UN GGIM Global Geodetic Reference Frame September 2019





United Nations Initiative on Global Geospatial Information Management

Positioning geospatial information to address global challenges

Global Geodetic Reference Frame

- The Global Geodetic Reference Frame (GGRF) is the foundation of virtually every aspect of the collection, management and use of national geospatial information and global monitoring of the Earth
- The GGRF underpins:
 - Earth and Climate science
 - Economic Development and Sustainability
 - Public Safety and Disaster Management
 - Land and Water Administration, and Environmental Management



United Nations Initiative on Global Geospatial Information Management



Societal Benefits of Precision Geodetic Infrastructure



National Research Council report on Precision Geodetic Infrastructure (2010)

Positioning geospatial information to address global challenges

United Nations Initiative on Global Geospatial Information Management

UN-GGIM

Why the GGRF is Important: Supporting Society



United Nations Initiative on Global Geospatial Information Management

Economic Impact of Sea Level Rise

• Rising sea levels could cost the world \$14 trillion a year by 2100 (Flood damage costs under the sea level rise with warming of 1.5 °C and 2 °C, *Environmental Research Letters* (2018). DOI: 10.1088/1748-9326/aacc76 , http://iopscience.iop.org/article/10.1088/1748-9326/aacc76)



Positioning Australia UN-GGIM

United Nations Initiative on Global Geospatial Information Management

Positioning geospatial information to address global challenges

Potential for Economic Growth





Geospatial services industry generated revenue of approximately

US\$400 BILLION IN 2016.



significant productivity impact in sectors representing approximately **75% OF GLOBAL GDP.**



Positioning Australia

UN-GGIM

Positioning geospatial information to address global challenges

United Nations Initiative on Global Geospatial Information management



SBAS has economic benefits across a range of sectors

Agriculture	Aviation	Construction
\$2.2	\$404	\$1.2
		1.#
Consumer	Maritime	Resources
\$34	\$588	\$1.58
a		٢
Rall	Water Utilities	Road
\$193	\$277	\$1.1
	1	X

Economic Benefits in Society

- Conservative estimate of economic benefits based on a 10cm positioning capability across Australia and New Zealand
- Figures based on benefit to the projects tested, rather than the entire benefit
- Does Not include very precise positioning, or general GNSS positioning, both of which also rely on the GGRF

Positioning geospatial information to address global challenges

United Nations Initiative on Global Geospatial Information Management

GGOS Inter-Agency Committee

- Nov 2009 Meeting in Frankfurt to discuss the creation of an Intergovernmental Committee for GGOS
- Recognised that the global infrastructure was far from ideal and not sustainably funded
- The Frankfurt Declaration became an agreement that agencies signed onto
- In the year that followed it was realised that "Intergovernmental" was going to be hard to achieve, so it was agreed that the members should focus on Inter-Agency cooperation in the short to medium term, thus the Interagency Committee was created
- However the main long term objective was to work towards an appropriate Intergovernmental arrangement aimed at enhancing the sustainability and quality of the Global Geodetic Reference Frame



Positioning geospatial information to address global challenges

United Nations Initiative on Global Geospatial Information Management

United Nations Global Geospatial Information Management (UN GGIM)

At the Second Session of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM), held at the UN (New York) from 13 - 15 August 2012, the importance of the global geodetic infrastructure was highlighted by a paper bough forward by PCGIAP (later to become UN GGIM Asia Pacific). In particular, it was recognised that:

- A consistent global approach to positioning is a key enabler of spatial data interoperability and that global and regional issues, such as climate change and regional hazard assessment, are best addressed using consistent technology and approaches to positioning and spatial data management; and
- Positioning is a global capability that can only be delivered through international cooperation, the collaborative use of global geodetic infrastructure and the open availability of the collected data.



United Nations Initiative on Global Geospatial Information Management

It was further recognised that the UN-GGIM would be able to:

- Facilitate international cooperation to ensure the interoperability of spatial data by encouraging the sharing of geodetic data between countries, including GNSS, gravity, tide gauge and heighting datasets;
- Assist with the co-ordination of ground infrastructure development, e.g. GNSS and other geodetic observatories, so as minimise coverage gaps and excessive duplication;
- Assist with the development of mandates to assist national agencies in obtaining appropriate resourcing from their governments so as to ensure geodetic infrastructure is supported as a key component underpinning all spatial activity; and
- Provide a forum that supports governmental technical cooperation and the sharing of expertise particularly to developing countries.
- PCGIAP Geodesy Working Group / IAG / FIG commenced an informal consultation and questionnaire

United Nations Initiative on Global Geospatial Information Management

Positioning geospatial information to address global challenges

Questionnaire (100+ responses)

- 88% of responses indicated that the data, products and services of the international global geodetic community (e.g. ITRF, IGS orbits,...) were either critical or had high importance in their country
- Only 61% of responding countries are willing/able to freely share GNSS data to the global community



United Nations Initiative on Global Geospatial Information Management

Positioning geospatial information to address global challenges

UN resolution – Global Geodetic Reference frame

- The need for UN GGIM engagement in the GGRF was workshopped in Doha, February 2013 at the UN GGIM High Level Forum
- The UN-GGIM decided at its 3rd session of the Committee of Experts, in July 2013, to formulate and facilitate a resolution for a global geodetic reference frame (GGRF)
- The Working Group on the GGRF was created in January 2014
- Draft Terms of Reference, Resolution and Concept note were developed and submitted to the 4th Session in August 2014
- The UN GGIM report to the Economic and Social Council of the UN included the draft resolution on the GGRF. It was subsequently endorsed by ECOSOC later in 2014.



United Nations Initiative on Global Geospatial Information Management

UN resolution – Global Geodetic Reference frame

- The Permanent Mission of Fiji to the United Nations offered to put forward the resolution on behalf of the Member States. During January 2015, the Permanent Mission of Fiji hosted three informal consultations. The informal consultations were concluded on 23 January 2015 with an agreed resolution.
- Fiji's leadership and influence brought 52 Member States to cosponsor the resolution
- At its 80th plenary meeting, held on 26 February 2015, Ambassador Peter Thomson, Fiji's Permanent representative to the United Nations, introduced the draft resolution to the General Assembly
- The General Assembly adopted the resolution on a Global Geodetic Reference Frame for Sustainable Development (A/RES/69/266).



Positioning geospatial information to address global challenges

First Ever Geospatial UN General Assembly Resolution 26 February 2015





United Nations Initiative on Global Geospatial Information Management

Positioning geospatial information to address global challenges



The General Assembly,

E-C20-2016-3 Glo...

X

IAG Jeju

Reaffirming the purposes and principles of the Charter of the United Nations,

Reaffirming also its resolution 54/68 of 6 December 1999, in which it endorsed the resolution entitled "The Space Millennium: Vienna Declaration on

UNRCC GGRF GJ -...

General Assembly...

5:30 PM

5/10/2015

GGRF Resolution: Key Objectives

- 1. Develop a global geodetic roadmap for the GGRF
- Global cooperation in providing technical assistance in geodesy for those countries in need to ensure the development, sustainability and advancement of a GGRF
- 3. Implement open geodetic data sharing
- 4. Improve and maintain national geodetic infrastructure
- 5. Enhanced multilateral cooperation that addresses infrastructure gaps and duplications globally
- 6. Improved Outreach to make the GGRF more visible and



United Nations Initiative on Global Geospatial Information Management

ggim.un.org

Roadmap - GGRF Definition

An authoritative, reliable, highly accurate, and global spatial referencing infrastructure. The GGRF includes the celestial and terrestrial reference frame products and Earth Orientation Parameters (EOPs) that connect them, the infrastructure used to create them, and the data, analysis, and product generation systems. The GGRF also includes gravimetric observations, products and height systems which underpin measurements of elevation.



United Nations Initiative on Global Geospatial Information Management

Positioning geospatial information to address global challenges

VISION

An accurate, sustainable and accessible Global Geodetic Reference Frame to support science and society



Geodetic Infrastructure

Current situation

- Significant investment in geodetic infrastructure by member States
- Coordination undertaken by the International Association of Geodesy (IAG) and its technique services
- Geographical distribution of infrastructure is biased towards Northern Hemisphere
- Gaps in the networks of infrastructure exist, even in the North
- Many of the legacy infrastructure are aging and difficult to maintain, and some do not meet current and planned future specification requirements
- Operating costs for geodetic infrastructure are a risk for sustainable operation
- GNSS contributes to the GGRF in a variety of ways
- GNSS is the primary means of accessing the GGRF
 - Coordination across nations, regions and globally is not always fully



Positioning geospatial information to address global challenges

United Nations Initiative on Global Geospatial Information Management







G



United Nations Initiative on **Global Geospatial Information Management**



Positioning geospatial information to address global challenges ggim.un.org



Yarragadee Geodetic Observatory, Western Australia



United Nations Initiative on Global Geospatial Information Management

Positioning geospatial information to address global challenges

Current Distribution



Positioning geospatial information to address global challenges

United Nations Initiative on Global Geospatial Information Management

GI

UN-GGIM

Geodetic Infrastructure

Recommendations

- Member States establish sufficient geodetic infrastructure to allow efficient and accurate access to the GGRF. Member States who have the capacity to assist those countries with less capacity do so through bi-lateral and multi-lateral agreements or other arrangements
- Member States, working within a coordinated science plan developed by the IAG, commit to maintain current investments in the existing Core Observatories in order to ensure the continuation of the provision of services
- Member States make efforts to upgrade the current observing systems at geodetic observatories, in particular VLBI and SLR instruments to next generation technologies
- Member States support the IAG's continued efforts to quantify through simulation the global distribution and specification requirements for geodetic observatories
- Member States commit to fill the gaps where Core Observatories are needed in order to ensure an optimal geometry and coverage wherever they may exist



Positioning geospatial information to address global challenges

Global Geospatial Information Management

United Nations Initiative on

Data sharing, Policy, Standards and Conventions

Current situation

- Geodetic data sharing is inconsistent across Member States and the UN-GGIM regions at this time
- A lack of reliable internet access, and concerns about conflicting commercial arrangements, sovereign security, and other associated legal impediments limit effective data sharing
- A sparseness of infrastructure, technical expertise, and coordination also impedes sharing of some data types
- IAG has developed policies, standards and conventions that are openly shared
- Data sharing needs to be undertaken with full consideration of licensing, quality, liability, authority, and security issues, while at the same time respecting local and national legal and policy frameworks



United Nations Initiative on Global Geospatial Information Management

Data sharing, Policy, Standards and Conventions

Recommendations

- Member States support the efforts already undertaken by IAG and standards organisations such as ISO toward geodetic standards, and make these standards openly available.
- Member States more openly share their data, standard operating procedures, expertise, and technology
- Member States resolve their concerns that currently limit data sharing and establish appropriate governmental mandates where required, as a valuable contribution to the enhancement of the GGRF



United Nations Initiative on Global Geospatial Information Management

Education, Training, and Capacity Building

Current situation

- Utilisation of the GGRF helps build a foundation for a country's development and sustainability. A lack of geodetic skills blocks this utilisation. Hence, a lack of geodetic competence and capability hinders a Member States development and sustainability
- The skills required to install and operate geodetic instruments, and analyse the data, are very specific and mastered by only a small number of people worldwide
- The aforementioned skillsets are not generally taught in mainstream higher education programs
- Some countries have geodetic capability, but only in small numbers of people, resulting in reduced capacity to contribute to the GGRF
- Other countries have neither capability nor capacity
- IAG and FIG currently offer some capability development activities

United Nations Initiative on



Positioning geospatial information to address global challenges

Education, Training, and Capacity Building

Recommendations

- Development organisations consider investments in national and regional geodetic capacity building to ensure efficient access to, and utilisation of, the GGRF in developing countries.
- Member States, in cooperation with the IAG, establish a global geodetic technical assistance program
- Member States, which have the capacity, assist Member States with less capacity to build sufficient geodetic capacity to efficiently and accurately access and utilise the GGRF in order to realise the sustainable development goals.
- Member States take actions to ensure educational and research institutions recognise the importance of geodetic science, and increase the availability of geodetic-focused degrees and programs of study, as well as increase the number and availability of geodetic courses in other associated degrees.
- Member States openly share all geodetic skills



United Nations Initiative on Global Geospatial Information Management

Communication and Outreach

Current situation

- General awareness around the value proposition 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 prioritise GGRF investments above other initiatives
- Geodetic science is not well understood by decision makers, particularly at the political level
- Geodesy is inherently a complex field of science, and communicating the nuances of geodetic science to a diverse audience is not an easy task
- The lack of available communications tools and skills limits the geodetic effectiveness of outreach, and jeopardises the sustainability of the GGRF accordingly



United Nations Initiative on Global Geospatial Information Management

Communication and Outreach

Recommendations

- Member States cooperate to establish an agreed and coordinated global geodetic outreach program
- Member States support and enhance outreach in accordance with the global geodetic outreach program
- Member States initiate, encourage, and promote better outreach cooperation between national communications experts and geodetic experts
- Member States use the developed communication strategy and tools (including newsletters, video, unggrf.org and social media @unggrf) for the purpose of raising the base level of awareness around the benefits of the GGRF to society
- If necessary, Member States translate communication tools into multiple languages to make them understandable on a national basis



United Nations Initiative on Global Geospatial Information Management

Positioning geospatial information to address global challenges



Current situation

- There are currently a variety of governance mechanisms in place that loosely coordinate the maintenance and development of the GGRF including the IAG and its technique services. These governance mechanisms are not sufficient to ensure the sustainability of the GGRF in an optimum way
- Some bilateral agreements exist between space agencies and national mapping organisations, but there is no comprehensive internationally binding governance for the GGRF
- Contributions to the GGRF are given by individual Member States with no guarantee of availability and continuity in the long term
- There is very little political visibility of the role the GGRF plays in their State, which may be improved by more robust intergovernmental arrangements
- The role of regional entities, some of which are only recently established, needs to be enhanced



Positioning geospatial information to address global challenges

United Nations Initiative on



Recommendations

- The Member States note the importance of effective governance to the sustainability and enhancement of the GGRF
- The Members States collectively commence the development of an implementation plan for the recommendations in the GGRF road map, including a position paper of Governance
- Subsequent speakers will detail specifics from the Implementation plan

United Nations Initiative on Global Geospatial Information Management

Positioning geospatial information to address global challenges

Road Map for the GGRF

The highlights of the 5 categories of action issues are:

- Actions must be taken to maintain and upgrade current national infrastructure and secure all Member States accurate access to the Global Geodetic Reference Frame;
- Member States are urged to support efforts to develop geodetic standards, and more openly share their data, standardised operating procedures, expertise, and technology;
- Actions must be taken to raise geodetic competence and skills, as a lack of geodetic capability currently limits utilisation of the global geodetic reference frame in many countries, and hinders their achievement of the sustainable development goals. It also threatens the development and sustainability of the Global Geodetic Reference Frame;
- Actions must be taken to raise the general awareness around the value proposition of the Global Geodetic Reference Frame
- Actions must be taken to improve the Global Geodetic Reference Frame governance mechanism, as this is needed to ensure the sustainability and improvement of the Global Geodetic Reference Frame.



Positioning geospatial information to address global challenges

Governance Position Paper

- Need a robust governance mechanism with the expectation that this will lead to greater mandate and sustainable funding
- Need for an Operational entity to provide capacity where needed – Geodetic Centre of Excellence
- Need a mechanism for funds management (trust fund) to support cooperation and activities of the operational entity
- Need to formalise relationships between current players

UN-GGIM

United Nations Initiative on Global Geospatial Information Management

ggim.un.org









Conclusion

- The Intergovernmental Mechanism for the Global Geodetic Reference Frame continues to be developed
- The Road map Implementation plan has now been developed and it can be used by Member states and development organisations to drive investment
- Work needs to continue on understanding the optimum governance arrangement for the GGRF in order to achieve the stated vision and Measures of success
- The focus now needs to move to increasing member nation engagement, and figuring out possible governance mechanisms, including cooperation between the UN system, the IAG and FIG globally, and regional entities like SIRGAS



Positioning geospatial information to address global challenges

United Nations Initiative on Global Geospatial Information Management