3.5.2 Rapid Service/Prediction Centre

Processing Techniques

The algorithm used by the IERS Rapid Service/Prediction Center (RS/PC) for the determination of the quick-look Earth orientation parameters (EOP) is based on a weighted cubic spline with adjustable smoothing fit to contributed observational data (McCarthy and Luzum, 1991a). Contributed data are corrected for possible systematic differences. Offsets and rates with respect to the 08 C04 system of the IERS Earth Orientation Centre (EOC) at the Paris Observatory are determined using a robust linear estimator (Matlab function 'regstats'). Statistical weighting used in the spline is proportional to the inverse square of the estimated accuracy of the individual techniques. Minimal smoothing is applied, consistent with the estimated accuracy of the observational data.

Weights in the algorithm may be either *a priori* values estimated by the standard deviation of the residual of the techniques or values based on the internal precision reported by contributors. Estimated accuracies of data contributed to the IERS Rapid Service/Prediction Center are given in Table 1. These estimates are based on the residuals between the series and the combined RS/PC EOP solution for 2012.

Table 1: Estimated accuracies of the contributors in 2012. Units are milliseconds of arc for x, y, $d\psi$, $d\varepsilon$, dX, and dY and milliseconds of time for UT1–UTC.

Contributor Information	Estimated Accuracy				
Name, Type	x	y	UT1	$\delta\psi$ (dX)	$\delta\varepsilon$ (dY)
ILRS SLR	0.19	0.17			
IAA SLR	0.22	0.21			
MCC SLR	0.15	0.22			
GSFC VLBI Intensives			0.020		
USNO VLBI Intensives			0.018		
GSI Intensives			0.015		
GSFC VLBI	0.13	0.12	0.004	0.51	0.20
IAA[1] VLBI	0.22	0.13	0.007	(0.07)	(0.08)
IVS[1] VLBI	0.17	0.17	0.003	(0.03)	(0.04)
USNO VLBI	0.18	0.14	0.004	0.20	0.08
IGS Final	0.01	0.01			
IGS Rapid	0.03	0.03			
IGS Ultra*	0.04	0.05	0.007*		
USNO GPS UT*			0.017*		

*All satellite techniques provide information on the rate of change of Universal Time contaminated by effects due to unmodeled orbit node motion. VLBI-based results have been used to correct for LOD biases and to minimize drifts in UT estimates.

[1] IAA and IVS VLBI nutation values are in terms of dX/dY using IAU 2000A Nutation Theory (see Petit and Luzum, 2010).

Table 2: Mean and standard deviation of the differences between the Rapid Service/Prediction Center combination solutions and the 08 C04 EOP solutions for 2012. Polar motion x and y values are in milliseconds of arc and UT1–UTC values are in units of milliseconds of time.

	Bulletin A – C04	
	Mean	Std. Deviation
Bulletin A Rapid Solution (finals.data)		
x	0.00	0.02
y	0.00	0.03
UT1-UTC	0.004	0.018
Bulletin A Weekly Solution (finals.data)[1]		
x	0.03	0.04
y	0.02	0.04
UT1-UTC	0.002	0.023
Bulletin A Daily Solution (finals.daily)		
x	0.02	0.05
y	0.03	0.05
UT1-UTC	-0.001	0.035

[1] Statistics computed over the 7-day combination solution period prior to solution epoch.

Operationally, the weighted spline uses as input the epoch of observation, the observed value, and the weight of each individual data point. The software computes the spline coefficients for every data point, which are then used to interpolate the Earth orientation parameter time series so that x, y, UT1–UTC, $\delta\psi$, and $\delta\varepsilon$ values are computed at the epoch of zero hours UTC for each day. While the celestial pole offset combination software can combine either $\delta\psi$ and $\delta\varepsilon$ or dX and dY, for historical reasons, it uses $\delta\psi$ and $\delta\varepsilon$. Therefore, IAA and IVS VLBI dX and dY values are converted to $\delta\psi$ and $\delta\varepsilon$ in the combination process. The LOD for the combination are derived directly from the UT1–UTC data. The analytical expression for the first derivative of a cubic spline passing through the UT1–UTC data is used to estimate the LOD at the epoch of the UT1–UTC data.

The only data points that are excluded from the combination process are the points whose errors, as reported by the contributors, are greater than three times their average reported precision, or those points that have a residual that is more than four times the associated *a priori* error estimate. Since all of the observations are reported with the effects of sub-daily variations removed, the input data are not corrected for these effects (see IERS Gazette No. 13, 30 January 1997).

The uncertainties in the daily values listed in Bulletin A are derived from the quality of the spline fit in the neighborhood of the day in question. Table 2 shows the accuracies of Rapid Service/Prediction Center's combination solution for the running, weekly, and daily products compared to the 08 C04 series maintained by the IERS EOC. The running solution is the combination solution over the past 366-day period. The statistics for the running solution at year's end show the agreement between the Bulletin A running combination solution and the C04 series.

The comparison of the 52 weekly solutions to the 08 C04 series gives the statistics of the residuals computed over the new combination results for the 7-days prior to the solution epoch ("Bulletin A Weekly Solution" statistics). The statistics for the daily solution are determined from a series of differences spanning one year where each element of the series is the difference for the day of the solution epoch ("Bulletin A Daily Solution" statistics). EOP accuracies for the Bulletin A rapid weekly solution for the new combination for the day of the solution run and daily solution at the time of solution epoch are similar and, therefore, not included in the table.

Figure 1 shows the residuals between the daily rapid solution and the 08 C04 and presents the data used in Table 2 for the determination of the daily solution statistics. In 2012, the mean residuals between the daily solution and the 08 C04 were essentially the same as in 2011.

Prediction Techniques

In 2007, the algorithm for polar motion predictions was changed to incorporate the least-squares, autoregressive (LS+AR) method created by W. Kosek and improved by T. Johnson (personal communication, 2006). This method solves for a linear, annual, semiannual, 1/3 annual, 1/4 annual, and Chandler periods fit to the previous 400 days of observed values for x and y. This deterministic model is subtracted from the polar motion values to create residuals that are more stochastic in nature. The AR algorithm is then used to predict the stochastic process while a deterministic model consisting of the linear, annual, semiannual, and Chandler terms is used to predict the deterministic process. The polar motion prediction is the addition of the deterministic and stochastic predictions. The additional unused terms in the deterministic solution help to absorb errors in the deterministic model caused by the variable amplitude and phase of the deterministic components (T. Johnson, personal communication, 2006). For more information on the implementation of the LS+AR model, see Stamatakos *et al.* (2008). A deficiency with the current implementation of this algorithm occasionally causes poor quality short-term polar motion predictions. Mitigation strategies are currently being investigated.

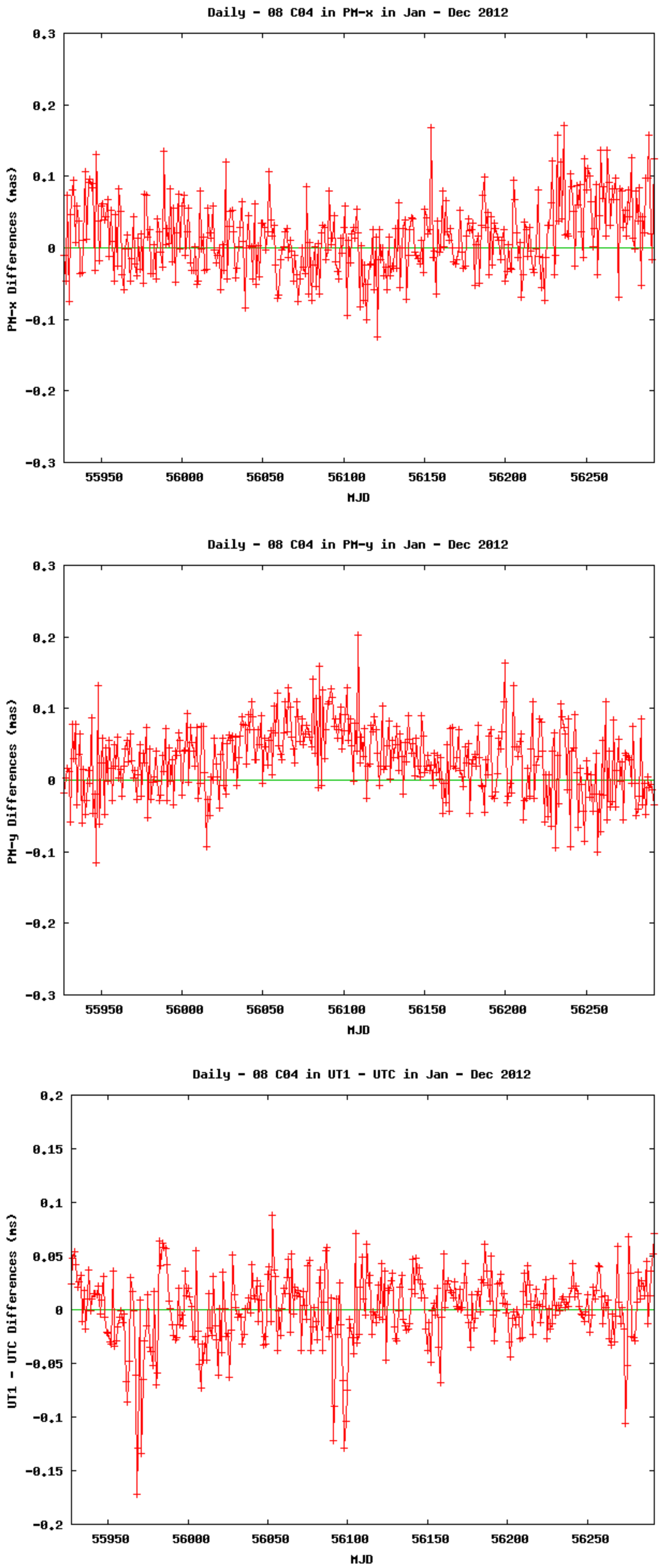

Fig. 1: Differences between the daily rapid solutions at each daily solution epoch for 2012 and the Earth orientation parameters available in the 08 C04 series produced in April 2013.

The UT1–UTC prediction makes use of a UT1-like data product derived from a combination of the operational National Centers for Environmental Prediction (NCEP) and U.S. Navy's Operational Global Atmospheric Prediction System (NOGAPS) model's AAM analysis and forecast data (UTAAM). AAM-based predictions are used to determine the UT1 predictions out to a prediction length of 7.5 days. For longer predictions, the LOD excitations are combined smoothly with the longer-term UT1 predictions described below. For more information on the use of the UT AAM data, see Stamatakos *et al.* (2008).

The procedure for UT1–UTC involves a simple technique of differencing (McCarthy and Luzum, 1991b). All known effects such as leap seconds, solid Earth zonal tides, and seasonal effects are first removed from the observed values of UT1–UTC. Then, to determine a prediction of UT1–UTC n days into the future, $(UT2R–TAI)_n$, the smoothed time value from n days in the past, $<(UT2R–TAI)_{-n}>$ is subtracted from the most recent value, $(UT2R–TAI)_0$

$$(UT2R–TAI)_n = 2(UT2R–TAI)_0 - <(UT2R–TAI)_{-n}>.$$

The amount of smoothing used in this procedure depends on the length of the forecast. Short-term predictions with small values of n make use of less smoothing than long-term predictions. Once this value is obtained, it is possible to restore the known effects in order to obtain the prediction of UT1–UTC. This process is repeated for each day's prediction.

The UT1–UTC prediction out to a few days is also strongly influenced by the observed daily Universal Time estimates derived at USNO from the motions of the GPS orbit planes reported by the IGS Rapid service (Kammeyer, 2000). The IGS estimates for LOD are combined with the GPS-based UT estimates to constrain the UT1 rate of change for the most recent observation.

Errors of the prediction estimates are derived from analyses of the past differences between observations and the published predictions. Formulas published in Bulletin A can be used to extend the tabular data, but predictions derived from these formulas are significantly less accurate than the tabular predictions and are not recommended for operational use. The predictions of $\delta\psi$ and $\delta\varepsilon$ are based on the IERS Conventions (McCarthy, 1996; McCarthy and Petit, 2004).

For 2012, the polar motion prediction errors were roughly the same accuracy as compared to the 2011 values. Figure 2 provides a plot of the prediction error as a function of polar motion value. The improvement over the last few years in UT1–UTC short-term prediction is due to the improved availability of rapid turnaround e-VLBI intensives. Table 3a shows the root mean square of the differences between the daily solution predictions and the 08 C04 solution for 2012.

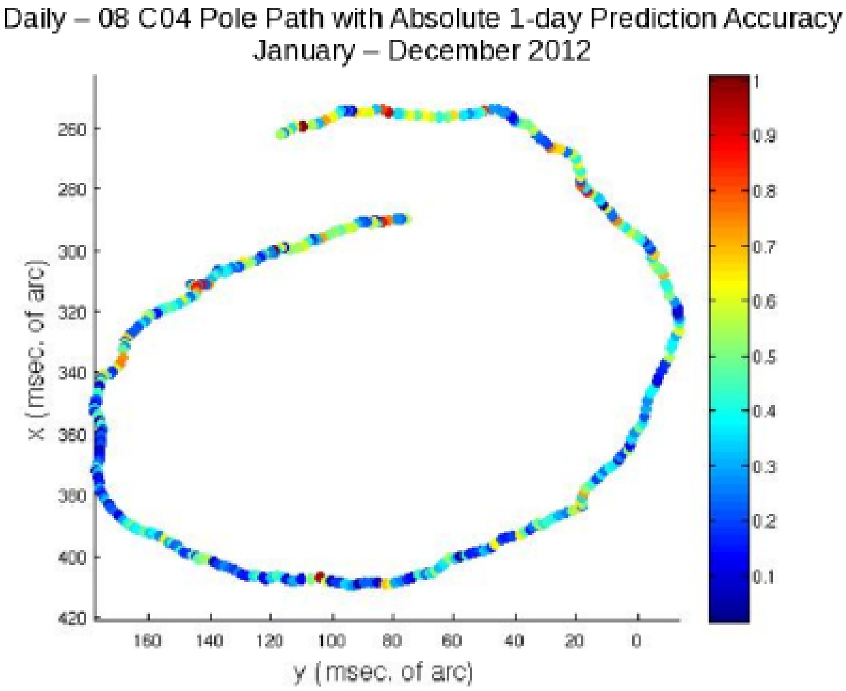

Fig. 2: Plot of the prediction error as a function of polar motion. The prediction error is in units of milliseconds of arc.

Table 3a: Root mean square of the differences between the EOP time series predictions produced by the daily solutions and the 08 C04 combination solutions for 2012. Note that the prediction length starts counting from the day after the last available observation is made for polar motion or UT1–UTC (or UT-like data).

Days in Future	PM-x mas	PM-y mas	UT1-UTC ms
1	.35	.25	.063
5	2.01	1.35	.256
10	3.92	2.76	.662
20	7.52	5.66	2.22
40	13.7	11. 3	5.77
90	22.1	24.4	10.8

The predictions of celestial pole offsets (both dX/dY and $\delta\psi/\delta\varepsilon$ representations) are produced through the use of the KSV1996 model (McCarthy, 1996). In addition, a bias between the model and the last 20 days of celestial pole offset observations is computed. Correcting for this bias allows for a seamless transition between the observed and predicted celestial pole offsets. This bias is tapered so that as the prediction length is extended, the bias becomes progressively smaller. Since celestial pole offsets are based solely on VLBI data, if no new VLBI 24-hour session observations are available, a new rapid combination/prediction of these angles is not determined. Therefore, the predictions of celestial pole offsets start before the solution epoch and the length of the prediction into the future can and does vary in the daily solution files. The differences between the daily predictions and the 08 C04 for 2012 are given in Table 4.

Table 4: Root mean square of the differences between the nutation prediction series produced by the daily solutions and the 08 C04 combination solutions for 2012.

Days in Future	dX mas	dY mas	δψ mas	δε mas
1	.13	.14	.32	.13
5	.13	.15	.34	.14
10	.15	.16	.38	.15
20	.17	.18	.44	.17
40	.22	.23	.57	.22

Predictions of TT–UT1, up to 1 April 2023, are given in Table 5. They are derived using a prediction algorithm similar to that employed in the Bulletin A predictions of UT1–UTC. Up to twenty years of past observations of TT–UT1 are used. Estimates of the expected one-sigma error for each of the predicted values are also given. These errors are based on analyses of the past performance of the model with respect to the observations.

Additional information on improvements to IERS Bulletin A and the significance for predictions of GPS orbits for real-time users is available (Luzum *et al.*, 2001; Wooden *et al.*, 2005; Stamatakos *et al.*, 2008; Stamatakos *et al.*, 2009; Stamatakos *et al.*, 2010).

Center Activities in 2012

During 2012, a number of significant changes occurred in the RS/PC products. On 29 November 2012, the zonal tide model was changed to be compliant with the IERS Conventions (2010). There are no statistical differences between solutions with the two zonal tide models.

For 2012, the IERS RS/PC computed four EOP solutions each day — the original solution at 17:10 UTC and new solutions at 21:10, 03:10, and 09:10 UTC. These solutions are collectively referred to as the Nxdaily solutions. The original solution at 17:10 UTC has been produced by the IERS RS/PC each day for over 10 years. The additional solutions are part of an ongoing effort to improve the accuracy of the EOP solutions by updating EOP solutions soon after new observational data are available, thereby reducing the latency between observations and EOP solution updates. Examples of these new observational input data are eVLBI intensives and IGS Ultra-Rapid solutions (IGS ultras). Tables 6a and 6b illustrate the relationship between the EOP solution times and these input data.

Table 5: Predicted values of TT–UT1, 2013–2023. Note that UT1–TAI can be obtained from this table using the expression UT1–TAI = 32.184s – (TT–UT1).

DATE	TT–UT1 (s)	Uncertainty (s)
2013 Jul 1	67.121	0.008
2013 Oct 1	67.16	0.01
2014 Jan 1	67.27	0.02
2014 Apr 1	67.38	0.02
2014 Jul 1	67.5	0.2
2014 Oct 1	67.6	0.3
2015 Jan 1	67.7	0.4
2015 Apr 1	67.8	0.4
2015 Jul 1	67.9	0.5
2015 Oct 1	68.1	0.7
2016 Jan 1	68.2	0.8
2016 Apr 1	68.3	0.9
2016 Jul 1	68.	1.
2016 Oct 1	69.	1.
2017 Jan 1	69.	1.
2017 Apr 1	69.	1.
2017 Jul 1	69.	2.
2017 Oct 1	69.	2.
2018 Jan 1	69.	2.
2018 Apr 1	69.	2.
2018 Jul 1	70.	2.
2018 Oct 1	70.	2.
2019 Jan 1	70.	2.
2019 Apr 1	70.	3.
2019 Jul 1	70.	3.
2019 Oct 1	70.	3.
2020 Jan 1	70.	3.
2020 Apr 1	70.	3.
2020 Jul 1	71.	3.
2020 Oct 1	71.	3.
2021 Jan 1	71.	4.
2021 Apr 1	71.	4.
2021 Jul 1	71.	4.
2021 Oct 1	71.	4.
2022 Jan 1	71.	4.
2022 Apr 1	71.	5.
2022 Jul 1	71.	5.
2022 Oct 1	72.	5.
2023 Jan 1	72.	5.
2023 Apr 1	72.	5.

At each Nxdaily UTC solution time listed in Tables 6a and 6b, major contributors are listed with an associated “epoch at midpoint”. IGS and VLBI solutions are determined from a span of observations and the EOP estimate is provided at the midpoint of this span. Typically IGS orbits are integrated over a 24-hour period and VLBI intensives observations of quasars are integrated over a 1-hour period. The Contributor column contains the most recently available input at the time of each UTC solution.

Table 6a lists the most recent major input contributors for each polar motion Nxdaily solution. For example, by the polar motion 17:10 UTC <MJD> solution time, the most recently computed IGS Rapid solution, which has an epoch at midpoint of 12:00 UTC noon from the previous day, <MJD-1>, is available. In addition, there are two IGS ultras available that contain an epoch at midpoint after the IGS rapid. By 21:10 UTC <MJD>, the IGS has produced an updated IGS ultra, the 18-hr solution, and the corresponding EOP solution will use this latest data. Similarly, the 03:10 UTC and 09:10 UTC solutions will have later IGS ultra data available as shown in the table. Finally, for the next day, <MJD+1>, the sequence of IGS Rapids and Ultras will repeat — the 17:10 UTC <MJD+1> solution will have the next IGS rapid solution whose midpoint was at 12:00 UTC <MJD> along with the next 6-hr and 12-hr Ultras.

In Table 6b, a similar pattern for UT1-UTC to what was described above for polar motion is shown. In addition to the IGS contributions, the VLBI intensives series and AAM contributions are included. VLBI intensives are not available as regularly as the IGS observations, and so the contributors shown for each solution are only an ideal case that occurs roughly 70% of the time. The INT1 intensives are typically only observed on weekdays, the INT2 intensives on weekends, and the INT3 intensives on Mondays. For more information about the relation of the INT1, INT2, and INT3 VLBI intensives observation times to the EOP solution see Stamatakos *et al., AGU poster G51A-1084*.

Within each Nxdaily EOP solution file — each called finals.daily and finals2000A.daily, but located in separate sub-directories — there are EOP solutions for polar motion, UT1–UTC and celestial pole offsets. Each has an identical format to the original 17:10 UTC solution.

Tables 3a through 3d contain the RMS for the 1- to 90-day prediction errors for the 17:10, 21:10, 03:10, and 09:10 UTC EOP solutions for 2012. The polar motion short-term prediction solutions should improve at each later EOP update (starting from the 17:10 UTC <MJD> to the 09:10 UTC <MJD+1> solution) since the later EOP solution will have more recent observations. The 2012 one and five day polar motion prediction results shown in Tables 3a and 3d confirm this improvement. The 1-day polar motion prediction

Table 6a and 6b: Tables describing the data available for each of the NXdaily solutions.

Table 6a: Major Contributors for the Polar Motion EOP solution at the Nxdaily Solution Times

1700 UTC solution		2110 UTC solution		0310 UTC solution		0910 UTC solution	
Contributor	**Epoch at Midpoint***	**Contributor**	**Epoch at Midpoint***	**Contributor**	**Epoch at Midpoint***	**Contributor**	**Epoch at Midpoint***
IGS 12 hr Ultra	00:00	IGS 18 hr Ultra	+06:00	IGS 0 hr Ultra	+12:00	IGS 6 hr Ultra	+18:00
IGS 6 hr Ultra	-06:00	IGS 12 hr Ultra	00:00	IGS 18 hr Ultra	+06:00	IGS 0 hr Ultra	+12:00
IGS Rapid	-12:00	IGS 6 hr Ultra	-06:00	IGS 12 hr Ultra	00:00	IGS 18 hr Ultra	+06:00
		IGS Rapid	-12:00	IGS 6 hr Ultra	-06:00	IGS 12 hr Ultra	00:00
				IGS Rapid	-12:00	IGS 6 hr Ultra	-06:00
						IGS Rapid	-12:00

Table 6b: Major Contributors for the UT1-UTC EOP solution at the Nxdaily Solution Times

1700 UTC solution		2110 UTC solution		0310 UTC solution		0910 UTC solution	
Contributor	**Epoch at Midpoint***	**Contributor**	**Epoch at Midpoint***	**Contributor**	**Epoch at Midpoint***	**Contributor**	**Epoch at Midpoint***
AAM LOD[3]		AAM LOD[3]		AAM LOD[3]		AAM LOD[3]	
INT2 / 3 VLBI intensive[1]	+08:00	INT2 / 3 VLBI intensive[1]	+08:00	IGS 0 hr Ultra	+12:00	IGS 6 hr Ultra	+18:00
IGS 12 hr Ultra	00:00	IGS 18 hr Ultra	+06:00	INT2 / 3 VLBI intensive[1]	+08:00	IGS 0 hr Ultra	+12:00
INT1 VLBI intensive[2]	-05:00	IGS 12 hr Ultra	00:00	IGS 18 hr Ultra	+06:00	INT2 / 3 VLBI intensive[1]	+08:00
IGS 6 hr Ultra	-06:00	INT1 VLBI intensive[2]	-05:00	IGS 12 hr Ultra	00:00	IGS 18 hr Ultra	+06:00
IGS Rapid	-12:00	IGS 6 hr Ultra	-06:00	INT1 VLBI intensive[2]	-05:00	IGS 12 hr Ultra	00:00
		IGS Rapid	-12:00	IGS 6 hr Ultra	-06:00	INT1 VLBI intensive[2]	-05:00
				IGS Rapid	-12:00	IGS 6 hr Ultra	-06:00
						IGS Rapid	-12:00

* IGS and VLBI solutions are determined by integrating a period of observation times. The EOP reported is the observation mid-point.

1 INT2 and INT3 intensives are normally observed Saturday through Monday with an epoch at midpoint at approximately 08:00 UTC.

2 INT1 intensives are normally observed Monday through Friday with an epoch at midpoint at approximately 19:00 UTC.

3 The AAM LOD inputs contain 7.5 days of forecast data from 00:00 to 180:00 hours.

from the 17:10 UTC <MJD> EOP solution will make a prediction of the polar motion at 00:00 UTC <mjd+1>. The 1-day polar motion prediction from the 09:10 UTC <MJD+1> EOP solution will make a prediction of the polar motion at 00:00 <MJD+1>. The percentage decrease in error was significant — 21% for PMx and 24% for PMy. Improvements of a consistently smaller magnitude are made between the 17:10 and 21:10 UTC and between the 17:10 and 03:10 UTC solutions, as can be seen by comparing results among Tables 3a, 3b, 3c, and 3d.

Table 3b, 3c, and 3d: Root mean square of the differences between the EOP time series predictions produced by the 4x daily solutions and the 08 C04 combination solutions for 2012. Note that the prediction length starts counting from the day after the last available observation is made for polar motion or UT1–UTC/LOD.

Table 3b: RMS for the 21:10 UTC EOP solution for 2012.

Days in Future	PM-x mas	PM-y mas	UT1-UTC ms
1	.30	.22	.062
5	1.93	1.31	.257
10	3.86	2.74	.666
20	7.48	5.67	2.22
40	13.7	11.4	5.77
90	22.2	24.1	10.8

Table 3c: RMS for the 03:10 UTC EOP solution for 2012.

Days in Future	PM-x mas	PM-y mas	UT1-UTC ms
1	.28	.19	.057
5	1.88	1.27	.261
10	3.84	2.71	.669
20	7.49	5.64	2.22
40	13.7	11.3	5.74
90	22.1	23.9	10.7

Table 3d: RMS for the 09:10 UTC EOP solution for 2012.

Days in Future	PM-x mas	PM-y mas	UT1-UTC ms
1	.27	.19	.055
5	1.84	1.28	.263
10	3.83	2.74	.675
20	7.50	5.0	2.22
40	13.8	11.4	5.73
90	22.4	23.9	10.7

For the 5-day polar motion predictions, the percentage decrease in error was significant (but smaller than for the 1-day predictions) — 8% for PMx and 5% for PMy. For the 10-, 20-, 40-, and 90-day predictions, there is no statistically significant change in prediction accuracies among the various Nxdaily solutions.

The UT1–UTC 1-day predictions also show improvements from the 17:10 UTC <MJD> to the 09:10 UTC <MJD+1> solutions; however, the percentage decrease is much smaller than it was for polar motion — a decrease in error of 12%. The 5-day predictions do not show an improvement. There also was improvement in the 1-day predictions when comparing the 17:10 UTC to the 21:10 and 03:10 UTC solutions; yet, as to be expected the improvement was less than 12%.

There are no rapid turnaround estimates of celestial pole offsets; only 24-hour VLBI solutions provide celestial pole offsets. These 24-hr solutions can be latent by one to two weeks, and therefore, it is anticipated that there will be no statistically significant difference between celestial offset prediction solutions. No tables of statistics for celestial pole offsets are presented in this report.

Each of the Nxdaily EOP solutions are updated daily at approximately 17:10 UTC, 21:10 UTC, 03:10 UTC, and 09:10 UTC, respectively. They are located in subdirectories of the following URLs:

<http://maia.usno.navy.mil/> or <http://toshi.nofs.navy.mil/>

Time (UTC)	**Sub-directory**
17:10	ser7
21:10	eop2100utc
03:10	2xdaily
09:10	eop0900utc

For, example, the EOP USNO DC solution produced at 03:10 UTC is located at <http://maia.usno.navy.mil/2xdaily/finals.daily> or finals2000A.daily.

An identical process has been implemented for 2013 to what was implemented for 2012. Solution names and locations have remained the same from 2012 to 2013.

New global solutions were received from the GSFC VLBI Analysis Center (gsf2012a) and the USNO VLBI Analysis Center (usno2012a and usno2012b). These new solutions were examined and new slopes and biases were computed before being incorporated into operations.

The IERS RS/PC now provide the same operational EOP products generated at USNO DC at an offsite location at the Naval Observatory Flagstaff Station (NOFS). The solutions at the USNO DC and NOFS are checked on a daily basis to ensure that there are no discrepancies between the two. This redundancy provides an alternative location from which to obtain a solution should the primary facility at USNO DC be unable to deliver its EOP product due to internet outage, power outage, etc.

The EO transformation calculator was maintained throughout the year. The calculator can now produce rotation matrix elements calculated using the IERS Technical Note 36 equinox-based algorithm (Petit and Luzum, 2010). This web-based product will provide both the transformation matrices as well as quaternion representations of the rotations between terrestrial and celestial reference frames.

Availability of Rapid Service

The data available from the IERS Rapid Service/ Prediction Center consist mainly of the data used to derive the IERS Bulletin A combination solution. These data include: x, y, UT1–UTC, dX and dY from IAA VLBI; x, y, UT1–UTC, $\delta\psi$ and $\delta\varepsilon$ from GSFC VLBI; x, y, UT1–UTC, $\delta\psi$ and $\delta\varepsilon$ from USNO VLBI; x, y, UT1–UTC, dX and dY from IVS combination VLBI; UT1–UTC from GSFC 1-day Intensives; UT1–UTC from USNO 1-day Intensives; UT1–UTC from GSI 1-day Intensives; x, y from International Laser Ranging Service 1-day SLR; x, y from Institute of Applied Astronomy 1-day SLR; x, y from the Russian Mission Control Centre 1-day SLR; x, y, LOD from the International GNSS Service; UT from USNO GPS; UT from NCEP AAM; UT from NAVY NOGAPS AAM; x, y, UT1–UTC, $\delta\psi$ and $\delta\varepsilon$, and dX and dY from the IERS Rapid Service/ Prediction Center; x, y, UT1–UTC, $\delta\psi$ and $\delta\varepsilon$ from the IERS Earth Orientation Centre; and predictions of x, y, UT1–UTC, $\delta\psi$ and $\delta\varepsilon$, and dX and dY from the IERS Rapid Service/Prediction Center.

Other data sets are available that include: UT from NRCanada (EMR) GPS; UT0–UTC from University of Texas as Austin LLR, UT0–UTC from JPL LLR; UT0–UTC from CERGA LLR; UT0–UTC from JPL VLBI; latitude and UT0–UTC from Washington PZTs 1,3,7; latitude and UT0–UTC from Richmond PZTs 2,6; LOD from ILRS 1-day SLR; x, y, UT1–UTC from CSR LAGEOS 3-day SLR; x and y from CSR LAGEOS 5-day SLR; x and y from Delft 1-, 3- and 5-day SLR; and x, y, UT1–UTC, $\delta\psi$ and $\delta\varepsilon$ from IRIS VLBI.

The data described above are available from the Center in a number of forms. You may request a weekly machine-readable version of the IERS Bulletin A containing the current 365 days' worth of predictions via electronic mail from

ser7@maia.usno.navy.mil or through
<http://www.usno.navy.mil/USNO/earth-orientation>.

Internet users can also direct an anonymous FTP to

<ftp://maia.usno.navy.mil/ser7> or
<ftp://toshi.nofs.navy.mil/ser7>

where the IERS Bulletin A and more complete databases can be accessed including the daily solutions.

Center Staff

The Rapid Service/Prediction Center staff consisted of the following members:

Brian J. Luzum	Director
Nick Stamatakos	Operational program manager, research, and software maintenance
Merri Sue Carter	Assists in daily operations and support
Beth Stetzler	Assists in daily operations and support, research, and software maintenance
Nathan Shumate	Assists in daily operations and support, research, and software maintenance

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