New Agenda Item for WRC-2031:

PROTECT GEODETIC VLBI

IVS INTERNATIONAL VLBI SERVICE FOR GEODESY AND ASTROMETRY

What is geodesy?

Geodesy is the **science of measuring the Earth's shape, orientation, gravity field, and determining the orbits of satellites**.

Geodesy provides **reference frames**: the backbones for positioning, navigating, time-keeping, and monitoring changes of planet Earth.

Geodetic data have a **wide range of applications**:

- Navigation on land, in air and space, and at sea, including **GPS or GNSS navigation** systems and **accurate mapping**
- Specifying accurate ownership in land registries and the definition of global international borders
- Monitoring **sea-level rise** and maintaining the necessary global reference frame with 1mm position accuracy and 0.1mm/year position change rate accuracy

and others, all of which rely on consistent reference frames. Geodesists work on the realization and updates of geodetic reference frames to **ensure our modern quality of life**.

What is VLBI?

Very Long Baseline Interferometry (VLBI) is an measurement technique based on a **global network of radio telescopes** that simultaneously measure radiation from a cosmic source.

During the observation of the source, the Earth rotates and the geometry of the radio telescope network as seen from the source changes. These changes can be calculated by analysing the measurement data. The results are used in geodesy and astronomy.

What is geodetic VLBI?

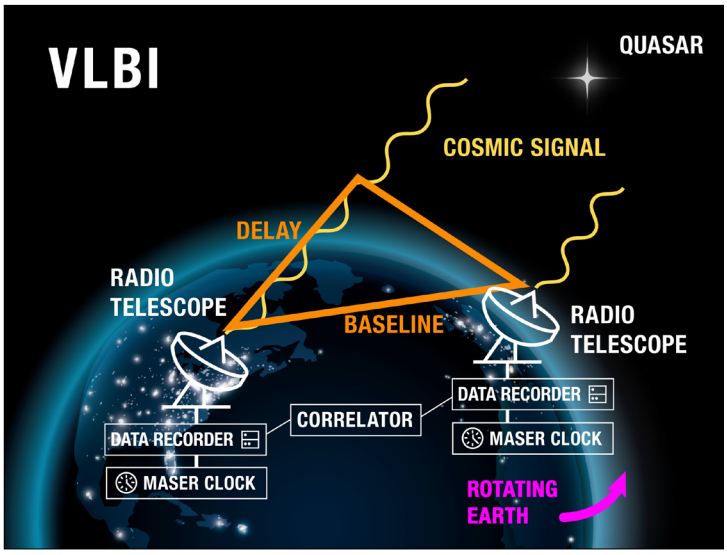
Geodetic VLBI is a unique space geodetic technique; it provides the most accurate Earth orientation measurements and enables the definition of the celestial reference frame and its connection to the terrestrial reference frame.

geodesy + VLBI = GEODETIC VLBI

Geodetic VLBI data provides the accurate time difference, dUT1, between UT1 (universal time based on the rotation of the Earth) and UTC (coordinated atomic universal time). This parameter is fundamental for **GPS, precise satellite orbits and space navigation**.

Because the Earth's motion in space is not constant, a daily monitoring of the Earth orientation is performed by the [International VLBI Service for Geodesy and Astrometry (IVS), https://ivscc.gsfc.nasa.gov/index.html](https://ivscc.gsfc.nasa.gov/index.html).

The global geodetic VLBI network consists of about 25 radio telescope sites operated in about 20 countries.



What does geodetic VLBI need?

VLBI radio telescope stations need a **radio-quiet environment**. The targets are distant cosmic radio sources called quasars (quasi-stellar objects). The intensity of their radiation is extremely weak. Geodetic VLBI cannot be shifted to other frequency regions due to the unique transparency of the atmosphere for this frequency range.

These VLBI radio telescopes operate in the 2-14 GHz range, using 32 channels with 32 MHz bandwidth each. These observation channels are intentionally selected to optimize geodetic accuracy.

The individual radio telescope sites in different countries on different continents work as a **global sensor together**. Radio interference at one station has an impact on the others and on the final geodetic product.

Threats to geodetic VLBI

The commercial use of space has led to a recent boom in privately funded satellite projects. By 2030, some 100,000 transmitting satellites will fill up almost every area of the sky with transmitting antennas.

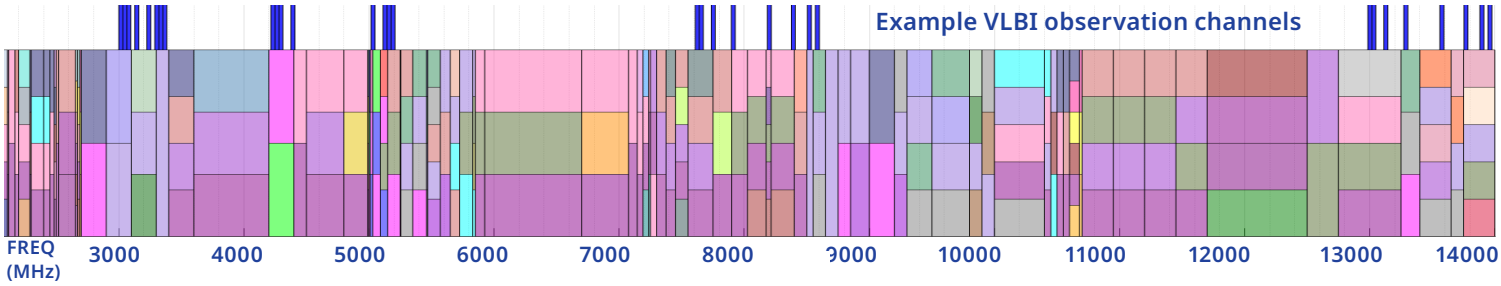
We are also experiencing the rapid expansion of mobile telecommunication networks, with each generation (3G, 4G, 5G, 6G) requesting its share of the electromagnetic spectrum. The expansion of telecommunications services is an **existential threat to geodetic VLBI**, because any manmade electromagnetic signal is magnitudes stronger than the natural cosmic radiation from quasars at the edge of the universe.

The essential services such as GPS and its need for long-term accurate Earth rotation monitoring are thus in danger. The immediate protection of geodetic VLBI is necessary to continue such crucial services.

FOR MORE INFORMATION:

rudiger.haas@chalmers.se

https://ivscc.gsfc.nasa.gov



Shown here are the color-coded spectrum allocations to different services according to the Radio Regulations—click to view details in browser

HOW TO PROTECT GEODETIC VLBI

1. Registration of VLBI site at ITU-R

Geodetic VLBI sites should be registered at the International Telecommunications Union (ITU) as Earth station for Radio Astronomy through the national spectrum authority. Your station can be determined here:

https://www.itu.int/go/ITUSpaceExplorer

2. Introduction of local protection zone

A local protection zone around the radio telescope site should be granted by the national spectrum authority. Ideally, it would be a radio-quiet zone. In populated areas, coordination zones may avoid conflicts between new services and the VLBI observations.

3. Allocation of bands used by geodetic VLBI

The frequency bands used by geodetic VLBI observations should be entered in the Radio Regulations (RR). "Geodetic VLBI" must be a new Agenda Item at the World Radio Conference 2031 (WRC-2031), whose agenda will be set at WRC-2027.

National spectrum agencies should propose Geodetic VLBI as a preliminary Agenda Item to the WRC-2027 and/or support such an initiative in a joint proposal.

Without such protective measures, the demand for high-quality geodetic VLBI data that we all depend on is not effectively fulfilled. It endangers the goals of the UN GA Resolution 69/266 "A global geodetic reference frame for a sustainable development":

https://ggim.un.org/documents/a_res_69_266_e.pdf