

**living planet
symposium** | BONN
23-27 May
2022



**FUTURE
EO**

Pioneering world-class
science missions for Earth



Earth Explorer 11 Candidate Missions: New Earth Science Insights for the Next Decade

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08/05/2022

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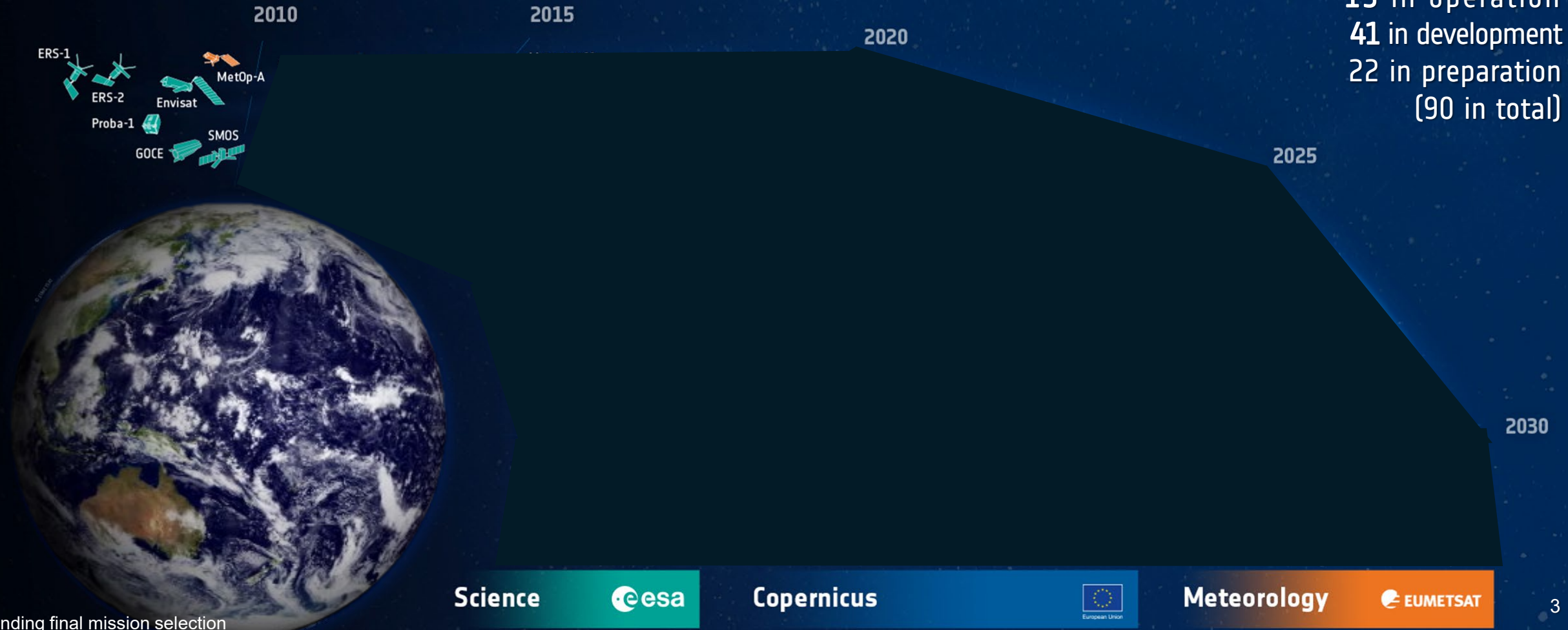


→ THE EUROPEAN SPACE AGENCY

Decadal Evolution in ESA Earth Observation



Current Satellites
 12 heritage
 15 in operation
 41 in development
 22 in preparation
 (90 in total)



*Pending final mission selection



Science 
Copernicus 
Meteorology 

ESA Earth Observation (EO) Programmes



FutureEO*

*(former EOEP)

Foundations and Concepts
Research Missions
Mission Management and Ground Segments
Earth Science for Society

Operational EO

Copernicus Missions
Meteorology Missions

In partnership with European Commission and EUMETSAT

Customised EO

Climate Change Initiative
Investing in Industrial Innovation (InCubed)
Global Development Assistance
Customised Missions (e.g. ALTIUS)

Basic Activities

EarthNet (Third Party Missions) & Heritage Data Programme
EO support from transversal programme elements such as Discovery, Preparation and Technology Development (DPTD)



“Taking the Pulse of our Planet”



FutureEO Outlined

Nurtures scientific excellence

Delivers new scientific understanding to
address global challenges

Bolsters societal and economic resilience



Forges cutting-edge space technology

Underpins future Earth observing systems

Increases space industry competitiveness

Maintains Europe as a world leader in
Earth Observation

Flexibility to respond to emerging needs and
opportunities

Builds cooperation for greater success

Stimulates a rich and evolving European Earth
observation research and applications community

FutureEO Programme: Structured around 4 blocks

Foundations and Concepts



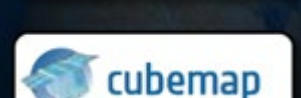
Research Missions



Mission Mgmt. & Ground Segment



Earth Science for Society

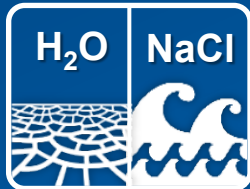


Flying Missions

GOCE
2009-2013



SMOS
2009



CryoSat
2010



Swarm
2013



Aeolus
2018



Science & Innovation



4.700+
Reg. Users

Future Missions

EarthCARE
2023



Biomass
2023



FLEX
2025



FORUM
2027



EE-10
2029

Ph A
Candidate
Harmony



300+ Publ.
per Year

**High Risks for
Great Rewards**

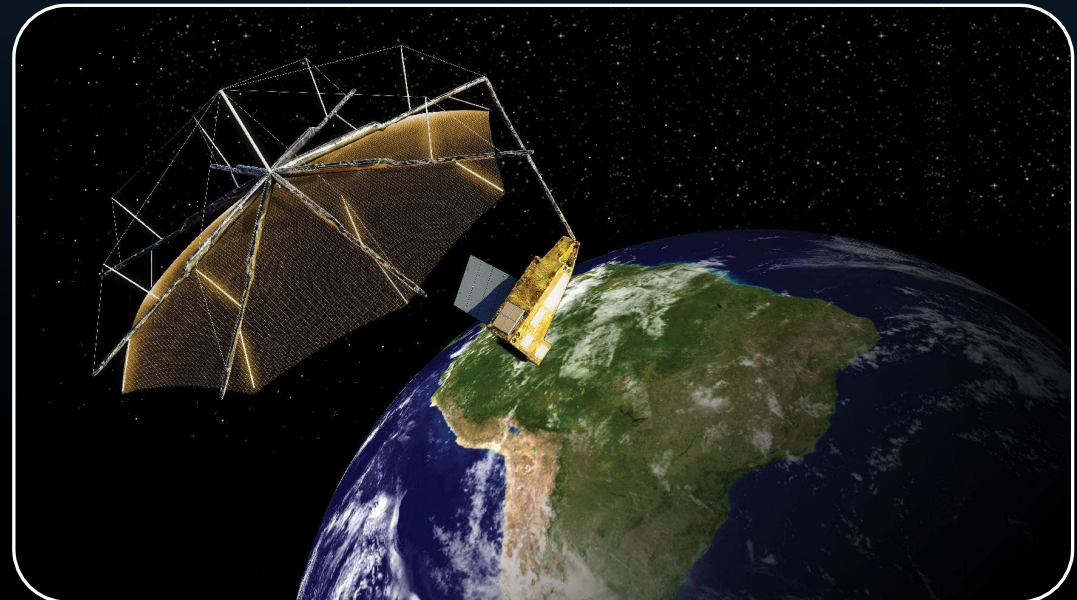
EE6 EarthCARE

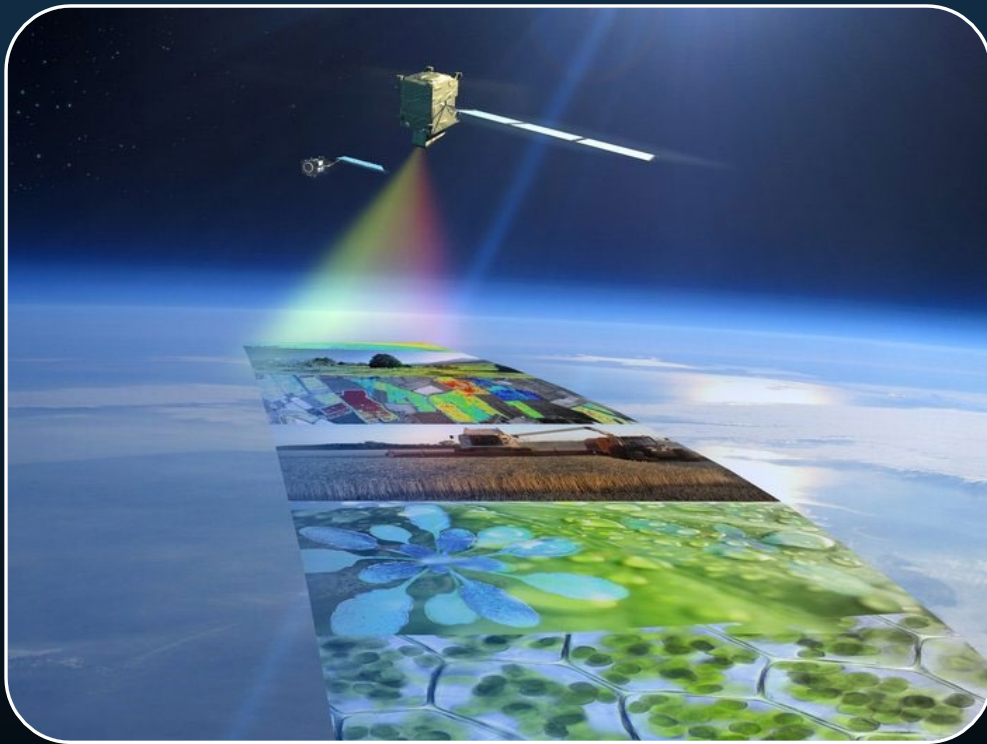
- Clouds, aerosols & radiation
- High performance lidar & Doppler radar.
- Partnership with JAXA
- Launch planned 2023 (*TBD)



EE7 Biomass

- Estimates of forest Biomass
- First P-band SAR in space
- Launch planned 2023



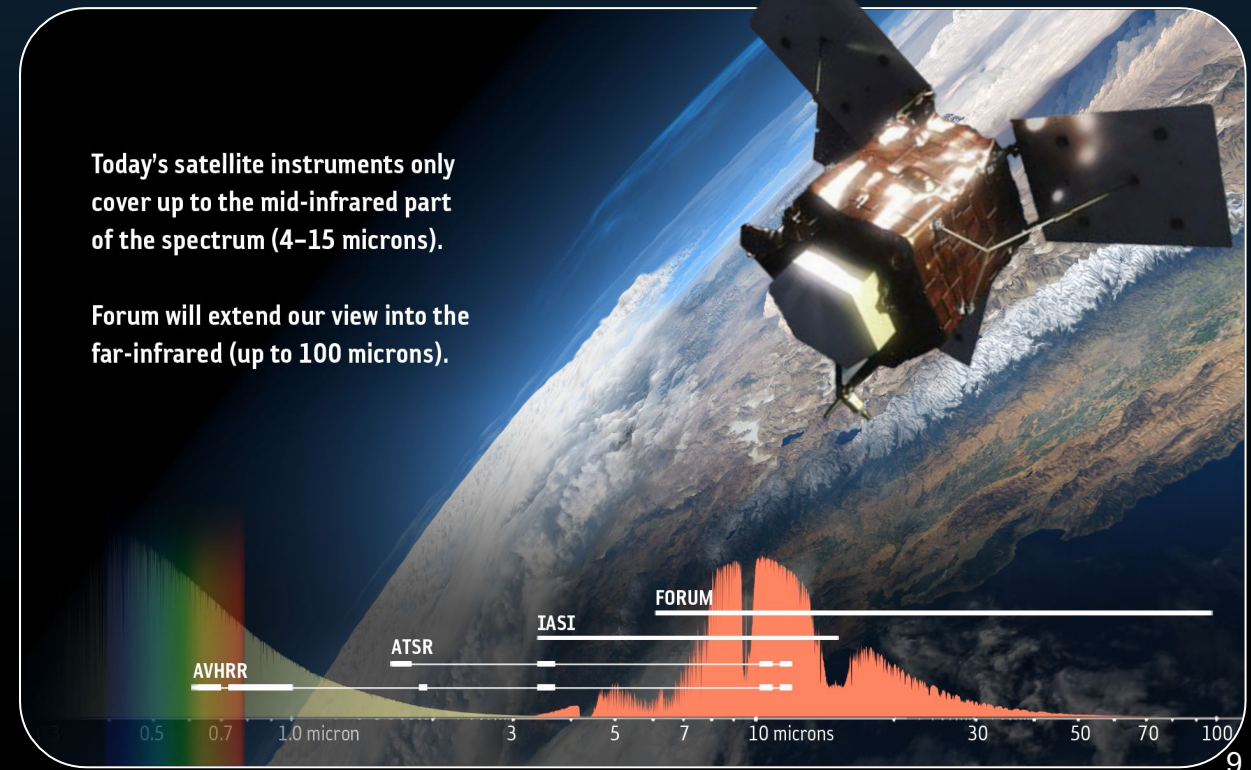


EE8 FLEX

- Vegetation fluorescence, indicator of photosynthesis and stress
- Satellite CDR completed
- Launch foreseen in 2025

EE9 FORUM

- Ph B2/C/D/E1 Contract KO in April 2022
- Measures outgoing radiation for investigating controls on Earth's radiation budget



Harmony: Candidate Earth Explorer 10 Mission

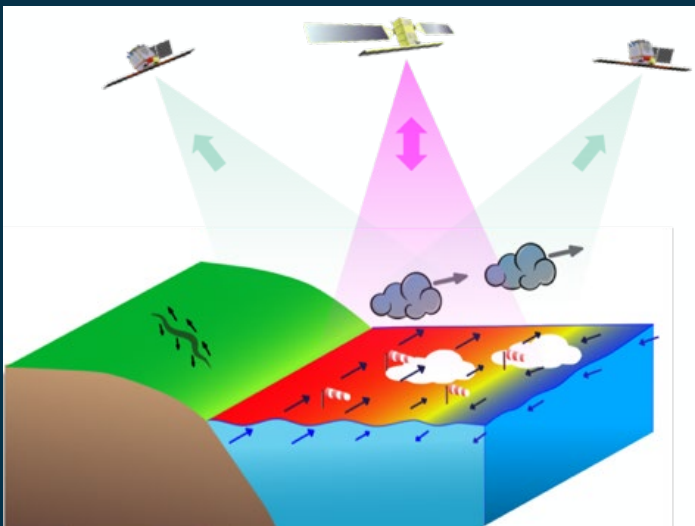


Harmony is comprised of two companion satellites in a loose convoy with Sentinel-1D (along-track separation ~350-400 km).

- Multi-faceted mission (solid Earth, land ice and ocean)
- Payload suite consists of a passive SAR and a multi-view TIR instrument
- Launch foreseen in 2029

Current Status

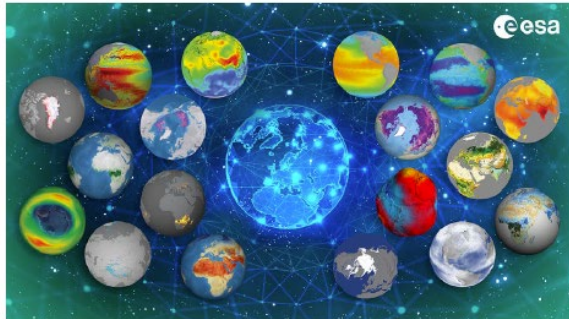
- Completion of Harmony PRR for both consortia
- 5th July - User Consultation Meeting (UCM)
- <https://atpi.eventsair.com/ucm-2022/>
- 6-7 July 2022 - ACEO Meeting to prepare recommendation to D-EOP
- Sept. PB-EO decision on implementation of Harmony as flagship EE10 research mission



EE11 Call: Objectives, Scope and Boundary Conditions

ESA/EXPLORER/EE11
Page 1

The Future Earth Observation Programme
FutureEO Period-1

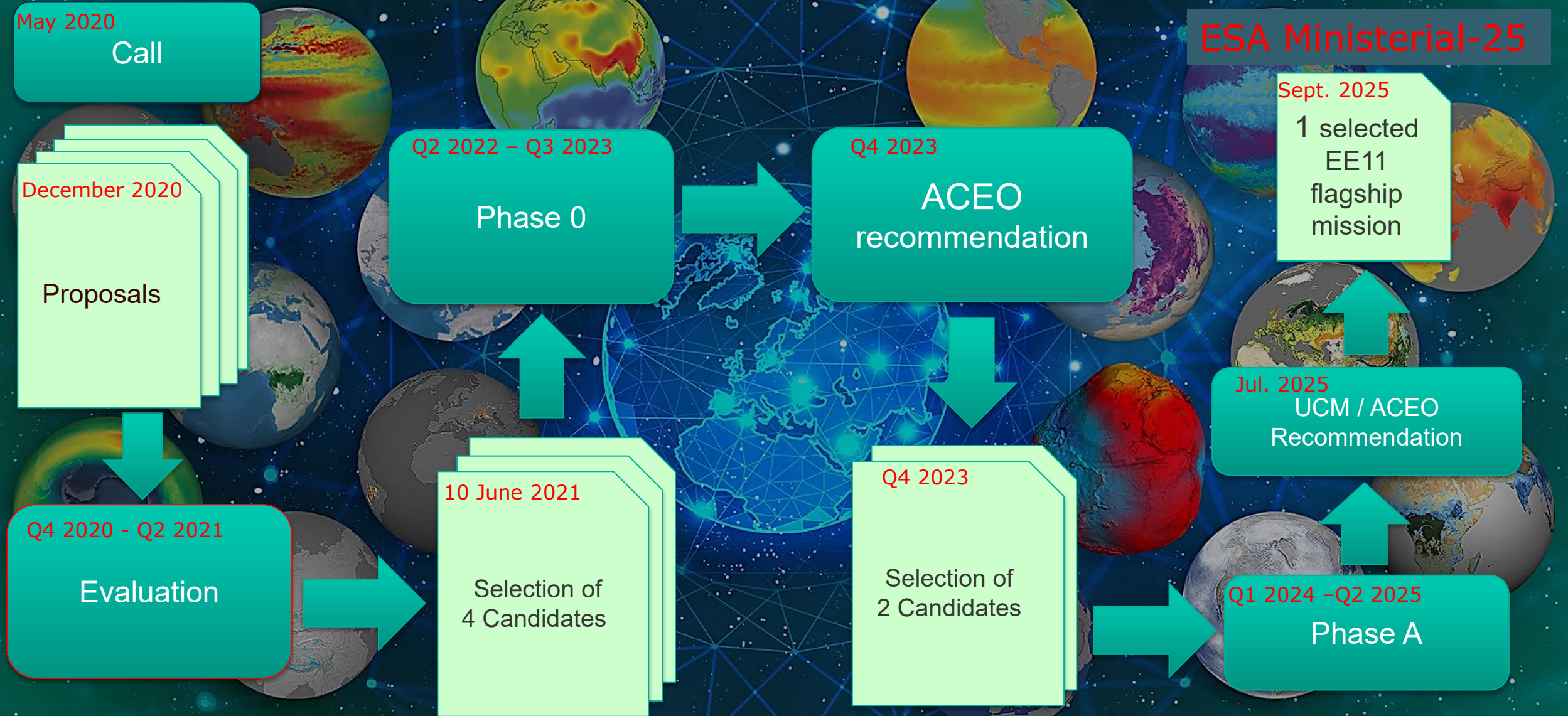


Call for Earth Explorer 11 Mission Ideas

25 May 2020

- FutureEO-1 Segment 1 Programme Proposal contained plans for a Call for Ideas for a Large Research Mission (Earth Explorer 11) in May 2020
- Responses to the Call could cover **any Earth Science topic** relevant to the **FutureEO Programme**, in accordance with the Earth Observation Science Strategy for ESA: *A New Era for Scientific Advances and Societal Benefits*
- Evidence was requested in the Proposals that a Science Readiness Level (SRL) of 5 can be achieved at the end of Phase A and TRL of 5 at the end of phase B1
- Target of a CaC at **~450 M€** (2020 e.c), with **250 M€** allocated to space segment development
- Launcher selection shall follow the ESA launcher policy
- Decision on of EE11 mission implementation scheduled to be taken in **2025, prior to the CM-25**
- Implementation of the EE11 flagship to be financed by Segment 3 of the FutureEO-1 Programme (i.e. at CM-25)
- EE11 flagship mission launch targeted in approx. **2031/2032**.

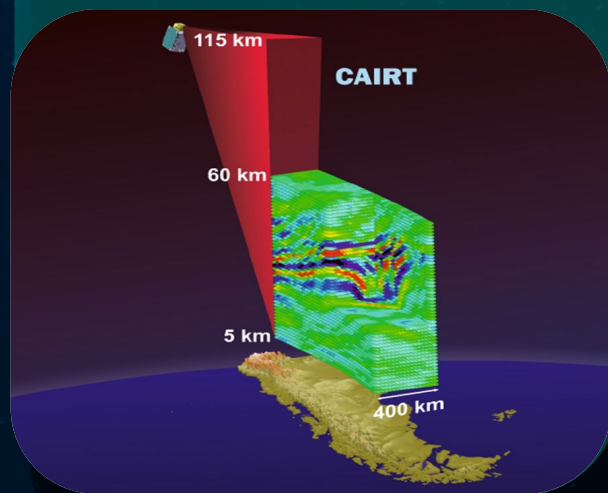
Earth Explorer 11 Preparation & Selection Roadmap



CAIRT

Understanding atmospheric composition, structure and dynamics from 5 to 115 km

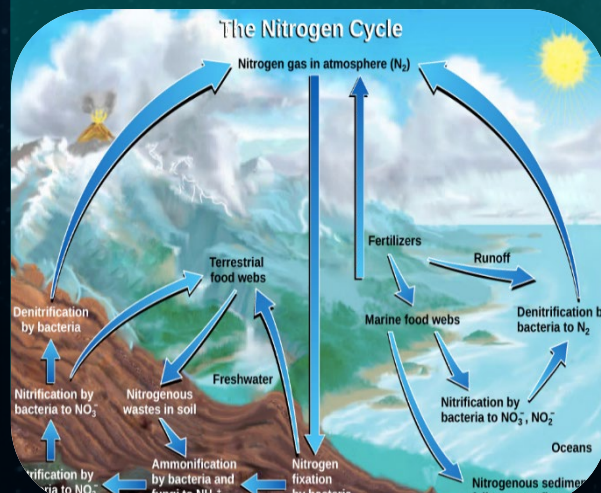
Infrared limb emission imaging with Fourier-transform infrared technology in space



Nitrosat

Understanding links between climate change and the carbon and nitrogen cycles at landscape scale

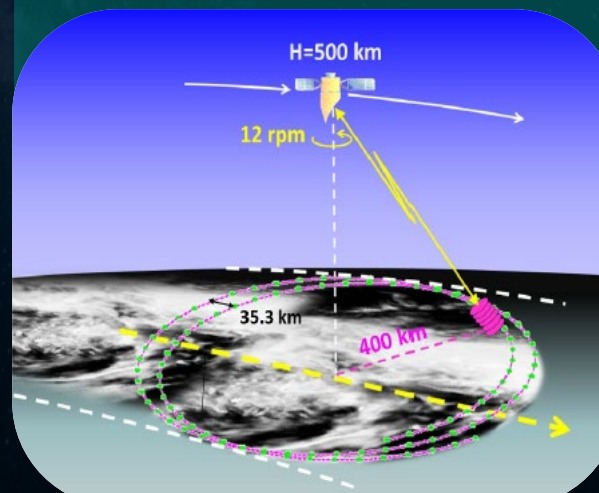
Measures key reactive atmospheric nitrogen compounds nitrogen dioxide (NO₂) and ammonia (NH₃)



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 rain, snow, ice water profiles



SEASTAR

Understanding air-sea interactions using two-antenna along-track interferometric radar

1 km res. ocean surface current & wind vectors for coastal ocean, shelf seas and sea ice margins



FutureEO-1 Segment 2 – The key highlights

Earth Explorer

- Implement Boost FutureEO early phases, including:
 - New EO Science Strategy with revised science priorities to guide EE Calls
 - Initiate first round of New Earth Observation Mission Ideas (NEOMI) studies
- Implementation of Harmony as Earth Explorer 10 (pending UCM and PB-EO decision Sept.22)
- Prepare the 4 candidate Earth Explorer 11 missions
- Issue Call for Earth Explorer 12 (2023) and prepare candidates to end of Phase-A
- Prepare and Issue Call for Earth Explorer 13 (*guided by New EO Science Strategy)
- Operate and manage growing number of Earth Explorers in orbit

Additional Complementary Research Mission highlights

- Implement Next Generation Gravity Mission
- 2nd Scout challenge and implementation

- Earth Explorers underpin the Science and Research ambition and scientific excellence of the FutureEO Programme
- Four new Earth Explorer candidates embark on a competition to be selected as the flagship EE11 mission at the 2025 ESA Council meeting at Ministerial level.
- FutureEO continues to offer opportunities for science-driven missions, and its ambition is to maintain the scientific excellence in this Programme through regular mission Calls
- The new Boost FutureEO early phases activity is being implemented to help catalyse new EO mission ideas originating from the Earth science community
- With sustained positive engagement of the research community, Earth Explorers will continue to deliver new Earth science insights well into the next decade