

GEO-PHYSICAL INFORMATION CONTENT IN GNSS RO REFLECTED SIGNALS

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Some signatures detected in radio-holographic images of the Global Navigation Satellite System Radio-Occultations (GNSS-RO) correspond to the interference with signals of the same GNSS satellite that rebound off of the surface of the Earth, in a very slant geometry. The potential use of these reflected signals requires an automatic way to detect and flag the RO according to the presence of reflections. As presented at the ECMWF GRAS-SAF Workshop 2008, this was achieved and by means of a Support Vector Machine (SVM), an algorithm that outputs a scalar value which relates to the certainty of presence/lack of signal. In particular, two major conclusions were obtained: (a) simulation work shown that current standard techniques applied in the RO inversion are not affected by the interference with the reflected signal, meaning that reflected signals do not disturb canonical-transform or full spectrum inversion retrievals; (b) empirical work shown that GPS-inverted and ECMWF post-processed refractivity profiles yield better comparisons when reflected signals are present. A possible explanation to these results is being investigated under the EUMETSAT's GRAS SAF project. The correlation between the goodness of the data and the presence of reflected signals might have operational applications, such as a quality flag for properly weighted assimilation of the RO data into Numerical Weather Prediction Models (NWPM). On the other hand, the geographical and seasonal patterns and statistics might help identifying the conditions under which reflections are captured by the receiver, which in turn can help identifying potential applications of the reflected-RO for geophysical studies: A set of two months of COSMIC data, November and December 2008, has been used to look at the statistics of the reflection events. The percentage of RO with reflections sum up to 36%. 45% of the setting occultation do present reflected signals, against 24% of the rising RO. If we focus on ROs over the Oceans, 44% of them present reflected signatures. The statistics present a clear dependence on the latitude: the percentage of reflections increase with the latitude (e.g. 32% of reflected signals across the Tropical Oceans; 75% in mid latitudes; and 80% in Polar Waters). According to these results, reflections might occur at any sort of surface (ocean, ice, land), however, land-reflections are sparse (and concentrate in smooth areas, free of vegetation, or continental ice). This opens the question about the reasons why not all the ocean RO contain reflected signals, and in particular, why the Ocean reflections depend on the latitude. Ocean surface roughness conditions do not drive the presence/lack of reflected signals, since no correlation has been found between QuikSCAT scatterometer surface wind at the location/time of the RO event and the SVM reflection flag. However, the sea surface temperature does anti-correlate with reflections, independently of the latitudinal belt. One might think that the temperature affects the reflectivity of the surface. This is in general true, but the Fresnel reflection coefficients for the co-polar component of circular polarized signals do not change significantly with temperature at grazing angles (much less than 0.1% variation from 1 to 20 deg. C). Therefore, the lack of reflected signals must link with some special tropospheric conditions. Several atmospheric parameters extracted from the same RO-profiles have been checked

for correlation with the SVM flag. Although in general those are not correlated, most of them do present different behaviors depending on the reflection flag value (correlation of the envelope). The average wet-temperature does anti-correlate with the SVM-flag, similarly to the Sea Surface Temperature.