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To: EDGES Group

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Subject: Photogrammetric mapping of low2 ground plane

Figure 1 shows the data from FourthFinalRuns.csv plotted on the outline of the low2 ground plane following the removal of a slope of 4.0 degrees down from south to north and a 1.8 degree slope down from the east to the west. The data has been centered on the antenna by adding 4265 and 5458 mm to the y and z terms respectively in FourthFinalRuns.csv along with subtracting the average height of 255 mm following the slope correction. The ground plane slope estimates from the photogrammetry do not represent the true slopes of the ground plane as the there was no accurate calibration of the slopes. An approximate estimate from visits to the site is a slope of about 2.0 degrees down from south to north and a smaller slope down from east to the west.

Figure 1 shows that the peak to peak deviations are about 10 cm. Unfortunately, the photogrammetry results do not cover the entire ground plane. Figure 2 shows the ground plane panels which have at least one measurement within each square or triangle. In this plot Y is North and X is east.
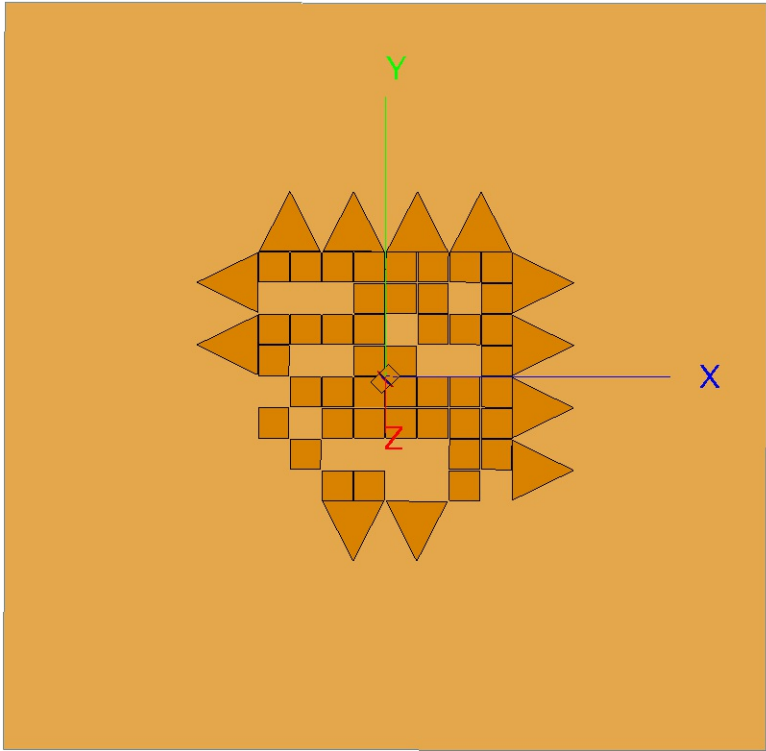
 Figure 3 Shows the beam chromaticity for low2-45 with 5-physical terms removed. Since the panels are placed on an infinite PEC ground plane the residuals are for the difference in beam chromaticity for the antenna with the raised panels shown in Figure 2 and the chromaticity of the antenna on a PEC ground plane. The antenna height above the PEC is adjusted so the average height is the same in both cases. The raised panels have sides which are connected to the PEC ground plane. For this case FEKO runs rapidly. In order to run on a soil ground all the panels would need to be present with connections between them.

The results show an anomalous residual at GHA = 20 of 98 mK which is not present in the PEC only reference beam. This anomaly which is seen in the low-2 45 data at a level of 300 mk in Figure 4 of memo 341 could be partly the result of the deviations in the ground plane.
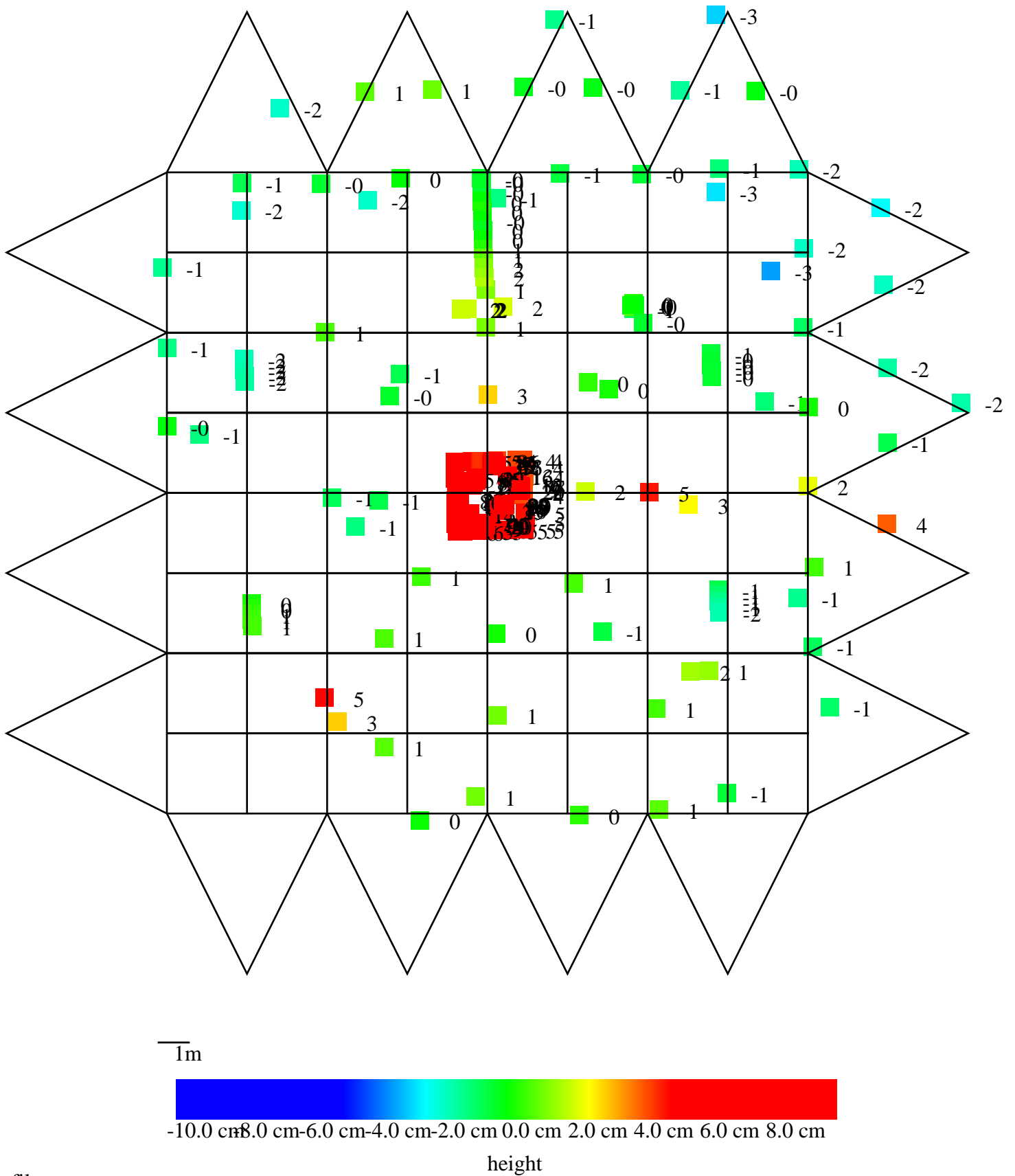
Figure 1. Plot of photogrammetry target locations and heights in centimeters relative to the average height after removal of the slopes. North is at the top of and east is on the right. The target locations have been shifted so that the solid panel in the center, which is raised up by about 5 cm, is in the center of the ground plane.
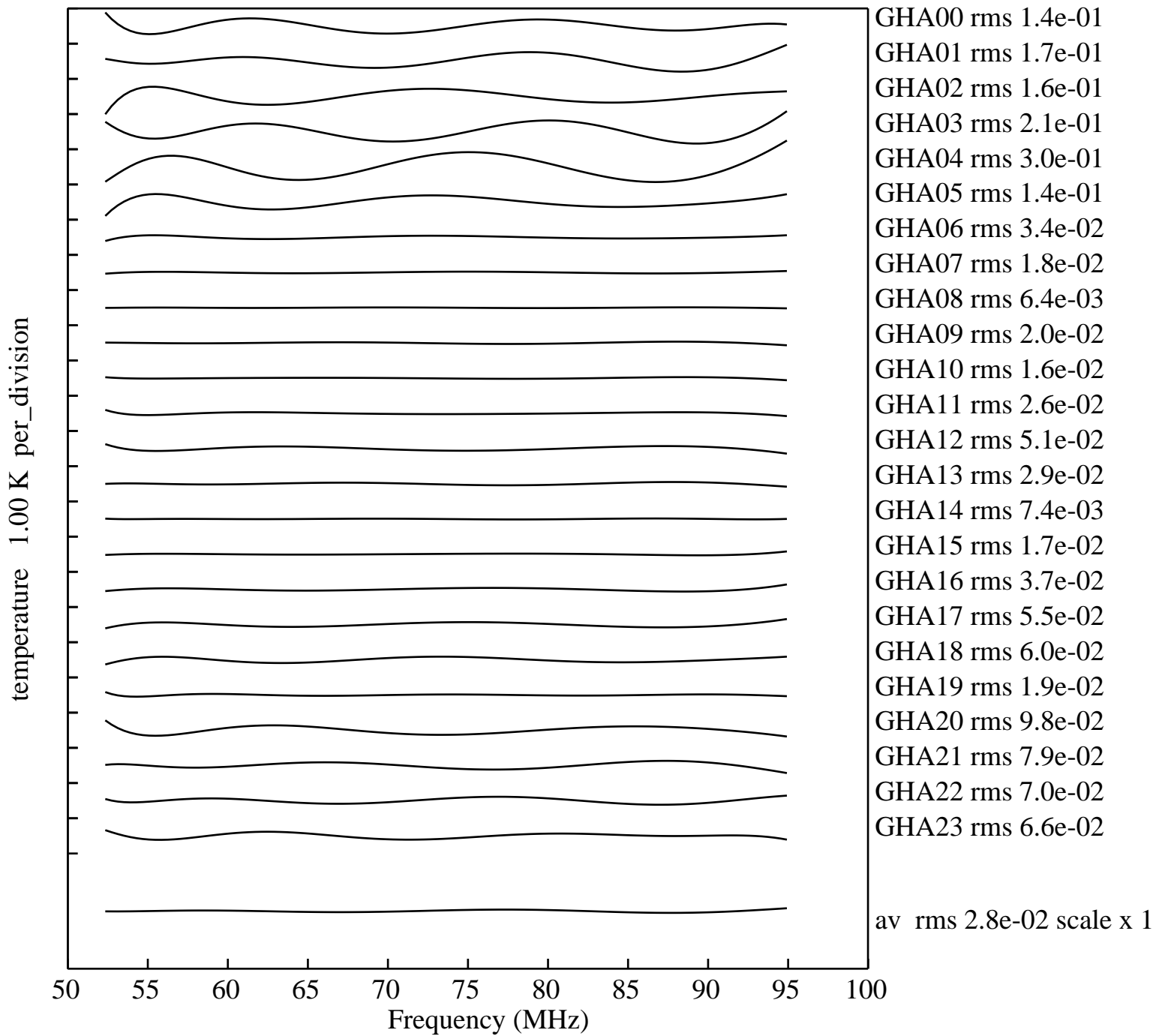
file: temp

| ![FEKO logo - Comprehensive Electromagnetic Solutions] | test7 2021-06-08 08:42 | View direction Theta = 11° Phi = 90° |

Figure 2. Locations of the panels in the FEKO model used to estimate the effect of the uneven ground plane on the chromaticity of the beam of the low-2 antenna which is oriented at an azimuth of 45 degrees relative to the North of the ground plane. 3

GHA00 rms 1.4e-01
GHA01 rms 1.7e-01
GHA02 rms 1.6e-01
GHA03 rms 2.1e-01
GHA04 rms 3.0e-01
GHA05 rms 1.4e-01
GHA06 rms 3.4e-02
GHA07 rms 1.8e-02
GHA08 rms 6.4e-03
GHA09 rms 2.0e-02
GHA10 rms 1.6e-02
GHA11 rms 2.6e-02
GHA12 rms 5.1e-02
GHA13 rms 2.9e-02
GHA14 rms 7.4e-03
GHA15 rms 1.7e-02
GHA16 rms 3.7e-02
GHA17 rms 5.5e-02
GHA18 rms 6.0e-02
GHA19 rms 1.9e-02
GHA20 rms 9.8e-02
GHA21 rms 7.9e-02
GHA22 rms 7.0e-02
GHA23 rms 6.6e-02

av rms 2.8e-02 scale x 1

avrms 0.0758

Figure 3. Plot of the beam chromaticity vs GHA with 5-physical terms removed using Haslam map – see text for the details.