crc•si Spatially Enabling Australia and New Zealand

Project 1.02 | Next Generation Australian & New Zealand Datum

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Objectives The objective of this project is to develop the theory, concepts, geodetic techniques, tools and standards required to implement the next generation geodetic datum which will underpin the National Positioning Infrastructure.

Outcomes A modernised geodetic datum for Australia and New Zealand that takes into account crustal dynamics, developed and maintained using the latest geodetic methodologies, in order to support the provision of real-time, centimetre-level positioning services.

Introduction

Precise positioning has the potential to positively impact many sectors of the Australian economy including construction, agriculture, and mining. In recognition of this, the Federal Government has made the development of the National Positioning Infrastructure (NPI) a national priority. The goal of the NPI is to provide real-time, centimetre-level positioning services regardless of location. However the current Australian datum (GDA94) is not accurate enough, nor does it satisfactorily take into account crustal motion and ground deformation. Hence modernisation of the national datum for Australia is critical if this goal is to be achieved. Similarly, improvements to the New Zealand datum (NZGD2000) are required.

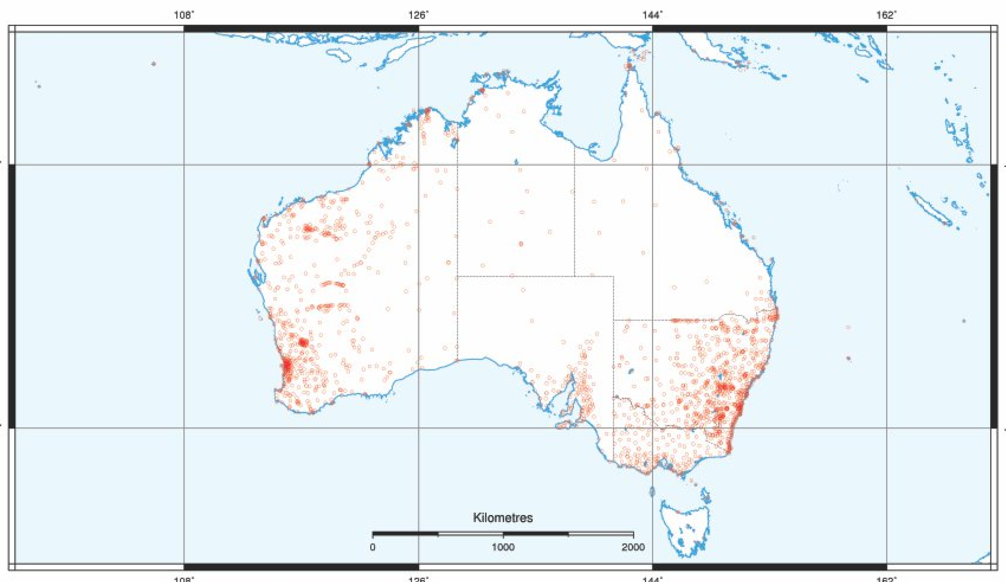

Figure 1: The locations of the 2,213 stations that comprise the current national GNSS campaign network.

Research Questions

Our research will focus on five major questions:

1. Coordinate Dynamics

How best to integrate horizontal, vertical and time-varying coordinates in a national geodetic adjustment that supports the dynamic inclusion of new terrestrial and GNSS coordinate/baseline observations (i.e., phased least squares estimation)? What form may a “dynamic datum” take?

2. Coordinate Uncertainty

How best to compute and communicate coordinate uncertainty within this “dynamic datum” paradigm?

3. Deformation

How best to measure, model and integrate estimates of ground deformation, including those determined from non-conventional geodetic observations such as remotely sensed data (i.e., InSAR and lidar), into a “dynamic datum”?

4. Business Process Automation

How to develop systems and tools for transferring, managing, and linking data and business processes for the administration of geodetic datum and infrastructure (i.e., eGeodesy and web-services) within a “dynamic datum” context?

5. Regulatory and Administrative Impediments

What are the regulatory and administrative impediments to “dynamic datum” implementation with respect to State, Territory and Commonwealth Legislation and business processes? What alternative options for “user frames” are there for those geospatial information generators or consumers who do not wish to manage continually changing coordinates?

Progress

Coordinate Dynamics

- Testing of the least squares adjustment software DynaNet on the National Computational Infrastructure supercomputer raijin has shown that it is capable of performing a rigorous national adjustment.
- A 500,000 station network consisting of ~3,000,000 measurements can be adjusted in just over two days.
- Data-mining, collation and cleaning of each jurisdiction’s primary network of geodetic data is continuing.
- An L1 norm (least absolute deviations) minimiser has been implemented as a pre-processing step to assist in the identification of decimetre-level errors.
- National adjustments are being performed regularly, as more data becomes available. The data included in these adjustments consists of the weekly APREF solutions (transformed to GDA94) and the jurisdictional GNSS campaign observations. The current national network consists of 2,213 station and 285,366 measurements (see Figure 1). The network will be supplemented with the jurisdictional data archives at a later date.
- Study of options for the definition of a “dynamic datum”, as well as of the terminology for the various models, datasets and reference frames.

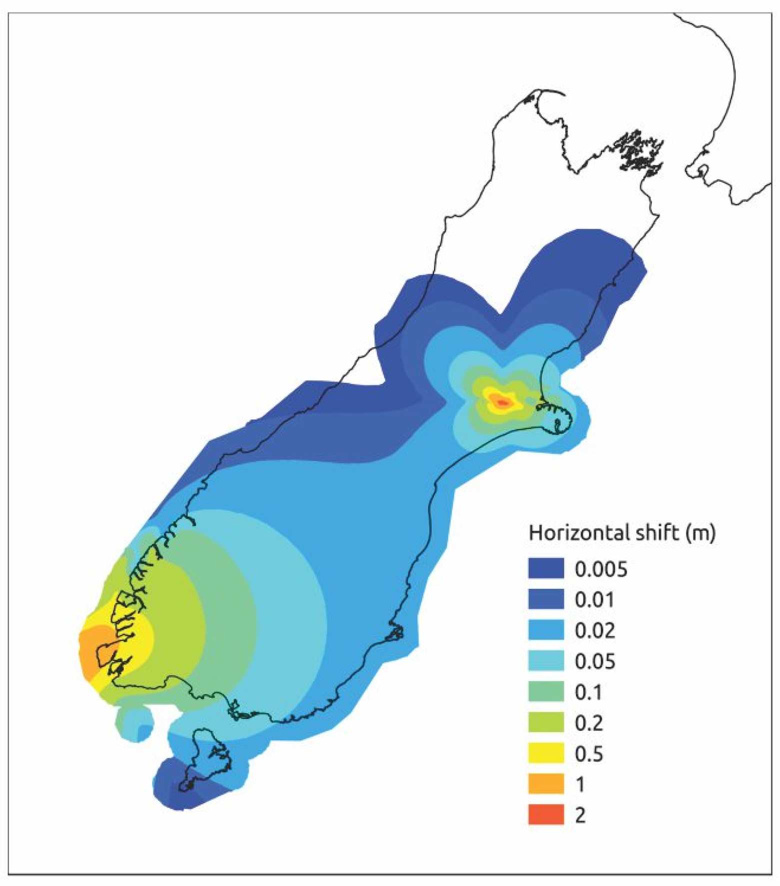

Figure 2: Cumulative horizontal displacement as a result of 8 earthquakes affecting the South Island of New Zealand.

Coordinate Uncertainty

- Version 2.0 of the Special Publication - Standards and Practices for Control Surveys (SP1) and Adjustment Guidelines was released.
- This version of SP1 includes an international best-practice approach to the expression of uncertainty by replacing class and order with position, survey, and relative uncertainty.

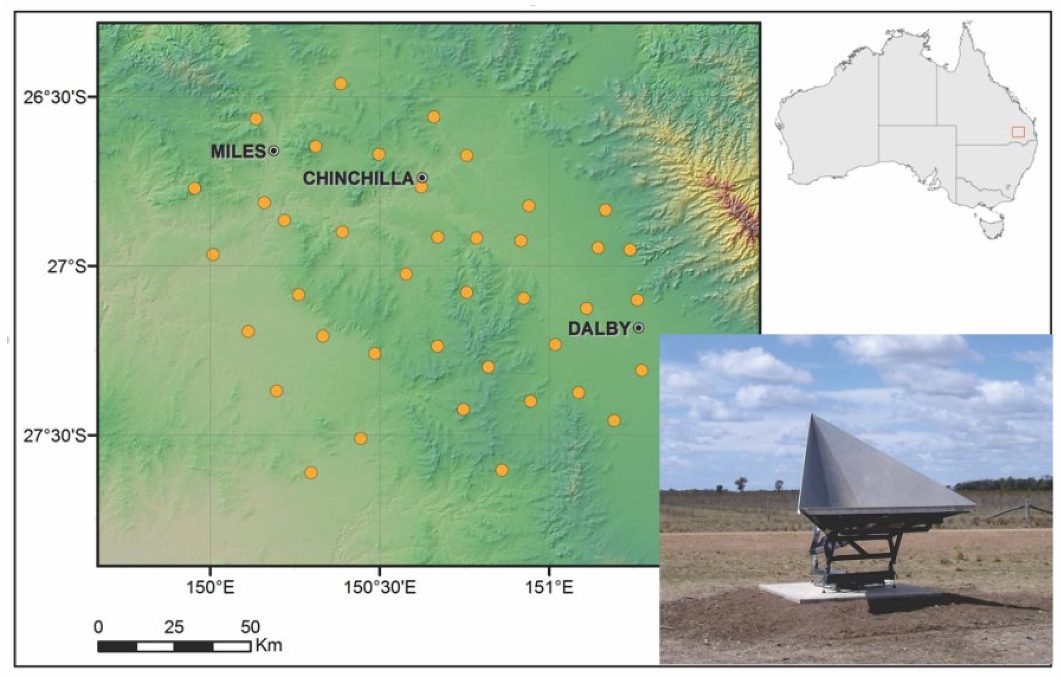

Figure 3: The network of corner reflector s (see insert) installed in the Surat Basin.

Deformation

- The NZGD2000 deformation model was updated to include ‘reverse patches’ for 8 earthquakes occurring between 2003 and 2011. This enabled spatial users to update their coordinates to reflect movements due to these earthquakes (see Figure 2).
- A network of radar corner reflectors has been installed in the Surat Basin, Queensland (Figure 3), which will enable the precise measurement of crustal deformation and the calibration of InSAR data.

Business Process Automation

- Development of a C++/STL support library for standardised access to GeodesyML files to be made available to third-party software developers.
- Development of a new extensible Oracle Geodesy database that is compliant with GeodesyML.
- Development of OGC web services to facilitate the transfer of geodetic data between jurisdictions.
- Extension of eGeodesy schema to include deformation modelling, multiple reference frame versions and non-conventional measurements (e.g. inSAR).
- Regulatory and Administrative Impediments
- CRCSI plans have been aligned to the PCG’s work-plan regarding Australian and New Zealand datum modernisation.
- Engagement with industry/users has been undertaken at several national and state geospatial industry forums.

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