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A novel method to measure sea-level with GLONASS-based GNSS-Reflectometry

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Global Navigation Satellite System (GNSS) applications usually process the received satellite signals to determine position, velocity or time of the receiver, or derive information about the atmosphere or ionosphere. In general, GNSS signals are transmitted from satellites and are expected to be received by a ground-based antenna, avoiding multi-path or reflections in order to achieve utmost high precision positioning results. Nevertheless, the information from reflected signals can become a valuable data source, from which (geo-) physical properties can be deduced. This approach, called GNSS-Reflectometry (GNSS-R), can be used to develop instruments that act as an altimeter when arrival times of direct and reflected signals are compared. Current GNSS-R systems usually entirely rely on signals from the Global Positioning Service (GPS). Field experiments could demonstrate that such systems can measure sea level with an accuracy of a few centimeter (Löfgren et al., 2011). However, the usage of the Russian GLONASS system, which has not been considered so far, has the potential to simplify the processing scheme and to allow handling of direct and reflected signals like a bi-static radar. Thus, such a GLONASS-based GNSS-R system was developed and deployed for test purposes at the Onsala Space Observatory, Sweden. Over a period of two weeks in October 2013, sea-level monitoring and measurements with the newly developed GLONASS-based GNSS-R system were carried out, in parallel to measurements with the conventional GPS-based GNSS-R installation at Onsala. In addition, data from tide gauge measurements were available for comparison. It can be shown that precision and accuracy of the GLONASS-based GNSS-R system is comparable to conventional GPS-based GNSS-R solutions. Moreover, the simplicity of the newly developed system allows to make it a cheap and valuable tool for a variety of ocean sciences applications. Such a system could be mounted on a vessel or aboard an airplane in order measure sea state parameters either close to the surface or from several kilometers above. When flown on a plane, so-called Delay-Doppler Maps (DDM) could be computed and this information could be used to determine, sea surface roughness, salinity, and to deduce wind parameters or other geophysical signals.

References:

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