Sea level monitoring with GNSS reflectometry based on non-parametric modelling

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Abstract

Kernel regression and clustering methods are applied to estimate the reflector height of a GNSS antenna above the sea surface at station FINO2 in the Baltic Sea. The results are compared to those from a periodigram analysis and an inverse modelling approach. The non-parametric estimation is based on the analysis of local extrema of the interference pattern which is present in the kernel-regressed signal to noise ratio (SNR) observations made with the antenna. The sine of the elevation angle of the GNSS satellite emitting the signal is used as predictor variable. A characteristic gap length between the local extrema in the interference pattern is determined with the aid of the clustering algorithm. For known carrier wavelength, this characteristic gap length can immediately be converted to an estimation of the reflector height. Moreover, certain cluster statistics are used to calculate a binary quality label for this reflector height estimation. The label is well-suited to discard potentially unreliable estimations. In order to account for the signal delay resulting from signal propagation through the troposphere, the estimations are further refined by means of a standard refraction correction applied to the elevation angle. Distributions of reflector height estimations for monthly periods are analyzed and compared for the different estimation methods. By transforming the estimated reflector height to the ITRF, a possible longterm shift of the peak observed in the aforementioned monthly distributions could serve as an indicator for changes of mean sea level.