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GNSS-Reflectometry based water level monitoring

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Due to climate changing conditions severe changes in the Mekong delta in Vietnam have been recorded in the last years. The goal of the German Vietnamese WISDOM (Water-related Information system for the Sustainable Development Of the Mekong Delta) project is to build an information system to support and assist the decision makers, planners and authorities for an optimized water and land management. One of WISDOM's tasks is the flood monitoring of the Mekong delta.
Earth reflected L-band signals from the Global Navigation Satellite System show a high reflectivity on water and ice surfaces or on wet soil so that GNSS-Reflectometry (GNSS-R) could contribute to monitor the water level in the main streams of the Mekong delta complementary to already existing monitoring networks.
In principle, two different GNSS-R methods exist: the code- and the phase-based one. As the latter being more accurate, a new generation of GORS (GNSS Occultation, Reflectometry and Scatterometry) JAVAD DELTA GNSS receiver has been developed with the aim to extract precise phase observations.
In a two week lasting measurement campaign, the receiver has been tested and several reflection events at the 150-200 m wide Can Tho river in Vietnam have been recorded. To analyze the geometrical impact on the quantity and quality of the reflection traces two different antennas height were tested. To track separately the direct and the reflected signal, two antennas were used. To derive an average height of the water level, for a 15 min observation interval, a phase model has been developed. Combined with the coherent observations, the minimum slope has been calculated based on the Least- Squares method. As cycle slips and outliers will impair the results, a preprocessing of the data has been performed. A cycle slip detection strategy that allows for automatic detection, identification and correction is proposed. To identify outliers, the data snooping method developed by Baarda 1968 is used. In this context, issues related to the stochastic modeling of GPS observations are addressed and a first model is proposed. First results of water level derivation with precisions below decimeter level are presented. These results could then be used as an approximation for the next computation step: the ambiguities fixing.