

## **A comprehensive characterization of water levels and local datums in remote Alaskan locations using GNSS buoys and GNSS-Reflectometry**

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Remote locations, like much of coastal Alaska can be challenging environments for installing conventional water level sensors and tide stations. GNSS buoys and GNSS-Reflectometry (GNSS-R) can provide quality water level measurements suitable for calculating local datums, and when combined over longer periods the absolute and relative sea level change can be separated using the GNSS observations of tectonic motion.

In the western Alaskan village of Stebbins, a GNSS buoy was co-located with a traditional pressure sensor. The measured water levels of both instruments had an average difference of 8 mm. Furthermore, when data from a local weather station was cross-correlated with the standard deviation of the difference between the water levels measured between the sensors, these differences were found to be directly correlated with wind speeds predominantly from the west to northern directions, which in this case were the offshore directions. The GNSS buoy, however, records absolute water level changes as it is not fixed to the ground surface as traditional water level sensors are.

Similarly, a comparison of water level datums calculated using GNSS-R methods with traditional datum calculations revealed variations of ~3 cm in the northern Alaskan community of Wainwright. However, the conventional pressure sensors were not in agreement with each other, and it was only by using water levels measured using GNSS-R that it could be devised which sensor moved, and when. GNSS-R is measured from a continuously operating GNSS station, so the water levels that are measured are relative to the antenna phase center and reflect relative sea level change. The conventional GNSS position measurements that are the primary data of interest are also relative to the antenna phase center however, so these relative sea level changes can easily be converted to absolute sea level change without having to do conversions between reference frames or points.