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Accuracy assessment of satellite altimetry over central East Antarctica by kinematic GNSS and crossover analysis

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Satellite altimetry is a unique technique to observe the contribution of the Antarctic ice sheet to global sea-level change. To fulfill the high quality requirements for its application, the respective products need to be validated against independent data like ground-based measurements.
Kinematic GNSS provides a powerful method to acquire precise height information along the track of a vehicle. Within a collaboration of TU Dresden and Russian partners during the Russian Antarctic Expeditions in the seasons from 2001 to 2013 we recorded several such profiles in the region of the subglacial Lake Vostok, East Antarctica. After 2006 these datasets also include observations along seven continental traverses with a length of about 1600km each between the Antarctic coast and the Russian research station Vostok (78° 28’ S, 106° 50’ E).
After discussing some special issues concerning the processing of the kinematic GNSS profiles under the very special conditions of the interior of the Antarctic ice sheet, we will show their application for the validation of NASA’s laser altimeter satellite mission ICESat and of ESA’s ice mission CryoSat-2. Analysing the height differences at crossover points, we can get clear insights into the height regime at the subglacial Lake Vostok. Thus, these profiles as well as the remarkably flat lake surface itself can be used to investigate the accuracy and possible error influences of these missions. We will show how the transmit-pulse reference selection correction (Gaussian vs. centroid, G-C) released in January 2013 helped to further improve the release R633 ICESat data and discuss the height offsets and other effects of the CryoSat-2 radar data. In conclusion we show that only a combination of laser and radar altimetry can provide both, a high precision and a good spatial coverage. An independent validation with ground-based observations is crucial for a thorough accuracy assessment.