Improving the Simulated spectra to fit the data better

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In Memo #142 the final table showed the difference in RMS between the simulated spectra and data for both old ground and new ground planes of the Low band system. The RMS values did not indicate significant improvement with the New ground plane. Hence the following idea is tried here:

- To include the absorption feature in the simulated spectra

The simulated spectra is generated by convolving the ***beam model of the new ground plane and Haslam sky map*** (that was scaled with a spectral index of -2.5)***.*** The data is also from the new ground plane set of low1 and low2 covering days from 2016_258 to 2017_142.
The plot below compares the residues after fitting the same 5 term loglog model independently to both the data and simulated spectra.

To improve the agreement between the residues obtained from data and simulation we try the following:

- Add the absorption feature (A = 0.5K, tau = 7, nu0 = 78MHz, w = 20 MHz) to the scaled haslam sky map and then convolve the beam.

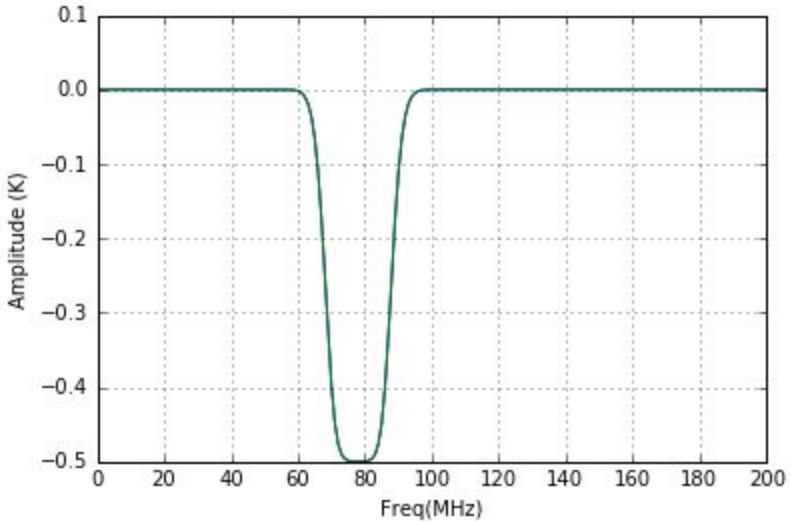


Fig1: A plot of the absorption feature that was added to the sky model.

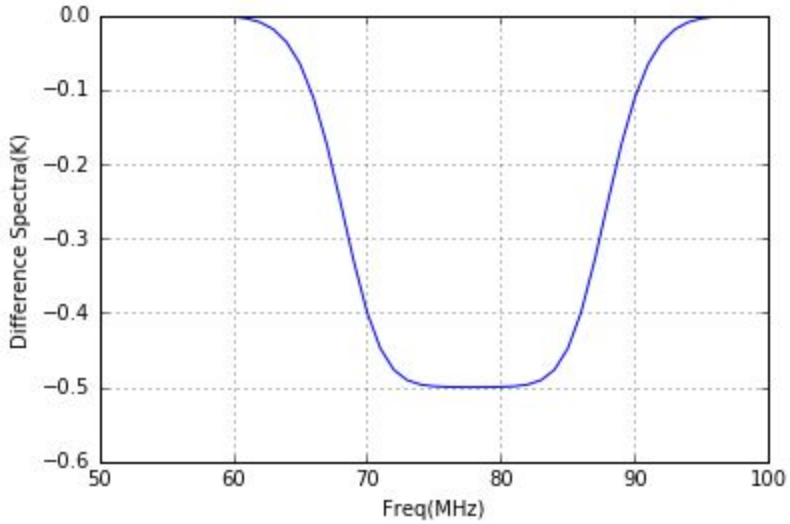


Fig2: Plot of the difference of simulated spectra with and without the absorption feature.

NEW Ground Data: Loglog + Absorption feature

The plot below compares the residues after fitting the same 5 term linlog model to both the data and simulated spectra (with absorption feature).

$$T_A(\nu) = \frac{\int_0^{2\pi}\int_0^{\pi/2} T_{sky}(\theta, \phi, \nu) * Gain_n(\theta, \phi, \nu)\, sin\theta\, d\theta\, d\phi}{\int_0^{2\pi}\int_0^{\pi/2} Gain_n(\theta, \phi, \nu)\, sin\theta\, d\theta\, d\phi}$$

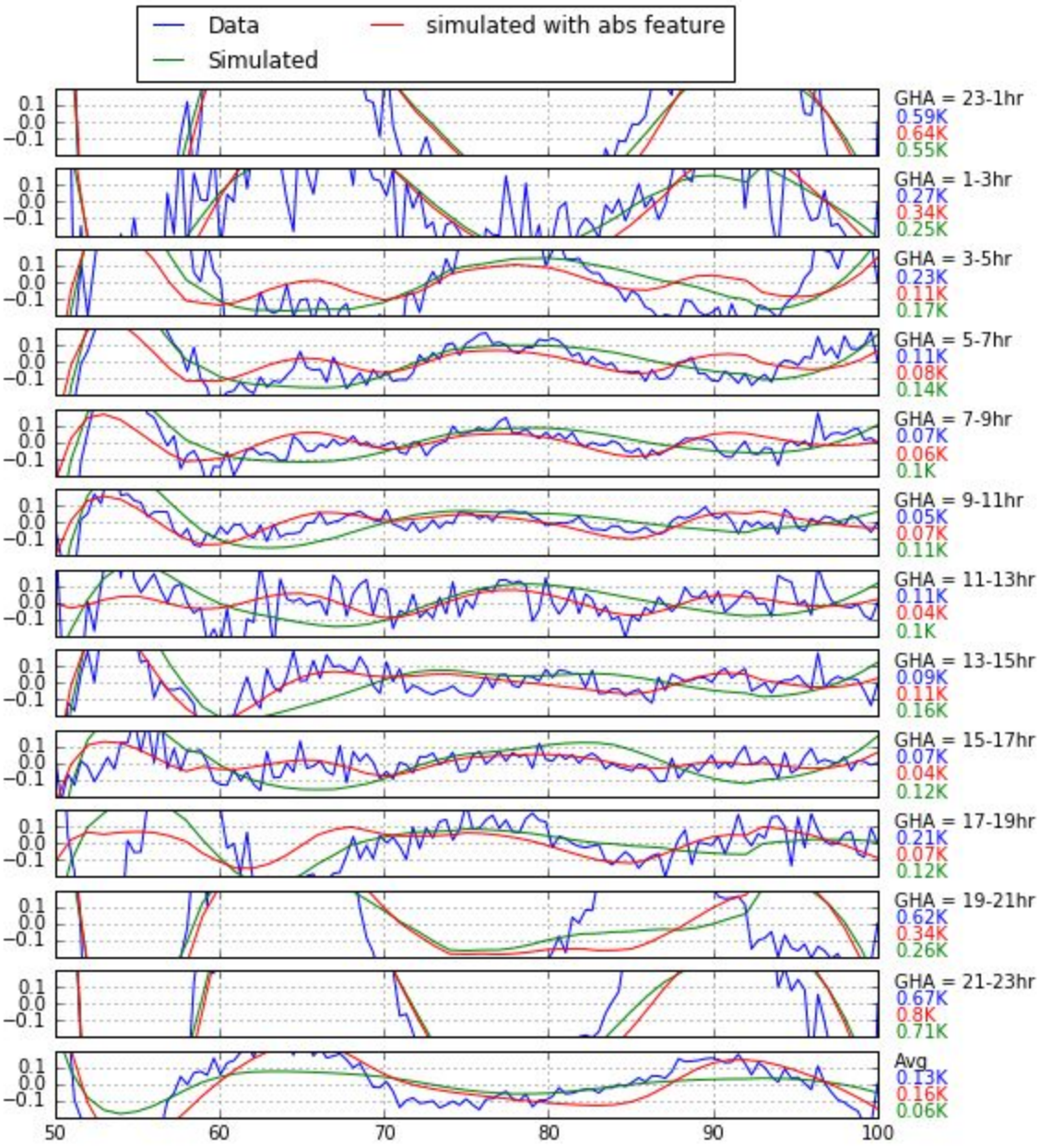


Fig 3: Comparison of residues after fitting a 5 term Loglog fit to the simulated spectra with absorption feature(red), without absorption feature(green) and processed New ground data (Blue) for different GHAs. The RMS is calculated between 55-95 MHz

Convolution changed to:

$$T_A(\nu) = \frac{1}{4\pi}\int_0^{2\pi}\int_0^{\pi/2} T_{sky}(\theta,\ \phi,\nu)\ * G(\theta,\phi,\nu)\ sin\theta\ d\theta\ d\phi\ +\ T_{amb}\ (1\ -\ \frac{1}{4\pi}\int_0^{2\pi}\int_0^{\pi/2} G(\theta,\phi,\nu)\ sin\theta\ d\theta\ d\phi)$$

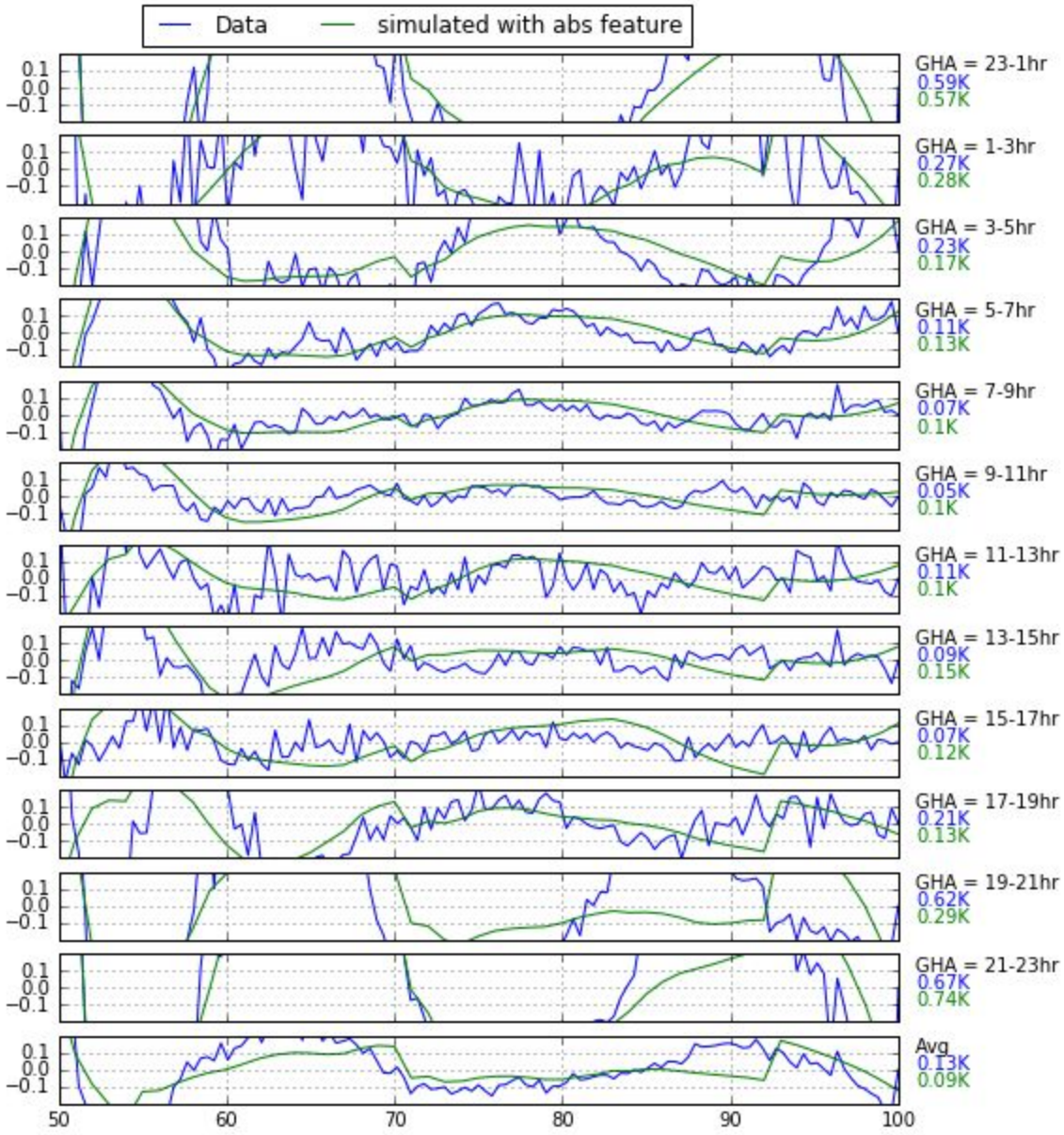


*Fig 4: Comparison of residues after fitting a **5 term Loglog** fit to the simulated spectra **including the power below the horizon**(green), and processed **New ground data** (Blue) for different GHAs. The RMS is calculated between 55-95 MHz*

I fit the 5 term loglog model individually to the two simulated spectra. To understand this feature, I plot the ***difference of the residues*** obtained after independently fitting the foreground model to the two simulated spectra (one with the feature and the other without the feature)

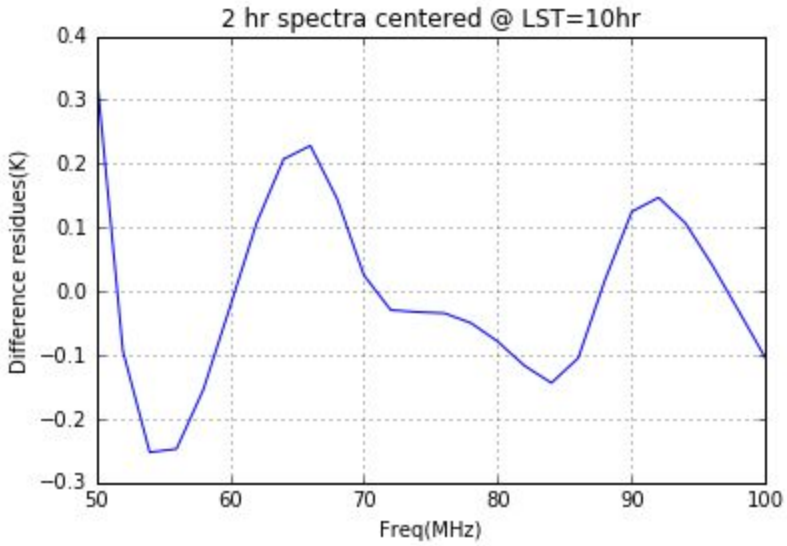


*Fig5:**difference of the residues*** obtained after independently fitting the foreground model to the two simulated spectra.

"Of course, all this really tells you is that neither of the simulations are perfectly fit by linlog, and that the added feature just changes the linlog fit." -S.M

I also tried:

- Fitting the foreground model to the simulated spectra without the feature.
- But obtained the residues by subtracting the spectra that had the feature

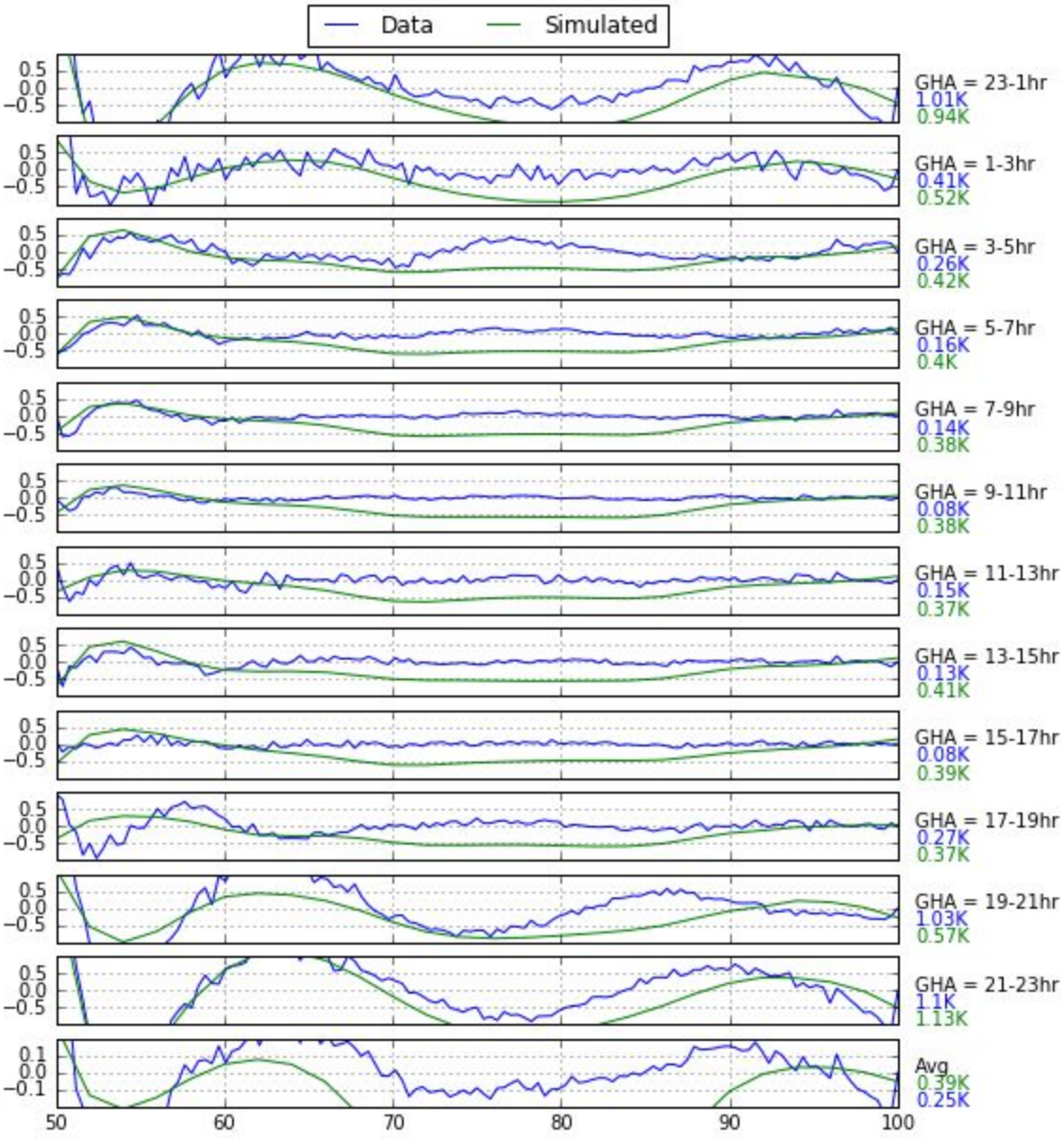


Fig 6: Comparison of residues after fitting a 5 term Loglog fit to the simulated spectra generated as mentioned above(Green), and processed New ground data (Blue) for different GHAs.

"I still don't think this is fair, if the model fit to data and sim has different parameters. Again, better just to do data - sim without any fitting." S.M

NEW Ground Data: Linlog+Absorption Feature

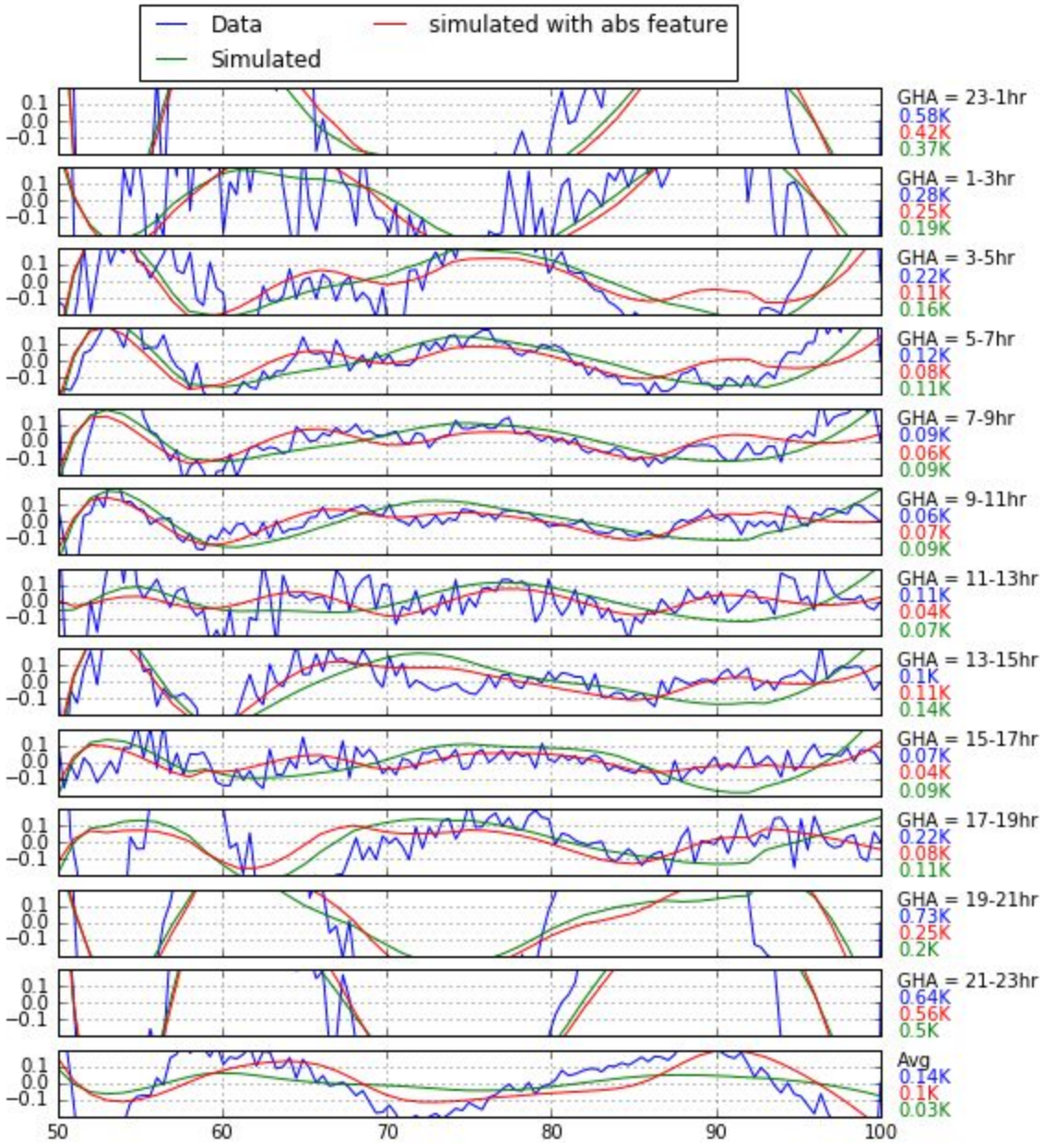


*Fig 7: Comparison of residues after fitting a **5 term Linlog** fit to the simulated spectra **with absorption** feature(red), **without (green)** and processed New ground data (Blue) for different GHAs. The RMS is calculated between 55-95 MHz*

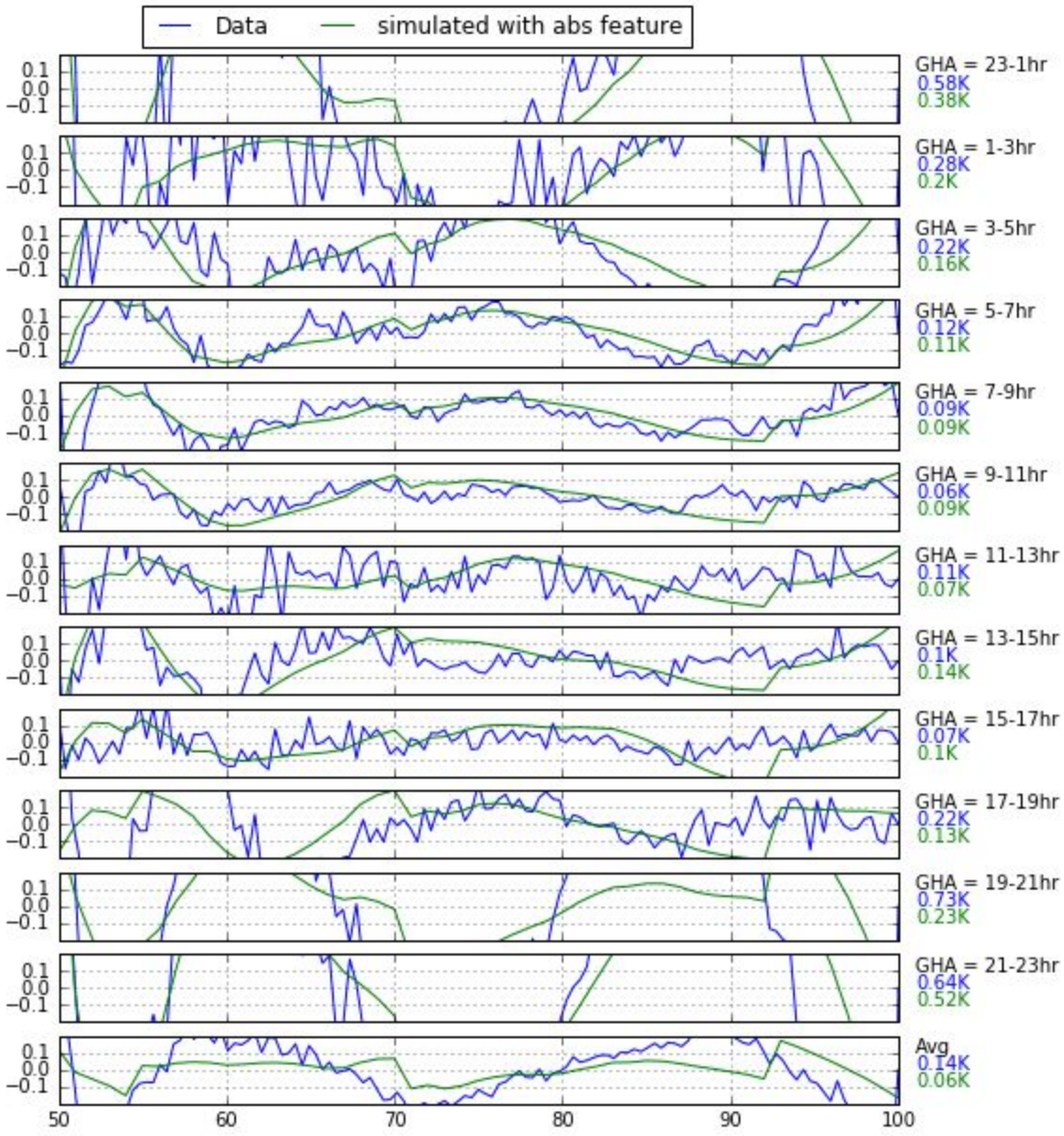


*Fig 8: Comparison of residues after fitting a **5 term Linlog** fit to the simulated spectra **including the power below the horizon**(green), and processed **New ground data** (Blue) for different GHAs. The RMS is calculated between 55-95 MHz*

OLD Ground Data: linlog + Absorption feature

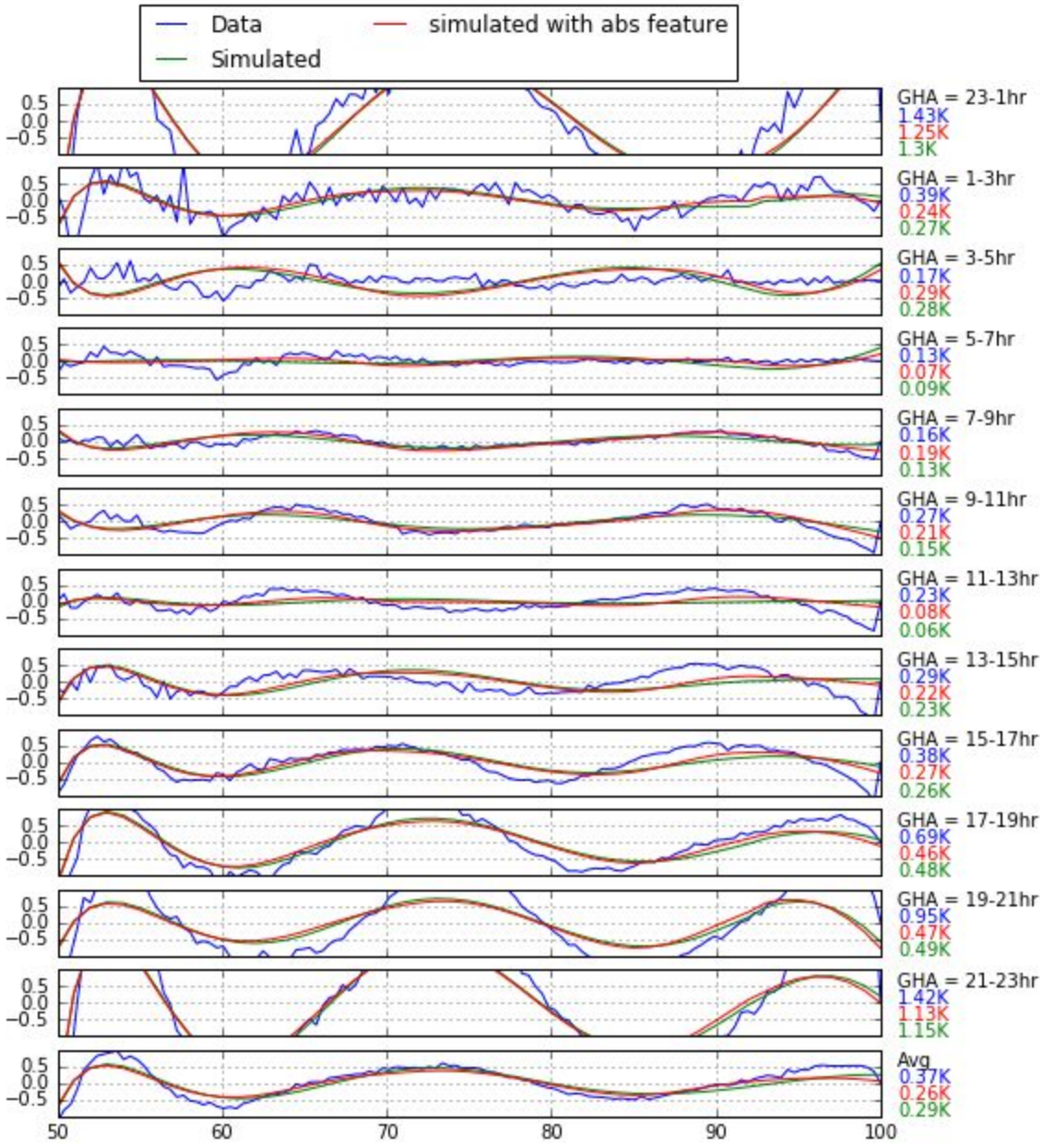


*Fig 9: Comparison of residues after fitting a **5 term Linlog** fit to the simulated spectra **with the absorption feature**(red), **without the feature** (green) and processed **old ground data** (Blue) for different GHAs. The RMS is calculated between 55-95 MHz*

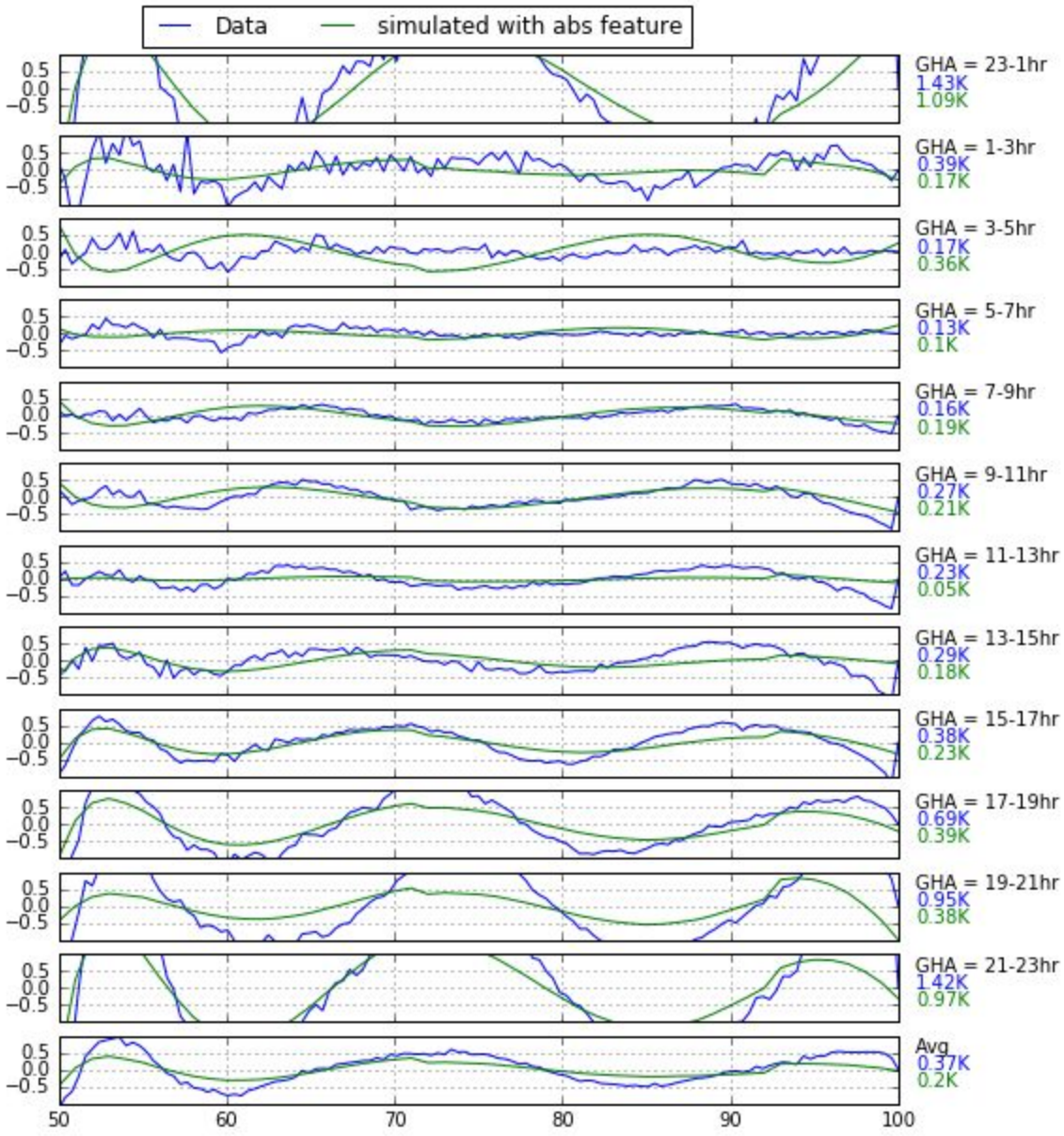


*Fig 10: Comparison of residues after fitting a **5 term Linlog** fit to the simulated spectra **including the power below the horizon**(green), and processed **old ground data** (Blue) for different GHAs. The RMS is calculated between 55-95 MHz*

OLD Ground Data: Loglog + Absorption Feature

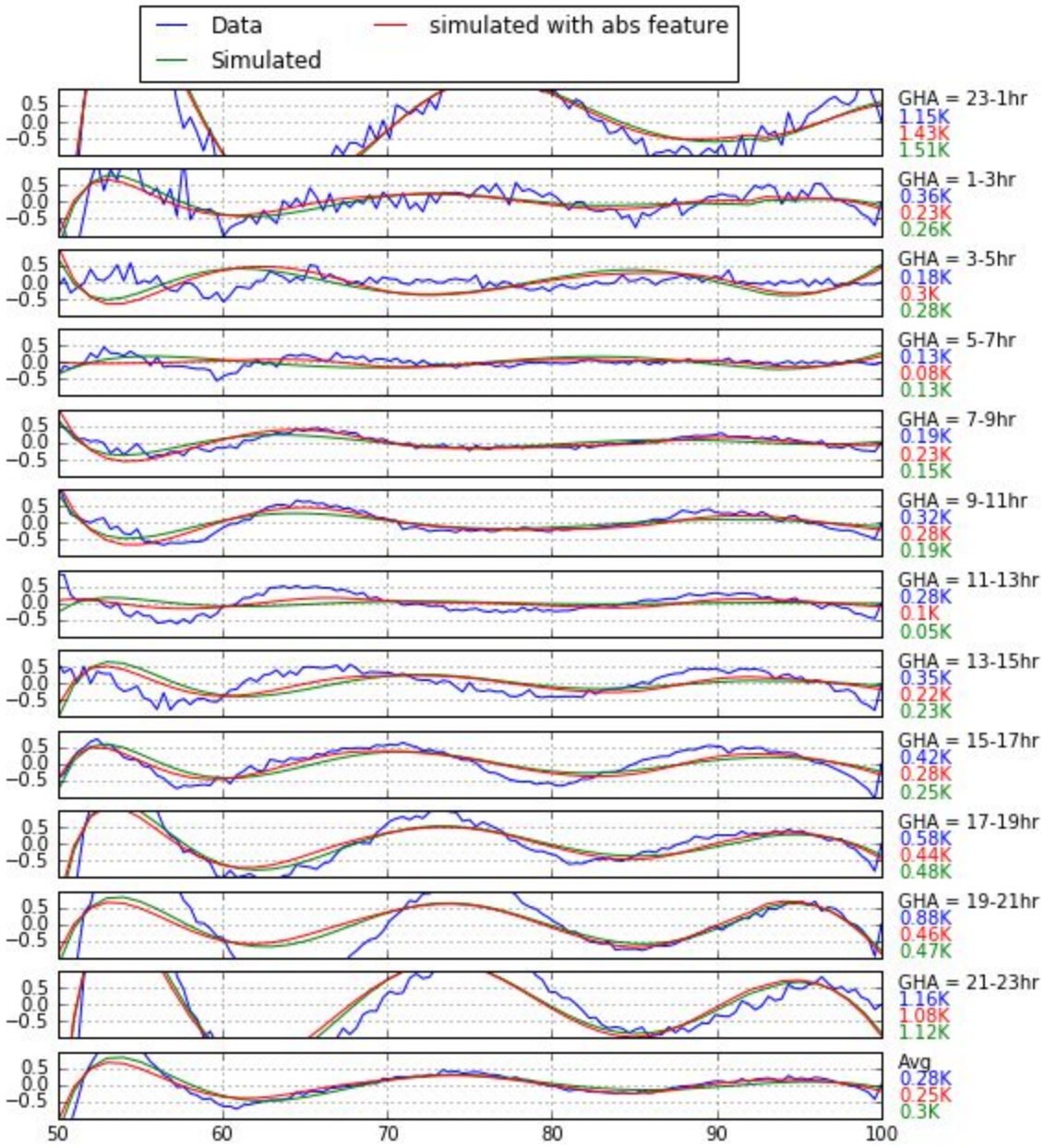


*Fig 11: Comparison of residues after fitting a **5 term Loglog** fit to the simulated spectra **with the absorption feature**(red), **without the feature** (green) and processed **old ground data** (Blue) for different GHAs.*

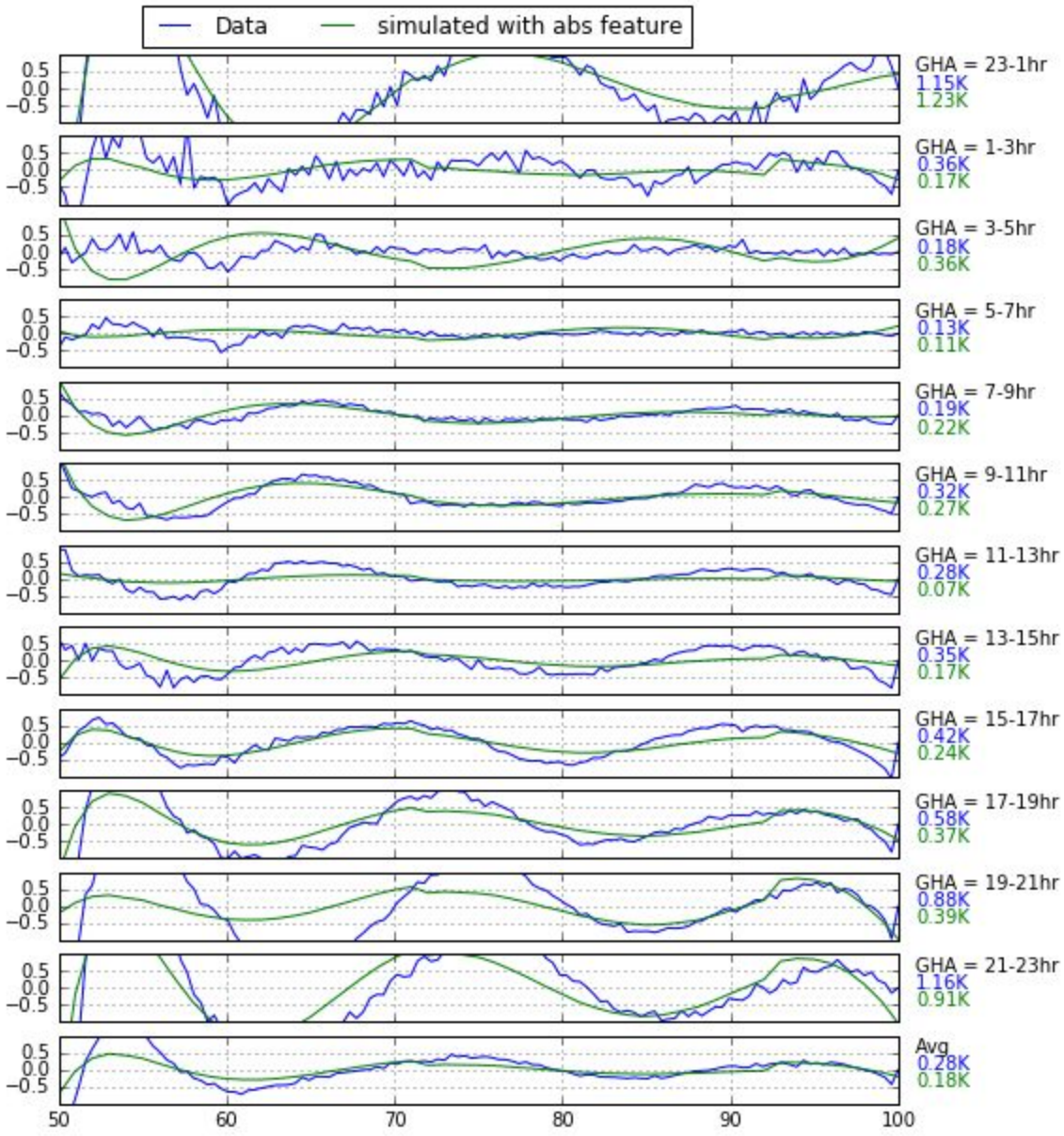
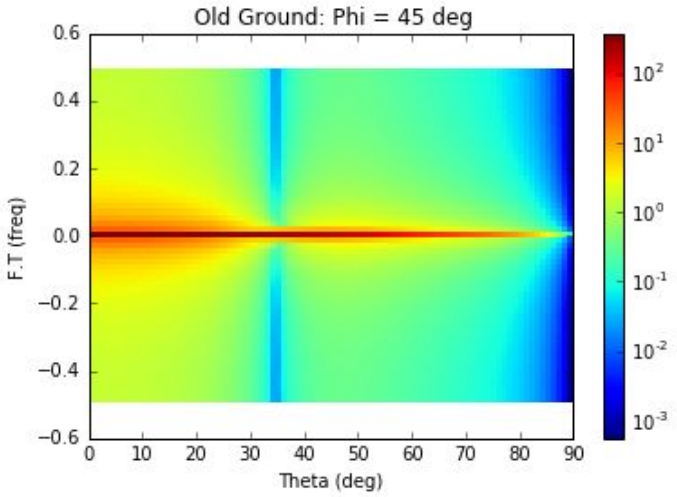
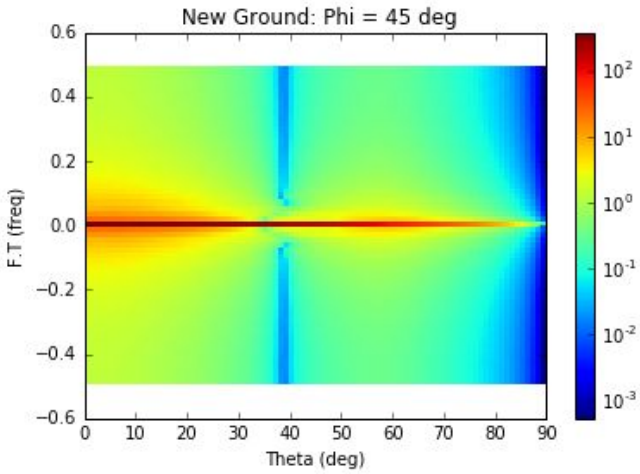
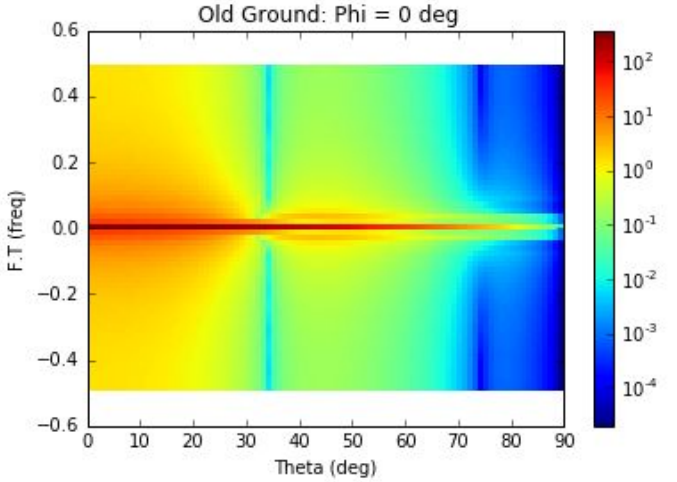


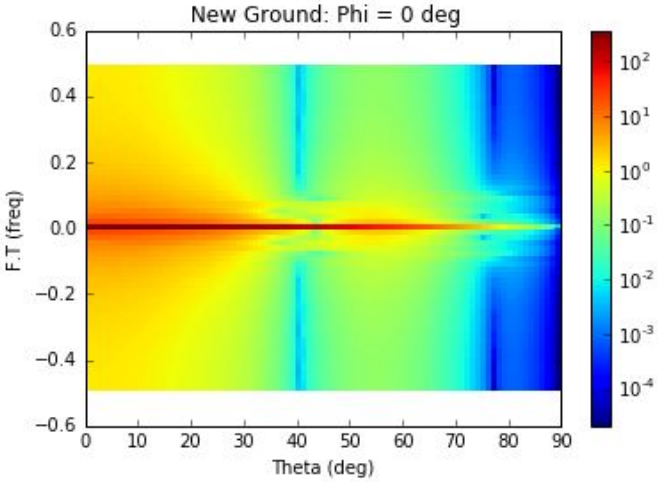
*Fig 12: Comparison of residues after fitting a **5 term Loglog** fit to the simulated spectra **including the power below the horizon**(Green), and processed **old ground data** (Blue) for different GHAs.*

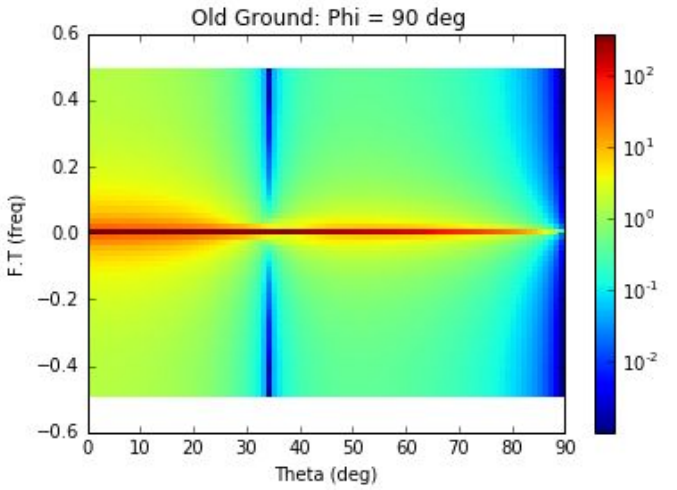
Fourier Transforms of the Beam (Old and New Grounds)

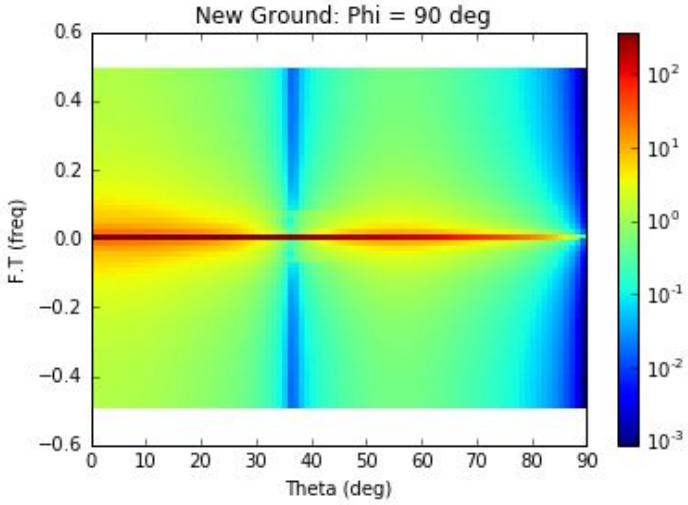












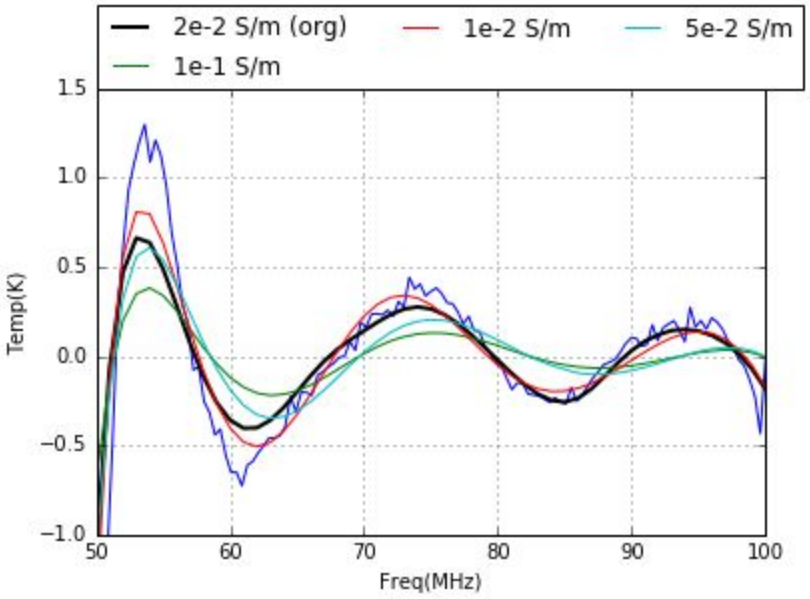


Fig14: Time averaged residues for the simulated Low band old ground beam solutions using different soil conductivities.

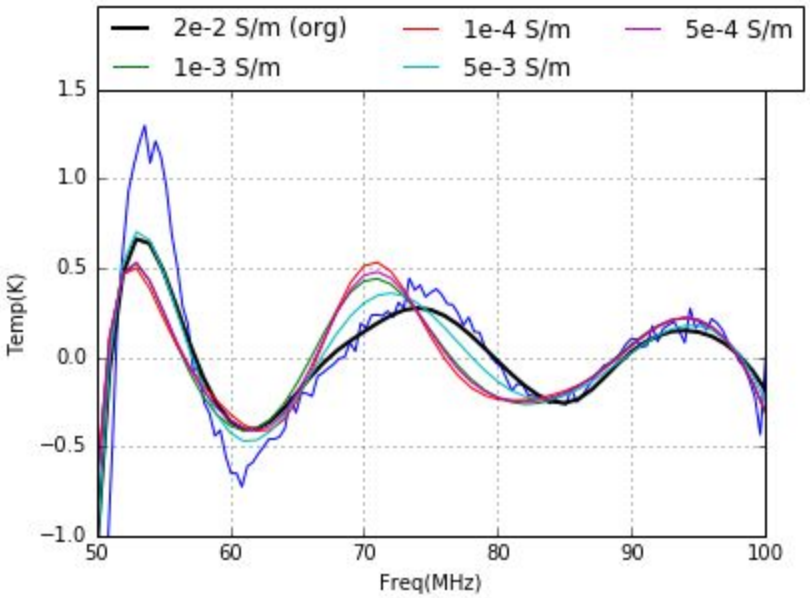


Fig14b: Time averaged residues for the simulated Low band old ground beam solutions using different soil conductivities.