

## Frequently Asked Questions and Answers on the Global Geodetic Reference Frame UN GGIM Initiative

- **What is the GGRF?**

The Global Geodetic Reference Frame (GGRF) is a generic term describing the framework which allows users to precisely determine and express locations on the Earth, as well as to quantify changes of the Earth in space and time. Most areas of science and society at large depend on being able to determine positions at a high level of precision. At present the GGRF is realized through the International Terrestrial Reference Frame (ITRF), International Celestial Reference Frame (ICRF) and physical height systems.

- **Why do we need a global geodetic reference frame?**

It provides a uniform and consistent platform for comparing positional measurements across space and time. This is particularly important for the collection of homogenous spatial data, and for measuring change through time. The GGRF is also used as a basis for regional or national reference frames.

- **Why do we need a global approach in the work with the GGRF?**

The generation of a global geodetic reference frame requires the collection, analysis and combination of high quality geodetic data from all over the world. The strength and accuracy of the GGRF comes from having an evenly distributed network of observing stations globally. A global distribution of data centres and analysis centres also helps to maintain enough redundancy to ensure continuous operation.

- **Why do we need a United Nations General Assembly resolution?**

While the GGRF is fundamentally important to society, it is not well understood by the governments of the world. This General Assembly resolution is intended to inform those governments; especially around the need for all countries to contribute since no one country can do it alone. The resolution will also provide a basis upon which national governments can build a mandate to contribute towards the Global Geodetic Observing System (GGOS) and the resulting GGRF.

- **What is the Global Geodetic Observing System (GGOS)**

The Global Geodetic Observing System (GGOS) is a complex system of activities that includes ground tracking infrastructure, data centers, analysis centers and product centers that collectively develop the GGRF. GGOS is an initiative of the International Association of Geodesy (IAG) intended to provide coordination at a non-governmental level.

- What is the exact infrastructure of the GGOS and GGRF, and who maintains it?**

The space geodetic techniques that provide measurements for the computation of the GGRF include the Global Navigation Satellite Systems (GNSS), Satellite Laser Ranging (SLR), Very Long Baseline Interferometry (VLBI), and Doppler Orbitography Radiopositioning Integrated by Satellite (DORIS). These techniques are organised as scientific services under the umbrella of the IAG as part of the GGOS initiative.
- Who maintains the infrastructure that contributes to the GGRF?**

It is a combination of national mapping agencies, research organisations and space agencies that resource the Global Geodetic Observing System, including ownership and maintenance of the observing infrastructure, and operation of the data centres and analysis centres. It is all done on a “best effort” practise.
- What is a “best effort” practise?**

Best effort denotes that national mapping agencies, research organisations and space agencies voluntarily contribute to data collection, data analysis, data sharing and infrastructure management to generate the ITRF, ICRF and the physical height systems. No formal international arrangement (i.e. treaty) exists between all governments for the generation of the global geodetic reference frame or the governance of this work. As a consequence anyone of the contributing institutions can choose to not participate in this cooperation, ultimately impacting the accuracy and reliability of the GGRF.
- What causes countries to withhold data?**

Historically there has been a perception that releasing spatial data jeopardises national security. The advent of Google Earth and other global mapping utilities has reduced this perception. There is also withholding periods for research data which are put in place to protect the publication rights of students. Again, recent evidence indicates that immediate release of data enhances the research outcome.

Lastly, some developing countries perceive that withholding important geodetic data encourages robust cooperation from international agencies who are “forced” to cooperate in order to access the data, resulting in increased capacity development for the data owner.
- How can countries use the GGRF?**

The GGRF can be used for all kind of positioning purposes, either by using it directly for a common reference independent of continents and borders or as a base for regional and national reference frames.
- How can countries access the GGRF?**

The most common way of accessing the GGRF is through Global Navigation Satellite Systems (GNSS) like GPS. GPS gives a direct access to the reference frame in an easy and low-cost way.

- How can small countries contribute to the GGRF**

The determination and densification of the GGRF relies on continuous data from a globally well distributed geodetic infrastructure. A selection of the highest quality sites from all of those available are used for defining the GGRF. A small country like Samoa contributes by having a GNSS site which plays a significant part in filling a geographical gap in the global network. The remainder of the sites are used for densification activities and to model regional deformations. Hence, all sites play an important role in the GGRF provided the data are made openly available to the global community.
- How can small countries benefit from this "technology"**

While some small island countries may find it difficult to resource the relatively expensive geodetic observatories, they do have the opportunity to collaborate with those countries that have more resources to build capacity. With the advent of GNSS a country can easily and cost effectively, establish a national reference frame without the need to establish a large and costly in situ network of classical geodetic measurements.
- How does current infrastructure contribute to the GGRF?**

We have had a GGRF in place since the late 1980's. This initiative is around improving the accuracy and reliability of the GGRF. It also aims to raise the awareness levels of governments about the importance of the GGRF. The current infrastructure is used for the GGRF, however much of the infrastructure is aging and becoming obsolete. As refinement occurs new technologies are also required. Therefore new infrastructure is necessary to fill geographical gaps and to improve the capability through technology.
- What is the role of satellites?**

Satellites play a key role in the observing systems used for the GGRF. The satellite systems that are utilised by GNSS, DORIS and SLR are very important for the GGRF. When combined with VLBI they form the observational basis for the reference frame. Satellites are also used to provide global homogenous access to the GGRF. In addition there are many other applications of satellite data used in the determination and application of the GGRF.
- How long will it take to establish GGRF?**

The Earth is a dynamic planet. The GGRF is used as the platform for measuring this change. The GGRF does however also change through time, as does the ITRFs, ICRFs and the height systems. As such the maintenance of the GGRF is an ongoing activity. The accuracy of the observing systems also improves through time. We currently adopt the International Terrestrial Reference Frame as the best available GGRF. It does however continue to evolve.
- What commercial interests are there in the GGRF**

To date there has been little commercial interest in contributing to the fundamental definition and determination of the reference frame, other than the design and manufacture of the observing

instruments. There is however high levels of commercial interest in delivering the reference frame to the multitude of users. This initiative will not alter this arrangement.

- **Who is in control here? Who is managing this?**

The currently adopted GGRF is coordinated by the International Association of Geodesy and its component services under the broad umbrella of the Global Geodetic Observing System. While many national mapping agencies and space agencies contribute resources to the GGRF there is no intergovernmental entity that coordinates this activity.

- **Will this enhance military targeting/ Sensitive question of potential Security/Military implication**

This initiative is intended to enhance civilian application of the GGRF. The enhanced precision will have negligible impact on military applications which are already sufficiently served by existing GNSS systems.

- **What will happen after resolution, what would we do with this?**

The endorsement of the resolution at the General Assembly will provide high level support for those National agencies that wish to create a mandate within their respective countries for their contribution to the GGRF. Additionally the working group on GGRF will continue to develop a Roadmap that describes the current issues affecting the sustainability of the GGRF, and a set of proposed initiatives to enhance the refinement and sustainability of the GGRF. Lastly the Working Group will propose as part of the Roadmap a governance arrangement to take forward coordination of GGRF activities, under an intergovernmental umbrella.