

Economic and Social Council

05 July 2024

Committee of Experts on Global Geospatial Information Management Fourteenth Session

New York, 7 - 9 August 2024

Item 8 of the provisional agenda*

Global geodetic reference frame

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Note by the Secretariat

Summary

The present paper contains the report prepared by the Subcommittee on Geodesy for consideration by the Committee of Experts on Global Geospatial Information Management.

At its thirteenth session, held in New York from 2 to 4 August 2023, the Committee of Experts adopted decision 13/106, in which it welcomed the considerable efforts to continue to implement General Assembly resolution [69/266](#) of 26 February 2015 and grow the critical understanding, awareness and importance of the global geodetic reference frame as a vital foundation for global geospatial and Earth observation infrastructure. The Committee also welcomed the establishment and inauguration of the United Nations Global Geodetic Centre of Excellence at the United Nations campus in Bonn, Germany, in March 2023 and acknowledged that, as the first dedicated resource to support the implementation of resolution [69/266](#), the Centre would be an important platform to encourage investment in geodetic infrastructure, improve international cooperation, provide technical assistance and capacity development, and foster more significant planning and international coordination in pursuit of strengthening partnerships and opportunities enabled by geodesy.

The Committee of Experts noted the revised terms of reference of the Subcommittee and the establishment of three new working groups and welcomed the establishment of the International Advisory Committee of the United Nations Global Geodetic Centre of Excellence, which would provide the required guidance and advice on the development, implementation and review of the substantive annual programme of work of the Centre in a transparent and inclusive manner. The Committee reiterated the importance of consulting and engaging with Member States to determine their operational geodetic requirements and encouraged the Subcommittee to work with United Nations Global Geospatial Information Management regional committees and relevant partners.

In this present report, the Subcommittee on Geodesy provides information relating to its activities during the intersessional period and on the outcomes of its fourth plenary meeting, hosted by the United Nations Global Geodetic Centre of Excellence at the United Nations campus in Bonn in March 2024. The meeting was attended by Member State representatives from all United Nations Global Geospatial Information Management regional committees, and participants from international and regional organizations, geodetic research institutions and relevant stakeholders. At the meeting, participants welcomed the role of the Centre as a coordinator at the global level, while also noting that a great deal of work was needed to make the global messages relevant to the United Nations Global Geospatial Information Management regional committees and to Member States. Each regional committee has a working group or community of interest with a focus on geodesy. At the meeting, the regional working groups and communities of interest reported on their regions.

* E/C.20/2024/1

I. Introduction

1. The Global Geodetic Reference Frame (GGRF) is an authoritative, reliable, highly accurate, and global, spatial referencing infrastructure. It includes the celestial and terrestrial reference frame products, the infrastructure used to create it, and the data, analysis and product generation systems. The GGRF also includes gravimetric observations, products, and height systems, which underpin measurements of elevation. The GGRF is fundamental to supporting the collection, integration and utilization of all other geospatial data. It is relied upon for social, environmental and economic initiatives, Earth science, the measuring and monitoring of progress of the 2030 Agenda for Sustainable Development, the Paris Agreement¹, the Sendai Framework for Disaster Risk Reduction, the Antigua and Barbuda Agenda for Small Island Developing States (ABAS), and other global, regional and national development agenda and initiatives.

2. The GGRF enables accurate and robust alignment of geospatial datasets – a key requirement for sustainable development in fields such as land use planning and administration, construction and hazard assessment. The GGRF is also an essential foundation for national height systems, which enable sustainable water management and monitoring of climate change and its impacts, such as sea-level rise, droughts, glacial retreat and ice sheet melting. The coordinates used in these applications are ideally referred to as a mathematically well-defined geodetic reference frame.

3. Recognizing the growing demand for an accurate and stable GGRF and the importance of international cooperation, the General Assembly of the United Nations adopted in February 2015, entitled ‘A Global Geodetic Reference Frame for Sustainable Development’ ([Resolution 69/266](#)). The Resolution reflects that the GGRF is the foundation required for the collection, integration, and utilization of all geospatial information. Furthermore, precise positioning from Global Navigation Satellite Systems (GNSS) is critically dependent on geodetic parameters and products to operate. GNSS provides highly accurate timing information, which is used as a source for timekeeping and time-synchronization. As the foundation for accurate and reliable geospatial data collection and integration for decision-making, the GGRF has a significant impact on many activities within the programme of work of the Committee of Experts. The GGRF is one of 14 Global Fundamental Geospatial Data Themes and underpins the quality and usefulness of the other 13. It is a prerequisite for the accurate collection, integration and use of all other geospatial data. Analysis of the Global Indicator Framework for Sustainable Development Goals (SDGs) through a ‘geographic location’ lens shows that geospatial information has a direct or significant contribution to the production of SDGs indicators.

4. At its thirteenth session, held in person on 2-4 August 2023, the Committee of Experts adopted decision [13/106](#), in which it welcomed the report of the Subcommittee on Geodesy and its progress and activities, including its considerable efforts to continue to implement General Assembly resolution 69/266 and grow the critical understanding, awareness, and importance of the global geodetic reference frame (GGRF) as a vital foundation for global geospatial and Earth observation infrastructure.

5. In this report, the Subcommittee provides information on its activities in the intersessional period, including its efforts to continue to implement General Assembly resolution [69/266](#). The Subcommittee provides information on the outcomes from the Fourth plenary meeting of the Subcommittee on Geodesy hosted by the United Nations Global Geodetic Centre of Excellence (UN-GGCE) at the United Nations campus in Bonn from 20 to 21 March 2024.

6. The Committee of Experts is invited to take note of the report and to express its views on the activities and next steps of the Subcommittee and the way forward. Points for discussion and decision are provided in paragraph 32.

¹ The Paris Agreement under the United Nations Framework Convention on Climate Change or the Paris Climate Accords.

II. Activities of the Subcommittee during the intersessional period

Fourth Plenary Meeting

7. During the intersessional period, Australia (Geoscience Australia) stepped aside as a co-Chair of the Subcommittee on Geodesy. Germany (Federal Agency for Cartography and Geodesy) stepped in as a co-Chair for the remaining term, until the Fourteenth session. At its Fourth plenary meeting, the Subcommittee selected Japan (Geospatial Information Authority) as a Member of the Bureau of the Subcommittee. With this selection, the Bureau of the Subcommittee has representation from all regions.

8. The Fourth plenary meeting of the Subcommittee on Geodesy was hosted by the UN-GGCE at the United Nations campus in Bonn from 20 to 21 March 2024. The meeting was attended by 37 representatives from 19 Member States from across all regions covered by the five United Nations Global Geospatial Information Management (UN-GGIM) regional committees, and three participants from international and regional organizations, geodetic research institutions and relevant stakeholders. Participants also attended the Second meeting of the UN-GGCE International Advisory Committee from 18 and 19 March 2024. One staff member from the United Nations Secretariat substantively facilitated the plenary meeting.

9. In the meeting, the participants welcomed the role of the UN-GGCE as a coordinator at the global level, while also noting a great deal of work is needed to take the global message from the UN-GGCE and personalize it within regions and individual Member States. The UN-GGIM regional committees each have a working group / community of interest with a focus on geodesy. Regional geodesy working group Chairs reported and provided updates from their regions.

10. The International Association of Geodesy (IAG), International Federation of Surveyors (FIG) and National Aeronautics and Space Administration (NASA) are all partners of the Subcommittee. In the meeting, their representatives presented updates, focus areas and upcoming events of interest for the Subcommittee.

11. Knowledge transfer is one of the main FIG activities. FIG members have been involved in the UN-GGCE Listening World Tour and have also contributed to regional sessions. At the recent FIG Working Week 2024 in Accra, Ghana in May, FIG Commission 5 convened numerous sessions, including its first covering the links senior decision makers. An update on the FIG Publication “Reference Frames in Practice Manual” was released in June 2024 firstly in English language, and two further language translations will follow.

12. NASA appreciated the work the UN-GGCE has done, noting that to achieve the goals of NASA’s existing and new missions there is a significant dependence on geodetic infrastructure; and a lot of the existing infrastructure is old. NASA is working to enhance its Very Long Baseline Interferometry (VLBI) and Satellite Laser Ranging (SLR) networks in the coming years. NASA is also involved in the work on geodetic collocation in space, outreach, training, and VLBI training schools.

13. The IAG is planning an annual update of the International Terrestrial Reference Frame (ITRF) 2020. This is necessary to improve and maintain not only the stability of the reference frame but also the accuracy of its associated parameters. Some Subcommittee members were concerned with the impacts on limited capacity available in countries to achieve this plan and asked how much extra effort it takes to produce the ITRF every year instead of the ‘every ~5 years’. IAG indicated there will be some extra work, but the IAG Services are all supportive of the proposed strategy.

14. At the Fourth plenary meeting, the Subcommittee discussed a more accurate description of its role, as the UN-GGCE has been established as an operational entity. The Subcommittee’s consideration was subsequently refined by the Subcommittee’s Bureau. In short, the Subcommittee has the following roles at global, regional and national levels:

- (a) Global –
 - Assist in the development of a global plan to implement GA resolution [69/266](#);
 - Enhance the impact of UN-GGCE activities;
 - Improve cooperation between the Subcommittee and UN-GGCE to strengthen the GGRF; and
 - Be a ‘Think Tank’ of ideas on how to help sustain global geodesy.
- (b) Regional –
 - Coordinate through the regional committees to strengthen collaboration and coordination across all regions and areas of the world.
- (c) National –
 - Strengthen collaboration and coordination across governments (policy, science, defence) and industry within Member States.

Collaboration activities with the UN-GGCE

15. In the intersessional period, the Subcommittee worked closely with the UN-GGCE. This is also reflected in the report of the UN-GGCE prepared jointly with its international advisory committee to the Committee of Experts (E/C.20/2024/10/Add.2)

16. During the first months after the inauguration of the UN-GGCE, it became apparent that there were large overlaps between the mission of the two newly formed working groups of the Subcommittee and the operational activities of the UN-GGCE. To avoid duplication of work the Subcommittee agreed to dissolve its working groups on Global Geodesy Needs Assessment and State of Geodesy Report, and rather support the UN-GGCE in its work on these matters. To optimize its effort the Subcommittee will regularly revisit its work program and interact closely with the UN-GGCE. In doing so, additional working groups may be established as needed.

17. Members of the Subcommittee participated in the Second Consultative Meeting for the Global Geodesy Development Plan hosted by the UN-GGCE from 20 to 23 November 2023. In this meeting members of the Subcommittee and other experts actively contributed to scoping the global geodesy development plan and developing a roadmap for its preparation, development, consultations and consensus. During the intersessional period, the Subcommittee together with the UN-GGIM regional committees successfully attracted many participants to the UN-GGCE’s global “listening tour”.

Working Group Activities

18. Members of the working groups on Global Geodesy Needs Assessment and the State of Geodesy Report, substantially contributed to the Global Geodesy Needs Assessment and the First Joint Development Plan for Global Geodesy. These activities are elaborated in the report of the UN-GGCE.

Capacity and Education.

This working group was established in March 2023 to locate national, regional, and other groups in need of capacity and capability development (CCD), determine groups with education and training (E&T) capacities, and connect these groups. During this past year, the working group coordinated regional efforts in Africa, Americas and Asia, and the Pacific regions. Support in the Asia and the Pacific region is fairly robust and established, in particular for the Pacific Island Countries and Territories (PICTs). However, broader support is being evaluated for Southeast Asia. Many opportunities exist in the Americas for both CCD and E&T through regional organizations such as SIRGAS and the Academic Network of the Americas². Efforts from the working group focused on seeking to connect geospatial professionals and practitioners in both the public and private sectors with an eye to achieving the SDGs. Support

² A thematic network of the United Nations Global Geospatial Information Management Regional Committee for the Americas (UN-GGIM: Americas)

for Africa focused on refining areas where UN-GGIM-Africa, Member States and scientific bodies might better integrate to achieve synergy. As the UN GGCE evolved to take on this role, efforts of the working group are expected to shift towards developing the network between the UN GGCE and the respective regional committees of the Committee of Experts.

III. Geodesy groups within UN-GGIM regional committees

UN-GGIM: Africa

19. The Africa Reference Frame (AFREF) Working Group has not functioned since 2018 and Member States are trying to find ways to revitalize the working group. The major problems identified in the African Member States are the range of different datums used, lack of capacity and lack of awareness. Better coordination between African Member States to reorganize efforts was aired at meetings as the solution.

UN-GGIM: Americas

20. The Geodetic Reference Frame for the Americas (GRFA) Working Group is led by Uruguay. The working group chair is dual-hatted as the president of SIRGAS (Geodetic Reference System for the Americas), which implements the GGRF in the Americas. With thirty years of prolific work, SIRGAS combines working groups for geometric and physical heights for twenty-two Member States in the Americas. SIRGAS seeks to incorporate all Caribbean countries to achieve full implementation of the GGRF in the Americas. During this past year, SIRGAS held a variety of education, training, and outreach efforts on Geodesy at the regional level. This includes the SIRGAS School on “Reference Systems” in Costa Rica, and the XIV International School on “The determination and use of the Geoid”, held in Argentina with the support of the Pan American Institute of Geography and History (PAIGH) and the International Association of Geodesy (IAG).

UN-GGIM: Arab States

21. A roadmap to implement the Arab States Reference Frame (ARABREF) is being prepared. The challenge is how to best encourage Member States to share their data. The IAG agreed to support the regional committee to ensure there is progress with the roadmap. The UN-GGCE is also planning a capacity development workshop to demonstrate the benefits of data sharing, which will need to be conceptualized and scoped together with the regional committee.

UN-GGIM-AP

22. The Working Group on Geodetic Reference Framework is jointly collaborating with IAG to improve access to the global geodetic reference frame by developing a regional geodetic reference frame; the Asia-Pacific Reference Frame (APREF). The APREF data/analysis centres have been continuously operated by the working group members and ensure stable access to the global geodetic reference frame. In addition to the continuous operation of APREF, an annual GNSS observation campaign, the Asia Pacific Regional Geodetic Project (APRGP), was conducted to further densify the regional frame, especially in the countries which still have difficulty operating a sufficient number of continuously operating GNSS stations. The working group organized several capacity development events on geodetic reference frames in the region, including the Workshop on Geodetic Reference Frame and Applications for Disasters, co-organized by the working group, IAG, FIG and the Geospatial Information Authority of Indonesia.

UN-GGIM: Europe

23. The regional committee has decided to translate its Geodetic Reference Frame (GRF) Working Group into a GRF Community of Interest as the working group was not active in the past few years. The UN-GGCE global ‘Listening Tour’ session in Europe brought several new members to the new UN-GGIM: Europe - GRF Community of Interest. The community is discussing a draft strategy related to the region’s needs with an emphasis on the lack of

geodesists, enhanced training and raising awareness. The GRF Community of Interest is also working to collaborate with EUREF to avoid duplication of effort.

IV. Next Steps

24. In the coming intersessional period, the Subcommittee will continue to collaborate with and assist the UN-GGCE, the International Advisory Committee, Partners, and other relevant stakeholders. It also intends to revisit its work program to avoid duplication of work and to align its work program with its newly refined roles.

25. The Working Group on Capacity and Education will continue coordinating efforts regionally with a focus on developing a network between the UN-GGCE and regional partners. The collaboration will continue with the International Federation of Surveyors, the International Association of Geodesy, the UN-GGIM regional committees, the UN-GGIM Academic Network, and other relevant regional organizations. A key focus will be on developing a network between national and regional requirements and those who can meet the requirements while involving the UN-GGCE to ensure continuity of effort in global plans.

26. The Subcommittee will continue to collaborate with the Expert Group on Land Administration and Management, Working Group on Marine Geospatial Information, Working Group on Policy and Legal Frameworks, and the UN-GGCE to advance consideration related to the integration of terrestrial, maritime, built and cadastral domains and to support the GGRF and better implementation of the GGRF.

27. The Subcommittee intends to convene its fifth plenary and in-person meeting in conjunction with the meeting of the UN-GGCE IAC during the upcoming intersessional period.

V. Recommendations

28. The Subcommittee recommends Member States to make use of or benefit from the policy briefs and reports developed by the UN-GGCE, and endeavor to utilize these resources to raise awareness of the vulnerability of the global geodesy supply chain, its importance to the Global Geodetic Reference Frame (GGRF) and the successful implementation of the 2030 Agenda for Sustainable Development.

29. As national economies are increasingly reliant on revenues generated by satellite services, which depend on geodetic capabilities, the Subcommittee recommends Member States to participate in the activities of the Subcommittee and the geodesy working groups of regional committees to improve competence in geodesy.

30. Since the adoption of General Assembly resolution 69/266 in February 2015, the global geodetic infrastructure underpinning the GGRF has continued to degrade. To meet the 2030 Agenda, the Subcommittee advocates drawing ECOSOCs attention to the need for a stronger mandate to develop a sustainable GGRF and the infrastructure on which it is built.

31. The Subcommittee also advocates for focusing ECOSOC attention on the need for a sufficient cadre of professionals with the skills required to maintain the global geodesy supply chain and appropriate resources to maintain their capacity and capability, especially in developing countries.

VI. Points for discussion

32. The Committee of Experts is invited to:

(a) Take note of the present report, the work and progress of the Subcommittee, including its considerable efforts to grow the critical understanding, awareness and importance of the GGRF as a vital foundation for global geospatial and Earth observation infrastructure;

(b) Provide guidance to the Subcommittee on how to develop a stronger mandate to develop a sustainable GGRF and the infrastructure on which it is built;

- (c) Provide guidance on appropriate resource mobilization and active participation to support the Subcommittee, the geodesy working groups of regional committees and the UN-GGCE, and encourage Member States and relevant geodetic stakeholders to contribute; and**
- (d) Take note that the Subcommittee plans to organize the fifth plenary and in-person meeting of the Subcommittee on Geodesy in conjunction with the meeting of the UN-GGCE IAC during the upcoming intersessional period.**