SURVEYS AND ANALYSIS OF RFI IN THE SMOS CONTEXT

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A number of experimental campaigns, including airborne L-band radiometer measurements, have been carried out in support of ESA's Soil Moisture and Ocean Salinity (SMOS) mission. The radiometer used in this context is fully polarimetric and has built-in Radio Frequency Interference (RFI) detection capabilities. Thus the instrument, in addition to providing brightness temperature data for algorithm validation, gave valuable information about the RFI environment. Campaigns were carried out in Australia and in a variety of European locations, resulting in the largest and most comprehensive data set available for assessing RFI at L-band.

The radiometer system [1] detects RFI using the kurtosis method [2]. The percentage of data, that are typically flagged as being corrupted by RFI, range from about 1% in Northern Europe, to a few percent in Germany, France, Spain, and Australia, with a tendency for somewhat higher values (20 – 40%) in areas of southern France. RFI is generally scarce over the ocean and rural areas where typically less than 1% of data are flagged, but it is more dominating over cities, airports, and occasional special installations, where up to 100% of data may be contaminated. In addition to this uneven distribution in space, there are also large variations over time: covering the same area on different days reveals special days with much enhanced RFI even over generally quiet areas like the ocean [3].

Analysis of the data shows that in general the kurtosis method is an efficient and good RFI detector, however with some shortcomings: often RFI signals, so small that they would not contribute significantly to the true brightness temperature, are flagged ("false alarms"), and in other cases, even very clear hot spots are undetected. The 3rd and especially the 4th Stokes parameters over natural targets are expected to be small at L-band. In contrast, RFI can generally be expected to produce contributions to one of the same parameters. Analysis shows that indeed it is often seen that kurtosis flagged data also show a large response in the 3rd and 4th Stokes channels, but there are also cases where hot spots, un-flagged by kurtosis, clearly are detected using those channels. It has also been investigated, how the use of the *standard deviation* of the Stokes channels rather that the *absolute values* performs. This seems a promising procedure, and will be discussed. The kurtosis method, and flagging of excessive 3rd and 4th Stokes parameter values / standard deviations, complement each other in some cases, and using both results in a cleaner signal. But it is also evident that the Stokes method in itself is often a very powerful and comprehensive method.

SMOS was launched in November 2009, and it was designed years ago. Hence, fancy RFI detection methods, like the kurtosis method, were not foreseen, and the baseline is to resort to classical tools like looking for unusually large brightness temperatures. However, SMOS will be operated in a polarimetric mode at least for periods of its lifetime, and the Stokes RFI detection method can be applied. The presentation will elaborate on this and present first results from the commissioning phase, as well as the latest results form the Cal/Val campaign to be carried out in May - June 2010.

[1] N. Skou, S. S. Søbjærg, J. Balling, and S. S. Kristensen: "A Second Generation L-band Digital Radiometer for Sea Salinity Campaigns", Proc. IGARSS, Denver, USA, 4p., July 2006.

[2] C. S. Ruf, S. M. Gross, and S. Misra: “RFI Detection and Mitigation for Microwave Radiometry with an Agile Digital Detector,” IEEE Trans. Geosci. and Remote Sens., vol. 44, no. 3. pp. 694-706, March 2006.

[3] N. Skou, S. Misra, J. E. Balling, S. S. Kristensen, and S. S. Søbjærg: "L-band RFI as Experienced During Airborne Campaigns in Preparation for SMOS," accepted for publication in IEEE Trans. on Geoscience and Remote Sensing, Vol. 48, 2010.

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