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Estimation of significant wave heights using GNSS-SNR data from moving ships

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It is well-known that GNSS-SNR data can be utilized to derive water surface heights. Existing inversion techniques work very well for calm to moderate sea condition but with increasing wave heights the attenuation of the SNR data is likewise increased. For higher waves and larger elevation angles, the coherence between the direct and the reflected signal might be lost so that the oscillation of the SNR data becomes diffuse and the inversion fails.

Some authors suggested to use the angle at which the coherence is lost for the estimation of the significant wave height (SWH). For this, an attenuation factor has to be determined from the inversion of a full SNR model together with parameters describing the water level height. Up to now, this application has only be tested using SNR observations from static GNSS antennas. The use of this technique on moving ships would allow observing SWH offshore and could complete rare buoy data.

The movements of the ship can be calculated from the observations of at least three GNSS antennas aboard the ship and will be used to correct for the short-periodic variations of reflector heights in the inversion of the full SNR model. The inversion is carried out by global optimization based on interval analysis. The resulting attenuation factor can be used together with the amplitude and the rms of the SNR data to find the elevation angle at which the coherence is lost. The SHW can be found based on an empirical relation.

This method will be applied to a three-month data set from a ferry operating in the German Bight. The resulting SWH are compared to buoy data from the operating area of the ship. The results from this experiment will be presented and future applications will be discussed.