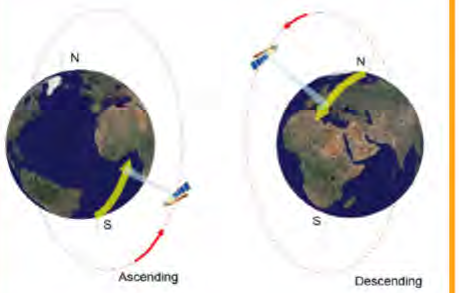
Operational Offshore Platform monitoring

What does "InSAR technology" mean?

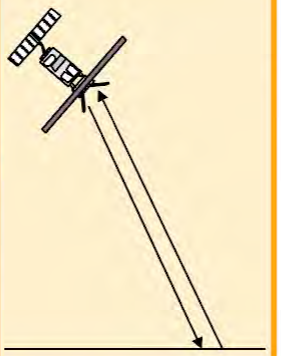
Radar satellites

In terferometric = Superimposition of waves to detect differences

S ynthetic
A perture = High resolution
R adar radar system

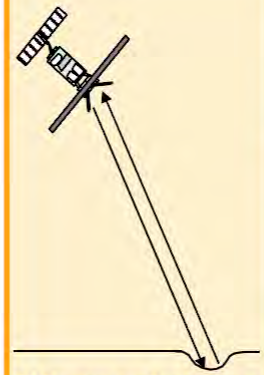


First measurement



Travel phase between ground and sensor gives millimetric distance

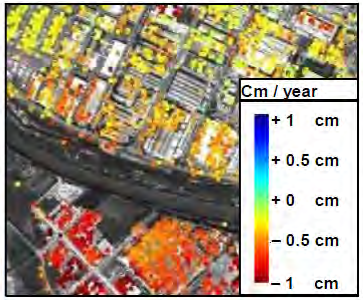
Second measurement (afterwards)



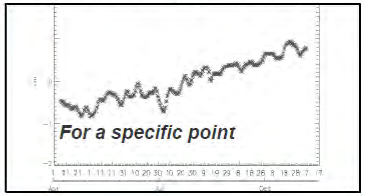
Difference between two measurements indicates ground movement over time

Results

Ground motion



Ground movement time series



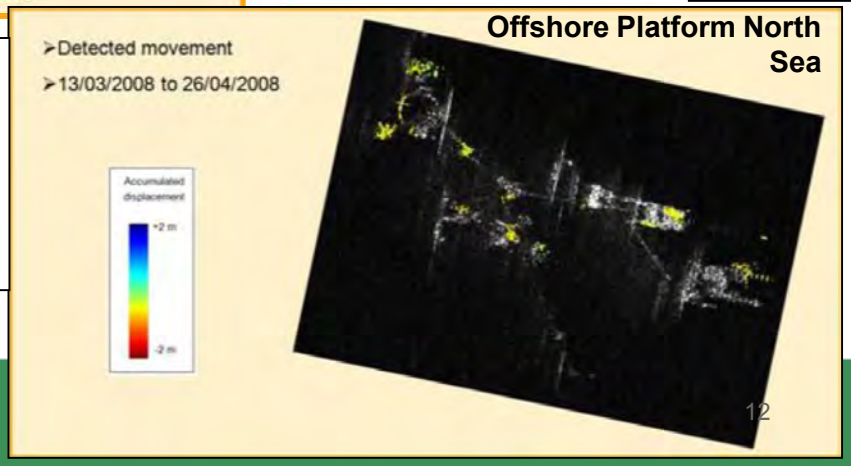
COSMO-SkyMed x 3

Launch: June & December 2007, October 2008
Owner: Italian Space Agency
Frequency: X-band

TerraSAR-X

Launch: June 2007
Owner: German Space Agency
Frequency: X-band

Ground movement is measured with radar satellites, comparing satellite distance at different moments in time



Courtesy: Altamira Information technology

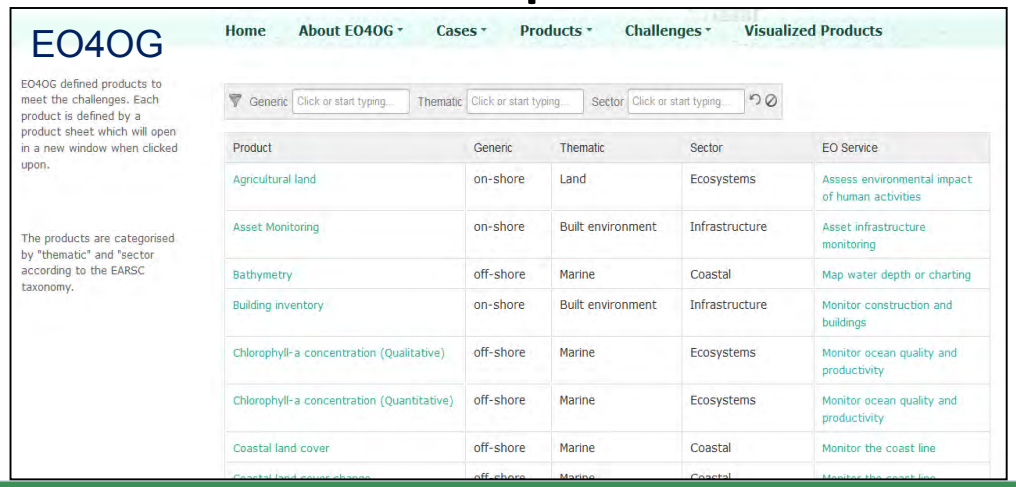
OGEO, EO4OG, EO Portal and more …

ogeo
oil and gas earth observation group

The portal still exists : http://www.ogeo-portal.eu/

It is fully linked with the EARSC EO portal – but secured; OGEO members can see all EARSC content – but OGEO content is secured from non-OGEO logins, unless allowed

=> Free & public information !



IPIECA

International Association of Oil & Gas Producers

The O&G industry is actively engaging with stake holders to develop good practise guidelines and synergise efforts

EO4OG – example product sheet – iceberg monitoring

EO4OG PROJECT esa

Iceberg Monitoring

Different satellite sensors are available to detected and monitor icebergs, including SAR and optical systems, as well as satellite altimeters. Operational monitoring typically involved the analysis of single and multiple images in near real-time (NRT). Historical data are analyzed to provide a statistical perspective of the size distribution and variability of iceberg populations.

Current Use:

- **Historical analysis for environmental characterization, ice management specifications and platform design**
- **Operational monitoring in NRT for exploration and production**
- **EO especially useful when monitoring large, remote areas with limited infrastructure and surveillance capacity and limited existing information on iceberg occurrence**

Geo-Information Requirements	This product relates to the following challenges: • CLS_4.1: SAR imagery to detect ships and icebergs
Thematic Information Content	Iceberg size [m], location [lat/long], shape characteristics, classification [ship/iceberg], detection and classification confidence [low, medium, high], spatio-temporal size distributions
Spatial Resolution	5 m to 1 km (dependent on user needs and available/selected source satellite data)
Spatial Coverage	Varies depending on user requirements from 20 km swath to transit route exceeding 1500 km
Minimum Mapping Unit (MMU)	Desire to detect icebergs 1 m and larger, but choice of data dictates what size icebergs will be detectable
Temporal Resolution	Range from a single pre-season survey to daily coverage
Geographic Coverage	• Arctic and sub-Arctic areas • Antarctic and Southern Ocean
Timeliness	NRT or archival processing (depending on user requirements); NRT product availability typically within 3 hours of sensing
Accuracy	• Probability of detection and classification <80% to >95% (depends on sea state and imaging mode) • Geometric accuracy: +/- 1 to 5 pixels (depending on geospatial reference data and sensor spatial resolution)
Data Format	• Vector polygons, gridded or plain text formats based on user requirements • Historical analysis typically provided as report
Data Access	Restricted access through commercial suppliers
Validation Approach	• Comparison with high resolution optical images, aerial surveillance and vessel-based observations • Geometric accuracy assessed with geospatial reference data

EO4OG PROJECT esa

Method	• CFAR/thresholding technique for detection in open water; principal data source is SAR imagery • Detection in sea ice uses more advanced and non-standard methods (e.g. quad-pol SAR data)
Degree of Automation	• Automated detection followed by manual quality control • Detection in sea ice requires additional analyst interaction
EO Input Data	e.g. LANDSAT-8; MODIS;SPOT; Quickbird; IKONOS; ENVISAT (archival); RADARSAT-2; TerraSAR-X; COSMO SkyMed; CryoSAT, Jason-1/2
Non-EO Input Data	• Training information for supervised detection and classification • Land and space-based AIS data
Contribution of EO	Major: this product is primarily based on EO imagery verified with aerial or other validation data
Data Source	• EO data: imagery providers • Non-EO data: user,
Prospects	High reliance on EO data especially during pre-license and exploration stages. During production EO data will be useful for planning rather than tactical operations
Maturity and availability	• For SAR and optical systems, TRL = 7 • For satellite altimeters, TRL = 5 to 6 • Product available from commercial suppliers on demand and publically available data sources also available
Constraints and Limitations	• Cloud cover limits of ground truth/training data collection and optical image collection • Radar images require interpretation and can be challenging when there are high sea states or precipitation • Altimeter data can only detect larger icebergs, has limited target discrimination capabilities and does not fully cover an area of interest • AIS useful for target discrimination, but only required on larger vessels and vessels may turn AIS transponders off
References	• WMO (World Meteorological Organization) (1970) WMO sea-ice nomenclature. WMO/OMM/BMO No 259.TP.145, Geneva • Power, D., Bobby, P., Howell, C., Ralph, F., Randell, C. (2011). State of the Art in Satellite Surveillance of Icebergs and Sea Ice, Arctic Technology Conference. • Bobby, P., Bruce, J., Power, D., & Fournier, N. (2012, December 3). Historical Analysis of Ice Conditions for Risk Assessment. Offshore Technology Conference
Applicable Standards	WMO 259, WMO 574; products for oil and gas industry are based on augmented versions of existing standards

Currently in progress : EO4SD

ESA lead Industry engagement project to focus potential EO based solutions to O&G issues

Outlook and Knowledge Gaps

In-situ metocean observations very limited hence wave, current and sea ice models have limited skill (IMarEST, p16)

Arctic Operations Handbook concludes:

> *The following main operational gaps in standards and guides have been found related to metocean and ice:*

- Wind and current monitoring
- Temperature monitoring and the effects of ice spray on personnel exposure
- Weather windows and metocean and ice conditions for different operational seasons
- Sea ice and iceberg data and monitoring. Satellite imagery may need to be enhanced providing higher frequency, more coverage and better resolution
- Ice behaviour and ice drift monitoring and forecasting

Outlook and Knowledge Gaps – oil spill

From IOGP Arctic Response Technology Report – Remote Sensing

- Validate and test currently operational technologies in ice conditions
  - Hyperspectral / laser / microwave systems
- Integrate networks of multiple sensors
  - No single technology suitable for all aspects of oil in ice detection
  - Satellite, aerial, surface and subsurface technologies
  - Integrate data streams with accurate geo-positioning
- Improve and automate detection algorithms and provide rapidly readily assimilated products for responder actions
- Develop standards for output products with stakeholders

We have the scientists, we have the skills, we have the knowledge
We need programmes and resources to develop, establish & implement good practise guides
… for all operations in the artic environment not only for oil & gas

before we start operating there !

Questions ??

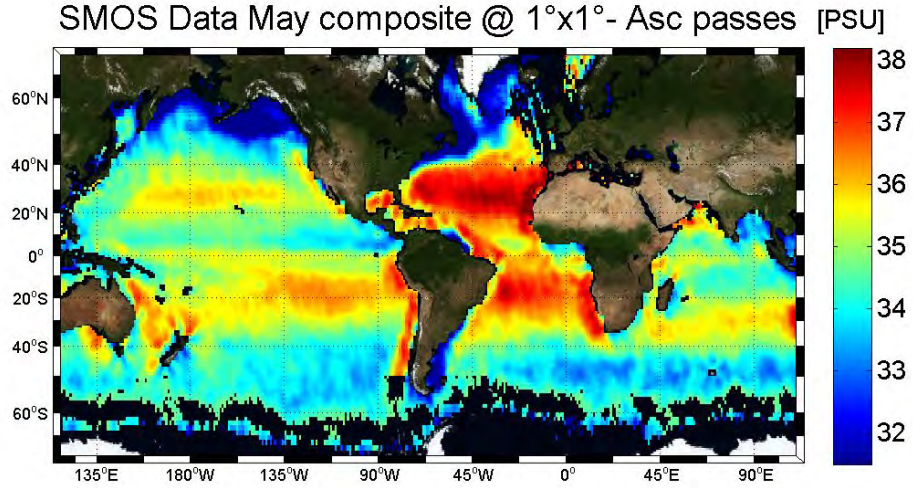
A new dawn in Earth Observation on all levels will bring:

- ***Better spatial detail & more often***
- ***More spectral channels & radar choices***
- ***Continuous time series for optical & radar***
- ***Data multiple times a day & fully integrated***
- ***Near real time access to new and archive data***

Science mission (s) to expand knowledge for operational services in the Arctic needed

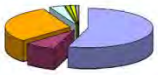
The bigger picture: only possible with satellites

Ocean sea surface salinity: May 2010

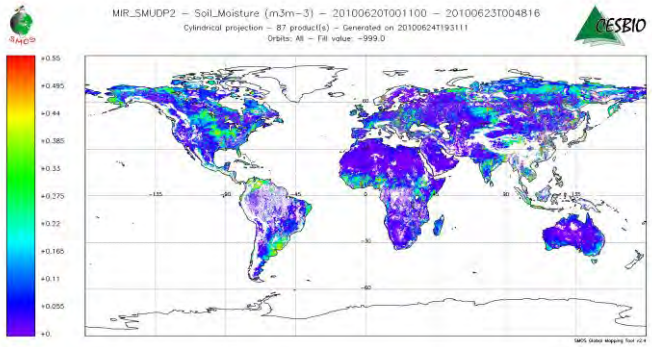


Ocean Salinity ≡ ionic salt concentration in sea water

Unity = PSU (Practical Salinity Unit)
1 PSU≈ 1 g/kg.



Chloride (Cl-):	19 g
Sodium (Na+):	11 g
Sulphate (SO4--):	3 g
Magnesium (Mg++):	1.5 g
Calcium (Ca++):	0,35 g
Potassium (K+):	0,35 g
Others :	0,00.. g
Total ≈ 35 g/kg	

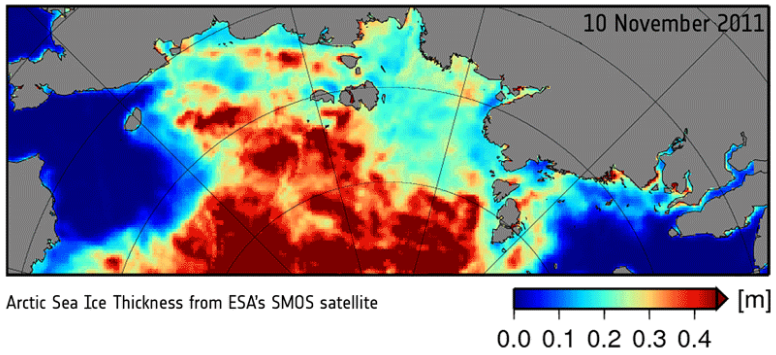


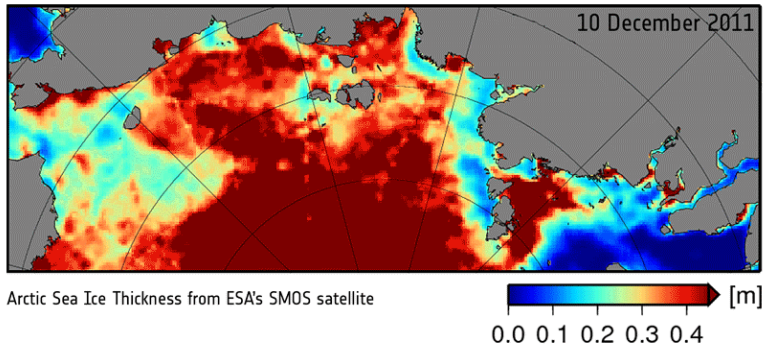
Soil moisture – world map: June 2010

e.g. Soil Moisture and Ocean Salinity mission

One stone !
three birds !!!

Arctic Ice cover / thickness maps





Successful ESA mission addressing larger scale phenomena

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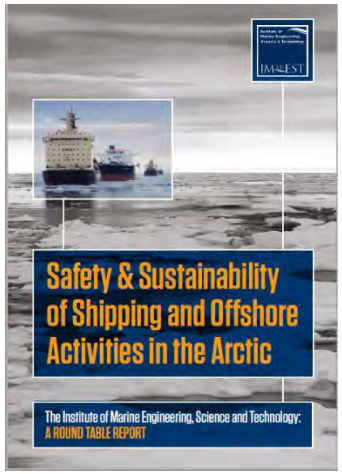

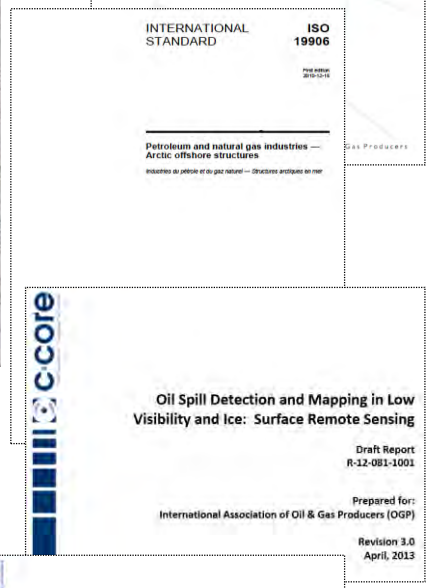

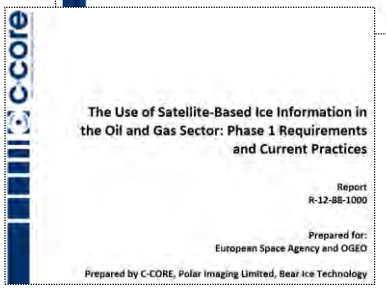

EO info > https://www.polarview.org/news-press/polar-view-awarded-polaris-project/