

LoCo Lab EDGES Memo 185

Features in the Solid Angle of Some EDGES Antenna Beams from FEKO

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Abstract

Here we show that when the beams of some EDGES antennas are computed using FEKO, their solid angle shows features in the frequency range $\sim 70 - 97$ MHz.

1 Beam Solid Angle Above the Horizon

We compute the beam solid angle above the horizon as

$$\frac{1}{4\pi} \int_{\phi=0}^{\phi=2\pi} \int_{\theta=0}^{\theta=\pi/2} D(\theta, \phi) \sin \theta d\theta d\phi. \quad (1)$$

where D is the antenna directivity.

The beam solid angle above the horizon was computed for ten antenna directivity models from FEKO. Eight of them were calculated by Alan and the other two by Nivedita. In each case, we also fitted and removed a polynomial in frequency in order to examine the structure in the residuals.

The antenna models are:

1. High-Band Blade, no ground plane, only soil.
2. High-Band Fourpoint, plus-sign ground plane.
3. High-Band Blade, plus-sign ground plane.
4. Low-Band 3 Blade, plus-sign ground plane.
5. Mid-Band Blade, infinite PEC ground plane.
6. Low-Band Blade, 10m x 10m ground plane.
7. Low-Band Blade, 30m x 30m ground plane.
8. Low-Band Blade, 30m x 30m ground plane, from NIVEDITA.
9. Mid-Band Blade, 30m x 30m ground plane.
10. Mid-Band Blade, 30m x 30m ground plane, from NIVEDITA.

2 Comments

1. The results are shown in Figures 1 and 2.
2. In the figures we see that there are sharp features in the solid angle in the range $\sim 70 - 97$ MHz in all the models consisting of Blade antennas with real (as opposed to infinite PEC) metal ground planes. This occurs in models from Alan and Nivedita.
3. The following models do not show features: (a) High-Band Blade with no metal ground plane (just soil), (b) High-Band Fourpoint antenna with plus-sign ground plane, and (c) Mid-Band with infinite PEC ground plane.
4. The features are similar between all the Low-Band antenna cases, no matter which ground plane is used (10m x 10m, 30m x 30m, plus-sign). Typically there is a decrease in solid angle at ~ 70 MHz and an increase in the range $\sim 90 - 97$ MHz.
5. For the High-Band Blade with plus-sign ground plane, the increase is at 79 MHz, while for the Mid-Band Blade with 30m x 30m ground plane, from Alan and Nivedita, there is no decrease at 70 MHz and only an increase at 93 MHz.
6. The features change if the ground plane is kept fixed but the Blade antenna itself is changed between Low-, Mid-, and High-Band.
7. Because the features are present in several cases, it is difficult to interpret them as only numerical artifacts. They might be representing real effects. More investigation is warranted.

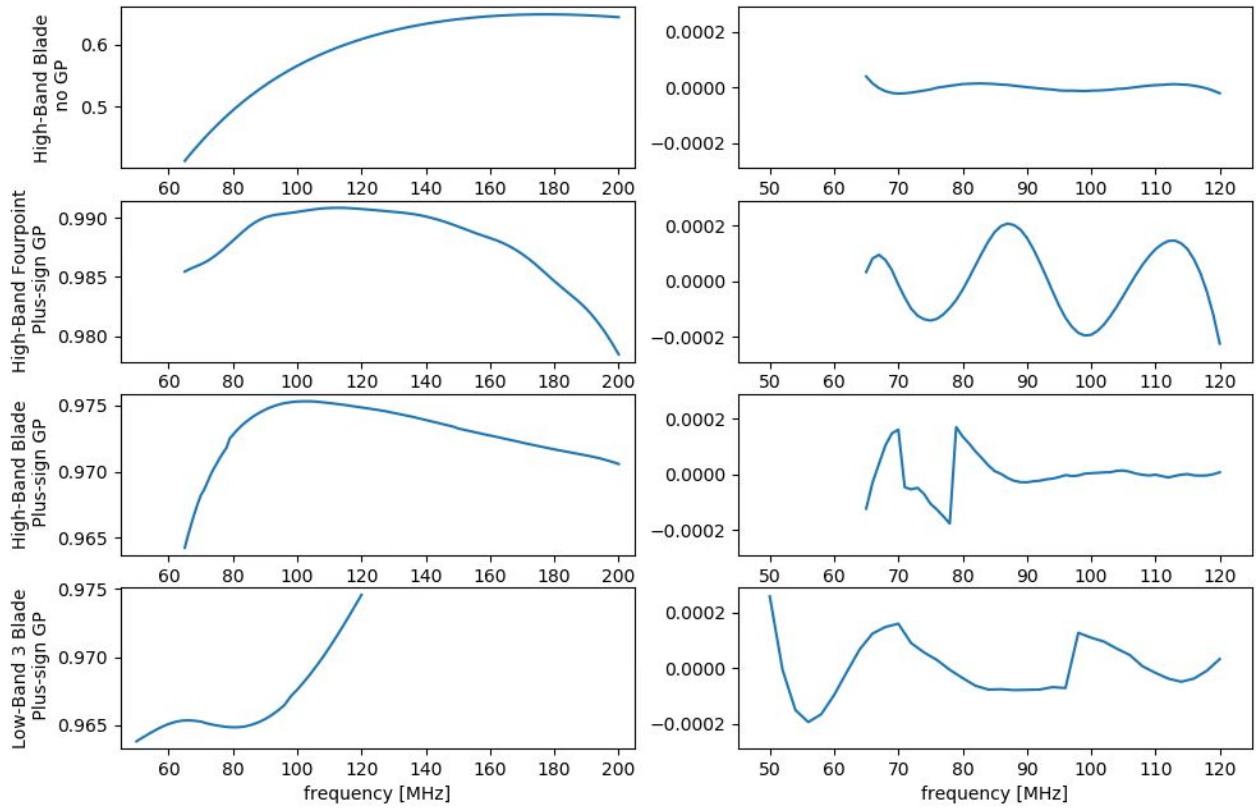


Figure 1: Solid angles above the horizon (left column) and residuals (right column), for four of the models examined.

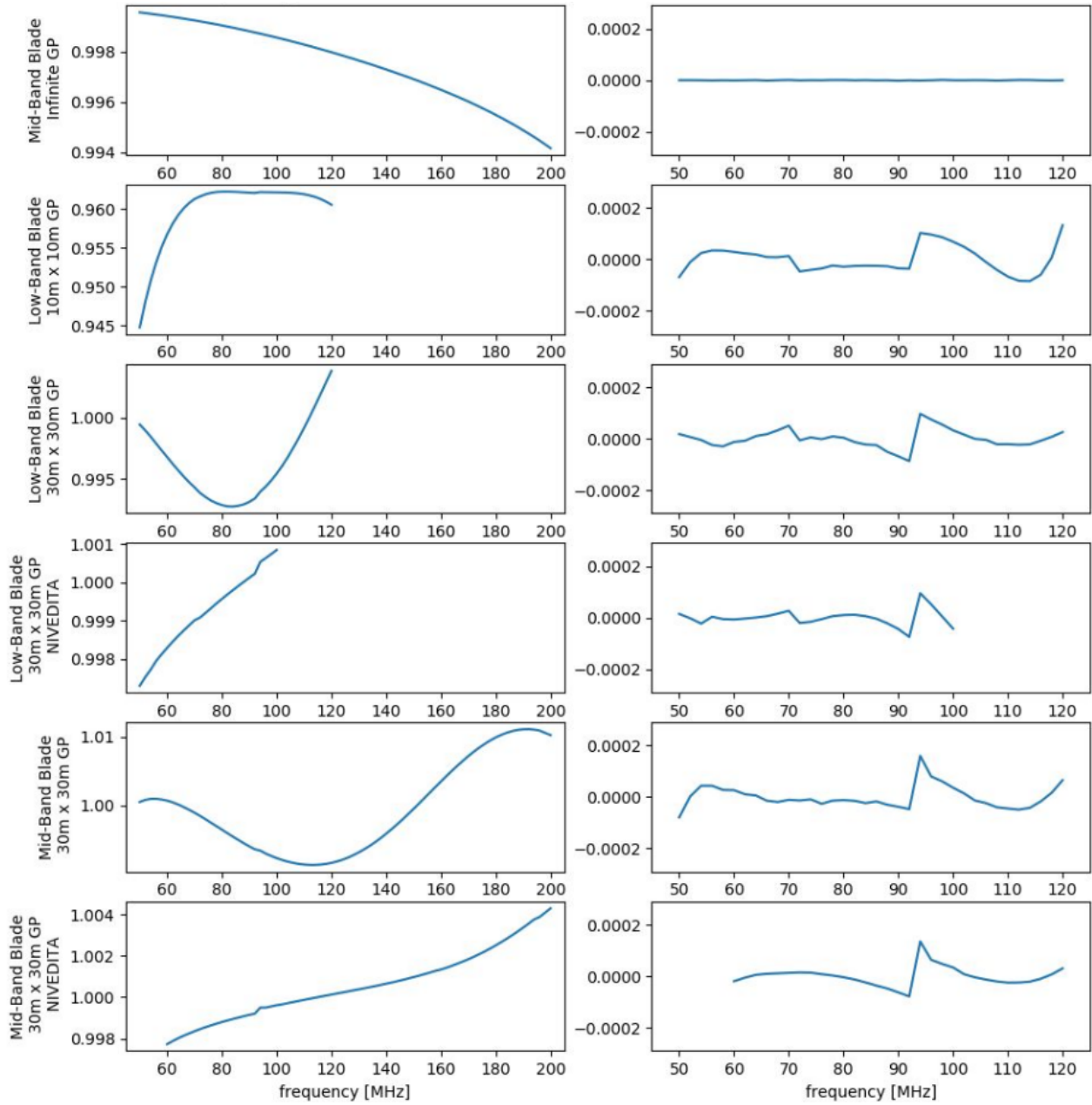


Figure 2: Solid angles above the horizon (left column) and residuals (right column), for six of the models examined.