

GPS tide gauge using multipath signatures

Yuki Nakashima^{1*}, Kosuke Heki¹

¹Dept. Natural History Sci., Hokkaido University

Sea level measurements are important for monitoring tsunami, sea level rise due to global warming, and estimation of the geoid height. Various government agencies or research institutes routinely observe the sea level with traditional tide gauges. Recently, satellite altimeters have also been used to monitor the sea level.

Tide gauges data include not only sea level information but also vertical crustal movements. It is impossible to isolate the former only with tide gauges, i.e. we need another instrument, e.g. GPS, to measure the latter. However, if we could measure sea level with GPS, we might be able to measure sea level free from vertical crustal movements. This new method may realize a denser network of sea level measurements.

Multipath implies interference of direct microwave signals from GPS satellites and those reflected by ground, sea surface, or buildings. Multipath causes cyclic changes in quantities such as SNR (signal-to-noise ratio) or L4 (geometry-free linear combination) phases. By analyzing these changes, we can infer heights of GPS antennas from reflecting surfaces. This has been applied for measurements of snow depths [Larson et al.,2009; Ozeki and Heki,2010] or soil moisture [Larson et al.,2008].Larson et al.[2013] recently reported that GPS can measure the sea level in the same way.

In this study we explore the possibility of measuring the sea level with GPS stations deployed for geodetic purposes. We compared results from the GPS tide gauges based on multipath observations and traditional tide gauges during the period from 2012/6/1 to 2012/7/31 at 39 coastal GPS stations. Among them, 37 GPS stations are called GPS-P stations, which are installed next to tide gauges in order to correct for vertical crustal movements by Geospatial Information Authority (GSI) of Japan. We will report that we can use some of these GPS stations as tide gauges although the measurement accuracies are less than those reported in Larson et al.[2013].

Keywords: GPS, GNSS, multipath, sea level change