



NanoMagSat, a constellation to monitor the Earth magnetic field and ionospheric environment – A status update

UK EO Week/CEOI – Future ESA Missions with a UK interest

06/09/2021

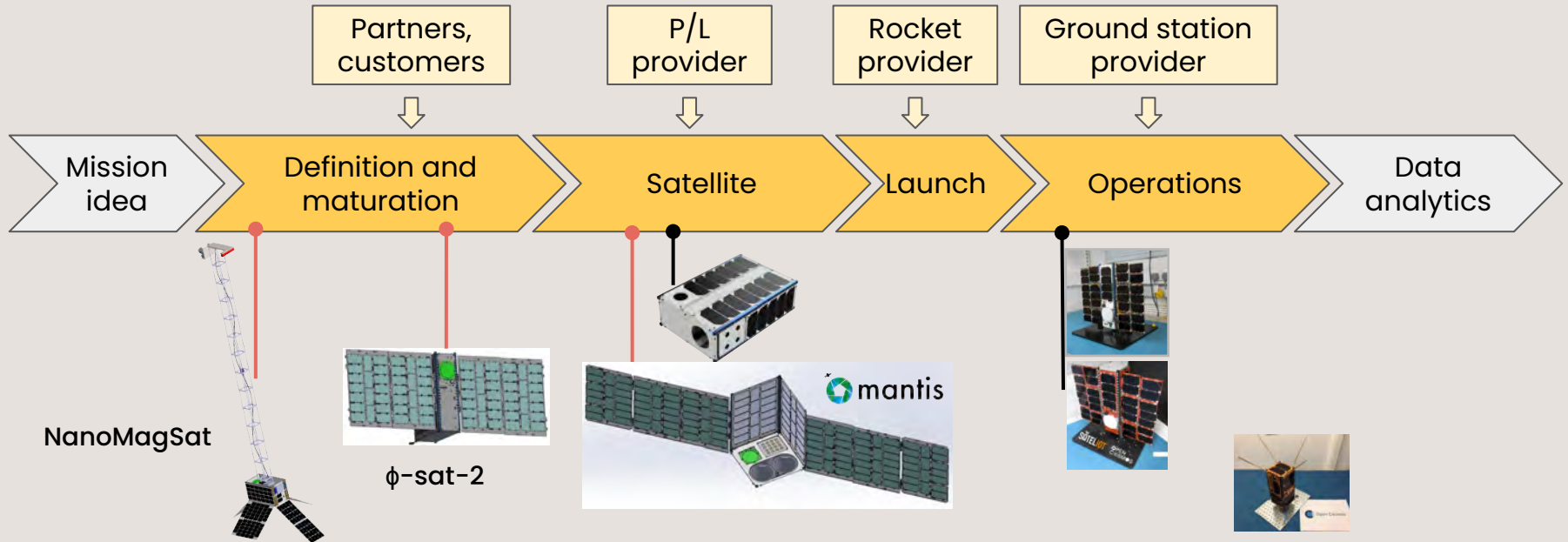
Presented by:

Florian Deconinck
VP, Institutional Partnerships & Future Missions

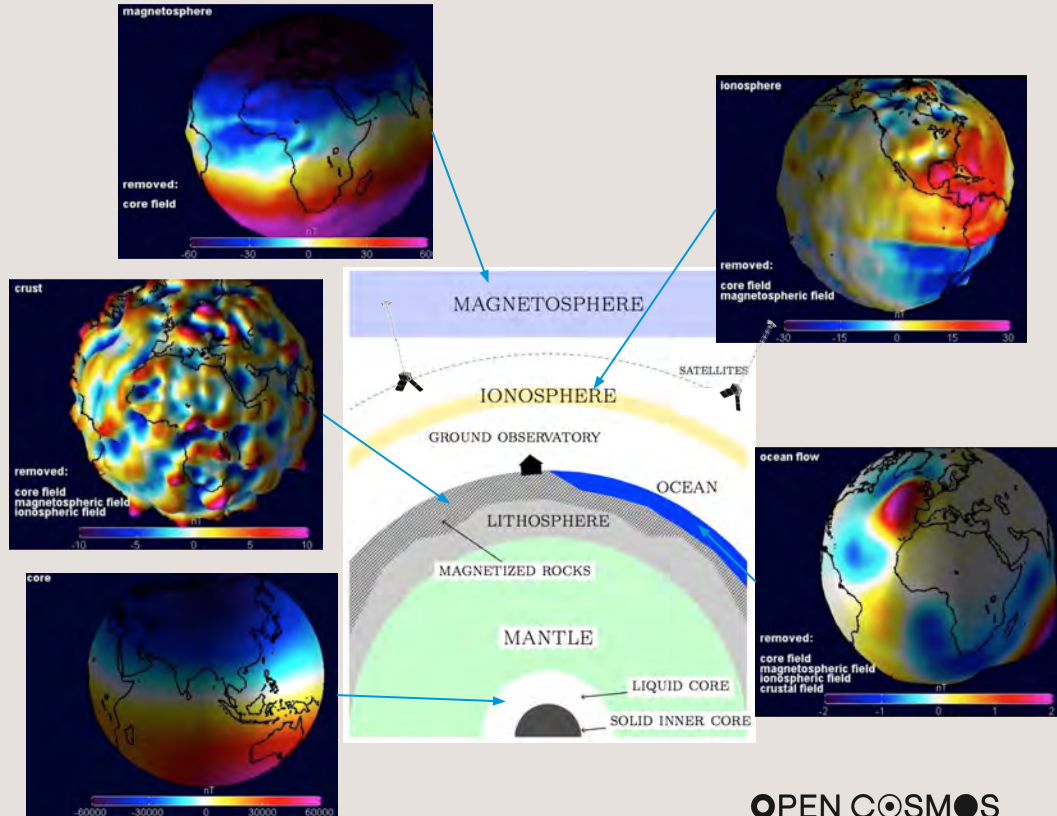
The view expressed herein can in no way be taken to reflect the official opinion of the European Space Agency

Open Cosmos, a space mission provider

- A one-stop-shop for entities to exploit satellites
- Simpler, cheaper, faster, at scale

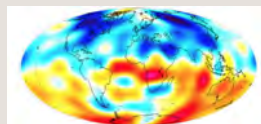
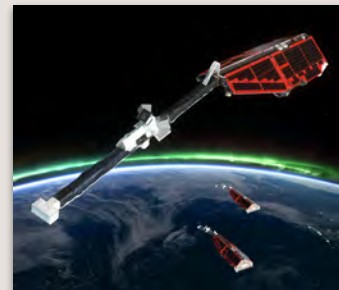
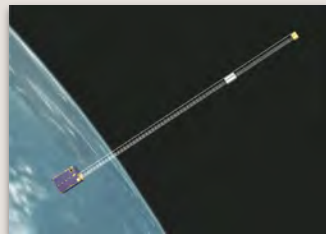


Scientific need: Earth's magnetic field and ionospheric environment

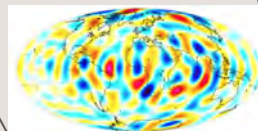


- Targeting **recovery of fast planetary changes in core, ionospheric and magnetospheric fields**, also improving **recovery of crustal and oceanic signals**
- To investigate **fast core dynamics, solar-terrestrial interactions, crust and deep Earth properties** and possible signatures of climate change

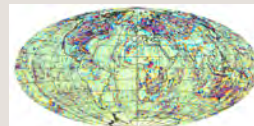
Brief history of magnetic missions



MagSat



CHAMP



Ørsted

Swarm-A
Swarm-B
Swarm-C

NanoMagSat
NanoMagSat
NanoMagSat

1980

1990

2000

2010

2020

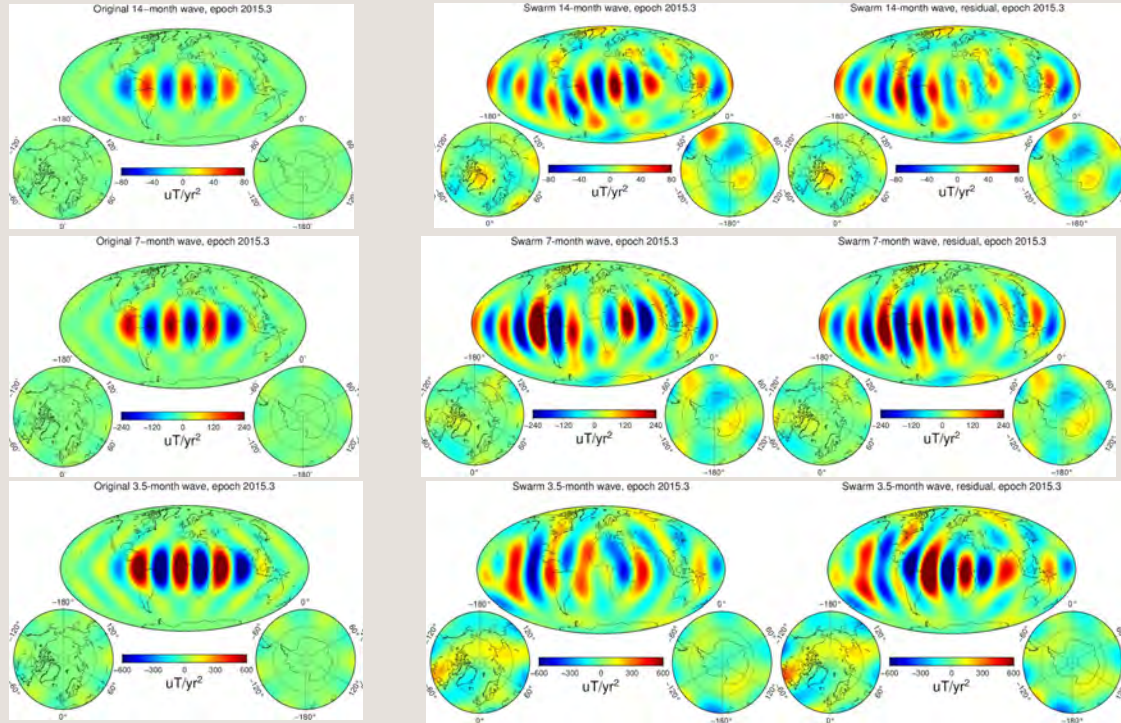
2030

Goal is a fast revisit of location at different local times

Synthetic wave

Swarm recovered

Swarm residuals



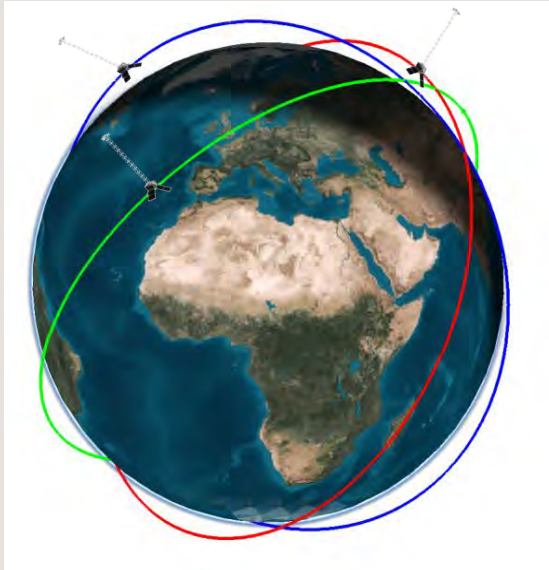
DTU Technical University of Denmark



Core waves with 14 (top), 7 (middle) and 3.5 (bottom) months periods cannot be received with Swarm data

NanoMagSat

Monitoring the Earth's magnetic field and ionospheric environment



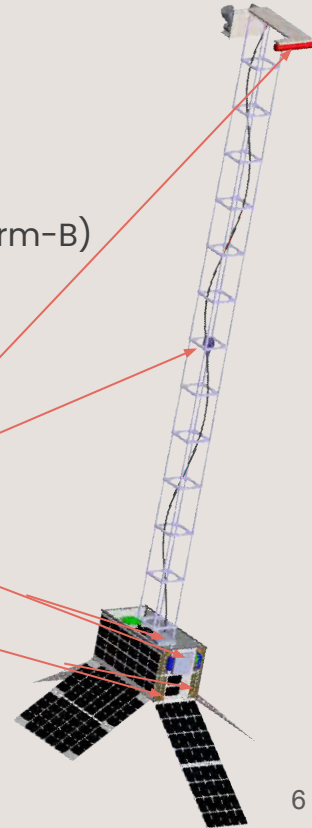
A 3x16U Cubesat constellation at 575 km initial altitude

- **1 satellite at 60° inclination**
- **1 satellite at 60° inclination offset by 90°-RAAN**
- **1 satellite in near-polar orbit** (optimised with Swarm-B)

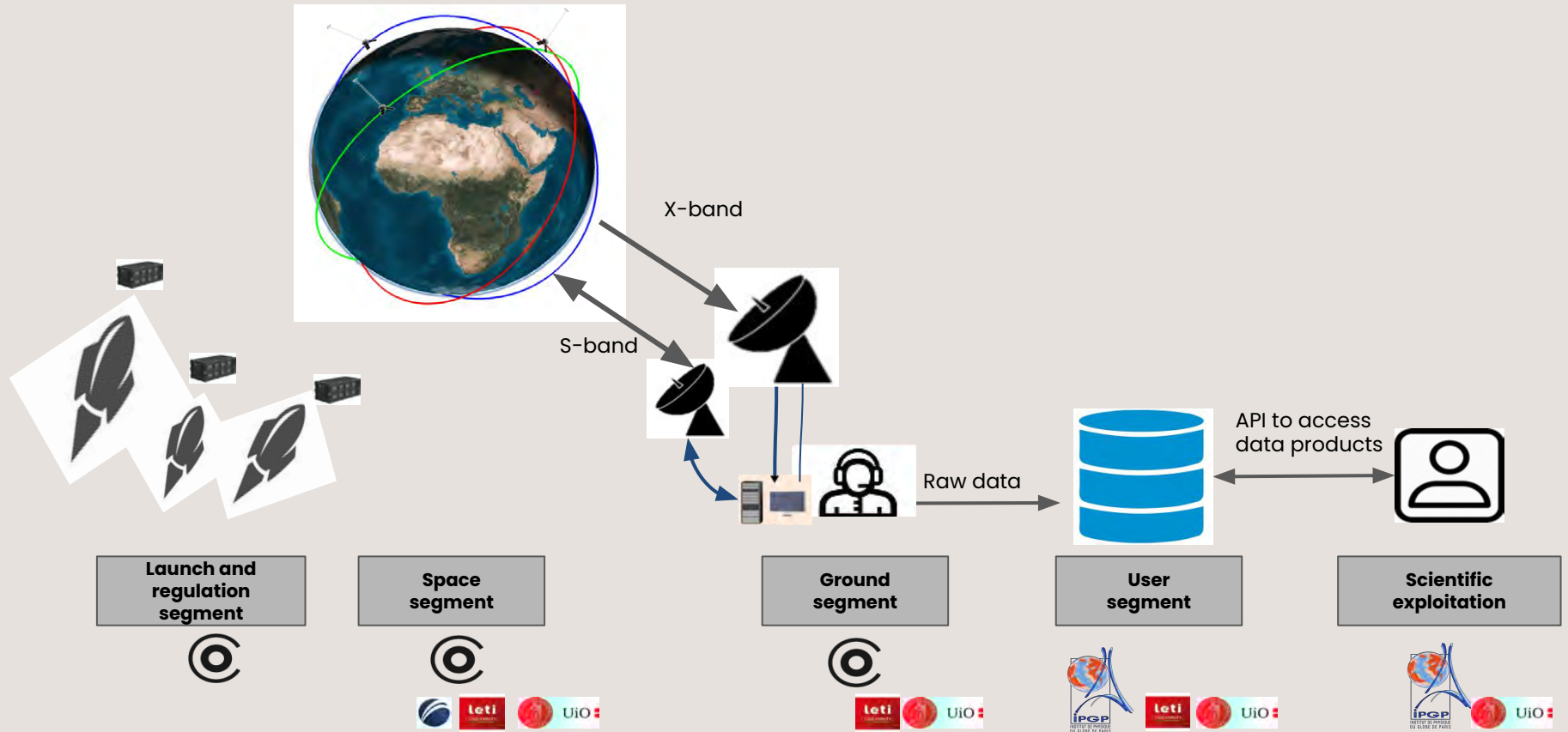
State of the art compact payloads

- A **Miniaturised Absolute Magnetometer (MAM)** with a set of **two Star Cameras (STR)**
- A **High Frequency Magnetometer (HFM)**
- 2 **dual-frequency GNSS**
- A **multi-Needle Langmuir Probe (m-NLP)**

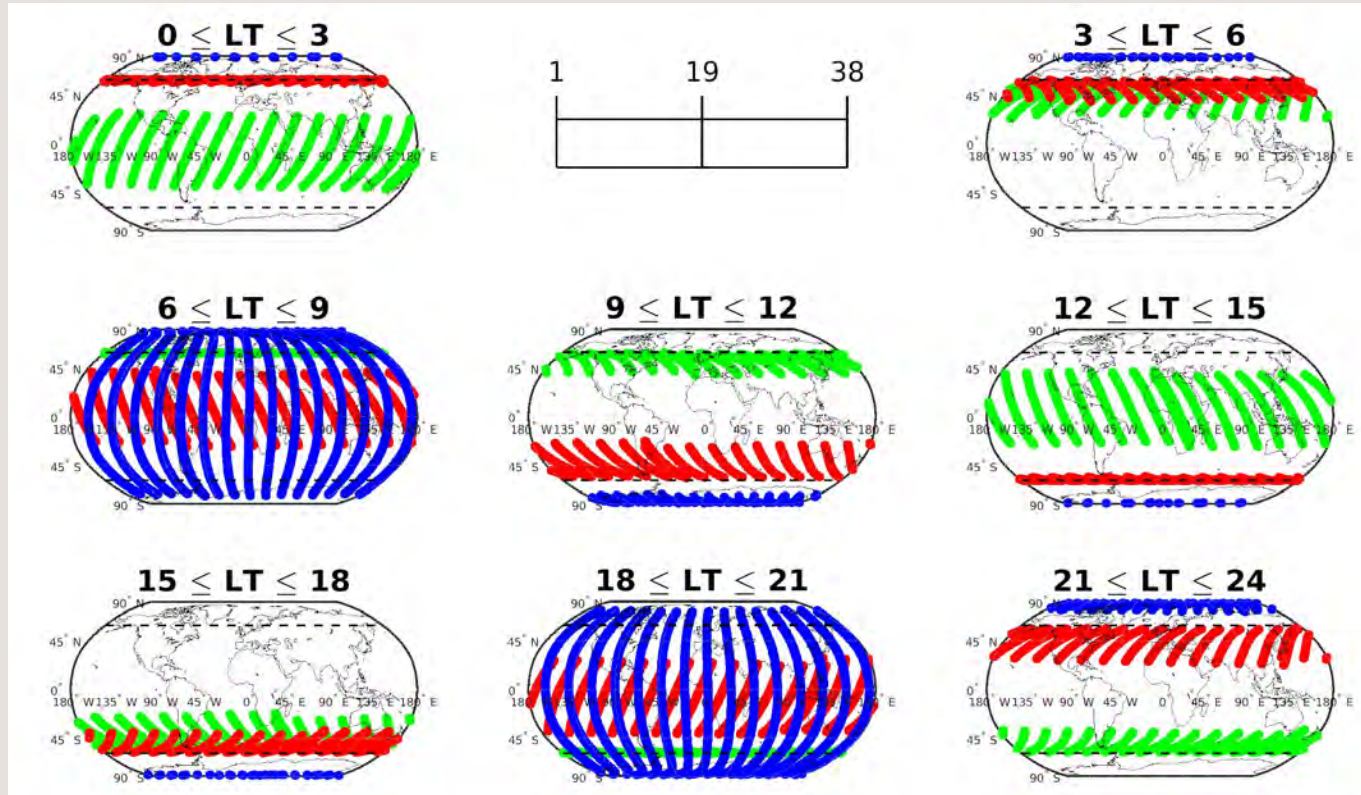
Initiating a **low-cost scalable collaborative constellation solution for very long-term observations** (extending to space the Intermagnet network of magnetic observatories)



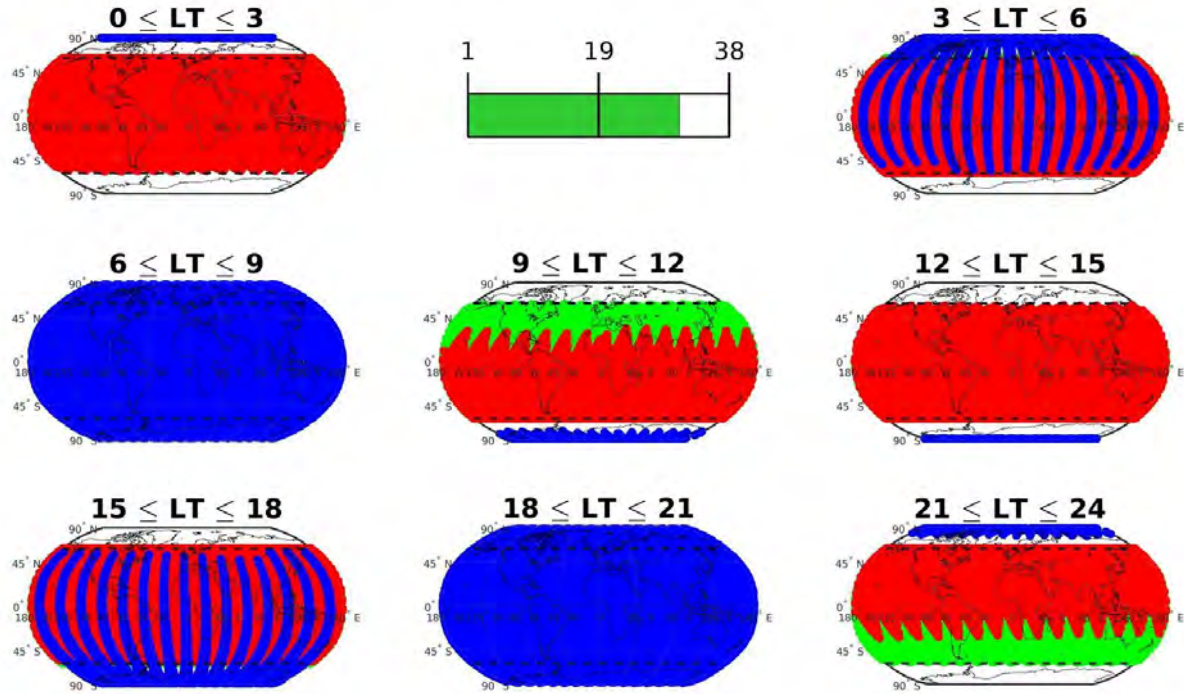
Mission concept, architecture and consortium



A tailored orbital configuration



A tailored orbital configuration



Goal is a fast revisit of location at different local times

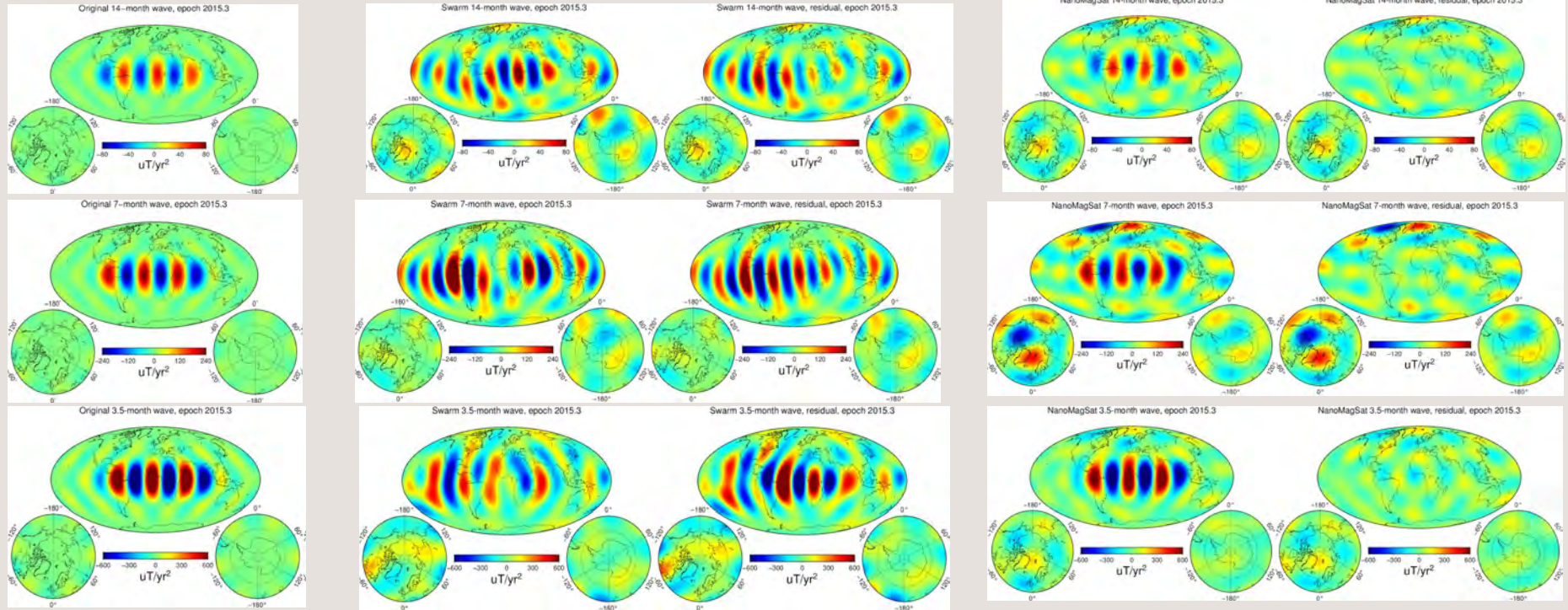
Synthetic wave

Swarm recovered

Swarm residuals

NanoMagSat recovered

NanoMagSat residuals

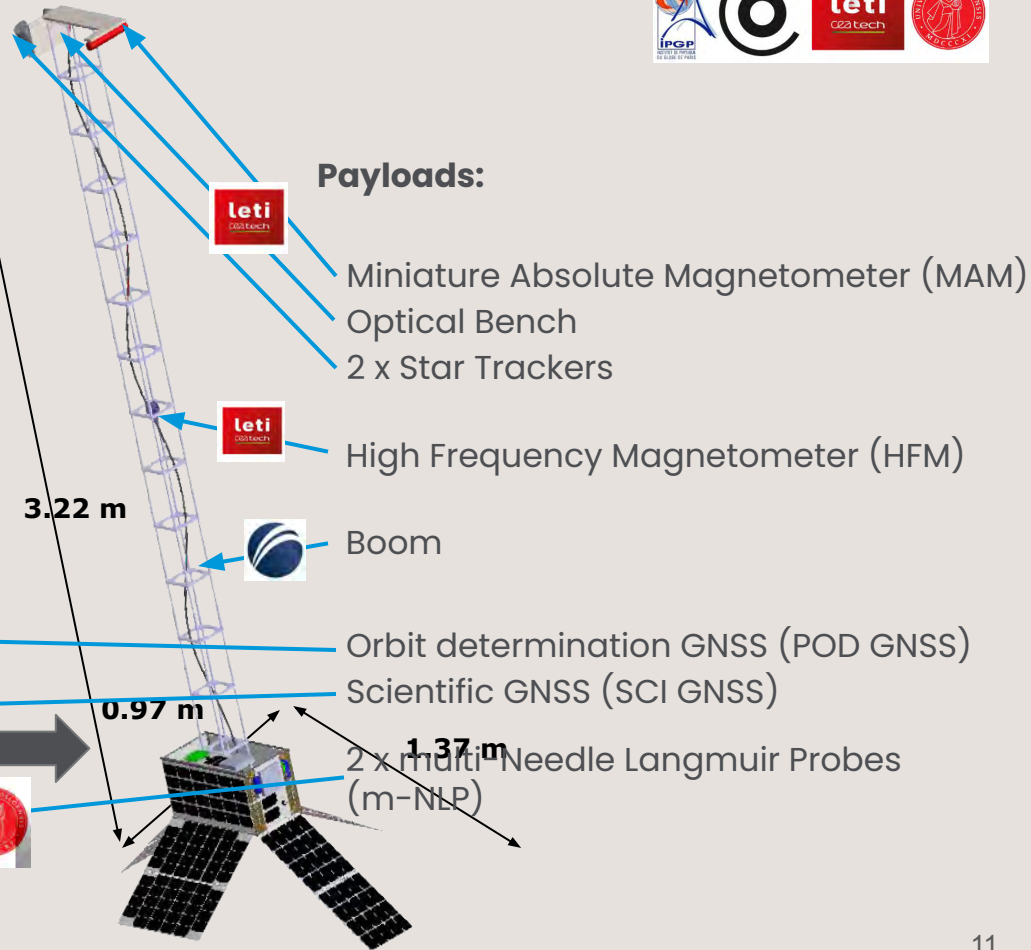
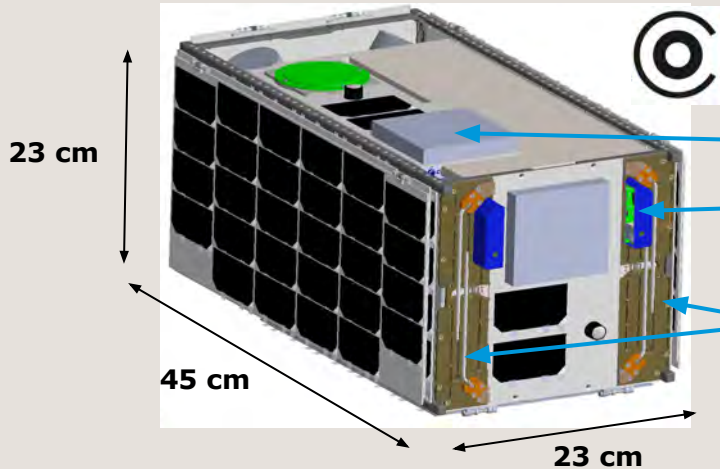


Core waves with 14 (top), 7 (middle) and 3.5 (bottom) months periods can be recovered



Satellite configuration

- 3 **identical** 16U Cubesats, **suitable for all orbits**
- AOCS with **magnetorquers**, **sun sensors**, **magnetometers** and **GNSS POD**
- **Minimal vibration and EMI environment**

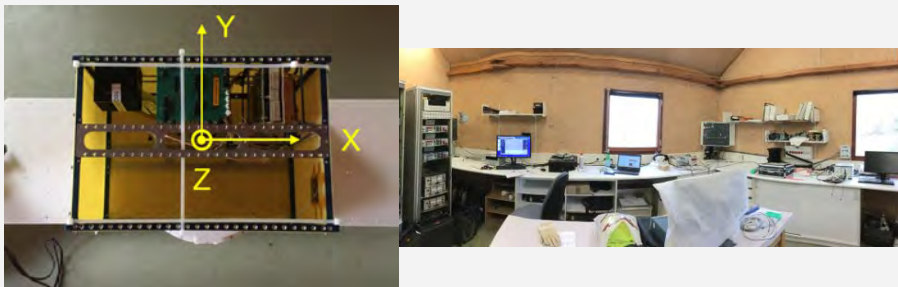


A satellite optimised for low EMI environment

Satellite Electromagnetic Interference

EMI < 1nT after level 2 corrections

- EMI Testing of platform and payload systems



- Characterise and measure critical current loops, correct for them post-processing
- Avoid soft magnetic materials
- Aircoils-only, gravity gradient stabilised ADCS
 - no EMI from reaction wheels
 - minimise micro-vibrations
- Boom to separate sensors from platform

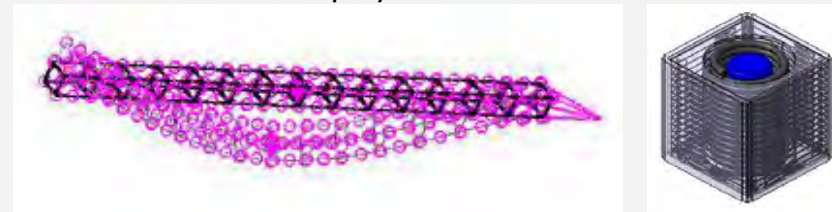
Boom development

Key technology requiring bespoke design

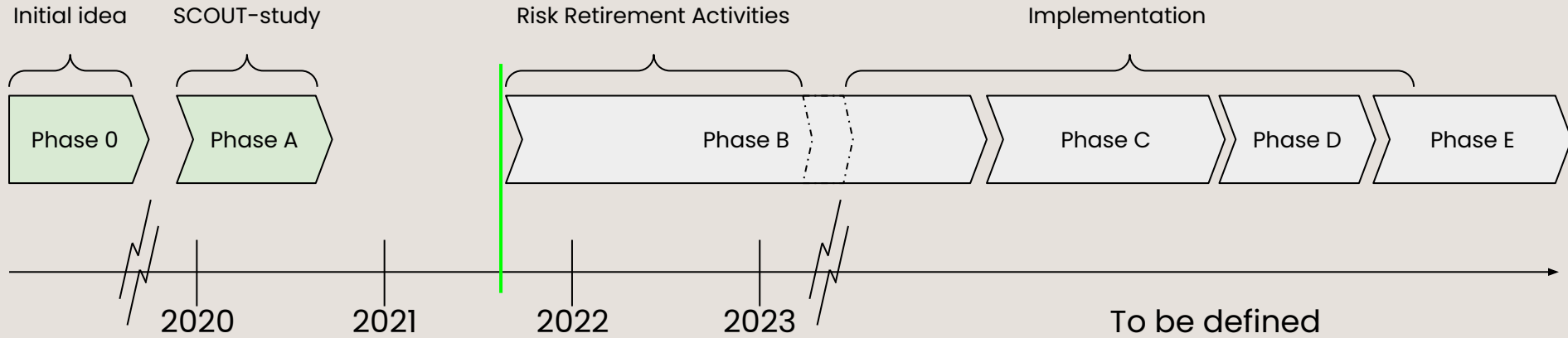
- TRL 4 reached with demonstrators



- Spring activated
- EMI compliant
- Modal frequencies tuned to minimise disturbance of payload sensors



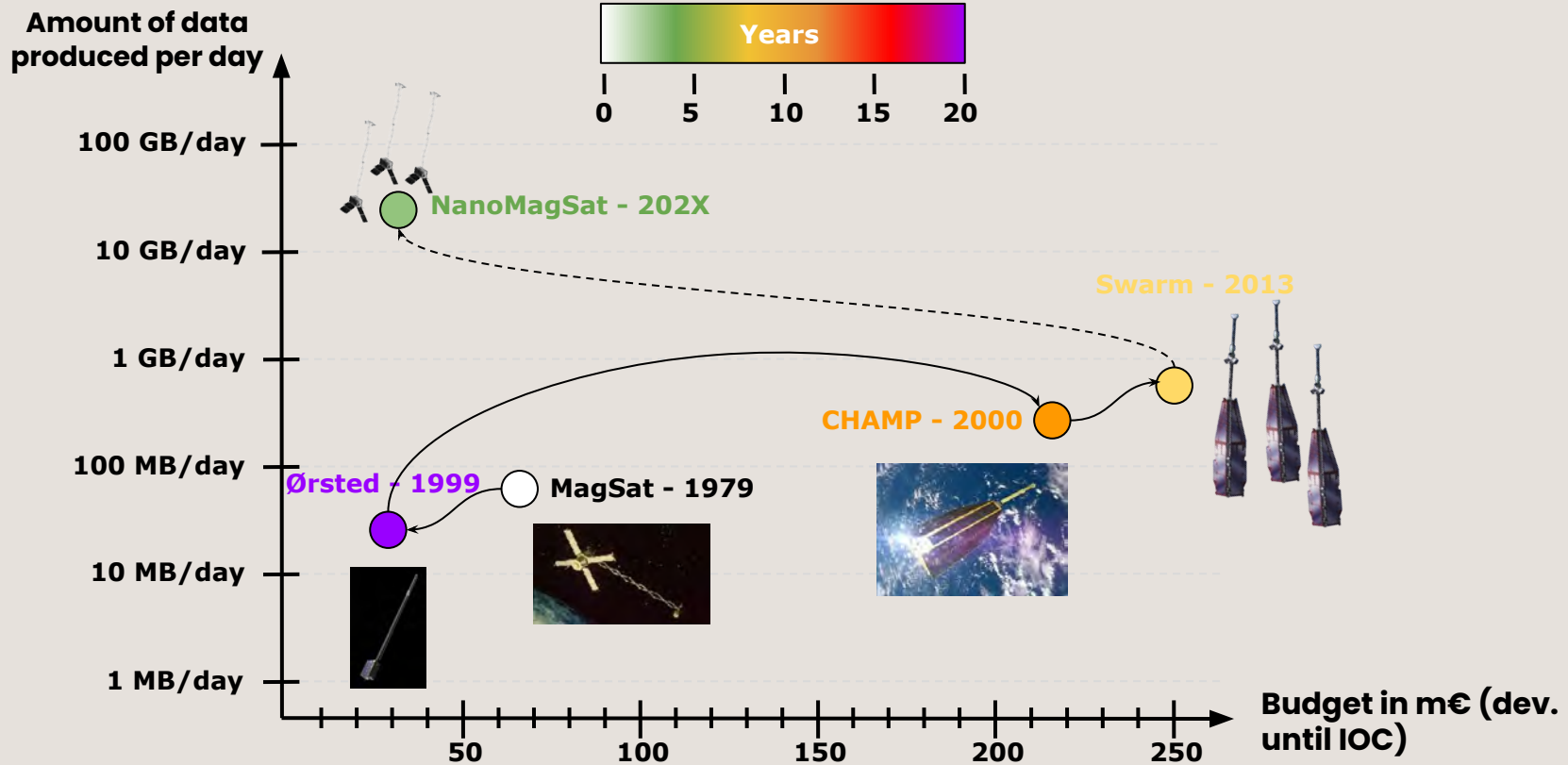
Status



Scope of Risk Retirement activities:

- Structural model of the deployable boom
- Development of the magnetometers electronics
- EMC characterisation of the satellite

A complementary solution for scientific missions



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Thank you

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