



Reference Frame in Practice Workshop 2A

Asia Pacific Reference Frame (APREF)

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Using a ITRF based reference frame is the future! Such as the Asia Pacific Reference Frame - APREF !

Establishment of GNSS-CORS infrastructure is the most cost-effective way to connect to APREF / ITRF

Establishing GNSS CORS infrastructure gives the users the opportunity to use and access traditional and new positioning related applications / services

Source: Lilje / Sarib– SEASC Manila, June 2013

FIG Pacific Small Island Developing States Symposium

Policies and Practices for Responsible Governance



Fiji 18–20 September 2013

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Why APREF / ITRF ?

- Integration of and access to information and data from -
 - GNSS (GPS, Galileo, Compass, ...) inherently work in the ITRF
 - Precise positioning service providers inherently work in the ITRF
 - High resolution imagery is collected with respect the ITRF
 - LiDAR is collected with respect the ITRF

Source: Lilje / Sarib– SEASC Manila, June 2013

FIG Pacific Small Island Developing States Symposium

Policies and Practices for Responsible Governance



Fiji 18–20 September 2013

CC-BY 2.0, photo by Matt Wright

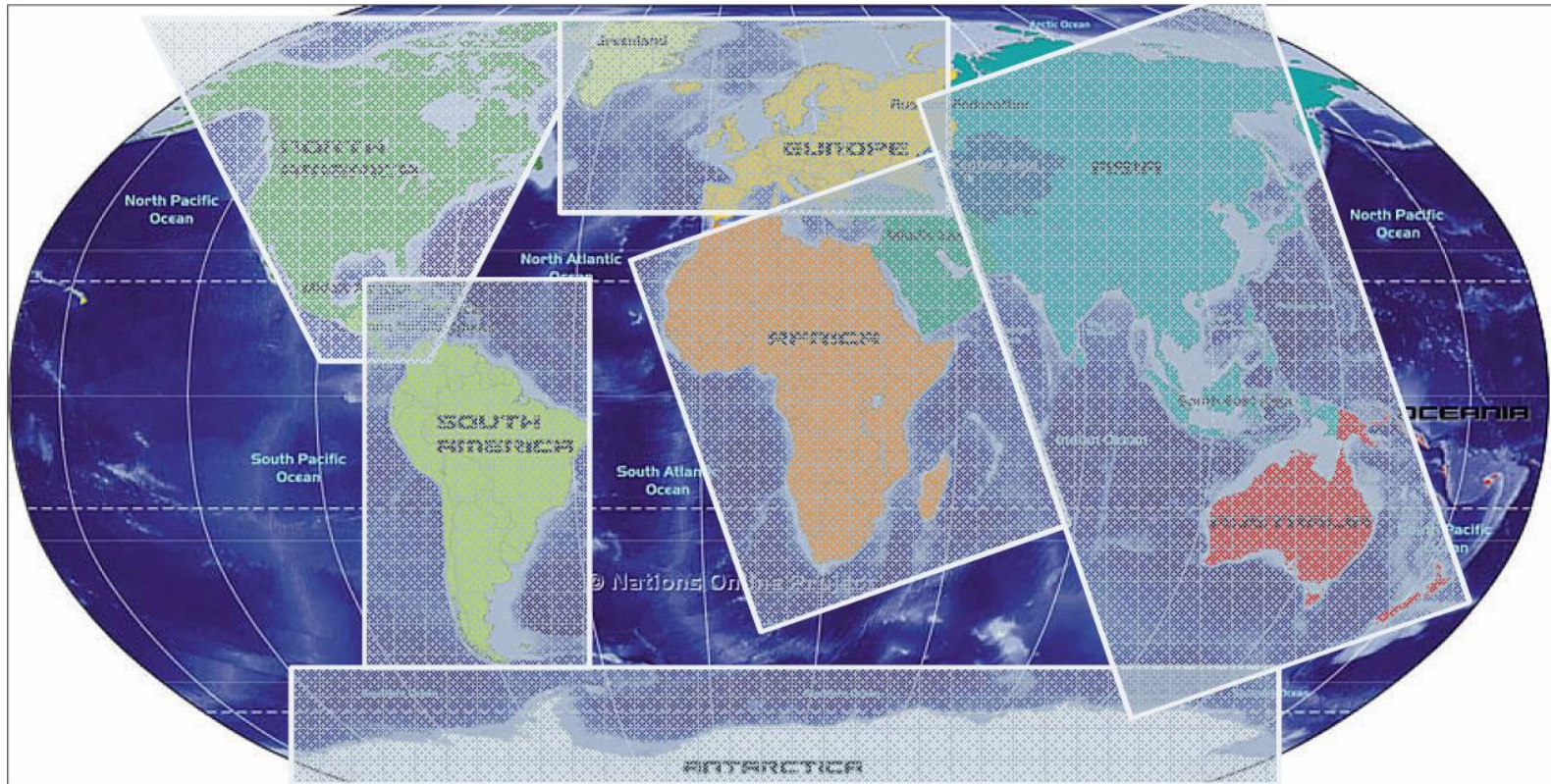
Why APREF / ITRF ?

- allows for a single standard for collecting, storing and using geospatial information / data.
- will ensure compatibility across various geographic, land and survey systems at the local, regional, national and global level.
- is becoming the reference layer for the cadastre or land administration system, transit / road networks, infrastructure corridors like gas, water, power, communications etc.

Source: Schwieger / Lilje / Sarib– FIG Hanoi, Oct 2009

Regional Reference Frame Densification

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



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

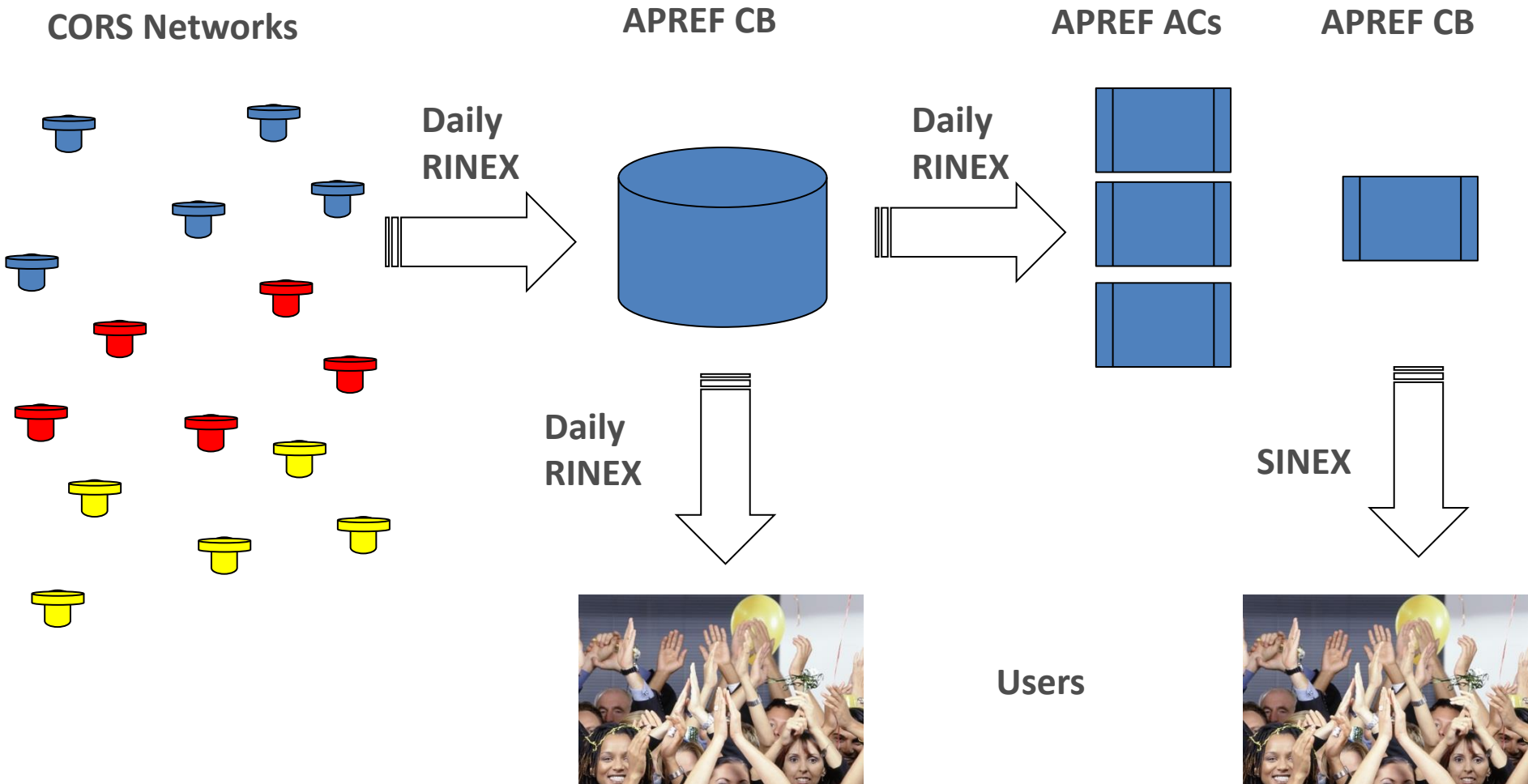
**Annual APRGP
GNSS Campaigns**



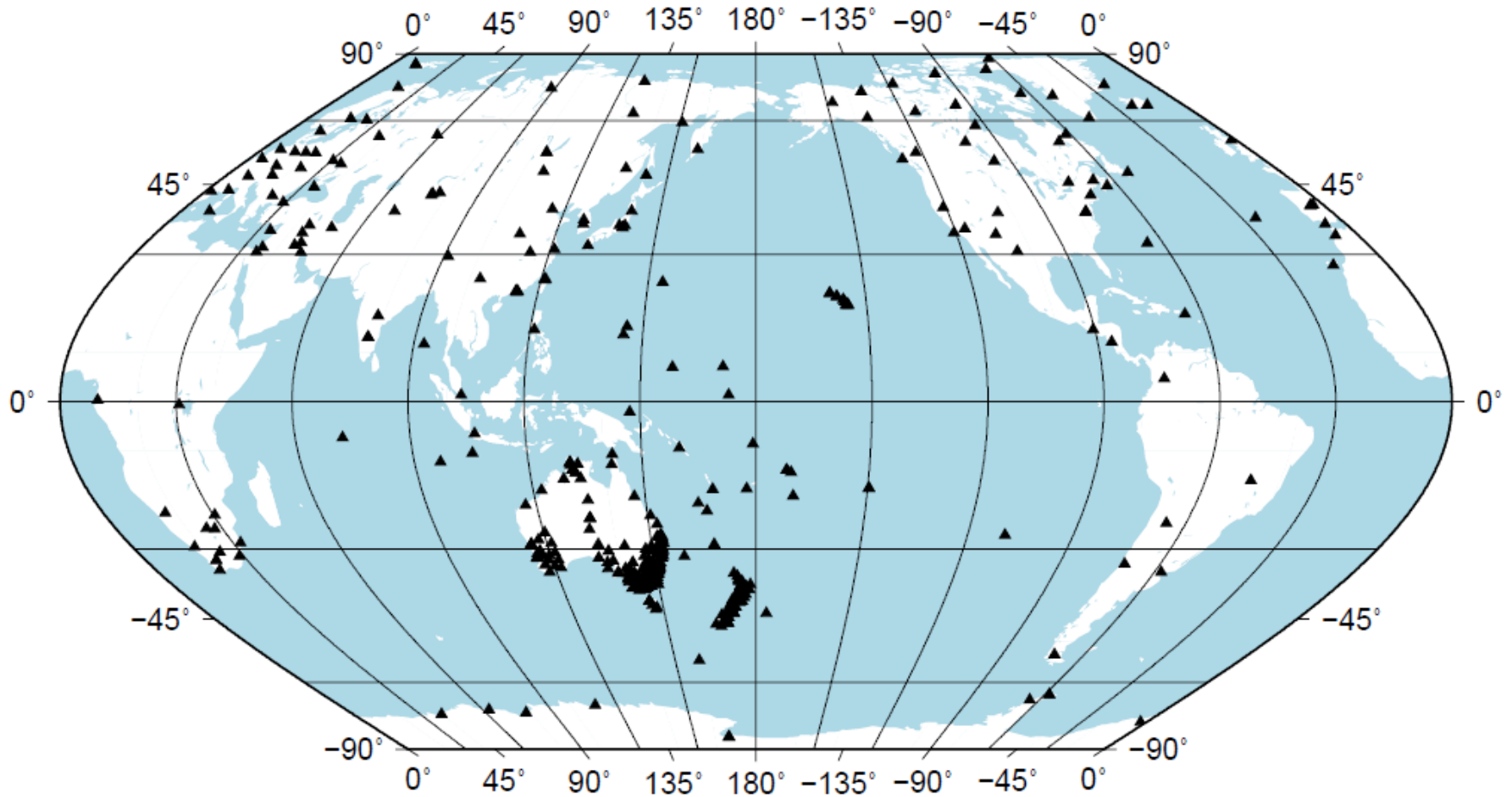
**Asia Pacific Reference
Frame (APREF)**

- 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

Asia Pacific Reference Frame Data Flow



APREF status as of June 2013



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

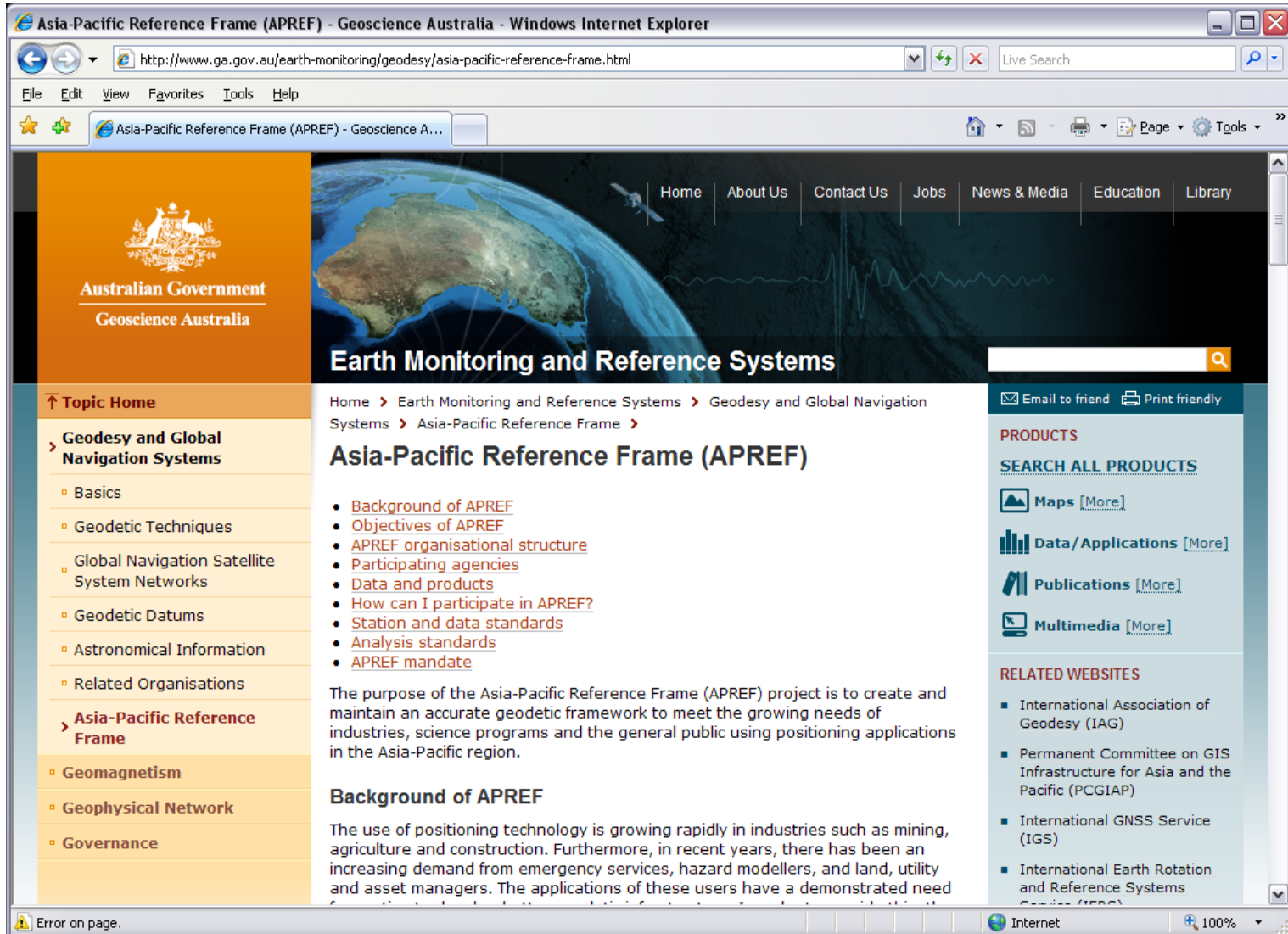
GA weekly solution

- 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 a Windows Internet Explorer browser window displaying the APREF website. The address bar shows the URL: <http://www.ga.gov.au/earth-monitoring/geodesy/asia-pacific-reference-frame.html>. The page features 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. A left sidebar lists navigation topics such as "Geodesy and Global Navigation Systems" and "Asia-Pacific Reference Frame". The main text area contains a list of links for "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". Below this list is a paragraph describing the purpose of the APREF project. A right sidebar contains sections for "PRODUCTS" (with links for Maps, Data/Applications, Publications, and Multimedia) and "RELATED WEBSITES" (listing organizations like IAG, PCGIAP, IGS, and IERS).

Asia-Pacific Reference Frame (APREF) - Geoscience Australia - Windows Internet Explorer

[http://www.ga.gov.au/earth-monitoring/geodesy/asia-pacific-reference-frame.html](#)

File Edit View Favorites Tools Help

Asia-Pacific Reference Frame (APREF) - Geoscience A...

Home About Us Contact Us Jobs News & Media Education Library

Australian Government
Geoscience Australia

Earth Monitoring and Reference Systems

Topic Home

- Geodesy and Global Navigation Systems
 - Basics
 - Geodetic Techniques
 - Global Navigation Satellite System Networks
 - Geodetic Datums
 - Astronomical Information
 - Related Organisations
 - Asia-Pacific Reference Frame**
 - Geomagnetism
 - Geophysical Network
 - Governance

Home > Earth Monitoring and Reference Systems > Geodesy and Global Navigation Systems > Asia-Pacific Reference Frame >

Asia-Pacific Reference Frame (APREF)

- [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](#)
- [APREF mandate](#)

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.

Background of APREF

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

Email to friend Print friendly

PRODUCTS

[SEARCH ALL PRODUCTS](#)

- [Maps \[More\]](#)
- [Data/Applications \[More\]](#)
- [Publications \[More\]](#)
- [Multimedia \[More\]](#)

RELATED WEBSITES

- International Association of Geodesy (IAG)
- Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP)
- International GNSS Service (IGS)
- International Earth Rotation and Reference Systems Service (IERS)

Error on page.

Internet 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.

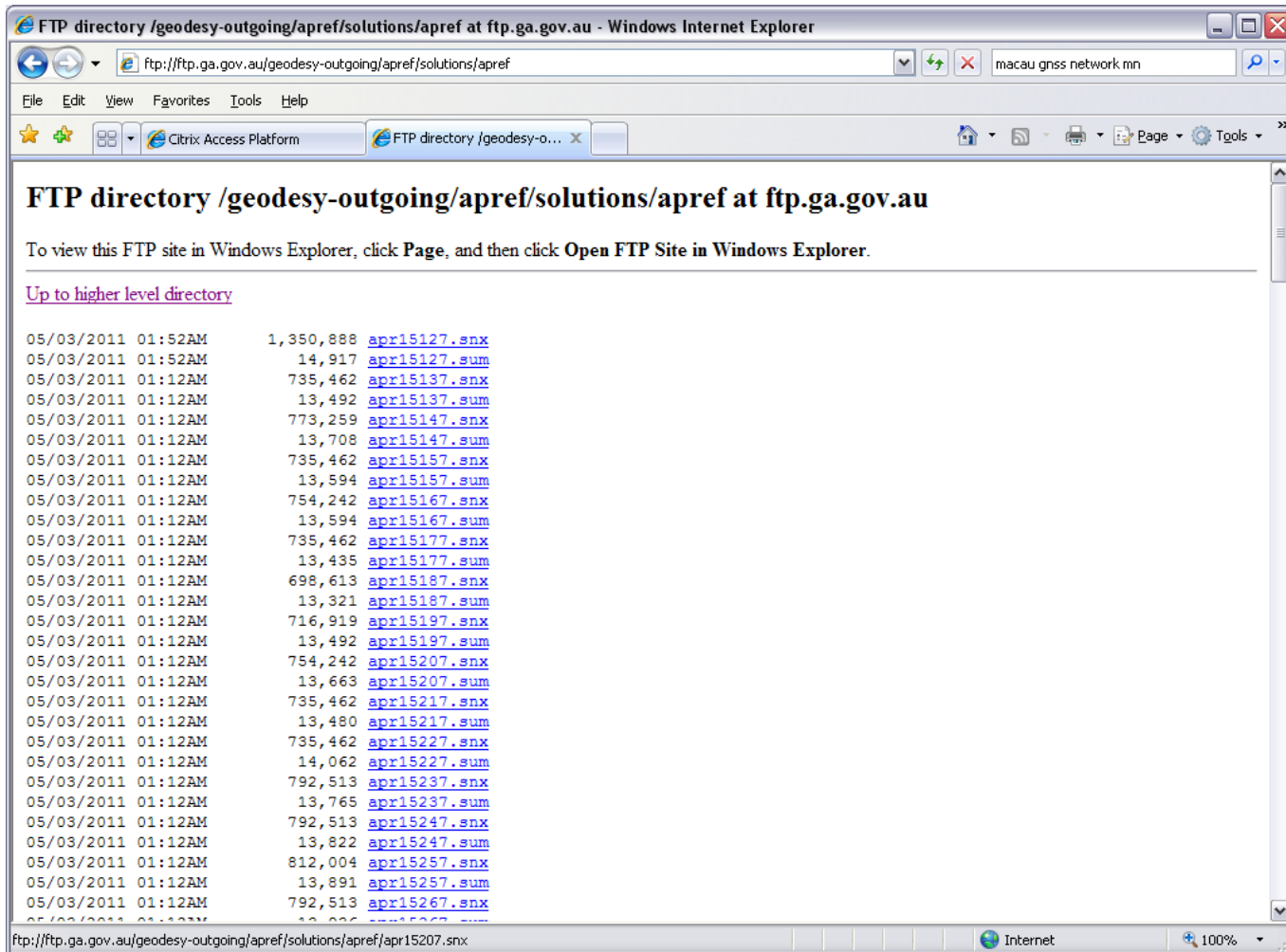
- Daily GNSS RINEX data with a delay of 24 hr after observation, see:

<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)



The screenshot shows a Windows Internet Explorer browser window displaying an FTP directory listing. The address bar shows the URL: ftp://ftp.ga.gov.au/geodesy-outgoing/apref/solutions/apref. The page title is "FTP directory /geodesy-outgoing/apref/solutions/apref at ftp.ga.gov.au". Below the title, there is a message: "To view this FTP site in Windows Explorer, click Page, and then click Open FTP Site in Windows Explorer." A link "Up to higher level directory" is provided. The main content is a list of files and directories, each with a date, time, size, and filename. The files are organized into a grid-like structure with columns for date, time, size, and filename. The filenames are hyperlinks to the respective files.

Date	Time	Size	Filename
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

Weekly Station Coordinate and Performance

Weekly station coordinates

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

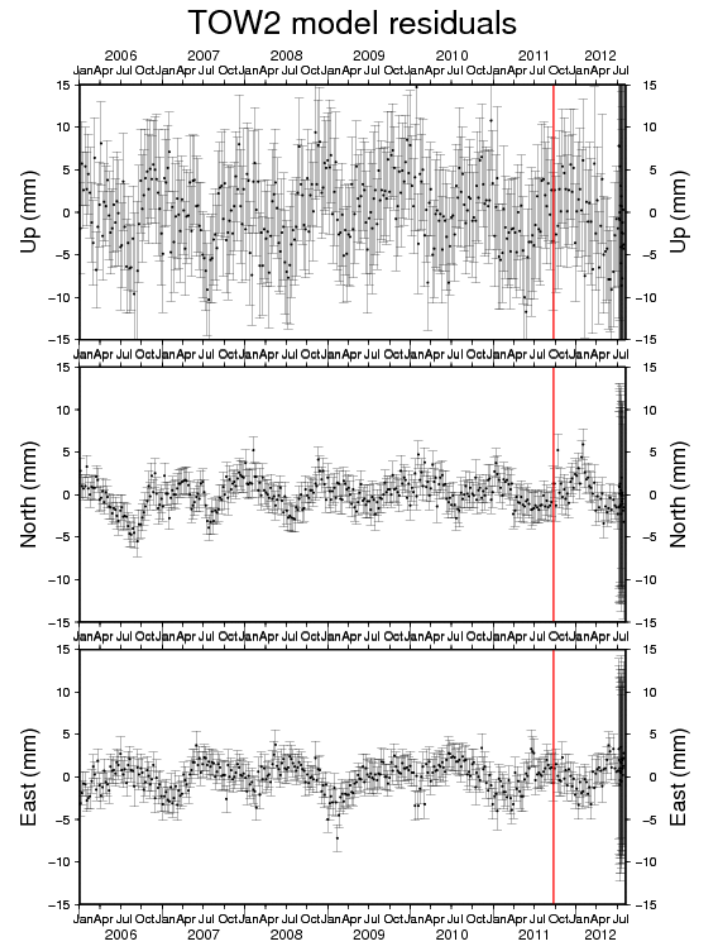
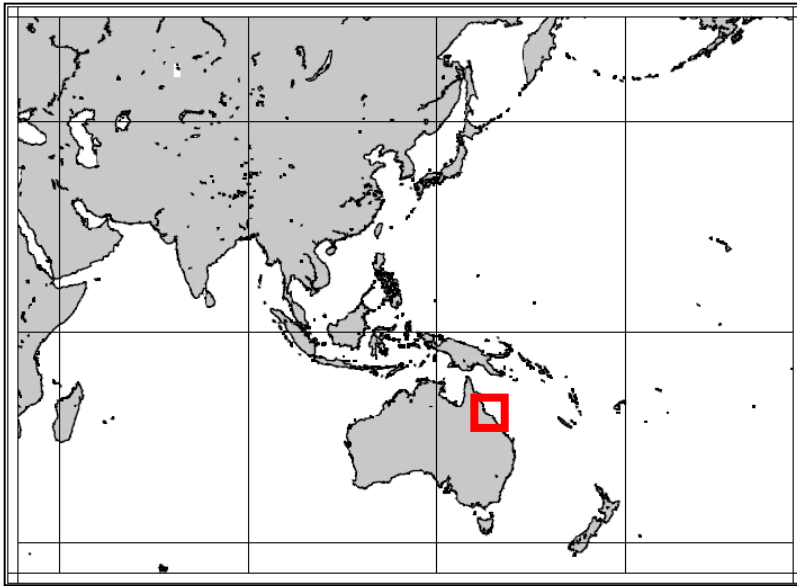
00NA	59975M001	-4073662.2922	4712064.7447	-1367874.4683
01NA	59974M001	-4084823.4609	4702026.6604	-1369125.8453
02NA	59973M001	-4078496.4549	4711380.1330	-1355915.1332
20NA	59972M001	-4050985.3396	4212133.7934	-2547954.8094
21NA	AUM000184	-4048578.9364	4210151.5056	-2554917.6069
ADEL	AUM000008	-3926936.9094	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	XXXXX	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



How Do I Contribute CORS data into APREF

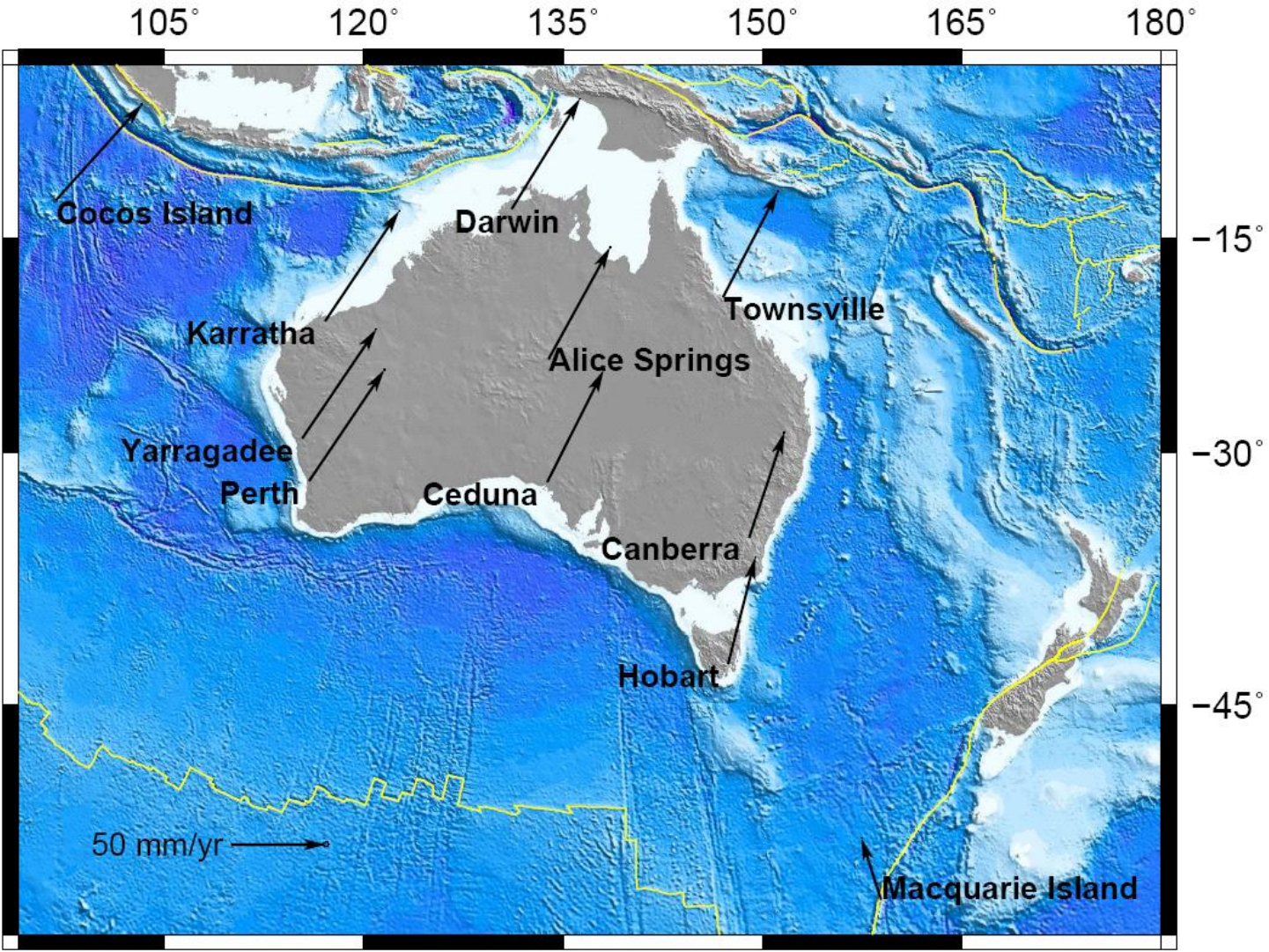
- Send an email to geodesy@ga.gov.au with the subject heading “Proposed APREF CORS”, in this email include:
 - the proposed 4-character site
 - photographs of the proposed site
 - a completed site log-file
 - a link to some sample data from the site



- Linking ITRF/APREF to national datum
- → Example: Australia

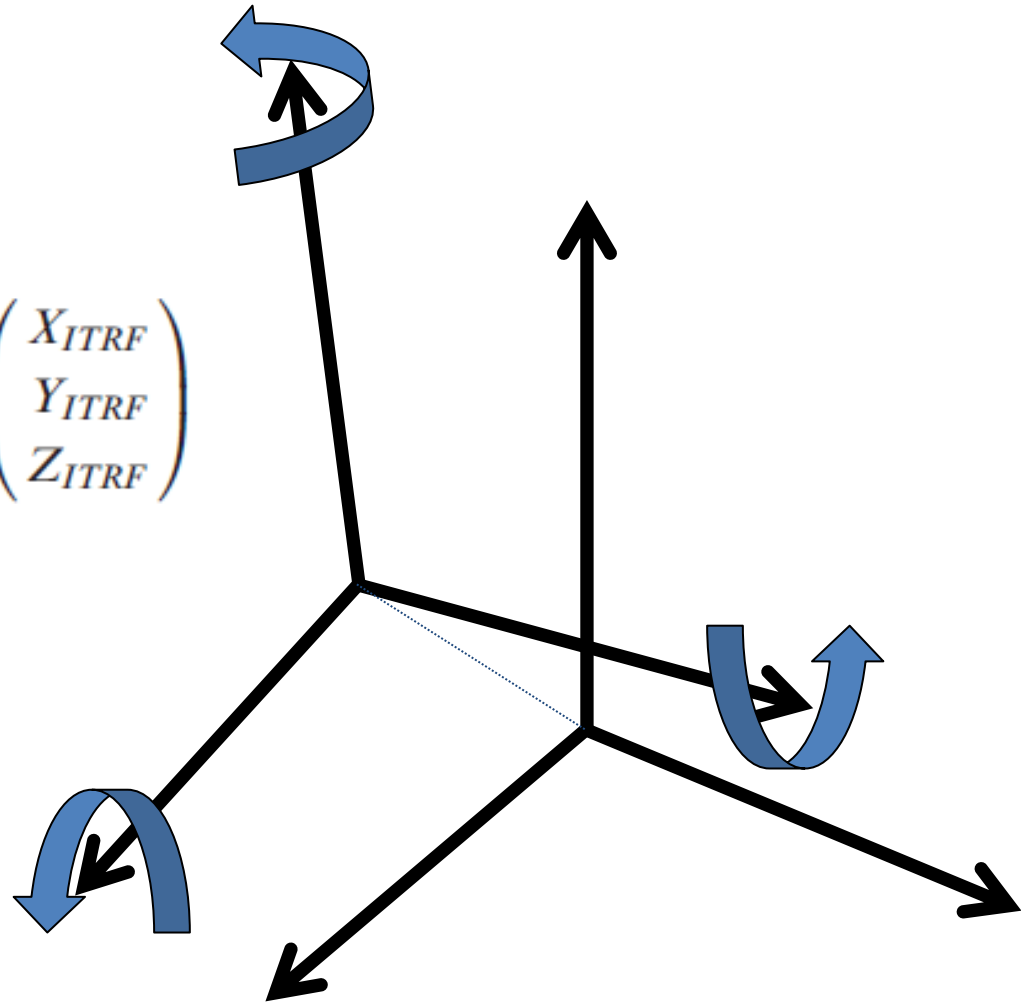


Geocentric Datum of Australia



Seven Parameter Transformation: ITRF → GDA94

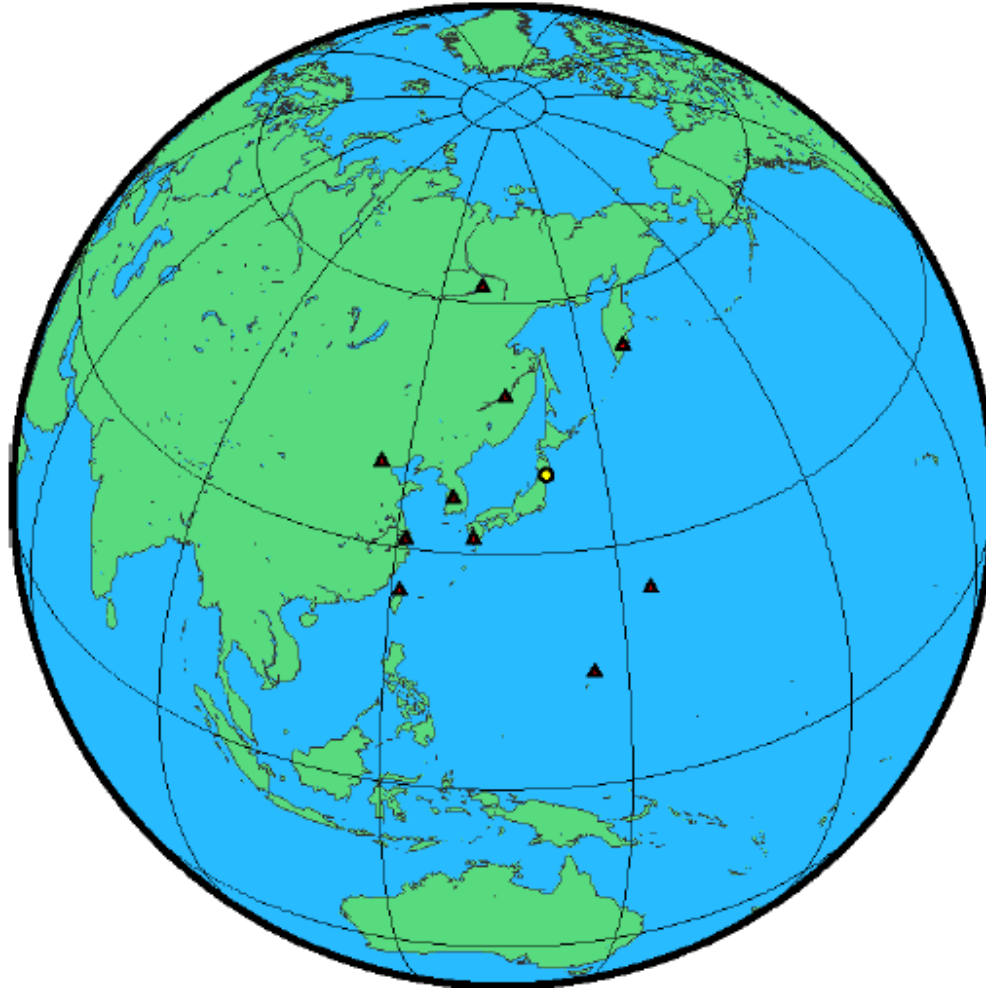
$$\begin{pmatrix} X_{GDA94} \\ Y_{GDA94} \\ Z_{GDA94} \end{pmatrix} = \begin{pmatrix} T_x \\ T_y \\ T_z \end{pmatrix} + (1 + S_c) \begin{pmatrix} 1 & R_z & -R_y \\ -R_z & 1 & R_x \\ R_y & -R_x & 1 \end{pmatrix} \begin{pmatrix} X_{ITRF} \\ Y_{ITRF} \\ Z_{ITRF} \end{pmatrix}$$



- APREF and AUSPOS
- → Improving online positioning



An example for international users



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