EGU2020-16586
https://doi.org/10.5194/egusphere-egu2020-16586
EGU General Assembly 2020

Coherent Time and Frequency for an Improved Global Geodetic Observing System

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The toolbox of space geodesy contains a number of measurement techniques, which are globally distributed. In this diverse network fundamental stations are playing an important role as they are forming the backbone of the global geodetic observing system. They provide the ties for the combination of the techniques.

Until recently these ties were only considering the spatial relationship between the measurement techniques. Upon closer inspection it turns out that clocks are also playing an important role. Variable delays within the main techniques of space geodesy, namely SLR, VLBI, GNSS and DORIS are limiting the stability of the measurements and hence the entire observing system. This leads to the rather paradox situation, that each technique has to adjust the clock offsets independently. Although all main measurements systems on an observatory are usually based on the same clock, each technique provides different offsets, thus weakening the local ties. This reflects the fact that the clock adjustments are also contaminated with (variable) system specific delays. Increasing the coherence of time on these GGOS observatories disentangles erroneous system delays from local ties, thus strengthening the entire observing system.

We have designed and built such a coherent time and frequency distribution system for the Geodetic Observatory Wettzell. It is based on a mode-locked fs- pulse laser, fed into a network of actively delay controlled two-way optical pulse transmission links. This utilizes the ultra low noise properties of optical frequency combs, both in the optical and electronic regime. Together with a common central inter- and intra- technique reference target time can provide consistency for the complex instrumentation of SLR and VLBI systems in situ, which was not possible before. This talk outlines the concept and its potential for GGOS.