The anomaly was believed to be associated with NRC Incident Report #1251312. The anomaly was directly connected to the oil facility mentioned in the associated NRC. The anomaly was approximately 11.31 nm oriented N-S and approximately 1.19 nm at its widest. The dark colored anomaly had high contrast to its homogeneous surroundings. Winds near the time of the image were coming from the W between 5-10 kts. which aligned well with the orientation of the northern end of the anomaly.

UNCERTAINTIES: The full extent of the anomaly was unknown due to a known natural seep site near the southern end of the anomaly.

ANALYST: RODRIGUEZ

For further information on oil spill response and assessment go to: https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills



Optical Imaging for Oil Spill Monitoring

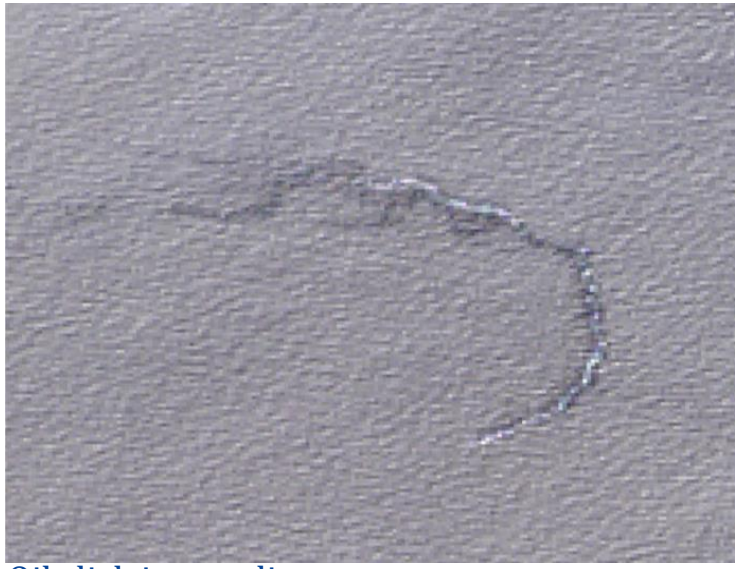
Advantages

- Oil colors & relative thickness detectable
- False positive identification possible

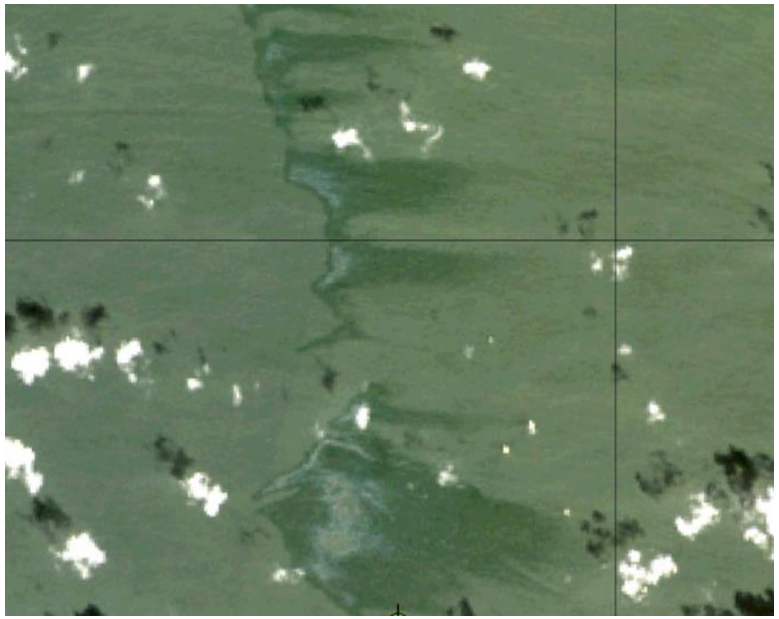
Disadvantages

- Oil spill detection dependent on cloud-free conditions
- Not as useful when sunglint is not present
- Usefulness currently restricted to daytime data

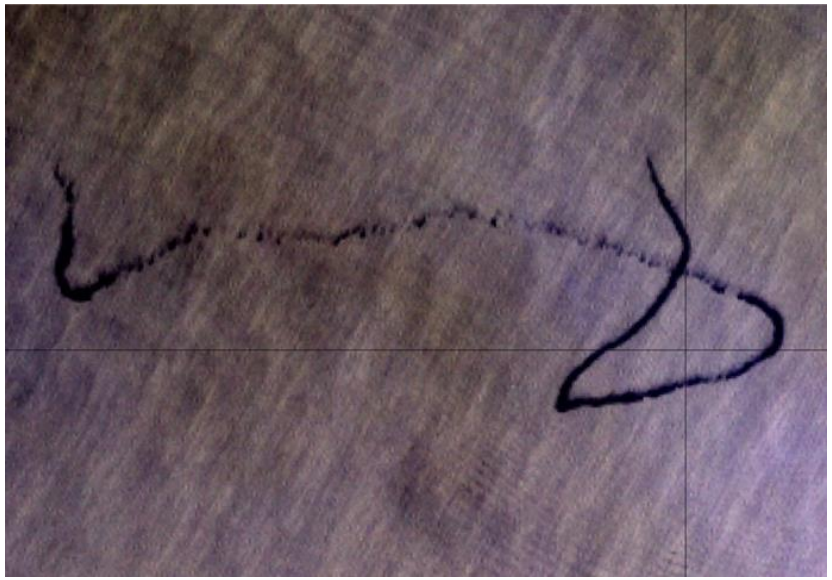
Oil Spill Traits in Optical Data



Oil slick in sunglint



Well-defined borders/edges



Oil spill with well-defined borders, strong contrast and unnatural curves

MPSR with High Resolution Optical Data

MARINE POLLUTION SURVEILLANCE REPORT

Analysis by: The National Oceanic and Atmospheric Administration, Satellite and Information Service (NOAA/NESDIS)

REPORT DATE/TIME: 6/1/2018 0515Z (UTC)

DATA SOURCE: LANDSAT8 OLI
MODE: Multispectral
RESOLUTION: 30 meter
IMAGE DATE/TIME: 5/31/2018 1625 (UTC)

Possible Oil

Possible Thicker Oil

Destroyed Taylor Platform: [28°56'16" N/88°58'14" W]

39.25 km² Total Area of Possible Oil

AREA/BLOCK: MISSISSIPPI CANYON 20

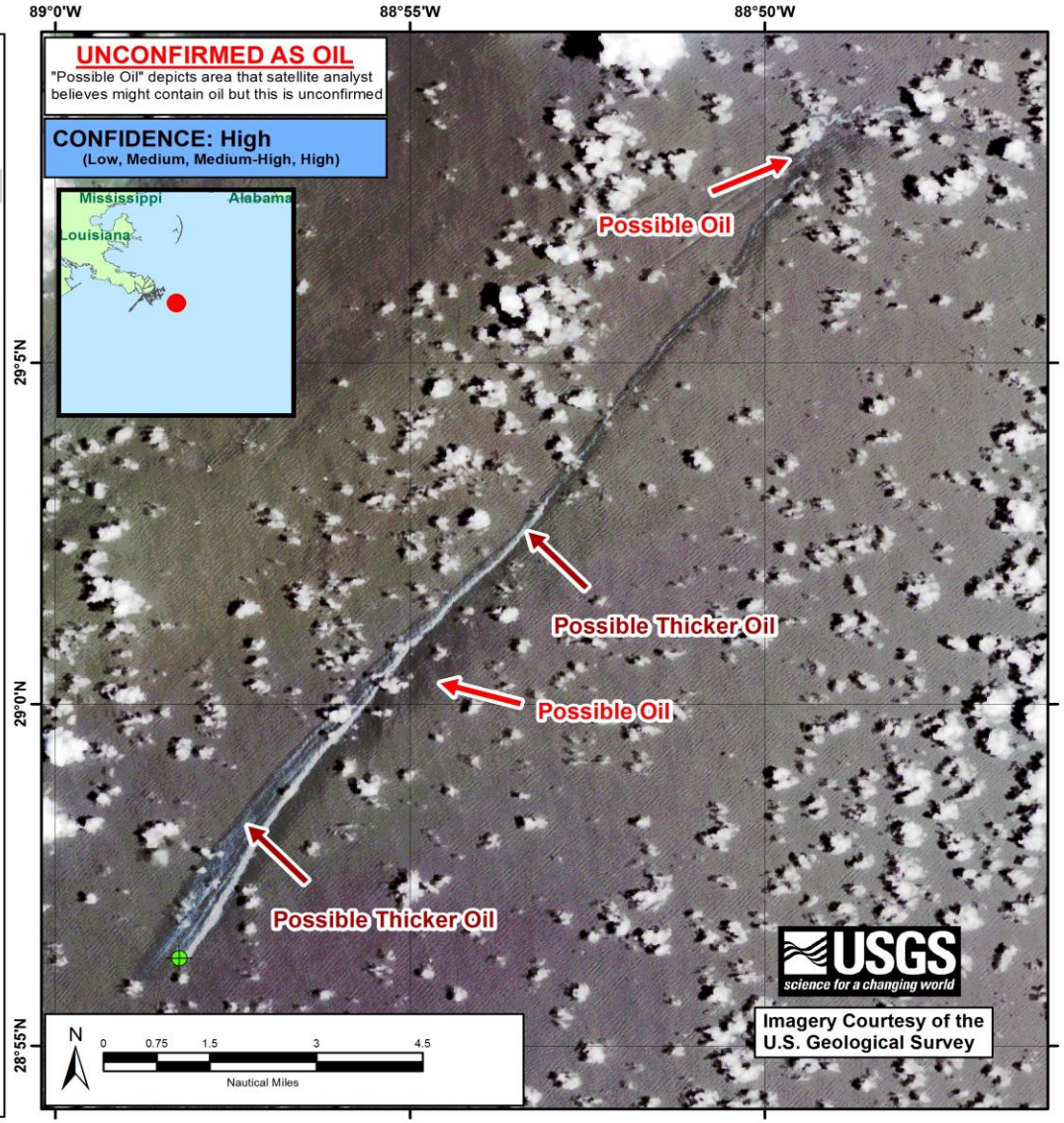
REMARKS: Possible oil was observed in satellite imagery. This anomaly is unconfirmed as oil.

The anomaly stretched a total of 17.25 nautical miles and showed mostly good contrast to its background. Surface winds around the time of the image were from the South around 10 knots, which align well with the anomaly. Confidence is deemed to be High given this is a known repeat leak source and the aforementioned characteristics.

UNCERTAINTIES: Due to cloud cover, the anomaly's full extent is unknown. There are not other uncertainties due to the Destroyed Taylor Platform being a known repeat leak source.

ANALYST: WHISNANT

For further information on oil spill response and assessment go to: https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills



MPSR with High Resolution Optical Data

MARINE POLLUTION SURVEILLANCE REPORT

Analysis by: The National Oceanic and Atmospheric Administration, Satellite and Information Service (NOAA/NESDIS)

REPORT DATE/TIME: 8/27/2018 0740 (UTC)

DATA SOURCE: SENTINEL2B
MODE: Multispectral
RESOLUTION: 10 meter
IMAGE DATE/TIME: 8/26/2018 1628 (UTC)

Possible Oil

Possible Thicker Oil

Suspected Point Source: [29°18'58" N/88°55'13" W]

38.63 km² Total Area of Possible Oil

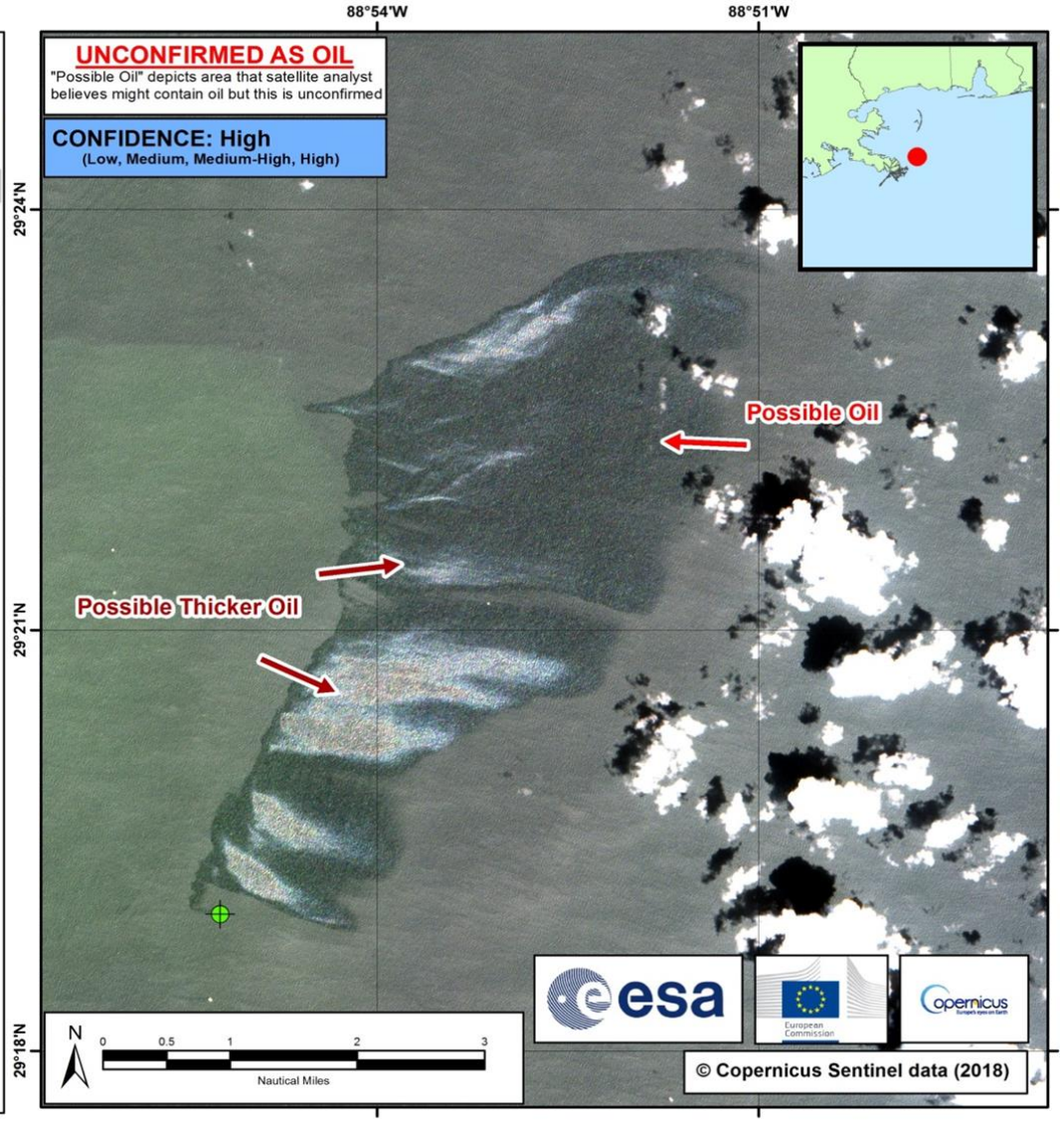
AREA/BLOCK: MAIN PASS 61

REMARKS: Possible oil was observed in satellite imagery. This anomaly is unconfirmed as oil. It was located approximately 82 nmi SE away from New Orleans, LA. The anomaly extended 6.6 nmi NNE away from the point source, and was measured 3.2 nmi wide. It widened with increasing distance and exhibited dark and bright silvery appearance near sun glint using high resolution imagery. The anomaly was also seen to exhibit feathering to the east. The direction of the anomaly was very consistent with ocean current models near the time of the image.

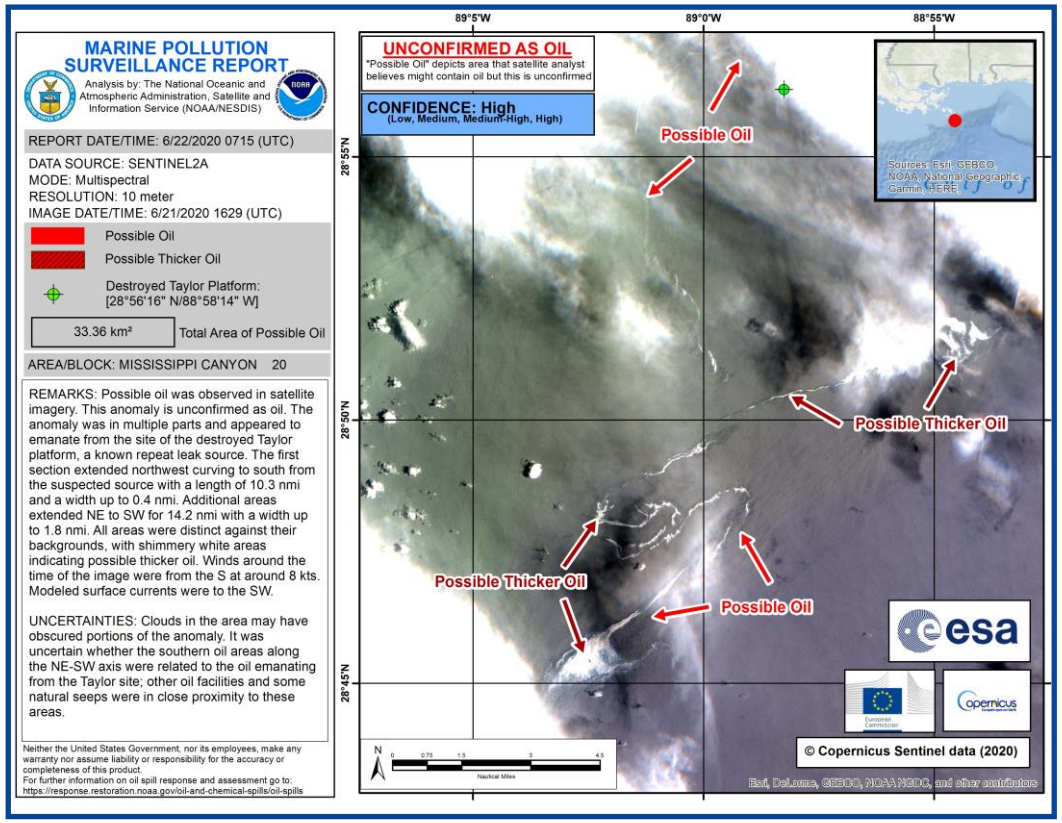
UNCERTAINTIES: Since the anomaly has an obvious point source, there were no uncertainties involved.

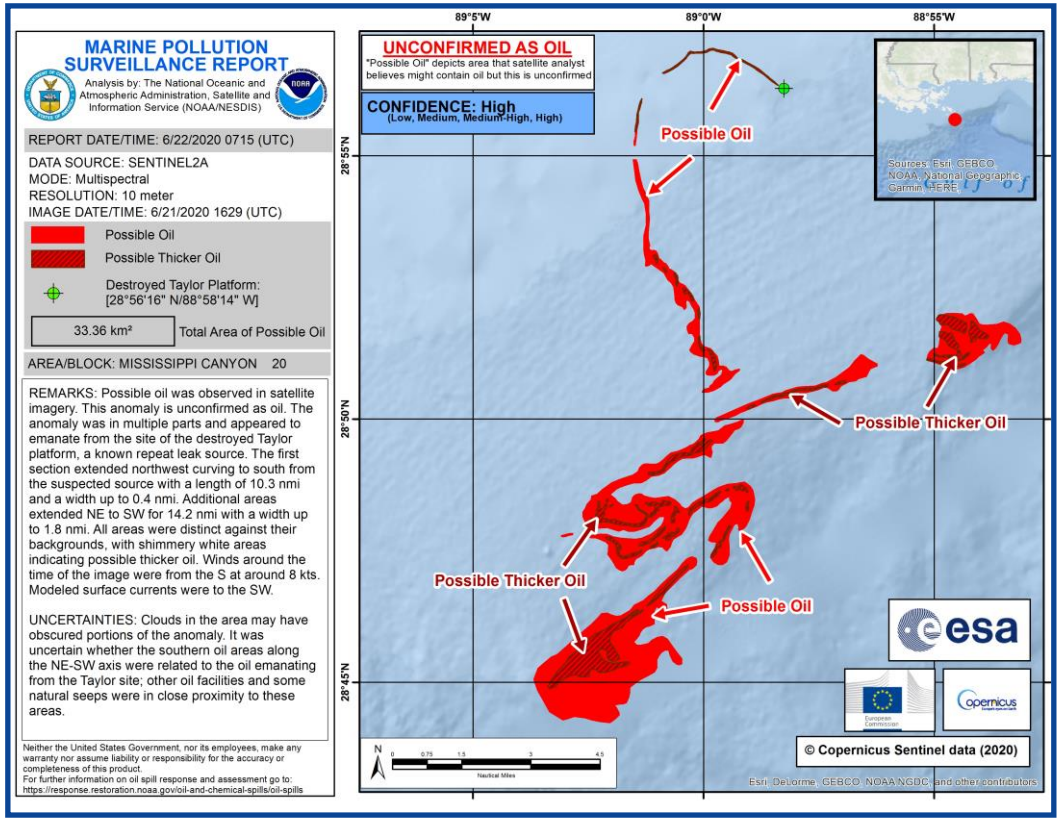
ANALYST: KIM

For further information on oil spill response and assessment go to: https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills



Typical MPSR Products





KMZ

ESRI Shapefile

TXT

MPSR Access Via the Web

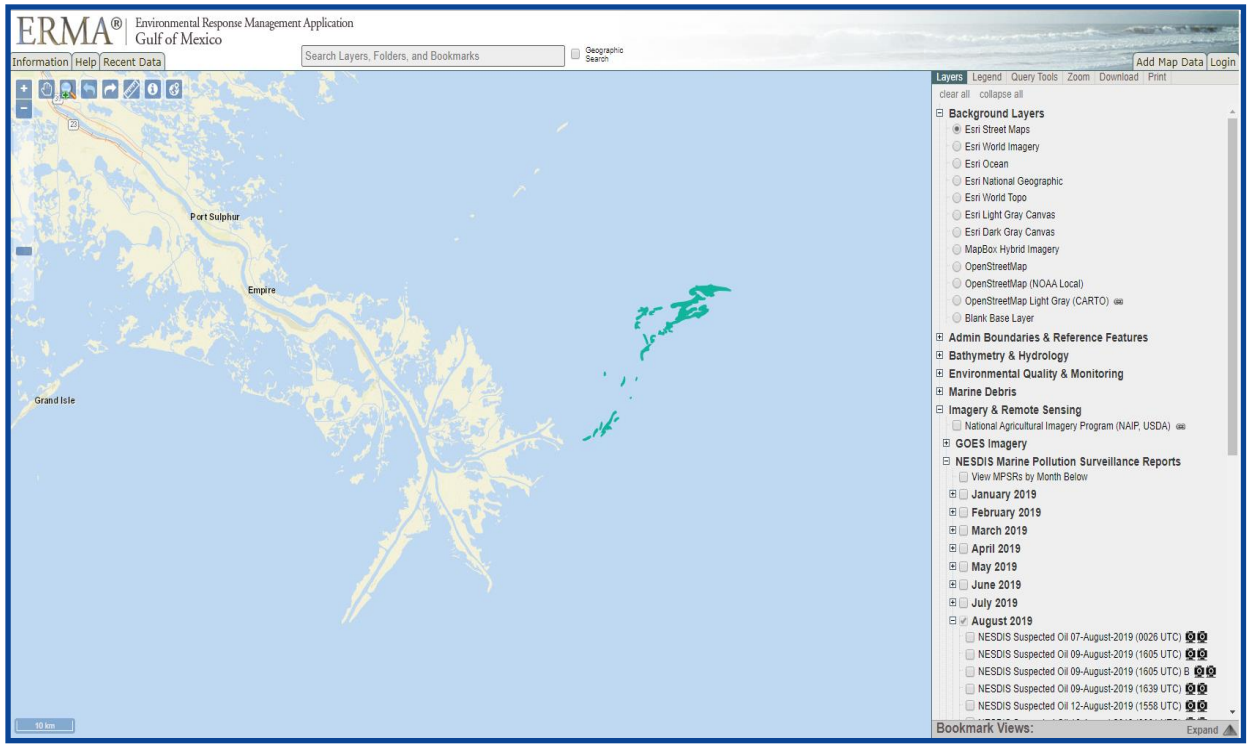
NESDIS Marine Pollution Products

MOST RECENT REPORTS — Last Update: 11/23/2020 2048 UTC

Region	Issue Date	Source	Image Time	Area (km²)	Confidence	Products	COP*	View
ATLANTIC	11-23-2020	SENTINEL1B	11-23-2020 1048 UTC	0.48	High	txt | jpg | zip	ERMA	zoom
ATLANTIC	11-23-2020	SENTINEL1B	11-23-2020 1048 UTC	0.48	High	txt | jpg | zip	ERMA	zoom
ATLANTIC	11-22-2020	SENTINEL1A	11-21-2020 2257 UTC	26.56	Medium-High	txt | jpg | zip	ERMA	zoom
PACIFIC	11-18-2020	SENTINEL1B	11-18-2020 0157 UTC	9.15	Medium	txt | jpg | zip	ERMA	zoom
ATLANTIC	11-15-2020	SENTINEL2B	11-15-2020 1535 UTC	0.14	High	txt | jpg | zip	ERMA	zoom
GULF OF MEXICO	11-14-2020	SENTINEL1A	11-14-2020 0001 UTC	0.19	Medium	txt | jpg | zip	ERMA	zoom

*ERMA Common Operational Picture

https://www.ospo.noaa.gov/Products/ocean/marinepollution/



Environmental Response Management Application (ERMA) hosted by NOAA Office of Response and Restoration: the JPEG(s) and the shapefile overlay of the location of the events reported can be found on this web application.

Some SAB Achievements

- Produced daily Deepwater Horizon spill reports
- Reported illegal ship discharges leading to fines
- Identified oil leaks from aging infrastructure in Texas and Louisiana waters
- Performed oil spill surveillance related to hurricane impacts
- Refuted under-reported oil spills
- Assisted with analysis of major oil spill events via U.S. Dept. of State
  - Mauritius spill from oil tanker MV Wakashio in July 2020
  - Brazil mystery spill in 2019

Ship Pollution in the News

Judge Threatens to Bar Carnival Cruise Ships from U.S. Ports

The Westerdam (file image courtesy Holland America)

BY **THE MARITIME EXECUTIVE** 04-12-2019 12:27:18

Carnival Corporation's vessels could be banned from U.S. ports over alleged violations of the cruise line's oil pollution probation agreement, a federal judge warned Wednesday. The impact would be immediately felt in South Florida, Carnival's home base and the center of the world's cruise industry.

Judge in ocean pollution case won't make it easy for Carnival to resume cruise operations

In this Monday, March 9, 2020 photo, the Carnival Liberty leaves Port Canaveral, Fla. Carnival Cruise Line announced the suspension of all of their cruises in North America through April 9, 2020, in response to the coronavirus threat. (Joe Burbank/Orlando Sentinel via AP) (Orlando Sentinel)

MIAMI – Since Carnival Corp. is on probation over an environmental crimes case, a U.S. District Judge for the Southern District of Florida announced Friday that she is not going to make it easy for Carnival Corp. to resume cruise operations in the U.S.

Carnival Corp. has been on probation for about three years after pleading guilty to **2016 felony charges** stemming from its deliberate dumping of oil-contaminated waste from one of its vessels and intentional acts to cover it up.

Satellite Analysis Branch Information

NOAA Satellite Analysis Branch – Marine Pollution Surveillance Desk

+1 (301) 683-1403

Email: oceanmap@noaa.gov

http://www.ospo.noaa.gov/Products/ocean/marinepollution/

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