MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886
March 6, 2014

To: EDGES Group

From: Alan E.E. Rogers
Subject: Iterative RFI Excision

There are many possible schemes for the excision of RFI from EDGES data. In the past some complex filtering of the FM, aircraft, Orbcomm, and digital TV bands has been used. However, a simple and effective scheme is to perform an iterated weighted least squares fit to the 3-position switched data from an hour of data prior to applying the full calibration.

In the first iteration each frequency bin is given unit weight and then tested for its positive departure from the fit. Frequency bins are then assigned zero weight when they exceed a specified value of sigma. Where sigma is the ratio of the positive residual to rms deviation of all weighted points to the fit. A good choice for a value of sigma is 3 or 4. In addition, to setting the weight of a frequency bin to zero the weight of an adjacent bin on each side of the bin that exceeds the specified limit can also be set to zero. Iterations continue until no additional frequency bins are set to zero.

In addition to excision of frequency bins it is sometimes necessary to exclude all the data in an individual 3-position cycle if the cycle contains a very strong signal which can saturate the ADC or produce significant intermodulation. Any data which contains a spectral signal which is more than 40 dB above the noise or any transient that results in more than a 50% increase in the total power from the antenna should be excluded.

A Fourier series, is found to be better than a polynomial for a fitting function. For the frequency range of 80 to 200 MHz a good choice is about 10 to 20 terms with a period, for the lowest order sine and cosine terms, of about 1.5 times the frequency span of 120 MHz.

Figures 1 and 2 show examples of RFI excision for the period 23 to 24 UT on day 57 2014 with and without the exclusion of very strong signals.
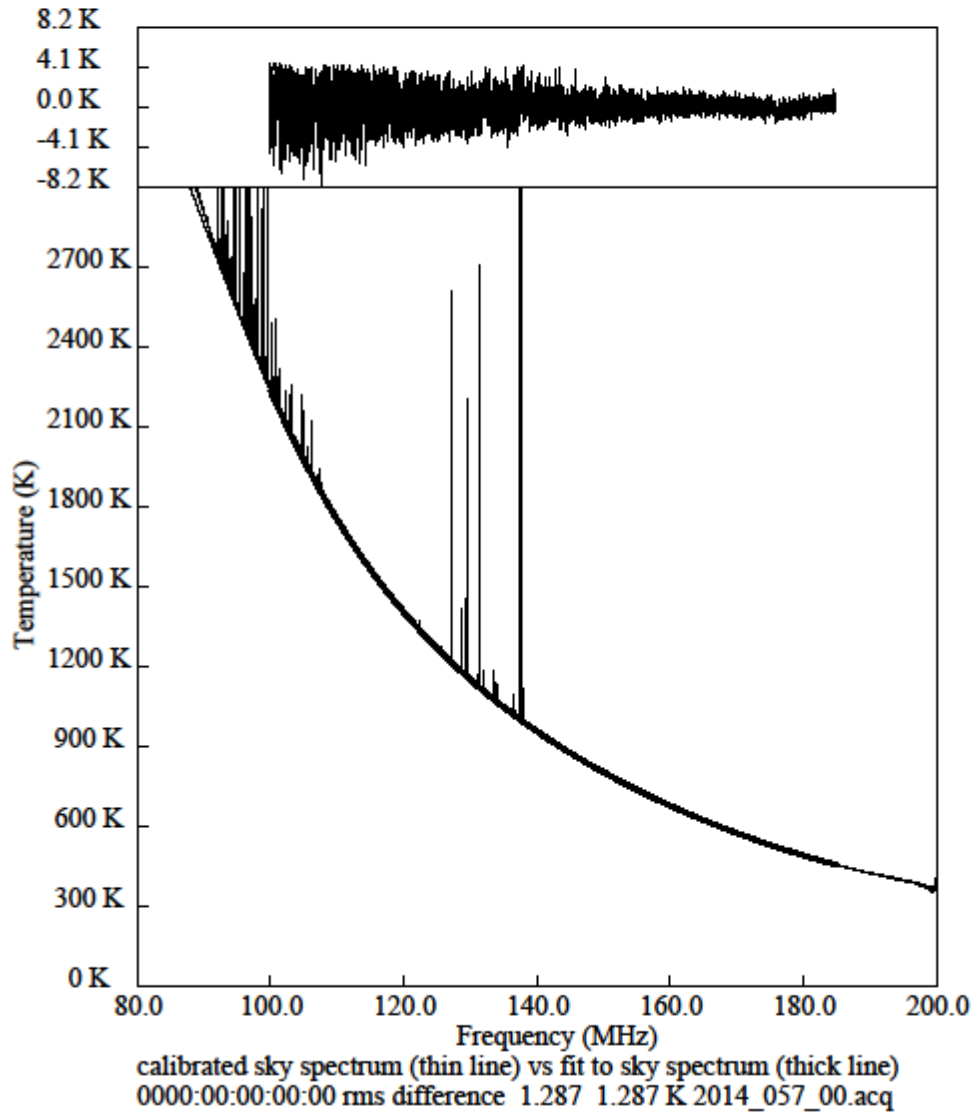
Figure 1. The plot at the top shows the residuals to the calibrated spectrum after the removal of RFI. In this case the fit to the calibrated spectrum is the first 6 basis functions listed in memo #118.
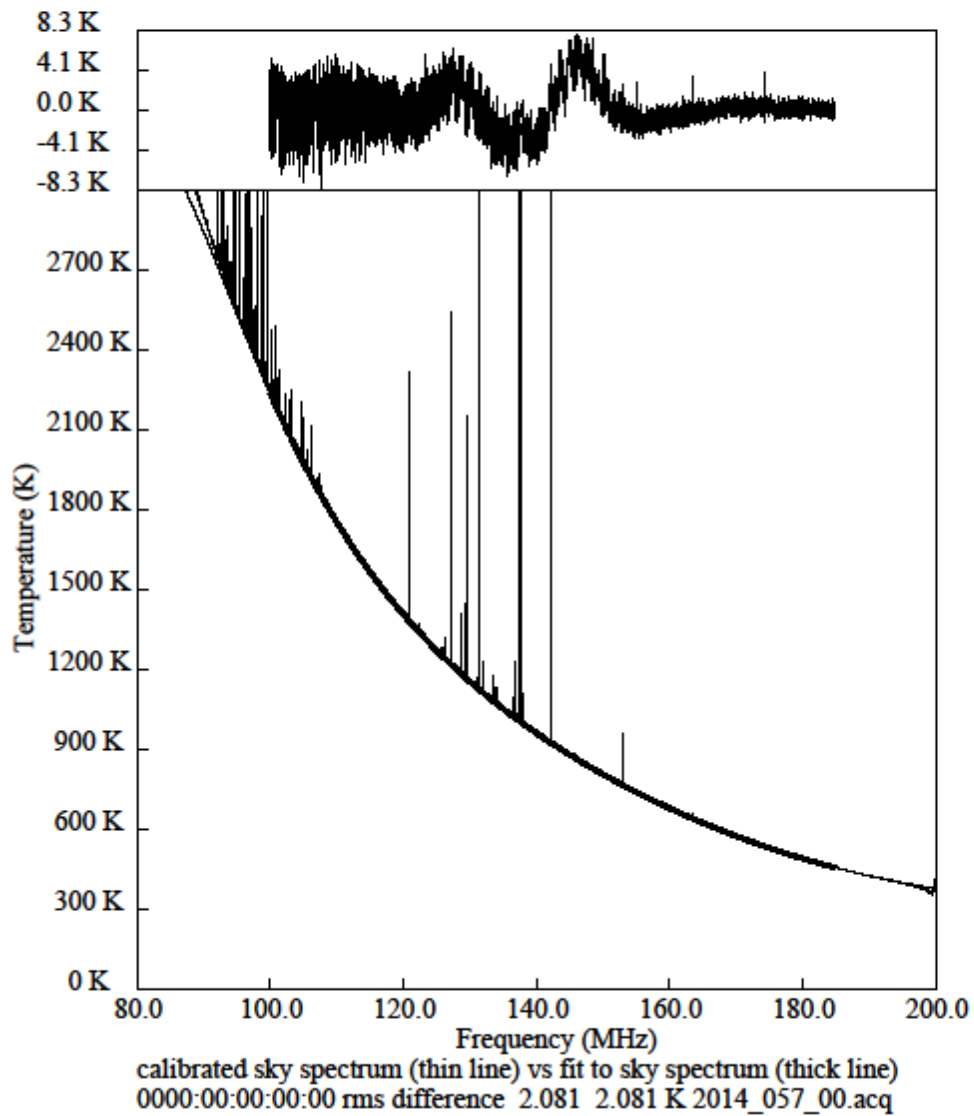
Figure 2. Results of the failure to exclude data with very strong RFI. In this case there is structure in the residuals which cannot be well fit using the first 6 basis functions in memo #118.