

# → EO SCIENCE FOR SOCIETY

Luxembourg Earth Observation and Integrated Applications Day

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Data Applications Division

19/04/2018

### **EO Science for Society #EO4society**

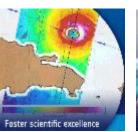


# EO Science for Society (EOEP5 Block 4) built on successes of previous ESA exploitation activities:

- adapting them to the new European EO context
- · responding to recommendations of programmatic and scientific review.

### MAIN OBJECTIVES

- Foster scientific excellence
- Pioneer new EO applications
- Stimulate downstream industry growth
- Support international responses to global societal challenges
- Develop platforms technical capabilities
- Build network of resources













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### **PRINCIPLES**



- All activities shall respond to needs of authoritative international user communities and downstream industries, who shall be consulted systematically and participate in co-design, implementation and assessment
- <u>All activities</u> shall be designed to complement, seed, cross-fertilize and enrich relevant activities of ESA Member states' national programmes, H2020 and Copernicus.
- Access and utilization of EO data shall be massively enhanced and democratized by accelerated use of ICT, bringing users to data and scalable hosted processing (i.e. Network of Platforms)















# The EO Ecosystem: the past



- ... Mission Ground Segments make data available for download
- ... Users process the data on their own infrastructures





# Digital Platform Economy: Citations



#### Erik Vermeulen, Professor of Business and Financial Law at Tilburg University:

The future of the digital age will be platform-driven ecosystems in which multiple players participate. The most influential companies will be the ones that position themselves as "platform owners". Established and "traditional" companies must also make this transformation.

The rule is very simple: "You either become a platform or you will be killed by one."

Haydn Shaughnessy, Author, Innovation Researcher and Fellow at the Centre for Digital Transformation, University of California:

I see these as the essentials of a platform: Smart platforms don't follow a set of design rules. They are able to orchestrate strategy on the fly.

They restructure markets horizontally and they enable exponential growth. If a platform is not going to create substantial growth then something is wrong with the strategy.

**Content is critical to platform development** for without good content you have no advocacy and advocacy is perhaps the single most important gain from being in a globally connected network.

Platforms are essentially seamless transaction engines exploiting micro-payments.

They also have a culture of restless technical innovation
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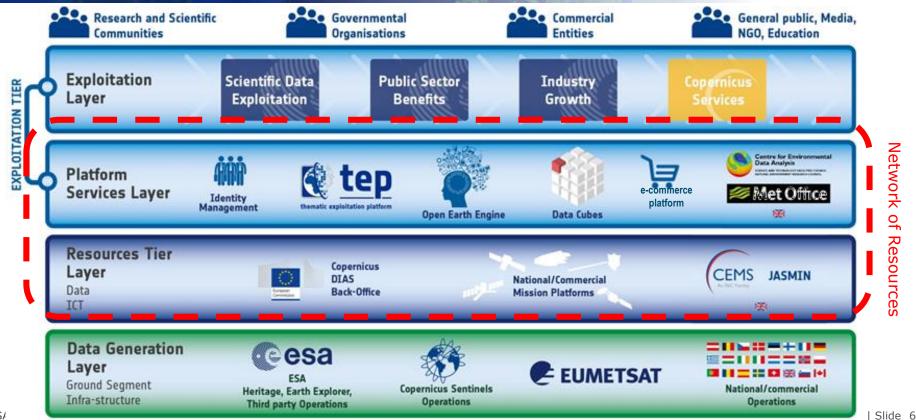






### The EO Ecosystem: a platform-based economy

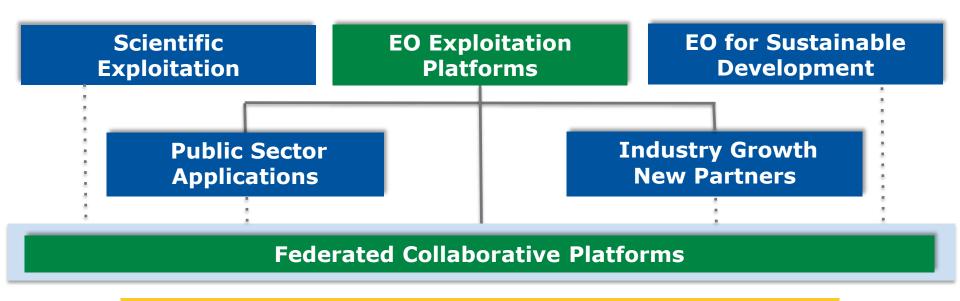




**Network of Resources** 

### **#EO4society - Components**





**New:** Some 10% of the total budget will be assigned via **open calls** to support industry/users initiatives.

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### **Opportunities – Open call**



EO Science for Society Open call for proposals EOEP-5 Block 4



- Permanently open call
- Framework to rapidly respond to new innovative ideas from bidders.
- Submission deadline for the second batch of proposals:
   1st March 2018
- Applications:

http://emits.sso.esa.int/



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# **EO Science for Society**



Scientific Exploitation EO Exploitation Platforms EO for Sustainable Development

Public Sector Applications

**Industry Growth** 

**Federated Collaborative Platforms** 

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# **Thematic Exploitation Platforms**





# **EO Exploitation Platforms Federated Collaborative Platforms**



Projects under this line will accelerate scientific research and application development by making shared resources discoverable and easily usable according to the "bring the user to the data" paradigm

### **Network of EO Resources**

Integrate <u>existing</u> capabilities into an integrated network, ensuring administrative and technical interoperability

- Data Providers & Services
- Data Analytics Tools
- Visualisation Tools
- Collaboration Tools

### **Shared Architecture**

Evolve standards and best practises in OGC and CEOS and provide reusable open source components for

- Federated Identity Management
- Workflow Management
- Information Extraction
- Data Management

### **Evolving Capabilities**

Build new innovative <u>platform</u> services to support science or application developers, e.g.

- Data Mining Environments
- Datacube
- AI Platforms
- Crowdsourcing Platforms

**Primary Users**: Application Developers, Science Community

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### Network of EO Resources



Creation of a portfolio of pre-qualified National and European Resource providers for subsequent use in scientific and value adding activities of resource services from both layers

### **Framework Coordination**

Neutral Network of Resources management, procurement of contributing resources and coordination of services provided to science and value adding activities

- Service Catalogue & Helpdesk
- Resource Tier Subcontracts
- Platform Services Subcontracts

Open ITT Q1/18, E.Doyle

3+2 years, 2000+1000K

#### **Resource Tier Services**

Provide combined operational Data and Infrastructure (DaaS + IaaS) pay-per-use services to science and value adding activities

- Host platform services
- Technical I/F Standardisation
- T&C Standardisation

Open BP ITT Q3/18, E.Doyle

Every year, total 2000-4000K

#### **Platform Services**

Provide operational higher level data analytics support or logistic services to science and value adding activities

- Operational Service Provision
- Technical I/F Standardisation
- T&C Standardisation

Open BP ITT Q3/18, E.Doyle

Every year, total 3000-5000K



### **Evolving Technical Capabilities**



Creation of a world-leading European operated Platform Services offering

### **Datacube Facility**

Provide operational Datacube Services for higher-level data with an engine allowing algorithm plug-in to generate them from L1/2 data without need for data storage duplication

- Data/Algorithm Hosting
- Standard I/F Open Source
- Integration into TEPs

Open ITT Q2/18, R.Leone

3+2 years, 3000+?K

### **Quality Assurance Facility**

Develop and operate a service to ensure traceability and quality stamping for processes and products

- Methodology&Process Definition
- Tool Development
- Service Provision

Open ITT Q4/18, O.Grabak

3 years, total 500-1000K

### **Open Earth Engine**

Interactive algorithm development with integrated GIS visualisation of results available on multiple resource tier platforms

- Operational Service Provision
- Technical I/F Standardisation

Open ITT Q4/18, P.Mougnaud

3 years, total 900K



### **Evolving Technical Capabilities**



Creation of a world-leading European operated Platform Services offering

# E-commerce platform for micro-geoservices

Provide operational service to support small value-adders to publish and sell information-as-aservice: service/AOI selection, quotation, billing

- Operational Service Provision
- Technical I/F Standardisation
- Integration into TEPs

Open ITT Q2/18, P.Mougnaud

2 years, 300K each, 2 providers

#### Video Remote Sensing Platform

Platform pathfinder to investigate innovative services for video sensor types

 Demonstration platform service

Open ITT Q4/18, tbd

1-2 years, 500K

### **NRT Exploitation Platform**

Provide an operational service where space data are guaranteed to be available within "few minutes" and where commercial application operators can host their applications

- NRT "hosted processing" Service
- Technical I/F Standardisation
- Integration into TEPs

Open ITT Q4/18, E.Doyle

3 years, total 2000K (tbc)



### Common Architecture



Interconnecting a large OPEN ecosystem built upon federation of resources ....

### **Framework Coordination**

Manage Common Architecture activities, OGC testbeds, open source contributions, support to participants to Network of EO resources;

#### NO CODING

- Standardisation Process Mgmnt.
- Reference Architecture
- Dev./Ops Subcontracts

Open ITT open now, C.Lopes

2+2 years, 800+700K

## Domain Development & Operations

Implement standard I/F middleware and operate on selected platforms for:

- Federated Identity Mamnt.
- Processing & Chaining
- Data Provisioning & Accounting
- Updated ICDs
- Middleware software
- Operated middleware service

Open BP ITT Q4/18, C.Lopes

1.5+2 years, ~1500+1500K total

## OGC/Open Source activities

OGC sponsored activities with selection of product mplementors in testbeds, etc.

- Prototype solutions
- Engineering reports

Open BP ITTs 2019-21, C.Lopes

6 months each, total 1500-2000K



### Common Architecture



Interconnecting a large OPEN ecosystem built upon federation of resources ....

### **IPR Protection Study**

How to protect Algorithm owner's IPR via legal means and technical implementation?
What is the impact of GDPR on the Ecosystem implementation?

- Study Report
- Draft Service Agreement Template
- Implementation Plan

Open ITT Q4/18, A.Burzykowska

6 months, 200K

# Commercial Operator Identity Hub

Provide Operational Identity
Management Service where
commercial value adders are
registered with guaranteed
identities against which
accounting can be performed

 Operational Service compliant with GDPR

Open ITT Q4/18, F.Marinic

3 years, 600K

# **EO Science for Society**



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**Federated Collaborative Platforms** 

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### SCIENTIFIC EXPLOITATION



Addressing the needs of the scientific community in terms of novel observations, new methods, innovative product and leading edge scientific results maximizing the scientific return of ESA and European missions

Engaging international

Velence community

Developing Open
Science Practices-

Advancing EO methods and Techniques

Advancing Earth
System Science

Translating Exploitat. Results in **Expanding dialogue** with the international scientific community with focus on the young generations

**Developing Open Science** activities and practices using latest tools and techniques

**Launching** state-of-the-art **R&D** studies for maximizing scientific exploitation of EO missions (methods and products);

**Addressing** open questions in **Earth system science** in collaboration with major international science initiatives

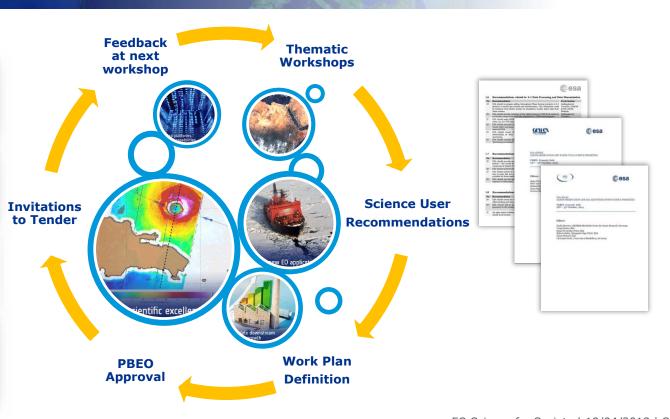
**Reinforcing** the role of **exploitation** results as a **driver** for **future missions** 

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### **#EO4society – Consultations**







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## **Engaging Science communities**



### Planned Advance Training Events 2018

- •2<sup>nd</sup> Advance Training on Cryosphere Remote Sensing, 11-16 June 2018, University Centre in Svalbard, NO
- •8<sup>th</sup> Advance Training on Land Remote Sensing, University of Leicester, UK, TBD
- 3rd Advance Training on Atmospheric Remote Sensing, TBD



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### **EO Open Science**



	Procurement title	New Generation of ESA Open Science Education
	OBJECTIVES	New generation of ESA Open Science education and training activities, maximizing the use of ITC, modern education methods, advanced visualization techniques, and community tools, including hackathons, serious games, on-line education channel and stimulation of an open science community promoting debate and full scientific discussions.
	DELIVERABLES	<ol> <li>Sessions of Hackathons focused on key aspects of science and EO technology aimed at learning by doing: e.g., addressing challenges, developing, coding and validating methods, advancing SNAP capabilities, exploiting ESA Virtual Labs, etc</li> <li>Series of Serious Games as a new mechanisms for ESA advanced training sessions</li> <li>New science education on-line video channel focus on short science videos</li> <li>Develop the new generation of visualization and education material based on the latest development in ICT freely and regularly available to students and teachers.</li> <li>Stimulation of an open science community debate to assess and develop a full scientific discussion of each visualization case.</li> </ol>
*	Amount / Duration	500K / 24 Months
	ITT/ Kick Off	Q2 2018/Q3 2018

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Name Surname | 19/11/2015 | Slide 22





























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## **EO Open Science**



349	Procurement title	CRYOSPHERE VIRTUAL LAB – Svalbard Observatory
	OBJECTIVES	Develop a virtual research environment (VRE) to allow scientists to discover and then to handle jointly and to analyse, in a collaborative, flexible and intuitive way, the various co-located EO datasets, EO-based products, in situ data and tools to develop new methods, sharing results and investigate different Arctic relevant topics: e.g., Snow, Sea Ice, Ice Caps, Glaciers, Glacier Albedo, while benefiting from ESA latest developments and state of the art products. Developed tools on the VRE shall foster the emergence of new methods prototype and products making use of the complementarity between sensors to study Cryosphere related processes.
	DELIVERABLES	On-Line Cryo Virtual Lab tool, user support and project documentation
	Amount /DURATION	500 K Euros / 24 Months
A 12	ITT /Kick Off	Q2 2018 / Q3 2018

### **EO Open Science**



Procurement title	MICROWAVE VIRTUAL LAB
OBJECTIVES	Develop a virtual research environment (VRE) to allow scientists to discover and analyse collocated active and passive microwave data sets in support to global land surface process studies. Tools for reading and jointly analysing the data sets shall be provided, fostering the scientific understanding of the interaction of microwaves with the land surface across the entire microwave spectrum and at all polarisations. The insights gained will help to improve the retrieval of vegetation, soil moisture, and other land surface variables. The VRE shall provide convenient and flexible access to collocated multi-frequency backscatter and brightness temperature observations acquired by scatterometers, microwave radiometers, and wide-swath SARs, global models and re-analysis data sets (e.g. ERA, GLDAS), and available in situ network data.
DELIVERABLES	On-line Virtual Lab providing pre-configured virtual machines with access to open source tools, documented data sets, and scalable processing resources; tools for collaboration and code/data sharing.
Amount /DURATION	300-500 K Euros / 24 Months
ITT /Kick Off	Q2 2018/Q3 2018

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#### **Sentinel- 1 Change Detection / Amazonas**

Due to the high temporal revisit frequency S1 is a unique instrument to track change. So far change algorithms typically used simple threshold approaches based on difference images. New methods recently developed allows a proper treatment of the statistical properties of the SAR data and has the advantage that it also provide statistical significance levels.

The new acquisition scheme of S1 allows a systematic observation of the Amazonas. This provides an excellent area of study for change detection methods and in particular on deforestation and regrowth.

ATBD, Validation Report, Platform Experimental tests, Impact Assessment, Prototype software module

300K-350 Euros/ 18 Months

Q2 2018 / Q3 2017

#### **ForestSCAN**

Exploring novel technologies (e.g., drones) to measure forest structure (based on airborne LIDAR, supported by ground LIDAR), enhance current observation networks with new datasets and advance our understanding in forest characterisation, monitoring and global biomass mapping from satellites.

The project will complement existing and planned ESA activities: e.g., CCI Biomass, BIOMASS mission studies, SMOS+ Vegetation, S1 CD/Amazonas, ESA Virtual Carbon Constellation Study.

Partnerships with existing networks of in-situ data will be established: e.g., ForestPlots.Net

ATBD, Validation Report, Datasets, Impact Assessment, Prototype software module

500K Euros/ 18 Months

Q2 2018 / Q3 2018

#### **Sentinel-1 InSAR IoTrop**

The recommendations from the last FRINGE workshop call for a better correction of the tropospheric and ionospheric effects in the INSAR processing.

This activity will address this need y exploring novel techniques and models to better characterise and correct for the impact of the ionosphere and enhance the wet tropospheric correction for InSAR measurements.

ATBD, Validation Report, Datasets, Impact Assessment, Prototype software module

300KEuros/ 24 Months

Q3 2018 / Q4 2018

#### **Sentinel- 1 Coherence Study**

The global seasonal behavior of C-band VV/VH InSAR coherence of distributed scatterers is currently unknown at the 6/12-day repeat-cycle of the Sentinel-1 constellation. This behavior needs to be understood globally over the widest possible selection of land cover and land use (LCLU) types, in order to advance scientific understanding, and to assist S-1 Mission Planning in the monitoring of tectonic areas, volcanoes, forests, agricultural areas and land ice.

ATBD, Validation Report, Platform Experimental tests, Impact Assessment, Prototype software module

500K Euros/ 30 Months

Q2 2018 / Q3 2017

#### **SARIN-Coastal**

Consolidate the algorithms and methods for the use of SarIn Cryosat data for coastal altimetry. The project will consolidate and validate new algorithms and methods and generate a new set of costal altimetry products exploiting the new SarIn acquisition mask expected for 2018.

ATBD, Validation Report, Experimental Dataset, Impact Assessment

300-400K€ / 24 Months

Q2 2018 / Q2 2018

#### **SARIN-Hydrology**

Consolidate the algorithms and methods for the use of SarIn Cryosat data for inland waters altimetry. The project will consolidate and validate new algorithms and methods and generate a new set of water level and river discharge products.

ATBD, Validation Report, Experimental Dataset, Impact Assessment

300-400K€ / 24 Months

Q2 2018 / Q2 2018

#### **SAR Altimetry - Hydrology**

SAR Altimetry for River Discharge in synergy with OLCI and SLSTR. Error characterization. Investigate River Discharge in global estuaries as a contribution to the sea level budget closure

Prototypes of innovative algorithms, Datasets, Publications

300~350 K Euros/ 24 Months

Q2 2018 / Q2 2018

#### **SAR Altimetry - COASTAL**

Develop innovative Delay-Doppler processing algorithms, Improve the error characterization in the Coastal Zone

Prototypes of innovative algorithms, Datasets, Publications

300~350 K Euros/ 24 Months

Q2 2018 / Q2 2018

To be integrated in a single large community project to exploit synergies in methods, techniques and scientific results: River Discharge and Coastal Altimetry (1.4Million Euro, 3 years, ITT in Q1 2018).

#### **ICE SHEET SAR ALTIMETRY**

Develop innovative Delay-Doppler processing algorithms, radar wave interaction with the snowpack and error characterization for Ice Sheets SAR altimetry retrievals for Sentinel-3.

Prototypes of innovative algorithms, ATBD, Validation Report, Experimental Dataset, Impact Assessment, Publications

200~250 K Euros/ 24 Months

On Hold

#### **SEA ICE SAR ALTIMETRY**

Develop innovative Delay-Doppler processing algorithms for Sea Ice freeboard with appropriate error characterization for Sentinel-3.

Prototypes of innovative algorithms, ATBD, Validation Report, Experimental Dataset, Impact Assessment, Publications

200~250 K Euros/ 24 Months

On Hold

#### **CRYOSAT+** Antarctica

Define a new algorithm for retrieving improved sea-ice freeboard and thickness in Antarctica (complex sea-ice conditions) as well as novel methods to compute sea-surface height and current in sea-ice polynyas, leads and crack from CryoSat-2 to analyse variability of the ocean dynamics (from mesoscale to inter-annual signals).

Prototypes of innovative algorithms, ATBD, Validation Report, Experimental Dataset, Impact Assessment, publications

350K€ / 24 Months

IIT Open (Closing date: 28/2/2(18)

Procurement title	S5P+ Innovation
OBJECTIVES	Set of exploratory activities to maximize the scientific impact of S5P. Projects will explore the potential of S5P to derive new observations and innovative products for the atmosphere, land (e.g., fluorescence) and ocean (e.g., ocean color in synergies with S3);
DELIVERABLES	<ol> <li>Algorithm theoretical Basis Document (ATBD)</li> <li>Open Source Processor plugin for SNAP</li> </ol>
Amount /DURATION	5x200K Euros/ 24 Months
ITT /Kick Off	Q3 2018 / Q4 2018
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Procurement title	Cloud Impact on Trace Gases
Procurement title	Cloud Impact on Trace Gases  Assessment of impact of 3D cloud structures in the retrieval of trace gases by the new suit of atmospheric Sentinel missions: i.e., S5p, S4, S5. The project
Procurement title  OBJECTIVES	Cloud Impact on Trace Gases  Assessment of impact of 3D cloud structures in the retrieval of trace gases by the new suit of atmospheric Sentinel missions: i.e., S5p, S4, S5. The project will also explore potential correction and advance in the RT modeling of  1. Algorithm theoretical Basis Document (ATBD)

Title	Aeolus+ Innovation
Objectives	Ensure a fast exploitation of ADM through a set of parallel short feasibility projects advancing beyond the primary products of ADM (e.g., vertical winds, boundary layer winds, gravity waves, ADM signal over oceans,) in preparation for larger activities in 2018/19;
Deliverables	ATBD, Validation Report, Prototype Dataset, Impact Assessment
Amount / Duration	6/7 parallel studies up to approx. 1Million€ overall/12-18 months
ITT / Kick-off	Q3 2018 / Q1 2019 (depending on Aeolus launch)

Title	Aeolus+ Aerosols
Objectives	Develop and validate novel retrieval methods for aerosol characterisation in view of creating new products also in synergy with other EO datasets.
Deliverables	ATBD, Validation Report, Experimental Dataset, Impact Assessment
Amount / Duration	350K€ / 24 Months
ITT / Kick-off	Q4 2018 / Q1 2019 (depending on Aeolus launch)

#### 4DEarth - DeepEarth

Contribution to the 4DEarth initiative addressing the deep earth modelling from lower mantle to core complementing the on-going 3DEarth project (crust-upper mantle)

ATBD, Validation Report, Experimental Dataset, New Models, Impact Assessment

500K€ / 24 Months

Q2 2018 / Q2 2018

#### **4DIonsphere**

New activity to exploit the Swarm data in synergy with additional datset to provide a better characterisation of the ionosphere processes, structure and dynamics.

ATBD, Validation Report, Prototype Dataset, New Models, Impact Assessment

500K€ / 24 Months

Q3 2018 / Q3 2018

### **Couple Ionosphere-Lower Atmosphere Pathfinder**

Set of exploratory projects investigating the potential of Swarm to study the coupling and interactions between the ionosphere-magnetosphere and the lower atmosphere and biosphere.

ATBD, Validation Report, Experimental Dataset, New Models, Impact Assessment

700K€ / 24 Months

Q2 2018 / Q2 2018

#### Ocean+ Carbon

New activities responding to the recommendations from the 3<sup>rd</sup> Carbon from Space Workshop, Exeter (UK), January 2015, and the EO for sea-air interactions science conference, Frascati (IT), 2014, with focus on the Carbon ocean cycle.

ATBD, Validation Report, Experimental Dataset, Science Results, Impact Assessment

500K€ / 24 Months

On Hold

#### Ocean+ Extremes

New activity responding to the needs of the SOLAS community, to explore the potential of EO data in the characterisation of extreme ocean conditions (e.g., strong winds) and its impacts in terms of momentum, energy and mass fluxes.

ATBD, Validation Report, Prototype Datasets, Science results, Impact Assessment

400-500K€ / 24 Months

On Hold

#### Ocean+ Acidification

Advance research towards a quantitative, accurate and routine estimation of surface ocean pH and additional carbonate system parameters by means of satellite EO, especially capitalizing on the recent advent of remotely-sensed salinity measurements.

ATBD, Validation Report, Prototype Datasets, Science results, Impact Assessment

400-500K€ / 24 Month

Q1 2018 / Q2 2018

#### Arctic+ Ocean

Contribution to the Arctic+ Initiative in collaboration with CliC and EC-RTD to study ocean circulation and ocean/sea-ice/atmosphere interactions in the Arctic ocean.

ATBD, Validation Report, Prototype Datasets, Science results, Impact Assessment

400-500K€ / 24 Months;

On Hold

#### **Arctic+ Salinity**

An additional smaller activity will be dedicated to salinity in the Arctic and the feasibility to characterise fresh water fluxes.

ATBD, Validation Report, Prototype Datasets, Science results, Impact Assessment

150-200K€ / 18 Months

Q1 2018 / Q2 2018

#### Polar+ Ice Shelfs

Study the potential of EO technology to characterize and monitor ice shelf stability and study the ice shelf interactions with the ocean and their impacts on climate.

Prototypes of innovative algorithms, Datasets, Publications

500 K Euros/ 24 Months

Q3 2018/Q3 2018

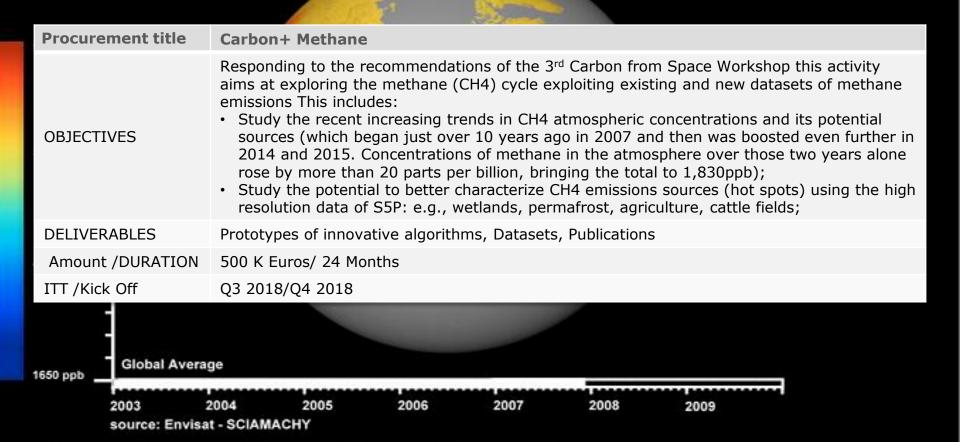
#### Polar+ 4DAntarctica

Interdisciplinary study over Antarctica of the ice sheets dynamics and the interactions between the lithosphere, bedrock, heatfluxes ice sheet temperature profiles and sopra- and subglacial hydrological processes.

Prototypes of innovative algorithms, Datasets, Publications

1-1.5 MEuros/ 36 Months

Q3 2018/Q4 2018



Procurement title	Aeolus+ Processes
OBJECTIVES	<ul> <li>Exploit ADM capabilities to significantly advance atmospheric dynamics science and understanding of key circulation processes (1.5Million - Q3 2018):</li> <li>Tropics (shown so far in OSSE, OSE and EPS studies);</li> <li>Mid-latitudes: intense storms and meso-scale circulation (Shown so far in OSSE and OSE studies);</li> <li>Atmospheric tides (small scale and superimposed on the highly variable dynamical processes in the atmosphere)</li> <li>Arctic: Exploring impact of ADM in Polar predictions: as contribution to the Year of Polar Prediction (Shown so far in OSSE and OSE studies). (Link to STSE Arctic+ initiative);</li> <li>Changes in Brewer-Dobson circulation due to changes in tropical upwelling and tropical gravity waves;</li> <li>Climate variability (process studies focused on ENSO, MJO, QBO, telecoupling, extratropical transition of tropical storms,)</li> </ul>
DELIVERABLES	Prototypes of innovative algorithms, Datasets, Publications
Amount /DURATION	1.5 Million Euros/ 24 Months
ITT /Kick Off	Q4 2018/Q1 2019

### Transferring Exploitation Results into Future Missions

#### **SNOW NEXT**

Based on the recommendations from the Polar Science Collocation Meeting, SnowNext will involve a set of activities aiming at advancing the retrievals of volumetric snow parameters on both sea ice (snow depth) and land (snow depth, SWE). It will include activities aimed at promoting common and harmonized approaches (e.g., land and sea-ice retrievals), new insitu data collection (e.g., supporting the 2019 MOSAiC campaign), exploiting new emission/backscatter models (e.g., SMRT) and addressing key methodological aspects (e.g., snow stratification/microstructure, exploring new wavelengths, including Ku and Ka bands, new synergistic active/passive retrievals) in view of establishing a solid science basis for new products and potential future snow missions.

Prototypes of innovative algorithms, Datasets, Publications

500K€ / 24 Months;

Q4 2018

#### RainCast

Based on the recommendations from the EO for water Cycle Science Conference, this project aims at exploiting new campaign data to explore potential new retrieval methods and observational principles (e.g., based on Ka and W radar bands) to address gaps in rainfall observations as a basis for potential future rainfall constellation concepts:

- Measure the precipitation rate on scales compatible with current mesoscale meteorological models;
- Enhancing estimates of light and shallow precipitation;
- Enhancing characterization of small-scale (shower) events:
- Special emphasis should be put in ensuring all-region capability – including cold regions and cold seasons, and dealing with snow.

Prototypes of innovative algorithms, Datasets, Publications

250K€ / 24 Months;

Q2 2018

#### Transferring Exploitation Results into Future Missions

#### **ESA Virtual Carbon Constellation Study**

Following the recommendations of the 3<sup>rd</sup> carbon from Space workshop, this set of activities aim at exploring the joint potential of BIOMASS, FLEX and SMOS, S5P (e.g., fluorescence) and Sentinel 1/2/3 to address the Carbon Cycle over land in preparation for the joint exploration of these missions after 2021+.

This will involve different activities (ITTs): e.g., dedicated campaign activities, exploiting/enhancing existing in-situ data networks (e.g., GEMPLOTS), joint inversions and data assimilation in carbon models and dedicated process studies to investigate S1-3, S5P, SMOS, FLEX and BIOMASS synergic potential in connection also with other non-ESA missions (e.g., GEDI, NISAR).

Prototypes of innovative algorithms, Datasets, Publications

500-600K€ / 24 Months;

Q4 2018

#### **HAPS-Air**

This activity will exploit existing models and knowledge about air quality in urban contexts to simulate potential future scenarios for using both high temporal resolution observations provided by air quality sensors on-board of High Altitude Platforms (HAPs) in synergy with lower temporal resolution satellite missions such as S5p.

Prototypes of innovative algorithms, Datasets, Publications

400K€ / 24 Months;

Q4 2018

### **EO Science for Society**



Scientific Exploitation EO Exploitation Platforms EO for Sustainable Development

Public Sector Applications

Industry Growth

**Federated Collaborative Platforms** 

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### **EO Exploitation Platforms Expanding Public Sector Benefits**



Projects under this line will, in conjunction with committed end-user organizations, define, develop, demonstrate and validate new applications and precursor services at Global, Regional and National scales

#### **GLOBAL**

Development of global EO-based Applications to support major international initiatives.

- Intl. Env. agreements
- GEO Initiatives
- Global Environment Programs

#### **REGIONAL**

Enhance and integrate EO within existing regional monitoring and assessment systems in cooperation with regional/ national authorities.

- In Europe and neighbor countries.
- Over Atlantic, Baltic, Black Sea, Mediterranean, Alps.

#### NATIONAL

Foster new EO capacities and demonstrate EO applications that have public impact and visibility to decision makers and ministries:

- In countries without EO national programs.
- In new and small ESA Member States

Activities will build on user dialogue and engagement methods that were successful in DUE projects.

Users: international organisations, inter-governmental bodies, national governments and agencies, civil society, NGOs

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### **User Driven Thematic Conferences** 2018/2019



2<sup>nd</sup> Mapping Water Bodies from Space Conference 27-28 March 2018 [ESA-ESRIN]

#### **Background**

In the frame of the EO Science for Society Programme Element, the European Space Agency is organising the  $2^{\rm nd}$  Mapping Water Bodies from Space Conference.

The purpose of this conference is to provide scientists and data users with the opportunity to present first-hand and up-to-date results from their on-going research and application development activities by using data from past and current Satellites.

#### **Participation**

- ✓ ESA Principal Investigators
- ✓ Co-investigators
- ✓ Sentinel-1, Sentinel-2 and Sentinel-3 users
- ✓ Scientists
- ✓ Students
- Representatives from national, European and international space agencies, research labs and value adding industries



#### 2<sup>nd</sup> Mapping Urban Areas from Space Conference 30-31 October 2018 [ESA-ESRIN]



#### WorldCover 2019 Conference February 2019 [ESA-ESRIN]































Large scale Mapping and monitoring at high resolution require large scale automatic processing of high resolution data like of S1A/S1B and S2A/S2B, which can benefit from computer platform offerings such as DIAS, Amazon, Google, ...

#### **World Cover**

Mapping and monitoring of worldwide land cover at high resolution from this year operationally from the Copernicus constellations of S1A/S1B and S2A/S2B.

- fast update of world cover maps at continental/worldwide level.
- support International Environmental conventions as UNFCCC, UNCCD, UNCBD and Environmental Agencies as UNEP

Open ITT Q3/18

2 years, 1500K

#### **Coastal Erosion**

Mapping and monitoring of worldwide Coastal Erosion at high resolution from this year operationally from the Copernicus constellations of S1A/S1B and S2A/S2B.

 Methods & algorithms applied to EO satellite archives (ESA and member states) in 3 different European countries according to authoritative users requirements.

Open ITT Q1/18

2 years, 1500K

#### **WorldPeatland**

Improved mapping and monitoring of intact, degraded and cultivated peatlands, based on requirements from user organisations like UNEP, UNFCCC, FAO, RAMSAR convention and Wetlands International

- Mapping and monitoring of peatland location and extent in Europe, the boreal zone and the tropics
- best practice guidance and standardized methods for the assessment of peatlands

Open ITT Q2/18

3 years, 1500K

			Separated Separated						
Exploitation Layer			Public Sector		`	^		ľ	`
ES/E	1		Benefits			1	1	1/4	

#### Sen4Stat

Demonstrate potential of S-1/-2 missions in support of **national agricultural statistical services**. Applications range from national reporting within the frame of the Sustainable Development Goals to crop commodity trading or emergency response; contributes to the GEOGLAM initiative.

Users: Governmental statistical offices, FAO, WFP, World Bank, OECD and CGIAR

- algorithms supporting agricultural statistical monitoring
- Open source tools enabling cloud-based national scale processing
- Synergy with national statistical in-situ data such census or household surveys
- National demonstrations in a number of to be selected pilot countries representative for different agricultural systems.
- Installation on DIAS or other cloud computing facilities
- Transfer to stakeholders e.g. including capacity building

Open ITT Q3/18

2 years, 1500K

#### Sen4Rapp

High resolution rangeland monitoring EO products in support of livestock carrying capacity in the context of GEOGLAM RAPP initiative. **EO rangeland monitoring** is essential for national to regional forage estimation & prediction, avoiding land degradation and supporting pastoralism in food insecure countries.

Users: : Agricultural Ministries, FAO, ILRI-CGIAR, NGOs, trade, pastoralism community, ranchers

- Develop & validate open source algorithms for grassland biomass and conditions monitoring based on S1 and S2
- Demonstration of rangeland monitoring at national to regional scale in Africa based on cloud processing capabilities
- Support national reporting schemes related to SDG 2 & 15
- Installation on DIAS or other cloud computing facilities
- Transfer to stakeholders e.g. including capacity building

Open ITT Q4/18

2 years, 1000K

	Specialistics			
Exploitation Layer	Public Sector Bendits			

#### **Land Degradation Neutrality**

Develop new capabilities to monitor Land Degradation at high spatial resolution based on the changes in land cover, land productivity and carbon stocks as a support to country obligation to monitor their degraded land under UNCCD LDN and SDG 15.3.1.

Users: UNCCD, FAO, National authorities responsible for land management, National authorities responsible for SDG 15.3 monitoring and reporting, Agriculture pastoralism (livestock management / GEOGLAM RAPP)

- New methodology to estimate land degradation at high resolution, which exploits the dense time series of S1 and S2 (complemented with L8) and the complementarity of current moderate resolution approaches (300m-1km).
- Round-Robin approach as agile development tool on pilot sites with field validation.
- Open source tools enabling large scale cloud processing
- Country demonstration on cloud platforms (3 countries).
- Dynamic water body maps for 2016-19 over Africa.
- Transfer to UNCCD framework; training/capacity building.

Open ITT Q3/18

2 years, 500K

#### **Dynamic Water Body Monitoring**

Develop dynamic water body monitoring capabilities at high resolution over Africa addressing water and food security issues and SDG 6 monitoring

Users: UN Environment, FAO, Ramsar, UNCCD, African national and river basin authorities, irrigation schemes, pastoralism

- Development of small water body algorithms based on S-1/-2
- Round-Robin approach as agile development tool
- Open source tools enabling continental scale cloud processing
- Dynamic water body maps for 2016-19 over Africa (regional to continental demonstration & validation)
- Installation at DIAS and African Research Cloud
- Transfer to African stakeholders e.g. GMES & Africa including capacity building

Open ITT Q2/18

2 years, 1500K

	Separation and Deposits of the separation of the
Exploitation	Public Sector
Layer	Benefits

#### **GOFC-GOLD Land Cover Project Office**

The GOFC-GOLD Land Cover Project Office will act as focal point for forest and land monitoring from space, to link better the global land cover community with the policy sector. Its project overarching activities are:

- Global and regional Land Cover, validation and accuracy assessment;
- Land monitoring issues related to SDGs;
- R&D coordination for GFOI and organisation of expert workshops;
- Biomass estimation (ECV Biomass, EE7 user preparation).
- Technical notes to the four activity
- Quarterly activity reports and annual reports;
- Expert workshops on GFOI R&D priority topics;
- GOFC GOLD plenary;

Open ITT Q2/18

3 years, 500K

#### **EO4AFRICA Initiative**

Develop an African-European R&D partnership to facilitate the sustainable uptake of the Sentinels in Africa. The African Union Commission (AUC) with their GMES & Africa initiative are identified as the main partners to establish a full continental R&D collaboration. The SDGs in general and due to their urgency in Africa water and food security in particular are proposed as the first thematic priorities for EO4AFRICA.

- Engage and collaborate with African user & research communities, e.g. TIGER
- Research for algorithm and EO product development for African needs e.g. GMES & Africa services
- Facilitate Sentinel uptake in Africa with cloud
- National to continental demonstrations to African authorities
- Capacity Development
- Validation making use of Crowdsourcing and local partners
- Use of local & international partnerships

Coordinated open ITTs

2 years (phase 1) , 1500K

### **EO Science for Society**



Scientific Exploitation EO Exploitation Platforms EO for Sustainable Development

Public Sector Applications

Industry Growth

**Federated Collaborative Platforms** 

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### **EO Exploitation Platforms Enabling Industry Growth**



Projects under this line will foster growth in commercial EO information industry through the development of new user-demand and the generation of marketable EO-based products and services that respond to this demand.

#### **Expand Demand**

User sectors that offer significant potential to grow the use of EO enabled by step-increase in operational demonstrations (eg. Large-scale, NRT, massive computing, Data Analytics).

#### **New Opportunities & Actors**

Stimulate entrepreneurship/innovation by exploring many small-scale disruptive ideas, Develop a network of Earth Lab Accelerators (ELA), Develop outreach / MOOC portfolio.

#### **Best-Practices**

User sectors initial use of EO has been made, but comprehensive understanding of the EO potential needs to be established through trade associations/organizations.

Making use of European National Missions (VHR Radar & Optical)

**Primary Users**: Industrial Private-Sector

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## **Industry Growth**Best Practices



Based upon a careful examination of the sector business processes, establish industry specific geo-information requirements and challenges in close dialog with key representatives from the sector.

Develop and document how mature and available EO based services can respond to these requirements including well documented case studies demonstrating the impact and benefits associated with exploiting EO based solutions

#### Batch 1: 2 contracts

#### User sectors:

- Agri-Insurance
- Mining
- Documented industry best practice for the use of EO based products and services within selected market sectors.

Open ITT Q2/18, 2 Contracts

1.5 years, 500K each

#### Batch 1: 2 contracts

#### Candidate Sectors include:

- Polar Tourism
- Agro-Chemicals
- Rail Transport
- Documented industry best practice for the use of EO based products and services within selected market sectors.

Open ITT Q3/18, 2 Contracts

1.5 years, 500K each



# Industry Growth New Opportunities & Actors



#### **EO Big Data Analytics**

To foster the use of Artificial Intelligence and machine learning to maximise the value of large multivariate data sets, in particular from Copernicus missions.

- Open source workflows
- use cases portfolio
- Specifications

Open ITT Q2/18

1.5 years, 500K

#### Φ-lab EO Accelerator

small-scale demonstration activities to harness the power of exponential digital and sensing technologies, such as Deep Learning, in partnership with new non-space actors, such as ICT giants, data science groups, and start-up ecosystems to incubate new ideas, new EO services, and business opportunities.

- Open Innovation environment and ecosystem
- innovation platform, strategy and roadmap documents

Open ITT Q3/18

1.5 years, 500K



# **Industry Growth**Expand Demand



#### **TEP Capability Demonstration**

Demonstrate the operational impacts resulting from the use of TEP capabilities in those user sectors that present requirements and opportunity for enhanced ICT (processing & data). Candidate Sectors include:

- Arctic (natural resources, transport, tourism)
- Urban (planning, management)
- Risk (Re/Insurance, Civil Protection)
- Demonstration products and assessments

Open ITT Q2/18, up to 5 contracts

1 years, 100-200K each

#### **Stakeholder Demonstrations**

Demonstrate mature and available EO capabilities to stakeholders, building upon previous developments and by taking advantage of enhanced ICT capabilities.

Candidate sectors include:

- Law Enforcement
- Ports & e-Maritime
- Corporate Sustainable Development
- on-line interactive environment including market information
- provision of standardized (non-bespoke) demonstration EO products
- large scale on-line demonstration based on hosted processing.
- Report of current limitations & challenges for EO services
- Demonstration readiness review report; Report of enhanced service Demonstration
- Action plan for deployment; promotion material.

Open ITT Q3/18, 2 Contracts

2 years, 700K each

### **EO Science for Society**



Scientific Exploitation EO Exploitation Platforms EO for Sustainable Development

Public Sector Applications

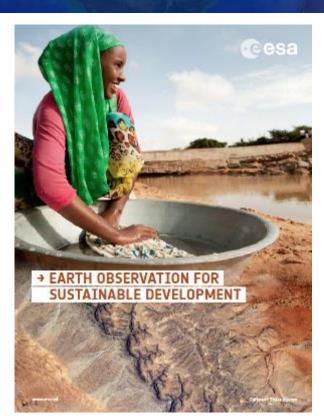
**Industry Growth** 

**Federated Collaborative Platforms** 

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#### **EO FOR SUSTAINABLE DEVELOPMENT**





- Phase 1 (3 years, EOEP-5): Consolidate
   Requirements, engage stakeholders (IFIs & Client States) via regional demonstrations of EO.
- Phase 2 (5 years, EW TBD, C-MIN19):
   Mainstream & Transfer EO into operational working processes & financing of ODA as 'best-practice' source of environmental information in Environmental Safeguards Systems and Monitoring & Evaluation methodologies, SDGs of highly relevant.
- Priority thematic areas :

Urban, Marine & Coastal, Agriculture, Risk Management, Energy & Extractives, Water Resources, Forest, Ecosystems Services, Fragile & Conflict States, Climate Resilience & Proofing.

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#### Sustainable Development



### Larger-Scale Regional Demonstrations of EO-based information for Bank Programmes

Perform 2-3 regional demonstrations (each region 2-3 countries) of EO-based information that delivers benefit to key Bank projects /Programmes, with emphasis on World Bank, IFAD, ADB and IADB. 2 Domains: Forest Management, Ecosystems Services

- Documents: eg. Strategic Plan, Service Specifications, Capacity Building Plan, Stakeholder engagement, Communications Package, Service Utility and Impact, Stakeholder engagement review, Mainstreaming Roadmap, ....
- EO products & information services.

Open ITT Q2/18

3 years, 2000K

#### **EO** Clinic

Enable the small-scale, exploratory uses of innovative EO information in a wider range of development bank projects/activities.

Emphasis on quick turnaround (weeks) of small but relatively frequent (2 per month, each  $40K \in E$ ) EO support queries raised by the banks.

- EO information products

#### Open ITT Q2/18

Procurement based on pre-qualification of a number of European EO service providers (grouped in at least two competing consortia) for a predefined set of EO thematic areas.

2 years, 2000K



































#### Sustainable Development



#### **Development Aid Community Initiative**

Develop and implement an environment where the Official Development Assistance (ODA) actors from across the community (i.e. IFIs/MDBs, EU National Aid international Agencies, NGOs, ODA approved countries, industry) can access introductory EO information guides, data sets, analysis & visualisation tools, hosted processing. The environment will make maximum use of the capabilities of the Thematic Exploitation Platforms (TEPs), where appropriate.

- EO Information products, tools. The content will be customised to the language and practices of the ODA domain.

Open ITT Q2/18

2 years, 1000K

#### **Monitoring & Safeguards**

Address International Finance Institutions (IFIs) needs dealina with (environmental) Monitorina and Safeguards methodologies and policies.

The activities will build on existing engagement from recently completed first demonstration exercises with Inter-American Development Bank (IaDB).

The contract shall expand the range of technical capabilities and initiate further demonstrations with additional IFIs (eq, IFC, EBRD, ADB). In addition, the scope for adopting analysis approaches based on Thematic Exploitation Platform (TEP) capabilities shall be assessed.

EO information products

Open ITT Q3/18

2 years, 500K





































# living planet MILAN 13-17 May 2019

UNDERSTANDING THE EARTH SYSTEM

SPACE 4.0 AND EARTH OBSERVATION

BENEFITS FOR A RESILIENT SOCIETY

**PUBLIC AND PRIVATE SECTOR INTERACTIONS** 

#### **Deadlines**

Session Proposals 17 June 2018 Abstracts 11 November 2018 Registration April 2019

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