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GNSS-SNR for measuring the dynamic draught of moving ships

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Moving ships are exposed to dynamic draught and trim changes of several decimeters in total. This hydrodynamic effect is called squat. The squat depends on many factors like the current speed through water (STW), the depth of the water (D) and the form of the ship's hull. Knowing about the squat's magnitude is important e.g. for scheduling safe voyages in confined waters. Squat models play also an important role when the sea surface height (SSH) shall be measured with GNSS on ships. Here a correction for the dynamic draught change must be used to get the undisturbed SSH at a reference point. If no individual squat calibration was done or the main input parameters STW and D aren't available the calculated squat values have an insufficient accuracy.

Besides using GNSS for positioning purposes the analysis of the GNSS signal-to-noise ratio (SNR) became an established tool for height measurements between a receiving antenna and a reflecting surface. When using antennas mounted on a ship, height variations caused by the ships attitude and the waves have to be taken into account. GNSS observations of at least three antennas can be used to estimate the ships attitude and to calculate the wave correction. The difference between the height, based on reflectometry, and the antenna height in a ship reference frame is the dynamic draught. The squat can be calculated by subtracting the static draught. By using this technique the dynamic draught can be measured directly and no special squat models are necessary.

The authors applied this GNSS-SNR based method to a three month set of GNSS data. This data was gathered by three antennas mounted aboard a ferry, sailing between the harbour of Bremerhaven and the island of Helgoland. Time periods with a constant STW were analysed. The results were compared to dynamic draught change values, calculated for the arrival periods at Helgoland. The reflectometry based method and the comparison will be presented and discussed.