High frequency Earth rotation variations from CONT11

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Introduction

Normally geodetic VLBI observations are only performed a few days per week. Occasionally, approximately every third year, campaigns with continuous VLBI observations over a 15 day period are made. The goal is to demonstrate the best performance that presently can be achieved with geodetic VLBI. The data from these campaigns can for example be used to study high frequency variations in the Earth orientation parameters (EOP). In this work we investigate the sub-daily EOP variations estimated from the latest of these campaigns: CONT11.

The CONT11 campaign

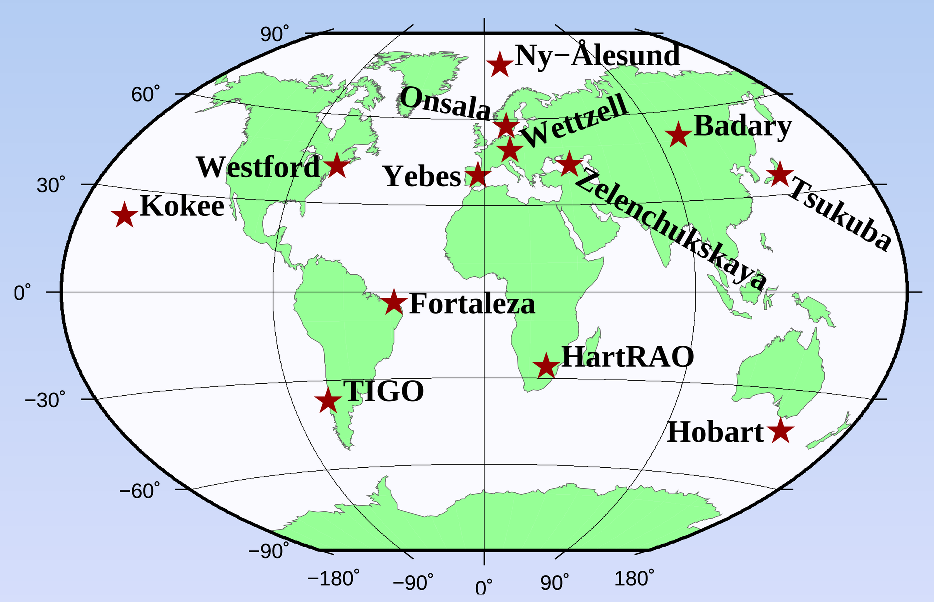

Figure 1: The CONT11 network

The CONT11 campaign was carried out 15–29 September, 2011. In total 13 VLBI stations participated in the campaign.

Data analysis

The data was analysed with the Vienna VLBI Software (VieVS Böhm et al., 2012). Polar motion and DUT1 were estimated with hourly resolution, while precession/nutation was fixed to the IAU 2006 model plus corrections from the IERS 08 C04 series. In addition, station coordinates (one set for the whole campaign), tropospheric zenith wet delays and gradients, and clocks were estimated.

High frequency EOP

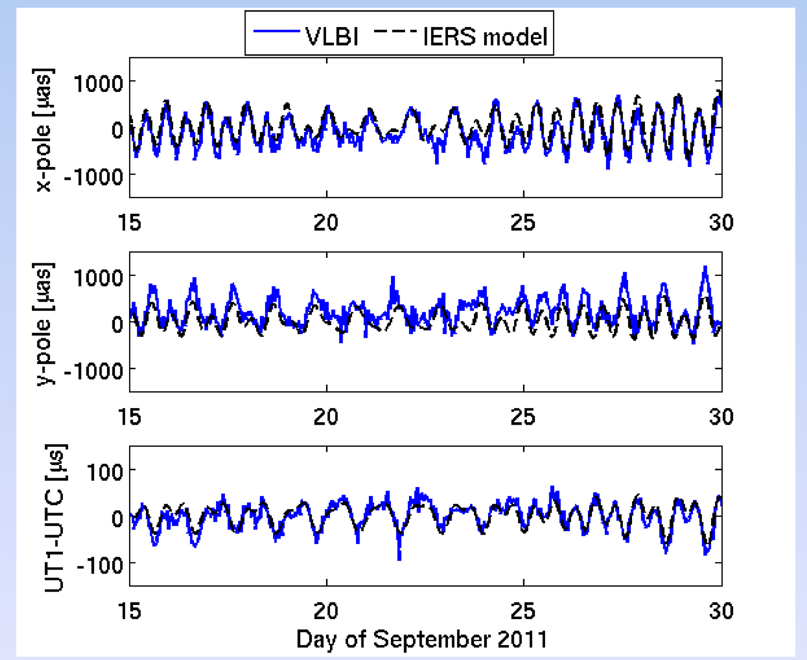

Figure 2: Hourly polar motion and DUT1 estimated from CONT11. From the time series the IERS C04 values have been subtracted in order to remove the low frequency variations. For comparison the IERS recommended model for high frequency EOP variations (Petit and Luzum, 2010) is plotted.

Atmospheric excitations

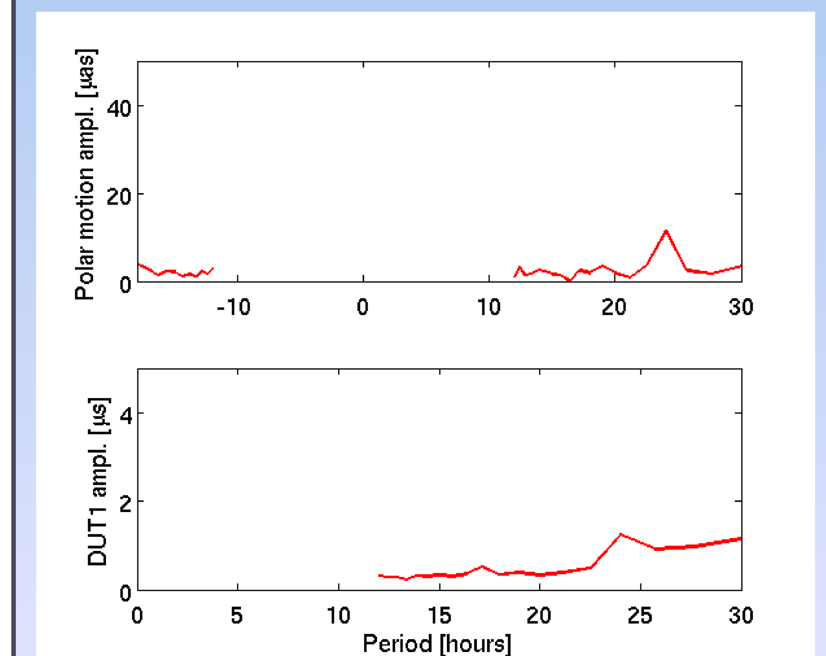

Figure 6: Spectra of the atmospheric EOP excitations during the CONT11 period. The atmosphere has only a minor impact on the sub-diurnal EOP variations. The excitations are calculated from ECMWF data with 6 houly resolution. These time series are available at `http://ggosatm.hg.tuwien.ac.at/`.

Comparison with ring laser data

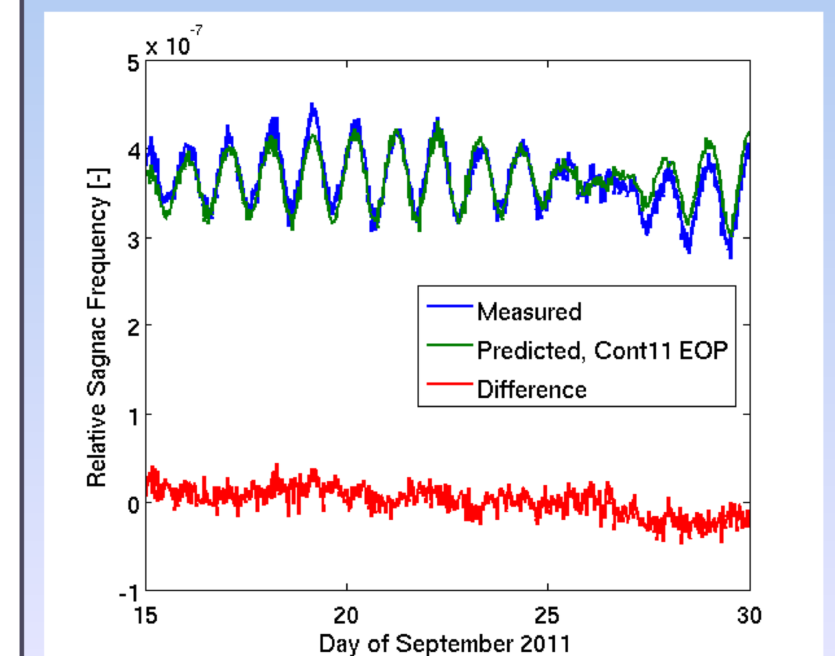

Figure 7: Observations made by the Wettzell "G" ring laser gyroscope (Schreiber et al., 2009) during CONT11 (a constant offset has been removed). As comparison, the predictions calculated using the observed EOP variations are plotted.

Comparison with high frequency EOP models

The estimated hourly EOP have been compared to three different models describing the diurnal and sub-diurnal EOP variations. The models are able to explain most of the variations seen, however not all.

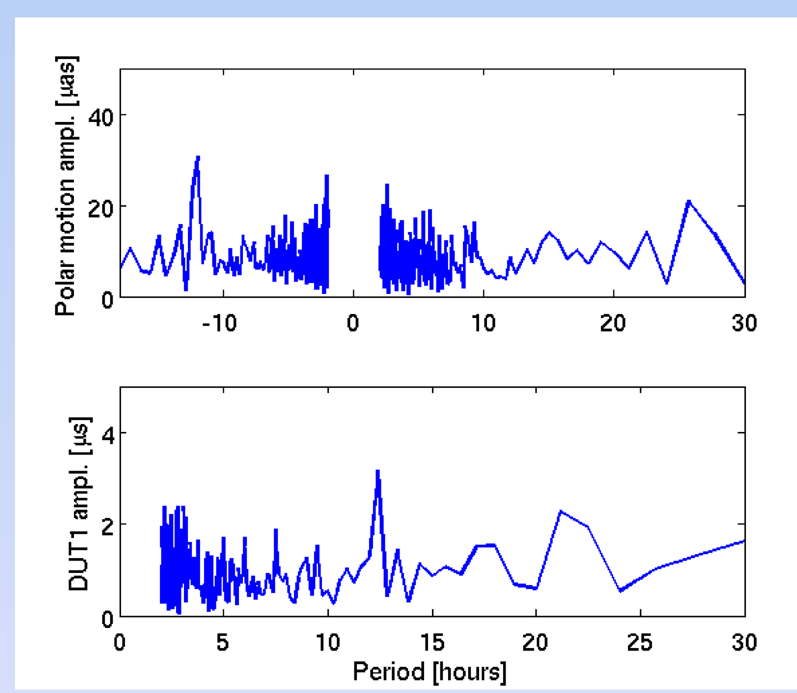

Figure 3: Fourier spectra of the residual polar motion ($x_p - i\,y_p$) and DUT1 after subtracting the IERS recommended model for high frequency EOP variations (based on an ocean tidal model).

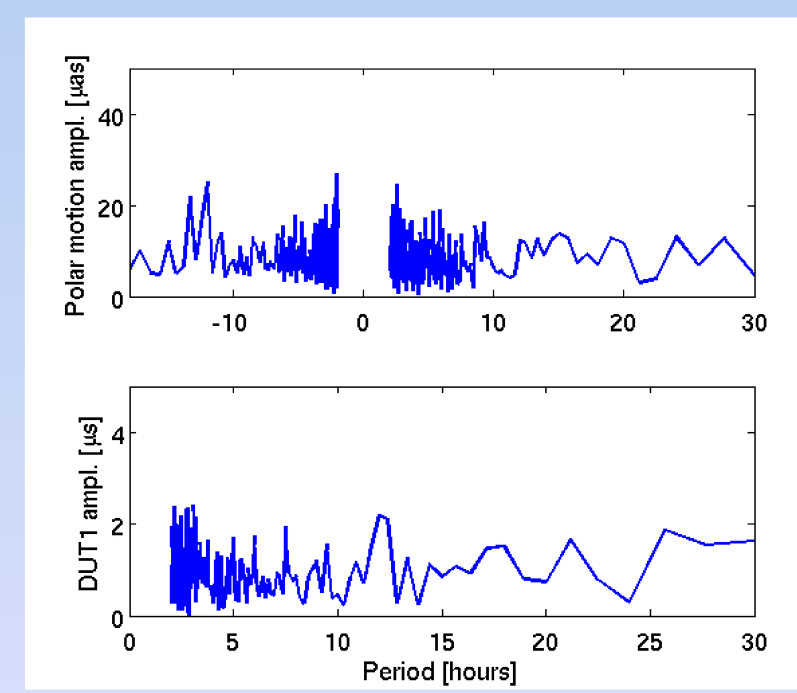

Figure 4: Fourier spectra of the residual polar motion and DUT1 after subtracting an empirical high frequency EOP model based on VLBI data. The model was estimated in a global solution with VieVS using VLBI data from 1984–2010.

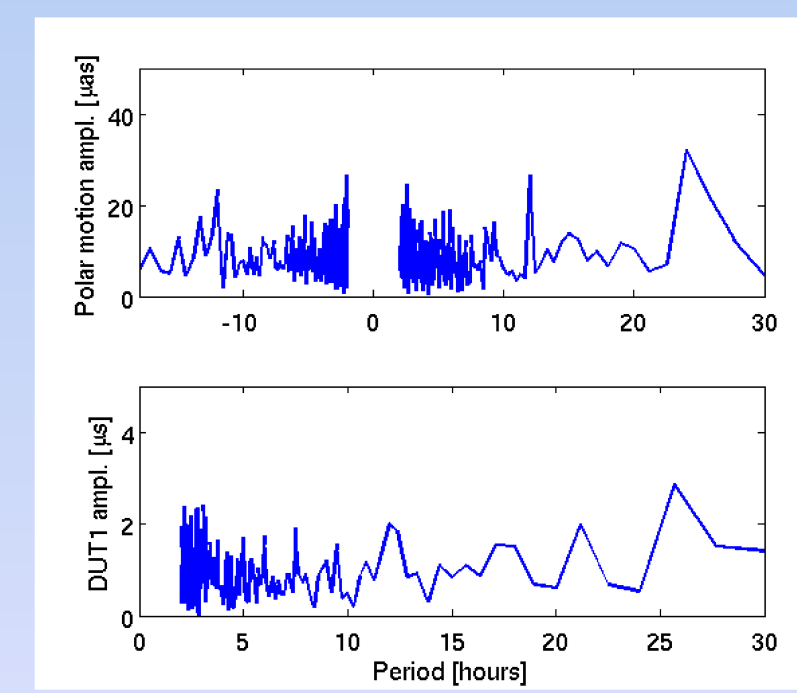

Figure 5: Fourier spectra of the residual polar motion and DUT1 after subtracting the high frequency EOP model by Artz et al. (2012) (an empirical model estimated from a VLBI+GPS combination).

VLBI+ring laser combination

We have combined the CONT11 VLBI data with observations from the "G" ring laser in Wettzell, in order to estimate accurate EOP. The combination procedure is described in Nilsson et al. (2012). However, the ring laser has only minor impact on the estimated EOP. The reason is that VLBI is the more accurate technique, and only one ring laser was used (compared to 13 VLBI antennas).

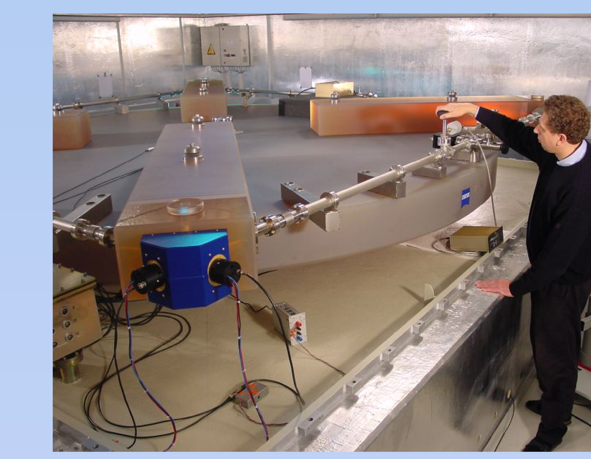

Figure 8: The "G" ring laser in Wettzell, Germany.

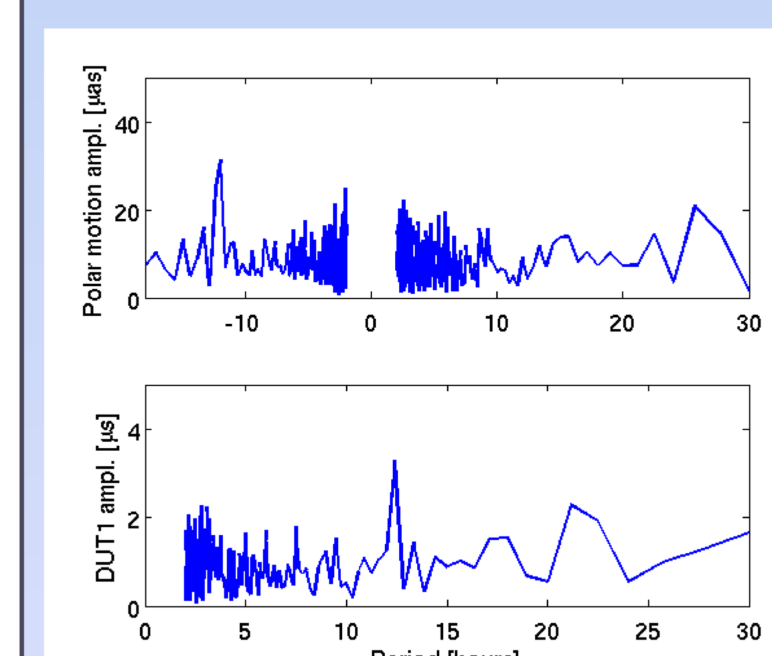

Figure 9: The spectra of polar motion and DUT1 estimated from the VLBI–ring laser combination. The IERS high frequency EOP model has been subtracted.

In the future a comparisons with independent techniques, like GNSS, will be performed.

Table 1: RMS differences between the IERS high frequency model and the EOP estimated from VLBI and the VLBI–ring laser combination, respectively.

	VLBI only	VLBI+ring laser
x-pole [μas]	164	164
y-pole [μas]	180	177
DUT1 [μs]	14.7	14.3
x-pole rate [mas/day]	4.3	4.3
y-pole rate [mas/day]	5.2	5.0
LOD [μs]	404	376

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Acknowledgements

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