J Geod
DOI 10.1007/s00190-017-1039-5

ORIGINAL ARTICLE

Influence of subdaily polar motion model on nutation offsets estimated by very long baseline interferometry

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Received: 18 November 2016 / Accepted: 15 May 2017

Abstract This paper studies the connection between the subdaily model for polar motion used in the processing of very long baseline interferometry (VLBI) observations and the estimated nutation offsets. By convention accepted by the International Earth Rotation Service, the subdaily model for polar motion recommended for routine processing of geodetic observations does not contain any daily retrograde terms due to their one-to-one correlation with the nutation. Nevertheless, for a 24-h VLBI solution a part of the signal contained in the polar motion given by the used subdaily model is numerically mistaken for a retrograde daily sidereal signal. This fictitious retrograde daily signal contributes to the estimated nutation, leading to systematic differences between the nutation offsets from VLBI solutions computed with different subdaily polar motion models. We demonstrate this effect using solutions for all suitable 24-h VLBI sessions over a time span of 11 years (2000–2011). By changing the amplitudes of one tidal term in the underlying subdaily model for polar motion and comparing the estimated parameters to the solutions computed with the unchanged subdaily model, the paper shows and explains theoretically the effects produced by the individual subdaily terms on the VLBI nutation estimates.

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Keywords Terrestrial reference frame · Celestial reference frame · Earth rotation parameters · Subdaily tidal models · VLBI

1 Introduction

Very long baseline interferometry (VLBI) is the only space geodetic technique which provides access to all parameters needed for the transformation between the terrestrial and the celestial reference systems. In principle, only three parameters are needed for such a transformation in a three-dimensional space. In space geodesy, five parameters are used traditionally, what implies that these parameters are not fully independent. From these five parameters, two are called the polar motion and describe the position of the celestial intermediate pole (CIP) in the International Terrestrial Reference Frame (ITRF, Petit and Luzum 2010; Altamimi et al. 2011). One parameter is needed to locate the Greenwich meridian in the inertial space, it is called the Universal Time (UT1). Two remaining parameters relate the CIP to the pole of the celestial reference frame. They are small empirical corrections to the nutation offsets given by the precession–nutation model which defines the position of the CIP in the International Celestial Reference Frame (ICRF, Petit and Luzum 2010; Ma et al. 1998). All five transformation parameters are called Earth orientation parameters (EOP), and a subset of three parameters containing the polar motion and UT1 is usually referred to as Earth rotation parameters (ERP).

The VLBI observations are coordinated by the International VLBI Service for Geodesy and Astrometry (IVS, Schuh and Behrend 2012), which maintains a network of VLBI stations and organizes regular observation programs with different objectives. There are daily 1-h intensive ses-

Published online: 29 May 2017

sions scheduled for the Universal Time (UT1) estimation. For all other programs, the observations are normally performed in 24-h sessions, and the most regular sessions are devoted specially to the EOP estimation and are held two times a week on Monday and Thursday. The 24-h sessions with other objectives are usually held several times per year. Together it makes several (at least two) 24-h VLBI sessions per week available for a routine processing by analysis centers (ACs) of the IVS.

The EOP solution for each 24-h session is one of the official products of the IVS. The description of the IVS products in general and specifically of the EOP time series from VLBI can be found on the IVS web site (http://ivscc.gsfc.nasa.gov). The quality of the EOP solutions from the individual analysis centers as well as the quality of the combined solutions is checked by internal comparisons between the VLBI solutions and by external comparisons with the combined C04 EOP time series provided by the International Earth Rotation Service (IERS).

Since VLBI is the only space geodetic technique which allows the determination of the orientation of the Earth in inertial space, the interpretation of the VLBI results for nutation is of special interest. Recognizing the effects influencing the estimation of nutation offsets can contribute to a better understanding of the VLBI solutions. In this paper, we focus on one of such effects demonstrating how the used subdaily model for polar motion affects the estimated nutation offsets. The a priori polar motion used in the processing has to include the subdaily variations, since the Earth rotation is noticeably influenced on the subdaily timescales by the daily and semi-daily ocean tides and other tidal phenomena. Neglecting the subdaily variations leads to systematic errors in the estimated parameters (Ray and McCarthy 1996). Acknowledging this, the IERS recommends to use in the routine processing of geodetic observations a model for subdaily variations in the ERP. The standard IERS subdaily model can be found in the IERS Conventions (2010) (Petit and Luzum 2010). It was derived from an ocean tide model based on satellite altimetry and provides the amplitudes of variations in the polar motion and UT1 for a set of tidal frequencies. The latest IERS subdaily model for the Earth rotation parameters contains 71 tidal terms.

In this paper, we study a connection between the nutation offsets from VLBI solutions and the subdaily model for the polar motion. In Sect. 2 the nature of this connection is discussed, and the VLBI data and the solutions computed to demonstrate the effect are described. In Sect. 3 the influence of changes in the individual tidal terms from a subdaily polar motion model on the estimated nutation is shown and compared to the theoretically computed effect induced by the respective tidal terms. Finally, in Sect. 4 we shortly consider the influence of the subdaily models on the estimated daily polar motion.

2 VLBI data and solutions

The subdaily model for polar motion contains prograde daily terms and prograde and retrograde semi-daily terms. The retrograde daily terms correspond to nutation in the inertial space and thus are conventionally a part of the nutation model and not a part of the ERP model. This means that in principle the used subdaily pole model and the estimated nutation should be fully independent. At the same time, as is known from the spectral analysis, over a time span of 24 h the prograde and retrograde terms with daily and semi-daily periods cannot be fully separated. For this reason in a 24-h solution, a part of the signal contained in the subdaily polar motion given by a model is numerically mistaken for a retrograde daily sidereal signal. This fictitious retrograde daily signal contributes to nutation and will be corrected for by the estimated nutation offsets. In this way, the nutation corrections estimated from VLBI observations always contain a small part induced by the errors of the used subdaily pole model.

This effect can be seen if we compare two VLBI solutions computed with different subdaily polar motion models. If within the considered solutions the ERP are estimated with a subdaily resolution (e.g., 1 h), the change in the subdaily model would be absorbed by the estimated polar motion parameters, leaving the nutation estimates unaffected. In such a case, the time series of the nutation offsets from the two solutions would show no systematic differences. It needs to be shortly mentioned that estimating the subdaily polar motion together with nutation is possible only with an additional constraint on polar motion to block the retrograde daily signal. In case of a standard VLBI solution (e.g., the routine EOP solutions made by the IVS ACs) where the ERP and their rates are estimated once per 24 h, the subdaily model cannot be corrected by the ERP themselves. In this case, the estimated nutation offsets absorb a part of the signal from the subdaily polar motion model corresponding to the fictitious retrograde daily signal. Theoretically, this fictitious retrograde signal could be absorbed also by the radiosource positions if the nutation was kept fixed and the coordinates of the sources estimated freely. However, in practice it is never done this way: If the radiosource positions are estimated, the nutation is estimated as well and a no-net-rotation condition is applied on the source coordinates preventing them from absorbing the retrograde daily signal.

The celestial pole offsets (CPO) which we will further refer to as the nutation corrections are measured in two directions (dX and dY), and the contribution of the fictitious retrograde daily term is also measured in two directions as the amplitude of the sine term and the amplitude of the cosine term. Different subdaily polar motion models contain fictitious retrograde daily signals with different sine and cosine amplitudes, and the nutation corrections are shifted respectively differently. As a result, time series of the nutation differences between the standard VLBI solutions computed with different subdaily models shows a systematic behavior. This is demonstrated by computing different VLBI solutions starting from the normal equations (NEQ) using the data and the procedure described further in this section.

As data set, we used free normal equations for all suitable 24-h VLBI sessions over a time span of 11 years (2000–2011) provided by the TU Vienna and obtained within the GGOS-D project (Rothacher et al. 2011). The parameters explicitly present in these daily NEQ are station coordinates, quasar coordinates, ERP with 1-h resolution and nutation offsets set up for each 24 h. The standard IERS subdaily model for the ERP was used and kept fixed in the processing. The basic solution which was computed for each session included the following explicitly estimated parameters: ERP freely estimated as a piecewise linear function over 24 h, the nutation offsets estimated once per session, and the station coordinates estimated also once for 24 h with no-net-rotation and no-net-translation conditions applied over a set of stable stations. The quasar coordinates were kept fixed to their a priori values given by the second realization of the International Celestial Reference Frame ICRF2 (Fey et al. 2015).

To compute on the NEQ-level solutions with different subdaily models, we used a procedure described in Panafidina et al. (2014). Summarizing the procedure shortly, the ERP with 1-h resolution are transformed into tidal terms, on which they linearly depend (the transformation can be found in Artz et al. 2011). Then, the a priori values for the tidal amplitudes are changed and fixed to the new values as described in Thaller (2008). The resulting solution refers to the modified subdaily model. In this way, we can compute VLBI solutions with different underlying subdaily models and compare the resulting parameters.

3 Influence of the subdaily model for polar motion on the estimated nutation offsets

To demonstrate the effect of the used subdaily model on the estimated nutation offsets, we use daily VLBI solutions computed as described in Sect. 2. First, we obtain a time series of nutation offsets from VLBI solutions computed with the standard IERS subdaily model. Then one term in the subdaily model is changed, and a time series of nutation offsets from VLBI solutions computed with the changed subdaily model is obtained. A time series of the differences between the estimated nutation offsets is computed. The systematic signal seen in the time series of nutation differences is attributed to and explained by the differences in the used subdaily models since no other changes were applied to the solutions. To make the interpretation easier, we change in the standard IERS subdaily model one tidal term in polar motion at a time. The amplitudes of both sine and cosine for a selected tidal term were changed by 100 μas.

Further, we look at the retrograde daily signals in the time series of polar motion given by two different subdaily polar motion models and compare the differences between their amplitudes for the sine and cosine terms to the differences in nutation offsets from VLBI solutions. It can be done in such a way: (1) We compute with 1-h resolution a time series of x- and y-pole coordinates from the standard IERS subdaily model and then the same from the changed subdaily model; (2) for both time series for each 24-h time span corresponding to a VLBI session, we compute by the least squares (LS) estimation an amplitude for sine and cosine of the daily retrograde signal with a period of sidereal day (23.93 h). Additionally, the linear trends in x- and y-pole are estimated, since in our VLBI solutions the linear trends in polar motion are estimated as well; (3) we compute the differences between the two time series of the LS-estimated amplitudes of the retrograde daily signal. These differences show the different contribution of the considered subdaily polar motion models to the estimated nutation; (4) the differences in sine and cosine amplitudes of the retrograde daily signal are compared to the time series of nutation differences for VLBI solutions computed with the same standard and changed subdaily models.

In Fig. 1 we present a time series of the differences in nutation offsets between VLBI solutions computed with the standard IERS subdaily model and a model where the S1 (24.00 h) tidal term in polar motion was changed by 100 μas. The differences in amplitudes of the contributing fictitious retrograde daily signal for these polar motion models are also plotted. It can be seen that the changes in the estimated nutation offsets for both dX and dY corrections are in a very good agreement with the changes in the amplitudes of the sine and cosine terms of the retrograde daily signal.

In Fig. 2 the same time series is presented for a case of comparing VLBI solutions with the standard IERS subdaily model and with a model where the O1 (25.82 h) tidal term in polar motion was changed by 100 μas. Again, the agreement between the contributing fictitious retrograde daily signal and the changes in the nutation offsets is obvious.

The amplitude of the systematic signals presented in Figs. 1 and 2 is rather big: It is about 50 μas, which is a half of the change in the amplitude of a tidal term in the subdaily pole model. Given the mechanism of coupling of subdaily pole errors with fictitious daily retrograde pole terms, it is straightforward to compute the amplitude of the nutation term caused by a subdaily pole term with a given amplitude and frequency. Figure 3 shows the nutation amplitude estimated together with pole offsets and drift for a 24-h session as a function of the subdaily term with a unit amplitude. For daily and half-daily subdaily pole parameters, the amplification factor in nutation is 0.4 resp. 0.2. Further, the actual ampli-

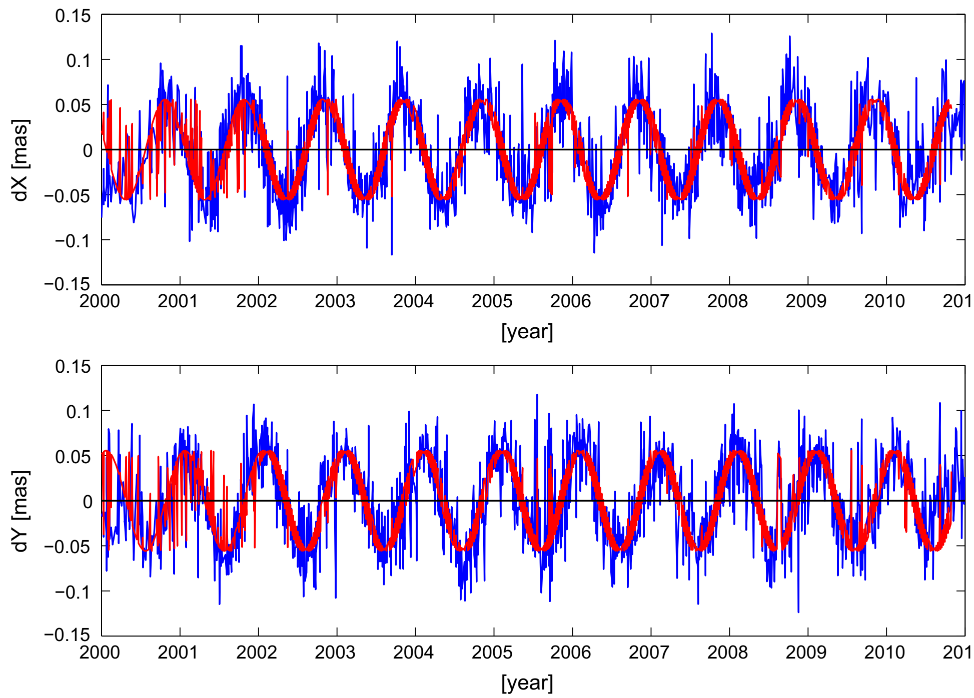

Fig. 1 Differences in nutation offsets (*blue*) between VLBI solutions computed with the standard IERS subdaily model and with subdaily model with changed S1 (24.00 h) term in polar motion; differences in the LS-computed amplitudes of the retrograde daily signal (*red*) between the standard IERS subdaily model and the subdaily model with changed S1 (24.00 h) term in polar motion

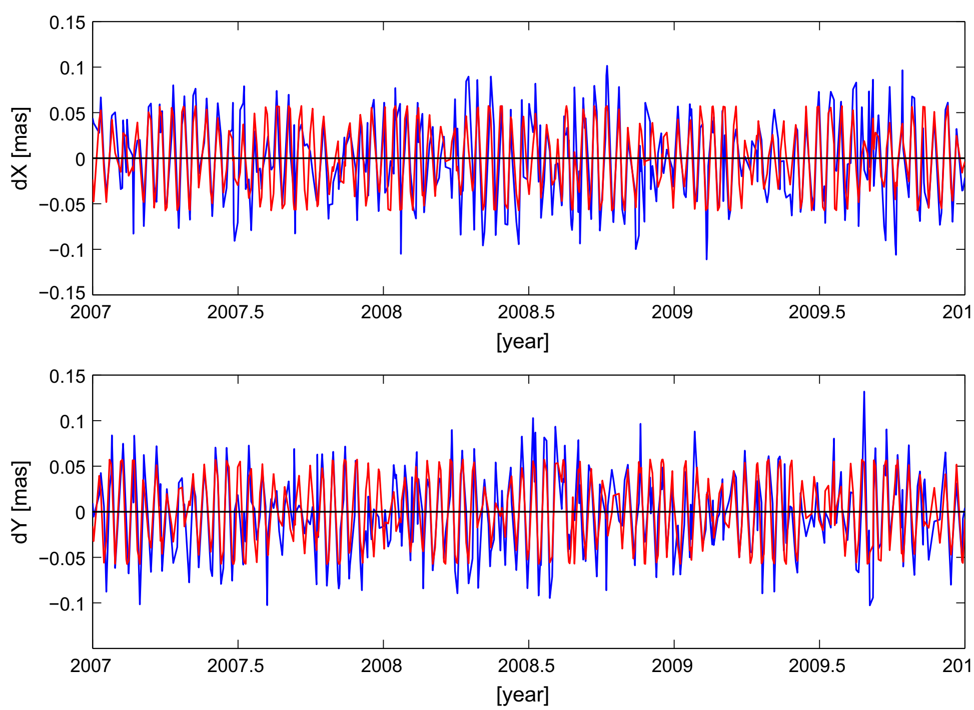

Fig. 2 Differences in nutation offsets (*blue*) between VLBI solutions computed with the standard IERS subdaily model and with subdaily model with changed O1 (25.82 h) term in polar motion; differences in the LS-computed amplitudes of the retrograde daily signal (*red*) between the standard IERS subdaily model and the subdaily model with changed O1 (25.82 h) term in polar motion

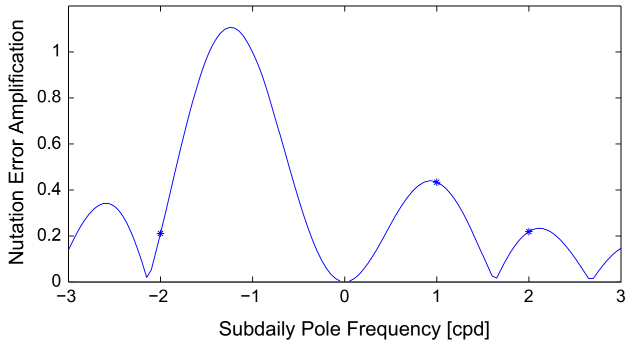

Fig. 3 Amplification factor of fictitious nutation term for error in subdaily pole term with given frequency for observations covering 24 h. *Symbols* indicate 2/day retrograde (factor 0.21), 1/day prograde (0.43) and 2/day prograde (0.22)

tude of the fictitious retrograde daily term depends strongly on the length of the time span used: The longer the time span is, the smaller is the amplitude of the retrograde term, since the signals are better decorrelated. It needs also to be mentioned that estimating the daily linear trends in x- and y-pole influences strongly the amplitude of the fictitious retrograde daily term. The linear motion and the daily periodic signal over a time span of 1 day are highly correlated which leads to an amplification of the amplitude of the fictitious retrograde term. If the polar motion is not estimated at all or only the offsets are estimated but no rates, the amplitude of the changes in the nutation time series would be about 10 times smaller.

The period of the systematic signal in the time series of nutation differences produced by a change of one tidal term in the subdaily polar motion will be explained on the example of changed S1 term and then generalized for any other term. We consider two sessions starting at the same time on consecutive days (e.g., during the CONT campaigns). During the first 24-h session, the S1 wave will have elapsed exactly 360°, and its phase at the beginning of the second session will be the same as it was at the beginning of the first session, since the S1 period is exactly 24 h. From this S1 wave, a part corresponding to the retrograde daily wave K1 is absorbed by nutation. The K1-wave has the period of the sidereal day, ∼23.93 h. It is shorter than 24 h, so the retrograde daily wave will have elapsed more than 360° during the first session and at the beginning of the second session it will have a different phase. The change in phase for the retrograde daily wave over 24 h can be computed from its angular velocity ω (°/h) as ($\omega \cdot 24° - 360°$). This difference in phase of the K1-wave for the second session compared to the first session will be reflected by a respective difference in the estimated phases of the retrograde daily wave for the first session and for the second session. In our case, the phase is estimated implicitly as the amplitude of the sine and cosine terms, and these estimated parameters will be systematically changing due to the systematic changes in the phase of the retrograde K1 wave from day to day. A full cycle in the estimated sine and cosine amplitudes will be fulfilled within the time needed for the retrograde K1 wave to reach the same position relative to the S1 wave at the beginning of a session as it was for the first considered session. This time can be easily computed as 360° divided by the phase change over one day, which gives the period of 365.24 days.

Table 1 Periods of variations in nutation time series caused by eight main tidal terms and S1 term

Tide	Period (h)	Period of variations in nutation (days)
Daily tidal terms		
Q1	26.87	9.61
O1	25.82	14.77
P1	24.07	Inf
S1	24.00	365.24
K1	23.93	182.62
Prograde semi-daily tidal terms		
N2	12.66	9.87
M2	12.42	15.39
S2	12.00	365.24
K2	11.97	121.75
Retrograde semi-daily tidal terms		
N2	12.66	9.37
M2	12.42	14.19
S2	12.00	365.24
K2	11.97	365.24

The same consideration can be done for any other polar motion tidal term. The only difference is that any other changed term, unlike S1 term, will not have the same phase at the beginning of each session anymore. Its phase will be systematically changing with the speed depending on its angular velocity. The change in phase at the beginning of a session of the retrograde K1 wave relative to the changed tidal term will define the resulting period of variations in the estimated amplitudes of the K1 sine and cosine terms. During the computation, the direction of the changed wave—prograde or retrograde—needs to be taken into account.

This consideration makes clear that the observed period in the nutation differences depends directly on the length of the session. If VLBI sessions had another length, the resulting periods in the nutation time series would be also different from those which are presented and discussed here. The periods in the nutation time series produced by the eight main tidal terms and the S1 term are summarized in Table 1.

A relevant effect present in VLBI solutions and shown in Figs. 1 and 2 is explained by the consideration above. The VLBI sessions take place irregularly several times per week,

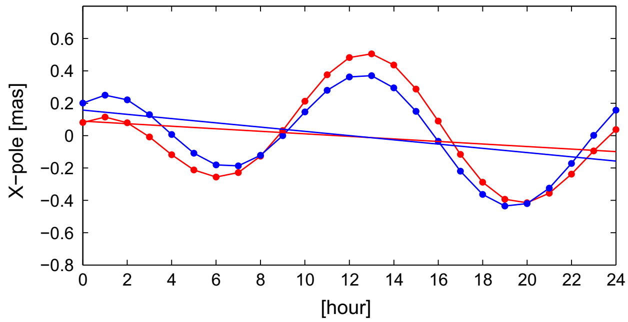

Fig. 4 *x*-Pole coordinates computed with 1-h resolution from the standard IERS subdaily model and its linear trend (*blue*); *x*-pole coordinates computed with 1-h resolution from subdaily model with changed S1 (24.00 h) term in polar motion and its linear trend (*red*)

and the time of the session start varies from session to session, according to the schedule of the observations set up by the IVS. There are sessions starting at 17 or 18 o'clock, e.g., the regular rapid sessions R1 and R4 held on Monday and Thursday, and there are also sessions starting at other times of the day. This influences strongly the estimated amplitude of the fictitious retrograde daily signal, which depends heavily on the phase of the signal from the subdaily polar motion model. As a result, to see a regular periodic signal in the time series of the retrograde daily terms and of the nutation differences between the solutions with different subdaily models, we would need to have the solutions based on 24 h of observations starting always at the same time of the day. Since it is not the case for VLBI solutions, there are some irregularities in the time series presented in Figs. 1 and 2, especially well seen in the beginning for the years 2000–2001. On the other hand, since most of the VLBI sessions used in this study were the rapid sessions R1 and R4 which start around 17 or 18 o'clock, we still can see clearly the systematic effect produced by the fictitious retrograde daily term on the estimated nutation offsets.

Another related aspect concerns the example of changed O1 (25.82 h) term in polar motion. In Fig. 2 we can see a modulation of the signal. This is caused by the fact that changes in the O1 tidal term lead to a change in the nutation offsets with a period of about 15 days, as shown in Table 1, and the number of the used sessions over such a time span is usually too small to define well the whole wave. For example, if only the R1 and R4 sessions are available, the number of the used sessions is not more than 4. This leads to the demonstrated modulation.

4 Influence of the subdaily model for polar motion on the estimated daily *x*- and *y*-pole

The influence of the subdaily model on the estimated ERP is not the main topic of the presented study. Nevertheless, the ERP are a part of the VLBI solutions used here to demonstrate

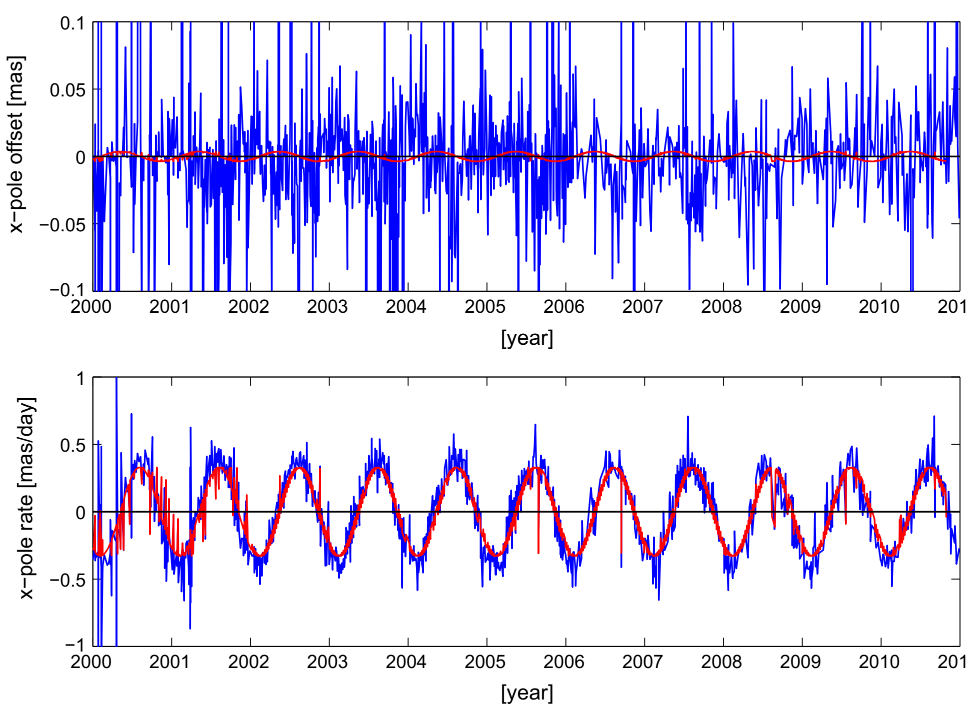

Fig. 5 *x*-Pole: differences in *x*-pole offsets and rates (*blue*) between VLBI solutions computed with the standard IERS subdaily model and with subdaily model with changed K1 (23.93 h) term in polar motion; differences in the LS-computed offsets and rates (*red*) for *x*-pole given by the standard IERS subdaily model and the subdaily model with changed K1 (23.93 h) term in polar motion

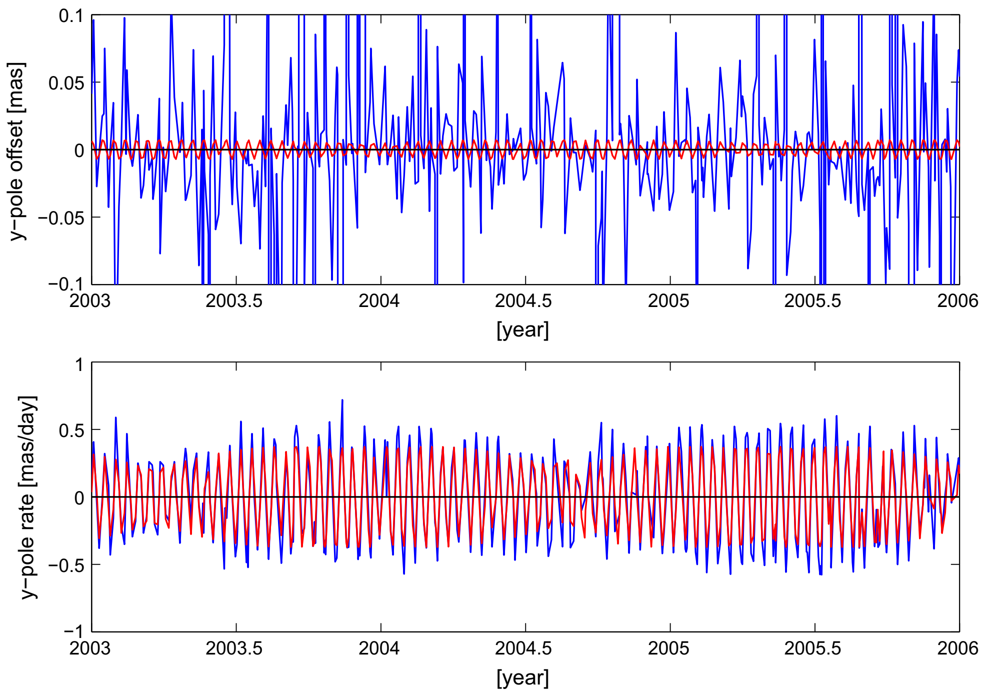

Fig. 6 *y*-Pole: differences in *y*-pole offsets and rates (*blue*) between VLBI solutions computed with the standard IERS subdaily model and with subdaily model with changed O1 (25.82 h) term in polar motion; differences in the LS-computed offsets and rates (*red*) for *y*-pole given by the standard IERS subdaily model and the subdaily model with changed O1 (25.82 h) term in polar motion

the connection between the estimated nutation and the subdaily polar motion, and it is well known that changes in the subdaily model influence strongly the estimated polar motion rates (Kouba 2003; Artz et al. 2012). We demonstrate shortly this effect by comparing the time series of the polar motion offsets and rates estimated in VLBI solution with different subdaily models.

The actual a priori values for the ERP get changed, when the underlying subdaily model is changed. A part of this change can be absorbed by the estimated 24-h ERP. As an illustration, we show in Fig. 4 the subdaily *x*-pole over 24 h computed from the standard IERS subdaily model and from a subdaily model with the S1 (24.00 h) tidal term in polar motion changed by 100 μas. As can be seen, the linear trends get changed as well, and this linear part will be absorbed by the estimated daily *x*- and *y*-pole.

In Fig. 5 we present the time series of differences in *x*-pole rates and offsets between VLBI solutions computed with the standard IERS subdaily model and with a model where the K1 (23.93 h) tidal term in polar motion was changed by 100 μas. The picture for the *y*-pole differences looks very similar and is not presented. Figure 6 shows the differences in *y*-pole rates and offsets for a case where the O1 (25.82 h) tidal term in polar motion was changed by 100 μas. The picture for the *x*-pole differences looks very similar and is also omitted.

As was described in the previous section, the offsets and rates in *x*- and *y*-pole given by the standard and the changed subdaily models were computed with the LS together with the amplitudes of the retrograde daily signal. The differences in these LS-estimated offsets and rates for *x*- and *y*-pole are also shown in Figs. 5 and 6. As can be seen, the changes in rates are, as expected, rather large and show a very good agreement between the VLBI solutions and the LS estimates. The offsets are on the level of several microarcsecond, which is negligible, and the accuracy of the VLBI estimation is probably not enough to show the small systematic signal seen in the LS estimates.

Table 2 Periods of variations in estimated polar motion caused by eight main tidal terms and S1 term

Tide	Period (h)	Period of variations in PM (days)
Daily tidal terms		
Q1	26.87	9.37
O1	25.82	14.19
P1	24.07	365.24
S1	24.00	Inf
K1	23.93	365.24
Semi-daily tidal terms		
N2	12.66	9.61
M2	12.42	14.77
S2	12.00	Inf
K2	11.97	182.62

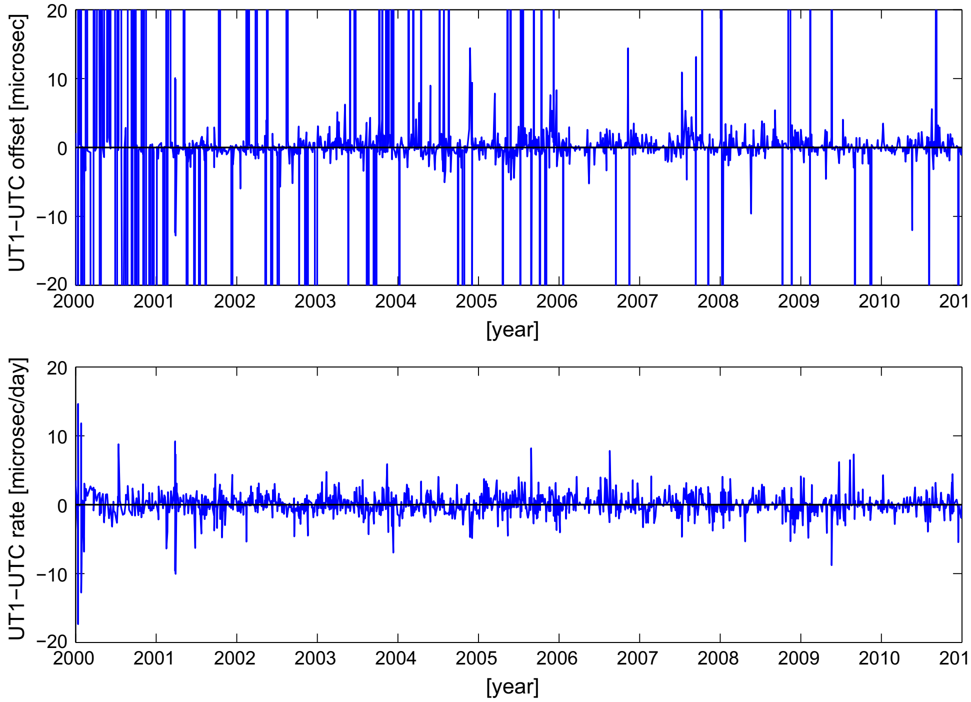

Fig. 7 UT1–UTC: differences in UT1 offsets and rates between VLBI solutions computed with the standard IERS subdaily model and with subdaily model with changed K1 (23.93 h) term in polar motion

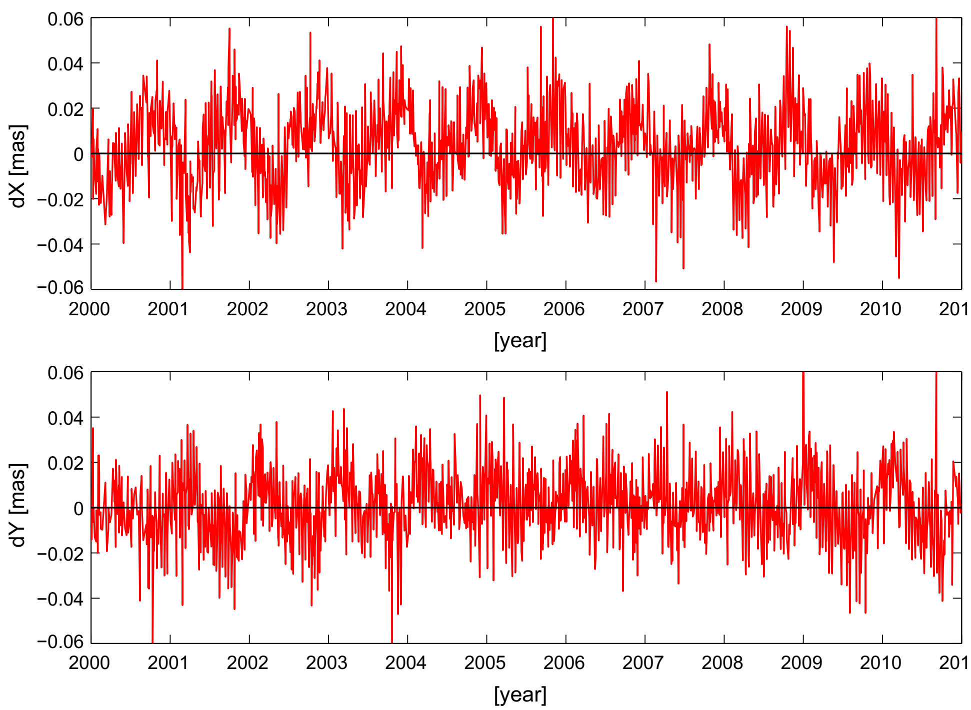

Fig. 8 Differences in nutation offsets (*red*) between VLBI solutions computed with the standard IERS subdaily model and with empirical subdaily model derived from VLBI observations by Artz et al. (2011)

The period of the variations in the estimated polar motion can be computed by sampling the wave corresponding to the changed tidal term each 24 h. The summary of the variation periods in polar motion caused by the eight main tidal terms and the S1 term is presented in Table 2.

The estimates of UT1 are not affected by changes in the subdaily polar motion model. For completeness, we show in Fig. 7 the time series of differences in UT1 rates and offsets between VLBI solutions computed with the standard IERS subdaily model and with a model where the K1 (23.93 h) tidal term in polar motion was changed by 100 μas. As can be seen, the differences are on the level of several microseconds for both offsets and rates and there are no systematic effects.

5 Conclusion

We considered a connection between the nutation corrections estimated from VLBI observations and the subdaily polar motion model used in the processing. It was found that, even though the subdaily model for polar motion does not contain any retrograde daily terms, a part of the signal from the subdaily model is numerically mistaken for a retrograde daily signal, which contributes to the estimated nutation offsets. This fictitious retrograde daily signal appears in solutions for 24-h observational sessions due to numerical inseparability of the prograde and the retrograde signals with approximately daily periods over such a short time span. As a result, the nutation corrections estimated with different subdaily models for polar motion show differences equal to the differences in the respective fictitious retrograde daily signals present in the subdaily polar motion models in use.

The effect was demonstrated by computing VLBI solutions with different subdaily models and showing a very good agreement between the time series of the nutation differences and the differences in the amplitudes of the retrograde daily signals.

We considered here an artificial change in the subdaily polar motion model, and the results showed that a change of 100 μas in the amplitude of both sine and cosine terms for one tidal wave leads to a systematic change in the VLBI nutation estimates with amplitude of about 50 μas. For a real VLBI solution, any errors in the used subdaily polar motion model will influence the resulting nutation estimates. The total amplitude of the current standard IERS subdaily model for polar motion is often about 600 μas, reaching for some days about 900 μas. Since this model is theoretically computed on a basis of an ocean tidal model, all the uncertainties of the underlying ocean model will be propagated into the subdaily ERP model. Additionally the ocean tides, while being the most significant influence causing the subdaily variations in the Earth rotation, are not the only reason for these variations. Other physical phenomena like atmospheric tides and non-tidal ocean modes also contribute to the subdaily Earth rotation variations. This means that the used subdaily model always contains errors, the real size of which is difficult to know precisely. There are a number of empirical models computed from different geodetical observations, from the comparisons of these empirical models with each other and with the tidal IERS model one can try to estimate the real accuracy of the subdaily models. Griffiths and Ray (2013) give this resulting accuracy to be on the level of about 20%. This means that the total amplitude of the subdaily polar motion from the IERS subdaily model can be in error of up to 120 μas. Such an error in the subdaily polar motion would lead to about 60 μas error in the estimated nutation offsets, which is not negligible, considering that this is approximately the level of the differences shown by the IVS nutation series w.r.t. the IERS C04 combined nutation series (Bachmann et al. 2016, IVS website: www.ccivs.bkg.bund.de/EN/Rapid/rapid_node.html).

To demonstrate the effect of a real empirical tidal model on the nutation, we used the subdaily model published in Artz et al. (2011). It is derived from VLBI observations and shows noticeable deviations w.r.t. the IERS 2010 model for a number of tides. Especially affected are the tides S1 (24.00 h), K1 (23.93 h), S2 (12.00 h) and M2 (12.42 h), for which the deviations are on the level of 10–15 μas. Figure 8 shows the resulting differences in nutation offsets between the solutions computed using the IERS 2010 model and solutions computed using the empirical model from Artz et al. (2011). The influence on nutation remains systematic as in our study for just one tidal term and the amplitude, as could be expected, is smaller and lies around 20–40 μas.

Additionally, we have found that the described influence of the subdaily polar motion model on the nutation corrections estimated from the VLBI remains the same in the case of a combined multi-session solution (e.g., weekly or monthly solutions). Formally, the fictitious retrograde daily signal should vanish when a longer than 24-h time span is considered, since the prograde and the retrograde near-daily terms could be then fully decorrelated and separated from each other. But in practice, since VLBI solutions are not continuous and mostly have breaks of some days between 24-h sessions, errors in the subdaily polar motion model influence the estimated nutation noticeably also in a multi-session VLBI solution. This situation can be improved in the future, when the continuous VLBI observations from the VGOS (VLBI2010 Global Observing System, Petrachenko et al. 2009) are available.

Acknowledgements This work was done within the research unit “Space-time reference systems for monitoring global change and for precise navigation in space” (FOR 1503) of the German Research Foundation (DFG).

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