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Comparison of RFI detection algorithms for SMOS and AMSR2 data using GRDS

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Radio Frequency Interference (RFI) is an increasing problem in remote sensing missions. RFI affecting remote sensing instruments vary largely for different frequency bands. They depend on the communication services they provide in their allocated adjacent bands or even within the Earth-Exploration satellite services allocated frequency bands if the RFI is transmitting illegally. Moreover, within the same service, RFI can also vary in intensity levels, polarizations, directivity characteristics, geographical extensions, density or duty cycles. Therefore, there is no single RFI detection algorithm that can detect all RFI instances.

The Ground RFI Detection System (GRDS) is a software tool that has been developed with funds from the European Space Agency (ESA) that ingest data from Earth Observation observatories and scans the measurements for RFI using a library of RFI detection algorithms. The list of detection algorithms include: excess BT intensity, excess spatial variability, excess polarization differences, an outlier algorithm, a high pass filter, the generalized RFI index algorithm [1], Kurtosis and skewness detections.

A comparative analysis has been performed for SMOS and AMSR2 data to analyze the performance of these different algorithms in flagging data contaminated with RFI. The analysis includes assessment of:

- The effectiveness of different algorithms in improving quality metrics.
- the dependency of the techniques with threshold adjustments.
- the false alarm rates for each technique.
- the spatial correlation between different techniques to assess how complementary are these techniques in detecting different type of RFI contamination.
- combined performances when using more than one technique at the same time.

Figure 1 (left) shows the reduction of the global first guess departure (FGD) standard deviation for SMOS data for each of the techniques. The following techniques have been assessed: excess BT intensity for H or V polarization (flag 2), excess intensity for HV polarization (flag 3), excess polarization differences (flag 6), excess spatial variability (flag 7), a high pass filter algorithm (flag 8), an outlier algorithm for H or V polarization (flag 10), an outlier algorithm for HV polarization (flag 11), Kurtosis detection (flag 12) and skewness detections (flag 13).The combination of all flags is represented with the New RFI flags.

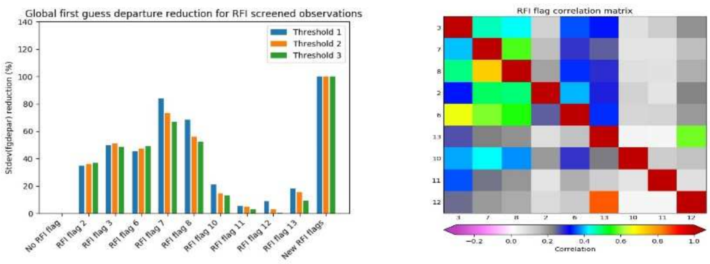

Figure 1: Statistic results for the different RFI detection techniques used in SMOS data. Left: Percentage of the contribution of the reduction of the FGD standard deviation for each technique for three different threshold levels. Right: Spatial correlation of the flagged pixels for two techniques combined.

The above results show that flag 7 alone accounts for 65-80% of all FGD reduction, whereas flags 11, 12 and 13 do not work well for SMOS. Figure 1 (right) shows the spatial correlation matrix for each two techniques. It can be observed that except for flag 7 and 8, the spatial correlation is rather low, which indicates that these techniques are complementary in detecting RFI contamination.

References

[1] D. W. Draper and P. de Matthaeis, "Radio Frequency Interference Trends for The AMSR-E and AMSR2 Radiometers," *IGARSS 2018 - 2018 IEEE International Geoscience and Remote Sensing Symposium*, Valencia, 2018, pp. 301-304.