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

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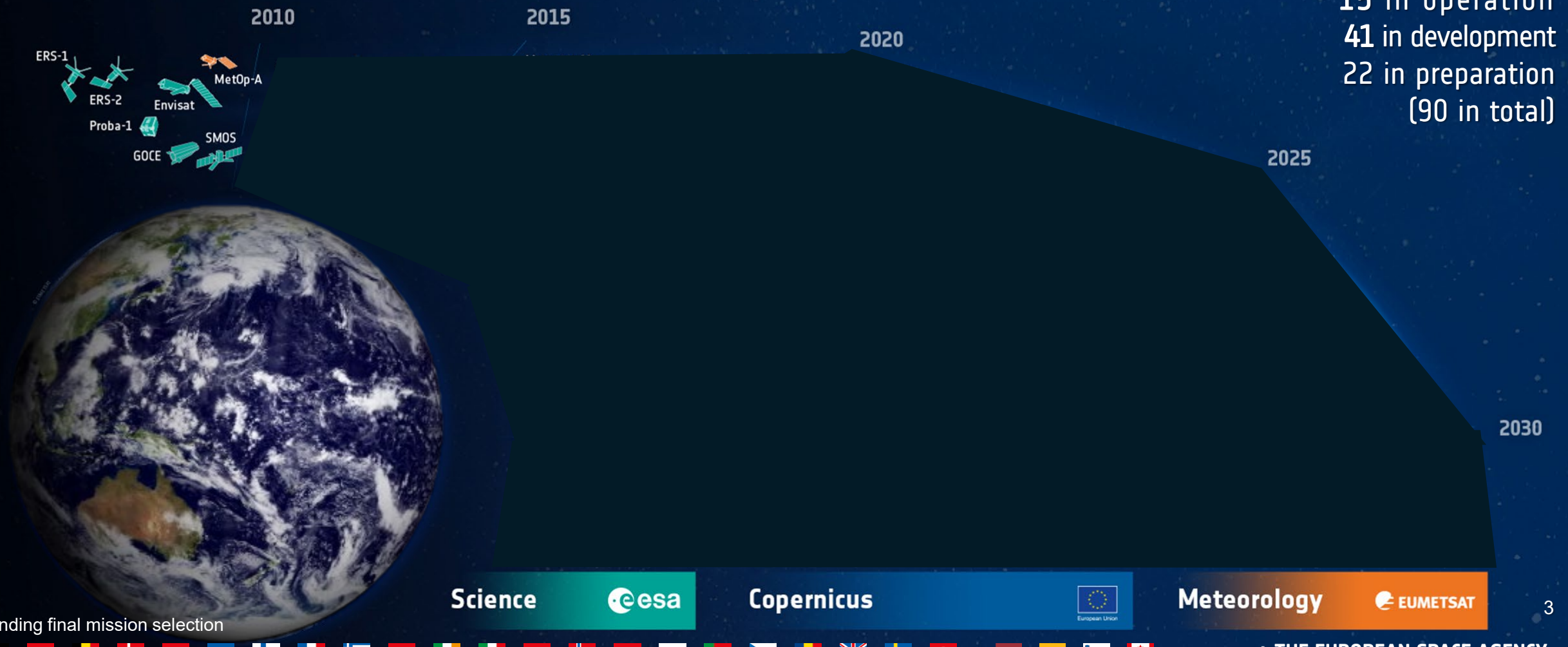
Decadal Evolution in ESA Earth Observation

Current Satellites

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



*Pending final mission selection

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

- Forges cutting-edge space technology
- Underpins future Earth observing systems
- Increases space industry competitiveness
- **Maintains Europe as a world leader in Earth Observation**

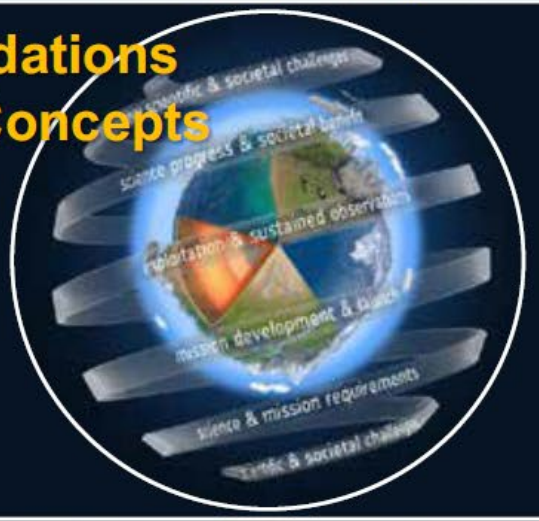
- Nurtures scientific excellence
- Delivers new scientific understanding to address global challenges
- **Bolsters societal and economic resilience**

- 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

esa

Foundations and Concepts



Research Missions

- EE-11
- Scout 3 & 4
- MAGIC /NGGM
- EE-10 Harmony
- earthcare
- forum
- aeolus
- hydrognss
- swarm
- cubemap
- cryosat
- flex
- smos
- biomass

Mission Mgmt. & Ground Segment

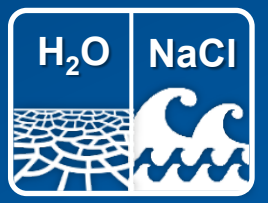
Earth Science for Society

FutureEO – Earth Explorer Missions

Flying Missions

GOCE
2009-2013

SMOS
2009



CryoSat
2010

Swarm
2013

Aeolus
2018

Future Missions

EarthCARE
2023

Biomass
2023

FLEX
2025

FORUM
2027

EE-10
2029

Ph A
Candidate
Harmony

Science & Innovation

4.700+ Reg. Users

300+ Publ. per Year

High Risks for Great Rewards

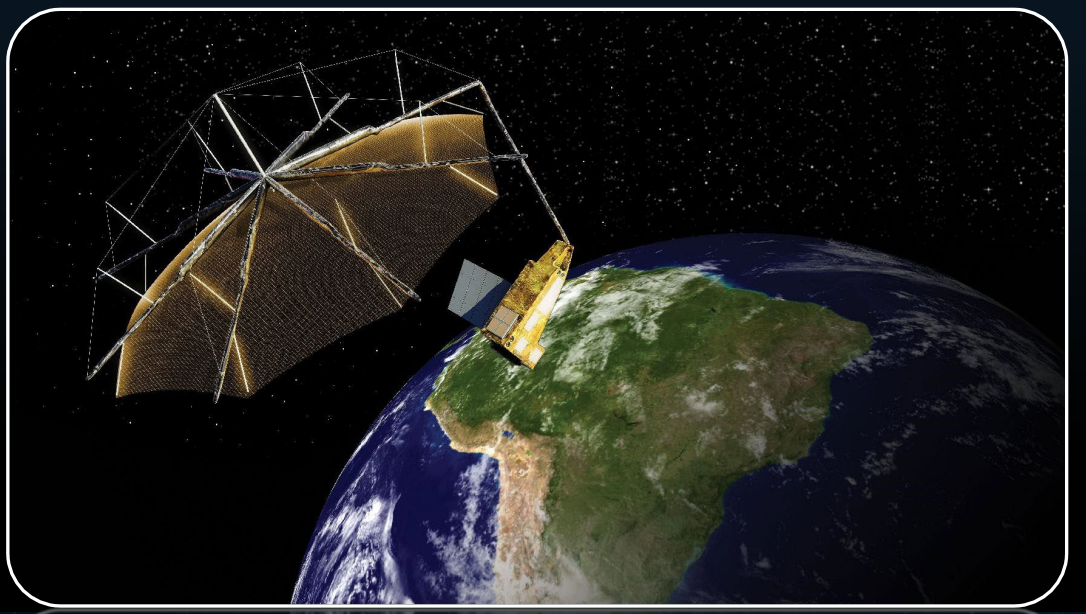
Earth Explorers in development

EE6 EarthCARE

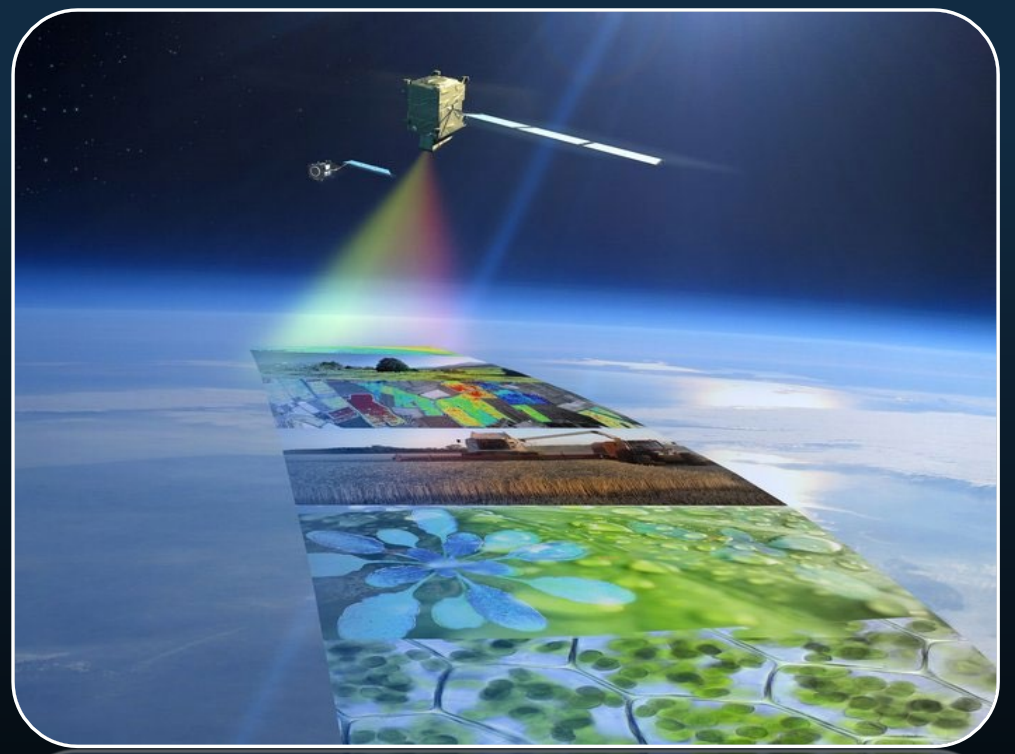
- Clouds, aerosols & radiation
- High performance lidar & Doppler radar.
- Partnership with JAXA
- Launch planned 2023 (*TBD)

EE7 Biomass

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



Earth Explorers in development

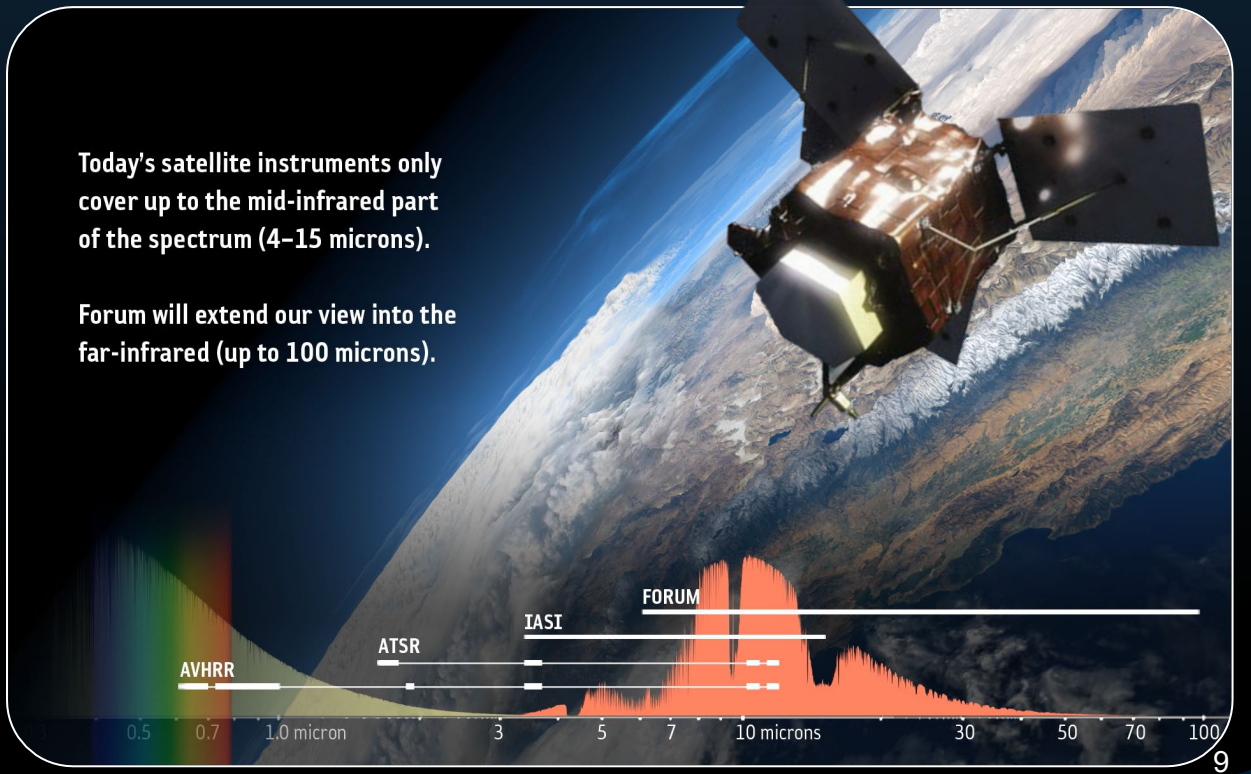


EE8 FLEX

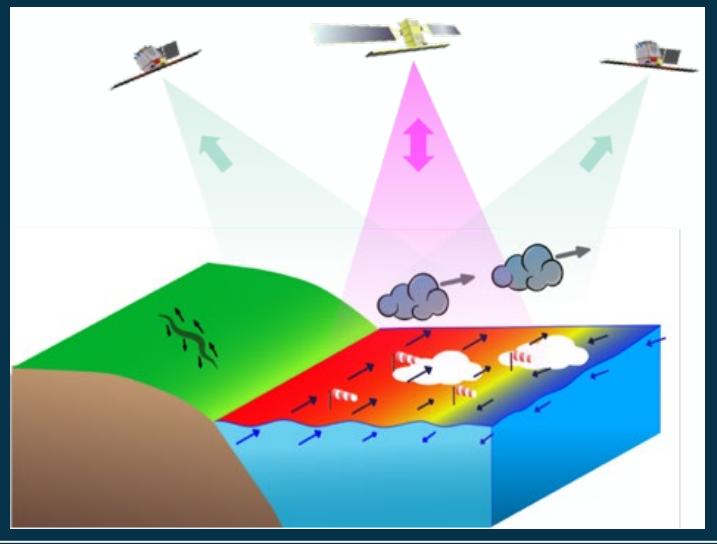
- Vegetation fluorescence, indicator of photosynthesis and stress
- Satellite CDR completed
- Launch foreseen in 2025

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



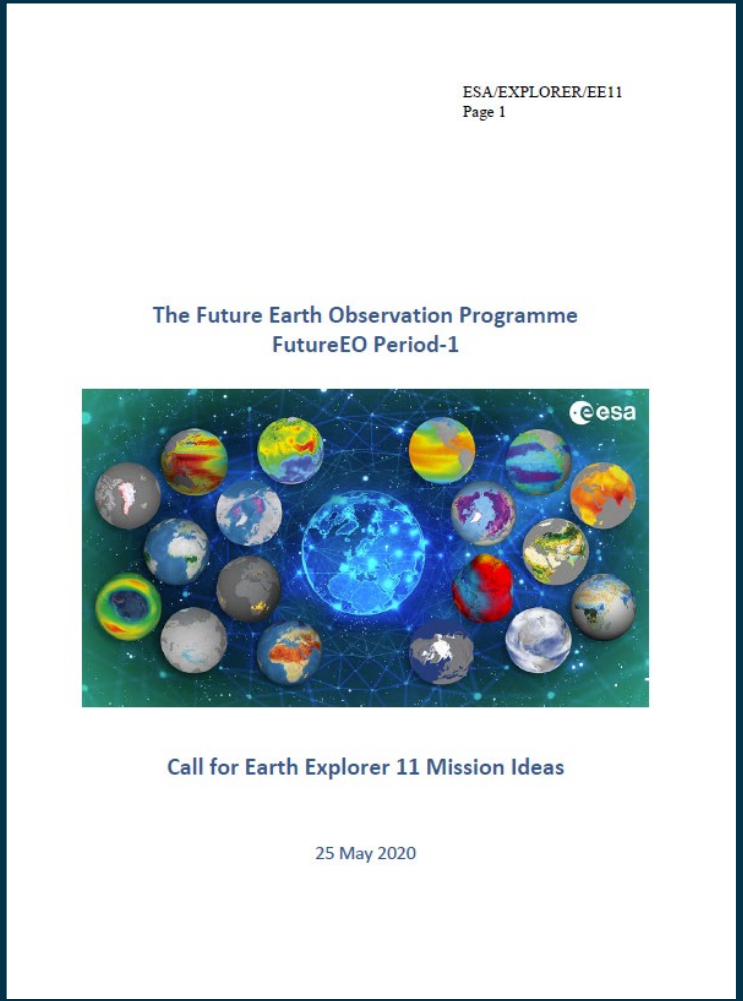
Harmony is comprised of two companion satellites in a loose convoy with Sentinel-1D (along-track separation ~350-400 km).

- 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



- 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

Preparing 4 EE11 Candidates for the future

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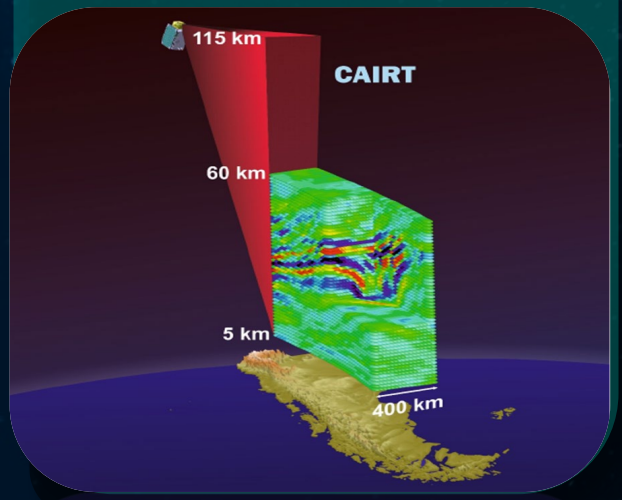
CAIRT

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

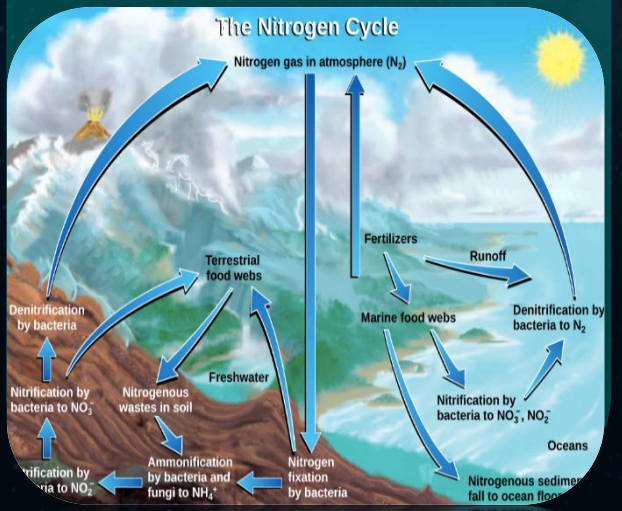
Infrared limb emission imaging with Fourier-transform infrared technology in space



Nitrosat

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

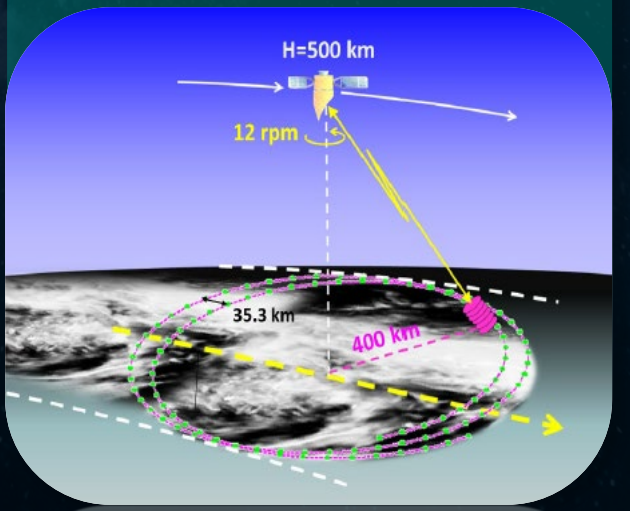
Measures key reactive atmospheric nitrogen compounds nitrogen dioxide (NO2) and ammonia (NH3)



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

Synopsis

- 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