

**ECONOMIC AND SOCIAL COUNCIL**

---

**Nineteenth United Nations Regional Cartographic  
Conference for Asia and the Pacific  
Bangkok, 29 October – 1 November 2012  
Item 4 of the provisional agenda  
Report of the Permanent Committee on Geographical  
Information System Infrastructure for Asia and the Pacific**

**Report Of The Working Group 1: Geodesy Technologies  
And Applications**

**Submitted by the Permanent Committee on Geographical Information  
System Infrastructure for Asia and the Pacific (PCGIAP)  
Working Group 1: Geodesy Technologies and Applications\***

---

\* Prepared by Shigeru Matsuzaka, Chairman, John Dawson and Hanjiang Wen, Vice Chairmen



**Permanent Committee on GIS Infrastructure for Asia and the Pacific**

## **Working Group 1**

### **Geodesy Technologies and Applications**

#### ***Status Report***

for

#### **The 19<sup>th</sup> UNRCC-AP**

Bangkok Thailand

29<sup>th</sup> October – 1<sup>st</sup> November 2012

#### **Chairman**

Shigeru Matsuzaka, Japan - [shigeru@gsi.go.jp](mailto:shigeru@gsi.go.jp)

#### **Vice Chairman**

John Dawson, Australia - [John.Dawson@ga.gov.au](mailto:John.Dawson@ga.gov.au)

Hanjiang Wen, China - [wenhj@casm.ac.cn](mailto:wenhj@casm.ac.cn)

## **1. Resolutions Adopted at the 18<sup>th</sup> UNRCC-AP (2009)**

The importance of improving the geodetic network as a basis for spatial data infrastructure was recognized at the 18<sup>th</sup> United Nations Regional Cartographic Conference for Asia and the Pacific (UNRCC-AP) in Bangkok, October 2009, the following resolution was adapted with newly proposed Asia-Pacific Reference Frame (APREF) initiative (see next section) in mind,

The conference,

Recognizing the importance of establishing a homogeneous geodetic network as the basis for the Asia and the Pacific regional spatial data infrastructure as well as for activities concerning disaster management of the region,

Noting the progress made by the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) working group on regional geodesy in improving the regional geodetic framework as the base layer for a regional spatial data infrastructure,

Considering the frequency of earthquakes, volcanic eruptions and tsunamis in the region and more generally the significant ongoing regional crustal deformation,

Considering also the need of member States to provide users with access to the reference frame with an accuracy of 1 cm or better to support spatial data collection for a wide range of applications,

Realizing the need to establish a new and precise geodetic framework in the Asia and the Pacific region, which is linked to the International Terrestrial Reference Frame (ITRF), to support disaster prevention/mitigation programmes,

Recommends that member States support the Asia-Pacific Reference Frame (APREF) initiative by:

- a) Participating in the APREF initiative,
- b) Sharing data from Continuously Operating Reference Stations (CORS) operated in their respective countries,
- c) Undertaking routine and continuous geodetic analysis, if the capability exists, of CORS data from all or a sub-component of the region,
- d) Installing additional CORS,
- e) Supporting geodetic experts from member States to attend appropriate regional forums, such as the PCGIAP regional geodesy WG meetings.

The major work of WG1 will be to take the details of the resolution forward through coordination and communications among member countries and relevant international bodies.

## **2. Actions Taken since the 18<sup>th</sup> UNRCC-AP (2009)**

### **1) Background and objectives of APREF project**

Asia-pacific region is a very active region on the face of the earth and its geodetic situation is complicated by the frequent earthquakes and continuous deformation and current, campaign-based framework could not address those changes adequately and provide a precise and reliable reference. Improvement in network density and quality with more continuous, long-term observations, and state-of-the-art, routine analysis characterising offsets, and linear and non-linear effects on reference station position will be required to overcome the problem and the Asia-Pacific Reference Frame (APREF) project call for participation was released in March 2010.

The objectives of APREF project are to

- Create and maintain an accurate and densely realised 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 GPS/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.

APREF is a voluntary, collegial, non-commercial endeavour, and there is no central funding source and participating organisations contribute their own resources.

## 2) Progress of APREF project

Steering committee was established consisting of representatives from PCGIAP member countries and International Association of Geodesy (IAG);

John Dawson (Australia)  
 Shigeru Matsuzaka (Japan)  
 Hanjiang Wen (China)  
 Cecep Subarya (Indonesia)  
 Hadi Vaezi (Iran)  
 Chris Rizos (IAG)

The project was also announced at FIG2010 in Sydney, April 2010, by John Dawson.

In response to the March 2010 Call for Participation (CfP) a large number of agencies have agreed to participate in APREF, Table 1 summarizes their commitments. 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).

Up to date, GNSS data from a CORS network of approximately 420 stations, contributed by 28 countries is now available and 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 SINEX files and updated ITRF coordinate 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 archive and product distribution or supply data from GNSS stations (as of 24 April 2012).**

Country/Locality	Responding Agency	Proposed Contribution		
		Analysis	Archive	Stations
Afghanistan	National Geodetic Survey (USA)			2
Alaska, USA	National Geodetic Survey (USA)			90
American Samoa	National Geodetic Survey (USA)			1
Australia	Geoscience Australia	✓	✓	50
Australia	Curtin University	✓		1
Australia	Department of Environment and Resource Management, Queensland			8
Australia	Department of Sustainability and Environment, Victoria	✓		55
Australia	Department of Lands and Planning, Northern Territory			5
Australia	Department of Primary Industries, Parks, Water & Environment, Tasmania			2
Australia	Land and Property Management Authority, New South Wales			63
Brunei	Survey Department, Negara Brunei Darussalam			1
Cook Islands	Geoscience Australia			1
Cook Islands	Geospatial Information Authority of Japan			1
Federated States of Micronesia	Geoscience Australia			1
Fiji	Geoscience Australia			1
French Polynesia	Geospatial Information Authority of Japan			1
Guam, USA	National Geodetic Survey (USA)			1
Hawaii, USA	National Geodetic Survey			19
Hong Kong, China	Survey and Mapping Office			7
Indonesia	Bakosurtanal			4
Iran	National Cartographic Center, Iran			6
Iraq	National Geodetic Survey (USA)			6
Japan	Geospatial Information Authority of Japan	✓	✓	10
Kazakhstan	Kazakhstan Gharysh Sapary			2
Kiribati	Geoscience Australia			1
Kiribati	Geospatial Information Authority of Japan			2
Macao, China	Macao Cartography and Cadastre Bureau			3
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	✓	✓	38
Northern Mariana Islands	National Geodetic Survey (USA)			1
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	✓	✓	4
Samoa	Geoscience Australia			1
Solomon Islands	Geoscience Australia			1
Tonga	Geoscience Australia			1
Tuvalu	Geoscience Australia			1
Vanuatu	Geoscience Australia			1

### **3) APRGP annual campaigns**

Annual GNSS campaigns will be continued along with APREF, for some time as countries without CORS would like to connect their reference stations to the regional/global network.

2009 GNSS Campaign (APRGP2009) was carried out for 04<sup>th</sup> October 2009 to 10<sup>th</sup> October 2009 (GPS week 1552) through the coordination by Geoscience Australia (GA). The data were contributed from eleven countries and regions, i.e., Cambodia, Fiji, Hongkong, Japan, Macau, Malaysia, New Zealand, Philippine, Singapore, Vietnam and Australia. The analysis report for this campaign has been distributed through the participant member countries and reported in the 16<sup>th</sup> PCGIAP meeting in Singapore, 18<sup>th</sup>-22<sup>nd</sup> October 2010.

2010 GNSS Campaign (APRGP2010) was undertaken from 12<sup>th</sup> to 18<sup>th</sup> September 2010 (GPS week 1601) through the coordination by Geoscience Australia (GA). Data was received from six countries and regions, i.e., Cambodia, HongKong, Malaysia, Philippine, Singapore and Vietnam. Note that both HongKong and Philippine also contribute CGPS data to the APREF project. The analysis report has been distributed through the participant member countries and reported in the 17<sup>th</sup> PCGIAP meeting in Mongolia, 18<sup>th</sup>-22<sup>nd</sup> July 2011.

APRGP2011 was carried out from 11<sup>th</sup> to 17<sup>th</sup> September 2011 (GPS week 1653). Data was received from seven countries and regions, i.e., Brunei, Japan, Korea, Malaysia, Philippine, Singapore and Vietnam. Note that Philippine also contributes CGPS data to the APREF project. The analysis report will be distributed in the 19<sup>th</sup> UNRCC-AP meeting in Bangkok, 29<sup>th</sup> October – 1<sup>st</sup> November 2012.

### **3. Other activities**

#### **1) Report for the 2<sup>nd</sup> UNCE-GGIM**

WG1 was invited to submit a report on “Development of the Global Geodetic Reference System” for the Second session of the UN Committee of Experts on Global Geospatial Information Management (UNCE-GGIM), held in August 2012, New York. WG Chairman and Vice Chairmen cooperated to write a paper on the theme.

#### **2) Report of the fatal earthquakes in the region and their analyses**

We had experienced a number of disastrous earthquakes in the past and 2009-2012 was no exception.

WG1 reported the analysis results of the two disastrous earthquakes at the 17<sup>th</sup> PCGIAP meeting in Mongolia in 2011 (see Appendix).

- a) New Zealand: South Island earthquake (M6.3), Feb.22, 2011.  
Fatalities: 406  
Significant damages to the city of Christchurch.
- b) Japan: 2011 Tohoku-Oki earthquake (the Great East Japan Earthquake, M9.0), Mar.11, 2011.  
Fatalities: 20000 (includes missing)  
Biggest earthquake in the history of modern Japan. Huge damages by tsunamis to the pacific coast of north-east Japan.

**Appendix: Analysis results of the earthquakes**

a) InSAR analysis of South Island, NZ earthquake

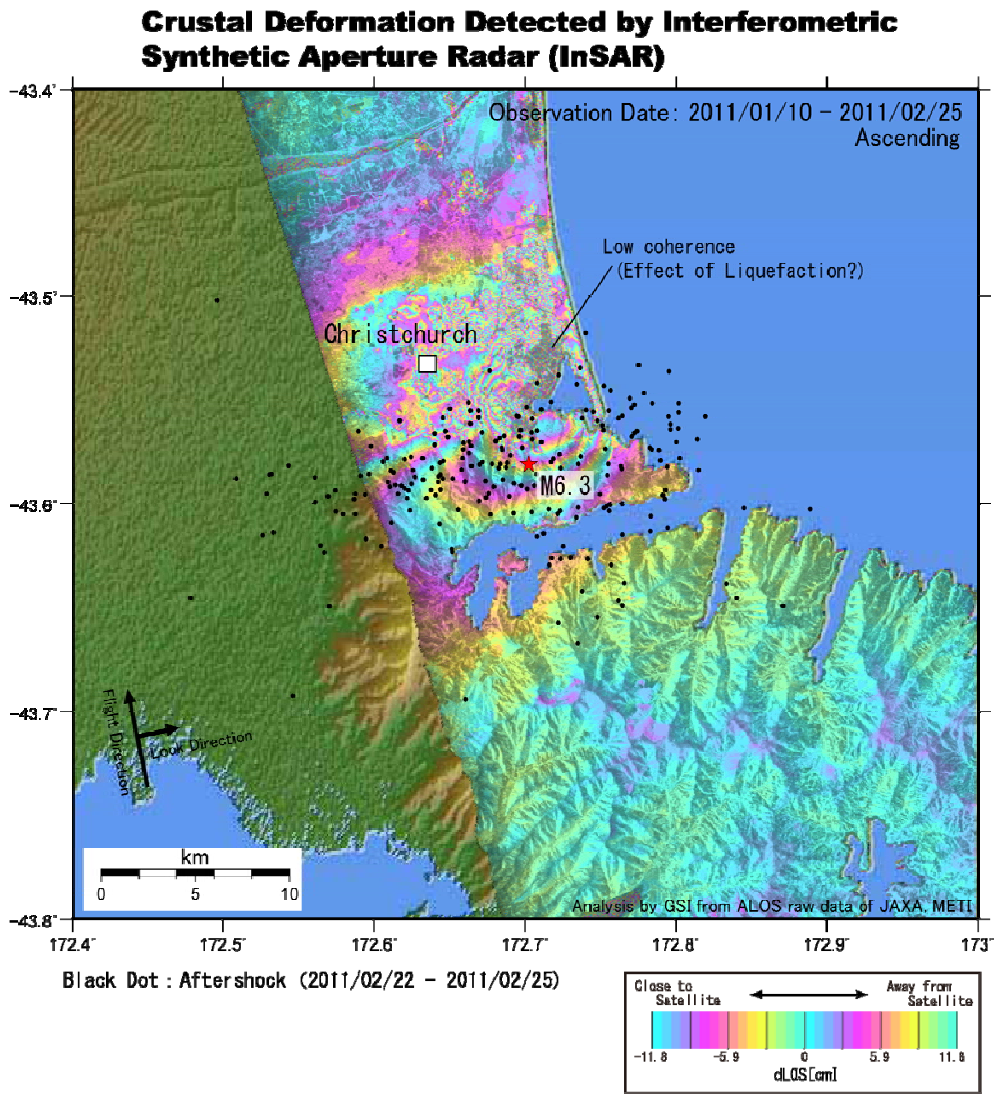


Figure 1. InSAR images of the earthquake

b) Crustal deformations and a slip model of the Tohoku-Oki earthquake, Japan  
 (analysis by GSI, Japan and JHOD)

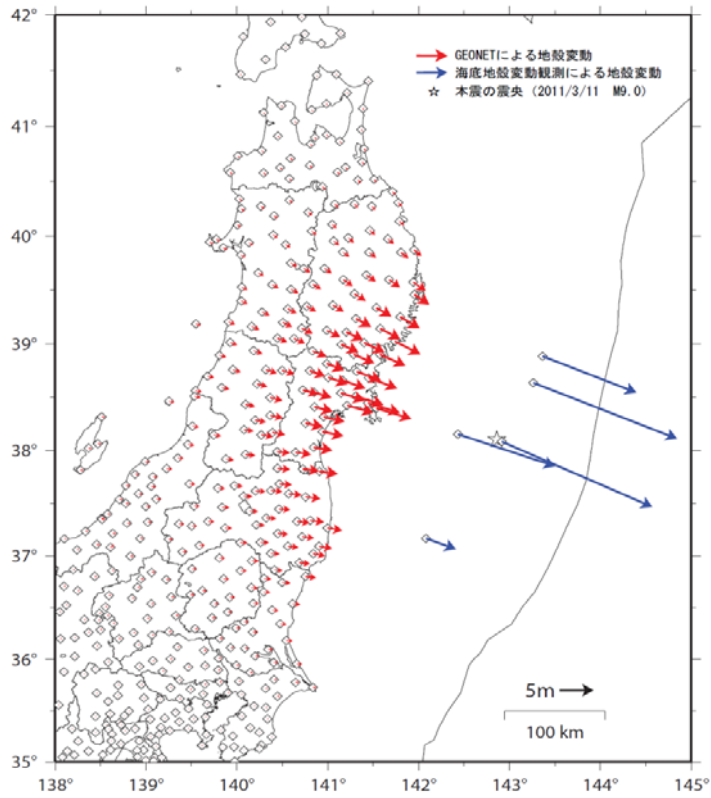


Figure 2. Horizontal displacements on the ground and sea-bottom

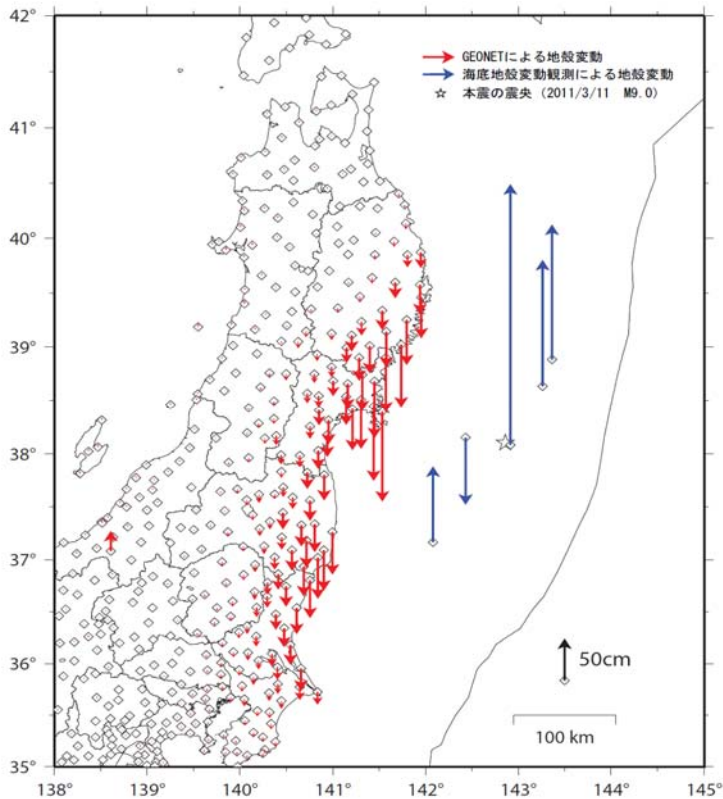




Figure 3. Vertical displacements on the ground and sea-bottom

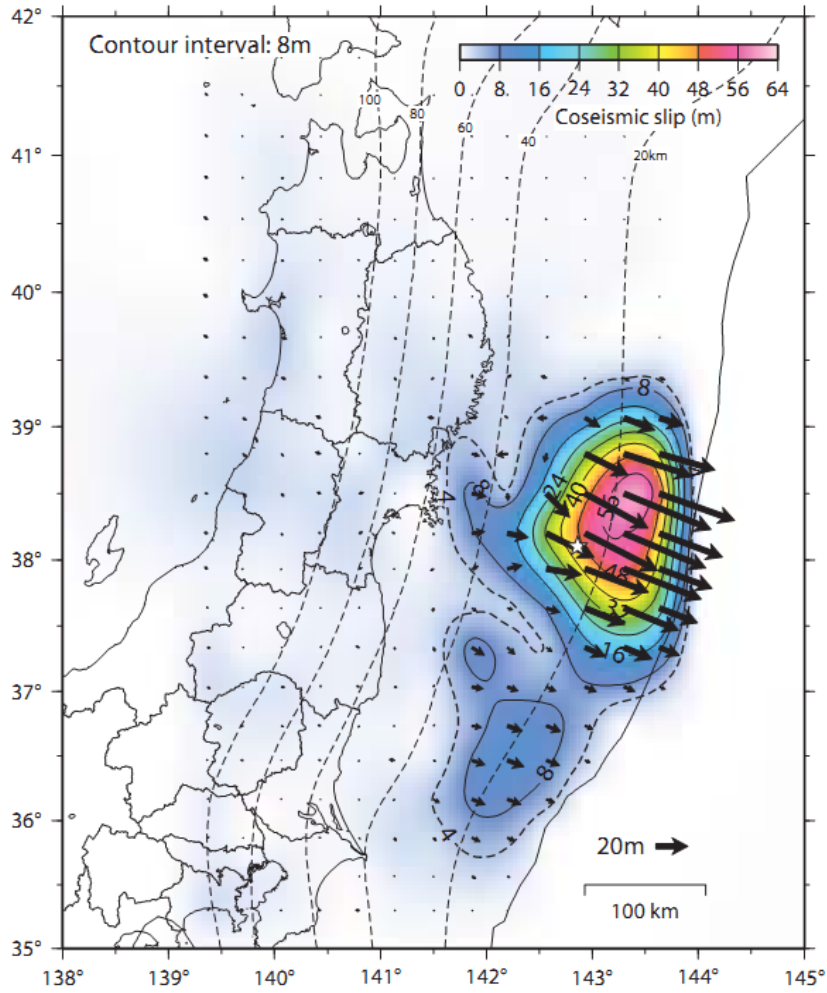


Figure 4. Model of slip displacements on the plate boundary