

# U.S. Naval Observatory VLBI Analysis Center

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## Abstract

This report summarizes the activities of the VLBI Analysis Center at the United States Naval Observatory for calendar year 2004. Over the course of the year, Analysis Center personnel analyzed biweekly diurnal experiments with designations IVS-R1 and IVS-R4 for use in-house and continued timely submission of IVS-R4 databases for distribution to the IVS. During the 2004 calendar year, the USNO Analysis Center produced two periodic global Terrestrial Reference Frame (TRF) solutions with designations usn2004a and usn2004b. Earth orientation parameters based on these solutions, updated by the diurnal (IVS-R1 and IVS-R4) experiments, were submitted to the IVS. New activities in the 2004 calendar year included the generation of daily solution files in the SINEX format based on the 24-hr experiments from January 1996 to present. In addition, analysis center personnel began analyzing intensive experiments for production of an in-house EOP-I series, which should be made available to the IVS in 2005. In regards to the Celestial Reference Frame (CRF), Analysis Center personnel continued a program designed to increase the sky density of ICRF sources especially in the southern hemisphere. Activities included scheduling, analyzing and submitting databases for IVS-CRF experiments and the production of global CRF solutions designated crf2004a and crf2004b. This report also describes activities planned for the 2005 calendar year.

## 1. Introduction

The USNO VLBI Analysis Center is supported and operated by the United States Naval Observatory (USNO) in Washington, DC. The primary services provided by the Analysis Center are the analysis of diurnal experiments, the production of periodic global Terrestrial Reference Frame (TRF) and Celestial Reference Frame (CRF) solutions, and the submission to the IVS of session-based Earth orientation parameters (EOP-S) based on USNO global TRF solutions. Analysis Center personnel maintain the necessary software required to continue these services to the IVS including periodic updates of the GSFC CALC/SOLVE software package. In addition to operational VLBI analysis, USNO personnel engage in research aimed at developing the next generation ICRF. Information on USNO VLBI analysis activities may be obtained at:

<http://rorf.usno.navy.mil/vlbi/>.

## 2. Current Analysis Center Activities

### 2.1. Experiment Analysis and Database Submission

During the 2004 calendar year, personnel at the USNO VLBI Analysis Center continued processing of diurnal (IVS-R1 and IVS-R4) experiments for use in internal USNO global TRF and CRF solutions. USNO is also responsible for the timely analysis of the IVS-R4, and the resulting databases are submitted within 24 hours of correlation for dissemination by the IVS. In addition, Analysis Center personnel continue to be responsible for the analysis and database submission for the periodic IVS-CRF experiments. The primary goal of these experiments is the densification of ICRF sources in the southern hemisphere. In 2004, USNO scheduled and analyzed 15 CRF experiments including IVS-CRF25 through IVS-CRF30, IVS-CRFS1 through IVS-CRFS3, and IVS-CRDS10 through IVS-CRDS15. The analyzed databases were submitted to the IVS. In the

2004 calendar year, Analysis Center personnel also began analyzing IVS intensive experiments for use in an in-house EOP-I time series.

## 2.2. Global TRF Solutions, EOP and SINEX Submission

USNO VLBI Analysis Center personnel continued to produce periodic global TRF solutions (usn2004a and usn2004b) over the course of the 2004 calendar year. All USNO global TRF solutions including the most recent solution may be found at: <http://rorf.usno.navy.mil/solutions/>.

Session-based Earth orientation parameters derived from these TRF solutions were compared to those derived from GSFC periodic TRF solutions and with the IERS-C04 time series prior to submission to the IVS. Figure 1 shows an example of the comparison information available at the web site mentioned above. In this figure, differences in pole position estimates derived from the

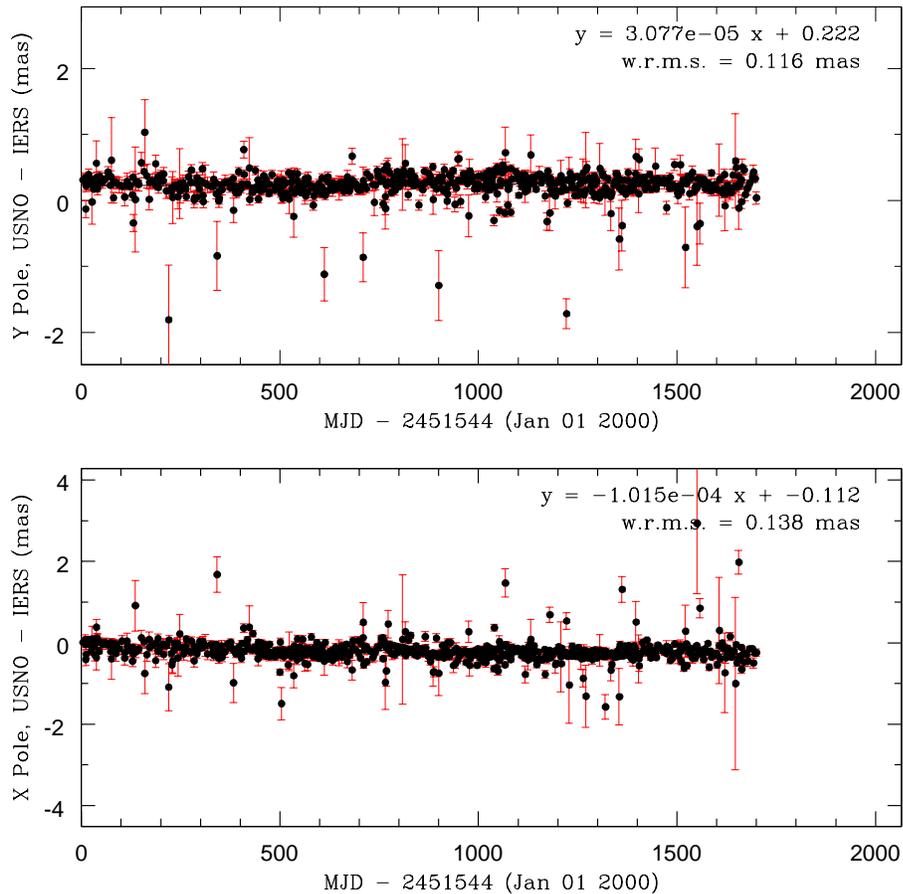


Figure 1. Differences between pole positions estimated from the usn2004b TRF solution and the IERS-C04 time series from January 2000 through August 2004. A weighted least squares linear fit to the data and the weighted RMS are shown in the upper right corner of each plot.

usn2004b solution and the IERS-C04 time series are plotted.

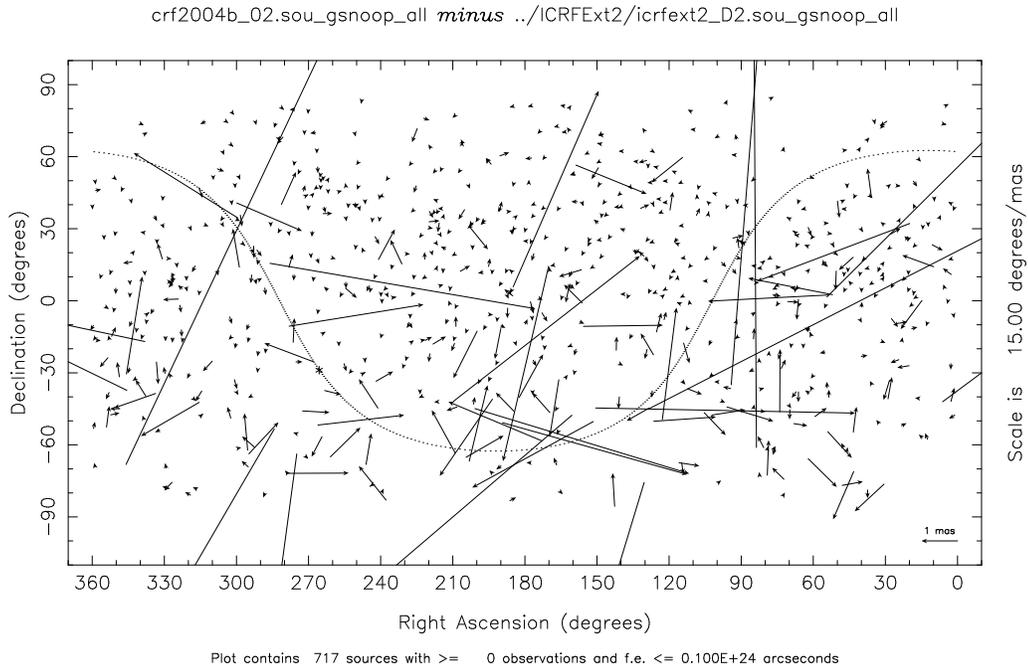
Analysis Center personnel continued to produce an EOP-S series based on the global TRF solutions and continuously updated by new data from the IVS-R1/R4 experiments since the most recent global solution. This updated EOP-S series is submitted to the IVS twice weekly within 24 hours of experiment correlation and is included in the IERS Bulletin A. Analysis Center personnel also worked to produce suitable SINEX format files based on the 24-hr experiments retroactive to January 1996. The SINEX series is continuously updated as new experiments are processed and the resulting files submitted to the IVS.

In addition to EOP-S and SINEX series, USNO Analysis Center personnel began producing an EOP-I series based on the IVS intensive experiments in house. This series is currently being included in the IERS Bulletin A and will likely be made available to the IVS in 2005.

### 2.3. Celestial Reference Frame

During the 2004 calendar year, Analysis Center personnel continued work on the production of global CRF solutions for dissemination by the IVS including crf2004a and crf2004b. These solutions are routinely compared to the current ICRF and are available through the previously mentioned web site: <http://rorf.usno.navy.mil/solutions/>. As an example, Figure 2 shows the differences between USNO crf2004b source positions and the corresponding ICRF-Ext.2 positions for 717 sources.

During 2004, Analysis Center personnel also continued research into the densification of the



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Figure 2. Differences in the source positions as derived from the most recent CRF solution (crf2004b) and ICRF-Ext.2 solution. Plotted are 717 sources in the ICRF. The dotted line represents the galactic equator.

ICRF. Extension 2 of the ICRF was published (Fey et al. 2004, AJ, 127, 3587), which added 109 new sources to the ICRF. All but 4 of these new sources are located at declinations north of  $\delta > -30^\circ$ . In addition, research designed to increase the sky density of ICRF sources in the southern hemisphere through IVS-CRF and ATNF/USNO observations was continued in 2004. Results from observations recorded between 2002 March and 2004 September are reported in two papers by Fey et al. (2004, AJ, 127, 1791 and 2004, AJ, 128, 2593). Results include astrometric positions for 47 sources with declinations south of  $\delta > -30^\circ$ .

### 3. Staff

The staff of the VLBI Analysis Center is drawn from individuals who work at the USNO. The staff and their responsibilities are:

Name	Responsibilities
David A. Boboltz	Periodic global TRF solutions and comparisons, Sinex generation and submission, web page administration, VLBI data analysis.
Alan L. Fey	Periodic global CRF solutions and comparisons, CRF densification research, web page administration, VLBI data analysis.
David M. Hall	VLBI data analysis and database submission, IVS EOP-S submission.
Kerry A. Kingham	Correlator interface, VLBI data analysis

### 4. Future Activities

For the upcoming year January 2005–December 2005, USNO VLBI Analysis Center personnel plan to accomplish the following activities:

- Continue the processing of biweekly IVS-R1/R4 experiments for use in internal TRF and CRF global solutions and continue submission of IVS-R4 databases for dissemination by the IVS.
- Continue the production of periodic global TRF solutions and the submission of EOP-S estimates to the IVS updated by the IVS-R1/R4 experiments.
- Continue the submission of SINEX format files based on USNO databases for dissemination by the IVS.
- Continue the analysis of intensive experiments and begin submission of EOP-I estimates to the IVS.
- Continue the analysis and database submission for all IVS-CRF experiments.
- Continue ATNF/USNO astrometric observations and research regarding the densification of the ICRF in the southern hemisphere.
- Continue the production of periodic global CRF solutions.