

The Global Geodetic Reference Frame for Sustainable Development



In February 2015 the UN General Assembly adopted the resolution “A Global Geodetic Reference Frame for Sustainable Development” – the first resolution recognizing the importance of a globally-coordinated approach to geodesy.

Geodesy plays an increasing role in people’s lives, from finding directions using a smart phone to alleviating poverty.

Because the Earth is in constant motion, an accurate point of reference is needed for making measurements. Geodesy provides a very accurate and stable coordinate reference frame for the whole planet: A Global Geodetic Reference Frame.

The economic benefit of implementing the Global Geodetic Reference Frame is significant. So is its role in underpinning the Sustainable Development Agenda.

IMPORTANT APPLICATIONS ARE:



PHOTO: BJØRN-OWE HOLMBERG



PHOTO: ANNE JØRGENSEN



PHOTO: MORTEN BRUN

Natural hazard and disaster management

Decision makers need an accurate and stable global geodetic reference frame to make good decisions for the future and to identify areas under threat of flooding, earthquakes or drought and to adopt preventive measurements to protect them. Geodesy provides the location basis for such decisions.

Climate change and sea level monitoring

Climate change is a global challenge that puts stronger requirements on the precision of the global geodetic reference frame. Geodesy provides information about sea level changes, plate movements, land uplift, and ice sheet and glacier changes. Global society requires information about current trends at a scale measured in millimeters to detect changes of the Earth system with sufficient accuracy, for local, regional and global planning.

To be able to monitor and estimate future sea level variations, significant improvements in both geodetic infrastructure and data analysis are needed.

Geospatial information, mapping and navigation

‘Location-based’ services are becoming increasingly important in modern society.

The global geodetic reference frame supports satellite positioning technology and is a critical enabler of geospatial information interoperability and applications such as surveying, defining sea baseline, engineering construction, precision agriculture, intelligent transport and navigation.



AUSTRALIA

Goes global to meet future needs

Australia’s national committee on Surveying and Mapping have agreed to update the national datum to the latest version of the Global Geodetic Reference Frame (GGRF). Australia will be the first nation to do this.



PHOTO: GEOSCIENCE AUSTRALIA

AUSTRALIA: *The current national datum is not meeting user requirements.*

“As Australia’s coordinate datum underpins all fit-for-purpose position, navigation and timing (PNT) applications it is necessary to ensure that it will meet the needs of current and future

users. It is widely recognised that the current datum, the Geocentric Datum of Australia 1994 (GDA94), is not meeting user requirements, says John Dawson, Geodesy section leader at Geoscience Australia. He’s in charge of Australia’s update to the GGRF.

Underpins all geospatial data

A datum is an official, fully-defined, spatial reference system or surface to which measurements and coordinates upon the earth may be defined and related. It underpins all geospatial data. The ability to position both information and objects accurately will be an increasingly important driver of productivity into the next decade.

Benefit of 200 billion

“In Australia, Global Navigation Satellite System (GNSS) has the potential to generate a cumulative benefit of close to AUD 200 billion over the next 20 years,” Dawson says. He explains that this growth will be further leveraged by efficiency gains if we ensure that the positioning, navigation and timing information from global positioning systems are interoperable with the Australian datum.

Implementation of the new datum will commence on 1 January 2017 with a new and more rigorous national adjustment with the coordinates projected to a reference date of 1 January 2020.

JAPAN

Key enabler for monitoring disasters

In Japan nearly all geospatial services are provided through the Global Geodetic Reference Frame.

“The Global Geodetic Reference Frame (GGRF) is the essential infrastructure and legally defined platform for mapping and surveying as well as geospatial information management conducted by public organizations in Japan,” says Basara Miyahara, director at the Geospatial Information Authority of Japan.

Recovering from disasters

In Japan four active plates are colliding, making the country prone to a lot of disastrous earthquakes and volcanic activities.

“Japan has an important reason to adopt GGRF as a key enabler not only for monitoring these disasters, but also recovering from them”, Miyahara says.

In the case of The 2011 off the Pacific coast of Tohoku Earthquake on 11 March 2011, the ground surface displacement of as large as 5.4 m in the horizontal and 1.2 m in the vertical directions was measured with the



PHOTO: GEOSPATIAL INFORMATION AUTHORITY, JAPAN

JAPAN: *After The 2011 off the Pacific coast of Tohoku Earthquake.*

CORS network of GNSS Earth Observation Network System (GEONET) within a few hours after the earthquake.

Facilitates reconstruction activities

In addition, GEONET enabled to revise the geodetic reference framework in about seven months after the earth-

quake, and greatly facilitated the reconstruction activities in the areas devastated by the tsunamis.

“It is now fair to say that GGRF is an integral part of the Japanese society. And nobody would be able to imagine what would take place in Japan without GGRF,” says Miyahara.

FIJI Will reduce flood losses

The Global Geodetic Reference Frame is key element in a project aiming to develop integrated flood management for the Pacific.

“Fiji is highly susceptible to flooding, with severe floods and cyclones the key natural disasters facing the country,” says Andrick Lal, Senior Surveyor, Secretariat of the Pacific Community.

Mountainous Pacific countries are particularly susceptible to flood impacts. Aside from the obvious humanitarian impact of flooding, flooding also has an economic dimension. In the Pacific, cyclones account for nearly 80 percent of all reported disasters.

Flood preparedness

The surveyor explains that until recently, despite the immense social and economic costs, Pacific Island countries have been reactive rather than proactive in dealing with flood preparedness and response. However, this is changing.

PHOTO: RAJENDRA PRASAD



FIJI: In the Pacific, cyclones account for nearly 80 percent of all reported disasters.

PHOTO: ANDRICK LAL, SPC



PRECISE OBSERVATIONS: Having a global geodetic reference frame is key.

“A project addressing flooding of Fiji’s river Nadi, is aiming to strengthen flood forecasting and warning systems, flood risk assessment and address institutional strengthening for integrated flood management,” Lal says.

The Nadi Integrated Flood Management is a pilot project aiming to develop integrated flood management for the Pacific using Nadi as a case study.

Topography model

Among the deliveries are operating procedures for flood warning services and a high-resolution topography model for the low-lying areas of Nadi using Light and Detection Ranging (LiDAR) survey. LiDAR is a remote sensing method used to examine the surface of the Earth.

Another delivery is use of a 2D flood inundation model and flood hazard and risk maps to recommend flood mitigation measures and dissemination of the methodology to the Pacific region.

The models will also be important for decision making and can provide guidance on land-use practices and whether to avoid development in particular areas.

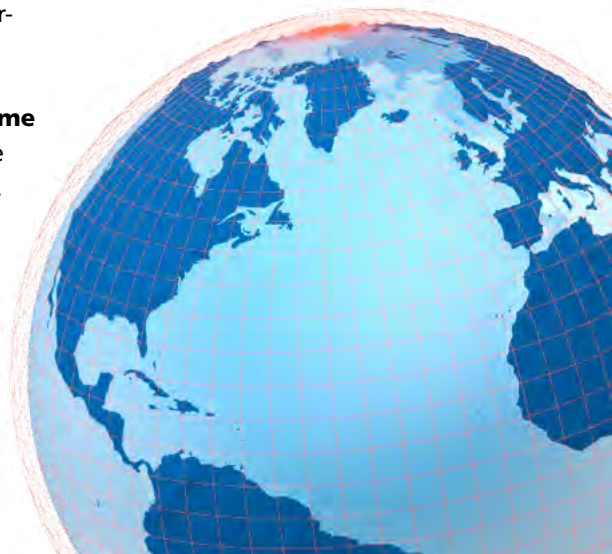
Seamlessly with a Reference Frame

“Having a Global Geodetic Reference Frame is key for precise observations. The reference frame will allow the

future work to be seamlessly combined with the Nadi project’s dataset,” says Lal.

The Global Geodetic Reference Frame is accessed by the nearby existing Global Navigation Satellite System (GNSS) and Continuous Operating Reference Stations (CORS) and enables more precise observations of height.

Key stakeholders in the Nadi project include the National Disaster Management Office, Town and Country Planning, Water Authority of Fiji, Fiji Meteorological Services and Land & Water Resources Management.



NEW ZEALAND

Earthquakes emphasise the need for reference frames

PHOTO: ROSS BECKER/THE CANTERBURY EARTHQUAKE RECOVERY AUTHORITY



NEW ZEALAND: After the Canterbury earthquake 2011, Christchurch Cathedral.

New Zealand is at high risk of earthquakes and associated land surface deformations.

“A global geodetic reference frame is therefore important to New Zealand,” says Land Information New Zealand Chief Geodesist, Graeme Blick.

The Canterbury earthquakes of 2010 and 2011 in New Zealand caused significant damage to Canterbury, including the Christchurch urban area.

Understand the nature of events

“Having a common reference frame allows geodetic datasets to be combined in order to better understand the nature of these events,” Blick says.

It’s a view shared by Kelvin Berryman. He is manager of Natural Hazards Research Platform hosted by GNS Science, a New Zealand earth and geoscience research center.

Increase understanding of earthquakes

“A common reference frame makes it possible to combine GNSS, geological observations, LiDAR and other datasets to increase our understanding of the earthquakes and their impacts on the land,” says Berryman.

Benchmark for infrastructure

In Christchurch, the geodetic reference frame has provided an accurate benchmark for infrastructure recovery projects, allowing adjacent or overlapping work to be carried out as efficiently as possible.

It has also meant that land changes associated with earthquake fault movement and liquefaction can be used to evaluate the risk of river flooding.

JAMAICA

Small islands at risk



PHOTO: NATIONAL SPATIAL DATA MANAGEMENT DIVISION, JAMAICA

JAMAICA: 90 percent of Jamaica’s GDP is produced within coastal areas.

Over the years Jamaica and other Caribbean Islands have seen significant loss of life and damage to infrastructure due to weather related catastrophes such as tropical storms and hurricanes.

“It is critical that we have knowledge in the area of weather, climate and sea level change, and that an understanding of a global geodetic reference frame is applied to inform mitigation efforts and decision making for sustainable development,” says Rohan Richards, Principal Director in the National Spatial Data Management Division of the Ministry of Water, Land, Environment and Climate Change.

Effects on economy

Over 400 of Jamaica’s 900 communities are ranked high or moderately high to natural hazards. Between 2004 and 2012 the country experienced eight major hurricane events each bringing with it varying levels of damage to infrastructure and effects on Jamaican economy.

Extremely vulnerable

One of every four persons employed in Jamaica is part of the tourism industry, according to Jamaica Tourist Board.

25 percent of Jamaica’s population lives within coastal areas and 90 percent of Jamaica’s GDP is produced within these areas. This makes this island nation extremely vulnerable.

“We must therefore protect the natural resources on which the economy of small islands such as Jamaica depends,” says Rohan Richards.

