CORE Operations Center

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Abstract

This report gives an overall view of the CORE program at Goddard Space Flight Center (GSFC). It summarises the different CORE sessions and gives information about the technical staff. The outlook summarizes the evolution of the different CORE programs.

1. CORE Program Description

The continuous observations of the rotation of the Earth (CORE) program was initiated by the geodetic very long baseline interferometry (VLBI) community in 1997. The program is being carried out using geodetic VLBI stations for data acquisition and VLBI analysis centers for data processing and analysis. The CORE program will evolve over the period 1997-2001.

The goal of the CORE program is to generate an Earth rotation data set of unprecedented time resolution and accuracy for Earth science and global change research. The program will continue to produce basic observational data for studies of the continuous momentum exchange among the solid Earth, the atmosphere, and the hydrosphere, enabling exciting research areas that heretofore have been impossible.

The current Earth orientation parameter goal of the CORE program is 3.5 μs for UT1 and 100 μas in pole position. The full CORE program has the potential for a typical precision of 1 μs in UT1 and 25 μas in pole position, for daily sessions with a 5-station network. These values are three times better than those measured weekly with the NEOS network and could be available daily.

The breakthrough in the availability of continuous, high accuracy Earth rotation data is possible due to the Mark IV technology that will become available in late 1999. Improved sensitivity in the Mark IV data acquisition system together with the high playback efficiency of the Mark IV correlator are both necessary to produce the proposed data.

CORE experiments were run with four basic network configurations: CORE-A, CORE-B1, CORE-B2, and CORE-B3 during 1997 and 1998. During 1999, the networks of the CORE-B sessions changed and the sessions were named CORE-B4, CORE-B5, and CORE-B6. The CORE-A sessions are simultaneous with NEOS sessions and CORE-B and NEOS sessions are on sequential days during both 1998 and 1999.

2. CORE Sessions During March 1998 to March 1999

This section displays the purpose of the CORE-A and CORE-B sessions and lists other programs used by CORE.

- CORE-A: These experiments validate the CORE concept of measuring EOP continuously using different networks. Comparisons of the EOP results from simultaneous sessions in 1997 and 1998 have shown fairly good agreement, but there are some puzzling systematic differences. It is hoped that additional data to be obtained during 1999 will contribute to understanding this data set.

The network for CORE-A included Fairbanks, HartRAO, Hobart, Algonquin, Matera and Westford during 1998. Medicina was added to the network during the first quarter of 1999. Tsukuba will be added to the network starting the second quarter of 1999.

- CORE-B: The purpose of these sessions is to provide additional data for comparison of EOP measurements, to obtain long 48-hour data sets for geophysical studies and to provide observing sessions during which the stations can demonstrate their performance and their ability to participate in future regular CORE sessions.

There is data from other programs established by Bonn (IRIS-S, CORE-OHIGGINS, and EUROPE), USNO (NEOS, NAVEX, CRF), and GSI (APSG) that are used by the CORE program. Some of the data is used to help determine the direction of the CORE program during its evolution.

3. Current Analysis of CORE

Comparisons of daily EOP estimates made by the CORE-A, CORE-B and NEOS networks show that there are systematic differences in EOP. There are statistically significant mean offsets of 147 μas, 85 μas, 3.7 μs between X, Y, and UT1 estimates, respectively, from the CORE-A and NEOS networks. Between NEOS and CORE-B, the UT1 difference of 10.6 μs is significant. The source of these differences is under active investigation.

One of the measures of performance of the CORE experiments is the size of the formal EOP uncertainties. The uncertainties range from about 70-100 μas for X-pole, 50-100 μas for Y-pole, and 2.5-3.5 μs for UT1. For most sessions, observed uncertainties are 20-50% greater than EOP uncertainties from simulations using scheduled observations and uncertainties. The observed uncertainties are generally less than the minimal goal of 100 μas for PM and 3.5 μs for UT1.

4. The CORE Family

Figure 1 shows a subset of the CORE family after a Wednesday staff meeting where we come together to discuss the various activities that have taken place during the week and the upcoming events.

Table 1 lists the key technical personnel and their responsibilities so that everyone reading this report will know who to contact about their particular question.

5. Evolution of CORE

Although the CORE observing program for 1999 is proceeding according to plan, the Mark IV correlator plan has changed. The correlator should be available on the planned schedule with Mark III capabilities, but it will not have many Mark IV capabilities until later this year. The Mark IV correlator capabilities that we need for the next step in the evolution of the CORE program are fan-out and increased processing efficiency.

Since the CORE-3 sessions, originally scheduled to start in July, require these capabilities, we delayed the start of CORE-3 until at least the fourth quarter of 1999. The start-up of CORE-3 in October will depend on the correlator capabilities and the performance of the new correlator during its shakedown period.

The start of the CORE-3 sessions will be the beginning of the true CORE program, recording

Figure 1. The CORE Operations Center Family listed from left to right starting with the back row: R. Gonzalez, C. Ma, B. Boyer, D. MacMillan, E. Himwich, B. Schupler, W. Wildes, D. Gordon, K. Refinetti, C. Kodak, K. Baver, N. Vandenberg, T. Clark, and C. Thomas. Please note that all of the CORE family members are not pictured.

Table 1. Key Technical Staff of the CORE Operations Center

Name	Responsibility	Agency
Tom Buretta	Recorder and electronics maintenance	Haystack
Brian Corey	Analysis	Haystack
Irv Deigel	Maser maintenance	ATSC
Frank Gomez	Software engineer for the Web site	Raytheon/STX
David Gordon	Analysis	Raytheon/STX
Ed Himwich	Network Coordinator for CORE stations	NVI, Inc./GSFC
Chuck Kodak	Receiver maintenance	ATSC
Cindy Lonigro	Analysis	Raytheon/STX
Dan MacMillan	Analysis	NVI, Inc./GSFC
David Shaffer	Sources and antenna parameter maintenance	Radiometrics/NVI, Inc.
Dan Smythe	Tape recorder maintenance	Haystack
Cynthia Thomas	Coordinate master observing schedule and prepare CORE experiments observing schedules	NVI, Inc./GSFC
Nancy Vandenberg	Organizer of CORE program and sked manager	NVI, Inc./GSFC
William Wildes	Procurement of materials necessary for CORE operations	GSFC/NASA

in high sensitivity Mark IV modes. The tentative CORE evolution plan for the next few years is summarized in Table 2.

We are working on identifying the participating stations for each new CORE network. We will need more antenna observing to fulfill this plan. The goal for CORE is continuous observing but we recognize that it will be very difficult to fill in the weekend days for CORE-5, -6, and -7. Weekend observing is costly both in funding and in inconvenience to operators. We would appreciate any ideas you have about how to attack this problem. Volunteers for weekend observing would be very welcome!

Table 2. Planned CORE Evolution

Start Date	Experiment Name	Avg Days per Week	Notes
1-Oct-1999	CORE-3 weekly	2.5	NEOS is on day 2
1-Jan-2000	CORE-4 bi-weekly	3.0	Discontinue CORE-A
1-Jul-2000	CORE-1 bi-weekly	3.5	Reduce to two CORE-B networks
1-Jan-2001	CORE-4 weekly	4.0	CORE-B networks as needed

References

[1] Clark, T.: CORE White Paper, June 2, 1997