

Reference Frame in Practice

Manila, Philippines 21-22 June 2013



Asia Pacific Reference Frame (APREF)

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National Geospatial Reference Systems
Geoscience Australia

Sponsors :

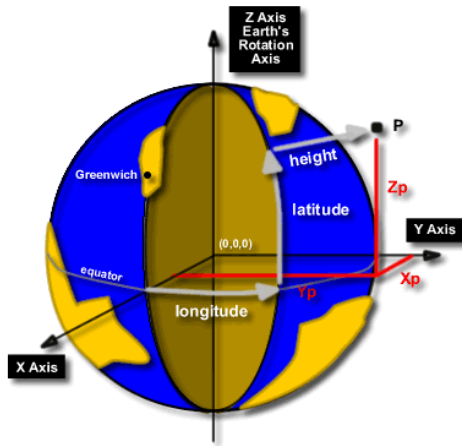


Objectives

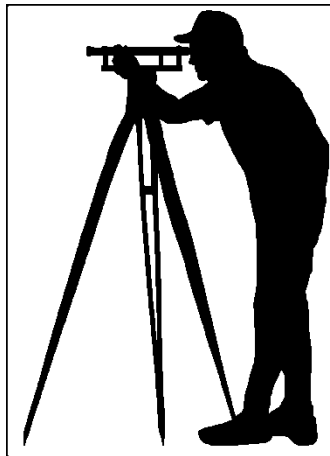
To learn about:

- Drivers for regional and global approaches to geodesy
- The Asia Pacific Reference Frame (APREF)
- APREF products and services
- The benefits of participating in APREF
- Practical advice on how to participate in APREF
- Who to contact for more information on APREF

The Changing World of Geospatial



Precise coordinates for and by the masses (no monopoly for surveyors anymore)



The Changing World of Geospatial



Cheaper
geodetic
receivers



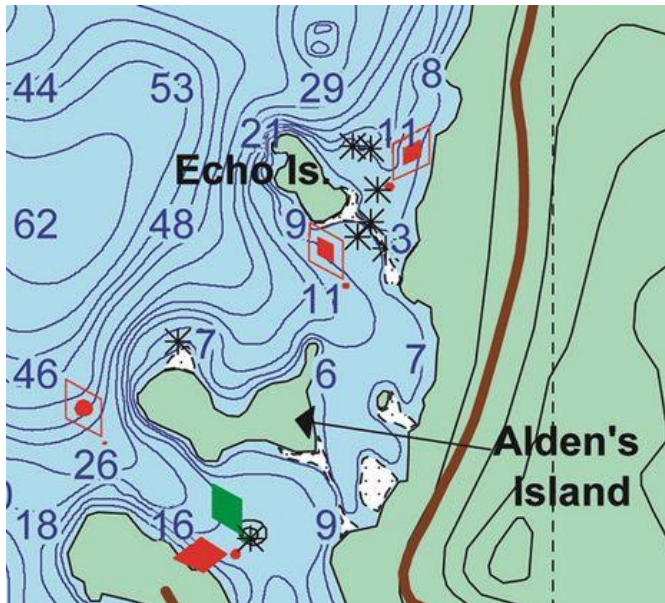
The Changing World of Geospatial



Fewer Surveyors



The Changing World of Geospatial



Data poor

Big data
➔



Data rich

The Changing World of Geospatial

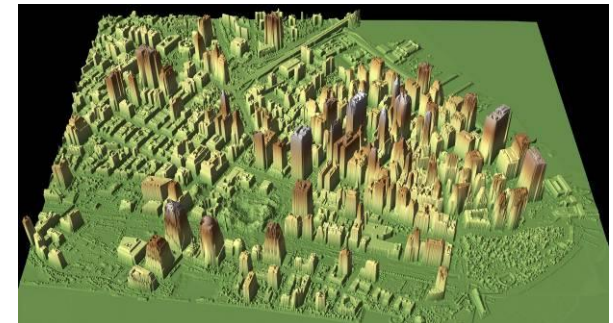
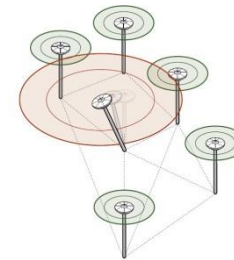
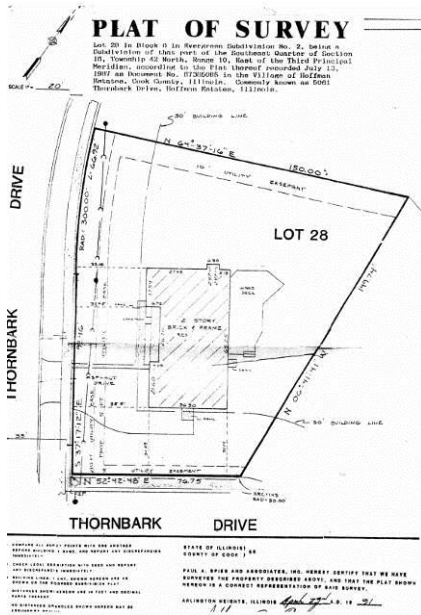
Precision positioning
will contribute 2.1%
of Australia's
GDP by 2030

Automated mines,
driverless cars,
UAVs



The Changing World of Geospatial

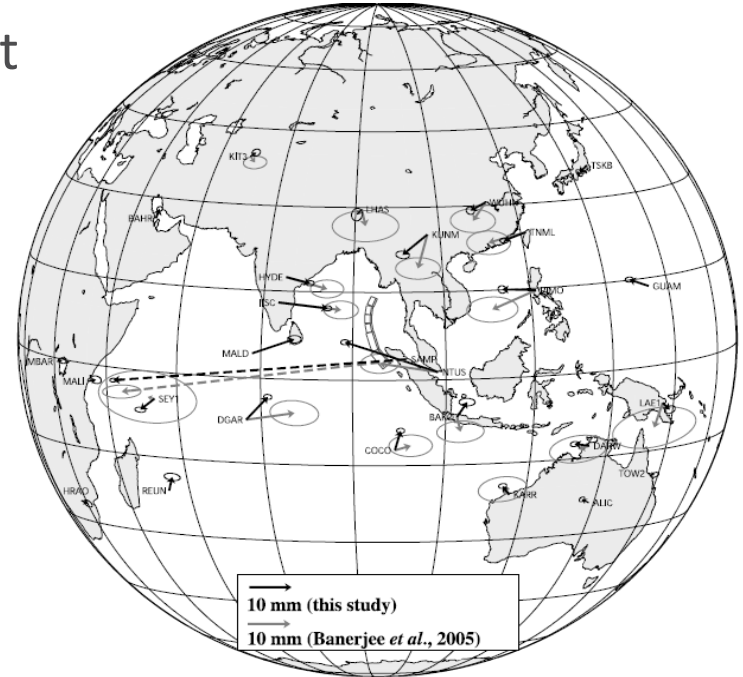
User expectation
of seamless
interconnection
in 3D



The Changing World of Geospatial

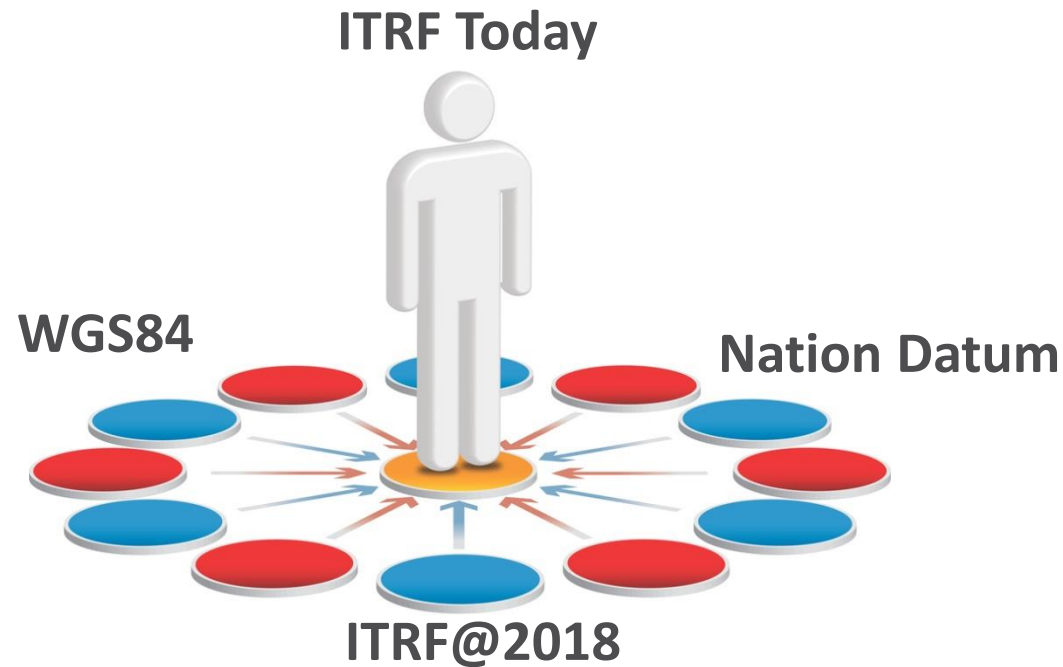


Recognising that
the Earth is
dynamic



From: Kreemer et al 2006

The Changing World of Geospatial



User-centric view of datum

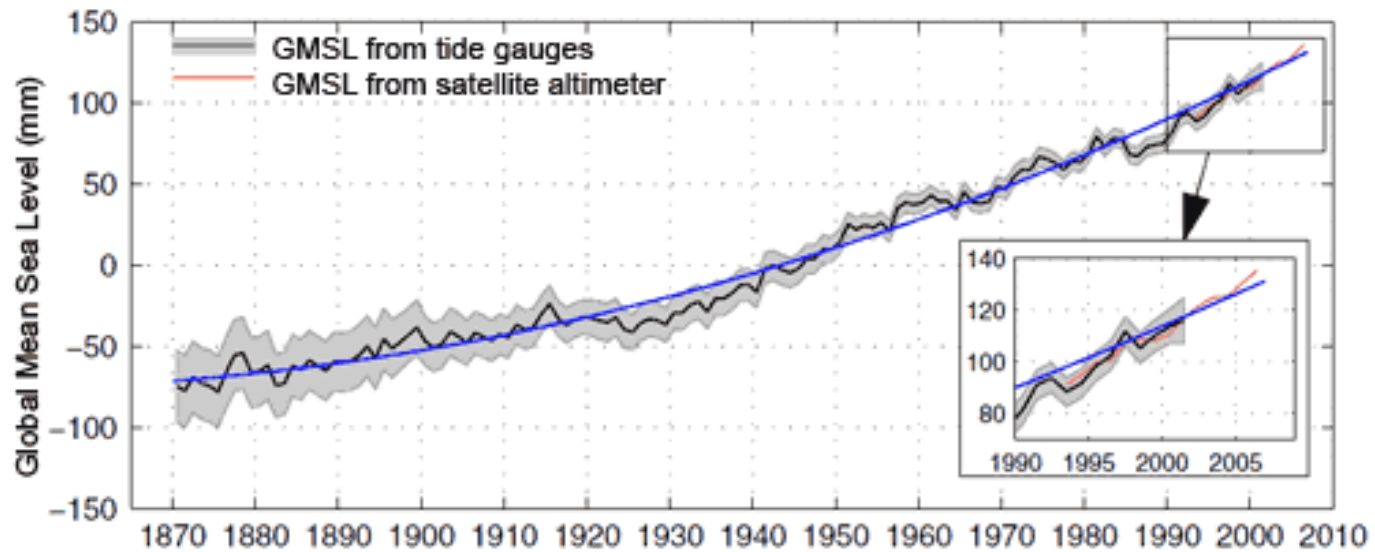
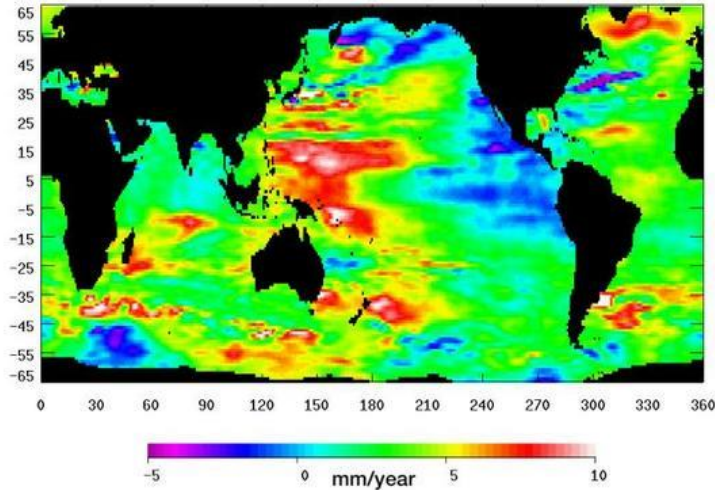
→ why can't **you** provide your data in my datum!

Underpins the understanding of the Earth System

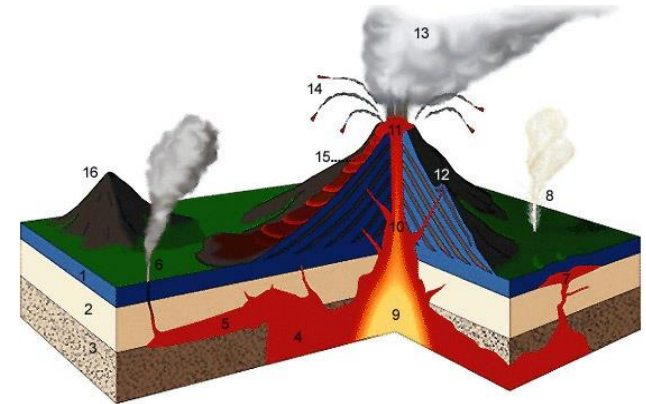
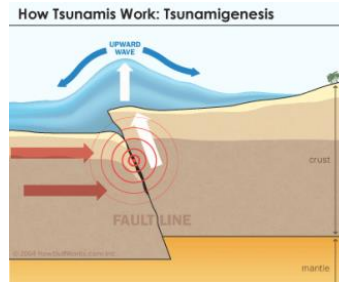


Understanding the Earth System

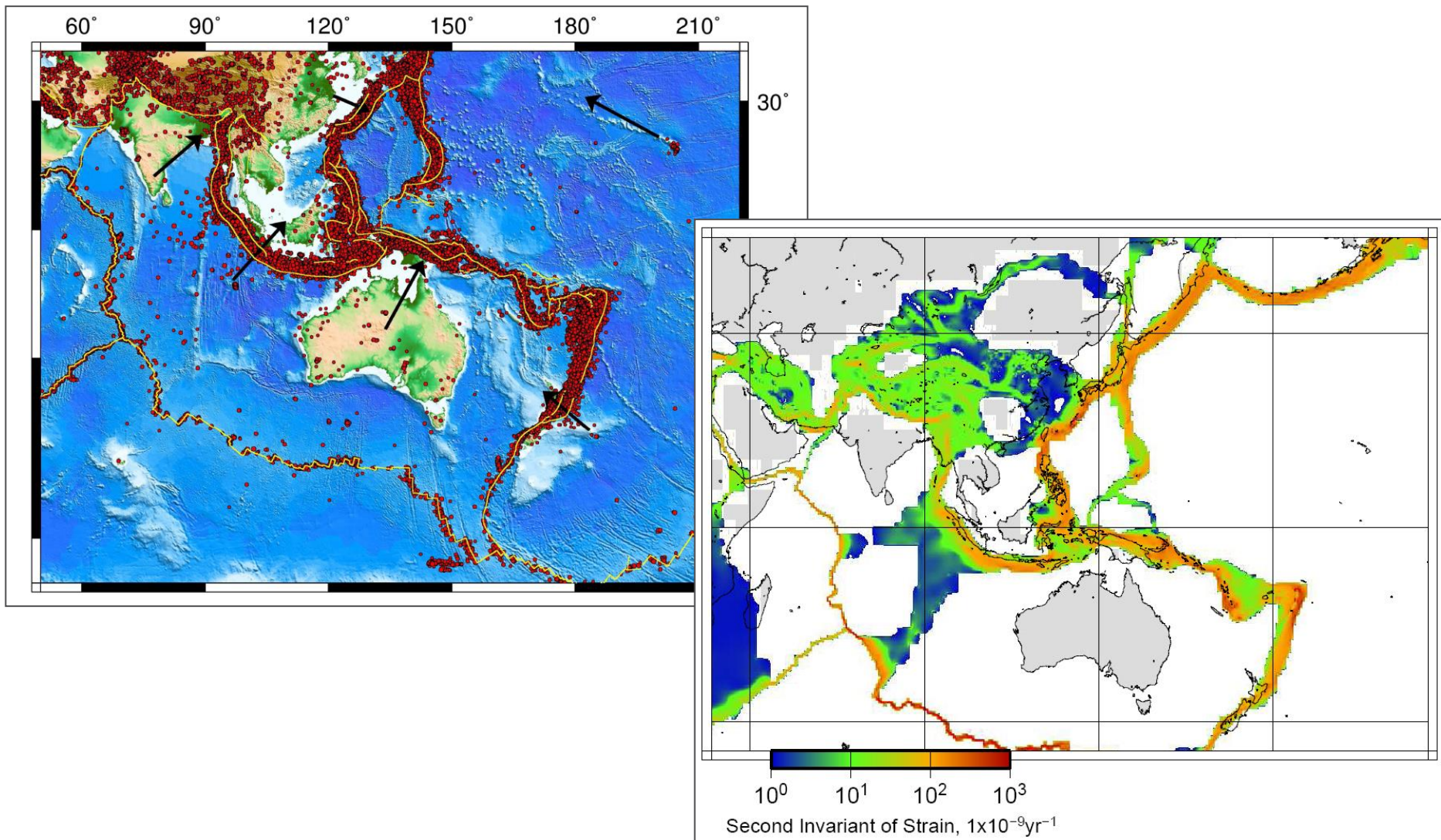
Trend of Sea Level Change (1993-2008)



Understanding the Earth System



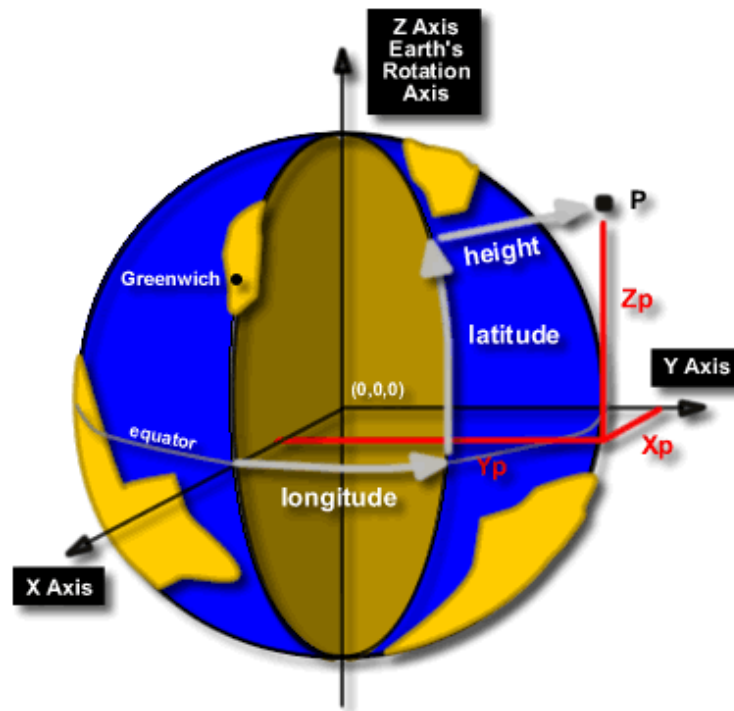
Crustal Strain and Earthquakes: Asia Pacific



International Terrestrial Reference Frame (ITRF)

ITRF underpins all satellite positioning technology which is a key enabler of spatial data interoperability

ITRF is the global 'standard'



Global Efforts

- 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
- Questionnaire format and content discussed after the United Nations Regional Cartographic Conference (UNRCC) forum in Bangkok, October 2012
- Questionnaire distributed globally in December 2012 by the UN
- 100 responses received by June 2013

Global Questionnaire Key Findings

- 88% of responses indicated that the data, products and services of the international global geodetic community (e.g. ITRF, IGS orbits,...) were either critical or had high importance in their country
- 80% of all responding countries use the International Terrestrial Reference Frame (ITRF) to underpin their national coordinate datum

Global Efforts Next Steps

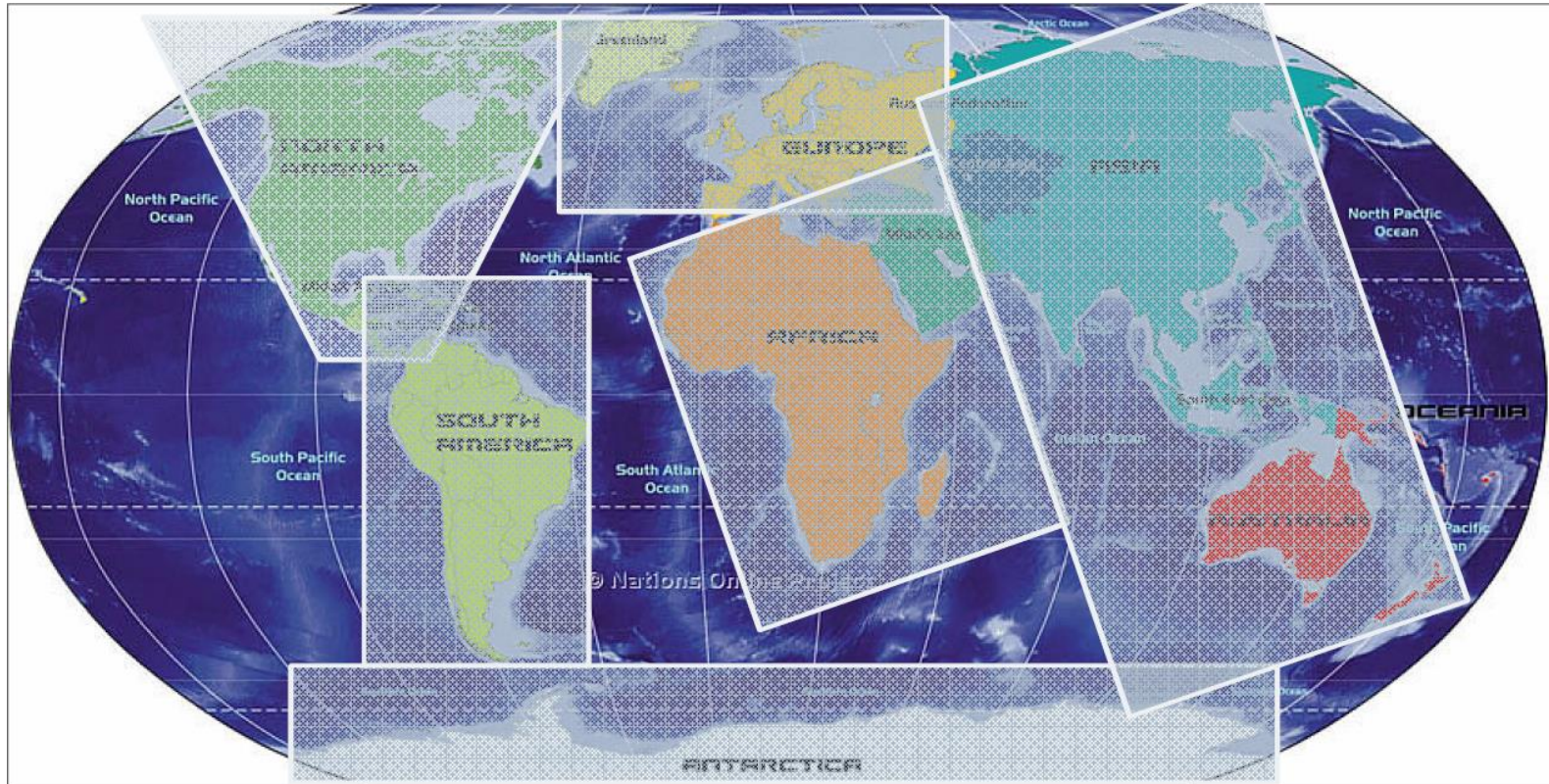
UNGGIM Committee of Experts will recommend at its Cambridge Meeting in July 2013 that a Working Group be setup to draft the text of a **United Nations General Assembly Resolution** that

- Acknowledges the role and importance of the ITRF
- Encourages investment in infrastructure
- Encourages international data sharing

See http://ggim.un.org/ggim_committee.html

Regional Reference Frame Densification

ITRF = APREF, AFREP, EUREF, NAREF, SIRGAS, ...



Asia Pacific Reference Frame

- Access to high quality positioning infrastructure is essential for effective competition with the other regions, including Europe and the Americas
- Coordination of regional geodetic activities not well developed in the AP



Asia Pacific Reference Frame

Open to all organisations (government, research, private) involved with CORS data collection and/or analysis

APREF encourages those organizations who are prepared to participate on an ongoing basis (at least two years)

- GNSS CORS stations data;
- Provide access and on-line archiving of APREF data and products for users; and/or
- Routinely analyse some, or all, of the APREF GNSS CORS data

Improving Access to the ITRF: Asia Pacific

**Annual APRGP
GNSS Campaigns**



**Asia Pacific Reference
Frame (APREF)**

- PCGIAP effort
 - Annual week long GPS campaign 1997, ..., 2012
 - Provides access to ITRF
 - Recognises not all member countries can operate CORS networks and contribute to APREF
- Joint UNGGIM-AP (formerly the PCGIAP) and IAG effort supported by FIG, ICG
 - Continuous, low-latency analysis of CORS networks
 - Provides access to ITRF, coordinate time series, station velocities and network monitoring
 - Commenced March 2010

APREF: Objectives

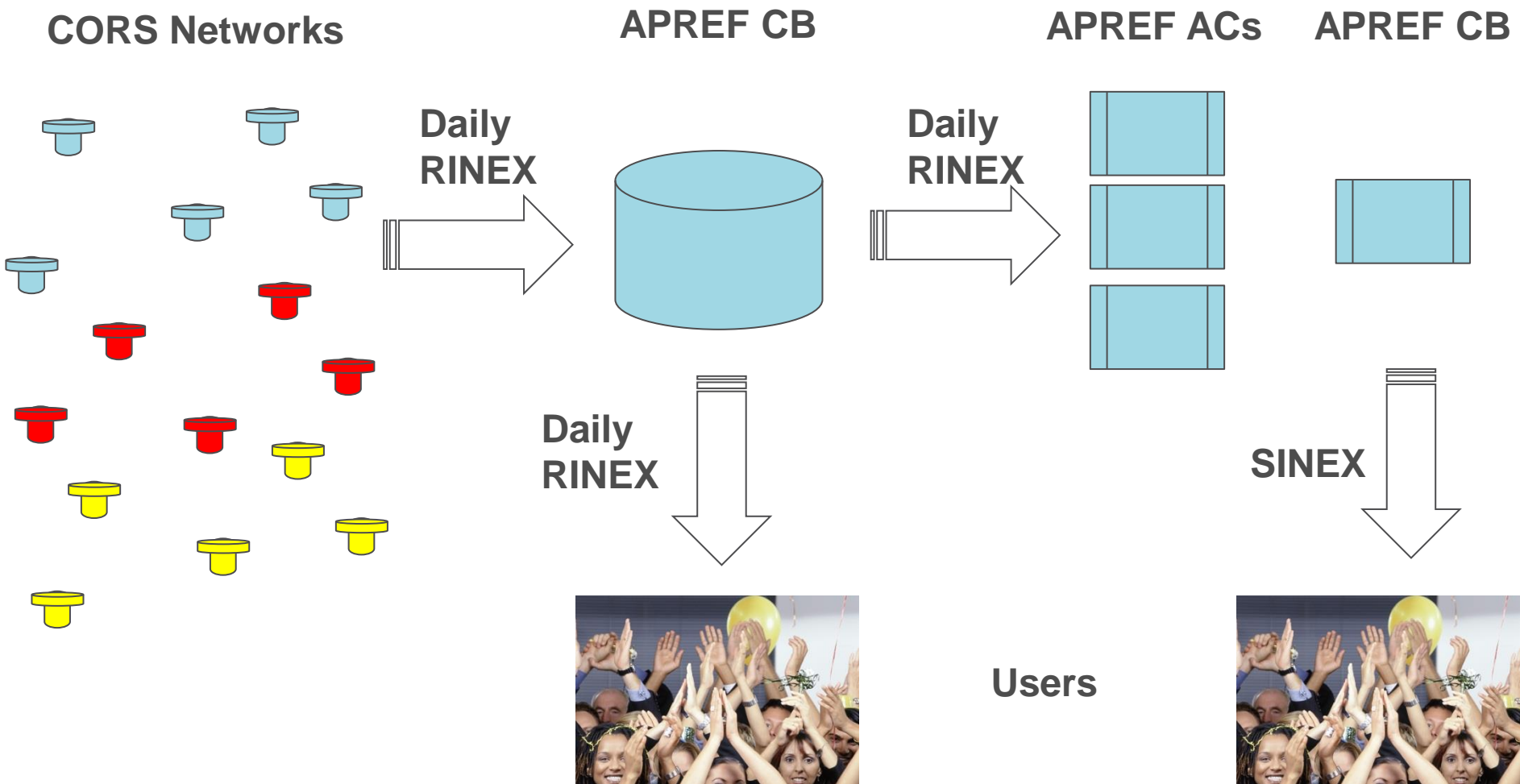
- Create and maintain an accurate and densely realised geodetic framework, based on continuous observation and analysis of GNSS data
- Encourage regional data sharing of GNSS CORS data and its analysis



Benefits of APREF Participation

- Improved and continuous link between national datums and CORS networks to the ITRF
- Contribute to a open and dense ITRF network in Asia and the Pacific
- Independent quality monitoring
- Improved access to GNSS data
- Providing an opportunity and a forum towards improving the regional geodetic infrastructure

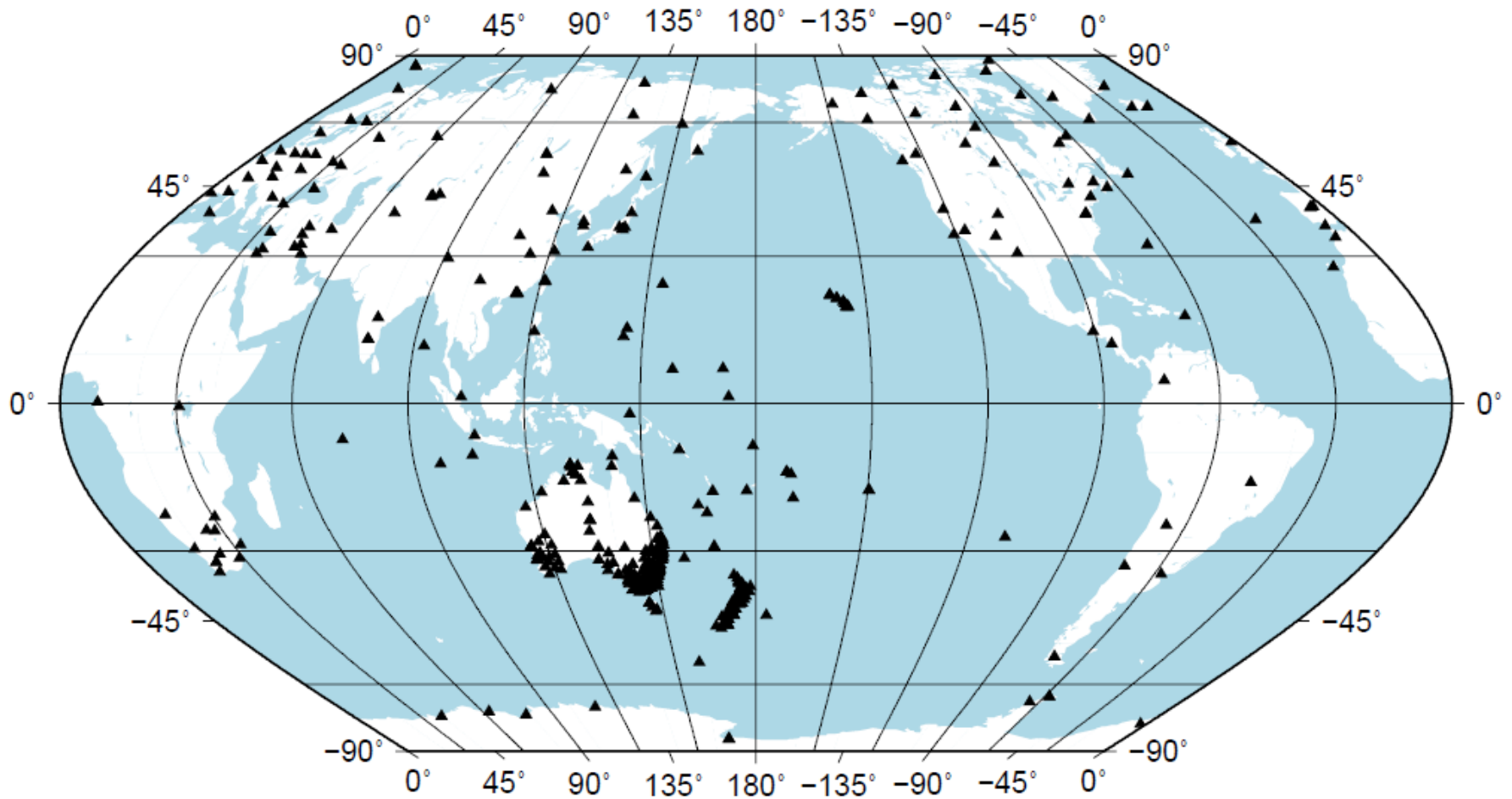
Asia Pacific Reference Frame Data Flow



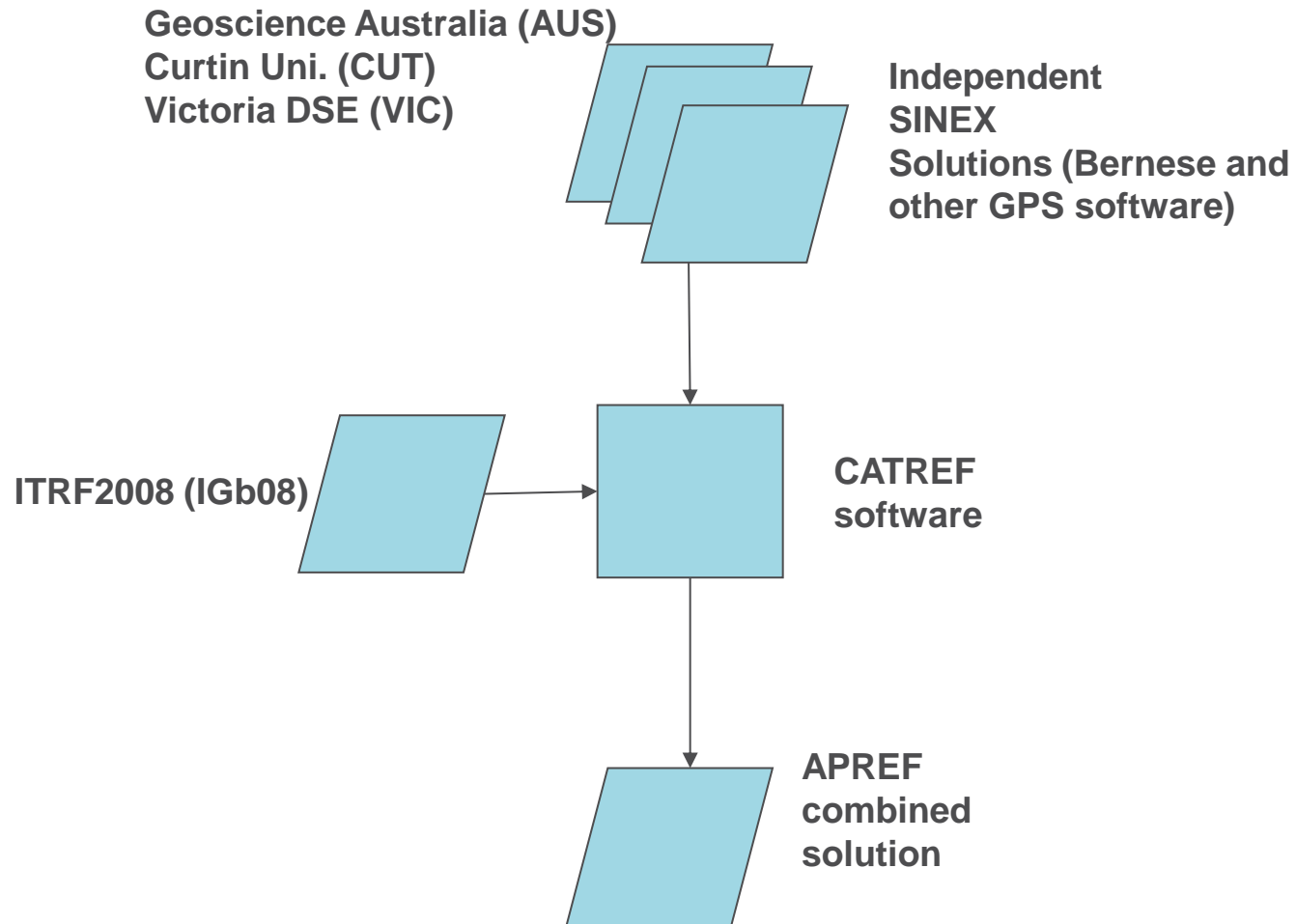
APREF status as of June 2013

- Data from 33 countries
- 16 national agencies participating
- 3 local analysis centres
- 2 universities participating
- ~ 400 Asia Pacific stations now available
- ~ 500 stations routinely analysed

APREF status as of June 2013



How the APREF Frame is Derived



APREF Solution Quality – Internal Consistency

Mean Weighted RMS with respect to the Combined Solution			
Solution	North (mm)	East (mm)	Up (mm)
Geoscience Australia	0.1	0.1	0.3
Curtin University	1.1	1.2	3.2
DSE Victoria	0.7	1.0	3.0

APREF Products

Official APREF product

- Weekly combination from GA (Central Bureau)
 - Local AC's are GA, CUT and DSE
 - Aligned and minimally constrained to IGS08
 - ~4 week latency
- Cumulative velocity field

GA weekly solution

- Minimally constrained to IGS08
- ~2 week latency

GA daily solutions

- Final ~2 week latency
- Rapid ~2 days latency
- Suitable for network monitoring, research purposes and advanced users

APREF Website

The screenshot shows the APREF website in a Windows Internet Explorer browser window. The address bar displays the URL: <http://www.ga.gov.au/earth-monitoring/geodesy/asia-pacific-reference-frame.html>. The browser's menu bar includes File, Edit, View, Favorites, Tools, and Help. The website header features the Australian Government Geoscience Australia logo on the left and a navigation menu with links for Home, About Us, Contact Us, Jobs, News & Media, Education, and Library. The main content area is titled "Earth Monitoring and Reference Systems" and includes a search bar. Below the header, a breadcrumb trail reads: Home > Earth Monitoring and Reference Systems > Geodesy and Global Navigation Systems > Asia-Pacific Reference Frame >. The main heading is "Asia-Pacific Reference Frame (APREF)". A list of links includes: Background of APREF, Objectives of APREF, APREF organisational structure, Participating agencies, Data and products, How can I participate in APREF?, Station and data standards, Analysis standards, and APREF mandate. The text below explains the purpose of the APREF project: "The purpose of the Asia-Pacific Reference Frame (APREF) project is to create and maintain an accurate geodetic framework to meet the growing needs of industries, science programs and the general public using positioning applications in the Asia-Pacific region." A section titled "Background of APREF" states: "The use of positioning technology is growing rapidly in industries such as mining, agriculture and construction. Furthermore, in recent years, there has been an increasing demand from emergency services, hazard modellers, and land, utility and asset managers. The applications of these users have a demonstrated need...". The right sidebar contains sections for "PRODUCTS" with a search bar and links for Maps, Data/Applications, Publications, and Multimedia; and "RELATED WEBSITES" listing the International Association of Geodesy (IAG), Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP), International GNSS Service (IGS), and International Earth Rotation and Reference Systems Service (IERS). The browser status bar at the bottom shows "Error on page.", "Internet", and "100%".

Where to Find APREF Data and Products

→ APREF data and products are provided with an open access data policy via the internet following the practice of the IGS.

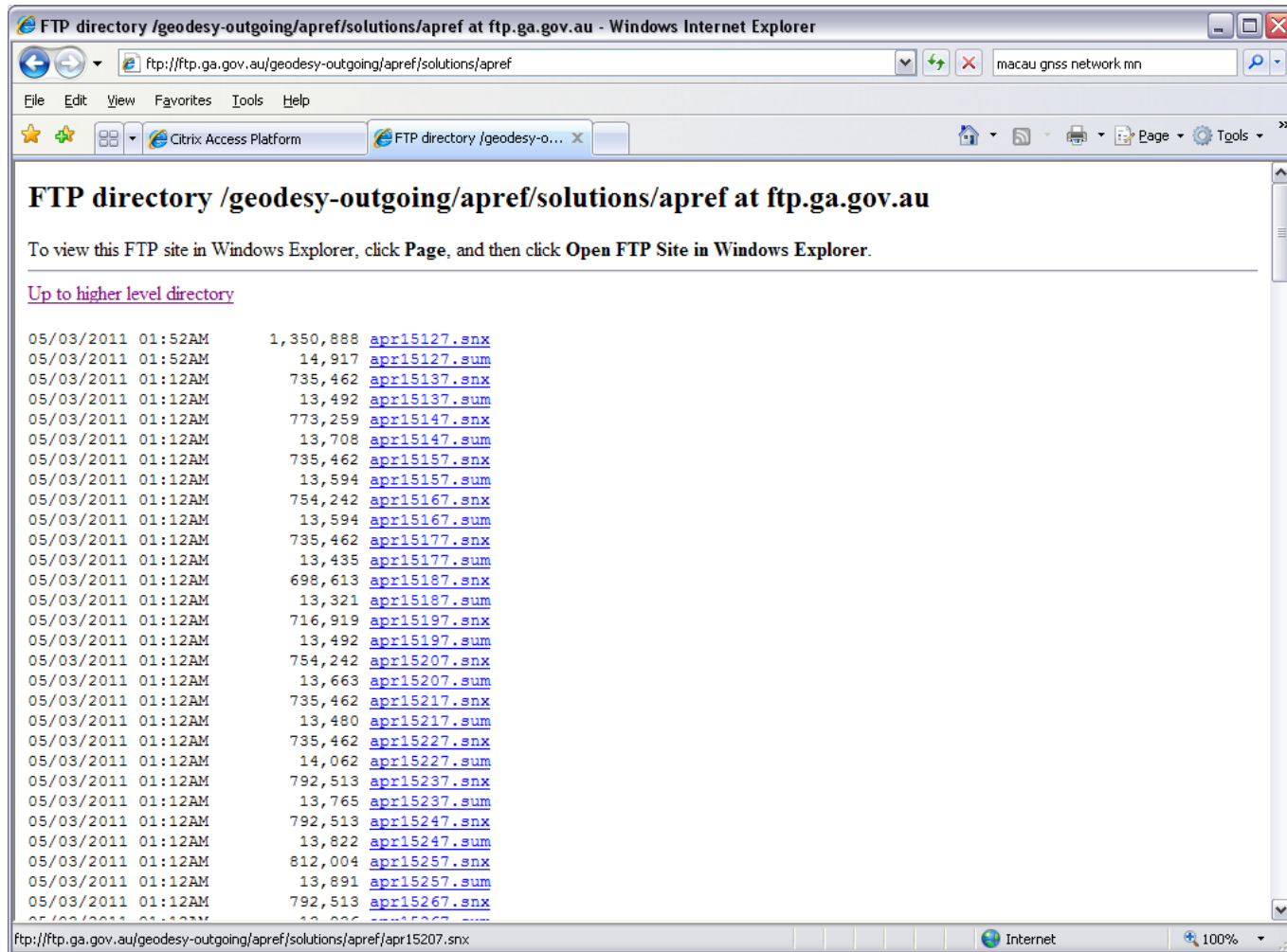
- Daily GNSS RINEX data with a delay of 24 hr after observation, see:

<ftp://ftp.ga.gov.au/geodesy-outgoing/gnss/data/daily/>

- Station log files, see:

<ftp://ftp.ga.gov.au/geodesy-outgoing/gnss/logs/>

APREF Weekly SINEX file (i.e. coordinates)



FTP directory /geodesy-outgoing/apref/solutions/apref at ftp.ga.gov.au - Windows Internet Explorer

ftp://ftp.ga.gov.au/geodesy-outgoing/apref/solutions/apref

File Edit View Favorites Tools Help

FTP directory /geodesy-outgoing/apref/solutions/apref at ftp.ga.gov.au

To view this FTP site in Windows Explorer, click **Page**, and then click **Open FTP Site in Windows Explorer**.

[Up to higher level directory](#)

05/03/2011	01:52AM	1,350,888	apr15127.snx
05/03/2011	01:52AM	14,917	apr15127.sum
05/03/2011	01:12AM	735,462	apr15137.snx
05/03/2011	01:12AM	13,492	apr15137.sum
05/03/2011	01:12AM	773,259	apr15147.snx
05/03/2011	01:12AM	13,708	apr15147.sum
05/03/2011	01:12AM	735,462	apr15157.snx
05/03/2011	01:12AM	13,594	apr15157.sum
05/03/2011	01:12AM	754,242	apr15167.snx
05/03/2011	01:12AM	13,594	apr15167.sum
05/03/2011	01:12AM	735,462	apr15177.snx
05/03/2011	01:12AM	13,435	apr15177.sum
05/03/2011	01:12AM	698,613	apr15187.snx
05/03/2011	01:12AM	13,321	apr15187.sum
05/03/2011	01:12AM	716,919	apr15197.snx
05/03/2011	01:12AM	13,492	apr15197.sum
05/03/2011	01:12AM	754,242	apr15207.snx
05/03/2011	01:12AM	13,663	apr15207.sum
05/03/2011	01:12AM	735,462	apr15217.snx
05/03/2011	01:12AM	13,480	apr15217.sum
05/03/2011	01:12AM	735,462	apr15227.snx
05/03/2011	01:12AM	14,062	apr15227.sum
05/03/2011	01:12AM	792,513	apr15237.snx
05/03/2011	01:12AM	13,765	apr15237.sum
05/03/2011	01:12AM	792,513	apr15247.snx
05/03/2011	01:12AM	13,822	apr15247.sum
05/03/2011	01:12AM	812,004	apr15257.snx
05/03/2011	01:12AM	13,891	apr15257.sum
05/03/2011	01:12AM	792,513	apr15267.snx
05/03/2011	01:12AM	13,822	apr15267.sum

ftp://ftp.ga.gov.au/geodesy-outgoing/apref/solutions/apref/apr15207.snx

Internet 100%

Weekly Station Coordinate and Performance

Weekly station coordinates

ITRF2008 Cartesian Coordinates (X,Y,Z) @ 22/06/2011

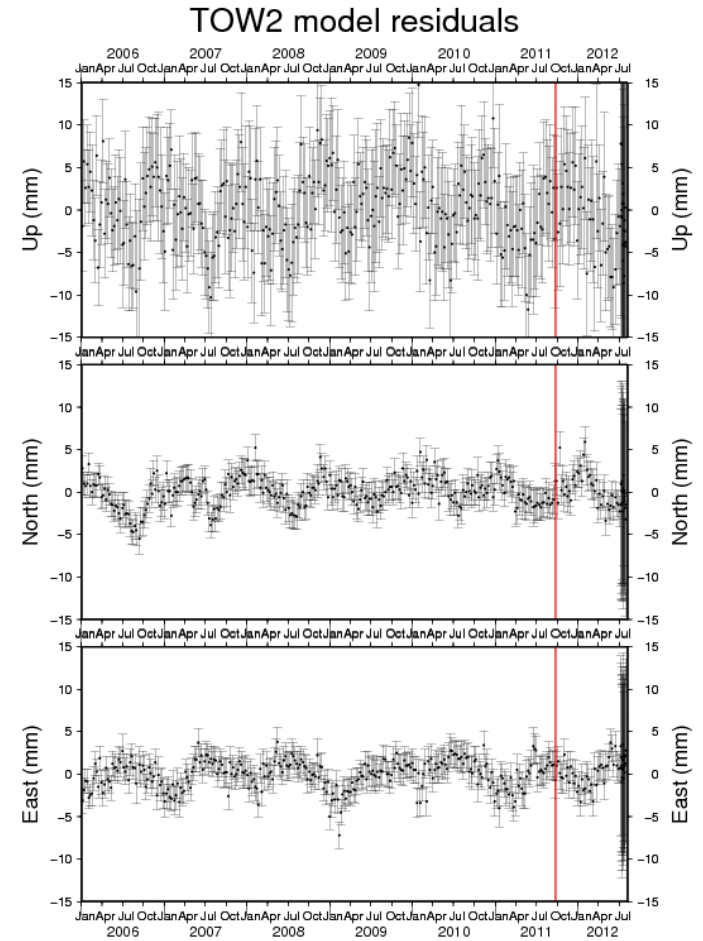
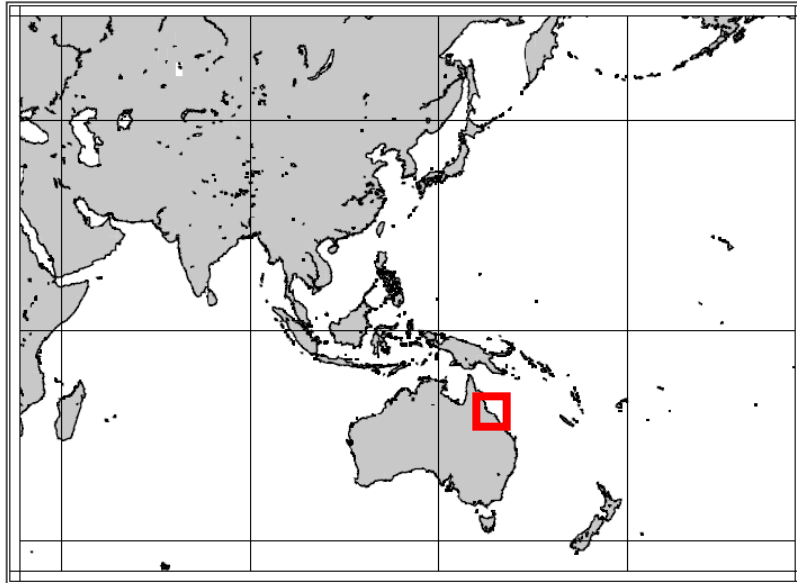
00NA	59975M001	-4073662.2922	4712064.7447	-1367874.4683
01NA	59974M001	-4084823.4609	4702026.6604	-1369125.8453
02NA	59973M001	-4078496.4549	4711380.1330	-1355915.1332
20NA	59972M001	-4050985.3396	4212133.7934	-2547954.8094
21NA	AUM000184	-4048578.9364	4210151.5056	-2554917.6069
ADEL	AUM000008	-3926936.9094	3461614.4215	-3631644.2263
ALBU	AUM000009	-4324312.5655	2817311.0325	-3735264.7605
ALBY	50191M001	-2441714.5963	4629128.5358	-3633363.2024

Weekly station performance

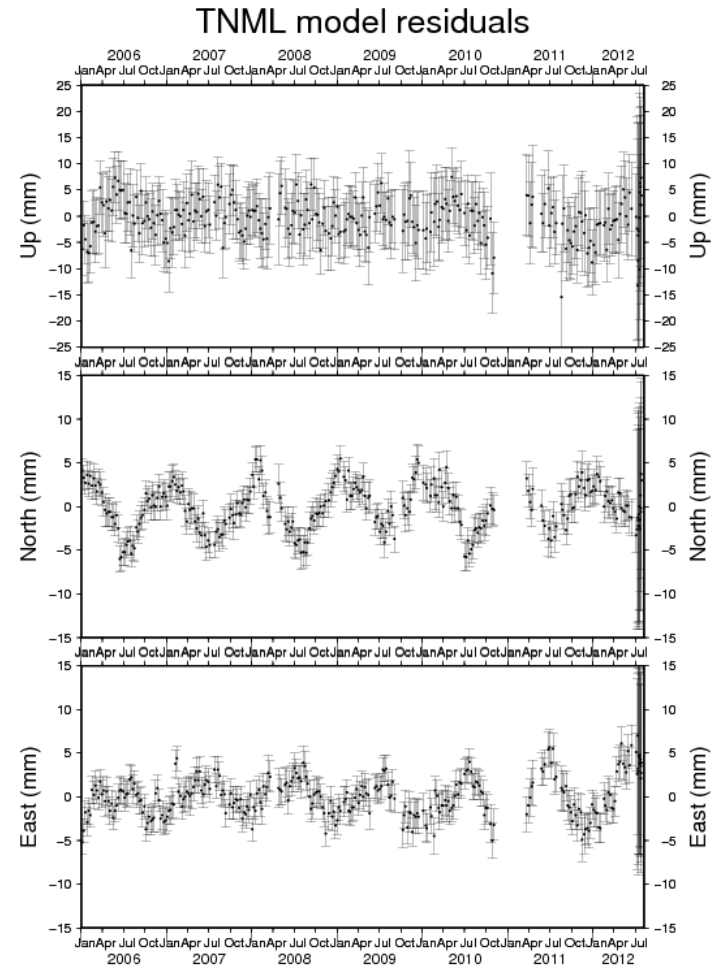
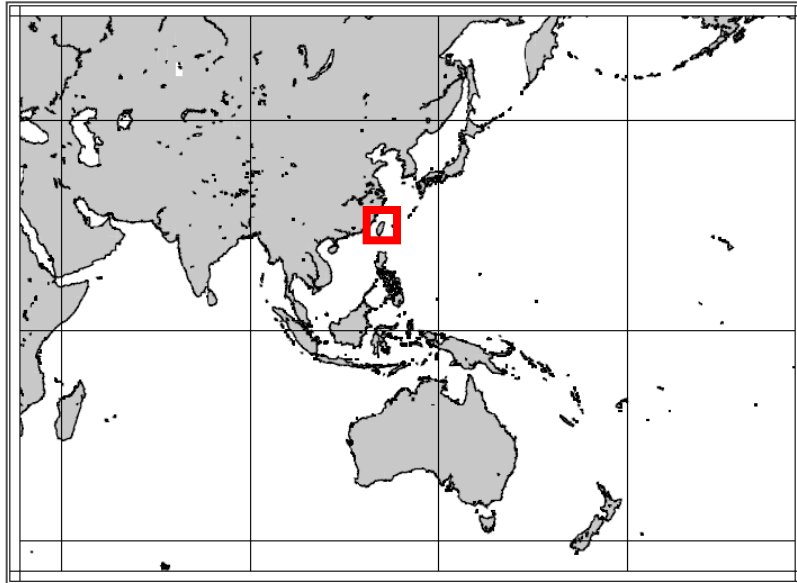
Total number of stations: 303

Station	#Days	Weekday 0123456	Repeatability (mm)			
			N	E	U	
00NA	59975M001	7	XXXXXXX	0.48	1.18	1.87
01NA	59974M001	7	XXXXXXX	0.54	1.61	5.80
02NA	59973M001	7	XXXXXXX	0.79	1.95	3.59
20NA	59972M001	7	XXXXXXX	0.41	1.29	2.00
21NA	AUM000184	7	XXXXXXX	0.61	1.65	0.98
ADEL	AUM000008	7	XXXXXXX	1.28	1.19	4.02
ALBU	AUM000009	7	XXXXXXX	1.64	0.98	5.10
ALBY	50191M001	7	XXXXXXX	1.62	2.87	4.30
ALIC	50137M001	4	XXXX	0.28	1.26	1.47
ANDA	59971M001	7	XXXXXXX	0.64	0.87	1.74
ANTW	AUM000010	7	XXXXXXX	1.47	0.83	3.70
APOL	AUM000011	7	XXXXXXX	1.44	1.44	7.61
APSL	AUM000012	7	XXXXXXX	3.27	1.23	5.96
ARMD	AUM000143	7	XXXXXXX	0.60	1.42	2.74
ARTU	12362M001	5	XXXXXX	3.16	2.20	3.20
ASPA	50503S006	7	XXXXXXX	2.39	2.88	12.17
AUCK	50209M001	7	XXXXXXX	1.27	1.66	4.47
AUKT	50216M001	7	XXXXXXX	1.63	1.66	4.81
BAIR	AUM000015	7	XXXXXXX	1.14	1.06	5.46
BAKO	23101M002	7	XXXXXXX	2.97	3.40	10.00
BALN	AUM000180	7	XXXXXXX	0.40	1.24	3.82
BAN2	22306M003	7	XXXXXXX	2.74	2.94	7.17
BBOO	59997M001	7	XXXXXXX	0.62	0.80	1.46
BDLE	50196M001	7	XXXXXXX	1.73	2.46	2.46
BDST	59981M001	7	XXXXXXX	0.80	1.43	2.86

Example Coordinate Time Series: Townsville

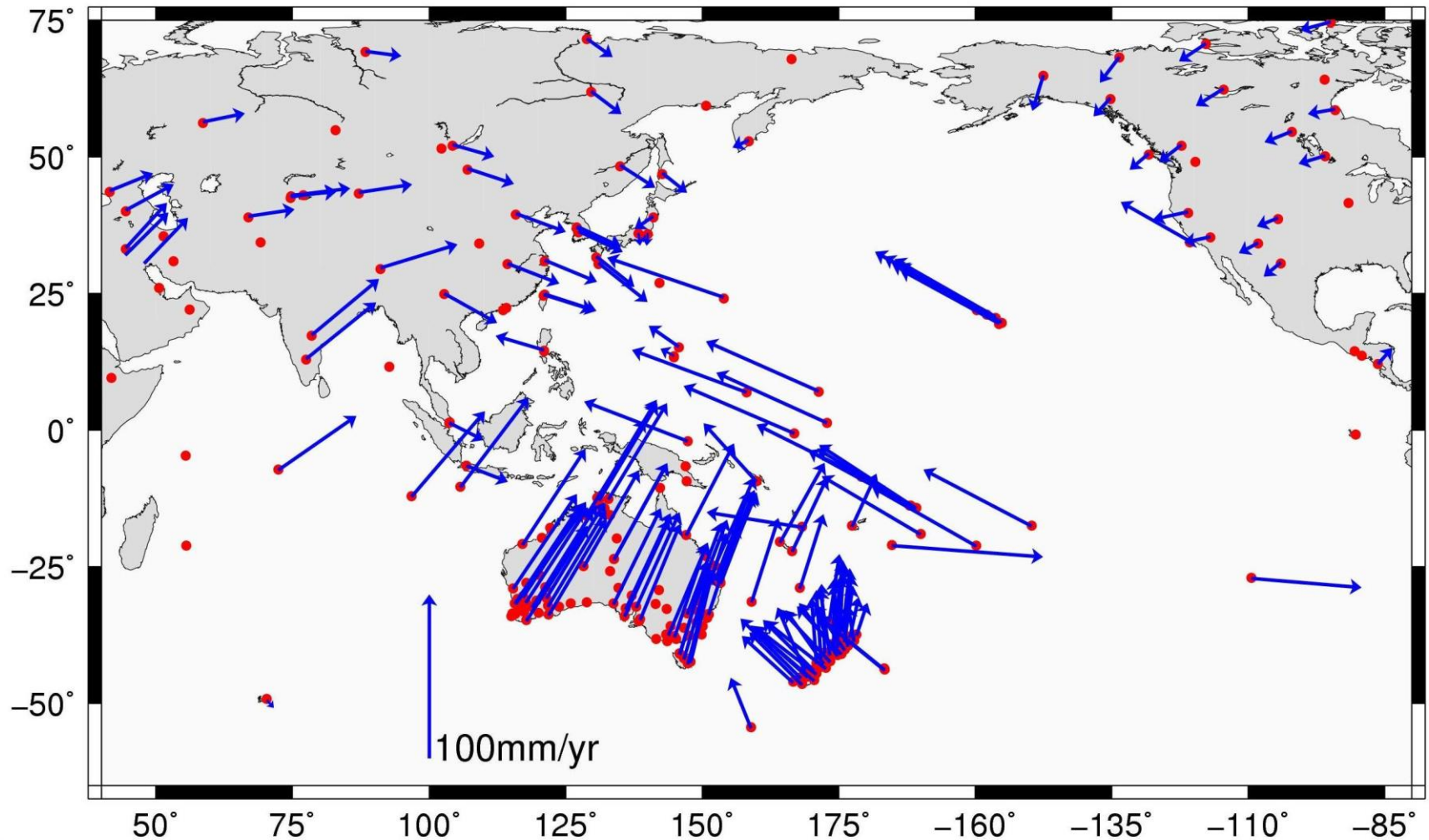


Example Coordinate Time Series: Hsinchu, Taiwan



APREF Crustal Velocity Field

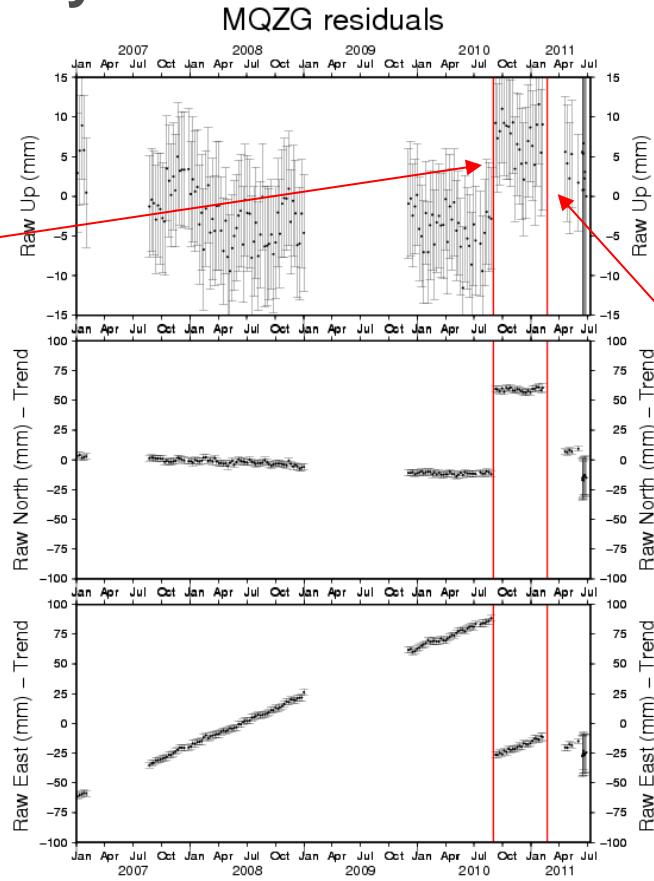
APREF Velocities



APREF Services and Applications

- Science applications, e.g., hazard assessment, sea-level change, crustal dynamics

Station MQZG event 1:
03-Sep-10
Christchurch
earthquake (7.1)



Event 2: 22-Feb-11
Christchurch
earthquake (6.3)

How Do I Contribute CORS data into APREF

Do I have a permanent GNSS station? 😊

Is my agency willing to share its data (30 sec, daily RINEX) 😊

Can I do this automatically everyday? 😊

Does it meet the IGS or APREF standards? Check 😊

→ IGS:

<http://igscb.jpl.nasa.gov/network/guidelines/guidelines.html>

→ APREF:

https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=72803

How Do I Contribute CORS data into APREF

Do I have a **Station Log File** for this GNSS station? e.g.,



```
ftp://ftp.ga.gov.au/geode x
ftp://ftp.ga.gov.au/geodesy-outgoing/gnss/logs/00na_20110112.lo
GA Intranet ARGN Status The Age - Business, ... JobOffice by nga.ne...

00NA Site Information Form (site log)
International GPS Service
See Instructions at:
ftp://igscb.jpl.nasa.gov/pub/station/general/sitelog_instr.txt

0. Form

Prepared by (full name) : Michael Moore
Date Prepared          : 2011-01-12
Report Type           : UPDATE
If Update:
  Previous Site Log    :
  Modified/Added Sections :

1. Site Identification of the GNSS Monument

Site Name              : Darwin Supreme Court
Four Character ID      : 00NA
Monument Inscription   :
IERS DOMES Number     : 59975M001
CDF Number             : n/a
Monument Description   : ROOF
  Height of the Monument : (m)
Monument Foundation   : ROOF
  Foundation Depth      : (m)
```

```
ftp://ftp.ga.gov.au/geode x
ftp://ftp.ga.gov.au/geodesy-outgoing/gnss/logs/00na_20110112.lo
GA Intranet ARGN Status The Age - Business, ... JobOffice by nga.ne...

3. GNSS Receiver Information

3.1 Receiver Type      : LEICA GRX1200PRO
  Satellite System     : GPS+GLO
  Serial Number        : 459941
  Firmware Version     : 5.62
  Elevation Cutoff Setting : 0
  Date Installed       : 2008-03-26T00:00Z
  Date Removed         : (CCYY-MM-DDThh:mmZ)
  Temperature Stabiliz. : none
  Additional Information : (multiple lines)

3.x Receiver Type     : (A20, but note the first A5 is used in SINEX)
  Satellite System     : (GPS+GLO+GPS+GLO)
  Serial Number        : (A20, but note the first A5 is used in SINEX)
  Firmware Version     : (A11)
  Elevation Cutoff Setting : (deg)
  Date Installed       : (CCYY-MM-DDThh:mmZ)
  Date Removed         : (CCYY-MM-DDThh:mmZ)
  Temperature Stabiliz. : (none or tolerance in degrees C)
  Additional Information : (multiple lines)

4. GNSS Antenna Information
```

Can I commit to notifying the APREF CB every time the **Station Log File** for this GNSS station changes?



How Do I Contribute CORS data into APREF

Send an email to geodesy@ga.gov.au with the subject heading “Proposed APREF CORS”, in this email include:

- the proposed 4-character site
- photographs of the proposed site
- a completed site log-file
- a link to some sample data from the site



How to participate in APREF: Analysis

APREF Analysis standards

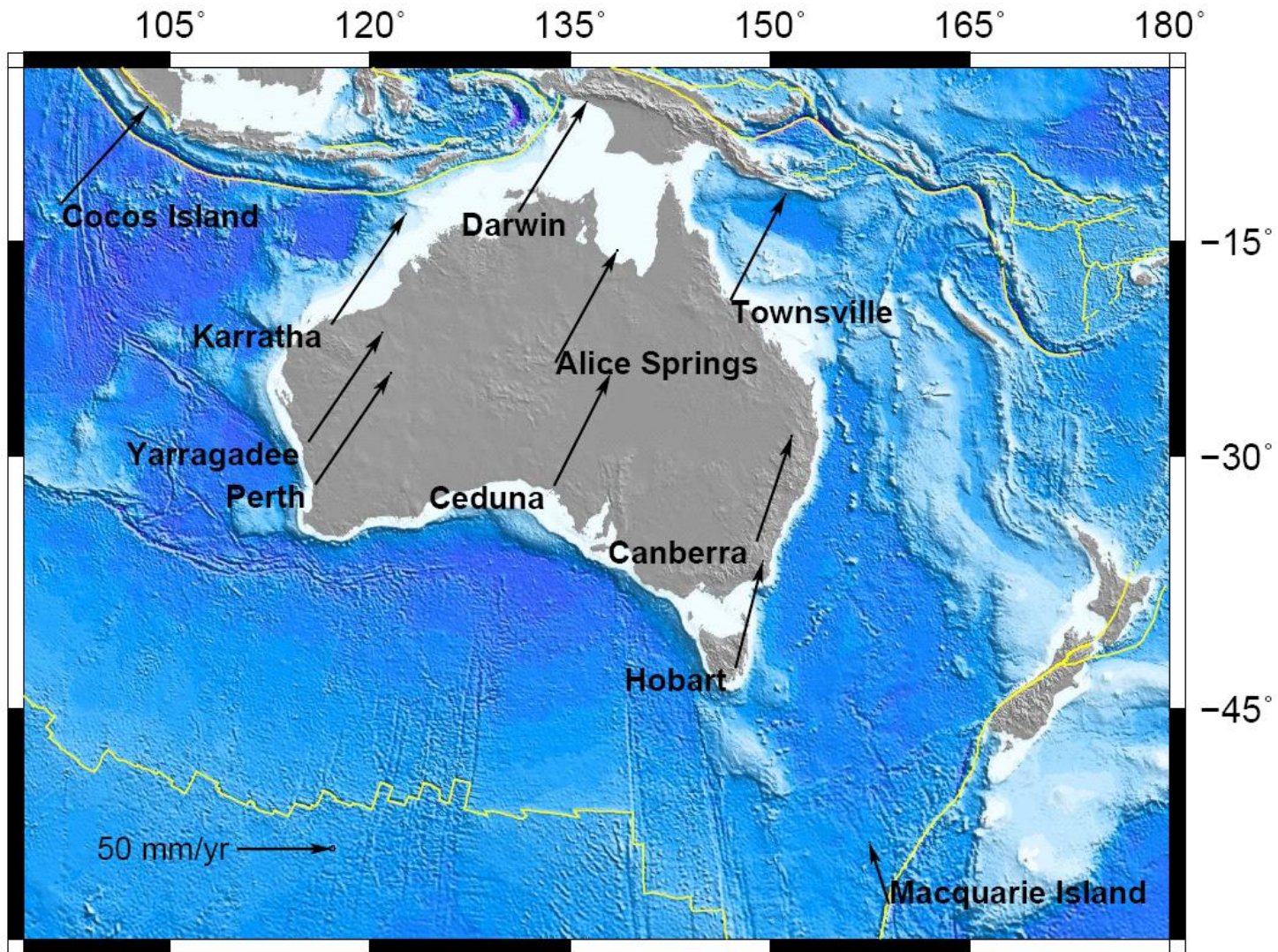
- use scientific software packages (e.g., Bernese, GAMIT, GIPSY)
- conforms to the IERS 2010 conventions
- contributed solutions in the SINEX format

Linking ITRF/APREF to national datum

→ Example: Australia

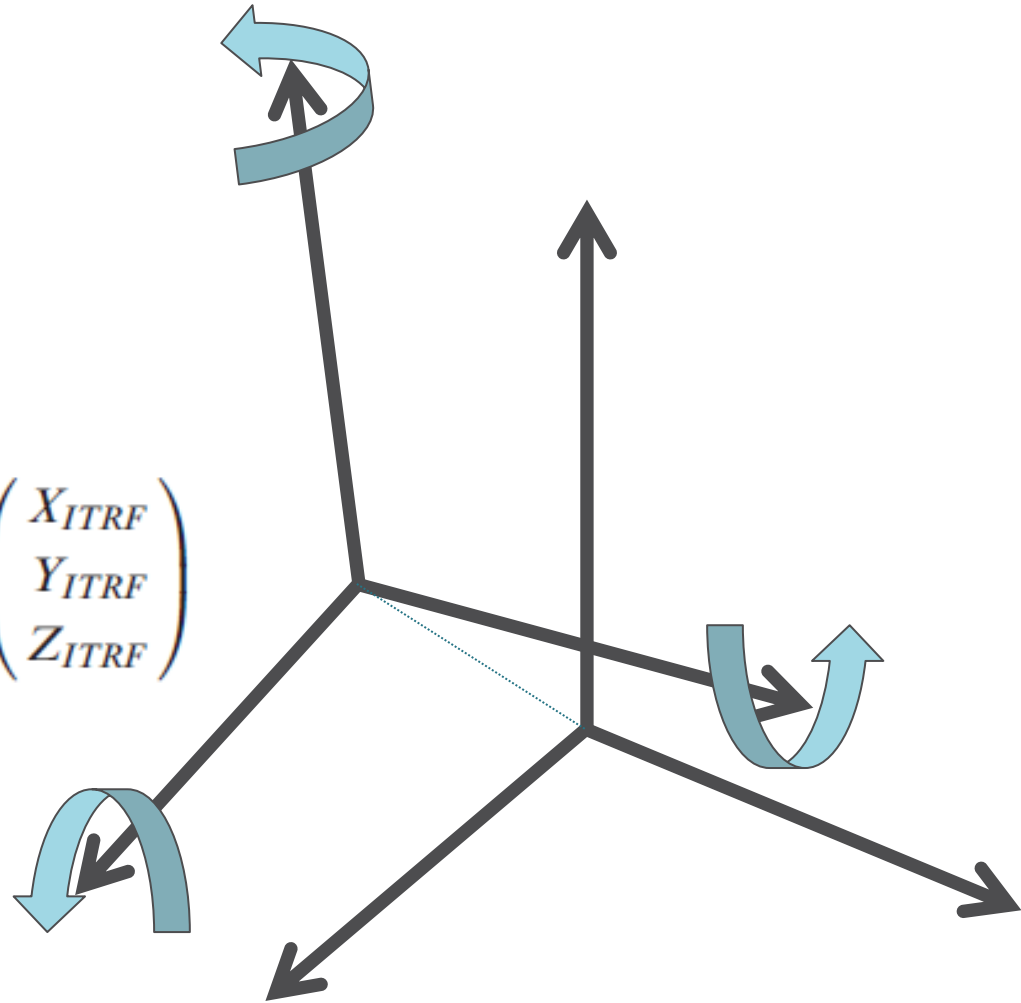


Geocentric Datum of Australia



Seven Parameter Transformation: ITRF → GDA94

$$\begin{pmatrix} X_{GDA94} \\ Y_{GDA94} \\ Z_{GDA94} \end{pmatrix} = \begin{pmatrix} T_x \\ T_y \\ T_z \end{pmatrix} + (1 + S_c) \begin{pmatrix} 1 & R_z & -R_y \\ -R_z & 1 & R_x \\ R_y & -R_x & 1 \end{pmatrix} \begin{pmatrix} X_{ITRF} \\ Y_{ITRF} \\ Z_{ITRF} \end{pmatrix}$$



Fourteen Parameter Transformation: ITRF→GDA94

$$\begin{pmatrix} X_{GDA94} \\ Y_{GDA94} \\ Z_{GDA94} \end{pmatrix} = \mathbf{T} \begin{pmatrix} X_{ITRF} \\ Y_{ITRF} \\ Z_{ITRF} \end{pmatrix} = \begin{pmatrix} t_x + \dot{t}_x(t - t_0) \\ t_y + \dot{t}_y(t - t_0) \\ t_z + \dot{t}_z(t - t_0) \end{pmatrix} + (1 + s_c + \dot{s}_c(t - t_0))$$
$$\begin{pmatrix} 1 & r_z + \dot{r}_z(t - t_0) & -r_y - \dot{r}_y(t - t_0) \\ -r_z - \dot{r}_z(t - t_0) & 1 & r_x + \dot{r}_x(t - t_0) \\ r_y + \dot{r}_y(t - t_0) & -r_x - \dot{r}_x(t - t_0) & 1 \end{pmatrix} \begin{pmatrix} X_{ITRF} \\ Y_{ITRF} \\ Z_{ITRF} \end{pmatrix}$$

Fourteen Parameter Transformation: ITRF→GDA94

	t_x, \dot{t}_x	t_y, \dot{t}_y	t_z, \dot{t}_z	s_c, \dot{s}_c	r_x, \dot{r}_x	r_y, \dot{r}_y	r_z, \dot{r}_z
<i>From ITRF2008 to GDA94</i>							
	-84.68	-19.42	32.01	9.710	-0.4254	2.2578	2.4015
±	0.91	0.78	1.06	0.126	0.0221	0.0236	0.0194
Rates	1.42	1.34	0.90	0.109	1.5461	1.1820	1.1551
±	0.08	0.07	0.11	0.013	0.0028	0.0030	0.0023
<i>From ITRF2005 to GDA94</i>							
	-79.73	-6.86	38.03	6.636	-0.0351	2.1211	2.1411
±	2.56	1.87	3.37	0.227	0.0883	0.0972	0.0600
Rates	2.25	-0.62	-0.56	0.294	1.4707	1.1443	1.1701
±	0.28	0.20	0.36	0.022	0.0096	0.0106	0.0070

Current differences between ITRF and GDA is approximately 1.4 metres

These transformation parameter can model that difference with an uncertainty of 1 to 2 cm.

Fourteen Parameter Transformation: ITRF→GDA94

Journal of Applied Geodesy 4 (2010), 189–199 © de Gruyter 2010. DOI 10.1515/JAG.2010.019

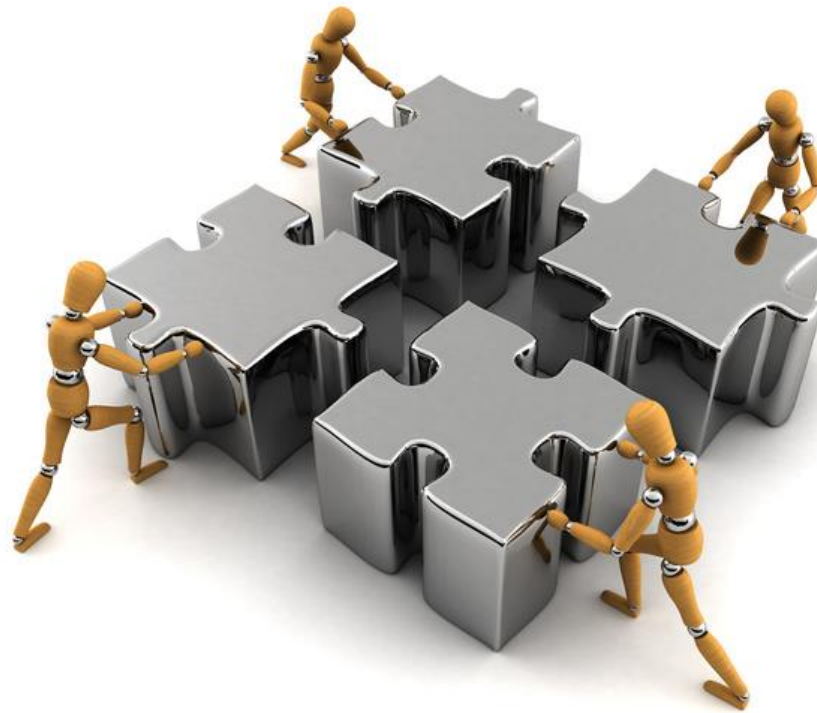
ITRF to GDA94 coordinate transformations

John Dawson and Alex Woods

<http://www.ga.gov.au/earth-monitoring/geodesy.html>

APREF and AUSPOS

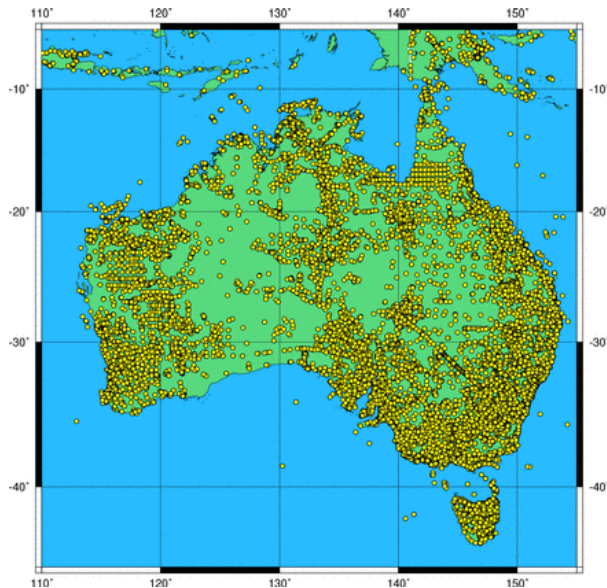
→ Improving online positioning



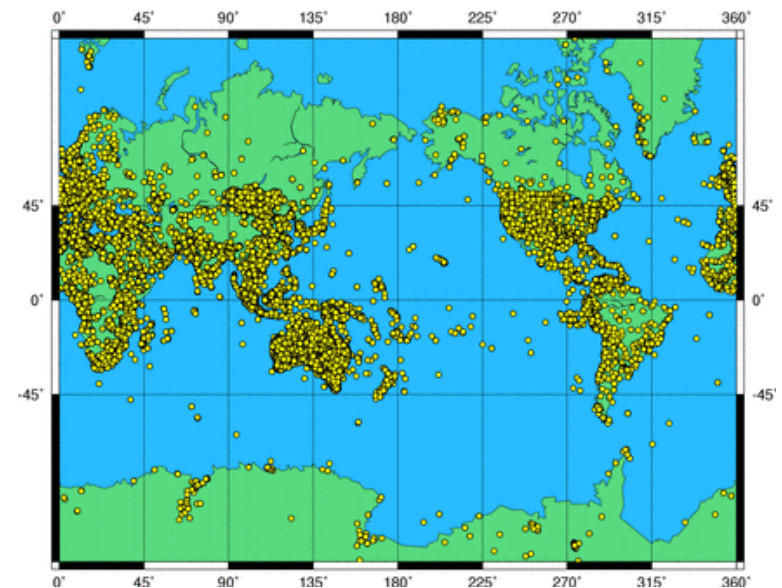
AUSPOS History

- First version of AUSPOS was developed in 2001
- 200,000 data files processed
- Since 2011 all APREF stations have been used in AUSPOS

Australia users



World users



Requirements

Dual frequency code and phase observations (L1 and L2)

1 hour → 1 week static GPS data

Users need to wait several hours for data submission after data collection, it's better after the end of UTC day so that reference sites data is available

For more details see:

<http://www.ga.gov.au/earth-monitoring/geodesy/auspos-online-gps-processing-service.html>

Requirements

AUSPOS - Online GPS Processing Service

- AUSPOS is a free online GPS data processing facility provided by Geoscience Australia
- AUSPOS takes advantage of both [The IGS Stations Network](#) and the IGS product range
- AUSPOS works with data collected anywhere on Earth
- Users submit their dual frequency geodetic quality GPS RINEX data observed in a 'static' mode to the GPS data processing system
- An AUSPOS report will be emailed to you (often in less than 5 mins) containing [Geocentric Datum of Australia 1994 \(GDA94\)](#) and [Internat](#)

AUSPOS Submission Checklist

Before submitting your GPS RINEX file/s, please ensure:

1. The GPS RINEX file/s contains more than one hour (preferably two) of GPS data
2. The GPS RINEX file/s do not contain any data from the current UT day
3. The GPS RINEX file/s do not contain more than seven days of data
4. The GPS RINEX file/s names do not contain spaces
5. When submitting multiple files, ensure the first four characters / numbers of the file names are not the same
6. You have used the IGS naming convention for the antenna type (refer the National Geodetic Survey (NGS) for more information)
7. The antenna height provided is the vertical distance from the ground mark to the Antenna Reference Point (ARP)

[Submit your data to AUSPOS](#)

AUSPOS FAQ's

- [AUSPOS - Step by Step](#)
- [Section 1 - Introduction to AUSPOS](#)
- [Section 2 - RINEX Data](#)
- [Section 3 - How AUSPOS Works](#)
- [Section 4 - Understanding the Results](#)
- [Section 5 - GPS Antennas](#)
- [Section 6 - Trouble Shooting](#)

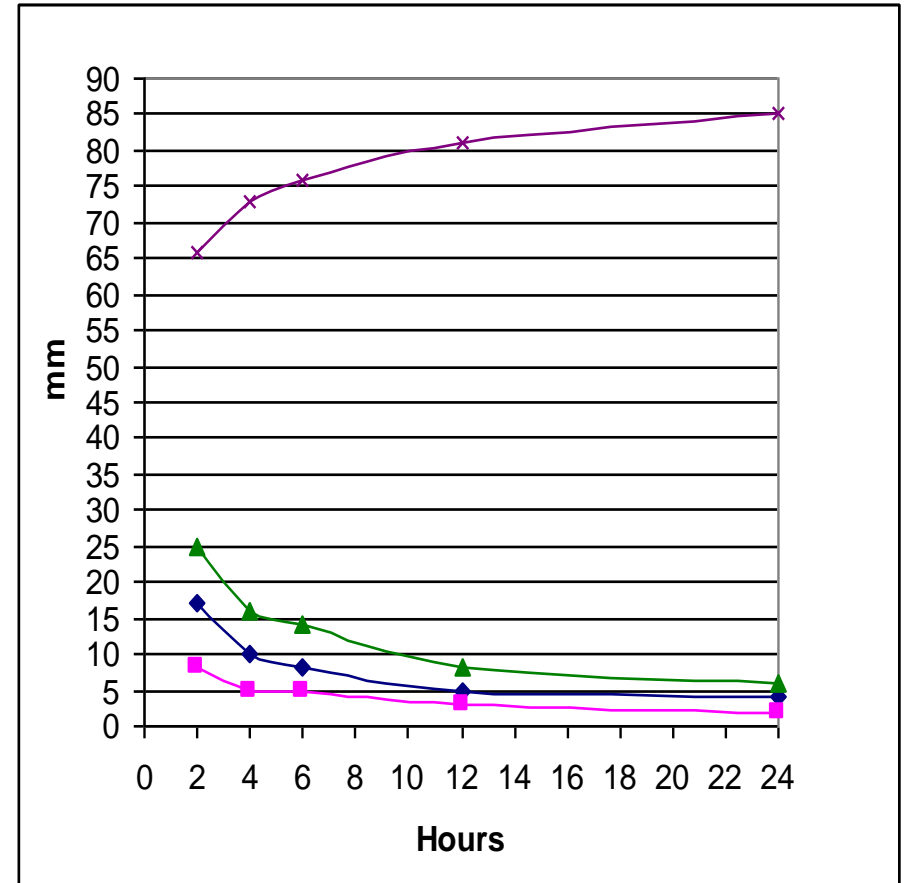
Limitations

AUSPOS cannot process:

- Single frequency data
- Real time and near real time data
- Kinematic data

Assessment of solution uncertainty

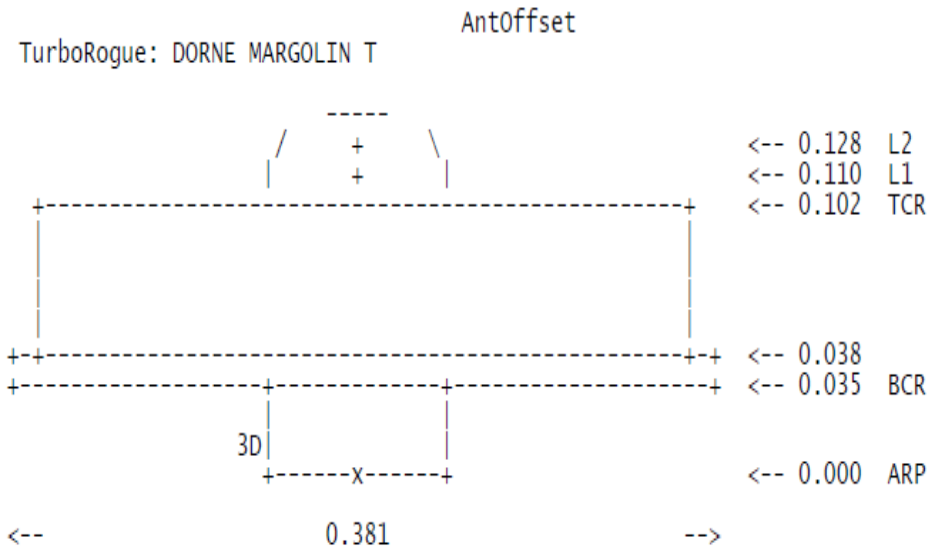
- averaged uncertainties
 - ✓ 2 - 8 mm East
 - ✓ 4 – 17 mm North
 - ✓ 6 - 25 mm Up
- ambiguity resolutions
 - ✓ 66% - 85% vary from 2 hours to 24 hours data
- For Australian users uncertainties and ambiguity resolutions should be much better as more dense reference sites available.



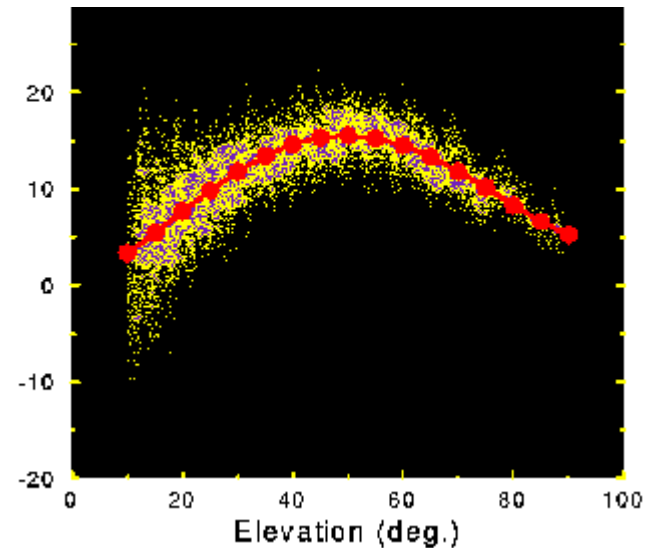
Things for AUSPOS Users

- Ensure data collection in a good environment
- Convert collected raw data into correct RINEX observation data (currently RINEX version 2.11)
- Provide a correct antenna height
- Select a correct antenna and dome type

Antenna and dome type



ARP: Antenna Reference Point BPA: Bottom of Preamplifier



Data submission



- ↑ Topic Home
- Astronomical Information
- Geodesy and Global Navigation Systems
 - Basics
 - Geodetic Techniques
 - Global Navigation Satellite System Networks
 - Geodetic Datums
 - Regulation 13 Certificates
 - Asia-Pacific Reference Frame
 - **AUSPOS - Online GPS Processing Service**
 - Step by Step
 - Introduction
 - RINEX Data
 - How it works
 - Understanding the Results
 - GPS Antennas
 - Trouble Shooting
 - Geomagnetism
 - Geophysical Network
 - Governance

Home > Earth Monitoring and Reference Systems > Geodesy and Global Navigation Systems > AUSPOS - Online GPS Processing >

Number of RINEX files: 20 Submit RINEX using: upload ftp

File Name	Height (m)	Antenna Type
H:\alic0500.13d.Z <input type="button" value="Browse..."/>	0.0015	LEIAR25.R3 NONE
H:\oedu0500.13d.zip <input type="button" value="Browse..."/>	0.0060	AOAD/M_T AUST
H:\tow20500.13o <input type="button" value="Browse..."/>	0.0033	LEIAR25.R3 NONE
H:\yar20500.13d.gz <input type="button" value="Browse..."/>	0.0814	AOAD/M_T JPLA
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)
<input type="button" value="Browse..."/>	0.0000	ACC123CGNSSA_XN NONE
<input type="button" value="Browse..."/>	0.0000	ACC2G1215A_XT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACC3G1215A_XT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACC4G1215A_XT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACC4G1215A_XT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACC5G1215A_XT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACC5G01215A_XT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACC72CGNSSA NONE
<input type="button" value="Browse..."/>	0.0000	ACC72GNSSA_XT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACCG3ANT_3AT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACCG3ANT_42AT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACCG3ANT_52AT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACCG5ANT_123CAN NONE
<input type="button" value="Browse..."/>	0.0000	ACCG5ANT_2AT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACCG5ANT_3AT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACCG5ANT_42AT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACC_G5ANT_52AT1 NONE
<input type="button" value="Browse..."/>	0.0000	ACC_G5ANT_72AT1 NONE
<input type="button" value="Browse..."/>	0.0000	AERAT1675_120 NONE
<input type="button" value="Browse..."/>	0.0000	DEFAULT(NONE)

Your Email Address:

- Submit your RINEX 2.11 observation data (eg. alic2550.13o)
- Select correct antenna and dome types for your data sets
- DEFAULT (NONE NONE) types can cause a more than 10 cm error in the height component.
- No any space and () for your file name and path.

Successful submission

AUSPOS Online GPS Processing Service



Dear minghai.jia@ga.gov.au,

Thank you for submitting a GPS processing job to the AUSPOS Online GPS Processing Service.

Your job reference is #21328. The following RINEX file(s) have been submitted for processing (#File, Filename, Antenna Type, Height) :

1. alic0500.13d.Z LEIAR25.R3 NONE 0.0015 m
2. cedu0500.13d AOAD/M_T AUST 0.0060 m
3. tow20500.13o LEIAR25.R3 NONE 0.0033 m
4. yar20500.13d.gz AOAD/M_T JPLA 0.0000 m

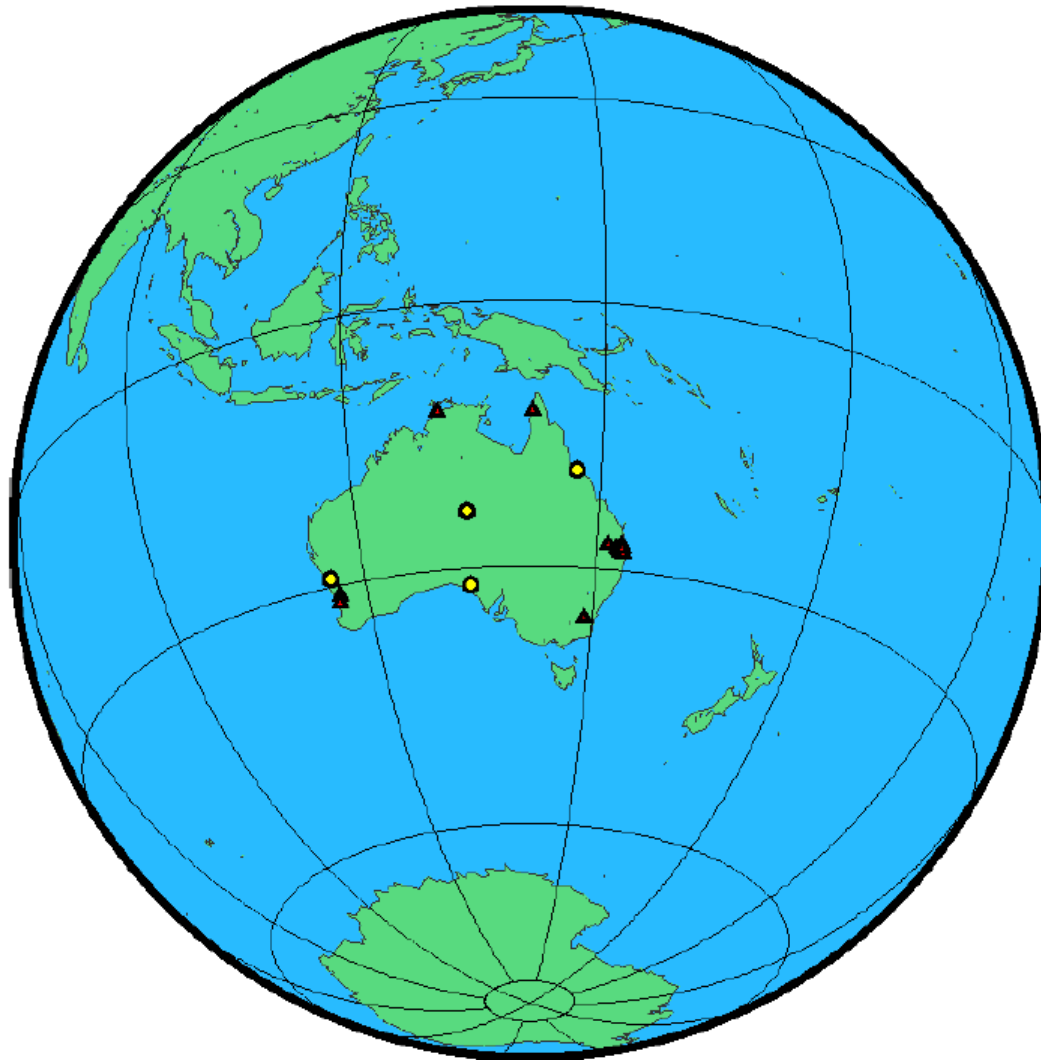
Your job has just been submitted to the AUSPOS GPS processing server.

Thank you for using the AUSPOS service.

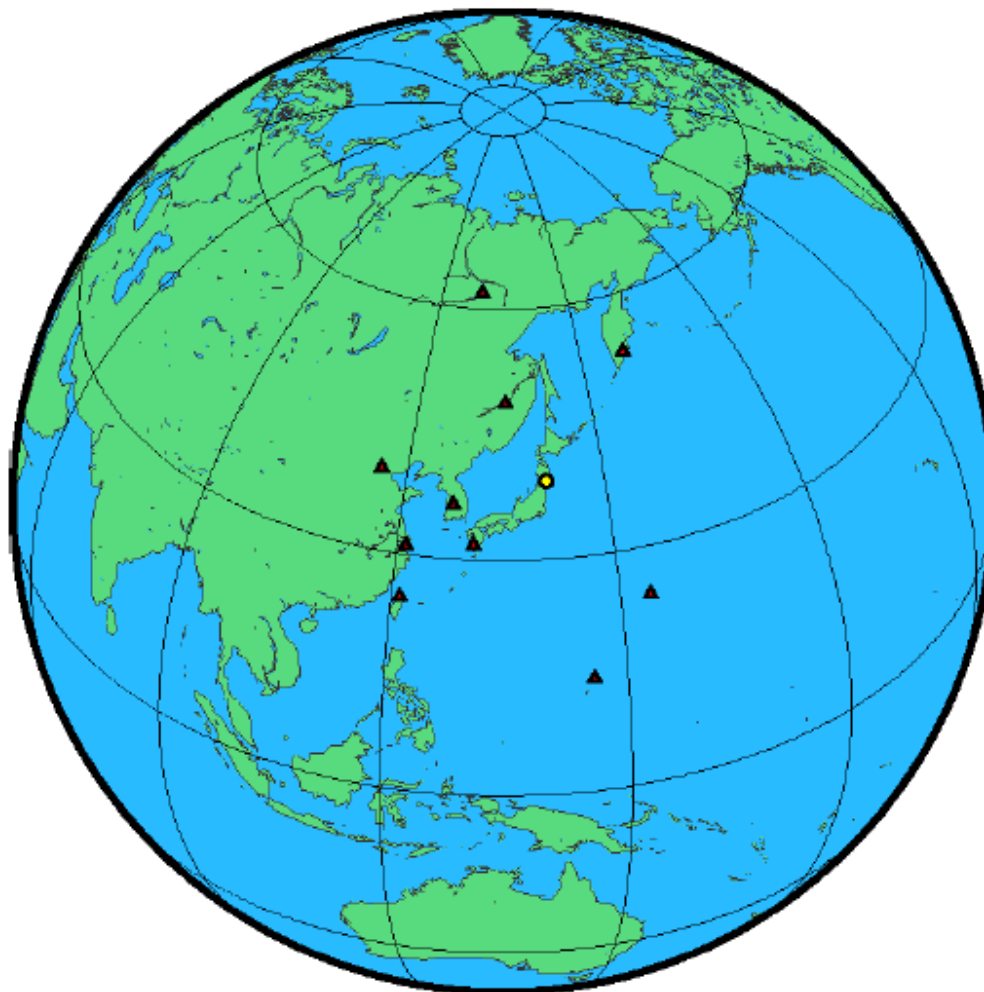
Solution report

- After data is processed successfully, AUSPOS will email a solution report to the user
- Or email an error message to the user if something is wrong

An example for Australian users



An example for international users



Report details for Australian users (1/3)

3.1 Cartesian, GDA94

Station	X (m)	Y (m)	Z (m)
ALIC	-4052051.768	4212836.198	-2545106.024
CEDU	-3753472.143	3912741.041	-3347961.041
TOW2	-5054582.657	3275504.557	-2091539.881
YAR2	-2389025.441	5043316.989	-3078530.939
BDST	-5021920.617	2559339.869	-2975290.670
CBLT	-5061144.441	2584178.828	-2886586.876
CLEV	-5055209.002	2546205.939	-2930072.265
DALB	-4979266.859	2730160.232	-2895220.925
DWNI	-4083214.808	4704504.479	-1365350.766
GATT	-5012218.434	2628002.742	-2931853.189
IPS2	-5028440.656	2588779.893	-2938802.552
NNOR	-2414151.166	4907778.465	-3270645.525
PERT	-2368686.822	4881316.513	-3341796.290
ROBI	-5034843.822	2523322.876	-2984064.622
TIDB	-4460996.067	2682557.134	-3674443.866
WEIP	-4899027.809	3838505.163	-1390728.000
WOOL	-5046788.342	2567555.320	-2926034.801

Report details for Australian users (2/3)

3.2 Geodetic, GRS80 Ellipsoid, GDA94

Station	Latitude (DMS)			Longitude (DMS)			Ellipsoidal Height(m)	Derived AHD (m)
ALIC	-23	40	12.44601	133	53	07.84803	603.347	587.497
CEDU	-31	52	00.01671	133	48	35.37571	144.819	153.613
TOW2	-19	16	09.42804	147	03	20.46546	88.207	29.453
YAR2	-29	02	47.61684	115	20	49.09991	241.454	266.623
BDST	-27	59	13.56951	152	59	42.27831	101.1023	60.709
CBLT	-27	05	03.97248	152	57	05.45891	83.9419	40.970
CLEV	-27	31	34.17666	153	15	59.52280	67.0083	25.404
DALB	-27	10	13.97540	151	15	49.65037	394.6917	352.658
DWNI	-12	26	35.92078	130	57	21.35177	87.8118	35.529
GATT	-27	32	38.17787	152	19	51.99975	140.5887	98.694
IPS2	-27	36	53.76282	152	45	33.62954	88.6520	47.156

Report details for Australian users (3/3)

3.3 MGA Grid, GRS80 Ellipsoid, GDA94

Station	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Derived AHD (m)
ALIC	386352.403	7381850.769	53	603.347	587.497
CEDU	387415.776	6473725.238	53	144.819	153.613
TOW2	505851.333	7869375.321	55	88.207	29.453
YAR2	339055.521	6785728.466	50	241.454	266.623
BDST	499515.931	6904226.325	56	101.102	60.709
CBLT	495193.285	7004211.623	56	83.942	40.970
CLEV	526320.098	6955257.198	56	67.008	25.404
DALB	327986.948	6993484.346	56	394.692	352.658
DWNI	712604.328	8623642.930	52	87.812	35.529
GATT	433957.480	6953137.979	56	140.589	98.695
IPS2	476254.234	6945429.043	56	88.652	47.156
NNOR	422969.549	6564716.429	50	234.893	262.432
PERT	394476.883	6480972.939	50	12.769	45.083

Report details for global users (1/2)

4.1 Cartesian, ITRF2008

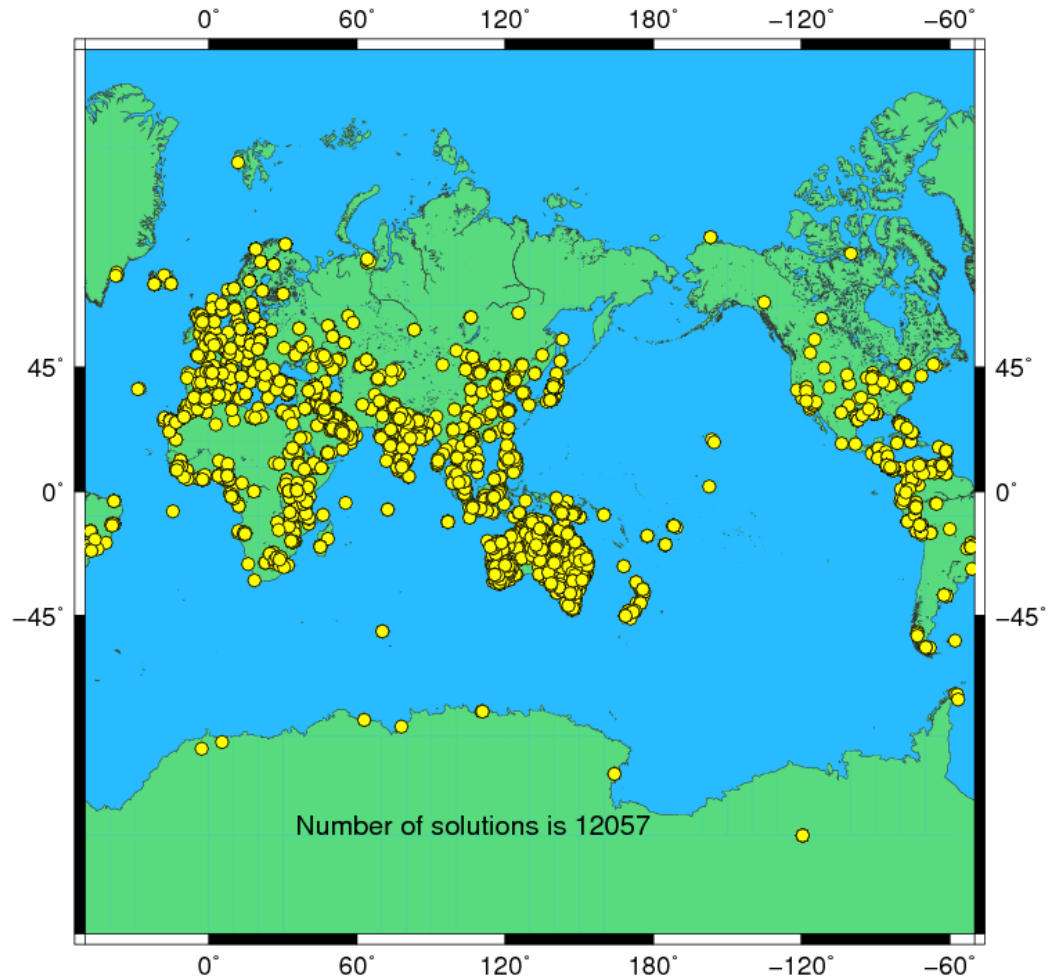
Station	X (m)	Y (m)	Z (m)	ITRF2008 @
ALIC	-4052052.470	4212836.021	-2545104.959	19/02/2013
CEDU	-3753472.910	3912741.016	-3347960.045	19/02/2013
TOW2	-5054583.181	3275504.207	-2091538.833	19/02/2013
YAR2	-2389026.326	5043317.075	-3078529.951	19/02/2013
BDST	-5021921.164	2559339.657	-2975289.717	19/02/2013
CBLT	-5061144.979	2584178.598	-2886585.915	19/02/2013
CLEV	-5055209.541	2546205.717	-2930071.310	19/02/2013
DALB	-4979267.416	2730160.011	-2895219.953	19/02/2013
DWNI	-4083215.426	4704504.125	-1365349.641	19/02/2013
GATT	-5012218.983	2628002.524	-2931852.228	19/02/2013
IPS2	-5028441.202	2588779.675	-2938801.594	19/02/2013
NNOR	-2414152.057	4907778.577	-3270644.550	19/02/2013
PERT	-2368687.720	4881316.640	-3341795.324	19/02/2013

Report details for global users (2/2)

4.2 Geodetic, GRS80 Ellipsoid, ITRF2008

Station	Latitude (DMS)			Longitude (DMS)			Ellipsoidal Height (m)	Derived Above Geoid Height (m)
ALIC	-23	40	12.40962	133	53	07.87023	603.248	588.104
CEDU	-31	51	59.98046	133	48	35.39742	144.728	153.771
TOW2	-19	16	09.39318	147	03	20.48527	88.097	30.162
YAR2	-29	02	47.58158	115	20	49.12811	241.373	267.101
BDST	-27	59	13.53622	152	59	42.29431	100.999	61.006
CBLT	-27	05	03.93915	152	57	05.47522	83.838	41.385
CLEV	-27	31	34.14342	153	15	59.53887	66.905	25.754
DALB	-27	10	13.94165	151	15	49.66713	394.588	353.041
DWNI	-12	26	35.88408	130	57	21.37490	87.704	36.237
GATT	-27	32	38.14439	152	19	52.01609	140.486	99.081
IPS2	-27	36	53.72945	152	45	33.64573	88.549	47.560
NNOR	-31	02	55.43178	116	11	33.79637	234.814	262.811
PERT	-31	48	07.06142	115	53	06.91483	12.690	45.425

2013 AUSPOS Use



Final Remarks

➤ Challenges

- Issues remain regarding free and open access to data for many Asia-Pacific countries
- Need to identify additional analysis centres
 - limited redundancy with only 3 analysis groups
 - redundancy to offer reliable service and products

➤ For more information, APREF Central Bureau

- www.ga.gov.au/earth-monitoring/geodesy/asia-pacific-reference-frame.html
- Email: john.dawson@ga.gov.au

Reference Frame in Practice

Manila, Philippines 21-22 June 2013



Asia Pacific Reference Frame (APREF)

John Dawson and Guorong Hu
National Geospatial Reference Systems
Geoscience Australia

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