The impact of erroneous a priori information on the estimation of UT1-UTC in VLBI Intensive sessions

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Intensive sessions

• single baseline sessions with 1 hour duration dedicated to derive UT1-UTC



remaining parameters fixed to their a priori value (EOP, coordinates, tropospheric gradients, ...)



Intensive sessions

• single baseline sessions with 1 hour duration dedicated to derive UT1-UTC



• goal: impact of errors in the a priori information on dUT1 – a simulation study





• artificial VGOS stations placed on a 10° x 10° global grid



- scheduling (VieSched++) and simulation (VieVS):
 - almost 3000 baselines investigated
 - focus corner observations scheduling algorithm*
- monthly schedules per baseline
- reduced source list

* (Nothnagel and Campbell, 1991) (Uunila et al., 2012) (Gipson and Baver, 2015) (Schartner et al., 2021)



Erroneous a priori information



- introduction of realistic errors in the a priori information in seperate evaluations
 - $-UEN \rightarrow 5mm$ $-x_p, y_p / dX, dY \rightarrow \sim 162 \mu as$

→ monthly dUT1 values of **unaltered vs. modified evaluation**

 \rightarrow mean difference in dUT1 ($\delta dUT1$) and standard deviation $\sigma_{\delta dUT1}$ / baseline





Impact of erroneous station coordinates





high $|\delta dUT1|$ values

 baselines with a midpoint close to equatorial plane + short baselines

$$\delta dUT1 \begin{cases} > 5 \ \mu s \ (8\%) \\ > 20 \ \mu s \ (2\%) \end{cases}$$

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Impact of erroneous station coordinates





high $|\delta dUT1|$ values

 baselines with a midpoint close to equatorial plane + short baselines

$$\delta dUT1 \begin{cases} > 5 \ \mu s \ (8\%) \\ > 20 \ \mu s \ (2\%) \end{cases}$$

north-south oriented baselines

baselines with a midpoint close to equatorial plane + short baselines

$$\delta dUT1 \begin{cases} > 5 \ \mu s \ (70 - 80\%) \\ > 20 \ \mu s \ (20\%) \end{cases}$$



Impact of erroneous station coordinates





high $|\delta dUT1|$ values

 baselines with a midpoint close to equatorial plane + short baselines

$$\delta dUT1 \begin{cases} > 5 \ \mu s \ (8\%) \\ > 20 \ \mu s \ (2\%) \end{cases}$$

north-south oriented baselines

baselines with a midpoint close to equatorial plane + short baselines

$$\delta dUT1 \begin{cases} > 5 \ \mu s \ (70 - 80\%) \\ > 20 \ \mu s \ (20\%) \end{cases}$$

low $|\delta dUT1|$ values

 long east-west baselines between reference station and station at midlatitudes



(Kern et al., 2022) – to be submitted to JOGE 5

Impact of erroneous polar motion





high $|\delta dUT1|$ values

- baselines with a midpoint close to equatorial plane
- equatorial baselines
- north-south oriented baselines

$$\delta dUT1 \begin{cases} > 5 \,\mu s \,(50/75 \,\%) \\ > 20 \,\mu s \,(9/27 \,\%) \end{cases} \,(x_p/y_p)$$



Impact of erroneous polar motion





high $|\delta dUT1|$ values

- baselines with a midpoint close to equatorial plane
- equatorial baselines
- north-south oriented baselines

 $\delta dUT1 \begin{cases} > 5 \,\mu s \,(50/75 \,\%) \\ > 20 \,\mu s \,(9/27 \,\%) \end{cases} \,(x_p/y_p)$

low $|\delta dUT1|$ values

long east-west baselines between reference station and station at midlatitudes



Impact of erroneous nutation components





- strongly depends on sidereal time + geometry \rightarrow no mean $\delta dUT1$, $\sigma_{\delta dUT1}$
- amplitude $A [\mu s] \leftrightarrow$ maximum impact



Impact of erroneous nutation components





strongly depends on sidereal time + geometry \rightarrow no mean $\delta dUT1$, $\sigma_{\delta dUT1}$

amplitude $A [\mu s] \leftrightarrow$ maximum impact

high A:

baselines with a midpoint close to equatorial plane (parallel to Earth's rotation vector)



Impact of erroneous nutation components







amplitude $A [\mu s] \leftrightarrow$ maximum impact

baselines with a midpoint close to equatorial plane (+ parallel to Earth's

(Kern et al., 2022) – to be submitted to JOGE 7

Conclusion

- ✓ provided a global evaluation of the impact of different errors in the a priori information on the determination of dUT1 through Intensive sessions
- ✓ almost **3000 baselines** investigated
- ✓ baselines with midpoint close to equatorial plane/ baselines close to parallel to Earth's rotation vector lead to high variations in the dUT1 differences → high sensitivity
- ✓ long east-west baselines between a station and another station at mid-latitudes of same hemisphere are most resistant against errors
- ✓ partly opposite systematics for southern Intensives
- ✓ impact of errors in the a priori information **not negligible**!



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