Automated analysis of dUT1 from IVS Intensive sessions

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1. Three analysis strategies

The Vienna VLBI Software (VieVS) version-1D is used in its batch mode to analyze IVS intensive sessions automatically in order to derive the Earth rotation parameter dUT1. The automation process uses a shell script that is run daily by a cron process. The goal is to achieve dUT1 results as soon as the observed delays are available as a NGS file. Three types of analysis strategies (S-1, S-2, S-3) are used in the process in order to compare different modeling options. The different modeling options used for the different strategies are listed in Table 1.

Table 1. Modelling options for strategies S-1, S-2 and S-3.

Strategy	S-1	S-2	S-3
EOP dUT1	USNO finals2000A	USNO finals2000A	IERS C04
Mapping function	GMF	VM1	VM1
Atm. loading	no	yes	yes

Table 2. Other models used.

TRF	VTRF2008
CRF	ICR2
Precession/nutation	IAU 2000A
Ocean loading	FES2004
Hf EOP	IERS conv. 2003
Ephemerides	JPL421

All other models are identical for the S-1, S-2 and S-3, see Table 2.

2. Latency of the results

The latency of the results for the S-1 is 2-3 days from the end of a session and is dominated by the time that is necessary to correlate the observational data and to pre-process the data, i.e. to provide a NGS file where group delay ambiguities are resolved and the ionospheric effects are corrected.
The latency of the results for the S-2 is slightly worse, about 3-4 days, mainly due to the time that it takes until VMF1 and atmospheric loading based on ECMWF analysis data are available.
The latency of the results for the S-3 is even worse, 30 days, and is dominated by the time that it takes until the IERS C04 data are available.

3. Results

Table 3 presents the RMS values of the corrections with respect to the a priori used dUT1 values and the RMS values of the formal errors for the three analysis strategies. As the latency becomes worse, the variation of the dUT1 gets smaller. In order to improve the latency of strategy S-1 we currently work on to include the necessary pre-processing steps, i.e. group delay ambiguity resolution and ionospheric corrections, directly into VieVS.
Figure 1 and 2 depict the dUT1 results for both INT1 and INT2 sessions using the three different strategies. Strategies S-1 and S-2 use a priori Earth orientation parameters (EOP) from USNO finals2000A. Usually, these values are predicted EOP, resulting in the results shown with red dots. In case of additional delays, e.g. late availibility of NGS files, the USNO finals2000A has been updated already by final EOP. Results obtained using these a prioris are shown with green dots.

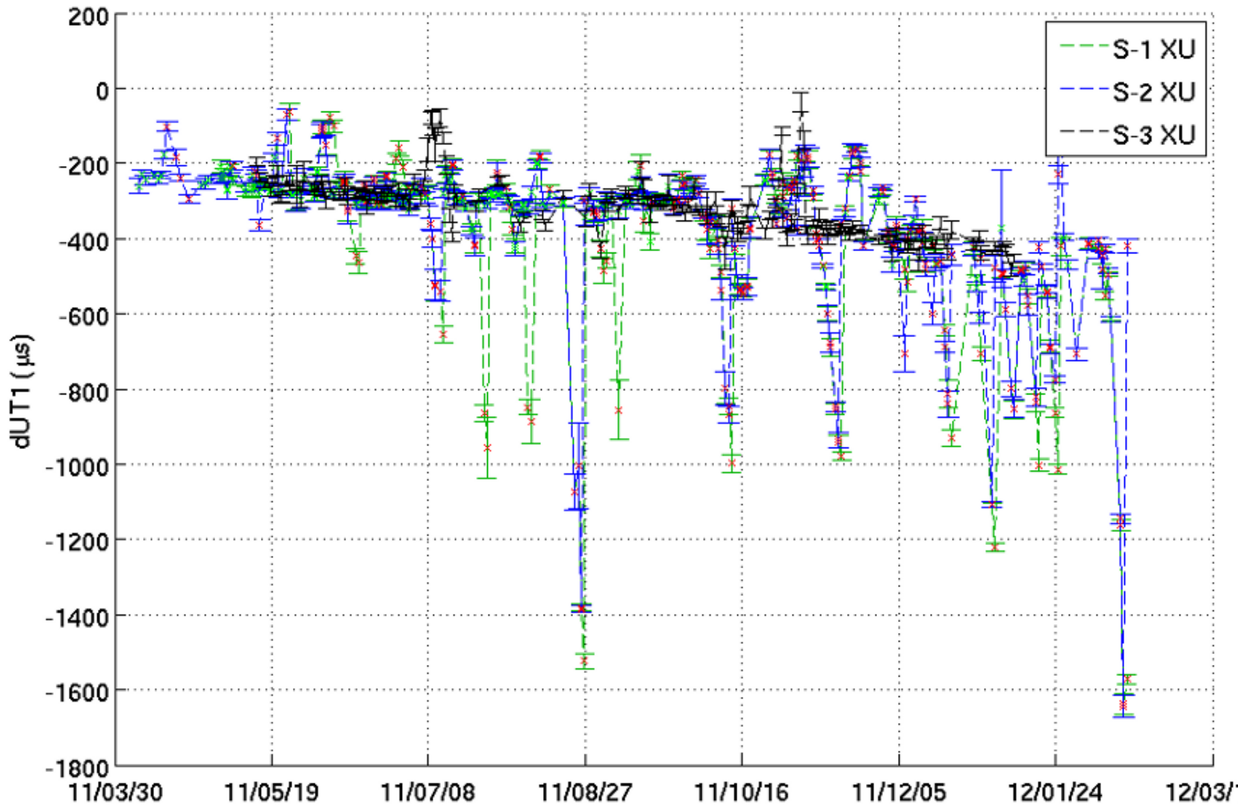

Figure 1. dUT1 from INT1 using strategies S-1, S-2 and S-3. Red and green dots indicate that the a priori EOP from USNO finals2000A were either predicted EOP (red) or final EOP (green).

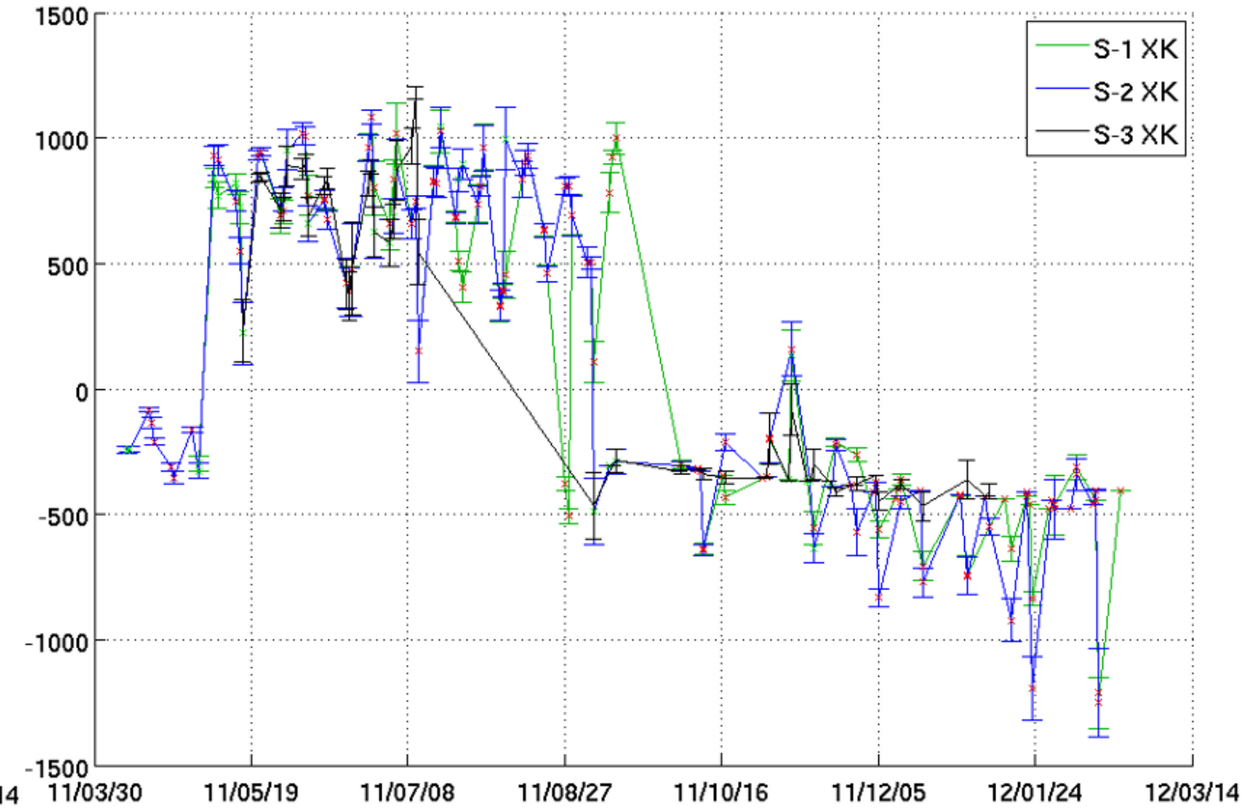

Figure 2. dUT1 from INT2 using strategies S-1, S-2 and S-3. Red and green dots indicate that the a priori EOP from USNO finals2000A were either predicted EOP (red) or final EOP (green).

Table 3. RMS values of the corrections with respect to a priori dUT1 values and the formal errors for the three strategies S-1, S-2 and S-3 for both INT1 and INT2 sessions.

Session/strategy	INT1/S-1	INT1/S-2	INT1/S-3
$RMS_{dUT1\_estimate}$ (µs)	234.05	163.76	56.88
RMS_{formal_error} (µs)	20.95	22.28	17.27
Session/strategy	INT2/S-1	INT2/S-2	INT2/S-3
$RMS_{dUT1\_estimate}$ (µs)	876.09	843.75	818.78
RMS_{formal_error} (µs)	67.70	70.42	76.11

The results of the automated analysis are provided both as data files and in graphical form on the Metsähovi Radio Observatory web pages
http://www.metsahovi.fi/vlbi/vievs/results_GMF .../results_VM1 .../results_C04
.../latest_dut1_S-1+S-2+S-3_XK.png
.../latest_dut1_S-1+S-2+S-3_XU.png
respectively.

RMS values of the INT1 and INT2 sessions for all three analysis strategies are provided on the web page
http://www.metsahovi.fi/vlbi/vievs/latest_RMS+WRMS.txt

4. Discussion

Figure 1 depicts large variations for the dUT1 results when predicted EOPs are used in the analyses (see S-1, S-2). This variation is not visible when final EOP values are used as a priori values in the analysis (S-3). The jump in Figure 2 can be explained by the Tohuku earthquake that affected the Tsukuba station. Accurate coordinates for Tsukuba were not available for the period March-September 2011, thus causing a jump in dUT1. This also causes the RMS values of the corrections with respect to the a priori used dUT1 to be large for the INT2 series. More data, especially using analysis strategy S-3, are needed to be able to compare the INT1 and INT2 dUT1 results. From the INT1 results, it can be seen that S-2 gives the largest formal error RMS value (22.28 microseconds), and S-3 the smallest (17.27 microseconds). The RMS value of the corrections to the dUT1 a priori values is largest with S-1, and smallest with S-3.