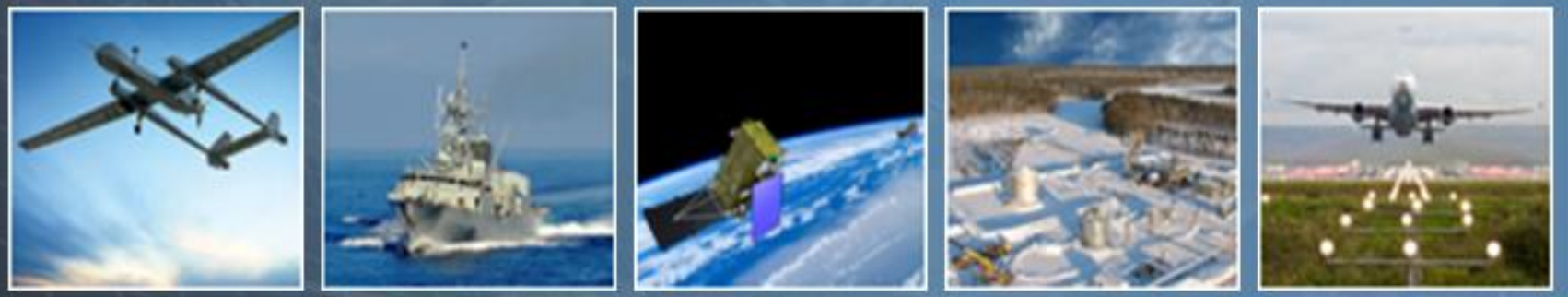

INFORMATION SYSTEMS

Oil Spill Preparedness and Response Using Spaceborne Radar

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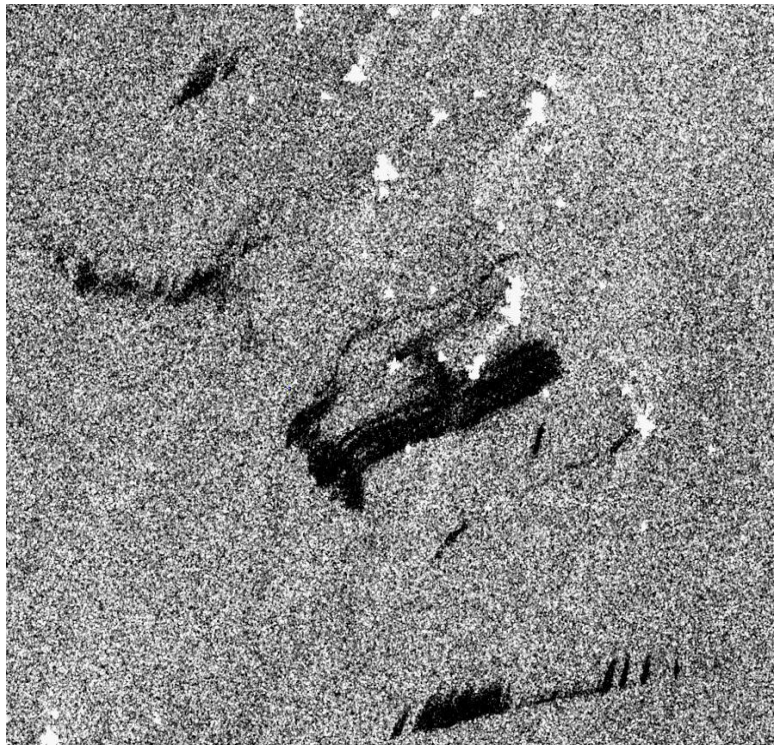
Outline

- Overview of spaceborne radar
- Spaceborne radar for emergency preparedness and response
- Summary

Overview of Spaceborne Radar

Slick Detection

- Good understanding of slick detection which depends on:
  - Radar parameters
  - Environmental conditions
  - Oil characteristics
- Semi-automatic approaches give effective results
- Skilled analysts improve information:
  - Mitigate false positives
  - Apply contextual information (platforms, ships, etc.)
  - Assign confidence / classification levels



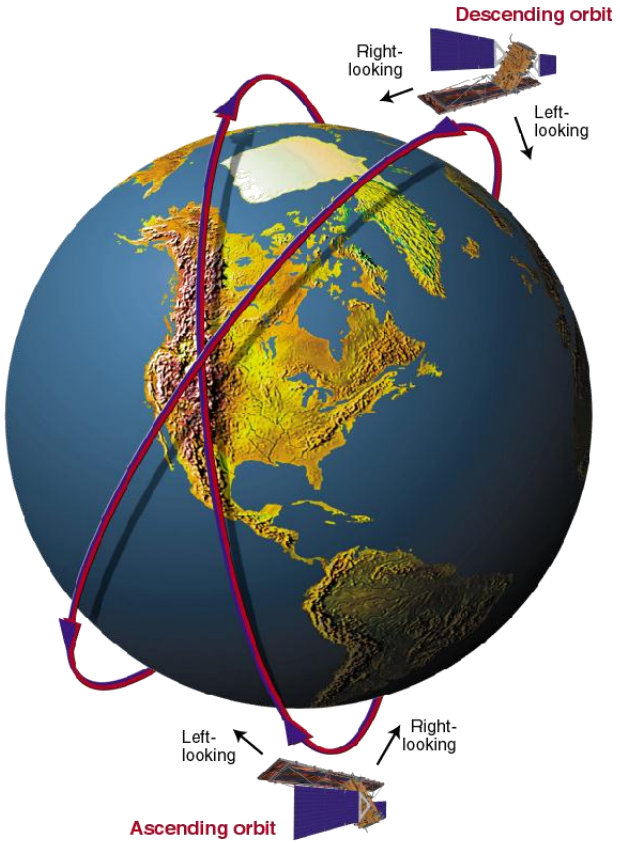
RADARSAT-2 image showing oil from offshore drilling platform. The oil appears as a dark tone, and the offshore platforms appear as bright white targets.

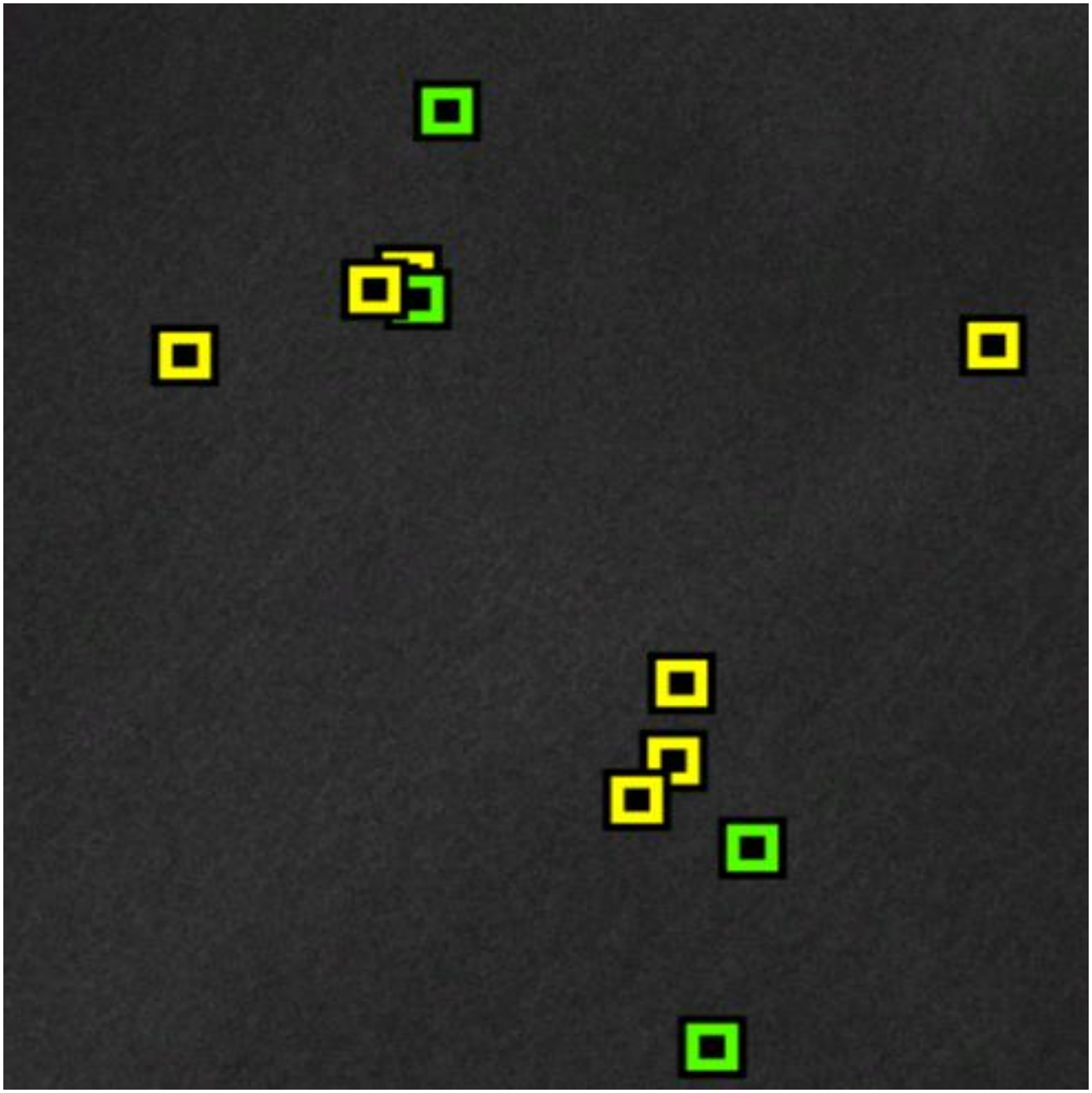
Information form Radar

- Size of the spill (surface area)
- Wind speed and direction (directly derived from the satellite imagery)
- Locations of vessels and other local/regional infrastructure to aid in response management
- Oil slick characteristics
  - *Sheen vs. emulsion*
  - *Oil types*

Satellite Imaging Times

- Satellites typically image on an ascending (northward) and descending orbit (southward)
- The imaging times vary by satellite, but depend on the orbit and the number of satellites
- For example, the times for RADARSAT-2 vary somewhat, but are approximately (local time):
  - Ascending ~ 6 PM
  - Descending ~ 6 AM
- Once an region-of-interest has been defined, the time from acquisition to data delivery is well-known





RADARSAT-2
ScanSAR image

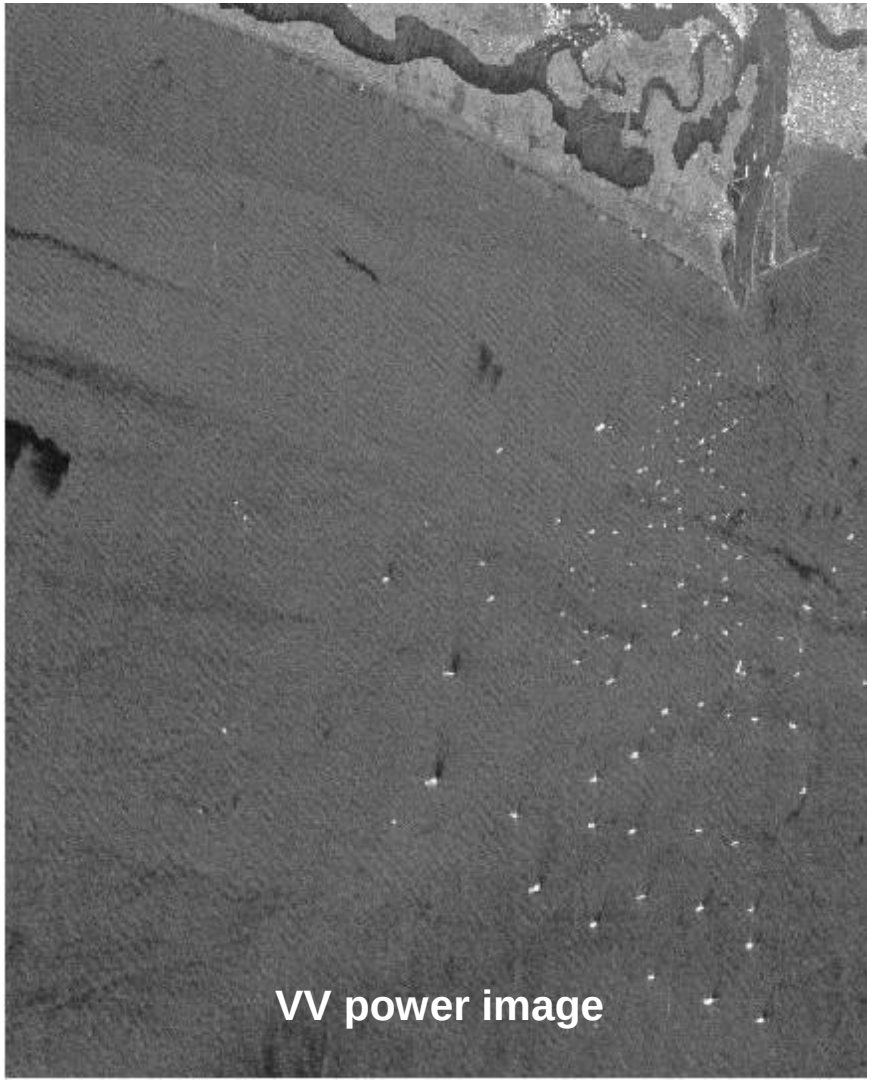
Wind Speed

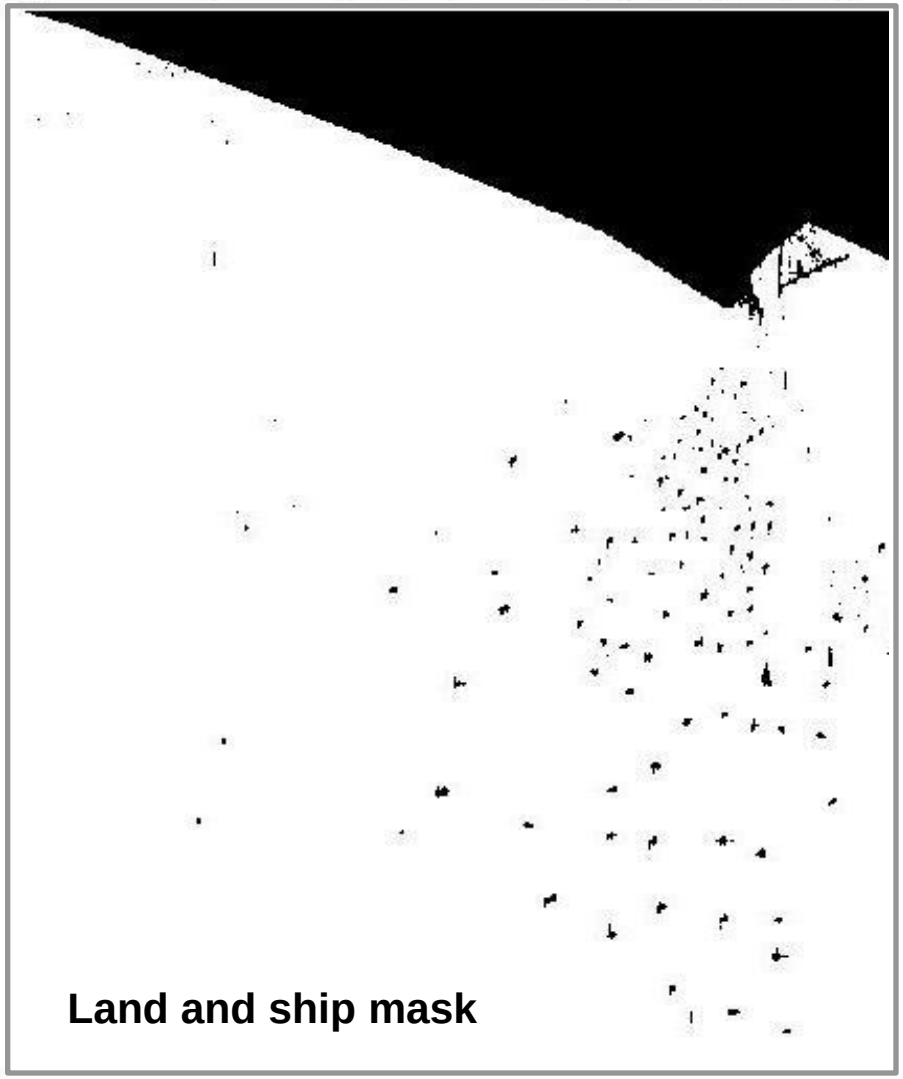
Wind Direction

Slicks
- Seeps
- Pollution

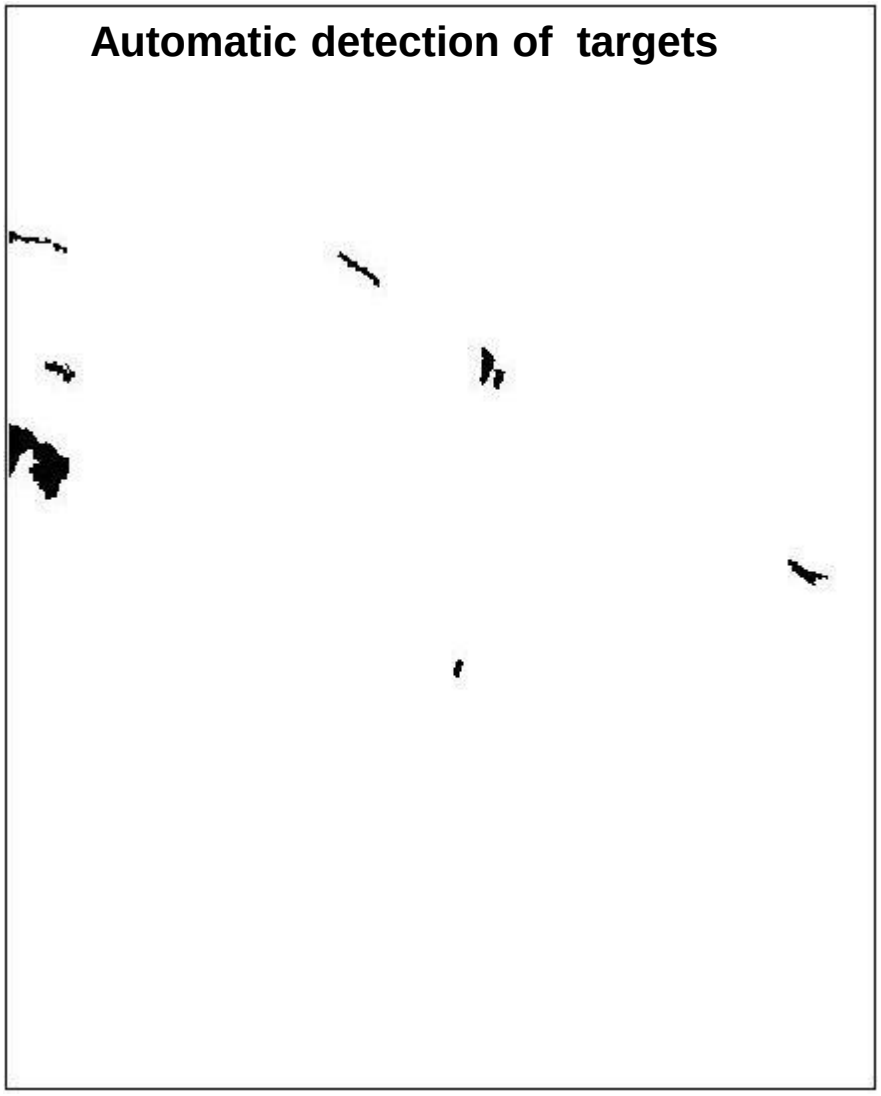
Ships/Other
- AIS correlated
- Non-AIS correlated

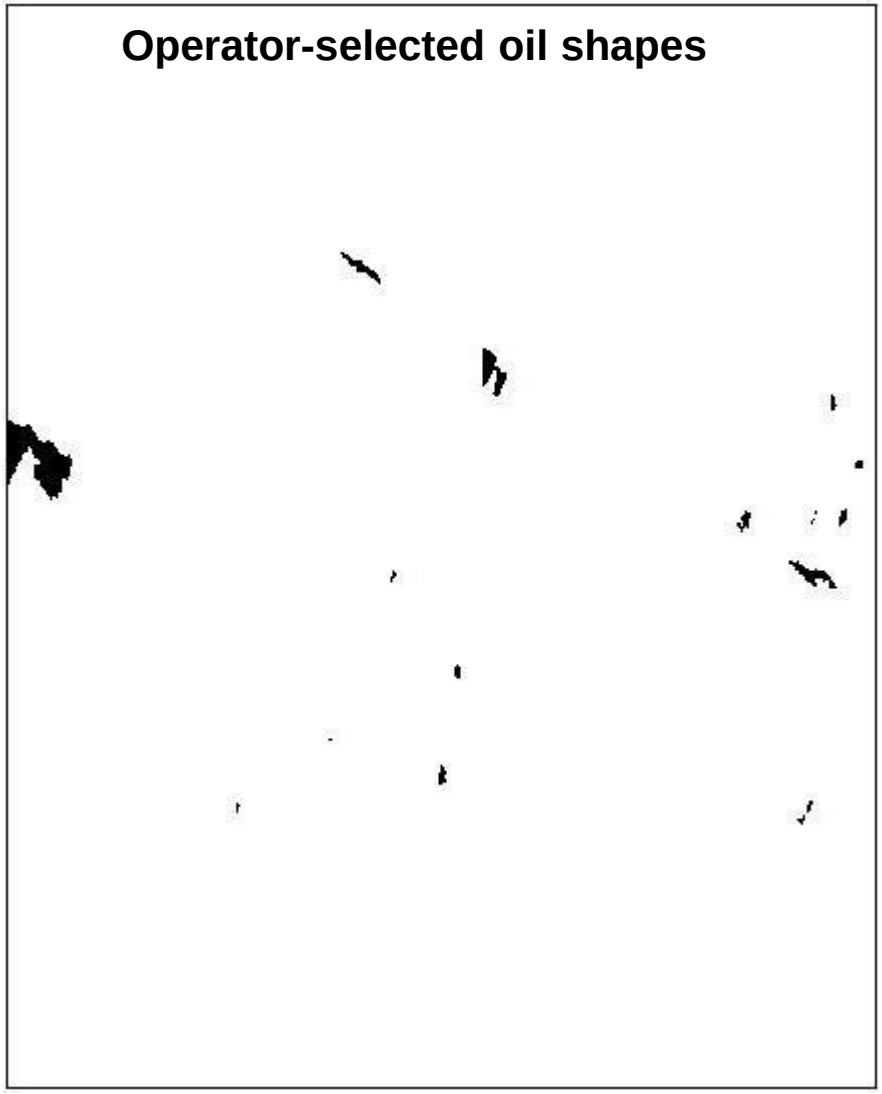
Land and Ship Mask



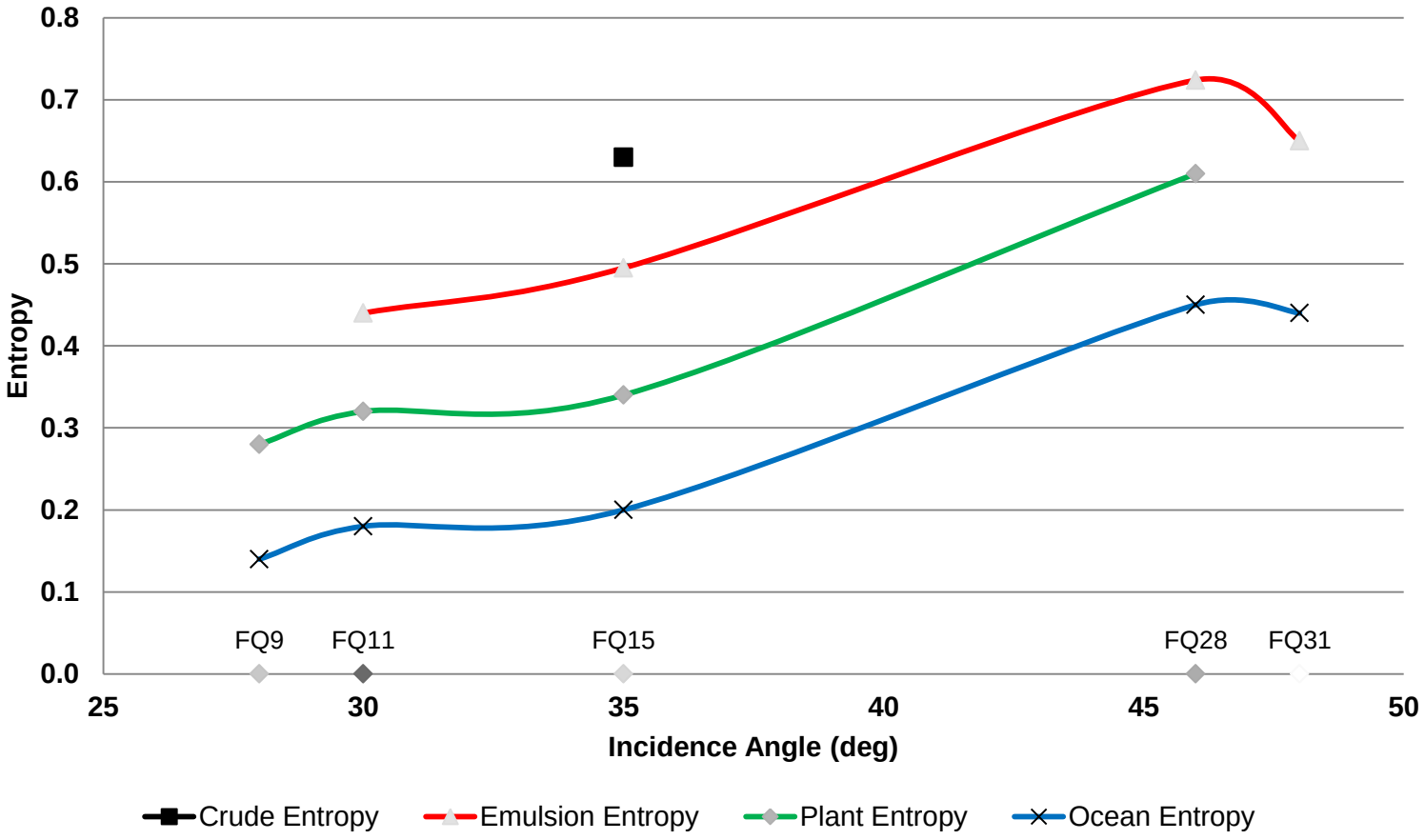


Automatic Detection vs. Operator Selected





Oil Type Discrimination



- The results were based on data acquired between 2011 and 2013.

Spaceborne Radar for Emergency Preparedness and Response

- Routine monitoring
- Multiple sensors
- Emergency preparedness
- Information products and Common Operating Picture

Routine Monitoring

- Satellite-based monitoring has typically been used after an incident was suspected or identified. During the first 24-48 hours after a spill, the need for information is very high, so acquisition latency is an issue.

- Routine monitoring of an operational area helps to mitigate some of the challenges associated with radar such as the lead time for the activation and reception of the first images.

- A recent simulation of emergency response timelines in the Gulf of Mexico showed that delivery of data is 4 times more likely within one day from the start of the incident versus a request for data acquisition after the incident occurred.

- Routine monitoring can be used to establish a baseline for the type of slicks that might be present due to natural and anthropogenic sources, e.g. seeps, algae blooms, bilge dumping.

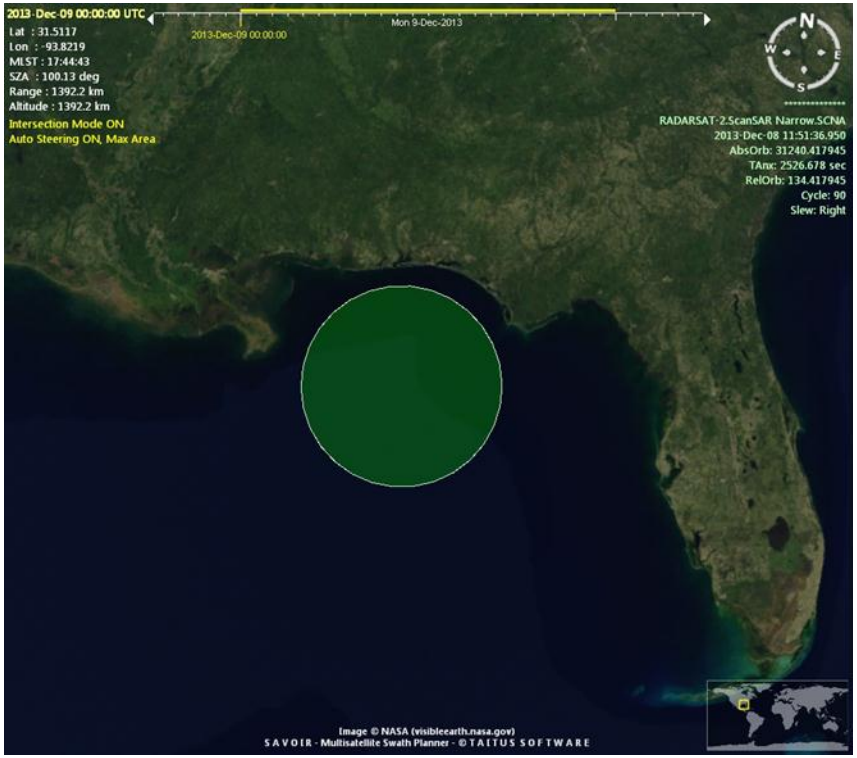
Multiple Sensors

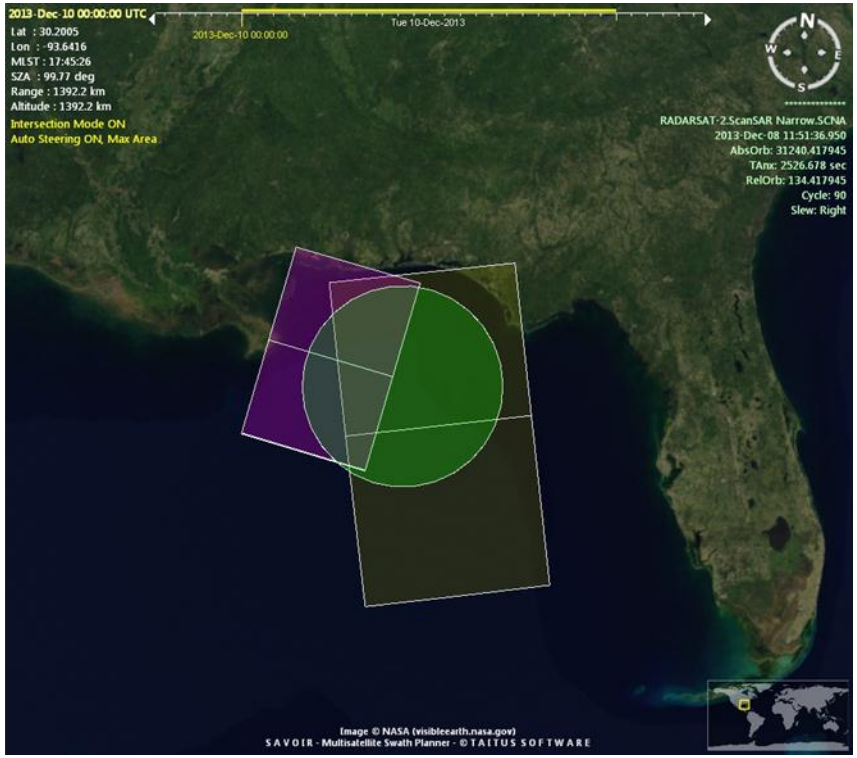
- A common approach is to use a broad-area sensor for primary coverage and a secondary sensor to fill schedule gaps or perform more focused imaging using alternate imaging modes

- Multiple sensors can also be used to reduce the time to acquire imagery and increase spatial coverage

- In a recent exercise conducted on behalf of the IOGP and working with OSRL, an emergency acquisition drill with multiple satellite operators was conducted:
  - The time to acquire the first image ranged from 14 hrs to 51 hrs for northern latitudes and 23 hrs to 58 hrs for equatorial latitudes;
  - Routine monitoring with multiple satellites would have reduced the time gap between image request and image delivery.

Multiple Sensors Improve Coverage





Day 9 and Day 10

RADARSAT-2: green
TerraSAR-X: purple

RADARSAT-2 only: 6 acquisitions
RADARSAT-2 + TerraSAR-X: 11 acquisitions

Emergency Preparedness

- Routine monitoring is a key step in the emergency preparedness end-to-end solution

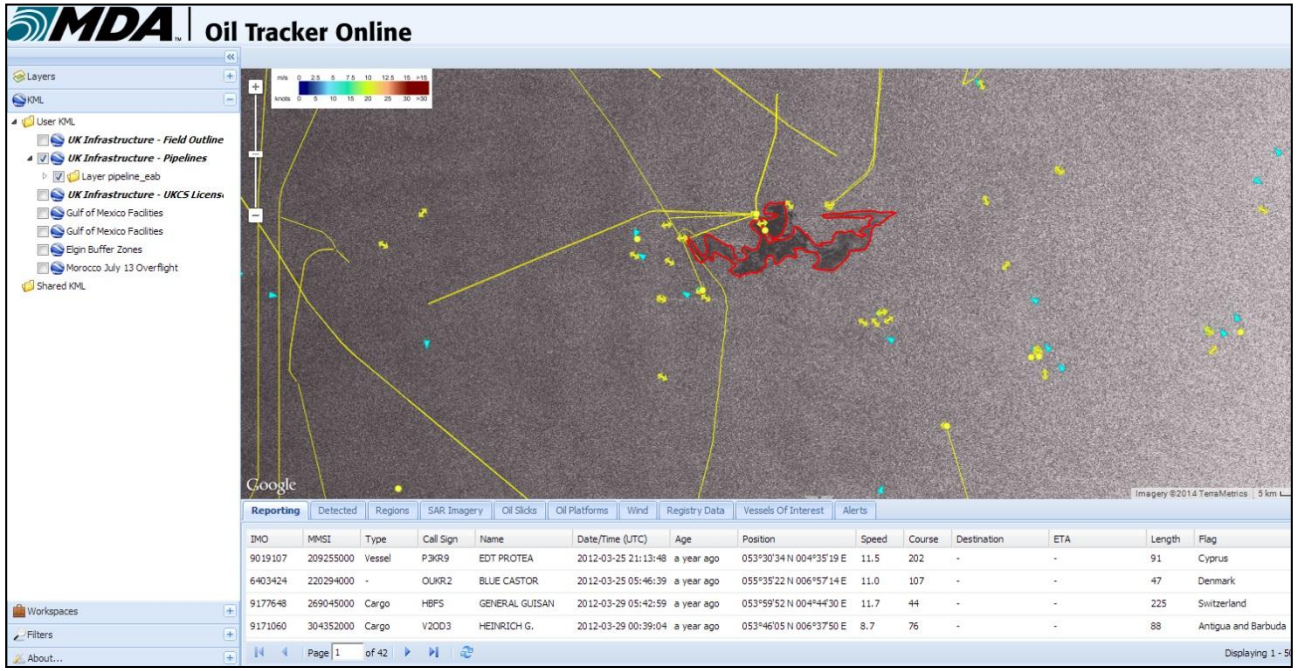
- Incorporation of radar data in spill response contingency plans:
  - Training on the procedures to order data
  - Training on the benefits and limitations of radar data
  - Integration of radar data in training exercises

- Verification that data volumes of radar-derived information products are commensurate with communication bandwidths

- Ensuring that information products are in a format that is compatible with end-user needs (e.g. geoTIFF, kml, shp)

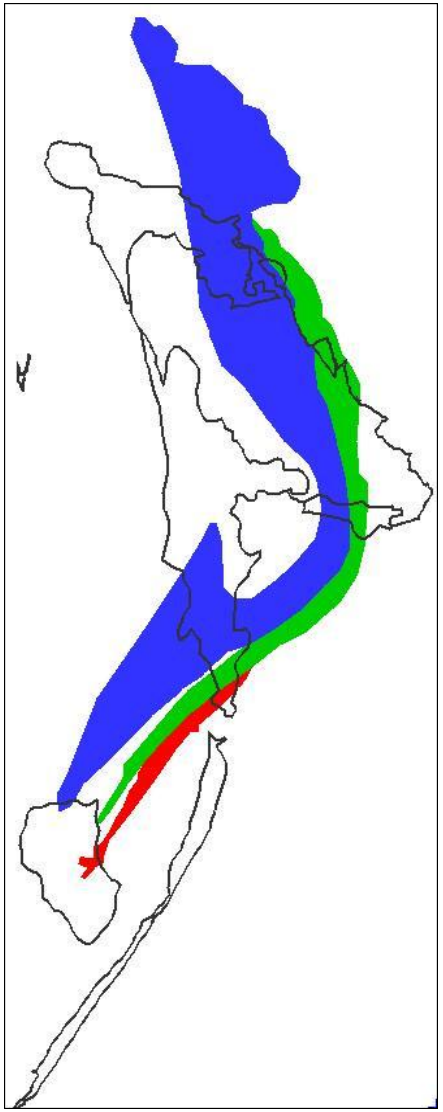
Information Products and Common Operating Picture (COP)

- To be of value, information products should be:
  - Interpretable
  - Interoperable
  - Timely



Example of information products (oil slick, ships, and AIS tracks) displayed in the MDA Oil Tracker which can be integrated into the COP.

RADARSAT-2 Data and Oil Spill Trajectory Models



Day 4

Day 4 (1)

Day 4 (2)

Day 4 (RS2)

- RADARSAT-2 data was used to initialize and update an oil spill trajectory model (OSCAR). The slick outline shows the slick location 4 days after the start of the spill.
- Day 4: Model only
- Day 4 (1): Model plus one image on Day 1
- Day 4 (2): Model plus image on Day 1 and Day 2
- Day 4 (RS2): Slick location from imagery only on Day 4.

Summary

- There is a good understanding of the benefits and limitation of spaceborne radar for oil spill preparedness and response.

- Information from radar:
  - Spill location and extent
  - Wind speed/direction
  - Ships and platforms
  - *Oil characteristics*

- Emergency preparedness and response
  - Routine monitoring helps to reduce acquisition latency and provides baseline information
  - Multiple sensors provide faster re-visit and increased spatial coverage
  - Integration of radar in oil spill contingency plans means that spill responders are familiar to data access timelines, data formats, and what to expect with information products
  - Radar can be readily integrated and used to update a COP

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