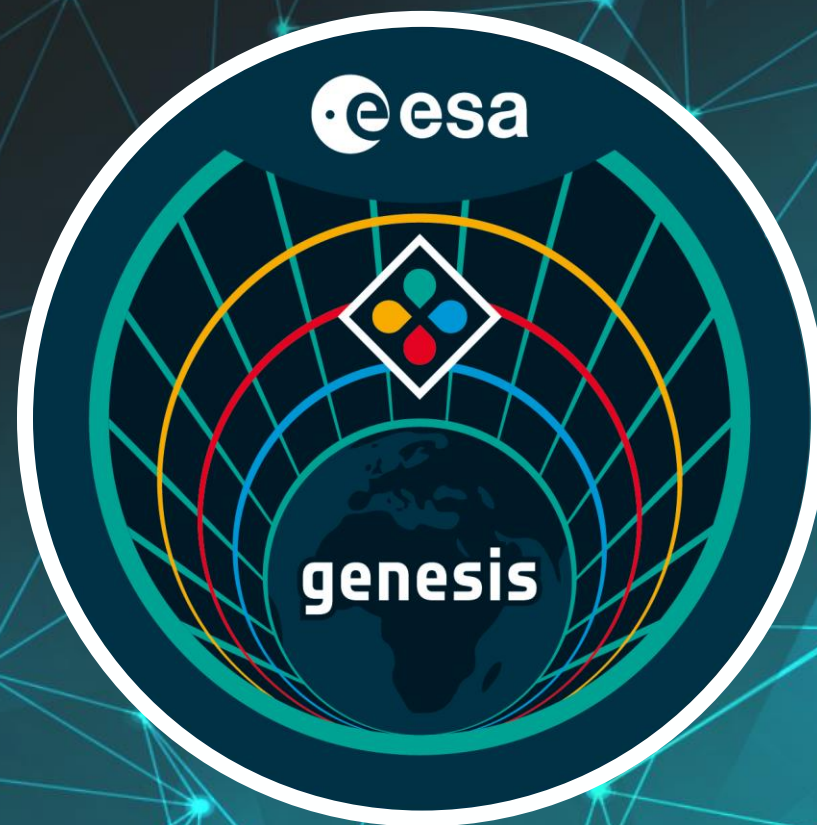


Genesis Mission Overview

Francesco Gini

Navigation Support Office at ESA / ESOC

Space Meetings Veneto, 20-22 May 2025 Venice

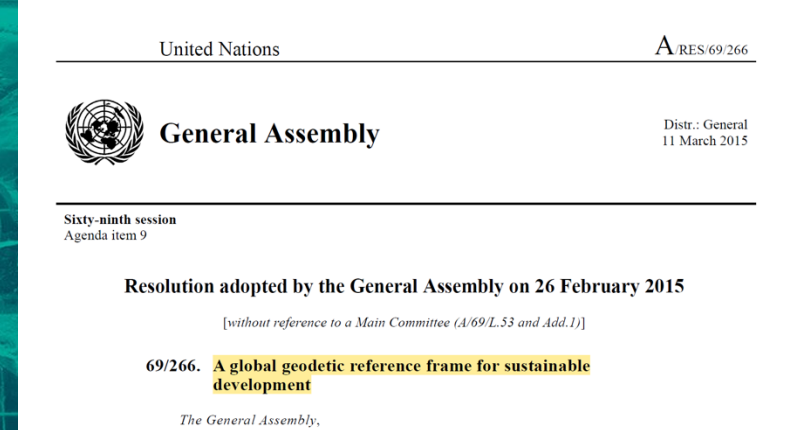


Genesis Primary Objectives



Contribute to improve ITRF accuracy and stability by providing in-orbit colocation and necessary combined processing for the four space-based geodetic techniques that contribute to its realization. The goal is to contribute to the achievement of the Geodetic Global Observing System (GGOS) objectives for the ITRF realisation, aiming for a parameter **accuracy of 1 mm and a stability of 0.1 mm/year**, in order to provide significant scientific benefits in Earth modelling, and to support a wide range of societal applications (as endorsed by the United Nation resolution A/RES/69/266).

Contribute to improve the link between the ITRF and the ICRF, thanks to the increased consistency of the Earth Orientation Parameters (EOP). In particular, this mission shall allow for the first time a link between the orbit reference frame, ITRF and ICRF.



Targets:
Accuracy: 1 mm
Stability: 0.1 mm per year

Overview of the Genesis Mission

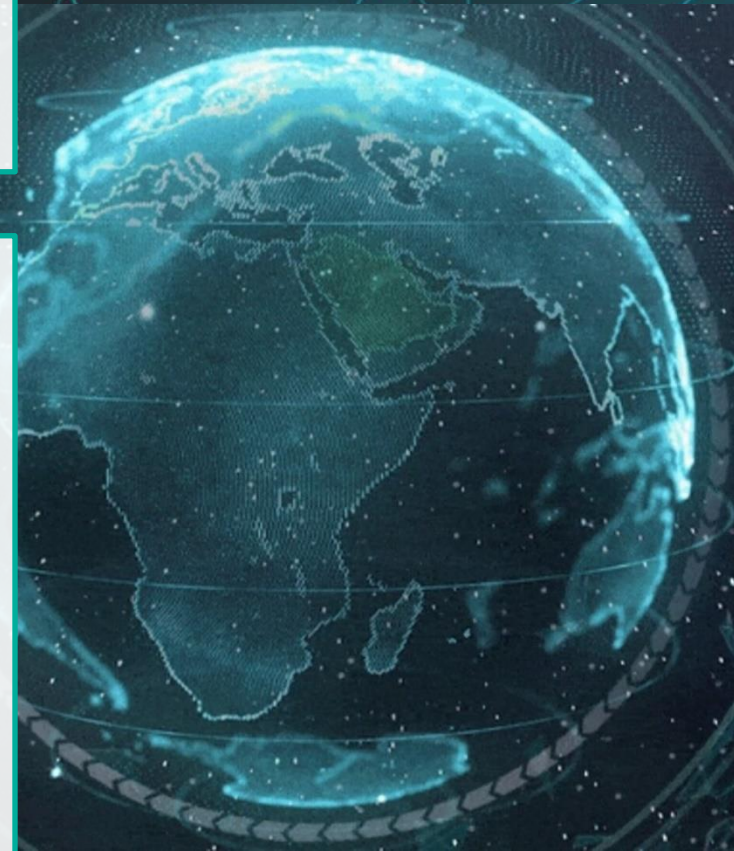


Overview

- Genesis is managed by the ESA Navigation Directorate and part of its **FutureNAV Programme**

Mission scope

- Design, development, qualification and calibration of the **satellite (incl. payloads) and ground segment**
- **Launch and early operations** including commissioning and calibration
- **Operations** (2 years, option for extension)
- **Data exploitation** (Including processing, archiving and data distribution from ESA facilities)
- Strong involvement of the **Scientific Community** and **International Geodetic Services**

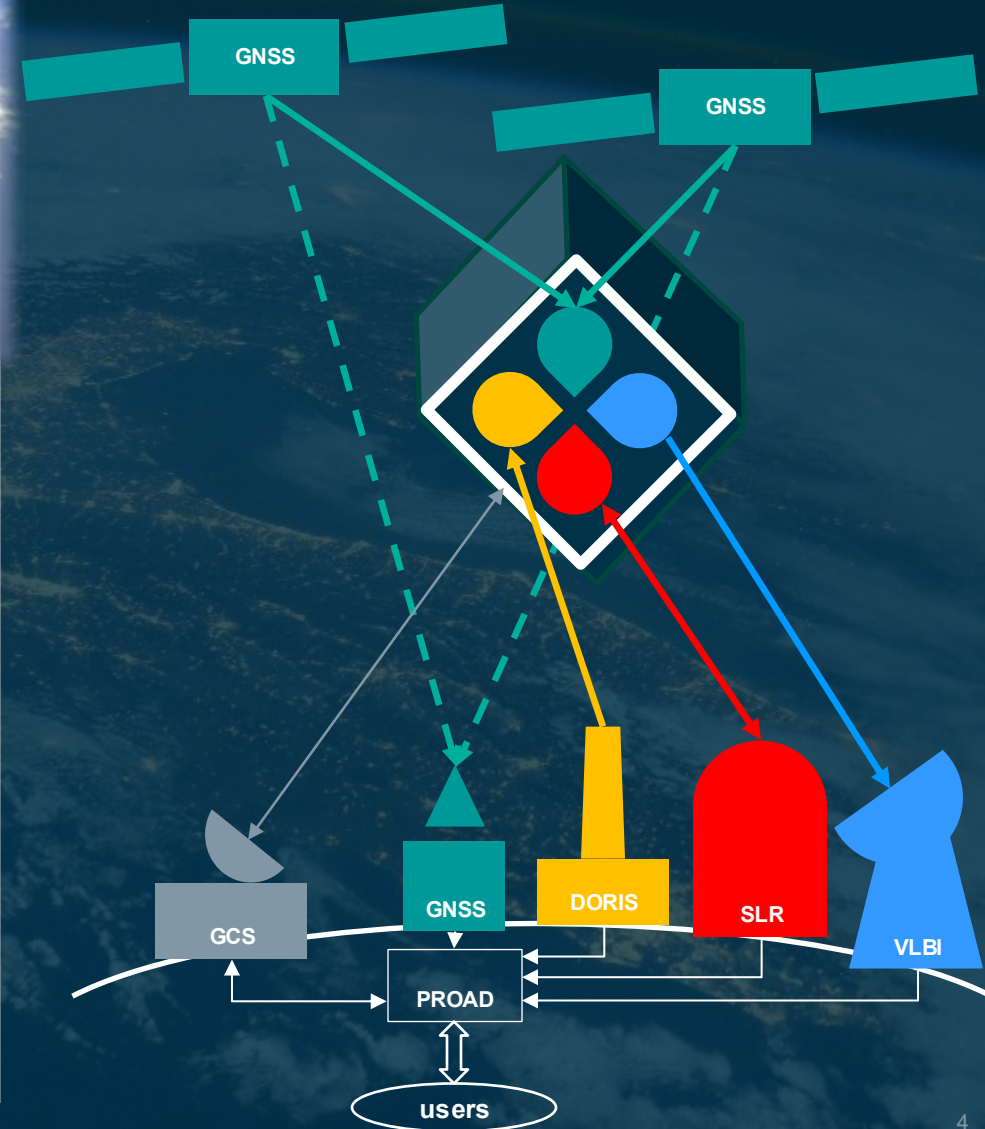
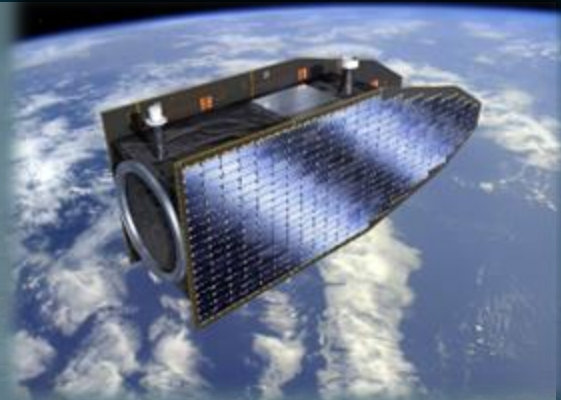


Genesis System Overview



Description

- **Satellite**
 - Mass: ~400 kg
 - Power: ~275 W (nominal)
 - Envelope: 1.7m X 0.7m X 2.6m
- **Orbit:**
 - ~6000km altitude (low MEO)
 - ~95.5° inclination
- **Platform:**
 - maximum reuse of qualified equipment
- **Payload:**
 - 4 co-located geodetic instruments
 - GNSS, DORIS, SLR, VLBI
 - ultra-stable oscillator for synchronisation



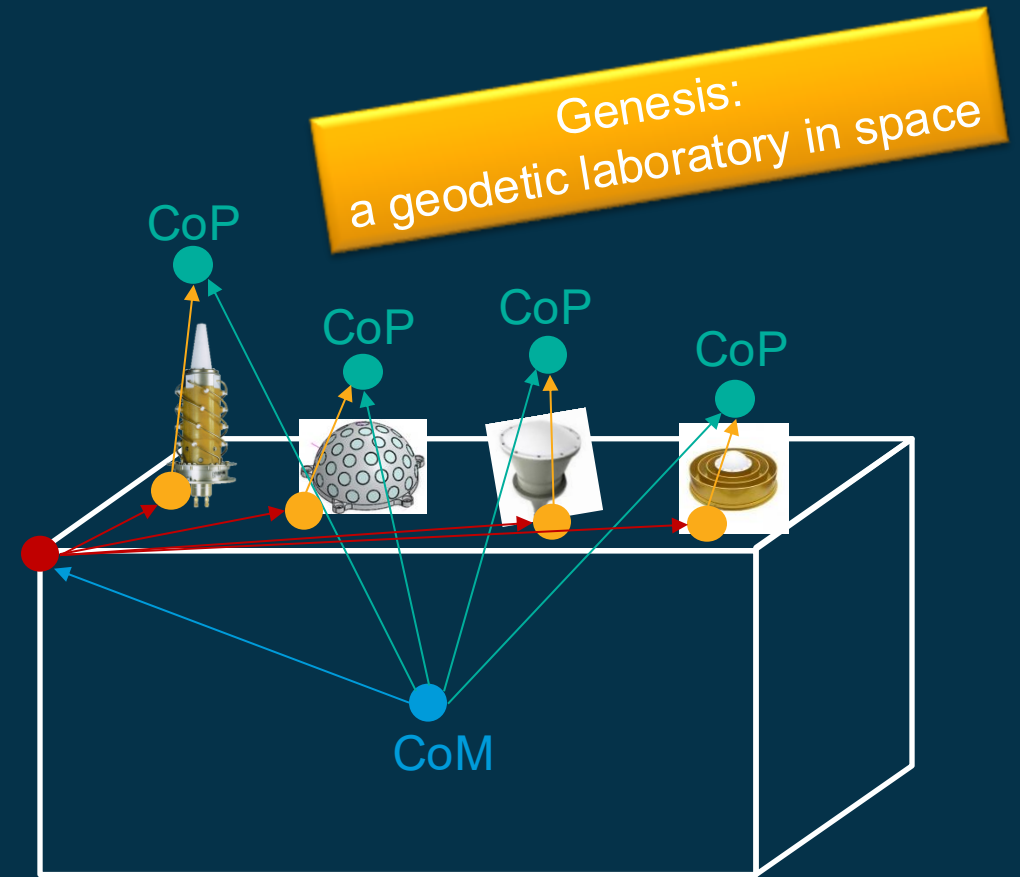
Calibration = characterization of the biases and their variations, within a given uncertainty, between:

- the **satellite Centre of Mass**
- the **instruments Centre of Phase**

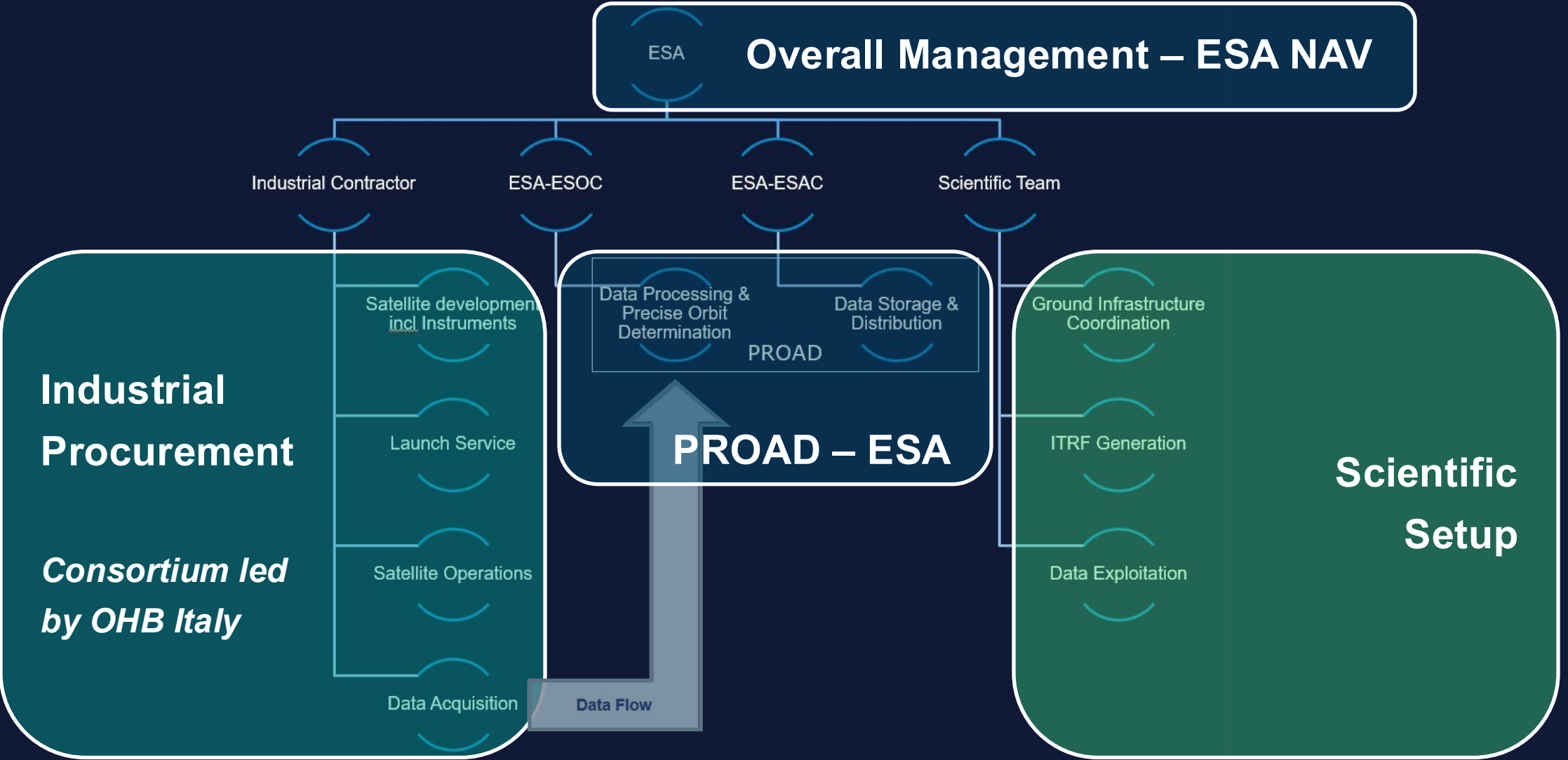
Uncertainty ~1mm is challenging!

In practice, biases are broken down to refer to physically measurable points:

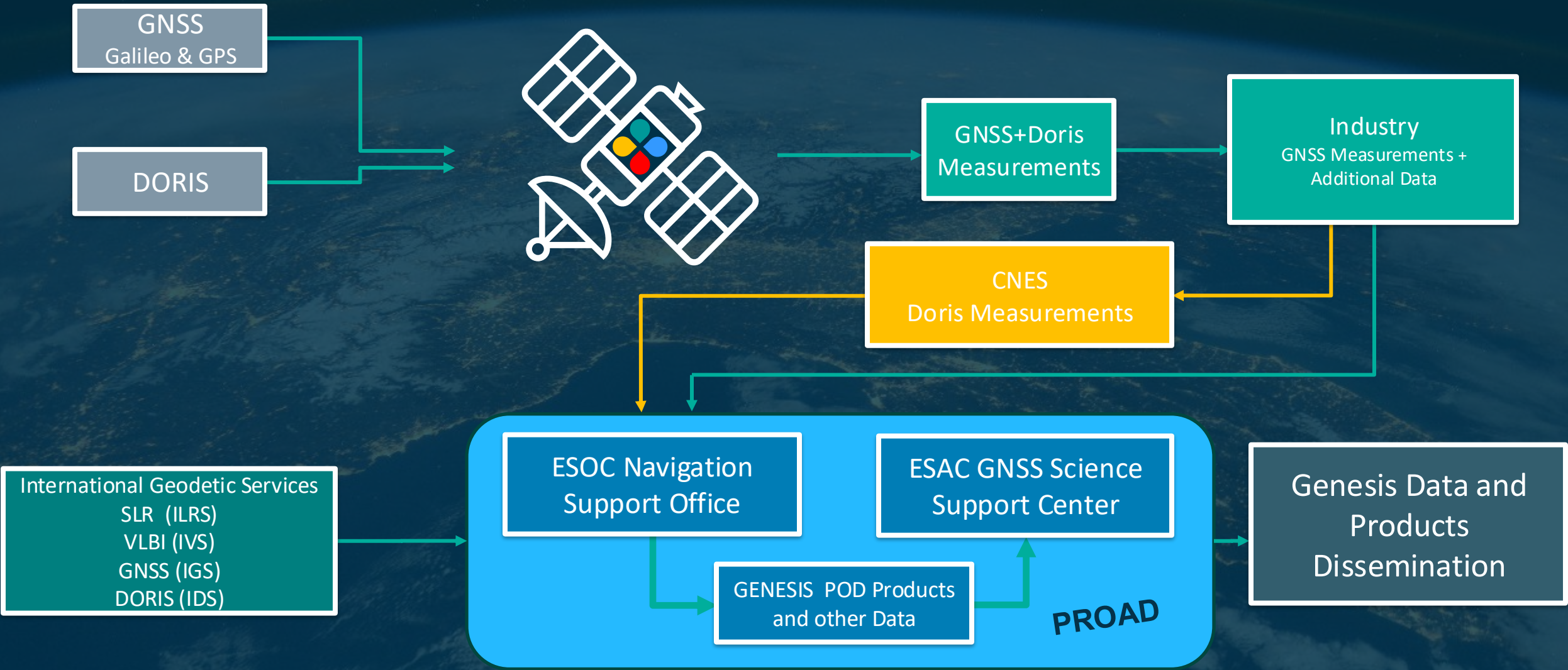
- **Satellite Mechanical Reference Point**
- **Instruments/Antenna Reference Point**



Overview of the Genesis Mission



Genesis – PROAD Data Flow



Genesis Mission Status



LAUNCH 2028
2 years of
Operations with
option for extension

Scientific
exploitation



Contract
Signature and
Kick Off of
activities
March-April 2024



System
Requirements
Review (SRR)
Q4 2024



Preliminary
Design Review
(PDR)
2025



Critical Design
Review (CDR)
2026



Qualification
and
Acceptance
Review (QAR)
2028



Genesis-enabled Science and Applications



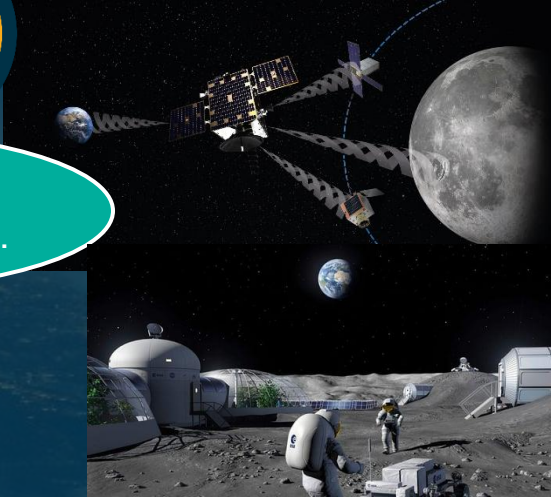
Geodesy, Reference Frames

Improved ITRF, EOPs,
Unified Reference
Frames

GNSS, Navigation

Improved GNSS POD
(LEO, MEO, GEO),
calibrations...

Navigation to the
Moon, and beyond...



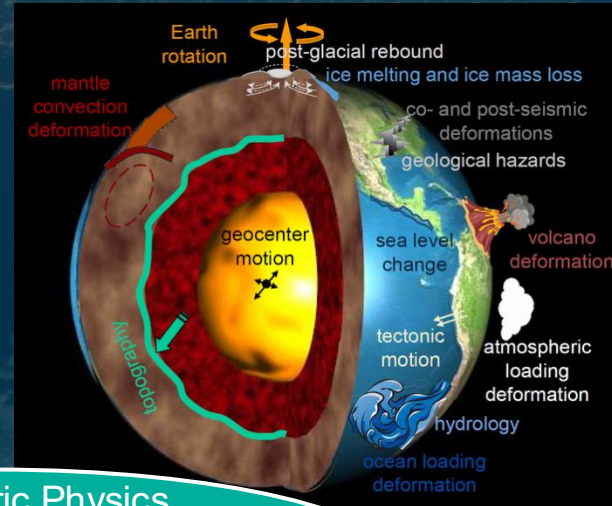
Earth Sciences

Geophysics: Deep Interior
- Geo-centre motion
- Core flows
- Magnetic field...

Geophysics: Mantle, Oceans
- Tectonic motions
- Post-glacial rebound
- Ice melting, Ice mass loss
- Sea level change...

Atmospheric Physics

- Iono, Plasmaspheric density
- Radiation budgets, Earth
Energy imbalance...



ENABLED SCIENTIFIC APPLICATIONS	
- Sea-level change - Water cycle - Geological hazards	- Weather/climate - Ecosystems - Geodynamics
GEOPHYSICAL OBSERVABLES	
- Land and ice deformation and change - Sea-surface height - Atmospheric parameters - Land and vegetation topography	- Mass change - Surface and ground water and soil moisture
EARTH ORBITING MISSIONS	
- Time-variable gravity - Altimetry - InSAR and SAR	- Radio occultation - GNSS reflections from space - Optical change detection
PRIMARY GEODETIC PRODUCTS	
- Precise positions - Orbit determination - Earth rotation	- Gravity field - Reflection and signal-to-noise ratio - Total electron content and tropospheric delay
TERRESTRIAL REFERENCE FRAME	
- Station coordinates as function of time - Origin (Earth system center of mass)	- Scale - Orientation
GEODETIC INFRASTRUCTURE	
- Geodetic techniques (SLR, VLBI, GNSS, DORIS) - Software	- Experts - Archives

GENESIS

"Evolving the Geodetic Infrastructure to Meet New Scientific Needs",
National Academies of Sciences, Engineering and Medicine (2020)

Genesis Science Exploitation Team Setup



Genesis Science Team

Genesis Science Management Board

- ESA Scientific Representative
- Lead Science Coordinator
- Lead Science Co-Coordinator
- Working Groups Chairs

IAG/IERS JWG 1.1.1

- Complementary working group under IAG
- Focused on science preparation and execution

Genesis Science Exploitation Team (GSET)

- Lead Science Coordinator
- Lead Science Co-Coordinator
- Working Groups (WGs)
 - WG1: ITRF and Combination of Techniques
 - WG2: GNSS
 - WG3: VLBI
 - WG4: DORIS
 - WG5: Laser Ranging

GSET Workshop Matera 2025



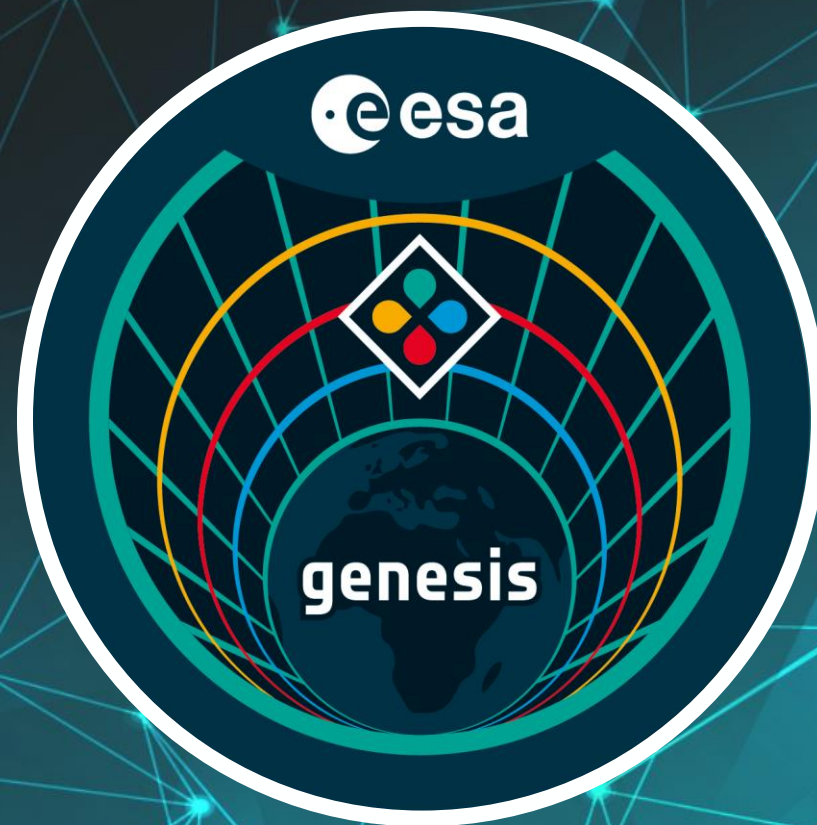
GSET Workshop ESA 2024



“GENESIS – A Mission for the World”

Genesis – AT THE FOUNDATION OF NAVIGATION

Thanks for your attention.



Contact Points

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PROAD: Francesco Gini – Francesco.Gini@esa.int