Attachment 2: Position paper - Appropriate governance arrangements

Introduction and summary

In 2013, already aware of the challenges regarding the development and sustainability of the global geodetic reference frame (GGRF), the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) requested the formulation of a resolution to strengthen the GGRF. February 25th 2015, the United Nations General Assembly adopted this resolution; Resolution (A/RES/69/266) "a global geodetic reference frame for sustainable development"[1]. The first Operational Paragraph (OP1) of the resolution notes with appreciation the establishment of a GGRF roadmap. The following year the UN-GGIM developed the GGRF roadmap and adopted it at its 6th session in August 2016.

The GGRF roadmap revealed to the UN-GGIM the need for an appropriate governance structure owned and driven by Member States to effectively implement the roadmap. As a result, the UN-GGIM at its 6th session requested the SCoG to "develop a position paper to define the appropriate governance arrangements for the global geodetic reference frame, while balancing the sustainability, investment and data-sharing needs"[2]. The UN-GGIM also emphasised that the UN-GGIM should be the appropriate intergovernmental mechanism for such a governance structure. This position paper is the answer to this request from the UN-GGIM.

The work process

The work with developing this position paper has been undertaken by a focus group (the GOVernance-group) consisting of representatives from nine Member States including both co-chairs and the Vice President of the International Organisation for Surveyors (FIG), the president of IAG, and a representative from NASA.

The process started with finding and discussing the governance attributes of an ideal governance mechanism for global geodesy based on request from the UN-GGIM, the roadmap findings and measures of success. As the work progressed, the GGRF focus groups engaged in developing the roadmap implementation plan, gave input regarding what governance attributes they felt were essential for a successful implementation of the roadmap. An overview of the ideal governance attributes is shown in the background documents following the SCoG report to the UN-GGIM 8th session.

To get a better understanding and a coordinated approach in the GOV-group towards developing the position paper, the group performed a gap analysis comparing the present governance mechanisms for the GGRF to the ideal situation as described by the ideal governance attributes.

The ideal governance attributes matched very well with the governance attributes of an intergovernmental organisation. This lead to a broad investigation of several existing intergovernmental organisations and the possibilities constituted by broad use of Memorandums of Agreements. The organisations investigated were World Meteorological Organization, International

[1] http://www.un.org/en/ga/69/resolutions.shtml

[2] Item 6/102, http://ggim.un.org/meetings/GGIM-committee/documents/GGIM6/E-2016-46-E-C.20-2016-15_GGIM6%20Report_en.pdf

Maritime Organization, International Hydrographic Organization, and the International Bureau of Weights and Measures. As part of this investigation, the GOV-group studied the conventions and protocols that constitute the governance foundation of these organisations. While studying these and other conventions and treaties it became apparent that the most efficient and just mechanism for facilitating Member State commitment is through conventions with or without underlying protocols.

To make sure every aspect of the governance measures proposed in this position paper were investigated thoroughly; they have been subject to Strengths, Weaknesses, Opportunities and Threats (SWOT)-analysis.

During the process with developing the position paper, the GOV-group presented its work to the rest of the working group/subcommittee to get comments and input.

Ideal and actual governance attributes for the GGRF

When preparing for writing the position paper the Subcommittee on Geodesy (SCoG) made an effort to describe the ideal governance attributes for the GGRF. The conclusion was that the ideal governance attributes for the GGRF very much resembled those of an intergovernmental organisation (IGO). An IGO usually has a congress, a governing board, an executive committee, a secretariat and several working groups and scientific committees. It has a mission, a vision and strategic plans. It is funded in a convention and has rules and regulations that clearly describe who can be members and what the rights and obligations of the members are and how the members and the IGO shall interact. Everything is transparent and governed. Note that only nations can be members of an IGO.

If we look at the governance mechanism of the GGRF in this perspective, the UN-GGIM can be said to be the congress, the SCoG the governing board, whereas the International Association of Geodesy (IAG), the International Federation of Surveyors (FIG) and other geodetic organisations constitute large complex scientific committees. The International Association of Geodesy promotes scientific cooperation and research in geodesy on a global scale and contributes to it through its various research bodies[3]. The FIG vision being "A modern and sustainable surveying profession in support of society, environment and economy by providing innovative, reliable and best practice solutions to our rapidly changing and complex world, acting with integrity and confidence about the usefulness of surveying, and translating these words into action"[4]. In addition, IAG plays an important role by being the main actor in developing the GGRF science plan as recommended in the roadmap[5].

Unlike the IGO, the SCoG does not have an executive committee, but this can be changed by revising the SCoG's Terms of Reference (ToR) as described in the Arguments chapter. Even though the UN-GGIM secretariat gives some secretary support to the SCoG, it is not comparable to that of an IGO secretariat. The IGO secretariat gives support to the bodies and groups in the IGO to facilitate progress towards realising the strategic plans of the IGO. The GGRF roadmap is the UN-GGIM GGRF strategy, the UN Resolution (A/RES/69/266) (the GGRF resolution), describes the vision, and the GGRF implementation plan will act as the strategic plan.

Table 1 in the Annex lists this comparison of the ideal governance attributes and the current equivalent for the GGRF.

[3] http://www.iag-aig.org/index.php
[4] http://fig.net/about/index.asp
[5] Roadmap, section geodetic infrastructure, recommendation c, http://ggim.un.org/meetings/GGIM-committee/documents/GGIM6/E-C20-2016-4%20Global%20Geodetic%20Reference%20Frame%20Report.pdf

The most substantial difference between the governance mechanism of an average IGO and of the GGRF is the level of intergovernmental commitment. By being a member of an IGO, a nation is committed to contribute to the mission, vision and strategic plans of the IGO. This commitment is often formalised by the nation giving an acceptance signature to a convention. No such intergovernmental commitment exists for the global geodetic reference frame, but both the GGRF-resolution and the roadmap state that this kind of commitment is vital to secure the development and sustainability of the GGRF. If the UN-GGIM were to establish a GGRF-convention to facilitate this kind of commitment, it would substantially strengthen the GGRF governance mechanism.

Coordination and direction of Member State contributions is necessary to realise the GGRF implementation plan, the roadmap and the GGRF resolution. To do this, some kind of GGRF coordinating entity with the necessary mandate must be operative. Presently this entity does not exist, and measures should be taken to investigate possible solutions to this problem.

Many developing Member States do not have sufficient geodetic infrastructure or skills to access and contribute to the GGRF. By establishing a trust fund, UN-GGIM can attract and enable more developing Member States to partake in the GGRF, and by so both facilitate to strengthen the GGRF and to boost prosperity.

Arguments

Formulate and negotiate a GGRF-convention

Claim A: A UN convention is key to facilitating the realisation of the GGRF UN resolution (A/RES/69/266) and the GGRF Roadmap recommendations

The overall intention of the UN General Assembly resolution (A/RES/69/266) is to enhance the development and sustainability of the global geodetic reference frame. The six operational paragraphs of the resolution are all encouraging, inviting and urging the Member States to take action. For example, Operational Paragraph 4 invites Member States to commit to improving and maintaining appropriate national geodetic infrastructure as an essential means to enhance the global geodetic reference frame. However, the resolution does not offer a framework facilitating these actions. The GGRF roadmap also states that development and sustainability of the GGRF is dependent on Member State commitment, but offers no framework facilitating this.

Even though the subcommittee on geodesy constitutes an improved governance mechanism for global geodesy, it does not in itself facilitate the level of Member State commitment encouraged in Resolution (A/RES/69/266), Operational Paragraph 4 and 5 or the GGRF roadmap recommendations c) and f), section “Geodetic Infrastructure”. The role of the subcommittee is more to contribute to create the necessary framework to make GGRF sustainable by advising the UN-GGIM on Member State actions to strengthen the GGRF. Member State commitment is dependent on the existence of an intergovernmental framework facilitating the commitment. This also accounts for other activities Member States can engage in to enhance the GGRF.

The GAP-analysis on governance attributes performed by the subcommittee as part of developing this position paper concludes that a UN-convention is the best measure to facilitate Member State commitment to the GGRF. It has the potential to very efficiently mend a major weakness in the governance structure of the GGRF as described in the introduction. In addition, formulating and negotiating a UN-convention is considered in line with the request from the UN-GGIM directing that the governance structure for the GGRF should be owned and driven by Member States, and that the

Committee of Experts should be the appropriate intergovernmental mechanism for such a governance structure.

Treaties and international agreements/conventions are much-used tools to enable and facilitate intergovernmental commitment. The Secretary-General of the United Nations is the depositary of more than 560 multilateral treaties, which cover a broad range of subject matters such as human rights, disarmament and protection of the environment[6]. It is normal to have amendments or protocols attached to a convention that the nations can agree to and sign if valued beneficial.

Nations sign and agree to international conventions on a voluntary basis. Only a minor number of nations need to agree on a convention initially for it to be valid. In the case of the Convention on the International Maritime Organization, nineteen nations signed the convention 6 March 1948[7]. This signature was not the formal acceptance signature of the convention, but the majority of these nineteen nations had formally accepted the convention five years later. At a steady pace, during the next five decades, most UN Member States gave their acceptance signature to this convention.

Protocols can be attached to a convention when it is written or added at a later stage. For instance, the United Nations Conference on Customs Formalities adopted the UN convention concerning Customs Facilities for Touring from 11 May to 4 June 1954[8]. At the same time, the conference adopted a protocol to the convention. Three years later, in June 1957, an additional protocol was added to this convention[9].

A convention may or may not have economic, legislative or administrative implications. The same accounts for attached protocols. In the case of the Convention of the International Hydrographical Organization (IHO), signing the convention has direct economic implications as the signing of the convention grants a membership to the organisation. Article XIV of the IHO convention gives directions about the annual contributions from Member Governments that shall be in accordance with a scale based on the tonnage of their fleets[10].

The Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment is a convention with legislative, administrative and judicial implications[11].

A convention can be UN-driven or non-UN driven. If we look at comparable areas to geodesy, like meteorology and safety at sea, where Member States have committed to contribute to/participate in activities that are of critical importance to the global society, the basis for these commitments are conventions. The World Meteorological Organization has both a UN-convention and a non-UN convention.

A convention can be very ambitious from the start and encompass all matters dealt with, or it can start simple and principle based and evolves to be more complex as time goes.

At this stage it appears to the SCoG, that the most efficient governance arrangement for the enhancement of the GGRF, is a principle based and overhead convention with no economic implications, where protocols can be added at a later stage; protocols for data sharing; protocols for maintaining national infrastructure; protocols for education training and capacity building; protocols

[6] https://treaties.un.org/
[7] https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XII-1&chapter=12&clang=_en
[8] https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XI-A-6&chapter=11&clang=_en
[9] https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XI-A-7&chapter=11&clang=_en
[10] https://www.iho.int/mtg_docs/com_wg/ISPWG/Documents/R11_iho_convention.pdf
[11] Article 2, https://treaties.un.org/doc/Treaties/1987/06/19870626%2002-38%20AM/Ch_IV_9p.pdf

for filling infrastructure gaps, etc. One important argument for designing a GGRF convention this way, is that it allows nations to develop in the area of geodesy in its own pace and manner, guided by the convention and its protocols. The large differences in the utilization and development in geodesy between regions and nations recommends this.

Another important argument that supports the establishment of such an overhead and principle based convention is that it has a relatively low level of complexity and therefore is easier to negotiate, administer and operate.

The establishment of a GGRF UN-convention will most likely have positive impact outside of the GGRF. Successful establishment of such a convention will clearly demonstrate the importance of UN-GGIM and the UN-GGIM decisiveness and ability to act. It will likely raise the awareness and profile of geospatial data in general.

To design a suitable convention for the GGRF is a complex task that demands thorough investigation. The SCoG recommends the UN-GGIM to initiate such an investigation and request that possible solutions are sought out, discussed and reported.

During the work with the UN GGRF resolution and the roadmap, single Member States provided extra monetary and human resources to conduct the ambitions of the UN-GGIM. The SCoG recommend the UN-GGIM to encourage the Member States to take on this kind of responsibility also for the work with investigating a GGRF convention.

In resolution (A/RES/69/266) the UN recognized the importance of international cooperation to realise the GGRF and the services needed to underpin global navigation satellite systems technology and provide a framework for all geospatial activity. The GGRF roadmap proves that to realise the GGRF resolution and implement the roadmap close intergovernmental cooperation is strongly needed. Today there is no intergovernmental treaties or organisations within the area of geodesy. The cooperation carried out is scientific, and even though this longstanding scientific cooperation has achieved amazing results, it is not sufficient to address ongoing and future challenges. A necessary development in order to implement the GGRF roadmap is to take the step from scientific cooperation to wider intergovernmental cooperation. Such intergovernmental cooperation must be based on intergovernmental commitment to the development and sustainability of the GGRF.

Investigate the need for a coordinating entity

CLAIM B: In the future, there will be a need for a professional entity with the mandate and resources to direct and coordinate the GGRF contributions

As explained in the introduction the limitations of secretarial and coordinating resources the present GGRF governance framework constitutes a gap to that of an Intergovernmental Organisation. This gap substantially reduces the productivity of the SCoG and threatens the implementation of the GGRF roadmap.

The development and sustainability of the GGRF is dependent on the contributions from many nations and often several agencies within these nations. The GGRF roadmap reveals that direction and coordination of the national contributions are necessary to realise the intention of the GGRF resolution. Today, IAG has a role coordinating most of the GGRF contributions from the Member States, but offers no direction to what each Member State shall contribute, as the International Association of Geodesy (IAG) has no mandate to direct the nations.

IAG is a constituent association of the International Union of Geodesy and Geophysics (IUGG), and is subject to the Statues and Bylaws of the IUGG. IUGG is one of the nearly 150 members of the

International Council for Science. IAG's members or Adhering Bodies, "may be either its [a country's] principal scientific Academy, or its National Research Council, or any other institution or association of institutions, whether non-governmental or governmental, representing the geodetic and geophysical activities of the adhering country"[12]. There is no claim in the IAG Statutes or Bylaws that the council delegates shall be responsible for geodetic infrastructure or other geodetic operations, and often they are not. This may create a substantial gap between the strategic goals of the IAG and the priorities of a nation's geodetic operation and development.

The GGRF work can only reach its full potential through direction and coordination of the national contributions. For this to be a reality, a framework must be in place for Member State commitment and an entity with the necessary mandate and resources to engage in the daily GGRF operations must exist. The SCoG cannot be this entity, as it does not have capacity, mandate and resources to perform this work.

The UN GGRF resolution is encouraging more Member States to contribute to the GGRF. If the nations presently not contributing to the GGRF answer to this challenge with the best of intentions, chances are that the contributions will not strengthen the GGRF. This is because the GGRF governance structure lack an entity with the mandate to, based on an analysis of the present situation, give directions and guidelines to what actions Member States should engage in.

The Operational Paragraphs 2, 3 and 5 of the resolution encourage, urge and invite the member states to cooperate. If many nations shall cooperate to reach the destined goal, the contributions must be directed and coordinated. To gain results it is vital that the nations respect and oblige the entity performing this coordinating activity. If nothing is done in this regard, chances are that in the future, the implementation plan will end up being a document of no use, the GGRF momentum will cease, progress slow down and the GGRF weakened further.

At present, no operational organization within the geospatial area, possesses the mandate, resources and the needed level of professionalism to operate a convention and its protocols. There is a need for more secretarial support in the operation of the SCoG. Further, it is unclear what kind of future support global geodesy can get from the UN-GGIM secretariat regarding the governance of global geodesy.

As a measure to strengthen the GGRF governance framework, the SCoG recommends the UN-GGIM to investigate the possibility to establish such an entity and whether an existing geospatial entity can take on or evolve to take on this responsibility. This work should be executed in parallel with the measure of investigating a GGRF convention, as this might inspire new aspects.

Revise the SCoG's Terms of Reference

CLAIM C: Revising the subcommittee Terms of Reference will strengthen the subcommittee on Geodesy as a governance arrangement for the GGRF

When the GGRF working group was elevated to a subcommittee, the UN-GGIM Committee of Experts requested the new subcommittee to determine its modalities and methods of work. Due to lack of experience and knowledge about what a subcommittee was in relation to a working group, the subcommittee Terms of Reference (ToR) very much resembles that of the GGRF working group. The experience during the first year as a subcommittee has revealed that the ToR is restricting the SCoG's work, and that a major revision of the ToR is necessary to create working conditions that allows the subcommittee to function effectively.

[12] Union Statues 4.a, http://www.iugg.org/statutes/composition.php

Further, it became evident when doing the GAP-analysis looking at the difference between the ideal governance attributes and the present situation, revising the SCoG's ToR would narrow some of the identified gaps in the GGRF governance mechanism. The SCoG has drafted a new ToR, modelled by the ToR of UN-GGIM: Europe, and will present this for adoption to the UN-GGIM at the UN-GGIM 8th session.

As the SCoG is a subcommittee under the UN-GGIM it is deemed right to develop the new SCoG terms of reference in line with the UN-GGIM Provisional Rules of Procedure given by the Economic and Social Council[13].

The production of the GGRF working group and the SCoG has been substantial and much is achieved so far. Presently, five focus groups are working to develop the GGRF roadmap implementation plan and the position paper describing appropriate governance arrangements for the GGRF. The activities of these focus groups must be coordinated and their input gathered and expressed in a coherent manner. The subcommittee has no secretarial resources of its own, but the UN-GGIM secretariat offers some support in connection with the annual report and the arrangement the annual official subcommittee meeting. Limitations in secretarial resources cause coordination and administration of the SCoG to fall on the co-chairs, hence progress is highly dependent on the co-chairs. This is adverse, and evidence recommends that an executive committee be established to make the organisation of the SCoG's activities more redundant. The working capacity of the SCoG's co-chairs to perform secretarial tasks is limited because they often are directors or in managerial positions nationally and have to prioritise the obligations their regular job brings upon them.

Closer interaction between the SCoG and the International Association of Geodesy (IAG) and the International Federations of Surveyors (FIG) is necessary to realise the UN GGRF resolution and the roadmap. As mentioned in the introduction, these organisations can be compared to complex GGRF scientific committees. To tie the work of the SCoG closer to these organisations, IAG and FIG are invited to take part in the SCoG executive committee meetings.

During the work with the GAP-analysis, it became evident that it was necessary to establish Rules of Procedure to make the SCoG's schedule of work more predictable for the members. Participating in a SCoG meeting demands planning, and may involve travelling costs and administrative issues for the members. It is important to schedule meetings and send out invitation to both work meetings and the official meetings well in advance, to avoid that member representatives are constrained from participating due to lack of time to get travel allowance or Visa. In addition, the new ToR also describes the rights and obligations of the SCoG members.

The members of the subcommittee count experts from 40 Member States nominated by the UN-GGIM regions. Professionals from state geodetic or space authorities, with specific knowledge of and responsibility for national, regional, global geodetic reference frames for positioning, navigation or timing applications represent the Member States in the subcommittee. The working capacity of the subcommittee is limited because these representatives often are directors or in managerial positions nationally and have to prioritise other obligations. To increase the working capacity of the SCoG the executive committee should have the mandate to formally invite a limited number of experts from new targeted Member States and invite these Member States to become members of the SCoG.

Membership to the UN-GGIM is described in the Provisional Rules of Procedure, Section II. Membership and composition, rules 2 to 6[14]. These rules disclose that only experts from UN Member

[13] http://ggim.un.org/meetings/GGIM-committee/documents/GGIM1/E-C20-2011-3-Rules%20of%20procedure.pdf

States can be members of the UN-GGIM. The member status "associate member" is not valid for the UN-GGIM. To make the new SCoG's ToR in line with the UN-GGIM Provisional Rules of Procedure, the SCoG wish to remove the associate member as a member status of the SCoG, and invite the present associate members of the subcommittee to become observers. The UN-GGIM Provisional Rules of Procedure, Section IX. Observers, Rules 39 to 42 describe who can become observers to the UN-GGIM.

To make sure that all aspects regarding revising the ToR were taken into account the SCoG made a Strengths, Weaknesses, Opportunities and Threat (SWOT)-analysis. In this analysis, several strengths and opportunities, but no weaknesses was found relating to the revision of the SCoG's ToR.

Establish UN-GGIM trust fund for enhancing the GGRF

Claim D: The establishment of a UN-GGIM trust fund for global geodesy will enhance the development and sustainability of the GGRF

There is substantial work left to do in order to implement the roadmap and by that secure the development and sustainability of the GGRF. To succeed with this more Member States must actively contribute to the GGRF in accordance with the implementation plan. Realising that the means to do this differs between nations and regions, guided education, training and capacity building is needed. The subcommittee realize that lack of resources can be a major limitation when it comes to attracting contributions from developing Member States.

Utilisation of the GGRF is a foundation for a nation's development and sustainability[15]. To allow efficient and accurate access the GGRF, Member States need sufficient GNSS infrastructure. Lack of geodetic skills also blocks the utilization of the GGRF. Consequently, lack of geodetic competence and capability restricts a nation's development, sustainability, and the realisation of the sustainable development goals.

The situation today, in many developing countries is a combination of lack of sufficient GNSS infrastructure and geodetic skills, making it hard to achieve geospatial data interoperability resulting in loss of competitiveness and societal disadvantage. In developing Member States that are at risk of natural disasters such as inundation due to sea level rise, tsunamis and earthquakes, addressing GNSS infrastructure gaps and Education, Training and Capacity Building (ETCB) are required to better facilitate mitigation strategies[16].

The current global distribution of core geodetic observatories is not homogeneous. It is particularly sparse in developing regions, such as Africa, Latin America and the Caribbean and South East Asia. This poor geometric coverage, coupled with under-performing instruments elsewhere, results in inconsistency and availability issues that jeopardize the GGRF accuracy and sustainability over time for all Member States. This is further exacerbated by geodetic observatories that rely on aging infrastructure, especially the legacy SLR and VLBI systems. This aging infrastructure will ultimately become unreliable and not fit-for-purpose, or fail to meet the emerging observational requirements[17]. This is especially adverse when facing the devastating challenges of climate change and climate change mitigation.

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[14] http://ggim.un.org/meetings/GGIM-committee/documents/GGIM1/E-C20-2011-3-Rules%20of%20procedure.pdf

[15] GGRF roadmap: http://ggim.un.org/meetings/GGIM-committee/documents/GGIM6/E-C20-2016-4%20Global%20Geodetic%20Reference%20Frame%20Report.pdf

[16] The GGRF roadmap, Section Geodetic Infrastructure

[17] The GGRF roadmap, Section Geodetic Infrastructure

The biggest challenge when addressing infrastructure gaps and ETCB is funding[18]. GGRF development and sustainability are dependent on more developing Member States contributing and accessing the GGRF. To strengthen the GGRF funds must be raised with the aim to increase the capability in the developing Member States in need.

The UN GGRF resolution operational paragraph 2 and the roadmap recommendation c, section Education, Training and Capacity Building, encourages Member States, which have the capacity, to assists Member States with less capacity to build sufficient geodetic capacity to efficiently and accurately access and utilize the GGRF to realize the sustainable development goals[19].

The subcommittee believes that a GGRF trust fund will direct more resources to the GGRF. The intention is that in the GGRF trust fund Member States can donate the amount they see fit to a purpose of their choice, and in this manner make donations in accordance with their national aid policy. It is believed that the existence of such a trust fund would attract and enable more developing Member States to partake in and access the GGRF.

The SCoG recommend the UN-GGIM to design and establish a GGRF UN Trust Fund that promotes Member State activities that contributes to realising the intention of the GGRF resolution and the road map. As other UN trust funds, the fund should be administered and managed by the UN. The establishment of such a trust fund will demand thorough investigation and planning to make sure it will work as intended. Measures that needs funding are (not restricted to):

- Build GGRF infrastructure in developing countries to boost prosperity
- Supporting GGRF education, training and capacity building measures for countries in need in accordance with recommendations in the implementation plan
- To cover travel expenses to SCoG meetings for experts from developing Member States
- To strengthen the GGRF governance structure by funding secretarial resources to the SCoG
- To cover expenses for hosting the official SCoG meeting
- To support GGRF communication and outreach measure in accordance with the recommendations in the implementation plan

The implementation plan demonstrates that the challenges differ regionally, supporting the establishment of a trust fund where nations can donate funds to specific measures in destined areas in accordance with the national aid policy.

The existence of a GGRF trust fund will facilitate national aid to be directed towards the GGRF, and hence motivate Member States to canalise funds to the GGRF. The mere existence of a GGRF trust fund will strengthen the UN-GGIM initiative. The utilisation of such a trust fund to strengthen the GGRF, realise the SDG's and boost shared prosperity will notably make the UN-GGIM known to be a benefactor of importance.

Conclusion

The most appropriate governance arrangements for global geodesy are:

1. **To start an investigation regarding the establishment of a GGRF UN-convention to enable Member States to commit to the development and sustainability of the GGRF in**

[18] GGRF Roadmap implementation plan, section Education, Training and Capacity Building
[19] GGRF roadmap: http://ggim.un.org/meetings/GGIM-committee/documents/GGIM6/E-C20-2016-4%20Global%20Geodetic%20Reference%20Frame%20Report.pdf

accordance with the UN General Assembly Resolution (A/RES/69/266) and the GGRF Roadmap recommendations.

2. **To investigate the future need for a professional operations organisation for the GGRF, and if an existing geodetic organisation can evolve to become this organisation.**
3. **To strengthen the subcommittee on Geodesy as a governance arrangement for the GGRF by revising the subcommittee Terms of Reference.**
4. **To initiate the establishment of a UN GGRF trust fund to support and promote Member State activities that contributes to realizing the intention of (A/RES/69/266) and the GGRF roadmap.**

Annex:

Governance attribute	**Governance equivalent GGRF**	**The GAP between the GGRF and an IGO**
Congress	UN-GGIM	The Congress makes decisions regarding the strategy and operation of the IGO long term. The UN-GGIM has a more guiding role than an IGO Congress.
Governing board	SCoG	The Governing Board is supposed to make decisions within the constraints given by the Congress. The SCoG has a more guiding role than that of an IGO. In addition, the SCoG is engaged in the daily operation of the SCoG producing the deliverables requested by the UN-GGIM. Usually the IGO-secretariat deals with this kind of activities.
Executive committee	-	The role of the Executive Committee is to implement the strategy, plans etc given by the board to reach the organisations vision. At present, the SCoG has no Executive Committee and this is limiting the working capacity of the SCoG.
Secretariat	-	Role partially executed by UN-GGIM Secretariat, but not at the level of an IGO secretariat.
Working groups	5 WG are in place (focus groups)	Five focus groups established to develop the implementation plan and position paper.
Scientific committees	IAG, FIG, etc.	Work goes on to find the appropriate way for effective interaction between the SCoG and the IAG, FIG
Mission, vision, strategic plan	GGRF Resolution, Roadmap, Implementation Plan	GGRF governance lacks the ability to realize the vision, strategy and implementation plan, where as an IGO has this ability.
Intergovernmental commitment	-	Governments commit to contribute to the mission of an IGO, usually by signing a convention. There is at present no level of intergovernmental commitment in the GGRF governance. To facilitate intergovernmental commitment to the GGRF a GGRF convention make up for the gap between the IGO and the GGRF.

Funding	-	A GGRF trust fund can strengthen the GGRF and compensate the gap between the GGRF governance and that of an IGO.

Table 1: Comparison of GGRF governance structure to that of an IGO

Counter Arguments

Counterclaims summarised

The most appropriate governance arrangement would be to strengthen existing entities, particularly the International Association of Geodesy (IAG) and the Group on Earth Observations (GEO), and in addition, to reinforce communication and exchange between these and other entities – such as national and international space agencies. A governance mechanism at UN level – involving UN-GGIM and the Subcommittee on Geodesy (SCoG) - produces additional overhead, tends to be slow and is not as flexible as relatively slim organizations like the IAG and its Global Geodetic Observing System (GGOS).

Supporting information for counterclaims

The IAG is a constituent Association of the International Union of Geodesy and Geophysics (IUGG) and was founded in 1862. The Global Geodetic Observing System (GGOS) is the Observing System of the IAG. Developed by the GGOS planning group, the proposal was accepted by the IAG Executive Committee and the IAG Council during the XXIII IUGG General Assembly in Sapporo 2003. The Global Geodetic Observing System works with the IAG components to provide the geodetic infrastructure necessary for monitoring the Earth system and global change research. The GGOS Mission is 1) to provide the observations needed to monitor, map, and understand changes in the Earth's shape, rotation, and mass distribution; 2) to provide the global geodetic frame of reference that is the fundamental backbone for measuring and consistently interpreting key global change processes and for many other scientific and societal applications; 3) to benefit science and society by providing the foundation upon which advances in Earth and planetary system science and applications are built.

GEO is a unique global network connecting government institutions, academic and research institutions, data providers, businesses, engineers, scientists and experts to create innovative solutions to global challenges at a time of exponential data growth, human development and climate change that transcend national and disciplinary boundaries. The unprecedented global collaboration of experts helps identify gaps and reduce duplication in the areas of sustainable development and sound environmental management. Together, the GEO community is creating a Global Earth Observation System of Systems (GEOSS) to better integrate observing systems and share data by connecting existing infrastructures using common standards. There are more than 400 million open data resources in GEOSS from more than 150 national and regional providers such as NASA and ESA; international organizations such as WMO and the commercial sector such as Digital Globe.

Refute counterclaims

The Mission of the IAG is the advancement of geodesy. The IAG implements its mission by furthering geodetic theory through research and teaching, by collecting, analyzing, modelling and interpreting observational data, by stimulating technological development and by providing a consistent representation of the figure, rotation, and gravity field of the Earth and planets, and their temporal variations. The IAG serves its purpose well; it is, however, a scientific organization in the field of geodesy. It promotes scientific cooperation and research in geodesy on a global scale and contributes to it through its various research bodies. The IAG is itself a sustainable organization and

an indispensable entity in reaching the goals of the GGRF Roadmap as it represents the global scientific geodetic community. The IAG, however, does not have the mandate, nor the financial means to establish a globally well-distributed and viable geodetic infrastructure.

GEO is a voluntary partnership of governments and international organizations. It provides a framework within which these partners can develop new projects and coordinate their strategies and investments. GEO focuses on facilitating access to Earth observation data for nine priority areas: natural and human-induced disasters, environmental sources of health hazards, energy management, climate change and its impacts, freshwater resources, weather forecasting, ecosystem management, sustainable agriculture, and biodiversity conservation. Thus also GEO does not have the mandate nor the financial means to establish a globally well-distributed and viable geodetic infrastructure.

National and international (space) agencies primarily take care that national (American, Russian, Chinese, etc.) or regional (European) needs for geodetic infrastructure are covered. Global geodetic infrastructure largely relies on “ad hoc” actions, bilateral agreements, etc. A globally coordinated effort would be a far more effective and efficient way to spend money and to establish a sustainable, global geodetic infrastructure.

There are currently many governance mechanisms in place that loosely coordinate the maintenance and development of the GGRF. These are based on best-efforts collaboration, with no contractual guarantee of continuity in the long term. Improved governance, particularly with respect to being owned and driven by Member States, is required to address this weakness and ensure the sustainability and improvement of the GGRF.

The currently established governance mechanism fulfils part of the ideal governance attributes. The governance, with UN-GGIM and SCoG at its basis, is the proper starting and can be further developed.

Evidence

The current global distribution of geodetic observatories is not homogeneous. It is particularly sparse in developing regions, such as Africa, Latin America and the Caribbean, and South-East Asia. This poor geometric coverage, coupled with under-performing instruments elsewhere, results in inconsistency and availability issues that jeopardise the GGRF accuracy and sustainability over time for all Member States. This is further exacerbated by geodetic observatories that rely on aging infrastructure, especially the legacy SLR and VLBI systems. This aging infrastructure will ultimately become unreliable and not fit-for-purpose, or fail to meet the emerging observational requirements.

The GNSS technique contributes significantly to the derivation of the GGRF. GNSS is also the most effective technology for accessing the GGRF. In the absence of appropriate GNSS infrastructure in many developing countries, the GGRF is weakened and becomes difficult to access, resulting in it being underutilised. As a consequence, interoperability of geospatial data is not easy to achieve in those countries, which in turn results in loss of competitiveness and societal disadvantage. This is further demonstrated in developing Member States that are at risk of natural disasters such as inundation due to sea level rise, tsunamis, and earthquakes. Addressing GNSS infrastructure gaps is required to help quantify and better manage these natural hazards and facilitate mitigation strategies.

There are currently a variety of governance mechanisms in place that loosely coordinate the maintenance and development of the GGRF. These governance mechanisms are not sufficient to ensure the sustainability of the GGRF. The loose and informal manner of the governance

mechanisms allows for inefficient and slow development processes, and the lack of formal commitment jeopardises sustainability and blocks progress. 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. These contributions are primarily given by developed Member States based on their national needs and then made available globally for the common good. The IAG services also produce global geodetic products based on these voluntary and time-varying contributions.

Presently, within the GGRF, there exists no governance mechanism that enforces and manages multilateral intergovernmental cooperation. Consequently, investments in geodetic infrastructure are not optimal and the geographical distribution of geodetic observatories globally is inconsistent, resulting in a weak global geodetic reference frame.

At the regional level, the UN-GGIM regional entities (Africa, Americas, Arab States, Europe and Asia-Pacific) and the IAG regional components (AFREF- Africa, APREF-Asia-Pacific, EUREF-Europe, NAREF-North America, SIRGAS- Latin America and the Caribbean and SCAR-Antarctica) make partially coordinated contributions. These contributions vary from region to region and are not coordinated globally in an optimal manner.

The development and sustainability of the Global Geodetic Reference Frame is reliant on an improved governance structure. Table 1 in the Position Paper summarizes the current status and recommendations for further development of the governance mechanism are given.