ESA Perspectives on EO Technology

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Presentation outline

- EO Overview
- Earth Explorers
- Copernicus + Meteorological
- Small and Nano Sats
- Technology vision
- CMIN-22

Devising Earth Observation Missions

Overall EOP Feature: User (SCI or App) Driven (LIVING PLANET PROGRAMME)

Research Missions

Member States

Earth Explorers

& Scouts

Open Calls :
Ideas from **science** partners
in Member States

Earth Watch Missions

EU

Copernicus

EUMETSAT

Meteorology

Industry

InCubed

- User needs from institutional partners & industry
- Mission definition by ESA with industry, partners & users

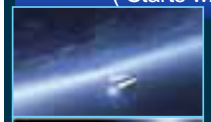
ESA EO: large range of missions - all User Driven

Colour Code:
Launched
To be launched

Living Planet
(SP-1304)

Earth Explorer
Research driven

Core Missions
(Starts with Ph. 0)


GOCE
2009-2013


Aeolus
Aug-2018


EarthCARE
2023


Biomass
(EE7) 2023

EE10 – Harmony - 2028

Call EE11 - 2031

Opportunity
(with partners)

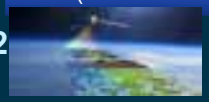

CryoSat-2
8 April 10


SMOS
2 Nov 09


Swarm
22 Nov 13

NASA collaboration
NGGM - MAGIC

Fast Track
(starts with Ph.A)

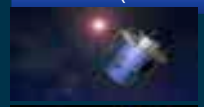

FLEX (EE8)
2022


FORUM – EE9
2025

Scouts
ESP-MACCS,
HydroGNSS
(2024)

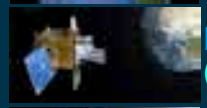
Earth Watch
Operational Service driven
In partnership

Meteorology
(with Eumetsat)


Meteosat


MSG - GEO
(1 s/c x 4)


(1 s/c x 3)


MTG - GEO
(2 s/c x 3)


MetOp SG
(2 s/c x 3)

Earth Watch
AWS, Altius, Truths

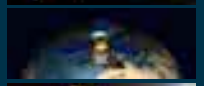
Copernicus
(with EC)

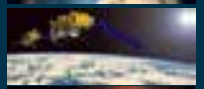

Sentinel 1 A/B/C/D


Sentinel 2 A/B C/D


Sentinel 3 A/B/C/D


Sentinel 4 (on MTG)


Sentinel 5 precursor


Sentinel 5 (on MetOp SG)


Sentinel 6 (Jason)

Copernicus Space Component:
HPCM: CO2M, LSTM, Cristal, CIMR, CHIME, ROSE-L
Evolution: Sentinel-1/2/3/6 NG

Earth Explorer 10 Mission Candidates

Decisions by PB-EO : 18-19 Feb. 2021

Harmony

moves to Ph.A (4 M€ x2 in //) – 14 months
+ 2 M€ support studies
→ Launch 2028

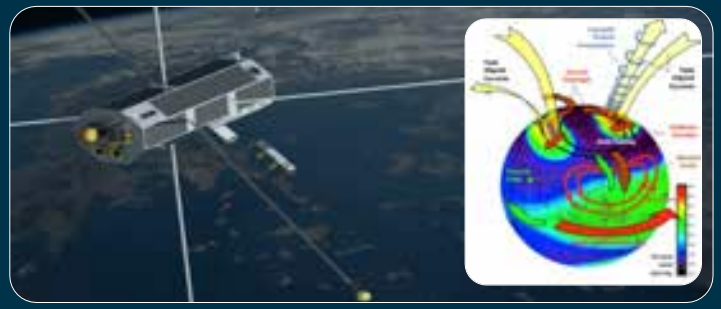
Measuring surface deformation

- Bistatic SAR with two satellites and passive receiving antennas, in formation with Sentinel-1 (C-band)
- 3D Doppler/backscatter measurements +TIR
- Baselines of ~250 km, configurable constellation for along- and cross-track interferometryt

Daedalus

Not selected, but NASA interested
(possible Mission of Opportunity – long-term)

Exploring the thermosphere-ionosphere



- Full suite of *in situ* plasma, neutral atmosphere, particles, and electro-magnetic fields instruments
- Coordinated flight for multi-point measurements
- Elliptical orbit with perigee ~150 km and deep dips

Hydroterra

Not selected,
(possible science activities)

Monitoring the diurnal water cycle

- C-band radar in geosynchronous orbit, with flexible imaging capability over Europe and Africa
- Excellent low to mid-latitude coverage

EE-11 250 M€ for space segment Ph.B/C/D (excl. launch serv.)

Proposal submission : 15 proposals received	04-Dec-20
Evaluation of Proposals	
Finalisation of Peer-Review reports	Mid April 2021
ACEO recommends	4-6 May 2021
PB-EO – Decision to enter Ph.0 (≤ 4 candidates) + Raise TRL other candidates	Jun-2021

Panels organized :
- 7 RF
- 8 Optical

(2 of them have RF& Optical)

Technology Developments (Missions in PhA + others)
- ~ 33% of the Ph.0/A budgets (≤4 candidates)
- ad-hoc in FutureEO
- TDE 2023-2024 complement

Q2 2022 – Q2 2023
Phase 0
≤ 4 concepts
1.2 M€
x2 consortia

Q4 2023 –Q2 2025
Phase A
≤ 2 concepts
4 M€
x2 consortia
with techno-development (~33@ of budget) in Ph.A

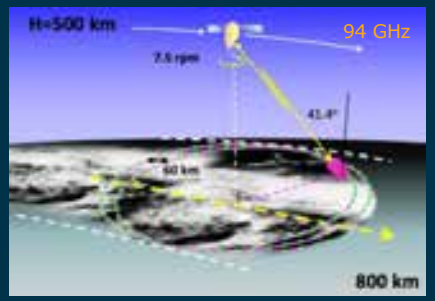
Jul. 2025
UCM/ ACEO Recommendation

Q2. 2025
1 selected EE11 mission
Ph.B1 5 M€
x2 consortia

2031-2032
Launch
Ph.B2/C/D 240 M€
x1 consortium

EE-11 Four concepts led by UK scientist

Wivern
(Univ Reading)

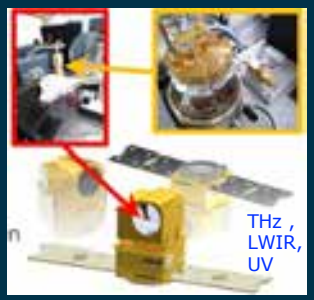


Atmosphere

SEASTAR (Wavemill)
(NOC)

Ocean

KEYSTONE (Locus)
(STFC - RAL)



Atmosphere

N8
(Univ. Exeter)

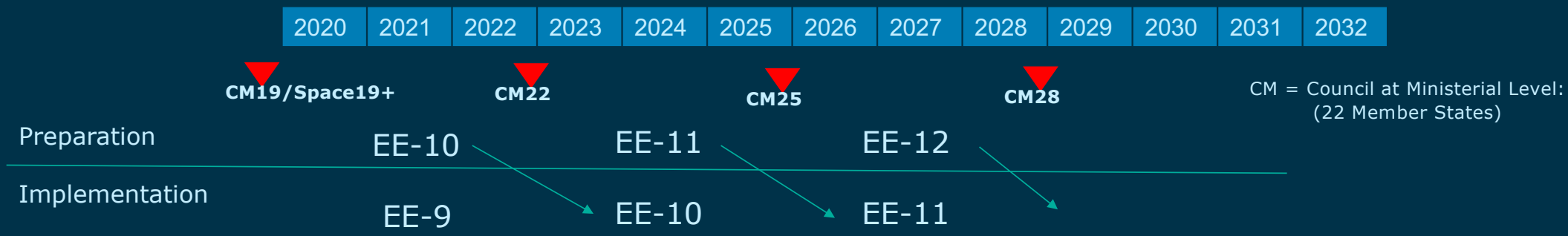
Terrestrial

- Very diverse mission concepts
- One new (not in earlier calls)

Future Earth Explorer Calls

- Flagship EE-Core missions :
  - Science driven vs affordability ? (Lessons Learned from EE-9,-10,-11)
- Can we mature more concepts for future Calls ?

Current model (every CMIN) is under discussion



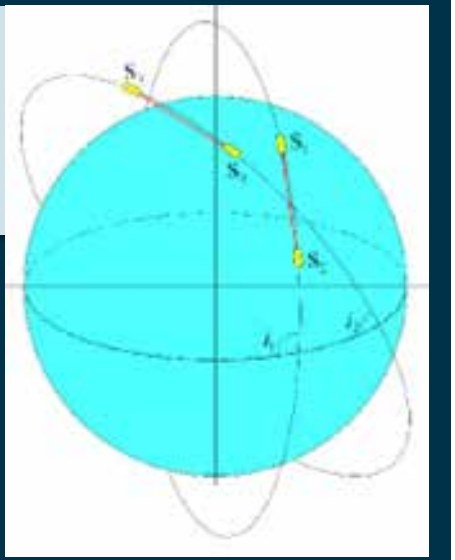
NGGM / MAGIC: Next Gravity – Mission of Opportunity

for ESA-NASA cooperation: Mass Change and Geosciences International Consellation (MAGIC)

Two satellite pairs in '**Bender formation**'

Interesting technologies

- **Laser ranging + accelerometry + POD (GNSS + SLR)**
- **Cold Atom Interferometry** (e.g. long term, but see possible CASPA complement later)



Grouped Procurement to Sept.2020 IPC – now committed or in negotiation

Activity	Tender type	Budget (M€)
Phase A studies (x2 in parallel)	ITT	9 (2 x 4.5)
Four Technology pre-developments	All DN, led by	
• Laser Tracking Instrument	STI (DE)	6.5
• FEEP technology *	FOTEC (AT)	2.5
• Accelerometer	ONERA (FR)	2
• T5 gridded ion engine *	QinetiQ / Mars Space (UK)	2.5

* Electric Propulsion techno also mini-RIT as baseline, developed in past and on-going activities