High spatial resolution Earth Observation - a reliable tool for site monitoring

Dr. Peter Hausknecht – Earth-i

Presented @ the IOGP Geomatics meeting in Aberdeen, April 2016

International Association of Oil & Gas Producers

Background Info

Earth-i:

formed in Sept. 2015; SME – currently just under 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. Peter Hausknecht:

Chief Scientist – Earth-i; 25+ years experience in Earth Observation

former Woodside – SME on EO; former chairman of IOGP Geomatics subcommittee on EO

Brief ‘history’ of ‘ very high resolution’ satellites (civil)

Data / Images @ **v**ery **h**igh spatial **r**esolution optical <= 1meter

Ikonos: USA – 1st 1m (80cm) satellite , 4m multispectral – launched **1999** only archived data

QuickBird: USA – 50cm satellite , 2m multispectral - launched 2001 only archived data

GeoEye1: USA – 50cm satellite , 2m multispectral - launched 2008

WorldView1: USA - 50cm satellite pan-chromatic channel only - launched 2007

WorldView2: USA – 50cm satellite pan - 2m multispectral - launched 2009
min. tasking starts @ 10 $ US !!! (not everywhere so)

WorldView3: USA – 30cm satellite pan -1/4m multispectral (16bands) - launched 2014
price quite high, limited swath, but high agility and coverage

Pleiades: France - 50cm satellite pan - 2m multispectral * 2 satellites launched 2011/12
very fast response tasking and delivery

[Spot7: France – 1.5m satellite pan - 6m multispectral * 2 satellites, with six tasking plans per day, per satellite – work together with Pleiades 90 deg. Offset]

Gaofen-2: China - 1m satellite pan - 4m multispectral - launched 2014

DubaiSat-2: S. Korea - 1m satellite pan - 4m multispectral - launched 2013

Deimos-2: S. Korea - 1m satellite pan - 5m multispectral - launched 2014 (owned now by Urthecast)

CartoSat-2: India - 1m satellite pan –4m multispectral multiple satellites for mapping and DEM generation

KompSat 3: S.Korea - <1m satellite pan - 3m multispectral - launched 2012

SkySat A: USA < 1m , Video & ‘super-sampling’ launched 2013 - start of a constellation

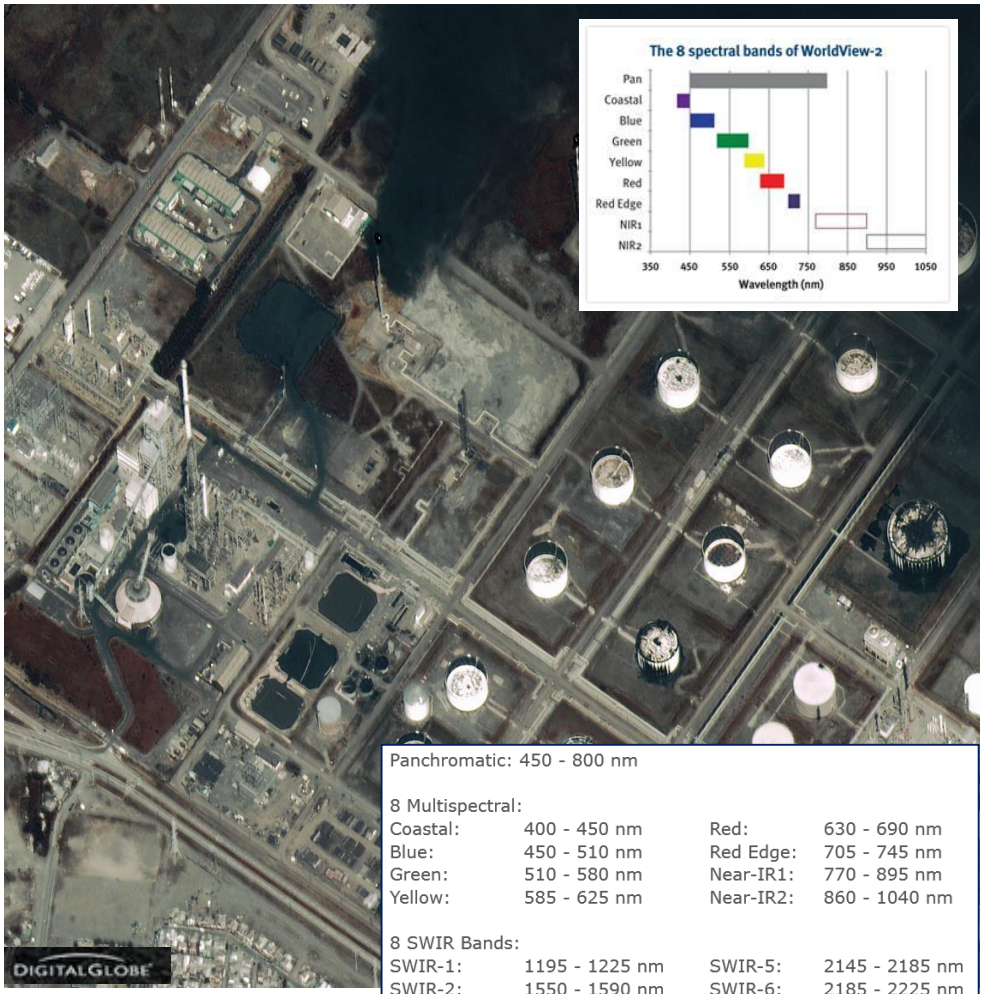
DMC3/TripleSat: UK - 1m satellite pan - 4m multispectral - launched 2015 – 3 satellites in orbit

Data availability varies – Defence interest often prevail

Situational Awareness and high res. satellite data

!! USA lifted ban on <50 cm commercial satellite data !!

Baseline Maps & Timeline monitoring of Infrastructure / Environment



Panchromatic: 450 - 800 nm			
8 Multispectral:			
Coastal:	400 - 450 nm	Red:	630 - 690 nm
Blue:	450 - 510 nm	Red Edge:	705 - 745 nm
Green:	510 - 580 nm	Near-IR1:	770 - 895 nm
Yellow:	585 - 625 nm	Near-IR2:	860 - 1040 nm
8 SWIR Bands:			
SWIR-1:	1195 - 1225 nm	SWIR-5:	2145 - 2185 nm
SWIR-2:	1550 - 1590 nm	SWIR-6:	2185 - 2225 nm
SWIR-3:	1640 - 1680 nm	SWIR-7:	2235 - 2285 nm
SWIR-4:	1710 - 1750 nm	SWIR-8:	2295 - 2365 nm

WorldView-3 data: 1 pan + 8 (VISNIR) + 8 (SWIR) spectral bands (31cm / 124 cm / 370 cm - nominal)

Using high resolution satellite data for Oil & Gas

Functions in O&G business using Remote Sensing data products:

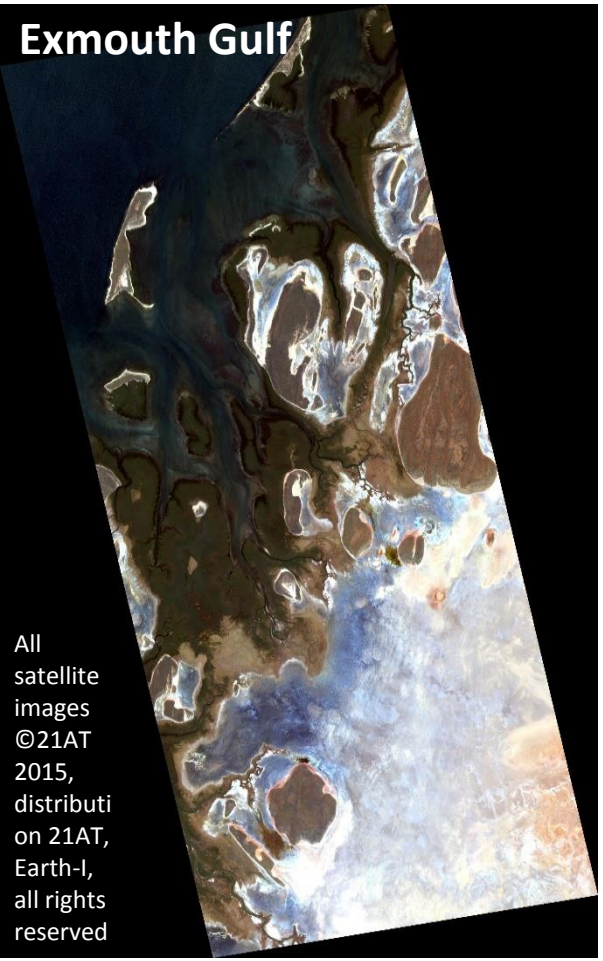
- Environmental Function: Baseline mapping ** ; timeline monitoring *
- Heritage: Evidence mapping ; change detection *
- MetOcean: Wind , Waves & Water
- Exploration: Seepage mapping ; site reconnaissance *
- Civil Engineering: Baseline mapping ** ; infrastructure monitoring ** ; cut & fill **
- Safety and Security: Fire & floods * ; breaches of security **
- Production: Subsidence monitoring ; Asset mapping *
- Emergency: Situational awareness * ; event monitoring **
- Geomatics: Survey operations planning * ; Elevation mapping *
- Corporate: Background images * ; insurance verification *

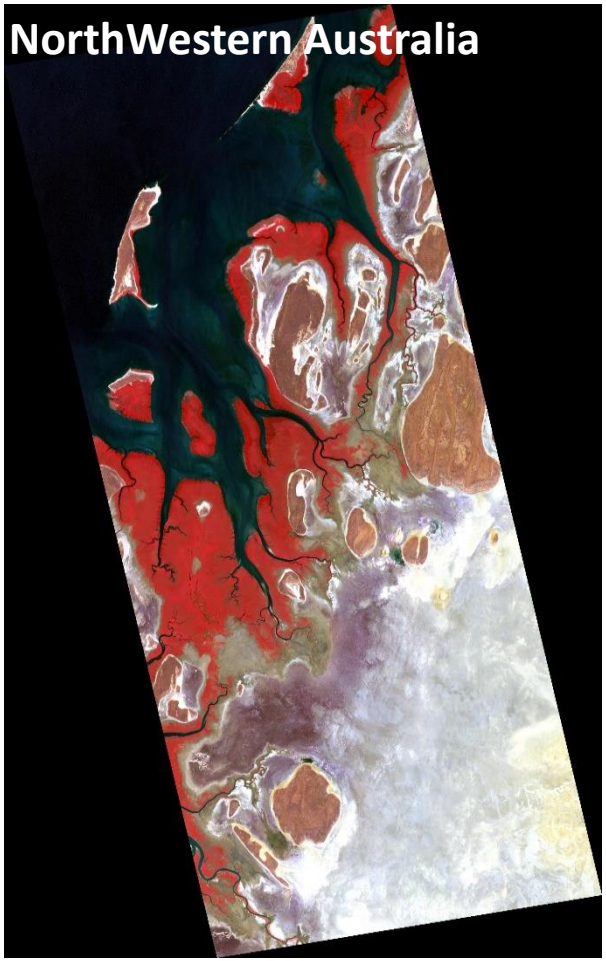
… and more

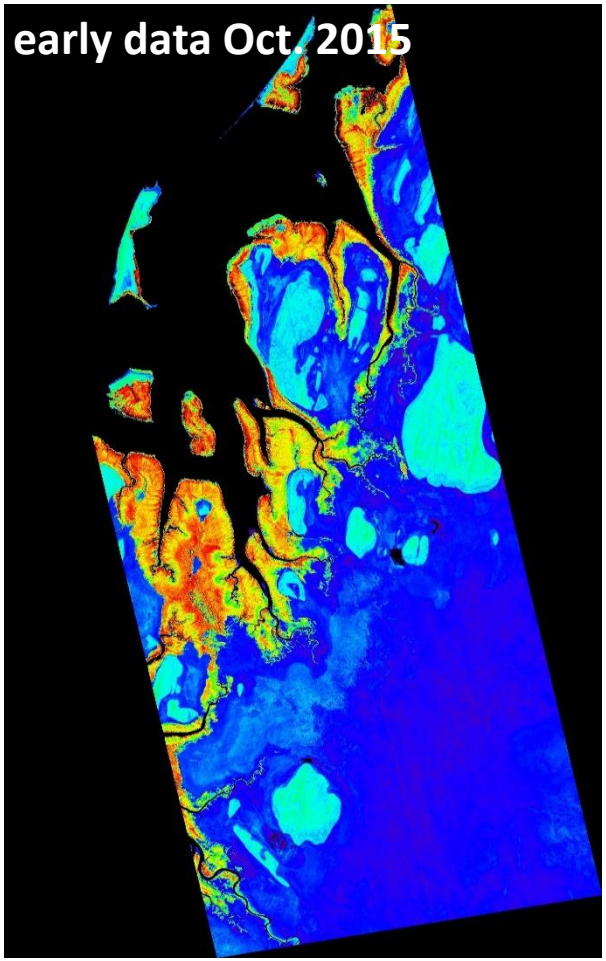
From published sources

Potential high spatial resolution application are marked with an * , ** if high res. critical

Using high resolution satellite data for Oil & Gas







Along the NW-Shelf, the prime oil and gas province in Australia, sits a vast stretch of pristine Mangrove areas, one of the most important and biodiverse habitats. Any oil spill would be a disaster; accurate mapping and monitoring is essential for preparedness.

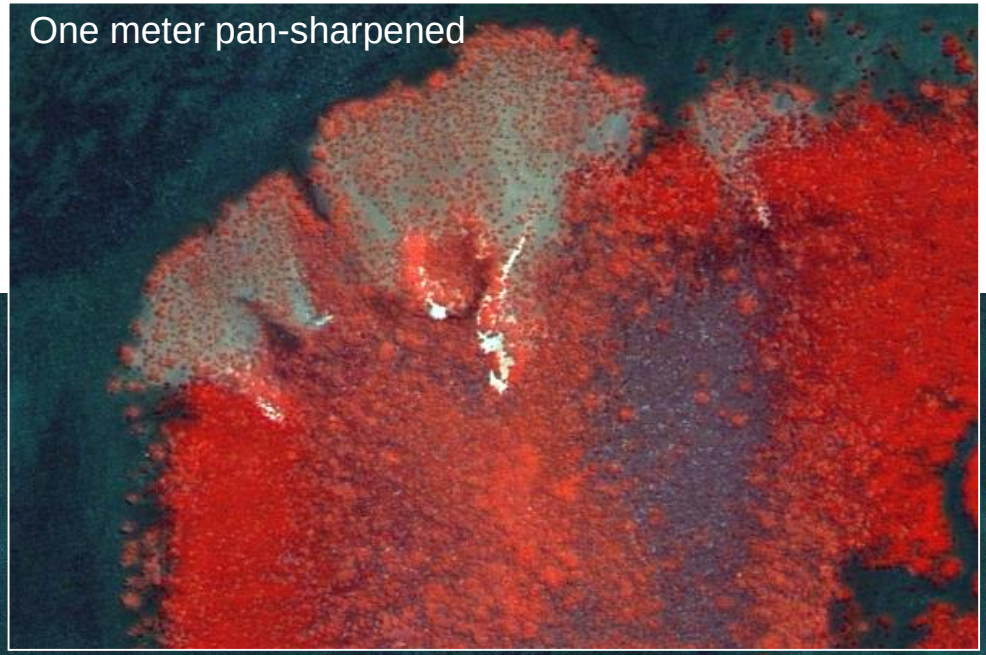
True color : channels 3,2,1 = RGB

False color IR: channels 4,3,2 = RGB

Vegetation index – NDVI
color coded: red = high

Using high resolution satellite data for Oil & Gas

Using the near infra-red spectral band for vegetation assessment allows even small changes to be monitored and attributed on a tree by tree level



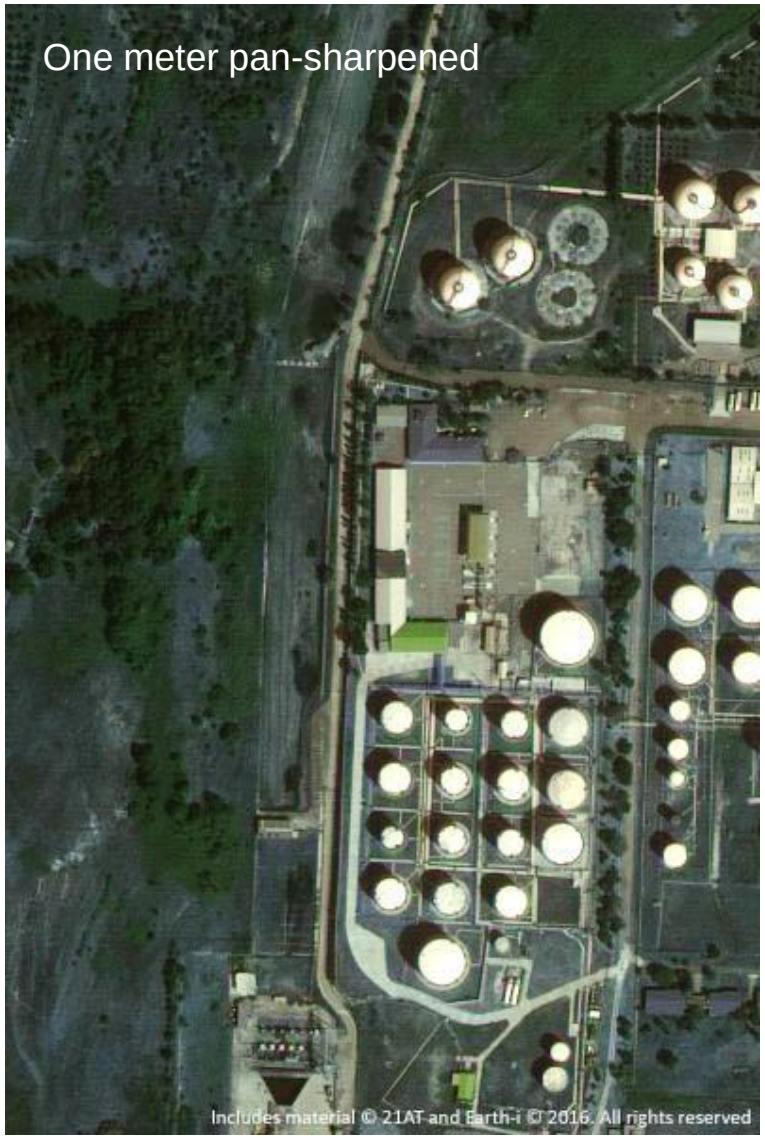
False color : channels 4,2,1 = RGB

Exmouth Gulf – NorthWestern Australia (early data Oct. 2015)

Environmental mapping- Australia

Using high resolution satellite data for Oil & Gas

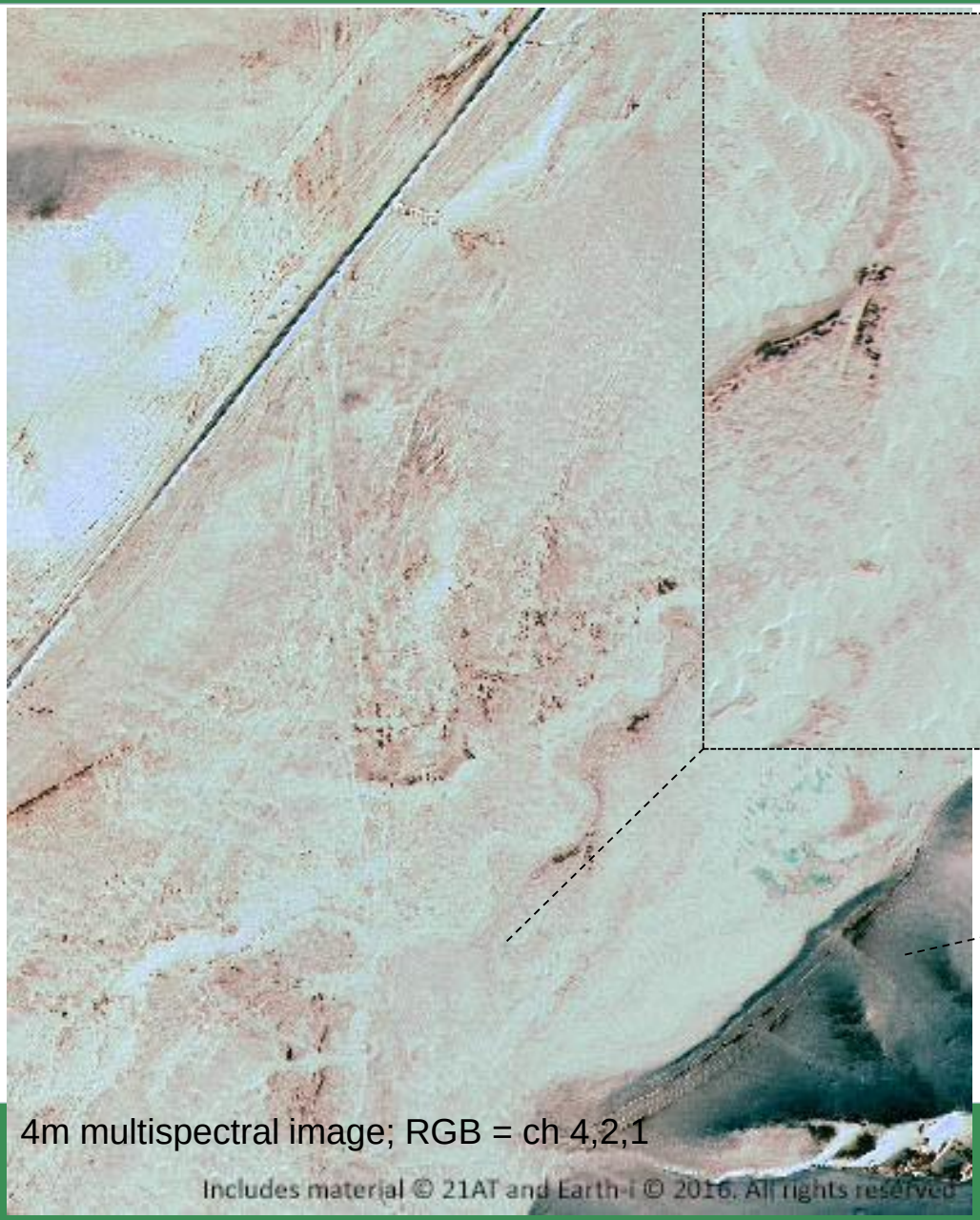
Above: DMC3 / Triplesat satellite data over a hydrocarbon storage facility near Istanbul, Turkey
Right: Subset of the image above showing the close proximity of the storage tanks to a bordering nature strip

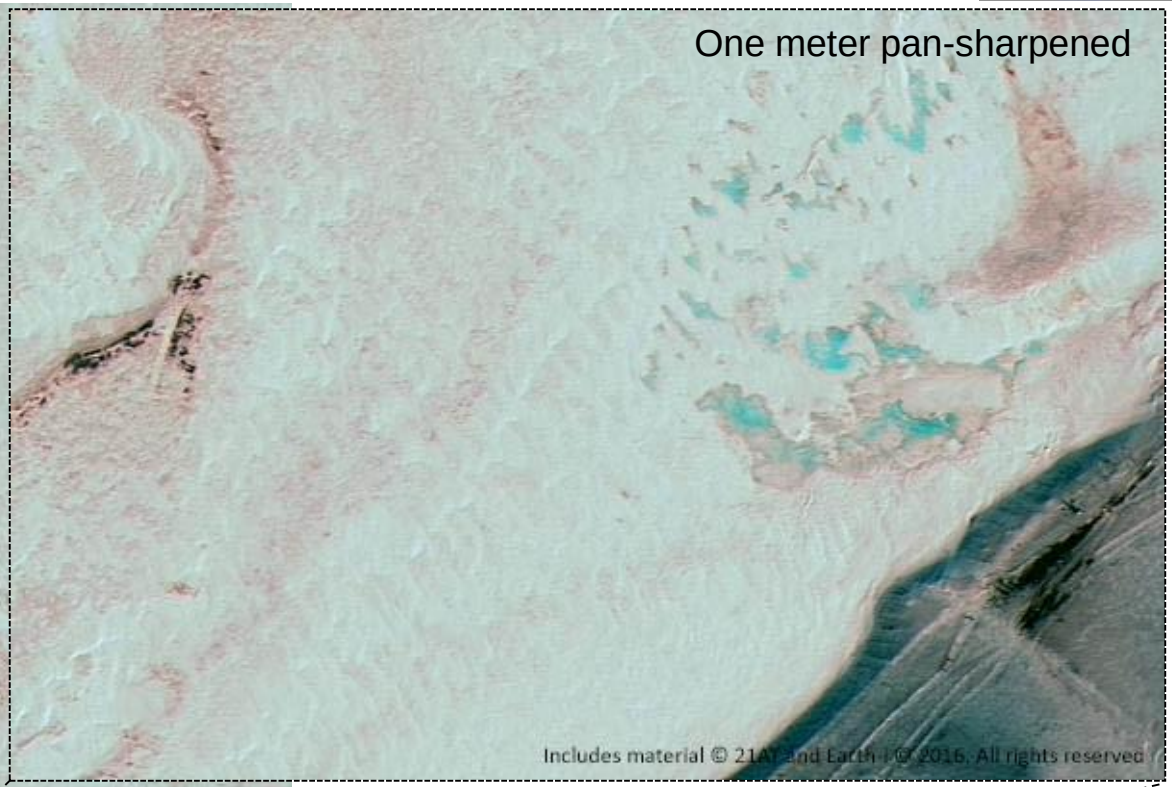


True color display : channels 3,2,1 = RGB

Asset monitoring - Europe

Using high resolution satellite data for Oil & Gas



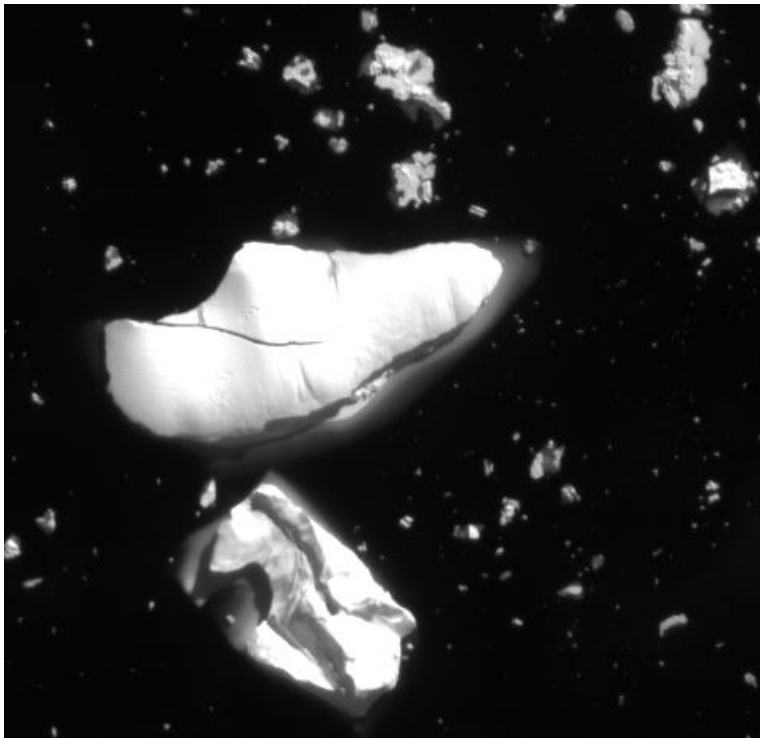


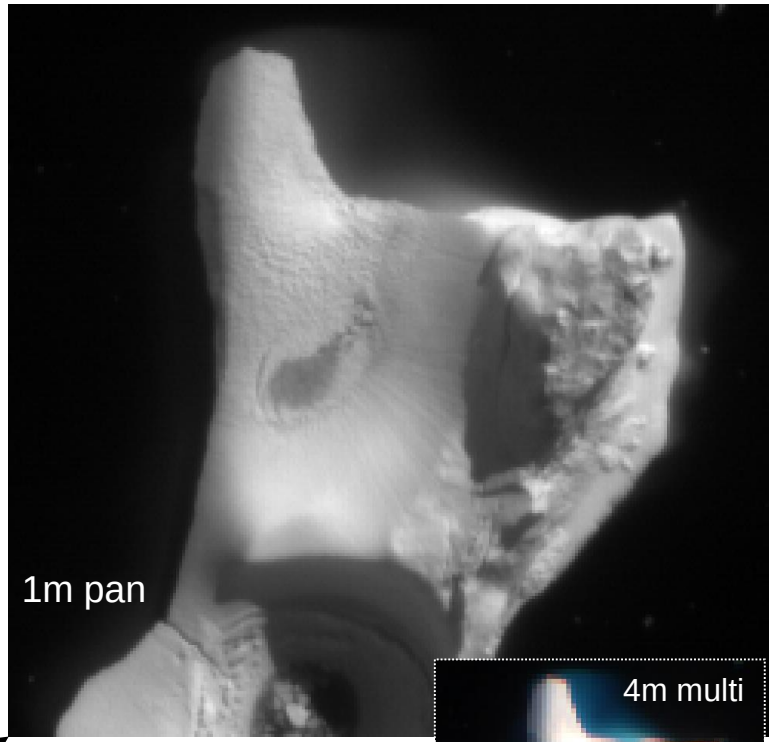
Left: DMC3/Triplesat satellite data over a desert area for survey planning near access road

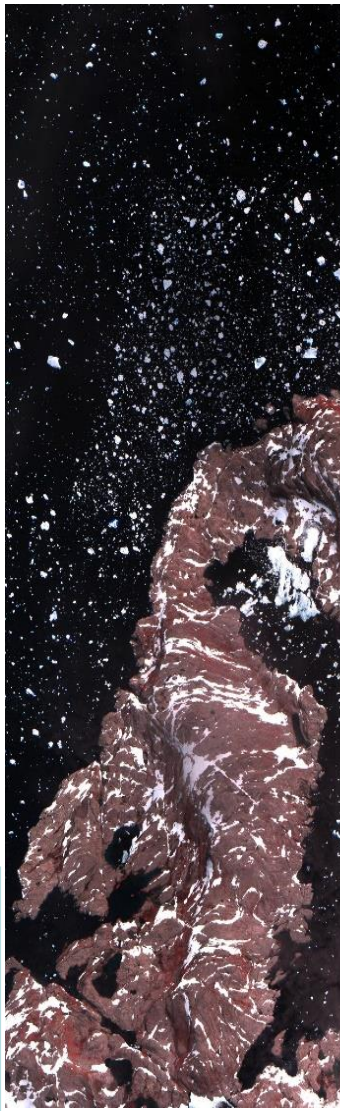
Above: Subset of the image to the left showing the spatial detail of landscape features, including a salt pan area indicating soft ground conditions

Survey planning - Central-Asia

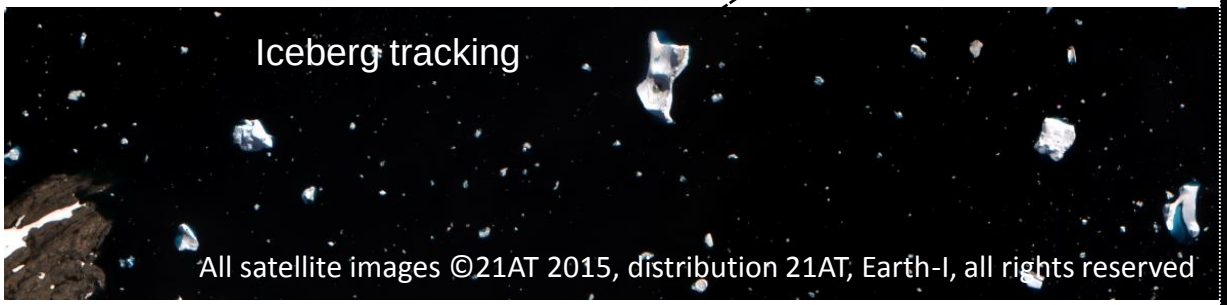
Using high resolution satellite data for Oil & Gas







Greenland – west coast



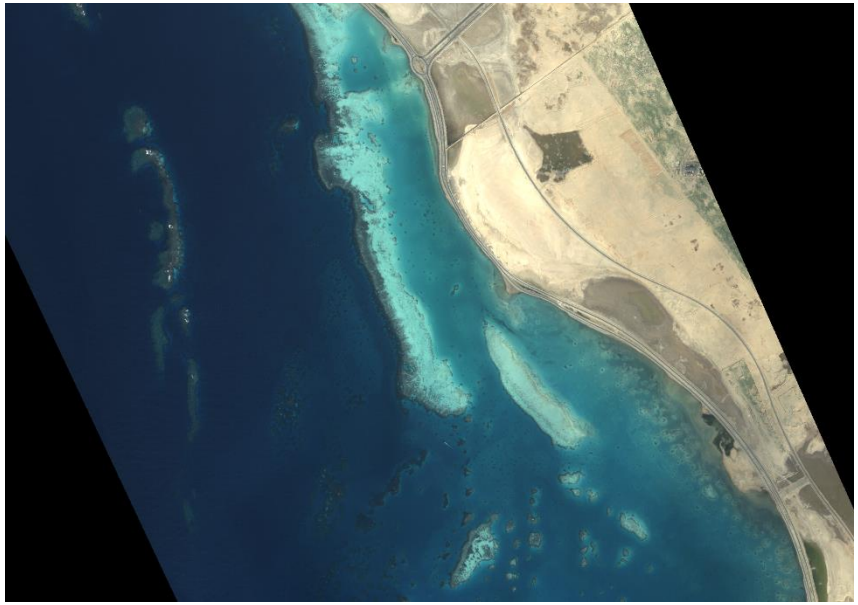
Early data – commissioning phase – Oct. 2015

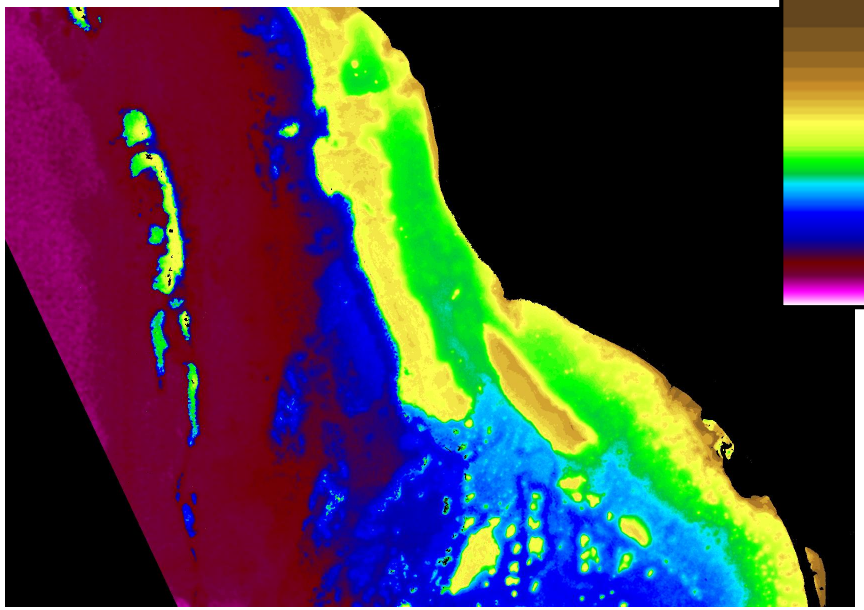
Iceberg monitoring and coastal mapping
Displayed is a 4m multispectral image; RGB = ch 4,3,2

Safety monitoring - Greenland

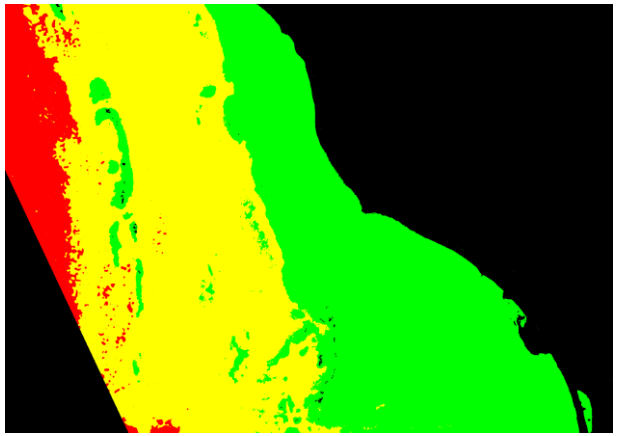
Using high resolution satellite data for Oil & Gas

Sensor WordView 2. 2010 Nov 6..Product generation by MIP





Deriving bathymetry from optical satellite data is now an established technique and in particular high resolution data allow it to be used as a reconnaissance tool for potentially much more expensive shipborne surveys. A ‘new’ type of hydro map = ‘minimum water depth’ can be derived with full confidence.

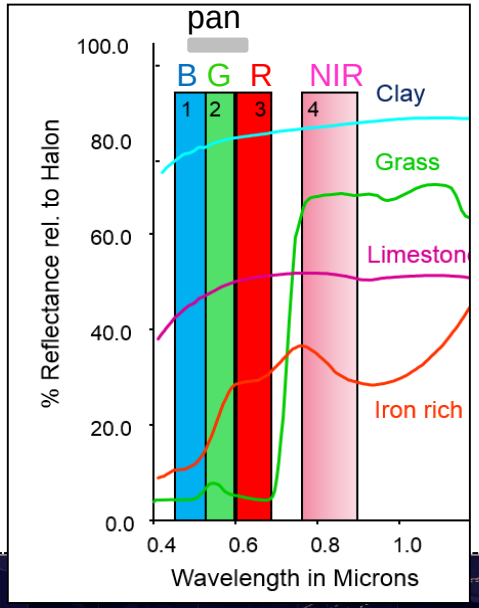


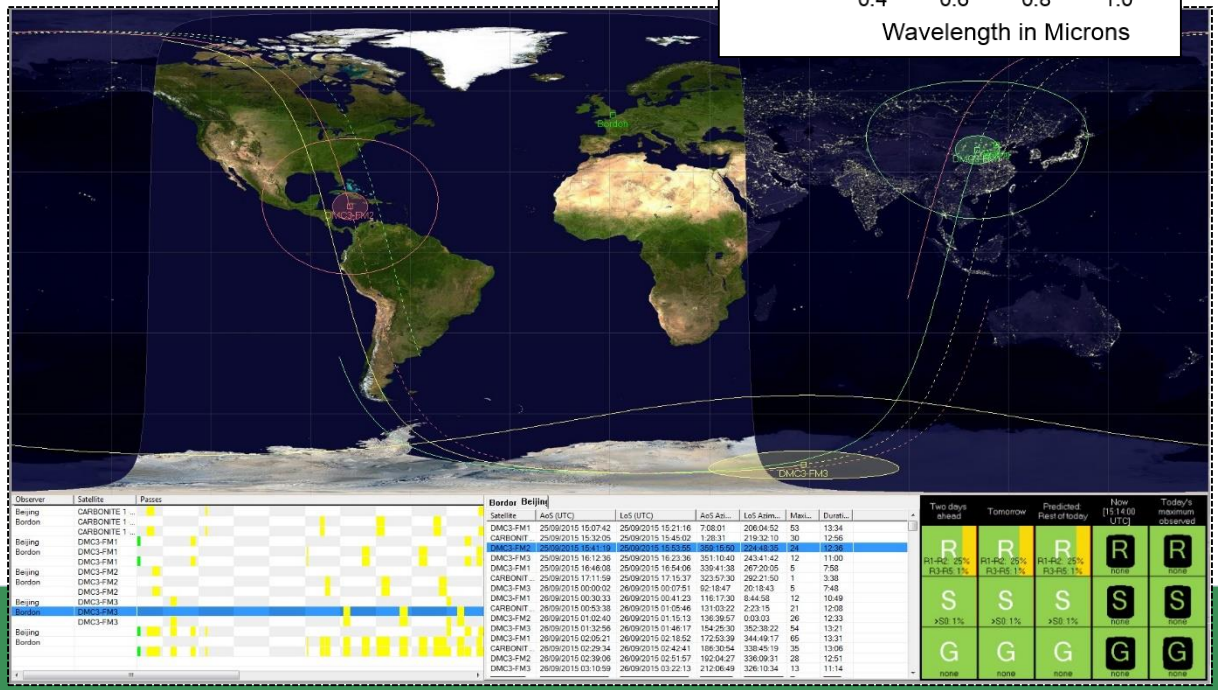
EOMAP

Bathymetry mapping – Middle East

DMC3 / Triple-Sat constellation – what's new ?

- Build by SSTL and fully owned by SSTL (UK)
- Data contingency sold to 21AT
- 4 bands (R,G,B,NIR) / 1 pan ; spatial 4m / 1m
- 200.000 sqkm a day per satellite possible
- Can and has been tasked from Guildford
- Secure tasking and download to be established from UK
- +/- 45 deg. tilt possible
- fully commercial
  no defence interests
- competitive pricing
- 3 identical satellites



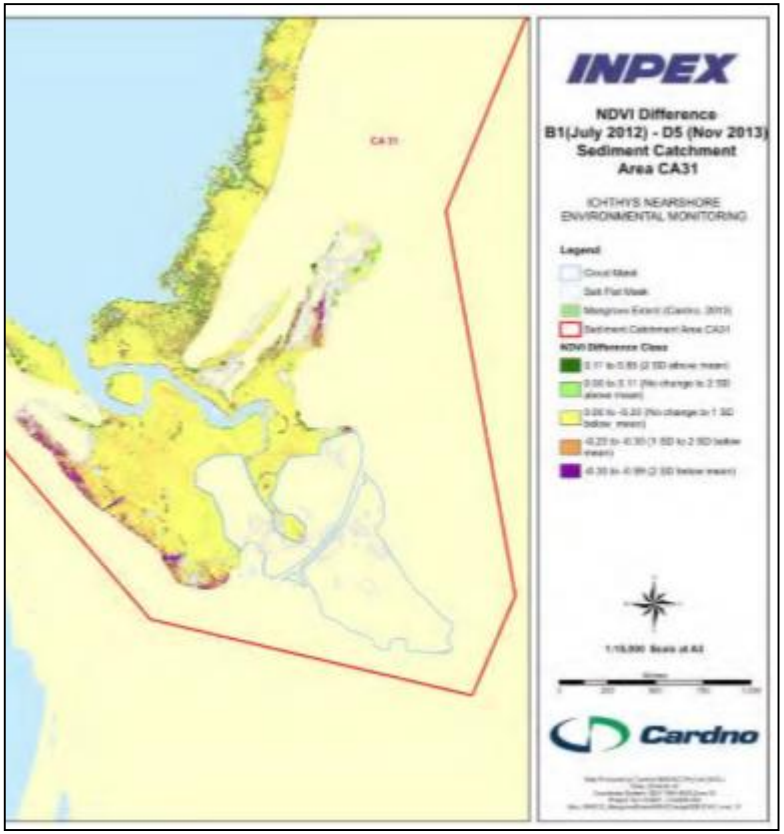


Every place on Earth

Everyday

Facing some particular O&G challenges:

Change detection: INPEX – Darwin, Australia

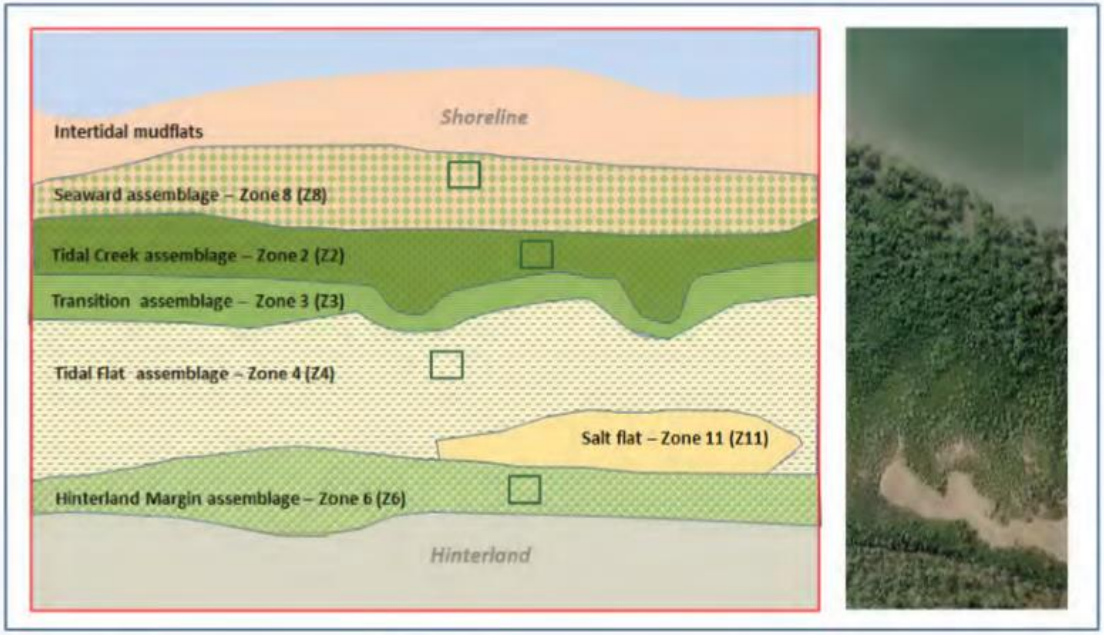


Area of NDVI difference relative to mean difference in mangroves to the east of East Point (CA31)

Reference: public document

Quarterly Remote Sensing – Dredging Report 5

Ichthys Nearshore Environmental Monitoring Program - L384-AW-REP-1152 , March 2014

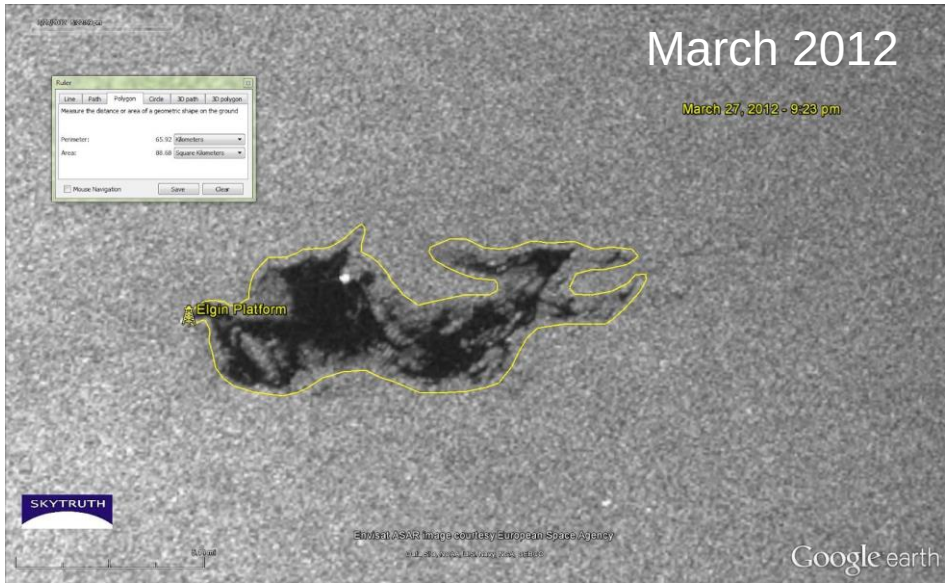


Schematic view of a remote sensing site indicating plots (20 m x 20 m) and mapped mangrove assemblages

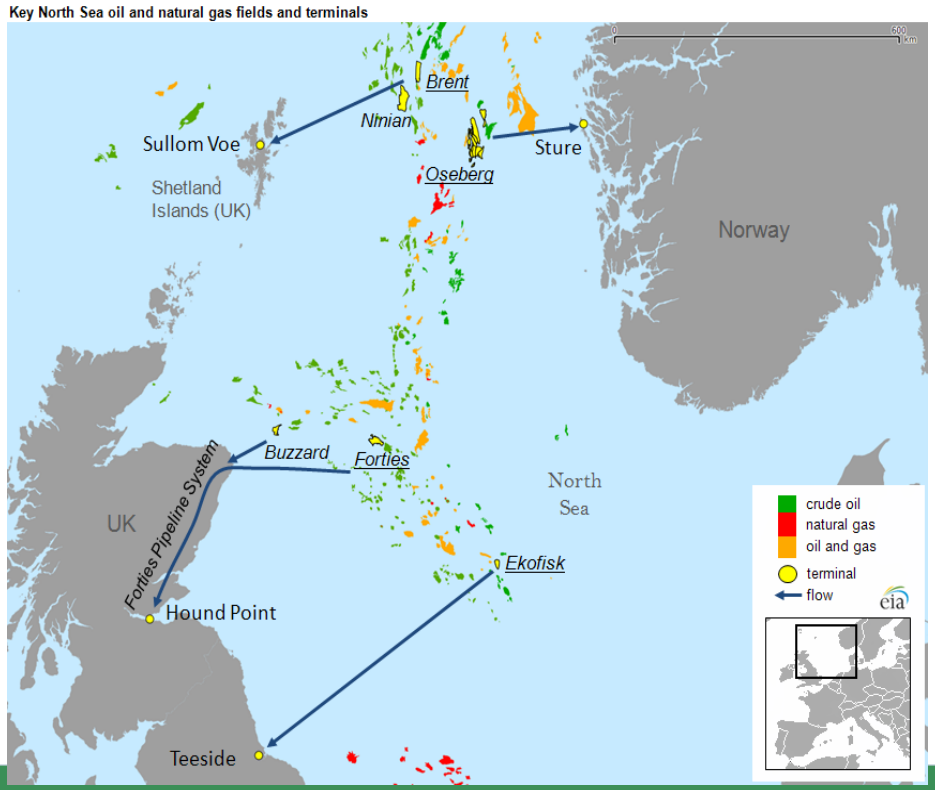
Quote from report: …. ' NDVI has been used as a measure of mangrove health as it is indicative of leaf chlorophyll content and green leaf density and biomass, indicating health or photosynthetic activity (e.g. Kovacs et al. 2005; RuizLuna et al. 2010; Meneses-Tovar 2012). Remote sensing of NDVI allows for the assessment of mangrove health change over large spatial scales over long time periods. It also enables monitoring of mangrove habitat that is largely inaccessible to field-based surveys'

Facing some particular O&G challenges:

Decommissioning: environmental & security issues



Using Earth Observation monitoring in areas of high risk and intense public interest will allow to demonstrate 'good industry practice & state of the art technology' to minimize any impacts and show transparency to regulators and public.



There is a very high chance nowadays that **'a'** satellite will have taken an image anyway and somebody will use it

Integration of medium and very high resolution

The ‘Sentinel’ challenge: optical S2a in orbit / S2b July 2016

The European Sentinel satellites
currently: S1: Radar S2: Optical S3: Global Mixed

End of 2016+ 1+ Petabyte / year

Data is freely available, but not really free, since somebody has to download, store, pre-process, collate, derive data products and integrate into value add products

⇒ Somebody needs to pay for that
⇒ Somebody needs to do that

⇒ But it’s an opportunity for somebody !

Incl. integration of high and medium resolution satellite data to maximise

Sentinel 2a data: Uluṟu-Kata Tjuṯa National Park , Central Australia (with Uluru, or Ayers Rock, on the right)

Current thinking:

- high resolution satellite data for baseline mapping and change verification
- medium resolution e.g. LandSat / Sentinel for monitoring and change detection

OGEO, EO4OG, EO Portal and more …

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 information - yes !!

Earth Observation Broker - Energy

Created by Kim Charles Partington, last modified by Graham Glanfield on Mar 23, 2016

EARTH OBSERVATION BROKER ENERGY

This ESA funded project will develop an EO broker application for the oil and gas sector

New 2016

Overview

Status (23-March-2016)	The first steering committee meeting and quarterly progress meeting will be held on the 29th March and 4th of April respectively.
Status (7-March-2016)	The steering committee has been confirmed and initial user case workflows are being summarised and integrated into the requirements consolidation WP and technology review WP.

The consortium, consisting of Geocento, Kongsberg Satellite Services, Satellite Applications Catapult, EOmap, Jeobrowser and Globesar, are keen to ensure that they are engaged with the oil and gas community, so that the application is well aligned with industry needs, and with the EO service sector to ensure visibility of the service sector, with EARSC playing an important role in this

Uptake and industry discussion very low

EO4OG

Home | About EO4OG | Cases | Products | Challenges | Visualized Products

EO4OG defined products to meet the challenges. Each product is defined by a product sheet which will open in a new window when clicked upon.

The products are categorised by "thematic" and "sector according to the EARSC taxonomy.

Generic: Click or start typing… Thematic: Click or start typing… Sector: Click or start typing…

Product	Generic	Thematic	Sector	EO Service
Agricultural land	on-shore	Land	Ecosystems	Assess environmental impact of human activities
Asset Monitoring	on-shore	Built environment	Infrastructure	Asset infrastructure monitoring
Bathymetry	off-shore	Marine	Coastal	Map water depth or charting
Building inventory	on-shore	Built environment	Infrastructure	Monitor construction and buildings
Chlorophyll-a concentration (Qualitative)	off-shore	Marine	Ecosystems	Monitor ocean quality and productivity
Chlorophyll-a concentration (Quantitative)	off-shore	Marine	Ecosystems	Monitor ocean quality and productivity
Coastal land cover	off-shore	Marine	Coastal	Monitor the coast line
Coastal land cover change	off-shore	Marine	Coastal	Monitor the coast line

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***