# Observational Needs for Operations

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**Presented @ UK Polar Earth Observation Meeting**

**Using EO data to support operational services**

# Background Info

## Earth-i:

formed in Sept. 2015; SME – currently ~ 20 employees;
Master distributor of DMC3/TripleSat data, promoting the uptake of using high spatial resolution data from space and bringing application and data supply together in dedicated EO alliances


## Dr. Colin Grant:

Consultant; 35+ years MetOcean experience in Oil & Gas industry, 30 with BP; former chairman of IOGP MetOcean committee

## Dr. Peter Hausknecht:

Chief Scientist – Earth-i; 25+ years experience in Earth Observation; former Woodside – SME on EO; former chairman of IOGP Geomatics subcommittee on Earth Observation

# Polar Operations – Industry Sectors & Activities

- Resource extraction - Oil & Gas / Minerals
- Shipping
- Fishing
- Research
- Defence
- Tourism

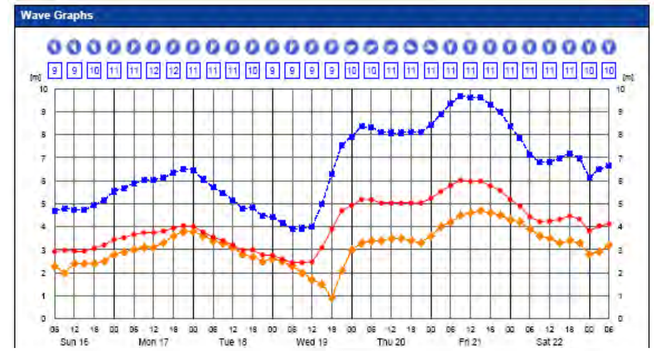
- Unique Operational Challenges (Physical)
  - Extreme temperatures / daylight hours
  - Sea ice / icebergs
  - Permafrost / polar lows
  - Visibility
  - Remoteness & lack of infrastructure

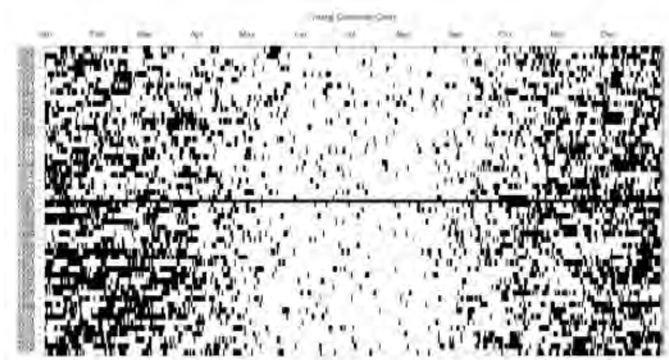

- Antarctic – research / fishing / tourism

# Operational Scenarios and Project stages

## Time horizons

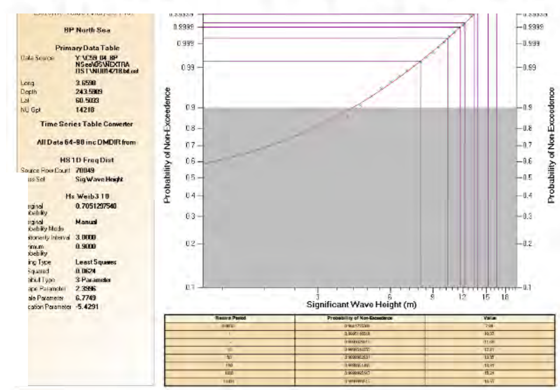
- Short term – Nowcasts & Forecasts
  - 0 to 10 days
- Medium term – Operational Planning
  - monthly, seasonal, annual variability
  - statistical products for risk assessments and planning
- Long term – Design Extremes
  - 1 in 100 years to 1 in 10,000 years



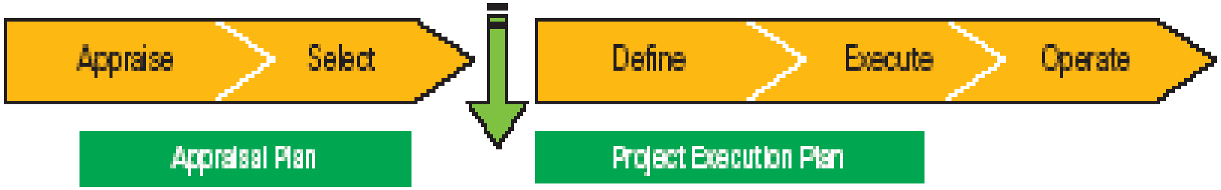



## Location issues

- Point <u>and</u> route data and statistics required




## Project stages



# Key physical parameters for Polar operations

**Meteorology / MetOcean:**

- Winds / waves / currents / water levels
- Air and sea temperatures
- Snow & icing (ice accretion)

**Ice:**

- Sea ice (first / second / multi year)
- Icebergs
- Permafrost

**Environmental:**

- Baseline assessments & water quality monitoring
- Change detection and evaluation

**Influence of climate change on all parameters over time**

Selection some application where we can establish a link to polar activities

# Earth observation for operational applications

## A service required – not an image !

The value add product – presented as an operational service is the key to a successful uptake in the industry

## Combination with other data and models

EO by itself can often provide some key information, but the combination with other sensors becomes the powerful tool

Surface altimetry > ocean current + water conditions > oil spill modelling

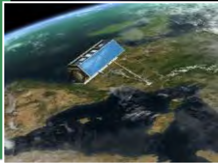
Radar data > water surface images > wind / wave statistics & solitons > ocean engineering design (e.g. for 1 in 10.000 year events)

Radar & optical > Icebergs & models > detection & forecast > ice risk map

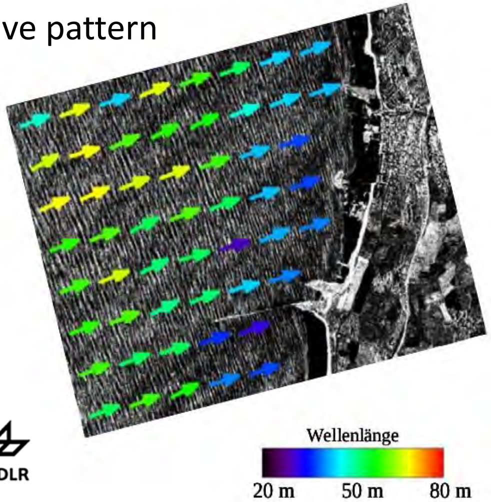
Optical data > water quality > baseline map > change > allowed turbidity limits

Radar data > InSar (2 different dates) > rel. distance> asset subsidence

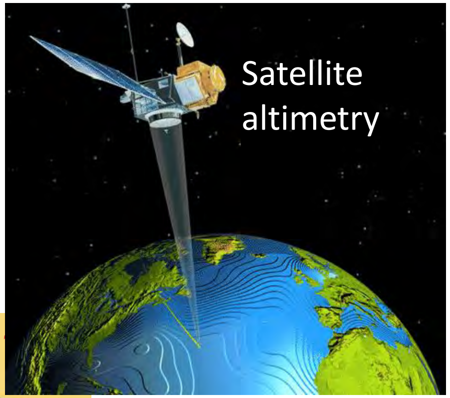
# Operational ocean current mapping and modelling

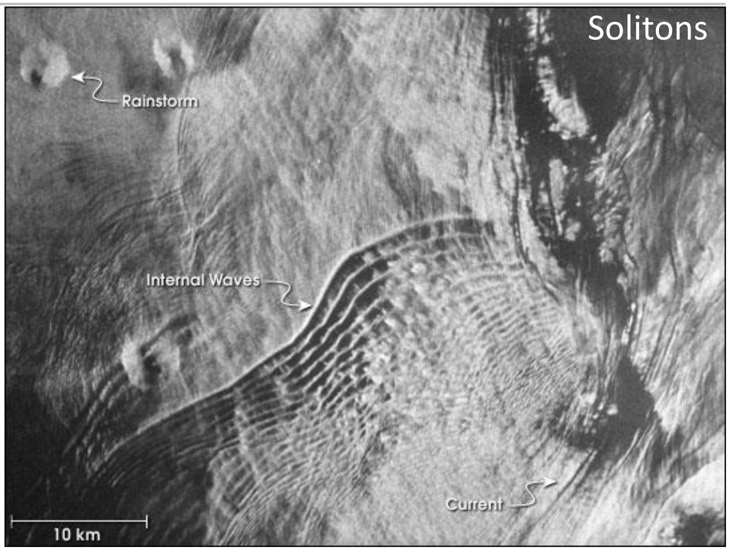


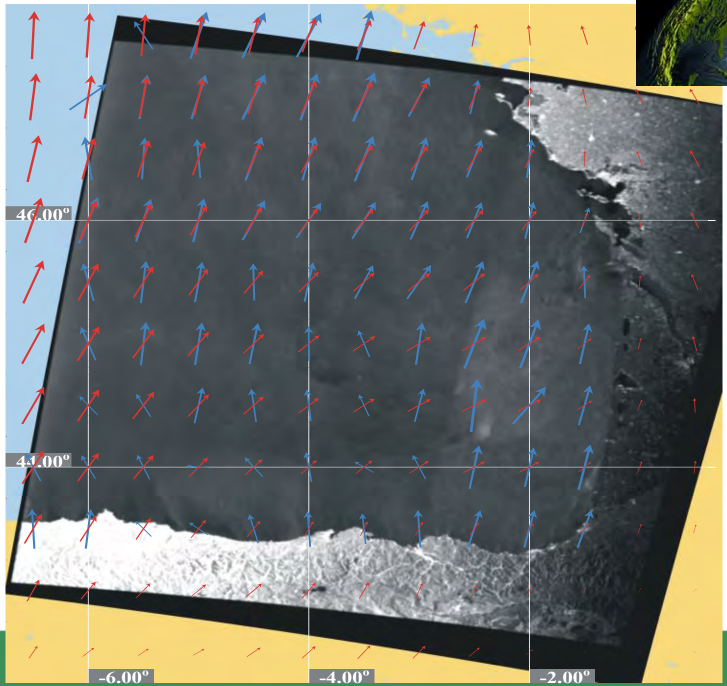
Wave pattern



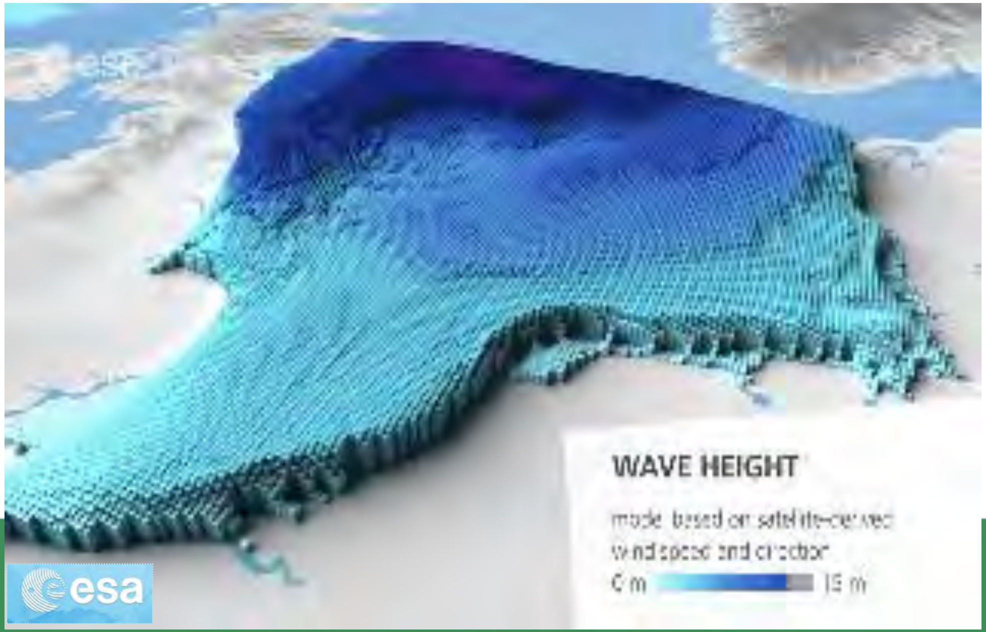

DLR



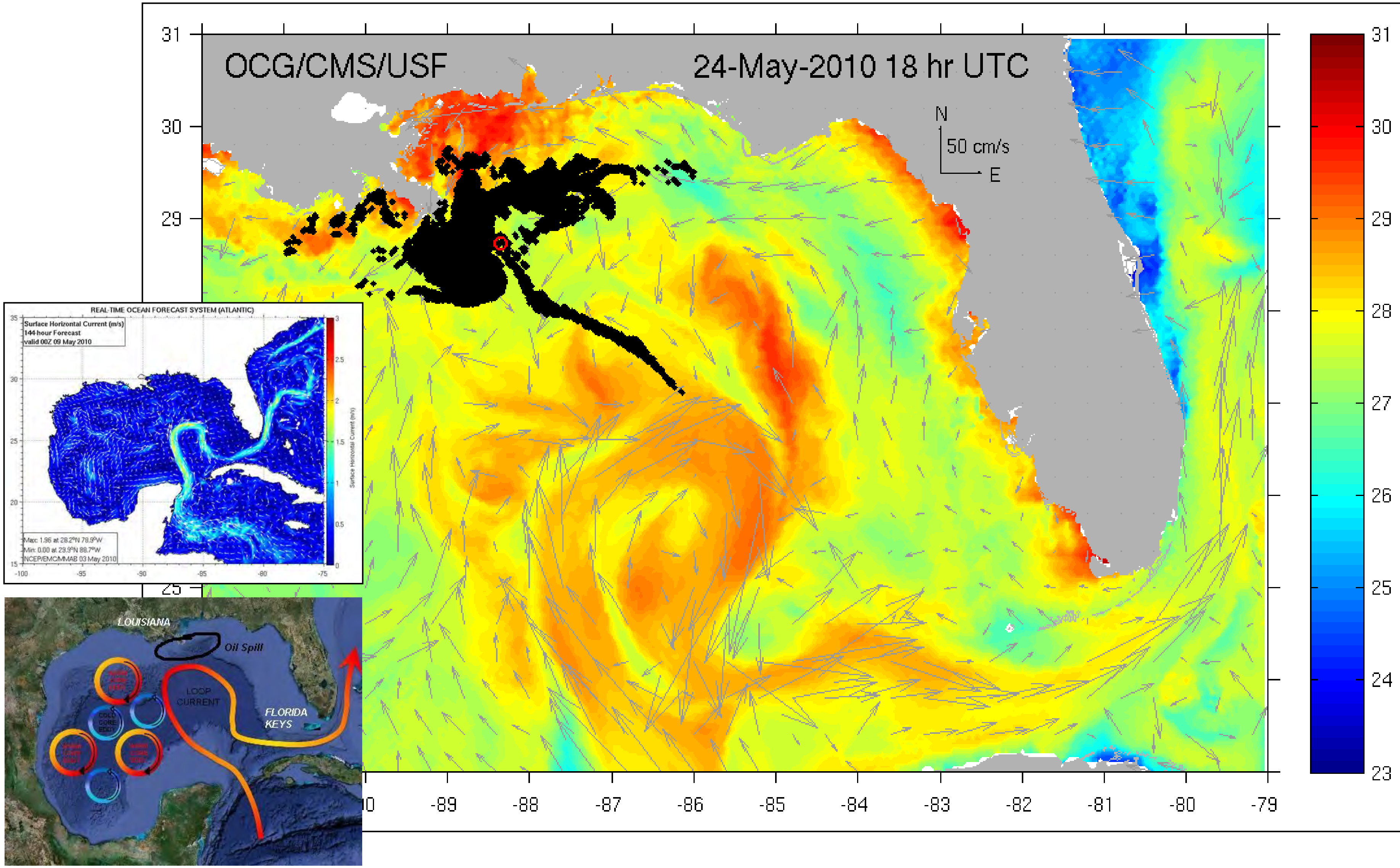




RadarSat derived Windfields: model vs observed



# GOM Oil-Slick modelling




using Ocean current data and sea surface temperature map

# Arctic Response Technology JIP

## REMOTE SENSING

### WHAT IS REMOTE SENSING?

Remote sensing is the detection, monitoring and tracking of oil on the water surface, under the ice, within the ice sheet, or on top of the ice by using sensors mounted on a variety of platforms: satellites, aircraft, helicopters, autonomous underwater vehicles, etc.

### ABOUT THE PROJECT:

The Joint Industry Programme (JIP) is conducting a rigorous test programme that systematically compares the different sensors under controlled conditions, with the aim of identifying the most effective combinations of sensors that can locate oil, as well as identify oil spreading and thickness.

#### Satellite Platforms

Sensors may include high-resolution optical imagers and synthetic aperture radar. Advantages of using satellites include wide area coverage, and in the case of radar imagery, independence from cloud cover, fog or darkness. Satellite detection of spills is most efficient in water with lower ice concentrations, making this technology most useful in conditions of partial ice cover.


#### Airborne Platforms

A number of Arctic nations and other countries where shipping is routinely conducted through ice employ sophisticated pollution surveillance aircraft to search for oil spills.
These aircraft normally carry a suite of sensors that complement one another to differentiate thin from thick slicks, identify oil type and operate in conditions of low visibility. Current efforts are focusing on how best to fuse the data from these different sensors into a useful operational product that response teams can use in real time.

#### Experimental Sensors

Several University-led and industry-sponsored development projects are under way to adapt new technologies to further advance detection of oil in ice. One of these programmes recently (2012) led to the development of a Frequency Modulated Continuous Wave radar designed to fly at low altitude to detect oil trapped in or under ice. Another initiative aims to use the known principles of Nuclear Magnetic Resonance to achieve a similar goal of detecting oil in ice with a specialized antenna mounted on a helicopter. JIP supports ongoing research efforts to test both of these technologies in a realistic setting, using crude oil and an artificially grown ice sheet.

#### Surface Systems

Surface remote sensing systems can be deployed from a bridge on a support vessel to detect oil on the water in light ice cover. Other surface systems include Ground Penetrating Radar that can be towed on the ice surface to detect oil buried under snow or trapped within ice. Another highly effective remote sensing system employs trained dogs on the ice to detect and find oil buried under snow or in the top surface of the ice.

#### Subsea Platforms

Sensors mounted on unmanned underwater vehicles, especially the latest generation of rapidly evolving autonomous underwater vehicles (AUVs), hold the potential to overcome some of the challenges associated with airborne systems (low visibility, difficulty in penetrating sea ice). AUVs carrying a range of sensors, such as cameras and sonar, could provide a direct view of oil under the ice and possibly of oil that is encapsulated by a layer of new ice growing beneath the oil. Preliminary tank tests have demonstrated positive results using upward looking sonar that can show not only where the oil is but also its thickness.

## ABOUT THE JIP

To further build on existing research and improve the technologies and methodologies for Arctic oil spill response, nine oil and gas companies established the Arctic Oil Spill Response Technology Joint Industry Programme (JIP). The goal of the JIP is to advance Arctic oil spill response strategies and equipment as well as to increase understanding of potential impacts of oil on the Arctic marine environment.

The Arctic Oil Spill Response Technology JIP is sponsored by nine oil and gas companies:

bp · Chevron · ConocoPhillips · eni · ExxonMobil · NCOC · Shell · Statoil · TOTAL

**http://www.arcticresponsetechnology.org**

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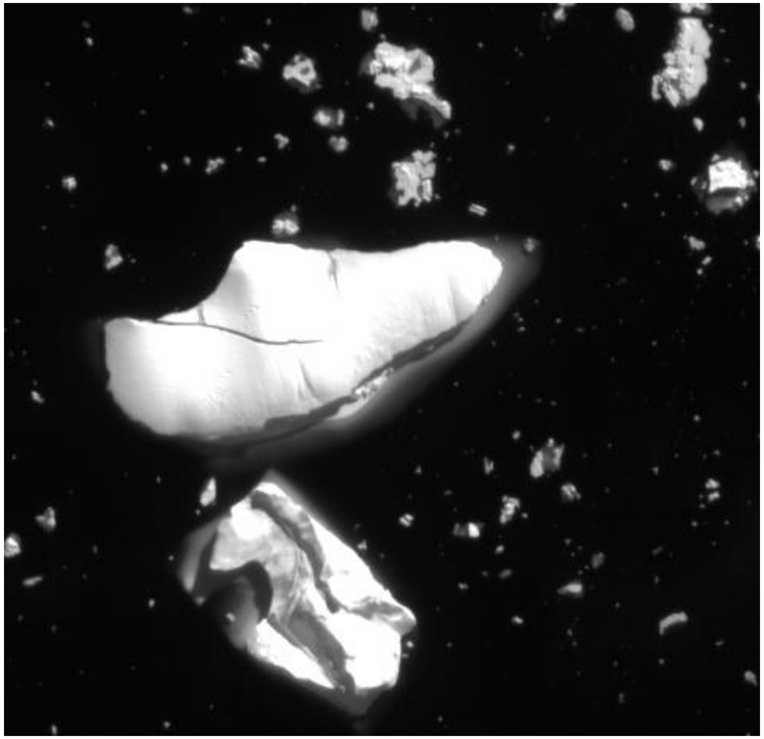
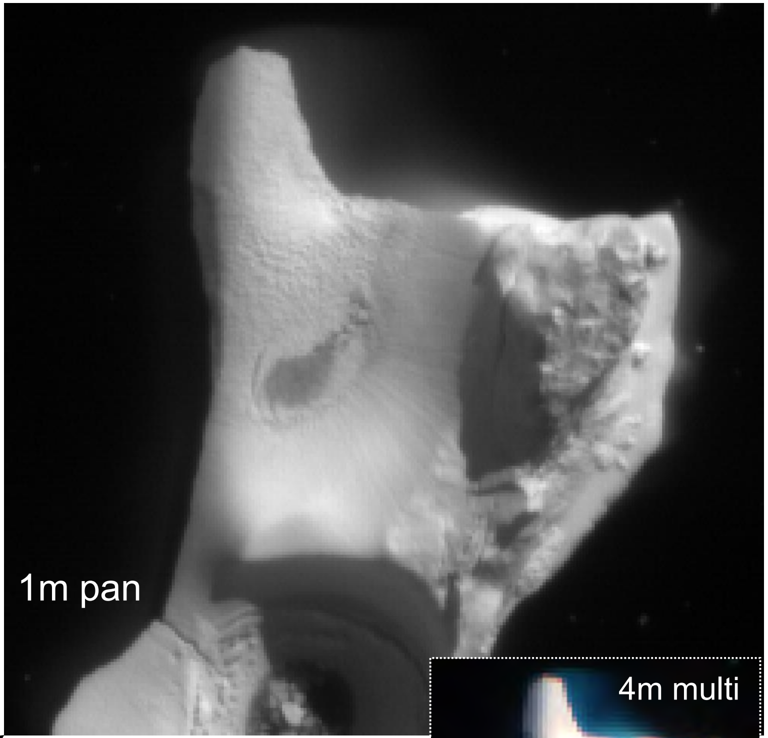
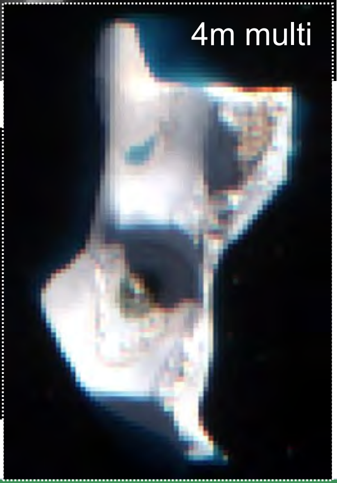
The industry is preparing for operations in the arctic

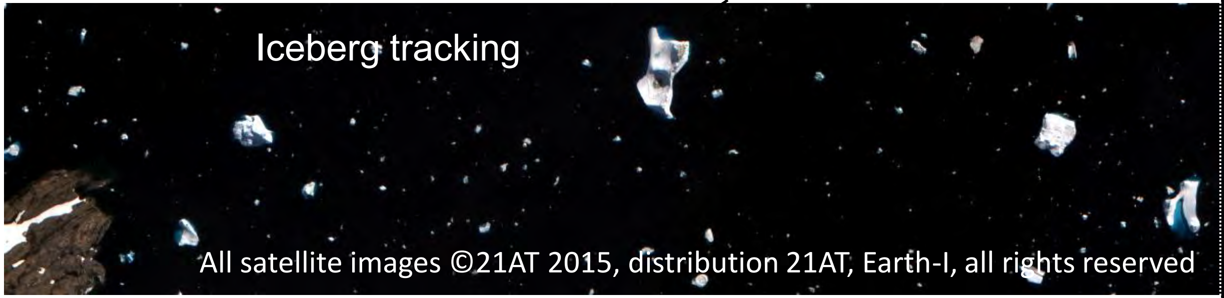
# Operational high resolution satellite data for O&G






Greenland – west coast

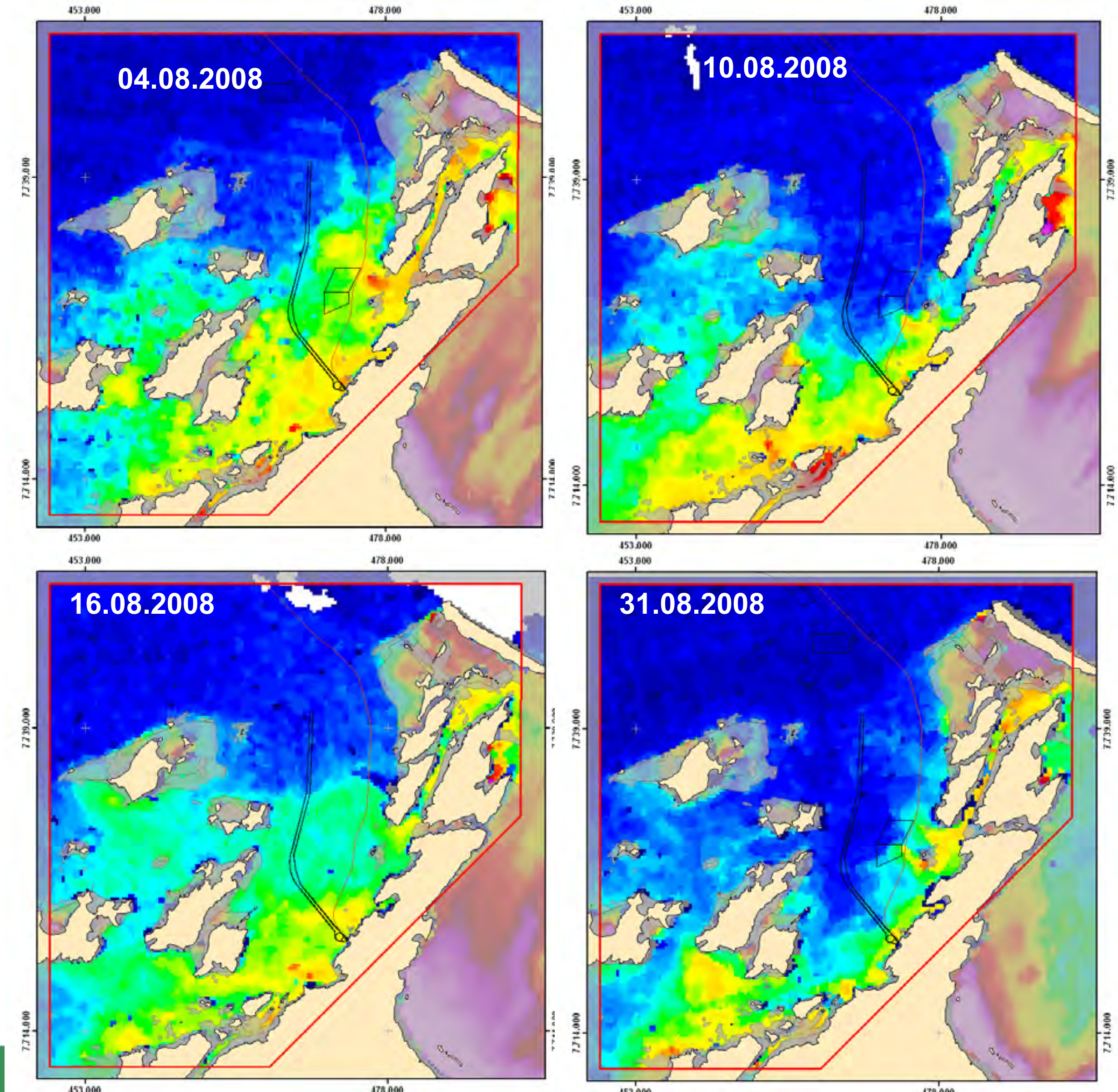



Working in synergy with radar monitoring and tracking

**Iceberg monitoring and coastal mapping**
**Displayed is a 4m multispectral image; RGB = ch 4,3,2**

## Safety monitoring - Greenland

# Operational water quality monitoring




MODIS Satellite data

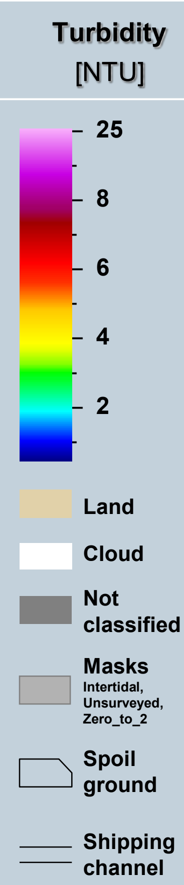
*250 m pixel-size*
*Time series in August 2008*

**420+ data sets**

**Oct. 2007**

**- mid 2010**

EXAMPLE DATA




One image delivered

on average every 2$^{nd}$ day

Many more processed

*Water quality monitoring area*

MODIS based water turbidity mapping:

for pipeline dredge monitoring
see 2010 ESA O&G workshop