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VLBI observations of GNSS satellites on the baseline Hobart-Ceduna

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Observations of satellites of Global Navigation Satellite Systems (GNSS) with the geodetic Very Long Baseline Interferometry (VLBI) technique open a variety of new possibilities and promote the integration of these techniques within the framework of GGOS, the Global Geodetic Observing System of the IAG. Such observations provide possibilities to directly connect the dynamic GNSS and the kinematic VLBI reference frame, which may result in improved future ITRF realizations. In our research we are trying to apply observation strategies, which are commonly used in geodetic VLBI, i.e. the main observables are group delay values derived from direct observations and the subsequent correlations of GNSS satellite signals. However, data acquisition schemes for VLBI satellite observations are still at an experimental stage. Further research is required to establish an operational process chain, similar to that applied for natural radio sources, such as quasars, which are observed generally.

In 2015 we successfully carried out several experiments on the Australian baseline Ceduna-Hobart. During these sessions, with a few hours duration each, GNSS satellites (GLONASS and GPS) were observed in the L1 and L2 band along with natural radio sources for calibrations. All experiments were based on schedule files created with the satellite scheduling module in the Vienna VLBI Software (VieVS). The recorded data were successfully correlated with the DiFX correlator software in combination with a suitable input model for near field targets. A preliminary analysis of the group delay measurements derived with the AIPS software suite was carried out with VieVS. Using this workflow we can achieve a measurement precision of the group delays down to a few picoseconds (5-30, depending on the satellite) over a 5 minutes track. Nevertheless, our results also show a residual signal of a few nanoseconds, which might be caused by the ionosphere or insufficient orbit modelling in the present state of our software.

The developed workflow tremendously eases the planning, the observation itself, and the analysis of such (test) VLBI observations to satellites of the GNSS, opening up the field for further investigations and improvements. Within this contribution we will give an insight into the applied data acquisition schemes, from scheduling, over correlation to data analysis, and we will present latest results.