Regional Committee of United Nations Global Geospatial Information Management for Asia and the Pacific (UN-GGIM-AP)

Established by a United Nations Resolution

Working Group 1

Geodetic Reference Framework for Sustainable Development

Activity Report

for

The Second Plenary Meeting of UN-GGIM-AP

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1. Executive Summary

This report overviews the activities of the UN-GGIM Working Group 1 (WG1) - Geodetic Reference Framework for Sustainable Development. In summary, WG1 has focused its efforts on improving access to the global geodetic reference frame while also supporting regional geodetic cooperation within the Asia Pacific region. Specific WG1 activities have included:

- The development of a global geodetic questionnaire for the UN-GGIM. This questionnaire was based on discussions held at the UNRCC forum in Bangkok, October 2012, after which the UN-GGIM AP Working Group 1 agreed to lead its development. The questionnaire was distributed globally in December 2012 by the United Nations Statistics Division. Results have been collated and analysed by WG1.
- The ongoing Asia Pacific Reference Frame (APREF) project, which is now incorporating GNSS data from a CORS network of approximately 500 stations, contributed by 28 countries in the Asia Pacific. Data are routinely processed by three Analysis Centres and made available publically.
- The ongoing regional GNSS campaigns. In 2012, the APRGP2012 campaign was carried out with data being contributed from eleven countries.
- The initiation of the Asia Pacific Regional Height System Unification (APRHSU) Project, which has commenced with the distribution of a regional questionnaire focused on the development of a regional height system.
- A geodetic capacity building symposium was held Manila in June 2013 and Fiji in September 2013 with a subsequent meeting planned for Malaysia (June 2014).

2. Working Group 1 - Work Plan

WG1 has developed the following work plan for the period 2012-2015:

No.	Project	Description	Status 2012-2015
1	Asia-Pacific Reference Frame (APREF)	The purpose of the Asia-Pacific Reference Frame (APREF) project is to create and maintain a densely realised and accurate geodetic framework, based on continuous observation and analysis of Global Navigation and Satellite System (GNSS) data.	Ongoing
2	Asia-Pacific Regional	The purpose of the Asia-Pacific Regional	

	Geodetic Project (APRGP)	Geodetic Project (APRGP) project is to provide access to the International Terrestrial Reference Frame (ITRF) for developing countries in the Asia and Pacific region based on an annual week long campaign of Global Navigation and Satellite System (GNSS) data.	Ongoing – 1 week per year
3	Asia-Pacific Regional Height System Unification (APRHSU)	The purpose of the Asia-Pacific Regional Height System Unification (APRHSU) Project is to encourage data sharing and facilitate technical exchange towards height system development. Data to be shared will include tide-gauge observations, GNSS observations at tide-gauges, geodetic levelling and terrestrial gravity observations. Technical exchange will focus on geoid determination and height system definition.	Ongoing
4	Asia-Pacific Geodetic Capacity Building (APGCB)	Participates will endeavour to support an annual regional geodetic workshop for governmental geodetic experts in the Asia Pacific.	Ongoing – 1 meeting per year

3. Status of the Asia Pacific Reference Frame (APREF) Project

The objectives of APREF project continue to be:

- Create and maintain an accurate and densely realized geodetic framework, based on continuous observation and analysis of GNSS data;
- Encourage the sharing of GNSS data from Continuously Operated Reference Stations (CORS) in the region;
- Share experiences and encourage regional consultation in regards to CORS GNSS networks;
- Develop the APREF Permanent Network, in close cooperation with IGS for the maintenance of the Asia-Pacific Reference Frame, as a contribution to the ITRF and as infrastructure to support other relevant projects;
- Provide an authoritative source of coordinates and their respective time-series for geodetic stations in the Asia-Pacific region in near real-time with high quality connection to ITRF; and

- Establish a dense velocity field model in Asia and the Pacific for scientific applications and the long-term maintenance of the Asia-Pacific reference frame.

Table 1 summarizes the current commitments of Member States. APREF products presently consist of a weekly combined regional solution, in SINEX format and a cumulative solution which includes velocity estimates. In addition to those stations contributed by participating agencies, the APREF analysis also incorporates data from the International GNSS Tracking Network including stations in the Russian Federation (16), China (10), India (3), French Polynesia (2), Kazakhstan (1), Thailand (1), South Korea (3), Uzbekistan (1), New Caledonia (1), Marshall Islands (1), Philippines (1), Fiji (1), and Mongolia (1).

GNSS data from a CORS network of approximately 500 stations, contributed by 28 countries is now available and routinely processed by three Analysis Centres (ACs): Geoscience Australia, the Curtin University, and the Department of Sustainability and Environment in Victoria, Australia. The APREF project websites was established as http://www.ga.gov.au/earth-monitoring/geodesy/asia-pacific-reference-frame.html. The weekly ITRF coordinate estimates in SINEX format, coordinates time series and velocity solutions for the APREF stations are published on the APREF website.

Table 1: Responses to the APREF Call For Participation. Responding agencies have indicated whether they would undertake analysis, provide data archive and product distribution or supply data from GNSS stations (as of 21 August 2013)

Country/Locality	Responding Agency	Proposed Contribution		
		Analysis	Archive	Stations
Afghanistan	National Geospatial-Intelligence Agency, USA			2
Alaska, USA	National Geodetic Survey (USA)			90
American Samoa	National Geodetic Survey (USA)			1
Australia	Geoscience Australia	x	x	114
Australia	Curtin University of Technology	x		1
Australia	University of New South Wales	x		1
Australia	Department of Environment and Resource Management, Queensland			10
Australia	Department of Sustainability and Environment, Victoria	x		55
Australia	Department of Lands and Planning, Northern Territory			5

Australia	Department of Primary Industries, Parks, Water & Environment, Tasmania			2
Australia	Radio and Space Weather Services, Bureau of Meteorology			3
Australia	Land and Property Management Authority, New South Wales			104
Brunei	Survey Department, Negara Brunei Darussalam			1
Cook Islands	Geoscience Australia			1
Ethiopia	Ethiopian Mapping Agency			3
Federated States of Micronesia	Geoscience Australia			1
Fiji	Geoscience Australia			1
Guam, USA	National Geodetic Survey (USA)			1
Hawaii, USA	National Geodetic Survey (USA)			19
Hong Kong, China	Survey and Mapping Office			7
Indonesia	Bakosurtanal			4
Iran	National Cartographic Center, Iran			6
Iraq	Iraqi Ministry of Water Resource General Directorate for Survey			6
Japan	Geospatial Information Authority of Japan	x	x	10
Kazakhstan	Kazakhstan Gharysh Sapary			2
Kiribati	Geoscience Australia			1
Kiribati	Geospatial Information Authority of Japan			1
Macau, China	Macao Cartography and Cadastre Bureau			3
Manus Island	Geoscience Australia			1
Marshall Islands	Geoscience Australia			1
Micronesia	Geoscience Australia			1
Mongolia	Administration of Land Affairs, Construction, Geodesy and Cartography (ALACGaC)			8
Nauru	Geoscience Australia			1
New Zealand	Land Information New Zealand	x	x	38
Northern Mariana	National Geodetic Survey (USA)			1

Islands				
Papua New Guinea	National Mapping Bureau, Papua New Guinea, and Geoscience Australia			2
Philippines	Department of Environment and Natural Resources, National Mapping and Resource Information Authority	x	x	4
Samoa	Geoscience Australia			1
Solomon Islands	Geoscience Australia			1
Tonga	Geoscience Australia			1
Tuvalu	Geoscience Australia			1
Vanuatu	Geoscience Australia			1

4. Status of the Asia Pacific Regional Geodetic Project (APRGP) Annual GNSS Campaigns

The UN-GGIM-AP Annual GNSS campaigns will be continued along with APREF so that countries without Continuously Operating Reference Stations (CORS) can connect their national geodetic infrastructure to the regional/global network.

In 2012 a GNSS Campaign (APRGP2012) was carried out from 9th September 2012 to 15th September 2012 (GPS week 1705). This campaign was coordinated by Geoscience Australia (GA). Data were contributed from eleven countries and regions, i.e., Brunei, Cambodia, Hong Kong, Japan, Korea, Lao, Malaysia, Nepal, Philippine, Singapore and Vietnam. The analysis of this campaign has been finished by Geoscience Australia (GA), the analysis report for this campaign will be distributed through the participant member countries after finalization.

Call for participation in APRGP 2013 GNSS campaign has been sent out to the UN-GGIM-AP community. This campaign will run from 8th to 14th September 2013 (GPS week 1757).

5. Status of the Asia Pacific Regional Height System Unification (APRHSU) Project

The objective of the APRHSU project is to encourage data sharing and facilitate technical exchange towards height system development in the Asia-Pacific region. A questionnaire on the current status of the height system in the countries of the Asia-Pacific region has been developed and distributed, see http://www.un-ggim-ap.org/wg/wg1.htm. This work activity is ongoing.

6. Status of the Asia-Pacific Geodetic Capacity Building (APGCB) Project

The working group has been closely involved in a number of regional workshops aimed at geodetic capacity building in the Asia Pacific. These include:

- The Reference Frame in Practice Symposium (Manila, Philippines 21-22 June 2013). This Symposium on geodetic reference frame was jointly organised by the UN Global Geospatial Information Management for Asia and the Pacific (UN-GGIM-AP) Working Group 1, the IAG (International Association of Geodesy), the FIG (Fédération Internationale des Géomètres), ICG (International Committee on GNSS) and the PhilGEGS – Philippines Geodetic Engineering and Geomatic Society. The seminar was held at the Philippine International Convention Centre (PICC), 21-22 June 2013, in Manila, Philippines. There were over 40 participants from the Asia-Pacific region and 20 technical presentations which focus on the status and issues of geodetic infrastructure, APREF status and determination, reference frame infrastructure, dynamic datum and the role of manufacture in geodetic infrastructure. The issues of hindering participation in the APREF project raised from the technical seminar are the lack of resources such as funding, knowledge and experience, and prohibitive data sharing policies.
- The FIG Pacific Small Island Developing States Symposium (Suva Fiji, planned for September 2013) will include a session entitled Reference Frame in Practice for Responsible Governance and Suitable Development.
- The XXV FIG International Congress (Kuala Lumpur, Malaysia, planned for June 2014) will include a workshop dedicated to the Asia Pacific Reference Frame (APREF).

7. Summary of responses to the UN-GGIM Geodetic Questionnaire

The concept of a global geodetic questionnaire arose from the Second Session of the United Nations Committee of Experts on Global Information Management in New York in August, 2012. The questionnaire format and content discussed after the UNRCC forum in Bangkok, October 2012, after which the UN-GGIM AP Working Group 1 agreed to lead its development. The questionnaire was distributed globally in December 2012 by the United Nations Statistics Division. The UN-GGIM Geodetic Questionnaire sought feedback on the following:

Q1. Is your organisation responsible for the national datum (i.e. ellipsoidal coordinate system)

Q2. Is your organisation responsible for the national vertical coordinate system (e.g., the orthometric heighting datum and geodetic levelling)?

Q3. Is your organisation responsible for a permanent Global Navigation Satellite System (GNSS) reference station network?

Q4. Is your organisation responsible for the national terrestrial gravity data?

Q5. Is your organisation responsible for the national sea-level tide gauge data?

Q6. Is your organisation responsible for any other geodetic observatories including for example Satellite Laser Ranging (SLR), Very Long Baseline Interferometry (VLBI) or super-conducting gravity meter facilities?

Q7. In your country, how important are geodetic data and datum?

Q8. In your country, how important are global geodetic data, products and services (e.g. those from the International Association of Geodesy and the Global Geodetic Observing System)?

Q9. In your country, do you currently contribute to the global geodetic community?

Q10. To make the products and services of the international geodetic community more robust and accurate, would you consider the development of new geodetic facilities in your country? If so, please specify [GNSS; SLR; VLBI]

Q11. What are the existing law, policy or regulations that apply to the management of your geodetic information?

Q12. Do you have pricing and licensing models/guidelines governing the sale and or distribution of geodetic data?

Q13. What is your country's attitude to providing international access to geodetic data? Specifically, what percentage of total data that potentially can be shared internationally?

Q14. To encourage greater global participation in the global geodetic community would your organisation benefit from having a high level mandate (such as a United Nations Resolution)?

There were 101 survey responses from 97 countries (multiple organisations from the same country completed individual surveys) shown in Figure 1, current as of 10 July 2013. The responses for Questions 1-6, 9, 10, 12 and 14 are plotted in Figure 2. Figures 3 and 4 show the responses to Q7 and Q8, respectively. From Figure 3 it can be seen that over 50% of the survey participants considered that

geodetic data and datums were of critical importance for mapping, cadastral, and administrative boundaries; and over 50% of the survey participants considered that geodetic data and datums were high importance for construction, transportation and land use planning. As indicated in Figure 4, over 80% of survey participants considered that geodetic data, products and services such as the ITRF, IGS tracking data and IGS tracking products were of high-critical importance in their country.

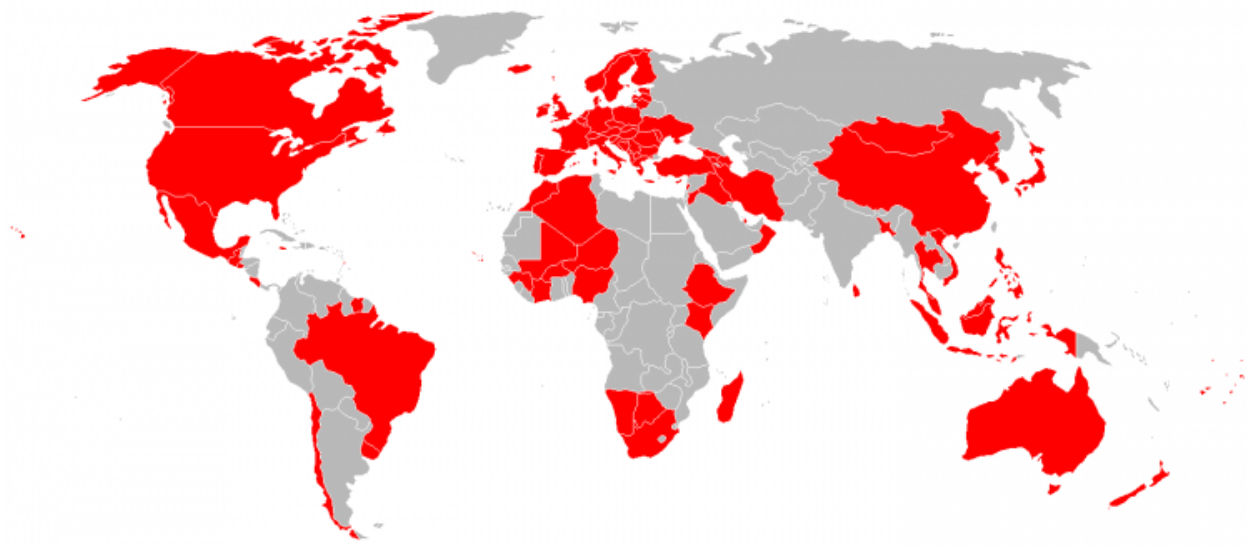


Figure 1: Distributions of the countries that responded to the questionnaire.

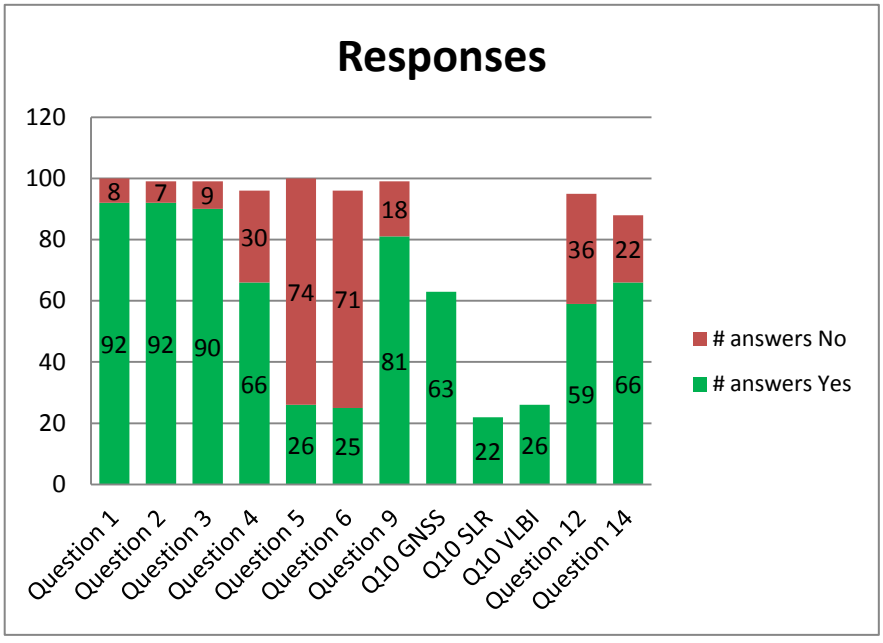
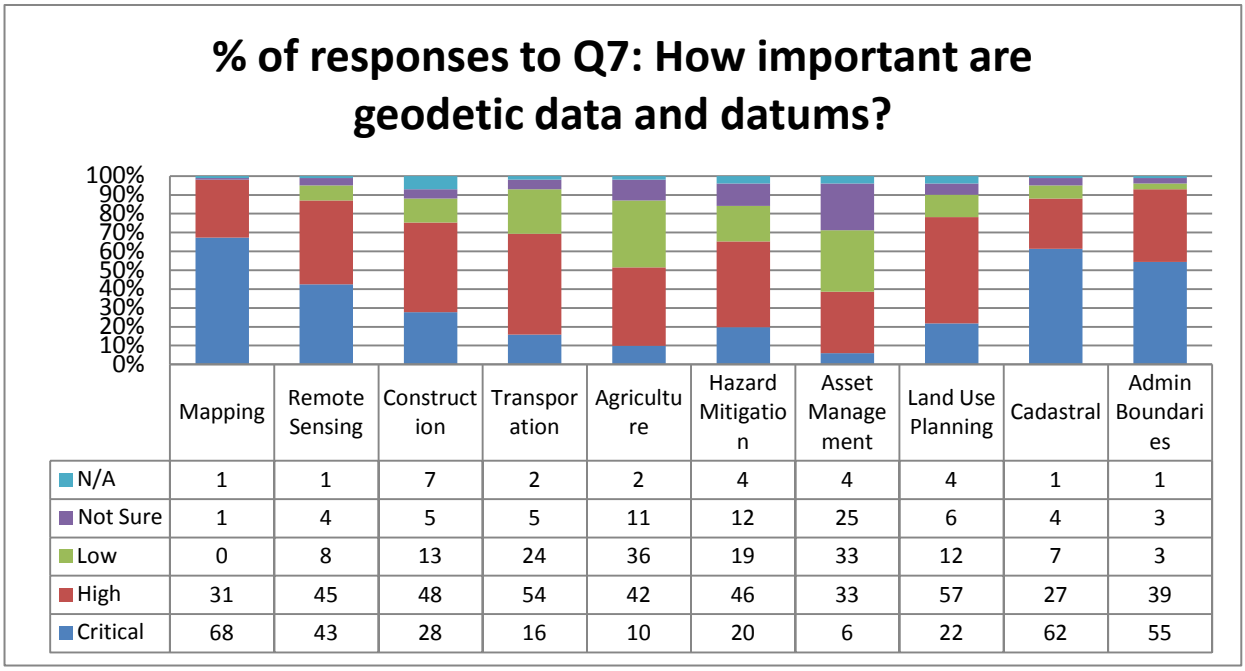
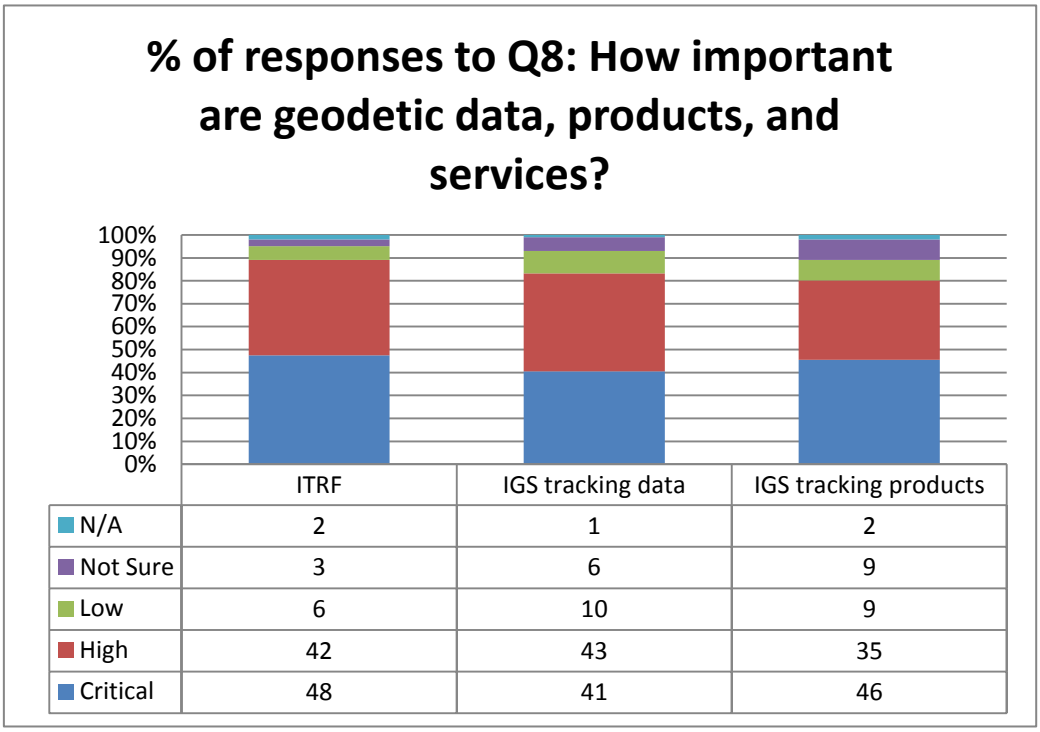


Figure 2: Responses for Questions: 1-6; 9; 10; 12 and 14.



	Mapping	Remote Sensing	Construction	Transportation	Agriculture	Hazard Mitigation	Asset Management	Land Use Planning	Cadastral	Admin Boundaries
N/A	1	1	7	2	2	4	4	4	1	1
Not Sure	1	4	5	5	11	12	25	6	4	3
Low	0	8	13	24	36	19	33	12	7	3
High	31	45	48	54	42	46	33	57	27	39
Critical	68	43	28	16	10	20	6	22	62	55

Figure 3: Responses to Q7, where the count of replies is shown in the table for comparison purposes. 100% = 101 survey responses.



	ITRF	IGS tracking data	IGS tracking products
N/A	2	1	2
Not Sure	3	6	9
Low	6	10	9
High	42	43	35
Critical	48	41	46

Figure 4: Responses to Q8, where the count of relies is shown in the table for comparison. 100% = 101 survey responses.

A report (E-C20-2013-4) that summarizes the major findings of the questionnaire was prepared by the UN-GGIM-AP Working Group 1 in conjunction with the International Association of Geodesy (IAG) and was presented at the UN-GGIM third session in Cambridge, United Kingdom (24-26 July 2013).

8. Draft Resolution

The Committee,

Recognizing the growing demand for more precise positioning services, the economic importance of the global geodetic reference frame and the need to improve regional cooperation within geodesy,

Acknowledging the progress being made by the member countries in establishing and developing geodetic infrastructure and data sharing,

Resolves

- To support the development of a resolution to be tabled at the 2013-14 Session of the UN General Assembly to seek support and commitment at the highest level for the global geodetic reference frame,
- To create and maintain a densely realised and accurate geodetic framework, based on continuous observation and analysis of Global Navigation and Satellite System (GNSS) data under the banner of the Asia Pacific Reference Frame (APREF),
- To provide access to the International Terrestrial Reference Frame (ITRF) for developing countries in the Asia and Pacific region based on an annual week long campaign of Global Navigation and Satellite System (GNSS) data data under the banner of the Asia Pacific Regional Geodetic Project (APRGP),
- To encourage data sharing and facilitate technical exchange towards height system development under the banner of the Asia-Pacific Regional Height System Unification (APRHSU) Project, and
- To support geodetic outreach and capacity building for governmental geodetic experts in the Asia Pacific under the banner of the Asia-Pacific Geodetic Capacity Building (APGCB) Project.

Appendix A – UNRCC-AP Resolution

At the Nineteenth United Nations Regional Cartographic Conference for Asia and the Pacific, Bangkok, 29 October-1 November 2012, the following Resolution was made. It is directly relevant to the activities of WG1 and is provided here for completeness.

1. **Geodetic framework**

The Conference,

Recognizing that geodetic infrastructure, products and services underpin satellite positioning technology, provide the framework for all geospatial activity and is a key enabler of spatial data interoperability, disaster mitigation and sustainable development,

Also recognizing that this is an important issue for the Committee of Experts on Global Geospatial Information Management to consider in consultation with Member States,

Further recognizing the need for the sustainability and improvement of the global network of geodetic infrastructure and International Association of Geodesy/Global Geodetic Observing System services and products, including the International Terrestrial Reference Frame,

Also recognizing the need to assist Member States in developing mandates and support for the provision of geodetic data, products and services,

Further recognizing the problems associated with the lack of coordination between Member States and the need to develop institutional arrangements and coordination frameworks, including those between regions,

Noting the progress made by the Permanent Committee on Geographical Information System (GIS) Infrastructure for Asia and the Pacific and its Working Group on Geodetic Technologies and Applications in improving arrangements for data-sharing and international cooperation,

Also noting the expertise of national geospatial information authorities and the International Association of Geodesy and the potential benefits of improving the communication between Governments and the Association,

Considering the potential security and commercial sensitivities of data sharing,

Realizing the need to improve the sustainability and capability of the Global Geodetic Observing System,

and the need to encourage and support the adoption of the International Terrestrial Reference Frame as the foundation reference frame,

Further realizing the challenges of building technical capacity in developing countries,

Recommends that Member States:

(a) Urge the Committee of Experts on Global Geospatial Information Management to consult with Member States to adopt and sustain a global geodetic reference frame and provide a road map for its implementation;
(b) Participate in and make commitments to the Global Geodetic Observing System to ensure its long-term sustainability;
(c) Support the adoption of the International Terrestrial Reference Frame by participating in regional geodetic programmes such as the Asia-Pacific Regional Reference Frame;
(d) Work towards the connecting and sharing of data on national height datums;
(e) Share foundation observation datasets, including Global Navigation Satellite System, geodetic levelling, terrestrial gravity and tide gauge data in open formats;
(f) Support geodetic experts from Member States to attend appropriate regional forums, such as the meetings of the Working Group on Geodetic Technologies and Applications.