

Overview of ESA's Earth Observation Technology

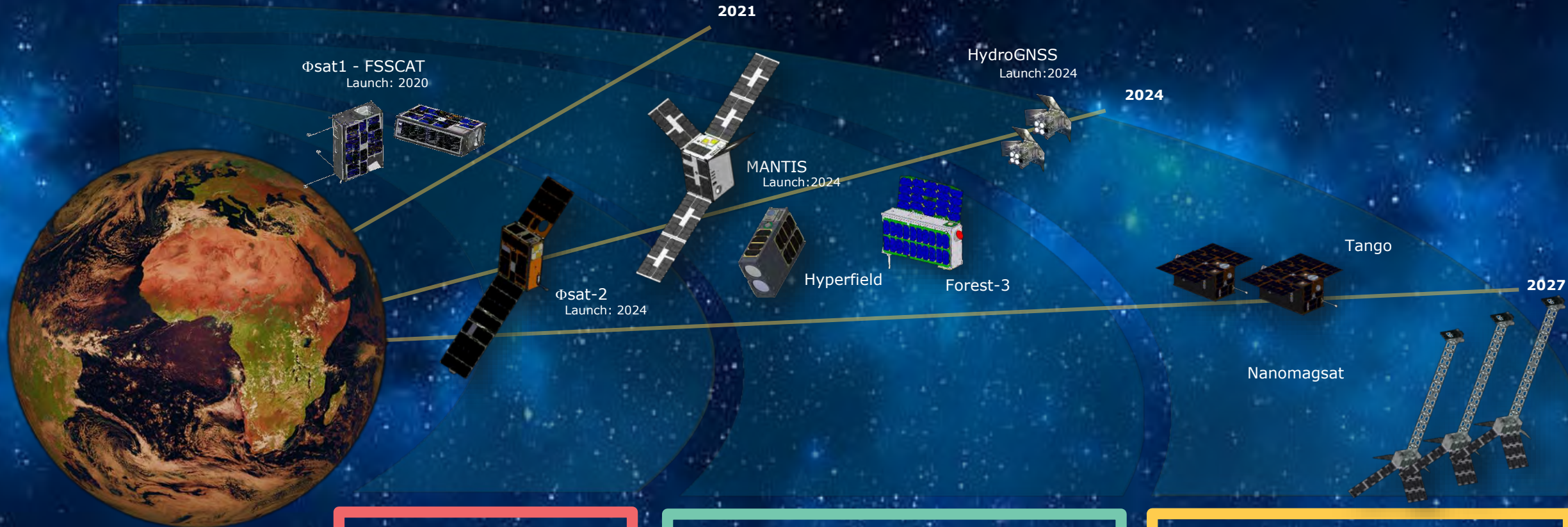
ESA Options outside Earth Explorer

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Technology Coordination & Freq. Mngmt Section
EO Future Missions and Instruments Division
Earth Observation Programme Directorate

ESA Opportunities outside EE



Φsats missions
 to develop missions for fast demonstration of EO new technique and enable capability of innovative / disruptive technologies such as AI.
Φsat-3: not announced yet

InCubed missions
 As part of Earth Watch, to invest in industrial innovation, including the development of end-to-end mission aimed to support and increase the European companies competitiveness;
InCubed: Open call

Scouts missions
 As part of Research missions, to demonstrate novel Earth Observation techniques in Earth science and related noncommercial applications;
Scout-2: Call opens 2024



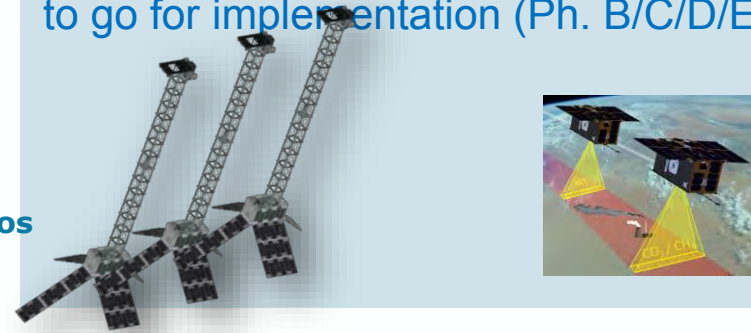
Next SCOUTS (current plan)

Under development for launch end 2024

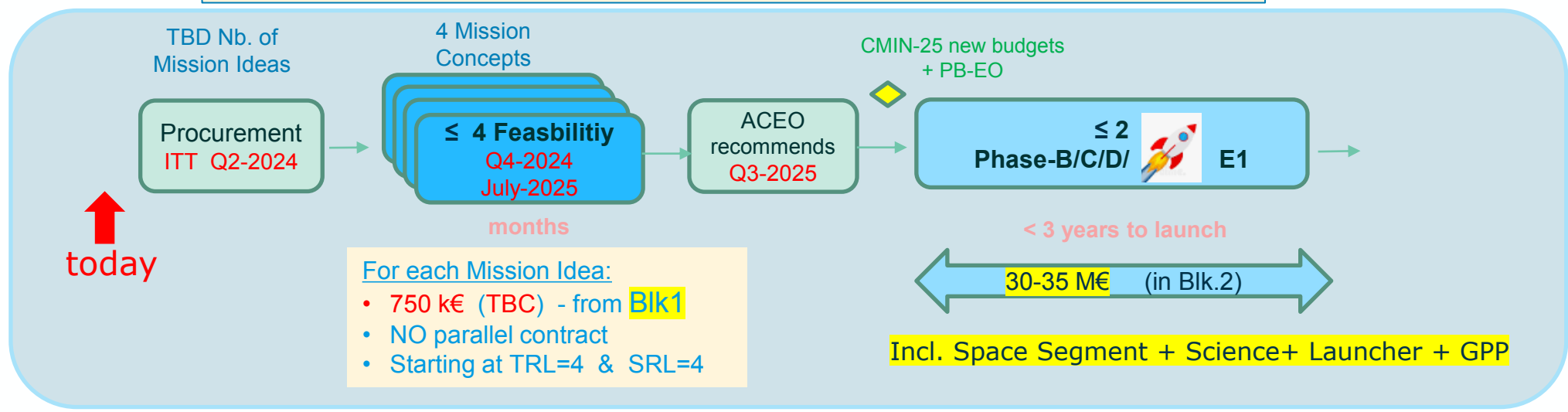


In Feb.2024 PB-EO approved
NanoMagSat & TANGO
to go for implementation (Ph. B/C/D/E1)

OpenCosmos



New Mission Concepts → New Feasibility studies before CM25



Φ-sat-2 Mission

→ **Φ-sat**: (IOD) of technologies. Φ-sat-1 & Φ-sat-2 → demonstration of applications Artificial Intelligence (AI) from space.

- **Space Segment:**
 - **6U Cubesat**, Deployable Sas, AOCS (4RWs on isolation dampers, STR, MEMS Gyro), X-band up to 400 Mbps
 - **Multispectral Camera** (7 bands + 1 Pan), **Lev 1B On-board processor** (band alignment, geolocation), **AI processor**
- CONOPS : **alternate the acquisitions for the various apps throughout the day** (min plat. pointing capability req to provide coverage)

Φ-sat-1 successfully launched in Sep 2020 on FSSCat and validated automatic on-board cloud detection with AI.

Φ-sat-2 on going developments



Mission Prime contractor



Payload Providers



AI Application Providers



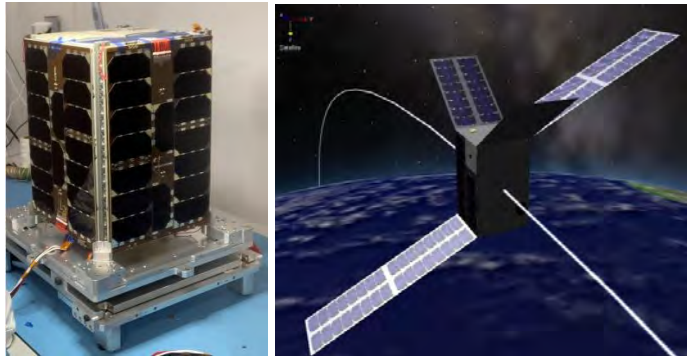
InCubed missions → ESA Earth Watch program : industrial innovation, incl. E2E mission development & support

Launched on 11-Nov-2023

MANTIS

(Open Cosmos – Satlantis – Terrabotics)

MANTIS : IoD 12U cubesat → compact binocular optical system
GSD @ 500km: 2.5m; 4 bands (RGB + NIR); 12km Swath
High perform. & reconfigurable on-board processing & super res



Hyperfield

(Kuva Space – VTT)

Hyperfield : 6U Hyperspectral cubesat → 10 sat constellation
Tuneable high-resolution imager VIS – NIR (SWIR next gen.)
AI/ML-based analytics → actionable data



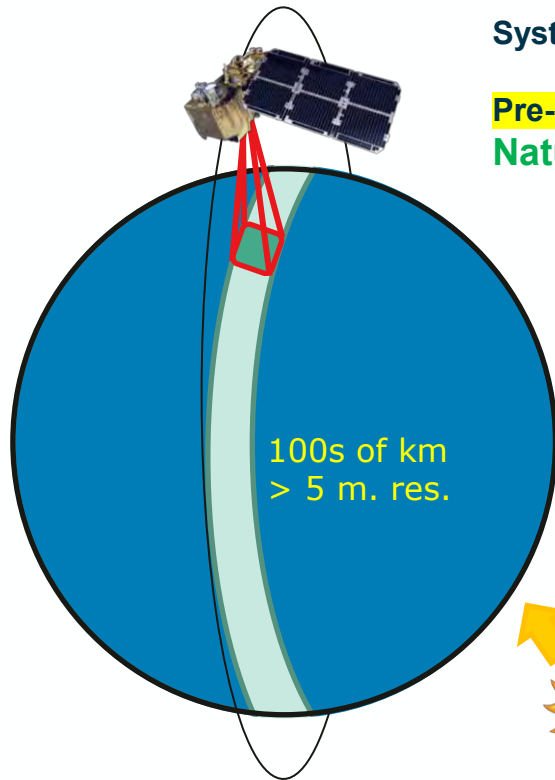
SAT4EO-CE

(DEIMOS – SSTL – Teledyne)

SAT4EOCE : VHR Observations → AOCs COTS subsystem product
GSD ~0.5m; VHR VNIR Channels; AOCs enabled
AOCs COTS → HW/SW Solution & performance for GSD ~0.5m



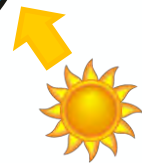
Systematic / Carpet mapping



Systematic coverage – mid-resolution

Pre-determined acquisitions (1x /day)
Natural phenomena

100s of km
> 5 m. res.

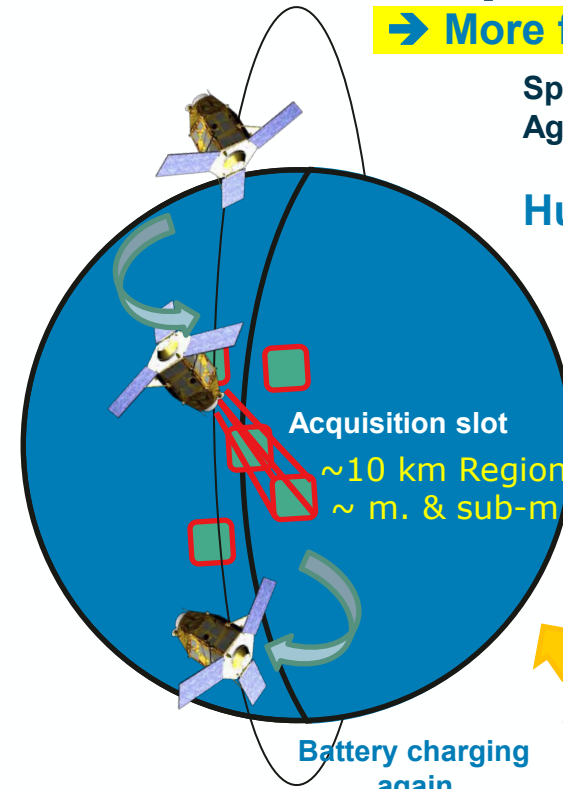


On-demand acquisition with SmallSat

→ **More frequent tasking – High Resolution**

Spotlight / focused acquisition
Agility → **Quick re-planning**

Human Activity (near real-time)



Acquisition slot
~10 km Region Interest
~ m. & sub-m resolution.



Battery charging again

Many New applications combining Traditional & SmallSats

- Agriculture: VHR complement to Sent.2
- GHG (CO₂,CH₄,NO₂): specific plant perpetrator ?
- Event: fire, ships, gas leaks, ...
- Others (e.g. security)



New technology needs (timeliness)

- On-Board processing, incl. AI
- Connectivity more frequent

→ Φsat missions

- Fast In-Orbit Demonstration of new EO techniques
- to showcase innovative/disruptive technologies such as on-board AI
- Mission selection through Calls or competitive ITT (consolidation + implementation phases)
- Open Data policy
- Budget: 3-5 Meuro
- https://www.esa.int/Applications/Observing_the_Earth/Phsat-2/Introducing_Phsat-2

→ Scout missions

- Research missions
- demonstrate novel EO techniques in Earth science and related non-commercial applications
- Mission selection through competitive ITT – then consolidation + implementation phases
- Open Data policy
- Budget: 30-35 Meuro
- https://www.esa.int/Applications/Observing_the_Earth/FutureEO/Scouts_ESA_s_agile_research_missions

→ InCubed (Investing in Industrial Innovation) Programme & missions

- Part of Earth Watch (National support required)
- To invest in European industrial competitiveness, commercially driven → Product Development
- Initial application through OSIP (pitch, proposal and final selection)
- Wide scope (up to E2E missions)
- Budget: any (up to 80% co funding for SME, up to 50% with non-SME)
- <https://incubed.esa.int/>

LOW MATURITY (led by D/TEC, sometimes with EO content)

ESA EOP Programmes typically require TRL 4+ onwards.

For lower maturity ideas: other ESA programmes can be envisaged:

→ **Discovery** as part of **D**P_{TD} Programme

Under **Open Space Innovation Platform (OSIP)** see <http://ideas.esa.int>, with 3 possible schemes, with unsolicited ideas or as part of Calls/Campaigns

- **co-sponsored research** (e.g. at PhD or advanced research (e.g. post-doc level), funding max. 50% and up to 90k€ from ESA)
- small **system study** (max 100k€)
- **early technology development** activity (max 175k€ from ESA)

→ **Technology Development** as part of DP_{TD} Programme

For Technology up to TRL=4.

also led by D/TEC, sometimes with EO content

→ **GSTP (General Support Technology Programme)**

GSTP performs its activities under 3 distinct elements:

- GTSP Develop (>TRL2)
- GSTP Make (>TRL3) - typically with co-funding by company
- GSTP Fly (TRL=9) IoD/IoV



Q & A

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