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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 eighth session, held in New York from 1 to 3 August 2018, the Committee of Experts adopted decision 8/103, in which it endorsed the revised terms of reference for the Subcommittee and the road map implementation plan as the third step in the process of improving the sustainability and enhancing the quality of the global geodetic reference frame. The Committee noted the initial work and progress made on the position paper on governance and requested that the Subcommittee initiate and undertake broad and detailed consultations thereon during the intersessional period and provide an update to the Committee at its ninth session. In this report, the Subcommittee provides information on its recent activities, including the main outcomes of its second meeting held on the margins of the United Nations World Geospatial Information Congress, convened in Deqing, China, in November 2018. The Subcommittee examined and discussed the recommendations and actions described in the road map implementation plan and the position paper on governance; developed its workplan; held a focus session on education, training and capacity-building; planned outreach and communication activities, in particular with appropriate regional initiatives; and identified steps towards strengthening ties and arrangements with the United Nations Global Geospatial Information Management regional committees. In the report, the Subcommittee also provides an update regarding the position paper on governance for the global geodetic reference frame.

* E/C.20/2020/1

I. Introduction

1. The global geodetic reference frame is the foundation of virtually every aspect of the collection, management and use of national geospatial information and global monitoring of the Earth. The criticality of the global geodetic reference frame for sustainable development was recognised by the General Assembly in adopting resolution 69/266¹, recognising, 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 global geodetic reference frame depends upon the participation of countries all around the globe. The cumulative importance of this resolution recognises that geodesy is the foundation for the spatial reference frames required for the collection, integration, and utilisation of 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 – the economy, society, and environment.

2. At its eighth session in August 2018, the Committee of Experts adopted decision 8/103, in which it endorsed the Subcommittee's revised terms of reference to provide clearer modalities and working procedures, commended the Subcommittee on the considerable progress made in the completion of the road map implementation plan, and endorsed the plan as the third step in the process of improving the sustainability and enhancing the quality of the global geodetic reference frame.

3. In making decision 8/103, the Committee of Experts also noted with interest the initial work and progress made on the position paper on governance and its use as a detailed discussion paper for addressing the need to fill the current gaps in governance arrangements for the global geodetic reference frame. The Committee noted that, given the difficulty in developing an appropriate governance structure, the position paper on governance served as an aspirational tool for engaging commitment from Member States in the medium to long term and therefore required careful consideration, in particular with regard to the different options available and the need for broad consultation and agreement in order to better understand the importance of the work involved. In this regard, the Committee of Experts requested that the Subcommittee initiate and undertake this consultation on the position paper on governance during the intersessional period.

4. The present report informs the Committee of Experts of the second meeting of the Subcommittee on Geodesy, convened on the margins of the United Nations World Geospatial Information Congress, held in Deqing, China in November 2018; its activities undertaken during the intersessional period; and the Subcommittee's progress in developing the position paper on 'appropriate governance arrangements'. The Committee of Experts is invited to take note of the report and to express its views on the way forward for the global geodetic reference frame. Points for discussion and decision are provided in paragraph 32.

¹ A/RES/69/266

II. Second meeting of the Subcommittee on Geodesy

5. The second meeting of the Subcommittee on Geodesy was convened on the margins of the United Nations World Geospatial Information Congress in Deqing, Zhejiang Province, China on 22 and 23 November 2018.²

6. The Subcommittee meeting was attended by 24 participants, of which 17 were from the following 15 Member States and Non-Member States: Australia, Burkina Faso, China, France, Finland, Japan, Mexico, Norway, Republic of Korea, Saudi Arabia, State of Palestine, Sweden, Tonga, United States of America and Uruguay. There were five experts from the International Association of Geodesy (IAG), the International Federation of Surveyors (FIG), the National Aeronautics and Space Administration (NASA), the Ahmadu Bello University of Nigeria, and the World Bank, one observer from the private sector, and two representatives from the Secretariat. The meeting was opened and chaired by Australia³.

7. The objectives of this Subcommittee meeting were to: i) examine and discuss the recommendations and actions described in the road map implementation plan and the position paper on governance; ii) develop the work plan to enact the actions from the implementation plan for the global geodetic reference frame road map; iii) provide a dedicated focus session on education training and capacity building; iv) discuss plans for outreach and communication, particularly with appropriate regional initiatives and activities; and, v) strengthen ties and arrangements between the Subcommittee and the Regional Committee of UN-GGIM Asia-Pacific's Working Group on Geodesy.

8. The Subcommittee reiterated the need for its meetings and activities to be open and encouraged and welcomed Member States to actively participate in its working groups. Also noted was the importance of the bureau of the Subcommittee in guiding and expediting its work and activities.

9. In accordance with the revised terms of reference, the Subcommittee had received nominations for, and subsequently approved, its Bureau. The Bureau is now composed of: Australia, Canada, France, Norway, Mexico, the Russian Federation, Sweden and the Kingdom of Tonga. During the selection exercise the Subcommittee considered and noted the geographical distribution and the potential imbalance of developed and developing countries. The Subcommittee agreed that the geographical balance in composing the Bureau will be monitored and addressed as required in the future.

10. The Subcommittee also discussed the challenges in clarifying relationships with global and regional partners such as the IAG, SIRGAS, and AFREF, and also with the respective UN-GGIM regional committees and their work/working groups on geodesy. The Subcommittee agreed that the IAG was best suited to discuss scientific issues, whilst the Subcommittee on Geodesy and the regional bodies were best positioned to operationalise geodetic services through government and inter-governmental processes. In considering its global work and potential, the Subcommittee concluded that it will need to redouble its efforts in engaging with the respective UN-GGIM regional committees (and other relevant regional entities) regarding their work/working groups on geodesy. The Subcommittee urges the regional committees and entities to engage with the global work of the Subcommittee and to emphasize the critical nature of geodesy to their respective national and regional executives.

² http://ggim.un.org/meetings/2018-Geodesy/documents/20181122_SCoG2_Report.pdf

³ The second co-Chair from Russian Federation was unable to attend.

11. Within the context of the roadmap and implementation plan, participants provided updates on their national geodetic issues and work. The Subcommittee agreed that collaboration is a critical component of data sharing and technical cooperation and emphasised the value for Member States and experts to participate within the meetings and support the work of the Subcommittee, especially within its plenary meetings to foster knowledge exchange, awareness raising, and identification of common challenges. In recognition of the importance of country reporting on their geodetic reference frame activities, the Subcommittee agreed that country reports will become a standard agenda item in its plenary meetings.

12. The Subcommittee reviewed its work plan, and pertinent updates in addition to other activities that were undertaken during the intersessional period are included in Section III of this present report.

13. The Subcommittee also discussed, edited, and by consensus decided on the Agreement on the International Terrestrial Reference System (ITRS) and the International Terrestrial Reference Frame (ITRF). Regional entities of the Committee of Experts and of the IAG rely on and adopt the ITRF for their operational geodetic and geospatial applications, as well as for the definition of their regional geodetic reference frames. The Agreement is detailed in Annex 1.

14. Also discussed was the proposed location and date of the third plenary meeting of the Subcommittee. Later, members agreed to aim for the third meeting to be held on the margins of the Sixth High Level Forum on UN-GGIM in April 2020 in the United Kingdom of Great Britain and Northern Ireland.

III. Subcommittee activities during the intersessional period

15. This section provides a summary of the work conducted by the Subcommittee's five working groups: i) Geodetic Infrastructure; ii) Education, Training and Capacity Building; iii) Outreach and Communication; iv) Policy, Standards and Convention; and v) Governance, during the intersessional period.

16. **Geodetic Infrastructure.** This working group, formerly lead by Australia, is now led by France. The group continues to advocate the need for improving the currently aging geodetic infrastructure that requires contributions from Member States, as detailed in the United Nations General Assembly Resolution (A/RES/69/266) on the global geodetic reference frame and the recommendations in the related road map. The working group emphasized that the commitment from Member States is needed to improve national geodetic infrastructures, which are essential to enhance the global geodetic reference frame. Failing to secure the commitment and support from Member States the global geodetic reference frame will be in danger of degradation over time, and consequently will gradually lose its required accuracy and its critical role in underpinning societal and scientific applications. The focus of the working group includes building stronger engagement mechanisms to raise the awareness to the Committee of Experts on the need to implement the "Road Map for the Global Geodetic Reference Frame for Sustainable Development"⁴ recommendations, in addition to the development of an IAG science plan that is easily communicated to non-specialists. The working group also emphasized their support for appropriate governance arrangements so that concrete actions can be taken for sustaining the global geodetic reference frame.

17. **Education, Training and Capacity Building.** At the second meeting of the Subcommittee, the Education, Training and Capacity Building working group, led by

⁴ <http://ggim.un.org/meetings/GGIM-committee/documents/GGIM6/E-C20-2016-4%20Global%20Geodetic%20Reference%20Frame%20Report.pdf>, Annex 1

Sweden⁵ shared the first steps of a proposal to address the lack of fundamental geodetic skills in the geodetic community. The working group also shared the preliminary results of an educational needs assessment to establish a priority list of short and long-term training needs. It was determined that strong institutional support from national geodetic organizations and international professional organizations such as the IAG and FIG may be required.

18. Based on the results from the needs assessment, the working group has actively engaged with international technical bodies and representatives of small island developing states to support capacity building and skills development workshops. A joint UNOOSA-Fiji workshop on “the Applications of GNSS” was conducted from 24 to 28 June 2019 at the University of the South Pacific in Suva, Fiji, at which the working group supported the session with presentations and a panel discussion on sustainability and modernization of GNSS, CORS and geospatial infrastructure through capacity development. Also discussed was the Subcommittee’s work in relation to the Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction, and the UN-GGIM-World Bank Integrated Geospatial Information Framework. In addition, a side meeting on regional issues related to geodesy, geodetic infrastructure and GNSS capacity was held with support from the UN-GGIM Asia-Pacific Working Group on Geodesy, FIG Asia-Pacific Capacity Development Network, FIG Commission 5 and the International GNSS Service.

19. The working group also plans to contribute to the “International Workshop for the implementation of the Global Geodetic Reference Frame in Latin America” which will be held at the National Geographic Institute in Buenos Aires City, Argentina, from September 16 to 20, 2019. The workshop is being organized by the IAG with the support of the International Association of Seismology and Physics of the Earth’s Interior (IASPEI), the UN International Committee on GNSS (ICG), the International Union of Geodesy and Geophysics (IUGG), and the National Geospatial Committees of Argentina, Brazil, Chile, Colombia and Costa Rica.

20. Since the eighth session of the Committee of Experts, the working group has supported several geodetic seminars and workshops, especially in the Asia-Pacific region, which has significantly raised the profile of the Committee of Experts. The following geodetic capacity building events have been organized in collaboration with the UN-GGIM-AP Working Group 1 Geodetic Reference Frame and FIG Asia-Pacific Capacity Development Network: References Frame in Practice Seminar on Operational Aspects of GNSS CORS in Suva, Fiji, a special session on Global to National Geodetic Frameworks: Core to Building a Better World at the United Nations World Geospatial Information Congress in Deqing, China and special sessions on Developing Capacity for Geodetic Infrastructure and Systems at FIG Working Week 2019 in Hanoi, Vietnam.

21. The working group emphasizes the need for regionally focused strategies, as the nature, size, and variety of challenges differ regionally and may include linguistic, technological, economic, and cultural impediments. Additional findings from the educational 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 readily and openly shared. A key to optimizing the efficiency of the group’s objectives is 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 will work in conjunction with FIG, the IAG and its technical services, as well with international organizations such as the Group on Earth Observations to build a central point of information. This may simplify the process of capacity building by identifying and explaining the first steps to geodetic capacity and provide additional advanced capacity development resources. The ongoing need to engage and leverage communities such as the UN-GGIM: Academic and Private Sector Networks was also noted.

⁵ The Swedish representative is also Vice President of FIG.

22. The working group noted with interest the potential uses of the Integrated Geospatial Information Framework (IGIF) and the proposed Implementation Guide. The IGIF has the potential to assist with integration across the UN-GGIM work items. The working group has proposed three guiding principles to support the IGIF: 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 geodetic support and advocacy organizations. In addition to the working group's effort to ensure integration across the Committee of Experts work items that similarly address capacity building and education, the working group will identify cross-linkages and contributions to both the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction.

23. **Outreach and Communications** During the inter-sessional period, the working group on Outreach and Communications, led by Norway, continued to provide outreach and communication services to the Subcommittee. At the second meeting of the Subcommittee, members were reminded that clear and direct communication and engagement are necessary to advance its objectives, and to achieve this dedicated communication experts are ideal and needed. Notwithstanding resource constraints, Member States were urged to take an active role in communication activities. The working group is also trying to identify and create a collaboration space in consultation with the Secretariat of the Committee of Experts and its other working groups, to avoid duplication of communications and outreach efforts. A standard PowerPoint presentation template will be developed and updated to be used by all Subcommittee members for general outreach and communication.

24. In addition, the working group has been following up on the road map implementation plans' outreach and communication actions on building a geospatial communications network and collaboration space. The second task on recruiting and engaging a geospatial communications coordinator is dependent on a successful realization of a coordinating unit; that is, the proposed Global Geodetic Centre of Excellence (GGCE).

25. **Policy, Standards, and Conventions.** The working group on Policies, Standards and Conventions has commenced activities to implement the action items identified in the Global Geodetic Reference Frame Implementation Plan. Its members are active in standards-related work on behalf of organizations such as the Bureau of Products and Standards of the IAG's Global Geodetic Observing System (GGOS) and the International Standards Organization (ISO) Technical Committee 211. Many of their activities have contributed to the action items identified in the Global Geodetic Reference Frame Implementation Plan. These include: i) the preparation of an ISO 19161-1 standard on the International Terrestrial Reference System (ITRS) that clarifies for Member States how a realization of the ITRS, and thus the GGRF, can be defined and implemented; ii) the continued updating of the inventory (catalogue) of standards and conventions by the GGOS Bureau of Products and Standards; iii) initiation of discussion with ISO to facilitate easier access to ISO standards for developing countries; and iv) the public availability of the ISO Geodetic Registry for the sharing of reference frame definitions and transformations to facilitate interoperability of data and products within the Global Geodetic Reference Frame. Planning is currently underway to commence work on other action items.

26. **Governance.** During the intersessional period the working group on Governance has been diligently pursuing the execution of decisions 6/102 and 8/103 adopted by the Committee of Experts at its sixth and eighth sessions respectively. This has included, conducting broad consultations, as identified in the position paper on governance, on identifying options for governance arrangements for global geodesy, and the refinement of the position paper on governance provided as a background document to the report of the eighth session. Additional information on these activities are detailed in Section IV of this report.

IV. Governance arrangements for global geodesy

27. At its sixth session in August 2016, the Committee of Experts adopted decision 6/102, which noted the need for an appropriate governance structure to effectively implement the road map for the global geodetic reference frame. The first iteration of the position paper on governance was presented to the Committee of Experts at its eighth session in August 2018, with the Committee noting with interest the initial work and progress made on the position paper on governance, and the need for broad consultation to better understand the importance of the work involved.

28. Recognising these decisions and noting the importance of the position paper as a mechanism to continue and widen the engagement regarding the appropriate governance arrangements for the global geodetic reference frame, the Subcommittee conducted broad consultations with the Secretariat, mission representatives to the United Nations, chairs of the UN-GGIM regional committees and their regional working groups on geodesy. Taking into consideration the feedback received from the consultations and guided by the progression of other activities and work of the Committee of Experts, such as the Integrated Geospatial Information Framework, the Subcommittee has significantly revised the governance position paper taking into account the need to balance the longer-term vision and operational requirements of the global geodetic reference frame. The revised position paper on governance is provided as a background document to this present report.

29. The revised position paper on governance begins with an executive summary that outlines the Subcommittee's recommendation to establish a Global Geodetic Centre of Excellence (GGCE). The body of the paper details why geodesy is fundamental to sustaining people and the planet, highlights the challenges being experienced, and proposes the solution to address these challenges, followed by an overview of the Subcommittee's journey from its landmark General Assembly resolution to the current situation. The core of the position paper details recommendations to create the GGCE, its goals, objectives and responsibilities, structure and financial arrangements.

30. The following are the main conclusions reached by the Subcommittee in defining the recommendations as outlined in the position paper on governance:

- (a) There is an imminent and pressing need to establish an operational capability that can address key challenges within the global geodetic community, including coordination, communication and outreach, and capacity building, among others.
- (b) The conversion of the Working Group on the Global Geodetic Reference Frame to the Subcommittee on Geodesy at the seventh session has offered additional permanence and status to the work on geodesy within the United Nations system, therefore mitigating the urgent need for additional mandate.
- (c) The working group on Governance has identified the possible option of establishing a Global Geodetic Centre of Excellence (GGCE), under the auspices of the Committee of Experts, to augment current governance arrangements provided by the Subcommittee, to achieve the decisions as stated in the General Assembly resolution, "A Global Geodetic Reference Frame for Sustainable Development".
- (d) The GGCE will be globally recognised and have three initial thematic priorities: i) enhanced global cooperation; ii) an operational centre providing coordination; and iii) provide technical assistance and capacity

building. The creation of the GGCE is subject to suitable funding being provided by one or more Member state donor(s).

- (e) It is proposed that the detailed modalities, including the role, work program and governance of the GGCE, will be determined through negotiations among the Committee of Experts, the Subcommittee and financial donors. The working group has proposed possible governance arrangements for the GGCE that include the creation of a Global Geodetic Governing Council and an International Advisory Committee. This governance structure would ensure that organisations which collect, manage, and are significant users of geodetic information will contribute to strengthening the management of geodetic information and infrastructure.
- (f) To support a GGCE a mechanism for the exchange and collection of donor funds will be needed.
- (g) The Subcommittee recognises and is committed to working closely with the IAG, and FIG to avoid duplication of existing structures and to enhance existing governance arrangements within the community.

31. The Subcommittee will be convening a forum on the Global Geodetic Reference Frame for Sustainable Development “Towards an appropriate governance framework” on the margins of this ninth session of the Committee of Experts, where the position paper on governance will be presented for consultation, and to seek additional feedback ahead of the plenary session.

V. Points for discussion

32. The Committee of Experts is invited to:

- (a) Take note of the present report and the work of the Subcommittee on Geodesy;**
- (b) Note the Subcommittee’s agreement on the International Terrestrial Reference System (ITRS) and the International Terrestrial Reference Frame (ITRF) as annexed to this present report;**
- (c) Express its views and provide guidance on the revised draft Position Paper on Governance (provided as a background paper to this present report) that recommends, inter alia, the creation of a Global Geodetic Centre of Excellence, and subsequent determination of its modalities in cooperation with the Committee of Experts and financial donors;**
- (d) Encourage Member States to actively participate in the working groups of the Subcommittee to ensure even geographical representation and a balance between developed and developing nations; and**
- (e) Take note of the next meeting of the Subcommittee on Geodesy, to be convened on the margins of the Sixth High Level Forum on UN-GGIM in the United Kingdom in April 2020.**

ANNEX I

Agreement on International Terrestrial Reference System and Frame (ITRS / ITRF)

Preamble

The motivation of this agreement is to formalize the adoption of the ITRS / ITRF by the Committee of Experts in the definition of their national reference frames and geo-referencing applications.

The International Earth Rotation and Reference Systems Service (IERS), created in 1988 by the International Union of Geodesy and Geophysics (IUGG) and the International Astronomical Union (IAU), is responsible for the mathematical definition of the International Terrestrial Reference System (ITRS) and its numerical realization, the International Terrestrial Reference Frame (ITRF). The IERS Directing Board is the authority that decides on the ITRF versions to be adopted as its official products.

This note is intended to formulate recommendations on the adoption of the ITRS, through its numerical realization, the ITRF.

Recommendations

- The Subcommittee on Geodesy agrees that the ITRS, through its numerical ITRF realization, be adopted for geospatial and scientific positioning applications. This adoption may be achieved by closely aligning to the ITRF, as defined by the ISO International Standard 19161-1, presently in its draft stage.
- Recognizing the development of the ISO International Standard 19161-1 on the ITRS, the Subcommittee urges Member States to record their national reference frame definition, and its alignment to the ITRF, in the ISO Geodetic Registry.
- The Subcommittee takes note of the developments that are currently undertaken by the IAG for the definition of the International Height Reference System (IHRIS), and its numerical realization, the International Height Reference Frame (IHRF).

Background

In order to ensure the interoperability of geospatial data for location-based, scientific and societal applications, it is critically important to adopt a unique, recognizable, traceable standard global geodetic reference system. The International Terrestrial Reference System (ITRS), that is numerically realized by the International Terrestrial Reference Frame (ITRF), was adopted for such applications by a number of international organizations, including the IUGG, the General Conference on Weights and Measures (CGPM), and the International Committee on Global Navigation Satellite Systems - GNSS (ICG). With reference to the ICG, and in an effort to ensure the interoperability of the user positioning applications using different GNSS systems, GNSS system providers have aligned their GNSS-specific reference frames to the ITRF, including WGS84 for GPS, PZ-90 for GLONASS, CGCS2000 for Beidou, the Galileo Terrestrial Reference frame (GTRF) for Galileo, and the Japanese Geodetic System (JGS) for QZSS. Regional entities of the Committee of Experts and of the International Association of Geodesy (IAG) rely on and adopt the ITRF for their operational geodetic and geospatial applications, as well as for the definition of their regional geodetic reference frames.

This agreement is aimed at ensuring that geospatial data managed by Member States is mathematically aligned to the ITRS/ITRF to ensure compatibility with GNSS positioning, and to allow consistency and

interoperability. This will further the standardisation efforts of geodetic information, ensure interoperability across national, regional and global geodetic reference systems and contribute to the overarching Integrated Geospatial Information Framework.