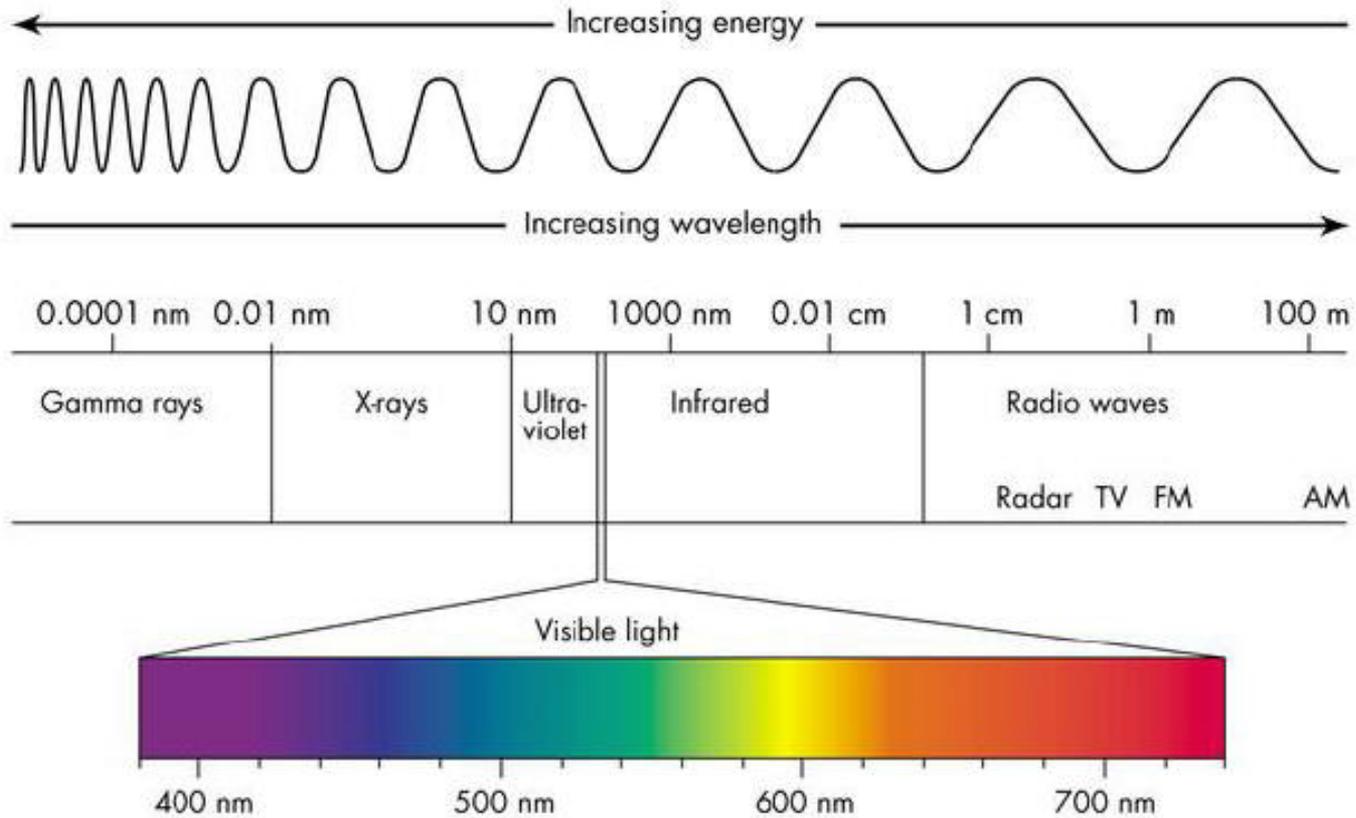


Satellite Imaging: Capabilities and Challenges

Panel IV: Sensor Technologies to Support
Maritime Domain Awareness

Virgil L. (Buck) Sharpton, PhD
President's Professor of Remote Sensing
Vice Chancellor for Research
University of Alaska Fairbanks

Sensors rely on EM Radiation



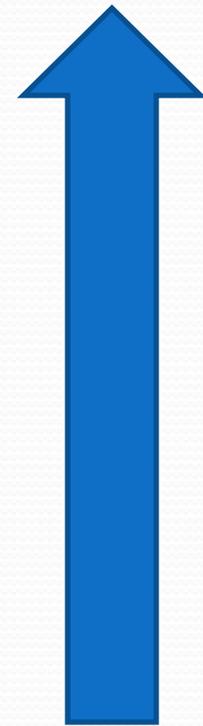
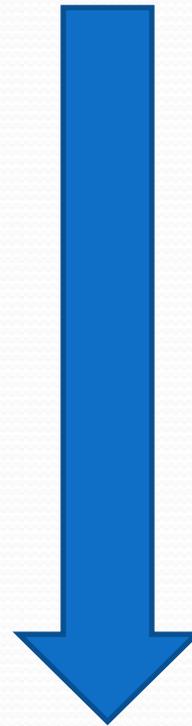
Benefits of Satellite Monitoring

- Spatially 'continuous'
- Radiances provide useful biophysical and chemical information
- Noninvasive
- Inconspicuous (possibly excepting SAR)
- Relatively inexpensive
- Important for benchmarking, change detection

Utility for Maritime Security

- Environmental
 - Weather
 - Sea state
 - Obstacles, barriers
- Damage Assessment
 - Oil Spills
 - Fires
- Ship Detection
- Ship Tracking
- Ship/Target Identification

Spatial Resolution



Revisit Frequency

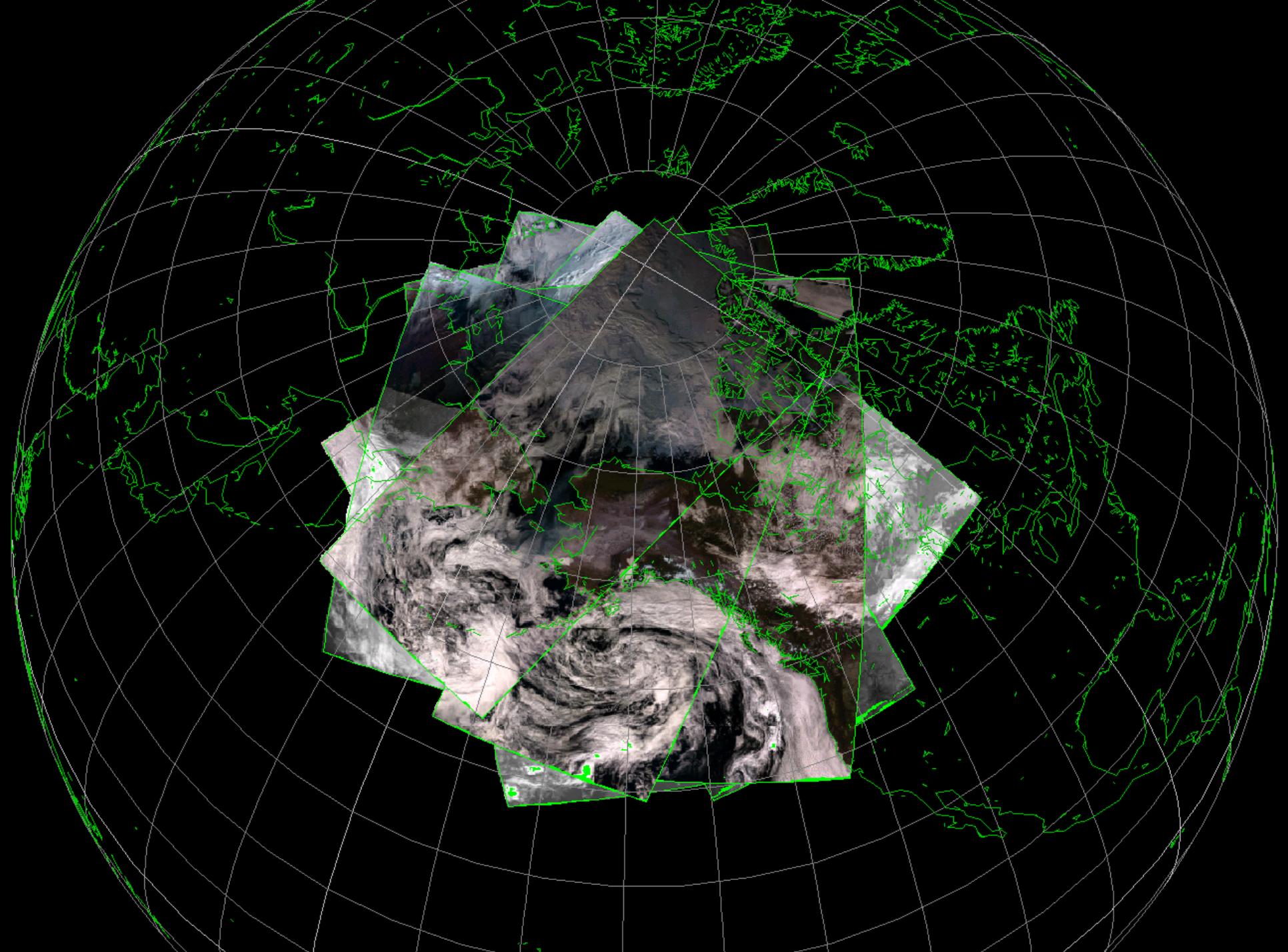
As a Decision Support Tool

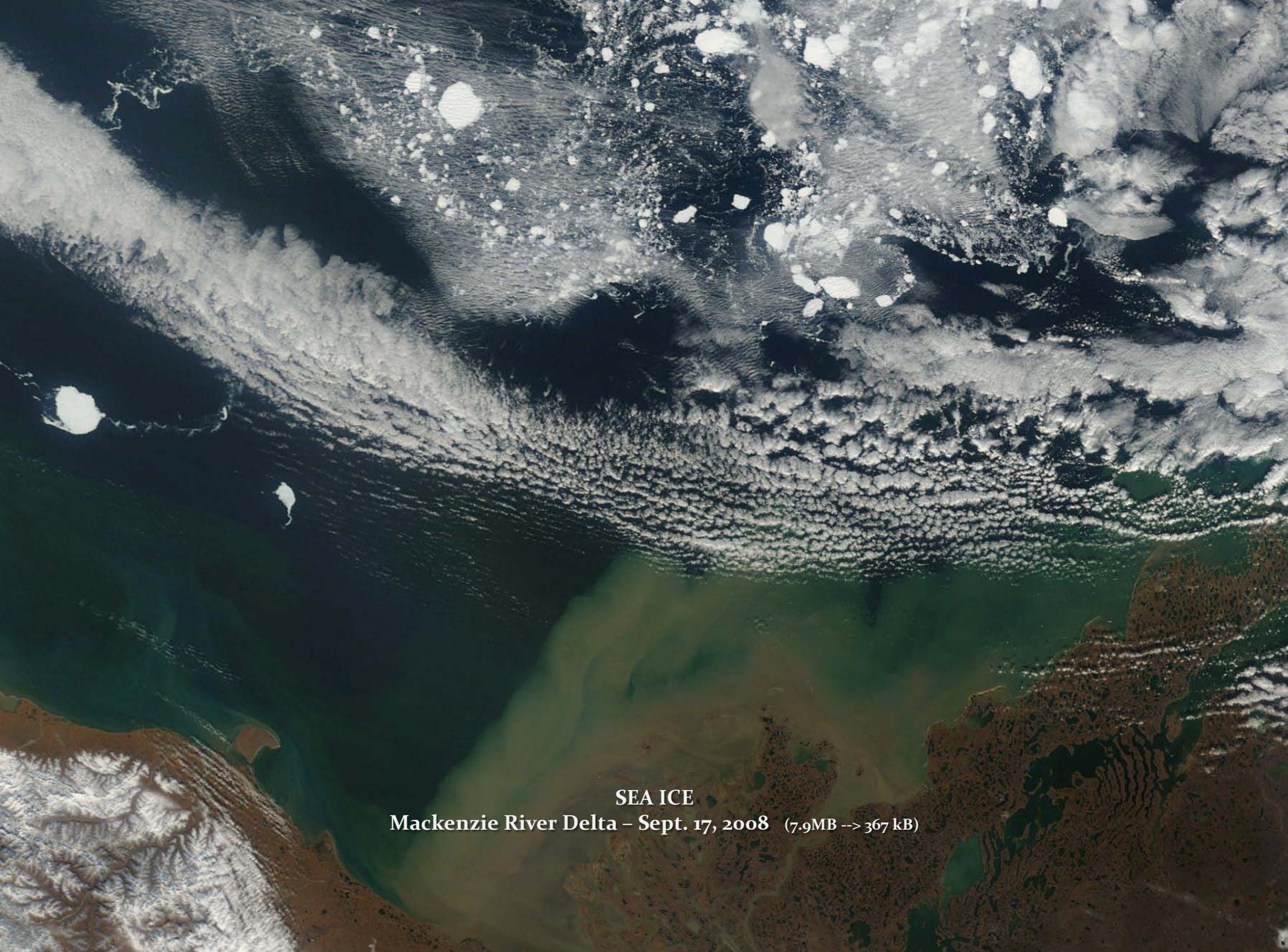
- Minimize latency
 - Direct Reception
 - Efficient Processing
 - Effective Post-processing
 - Speedy delivery through Internet
- Improve automated detection algorithms
 - Particularly difficult at high latitude
 - Flag anomalies for inspection
- Deliver information product designed for/by client
 - What are client's needs?
 - What are their capabilities?



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SEA ICE

Mackenzie River Delta - Sept. 17, 2008 (7.9MB --> 367 kB)

5km

147.50.58W 64.51.34N

Images **Linework**

Image Dataset: Terra-1 / MODIS/2005

1547 of 1654 scenes match:

SID	Date	Time
17.0007	2005-08-05	00:07:58 GMT
17.0144	2005-08-05	01:44:47 GMT
17.0322	2005-08-05	03:22:14 GMT
17.0455	2005-08-05	04:55:50 GMT
17.0632	2005-08-05	06:32:11 GMT
17.0810	2005-08-05	08:10:34 GMT
17.0951	2005-08-05	09:51:33 GMT
17.1820	2005-08-05	18:20:15 GMT
17.1957	2005-08-05	19:57:05 GMT
17.2135	2005-08-05	21:35:01 GMT
17.2312	2005-08-05	23:12:57 GMT
18.0050	2005-08-06	00:50:24 GMT
18.0402	2005-08-06	04:02:03 GMT
18.0537	2005-08-06	05:37:42 GMT
18.0715	2005-08-06	07:15:06 GMT
18.0854	2005-08-06	08:54:06 GMT
18.1036	2005-08-06	10:36:36 GMT
18.1902	2005-08-06	19:02:18 GMT
18.2039	2005-08-06	20:39:56 GMT
18.2217	2005-08-06	22:17:51 GMT
18.2355	2005-08-06	23:55:44 GMT
19.0133	2005-08-07	01:33:13 GMT
19.0310	2005-08-07	03:10:12 GMT

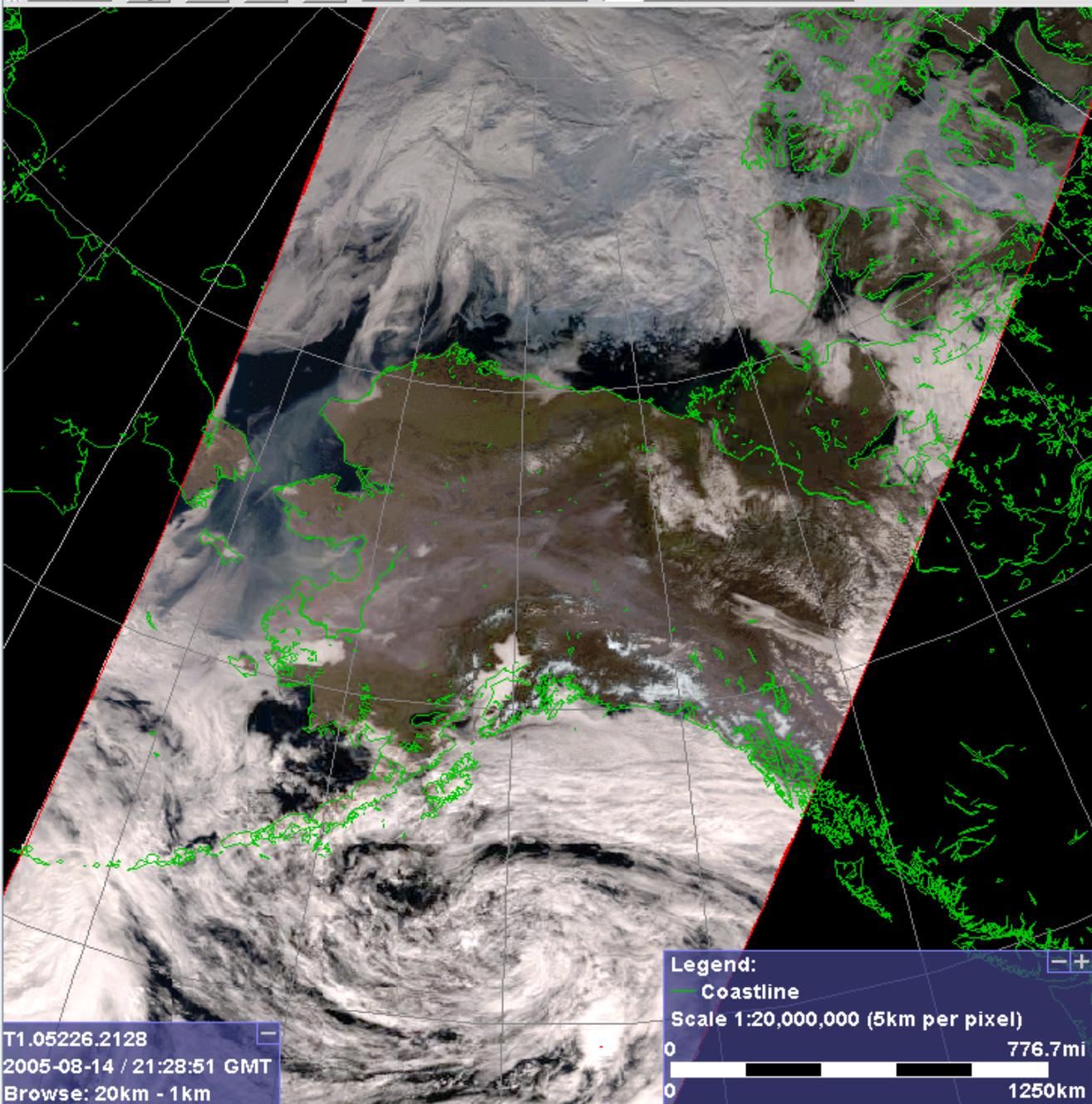
Histogram Equalize This Sensor

Info **Nav** **Select**

Scene information:

ID: T1.05226.2128
 Sensor: Terra-1 / Modis
 2005-08-14 / 21:28:51 GMT
 Browse: 20km - 1km

[View Full Metadata](#)



T1.05226.2128
 2005-08-14 / 21:28:51 GMT
 Browse: 20km - 1km

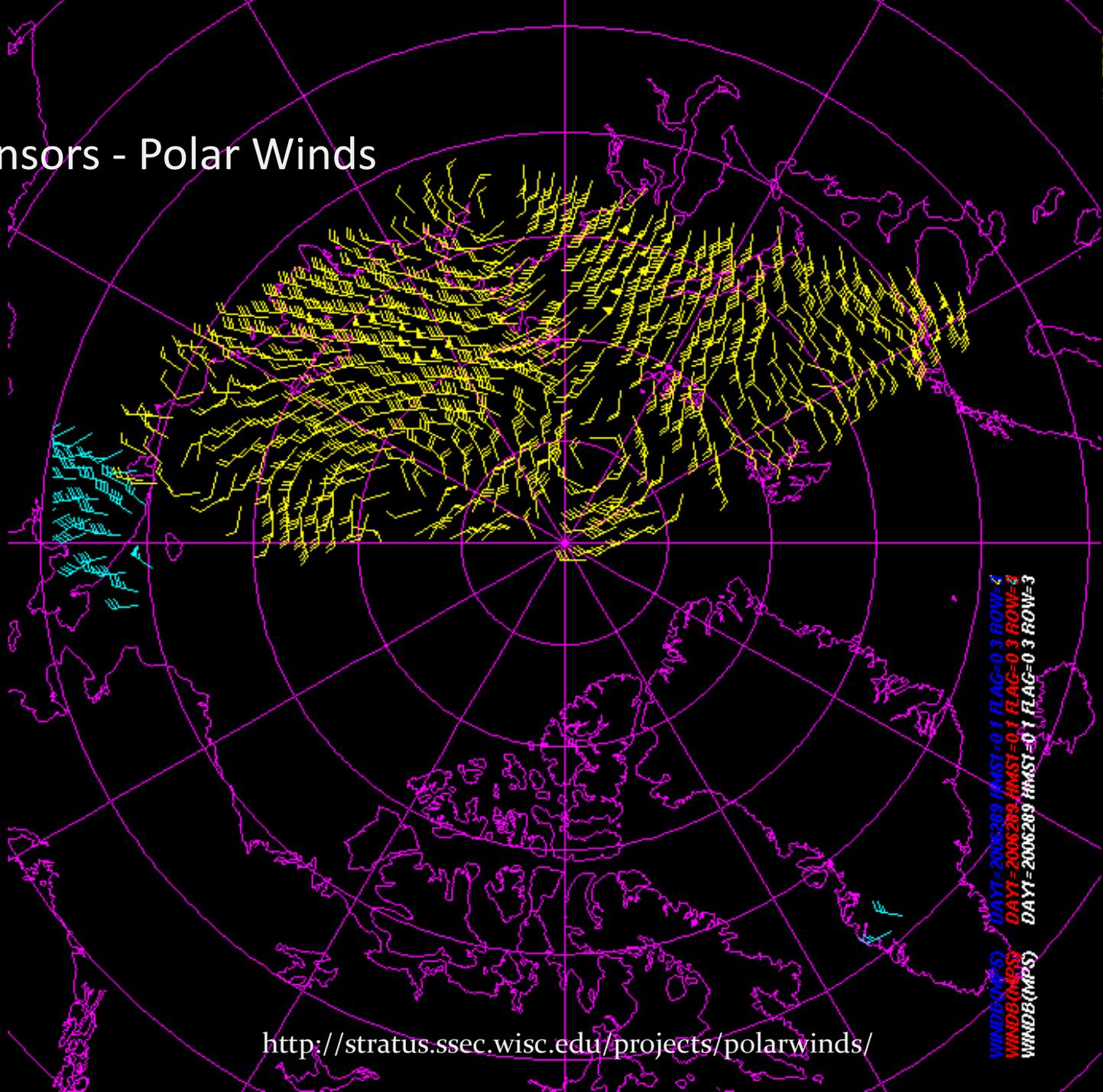
Legend:

- Coastline

Scale 1:20,000,000 (5km per pixel)

0 776.7mi
 0 1250km

All Sensors - Polar Winds





50cm
147.50.58W 64.51.34N Go

Images Linework

Image Dataset: Misc

1 of 62 scenes match:

SID	Date	Time
Show no image		
QB.FAIRBANKS	unknown	unknown

Histogram Equalize This Sensor

Info Nav Select

Selected scenes:

Add To List	Clear List
Add To Bg	Clear Bg
Move Up	Move Down



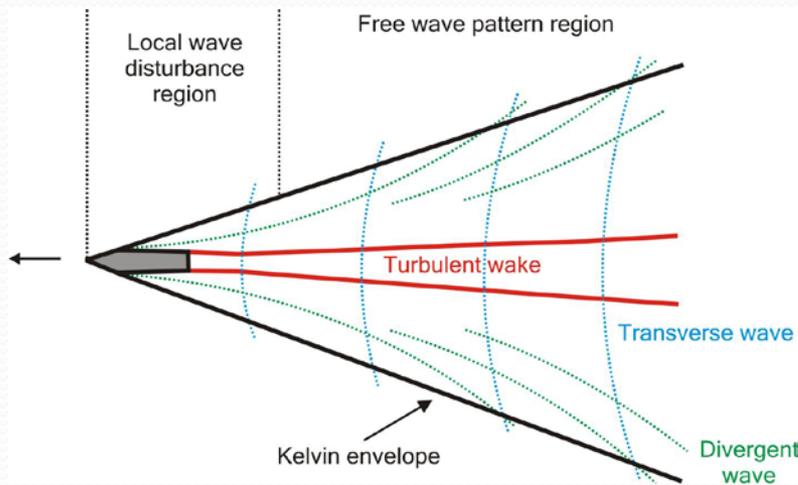
QB.FAIRBANKS
 60cm Composite
 From: FNSB (Image Courtesy of Digital Globe)
 2002-2003
 Browse: 200m - 50cm

Coastlines: No data in this area
 Scale 1:2,000 (50cm per pixel)
 0 410.1ft
 0 125m

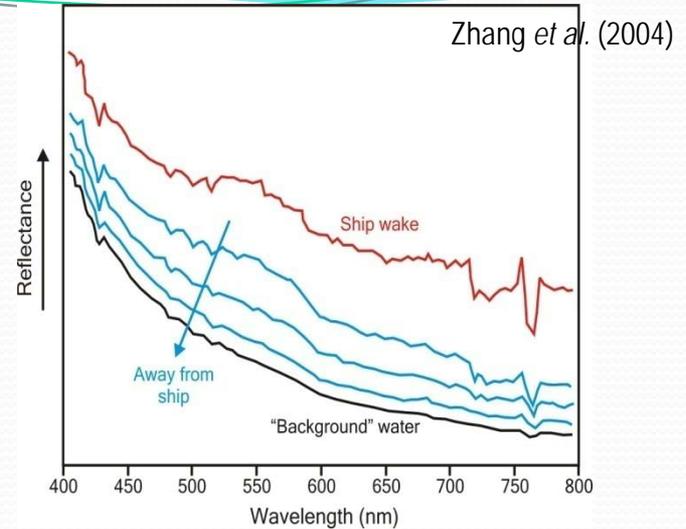
Wakes are apparent as ocean color anomalies

Ship wakes in optical images and ocean surveillance using small-satellites: Robert Wright, University of Hawaii

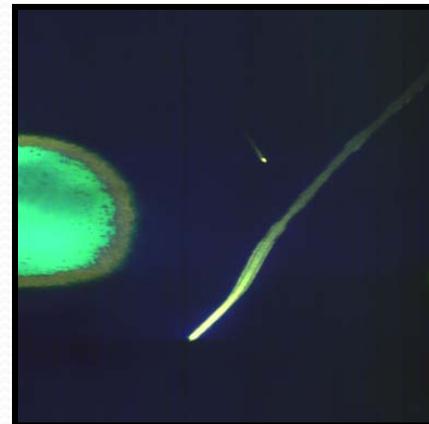
Idealized ship wake



The wake provides a target for detection that is much larger than the ship itself



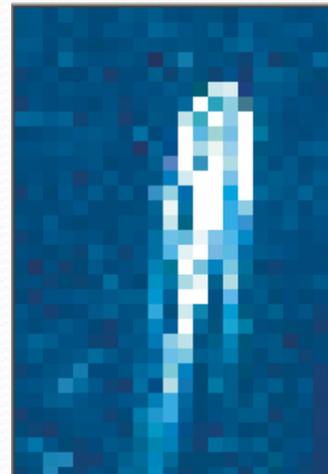
Instruments on satellites can measure the color of the water, and hence detect the ship wake



Ship wakes visible in Hawaii's HICO instrument

CIMES Objective: Identify the requirements for remote detection of ships using an optical remote sensing system

- Acquire high resolution data from an airborne HIGP-built sensor

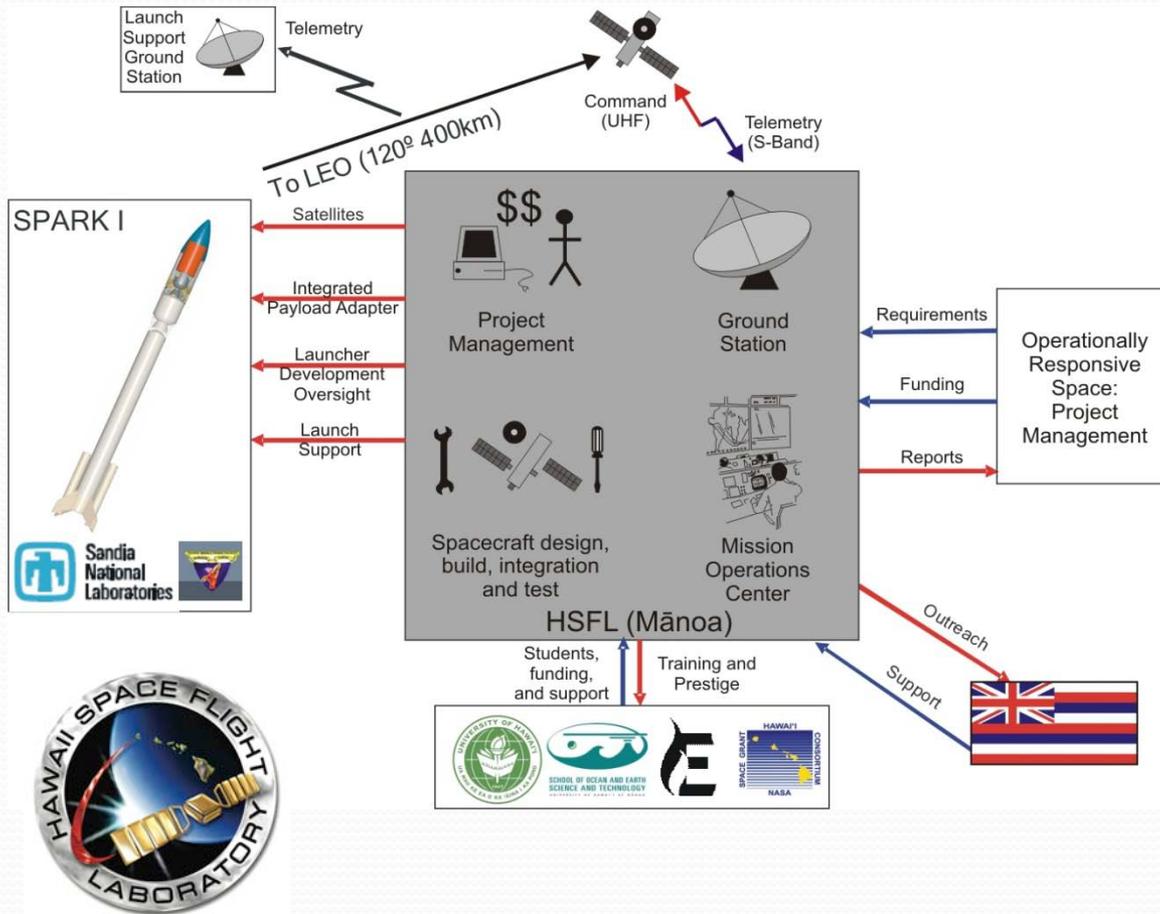


- Using this high resolution airborne reference data design an imaging camera that can detect ship wakes from space



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CIMES Concept Study for an Ocean Surveillance System Using Cheap, Multiple Small Satellites

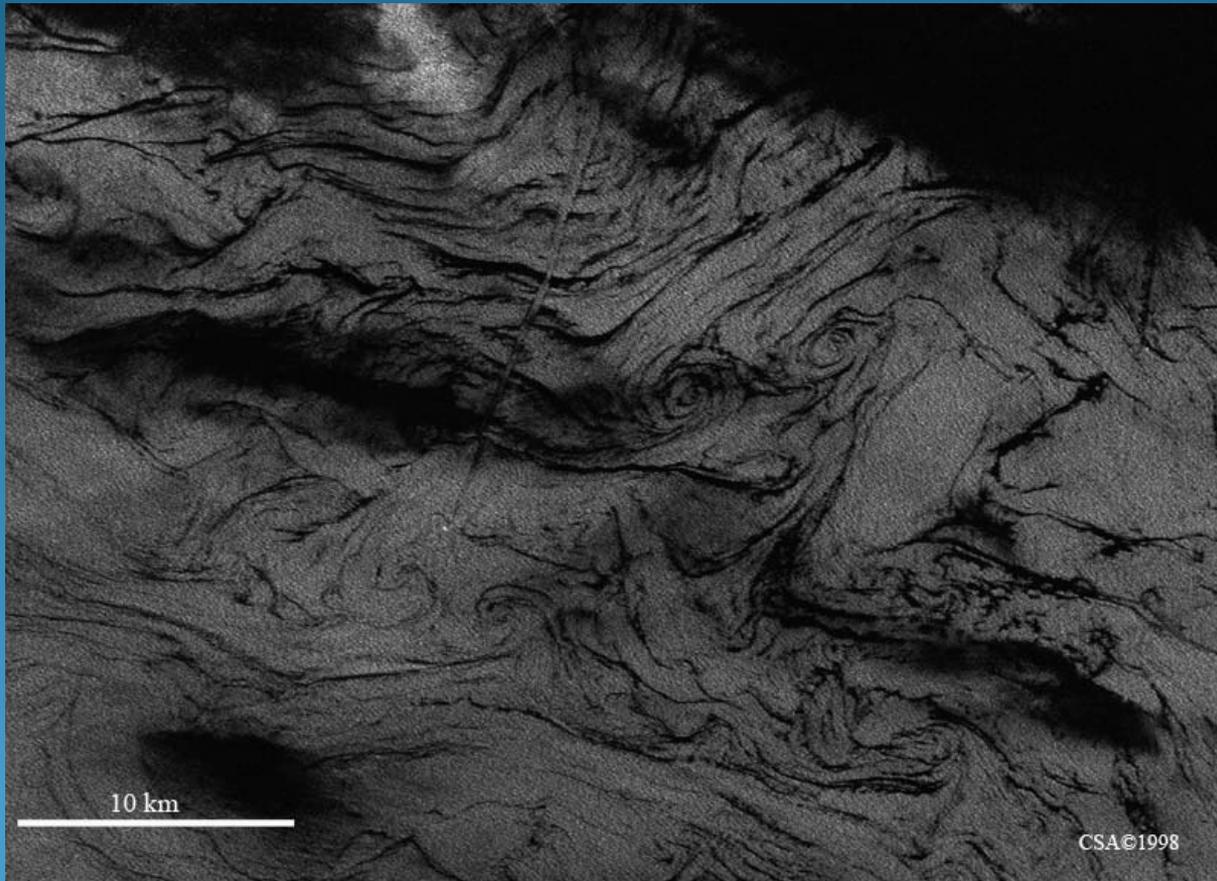


- Hawaii Space Flight Laboratory is currently developing a capability to place 300 kg into ~400 km orbit for ~\$16M



Slick Detection

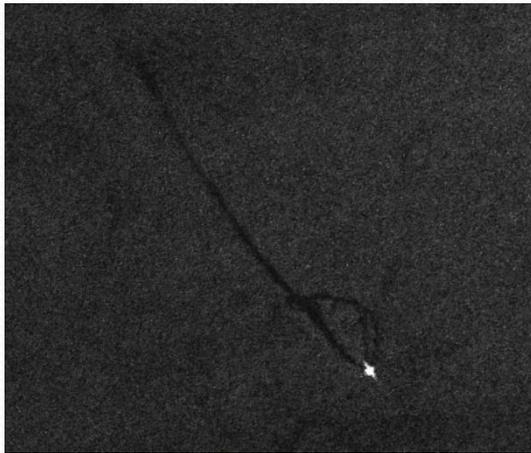
Biogenic Slicks



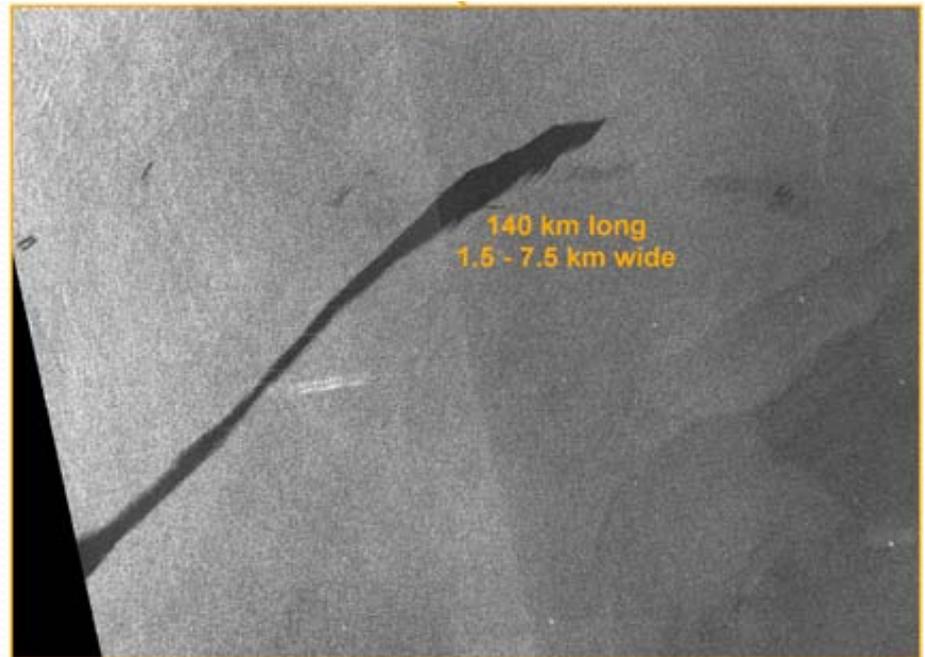
Gulf of Alaska

Slick Detection

Illegal Bilge Dumping



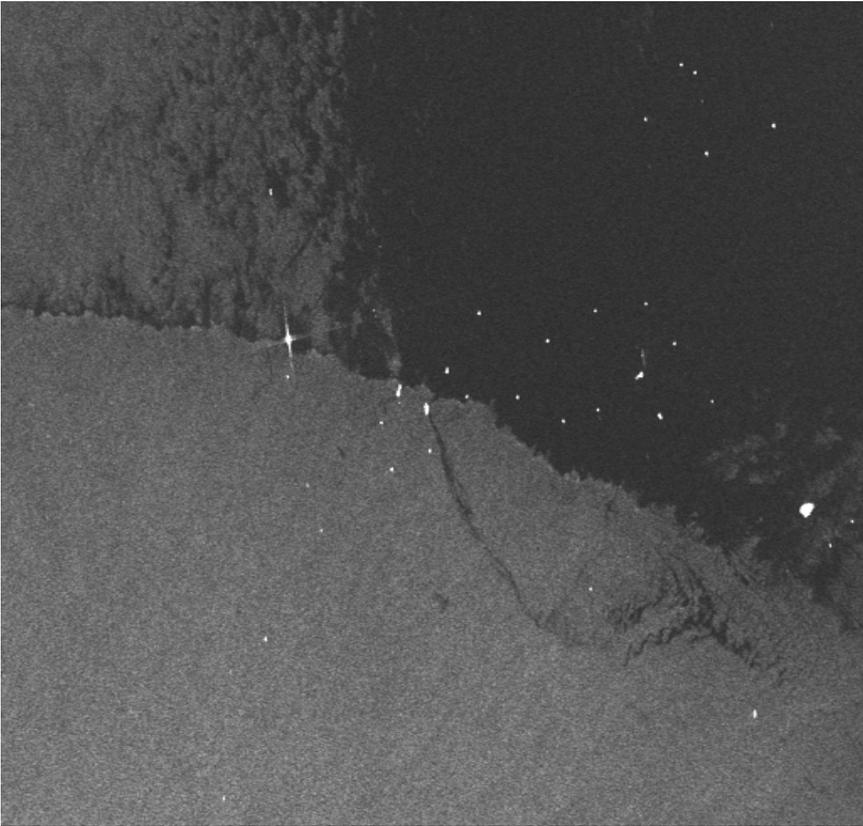
Accidents



Ship Collision off Sri Lanka

Ship Detection

Fishing Fleet



Ship associated with wake

