Geophysical Research Abstracts
Vol. 18, EGU2016-9409, 2016
EGU General Assembly 2016

GNSS reflectometry aboard the International Space Station: phase-altimetry simulation to detect ocean topography anomalies

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An ocean altimetry experiment using Earth reflected GNSS signals has been proposed to the European Space Agency (ESA). It is part of the GNSS Reflectometry Radio Occultation Scatterometry (GEROS) mission that is planned aboard the International Space Station (ISS). Altimetric simulations are presented that examine the detection of ocean topography anomalies assuming GNSS phase delay observations. Such delay measurements are well established for positioning and are possible due to a sufficient synchronization of GNSS receiver and transmitter. For altimetric purpose delays of Earth reflected GNSS signals can be observed similar to radar altimeter signals. The advantage of GNSS is the synchronized separation of transmitter and receiver that allow a significantly increased number of observation per receiver due to more than 70 GNSS transmitters currently in orbit. The altimetric concept has already been applied successfully to flight data recorded over the Mediterranean Sea. The presented altimetric simulation considers anomalies in the Agulhas current region which are obtained from the Region Ocean Model System (ROMS). Suitable reflection events in an elevation range between 3° and 30° last about 10min with ground track's length >3000km. Typical along-track footprints (1s signal integration time) have a length of about 5km. The reflection's Fresnel zone limits the footprint of coherent observations to a major axis extention between 1 to 6km dependent on the elevation. The altimetric performance depends on the signal-to-noise ratio (SNR) of the reflection. Simulation results show that precision is better than 10cm for SNR of 30dB. Whereas, it is worse than 0.5m if SNR goes down to 10dB. Precision, in general, improves towards higher elevation angles. Critical biases are introduced by atmospheric and ionospheric refraction. Corresponding correction strategies are still under investigation.