

EGU23-9320, updated on 26 May 2023

<https://doi.org/10.5194/egusphere-egu23-9320>

EGU General Assembly 2023

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ESA's GENESIS mission: Advancing terrestrial reference systems by co-location of geodetic techniques in space.

Özgür Karatekin¹ and the GENESIS Team*

¹Royal Observatory of Belgium, Brussels, Belgium (ozgur.karatekin@oma.be)

*A full list of authors appears at the end of the abstract

Improving and homogenizing time and space reference systems on Earth and, more specifically, realizing the Terrestrial Reference Frame (TRF) with an accuracy of 1 mm and a long-term stability of 0.1 mm/year are crucial to many scientific and societal endeavors. This is the purpose of the GENESIS mission, proposed as a component of the FutureNAV program of the European Space Agency (ESA) [1]. The knowledge of the TRF is fundamental for Earth and navigation sciences. For instance, quantifying sea level change strongly depends on an accurate determination of the geocenter motion but also of the positions of continental and island reference stations, such as those located at tide gauges, as well as the ground stations of tracking networks. In addition, numerous applications in geophysics require absolute millimeter precision from the reference frame, as, for example, monitoring tectonic motion or crustal deformation, contributing to a better understanding of natural hazards. The target TRF accuracy is based on the scientific needs of various disciplines in Earth Sciences and is reflected in the consensus of various authorities, including the International Association of Geodesy (IAG). Moreover, the United Nations Resolution 69/266 states that the full societal benefits in developing satellite missions for positioning and Remote Sensing of the Earth are realized only if they are referenced to a common global geodetic reference frame at the national, regional and global levels. Yet, when combining all these techniques for the TRF generation, the process is today affected by the accuracy on which we may determine the differential coordinates between the reference point of each technique and several unmodelled systematic errors.

The GENESIS platform will be a dynamic space geodetic observatory carrying all the geodetic instruments referenced to one another through carefully calibrated space ties. GENESIS will support the production of a more accurate TRF and enable the generation of an updated global model of Earth rotation, as well as a better-determined geocenter. The GENESIS mission would deliver exemplary science and societal benefits across a multidisciplinary range of Navigation and Earth sciences applications, constituting a global infrastructure that is internationally agreed to be strongly desirable. GENESIS got the green light at the ESA Ministerials held in Paris on November 2022. Here we will present the latest updates on the overall mission.

[1] Delva et al., 2023, GENESIS: co-location of geodetic techniques in space, accepted in Earth, Planets and Space

GENESIS Team: Pacôme Delva (SYRTE, Observatoire de Paris-PSL, Sorbonne Université, France), Zuheir Altamimi (Université de Paris Cité, Institut de physique du globe de Paris, France), Alejandro Blazquez (LEGOS, Université de Toulouse, France), Mathis Blossfeld (DGFI, Technische Universität München, Germany), Johannes Böhm (Technische Universität Wien, Austria), Pascal Bonnefond (SYRTE, Observatoire de Paris-PSL, Sorbonne Université, France), Jean-Paul Boy (Institut Terre & Environnement de Strasbourg, Université de Strasbourg, France), Sean Bruinsma (Centre National d'Etudes Spatiales, France), Grzegorz Bury (Institute of Geodesy and Geoinformatics, Wrocław University of Environmental and Life Sciences, Poland), Miltiadis Chatzinikos (SYRTE, Observatoire de Paris-PSL, Sorbonne Université, France), Alexandre Couhert (Centre National d'Etudes Spatiales, France), Clément Courde (Université Côte d'Azur, CNRS, Observatoire de la Côte d'Azur, France), Werner Enderle (European Space Operations Center, ESA/ESOC, Germany), Pierre Exertier (GET, Université de Toulouse, France), Rolf Dach (Astronomical Institute of the University of Bern, Switzerland), Véronique Dehant (Royal Observatory of Belgium), Simone Dell'Agnello (National Institute for Nuclear Physics – Frascati National Labs (INFN-LNF, Italy), Gunnar Elgered (Chalmers University of Technology, Onsala Space Observatory, Sweden), Susanne Glaser (German Research Centre for Geosciences (GFZ), Germany), Rüdiger Haas (Chalmers University of Technology, Onsala Space Observatory, Sweden), Wen Huang (German Research Centre for Geosciences (GFZ), Germany), Urs Hugentobler (Institut für Astronomische und Physikalische Geodäsie, Technische Universität München, Germany), Adrian Jäggi (Astronomical Institute of the University of Bern, Switzerland), Frank G. Lemoine (Geodesy & Geophysics Laboratory, NASA Goddard Space Flight Center, USA), Christophe Le Poncin-Lafitte (SYRTE, Observatoire de Paris-PSL, France), Susanne Lunz (German Research Centre for Geosciences (GFZ), Germany), Benjamin Männel (German Research Centre for Geosciences (GFZ), Germany), Flavien Mercier (Centre National d'Etudes Spatiales, France), Laurent Métivier (Université de Paris Cité, Institut de physique du globe de Paris, France), Benoît Meyssignac (LEGOS, Université de Toulouse, France), Jürgen Müller (Leibniz University Hannover, Institute of Geodesy, Germany), Axel Nothnagel (Technische Universität Wien, Austria), Felix Perosanz (Centre National d'Etudes Spatiales, France), Roelof Rietbroek (ITC Faculty of Geo-information Science and Earth Observation, Department of Water Resources (WRS), The Netherlands), Markus Rothacher (Institute of Geodesy and Photogrammetry, ETH Zurich, Switzerland), Harald Schuh (German Research Centre for Geosciences (GFZ), Germany), Hakan Sert (Royal Observatory of Belgium), Krzysztof Sosnica (Institute of Geodesy and Geoinformatics, Wrocław University of Environmental and Life Sciences, Poland), Paride Testani (HE Space Operations B.V. for ESA - European Space Agency, The Netherlands), Javier Ventura-Traveset (ESA Toulouse, Centre Spatial de Toulouse, France), Gilles Wautelet (University of Liège, Belgium), Radoslaw Zajdel (Institute of Geodesy and Geoinformatics, Wrocław University of Environmental and Life Sciences, Poland)