Recent Advances on GNSS Multipath Reflectometry (GNSS-MR) for Sea and Lake Level Studies

van Dam, T. M. ; **Tabibi, S.** ; **Geremia-Nievinski, F.** ; **Francis, O.**

Global navigation satellite system multipath reflectometry (GNSS-MR) has been used to exploit signals of opportunity at L-band for ground-based sea and lake level studies at several locations in the last few years. Although geodetic-quality antennas are designed to boost the direct transmission from the satellite and to suppress indirect surface reflections, the delay of reflections with respect to the line-of-sight propagation can be used to estimate the water-surface level in a stable terrestrial reference frame. In this contribution, signal-to-noise ratio (SNR) observations from commercial off-the-shelf systems are used to retrieve water level at multiple constellations and modulations. We constrained phase-shifts so as yield more precise reflector heights and further corrected for the tropospheric propagation delays for greater accuracy. We assess GNSS-MR accuracy and precision in two cases. In the first one, using the inversion formal uncertainty and modulation-specific variance factors, reflector heights are combined and converted to water level at hourly epoch spacing and eight-hourly averaging window length. The RMSE between GNSS-MR and tide gauge (TG) records for a single station in the Great Lakes is 1.93 cm for a 12-year period. In the second case, we employ an extended dynamic model, taking tidal velocity and acceleration into account, which is applied for ten stations worldwide. Regression slope between GNSS-MR and TG exhibits a smaller deviation from the ideal 1:1 relationship, compared to the conventional dynamic model (with no acceleration). The RMSE between sub-hourly GNSS-MR and TG is 1.98 cm, with 0.998 correlation coefficient. Tidal constituents agree at the sub-mm level between GNSS-MR and TG.

Publication:	American Geophysical Union, Fall Meeting 2018, abstract #G52A-03
Pub Date:	December 2018
Bibcode:	2018AGUFM.G52A..03V
Keywords:	9805 Instruments useful in three or more fields; GENERAL OR MISCELLANEOUSDE: 1222 Ocean monitoring with geodetic techniques; GEODESY AND GRAVITYDE: 1641 Sea level change; GLOBAL CHANGEDE: 4294 Instruments and techniques; OCEANOGRAPHY: GENERAL