

An update on Genesis Mission Status

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IDS Workshop 2026



FUTURE NAV esa.int/Applications/Navigation

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→ THE EUROPEAN SPACE AGENCY

Genesis Mission in a Nutshell

Primary Objectives

To contribute to the improvement of the ITRF, aiming at:

- 1mm in accuracy
- 0.1mm/year in stability

To contribute to the improvement of the link between ITRF and ICRF

Mission Principle

Co-location in space of the 4 space-based geodetic techniques
Reuse to the maximum extent the existing ground infrastructure

Mission Scope

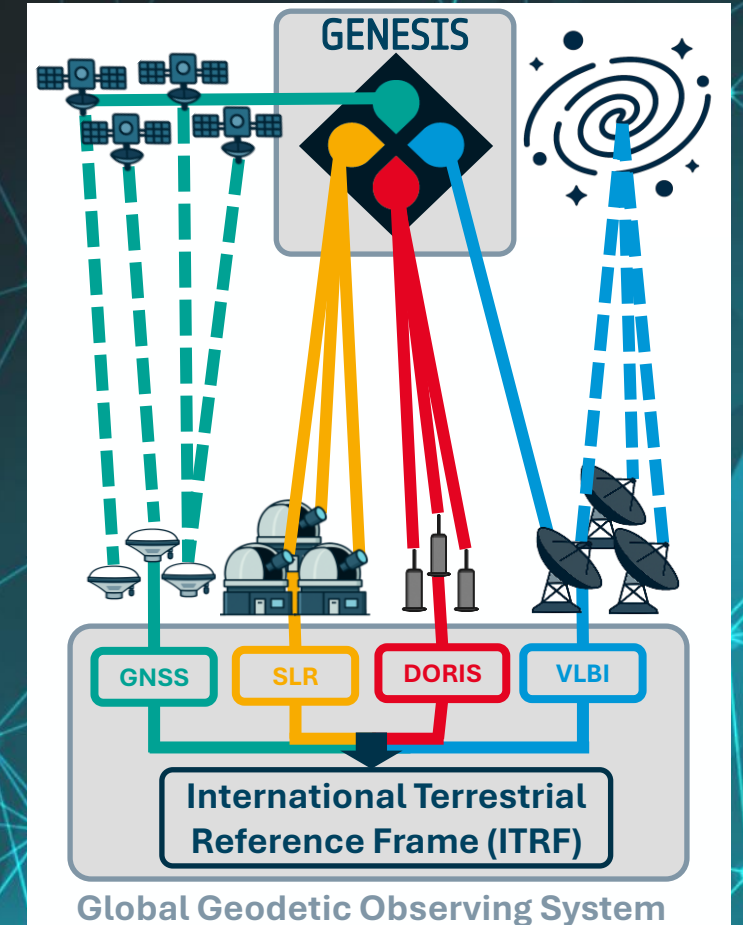
Design, development, launch of 1 satellite and associated ground segment

2 years operation (option for extension to 5 years)

Data collection, archiving, distribution and processing

Managed by ESA Navigation Directorate, under the FutureNAV programme

→ **Key involvement of the Scientific Community and International Geodetic Services**



Genesis-enabled Science and Applications



Geodesy, Reference Frames

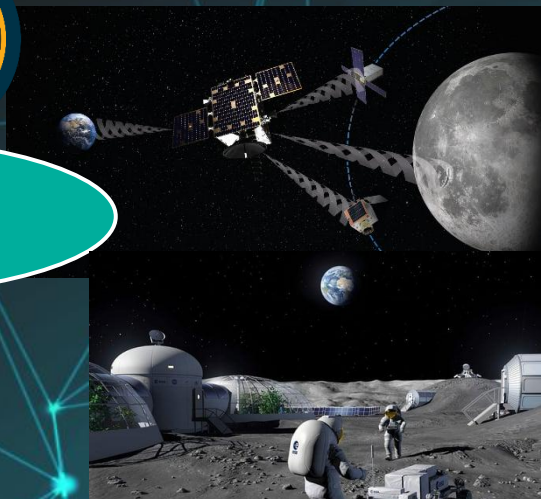
Improved ITRF, EOPs,
Unified Reference Frames

GNSS, Navigation, Reference Frames



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

Navigation to the
Moon, and beyond...



Earth Sciences

Geophysics: Deep Interior

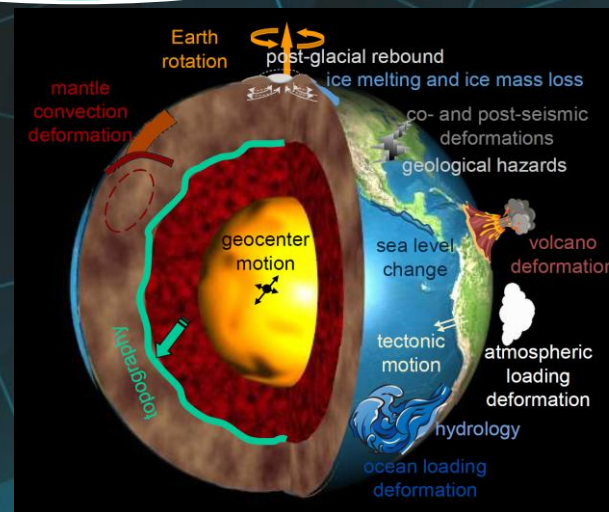
- Geo-centre motion
- Core flows
- Magnetic field...

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

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

Genesis Mission Organisation



ESA/ESTEC NAV
Overall Management

Industrial Contractor (led by OHB-Italy)

- Satellite and Instruments development, launch services
- Satellite Operations, Satellite Data collection

CNES

- DORIS instrument and system prime
- DORIS data processing and delivery

PROAD: ESA/ESOC, ESA/ESAC

- Satellite and scientific data collection, archiving, distribution
- Data processing, POD, ...

GSET: Genesis Scientific Exploitation Team

- Support to mission preparation and development
- Ground infrastructure coordination
- Data exploitation, ITRF generation, publication...

Genesis Mission Timeline



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)
Start 2026



Qualification
and
Acceptance
Review (QAR)
2029

LAUNCH 2029

2 years of
Operations with
option for extension
to 5 years

Scientific
exploitation

Genesis System: PDR Status



Satellite

Orbit: 6000km altitude (low MEO), 95.5° inclination

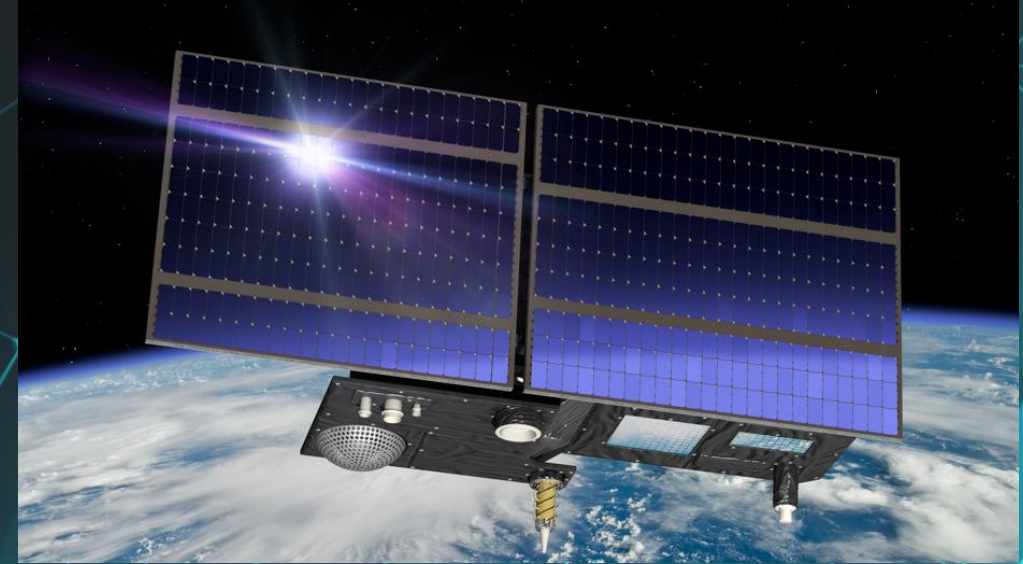
Mass: 406kg, Power: 280W (nominal)

Envelope: 1.9m x 1.3m x 3.4m

Attitude: 3-axis stabilised, Nadir pointing, yaw-steering law

Body-fixed solar panels, no movable parts, no propulsion

Payload: GNSS, LRR, DORIS, VLBI Instruments, external USO



Ground Segment

Mission Control Centre, S-band TT&C stations still to be selected

Launch and Operation

Launcher still to be selected

Commissioning Phase + 2 years of operation (option for extension)

Genesis Satellite: PDR Status



Platform Module

Houses platform units and payload electronic boxes

Box-shape Aluminium sandwich panels for radiation shielding

Bracket-elevated S-band TT&C antenna

Interface to launcher (Launcher Interface Ring – LIR)

Payload Module

Hosts instrument antennas, LRR and 2 star trackers

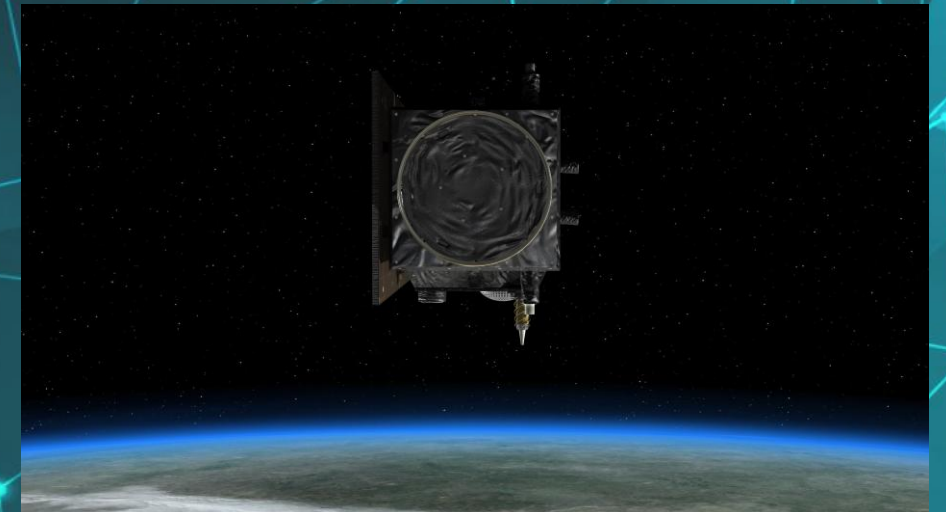
Structure in CFRP sandwich panels for low Thermoelastic Distortion

Connected to Platform Module through 4 titanium bipods

Solar Panels

Two body-mounted, fixed solar panels

One integrated on the platform, the other on the payload modules



Genesis Payload: PDR Status

Four Instruments, tightly tied:

GNSS

- Galileo E1/E5a, GPS L1/L2/L5
- Nadir + Zenith Antennae
- Tracking optimised for Genesis orbit
- High quality code and phase observables

Laser Retro-Reflector

- Compatible with ILRS stations (532nm)
- Nadir panel
- CCR & geometry optimised for Genesis orbit
- Increased optical cross-section (6Mm²)

Master USO +
Distribution Amplifier

VLBI

- Wideband signals in S, C and X-bands
- Compatible with VGOS stations
- 3 New Tx antennas
- One-way ranging capability

DORIS

- Legacy DGXX-S instrument, UHF/S-band
- Legacy LEO Antenna
- On-board processing tuned for Genesis orbit
- Use of external USO signal

Genesis Payload: PDR Status

Four Instruments, tightly tied:

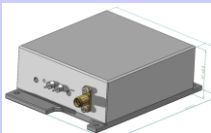
GNSS



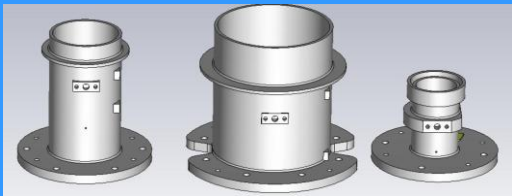
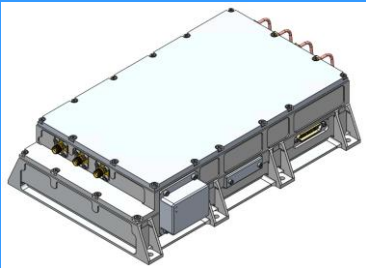
Laser Retro-Reflector



USO + DA



VLBI



DORIS



Genesis Payload: DORIS Status



Baseline

- Procured as “Customer-Furnished Item” to CNES
- Legacy DGXX-S Receiver (from Thales-DMS) and Antenna (Thales-AEC)
- DIODE SW updated/optimised by CNES

Genesis-specific

- Significantly harsher TID environment
- No internal USO, use of PL external USO
- Higher altitude than usual
 - Many more beacons in view (Doppler crossings)
 - Doppler signature divided by ~ 2 ($\pm 4\text{kHz}$ in UHF, $\pm 20\text{kHz}$ in S-band)
 - Reduced SNR (up to 13dB)
- Stringent Calibration requirements: Antenna Phase Centre, Receiver/Cable Phase sensitivity to temperature

Genesis Calibration: PDR Status

Satellite Calibration

Cover the “geometrical” reference points:

- CoM coordinates in satellite reference frame
- Instrument reference points coordinates in satellite reference frame
- and their variations over environment, lifetime...

Instrument Calibration

Cover the “measurement” reference points:

- Instrument Centre of Phase coordinates in Instrument reference frame
- and their variations over frequency, FoV, environment, lifetime...

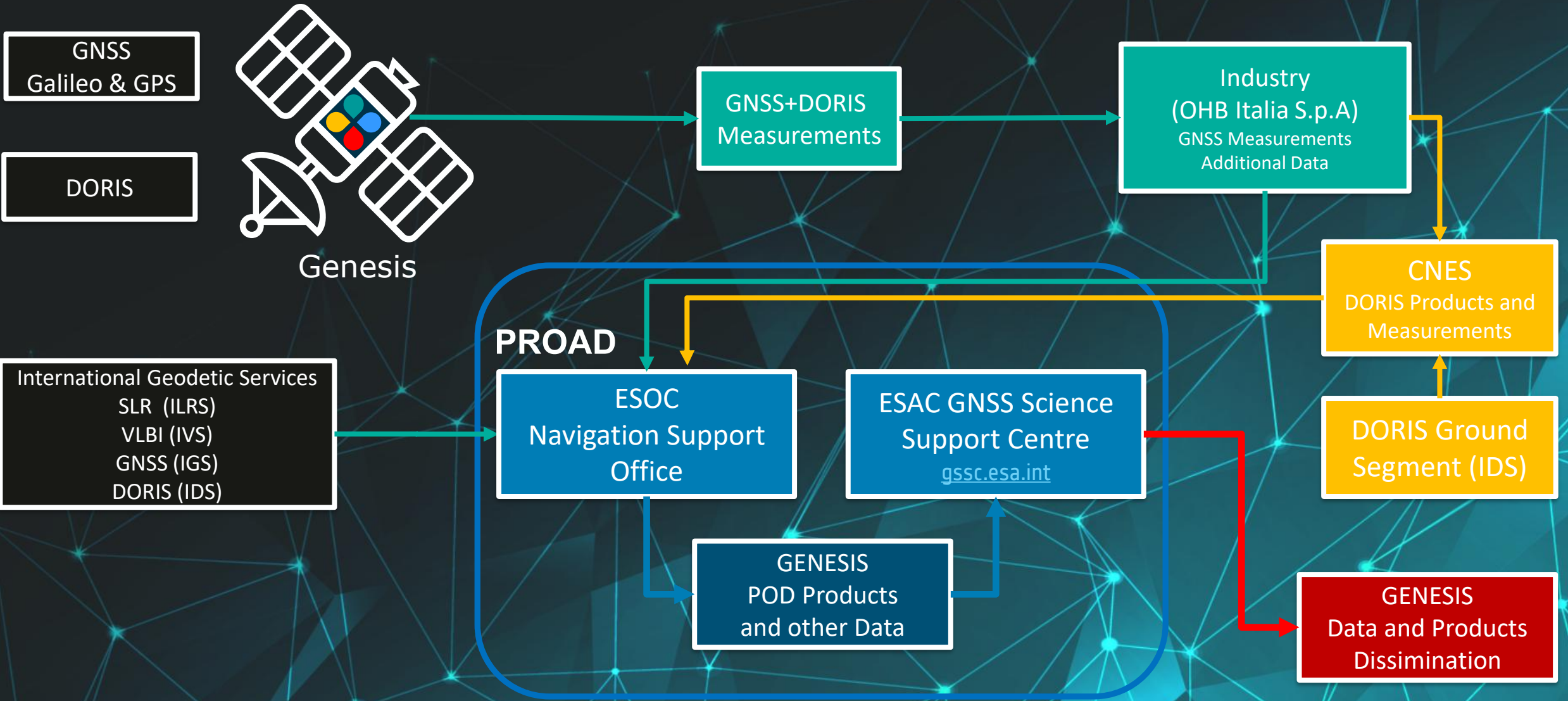
Calibration Plan

A preliminary version has been issued for PDR

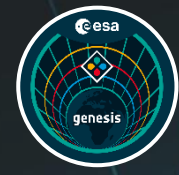
Will be iterated until CDR, in close cooperation with nominated GSET members



Genesis Data Flow: PDR Status



Genesis Science: GSET and IAG/IERS JWG 1.1.1



Genesis Science Exploitation Team (GSET) Composition

- Scientists & Experts organised in 5 Working Groups
- All Relevant International Geodetical Services:
 - IAG, IERS, IGS, IVS, ILRS, IDS

Genesis Science Exploitation Team (GSET) Management Board

- WG chairs, Lead & co-Lead Science Coordinators, ESA
- For coordination of GSET activities

IAG/IERS JWG 1.1.1 (Chair: J. Boehm)

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

Coordinator	Özgür Karatekin Royal Observatory of Belgium – RoB
Co-Coordinator	Francesco Vespe ASI Space Geodesy Centre at Matera
WG1: ITRF & Combination of Techniques	Zuheir Altamimi Institut national de l'information géographique et forestière – IGN Florian Seitz Deutsches Geodätisches Forschungsinstitut-TUM – DGFI
WG2: GNSS	Rolf Dach Universität Bern Benjamin Männel Deutsches GeoForschungsZentrum – GFZ
WG3: VLBI	Rüdiger Haas Chalmers Tekniska Högskola
WG4: DORIS	Guilhem Moreaux CLS-Collecte Localisation Satellites
WG5: Laser Ranging	Clément Courde Centre national de la recherche scientifique-Géoazur

Scientific Involvement in Genesis mission



Participation already from requirements consolidation in Phase A



Support ESA in the follow up of the industrial activities, with emphasis on instruments and calibration



Analysis of mission performance and the mission contribution towards target ITRF improvement



Preparation of the scientific data exploitation, covering any gaps in algorithms, tools or ground infrastructure required

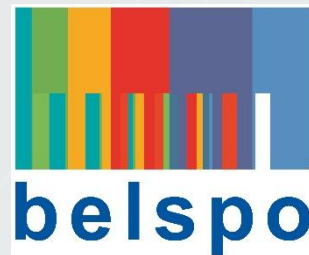


Preparation and execution of required ground-based campaigns (in particular VLBI, SLR)

Genesis Science Workshop 2026

Genesis Science Workshop 2026

- 3rd edition **Genesis Science Workshop 2026** was successfully held on 12th -13th March at the Institute of Natural Sciences in Brussels (BE)
- Organised by ESA in collaboration with BELSPO
- The workshop brought together **Genesis Scientific Community** with **ESA Project Team** and **Industrial Consortium**
- **Calibration Splinter** was held at RoB on 11th March



Genesis Science Workshop 2025 Matera, Italy



Genesis Science Workshop 2026
Brussels, Belgium



Genesis Science Workshop 2024 ESA, Germany

Genesis Science Data



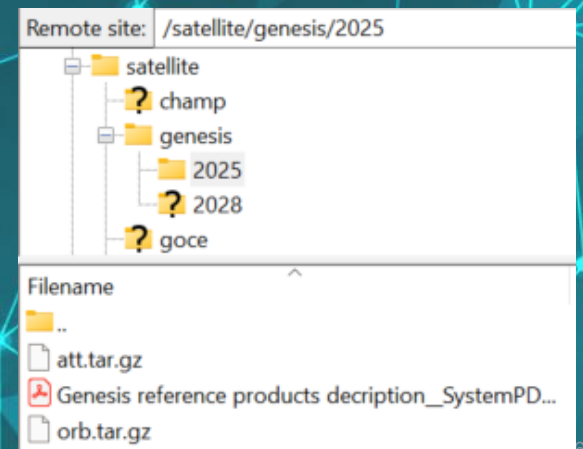
Genesis Reference Orbit

- Genesis orbit files for each day of 2025 (365 files) in SP3 format
- Genesis attitude (quaternion) files for each for each day of 2025 (365 files)
- Document containing description of the dynamical models, orbital elements used to generate the orbit, attitude description and ICD

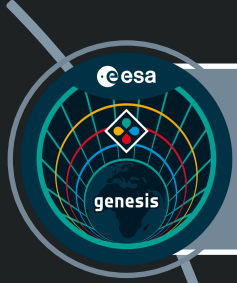
The files have been generated by the ESA Navigation Support Office and published by the GSSC to provide a common baseline for collaborative simulation, analysis and scientific activities related to Genesis.

These files are available in the [GSSC Archive](https://gssc.esa.int/archive/), under the path /satellite/genesis/

<https://doi.org/10.57780/esa-a0p3jgt>



To summarize...



Thanks to combined efforts from Scientific Community, ESA Member States, Industry and ESA, the Genesis Mission has become a reality



This challenging mission is currently in the design consolidation phase and will be a stepping stone towards improved GNSS with major positive impacts in Navigation and Earth Science



ESA, Industry and the Scientific community are fully committed to the success of the Mission

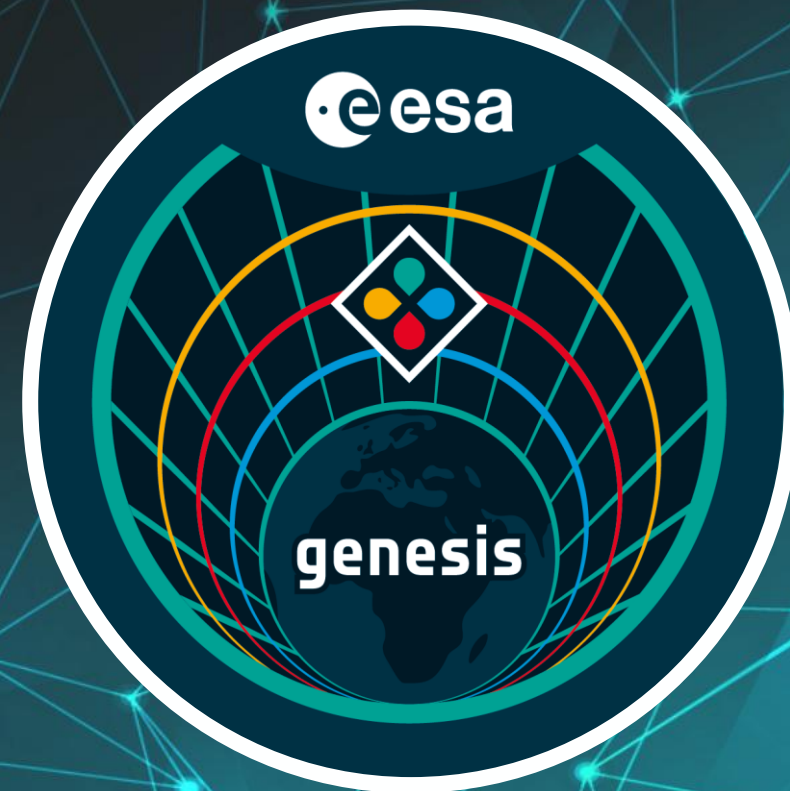


We are looking forward to updating the community on the progress of the Mission

Genesis: A Unique Geodetic Satellite Mission at the Foundation of Navigation

Thank you for your attention

Pierre Waller, on behalf of Genesis Team
IDS Workshop 2026
24th June 2026



FUTURE NAV esa.int/Applications/Navigation