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To: EDGES group  
From: Alan E.E. Rogers  
Subject: Effect of an adjacent ground plane on EDGES-3 beam chromaticity

The effect of placing another 48x48m ground plane close the existing 48x48m ground plane on which EDGES-3 was located at an azimuth of 250 degrees in November 2022 is evaluated using FEKO. The concern is that the added ground plane may need to have its mesh extend to within 0.3m of the current ground plane mesh and could have a significant effect on beam chromaticity.

Since FEKO takes about 2 days to calculate the beam from 50 to 120 MHz in 2 MHz steps for 2 adjacent 48x48m ground planes on soil it was decided to run some initial estimates using 24x24m ground planes in free space and then on soil with dielectric 3.5 and 5e-3 S/m.

Ground planes	ground	Separation m	Average rms K	Difference rms K	24 hour difference rms K
24.4x24.4	freespace	10	1.7	0.118	0.0472
24.4x24.4	freespace	0.3	1.7	0.237	0.0914
24.4x24.4	Soil 3.5 5e-3	0.3	0.37	0.049	0.0058
48.8x48.8	Soil 3.5 5e-3	0.3	0.092	0.047	0.0013

Table 1. FEKO simulations of the effects of an adjacent ground plane

Table 1 shows the results of the FEKO beam calculations used to simulate EDGES-3 data at the MRO in 1 hour blocks of GHA.

The average rms the residual using a 5-term physical term polynomial from 52 to 100 MHz using the Haslam 408 MHz sky map scaled to 50 -100 MHz using spectral index of -2.5.

The difference rms is the rms of the residual averaged over the 24 one blocks of GHA after using the FEKO beam with adjacent ground plane and applying beam correction of the simulated data using the beam without an adjacent ground plane. The 24 hour difference is the difference using a 24 hour data block.

The effects of another antenna on the adjacent ground plane and the effects of an adjacent ground plane are also studied in memo 318.

Based on the results of the simulations of 24x24m ground planes the effect of the adjacent ground plane increases by a factor of about 2 from a “tip-to-tip” separation from 10m down to 30 cm and the effect of the soil reduces the effect of the adjacent ground plane by a factor of about 5.

The general effect of the scatter from the adjacent ground plane is to produce ripple at the low end of the band as shown in Figure 1 which is a plot of the last entry in Table 1 and Figure 2 is the image of the FEKO model of the adjacent ground planes. The ripple introduced by the scatter can be filtered by

fitting the convolution of the beam with the sky map with a high order polynomial of 7 to 14 terms prior to the 5-term polynomial. However the ripple changes rapidly with GHA and averages out so the high order polynomial may not be needed.

In summary the effect of the adjacent ground plane is small and less than the effect of the hut examined in memo 342.

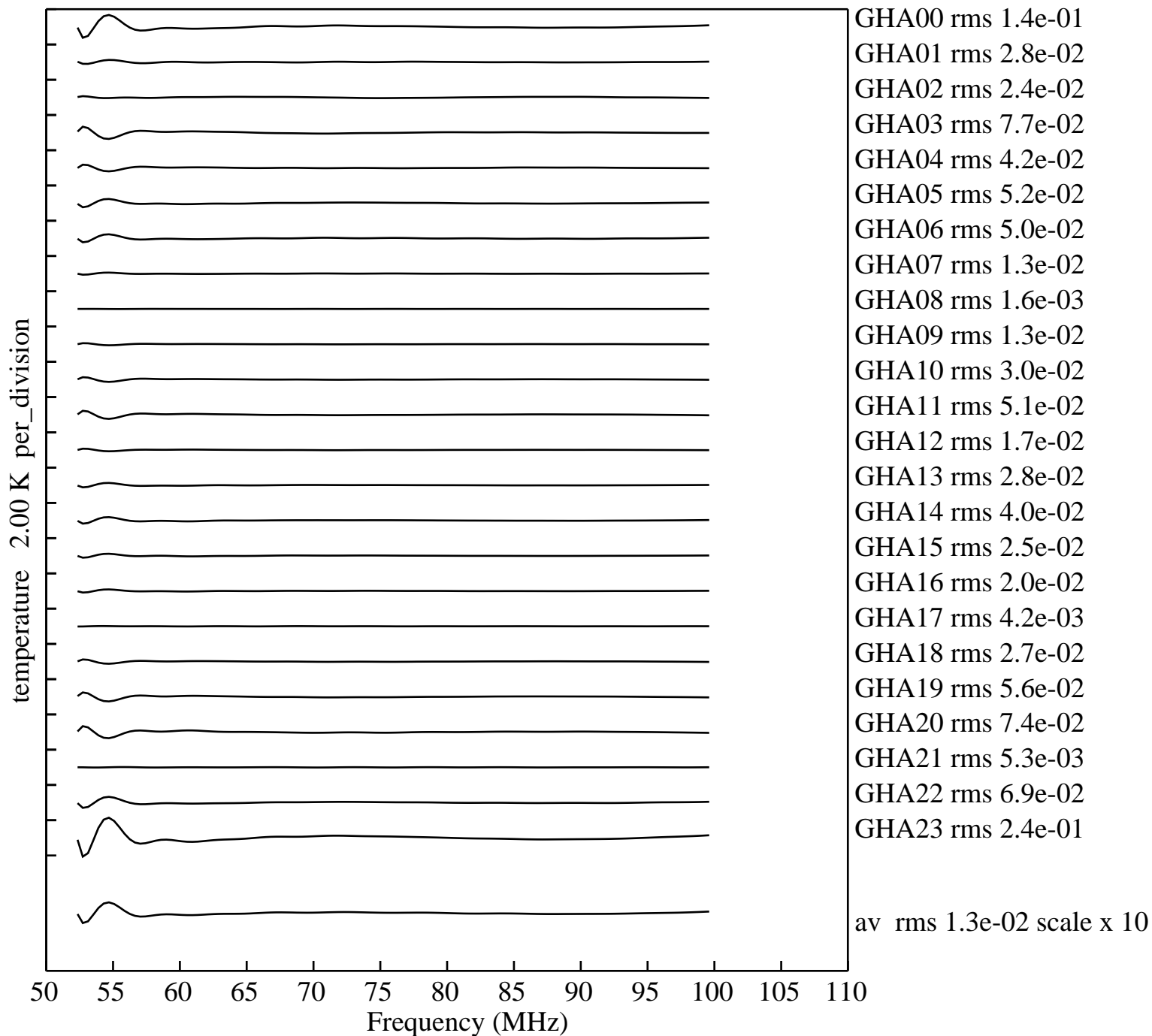
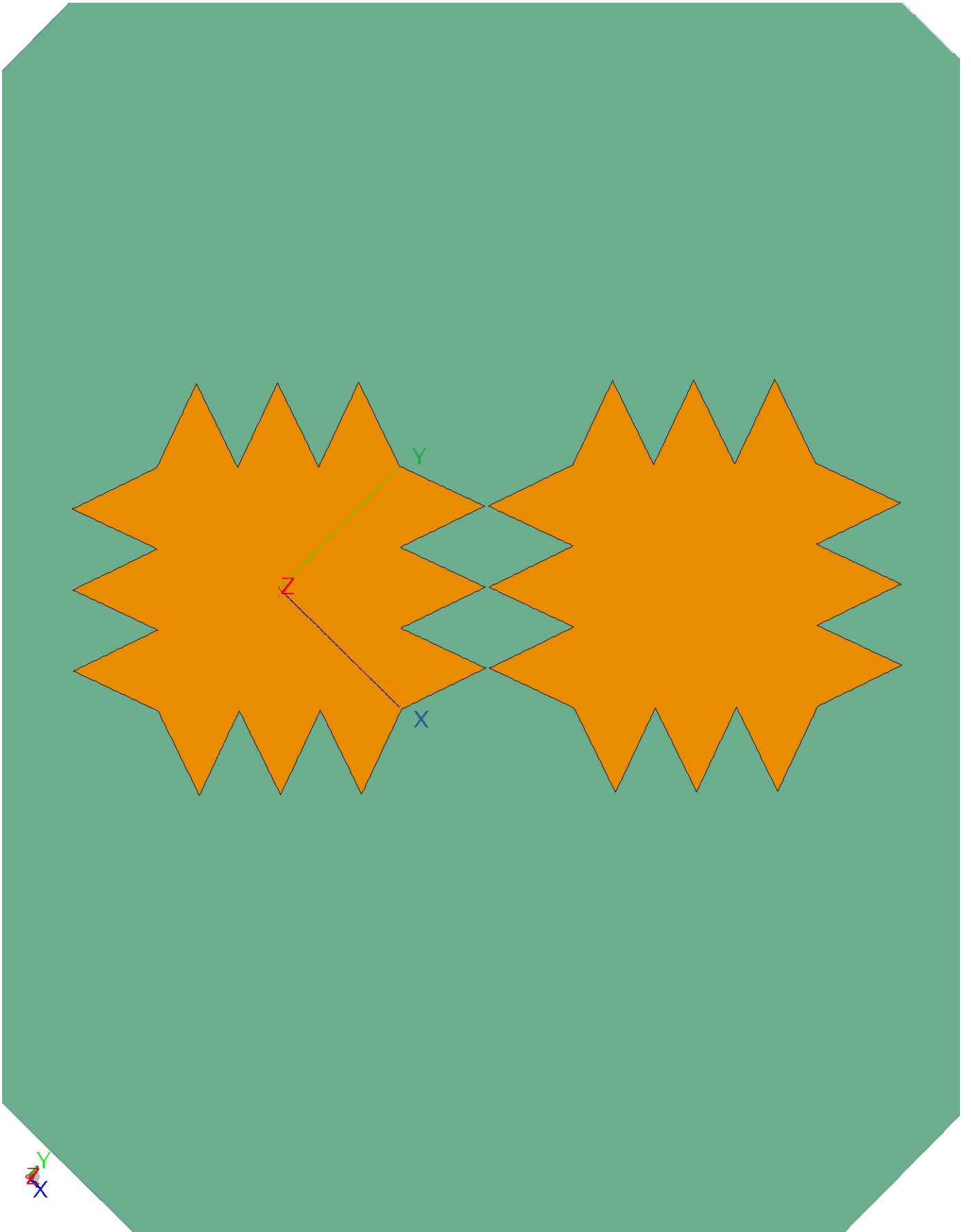


Figure 1. Plot of the residuals with 5-terms removed for effect of the adjacent ground plane.

avrms 0.0472



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