

# **UN Resolution on GGRF**

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## **SUMMARY**

The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) decided in 2013 to formulate and facilitate a resolution for a global geodetic reference frame and established a working group on the Global Geodetic Reference Frame (GGRF). The task of the working group was to formulate the resolution and prepare a roadmap for GGRF for sustainable development. In February 2015 the United Nations General Assembly adopted the resolution on a Global Geodetic Reference Frame for Sustainable Development (A/RES/69/266), recognizing the importance of a globally coordinated approach to geodesy. In August 2016 the UN-GGIM endorsed the GGRF Roadmap and decided to elevate the GGRF working group to a permanent sub-committee on geodesy.

UN-GGIM has established regional entities, including UN-GGIM:Europe. In connection with the implementation of the GGRF roadmap it is assumed beneficial that the regions contribute through regional GGRF working groups. The UN-GGIM:Europe working group “GRF-Europe” (Geodetic Reference Frames – Europe) was established in 2016. GRF-Europe will be working as a GGRF expert group within the UN-GGIM:Europe with close connection to geodesy-related organizations in Europe and actively contribute to the work of the sub-committee on Geodesy. GRF-Europe will provide a link between the geospatial community, scientists and policy makers. We will describe current status and plans of both groups.

# UN Resolution on GGRF

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## 1. INTRODUCTION

The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) decided in 2013 to formulate and facilitate a resolution for a global geodetic reference frame and established a working group on the Global Geodetic Reference Frame (GGRF) for the purpose. In February 2015 the United Nations General Assembly adopted resolution on a Global Geodetic Reference Frame for Sustainable Development (A/RES/ 69/266), recognizing the importance of a globally coordinated approach to geodesy.

The Global Geodetic Reference Frame is a necessary tool to help address the growing demand for more precise positioning and other georeferencing. It is also essential for effective decision making and a vital underpinning infrastructure which is applied in areas of natural hazard and disaster management, climate change and sea level monitoring, geospatial information, mapping and navigation by society at large every day.

Following the resolution of the UN GA, the UN-GGIM got the mandate to prepare a roadmap, and the task was made by the GGRF working group in 2015-2016. Additionally, regional UN-GGIMs were contacted with a task to organize the writing of a chapter of operation paragraphs in the roadmap. Later on this lead to establishment of the regional expert group GRF-Europe within the European subgroup UN-GGIM:Europe.

In August 2016 in the UN-GGIM meeting in the UN Headquarters in New York, GGRF working group presented the roadmap which was endorsed as a principle based briefing document for national governments. At the same time UN-GGIM decided to elevate the GGRF working group to a permanent sub-committee on geodesy (GGRF, 2016). Next task for the geodesy sub-committee is to prepare the roadmap-based implementation plan.



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Figure 1. UN-GGIM meeting in New York, August 2015 forwarded the mandate to the GGRF working group to create a roadmap for the global geodetic reference frame.

## **2. UN RESOLUTION ON GLOBAL GEODETIC REFERENCE FRAME**

The United Nations General Assembly adopted a resolution (69/266) on 26 February 2015, A global geodetic reference frame for sustainable development (UN, 2015). This was a great step forward in future maintenance of reference frames. National mapping agencies, research institutes and space organizations currently maintain global geodetic infrastructure on a voluntary basis. There have been no formal treaties between Nations or binding commitments to maintain the infrastructure and geodetic stations. It is quite amazing how such a fundamental task of modern society, basis of the whole geoinformation, is on voluntarily basis.

Current infrastructures and large observation equipment is aging and new technologies are also required. In particular, the renewal of large observation equipment such as satellite laser ranging (SLR) and the radio telescope used for very long baseline interferometry (VLBI) demands commitment on a national level and good international coordination. Currently, renewal of these equipments are going on at many sites, and new generation instruments will be widely used in a few years.

On international level, the International Association of Geodesy (IAG) and its services under the GGOS (Global Geodetic Observing System, Plag and Pearlman, 2009) coordinates the observing networks, data collection, analysis and delivery of products. As a scientific organization, IAG has no power over national or institutional decisions or any means to make binding agreements within the participants. The UN resolution may give such tools in the future; as well it also strives for an increased awareness of the issue at the highest political level. Current version does not explicitly implement binding commitments to Nations but even in current form it gives a mandate for Nations to maintain their geodetic infrastructure.

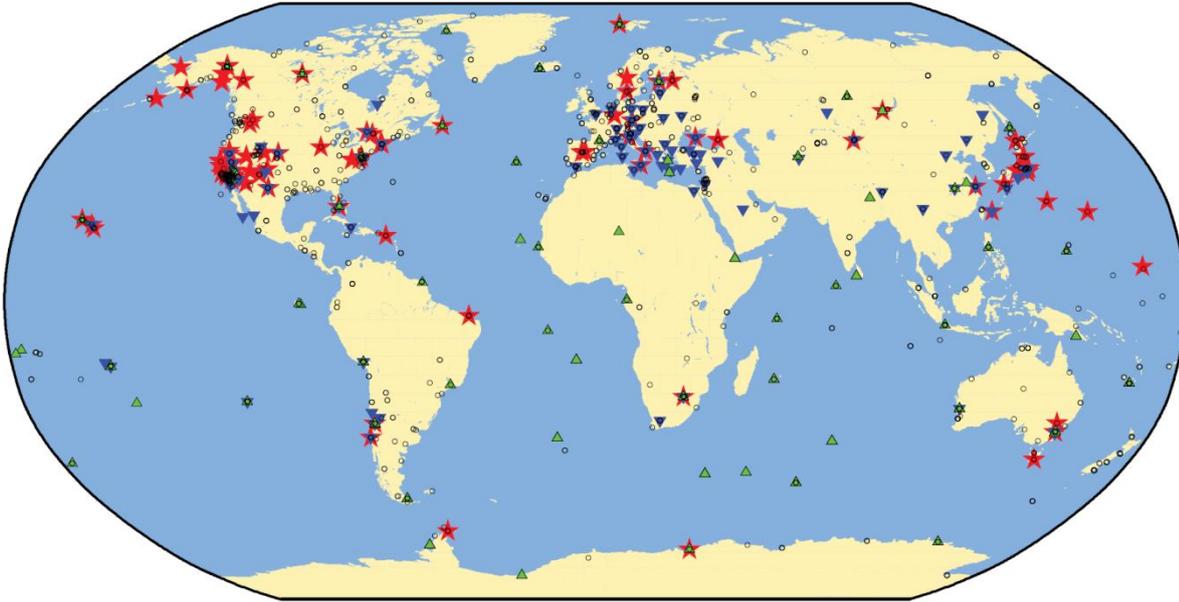


Figure 2. Geodetic stations defining current global geodetic reference frame, ITRF2014 with different symbols denoting different observing techniques (stars VLBI, upside-down triangles SLR, open triangles DORIS, and small open circles GNSS).

The key components of the global geodetic network defining the ITRF are the Core Sites where at least three of the techniques are located at the same site. None of the techniques alone is able to provide the full reference-frame-defining parameters but the combination of techniques is required. The core sites, together with a large number of other geodetic stations with fewer techniques, form the network of the GGOS. These will be the basis of the infrastructure meant by the UN resolution.

The UN resolution, among others, states that (UN, 2015):

*Recognizing the importance of international cooperation, as no one country can do this alone, to realize the global geodetic reference frame and services to underpin Global Navigation Satellite Systems technology and provide the framework for all geospatial activity, as a key enabler of spatial data interoperability, disaster mitigation and sustainable development,*

*Recognizing also the economic and scientific importance of and the growing demand for an accurate and stable global geodetic reference frame for the Earth that allows the interrelationship of measurements taken anywhere on the Earth and in space, combining geometric positioning and gravity field-related observations, as the basis and reference in location and height for geospatial information, which is used in many Earth science and societal applications, including sea-level and climate change monitoring, natural hazard and disaster management and a whole series of industrial applications (including mining, agriculture, transport, navigation and construction) in which precise positioning introduces efficiencies,*

*Acknowledging that the global geodetic reference frame depends upon the participation of countries all around the globe, and the need to take action to strengthen international cooperation,*

*Encourages Member States and relevant international organizations to enhance global cooperation in providing technical assistance, especially for capacity development in geodesy for developing countries, with the aim of ensuring the development, sustainability and advancement of the global geodetic reference frame;*

*Urges Member States to implement open sharing of geodetic data, standards and conventions, on a voluntary basis, to contribute to the global reference frame and regional densifications through relevant national mechanisms and intergovernmental cooperation, and in coordination with the International Association of Geodesy;*

*Invites Member States to commit to improving and maintaining appropriate national geodetic infrastructure as an essential means to enhance the global geodetic reference frame;*

In addition to international coordination of global reference frame and invitation of Member States to improve and maintain national geodetic infrastructure, one notable thing is the promotion of open data policy. Traditionally, all data submitted for IAG services have been free, but this resolution underlines the need for open data and services even more wider scope. Another important statement is, that such geodetic infrastructure is not possible to maintain by one Nation but large international collaboration and joint efforts are needed.

### **3. GGRF ROADMAP IMPLEMENTATION**

The GGRF roadmap is divided in five broad categories: Data sharing, Education and capacity building, Geodetic infrastructure, Communication and outreach, and Governance (Roadmap, 2016).

Geodetic infrastructure includes major space geodetic instrumentation (Fig. 2), sea-level tide gauges and dense networks of GNSS stations that support positioning services, and also human resources required to undertake analysis and services. The global distribution of geodetic observatories is not homogeneous, and stations' technical readiness and condition of instruments vary. This affects accuracy and sustainability over time and is further exacerbated by aging infrastructure. This issue is one of the major topics one needs to handle, and requires both national efforts to upgrade infrastructure but also that Member States having capacity should assist countries with less capacity. This is as well related to the education and capacity building item of the roadmap.

General awareness of the GGRF is necessary for its sustainability. If decision makers do not understand the value of an investment in the GGRF, then they are unlikely to prioritize GGRF investments above other initiatives. Given the ultimate importance and benefit of the GGRF to the whole society, it is surprisingly poorly known and understood by non-specialists outside geodesy. Coordinated geodetic outreach program is needed to promote and disseminate the information of GGRF.

After approval of the roadmap, the working plan was developed with a number of focus groups towards the preparation for Terms of Reference and implementation plan. The groups are Outreach and Communication; Geodetic Infrastructure; Education, Training and Capacity building; Governance; and Policy, Standard and Convention. This work is planned for 2017.

#### 4. EUROPEAN GEODETIC REFERENCE FRAME

The UN-GGIM: Europe working group “GRF-Europe” (Geodetic Reference Frames – Europe), established in 2016, will be working as an expert group within the UN-GGIM: Europe with close connection to geodesy-related organizations in Europe and actively contribute to the work of the sub-committee on Geodesy. GRF-Europe will provide a link between the geospatial community, scientists and policy makers (Fig. 3).

GRF-Europe has created the Position Paper and invitation to participate the UN-GGIM: Europe Expert Working Group. Objectives were defined to be

- Support European countries to respond to the General Assembly Resolution on A Global Geodetic Reference Frame (GGRF) for Sustainable Development and implementation of the GGRF Roadmap
- Develop promotion and outreach programmes to make the geodetic reference frames (coordinates, height, gravity) more visible and understandable to the society, support open-data policy and foster the usage of geodetic products in geo-referencing tasks
- Support and foster geodetic capacity building within Europe when improving and maintaining appropriate national geodetic infrastructure

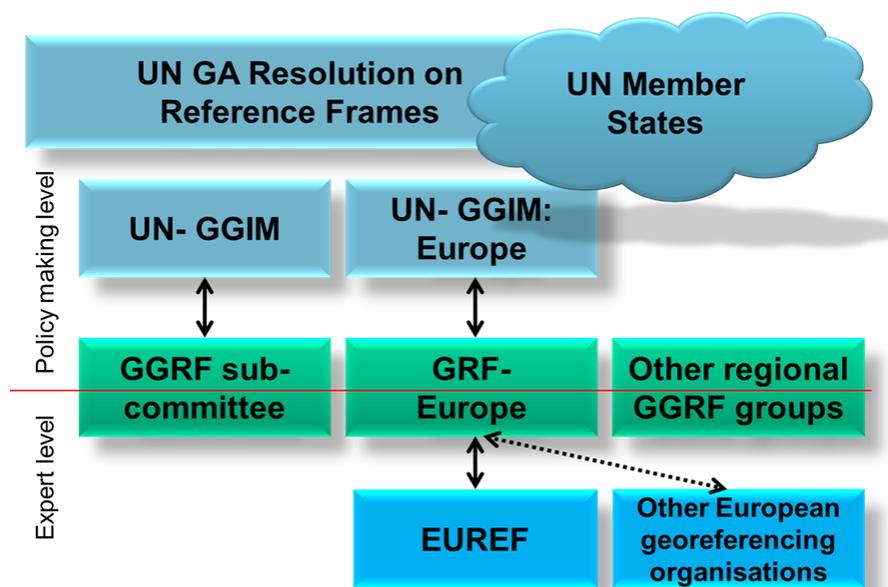


Figure 3. Relation of GRF-Europe as an interface between the expert level and policy making level.

There are many geodesy or georeferencing related organizations in Europe, which may contribute to or participate in the GRF Europe WG. Among these are EUREF, EUPOS, EuroGeographics,

International Federation of Surveyors (FIG), Council of European Geodetic Surveyors (CLGE), and European Plate Observing System (EPOS). There are also scientific communities that do not cover the whole Europe but are concentrating on specific areas or specific topics. Additionally, National Mapping Authorities are directly involved in the topic.

EUREF, the sub-commission of European reference frames has the major role in European reference frames (EUREF, 2017). EUREF deals with the definition, realization and maintenance of the European Reference Frame in close cooperation with the IAG components (Services, Commissions, and Inter-commission projects) and EuroGeographics, the consortium of the National Mapping Agencies (NMA) in Europe.

One of the major parts of EUREF activities is the EUREF Permanent Network (EPN), Fig. 4. More than 100 agencies, universities, and research institutions in more than 30 European countries contribute to EPN. European Terrestrial Reference System (ETRS89) is maintained via EPN and it is the European-wide coordinate reference system adopted by the European Commission (INSPIRE directive). The EUREF Technical Working Group is responsible, in general, for the control of EUREF activities and policy, it coordinates EPN and evaluates and accepts national realizations of ETRS89.

The major issue is the gap between the expert level and policy making level. EUREF can give recommendations and guidelines, but there is no direct formal connection to European Nations on policy making level. UN-GGIM:Europe special expert group GRF-Europe is meant to fill this gap, as well have connections to the GGRF as the European contributor to the global reference frames.

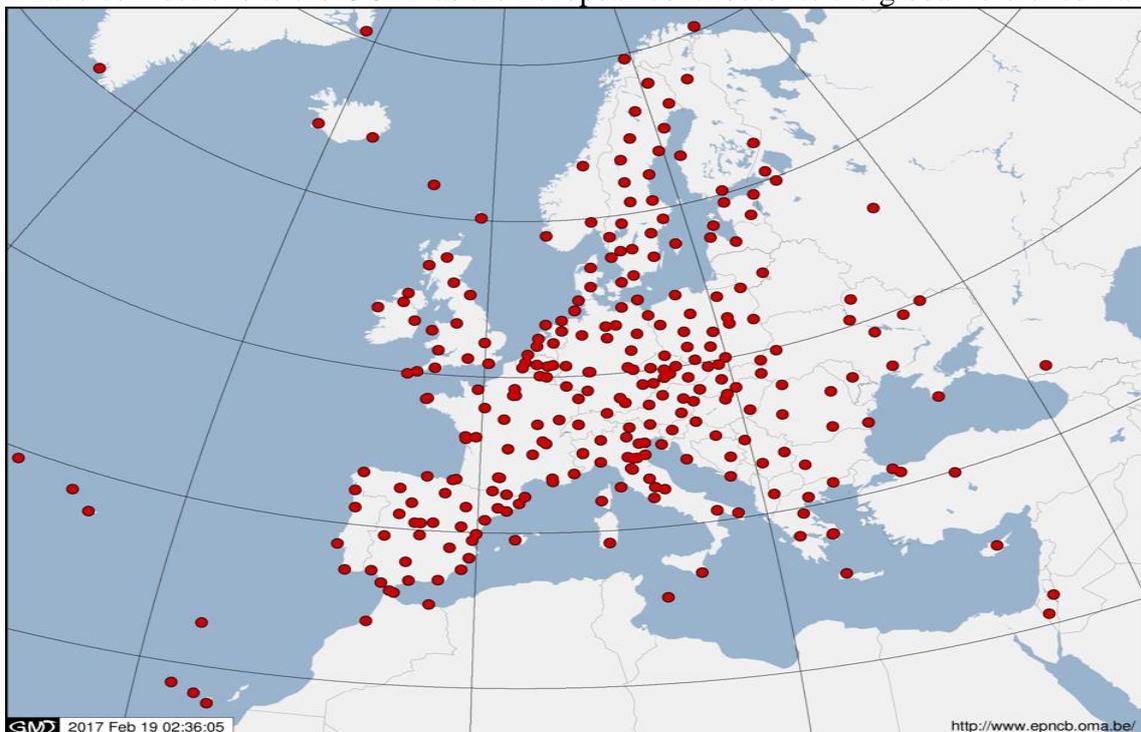


Figure 4. EUREF permanent GNSS Network, EPN (EPN, 2017).

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## BIOGRAPHICAL NOTES

Markku Poutanen is the director of the Department of Geodesy and Geodynamics of the Finnish Geospatial Research Institute FGI, National Land Survey of Finland. He has been working in FGI since mid-1980's, mostly on GPS and reference frame related tasks. He is among others the current president of EUREF, the IAG sub-commission of European reference frames, chairman of the expert group of UN-GGIM:Europe Geodetic Reference Frames (GRF-Europe), member of UN sub-committee GGRF on geodesy and former president of the Geodesy Division of the European Geosciences Union EGU.

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