Study on Correlation Between Airborne L-band Radiometric Measurements and GNSS-R Observations at the Baltic Sea

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L-band Global Navigation Satellite Systems (GNSS) were originally established for applications such as positioning, navigation, tracking, and timing. More lately, also GNSS signal reflections from the surface of the Earth are closely studied as they carry information about the scattering properties of the surface from which they are reflected. In general, such techniques are called GNSS-reflectometry (GNSS-R).

Potential of the GNSS-R technologies is recently studied for the use of sea surface salinity retrieval algorithms based on L-band radiometric observations. At L-band radiometric signal from sea surface is affected by surface roughness properties, so their influence needs to be modeled. In the near future, two orbital remote sensing missions, SMOS (Soil Moisture and Ocean Salinity) mission of ESA and Aquarius mission of NASA, are foreseen to make continuous and global sea salinity maps for scientific use by means of L-band radiometry. For the successors of these missions, on-board GNSS-R instruments are considered.

The SMOS mission was launched on November 2009, and Aquarius is foreseen to be launched in late 2010. Before the launch of SMOS ESA organized airborne campaigns for preparations of the actual space borne mission. Aalto University participated in the campaigns with University's research aircraft Short SC-7 Skyvan. During the campaigns in August 2007 and spring 2008 three remote sensing instruments were used on-board Skyvan: University's radiometer using aperture synthesis in two dimensions – HUT-2D, the EMIRAD radiometer from Technical University of Denmark and the GPS reflectometer GOLD-RTR (GPS Open Loop Differential Real Time Receiver) from Catalonian Institute of Space Studies. On August 2007, the objective was to detect the salinity gradient from the low salinity sea in the coastal area of Gulf of Finland. The measurement area was selected from the estuary of a river to further to the sea. The results indicated that the sea surface roughness was essential for the detection, and demonstrated the potential of GNSS-R-based techniques for the purpose. In spring 2008 data was collected by the three instruments during flights over the Baltic Sea on the way from Finland to Germany.

In this paper we will concentrate on the two airborne campaigns mentioned above and the data gathered over the sea areas to further study the correlation between the measurements of the two L-band radiometers and the measurements of GOLD-RTR. We shall use data from both radiometer systems on-board – EMIRAD and HUT-2D, former of which provides fully polarimetric measurements and the latter standing for the same technology as the SMOS payload. The collected GNSS-R data consist of complex and integrated waveforms, from which we extract a set of GNSS-R observables and estimate statistical parameters of the sea surface roughness fitting different scattering models. Both sets of observables and estimates will be compared to the radiometric observations for better comprehension of the L-band radiometric roughness effects and corrections.