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Azimuth selection for sea level measurements using geodetic GPS receivers

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Abstract

Based on analysis of Global Positioning System (GPS) multipath signals recorded by a geodetic GPS receiver, GPS Reflectometry (GPS-R) has demonstrated unique advantages in relation to sea level monitoring. Founded on multipath reflectometry theory, sea level changes can be measured by GPS-R through spectral analysis of recorded signal-to-noise ratio data. However, prior to estimating multipath parameters, it is necessary to define azimuth and elevation angle mask to ensure the reflecting zones are on water. Here, a method is presented to address azimuth selection, a topic currently under active development in the field of GPS-R. Data from three test sites: the Kachemak Bay GPS site PBAY in Alaska (USA), Friday Harbor GPS site SC02 in the San Juan Islands (USA), and Brest Harbor GPS site BRST in Brest (France) are analyzed. These sites are located in different multipath environments, from a rural coastal area to a busy harbor, and they experience different tidal ranges. Estimates by the GPS tide gauges at azimuths selected by the presented method are compared with measurements from physical tide gauges and acceptable correspondence found for all three sites.

Keywords: GPS, sea level measurements, reflected signals, signal-to-noise ratio

1. Introduction

Global warming, which is resulting in sea level change through the melting of glaciers and icecaps and via thermal expansion of the oceans (Jin et al., 2013), will have considerable effect on environments inhabited by humans, especially ocean coastal areas. Traditionally, sea level change has been measured using a tide gauge (TG), where the TG measures sea level variations with respect to a fixed datum (Feng et al., 2013). Recently, it has been demonstrated that Global Positioning System (GPS) receivers used for precise positioning applications can also be applied to water leveling using

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