CORE Operation Center 2013 Annual Report

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Abstract This report gives a synopsis of the activities of the CORE Operation Center from January 2013 to December 2013. The report forecasts activities planned for the year 2014.

1 Changes to the CORE Operation Center's Program

The Earth orientation parameter goal of the IVS program is to attain precision at least as good as 3.5 μs for UT1 and 100 μas for pole position.

The IVS program, which started in 2002, used the Mark IV recording mode for each session. The IVS program began using the Mark 5 recording mode in mid-2003. By the end of 2007, all stations were upgraded to Mark 5. Due to the efficient Mark 5 correlator, the program continues to be dependent on station time and media. The following are the network configurations for the sessions for which the CORE Operation Center was responsible in 2013:

- IVS-R1: 53 sessions, scheduled weekly and mainly on Mondays, five to twelve station networks
- RDV: Six sessions, scheduled evenly throughout the year, 14 to 16 station networks
- IVS-R&D: Ten sessions, scheduled monthly, six to ten station networks

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IVS 2013 Annual Report

2 IVS Sessions from January 2013 to December 2013

This section displays the purpose of the IVS sessions for which the CORE Operation Center is responsible.

- IVS-R1: In 2013, the IVS-R1s were scheduled weekly with five to twelve station networks. During the year, 19 different stations participated in the IVS-R1 network, but there were only eight stations that participated in at least half of the scheduled sessions—Tigo (51), Ny-Ålesund (47), Wettzell (41), Fortaleza (40), Westford (39), Hobart12 (28), Kokee (28), and Katherine (26). Aira participated in the IVS-R1 sessions for the first time during 2013.
  The purpose of the IVS-R1 sessions is to provide weekly EOP results on a timely basis. These sessions provide continuity with the previous CORE series. The "R" stands for rapid turnaround because the stations, correlators, and analysts have a commitment to make the time delay from the end of recording to the results as short as possible. The time delay goal is a maximum of 15 days. Eighty-one percent of the IVS-R1 sessions were completed in 15 or fewer days. The remaining 19% were completed in 16 to 24 days [16 days (four), 17 days (one), 20 days (two), 23 days (two), and 24 days (one)]. Participating stations are requested to ship disks to the correlator as rapidly as possible or to transfer the data electronically to the correlator using e-VLBI. The "1" indicates that the sessions are mainly on Mondays.
- RDV: There are six bi-monthly coordinated astrometric/geodetic experiments each year that use the

full ten-station VLBA plus up to six geodetic stations.

These sessions are being coordinated by the geodetic VLBI programs of three agencies: 1. USNO performs repeated imaging and correction for source structure; 2. NASA analyzes this data to determine a high accuracy terrestrial reference frame; and 3. NRAO uses these sessions to provide a service to users who require high quality positions for a small number of sources. NASA (the CORE Operation Center) prepares the schedules for the RDV sessions.

- R&D: The purpose of the ten R&D sessions in 2013, as decided by the IVS Observing Program Committee, was to support mixed mode observing (RD1301), vet sources for the good geodetic catalog (RD1302 and RD1304), vet sources for the good geodetic catalog and GAIA proposal sources (category 4) (RD1303), observe linked sources between GAIA and ICRF-2 (RD1305 through RD1308), and test the 512 Mbps recording mode for the CONT14 Campaign.

3 Current Analysis of the CORE Operation Center's IVS Sessions

Table 1 gives the average formal errors for the R1, R4, RDV, R&D, and T2 sessions from 2013. The R1 session formal uncertainties are not significantly different from the 2011-2012 errors. The R4 uncertainties for the 2012-2013 sessions are much better than for 2011. R4 stations performed better in 2012-2013 than in 2011, where 37 sessions lost one or more stations from the original scheduled network. R1 uncertainties for 2011-2013 could be reduced if we used a GPS a priori model to obtain the post-earthquake behavior at Tsukuba instead of estimating the TSUKUB32 position for each session, thereby weakening its contribution to EOP.

RDV uncertainties are about 10% larger for 2013 than for 2011 and 2012. The RDV formal errors are still better than the other experiment series. This is due to the large number of stations in the RDV sessions as well as to better global geometry. T2 uncertainties for X-pole and nutation in longitude are clearly better in 2013 than for 2011-2012. For comparison, we also included the formal uncertainties for the CONT11, which are much better than any of the networks discussed above that observed in 2013.

Table 2 shows EOP differences with respect to the IGS series for the R1, R4, T2, RDV, and CONT11 series. The WRMS differences were computed after removing a bias, but estimating rates does not affect the residual WRMS significantly. Except for the R4 X-pole, R1 and R4 series have worse WRMS agreement in X-pole, Y-pole, and LOD for 2013 than for these series since 2000. Part of this may be explained by the treatment of TSUKUB32 in solutions as discussed above. Adopting the improved GPS a priori model strategy above improves the R1 agreement with IGS by 20%. It is not understood why the R4 Y-pole WRMS difference relative to IGS is so much greater for 2013 than for the long-term series. Both the X-pole and Y-pole biases of the R1 and R4 sessions relative to IGS differ by 70 uas, which is much greater than the uncertainty of the bias estimates. Of all the series, the RDV series has the best WRMS agreement of X-pole and Y-pole with IGS estimates in 2013 and for the full period, 2000-2013. For comparison with the 2013 sessions discussed here, we included the statistics for the 15 CONT11 sessions, which shows the best WRMS agreement with IGS. This is expected because the CONT11 network 1) has better geometry and 2) is unchanged over the period of 15 days of continuous observing.

4 The CORE Operations Staff

Table 3 lists the key technical personnel and their responsibilities so that everyone reading this report will know whom to contact about their particular question.

5 Planned Activities during 2014

The CORE Operation Center will continue to be responsible for the following IVS sessions during 2014:

- The IVS-R1 sessions will be observed weekly and recorded in Mark 5 mode.
- The IVS-R&D sessions will be observed ten times during the year.
- The RDV sessions will be observed six times during the year.

Table 1 Average EOP Formal Uncertainties for 2013.

Session Type	Num	X-pole (μas)	Y-pole (μas)	UT1 (μs)	DPSI (μas)	DEPS (μas)
R1	51	67(73,67)	66(63,65)	3.1(3.4,3.0)	105(110,111)	42(44,45)
R4	5l	68(70,84)	66(67,75)	2.9(2.8,3.2)	120(124,160)	49(49,65)
RDV	6	54(48,49)	54(48,46)	2.8(2.5,2.5)	82(68,75)	33(28,30)
T2	6	67(83,89)	66(66,90)	3.4(3.9,4.3)	130(146,176)	50(57,67)
CONT11	15	39	38	1.7	42	17

Values in parentheses are for 2012 and then 2011.

Table 2 Offset and WRMS Differences (2013) Relative to the IGS Combined Series.

		X-pole		Y-pole		LOD	
Session Type	Num	Offset (μas)	WRMS (μas)	Offset (μas)	WRMS (μas)	Offset (μs/d)	WRMS (μs/d)
R1	51(620)	-103(-1)	124(104)	6(12)	122(91)	2.6(0.8)	22(17)
R4	51(618)	-33(-22)	97(113)	72(21)	134(115)	0.8(1.8)	18(18)
RDV	6(84)	41(58)	68(81)	-46(2)	70(68)	2.1(-0.2)	12(14)
T2	6(81)	0.3(3)	108(141)	47(5)	128(117)	10.8(2.2)	16(19)
CONT11	15	42 36	9	29	7.0	7	

Values in parentheses are for the entire series (since 2000) for each session type.

Table 3 Key Technical Staff of the CORE Operations Center.

Name	Responsibility	Agency
Dirk Behrend	Organizer of CORE program	NVI, Inc./GSFC
Brian Corey	Analysis	Haystack
Ricky Figueroa	Receiver maintenance	ITT Exelis
John Gipson	SKED program support and development	NVI, Inc./GSFC
Frank Gomez	Software engineer for the Web site	Raytheon/GSFC
David Gordon	Analysis	NVI, Inc./GSFC
Ed Himwich	Network Coordinator	NVI, Inc./GSFC
Dan MacMillan	Analysis	NVI, Inc./GSFC
Katie Pazamickas	Maser maintenance	ITT Exelis
David Rubincam	Procurement of materials necessary for CORE operations	GSFC/NASA
Braulio Sanchez	Procurement of materials necessary for CORE operations	GSFC/NASA
Dan Smythe	Tape recorder maintenance	Haystack
Cynthia Thomas	Coordination of master observing schedule and preparation of observing schedules	NVI, Inc./GSFC