Combination of common parameters for co-located VLBI antennas

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Introduction

In the future VGOS network there will be several so-called twin-telescopes. The two telescopes forming a twin will in general be close to each other and connected to the same hydrogen maser, thus it should be possible to estimate common atmospheric parameters and/or common clock functions for them.

Recently, Nilsson et al. (2015) showed, using simulated and real observations, that combination of the tropospheric parameters for a twin telescope improves the station position repeatability. In this work we extend that study by also considering the combination of the clock parameters.

Simulations of a potential VGOS network

Simulation description

We first tested the combination of common parameters with simulations. We made simulations for the VGOS network shown in Fig. 1. For details about the simulation procedure, see Nilsson et al. (2015).

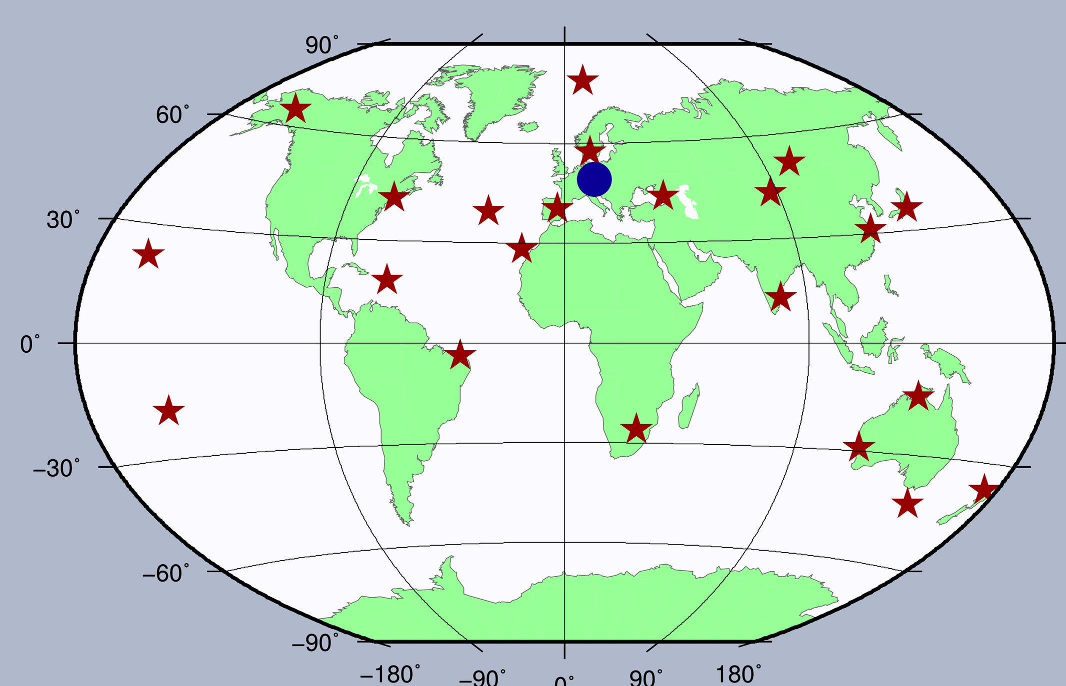

Figure 1: The VGOS network used for the simulation. It consists 23 sites, including a site with a twin telescope (Wettzell), marked with a blue circle. The distance between the twins is here assumed to be 100 m.

In the data analysis, we tested the following solutions:

None: No common parameters were combined

Clk 0: The clock parameters of the two telescopes were combined

Clk 1: As *Clk 0*, but an constant offset between the clocks was also estimated for each session.

Clk 2: The differences between the two clocks was modeled as a piece-wise linear function, with 1 h intervals and relative constraints of 0.8 ns/h.

Trop: The tropospheric parameters (ZWD and gradients) were combined.

Station position repeatability

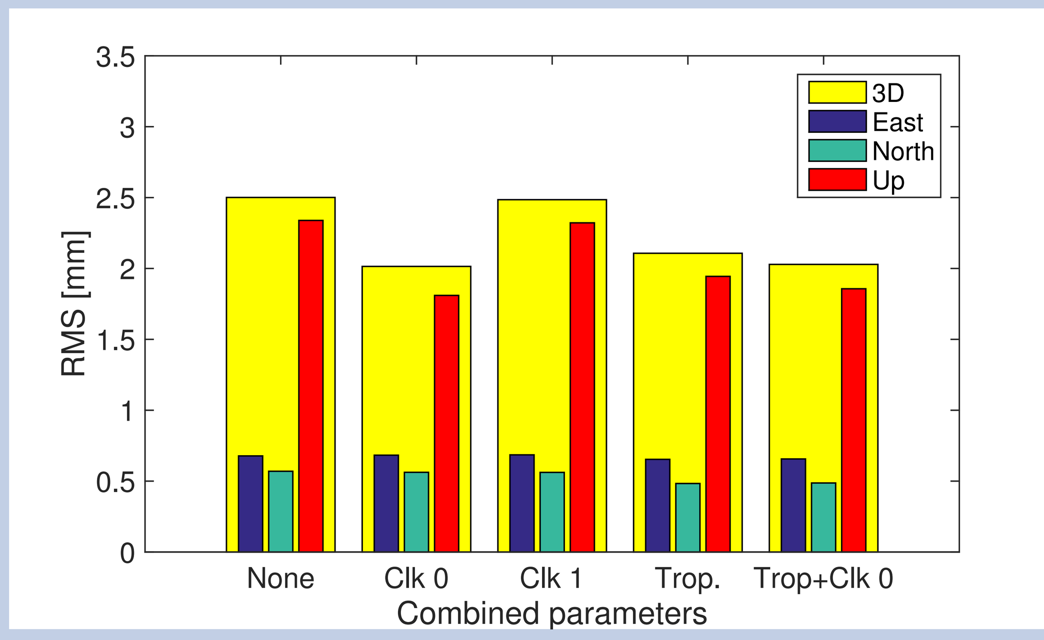

Figure 2: The figure shows the station position repeatabilities for the Wettzell twin telescope, when applying the different combination procedures. The solution *Clk 2* is not shown, it gives about the same results as *Clk 1*.

Repeatability of twin telescope baseline

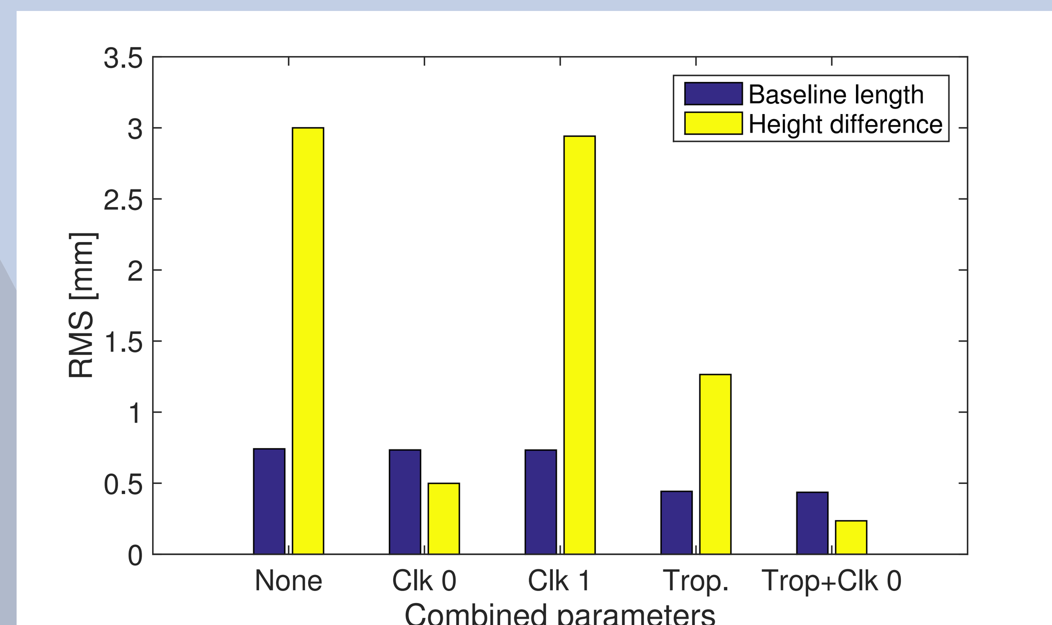

Figure 3: The figure shows the station position repeatability of the baseline between the two telescopes at Wettzell, as well as the repeatability of the height difference.

Results for the sibling telescopes in Hobart during CONT14

CONT14

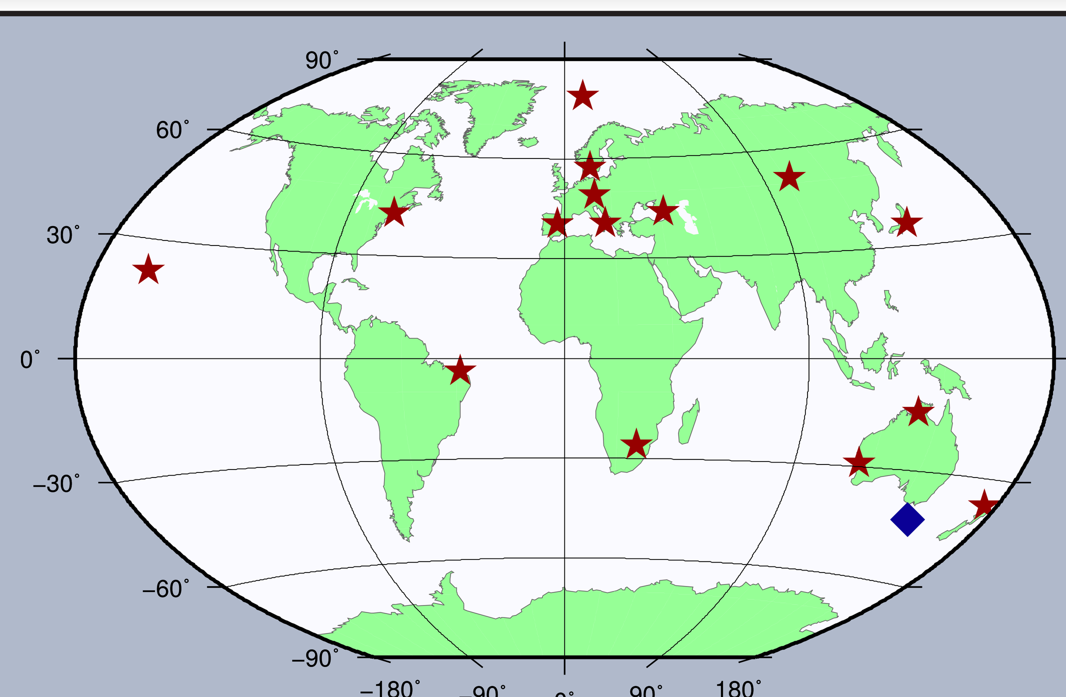

Figure 4: We also tested the combination using real data from CONT14. In this campaign, the sibling telescope in Hobart were observing (marked with a blue diamond in the map).

Station position repeatability

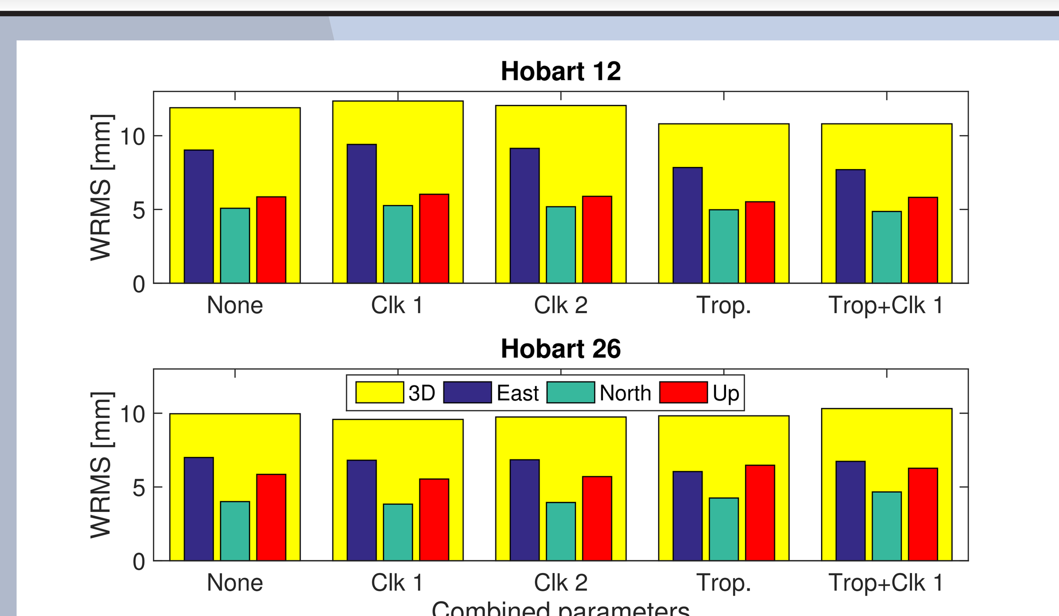

Figure 6: Shown are the station position reapeatabilities for the Hobart telescopes. The *Clk 0* solution is not shown; this solution is not working due to the huge offsets between the clocks (Fig. 5).

Clock differences

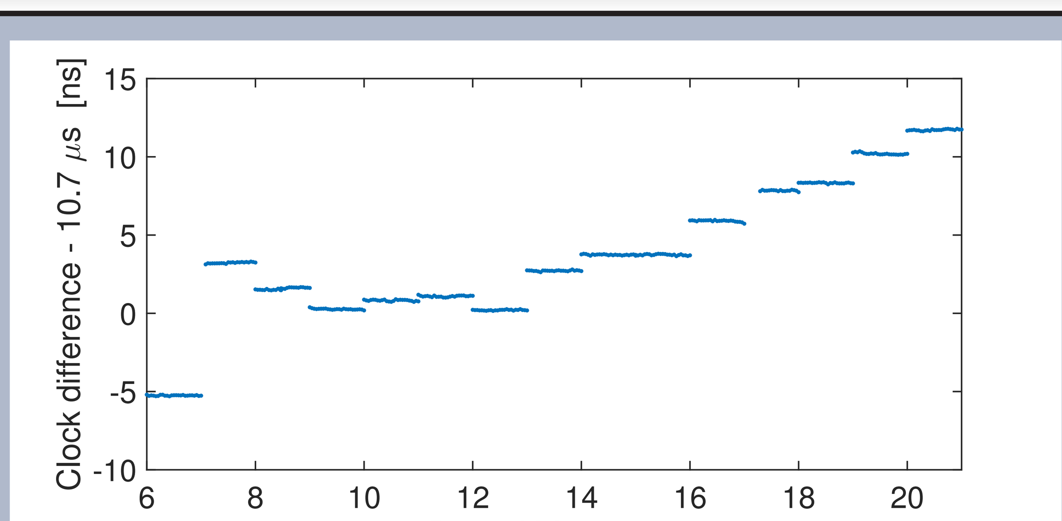

Figure 5: Difference between the estimated clock functions for the Hobart 12 and Hobart 26 telescopes. The difference is rather constant over each sessions, although occasionally small variations can be noted. However, between the sessions there are jumps.

Troposphere differences

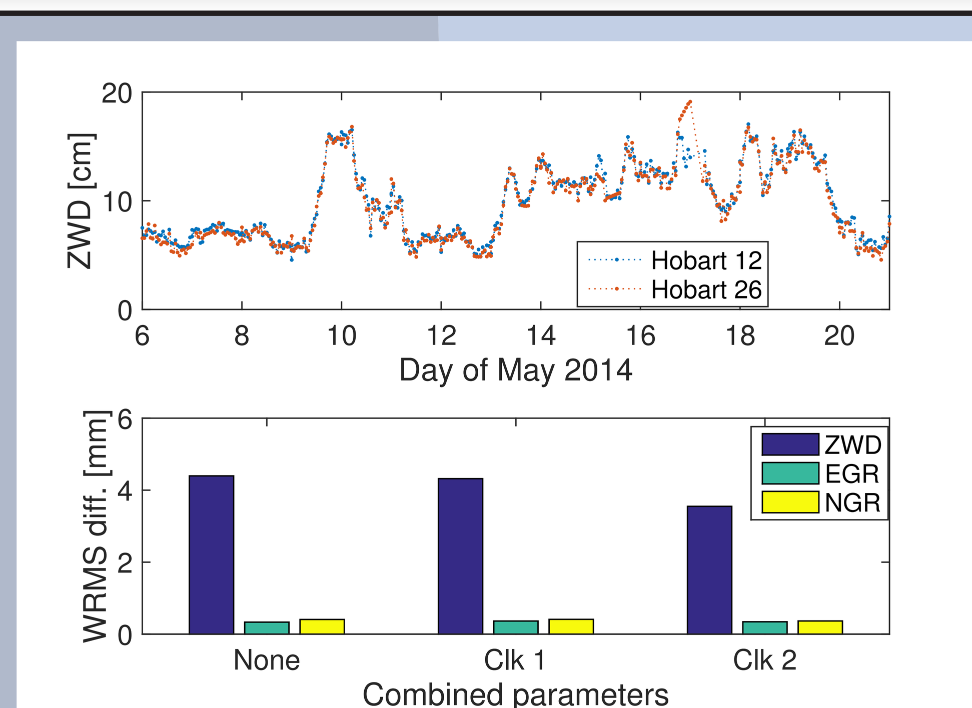

Figure 7: We also compared the tropospheric parameters estimated from the different solutions where the clocks are combined. Top plot shows the ZWD estimated in the *None* solution, lower plot the WRMS difference between estimated tropospheric parameters of the two telescopes in three different solutions.

Conclusions

The combination of common clock parameters can improve the station position repeatabilities especially if the clocks are well calibrated, i.e. no offset between the clocks (caused by e.g. an uncalibrated cable delay) needs to be estimated.

References

T. Nilsson, M. Karbon, B. Soja, R. Heinkelmann, C. Lu, and H. Schuh. Atmospheric modeling for co-located VLBI antennas and twin telescope. *J. Geodesy*, 2015. doi: 10.1007/s00190-015-0804-6. in press.

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