



Importance of Advocacy and Outreach for Geodesy



Initiatives led under GGOS

Martin Sehnal, BEV – Federal Office of Metrology and Surveying (Austria)
SAGWG | Friday, October 2, 2026



People use geodesy
every day ...

... without even
knowing it.

Navigation
Positioning

How do we explain
this to people outside
our community?

GEODESY

navigation systems
(GNSS)

digital maps

coordinate systems

satellite orbit

gravity field

Earth rotation
timing

Corrections
Atmosphere, tides, ...



Scientific Storytelling



Stories ...

- **Simplifies complexity**
- **Capture attention**
- Makes information **more memorable**

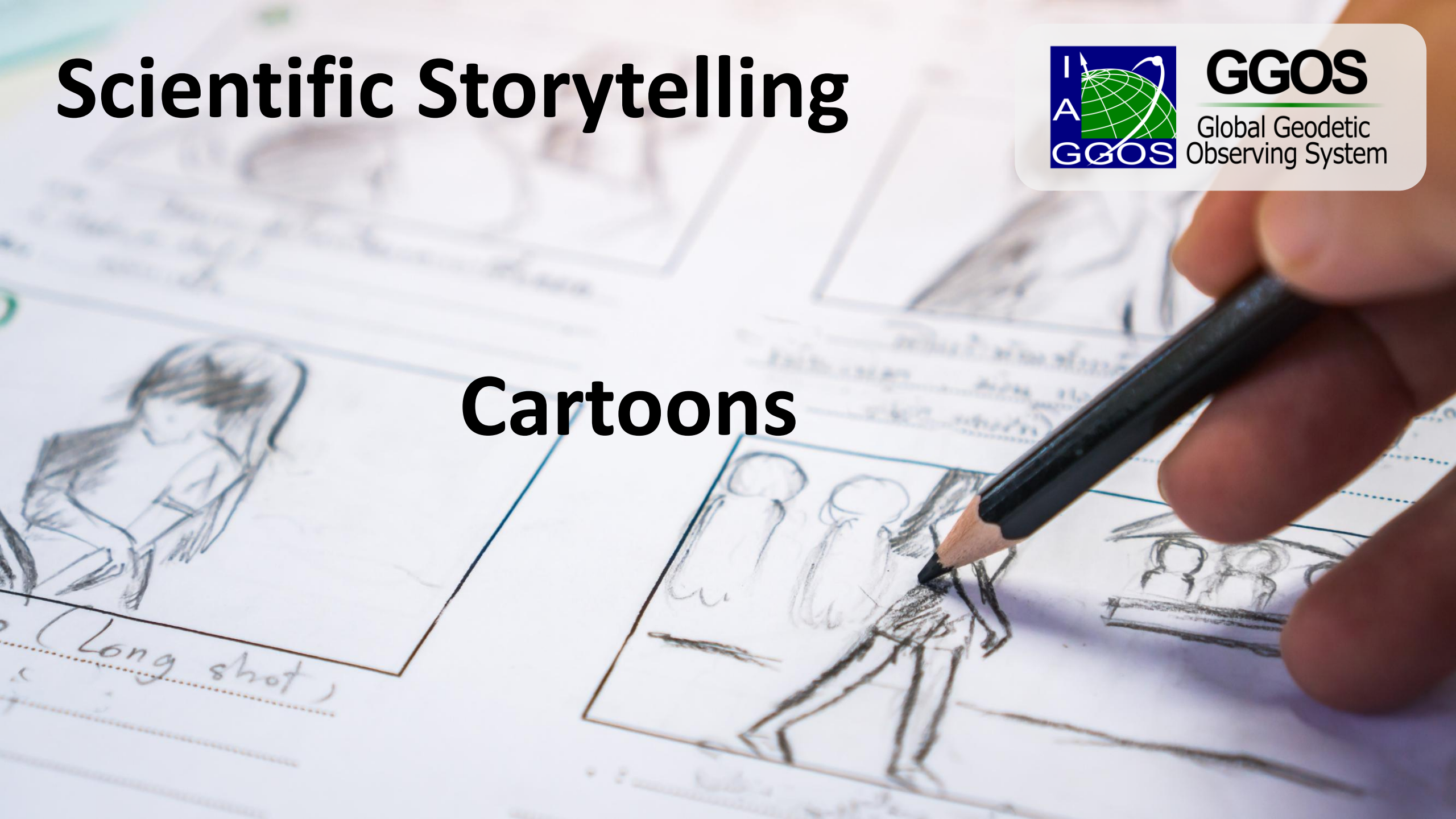
ideal for communicating complex science

Scientific Storytelling



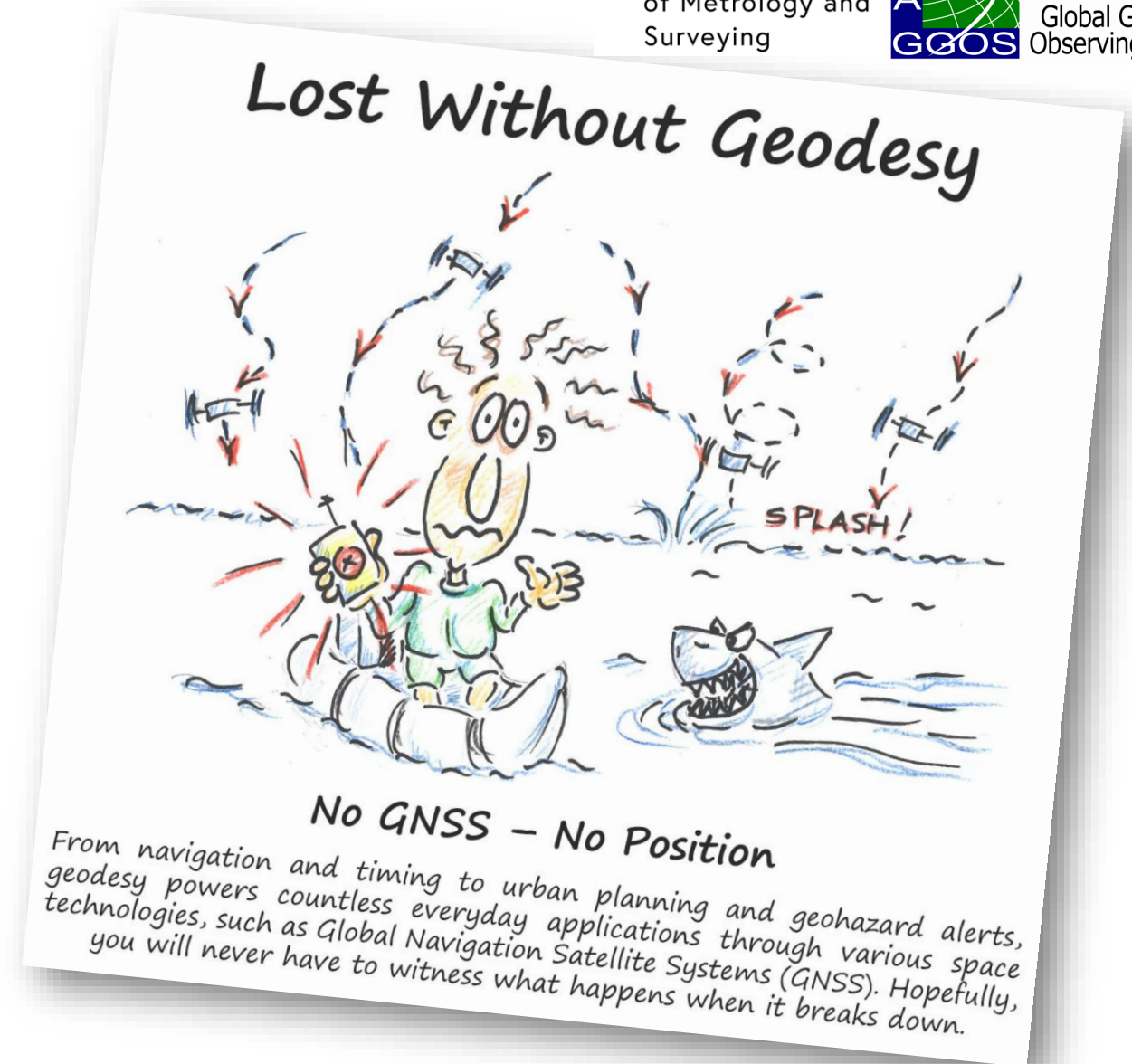
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Observing System

Cartoons



Geodesy Cartoons

- **New media for scientific storytelling**
- **Simplify** complex geodetic topics
- **Make Sciences Funny**
- **Reach wider audience**

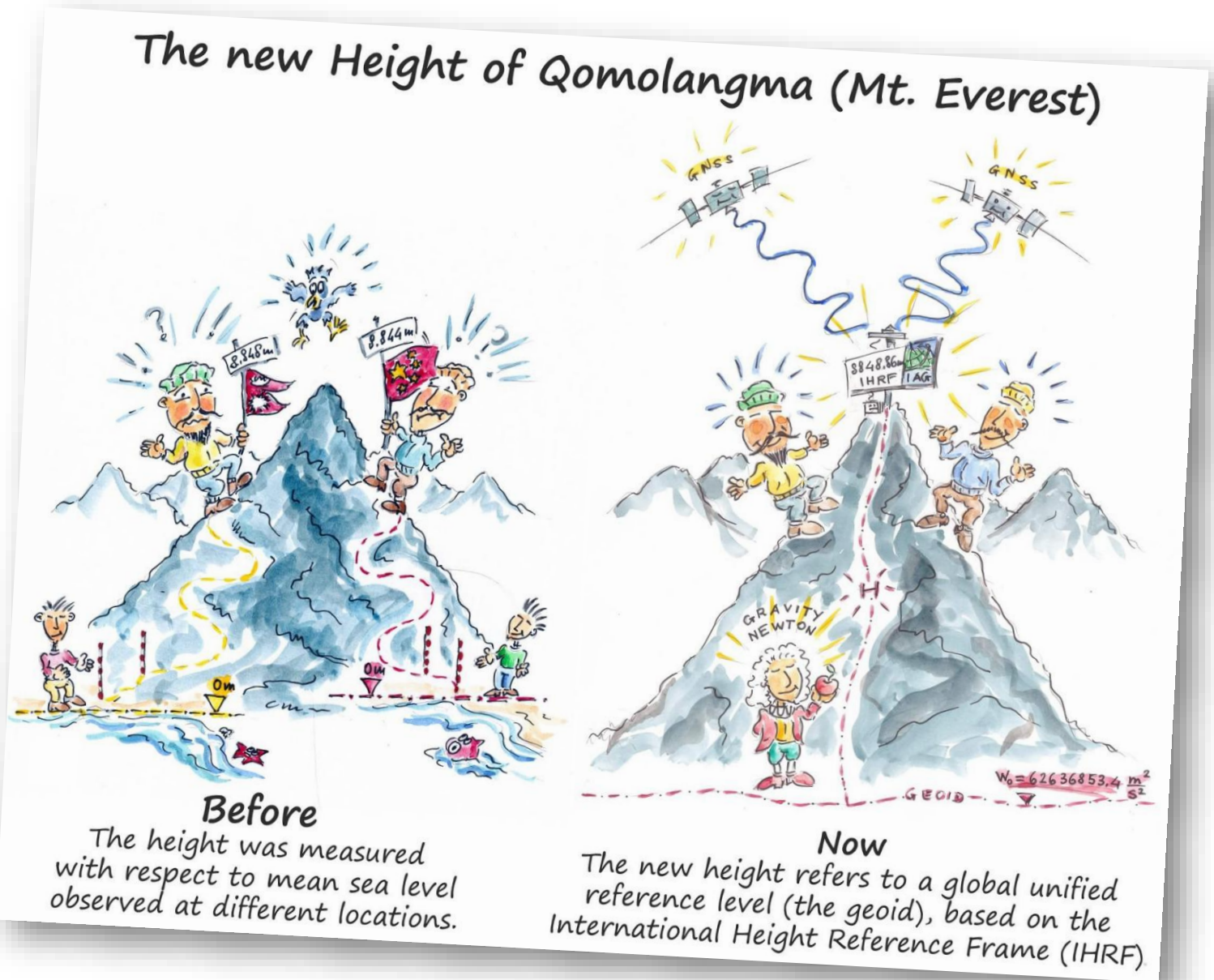


geodesy
.science
/cartoon

Geodesy Cartoons

- Idea and first cartoons in 2024
- First Concept: by Martin Sehnal, Laura Sánchez, Detlef Angermann
- Illustrated by

Riccardo
Barzaghi
cartoonist



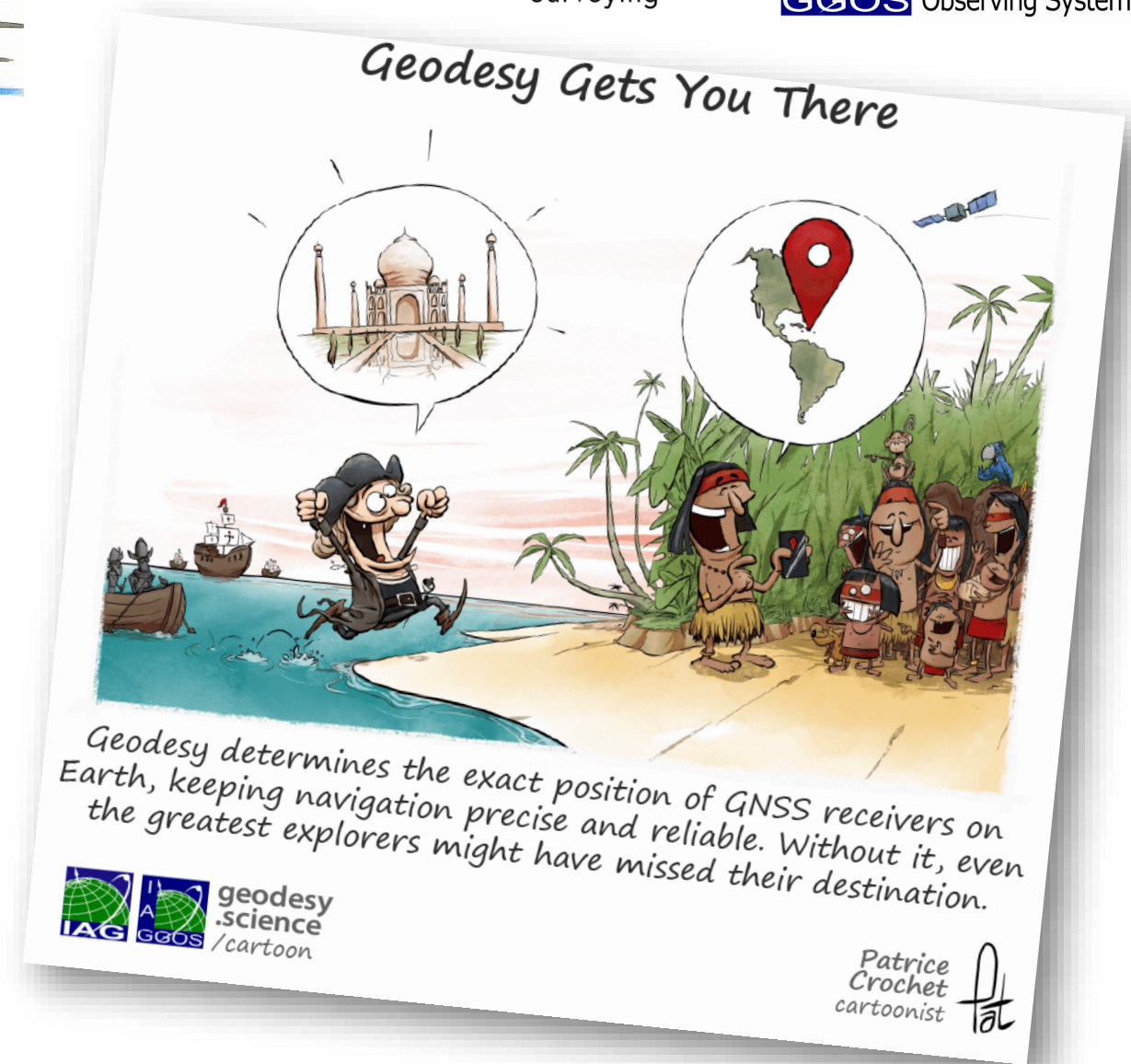
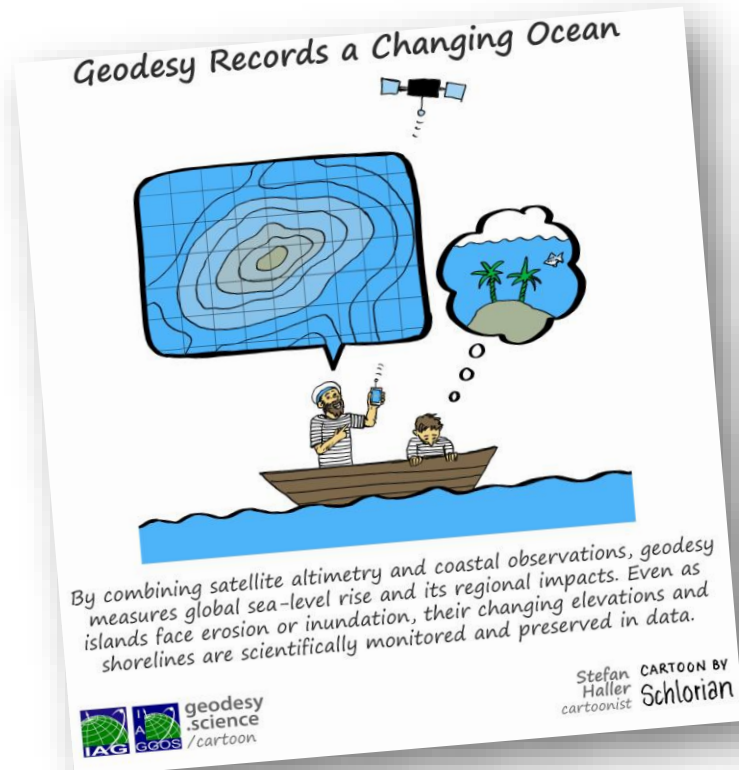
geodesy
.science
/cartoon

GEODESY CARTOON COMPETITION



Goal:

- Get cartoons for **promoting geodesy**
- **Free Use** (CC BY)
- **Encourage geodesy community** (creative minds)



these cartoons shown here are competition submissions

GEODESY CARTOON COMPETITION



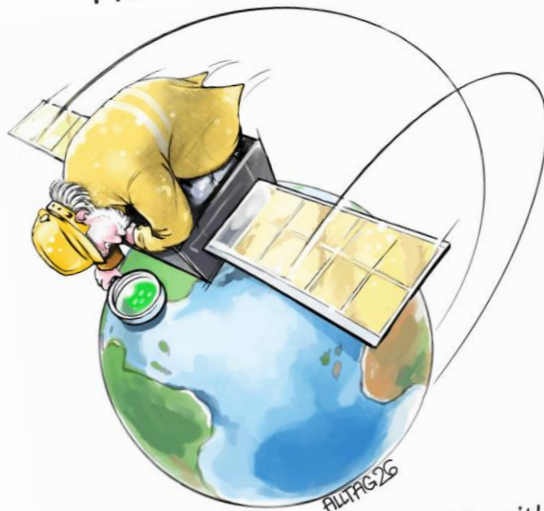
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- **3 Categories:** General, Observations, Products
- **Several Prizes:** 1800 € (in total for all categories, funded by IAG)

Precision from Space



Geodesy observes Earth from orbit with high precision via various satellite missions. Accounting for its constant motion to monitor our planet reliably.



Tristan A
cartoonist **ALLTAG26**



The Usual Suspect



Changing shape. Moving continents. Rising oceans. Whenever the planet acts up, geodesy is there to document the evidence — defining coordinates, reference frames, and the gravity field with millimeter precision. Earth may be dynamic. But it cannot escape measurement.



Daydier
Bernal Calvo
cartoonist



these cartoons shown here are competition submissions

GEODESY CARTOON COMPETITION



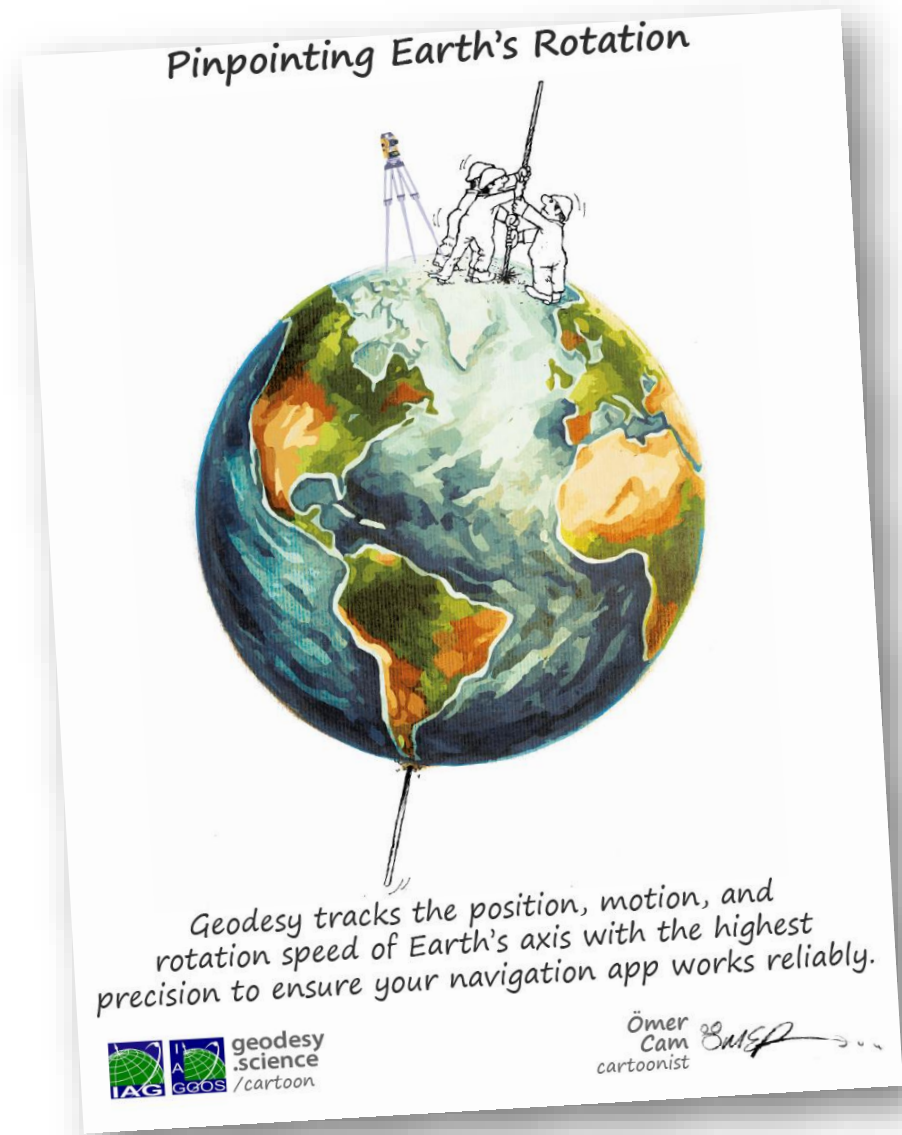
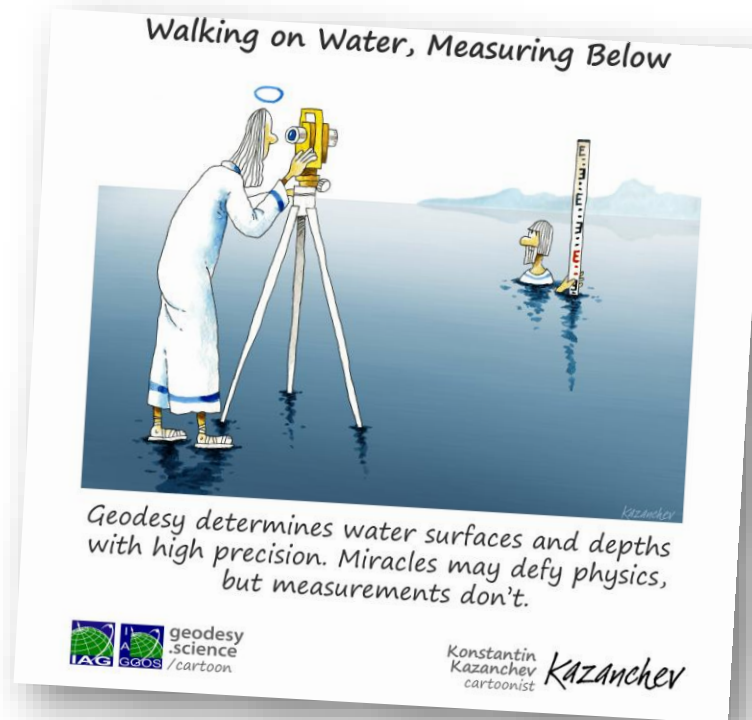
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Timeline:

- **Call Period:** Sept. 2025 - March 2026
- **Voting:** April 2026
- **Winner Announcement:** May 2026
(EGU26 – Geodesy Reception)



these cartoons shown here are competition submissions

GEODESY CARTOON COMPETITION



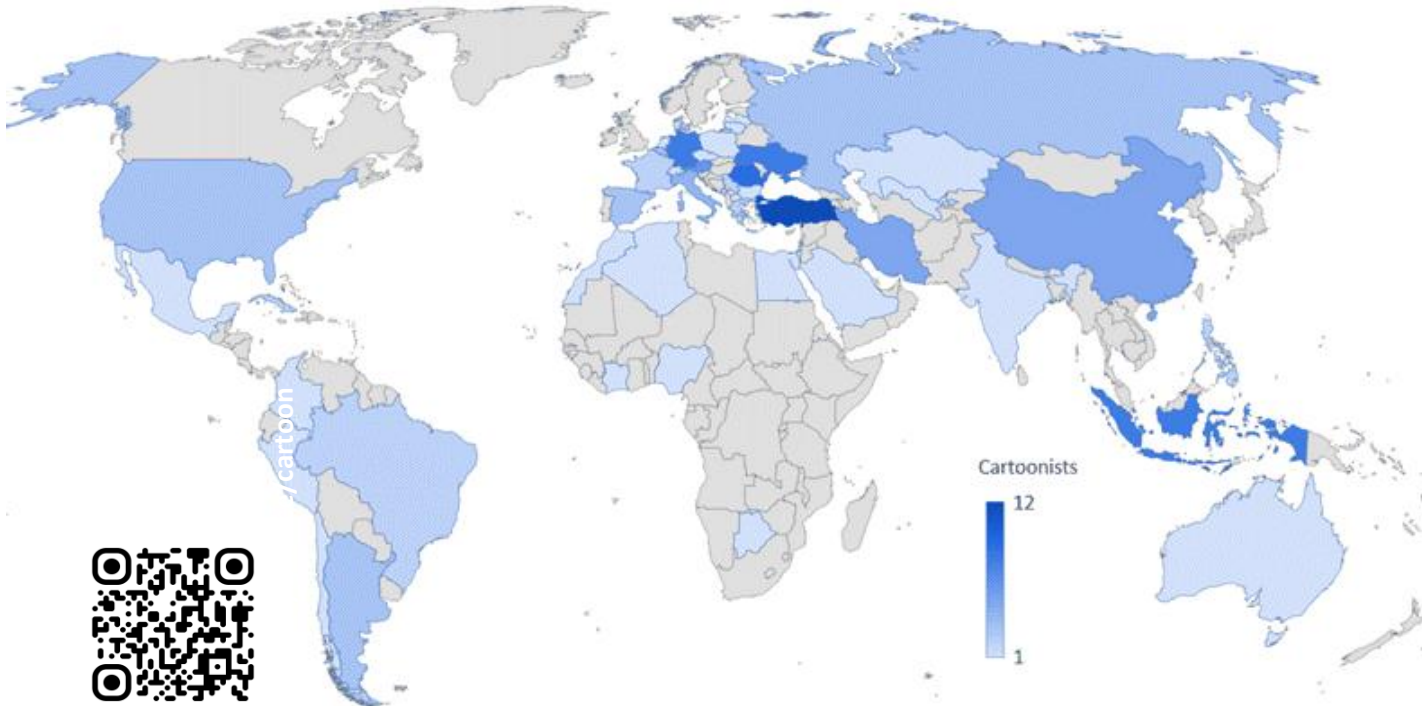
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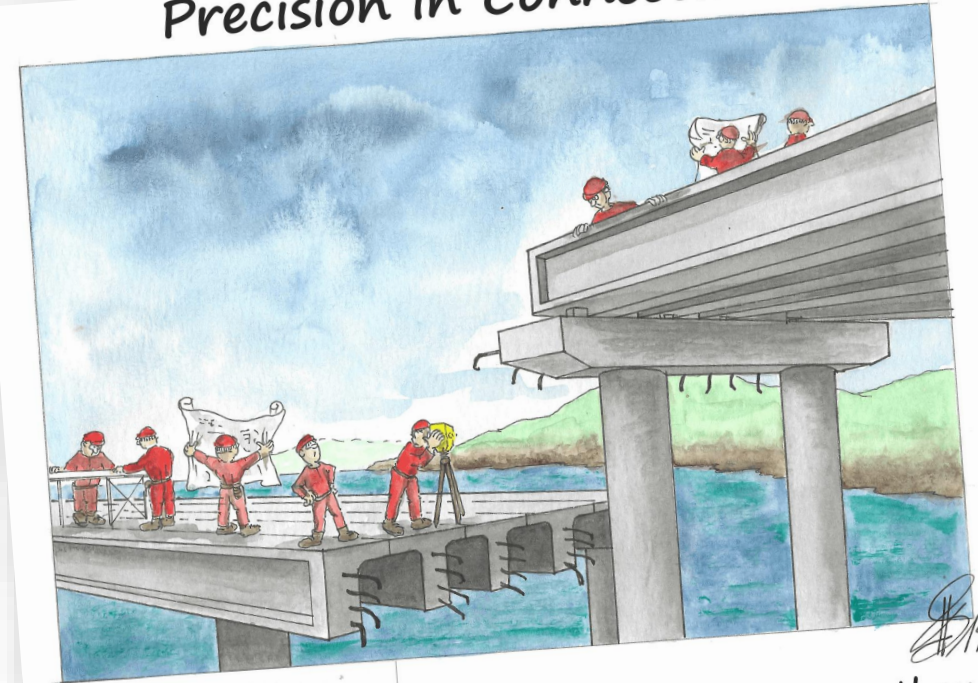
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Results:

- Submitted Cartoons: 274
- Cartoonists: 119 (35 of it by ECS)
- Countries: 46



Precision in Connection



Before structures connect, geodesy ensures they align. It is providing the precise measurements that make bridges meet perfectly. Just make sure both sides use the same reference frame.



Friedrich
Tasser
cartoonist

these cartoons shown here are competition submissions

GEODESY CARTOON COMPETITION



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available soon
in many languages

Where Is the Sea?



Beach day! But the ocean seems to be running late. Whether the tide is high, low, or temporarily far away, geodetic tide gauges keep measuring. Their long-term records help scientists understand sea level change and the dynamics of the oceans.



Eda
Uzunoglu
cartoonist



The Geodetic Tailor



Geodesists stitch together observations of Earth's surface, gravity, rotation, and their changes to tailor the most precise model of our dynamic planet.



Eda
Uzunoglu
cartoonist



these cartoons shown here are competition submissions

Scientific Storytelling



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Short Films

Explaining what cannot
be shown in one image

Geodesy Short Films

2022

Film 1: Discover GGOS & Geodesy

- 14 language versions + subtitles
- 29.000 views



2023/24

Film 2: Terrestrial Reference Frames

- 12 language versions + subtitles
- > 74.000 views



watch
here



youtube.com/@iag-ggos

Distribution Materials

Brochures, Flyers, ...



GGOS
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*image created
by AI (ChatGPT)*

GGOS Flyers

5 Flyers About Geodesy



3 Brochures About Geodesy



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6 Brochures Promoting GGOS & IAG Services



[http://geodesy.science/
media/outreach/](http://geodesy.science/media/outreach/)

Triangle Prism

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2 kinds
scientific & mapping

1. Print everywhere (A4)
2. Fold and glue / stick together
3. Put on table

A MAP LOOKS FIXED. THE EARTH ISN'T.

Our planet is always moving but coordinates must be exact - or nothing works.



Invisible. But Essential.

Positions Known
The world runs on location. How do we know exactly where anything is?

Boundaries Defined
Lines on maps must work on land and at sea. How are borders and property lines placed correctly?

Routes Guided
Vehicles move. Roads and rails must align. How do they stay on track?

Why Geodesy Matters!

Geodesy combines satellite signals and ground stations into reference frames that provide precise positions anywhere on Earth.

Geodesy connects legal boundaries to precisely measured coordinates on the dynamic Earth.

Geodesy provides positioning accurate to centimeters by tying navigation signals to global reference frames.

Learn more at geodesy.science (multiple languages)



United Nations | Global Geodetic Centre of Excellence
Statistics Division - Department of Social and Economic Affairs

IAG **GGODESY** | **FIG**
International Association of Geodesy | FIG Commission 5
Surveying and Measurement

available soon
in many languages

[geodesy.science/
media/outreach/](http://geodesy.science/media/outreach/)

Common Initiative by IAG, GGOS, UN-GGCE and FIG.

Contributors: Rebekka Steffen, Ryan Keenan, Martin Sehnal, Allison Craddock, Kaiwen Zi, Nick Brown and many volunteering people translating the content.



Website Based Outreach



GGOS

Global Geodetic
Observing System

Information Plattform
Data Search Portal



GEODESY

SCIENCE

of studying the Shape, Gravity Field and Rotation of the Earth

Learn More



<https://geodesy.science>

Geodesy in Everyday Life

Empowering Society and Shaping Our Future

Framing our World

Providing the Basis not only for Positioning, Navigation, and Timing but also for Earth System Monitoring

Imagine trying to navigate on a changing planet without a stable frame of reference — it would be like trying to measure the displacement of one moving object from another moving object. Geodetic reference frames, such as the International Terrestrial Reference Frame (ITRF), provide the invisible but essential foundation for everything from GNSS navigation and satellite-based Earth observation to climate monitoring and disaster management. Recognized by the United Nations as a key tool for sustainable development, these reference frames allow scientists to detect even the finest shifts in the Earth's surface, help governments coordinate consistent geographic data across borders, and tell you where you are when you ask your mobile phone. Without them, modern life and science would be unthinkable.

Would you like to know how we can track a planet in motion?

Find out how much your daily life depends on reference frames!



[long version available here \(in several languages\)](#)

What would a day without satellites look like?



Shaping the Path

Geodesy's Central Role in Navigation and Mobility

From autonomous vehicles to aircraft navigation and the smartphone in your pocket, modern mobility depends on geodesy. Global Navigation Satellite Systems (GNSS), such as GPS, GLONASS, GALILEO and BDS, rely on precise geodetic reference frames to determine position anywhere on Earth and in space at any time. This geodetic backbone enables, among many others, safe air travel, guides rescue teams during disasters, and powers location-based services used by billions of people every day. For researchers it is the main tool for detecting and understanding changes in the Earth system; for society, it is the hidden foundation for infrastructure development and helps us move through the world with confidence.

Curious how geodesy keeps us on track?

GGOS Website – Geodetic Products

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51
geodetic products

Station Positions and

- Station Position (SPTS)

Atmosphere State

- Products of the
- Products of the Thermosphere
- Products of the Atmosphere

Regional Reference Frame

- Regional Terrestrial Reference Frame
- Regional Gravity Frame (RGRF)
- Regional Height Frame (RHRF)
- Vertical Datum (VDP)

Regional Gravity Field

- Regional Geoid
- Regional Gravity Quantities (RGF)

Land and Marine Gravity

Sea Surface

- Mean Sea Surface (MSS)
- Sea Level Anomaly (SLA)
- Sea State (SES)
- Empirical Ocean Topography (EOT)

Sea Level

- Global Mean Sea Level (GMSL)
- Global Mean Sea Level Mean Dynamic Topography (MSL/MDT)
- Global Sea Level Change Dynamic Ocean Topography (SLC/DOT)
- Relative Mean Sea Level (RMSL)
- Relative Sea Level Change (RSLC)
- Mean Geostrophic Current (MGC)

Sea Water Level Records

- Sea Water Level Record (SWLR)

Sea Ice

- Sea Ice Extension (SIE)

Land Geometry

- Digital Elevation Model (DEM)
- Digital Terrain Model (DTM)
- Plate Kinematic Model (PKM)
- Earth Surface Deformation (ESD)

Inland Water Level

- Mean Regional Water Level (MRWL)
- Regional Water Level (RWLC)

Terrestrial Water Storage

- Terrestrial Water Storage Anomaly (TWSA)

Ice Sheets

- Ice Mass Change (IMC)
- Ice Sheet Thickness (IST)

Glaciers

- Glacier Mass Change (GMC)

Global Reference Frames

- Celestial Reference Frame (CRF)
- Terrestrial Reference Frame (TRF)
- Gravity Reference Frame (GRF)
- Height Reference Frame (HRF)

Global Earth Gravity Field

- Global Gravity Field Models (GGM)
- Topographic Gravity Field Models (TGFM)
- Global Gravity Field Quantities (GFQ)

Earth Orientation Parameters

- Celestial Pole Offset (CPO)
- Universal Time (UT1)
- Length of Day (LOD)
- Polar Motion (PM)

Satellite Orbits

- GNSS Satellite Orbits, Clocks and Biases (GOCB)
- Earth Observation Satellite Orbits (ESO)

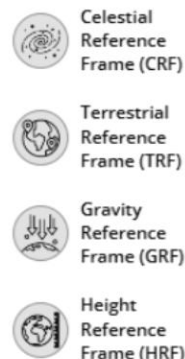


PRODUCTS

Search products

Enter a product name

Global Reference Frames



Global Earth Gravity



Global Gravity
Field Models

Digital Elevation Model and Digital Terrain Model

Geodetic Products of EGV: Land Geometry

How can the Earth's surface be represented?

Digital Elevation Model (DEM)

Digital Elevation Models is a generic term to indicate the discrete representation of the **surface of the Earth** using points generally placed on a **regular grid**. For each point its position is known in a chosen **reference frame** and represented through a chosen **coordinate system** [**horizontal coordinates**: geographic (latitude, longitude) or cartographic (East, North)] and **elevation** [heights or depths: orthometric with respect to a chosen **geoid** model or ellipsoidal with respect to a reference ellipsoid].

Digital Terrain Model (DTM)

The concept of **DTM** is not only limited to Earth's visible terrain surface. It also finds application in **bathymetry** (digital **bathymetry** models describing the geometry of the sea floor), polar **geodesy** (digital bedrock models to describe the rock below the ice sheets), and planetary sciences (**digital elevation models** of the planetary surfaces).

DTMs are usually provided in terms of regularly spaced grids which allow simple data handling, manipulation, and storage. Most recently, **DTMs** used in **Geodesy** are also given in terms of surface spherical harmonic coefficients computed from a high-resolution 2D grid. In this case, **DTM** heights are obtained through series expansion of the coefficients. Currently, those spherical harmonic **DTM** representations reach spatial resolutions of about 2 km, equivalent to harmonic degree 10,800.

<https://geodesy.science/ggos/products>

GGOS Website - EGV

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About Structure Observations Services Products EGV Resources

EGV – Essential Geodetic Variables



Global
Reference
Frames

Global Earth
Gravity Field

Earth
Orientation
Parameters

Satellite
Orbits

Station
Positions and
Variations

Atmosphere
State



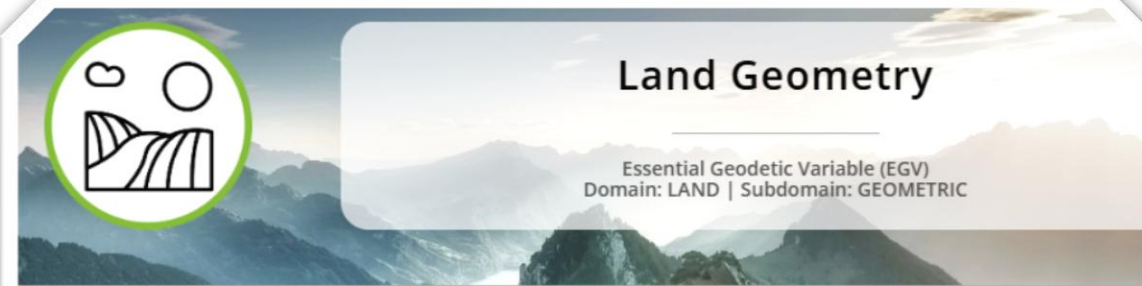
Regional
Reference
Frames

Regional
Gravity Field
Model

Land and
Marine
Gravity Data

18 EGV

<https://geodesy.science/ggos/egv/>



Land Geometry

Essential Geodetic Variable (EGV)
Domain: LAND | Subdomain: GEOMETRIC

Essential Geodetic Variables

Global

- Global Reference Frames
- Global Earth Gravity Field
- Earth Orientation

Sea Surface

Sea Level



Land
Geometry

Inland Water
Level

Terrestrial
Water
Storage

Monitoring the land surface and its changes over time is essential for updating and maintaining regional and global **reference frames**, as they require accurate plate kinematic and deformation models to remain consistent over time. Elevation models are necessary for producing accurate topography maps, contour lines, and elevation profiles, providing a basis for national, regional, and global topographic databases. These databases are essential for orthorectification and to facilitate land use and drainage management, placement, sight and inter-visibility analysis.

The following **geodetic products** are key to the Land Geometry Geodetic Variable:

Digital Elevation Model (DEM)

Digital Terrain Model (DTM)

Plate Kinematic Model (PKM)

Earth Surface Deformation (ESD)

GGOS Portal | Search Tool – Geodetic Data

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GGOS Portal Search Map

Search for geodetic data & products ...

Browse by Categories

Search all categories ...

Essential Geodetic Variables (EGV)

- EGV Levels
- EGV Domains
- EGV Subdomains
- Geodetic Products
- IAG Service or Component

	Atmosphere State	24 datasets
	Earth Orientation Parameters	61 datasets
	Geodetic Infrastructure	6378 datasets
	Geodetic Observations	14516 datasets
	Geodetic Standards and Conventions	10 datasets
	Station Positions and Variations	26 datasets
	Satellite Orbits	104 datasets

GGOS Portal Search Map Search Tool for Geodetic Data & Products

Change Map

2D 3D

Search Dataset >

SWOT

Mission / system SWOT

Category Altimetry DORIS receiver SLR tracked

Provider CelesTrak

Displayed orbit (24 h) 2026-09-16T15:04:53Z
2026-09-17T15:04:53Z

Available data 2026-07-13T14:31:15Z
2026-09-17T15:04:53Z

☐ Ground track (co-rotating)

[Open satellite info](#) [Open satellite orbit info](#)

<https://data.geodesy.science>



A

- A-GPS / A-GNSS - Assisted GPS
- AAM - Atmospheric Angular Momentum
- Absolute Gravimetry
- Absolute positioning
- AC - Analysis Center
- ACC - Analysis Center Coordinates
- Accuracy
- ADOP - Ambiguity Dilution of Precision
- ADT - Absolute Dynamic Topography
- AFREF - African Reference Frame
- AGGO - Argentine-German Geodetic Observing System
- AGrav - Absolute Gravity Data
- AGU - American Geophysical Union
- AIUB - Astronomical Institute of the University of Bern
- Almanac
- Altimetry
- Ambiguity resolution
- AOC - Advanced Operational Capability
- APREF - Asia-Pacific Reference Frame
- AROF - Ambiguity Resolution
- ARP - Antenna Reference Point
- AS - Anti-spoofing
- ASI - Italian Space Agency
- Atmospheric Delay
- Atmospheric Loading
- Atomic Clock

B

- B1 / B2 / B3 - BeiDou frequencies
- Baseline
- Bathymetry

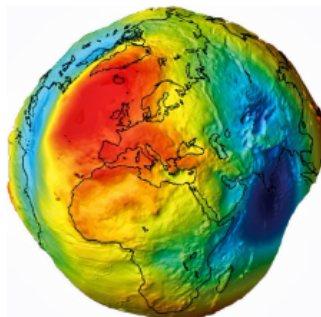
Geodesy Glossary

<https://geodesy.science/glossary-geodesy>

Geoid

The **geoid** is an **equipotential surface** of the Earth's **gravity field** that closely approximates mean sea level, that is, the average surface of the oceans in the absence of dynamic influences such as winds, **tides**, currents, and atmospheric pressure variations. It represents the surface to which water would settle if the oceans were allowed to adjust only under the influence of **gravity** and Earth's rotation. Because the **geoid** follows variations in the Earth's **gravity field** caused by uneven mass distribution within the planet, it has an irregular shape that differs from a simple geometric ellipsoid.

In **geodesy**, the **geoid** plays a fundamental role as the reference surface for the definition of **physical heights**. Heights measured in surveying and engineering are typically related to the **geoid** rather than to a purely geometric surface. Accurate knowledge of the **geoid** is therefore essential for establishing consistent height **reference systems**, such as the **International Height Reference System**, and for applications ranging from **mapping** and infrastructure development to oceanography, hydrology, and the study of mass transport and sea level change within the **Earth system**.



More Info:

- **Regional / Local Geoid Models**
- **Height Systems**
- **ISG - International Service on the Geoid**

- Short descriptions & more info links
- Idea: Use it as a **living resource**
- **Community**: review & updating

~ **600**
items

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April 2026
Announcement

8-9 k
Views / month

> 10 % of
website traffic

Top search terms

1	Geoid	2,907	
2	Reference Frame	1,943	
3	Gravity Field	1,315	
4	Earth Rotation	840	
5	Reference System	767	



<https://geodesy.science/glossary-geodesy>

Lessons Learned

1. **Outreach matters**
2. **Tell stories, not just facts** (storytelling: reduce complexity & make memorable)
3. **Think globally** (various languages)
4. **Engage the community** (geodesy cartoon competition, GGOS films)
5. **Collaborate with Stakeholders** (UN-GGCE, FIG, ...)
6. **Use different formats** (cartoons, films, print, websites, ...)
7. **Distribution is as important as creation** (social media, newsletters, ...)



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Thank you



Martin Sehnal

ggos@geodesy.science



science, technology
& innovation
Department:
Science, Technology and Innovation
REPUBLIC OF SOUTH AFRICA



land reform &
rural development
Department:
Land Reform and Rural Development
REPUBLIC OF SOUTH AFRICA



SARAO
South African Radio
Astronomy Observatory



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