
# ESA's proposal for FutureEO-1 Segment 2 at the CM22 (overview)

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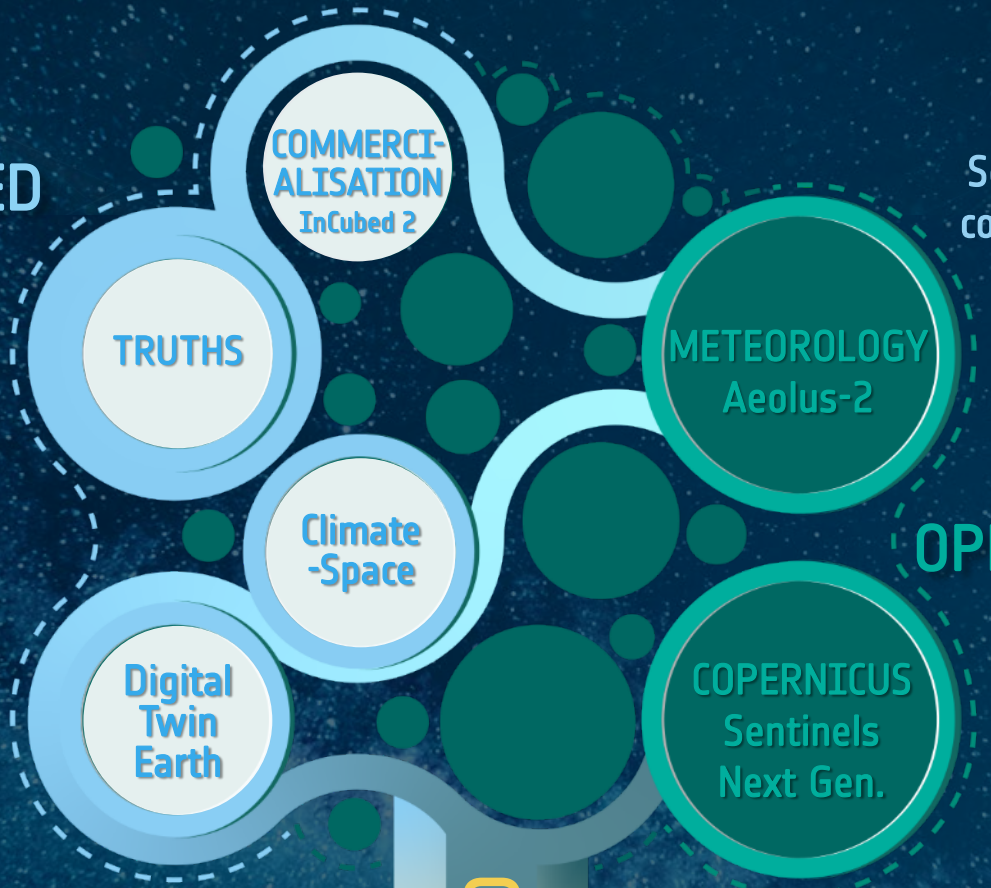
# EO at CM22

## CUSTOMISED EO

Pre-operational activities answering demands from user communities, industry, Member States




## OPERATIONAL EO

Securing the long-term continuation of Europe's eyes on our planet

Worldwide data and a walk in the past to better understand the present and the future

Earth Science, Preparation of EO future and World-class EO Research Missions

BASIC ACTIVITIES

*Earthnet* *Heritage Space* *DPTD*

# FUTURE EO

# An ESA Programme is:

A legal container = materialization of a collective will (by Interested Member States) to perform an activity together !

WHAT (activities/ deliverables)

HOW MUCH (Budget)

HOW LONG (Duration)

HOW (partnerships, implementation details)

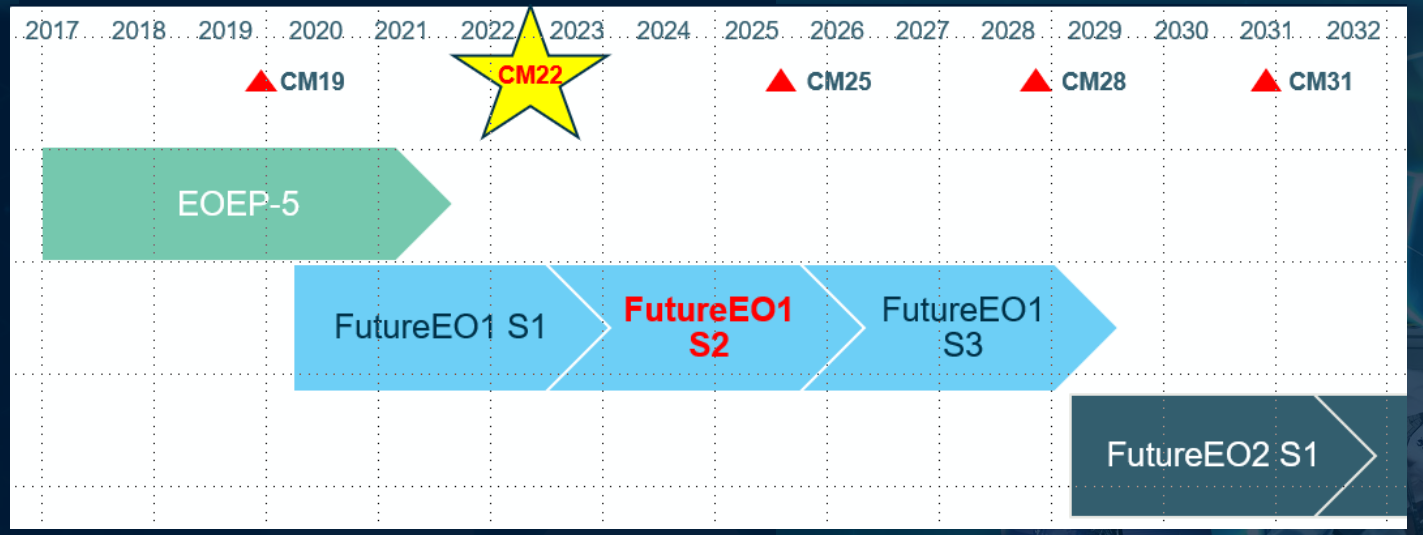

FutureEO1S2 – covers the whole nexus from pre-developments, mission implementation (**Harmony and NGGM / MAGIC**), mission management to scientific insights and applications

FutureEO1S2 – is the core ESA EO programme at CM22 asking for half of the ESA EO budget

FutureEO1S2 – 3 years segment embedded in a 9 years period (2020 – 2028) with a clear long-term vision

FutureEO1S2 – coordination with EC R&D, EC DEFIS, EUMTSAT and many international partner and a clear implementation structure

# What makes FutureEO an unique programme?

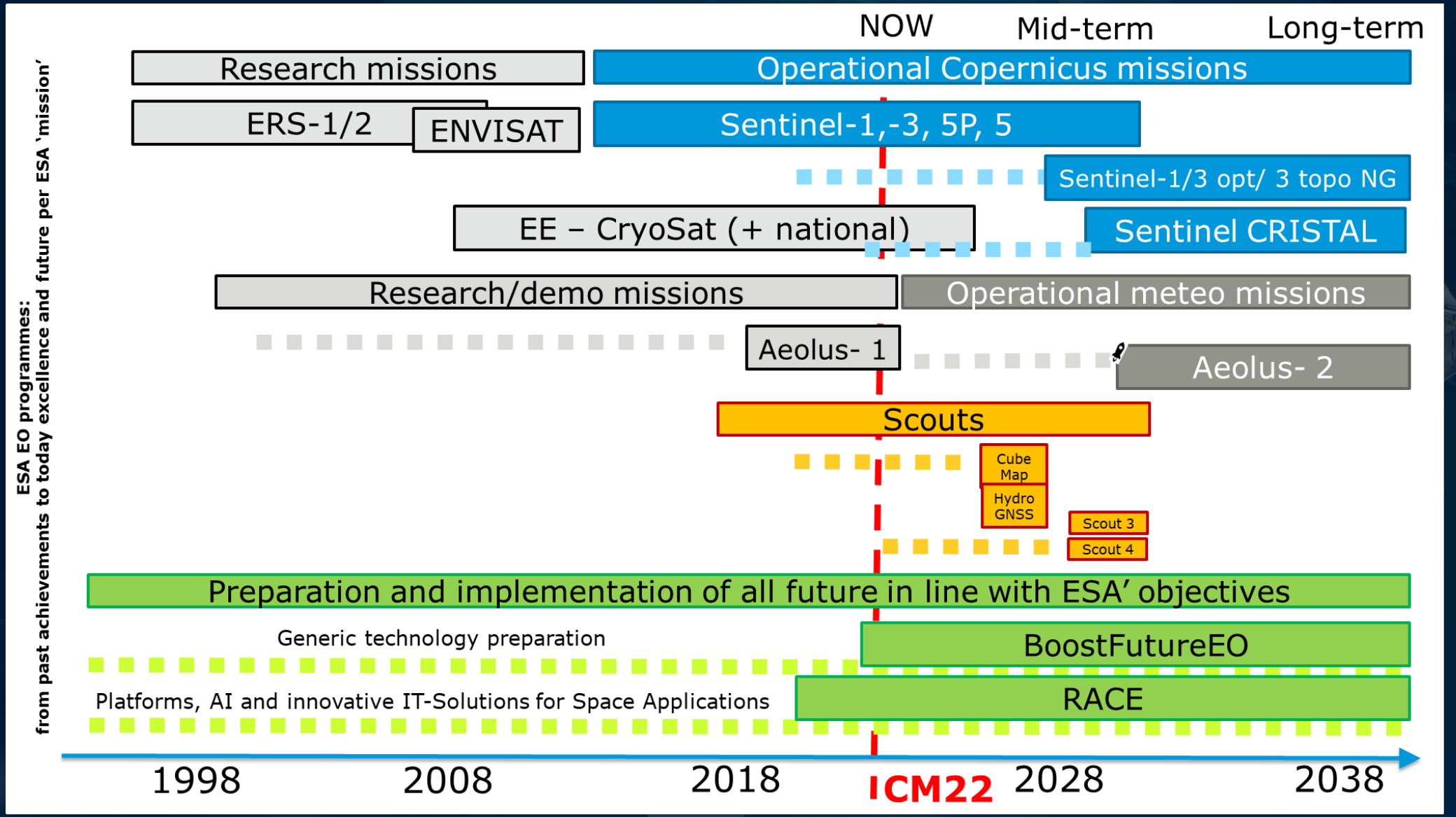



FutureEO1 Segment 2 is the **first ESA optional programme** approved for CM22 (18.05.2022)

## The backbone ESA Earth Observation programme for Earth Science

- Only ESA Programme subscribed by all ESA MS
- Flexibility of an envelope approach
- Driven by scientific excellence and technological innovation
- Nexus: science – technology – applications
- Long success story (~20 years) and promising future vision (Long-term vision)
- Continuity ("a never ending story...")

# From past achievements, to todays excellence and desirable future



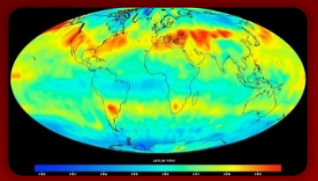
# Selected achievements of the recent past

## Preparing the future of operational missions

### Copernicus 2.0 (Expansion missions):

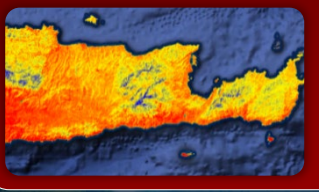
**Phase A/B1 and supporting activities (end-to-end simulator, support studies, campaigns) completed for the 6 Sentinel Expansion missions (formerly High-Priority Candidate Missions – or HPCMs)**

**Anthropogenic $CO_2$ Monitoring Mission**



Causes of Climate Change

**Land Surface Temperature Mission**

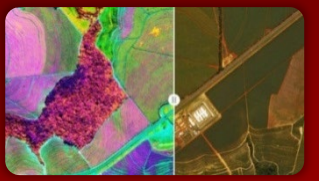


Agriculture & Water Productivity

**CRISTAL – Polar Ice & Snow Topography**

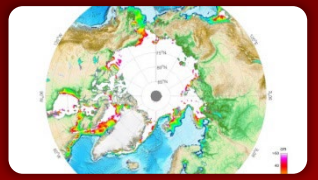
Effects of Climate Change

**CHIME – Hyperspectral Imaging Mission**



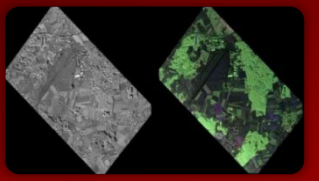
Food Security, Soil, Minerals, Biodiversity

**CIMR – Passive Microwave Radiometer**



Sea: Surface Temp. & Ice Concentration

**ROSE-L, L-band SAR Mission**



Vegetation & Ground Motion & Moisture

# An in-depth review looking back until 2017 just underlined

These findings were also fully supported by the Programmatic and Technical Review (March 2022) involving all Programme Participating States!

**19 recommendations** from the Independent Science Review and
**8 recommendations** from the Programmatic and Technical Review will help to make the Programme fit for the future.

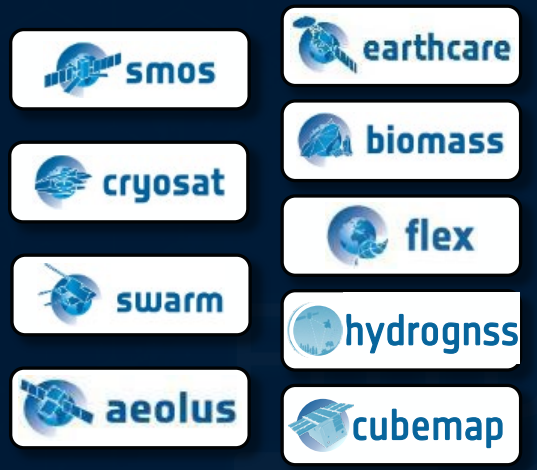
- maintained by sustained financial investments by ESA Member States. The Panel strongly endorses the continuation and strengthening of this excellent Programme.

# FutureEO - key objectives & structure

## Pioneering World-Class Science Missions For Earth


- Secure the “foundations and concepts” required for the future EO systems in Europe
- Deliver world-class EO Research Missions
- Demonstrate their scientific relevance
- Enable further applications, science and industrial competitiveness

# FutureEO-1 Segment 2 – Key highlights




## The Research Missions

- Implement BoostFutureEO early phases
- Implement Harmony as Earth Explorer 10
- Prepare candidate missions for Earth Explorer 11
- Issue and prepare call for EE 12 & 13 respectively
- Implement Next Generation Gravity Mission
- 2nd Scout cycle and implementation (Scout 3 and 4)
- Operate and manage growing amount of EEs in orbit


*See dedicated presentations

## Paving the way to the future

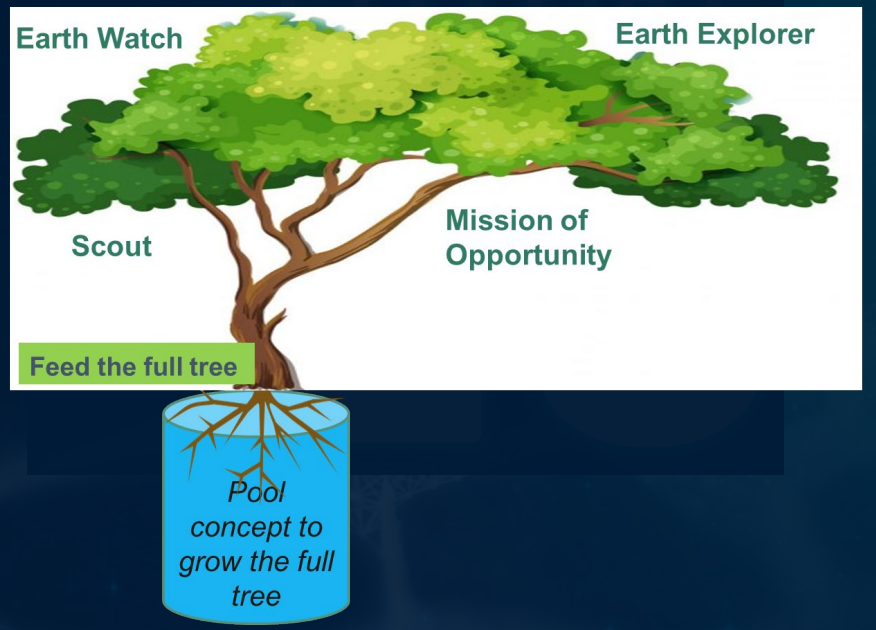
- Combining Mission Feasibility with enabling Technology & Science and Campaigns
- Prepare the whole EO family of missions
  - The Research Missions
  - Copernicus Sentinel Next Generation missions
  - Meteosat Fourth Generation and MetOp Third Generation missions
- Further science, applications and downstream industrial competitiveness

# FutureEO – BoostFutureEO early phases

## How can we enable ambitious and challenging Earth Explorer missions for the future?

"ESA maintains high levels of scientific excellence and technological innovation by pursuing different classes of missions that must include **large, ambitious and challenging Earth Explorer missions** to secure its position of international leadership in Earth Observation."

(Independent Science Review, 2021)




- User (science) driven & enabling the implementation of world class Earth science
- European leadership through science and technological innovation
- New blue sky mission proposals (more opportunities)
- Stimulating new idea generation through international cooperation of scientists and industry across Europe
- Reliable time to launch

# A possible solution to boost blond research missions?

## BoostFutureEO early phases “Global scenario outline”

Step 1: New approach to a revision of LPC including observational gap analysis

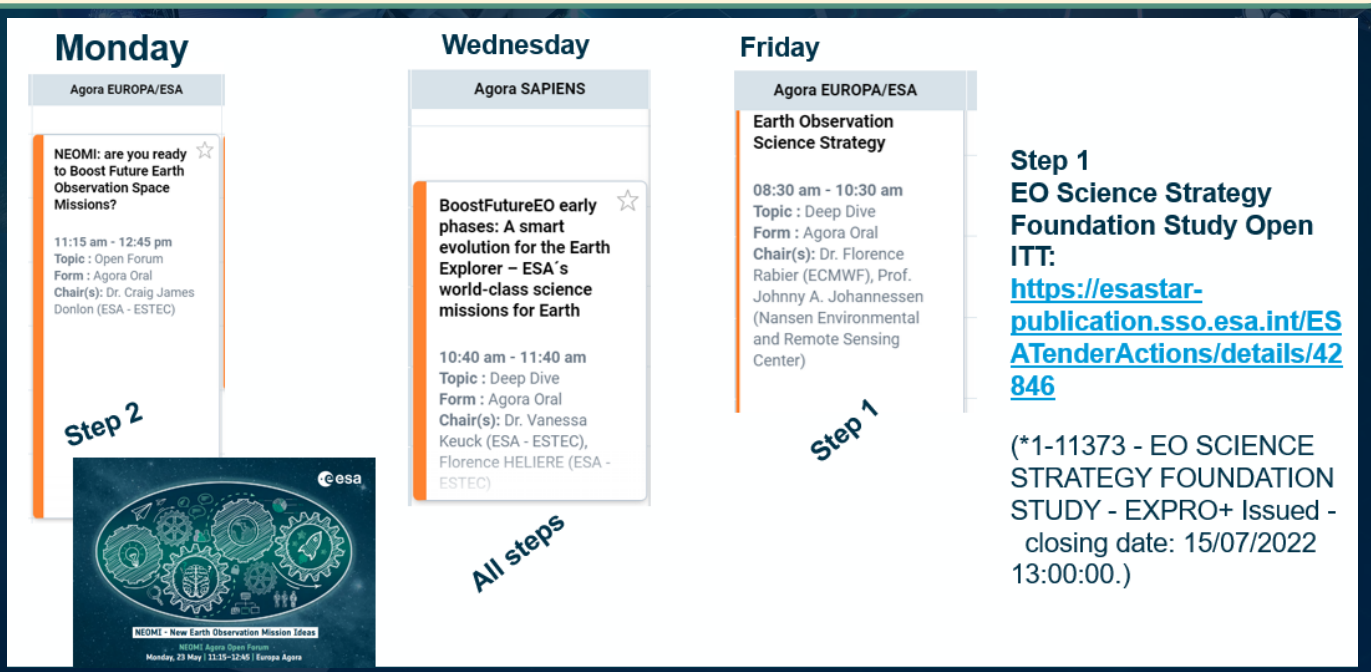
Step 2: New EO Mission Ideas (NEOMI)

Step 3: Call for ideas followed by Phases 0 and maturation activities for ‘commended’ missions

Step 4: Selection of missions for Phase A and implementation of Phase A

Step 5: Selection of mission for implementation followed by Phase B/C/D/E1

**Dedicated agora sessions**



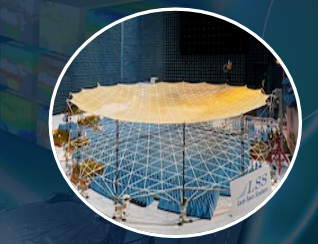
# FutureEO – Foundations and Concepts

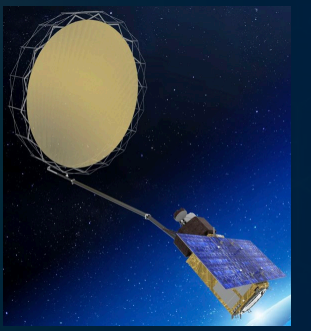
**Earth Explorer missions**: EE11 Phase A, EE12 Call and Phase 0, EE-13 Call and Implementation of BoostFutureEO early Phases

**Copernicus NG missions**: S2 NG Phase A/B1, S3 optical NG Phase A/B1, architecture studies to cover new/emerging user needs

**Meteorology future missions:** early activities to prepare NG of Meteosat and MetOp missions (aka Meteosat 4th Generation and MetOp 3rd Generation)

**Mission of Opportunity early Phases**





**2nd Scouts cycle early Phases**

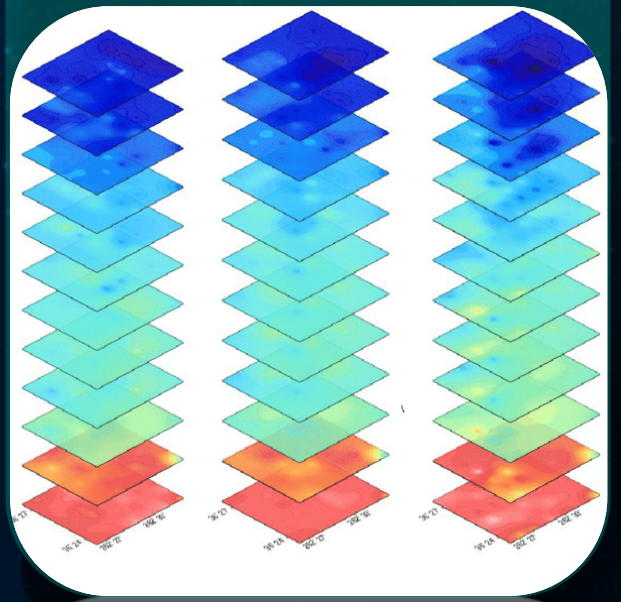
Generic preparation of the future - Instrument pre-developments - EO-enabling platform technologies

# FutureEO-1 Segment 2 – EE11 4 Candidates preparing for the future

## CAIRT

Understanding the links between CC and atmospheric chemistry and dynamics at 5 to 120 km

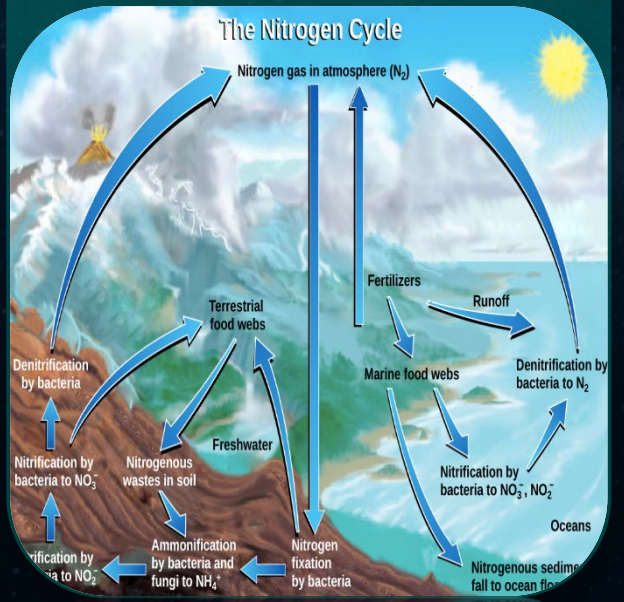
First limb-sounder with imaging Fourier-transform infrared technology in space



## Nitrosat

Understanding the links between CC and the natural carbon and nitrogen cycles

Measurement of nitrogen dioxide and ammonia, two important reactive nitrogen compounds in the atmosphere




## WIVERN

Improving the prediction of high-impact weather and hazard warnings

Dual-polarisation, conically scanning 94 GHz Doppler radar for measuring wind in clouds and delivering profiles of rain, snow and ice water

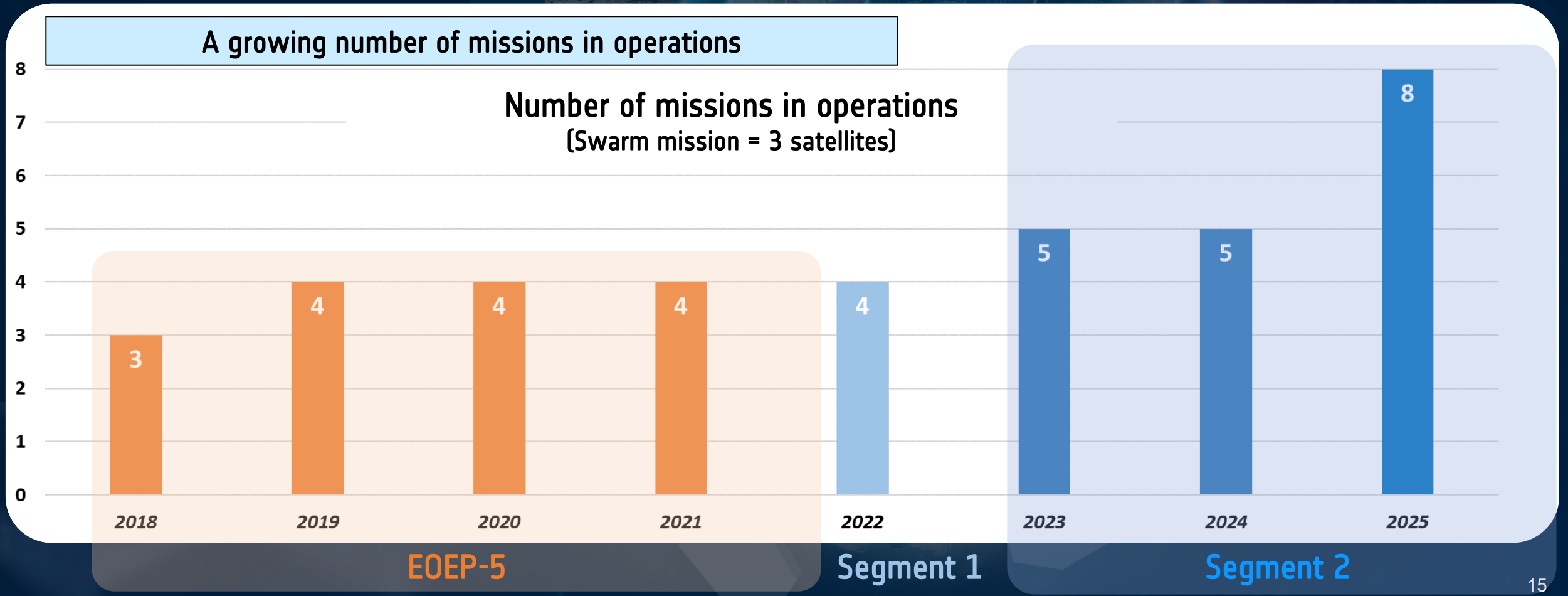
## Seastar

Understanding air–sea interactions using two-antenna along-track interferometry radar

Providing ocean surface current & wind vectors at 1 km resolution for all the coastal ocean, shelf seas and marginal ice zones

# FutureEO-1 Segment 2 – Mission Management

Parallel operations of 6 Earth Explorer missions, including some much beyond their nominal life time (SMOS, CryoSat, Swarm) plus additionally two Scouts.



# FutureEO-1 Segment 2 – EO for Society

## Supports global and European policies

(UN 2030 agenda on Sustainable Development, Multilateral Environmental Agreements and the EU Green Deal )

## Address environmental challenges

(climate change, natural disasters, droughts, forest fires)

## Regional initiatives

(natural resources and ecosystem management, sustainable economic growth)

## Ensure equitable access to water, energy and materials

## Facilitate EO uptake in Africa

Bolsters society

FutureEO

- Forges cutting-edge space technology
- Underpins future Earth observing systems
- Increases space industry competitiveness

**To come:**

**<u>Socio-economic impact assessment of FutureEO</u>**

Gross domestic product analysis

Spillovers results

Dedicated case study analysis for Water Management, Agriculture and Societal Resilience

- Offers flexibility to respond fast to emerging needs and opportunities
- Ensures cooperation for greater success
- **Stimulates Earth observation market growth**

1977 1991 1995 1997 1998 2021

Earthnet: European access to non-ESA missions

Meteosat
M-1, 2, 3 → Operational
M-4, 5, 6 → Transition
M-7

Meteosat (

M

1991

Earth Explorers
(Scouts)

Science

Envisat

POEM →

Earth
Watch

GMES / Copernicus
(with EC)

Applications
Services

**Let's continue the successful journey from FutureEO …**
**CM22 is only the next step!**