EDGES MEMO #318

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January 2, 2020

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To: EDGES Group

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Subject: Effects of adjacent ground planes and antennas

Plans for the deployment of EDGES-3 at the MRO include adding another ground plane and the extension of an existing ground plane. In addition, the plan is to continue operating EDGES-2. This plan raises some concern of interactions between systems.

1] Coupling between antennas

Separation (m)	Ground	Coupling dB
25	PEC	-55
50	PEC	-67
100	PEC	-79

Table 1. Coupling between mdband antennas pointing North separated along a EW line.

The coupling is strongest when the antennas are separated along a line perpendicular to the line between dipole elements and both antennas are pointing in the same direction or opposite directions. i.e. antennas pointing North separated on an EW line.

The coupling between antennas on separate ground planes is similar in magnitude. There is some dependence on the soil conductivity and frequency.

2] Effects on beam chromaticity

The effect of other structures, like the electronics hut has an effect on the beam chromaticity and have been studied in memos 194, 195, 201, 206, 207 and 214. Larger structures, like wire fencing were studied in memo 310 and it was found that they need to be more than 70 m from the antenna to have little effect.

ground plane	nearby object	separation (m)	rms mK)	s/m	case
4×4 m square	Antenna 4×4 m	25	134 (122)	2e-2	1
4×4 m square	Antenna on 4×4 m	25	454 (448)	2e-3	2
4×4 m square	4×4 m	25	448 (448)	2e-3	3
48.8 perf	Antenna	25	89 (87)	2e-3	4
48.8 perf	4×4 m	28	87 (87)	2e-3	5
48.8 perf	Antenna	50	87 (87)	2 e-3	6

Table 2 Effect of nearby antenna and ground planes on beam chromaticity.

For separations under 20 m the effects of another antenna or ground plane are large. The effects at 25 m separation are listed in Table 2 using the average rms over GHA as in memo 317 as a metric. The rms values in ( ) are those for the ground plane without a nearby object. The “48.8 perf” is the extended perforated ground plane case “A” with 3-triangle on each side proposed in memo 317.

In general, at 25 m separation the effect of another ground plane with or without an antenna are small. Figures 1 through 5 show the residuals to a 5-term fit for the cases listed in Table 2. In all cases the effects of the objects 25 m away show up as ripple with a period of 6 MHz and the largest effects are for GHA well away from 12 hours.

Figure 6 and 7 show the residuals for a 5-term fit for another EDGES-3 antenna 50 m away on the ground with soil conductivity 2e-3 S/m and 2e-2 S/m. The ripples with 3 MHz period can only just be seen at GHA=1hr.

In summary the presence of other antennas 25 m away from the extended perforated ground plane are small and probably not a concern.

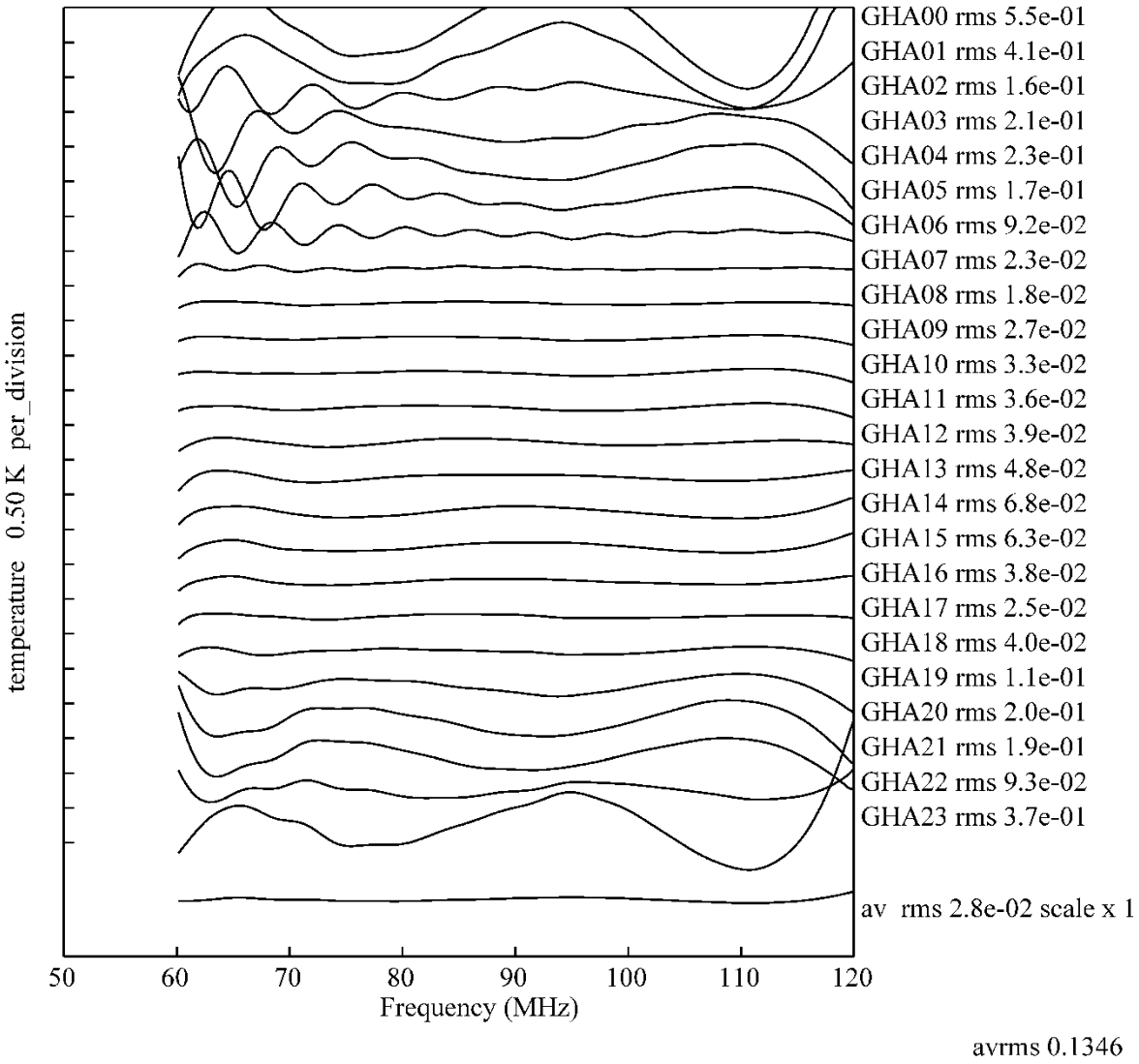

Figure 1. EDGES-3 on 4×4 m square with another EDGES-3 on 4×4 m square 25 m away with soil 2e-2 S/m.

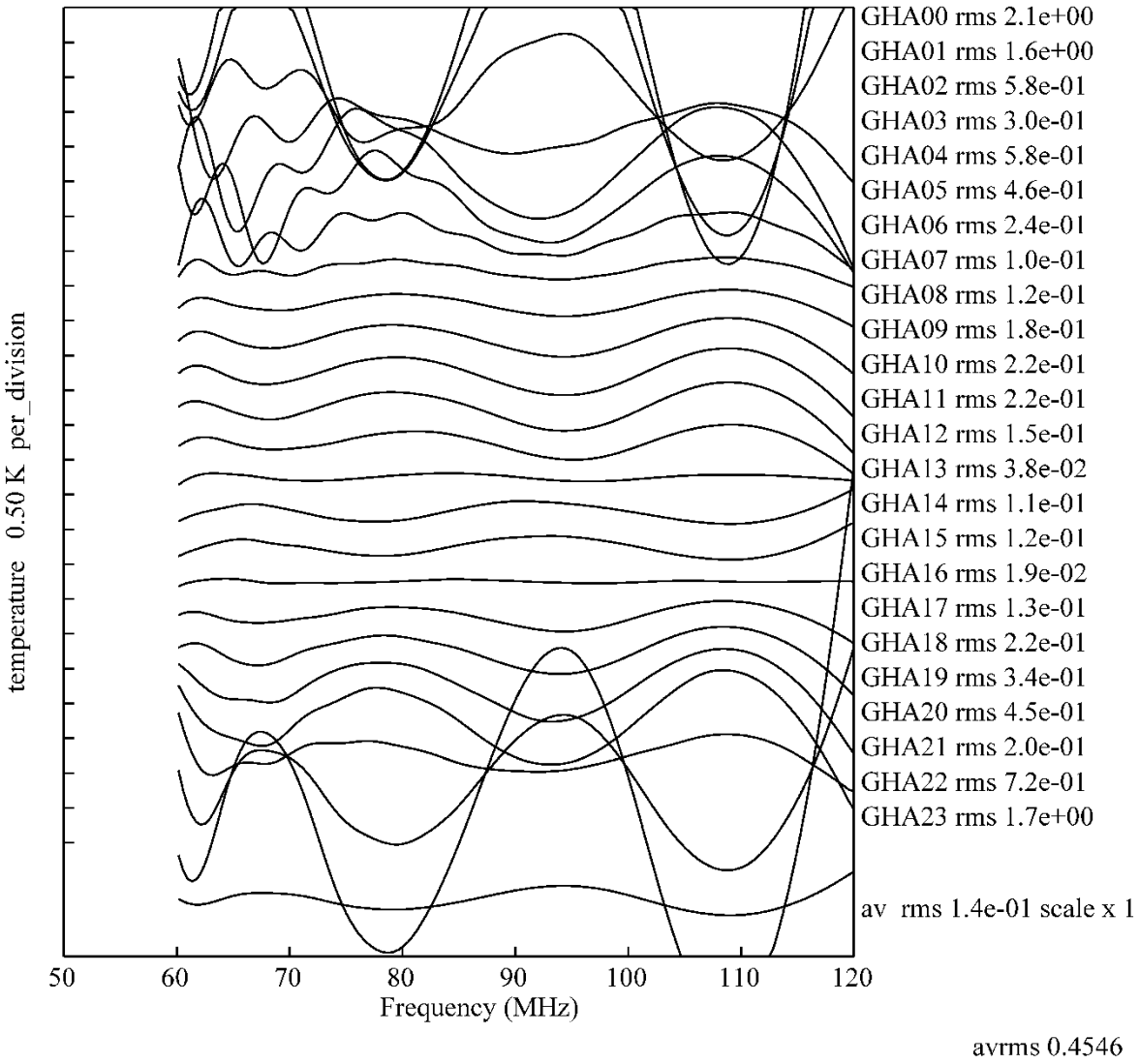

Figure 2. Same as case 1 with soil 2e-3 S/m.

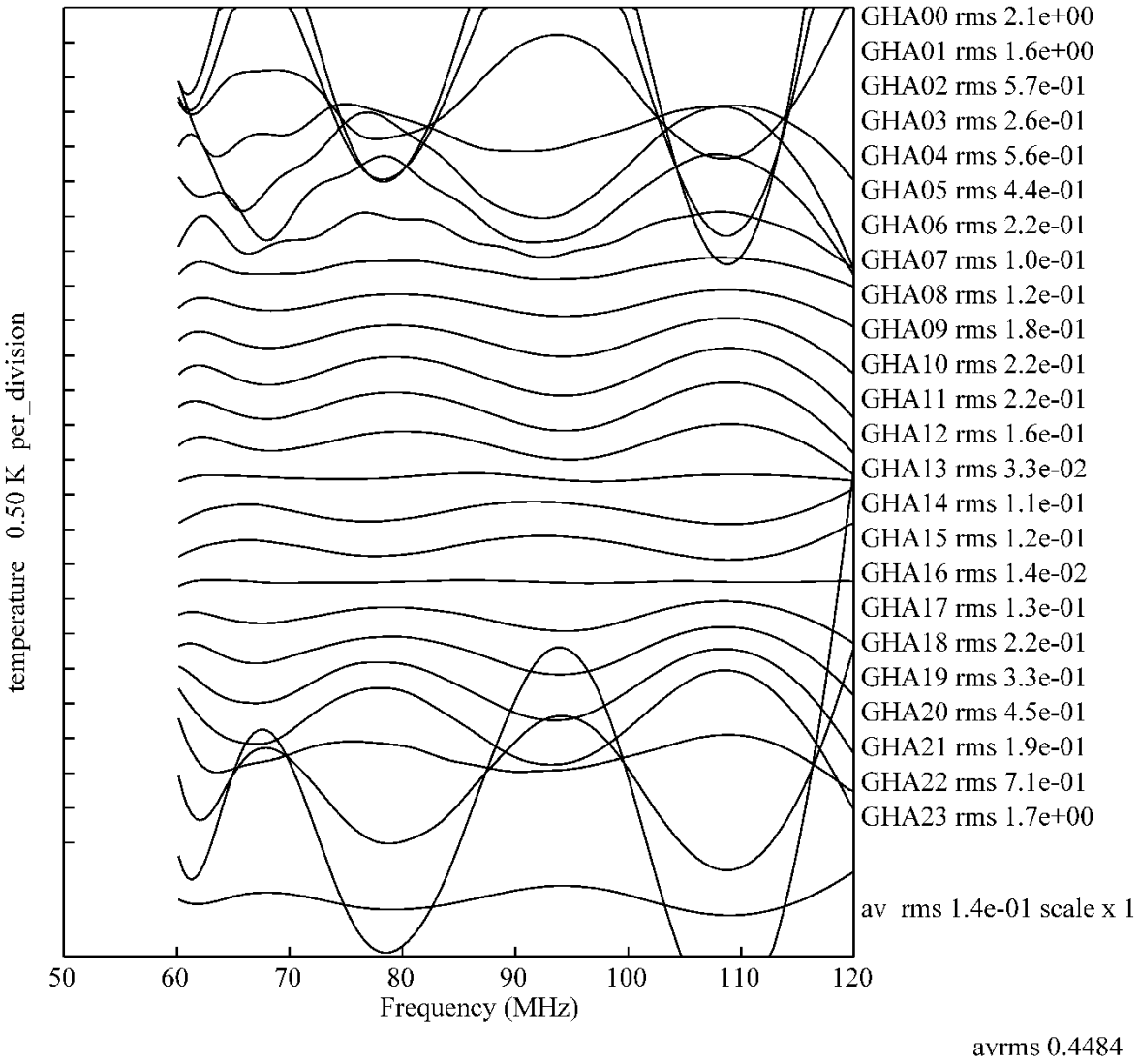

Figure 3. Same as case 2 without antenna on nearby 4×4 m.

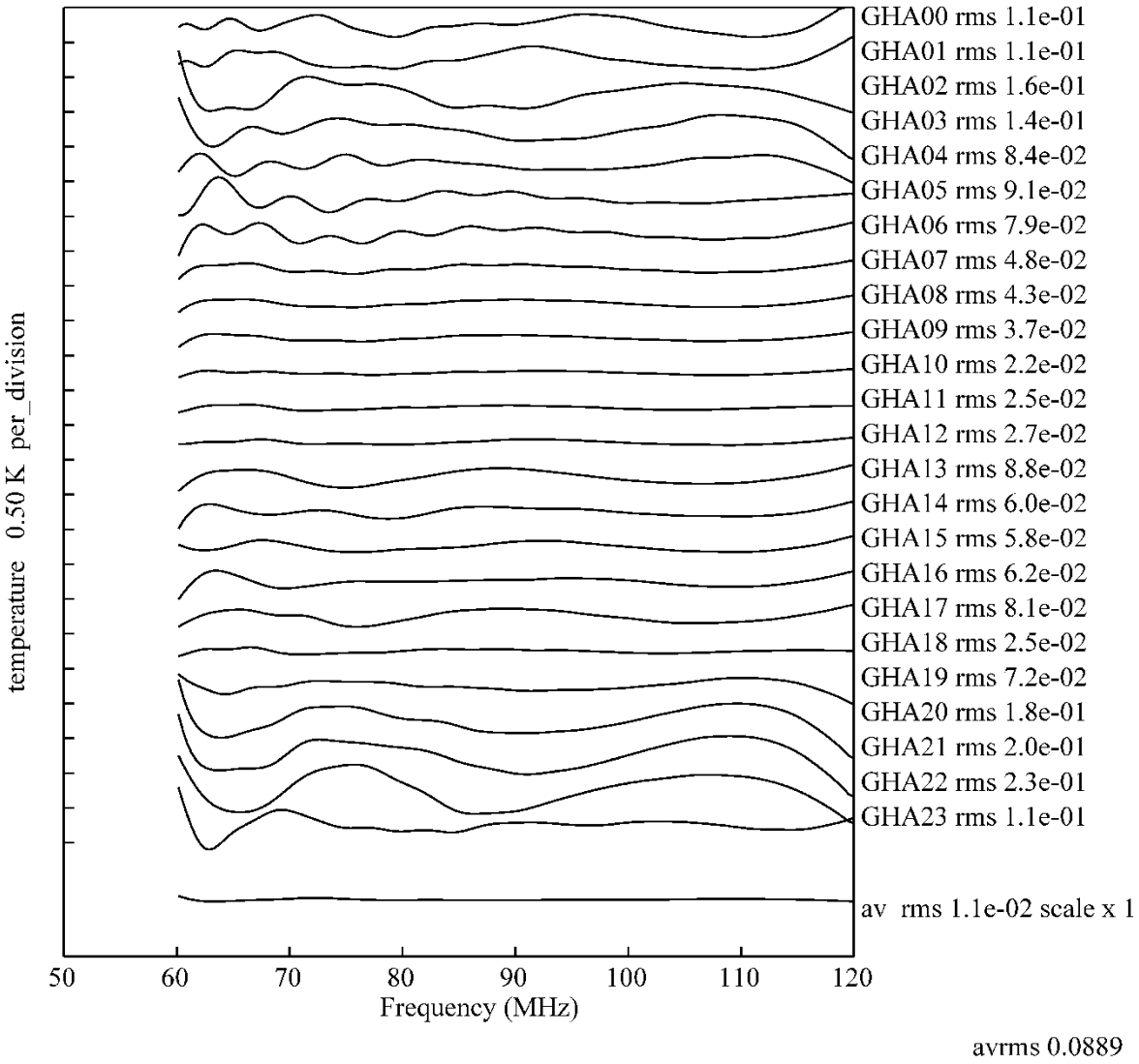

Figure 4. EDGES-3 on 48.8 m perforated ground plane with another antenna 25 m away.

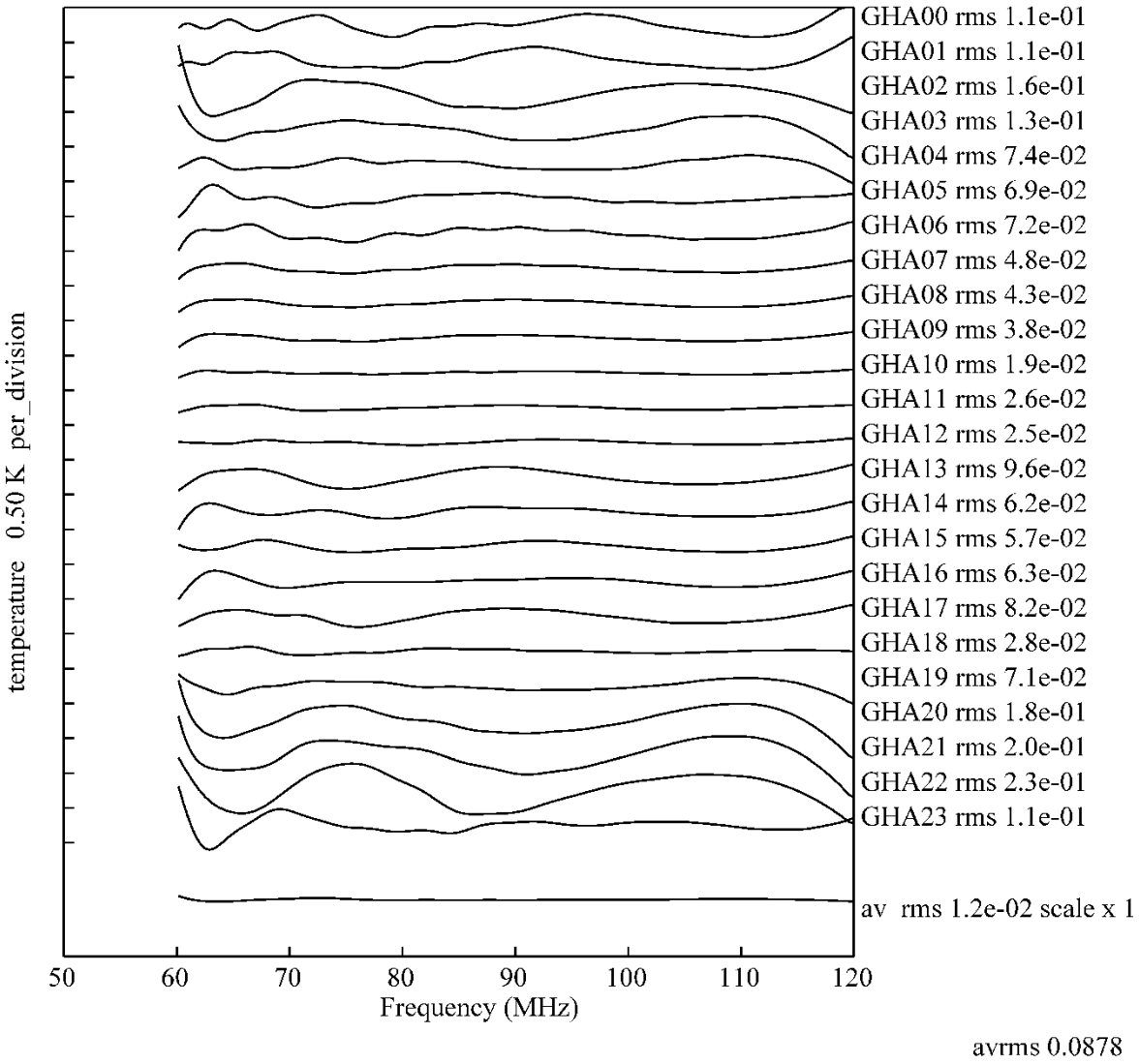

Figure 5. Same as case 4 with 4×4 m square ground plane 28 m away.

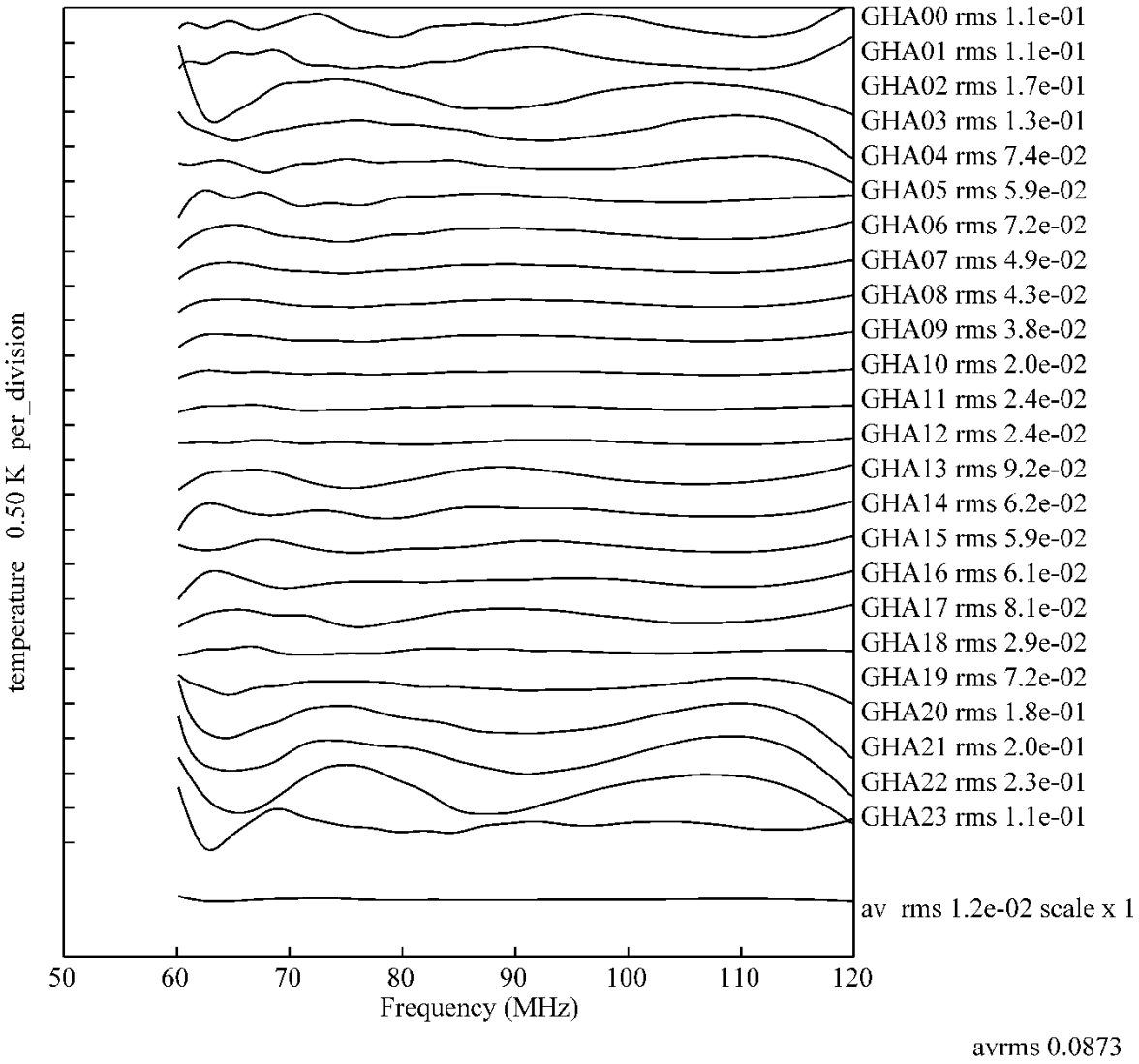

Figure 6. EDGES-3 on extended perforated ground plane with another EDGES-3 50 m away with soil 2e-3 S/m.

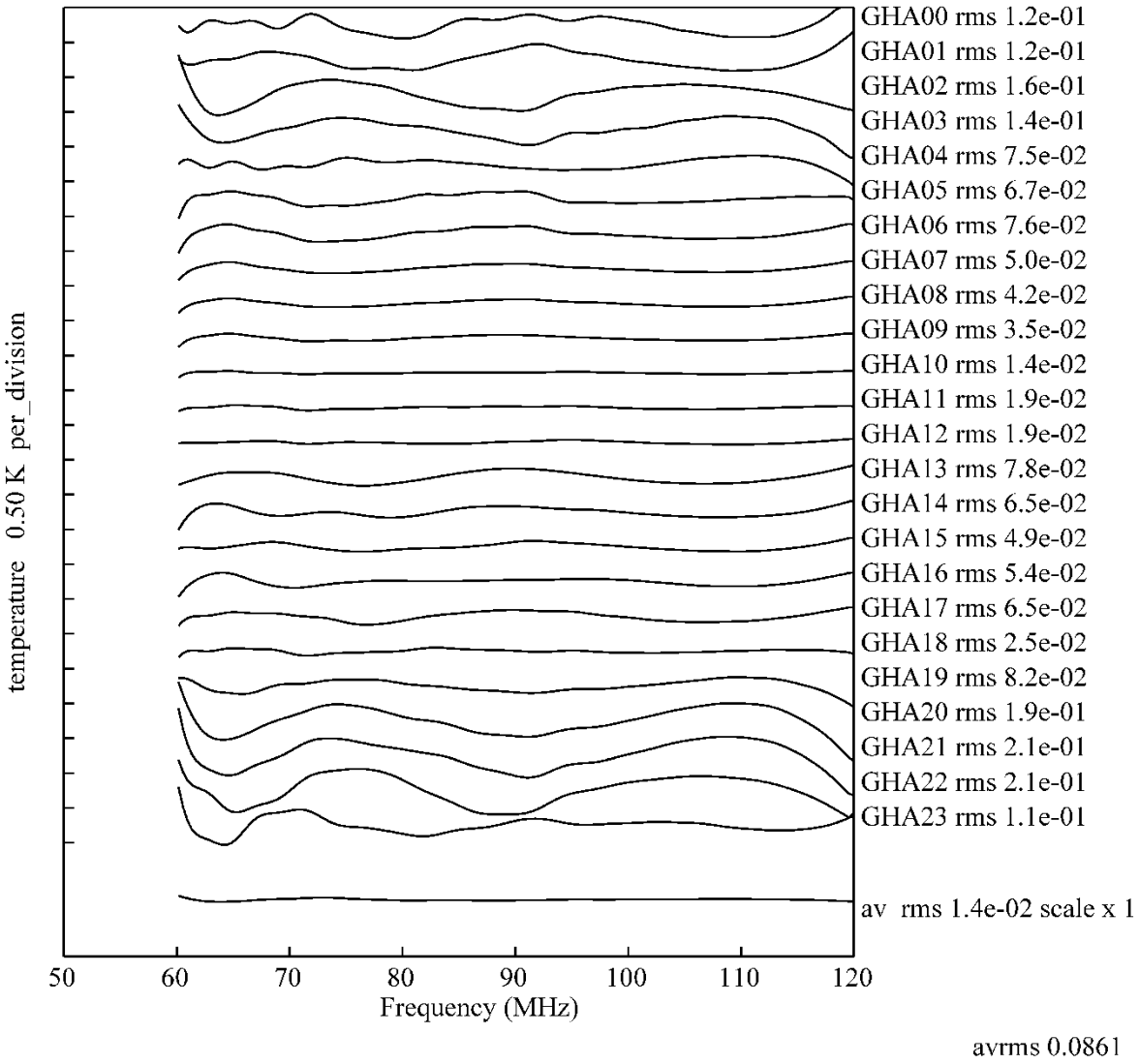

Figure 7. Same as case 6 with soil 2e-2 S/m.