IVS Newsletter

Issue 3, August 2002

Preparation Begins for CONT02 Campaign

–Nancy Vandenberg and Cynthia Thomas, NVI Inc./GSFC

The eight CONT02 stations will acquire state of the art VLBI data continuously for 15 days in October 2002.

CONT02 is a two-week campaign of continuous VLBI sessions, scheduled for observing beginning on Wednesday, October 16 and ending on Thursday, October 31. The CONT02 sessions are the follow-on to the spectacularly successful CONT94 observed in January 1994 and the follow-up CONT95 (August 1995) and CONT96 (fall 1996).

The plan for the CONT02 campaign is to acquire the best possible state of the art VLBI data over a continuous two-week period to demonstrate the highest accuracy of which VLBI is capable. The observing schedule will be designed to achieve simulated EOP results at least as good as 60 marcsec for pole position and 2 μsec for UT1.

The scientific and technical goals for the campaign are:

- *Science*: Analysis of the continuous high frequency (sub-daily) EOP will address discrepancies seen between models (tidal and atmospheric) and observations at the M2 and S1 frequencies as well as between long-term and short-term values of tidal amplitudes.
- *Technique improvement*: Continuous data allows comparison of estimates of troposphere zenith delay and gradients across experiment boundaries as a measure of the accuracy of the observations and analysis. Comparison with WVR measurements where possible is especially useful.
- *Accuracy assessment*: Analysis of reference frame repeatability day to day can be made and compared with previous continuous VLBI series.
- *Comparisons*: All stations have IGS GPS systems that are considered Global Stations. Investigation will be made of daily and sub-daily site motions for comparison with external factors such as atmospheric effects and temperature distortions of the antennas or pedestals.

The participating stations for CONT02 are shown in the map at left. The stations are now embarking on thorough pre-campaign check-out tests. The tests are designed to uncover previously unrecognized problems that could adversely affect the CONT02 results. The tests will check the phase cal total power, spurious signals, image rejection, orientation-dependent effects, time-dependent effects, cable cal, met sensors, antenna pointing, and tape recorder performance.

The CONT02 campaign will use a total of 240 tapes, about half of the total geodetic tape pool. The correlators started shipping tapes designated as "CONT02 tapes only" during May and this will continue through September.

More information is available on the CONT02 web page http://ivscc.gsfc.nasa.gov/cont02.

Vous êtes invités! -You're Invited!

An artist works on an ice sculpture for Winterlude in Ottawa.

Natural Resources Canada would like to extend an invitation to the third IVS General Meeting in Ottawa in February 2004.

As the national capital of Canada, Ottawa is much more than just a beautiful city. Located on the banks of the Ottawa River and Rideau Canal, Ottawa offers visitors a combination of national pride, a union of French and English culture and plenty of Canadiana throughout the streets of the city. With a population just over 1 million, Ottawa is located within an hour's drive from the U.S. border. February is a cold but excellent time to visit Ottawa and see and enjoy Canadian culture. In Canada, when it comes to culture, winter is a huge defining factor. In February the city will be celebrating "Winterlude"— North America's largest winter celebration. Bring your ice skates for the Rideau Canal - the world's longest (7.8 km) skating rink - and your skis for the trails or hills just minutes from the city.

Canadian VLBI'ers are proud of their long standing contributions to the field and are pleased to host this event in center of our beautiful capital city, Ottawa. Information about the meeting will be available via the IVS web site early in 2003.

Bonn Correlator

The Bonn Correlator, along with the Haystack Correlator, committed for the first time to do rapid-turnaround processing of the R1 sessions in the IVS schedule for 2002. This style of processing is not new to the Washington Correlator where they have processed the weekly NEOS sessions for years, but it was a challenge for the other Mark 4 correlators.

Arno Müskens and Walter Alef are the principal contacts at the Bonn Correlator. They were interviewed via e-mail for the Newsletter.

Q: Arno and Walter, for which agencies are you working?

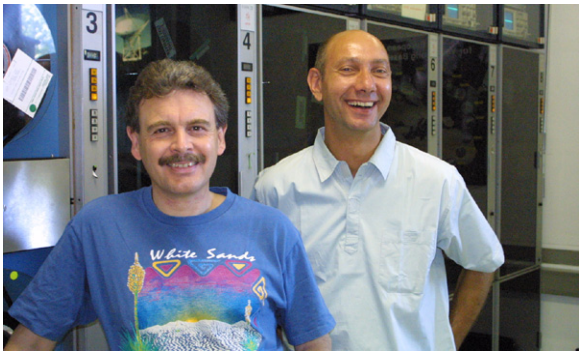
A: The history of VLBI correlators at the Max-Planck-Institute for Radioastronomy in Bonn (MPIfR) dates back to 1978, when a Mark II VLBI correlator was installed. Amongst the first users was a group of geodesists from the Geodetic Institute of the University of Bonn. This joint usage was continued with the coming of a Mark III correlator in 1982, and in 2000 with a Mark 4 VLBI correlator. Now the Mark 4 processor in Bonn is used for correlating geodetic and astronomical observations on a 50/50 basis.

Geodetic observations are processed under the supervision of a group from the Geodetic Institute of the University of Bonn led by Arno. The group is partially funded by the Bundesamt für Kartographie und Geodäsie (BKG) which also contributed a major part of the investment money for the new correlator. Arno is a real old-timer in this business. He started learning about VLBI in 1982 when the geodesists still used the Bonn Mark II correlator. Now he is responsible for all geodetic processing.

The group which maintains and operates the correlator has been led by Walter—a staff scientist at MPIfR—since December 1997. It consists of two engineers (Michael Wunderlich, Arno Freihold), one technician (Rolf Märtens), and two operators (Heinz Fuchs and Hermann Sturm). The group is also responsible for developing and implementing enhancements to the correlator. Walter graduated while working at the Mark III correlator. In 1988 he was assigned the task "friend of the correlator" and became responsible for software aspects of the correlator as well. Occasionally another scientist (Dave Graham) helps out with software work on the correlator.

Q: How is the Bonn correlator operated?

A: Two operators run the correlator during daytime hours for five days a week. Student operators cover the night shifts until about 1 a.m. and on the weekends.



Walter Alef and Arno Müskens in front of the Bonn correlator at MPIfR

The geodetic correlator group is responsible for all routine IVS experiments (IVS-R1, IVS-T3, Europe, IVS-OHIG) and includes for example tape shipment, correlation setup, post-processing, and correlation analysis. At present it consists of Arno and three part time employees: Izabela Rottmann, Ingrid Benndorf and Alessandra Bertarini.

The correlation of astronomical projects is organized in a different way from geodetic observations. The principal investigators who propose and schedule a particular observation occasionally supervise the correlation of their own data, too, while Walter has the overall responsibility for organizing the correlation of astronomical observations.

Q: In the IVS rapid turnaround experiment series the correlation must be done as soon as possible. What kind of changes did this bring to your daily work?

A: IVS-R1 experiments always have priority 1, which means we check daily for incoming tapes and prepare correlation setup-files in advance. When all the tapes of an IVS-R1 have arrived we do a short fringe check and start processing immediately afterwards. During processing the correlated data is fringe-fitted and checked regularly and re-fringe-fitting and possible reprocessing lists will be set up.

Q: With your first experiences of processing IVS-R1 sessions do you have some suggestions which would accelerate the job?

A: It still happens that stations don't send their tapes immediately after the observation so that processing is delayed. The same is true for logs which must be copied to CDDISA as soon as possible. The correlation could be speeded up further if the recordings were perfect, and if the correlator station units could be improved significantly. We have to abort and repeat roughly every 10th scan because of station unit malfunctions. In addition the correlator setup time for a scan is sometimes larger than the time it takes to correlate it.

Q: Do you have some statistics about the Bonn correlator?

A: We have had no backlogs at the correlator for quite some time now, but the correlator is nearly fully loaded. The correlator is productive for more than 60% of the total (wall clock) time.

— interview by H. Hase

The IVS Newsletter is published three times annually, in April, August, and December. Contributed articles, pictures, cartoons, and feedback are welcome at any time.

Please send contributions to ivs-news@ivscc.gsfc.nasa.gov. The editors reserve the right to edit contributions. The deadline for contributions is one month before the publication date.

Editors:
Nancy Vandenberg, General Editor
nrv@gemini.gsfc.nasa.gov
Hayo Hase, Feature Editor
hase@wettzell.ifag.de
Heidi Johnson, Layout Editor
hnj@haystack.mit.edu

The newsletter is published in color with live links on the IVS web site at http://ivscc.gsfc.nasa.gov/.

VLBI How to...

Implications of the IAU 2000 Resolutions for IVS

–Axel Nothnagel, Geodetic Institute of the Univversity of Bonn

On April 18-19, 2002, an IERS Workshop was held at Paris Observatory for discussion of all aspects related to the implementation of the IAU 2000 Resolutions. These resolutions also have a severe impact on the analyses carried out by the IVS. New models for relativistic parameters and the re-definition of Terrestrial Time TT may have only a minor effect. Large consequences, however, can be expected from the introduction of new Celestial and Terrestrial Ephemeris Origins also known as non-rotating origins together with a Celestial Intermediate Pole (see http://danof.obspm.fr/iaucom19). The implementation of these resolutions in the VLBI analysis software packages together with the new IAU 2000 Precession-Nutation Model will require considerable programming efforts.

At the time of the adoption of the IAU Resolutions, it was envisaged that the resolutions will take effect on January 1, 2003. However, a number of coefficients of the models have not yet been finalized, delaying the software implementation for several months beyond this date. Nevertheless, all VLBI analysis software development groups are encouraged to implement the IAU Resolutions as soon as possible.

In order to keep the implications for the users of earth rotation parameters (EOP) as small as possible, the IERS decided to maintain their EOP series based on the current models using the Celestial Ephemeris Pole and the dynamical equinox for as long as necessary in parallel to the new series. As a consequence the IVS will also continue to publish the current EOP series in parallel with the new one. This, of course, requires that the IVS Analysis Centers will also continue to submit the current series.

A Taste of History....

The Mark I VLBI system (1967-1979) recorded data on reels of computer tape, with each tape lasting 3 minutes. Then the tape had to be rewound, removed, and the next tape mounted. VLBI operations was a real physical workout! With the Mark III system (1979-1986), tapes lasted 20 minutes or more, giving operators a chance to have a cup of coffee between tape changes. The Mark IIIA system (1986-present) needs a tape change at most every 12 hours, so operators may not even have do a single tape change on their shift. With discs and e-VLBI on the horizon, tape changes will soon become a faded memory.

How things have changed....

Feeling nostalgic? Send your "taste of history" contributions to ivs-news@gsfc.nasa.gov. If we use your submission, you will receive a free IVS t-shirt (while supplies last). This issue's "taste" was suggested by Rich Strand, GCGO.

How to Confirm Data Quality for VLBI Observing Sessions

–Rich Strand, Gilmore Creek Geophysical Observatory

One of the challenges of VLBI observing is providing the IVS network with good data during a session while having very few clues that things are actually working. It's the nature of this geometric technique that the radio sources are very weak and few if any indicators are available to the station operators during quasar detection and acquisition.

The best verification. Until real-time VLBI can provide instant fringe checks, the best way to verify a working session is to make a short recording and ship the tape "ASAP" to the correlator. Called a "fringe" test, this recording is used to verify the station's basic operational status as the signal path from the receiver's waveguide to the recording media is checked. This technique is always used to verify a new station coming on line or one that had major repair or new equipment installed.

Pre-checks really work. All stations should use a pre-pass check-off sheet to offset the disadvantage of not being able to "fringe" every session. An example of this guide can be found in any Technical Operations Workshop handbook and in the Field System notebooks. Most stations adapt this check-off list to their own needs, but all will have operator verifications of station and telescope time, video levels, proper frequencies, system temperatures and cable calibrations. There are very few things that cannot be checked locally at the station.

Field System tools. The Field System has several tools that will provide the operator with an end to end systems check. The pointing program called "Fivept" will verify the telescope can see a radio source and the program "Onoff" will verify how well it sees this source. The FS will also look for errors in time and can measure phase cal amplitude. The FS will confirm good recording and parity, monitor the receiver and make system temperature measurements, all useful to verify the station's data quality.

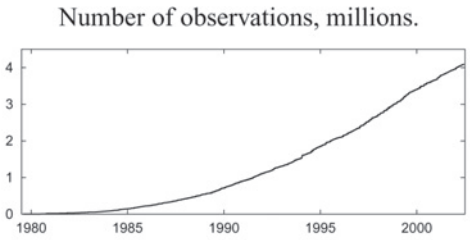
Station test equipment. To completely quantify the station's data collection ability several test instruments are needed. 1) An oscilloscope with a viewing filter to monitor phase cal from the data terminal will show that the receiver is working across the frequency range. 2) A second scope can monitor the recorder eye pattern to recognize recording failures. 3) Counters are necessary to verify 1PPS offsets from GPS and the formatter and cable measurements. 4) Spectrum and FFT analyzers are valuable to find RFI and troubleshoot RF failures.

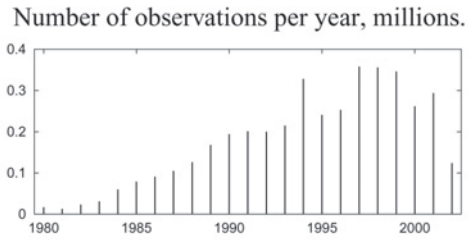
Only the correlator knows. The final verification of data quality can only come from the correlator after they receive two or more station tapes. Nevertheless, each station can follow these simple guidelines and complete system performance checks to maintain a high level of confidence that the data is of good quality. Top performing stations use the techniques mentioned here to provide quality data year after year.

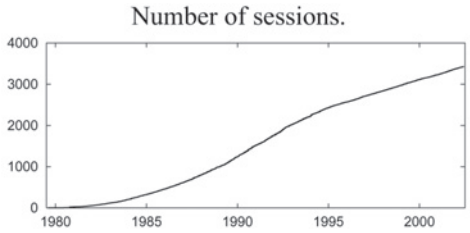
4,000,000 Delays!

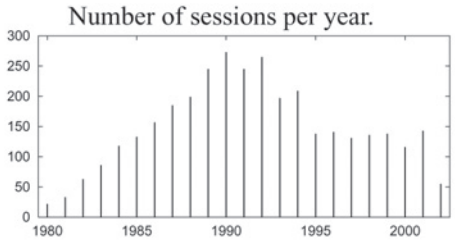
—Zinovy Malkin, Institute of Applied Astronomy

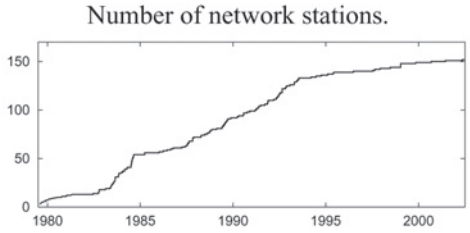
This is one of the brightest results of more than two decades of heroic efforts by geodesists and astronomers, engineers and programmers, network stations and correlator teams: more than 4,000,000 delays are now available in the IVS data base for scientific analysis. The pictures below show how this result was reached.

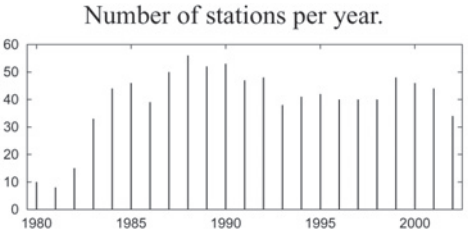


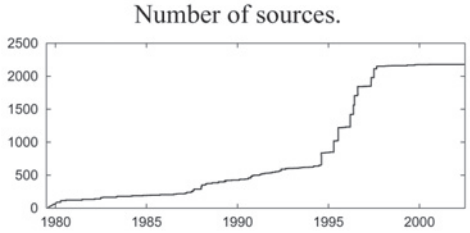


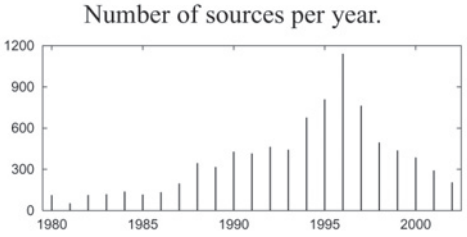












These observations were obtained during 3452 sessions, each 18 hours or greater, and 4400 shorter (mostly Intensives) sessions, on 1722 baselines. There were 2179 radio sources observed at 152 stations (including experimental stations). Unfortunately, only 27.5% of the sources are located in the southern celestial hemisphere. The most frequently observed radio source is 0552+398, observed in 230223 scans during 3207 sessions (93% of all sessions!). The second most-observed source is 4C39.25.

During these years the most active stations were Wettzell (1686 sessions and 742989 observations), Gilmore Creek (1539 and 826992), and Westford (1510 and 703040). In addition there were 4054 shorter sessions (mostly the 1-2 hour Intensives) at Wettzell and 2207 at Westford. The most observed baseline is Westford-Wettzell: 946 sessions, 121061 observations.

The total duration of the observations was 3736 days, equivalent to more than 10 years of continuous observations!

Certain interesting features in the plots are explained by known historical events. The build-up of geodetic observing during the Crustal Dynamics Project (CDP) in the 1980s is a clear feature in the stations and sessions plots. The dramatic increase in the number of sources in the late 1990s is from the VLBA Calibrator Survey which observed ~1200 new sources. These data have only recently become available in VLBI data base format. And, of course the statistics for the year 2002 are still incomplete.

Detailed statistics can be found at the IAA Analysis Center web site http://www.ipa.nw.ru/PAGE/DEPFUND/GEO/ac_vlbi/

Reflections on WG2

–Harald Schuh, University of Technology Vienna

An important part of the efforts of IVS is to provide the best ICRF, ITRF, and EOP products for the user community and to optimize the use of available global resources in making these products. Based on these considerations a Working Group for Product Specification and Observing Programs (WG2) was established by the IVS Directing Board, with the author appointed as chair. The charter of WG2 was to review current products, recommend goals, and suggest observing programs.

During the first weeks after establishment of WG2, it was decided to proceed step by step. In step 1 the present status of international VLBI activities within IVS was discussed. In step 2 we identified goals for future IVS products. In step 3 future observing programs, technological improvements, and further changes were considered. Step 4 was a written report to the IVS Directing Board as well as to the international VLBI community and its sponsoring agencies.

In the conclusions of the WG2 report it is said that:

...the following aspects must be accomplished:

- *significant improvement of the accuracy of VLBI products,*
- *shorter time delay from observation to availability of results,*
- *almost continuous temporal coverage by VLBI sessions.*

...The midterm observing program for the next 4-5 years seems to be rather ambitious, although it is feasible if all efforts are concentrated and the necessary resources become available.

I'd like to offer some personal comments: as almost usual for an international working group on scientific issues the start of WG2 was rather slow. It was mainly the IVS chairman Wolfgang Schlüter with his overwhelming energy who accelerated the progress of the work. A kind of breakpoint was the first meeting of WG2 in Barcelona on September 8th, 2001 with a rather long but very constructive discussion. It was a challenge for all of us to describe the rather heterogeneous situation in VLBI with very different users, different interests, different priorities and it was fascinating to put the various parts of the puzzle together. The WG2 chair wants to thank all who have contributed to the report. Their efforts allowed us to close WG2 less than one year after its establishment. The report can be downloaded from the IVS homepage http://ivscc.gsfc.nasa.gov/WG/wg2/.

Status Report on IVS 2002 Observing Program

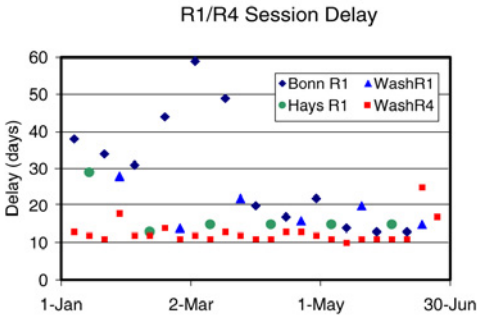
–Chopo Ma, NASA Goddard Space Flight Center

The recommendations of WG2 have been initially implemented in 2002 as shown in the table. Of particular note

Type	#	Network Size	Description
CRF	4	5	Provides astrometric observations useful in improving the current celestial reference frame.
CONT02	15	8	Provides a continuous series of the highest quality data that VLBI can produce in practice.
E3	10	4-5	Provides an additional monthly EOP session utilizing S2 technology for recording and processing.
R1	51	5-6	Provides weekly EOP results on a timely basis; continuity with previous CORE series.
R4	51	5-6	Provides weekly EOP results on a timely basis; continuity with previous NEOS series.
R&D	7	7-8	Investigates methods for improving the VLBI technique
T2	12	8	Monitors the TRF via monthly sessions; all stations included at least three times per year.

are R1 and R4 which double the time resolution of 24-hr EOP measurements; CONT02, which will include a fortnight of continuous observing in the fall; and E3, which introduces S2 recording into routine EOP monitoring.

One of the goals of R1 and R4 is turnaround within 15 days. The figure shows the delay between observing and posting of EOP results. It can be seen that the goal is already met in some cases and is improving significantly in others.



The IVS Program Committee has been regularly reviewing the observing program and monitoring the R1/R4 turnaround times.

OCCAM Users Workshop

–Oleg Titov, Geoscience Australia

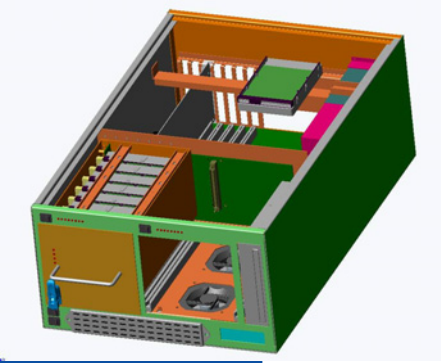
A two-day workshop for active OCCAM users was held 29-30 April, 2002 at the Institute of Geodesy and Geophysics (IGG) at the University of Technology in Vienna (Austria). In the first meeting of its kind, OCCAM users discussed new ideas and practical approaches that might be useful for OCCAM development. Representatives from IVS Analysis Centers at St. Petersburg University (Russia), Institute of Applied Astronomy (Russia), Geoscience Australia (Australia), DGFI (Germany), and IGG attended. Goddard Space Flight Center (USA) was also represented.

The first day included 12 scientific presentations about activities of all the groups, covering the history of OCCAM, current state-of-the-art and future perspectives. At the end of the day all the participants went to the "*Heurigen*" – a traditional Vienna restaurant to try a stylish *Östrich* meal.

The second day was devoted to planning further work on the OCCAM update, international cooperation, and comparison of OCCAM to alternative analysis software. The mail list ivs-occam@ivscc.gsfc.nasa.gov provides operational information to users. More information about the workshop and OCCAM itself can be found at the web address: http://luna.tuwien.ac.at/occam/meeting02.htm.

News Update: Mark 5 System Deployed for UT1 Intensives

–Alan Whitney, MIT Haystack Observatory



The new Mark 5 chassis design drawing shows one 8-pack module installed in the left front of the chassis. The right front is empty, ready for a second 8-pack module to be inserted.

The first Mark 5 disk-based data systems, specifically the Mark 5P model, are now deployed for testing in a routine operational environment. In early June, Kokee Park began collecting data on the Mark 5 in parallel with the normal VLBA tape system for the UT1 intensive sessions. Disk data were returned to Haystack, and the tape data were forwarded to Haystack after normal processing at the Mark 4 correlator at USNO. Though there were the few usual development hiccups, the correlation results from these experiments look entirely nominal.

In late June Wettzell began collecting UT1 Intensive data on a regular basis and shipping the disks to Haystack for correlation. To date, all disks have arrived safely at their destinations. Data collection with Mark 5 and correlation at Haystack is continuing for the UT1 Intensive sessions at Kokee and Wettzell in order to test the operational reliability of the Mark 5 systems.

Haystack is now in the process of building and testing 17 Mark 5P systems for deployment. These systems will allow the development partners to do thorough testing of the Mark 5P systems and provide feedback to Haystack Observatory on their results. In August 2002, we expect to receive the first prototype models of the new Mark 5 chassis which houses the disks in two "8-pack" removable modules, each holding 8 disks (see accompanying figure). This new configuration is expected to dramatically improve the logistical handling of the disk media, so that 8-pack modules can be handled in exactly the same way as Mark 4 or VLBA tapes, without the complications of handling many individual disks. The 8-pack module, loaded with 120 GB disks, will have the storage capacity of slightly less than two Mark 4 tapes. Deployment of this new chassis, along with the new Mark 5A I/O card, is expected in fall 2002.

Upcoming Meetings...

8th IVS Directing Board Meeting
Haystack Observatory
Westford, MA
October 7, 2002

New Technologies in VLBI
Gyeong-ju, Korea
November 5-8, 2002

4th IVS Analysis Wkshp.
Institute Geographique National
Paris, France
April 3-4, 2003

European Geophysical Society Meeting
Nice, France
April 6-11, 2003

16th Working Meeting on European VLBI
Leipzig, Germany
May 9-10, 2003

IVS Technical Operations Workshop
Haystack Observatory
Westford, MA.
June 2-5, 2003

http://ivscc.gsfc.nasa.gov
ivscc@ivscc.gsfc.nasa.gov
phone: 301-614-5939
fax: 301-614-5970

IVS Coordinating Center
NASA GSFC
Code 920.1
Greenbelt, MD 20771