



Ground-based water level observations at Lake Walchen with reflected GPS L1 C/A and L2C signals

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Within the German Indonesian tsunami early warning system (GITEWS) project, the GeoForschungsZentrum Potsdam (GFZ) has set up a team consisting of the GFZ, the German Aerospace Center (DLR) and JAVAD GNSS to adapt and extend their new generation GNSS receivers for advanced scientific space applications on small low Earth orbit (LEO) satellites. The GNSS occultation, reflectometry and scatterometry (GORS) space receiver prototype consists of a commercial off-the-shelf JAVAD GNSS GeNeSiS-112 72 channel receiver board with raw data and position solution output. As major step forward compared to current space receivers, the new GORS receiver prototype supports tracking of the civil L2C signal of the GPS constellation. This will enable loss-less dual frequency tracking of occultation events down to very low altitudes. Signal simulator tests show that the prototype provides proper GPS measurements for orbit determination and scientific applications under the signal dynamics of a user satellite in LEO. More than 65% of the time the number of tracked GPS satellites comprises between 9 and 11 with a minimum of 7 all the time. The raw measurement noise analysis indicates reasonable agreement with theoretical models for the CA code noise and LA carrier phase noise. In particular, noise values of 0.25 m (C/A), 0.15 m (P1 and P2), 0.6 mm (LA) and 0.4 mm (L1 and L2) are obtained at 45 dB-Hz.

The modified receiver allows output of in-phase and quadrature-phase accumulations at 5msec intervals (200 Hz). Currently, channel slaving can be performed for one GPS

satellite for L1 C/A and L2C in parallel. Hence, carrier phase observations of coherent reflected signals are now possible using civil codes on two frequencies.

Ground-based water level observations at Lake Walchen were conducted in the Bavarian Alps on July 17-19, 2007. On Mount Fahren (11.315°E , 47.607°N , 1673.5 m) a single right-hand circular polarized GPS L1/L2 patch antenna was positioned and tilted by 45° from zenith direction to allow direct and reflected GPS signal reception in parallel from Lake Walchen water surface 824.6 m below. Carrier phase observations of coherent reflected signals could be recorded successfully for both GPS L1 C/A and L2C signals. Height profiles of the lake surface could be obtained from both signal observations. A rudimentary mode to scan the reflected signals waveform was tested. The results are discussed and compared to in situ reference measurements of the lake surface.