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Global geodetic reference frame

Global geodetic reference frame

Note by the Secretariat

Summary

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

At its ninth session, held in New York from 7 to 9 August 2019, the Committee of Experts adopted decision 9/104, in which it supported the adoption of the International Terrestrial Reference System and the International Terrestrial Reference Frame as the standard for scientific, geospatial and operational geodetic applications. The Committee also requested the Subcommittee to explore a number of modalities to balance the longer-term vision, stability and operational requirements of the global geodetic reference frame, including the establishment of a global geodetic centre of excellence in cooperation with the Committee. The Committee further requested the Subcommittee to continue to ensure broad consultation on the progression and modalities of the position paper on governance, to establish global cooperation and to acquire a better understanding of how the practical and operational requirements of the global geodetic reference frame could be implemented. The Subcommittee was further encouraged to consult further on the practical implementation of the global geodetic centre of excellence, including modalities, function, financial arrangements and programme of work, in direct coordination with the Committee, and in coordination with other relevant geodetic stakeholders to avoid duplication of effort. In this present report, the Subcommittee provides information on its activities, including its progress on the position paper on governance in considering the sustainability and quality of the global geodetic reference frame in an increasing location-based world, and the complex issues associated with it. These include a lack of geodetic infrastructure, poor accessibility in some regions, a reliance on in-kind contribution and insufficient collaboration and coordination. In this regard, the Subcommittee provides its consideration towards achieving the long-term sustainability and quality of the global geodetic reference frame by delivering improvement in five focus areas, namely, governance including collaboration and coordination; policies and standards; geodetic infrastructure; education training and capacity building; and outreach and communication, and outlines a range of work packages to ensure short- and medium-term stability, quality and accessibility of the global geodetic reference frame across the five focus areas. In the report, the Subcommittee also updates the Committee on the modalities for the establishment of a global geodetic centre of excellence.

* E/C.20/2020/20

I. Introduction

1. Positioning, navigation and geospatial data are part of everyday life. In addition to the traditional survey, mapping and navigation fields, location-based positioning applications are increasingly critical for civil engineering, industrial automation, agriculture, construction, mining, recreation, financial transactions, intelligent transport systems, disaster response and emergency management, environmental studies and scientific research. The location and coordinates used in these applications are ideally referred to a mathematically well-defined geodetic reference frame.

2. The Global Geodetic Reference Frame (GGRF) is an authoritative, reliable, highly accurate, and global, geospatial referencing infrastructure and 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 Sendai Framework for Disaster Risk Reduction, the Small Island Developing States Accelerated Modalities of Action (SAMOA) Pathway, and other global, regional and national development agenda and initiatives.

3. 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 scope of work of the Committee of Experts. The GGRF is the reference frame for the Global Fundamental Geospatial Data Themes[1] and underpins the quality and usefulness of the other data themes. The GGRF is a prerequisite for the accurate collection, integration and use of all other geospatial data. Analysis of the Global Indicator Framework for the Sustainable Development Goals (SDGs), viewed with a 'geographic-location' lens, shows that geospatial information has a direct or significant contribution to the production of SDGs indicators.

4. The currently adopted product for the terrestrial geometric part of the GGRF is the International Terrestrial Reference Frame (ITRF). The ITRF has been developed by the International Earth Rotation and Reference Systems Service (IERS), a joint service of the International Union of Geodesy and Geophysics (IUGG) and the International Astronomical Union (IAU). At the ninth session of the Committee of Experts, the Subcommittee presented an Agreement on the International Terrestrial Reference System and the International Terrestrial Reference Frame. The Committee of Experts supported the adoption of the International Terrestrial Reference System (ITRS) and the International Terrestrial Reference Frame (ITRF) as the standard for scientific, geospatial and operational geodetic applications.

5. With the growth of satellite and telecommunications capabilities, the rising costs of implementing and maintaining geodetic infrastructure, and with the increasing importance of accurate location information across many industry sectors and in everyday life, there was a request to strengthen international cooperation in this area and for additional resources for geodesy. Recognizing the growing need for a high quality and sustainable GGRF to support good decision-making to an ever-increasing location-based society, with inclusive social progress, economic development, and environmental sustainability, the United Nations General Assembly adopted Resolution 69/266 in February 2015, entitled 'A Global Geodetic Reference Frame for Sustainable Development'[2].

6. Resolution 69/266 recognized the criticality of the GGRF for sustainable development, inter alia: the importance of international cooperation; the economic and scientific importance 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; and, that the GGRF depends upon the participation of countries all around the world. The cumulative importance of this resolution recognises that geodesy is the foundation for the reference frames required for the collection, integration, and utilisation of

[1] http://ggim.un.org/documents/Fundamental%20Data%20Publication.pdf
[2] https://ggim.un.org/documents/A_RES_69_266_E.pdf

all geospatial information. Furthermore, it supports precise positioning from Global Navigation Satellite Systems (GNSS) through the coordinate systems transmitted by the various GNSS, which is becoming a foundation for informed decision making, supporting the three pillars of sustainable development – society, environment, and economy.

7. Recognising the importance of the GGRF, at its sixth session in August 2016, the Committee of Experts adopted decision 6/102, in which it noted the need for an appropriate governance structure to effectively implement the road map for the GGRF. At its seventh session in August 2017, the Committee adopted decision 7/103, in which it endorsed the formal establishment and composition of the Subcommittee on Geodesy (Subcommittee) with its terms of reference, and expressed support for the development of appropriate governance arrangements for the GGRF. The Committee of Experts, at its eighth session in August 2018, adopted decision 8/103, in which it endorsed the revised terms of reference for the Subcommittee, and noted the initial work and progress made on the position paper on governance towards improving the sustainability and enhancing the quality of the GGRF.

8. At the ninth session of the Committee of Experts, held in New York from 7 to 9 August 2019, the Subcommittee provided a background document with its report, the '*Position Paper of the Subcommittee's Working Group on Governance*' on appropriate governance arrangements for sustaining the GGRF[3]. In adopting decision 9/104[4], the Committee of Experts requested that the Subcommittee explore a number of modalities to balance the longer-term vision, stability and operational requirements of the GGRF, including the establishment of a global geodetic centre of excellence in cooperation with the Committee. The Committee of Experts requested the Subcommittee to continue to ensure broad consultation on the progression and modalities of the position paper on governance, to establish global cooperation and to acquire a better understanding of how the practical and operational requirements of the GGRF could be implemented.

9. Also at the ninth session of the Committee of Experts, the Subcommittee was encouraged to consult further on the practical implementation of the global geodetic centre of excellence, including modalities, function, financial arrangements and programme of work, in direct coordination with the Committee, and in coordination with other relevant geodetic stakeholders to avoid duplication of effort.

10. In this present report, the Subcommittee informs the Committee of Experts of its progress on appropriate governance arrangements and considerations for the long-term sustainability and quality of the GGRF in an increasingly location-based world. In this regard, the Subcommittee is drafting its *Position Paper on Sustaining the Global Geodetic Reference Frame* that builds on the earlier position paper of its Working Group on Governance, and provides a plan to help achieve the long-term sustainability and quality of the GGRF by delivering improvement in five focus areas: Governance; Geodetic Infrastructure; Policies, Standards and Conventions; Education, Training and Capacity Building; and Communication and Outreach. Together with the position paper, the Subcommittee has also developed and drafted a *Concept Paper on Establishing a Global Geodetic Centre of Excellence* seeking to harness the spirit and momentum of global cooperation in geodesy. A key overarching goal of the Centre is to achieve the long-term sustainability, accessibility and accuracy of the GGRF through a programme of works that prioritizes and delivers improvements in the five focus areas[5], and by addressing many of the critical gaps in capacity and capability across the five focus areas.

11. This present report also provides information and updates to the Committee of Experts on the Subcommittee's activities, efforts and progress during this intersessional period. The Committee is invited to take note of the report, consider the progress of the Position Paper

3 http://ggim.un.org/meetings/GGIM-committee/9th-Session/documents/GGRF_Position_Paper2019_24July_web.pdf

4 http://ggim.un.org/meetings/GGIM-committee/9th-Session/documents/GGIM9-report-e.pdf

5 Governance; Geodetic Infrastructure; Policies, Standards and Conventions; Education, Training and Capacity Building; and Communication and Outreach.

on Sustaining the Global Geodetic Reference Frame and the Concept Paper on Establishing a Global Geodetic Centre of Excellence (GGCE), note the offer by the Federal Republic of Germany to establish a GGCE in Bonn, Germany, and provide its views and guidance on the Subcommittee's efforts to implement Resolution 69/266. Points for discussion and decision are provided in paragraph 41.

II. Subcommittee activities during the intersessional period

12. This section provides a summary of the work conducted by the Subcommittee's five working groups: Governance; Geodetic Infrastructure; Policies Standards and Conventions; Education Training and Capacity Building, and Communication and Outreach during the intersessional period.

13. The third plenary meeting of the Subcommittee on Geodesy was planned to take place on the margins of the Sixth High Level Forum on United Nations Global Geospatial Information Management in Windsor, United Kingdom from 18 to 19 April 2020. With the growing global health crisis posed by the COVID-19 outbreak in early 2020, and the World Health Organization's declaration of a global pandemic on 11 March, it was decided that the Windsor meeting of the Subcommittee be postponed until the situation globally permits. The Subcommittee and its bureau convened virtual online meetings to progress its work and address the more pressing issues that were on the agenda of its postponed third plenary meeting with the support of the Secretariat of the Committee of Experts.

14. In January 2020, Canada, as chair of the Working Group on Policies, Standards and Conventions of the Subcommittee, expressed intention to step down from the chair role due to other national commitments. The bureau, at its online meeting on 11 June 2020, agreed that Australia be appointed as the new chair of the Working Group. The Subcommittee, at its online meeting on 18 June 2020, was informed of the bureau's decision and expressed its appreciation to Canada for their contributions, progress and leadership. The Subcommittee also discussed and agreed to delay the election of a new co-Chair, replacing Australia, until after the tenth session of the Committee of Experts.

Governance

15. During the intersessional period the Working Group on Governance has been working to address decision 9/104[6] by developing a draft Position Paper on Sustaining the Global Geodetic Reference Frame, which explores the modalities to balance the longer-term vision, stability and operational requirements of the GGRF. This draft paper is an extension of the Position Paper of the Subcommittee's Working Group on Governance on appropriate governance arrangements for sustaining the GGRF, presented to the Committee at its ninth session. As part of the solution to sustain the GGRF, the Subcommittee has proposed establishing a United Nations led GGCE and was encouraged by the Committee of Experts at its ninth session to consult further on the practical implementation of the GGCE, including modalities, function, financial arrangements and programme of work.

16. The Working Group have led the development of a draft Concept Paper on Establishing a Global Geodetic Centre of Excellence, which describes the role of the GGCE and how it would work with Member States and geodetic organisations to improve collaboration and coordination, and maximise the benefit of global geodetic efforts. Due to the COVID-19 pandemic and the challenges it has put upon the Working Group and the world at large, there has been a delay in the Subcommittee's consultation process. Although the Subcommittee has considered and reviewed the draft papers, the consultation has not been as broad as initially planned and requested by the Committee. Consequently, these draft papers are presented to the Committee of Experts at this present session for broader consultation so that Member States and relevant geodetic stakeholders are able to ensure alignment with the practical and operational requirements proposed by the Subcommittee.

[6] http://ggim.un.org/meetings/GGIM-committee/9th-Session/documents/GGIM9-report-e.pdf

Geodetic Infrastructure

17. The Roadmap for the GGRF[7], developed by the Subcommittee, defines geodetic infrastructure to include: Very Long Baseline Interferometry (VLBI); Satellite Laser Ranging (SLR); Global Navigation Satellite Systems (GNSS); Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS); gravimetric, and other geodetic instrumentation which underpin the GGRF. It includes sea-level tide gauges and dense networks of GNSS stations that support positioning services. It also includes the systems and human resources required to undertake geodetic analysis and the provision of services.

18. Over the intersessional period, the Working Group on Geodetic Infrastructure concentrated its activities on developing a Geodetic Infrastructure Questionnaire that was sent out to the twelve services within the International Association of Geodesy (IAG) to provide a detailed description of their needs (both short and long-term) in order to meet the requirements of science and societal applications of their geodetic products. The questionnaire includes all aspects of the geodetic infrastructure, and more specifically the gaps and future needs with approximate costs, in terms of observatories of geodetic instruments, and human resources that operate the data collection, archiving and analysis.

19. The intention of the questionnaire is to make use of the responses to consider and develop a Global Geodesy Development Plan (GGDP) that can be articulated, and following two main objectives: (i) sustain and improve the accuracy of the GGRF (by improving and sustaining the geodetic infrastructure in the long term), and (ii) ensure an accurate access to the GGRF by all Member States, in particular via GNSS technology. The GGDP is intended to provide detailed elements of the needs that are necessary to enhance and sustain the geodetic infrastructure. The Working Group will assist in drafting the GGDP, particularly in ascertaining work packages, priorities or urgency levels, together with the GGCE and the Subcommittee. Once the GGDP is developed and finalized, the Subcommittee together with the Committee of Experts could develop communication and advocacy mechanisms to attract contributions from Member States and relevant geodetic stakeholders.

20. With regard to the questionnaire, eight responses were received so far from the following IAG Services: International VLBI Service (IVS); International Laser Ranging Service (ILRS); International GNSS Service (IGS); International DORIS Service (IDS); International Earth Rotation and Reference System Service (IERS); International Gravity Field Service (IGFS); International Centre for Global Earth Models (ICGEM); and International Digital Elevation Model Service (IDEMS). The responses were professional and comprehensive, providing clarity and details based on the IAG science requirements, i.e. the critical needs to fill the gaps in order to meet accurate and sustainable IAG geodetic reference products and services. Of particular importance are the responses from the ILRS and IVS, given the fundamental role and contribution of SLR and VLBI to the definition and long-term maintenance of the ITRF. As an example, the following table summarizes some of the ILRS and IVS critical needs, with their approximate costs:

# Instruments needed to fill the gaps in the network	# of additional Data Centers	# of additional Analysis Centers	New technology investment/development
20 Cost for one instrument: ~$8M	4 Total annual cost per center: ~$250K	6 Total annual cost per center: ~$600K	~$200M

[7] http://ggim.un.org/meetings/GGIM-committee/documents/GGIM6/E-C20-2016-4%20Global%20Geodetic%20Reference%20Frame%20Report.pdf, Annex 1, Glossary of Terms

Policies, Standards and Conventions

21. The Working Group on Policies, Standards and Conventions has the objective to encourage Member States to continue to make their data findable, accessible, interoperable and reusable. Over the intersessional period, members of the Working Group have been actively involved with international standards related activities that aim to make data access easier, more useful, more accurate and more efficient for users. This includes work within organizations such as the Technical Committee 211 of the International Organization for Standardization (ISO/TC-211) and the Bureau of Products and Standards of the IAG's Global Geodetic Observing System (GGOS). Notable activities from members of the Working Group include:

a) Implementation of ISO 19161-1: Standard on the International Terrestrial Reference System (ITRS) that defines the requirements and methods for realizing an ITRS, critical requirements for implementing the GGRF.

b) Publishing of ISO 19111: Spatial Referencing by Coordinates which is a joint ISO-OGC standard[8] that defines the schema used to represent reference frames and transformations in registries of such information. This update to ISO19111 includes inclusion of dynamic reference frames, geoid-based vertical datums and temporal coordinate systems.

c) Further development of the ISO Geodetic Registry, an online database of reference frames and transformations which is used to uniquely identify reference systems and transformations. As opposed to other geodetic registries, the ISO Geodetic Register is the only authoritative source for reference frames and transformations where data is entered/validated by government agencies.

22. The Working Group has observed that data sharing is inconsistent or absent across the Committee's five geographic regions. The barriers to data sharing include: legislative limitations; institutional and conflicting commercial concerns; lack of financial and technical resources; lack of regional collaboration and initiatives (often due to geographic isolation or national circumstances); sparseness of geodetic infrastructure and lack of data; and security concerns. The Working Group will continue to encourage Member States to: more openly share their geodetic data by contributing to existing international data portals or provide access to their own portal; use international metadata standards and metadata catalogues for their own portals; and continue to assist in data sharing workshops.

Education, Training and Capacity Building

23. The Working Group on Education, Training and Capacity Building (ETCB) shared with the Subcommittee at its online meeting of 18 June 2020 the final outcomes of a worldwide geodetic educational needs assessment to establish a priority list of short and long-term training needs. The outcomes of this analysis determined that strong institutional support from national geodetic organizations and relevant geodetic stakeholders, such as the IAG and International Federation of Surveyors (FIG), as well as to structure mechanisms for resourcing, will be required to realize the GGRF.

24. Based on the needs assessment, the Working Group has actively engaged relevant geodetic stakeholders and representatives of small island developing States to support the modernisation of geodetic infrastructure through capacity and skills development workshops. Integral to these engagements is the integration of geodetic capacity building and geospatial management to deliver the SDGs, the Sendai Framework, and the Integrated Geospatial Information Framework (IGIF).

25. Since the ninth session of the Committee of Experts, the Working Group has contributed widely to numerous geodetic workshops, seminars, and sessions in conferences and also plenary meetings in Asia and the Pacific and the Americas regions, all of which has

[8] Available from OGC for free

significantly raised the profile of the Committee of Experts and the Subcommittee. The Working Group especially note the collaboration with the regional committees for Asia and the Pacific and the Americas, and the Committee's Working Group on Geospatial Information and Services for Disasters.

26. The working group continues to emphasize the need for regionally focused strategies, as the nature, size, and variety of challenges differ regionally and may include linguistic, technological, economic, and cultural. Additional findings from the needs assessment indicated that access to highly skilled personnel varies widely among Member States, thus requiring the need to ensure that knowledge and competence are shared, that are findable, accessible, interoperable, and reusable. The Working Group observed that key to optimizing the efficiency of its objectives are to identify and make existing educational and capacity building resources easily discoverable, while identifying gaps in capacity and proposing short and long-term solutions to bridge these deficiencies. The Working Group plans to collaborate with FIG, the IAG and its technical services, as well with other relevant geodetic stakeholders such as the Committee on Earth Observation Satellites (CEOS) and the Group on Earth Observations (GEO), to develop a common point of information discovery and distribution.

27. The Working Group noted with interest the potential of the IGIF and its Implementation Guide, and proposed three guiding principles to support the implementation of the IGIF for geodesy: i) a strategic regional focus, sensitive to language and culture; ii) ensure that knowledge and skills are discoverable and openly shared; and iii) collaboration with relevant geodetic stakeholders. The Working Group plans to organize its future work with a strategic implementation plan to align with the goals in the Position Paper on Sustaining the GGRF, and supporting subsequent plans developed by the Subcommittee to achieve the long-term sustainability and quality of the GGRF with education, training and capacity building. This strategic implementation plan of the Working Group will advocate and leverage the guidance and recommended actions of the IGIF and its Implementation Guide where appropriate.

28. The Working Group notes the importance of leveraging participation amongst relevant geodetic stakeholders including the International Committee on GNSS (ICG). The Working Group worked with ICG representatives from the IAG, FIG, and IGS to realize an inaugural joint session with the ICG Working Group on Information Dissemination and Capacity Building (ICG WG-C) and the ICG Working Group on Reference Frames, Timing, and Applications (ICG WG-D). This joint session was held at the Fourteenth Meeting of the ICG, organized by the Indian Space Research Organization (ISRO) on behalf of the Government of India, in Bengaluru in December 2019. The Working Group notes the value of diverse perspectives in its work and encourages wider participation and contribution.

Communication and Outreach

29. During the intersessional period, the Working Group on Communication and Outreach continued to provide communication services to the Subcommittee. The Working Group had several teleconferences and worked on materials to communicate the work of the Subcommittee through social media and digital newsletter presented on the Subcommittee's web-sites[9].

30. The tenth newsletter[10] of the Subcommittee, in November 2019, reported the outcomes from the ninth session. The digital issue also presented the journey towards a GGCE and how a GGCE will strengthen the capacity to implement the Resolution 69/266 'A Global Geodetic Reference Frame for Sustainable Development'. The Working Group also consulted with the Working Group on Governance to socialize the draft Position Paper on Sustaining the Global Geodetic Reference Frame and Concept Paper on Establishing a Global Geodetic Centre of Excellence, to ensure consistent language and messaging.

9 http://ggim.un.org/UNGGIM-wg1/ and http://unggrf.org/

10 https://ggim.un.org/documents/UN%20GGIM_GGRF_Newsletter_10_DIGITAL.pdf

31. The Working Group had planned communications activities, including a revision of its web-site, unggrf.org, as a new platform ahead of the third plenary meeting of the Subcommittee that was postponed due to COVID-19 pandemic. However, the international documentary on geodesy, 'Quest for the Exact Position'[11] was made freely available. The documentary is an excellent tool to communicate the importance of the GGRF within countries and regions.

III. Draft Position Paper on Sustaining the Global Geodetic Reference Frame

32. In a world increasingly reliant on high accuracy measurements and location based services, the sustainability of the GGRF is more important than ever before. However, its quality, accuracy and accessibility are at risk of failure due to a multitude of complex issues. These include a lack of geodetic infrastructure, poor accessibility in some regions, a reliance on in-kind contribution, and insufficient collaboration and coordination. In response to a request from the Committee of Experts at the ninth session to explore a number of modalities to balance the longer-term vision, stability and operational requirements of the GGRF, the Subcommittee drafted a Position Paper on Sustaining the Global Geodetic Reference Frame. This paper builds on the position paper of the Subcommittee's Working Group on Governance on appropriate governance arrangements for sustaining the GGRF and provides a plan to help achieve the long-term sustainability and quality of the GGRF by delivering improvement in five focus areas:

a) Governance

b) Geodetic Infrastructure

c) Policies, Standards and Conventions

d) Education, Training and Capacity Building

e) Communication and Outreach

33. The draft position paper describes the current state and future requirements of the GGRF, discusses a range of work packages developed by the Subcommittee which aim to address the critical gaps in sustaining the GGRF, introduces and discusses the potential and role of a GGCE to sustain the GGRF. The draft position paper is provided as a background document to this present report. The Subcommittee looks forward to broader consultation with Member States and relevant geodetic stakeholders to ensure that the Subcommittee's work plan is aligned with their practical and operational requirements. The Subcommittee is also committed to continue working closely with the IAG, FIG, and other relevant geodetic stakeholders to avoid duplication of efforts and work programs, and to enhance coordination and collaboration within the global geodetic community.

IV. Draft Concept Paper on the Establishment of a Global Geodetic Centre of Excellence

34. At the ninth session of the Committee of Experts, the Subcommittee was encouraged to consult further on the practical implementation of the GGCE as one of the ways to sustain the GGRF. It is with this spirit of global cooperation in geodesy, and to provide guidance for Member States, that the Subcommittee developed its Concept Paper on Establishing a Global Geodetic Centre of Excellence. The Subcommittee considers the role of the GGCE is to assist in sustaining the GGRF by implementing operational paragraphs of Resolution 69/266. This can be paraphrased as to:

a) Enhance global cooperation and coordination across Member States and relevant geodetic stakeholders to maximize the benefit of ongoing geodetic efforts, ensure coherence, and avoid duplication of effort;

[11] https://vimeo.com/324592652

b) Strengthen geodetic infrastructure;

c) Assist Member States in making their geodetic data findable, accessible, interoperable and reusable in line with standards, policies and conventions;

d) Support education, training and capacity building; and

e) Improve communication and raise awareness.

By fulfilling these roles, the GGCE would address many of the critical gaps in capacity and capability and for the sustainability the GGRF.

35. It is intended that the GGCE will be established and operated as a United Nations Centre and will therefore be led and managed by the United Nations via well-established mechanisms and modalities. These typically comprise a Memorandum of Understanding and a Host Country Agreement between the United Nations and host Member States, as donors. In this regard, the United Nations will also establish a Trust Fund in accordance with prevailing rules, guidelines and practices of the United Nations.

36. A range of operational models are available, including a single host Member State model when the only host and donor is a Member State, and a federated model when multiple Member States co-host a GGCE. In order to achieve the overarching role and deliver improvement, a federated model is encouraged. This concept of a federated model is designed to be inclusive and enable a range of contributors and partners with multiple sources of funding and at multiple locations. The Subcommittee strongly encourages any Member State interested in the concept, and especially the federated model, no matter how small, to discuss options with the UN Secretariat.

37. Avoiding duplication, leveraging complementary strengths and resources, and collaborating through synergistic efforts is needed to achieve the long-term accuracy and accessibility of the GGRF. The concept of a GGCE, as a federated model approach, is beginning to emerge as a key and effective element of global geodetic efforts and collaboration for the sustainability and quality of the GGRF. A federated model can be viewed as multiple, often dispersed, centres as part of a larger, coordinated network which interact and collaborate to form a unified whole – offering integrated functionality and performance.

38. The draft concept paper on the GGCE is provided as a background document to this present report. The Subcommittee looks forward to broader consultation with Member States and relevant geodetic stakeholders to ensure that the concept and the practical implementation, including the GGCE's modalities, function, financial arrangements and programme of work, are coordinated and to avoid duplication of effort.

United Nations Global Geodetic Centre of Excellence, Bonn, Germany

39. As the draft Concept Paper on Establishing a Global Geodetic Centre of Excellence was being developed, initially by the bureau of the Subcommittee, Germany expressed an early interest with the UN Secretariat in taking the first steps towards establishing the GGCE. This interest has evolved during the intersessional period, and in coordination with the bureau of the Subcommittee and development of the draft concept paper. Subsequently, on 27 July 2020 the government of the Federal Republic of Germany, via note verbale 265/2020 through its Permanent Mission to the United Nations in New York, formally submitted an offer to host and establish a GGCE at the United Nations Campus in Bonn, Germany. The offer is endorsed by the city of Bonn, and the federal state of North Rhine-Westphalia.

40. Although only very recent, the detailed submission by Germany to host the GGCE has been well received by the Subcommittee and the international geodetic community. It supports the development of a globally coordinated public geodetic infrastructure enabling all Member States to work collaboratively towards the sustainability and quality of the GGRF. Germany's offer is provided as a background document to this present report, along

with letters of support from Argentina, Australia, Canada, Italy, Japan and Norway. Additionally, Norway, through their letter of support, proposes to contribute an experienced senior communications advisor by virtual secondment to the GGCE.

V. Points for discussion

41. **The Committee of Experts is invited to:**

(a) Take note of the present report and the work of the Subcommittee on Geodesy;

(b) Encourage Member States to actively participate in the working groups of the Subcommittee, and to ensure broad geographical representation and even development context;

(c) Express its views and provide guidance on the draft Position Paper on Sustaining the Global Geodetic Reference Frame;

(d) Express its views and provide guidance on the draft Concept Paper on Establishing a Global Geodetic Centre of Excellence; and

(e) Take note of the offer from the Federal Republic of Germany to host a Global Geodetic Centre of Excellence in Bonn, support the establishment of the Centre, and encourage Member States and relevant geodetic stakeholders to contribute to the Global Geodetic Centre of Excellence.