FUTURE
CIRCULAR
COLLIDER

Geodesy for science and society

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HEIG-VD Haute Ecole d’Ingénierie et de Gestion du Canton de Vaud - Suisse

Main tasks of Geodesy

1. Determination of the **position** of (all) objects on the Earth or in its vicinity.

2. Determination of the **gravity field** and its geometry.

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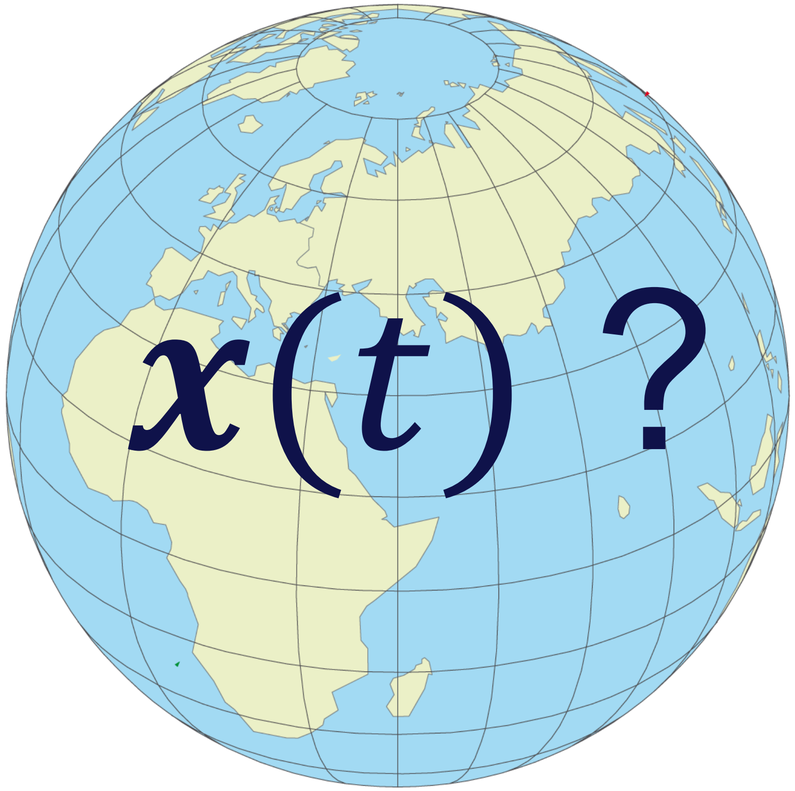

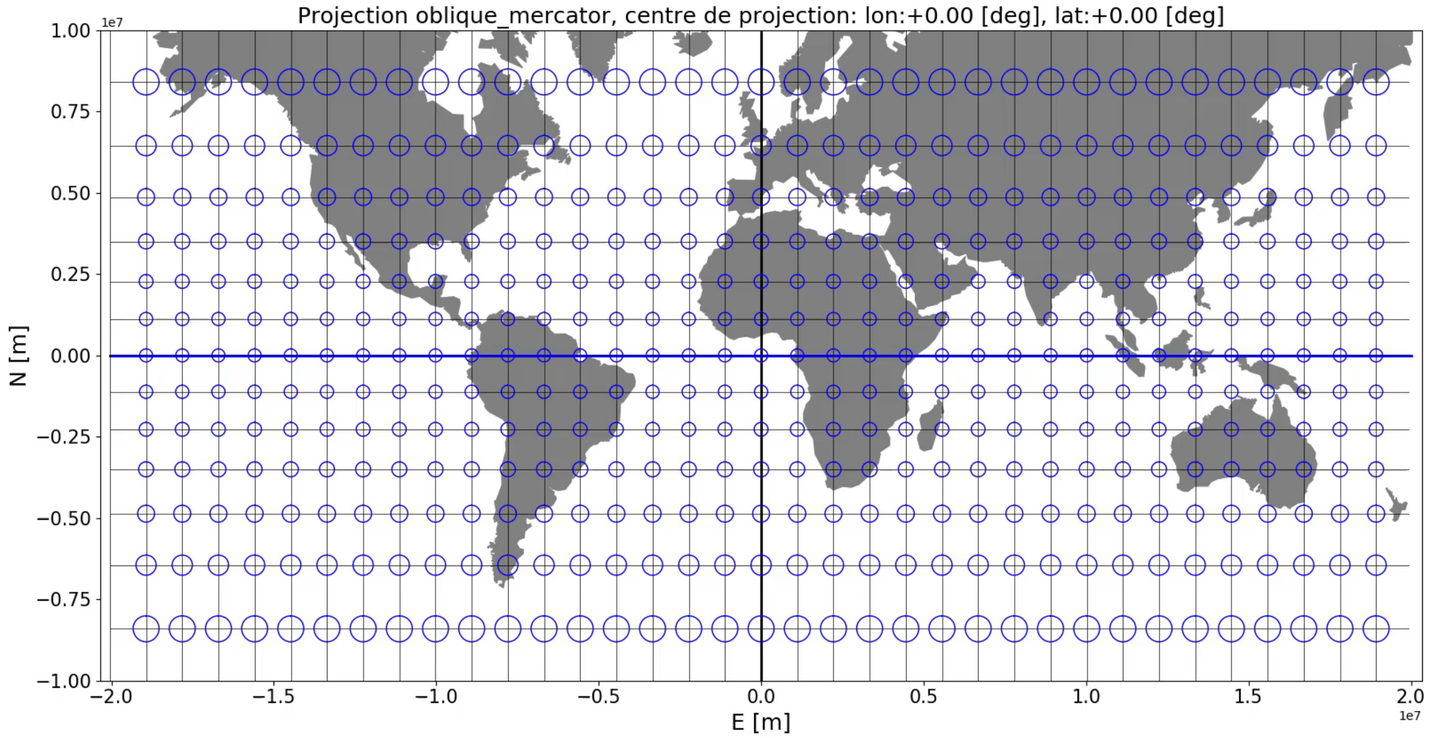

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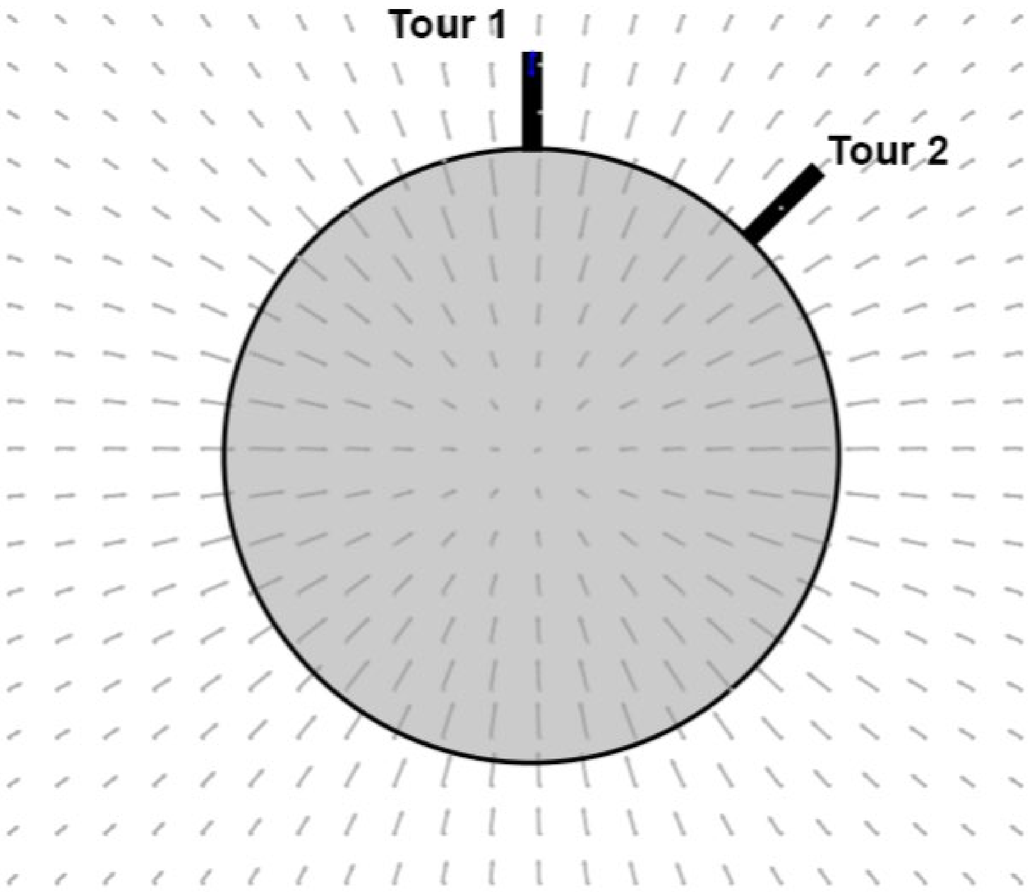

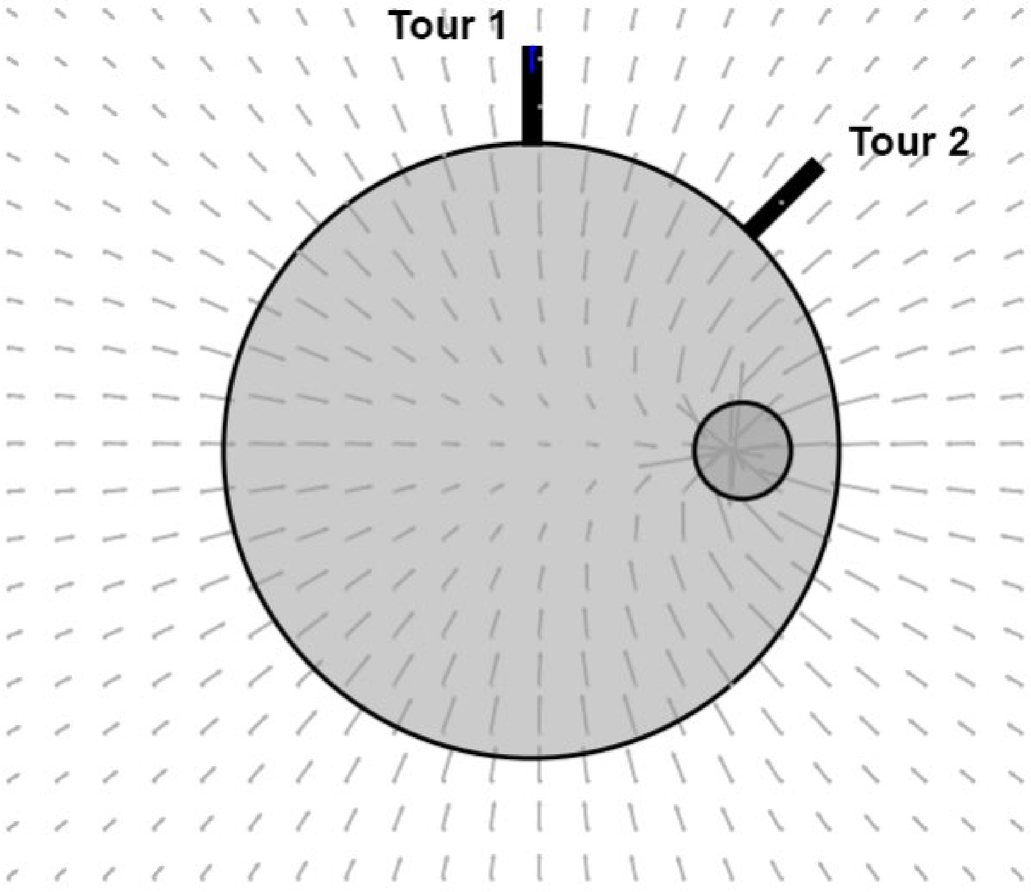

Reference Systems

established by the Geodetic community

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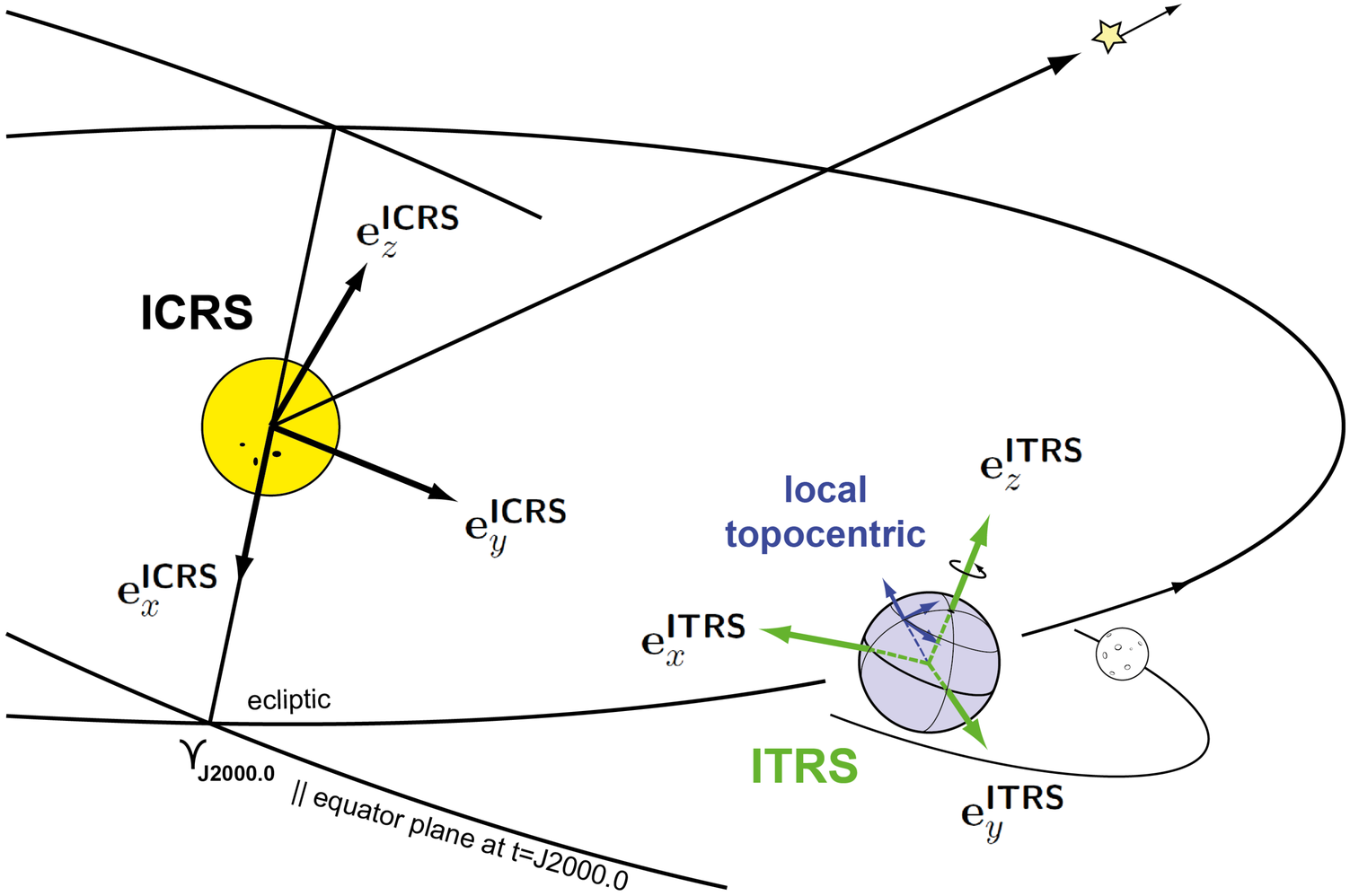
ICRS
International Celestial Reference System

ITRS
International Terrestrial Reference System

local topocentric
Natural system of an observer aligned with gravity vector



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ICRS

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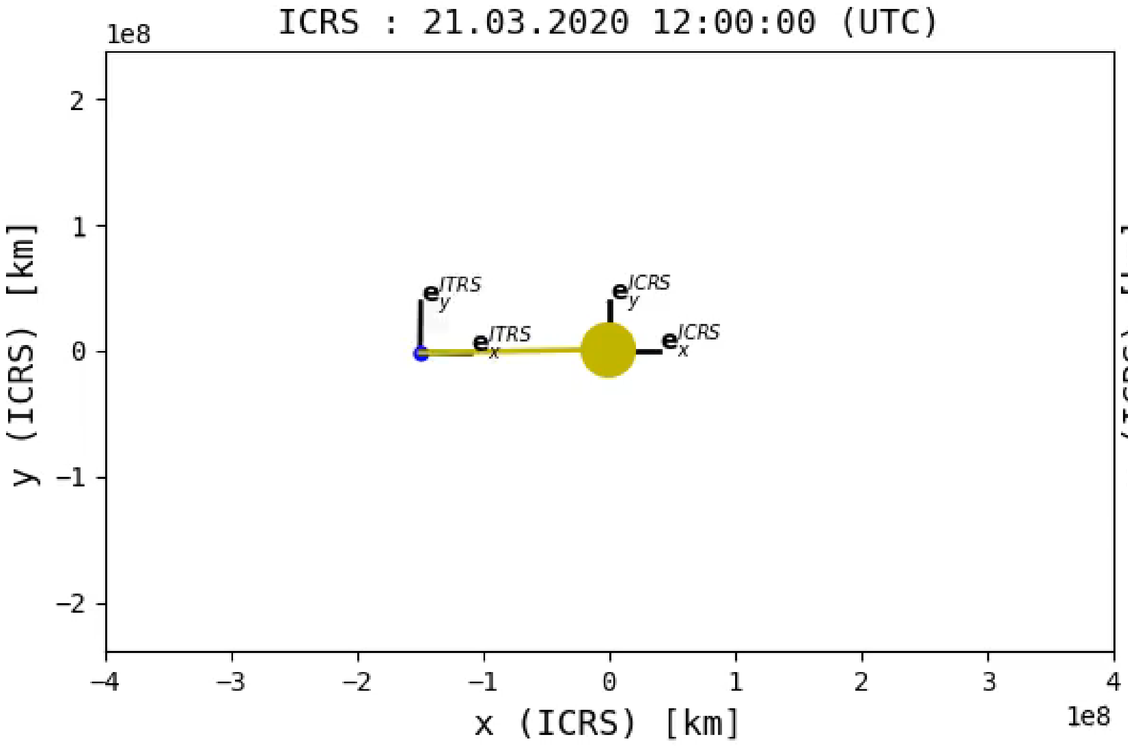
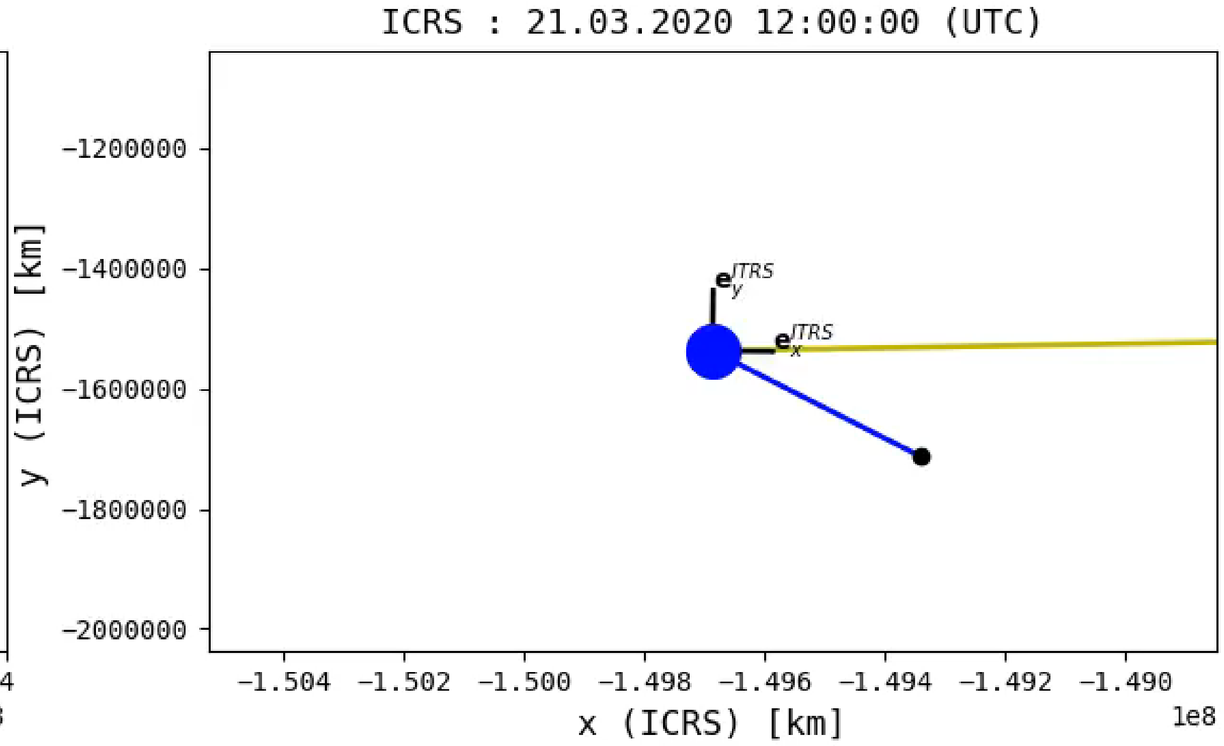
$$m \cdot \mathbf{a} = m \cdot \frac{\mathrm{d}^2\mathbf{x}(t)}{\mathrm{d}t^2} = \sum \mathbf{F}_{\mathrm{ext}}$$ ✓





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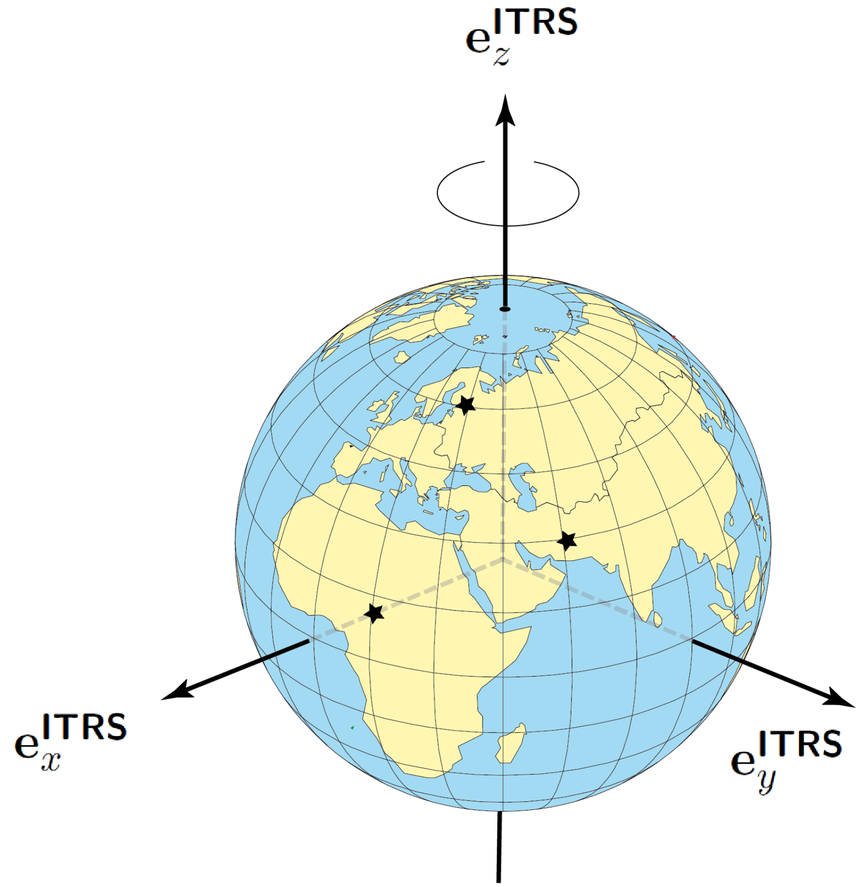

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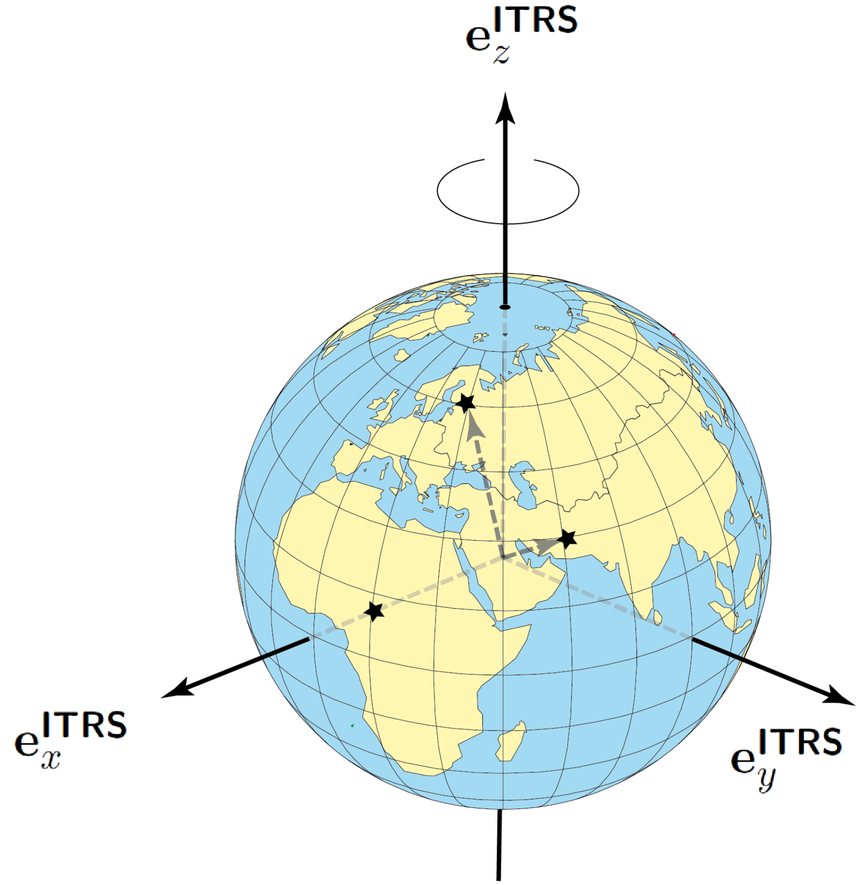
- set of **coordinates** and **velocities** of benchmarks at [mm] and [mm/year] precision, all around the world.



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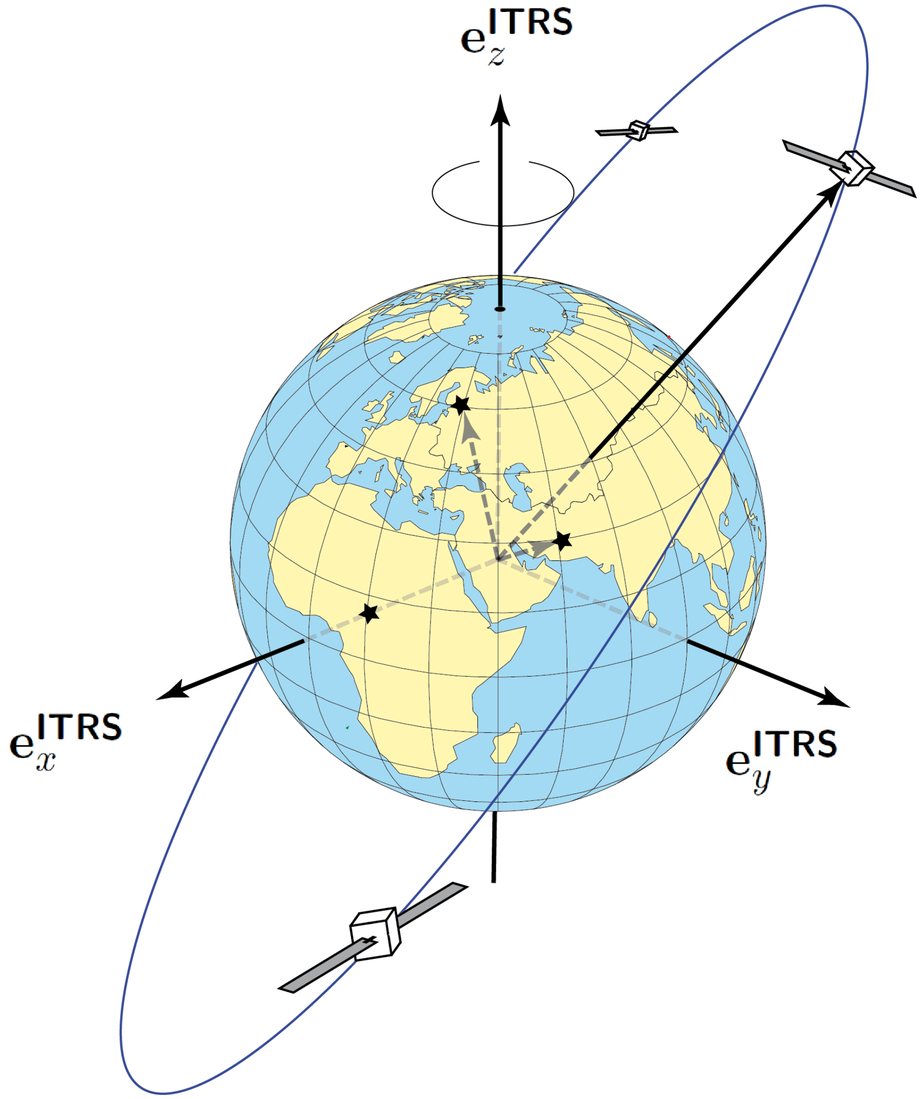

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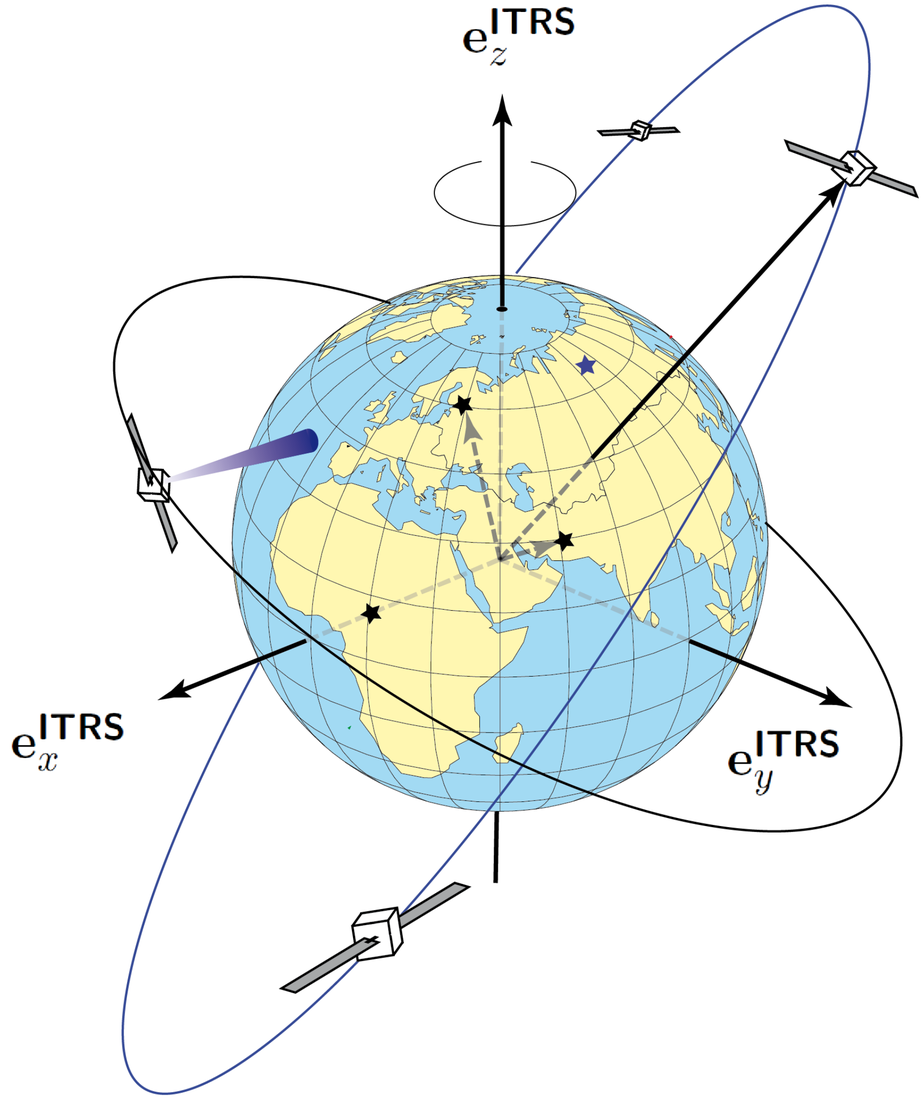

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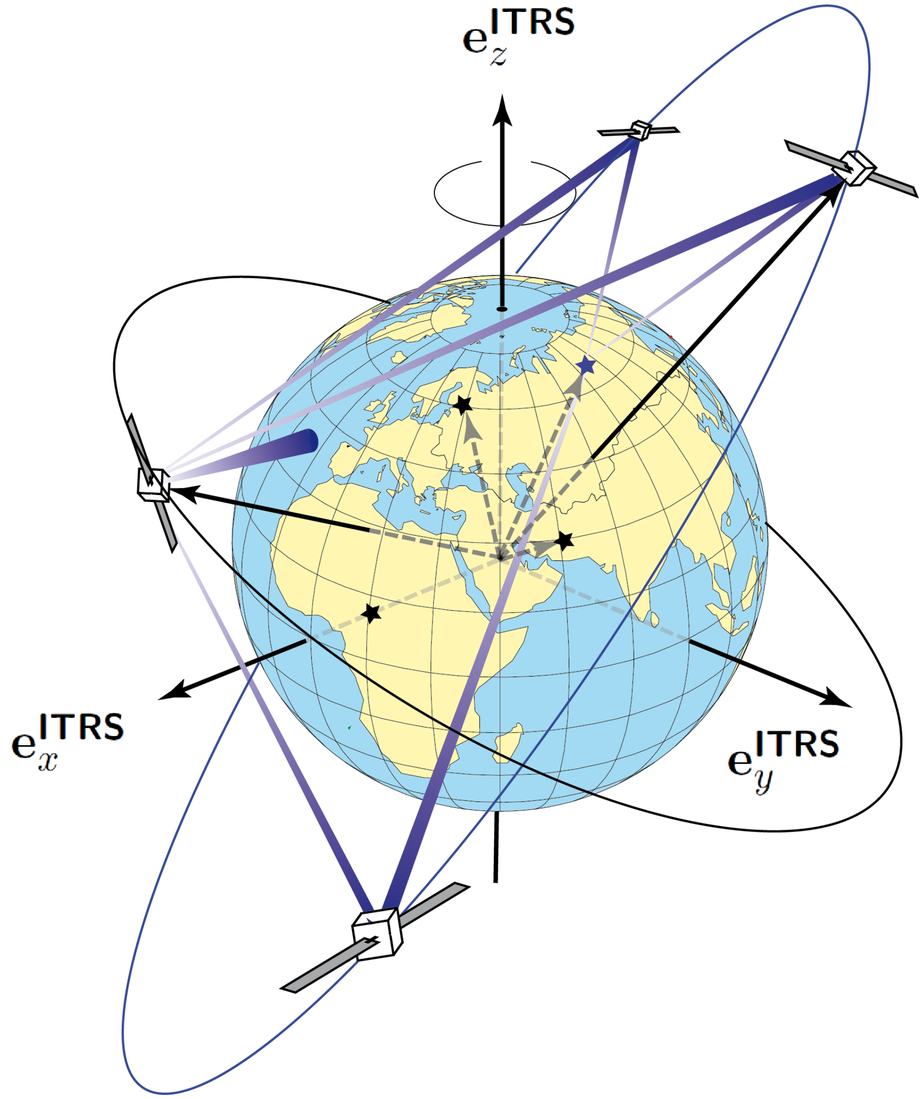

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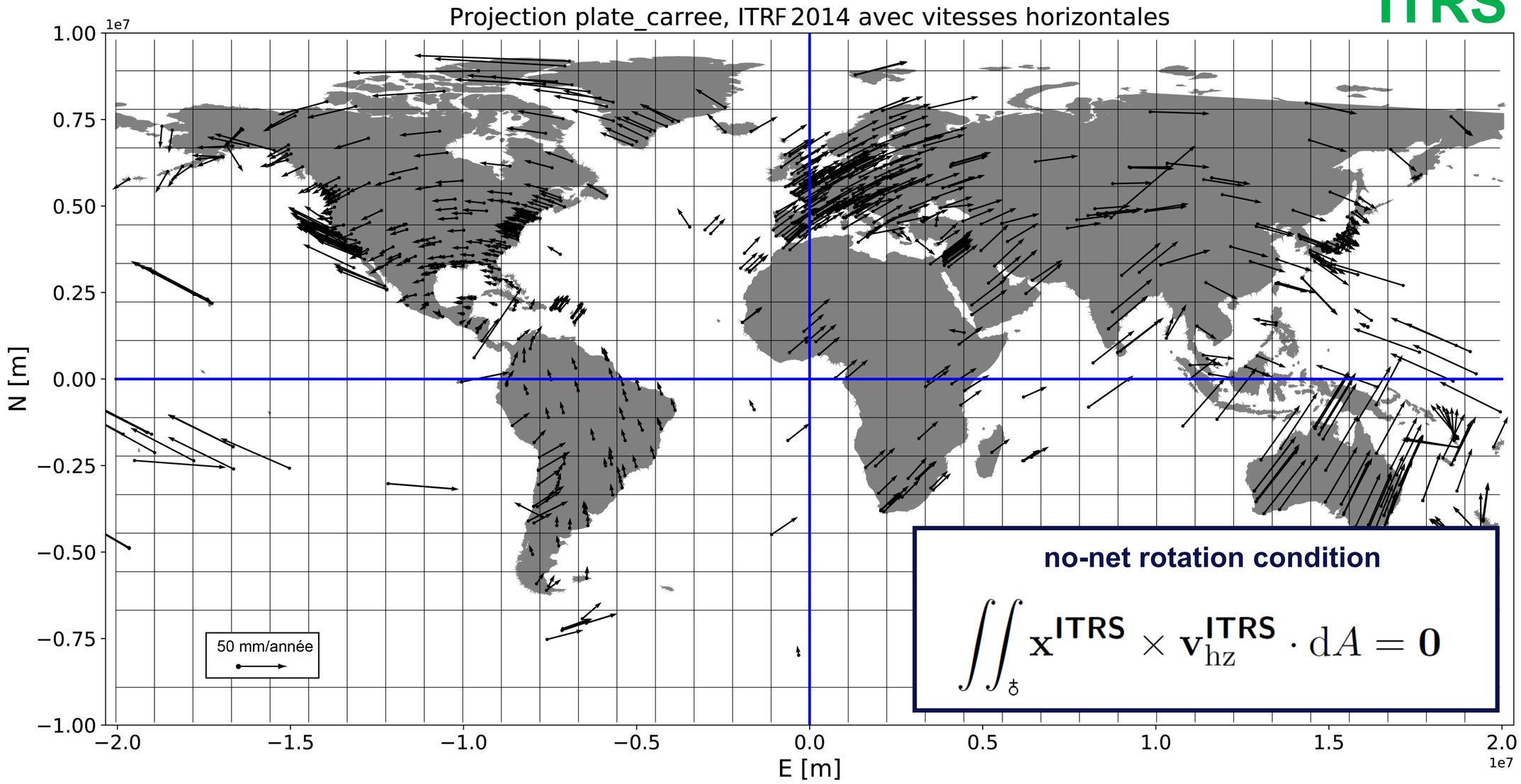

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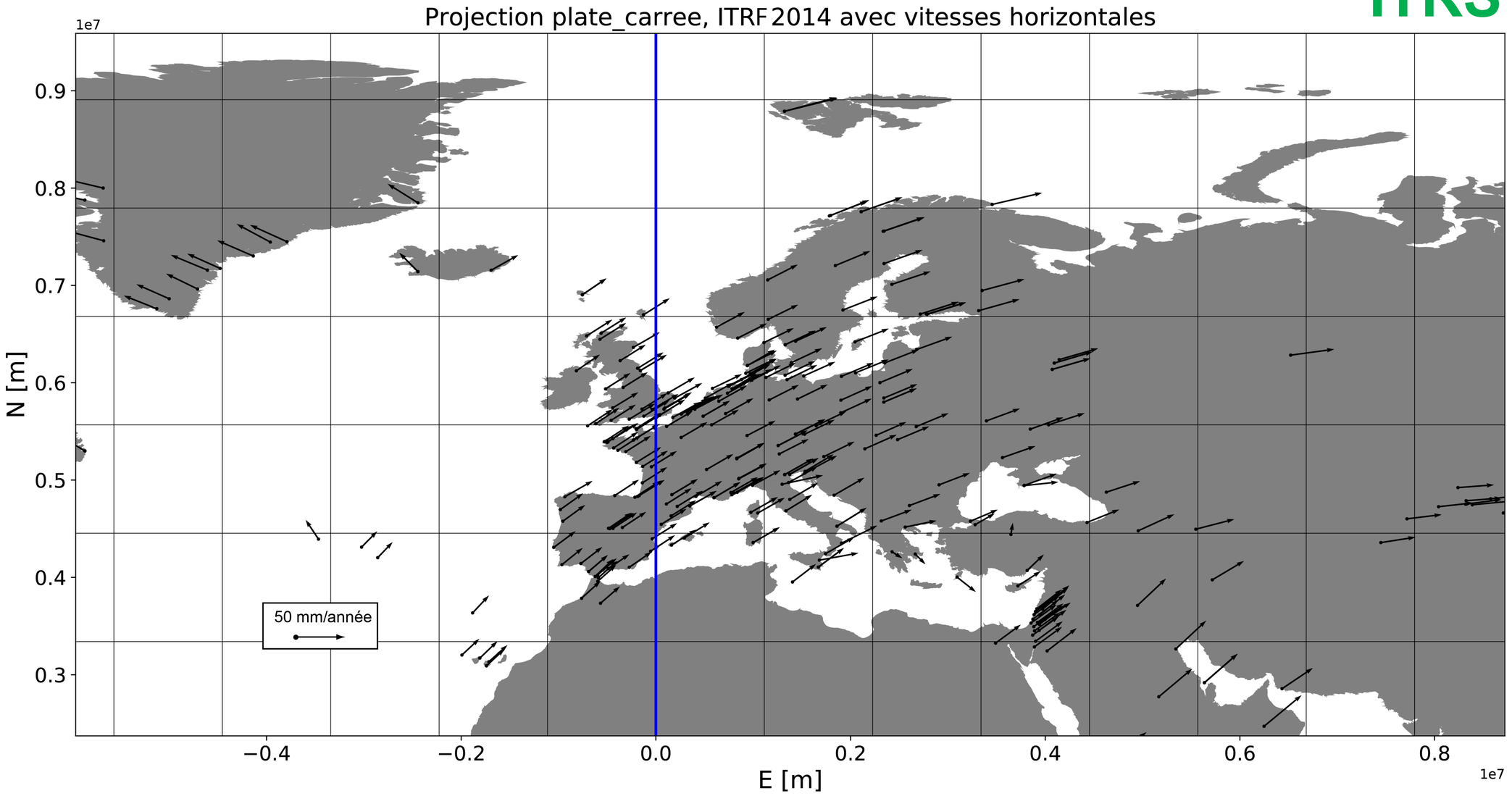

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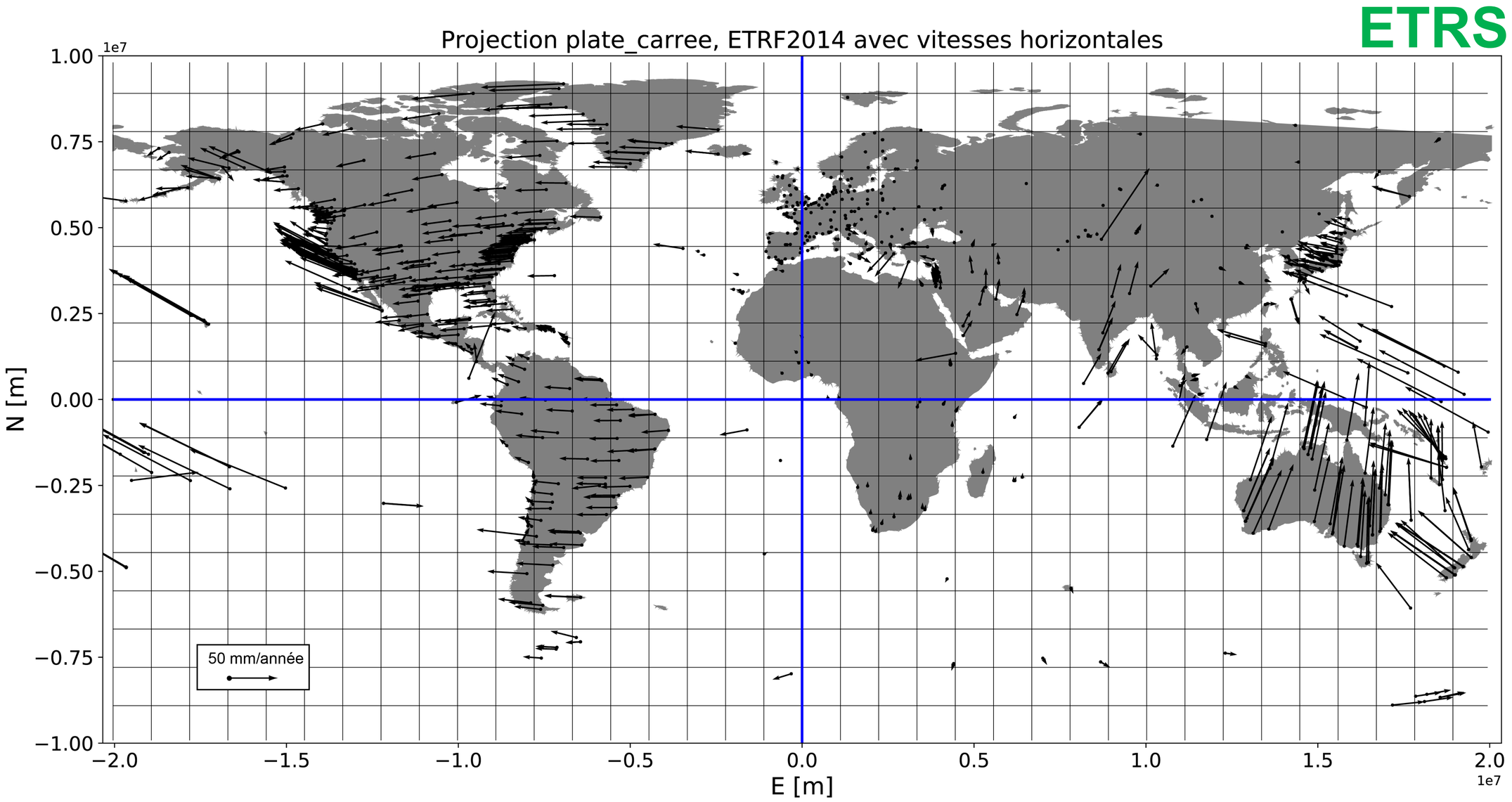
ETRS



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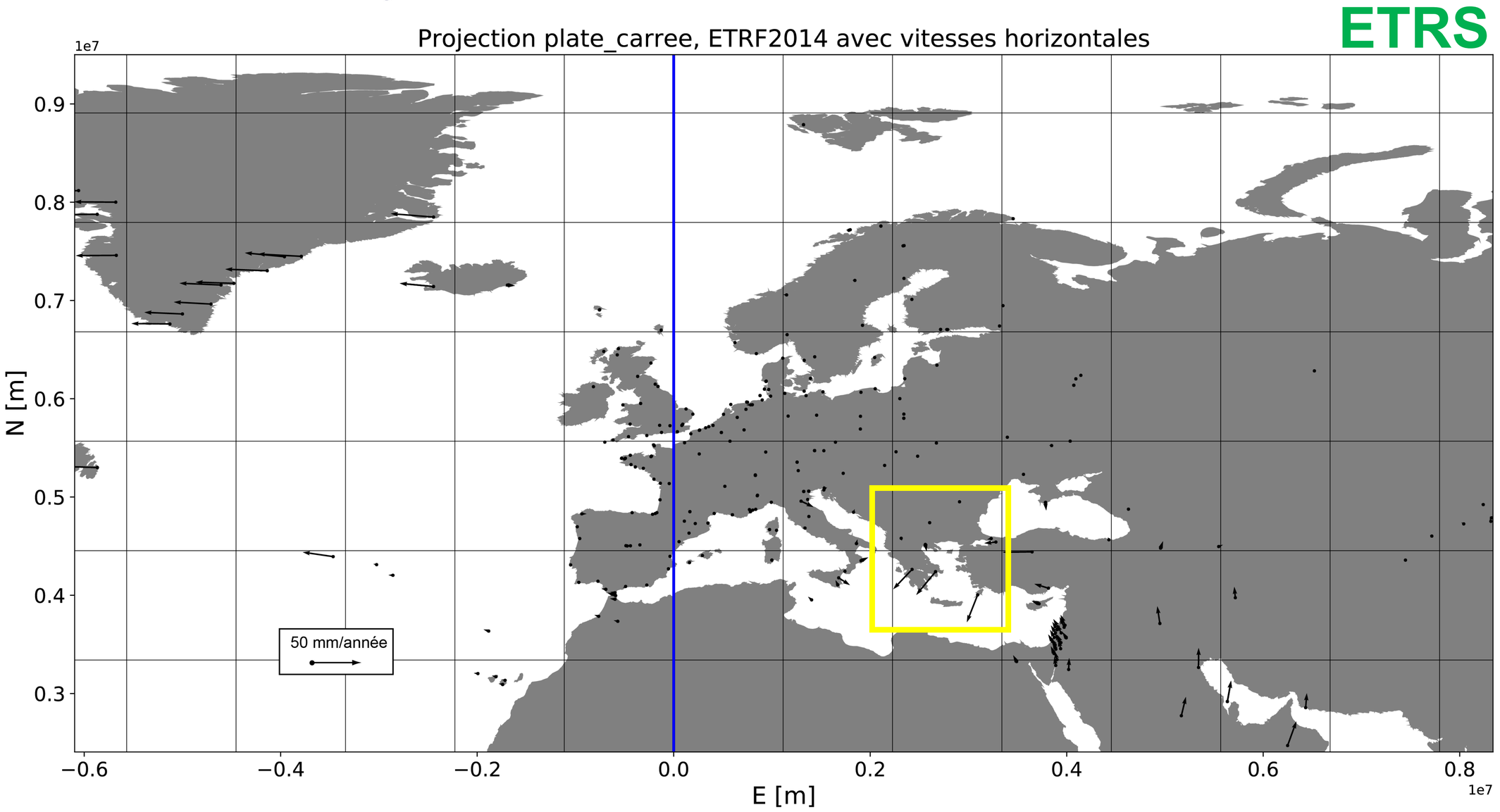

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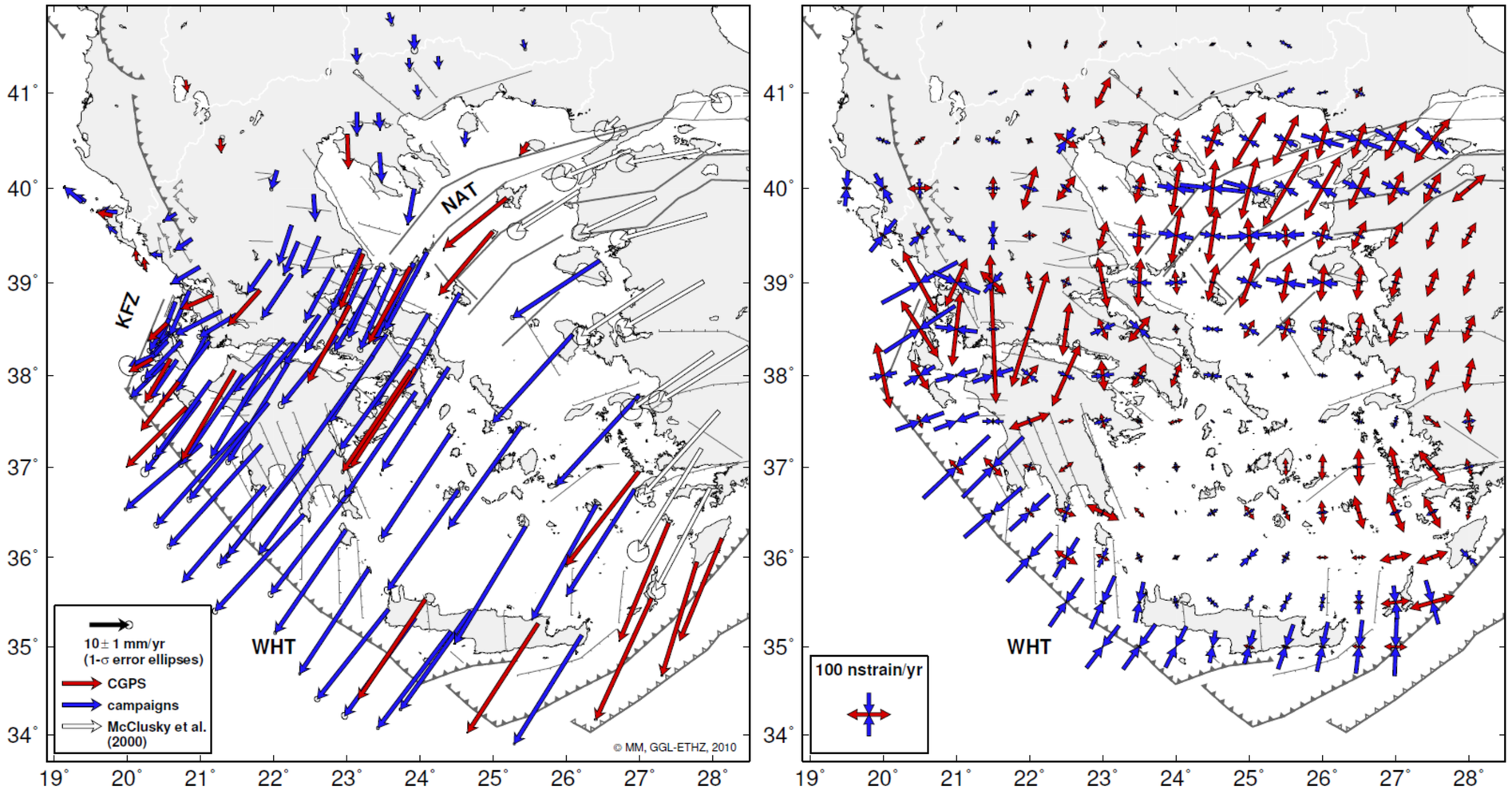

Source: M.D. Müller. Analysis of long-term GPS observations in Greece (1993-2009) and geodynamic implications for the Eastern Mediterranean. ETH Zürich

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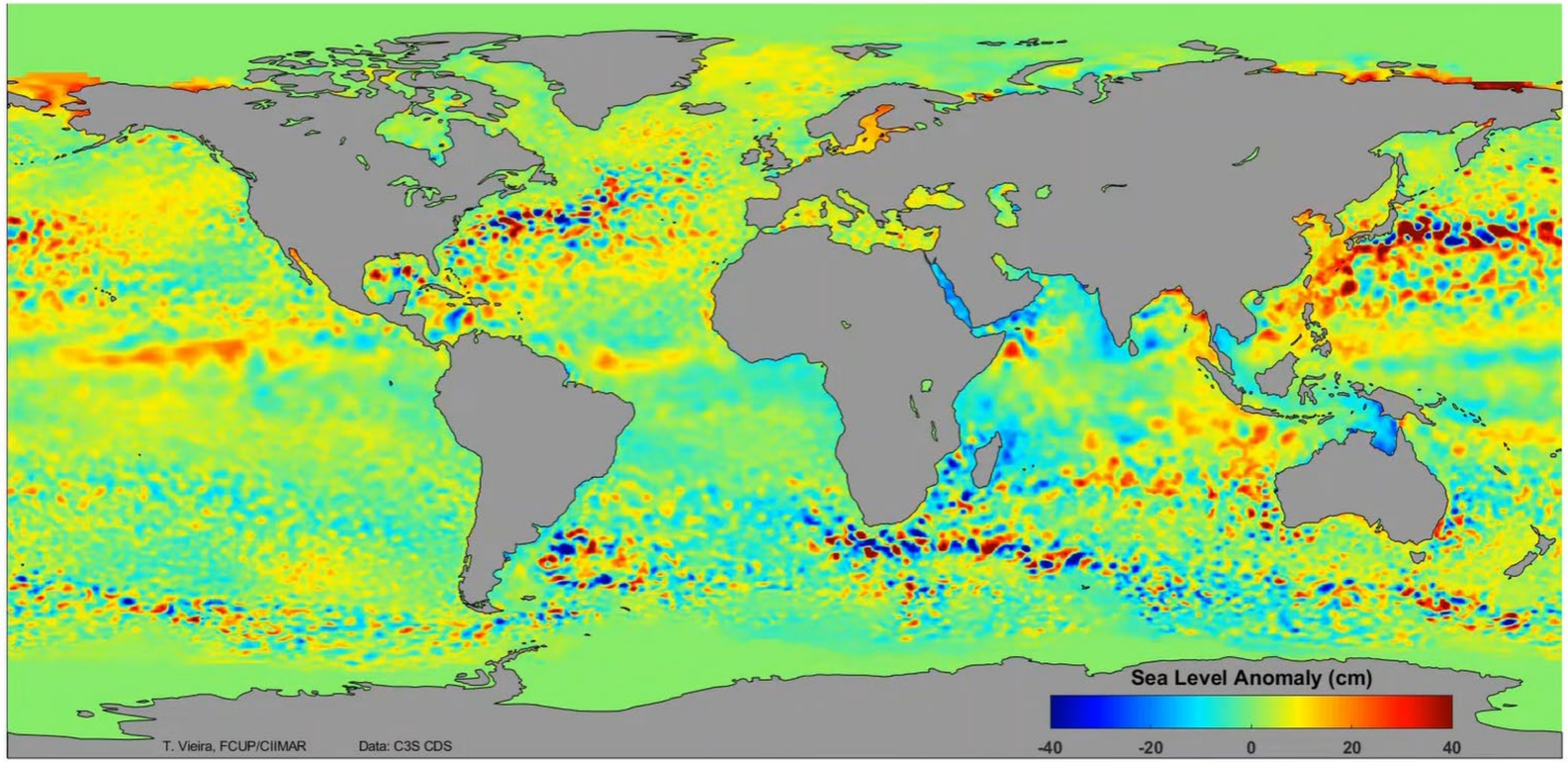
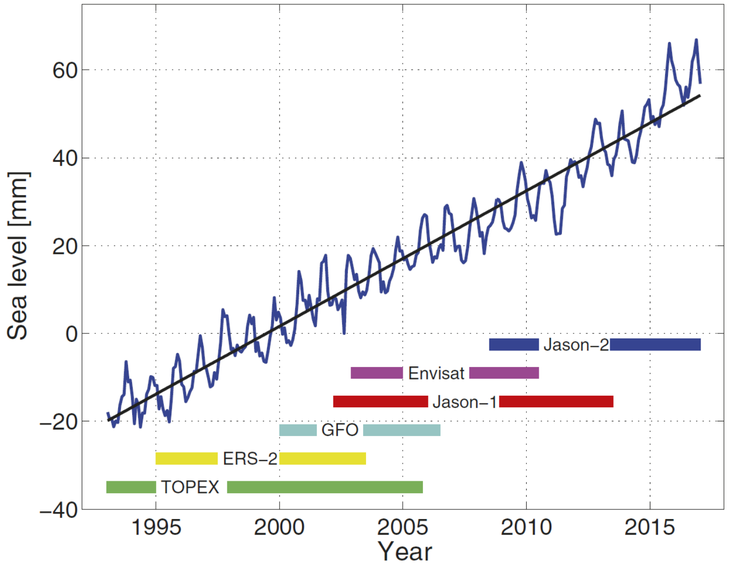
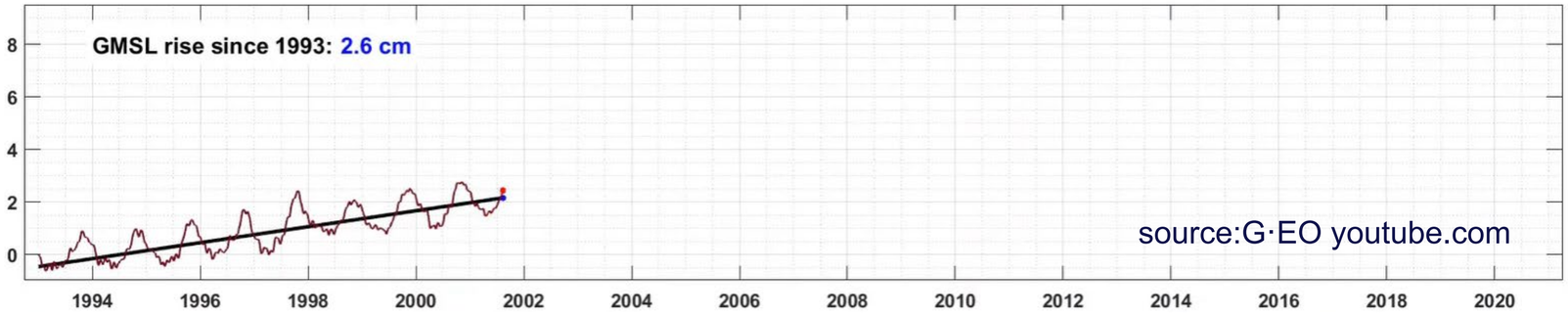




Source: Mission Earth, Detlef Angermann, Roland Pail, Florian Seitz, Urs Hugentobler. Springer Berlin, Heidelberg



source:G·EO youtube.com

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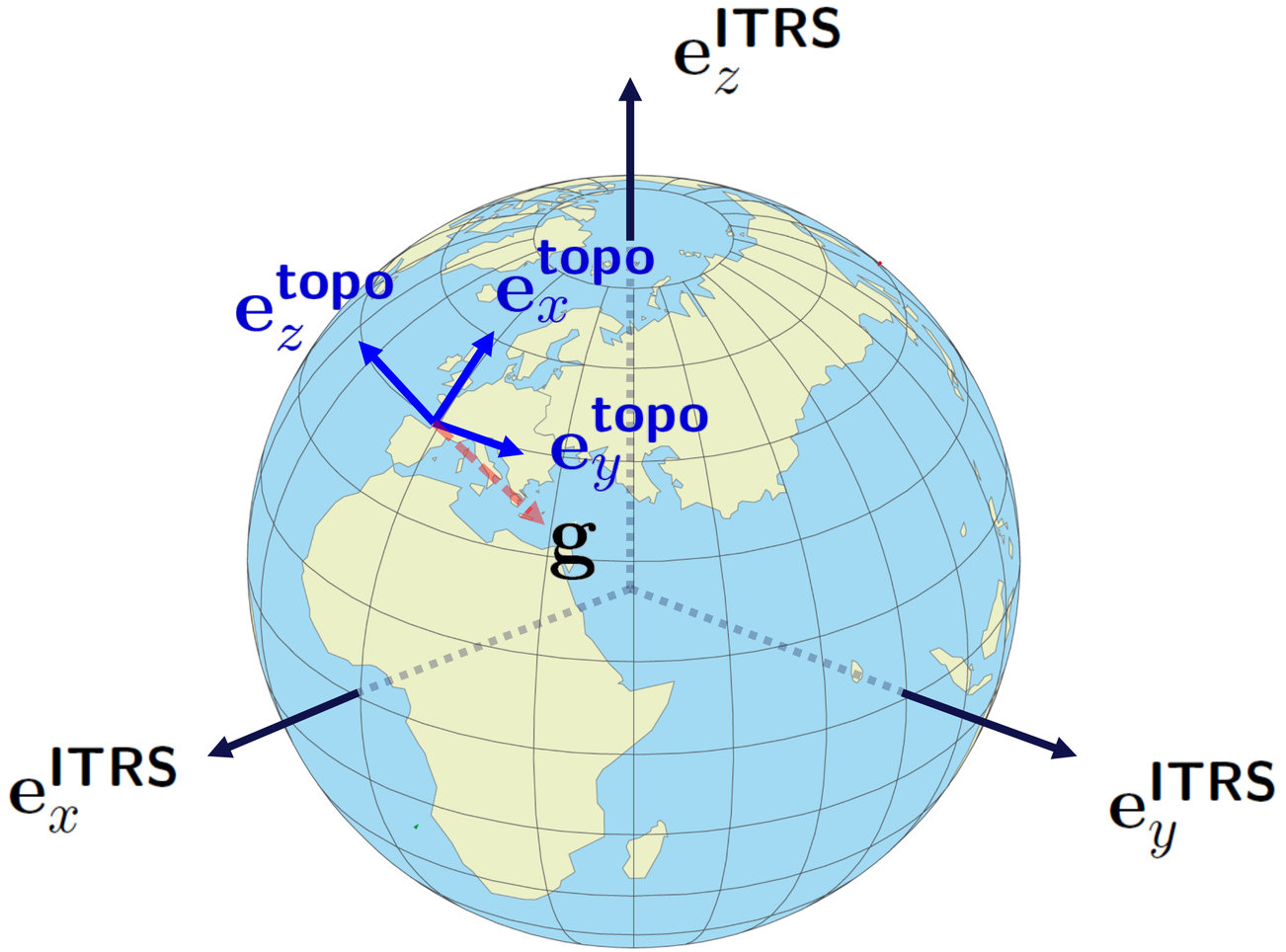

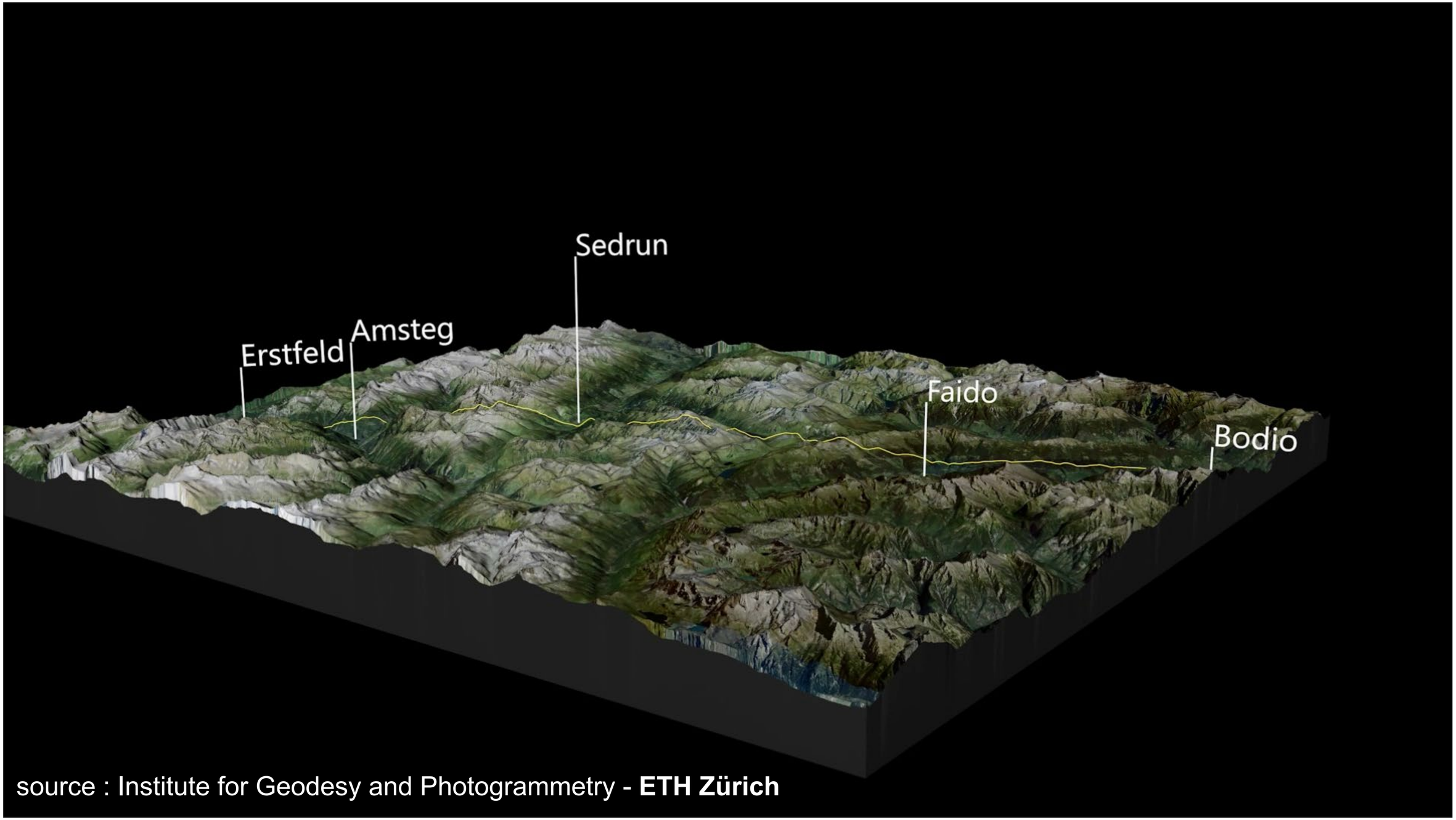

source : Institute for Geodesy and Photogrammetry - **ETH Zürich**

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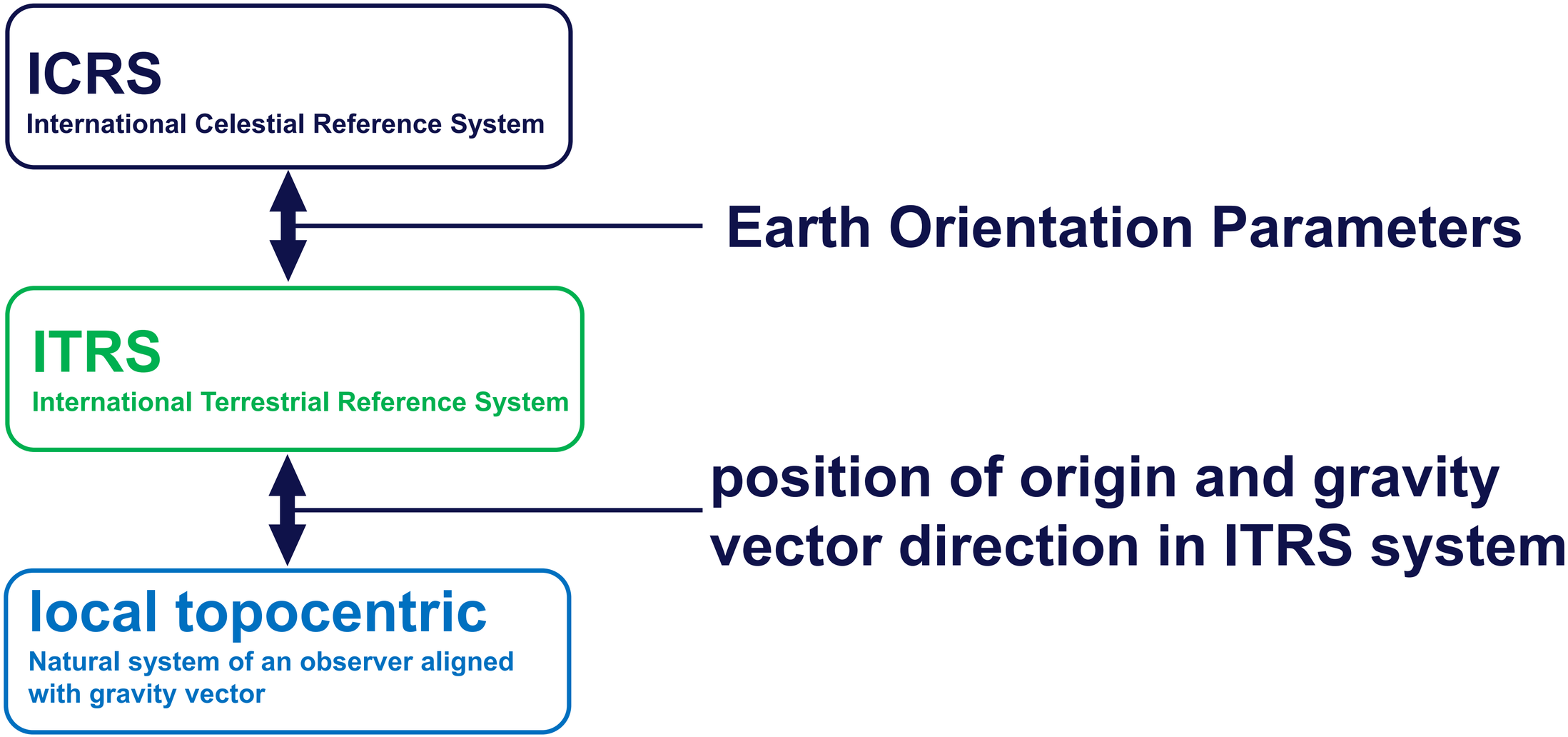
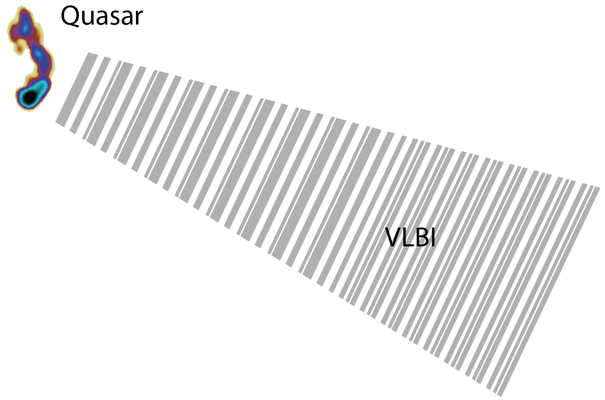
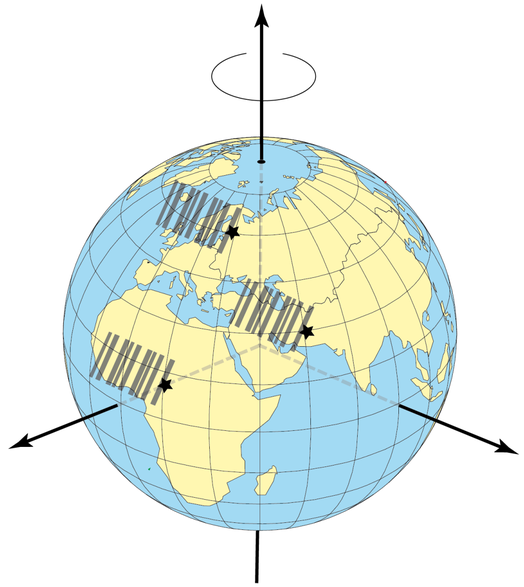


Reference Systems established by the Geodetic community

Global Geodetic Measurement Techniques : VLBI (Very Large Base Interferometry)

source: https://en.wikipedia.org/wiki/Geodetic_Observatory_Wettzell





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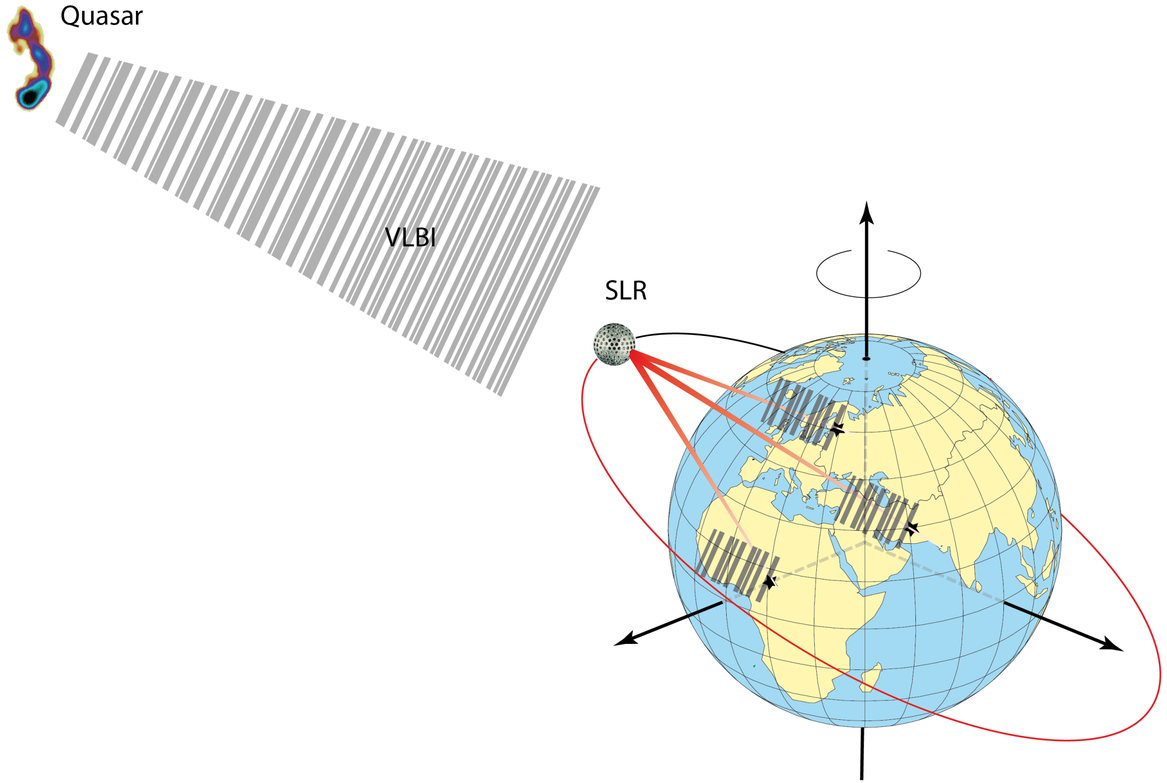
Global Geodetic Measurement Techniques : SLR (Satellite Laser Ranging)

source : https://www.iag-aig.org/topic/203



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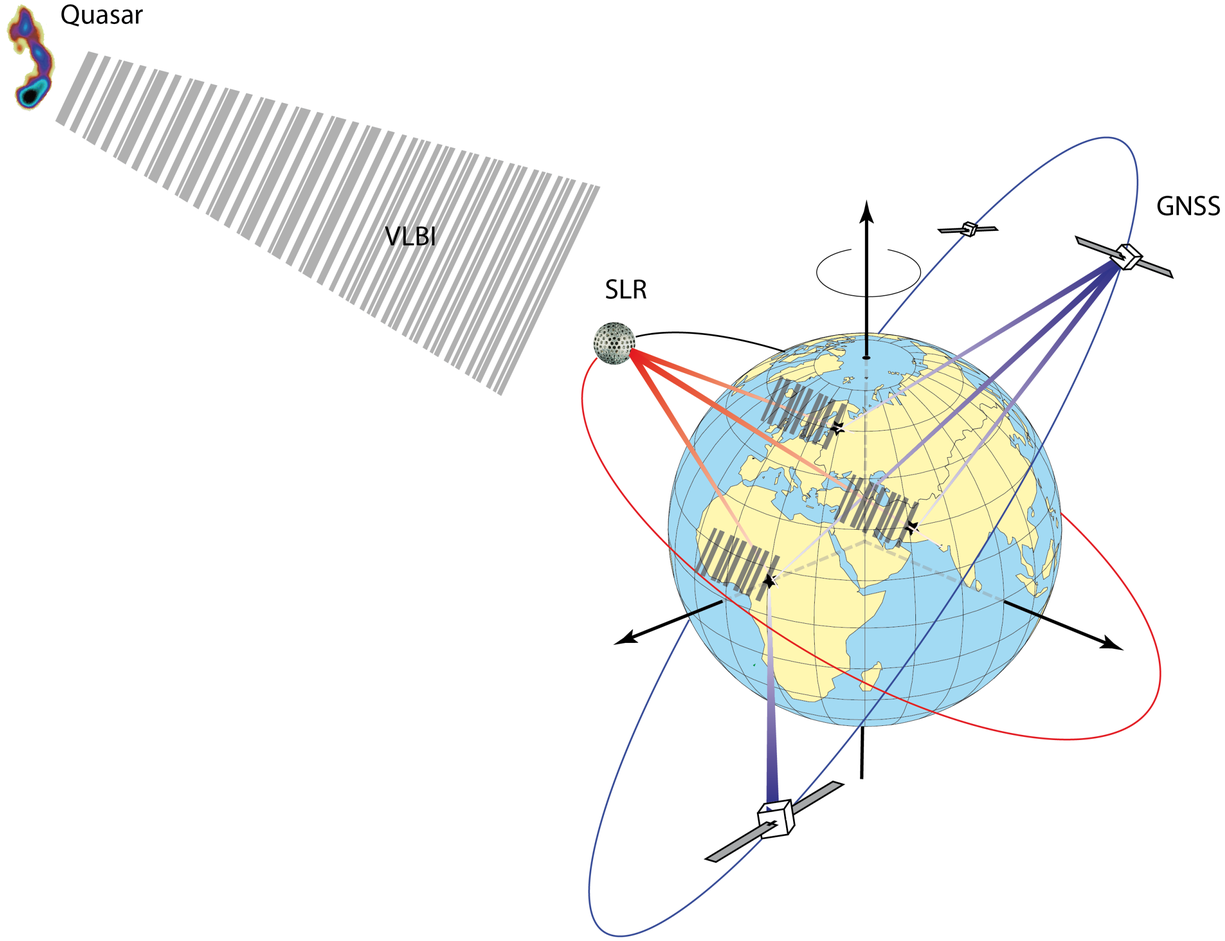
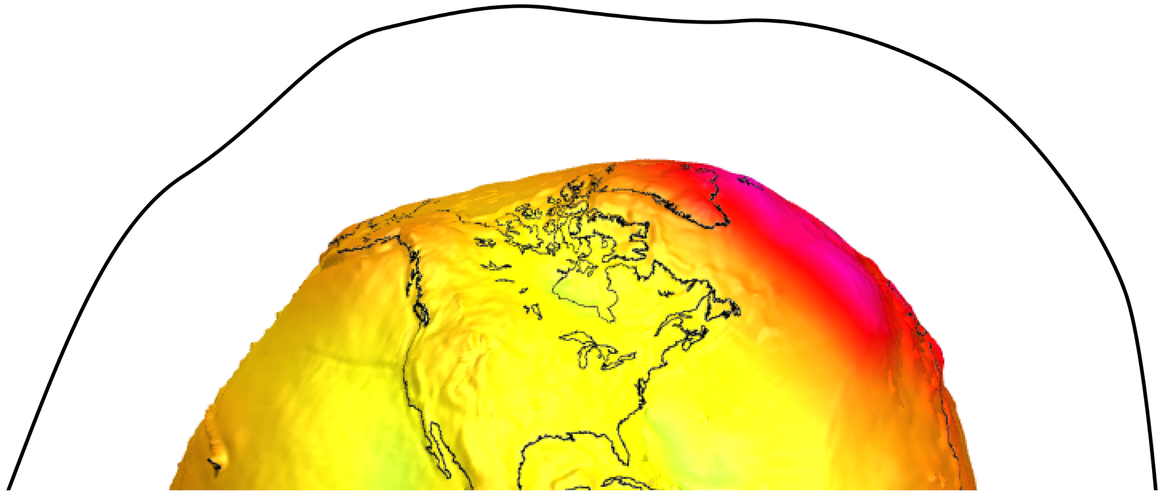
Global Geodetic Measurement Techniques : GNSS (Global Navigation Satellite Systems)

source : swisstopo – Zimmerwald ITRS station



Gravity Field

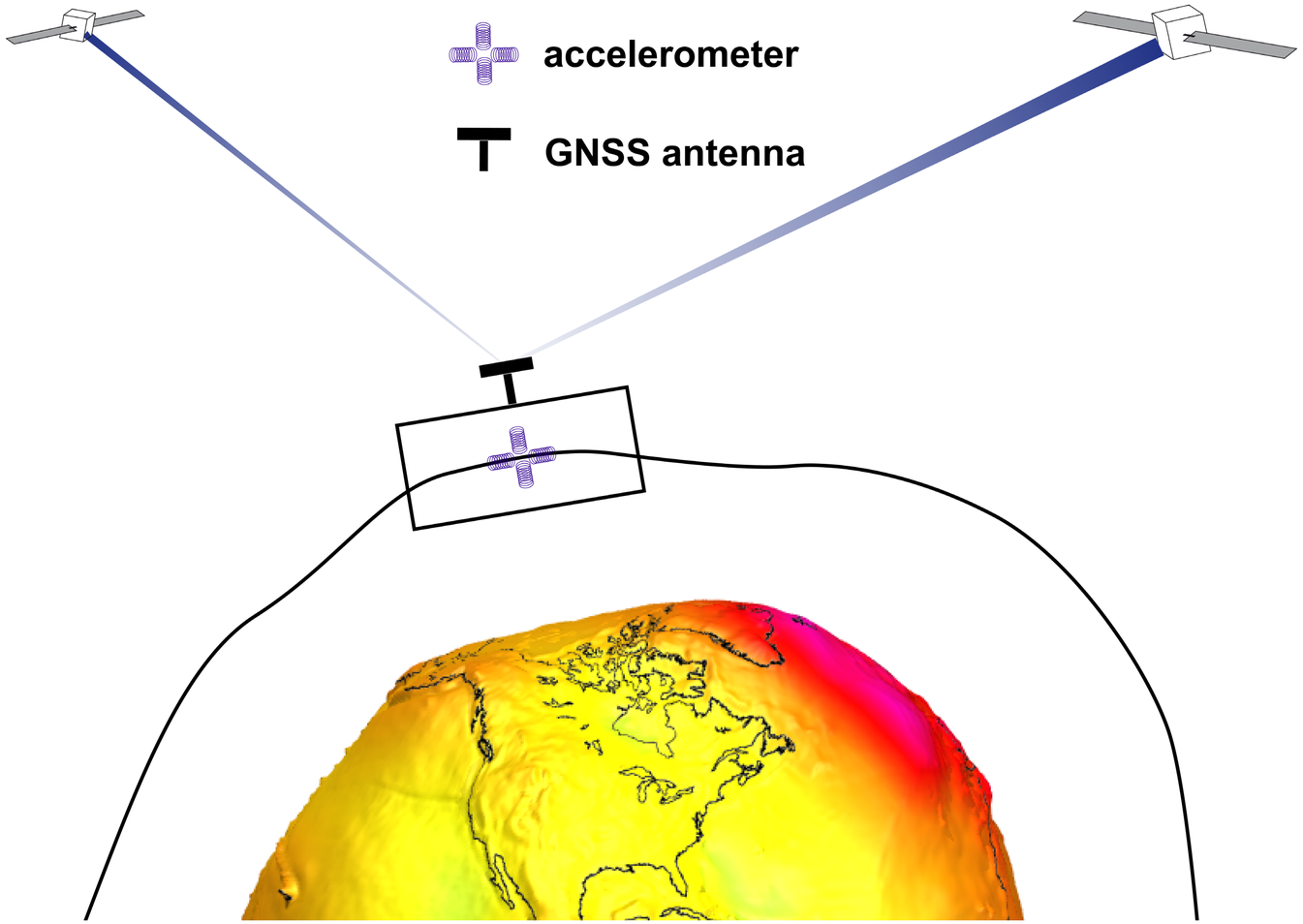
Gravity Field Methods of determination (global)



Gravity Field Methods of determination (global)

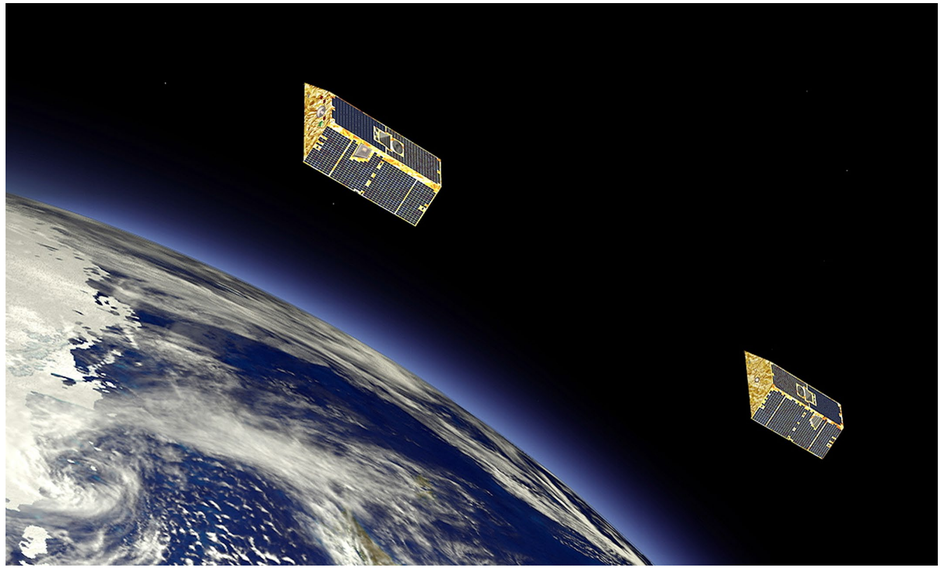
CHAMP

source : GFZ - postdam

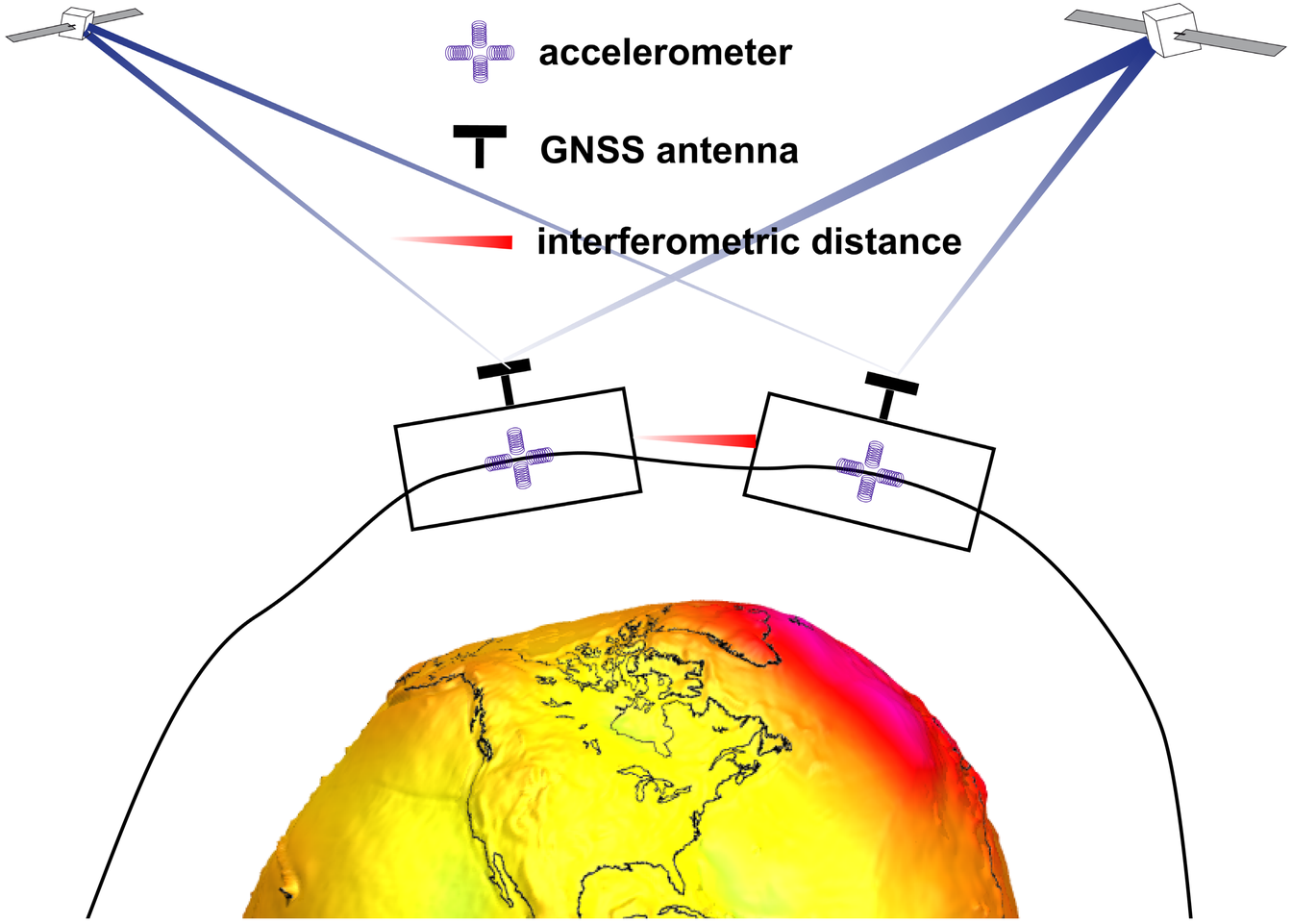


Gravity Field Methods of determination (global)

GRACE & GRACE Follow-On

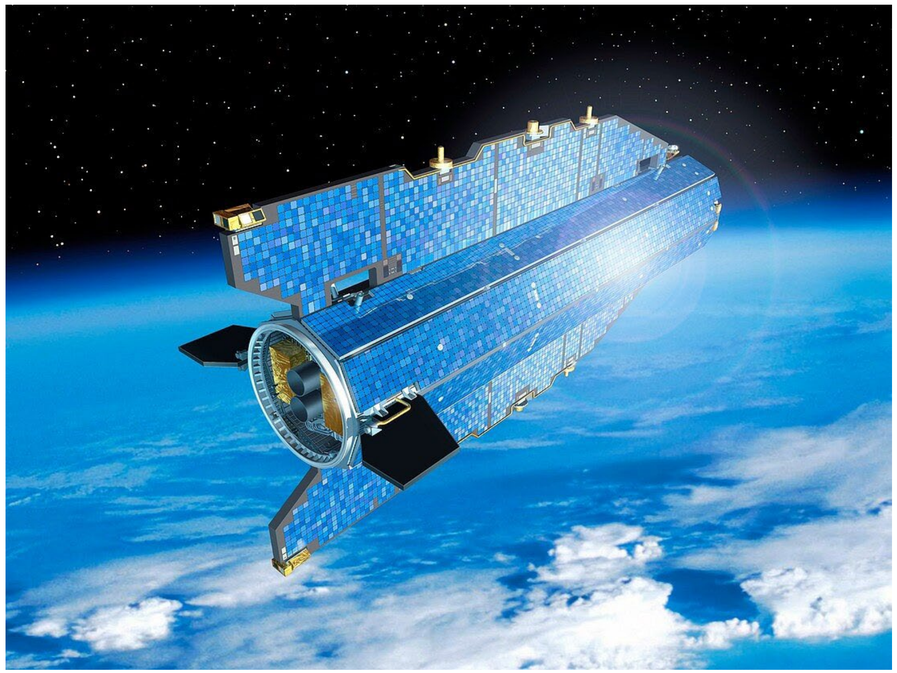


source : GFZ - postdam

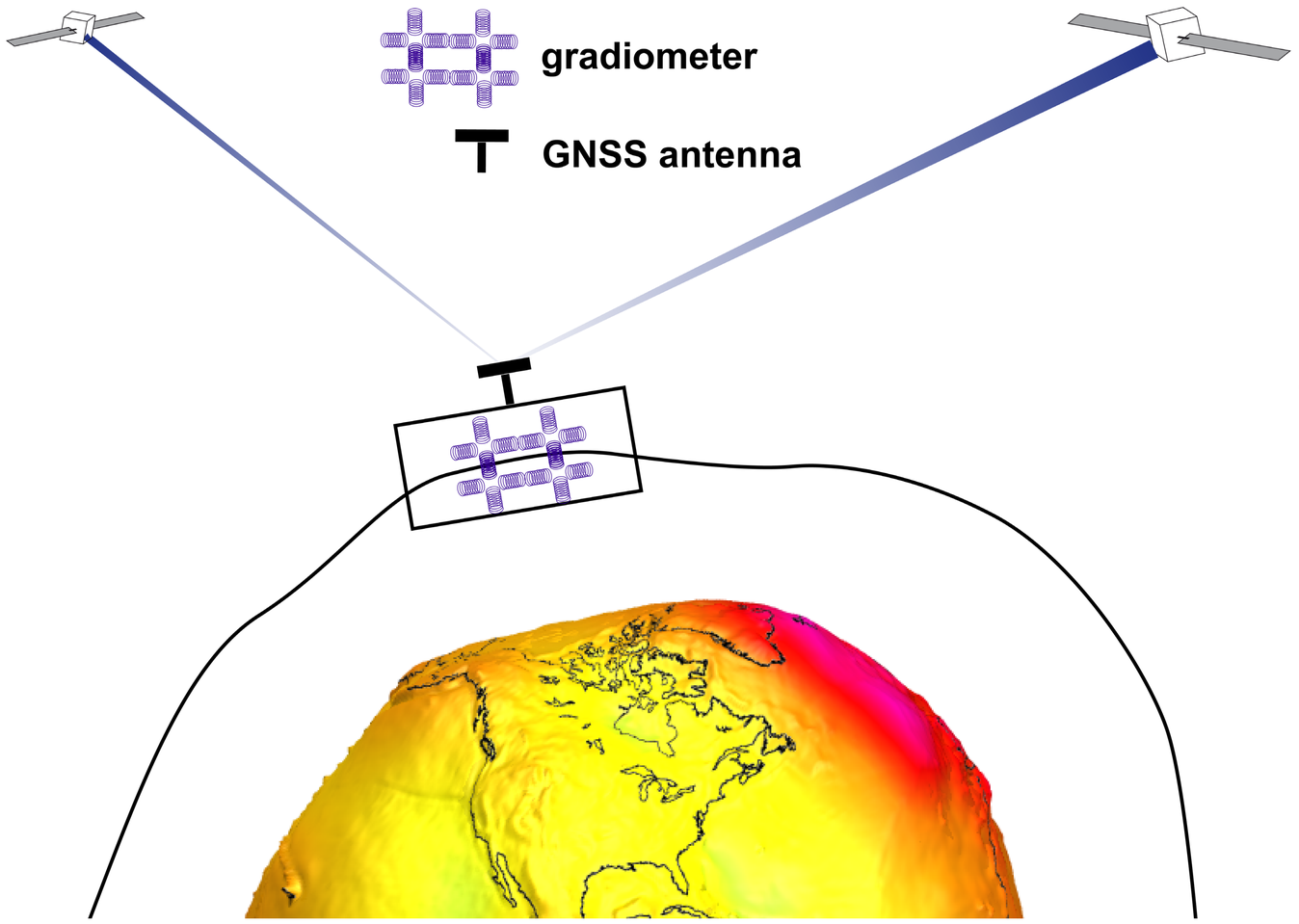


Gravity Field Methods of determination (global)

GOCE



source : ESA



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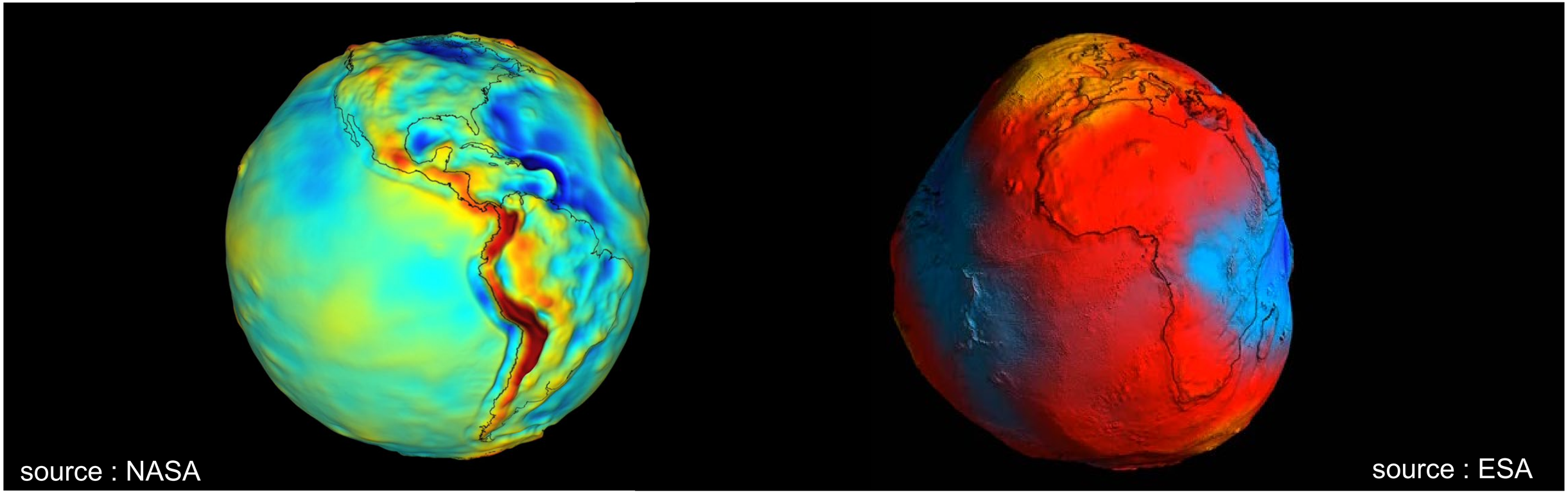
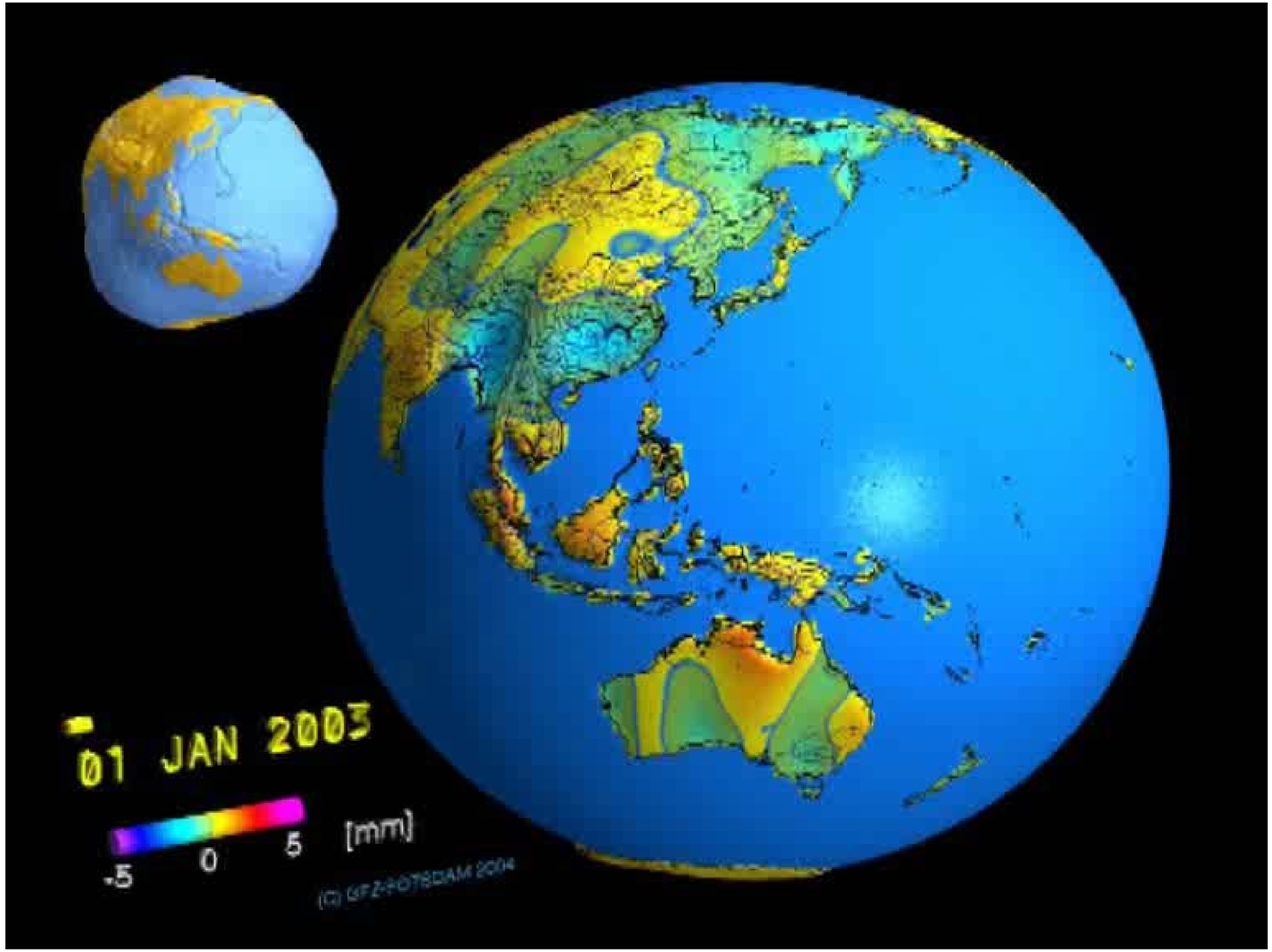


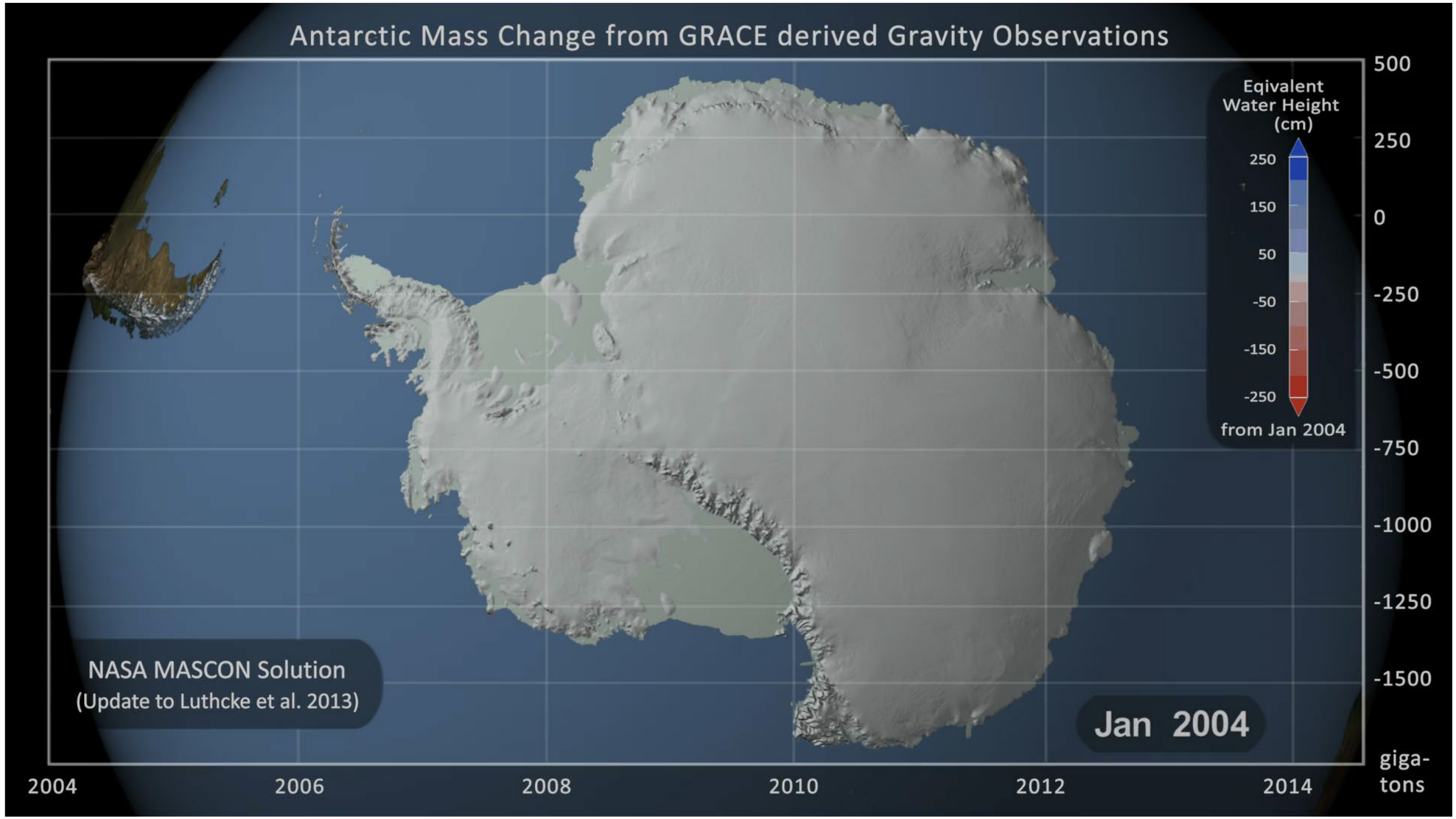
Gravity anomalies

Geoid (1 equipotential of gravity field)

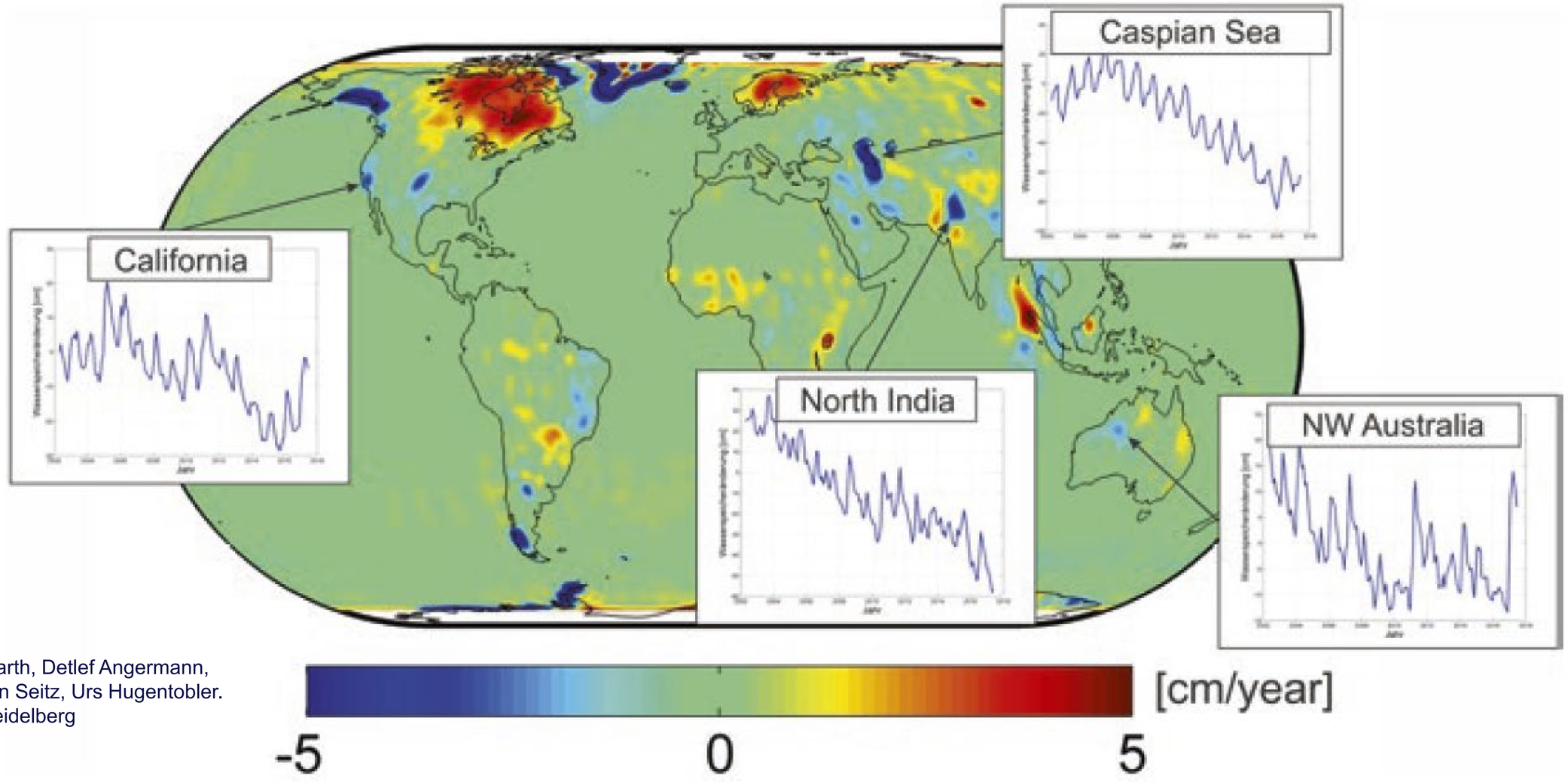
Gravity Field Monitoring the mass changes



Gravity Field Monitoring the mass changes

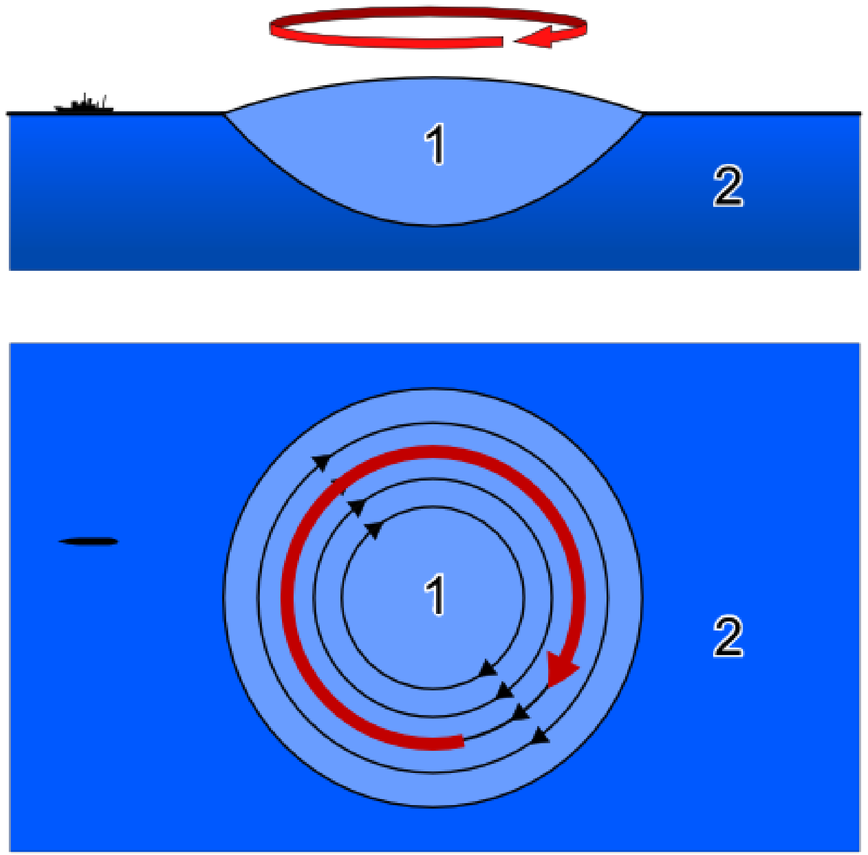


Gravity Field Long-term trends of water mass changes

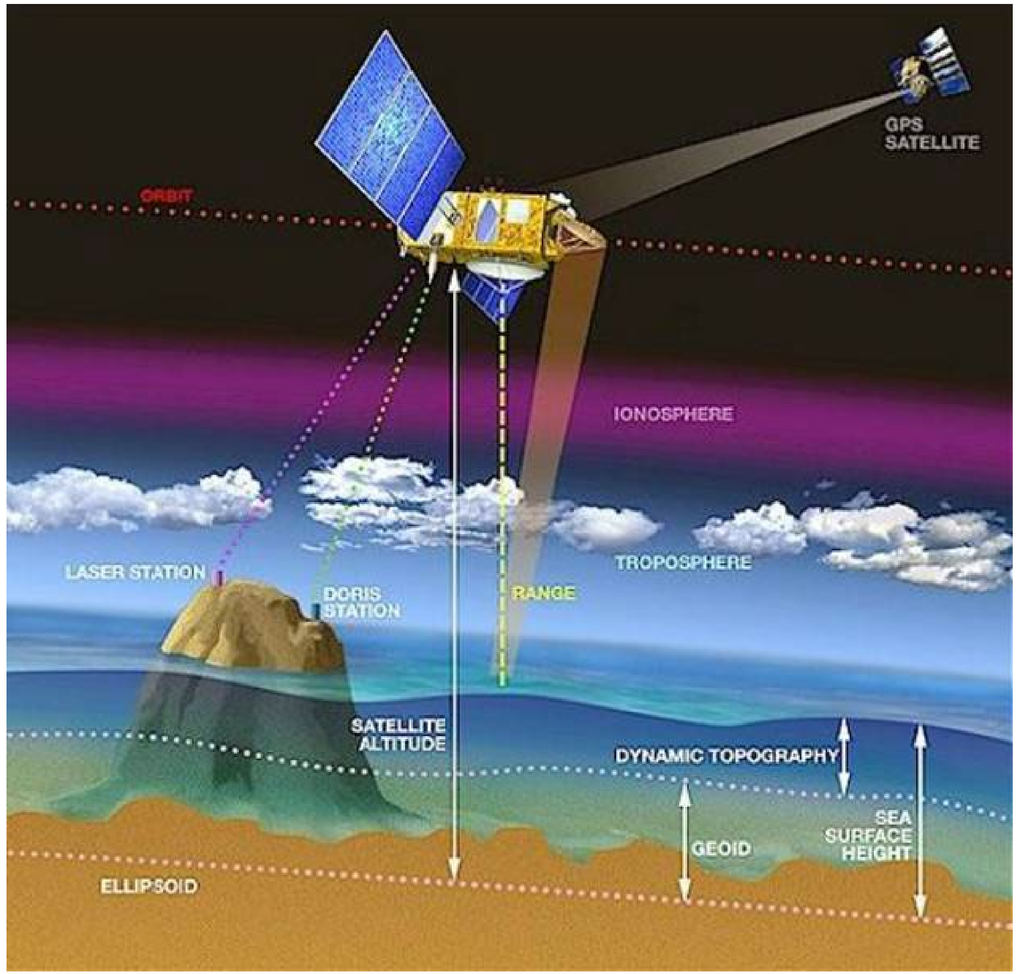


Source: Mission Earth, Detlef Angermann, Roland Pail, Florian Seitz, Urs Hugentobler. Springer Berlin, Heidelberg

Gravity Field Geostrophic currents by satellite altimetry and Geoid



source: wikipedia



source: EUMETSAT

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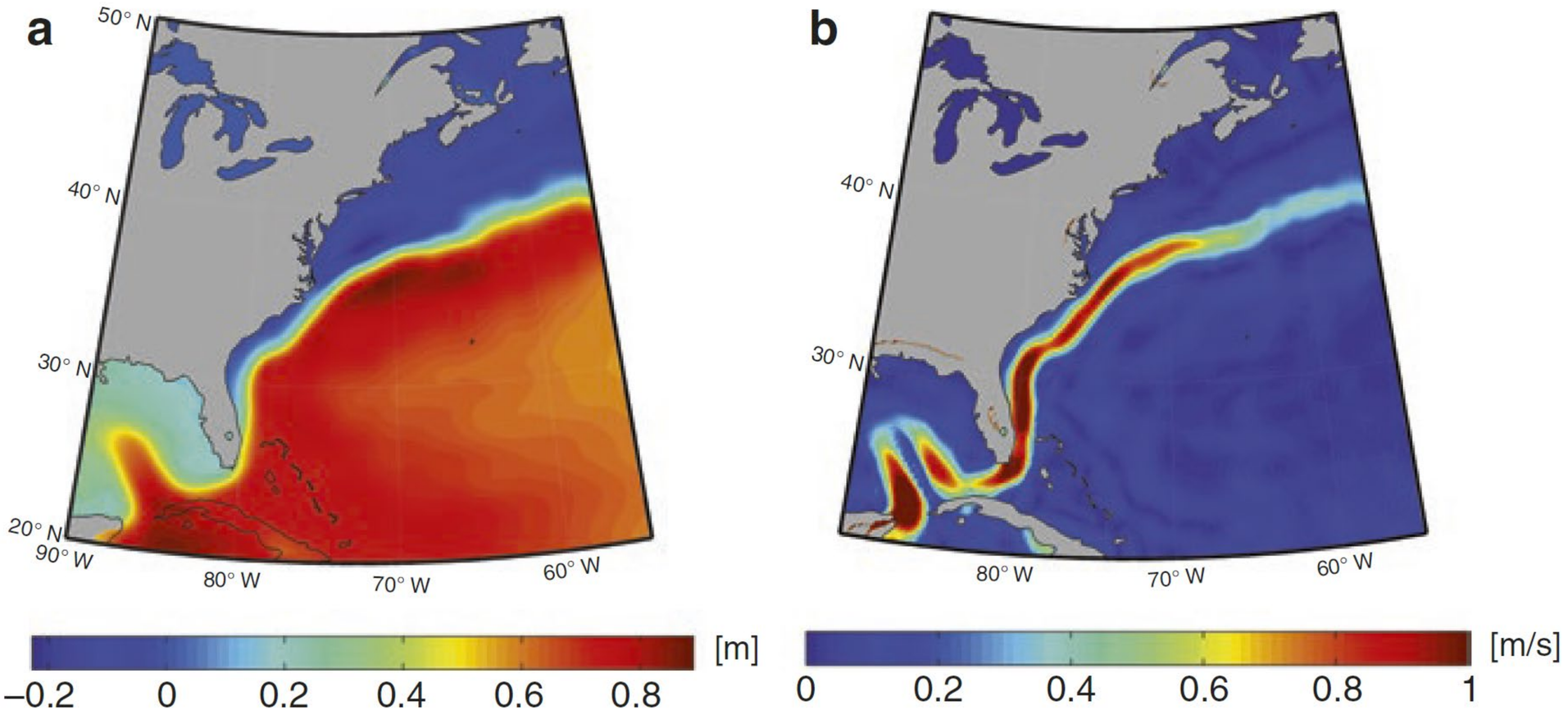
Mean Dynamic Topography
Satellite altimetry & Geoid

Geostrophic current velocities



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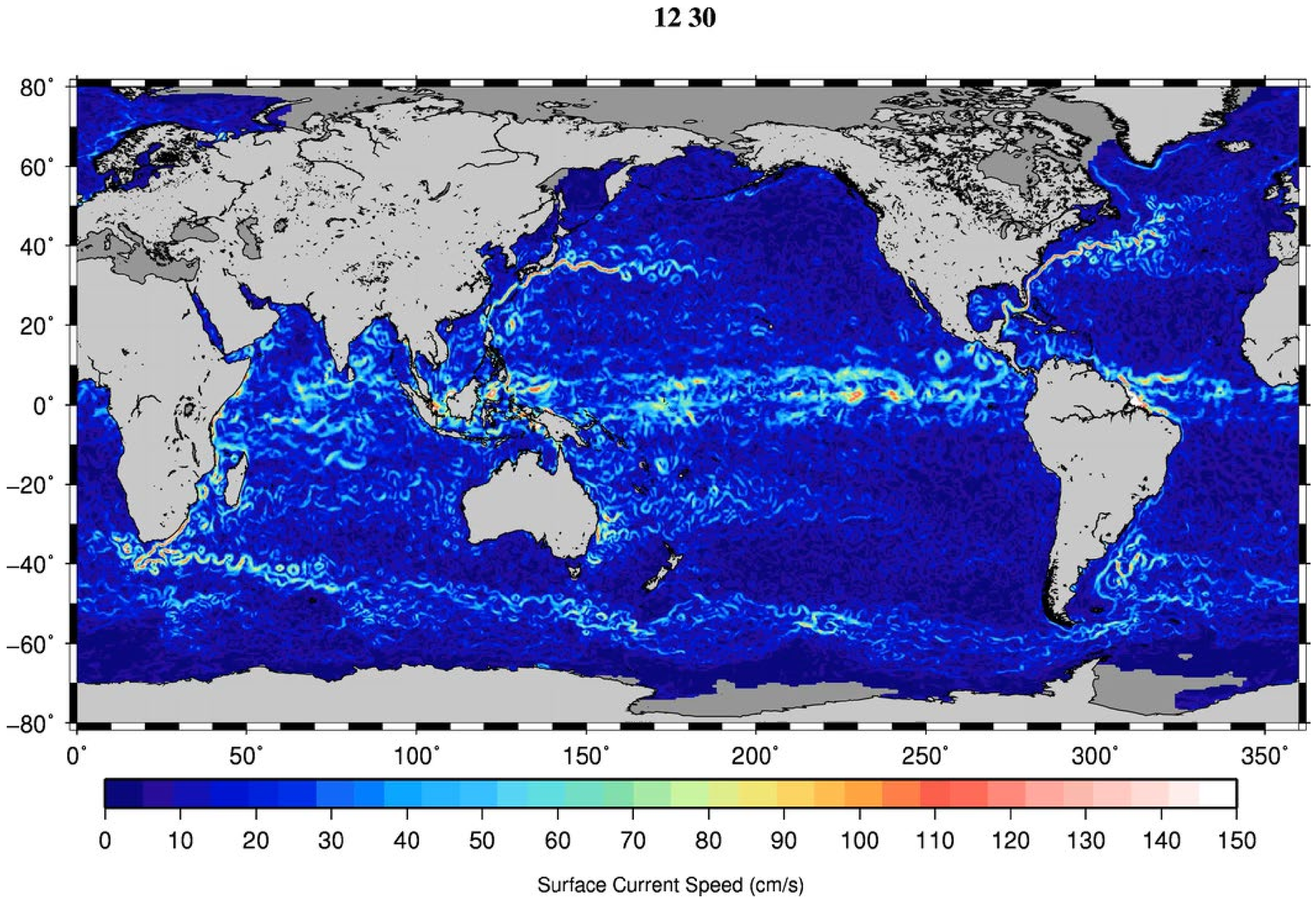

source:https://www.esa.int/spaceinvideos/content/view/embedjw/421907

Thanks for attention

sebastien.guillaume@heig-vd.ch