Geoscience Australia Analysis Center

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Abstract

This report gives an overview about activity of the Geoscience Australia IVS Analysis Center during the year 2007.

1. General Information

The Geoscience Australia (GA) IVS Analysis Center is located in Canberra. The Geodesy group operates as a part of the Geospatial and Earth Monitoring Division (GEMD).

2. Component Description

Currently the GA IVS Analysis Center contributes nutation offsets, three EOPs and their rates on a regular basis for IVS-R1 and IVS-R4 networks and their predeccesors (IRIS-A, NEOS-A). The EOP time series from 1983 to 2007 are available. The CRF catalogues using a global set of VLBI data since 1979 are regularly submitted. In addition the GA Analysis Center participates in the statistical analysis of baseline length repeatabilities.

3. Staff

- Dr. Oleg Titov - project manager

4. Current Status and Activities

Several CRF solutions have been prepared using the OCCAM 6.2 software. VLBI data comprising 3555 daily sessions from 25-Nov-1979 to 26-Apr-2007 have been used to compute several global solutions with different sets of reference radio sources. This includes 3,930,655 observational delays from 2066 radio sources observed by 60 VLBI stations.

The last four solutions (aus000a,aus001a,aus002a,aus003a) were submitted within the scope of the IERS/IVS Working Group on the Second Realization of the ICRF. The aus000a solution strategy used all radio sources as global parameters. The aus001a solution strategy used radio sources as close as possible to the ICRF [1]. Coordinates of 102 'other' ICRF sources were treated as local parameters and their positions were estimated for each VLBI session. The rest of the sources were treated as global parameters. The aus002a solution treated as global parameters only 582 radio sources which satisfy two conditions: 1) $z \geq 1$ and 2) not 'unstable' in the classification by Feissel-Vernier [2]. The aus003a solution treated as global parameters only 486 radio sources which satisfy two conditions: 1) $z \leq 1$ and 2) not 'unstable'. Statistics of these solutions are shown in Table 1.

Station coordinates were also estimated using NNR and NNT constraints. Long-term time series of the station coordinates have been established to estimate the corresponding velocities for each station. Due to a limited amount of observations the velocities have been estimated for 55 stations only. Velocities of five stations (DSS65A, MARCUS, METSAHOV, VLBA85 3,

Table 1. Statistics of CRF solutions

Solution	Number of global sources	Number of arc sources	Weighted rms (pks)	chi-squared
aus008a	all		15.4	0.866
aus008b	212 defining	102 other	15.2	0.862
aus008c	582 z≥1	1495	15.1	0.860
aus008d	486 z≤1	1591	15.5	0.905

and ZELENCHK) were not estimated. Tectonic motion for Gilcreek VLBI site after the Denali earthquake is modeled using an exponential function [4].

The adjustment has been done by least squares collocation method, [5] which considers the clock offsets, wet troposphere delays and troposphere gradients as stochastic parameters with apriori covariance functions. The gradient covariance functions were estimated from the GPS hourly values [3].

5. Geodetic Activity of the Australian Radiotelescopes

During 2007 two Australian radiotelescopes (Hobart and Parkes) were involved in geodetic VLBI observations. The GA geodesy group promoted the observations in different ways.

The Parkes 64-meter telescope participated in five geodetic VLBI sessions in 2007. Five sessions are planned for 2008 year. This program is promoted in cooperation with the Australian Telescope National Facility (ATNF). The last two sessions in November were recorded with Mark 5B recorder.

6. New Geodetic VLBI Network

In November, 2006 the geospatial bid within the National Collaborative Research Infrastructure Strategy (NCRIS) capability “Structure and Evolution of the Australian Continent” has been approved. The VLBI part of this bid includes three new modern VLBI sites to be built in different parts of the Australian continent. The proposed design includes small size dish (12 m) with high slewing rate (5 degrees/second) equipped with Mark 5B recorder. First telescope in Hobart is expected to be installed in 2008, two other telescope (Yarragadee, Western Australia and Katherine, Northern Territory) will be built in 2009. The radio astronomy group of UTAS takes responsibility for this network deployment.

7. Baseline Length Repeatability Analysis

Traditionally the baseline length repeatability is used as a measure of the quality of geodetic VLBI data. The repeatability R used to be fit by a linear model as a function of baseline length L only as $R = aL + b$. However, it was shown that the simple linear regression does not fit long baselines properly (e.g., [6], [7]).

It was shown [8] that the repeatability R can be fitted as a function of two parameters: baseline length L and slewing rate of radio dish V. Then the following expression can be given for R:

$$R^2 = \frac{AL^2 + B}{\sqrt{V}(C - DL)}$$

Here A,B,C,D are empirical parameters to be estimated by least squares. Fig 1 demonstrates the empirical values of the repeatabilities versus baseline length (black dots) and their approximation by the proposed formula (circles).

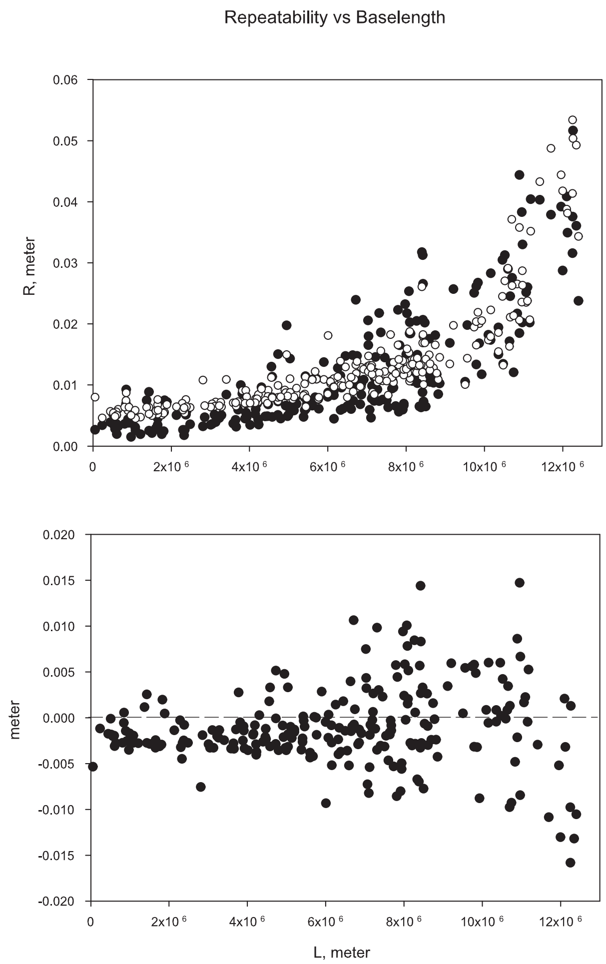

Figure 1. Fitting of the empirical relationship 'repeatability vs baseline length' (top) and post-fit residuals (bottom).

The horizontal and vertical uncertainties (σ_h and σ_v) can be also calculated using the same empirical values plus the radius of the Earth R_e as:

$$\sigma_h = \frac{\sqrt{B}}{\sqrt{2\sqrt{V}(C - DL)}}$$

$$\sigma_v = \sqrt{\sigma_h^2 + \frac{2AR_e^2}{\sqrt{V}(C - DL)}}$$

More details are available in [8].

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