EO Business

Koushik Panda

Technology and Business Innovation Expert

DEIMOS Engenharia

Located in **Lisbon, Portugal** since 2002

Staff of 50 Engineers

Areas of Expertise

Earth Observation Systems and

Applications

Guidance Navigation and Control

Ground Segment Systems

Satellite Navigation

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TECHNOLOGY COMPANY OF THE ELECNOR GROUP

SPACE **AERONAUTICS** **MARITIME** **TRANSPORT** **INDUSTRY & UTILITIES** **TELECOM & MEDIA**

+500
High-tech
projects

18
Years of
expertise

5
Countries

400
Highly-
qualified
employees

Excellence, commitment and innovation

SPACE

SPACE SCIENCE & EXPLORATION

SATELLITE NAVIGATION

EARTH OBSERVATION

SPACE SITUATIONAL AWARENESS

LAUNCHERS

Expertise across the entire value chain in satellite systems
Deimos technology is present in more than 60 satellites

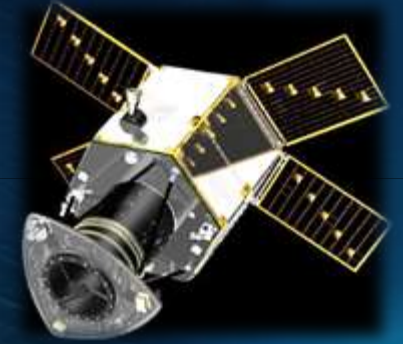**Capabilities to lead a complete space mission**

DEFINITION   DESIGN   DEVELOPMENT   LAUNCH   APPLICATIONS

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DEIMOS EARTH OBSERVATION SYSTEMS

PLATFORMS New launcher technologies, new satellites, UAVs

SENSORS Passive radars for oceanography, soil moisture and object detection
GNSS receivers for extreme conditions

DATA ACCESS Data archive catalogue & access
Multi-mission ground segments

DATA EXPLOITATION Services for data and user management
Chaining of (micro-)services, cloud deployment

EO APPLICATIONS User-driven value-added services, data processors

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DEIMOS-1

First Earth Observation Satellite
Copernicus contributing mission

Operated by Deimos Imaging

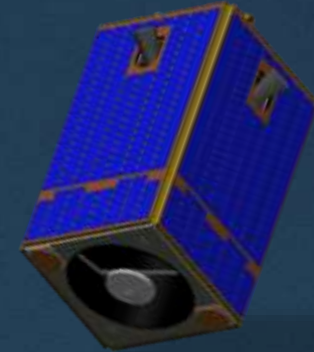| CHARACTERISTICS	APPLICATIONS	LAUNCH
Optical	Crop yield prediction	July 2009
Resolution: 22 m	Emergency response	
Coverage: 600 km	Maritime surveillance	

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sat4EO

Recurrent Platform for small satellites (< 250Kg)

CHARACTERISTICS:
Very High-Resolution optical
High performance image quality

APPLICATIONS
Intelligence
Precision agriculture
Emergency response
Urban planning
Security

FIRST LAUNCH
Planned for 2023

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OPERATIONAL GROUND STATIONS

Antenna Vertex 10,2 m

Puertollano (Earth observation (DEIMOS/ESA and SST)

Valladolid (DEIMOS)

2 private in Asia (DEIMOS)

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DEIMOS EARTH OBSERVATION SYSTEMS

Mission Payload Data Systems

- - Systems to handle satellite data
- - Ground segment products

*gs**4**EO*

Earth Observation Systems

- - EO applications
- - EO systems

*service**4**EO*

3 locations: Lisboa, Madrid, Harwell

4 teams:

- R&D Systems
- Products Operations

Main Clients

ESA	Thales
EUMETSAT	Airbus
EMSA	OHB

Research Centres & Agencies
SMEs, e.g. applications & VA Services

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European EO Downstream Market

In-situ sensors / Meteorological data / Topographic data / Non-geospatial sources

Upstream and midstream	Downstream: Intermediate users	Non-space community: End users

- Satellite data

Downstream: Intermediate users
- Pre-processing
- Analysis
- Value Added Services
- Display

"EO experts"

Non-space community: End users
- Input EO-based products in their business
- Tailored needs

"Non-EO experts"
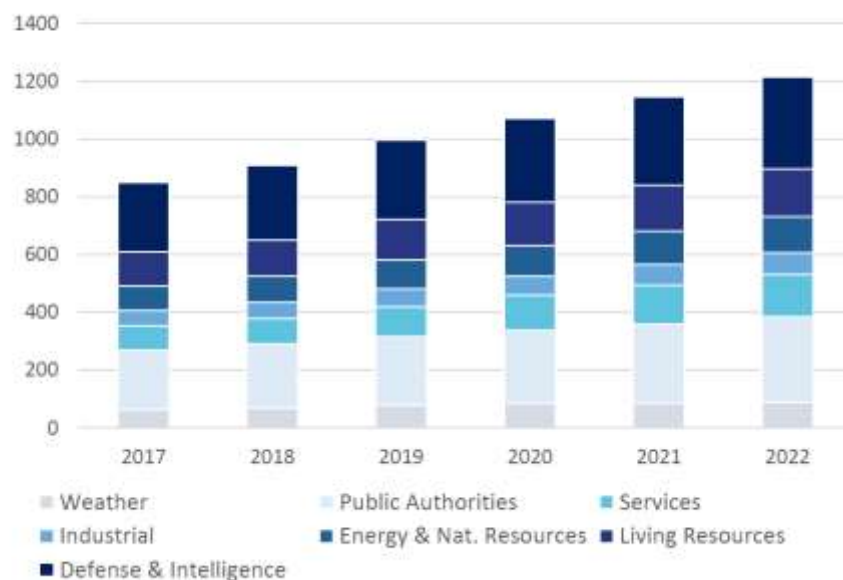
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European EO Downstream Market

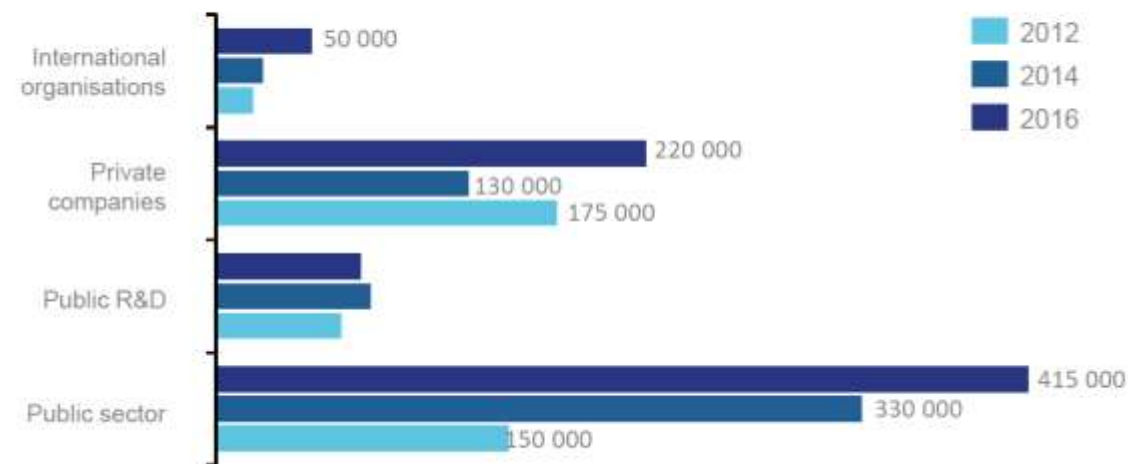€ 950 million — Revenues of the European EO downstream industry in 2017

33 % — Share of European EO downstream revenues in the global EO downstream market

European EO downstream market forecast by vertical
(Source: NSR)

Legend: Weather, Public Authorities, Services, Industrial, Energy & Nat. Resources, Living Resources, Defense & Intelligence

Comparison of EO downstream sales by customer segment in the EU, EUR K
(Source: EARSC)

Legend: 2012, 2014, 2016

International organisations: 50 000

Private companies: 220 000 / 130 000 / 175 000

Public R&D

Public sector: 415 000 / 330 000 / 150 000

Average annual growth rate of over 6%

Public sector accounts for 50% of the Market

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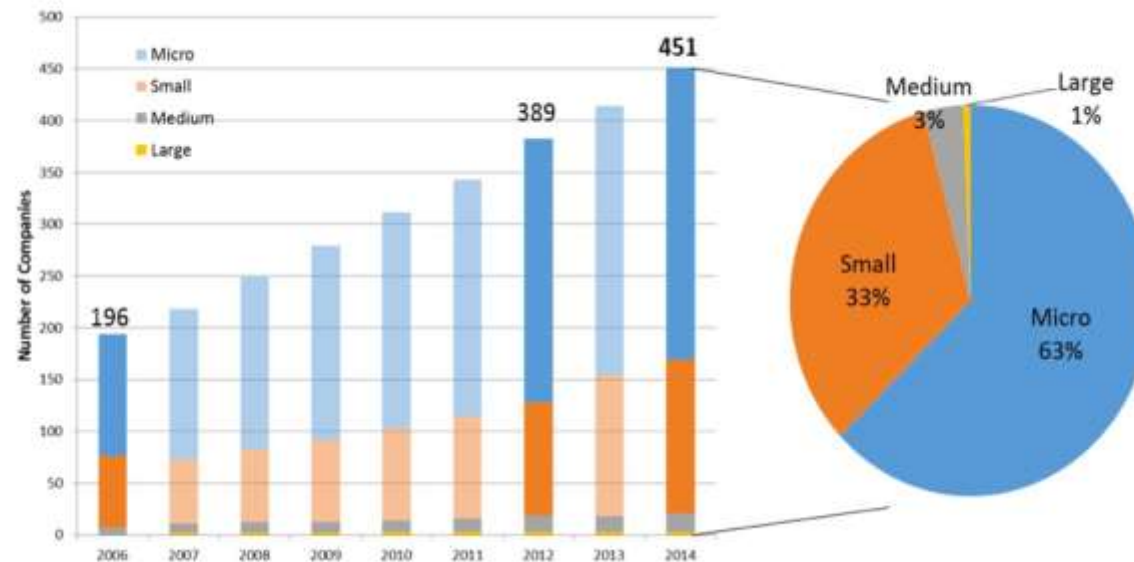elecnor group

European EO Downstream Market

European SMEs are the key movers of this market

EO Service sector in Europe with 500 companies generating 900M revenues
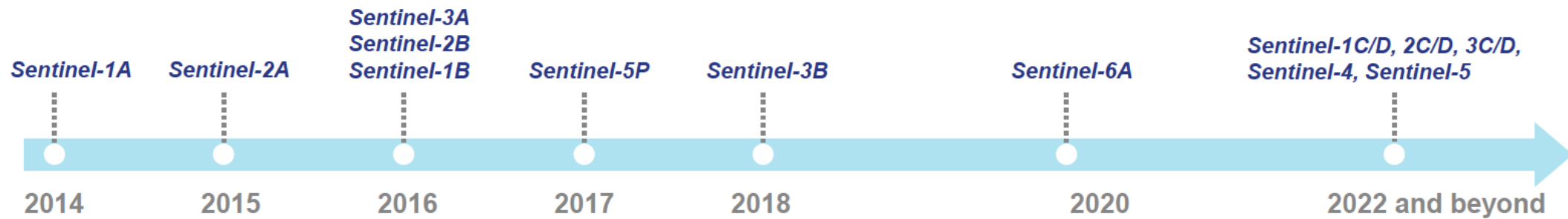
European EO Downstream Market

"fostering the development of a competitive European space and services industry and maximising opportunities for European enterprises to develop and provide innovative Earth observation systems and services "

EU (201 4 EU Regulation establishing the Copernicus programme as being operational, 377/201 4)

Copernicus Program

Actual and planned launch dates of the Sentinels (Source: European Commission, European Space Agency)

Sentinel-1A — 2014

Sentinel-2A — 2015

Sentinel-3A
Sentinel-2B
Sentinel-1B — 2016

Sentinel-5P — 2017

Sentinel-3B — 2018

Sentinel-6A — 2020

Sentinel-1C/D, 2C/D, 3C/D,
Sentinel-4, Sentinel-5 — 2022 and beyond

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Intermediate User´s Benefit (Copernicus)

DETAIL PER VALUE CHAIN

	Agriculture	Forestry	Urban Monitoring	Ocean Monitoring	Oil & Gas	Renewable Energies	Air Quality	Insurance for Natural Disasters	Response to Natural Disasters	Security
Copernicus enabled revenues for intermediate users in 2018 (EUR million)	19	12	10	59	19	4	1	11	9	25
Average annual growth rate up to 2020	+ 20 %	+ 13 %	+ 19 %	+ 23 %	+ 17 %	+ 16 %	+ 12 %	+ 5 %	+ 0 %	+ 0 %
Penetration of Copernicus data with regards to EO data (2018)	17 %	12 %	10 %	20 %	8 %	10 %	4 %	<1 %	60 %	40 %

The penetration of Copernicus data takes into account the Sentinel data, Copernicus Services products, and also contributing missions data when procured in the frame of Copernicus Services. The latter explains in particular the high penetration rates for response to Natural Disasters and Security.

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End User´s Benefit (Copernicus)

DETAIL PER VALUE CHAIN

Copernicus enabled revenues for 2018 (EUR million)

Average annual growth rate up to 2020

Value Chain	Revenues	Growth
Agriculture	318	+ 31 %
Forestry	77	+ 46 %
Urban Monitoring	24	+ 17 %
Ocean Monitoring	190	+ 4 %
Oil & Gas	417	+ 17 %
Renewable Energies	137	+ 25 %
Air Quality	537	+ 3 %
Insurance	14	+ 5 %
Civil protection	670	+ 12 %
Security	308	+ 8 %

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Development Revenues by EO Services
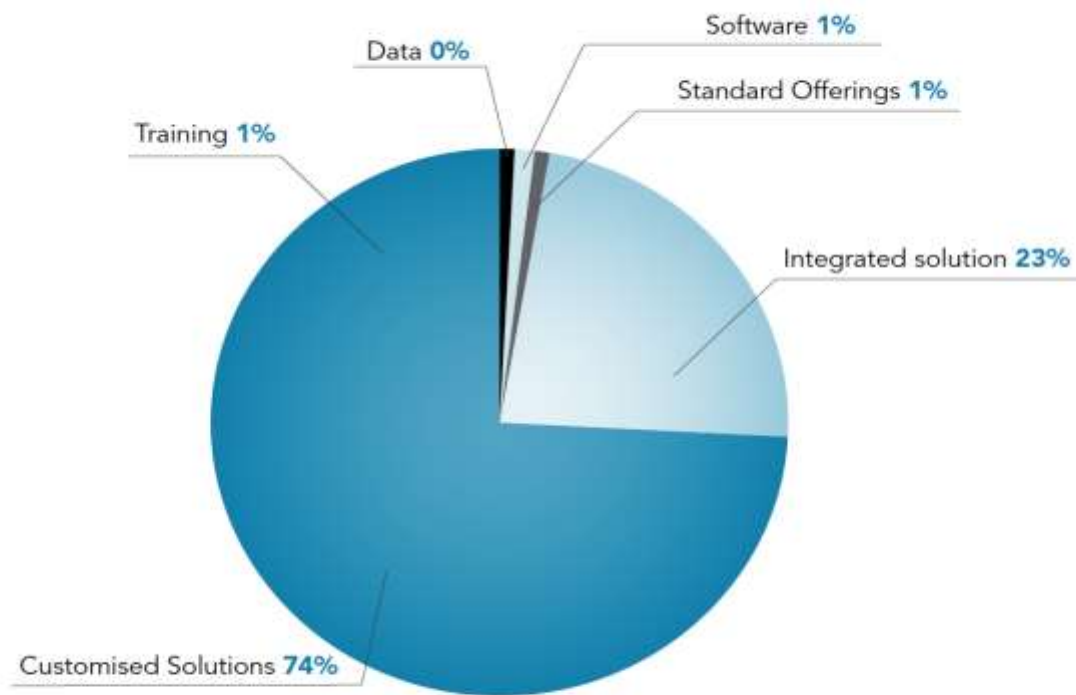
FIGURE 7. Development revenues by service. (Source: ESA-EOMD Compendium)

European EO Downstream Market Trends

- ➢ Diversification of users and their demands

- ➢ Evolution of business models

- ➢ Cloud Computing

- ➢ Data analytics and processing

- ➢ Data democratization and pricing

EO Service provisioning

End User

INFOaaS (Information As a Service)

PaaS (Platform As a Service)

IaaS (Infrastructure As a Service)

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Copernicus Data and Information Access Service (DIAS)

International Players (AWS and Google)

Agriculture

Applications :

- Crop Monitoring
- Smart and Precision Agriculture
- Water management

End Users :

- Farmers
- Agriculture Associations
- Public Authorities focused on Food Security
- Decision makers (e.g. national public authorities, international bodies)

Challenges :

- Difficult to provide services directly to farmers
- Lack of digital skill and awareness

Drivers :

- Sustainable Agriculture
- Food Security

Forestry

Applications :

- Resource Mapping and Monitoring

End Users :

- Forest Managers
- NGOs
- Government Institutions
- Timber Managers
- Fuel Wood resource Manager

Challenges :

- Constructing time series on certain parameters
- Validation with ground truth

Drivers:

- Cost reduction in monitoring
- Improve and preserve forest ecosystem and green infrastructure
- Improved yield in forest industry
- Deforestation measures

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Urban Monitoring

Applications:

- Urban Planning
- Urban Risk Management

Challenges:

- Combining existing data with satellite images
- Lack of cheaper high resolution images
- Lack of Historical reference point and non transferability to other regions
- Lack of awareness

End Users:

- Public Administration
- Government and Institutions
- Civil Engineers / Architects

Drivers:

- Sustainable resource management , resource allocation
- Accurate and up to date monitoring of problem areas and anticipate threats due to urban population

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Marine

Applications:

- Fishing and Aquaculture
- Shipping (Navigation)
- Water Quality and Marine Ecosystem
- Coastal Management
- Policies

Challenges:

- Long time series of EO data
- Data fusion with other sources data
- Diverse sector and need for tailored applications

End Users

- Fish Farmers
- Public Authorities
- Environmental Agencies
- Citizens
- Ship Owners
- Research Centers
- Municipalities
- EU

Drivers:

- Rapid changes in Ocean
- EU directives
- Blue growth Economy

Oil and Gas

Applications:

- Exploration
- Monitoring
- Environmental Impact Assessment
- Risk Assessment of offshore sites (eg.- floating ice)

Challenges:

- Volatile and Cyclical Market
- Unwilling to take risk with new technology due to traditional nature
- Reactive attitude rather than proactive

End Users:

- Survey Companies
- Oil and Gas companies
- Environmental consultancy

Drivers:

- Environmental responsibility driven by legislation (Safety of Offshore Oil and Gas Operations Directive)
- Steady oil demand
- Risk Assessment

Renewable Energy

Applications:

- Exploration (EU and outside EU)
- Monitoring
- Cost savings on maintenance
- Power production monitoring and forecast
- Solar > Wind > Hydropower

Challenges

- The sensitive environmental conditions of the renewable energy sources and satellite data is not yet sufficient
- Lack of accuracy in forecasting

End Users:

- Energy Producers
- Supplier to Energy providers
- Public Authorities
- Utilities
- Grid Managers
- Energy and carbon trader

Drivers:

- Increasing demand for renewable energy

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Air Quality

Applications:

- Air Pollution
- Allergy Monitoring
- Support to Tourism
- Public Health

End Users:

- Citizens
- Public Authorities
- Municipalities
- Research Centers
- Medical Centers

Challenges:

- Lack of budget from public authorities
- Need for high resolution data due to the local nature
- Low willingness to pay for Air Quality services by the end users

Drivers:

- Concerns from Citizens on air quality

Insurance for Natural Disaster

Applications

- Risk Modelling
- Event Footprint
- Index Products

Challenges

- Combining EO and statistical data for risk modelling
- Lack of internal expertise and awareness

End Users

- Insurers
- Reinsurer
- Insured people
- Emergency Services

Drivers:

- Index products offers steady approach for insurance
- Post event analysis allows insurance companies to provide better customer service

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service4EO Agro

esa

soilessentials
precision farming solutions

Users: **Agronomists, farmers** in **5 countries**: UK, Ireland, Netherlands, Ukraine and New Zealand and **expanding**

Demonstration 2017:
7 million ha monitored, **tested on 30,000 ha**, across 150 farms

>10 Use Cases: Crop problems, application maps, plant counting, weed identification, blight risk, mobile app, tractor data…

Main crop types: potatoes, cereals, grass

Airborne and space assets: UAVs + free and commercial **satellite imagery**

Mobile app

Desktop app

Deimos1

Worldview

Sentinel2

RapidEye

Sentinel1

Landsat8

PlanetScope

UAVs

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service4EO Urban
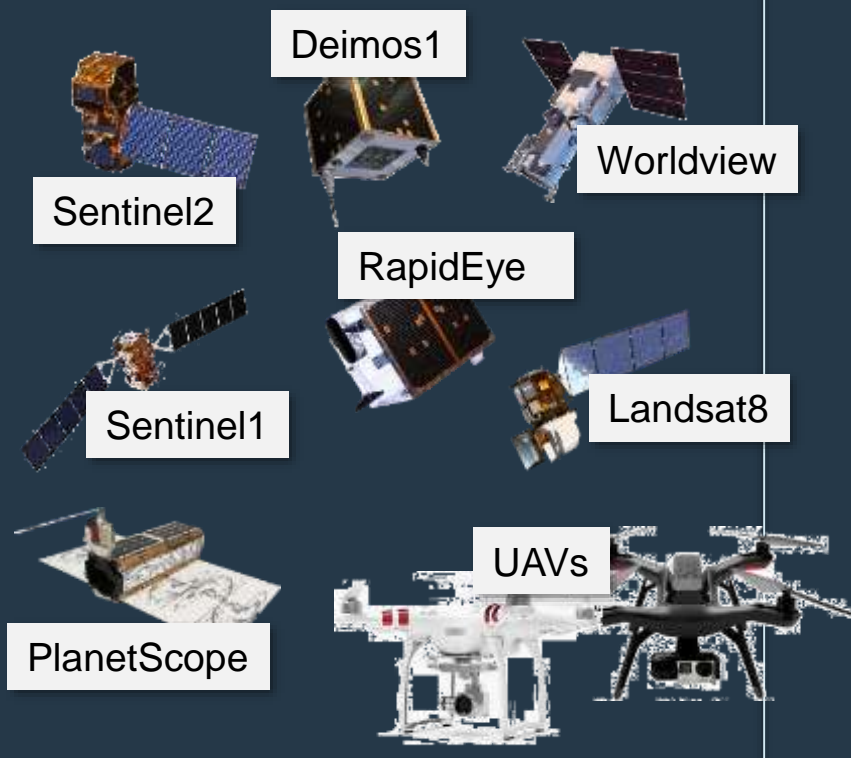
LULC mapping in Urban Environments

COS ground truth

Sentinel-2 L2A

Model results
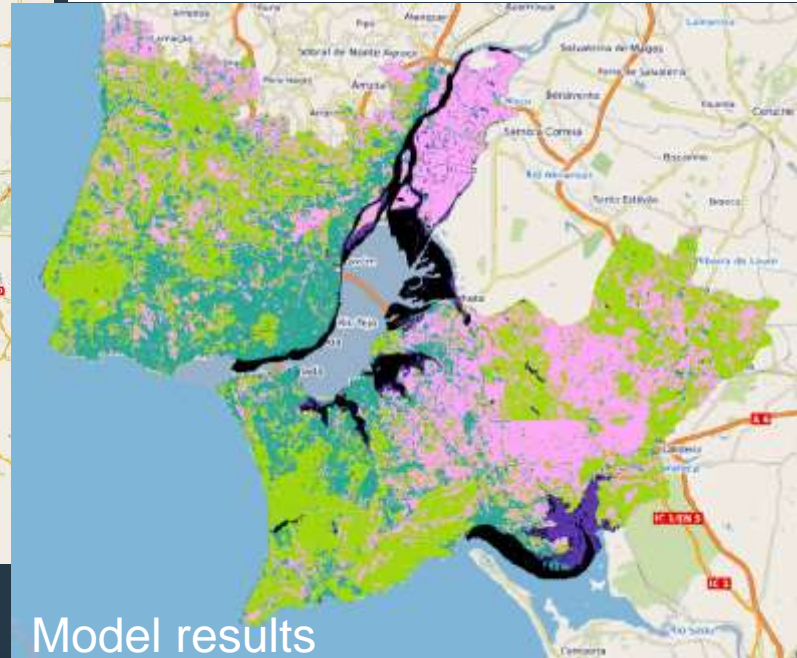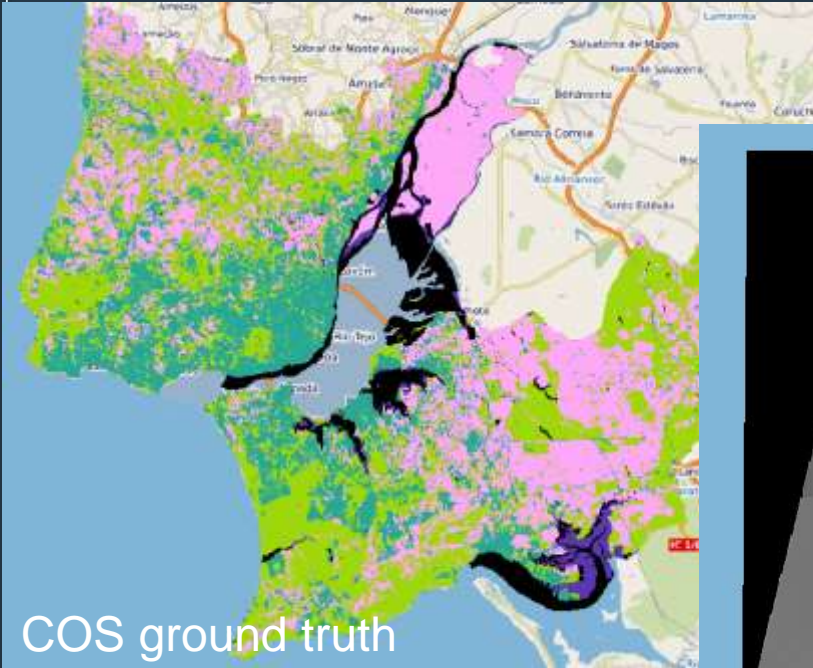
Scikit-learn - Machine Learning in Python

SVM

- gamma: auto
- kernel: rbf
- C: 100.0

F1-Score: 0.77

Confusion matrix

	0	1	2	3	4
Urban - 0	15434	2165	1527	144	29
Agriculture - 1	1880	22036	6340	199	8
Forests - 2	1886	5605	25299	183	3
Humid zones - 3	36	45	85	1401	142
Water - 4	95	67	78	616	4697

Predicted label

service4EO Urban

RWATCH: Car counting

WorldView-03 ~ 31 cm
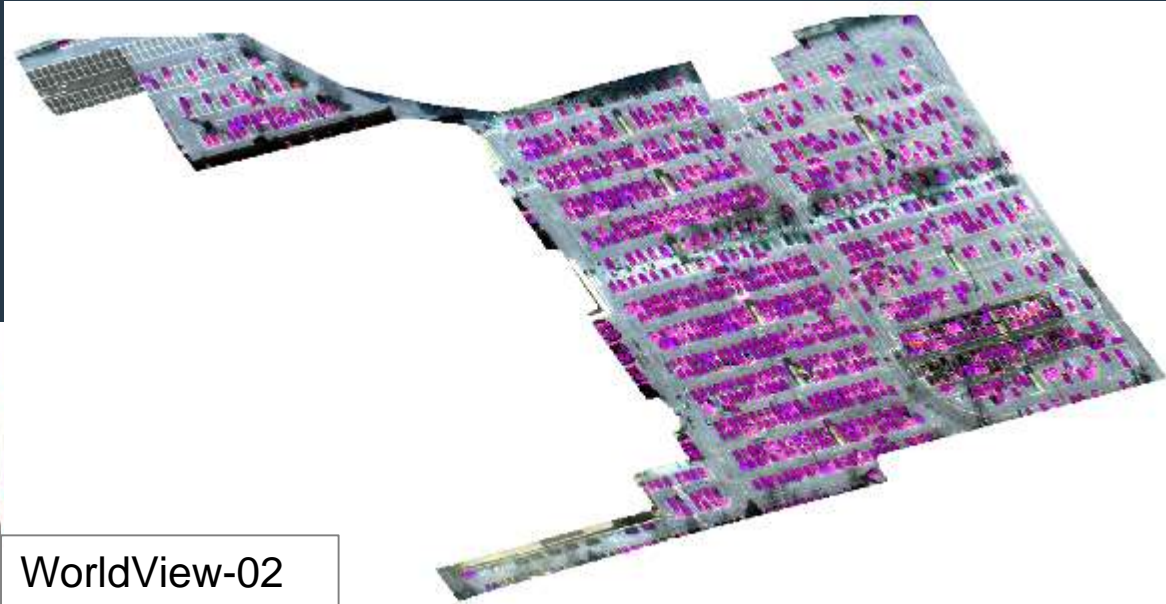
WorldView-02 ~ 40 cm
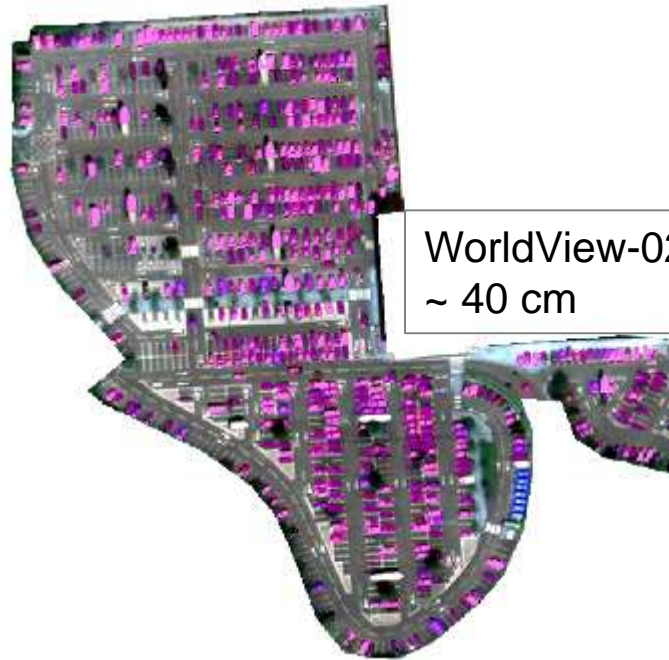
QuickBird-02 ~ 56 cm

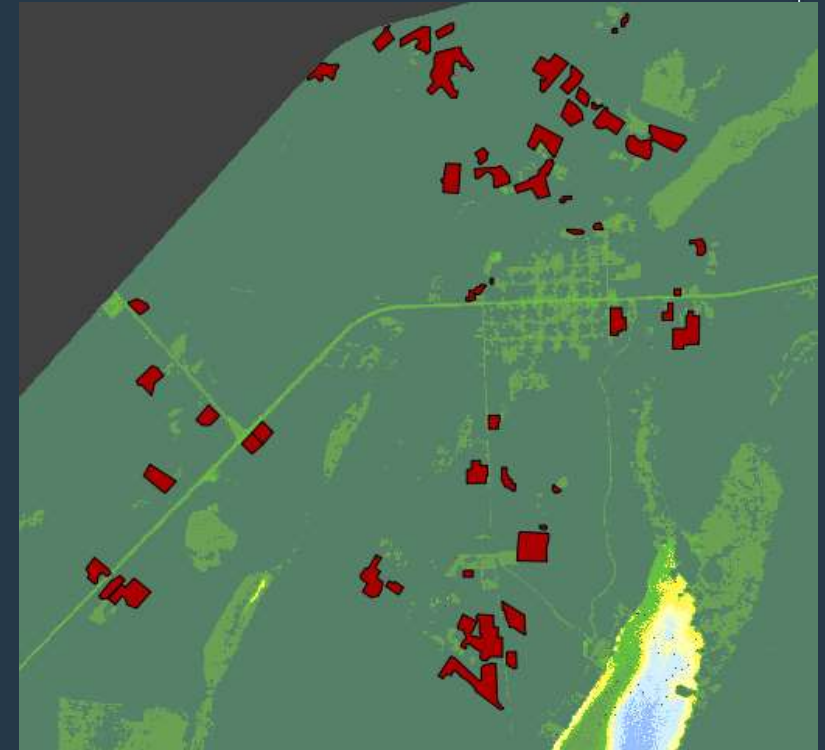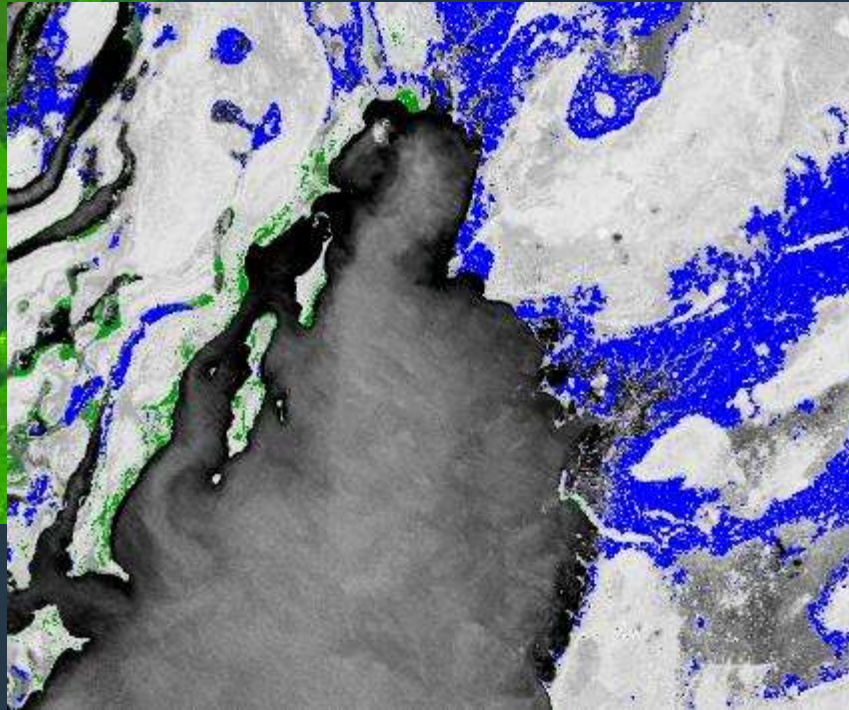GeoEye ~ 45 cm

service4EO Forestry
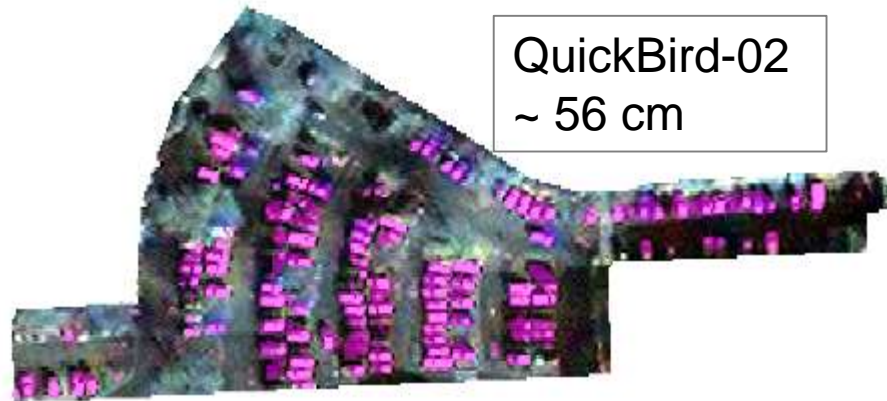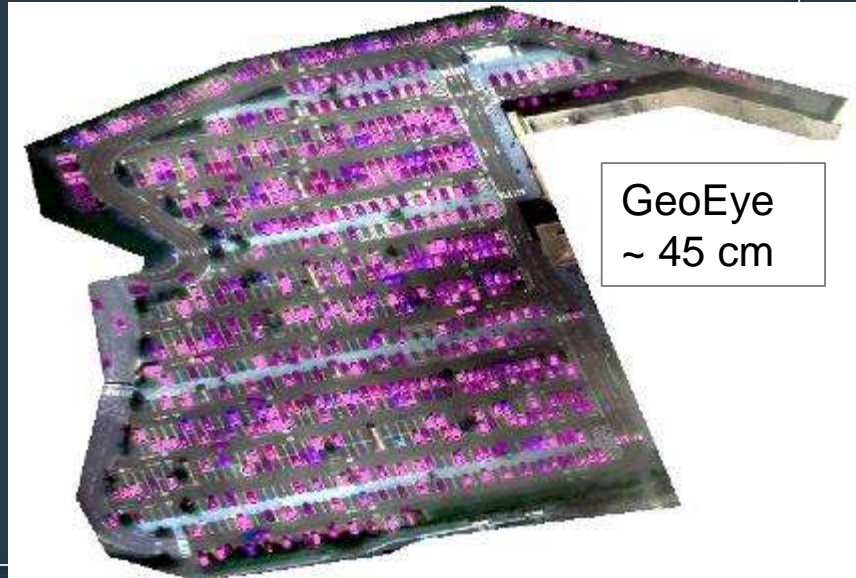
NDVI map

Mangrove classification

Deforestation due to urban growth

del results

service4EO Forestry

Image before change (2018-02-19)

Image after change (2018-05-15)

Detection of single tree cuts in Sentinel2 imagery (Guatemala)
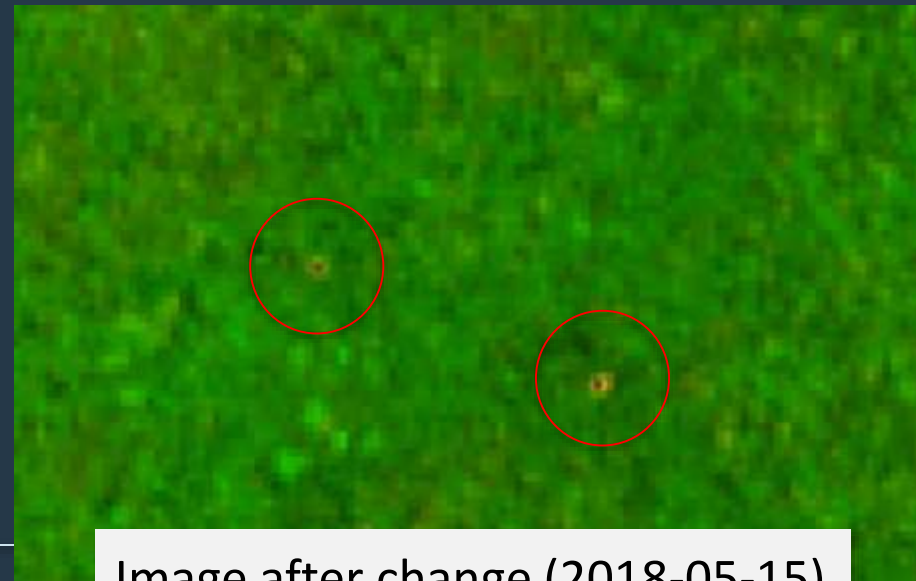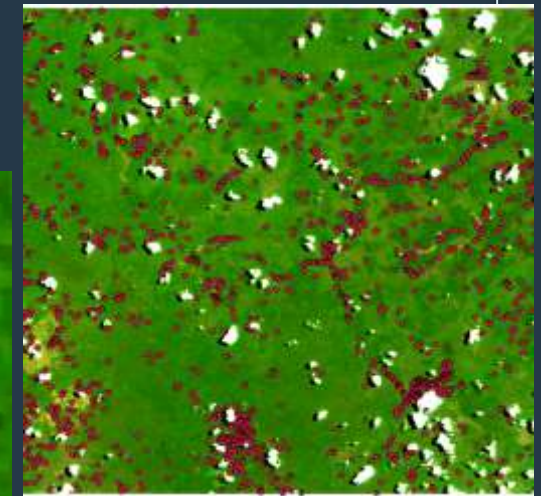
Image before change (2018-02-19)

Image after change (2018-05-15)

Single cut trees

detection overview

service4EO Ocean
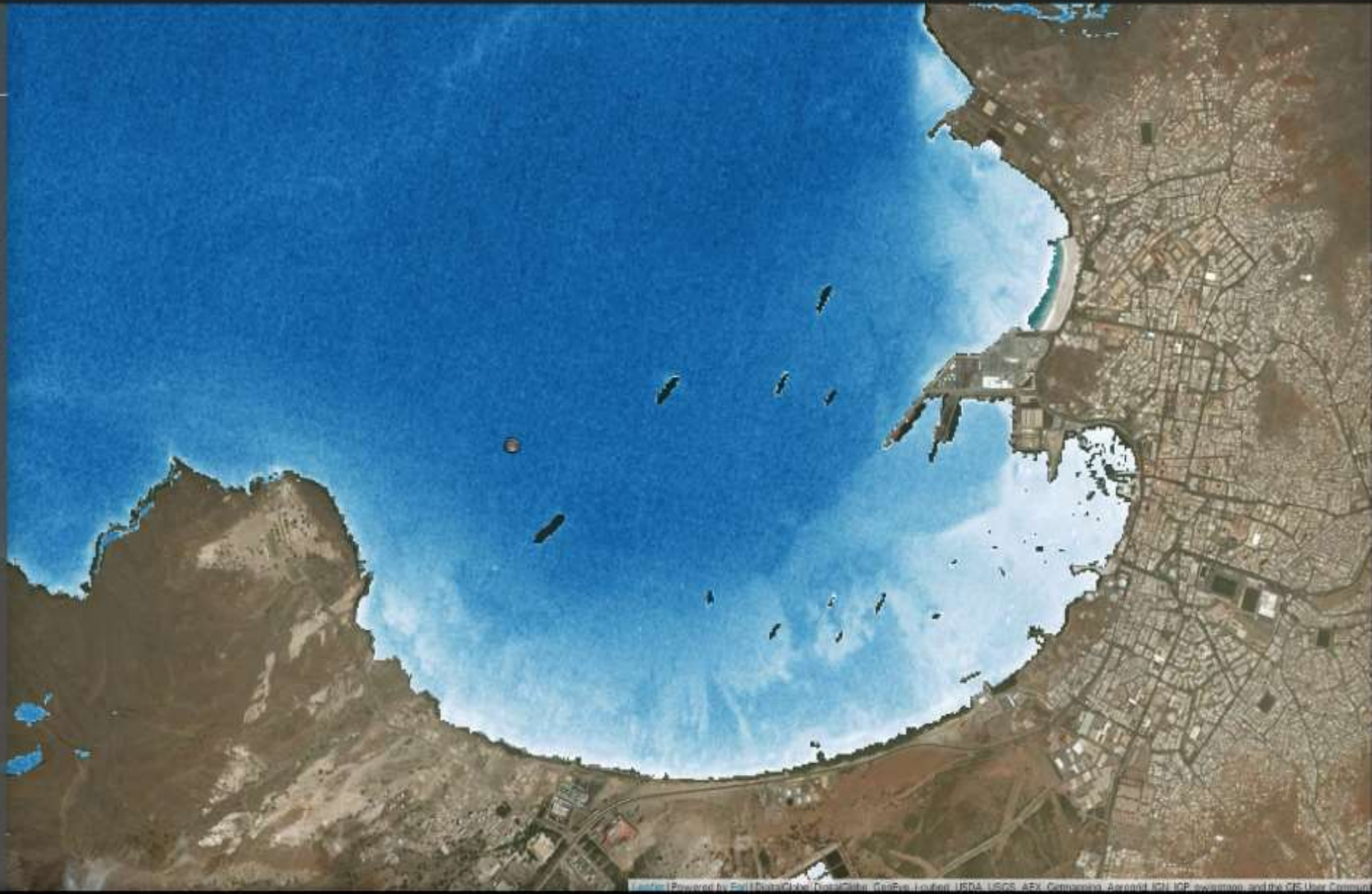
FISHING AREAS CHARACTERIZATION

Prediction of fish distributions and potential areas of catch for the main species along the Portuguese coast
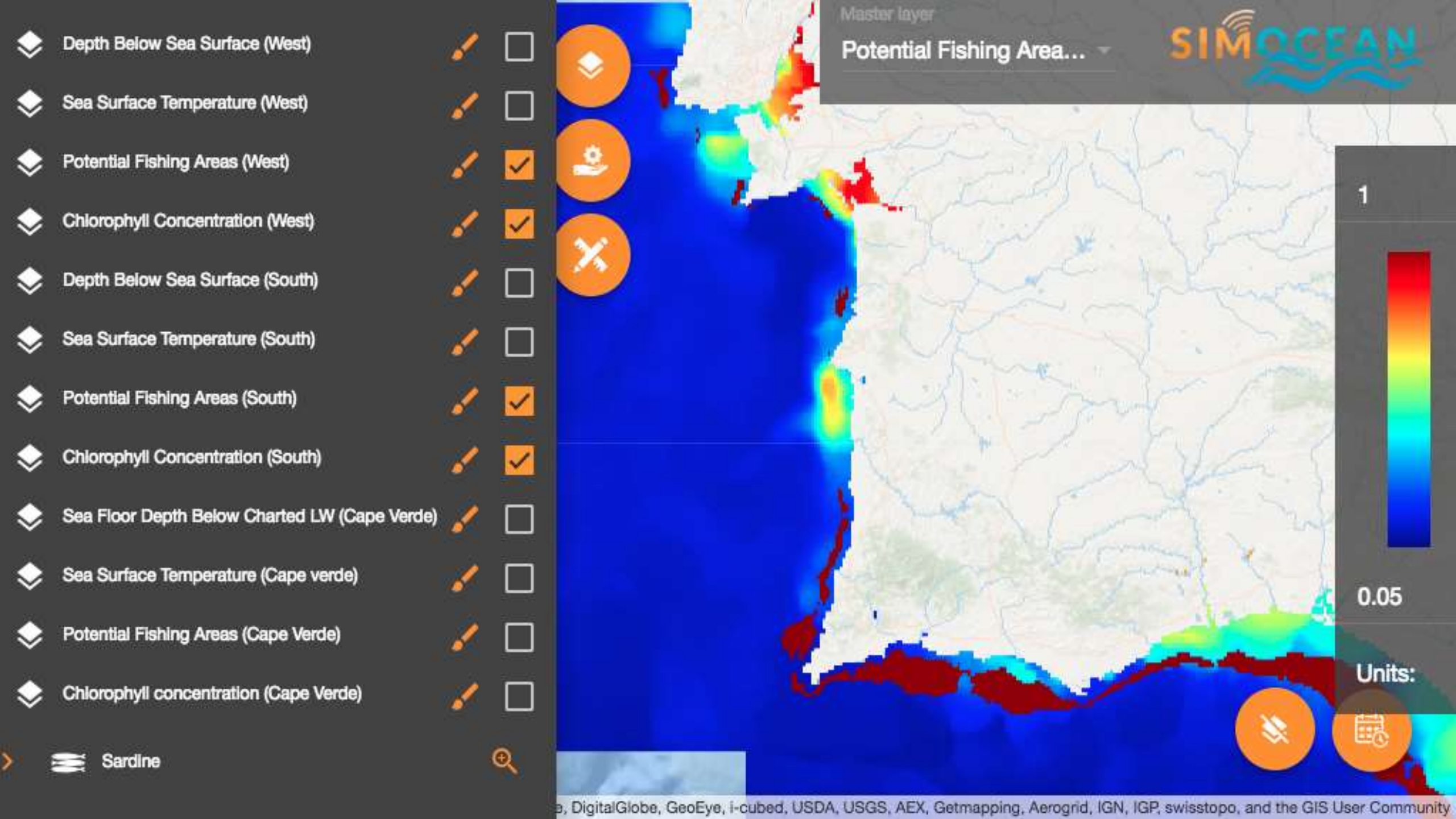
SEA STATE INDEX FOR HARBOUR APPROACHES

To provide access to real-time sea state information based on high-resolution forecast models for the port authorities.
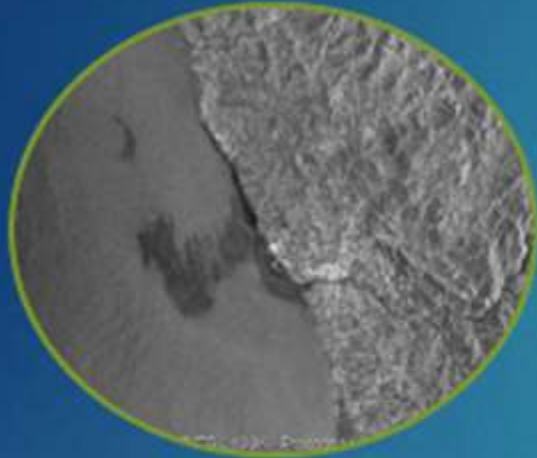
COMPARISON OF METEO-OCEANOGRAPHIC PARAMETERS

Integrated web visualization environment of different meteo-oceanographic fields
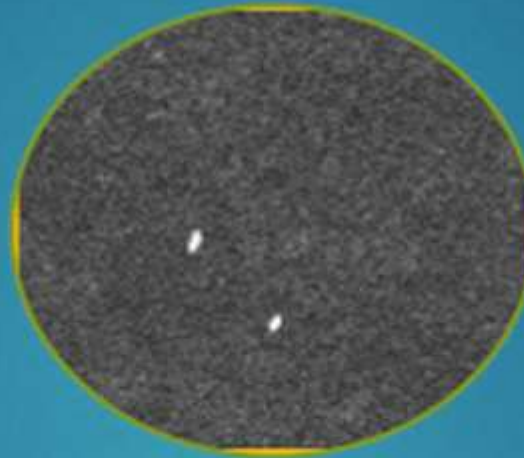
Depth Below Sea Surface (West)

Sea Surface Temperature (West)

Potential Fishing Areas (West) ☑

Chlorophyll Concentration (West) ☑

Depth Below Sea Surface (South)

Sea Surface Temperature (South)

Potential Fishing Areas (South) ☑

Chlorophyll Concentration (South) ☑

Sea Floor Depth Below Charted LW (Cape Verde)

Sea Surface Temperature (Cape verde)

Potential Fishing Areas (Cape Verde)

Chlorophyll concentration (Cape Verde)

Sardine

Master layer

Potential Fishing Area... ▾

SIMOCEAN

1

0.05

Units:
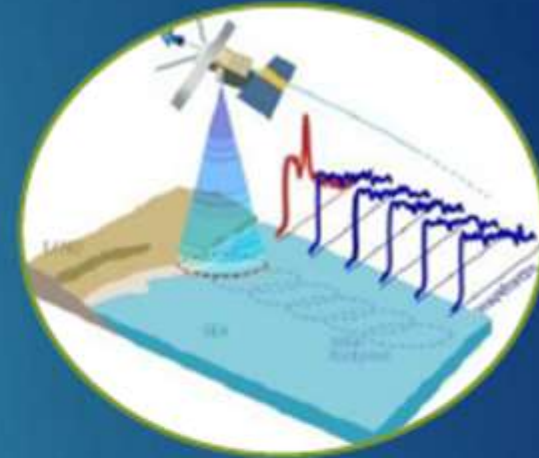
e, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
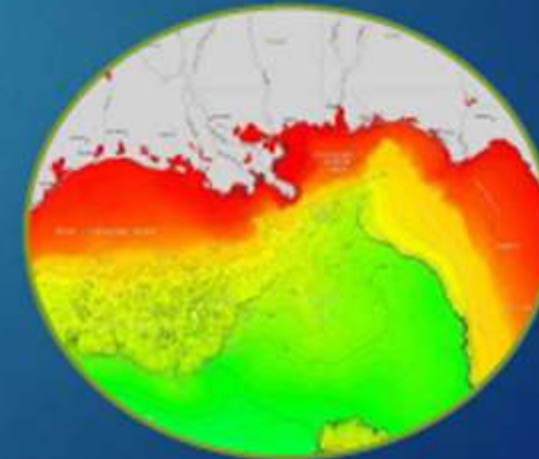
NEXTGEOSS
European Data Hub and Platform

- Five steps engagement process

- Data and services hub with community feedback

- Cloud Integration for large, systematic processing

- Operations and monitoring

Europe's Earth Observation Data Hub

Satellite, remote sensing, in situ, and citizen science data about climate change, agriculture, polution and more.

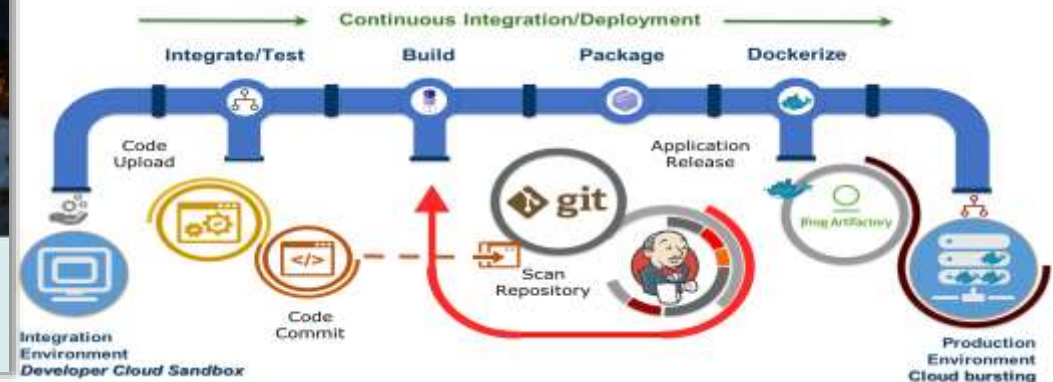1,174,183 Earth observation datasets

NextGEOSS Platform Services

An European contribution to the GEO Community

Data Cataloguing

Cloud Integration

Service Cataloguing

Cloud Bursting

Data Discovery

User Management

Geospatial User Feedback

Operations Analytics and Dashboards

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NextGEOSS Pilot Services

Innovative Pilot Services

IP1
Agricultural
Monitoring

IP2
Biodiversity

IP3
Space &
Security

IP7
Co-ReSyF
NEW

IP4
Cold Regions

IP5
Air Pollution
in Mega Cities

IP6
Disaster Risk
Reduction

NOA

Business Pilot Services

BP1
Territorial
Planning

BP2
Food Security

BP3
Smart Cities

BP4.1/2
Energy*

BP5 Marine
Drift
NEW

BP6 Geo
Wetland
NEW

Atlantic EO GEO Community Activity (aka AtlanticGEOSS)

Collaborative EO framework for systems and services:

- Engage Users and federate service needs
- Access to a wide range of geospatial data sources
- Collaborative R&D, development and operations
- Attract funding and ensure sustainability
- Support the SDGs and Belém Statement
- Leveraging GEO and GEOSS for the Atlantic

service4EO FOR EO APPLICATIONS AND SERVICES

identity4EO

User Management aaS
Authentication, incl. SSO

Authorisation for services

Accounting for BI and billing

COIH – with ESA and EARSC

portal4EO

Geoportal kit

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service4EO FOR EO APPLICATIONS AND SERVICES

identity4EO

User Management aaS

Authentication, incl. SSO

Authorisation for services

Accounting for BI and billing

COIH – *with ESA and EARSC*

portal4EO

Geoportal kit

Archiving and Cataloguing:

NextGEOSS

Operations and Monitoring

Analytics Dashboards

Micro-services chaining

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more to come 2020 onwards

What commercial users want ?

Information delivery
- Easy to understand for non-EO experts
- Timely (weekly, monthly or on demand)
- Faster and Accurate and Near Real time
- Integrated Solutions
- Customized

Business Model
- Flexible and affordable
- A la carta offering
- Specific to each client
- Prototyping to reduce new technology Investment

- **Client Value creation**
  - Reducing Operational cost
  - Increasing Revenue

- **Capacity Building**

Talk to the users and involve them in your application development from the beginning

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Are we there yet?

Lack of Operational Services

Data and Service Discovery is still not fully realized

High availability of Cloud Computing

Leveraging on API economy and Interoperability

Combination of EO and non EO data is crucial

Price of the services need to be lower with flexible business model

Time to market needs to be shorten

More PPP (Public Private Partnership)

Software Engineering

koushik.panda@deimos.com.pt

We are open for any collaboration

Any thoughts?