

Affordable GNSS PPP Results as Constraints for Pressure Time Series Offshore

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SUMMARY

This paper discusses offshore water level measurements and the accuracies possible using mass-market GNSS receivers (<\$2000). The goal is to develop an affordable and straightforward technique capable of continuous and accurate water level measurements at remote locations towards addressing the uncertainties inherent in the tidal datum transformation model offered by NOAA's Vdatum. This technique can be used either directly for tidal datum transfer when 30 plus days of GNSS data acquisition is possible or in short-term simultaneous observations with a seafloor-mounted pressure gauge to reference the longer term (30+ days) pressure time series to the ellipsoid before tidal datum transfer is performed. We applied precise point positioning (PPP) results from a mass-market GNSS receiver to constrain pressure sensor measurements to the ellipsoid. Limiting Vdatum uncertainties below 10 cm at a 95 % confidence level would require that GNSS height uncertainties be less than 5 cm in the error budget. It is then desirable to investigate the order of PPP vertical positioning accuracies possible with such a receiver on a dynamic platform at sea. We conducted two experiments at different locations offshore using GNSS+INS sensors to validate the mass-market PPP vertical positioning results. The GNSS+INS sensors in the post-processed kinematic (PPK) strategy validate the mass-market PPP vertical position results. We note that the second experiment's results are more consistent than the first following accurate lever-arms measurements for the GNSS antennas installed on an Echo boat (small uncrewed surface vehicle). Comparing water level moving averages between the two processing strategies shows a mean difference of 4 cm. That result compares instantaneous GNSS heights from the mass-market receiver without accounting for induced heave, suggesting that attitude measurements at sea for short lever arms are negligible. Briefly discussed is the preliminary validation of the tidal datum determination offshore using the mass-market vertical positions as the constraint.

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