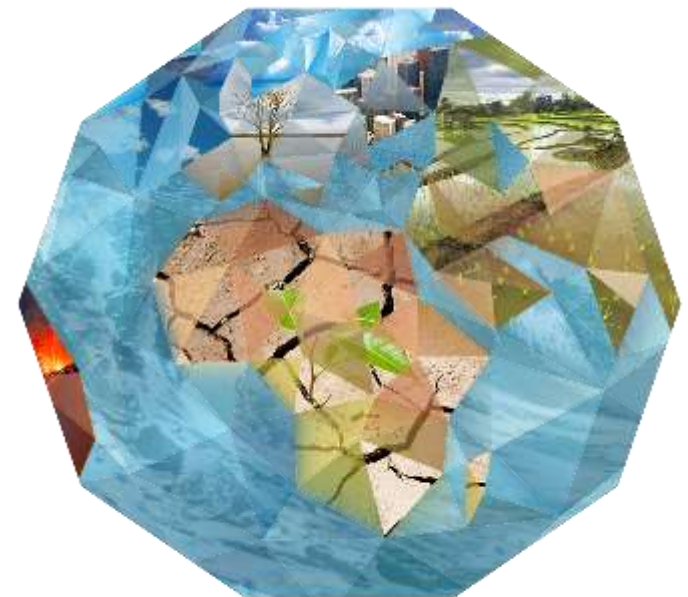


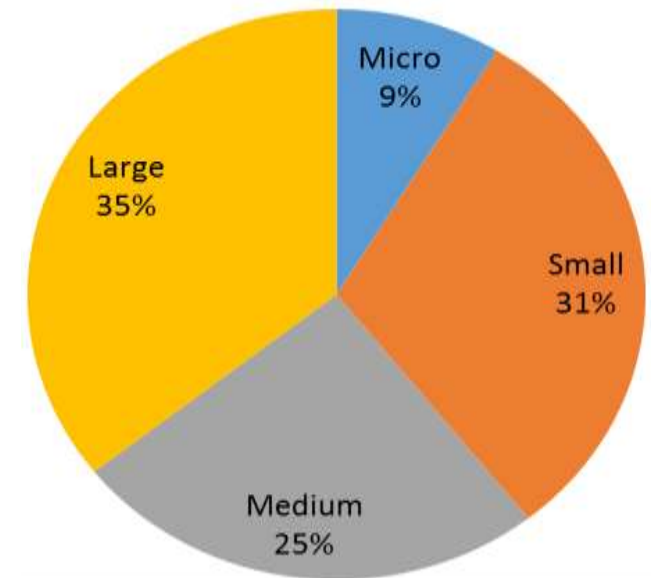
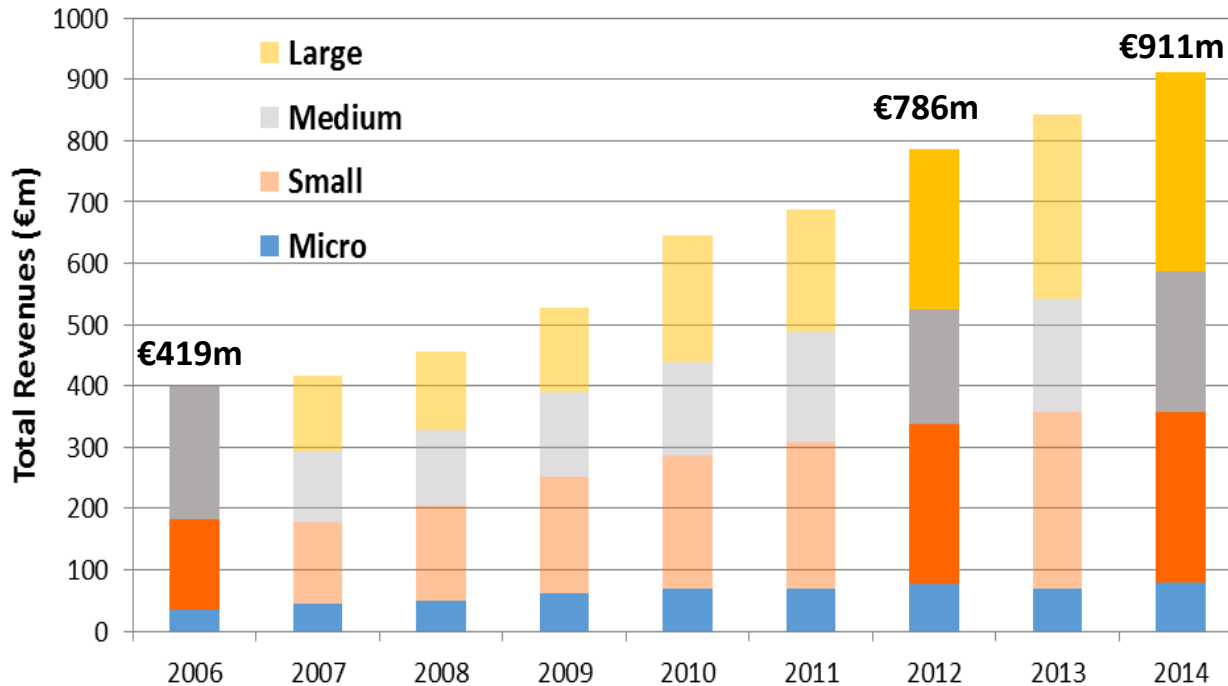
# **Delivering Services from Space: European Space Agency Earth Observation**

***Prof. Stephen Briggs***

***Senior Adviser, Earth Observation  
European Space Agency***



# Industry Revenue Profile



Total revenue has grown from €419m in 2006 to €911m in 2014

8 year growth rate of 11.8% p.a. (cagr)  
2012:2014 = 7.6%

Large and medium companies account for 60% of revenues.

# Percentage Revenues by Activity

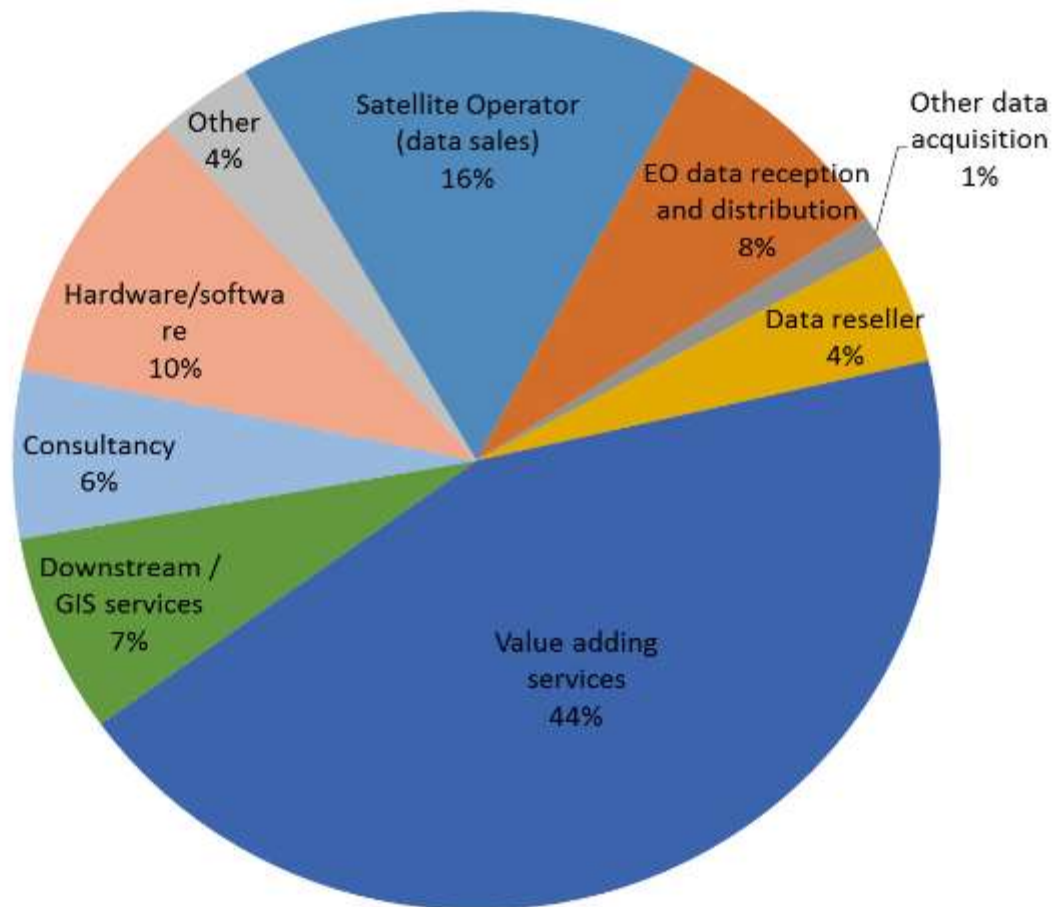
European Companies are active throughout the value chain

Data selling activities represent a 29% share of the market at €270m.

This represents a growth of 5% since 2012

The information services part of the business represents 51% of the market or €462m.

This represents a growth of 72% since 2012 (31% per annum).



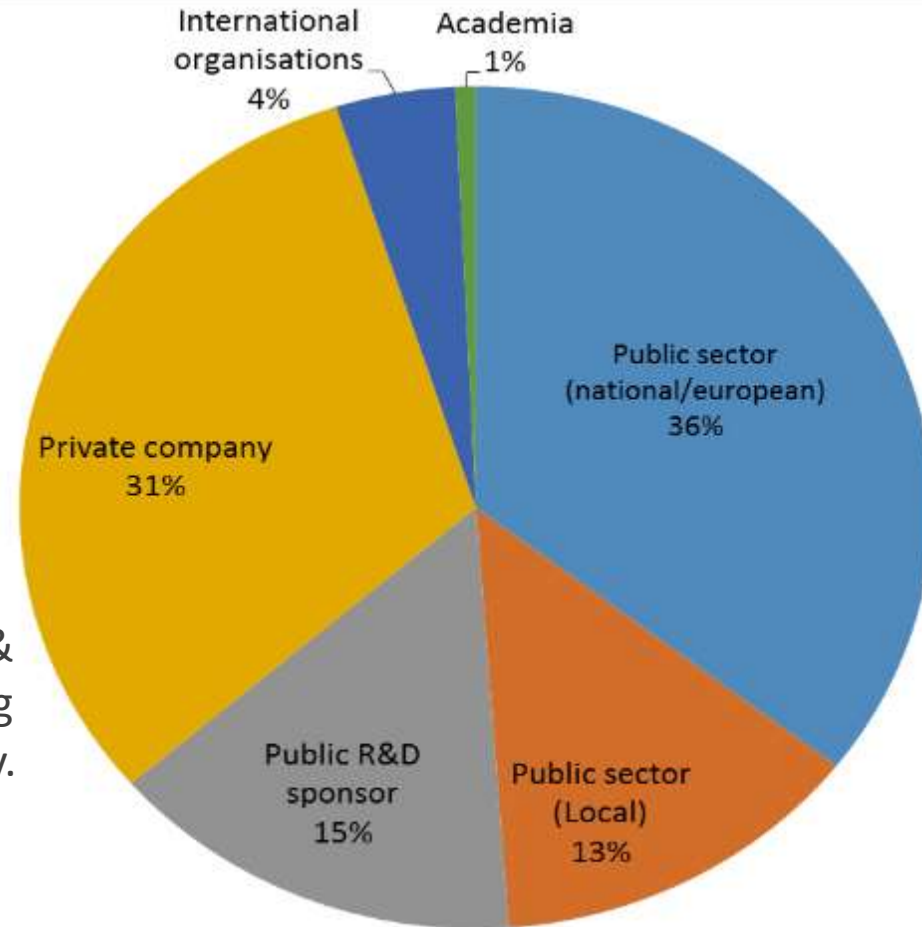
# Types of Customer

50% of revenues are coming from public sector operational customers at different levels (plus 15% R&D).

Around 4% comes from International organisations.

Around 30% of revenues is coming from sales to other industrial customers.

This shows an aggregate picture of 2012 & 2014 as a few large contracts are changing the year-to-year picture quite significantly.



# From Science to Applications and Services



Services Development

Applications Development

Science and Methods Development

1990

ERS-1

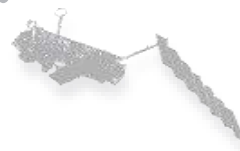


ERS-2



2000

Envisat



2010

Sentinels

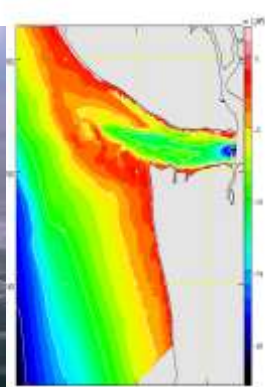


- **Renewable Energy**
  - Resources assessment (Solar, Wind, Snow),
- **On-Shore Operations**
  - Seismic Quality Mapping
  - Precision Land Motion
- **Off-Shore Operations**
  - Wind/wave/tide/current climatologies
  - SAR based Bathymetry Mapping
  - Iceberg detection and tracking
  - Sea ice analysis
- **Environmental Impact**
  - Land (Oil Sands - Shell), Marine (Gulf of Mexico - BP)
- **Sustainable Development Reporting**
  - Population dynamics in line with Global Reporting Initiative (GRI) guidelines (Dam construction, Brazil - Suez)

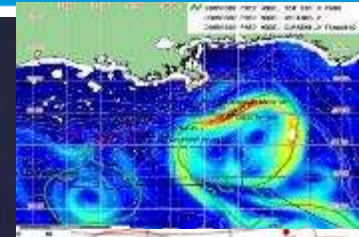




# Example : Ice/Wind/Wave/Current - Off-shore Operations



Fully Commercial  
Services Contract  
2009 – 2014  
Caspian Sea



Agip KCO



BMT ARGOS

## • EO Services

- For seepage slick mapping now a (modest) commercial market,
- Routine utilisation by oil & gas operators of
  - EO derived wind/wave/tide/current climatologies for offshore operations
  - SAR based Bathymetry Mapping
  - Iceberg detection and tracking
  - Sea ice analysis

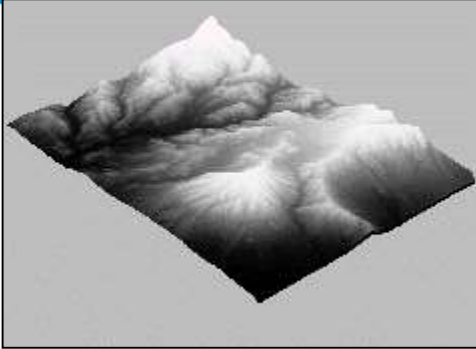
ESA UNCLASSIFIED – For Official Use

• One Large Services contract in place – AGIP KCO

# Renewable Energy : Hydropower



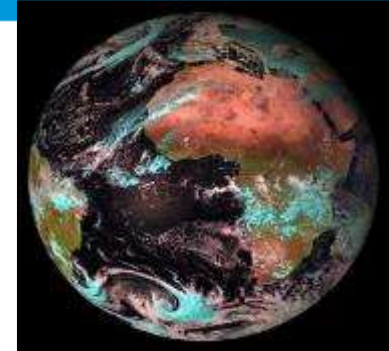
Digital Elevation Model  
Land Cover (ENVISAT/SAR)



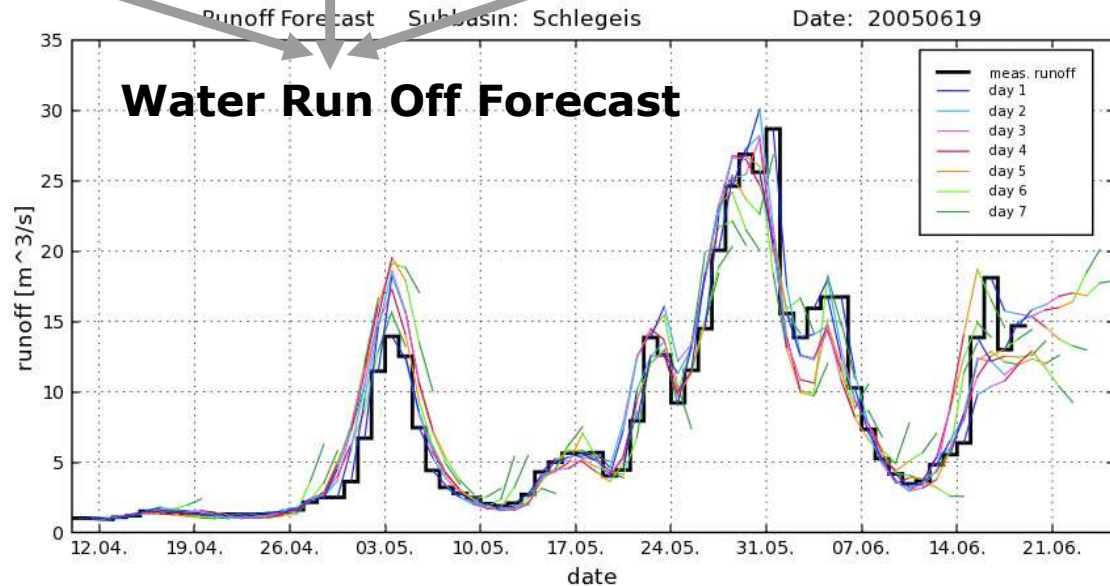
Snow Cover Extent (ENVISAT/MERIS)



Weather Conditions (MSG)



via Hydrological Model

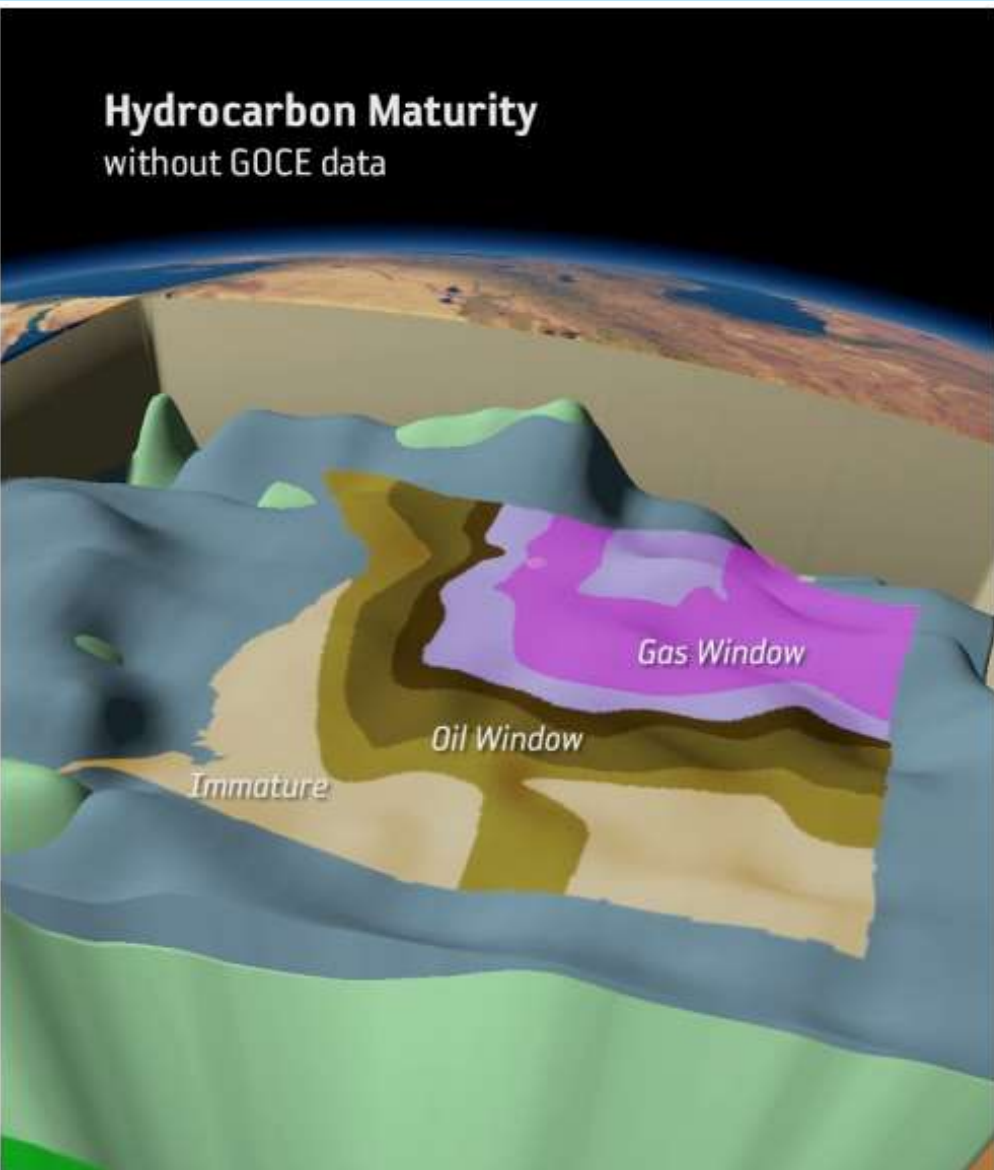




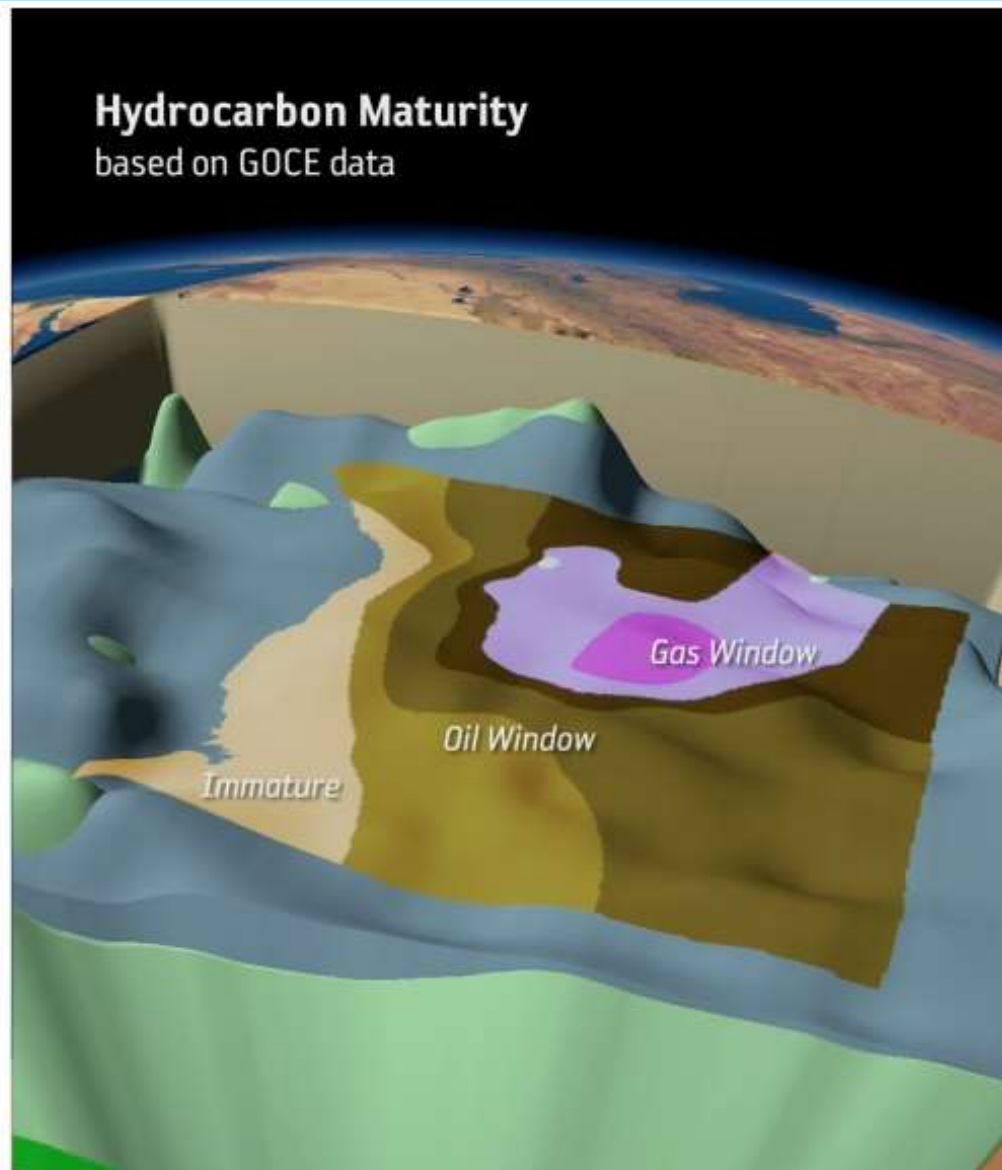
# GOCE for pinpointing Hydrocarbons



**Hydrocarbon Maturity**  
without GOCE data



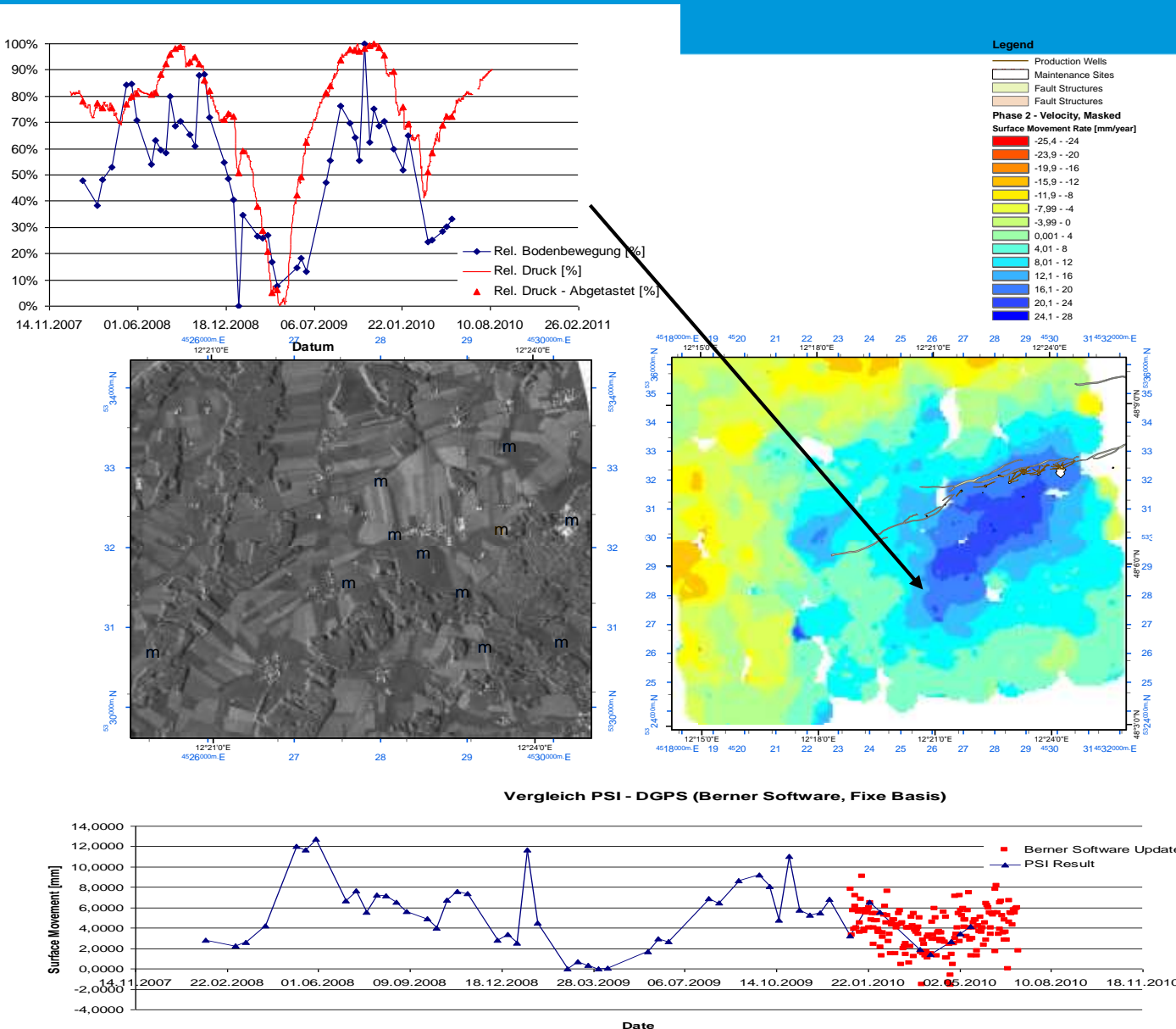
**Hydrocarbon Maturity**  
based on GOCE data



# EO Services : New Developments

## Land Motion for Carbon Capture & Storage (CCS)

- TerraSAR-X : increased Spatial & Temporal resolution,
- Gas storage site in Germany (E.ON),
- Technically challenging – non-linear surface motion & heterogeneous surface conditions,
- Comparison with known fault structure, in-situ gas pressure and improved DGPS processing,
- **EO-based land motion correlates well with known spatial & temporal in-situ,**
- **Complete geo-mechanical model of reservoir needed for full understanding.**

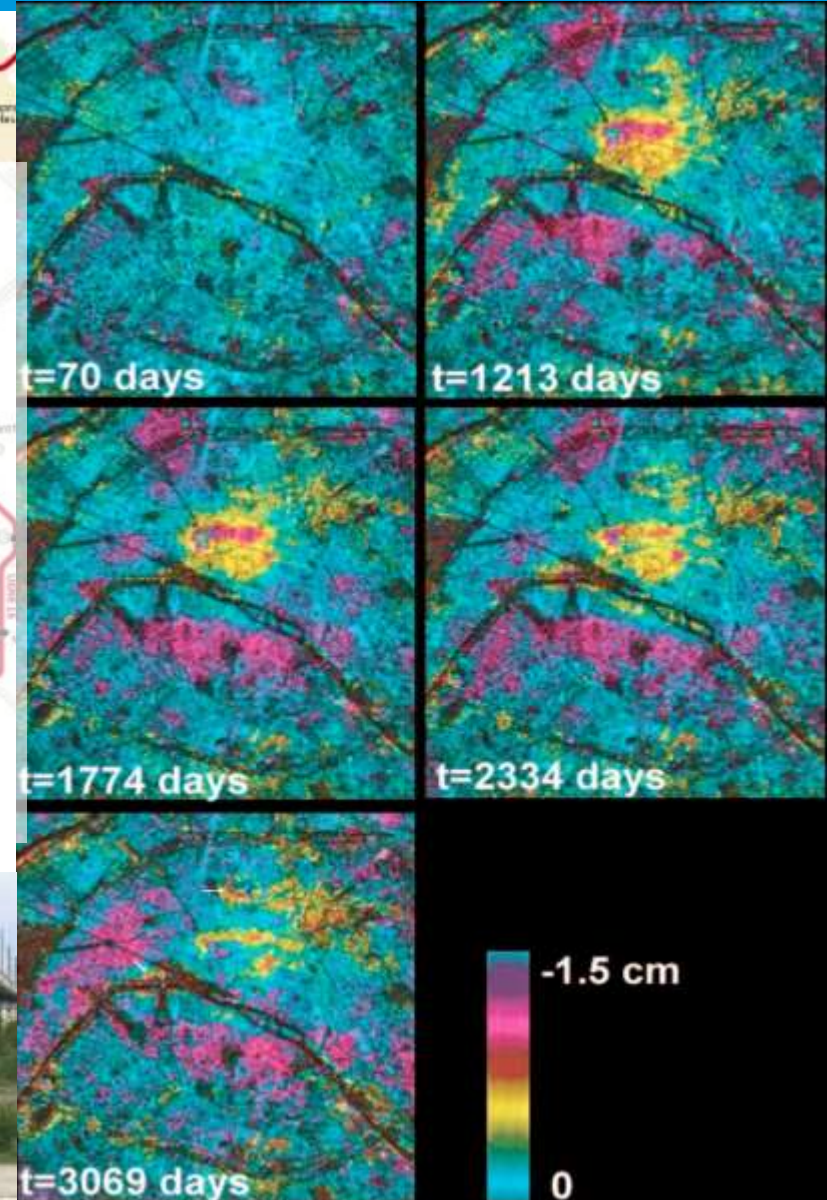




# Industrial follow-on contract Transport infrastructure monitoring



- **ESA project - Use of PS InSAR to monitor land deformation related threats to railway infrastructure (250K€ )**
- **Follow-on contract:**
  - **Historic baseline assessment and monitoring impact of construction activities for Grand Paris metro construction project (200km track and 68 new stations)**
  - **Service Provider CLS (Altamira)**
  - **Contract value – 4.5M€**



# Sentinel-2

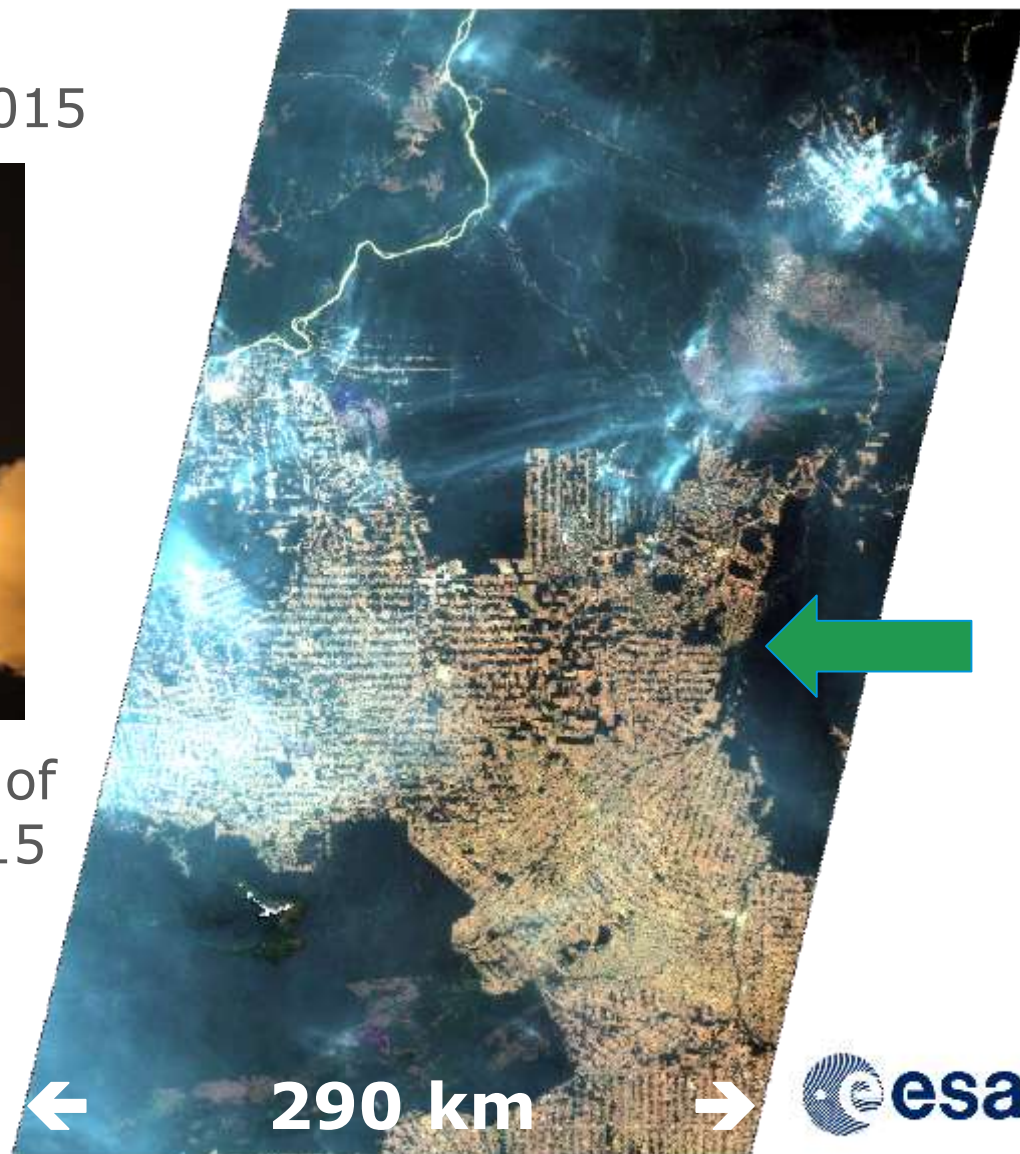


Sentinel-2A launched on 23 June 2015



Data available publicly after end of commissioning phase in Oct. 2015

→ <https://sentinel.esa.int/>





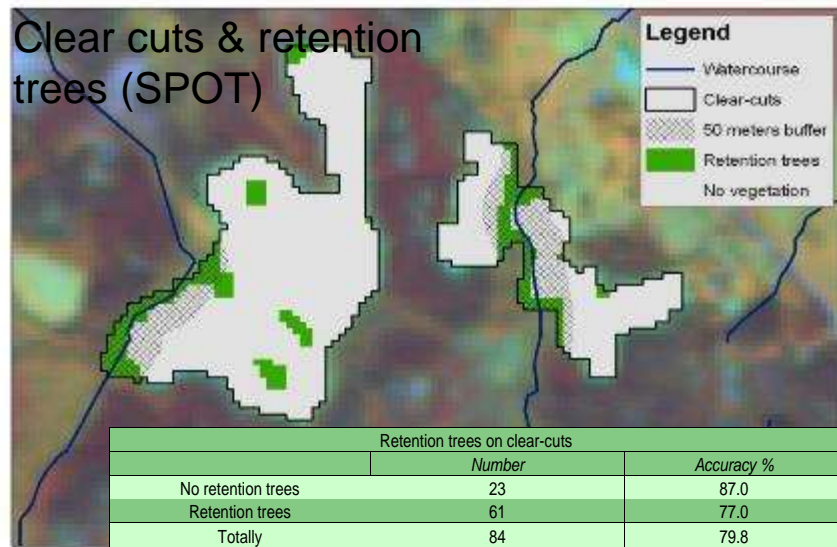
# Forest Monitoring for REDD+ (GFOI)

## e.g. Amazon: S-2 full resolution



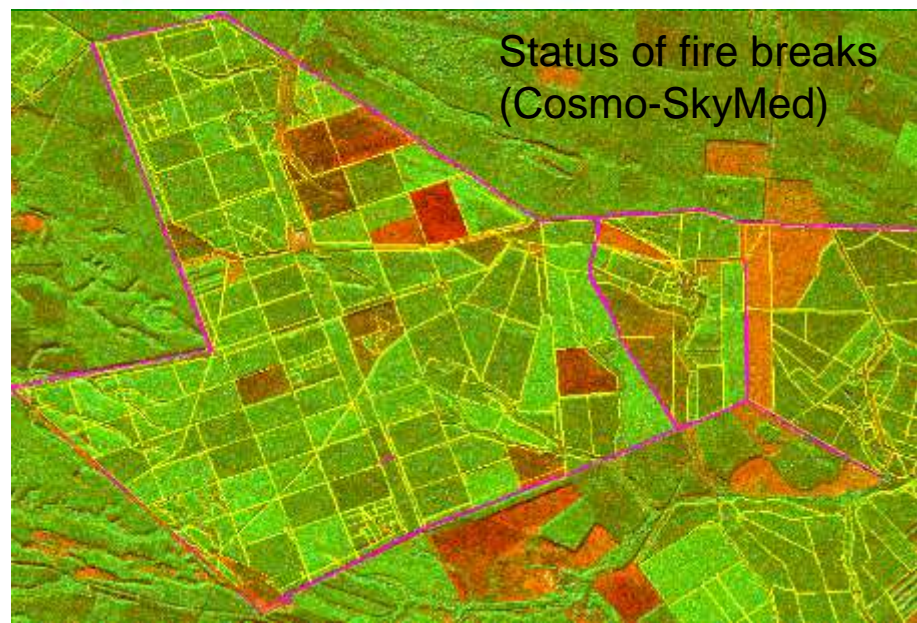
- 13 spectral bands in VIS/NIR/SWIR
- Spatial resolution: 10m / 20m / 60 m
- Swath: 290 km
- 5 days revisit at the Equator (with 2 spacecrafts)
- Systematic coverage between 84°N and 56°S

# Certification of Sustainable Forest Management (FSC)



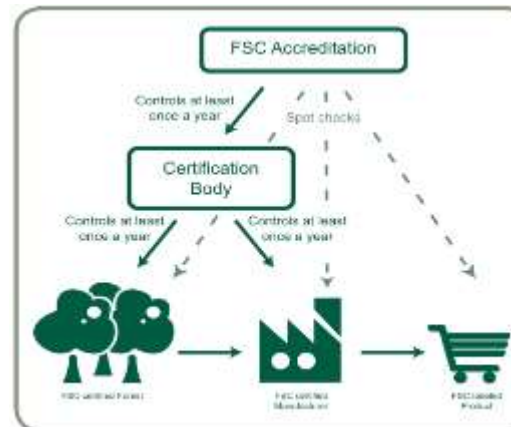
Buffer zon		
Error (m)	Number	Error (m)
-50	0	-50
-40	0	-40
-30	0	-30
-20	0	-20
-10	0	-10
0	14	0
10	16	10
20	3	20
30	3	30
40	2	40
50	1	50
Sum	39	Summa
Standard error	10.5	Standard error

- Evaluate EO “**operational best practices**” for FSC certification
- Possible integration in **FSC Principles and Criteria**
- Certification is one mechanism for the economical valuation of **ecosystem services**



## Forest Stewardship Council (FSC)

- **Voluntary certification** of sustainable forest management
- **> 130** millions ha certified
- in over **80** countries

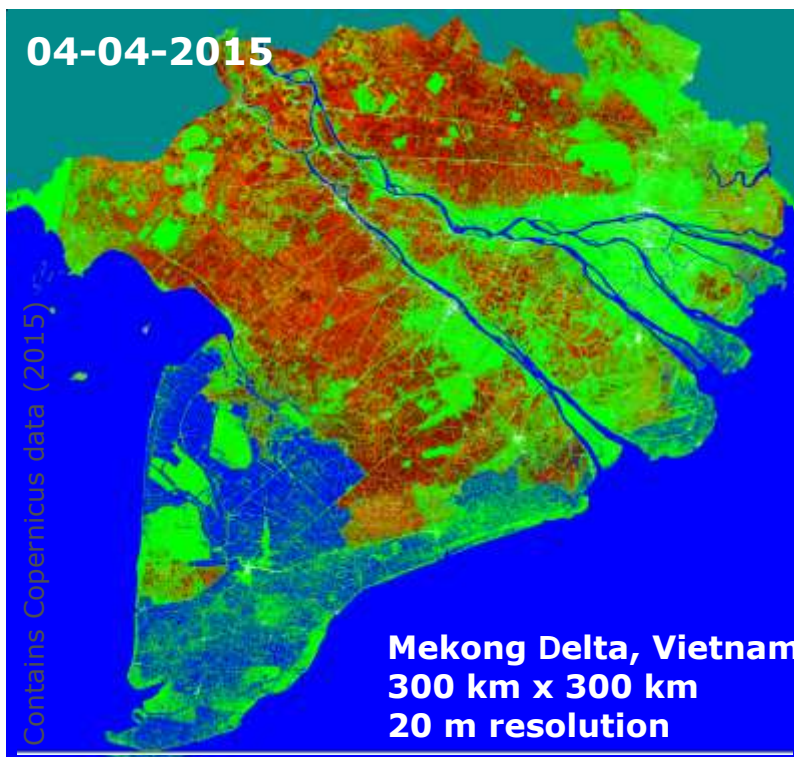




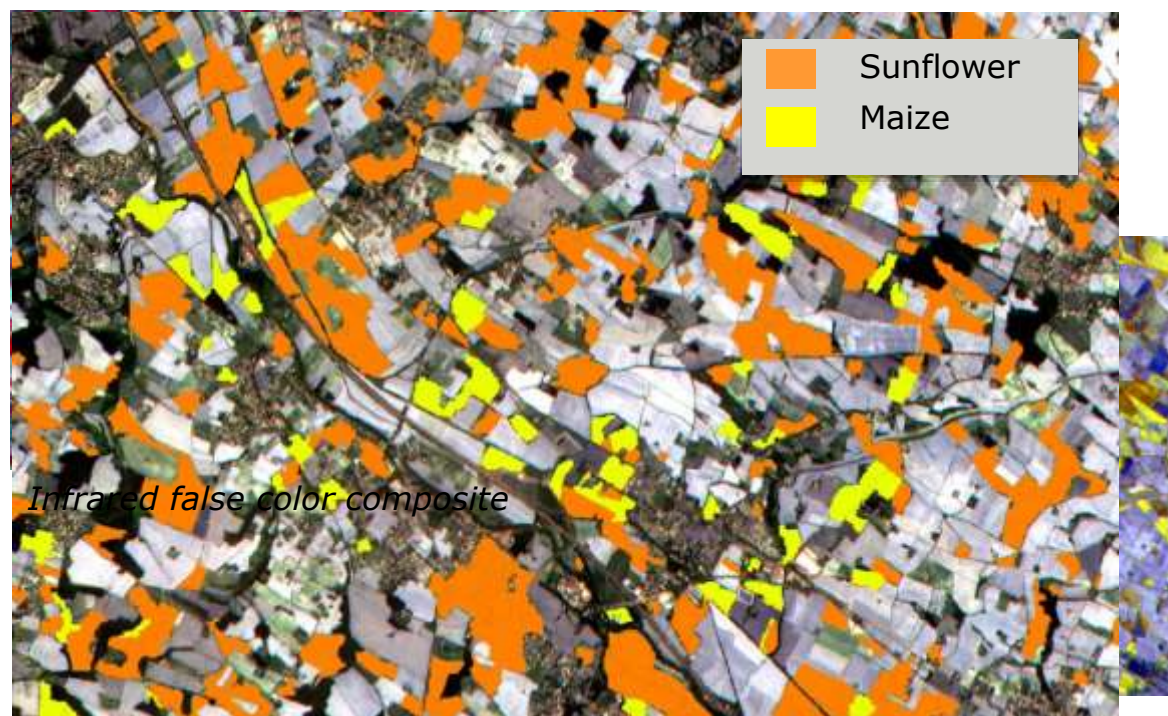
## Contributing to JECAM

- Local to global scales
- S2 algorithm benchmarking over 12 global sites (3 publications)
- S1 rice monitoring algorithm development

### S-1A: Rice crop stages



### S2-A: Summer crops discrimination



**JECAM**

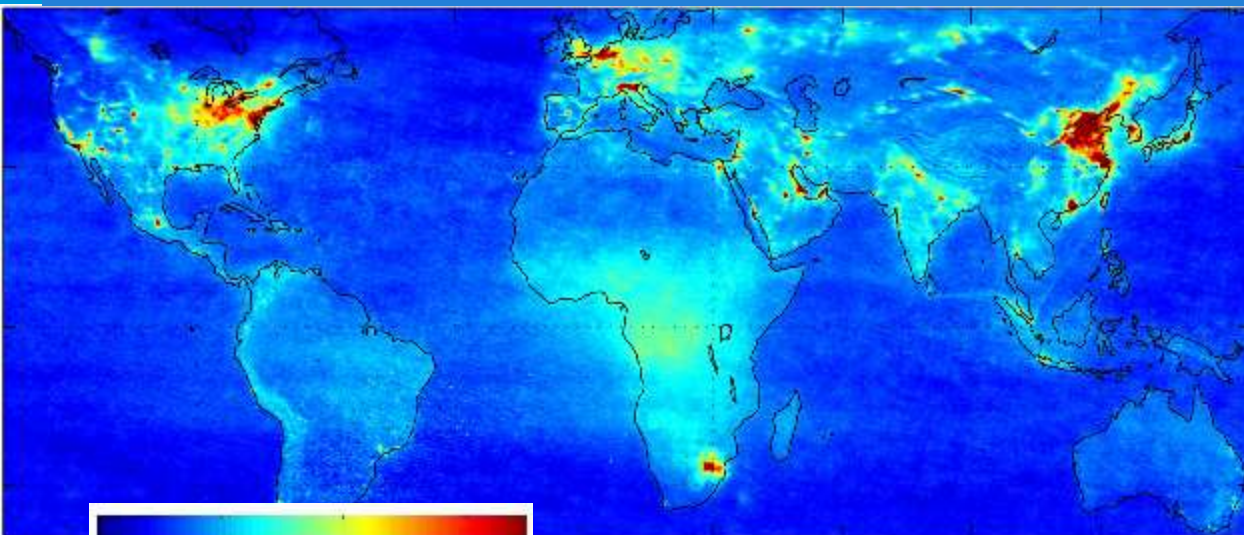
Joint Experiment for Crop Assessment and Monitoring

New red-edge color composite

Slide 15



# An Example : Atmospheric Pollution



## From GLOBAL ...

Image of global tropospheric NO<sub>2</sub> as derived from GOME / ERS and SCHIAMACHY / ENVISAT.

## To LOCAL ...

Street Map in **London**

- "The airTEXTs help me immensely, especially as my heart and lung condition has worsened over the last 18 months and my exercise tolerance is very poor. So thank you for the continuing hard work and keeping people like myself informed."
- "When I get the alerts in the evening I stay indoors next day. I only go out two days a week."
- "I think airTEXT is a great service and has helped my daughter a great deal."
- "I am grateful to you all for all you do to help us."

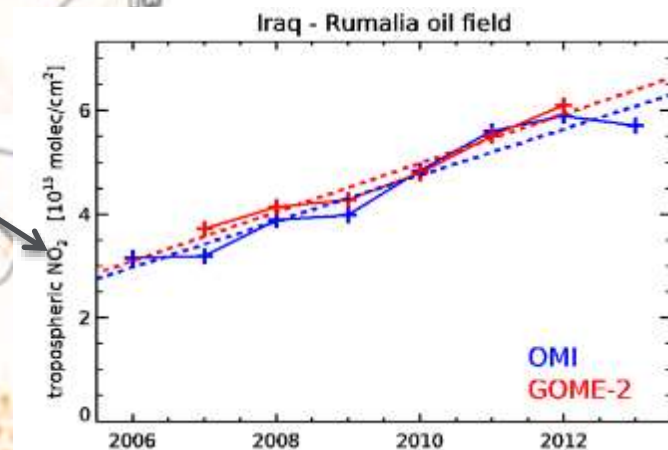
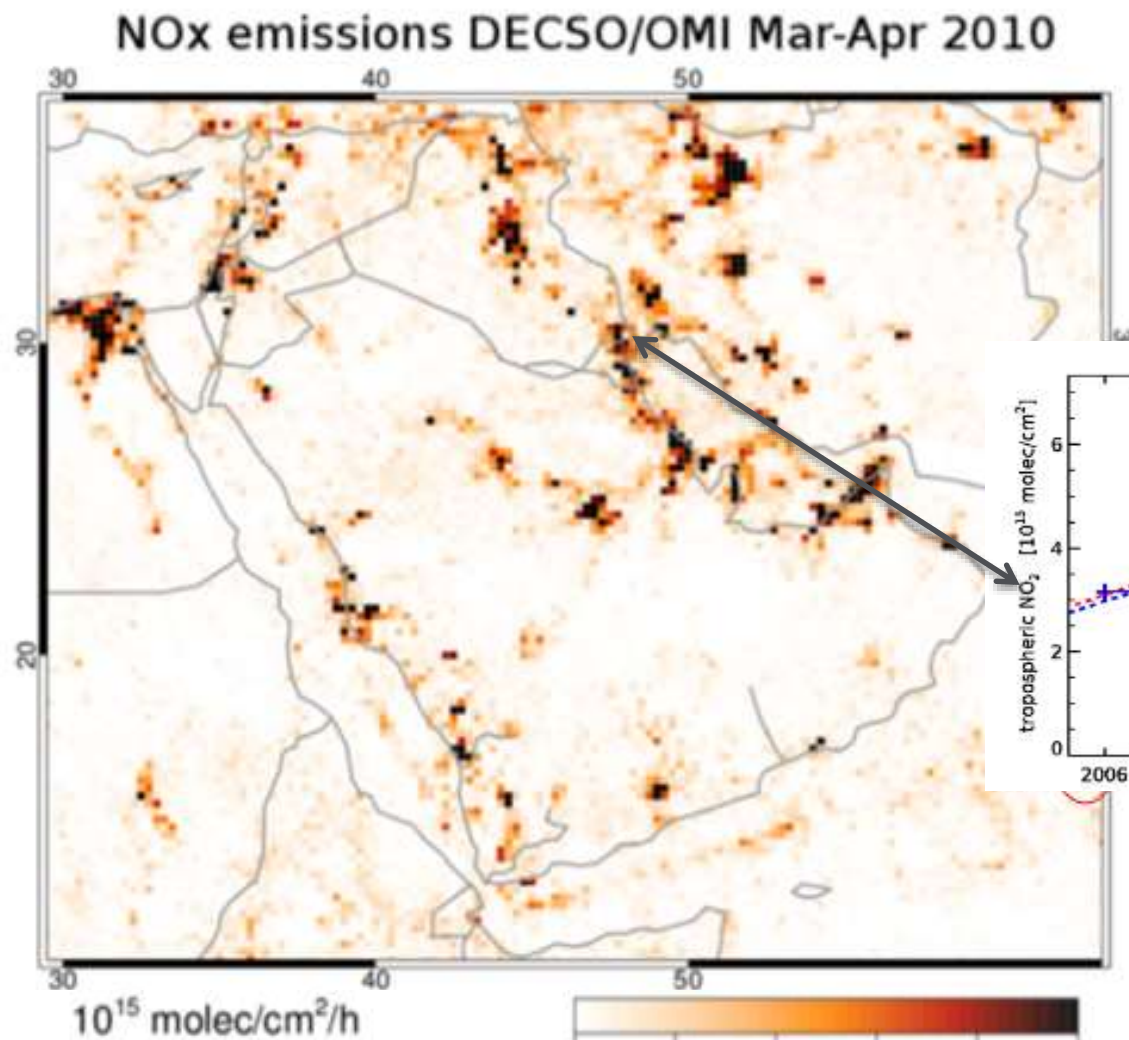
**CROYDON COUNCIL**  
www.croydon.gov.uk





# Preparing for sentinels 4, 5P and 5

## Emissions inventories: bottom-up vs top-down



<http://www.globemission.eu/>

Stavrakou et al. Atmos. Chem. Phys., 13, 9057-9082, 2013

# Market Expansion : Flood Demonstration for Insurance, June 2013



- NRT (daily) Flood maps (wide area synoptic and local VHR), + Maximum Flood Extent for Central European Flood in June (S. Germany, Austria, Czech Republic),





## ESA Objective

- Valuation of ecosystem services -> promote economic sustainable development and green growth

## Why EO ?

- Valuation needs objective assessment and monitoring tools.
- EO independent, validated and unbiased information
- Earth Observation has previously been used for FSC certification, wetlands management, EIA...

## ESA activities scaling up !

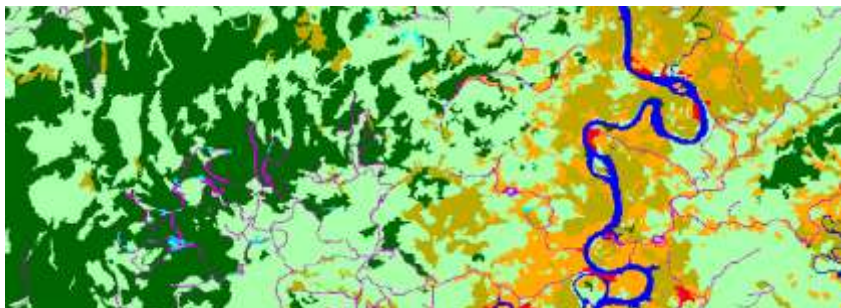
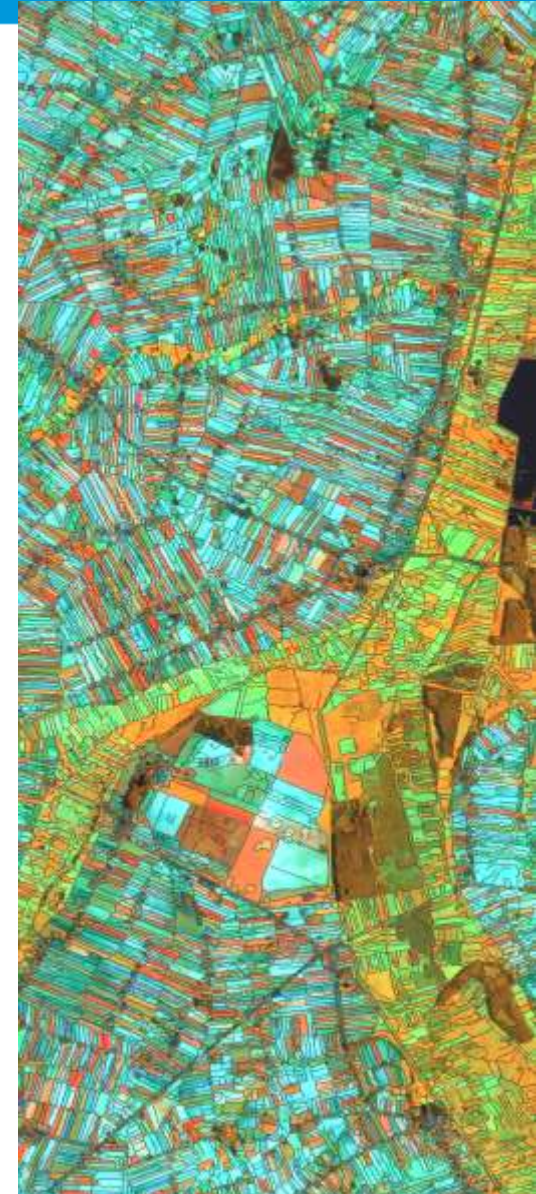
- Start January 2013 - End of activities December 2014
- Trials – 6 world wide trials ongoing 11 more to come
- Market expansion - study of uptake of EO for new users
- User consultations complete : Washington DC and London

## Selected attendance to user consultations

### (70+ organizations and companies attending):

- Althelia, Unilever, ESPA, FSC, Shell, BP, EIB, WBSCD, Carbon Neutral Co, Forum for the Future, World Bank....

**Press:** June 2013  
Althelia Ecosphere completes first closing for Althelia Climate Fund with over EUR60 million (US\$80m) raised for forest ecosystems

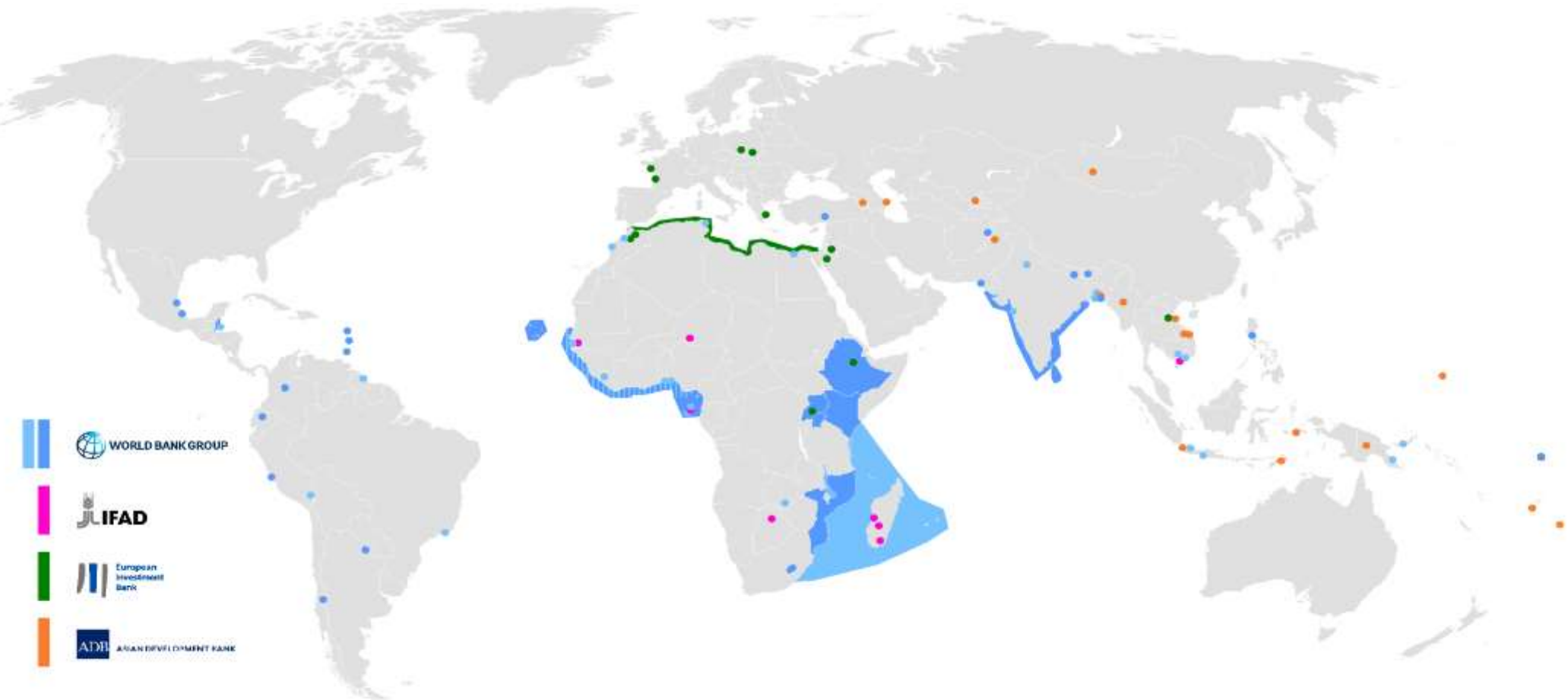


# 65 small-scale demonstrations :

## Responding to specific geospatial information needs



- **Land** Urban Infrastructure, Land Cover, Forest, Crops, Soil erosion, In-land Water,
- **Marine** Oil-spill, Fishing, Coral Reef, Coastal Change, Sea-level Height, Ocean Currents,
- **Risk** Floods, Land Motion Histories for subsidence, landslides, seismic,





- Sentinels for **sustainability**
- Earth Explorers for **innovation**
- Free and open data policy for **growth**
- International cooperation **for societal benefits**

**Thank you**

ありがとうございました