

ESA Earth Observation Programme Update and Space19+

ESSC Plenary
Brussels, 3 October 2019

Maurice Borgeaud, ESA

Head of the ESA Earth Observation Department
"Science, Applications and Climate"

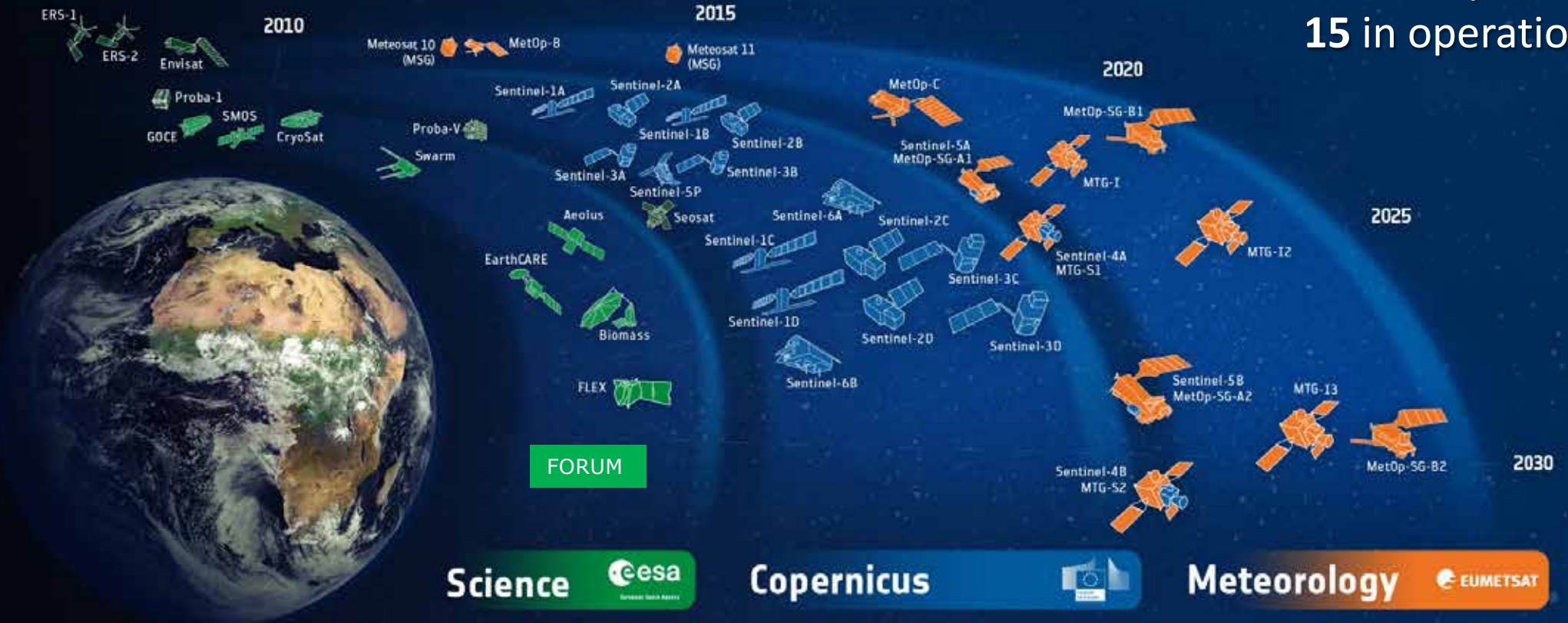


ESA-Developed Earth Observation Missions



Satellites

25 under development
15 in operation



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Wildfires in Siberia



Yakutsk

Lena River

Copernicus Sentinel-3
28 July 2019

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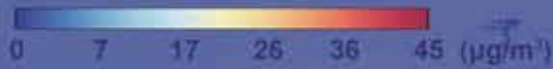


European Space Agency

Air Pollution over Europe: NO₂



01 November 2018
00.00



Nitrogen Dioxide Concentrations
November 2018
Copernicus Sentinel-5P

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Deforestation

Rondonia, Brazil

Sentinel 2

5 June 2019



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Φ Week 2019

- 700 selected participants of 1300 pre-registrations
- 5 days Bootcamp
- 160 posters
- 23 side events



Φ-Sat 2 Challenge

AI SIG Launched



ESA EO Programme Cornerstones



“Different parts of one single tree”



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FutureEO

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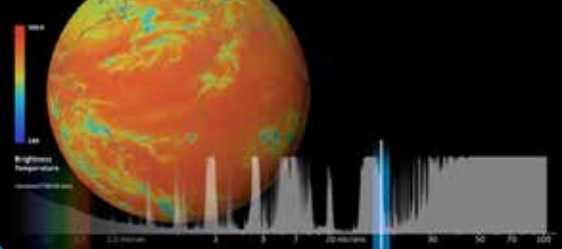
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FutureEO – new Elements of Innovation



Hardware & Technology

EE-9: FORUM



Scouts & Φ -Sats



HAPS

Operations

Increased Data
Diversity & Volumes



EO
AFRICA



Science & Applications

Machine Learning



AI for Space
and EO

Cloud Computing



Safety & Civil Security

EO contribution to
ESA-wide pillar



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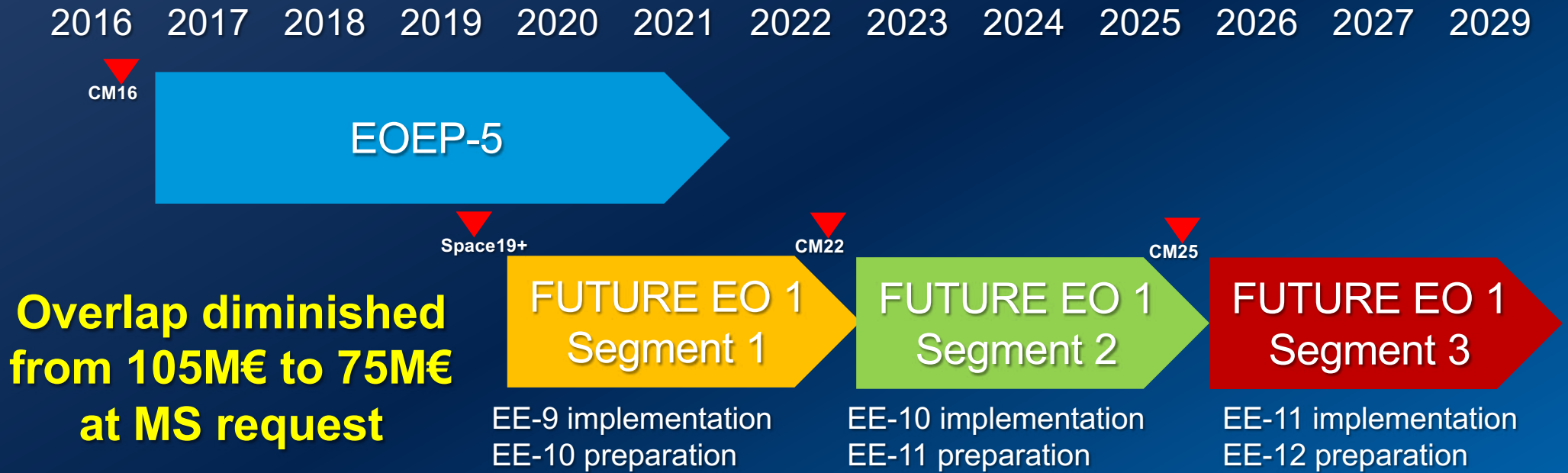
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FutureEO phasing with Ministerial Councils



Synchronisation of EO programmes with the Ministerial Council cycle:

3-year segments FutureEO-1



**Overlap diminished
from 105M€ to 75M€
at MS request**

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Future EO – Structured around 4 Blocks



**Future
Flagships
& Systems**

**1. Foundations,
Concepts &
Technology**

**2. Research
Missions**

FORUM or SKIM

**Operation &
Exploitation**

**3. Mission
Management**



**4. Earth Science
for Society**



FutureEO – new Elements of Innovation



Hardware & Technology



Scouts & Φ -Sats



HAPS

Operations

Increased Data Diversity & Volumes



EO AFRICA



Science & Applications

Machine Learning



AI for Space and EO

Safety & Civil Security

EO contribution to ESA-wide pillar

Cloud Computing



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Block 1 – Foundations, Concepts and Technology



E2E preparation of EO missions – incl. techno and science activities (raise TRL/SRL and mitigate risks)

- Call for Innovative Early (Mission) Concepts
- Early phases/campaigns/IPD for:
 - EE-11
 - Sentinel-1/2/3-topo/3-opt NG,
 - future Meteo Missions,
 - Mission of Opportunity (e.g. NGGM)
- Other Instrument Pre-developments
- Cross-cutting technology pre-developments, e.g. for small instrument concepts, platforms



Block 2 – Research Missions

Completion of Earth Explorer-9

Earth Explorer-10 phase B1

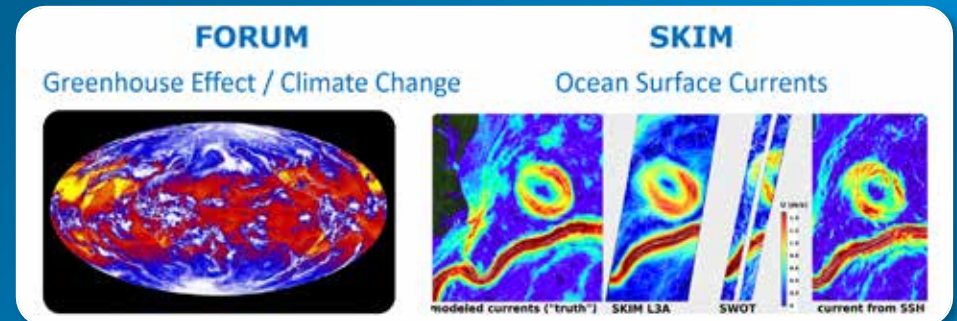
Up to 2 ‘Scouts’ (‘smallsats’)

- Valuable science for ~30 M€
- Challenge issued in early 2019
- Mission(s) selected after Space19+, for development and launch within 3 years

Timely early development activities

- A mission of Opportunity (e.g. NGGM)
- A future operational 3D-wind measurement mission

Phase A/B1 Industrial Teams



FORUM

Team 1

ADS-UK (prime)

Team 2

TAS-UK (prime)

SKIM

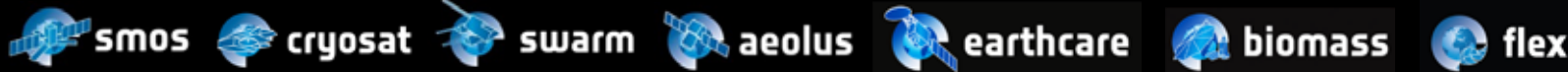
Team 1

ADS-ES (prime)

Team 2

OHB (prime)

Block 3 – Mission Management



+ EE-9 + EE-10

Mission Operations

- Phase E2 of Earth Explorer missions (Phase F if relevant)
- Extension before PBE0 in 2022 and part of 2023



Generic Fiducial Reference Measurements

Payload Data Ground Segment

Generic elements and Services for data accessibility, archiving, network, etc.

Geophysical Products

- Development & maintenance of 'Level 2' products
- For missions in Phases B/C/D/E (9), including cal/val campaigns

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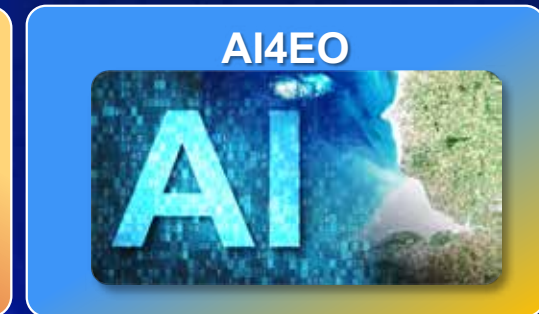
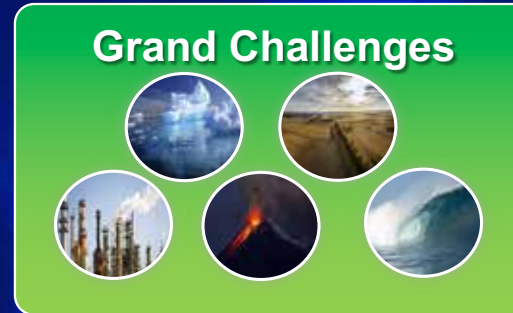


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Block 4 – Earth Science for Society



- Grand Science Challenges (with EC/RTD)
- Resilient Society (Environmental Threats)
- Regional Initiatives (Applications and Platforms)
- Pioneer Artificial Intelligence for EO (Big Data)
- HAPS
- EO Africa
- Civilian Security Applications
- **10% of budget via Open Call to foster innovative projects**



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Operational EO

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Copernicus – continue global leadership in EO



> 260.000

registered users
= tip of the iceberg



Land



Atmosphere



Ocean



Climate



Disaster



Security

6 operational services



250 TB satellite data
distributed per day



full, free & open
data policy

7 satellites flying

S1



S2



S3



S4



S5P



S5



S6



preparing Copernicus 4.0

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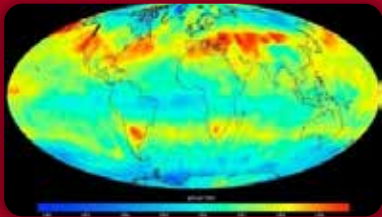
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Copernicus Space Component-4 (CSC-4)

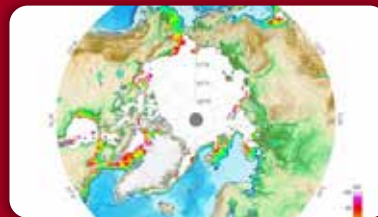


- New segment of existing programme; Space19+ is first of three phases
- 1402 M€ at 2019 e.c. (duration: 2020 – 2029)

Phase B2/C/D/E1 of the six High Priority Candidate Missions



CO2M



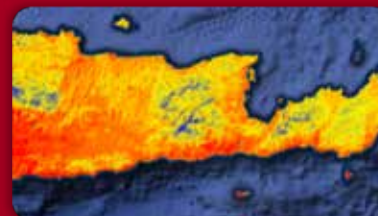
CIMR



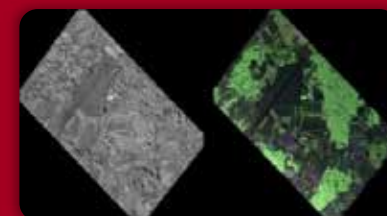
CHIME



CRISTAL



LST



ROSE-L

Ground Segment Development & Collaborative G/S activities

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CSC-4 Programmatic

- **New segment of existing programme:** implemented in three phases with only first phase (2020-2029) presented at Space19+
- **Phase 1 to support:**
 - Phase B2/C/D/E1 of the six High Priority Candidate Missions
 - Ground Segment Development & Collaborative G/S activities
- **Topped up by EC contribution** (recurrent models, launch, operations)
- **For each HPCM:** single procurement action under ESA procurement and project management for both prototype satellite (funded by ESA) and recurrent satellites (funded by EU)
- **Programmatic review at the end of ph B2** (before end of 2021)

Customised EO

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Customised EO programmes (2020-2024)



InCubed+

Continuation of InCubed
PPP scheme with IPR
for bidders
150 M€



Global Development Assistance

Bring operational EO
solutions in ODA
50 M€ ESA + 135 M\$



Altius (PhE)

Operational O₃ Monitoring
Launch + 3 years OPS
55 M€



Arctic Weather Satellite

Operational microwave meteo
demo: dev., launch, 1 yr OPS
42 M€



TRUTHS (PhA/B1)

Calibration to support
Climate Forecasting
42 M€



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EO Key Functions in Basic Activities



Earthnet

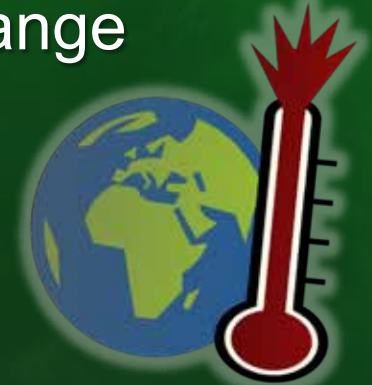
Data Access to >35 non-ESA EO Missions

International Cooperation

- International Charter
- CEOS
- USA, China, Africa

Heritage Space

Preserve heritage information for i.a. Climate Change science



Cross-Directorate:
EOP, HRE, OPS, SCI

Other: Innovation, Infrastructure, Networks & Knowledge



Return on European EO Investments



For every
€1 invested

Copernicus

€ 93-191 billion (2017-2035)

€1 → €10

Meteorology (MetOp-SG)

€ 16 – 63 billion (2020-2040)

up to €4 return in FutureEO



Comments received by ESSC on EO Programmes Proposals (PP's) at Space19+



- Detailed comments on PP's sent by the ESSC-EO representatives on 6/09/2019
- Executive summary of “Towards a European Cal/Val Service for Earth Observation” provided by ESSC on 19/09/2019
- ESA written replies provided on 02/10/2019
- ESSC comments much appreciated and allowed to clarify issues on the EO PP's
- Current schedule and status:
 - Consolidated version of the PP's discussed at the May PB-EO and sent to ESSC on 12/06/2019
 - New PP (Arctic Weather Satellite) proposed early September
 - Revised version of the PP's proposed to Member States on 09/09/2019 and ESSC on 02/10/19
 - PB-EO on 23-25/09/2019 and all PP's were then finalised
 - Final version of the PP's to be available by 11/10/2019
 - Annexes of the Declaration and Implementation Rules also endorsed/finalised at last PB-EO



Key comments received by ESSC (1/2)

- Cal/Val issues and stressing the need for a European leading role in satellite Cal/Val activities
 - During preparation/definition/development/exploitation, Cal/Val needs to be operated by space agencies
 - Room for coordination with ESA, EC, EUM, EUROMET, EEA for FRM (fiducial reference measurements), in-situ, network, etc.. but no need of setting up a dedicated Cal/Val entity/agency
- Role of universities and research centres
 - Key activities for universities and research centres in several EO programmes (FutureEO, Incubed+, GDA)
 - Fundamental research included in Earth System Science of FutureEO
- Peer review process
 - PB-EO and ACEO are praising the way ESA selects missions
 - Evaluation made by ESA transmitted to the bidder to ensure full transparency

Key comments received by ESSC (2/2)

- International collaboration
 - Long experience based on EarthCare (good and challenging aspects of international collaboration)
 - FutureEO and CSC relies on international collaboration (NGGM, S6, NASA Decadal Survey) but MS also keen to foster European industry
- Budget
 - Total of 2.4 B€ proposed for EO programmes at Space19+
 - Largest part for CSC-4 (1.4 B€)
 - Though not questioned by MS, FutureEO (650 M€) is at risk due to MS affordability
 - To build (recurrent satellites) and operate the 6 Copernicus HPCM's, significant EC part (2 B€) still needs to be secured in the frame of MFF-2

=> Lobbying and support of ESSC would be welcome!

ESSC interest on Earth Observation Calibration / Validation (1/3)



While ESA welcomes ESSC's interest and analysis on the Cal/Val activities for Earth Observation missions, ESA does not see the benefit of the creation of a new European entity dedicated to Cal/Val as proposed in the ESSC position paper "*Towards a European Cal/Val Service for Earth Observation*", for the following 3 reasons:

1. The Cal/Val activities are intimately linked to the development and operation of an EO mission (a mission can be composed of one or more satellites). They are established in mission cal/val plans, in the early phases of development, and are directly defined and managed by the space agency responsible of the mission development and/or the mission operations.

2. The Cal/Val activities are complex and diversified, requiring an high level of coordination and coherence that only space agencies can ensure:

2.1 They shall be end-to-end, i.e. system-wide, from instrument/satellite hardware down to data processors, supported by external measurements (i.e. campaigns, in-situ data) and with industrial and academic support,

2.2 They shall be consistent during the whole mission duration, spanning a very long period starting with pre-launch measurements, continuing post launch and during satellite operations, as well as after satellite operations,

2.3 They benefit from inter-comparison with other missions, often performed within cooperation activities between space agencies (e.g. CEOS, GSICS).



3. While most of the Cal/Val activities are generally adequately funded within a space agency, the **collection of external measurements** (i.e. in-situ data, campaigns) **would definitely benefit from a better coordination and funding in Europe:**

3.1 For in-situ measurements specifically dedicated to EO satellite Cal/Val, ESA and other space agencies have developed the concept of **Fiducial Reference Measurements (FRM)**

→ *ESA and EUMETSAT are preparing a joint vision on the R&D and Operations of FRMs, to be shared with the European Commission (DG GROW),*

3.2 For other in-situ measurements, the role of European member states is essential. Within Copernicus, the **In-Situ Component** (managed by the European Environment Agency) coordinates the availability of those measurements, often structured through **in-situ networks**, in relation with the Copernicus Services, with ESA and with EUMETSAT

→ *by nature, the in-situ networks are funded by different partners (at national, European and global scale) and would benefit from a reinforced coordination, taking advantage of the Copernicus framework,*

3.3 For campaign measurements (airborne, shipborne, balloon, etc...), ESA has a limited budget often complemented by **national funding**

→ *ESA would welcome a bigger attention from the European Commission to the campaign support, particularly when needed by Copernicus.*

ESSC interest on Earth Observation Calibration / Validation (3/3)



For the reasons exposed in the previous slide, ESA does not see the benefit of the creation of a specific entity. Instead, ESA would recommend an **higher level of coordination for the collection of measurements dedicated to Cal/Val of EO missions**, through a series of actions:

- involving the funders of those activities, i.e. :
 - ✓ the space agencies at European level (ESA, EUMETSAT) and at National level, both for R&D and for Operational aspects,
 - ✓ the European Commission, both for R&D aspects (Horizon Europe) and for Operational aspects (Copernicus),
 - ✓ the European Environment Agency, in its role of coordinator of the Copernicus In-Situ component,
 - ✓ the Member States when not adequately represented by the previous
- structured within e.g. an inter-institutional body,
- aiming for a long-term sustainable availability of measurements dedicated to Cal/Val of EO missions.



Thank you for your attention!

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