IGS goes to the Moon?

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IGS INTERNATIONAL GNSS SERVICE

Providing highest-possible quality GNSS data, products and services…

KARR00AUS
Karratha, Australia
Photo courtesy of Geoscience Australia


IGS
INTERNATIONAL
GNSS SERVICE
...on a free and openly available basis
to the benefit of science and society.
HOB200AUS
Hobart, Australia
Photo courtesy of Geoscience Australia

#

Formats and Standards

non-commercial, scientifically driven and manufacturer-neutral organization

IGS Data Standards

Improving Service Quality and International Collaboration

The IGS establishes and maintains
data exchange standards that enable
seamless and interoperable data transfers
among a broad variety of equipment and applications.

Applications: basic receiver data,
integrated GNSS solutions,
satellite orbits, station coordinates,
atmospheric parameters, *etc.*

https://igs.org/wg/rinex/

IGS standards greatly facilitate **international collaborations**
and the **interdisciplinary** contribution of GNSS to **Earth sciences,**
but also industry and even system providers. .

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IGS Data Standards

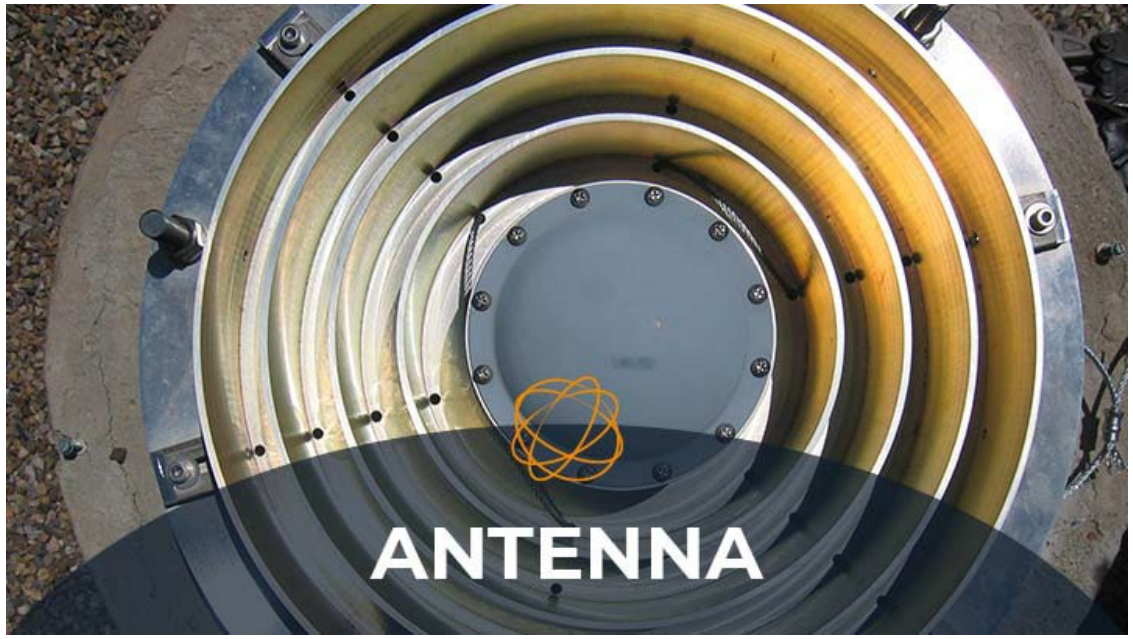
For the Moon we expect:

One observation format containing the measurements from all systems independent from the owner of the tracking system with a sufficient specification of the tracking mode

Products should also be exchanged and disseminated in internationally agreed formats.

Example: Antenna Calibration Standard

The IGS has **developed standards** **for calibrating GNSS receiver antennas**. To get the standard accepted it was helpful that the IGS does not act as equipment manufacturer on the market.



IGS Product Committee

Robot for GNSS receiver antenna calibrations at
Institute of Geodesy, Leibnitz Universität Hannover, Germany.

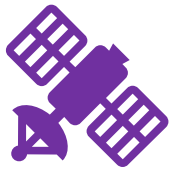
Interface to the community

Example: Metadata from GNSS satellites

IGS community

IGS central bureau

GNSS system provider



Interface to the community

Example: Metadata from GNSS satellites

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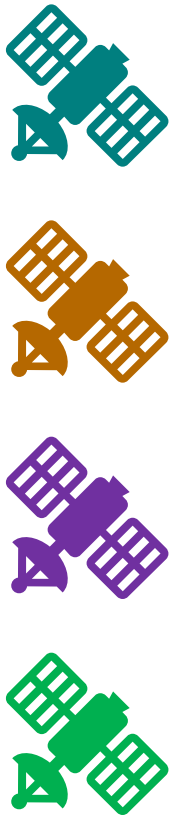
GNSS system provider

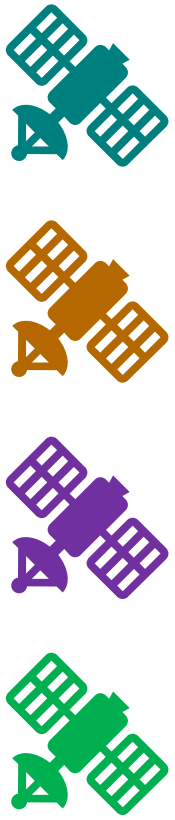


Interface to the community

Example:

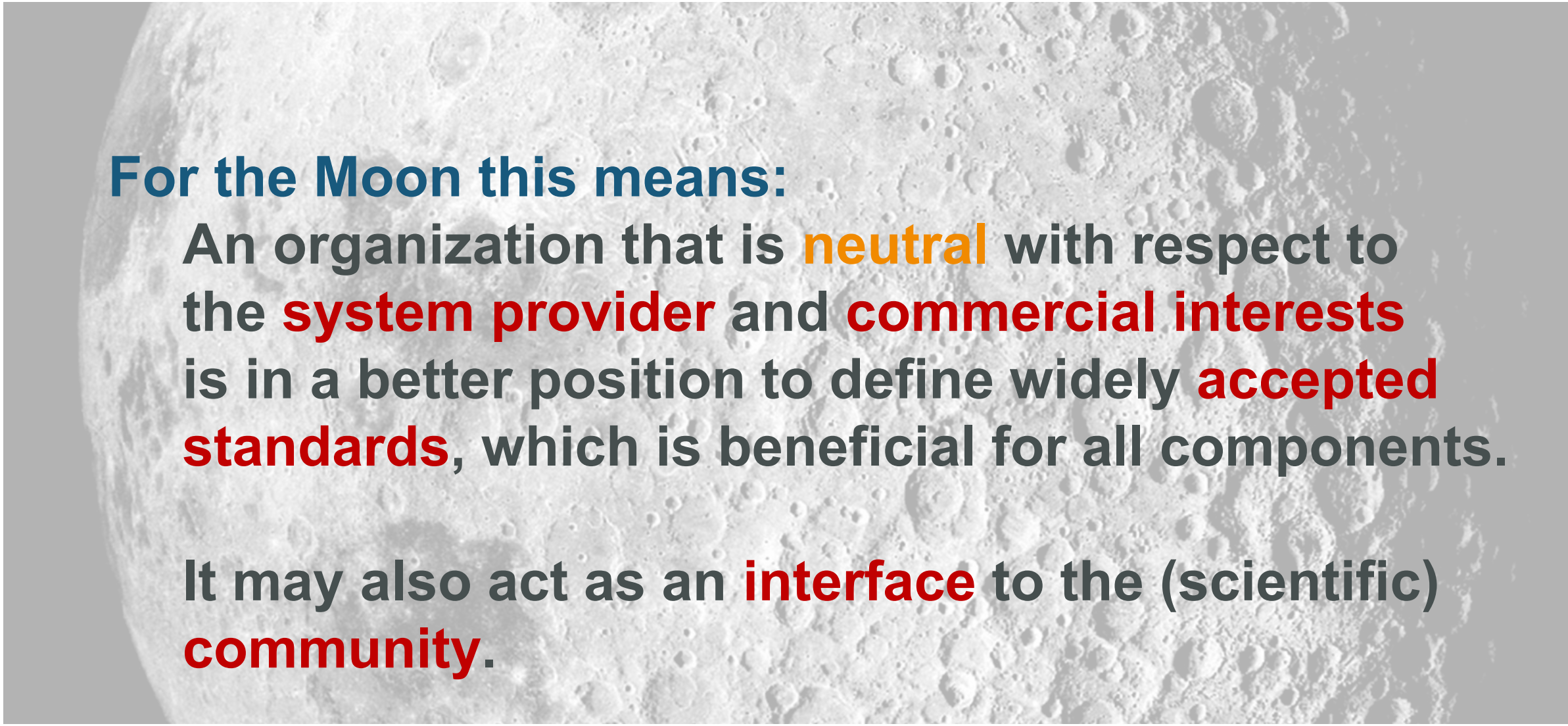
IGS community 

IGS central bureau 

GNSS system provider 

IGS INTERNATIONAL GNSS SERVICE

IGS Standards



For the Moon this means:

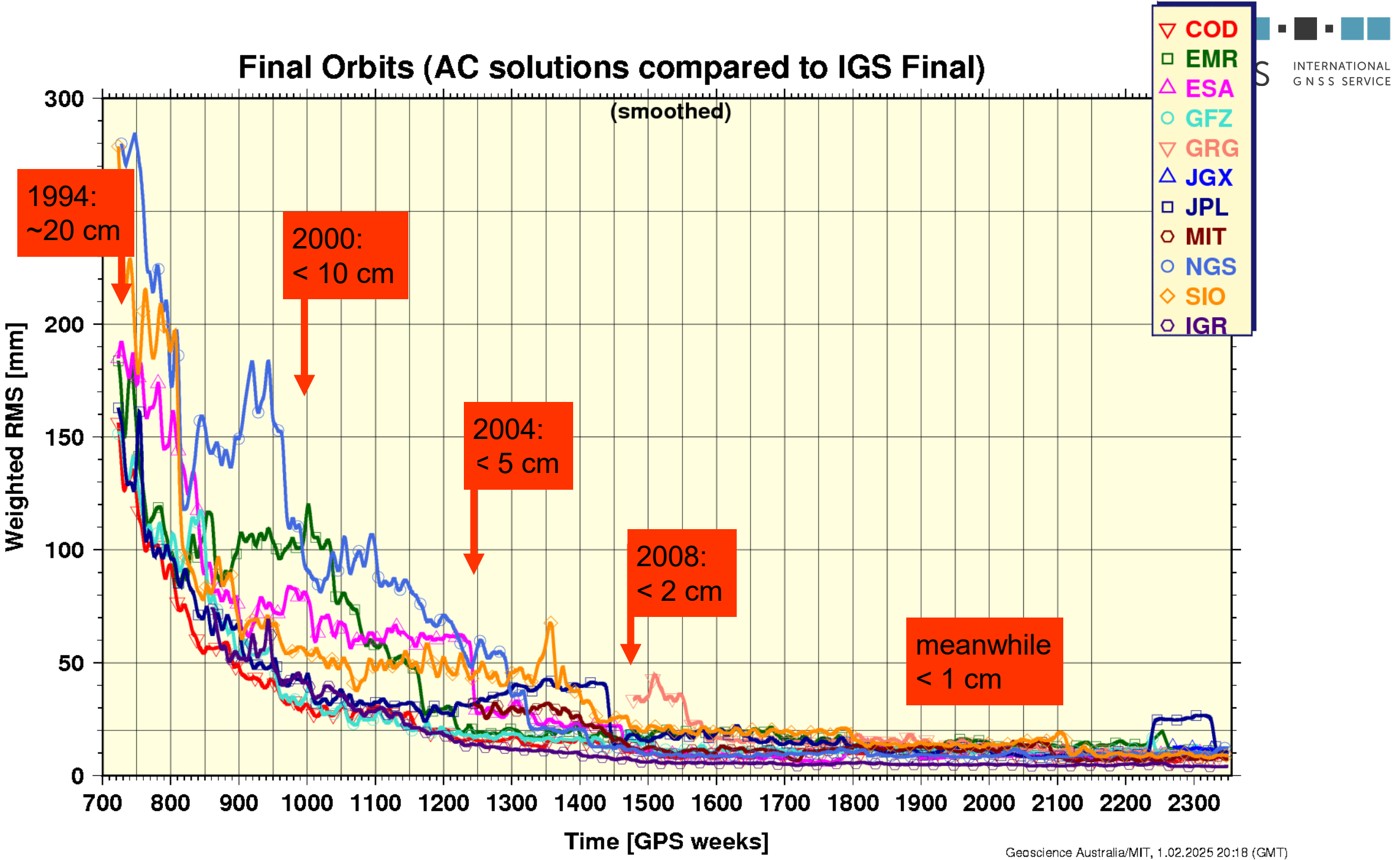
An organization that is **neutral** with respect to the **system provider** and **commercial interests** is in a better position to define widely **accepted standards**, which is beneficial for all components.

It may also act as an **interface** to the (scientific) **community**.

#

IGS Products

provide the geodetic basis for monitoring the system Earth and enable a quasi-infinity number of applications


Final Orbits (AC solutions compared to IGS Final)
(smoothed)
Weighted RMS [mm]
Time [GPS weeks]
300
200
150
100
50
0
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
1994:
~20 cm
2000:
< 10 cm
2004:
< 5 cm
2008:
< 2 cm
meanwhile
< 1 cm
COD
EMR
ESA
GFZ
GRG
JGX
JPL
MIT
NGS
SIO
IGR
Geoscience Australia/MIT, 1.02.2025 20:18 (GMT)

IGS Products

For the Moon this means:

An **open competitive environment** will develop the **quality of products** to the **technical limits** (and will not stop at the level of KPIs from a SLA).

The quality of these products set the **reference** for **all other applications**.

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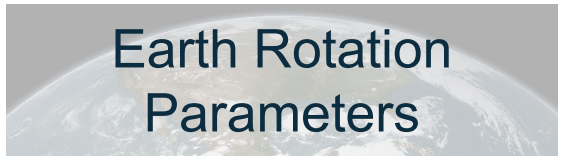
IGS Products

Ephemerides

Satellite Clocks
real-time available ✓

Station Clocks
real-time available ✓

Reference Frame



Local and regional Deformations

Path Correction

Code and Phase Biases

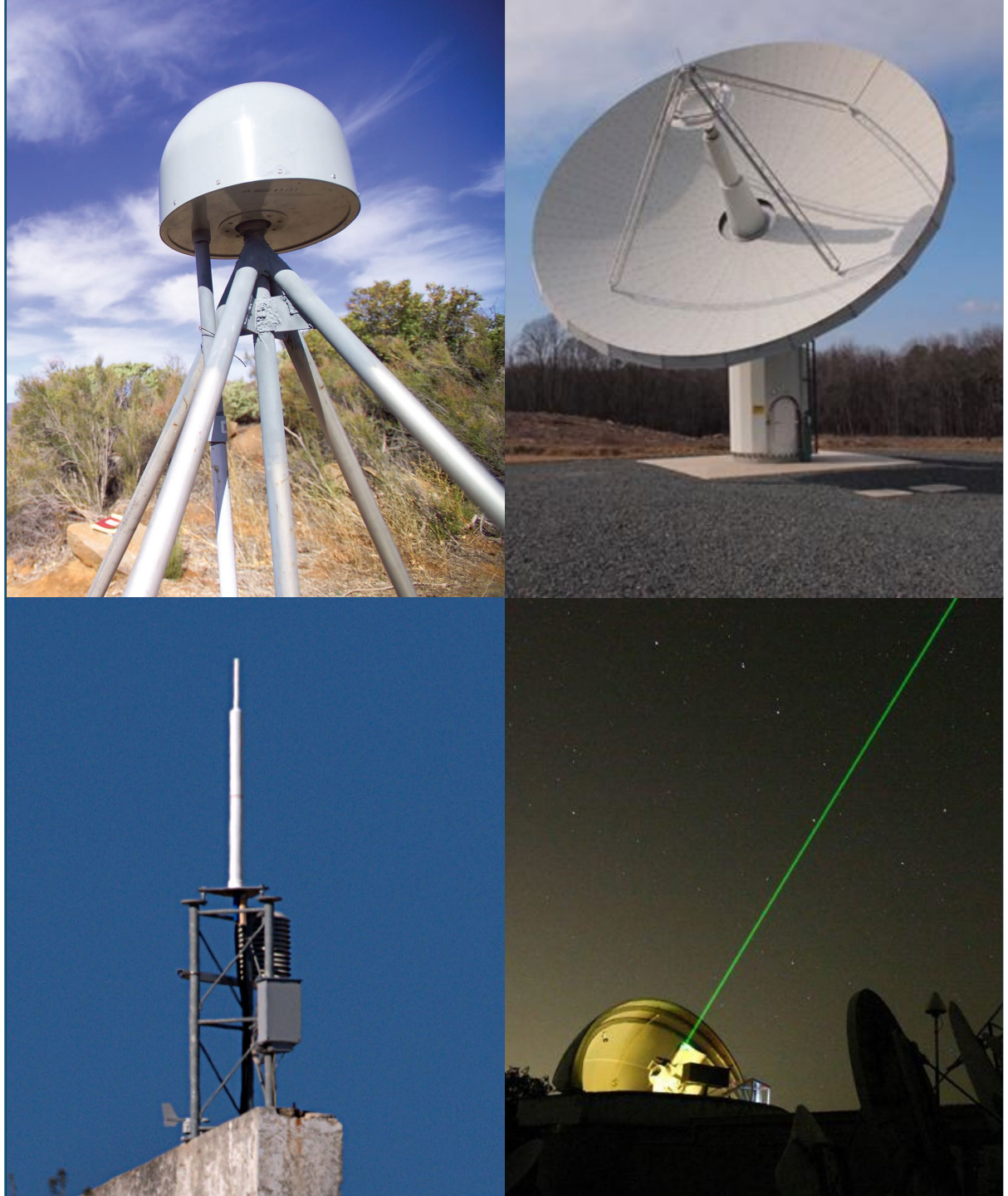
Latencies:

Final	Rapid	Ultra-Rapid	Real-Time
highest quality — weekly	high quality — daily	medium quality — sub-daily	basic quality — real-time

#

Terrestrial Reference Frame

The IGS contributes together with other space-geodetic techniques to the terrestrial reference frame and provides via its products access to the TRF.



IGS INTERNATIONAL GNSS SERVICE

The **IGS** is one of the 4 technical services of the International Association of Geodesy (IAG)

IUGG

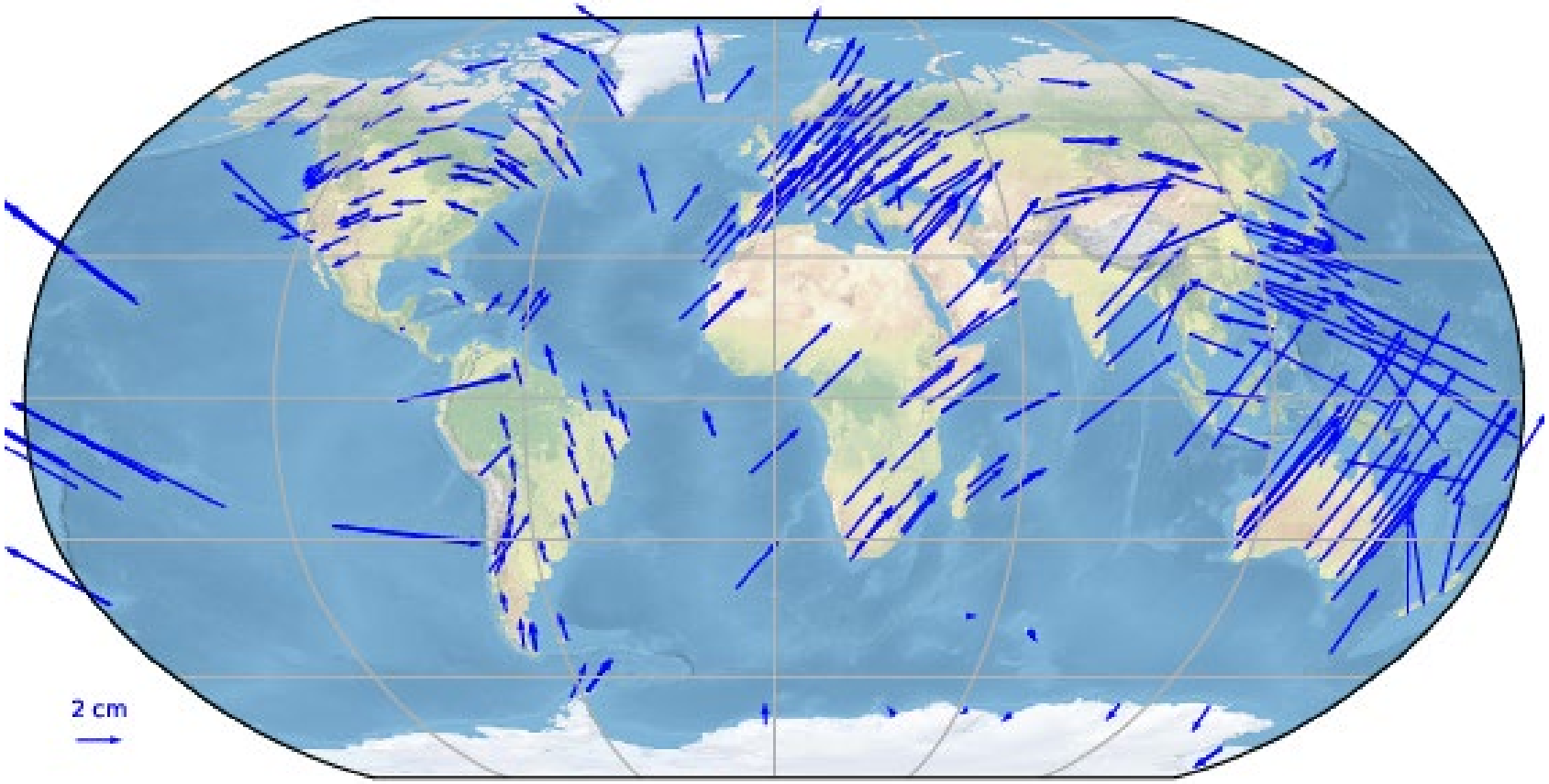
IAG GGOS Global Geodetic Observing System

- **IGS** INTERNATIONAL GNSS SERVICE — Global Navigation Satellite Systems (GNSS)
- ILRS — Satellite Laser Ranging (SLR)
- IVS — Very Long Baseline Interferometry (VLBI)
- IDS International DORIS Service — Doppler Orbitography by Radiopositioning Integrated on Satellite (DORIS)*

IGS INTERNATIONAL GNSS SERVICE

The IGS

contributes to the Terrestrial Reference Frame



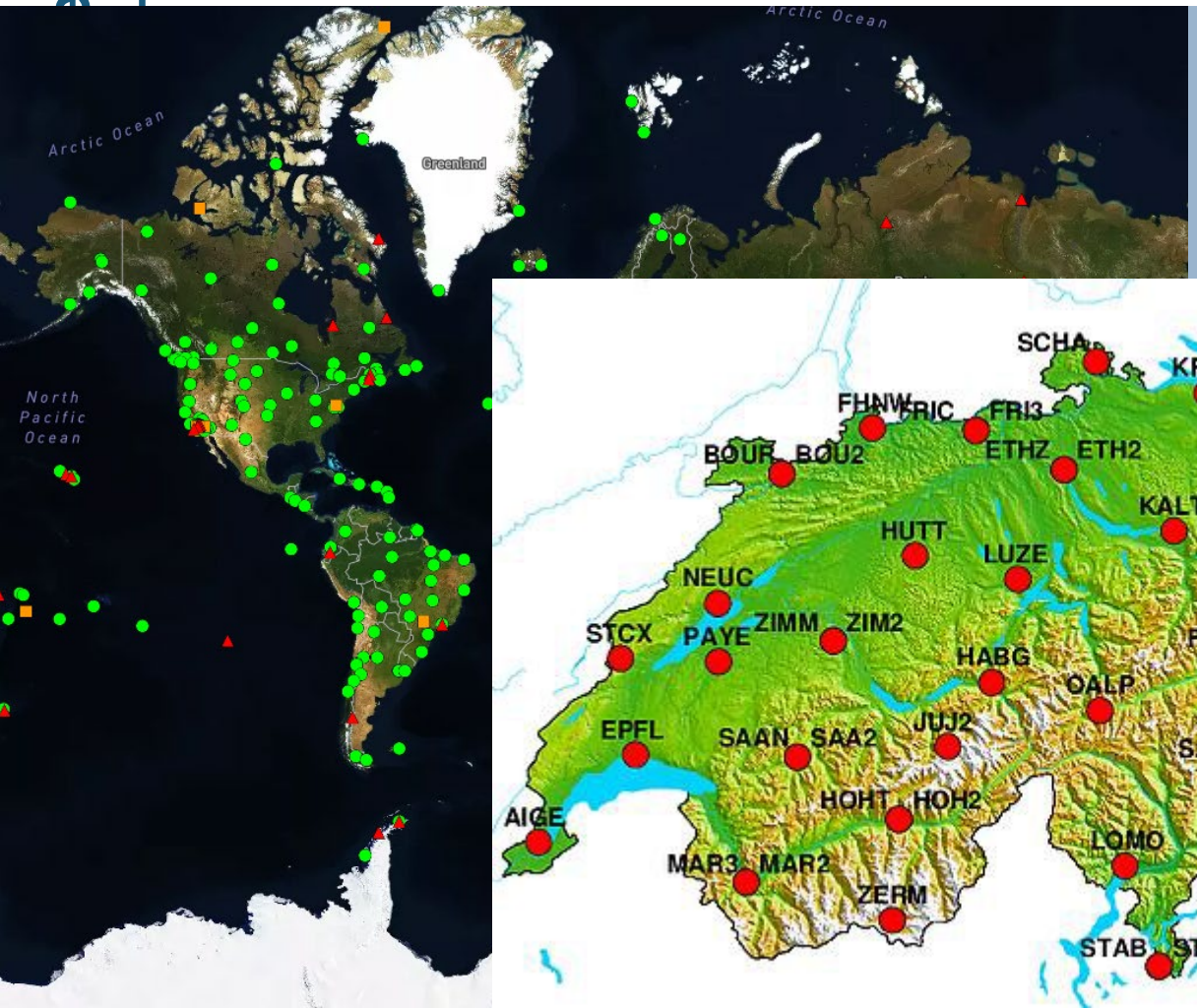
Velocity field from the IGS20 reference frame.

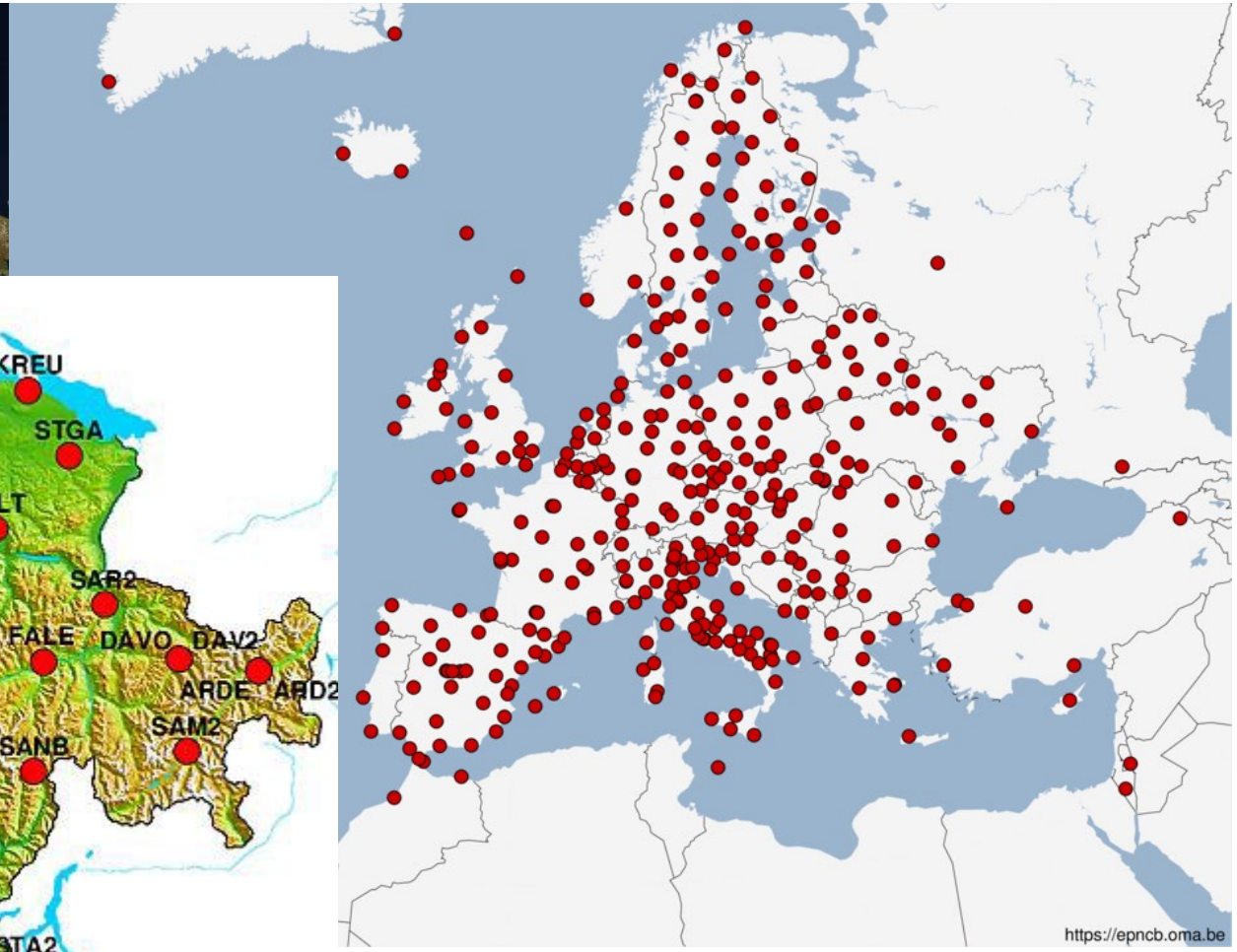
Derived from IGS reprocessing effort covering the year 1994 to 2020.

ence frame

The IGS

provides access to the Terrestrial Reference Frame

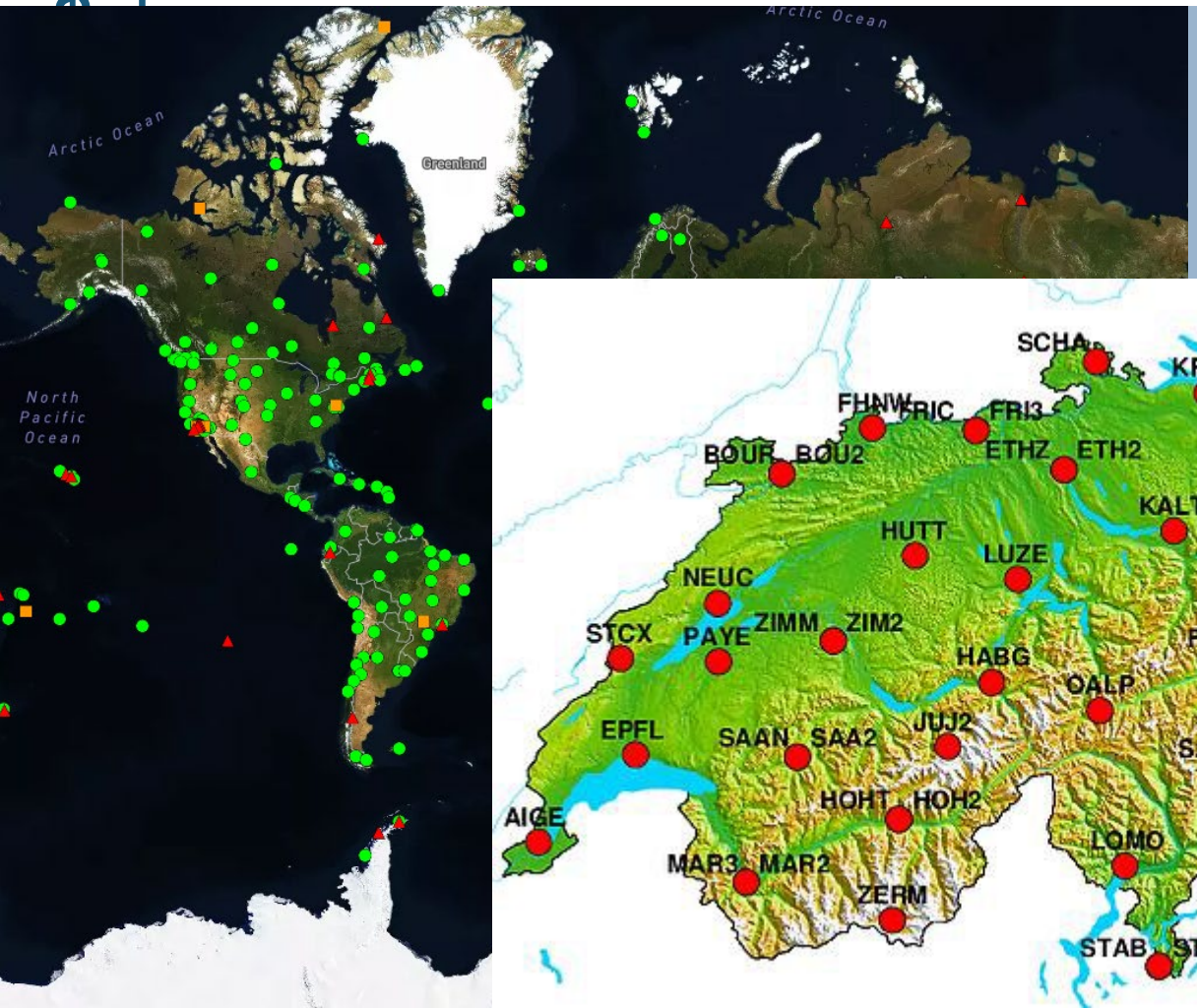




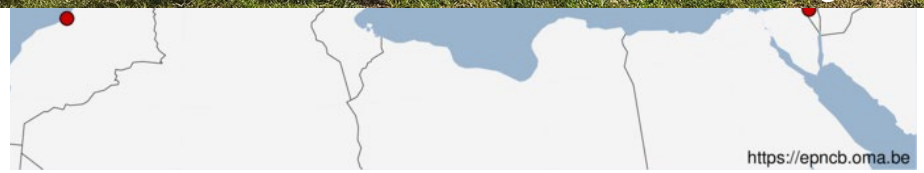
ence frame

The IGS

provides access to the Terrestrial Reference Frame



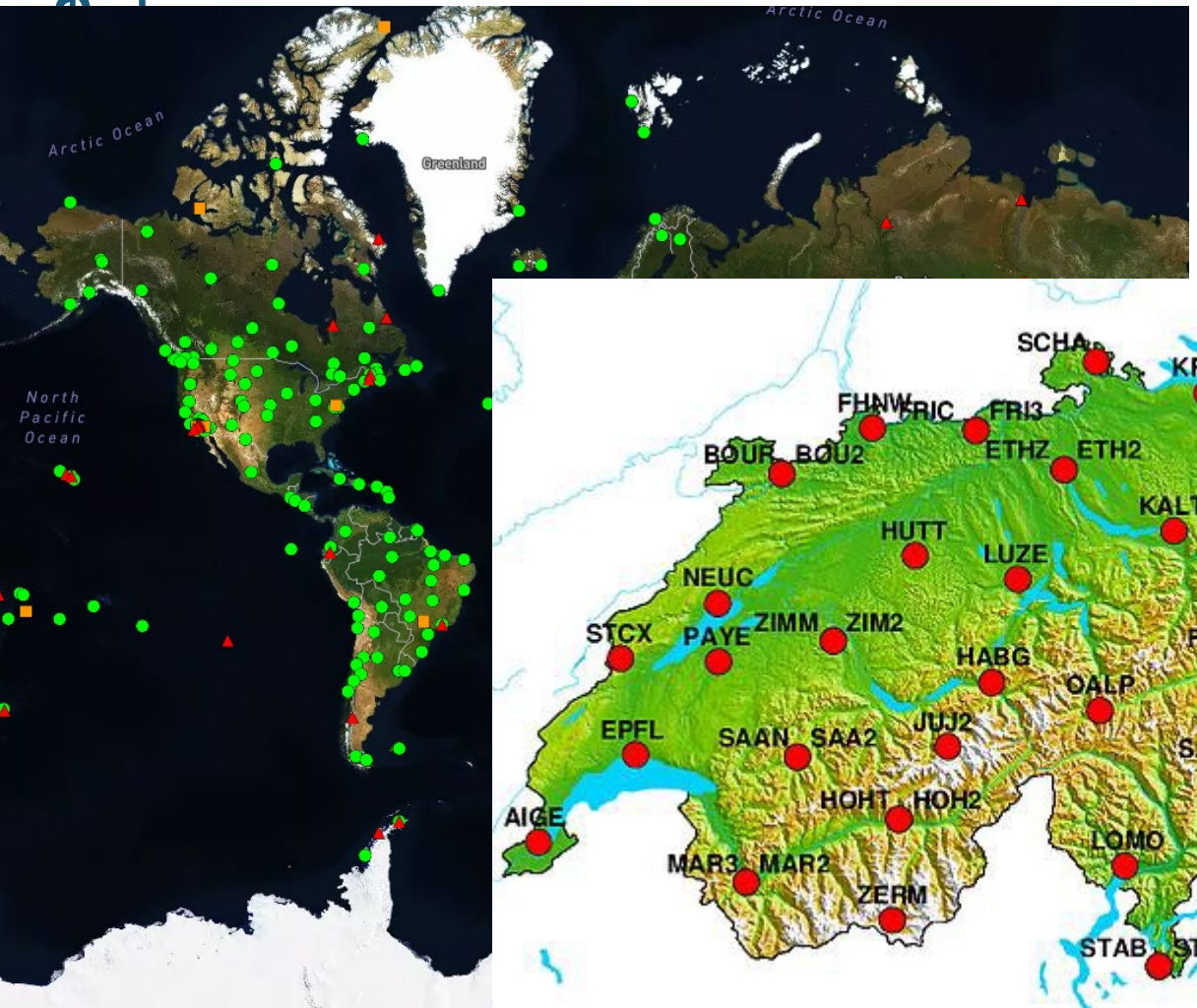

Brienz/Brinzauls GR, GNSS-Monitoring, HMQ AG



ence frame

The IGS

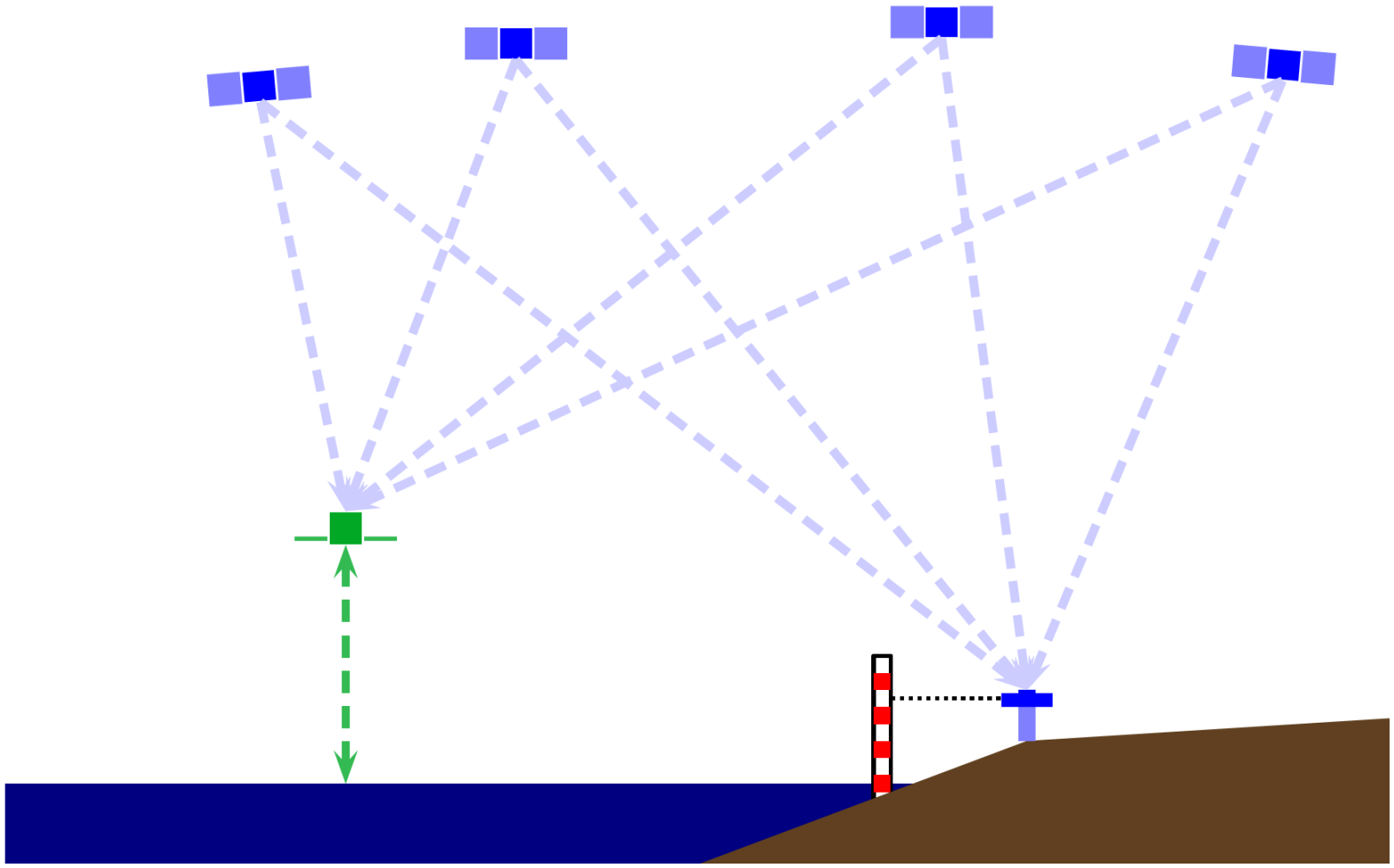
provides access to the Terrestrial Reference Frame



IGS INTERNATIONAL GNSS SERVICE

The IGS

provides access to the Terrestrial Reference Frame



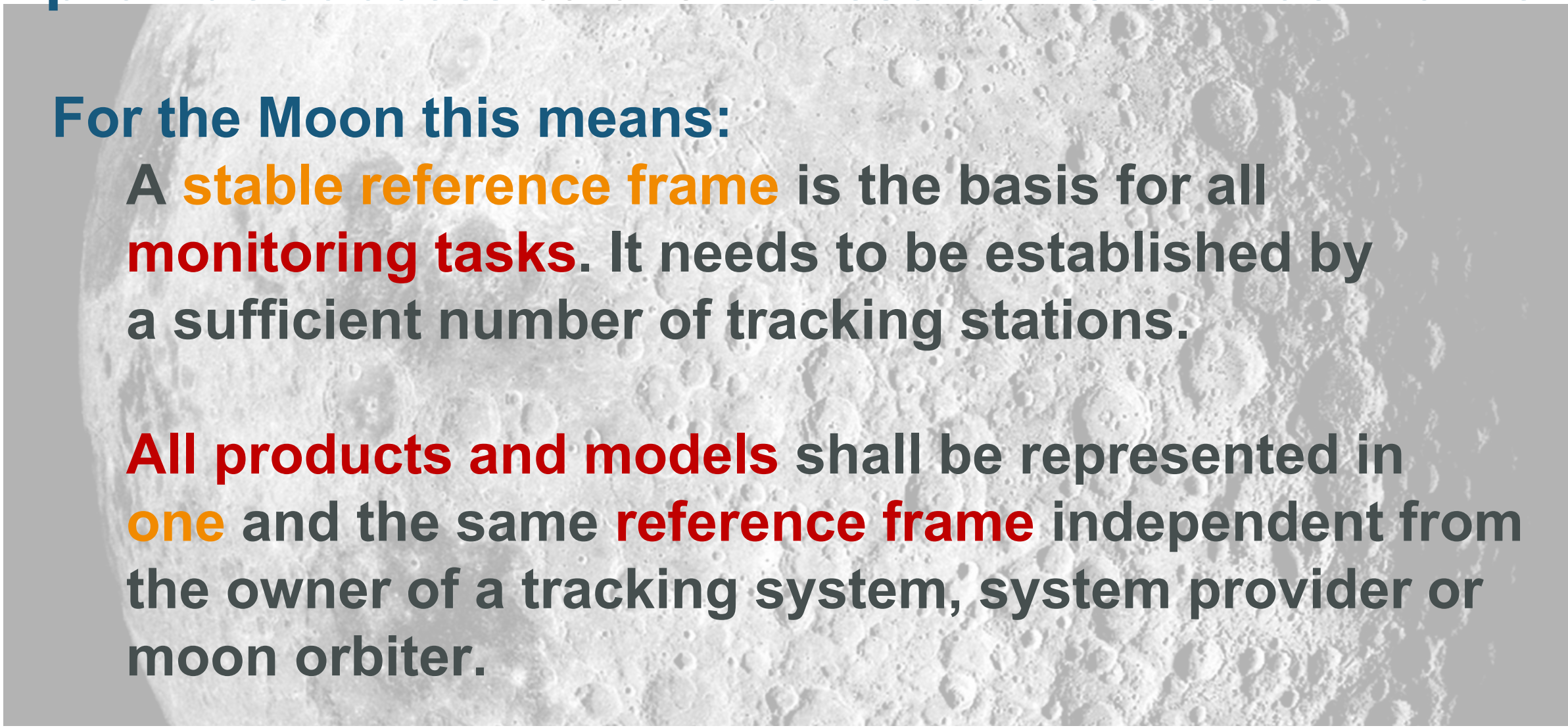
Using IGS products, orbits from **LEO satellites** are directly attached **to the ITRF**.

Application like measuring the sea level get a **long-term stable reference** that is **independent from the mission**.

IGS INTERNATIONAL GNSS SERVICE

The IGS

provides access to the Terrestrial Reference Frame



For the Moon this means:

A **stable reference frame** is the basis for all **monitoring tasks**. It needs to be established by a sufficient number of tracking stations.

All products and models shall be represented in **one** and the same **reference frame** independent from the owner of a tracking system, system provider or moon orbiter.

#

Contributions to the IGS

IGS INTERNATIONAL GNSS SERVICE

UNAVCO
+ Role in the IGS
+ Institution Description
UNAVCO.ORG

Jet Propulsion Laboratory California Institute of Technology
+ Role in the IGS
+ Institution Description
JPL.NASA.GOV

Australian Government Geoscience Australia
+ Role in the IGS
+ Institution Description
WWW.GA.GOV.AU

AIUB
+ Role in the IGS
+ Institution Description
WWW.AIUB.UNIBE.CH

CODE
+ Role in the IGS
+ Institution Description
WWW.AIUB.UNIBE.CH/CODE

GFZ Helmholtz Centre Potsdam
+ Role in the IGS
+ Institution Description
WWW.GFZ-POTSDAM.DE/EN/

IGN Institut National de l'Information Géographique et Forestière
+ Role in the IGS
+ Institution Description
IGN.FR

BKG
+ Role in the IGS
+ Institution Description
WWW.BKG.BUND.DE

Currently 350 organizations from 118 countries/regions contribute to the IGS.

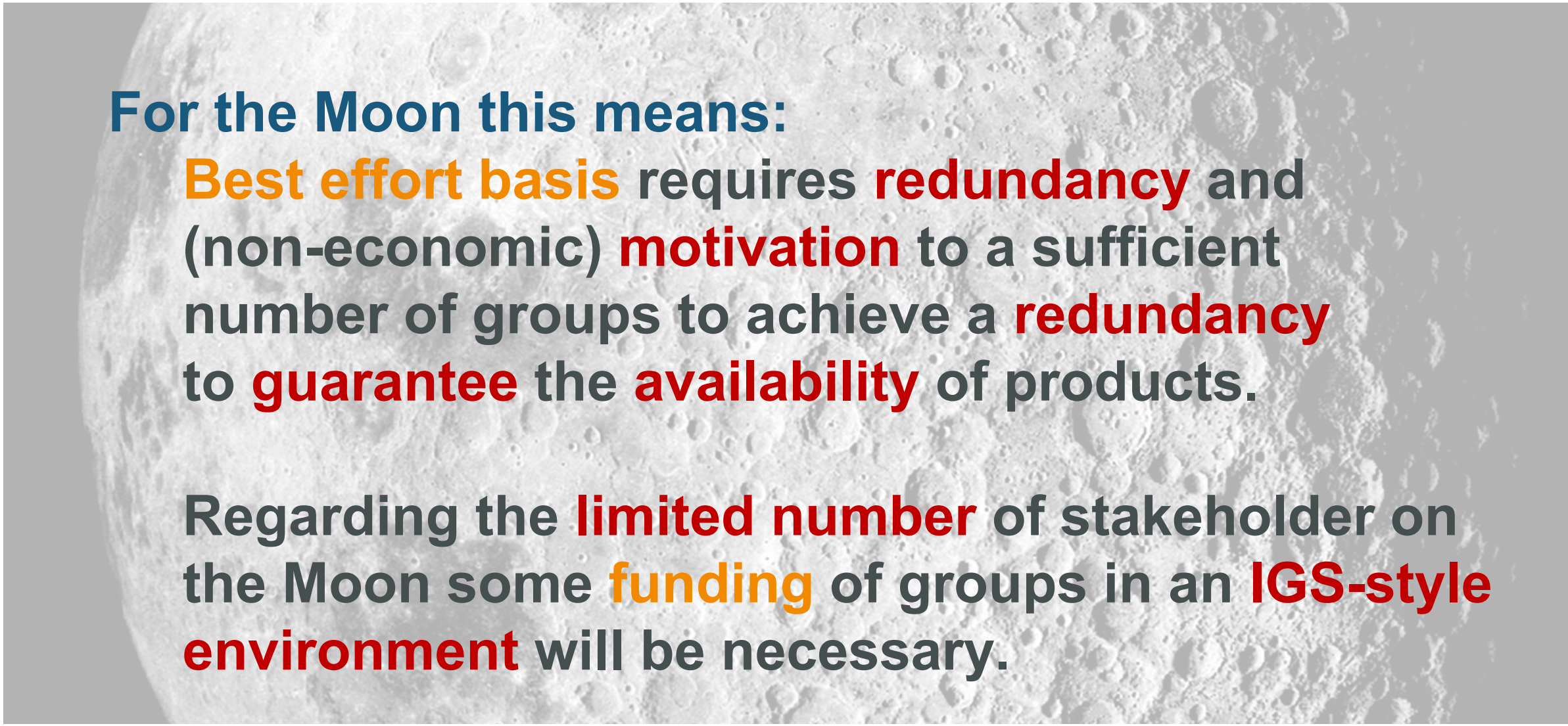
(from igs.org/about at Feb. 05th, 2025 07:30)

The IGS is no legal body.

All contributions to the IGS are on best effort basis!

IGS INTERNATIONAL GNSS SERVICE

Contributing to the IGS



For the Moon this means:

Best effort basis requires **redundancy** and (non-economic) **motivation** to a sufficient number of groups to achieve a **redundancy** to **guarantee** the **availability** of products.

Regarding the **limited number** of stakeholder on the Moon some **funding** of groups in an **IGS-style environment** will be necessary.

#

Summary

Key achievements of the IGS for GNSS:

- **IGS is a community** of experts in the field of **high quality GNSS data acquisition, dissemination, processing.**
- The **activities in the IGS** are only driven by the **motivation of the contributing people/agencies** in an **environment of "friendly competition"**.
- It is **neutral** with respect to any manufacturer of equipment and to the system providers. This position allows to **establish standards and formats** that can be **accepted** by all players.
- The IGS acts also a point of contact for system providers into the (scientific) community.

- **The IGS is not a legal body and is only working on a "best effort basis".**

Looking towards the Moon:

- The system providers have to work together with the related space industry and the scientific community to establish not just interoperability but **common standards and formats for data and product exchange.**
- An institution that is **neutral** to the system providers and the competitive space industry may be helpful here.
- An **open data policy** is **mandatory to motivate groups** to establish/join an **IGS-style activity for the Moon**.
- **Motivation is essential in a “best effort basis” environment.**

IGS goes to the Moon?


IGS
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GNSS SERVICE
Thank You
for your attention!