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RFI mitigation for SMOS: a distributed approach

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The Soil Moisture and Ocean Salinity (SMOS) satellite was launched by ESA on November 2nd, 2009. Its payload MIRAS (Microwave Imaging Radiometer by Aperture Synthesis), is a two-dimensional L-band interferometric radiometer, and measures brightness temperatures (BT) in the protected 1400-1427 MHz band.
Although this band was preserved for passive measurements, numerous radio frequency interferences (RFIs) are clearly visible in SMOS' data.
Three main foci of interest are detection, geo-localization and mitigation of the RFI sources.
In this contribution is presented a method that addresses detection and mitigation in a snapshot-wise sense using the L1A SMOS products and the hexagonal 256x256 grid. Localization of the sources can also be inferred.

Previous studies have already pointed out the large extent of RFIs impact on SMOS snapshots. Most of the RFI signal's energy is found around the source and its aliases, but it affects all points of the reconstructed BT scene.
In principle it is known how a point source influences all grid points, so one way of mitigating RFIs is to obtain the precise localization of the source and have a snapshot-wise estimation of the source's temperature. But particularly tricky configurations may appear. For example the BT distribution pattern of a RFI may not match that of a point source or multiple RFIs can be so close to each other to be hard to process independently.

This algorithm defines clusters around the points with highest BT, then within this cluster, it simulates an RFI source in a distributed sense, i.e. it simulates RFIs in various points inside the cluster, in order to obtain a BT distribution that is as close as possible to the distribution pattern in the measured data.
This is done knowing that a source in a grid point will affect all other grid points to a certain known amount, which depends on the G-matrix and the aposization window, and the final BT distribution we want to obtain.

Also, thanks to the use of detailed synthetic scenes, this method allows detecting and mitigating weak RFIs, as long as they are above the noise level of the differential BT scene.
To assess the performances of the algorithm, two methods are proposed: the comparison of the standard deviation of BT over the ocean, and the plot of BT as function of incidence angle for intermittent sources.
In fact rather strong sources create visible ripple patterns around them, and since we know the ocean to be a rather homogeneous target, if the source is strong enough the standard deviation would be mainly due to the RFI.
Intermittent sources may be turned on and off a few times during a satellite pass. If a plot of the BT as function of angular incidence is drawn, then it should show very high values for the snapshots in which the source was on; so if the source is mitigated correctly in these snapshot, the chart should be much smoother.