



**Australian Government**  

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**Geoscience Australia**

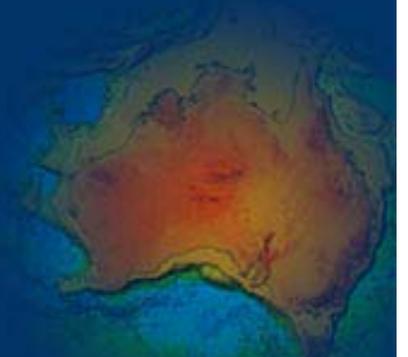
# The Use and Integrity Monitoring of IGS Products at Geoscience Australia (GA)

**Ramesh Govind, John Dawson, John Manning**  
**IGS-2004 Workshop and Symposium**  
**Berne, Switzerland**



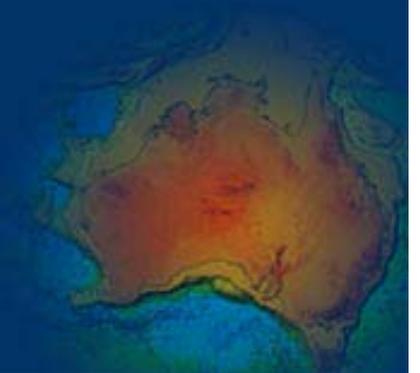
# Presentation Overview

- **Applications of IGS products**
  - **Brief review of the GA applications of IGS products**
  - **Including a review of the GA online GPS processing application (AUSPOS)**
- **Our experiences with IGS product use**
- **Our Quality control (integrity monitoring) of IGS products**



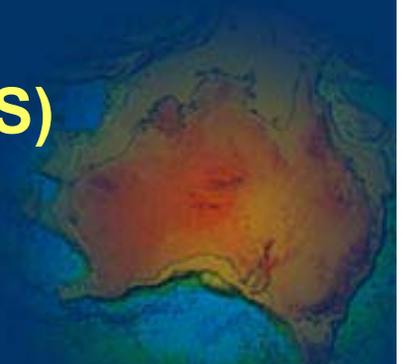
# IGS Products at GA

- **What IGS products do we use?**
  - **GPS data (RINEX)**
    - observation/navigation
  - **GPS satellite ephemerides (SP3)**
    - Ultra-rapid, rapid, final
  - **Earth Orientation Data (ERP)**
    - rapid, final
  - **Coordinate/velocity solutions (SSC)**
    - IGS combined cumulative solutions
  - **Network meta-data**
    - IGS.SNX
  - **IGS antenna phase centre models**
    - PHAS\_IGS.01



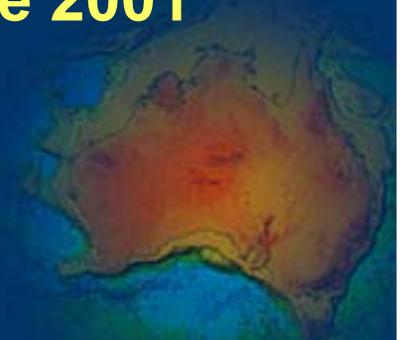
# Applications of IGS Products

- **What the IGS products are used for in GA?**
  - **Spatial data infrastructure (eg. Datum)**
  - **Regional tectonics and ITRF densification**
  - **Satellite altimeter calibration**
    - **GPS buoy solutions**
  - **Absolute sea level monitoring**
    - **crustal motion at tide gauges**
  - **ITRF to Geocentric Datum of Australia (GDA) coordinate transformations**
  - **Web based positioning services (AUSPOS)**



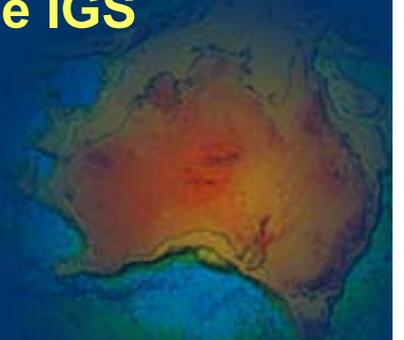
# Example Application - AUSPOS

- **Web based positioning service (AUSPOS)**
  - Internet based GPS processing service
  - Makes use of IGS product suite
    - Orbits, ERP, SSC
  - Provides precise positioning within the Australian region (or globally)
  - Designed to service Australian government and survey industry
    - however now used by a diverse group of users
  - 26,000 + user RINEX files processed since 2001
  - 1400 + unique users since 2001



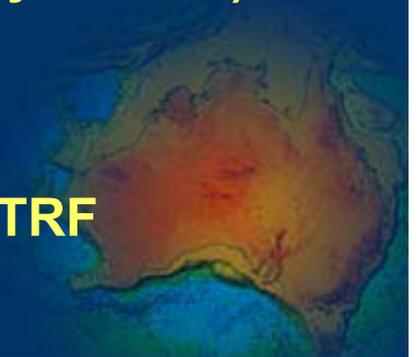
# Example Application - AUSPOS

- **Why do we use IGS products for AUSPOS?**
  - Survey control is often sparse in Australia (often several 100km away)
  - Ease of access to geodetic infrastructure is important for the user.
  - Access to the Geocentric Datum of Australia (GDA) can be provided by long baseline GPS processing against the Australian Regional GPS Network (ARGN) within the ITRF then by transformation to GDA
  - The IGS products provide the most accurate and least resource intensive method to do this (within Australia)
  - AUSPOS provides a simple web interface between the user with GPS data, the GPS processing engine and the IGS product suite



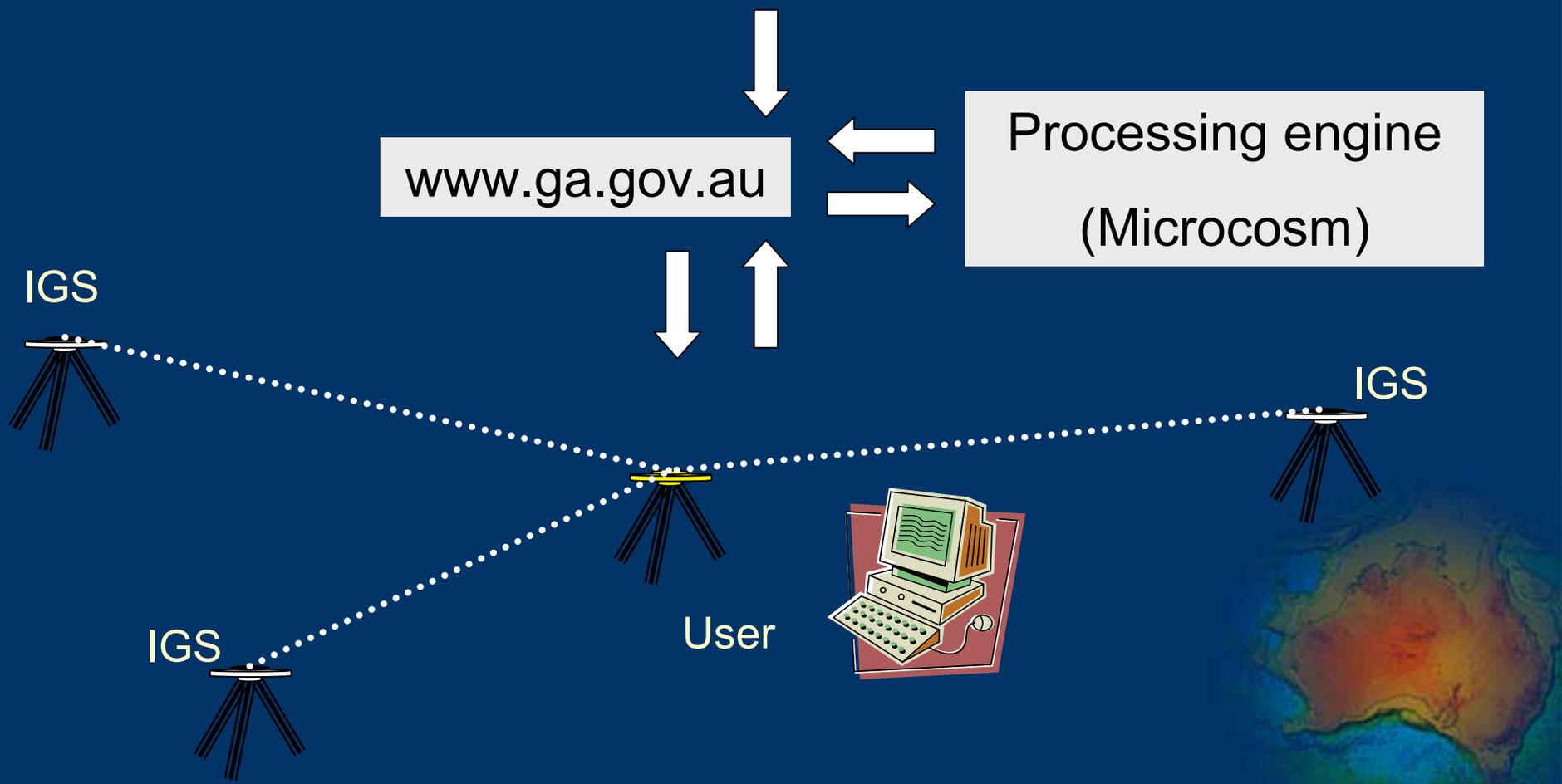
# AUSPOS User Applications

- **What are the applications for AUSPOS?**
  - **survey and cadastral applications**
    - remote sensing and aerial photography survey 'control'
    - offshore oil rig motion
    - mineral exploration and gravity surveys
    - Coordinated cadastral system
  - **geodetic infrastructure**
    - geodetic network quality control
    - maintenance of GPS networks (network quality control)
    - precise coordination of DGPS base stations
  - **Access to the reference frame**
    - precise positioning in developing countries (ITRF densification)



# AUSPOPOS GPS Processing Strategy

IGS: orbits, ERP, SSC, RINEX, IGS.SNX, PHAS\_IGS.01



# AUSPOS Input/Output

Geodesy - Microsoft Internet Explorer

Address: [http://www.auslig.gov.au/cgi-bin/gps.cgi?num\\_files=3&submit\\_files=upload](http://www.auslig.gov.au/cgi-bin/gps.cgi?num_files=3&submit_files=upload)

**GEOSCIENCE AUSTRALIA**  
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**Space Geodesy Analysis**

**AUSPOS**

AUSPOS first-time users please visit our [Step by Step User-Guide](#). Regular users please visit our [Latest News](#) and [User Profile](#) pages.

File Name	Height (m)	Antenna Type
<input type="text"/> Browse...	0.0000	DEFAULT(NONE)
<input type="text"/> Browse...	0.0000	DEFAULT(NONE)
<input type="text"/> Browse...	0.0000	DEFAULT(NONE)

Your Email Address:

Back to the AUSPOS Online GPS Processing Service [Introduction Page](#).

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## 2 Processing Summary

Date	IGS Data	User Data	Orbit Type
2002-03-13	str1 tow2	TWTB	IGS Rapid
2002-03-14	str1 tow2	TWTB	IGS Rapid
2002-03-15	str1 tow2	TWTB	IGS Rapid
2002-03-16	str1 tow2	TWTB	IGS Rapid
2002-03-17	str1 tow2	TWTB	IGS Rapid

Warning: An IGS Rapid orbit product has been used in this computation. For the highest quality coordinates please resubmit approximately 2 weeks after the observation session and to ensure the use of the IGS Final orbit product.

## 3 Computed Coordinates (GDA94)

For Australia users Geocentric Datum of Australia (GDA94, ITRF2000/1994.0) coordinates are provided. GDA94 coordinates are determined from ITRF coordinates by an Geoscience Australia (GA) derived coordinate transformation process. GA transformation parameters between ITRF and GDA94 are recomputed weekly, incorporating the latest available tectonic motions (determined from the GA GPS network). GA recommends that users within Australia use GDA94 coordinates. All coordinates refer to the Ground Mark.

For general information on GDA94 please see <http://www.auslig.gov.au/ausgda/gdatrat.htm>  
For technical information on GDA94 please see <http://www.auslig.org.au/iscm/gdatm/index.html>

### 3.1 Cartesian, GDA94

	X(m)	Y(m)	Z(m)
twd	-4460996.067	2682557.137	-3674443.861
tow2	-5054582.666	3275504.568	-2091539.892
str1	-4467102.300	2683039.532	-3666949.978
TWTB	-4770469.734	2805612.413	-3160358.728

### 3.2 Geodetic, GRS80 Ellipsoid, GDA94

The height above the Geoid is computed using the GPS Ellipsoidal height and subtracting a Geoid Ellipsoid separation. Geoid Ellipsoid separations are computed using a bilinear interpolation of the AUSGeoid98 grid. The height above the Geoid is only provided for sites within the AUSGeoid98 extents. For more information on AUSGeoid98 see <http://www.auslig.gov.au/geodesy/ausgeoid/goid.htm>

	Latitude (DMS)	Longitude (DMS)	Ellipsoidal Height (m)	Above-Geoid Height (m)
twd	-35-23 -57.1560	148 58 47.9846	665.427	646.142
tow2	-19-16 -9.4222	147 3 20.4653	88.224	30.136
str1	-35-18 -55.9396	149 0 36.1796	800.026	780.689
TWTB	-29-53 -40.4963	149 32 24.7989	221.685	191.169

### 3.3 MGA Grid, GRS80 Ellipsoid, GDA94

	East (m)	North (m)	Zone	Ellipsoidal Height (m)	Above-Geoid Height (m)
twd	478807.868	6080884.477	55	665.427	646.142
tow2	505851.328	7869375.315	55	88.224	30.136
str1	682726.015	6990110.672	55	800.026	780.689
TWTB	745297.786	6690184.401	55	221.685	191.169

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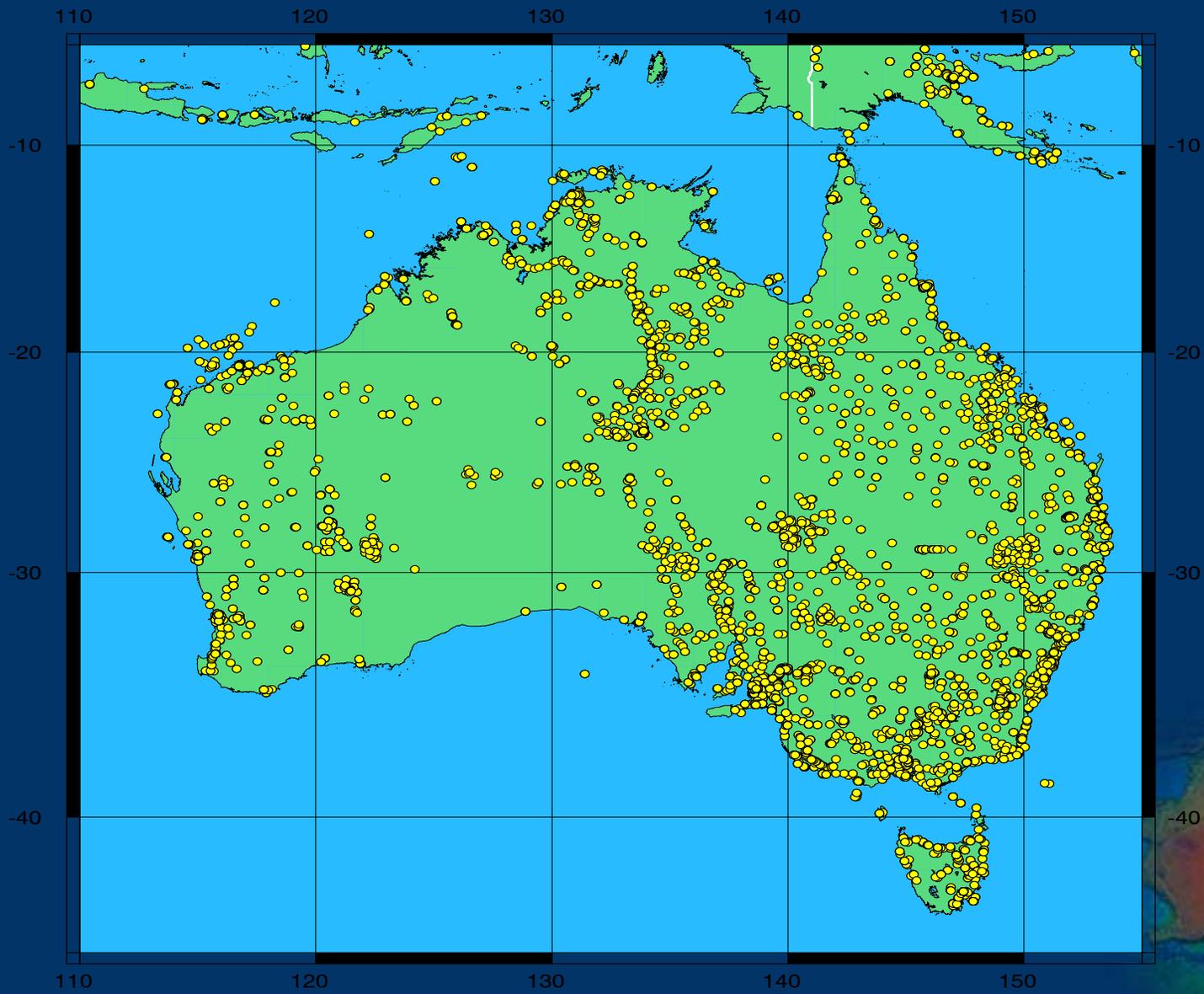
## 1 User and IGS GPS Data

All antenna heights refer to the vertical distance from the Ground Mark to the Antenna Reference Point (ARP).

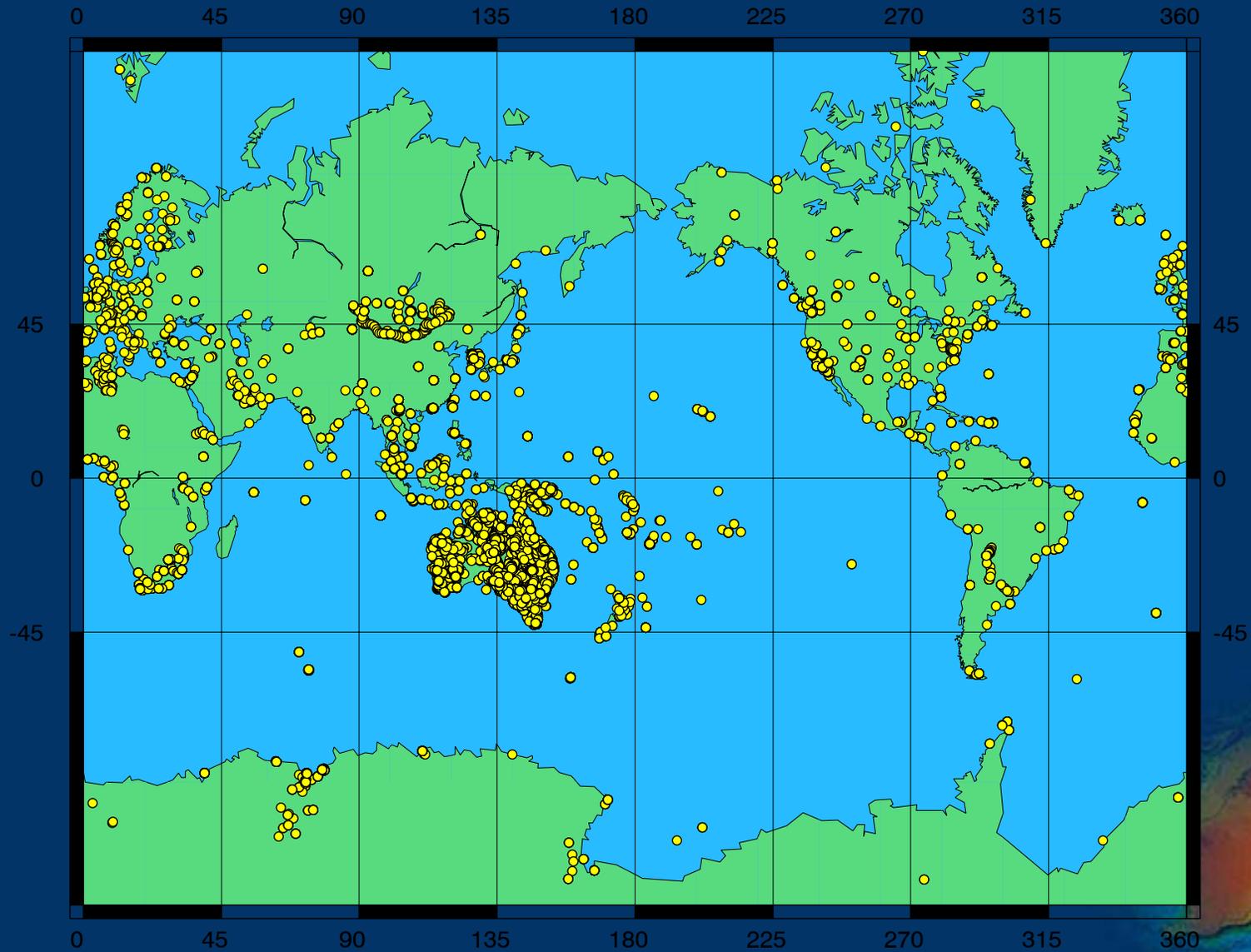
User File	Antenna Type	Antenna Height (m)	Start Time	End Time
TWY0724.02a	DEFAULT(GROUND)	0.0000	2002-03-13 03:07:00	2002-03-17 06:14:00

Figure 1: Global View - submitted GPS station(s) and nearby IGS GPS stations used in the processing; triangle(s) represent submitted user data; circle(s) represent the nearest available IGS stations.

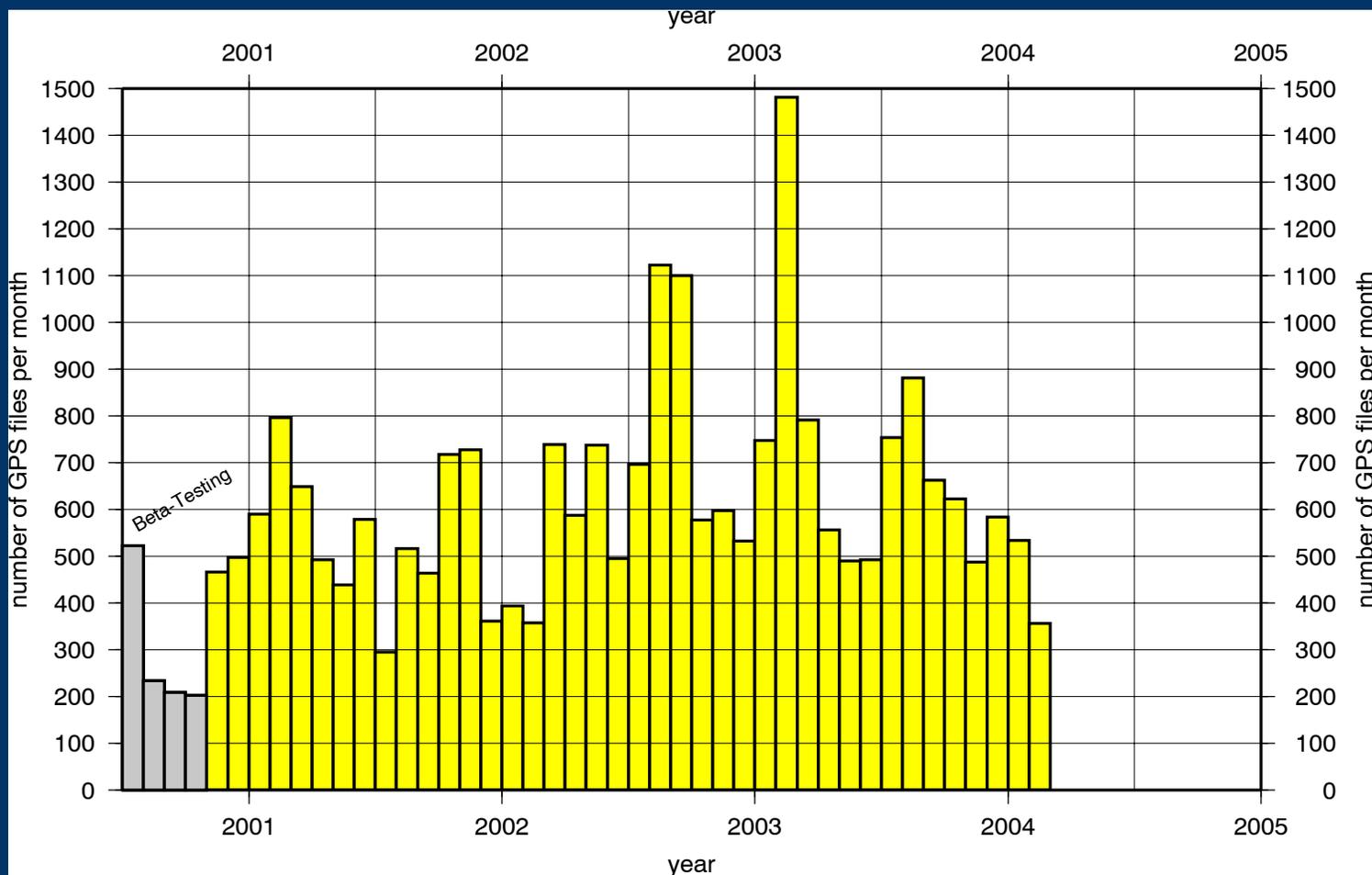
# AUSPOS Australian Usage



# AUSPOS Global Usage

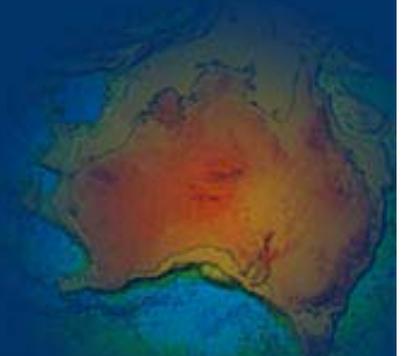


# AUSPOPOS Files Processed (per month)



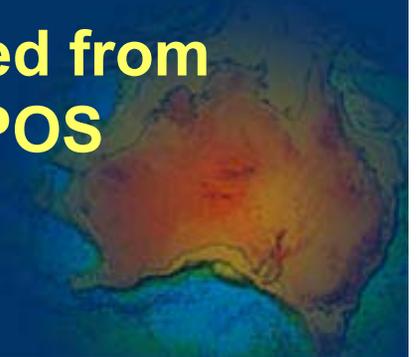
# IGS Product Experiences

- **IGS Data centres issues**
  - On several occasions some IGS data centres have been unavailable
  - This has been largely overcome by the redundancy in the IGS data centres
    - But has required software to automatically switch between data centres when an IGS centre is offline



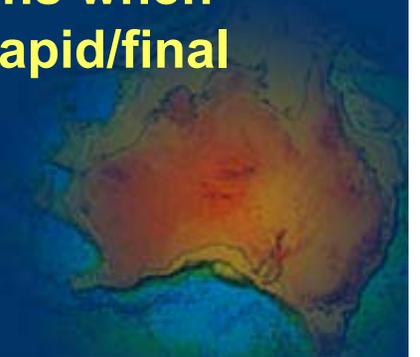
# Quality Control of IGS Products

- **Quality control of RINEX data**
  - **Part day RINEX files**
    - **Automatically checked and excluded as required**
  - **Bad RINEX data**
    - **ARGN network is monitored by GA during IGS RNAAC processing however this is around two weeks after observation**
    - **Poorly performed stations are excluded from automated applications such as AUSPOS**



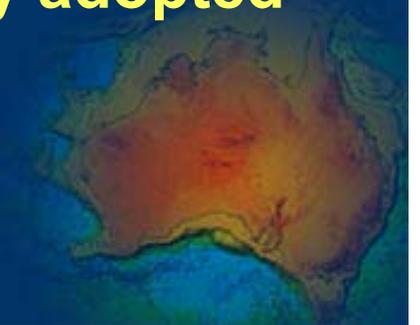
# Quality Control of IGS Products

- **Quality control of orbit (SP3) Data**
  - Automatic orbit model fit analysis when product is first used
  - Later routine regional solution conducted by analyst includes IGS SP3 orbit product assessment
  - Quality of ultra-rapid product is an issue for some positioning applications
    - AUSPOS users note the differences in solutions when comparing solutions that use the ultra-rapid/rapid/final products

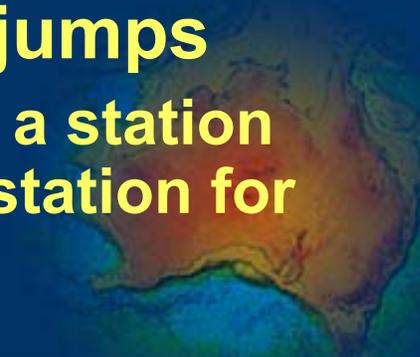


# Quality Control of IGS Products

- **Quality control of ERP data**
  - Is not currently checked for quality apart from basic format adherence
- **IGS.SNX**
  - Is not currently checked for quality apart from basic format adherence but its quality is essential for GA applications
  - Differences remain between RINEX headers and the IGS.SNX file; the IGS.SNX is currently adopted as truth



# IGS Product Experiences

- **Missing products**
    - From time to time IGS orbit (ultra-rapid and rapid) products have been missing from data centre archives
  - **Corrupt navigation data files**
    - Disrupting automatic pre-processing of RINEX observation data
    - Overcome by software to clean the IGS navigation file
  - **Earthquakes and station coordinate jumps**
    - Require immediate flag of an incident at a station so as to allow automatic exclusion of a station for a particular period
- 

# Conclusions

- **Generally only limited Integrity monitoring is performed/required on the IGS product suite used at GA**
- **Any future IGS integrity monitoring system needs to be easily accessible by automated processing systems such as AUSPOS**
- **IGS data and products remain critical components of the Australian national geodetic infrastructure**

