Pittsburgh Cylinder Simulations

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November 17

Cylinder Simulation Program

- Based on **"Formulation of Cylinder Visibilities"**
  - http://projects-docdb.fnal.gov/cgi-bin/ShowDocument?docid=778

Formulation of Cylinder Visibilities

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Feed Amplitude

The voltage received at a feed located at coordinate r is:

$$\frac{v(\vec{r})}{\sqrt{2R}} = \iint_{\Omega} f(\Omega)a(\Omega)e^{-j\vec{\beta}(\Omega)\cdot\vec{r}}d\Omega \quad (1)$$

The sky flux amplitude is:

$$|f(\Omega)d\Omega|^2 = \frac{kT_{sky}(\Omega)}{\lambda^2}d\Omega_{\text{pow}} \quad (2)$$

where $d\Omega_{pow}$ is the differential power solid angle area. The incoming wave vector is:

$$\vec{\beta}\big(\Omega(\theta,\phi)\big) = \frac{2\pi}{\lambda}(sin(\theta)\hat{x} + cos(\theta)sin(\phi)\hat{y}) \quad (3)$$

The collecting area of the feed is:

$$A(\Omega) = |a(\Omega)|^2 \quad (4)$$

The noise power generated by the feed amplifier is:

$$P_z = |p_z|^2 \quad (5)$$

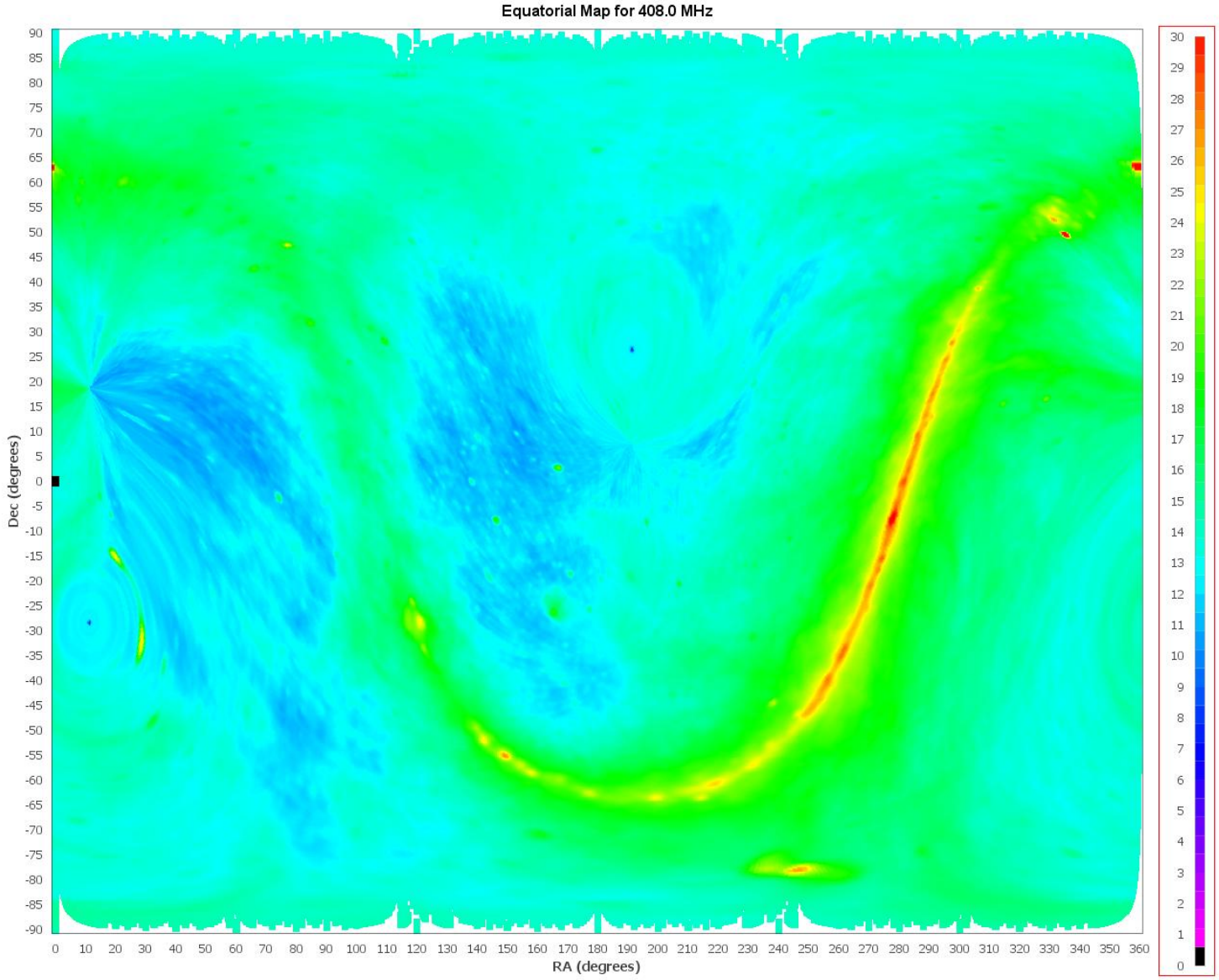
If the sky is pixelized into **q** pixels then, the signal amplitude at feed **n** of cylinder **m** is:

$$p_{n,m} = p_{z_{n,m}} + \sum_q \Delta\Omega_q f_q a_{q,n,m} e^{-j\vec{\beta}_q\cdot\vec{r}_{n,m}} \quad (6)$$

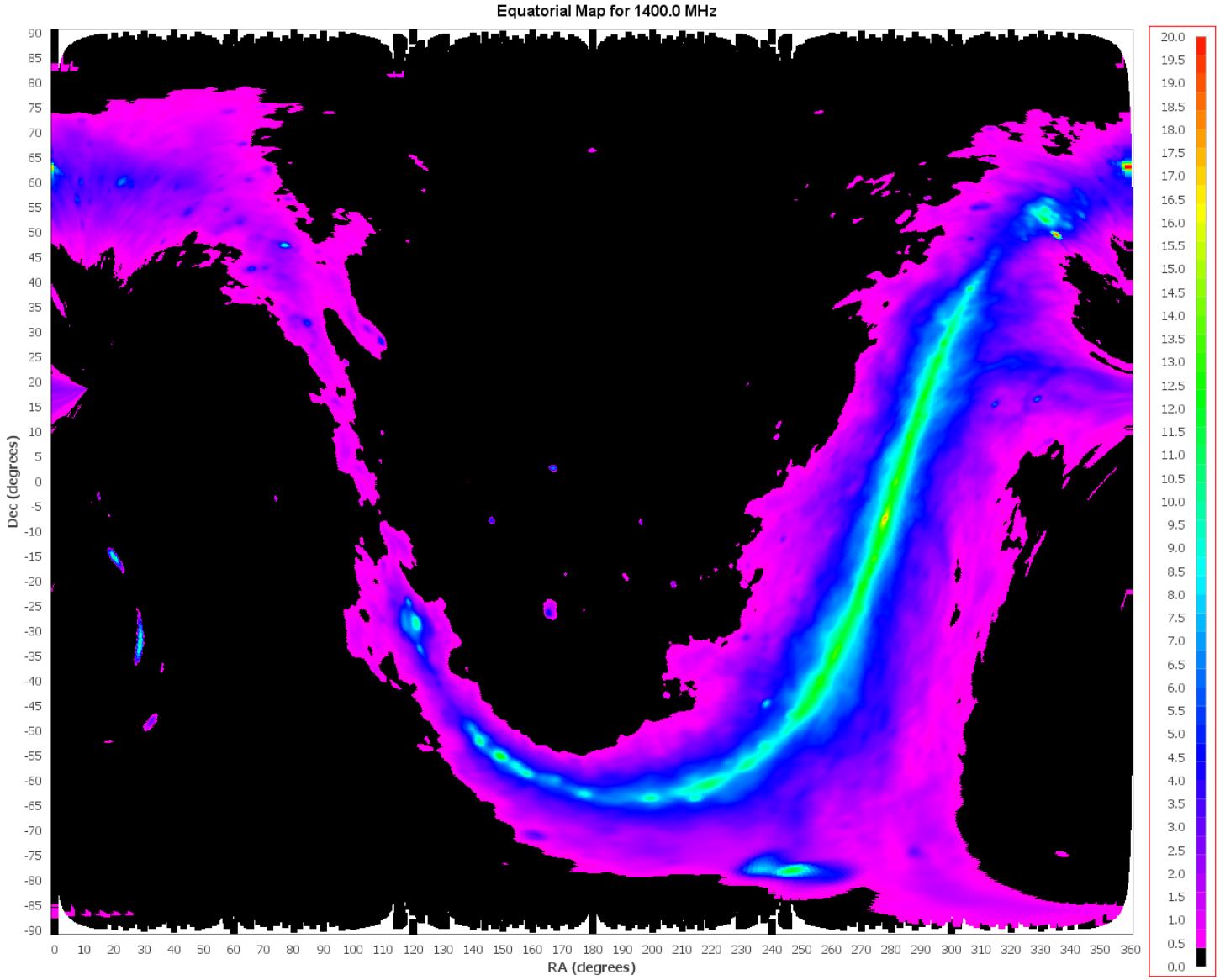
Cylinder Amplitude

A spatial Fourier transform will be taken of the cylinder feed voltage.

Sky Map at 408 MHz



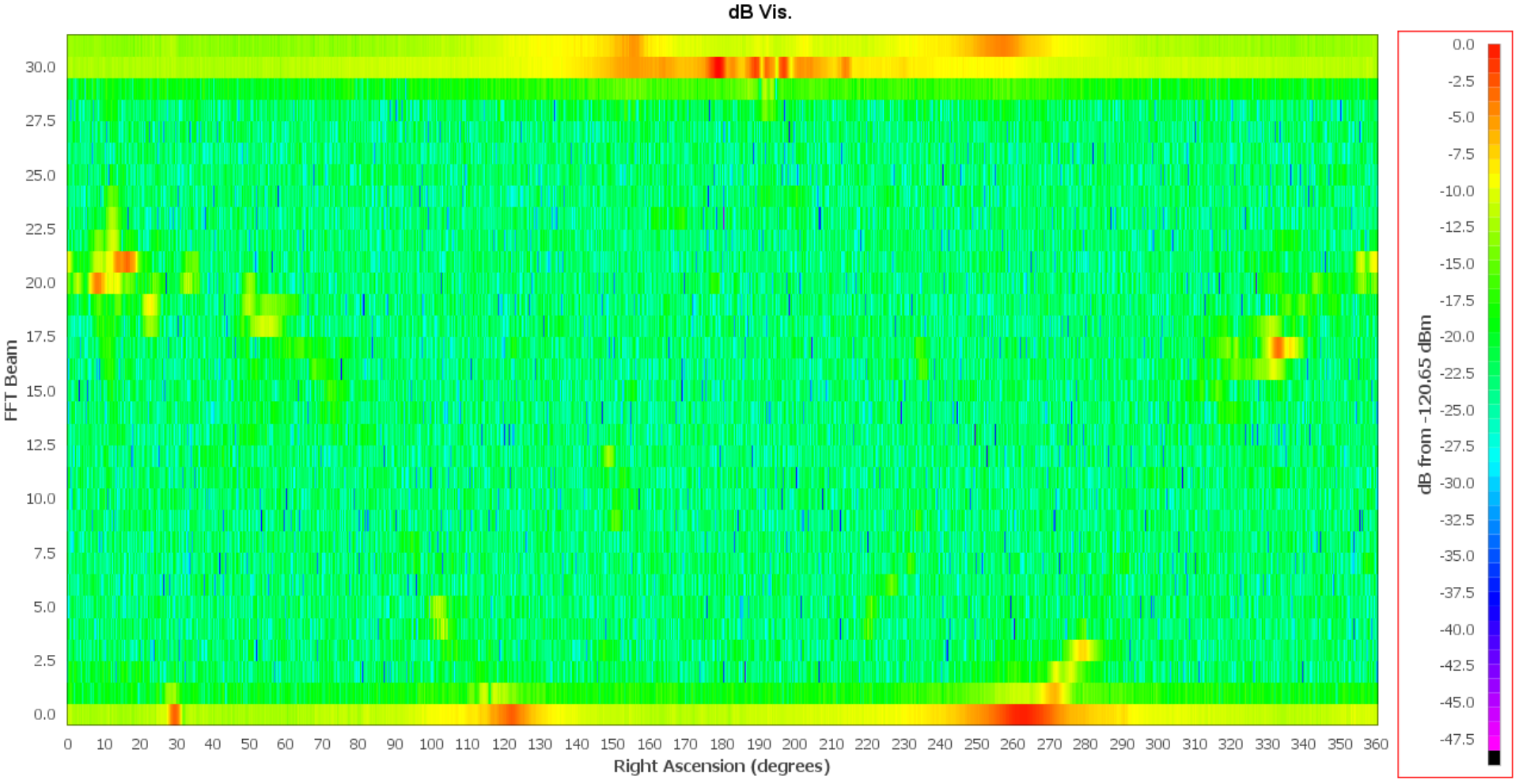
Sky Map at 1400 MHz



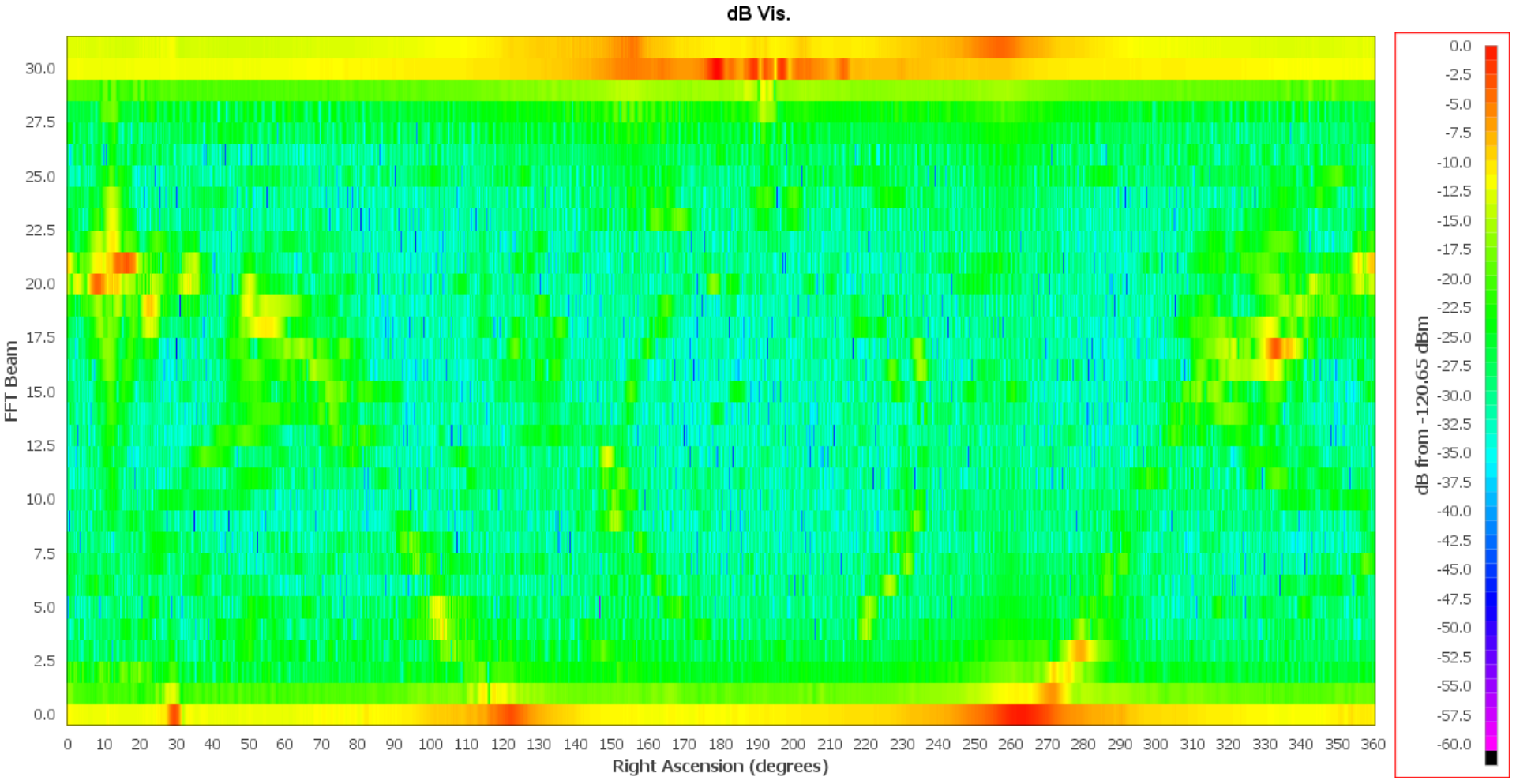
Input

- Frequency = 1400 MHz
- Number of Feeds = 32
- Feed Spacing = 10.5 cm
- Feed Power efficiency = 40%
- Effective cylinder width = 5 m
- Cylinder Spacing = 10m
- Amplifier Temperature = 50K
- Latitude = 43 degrees North

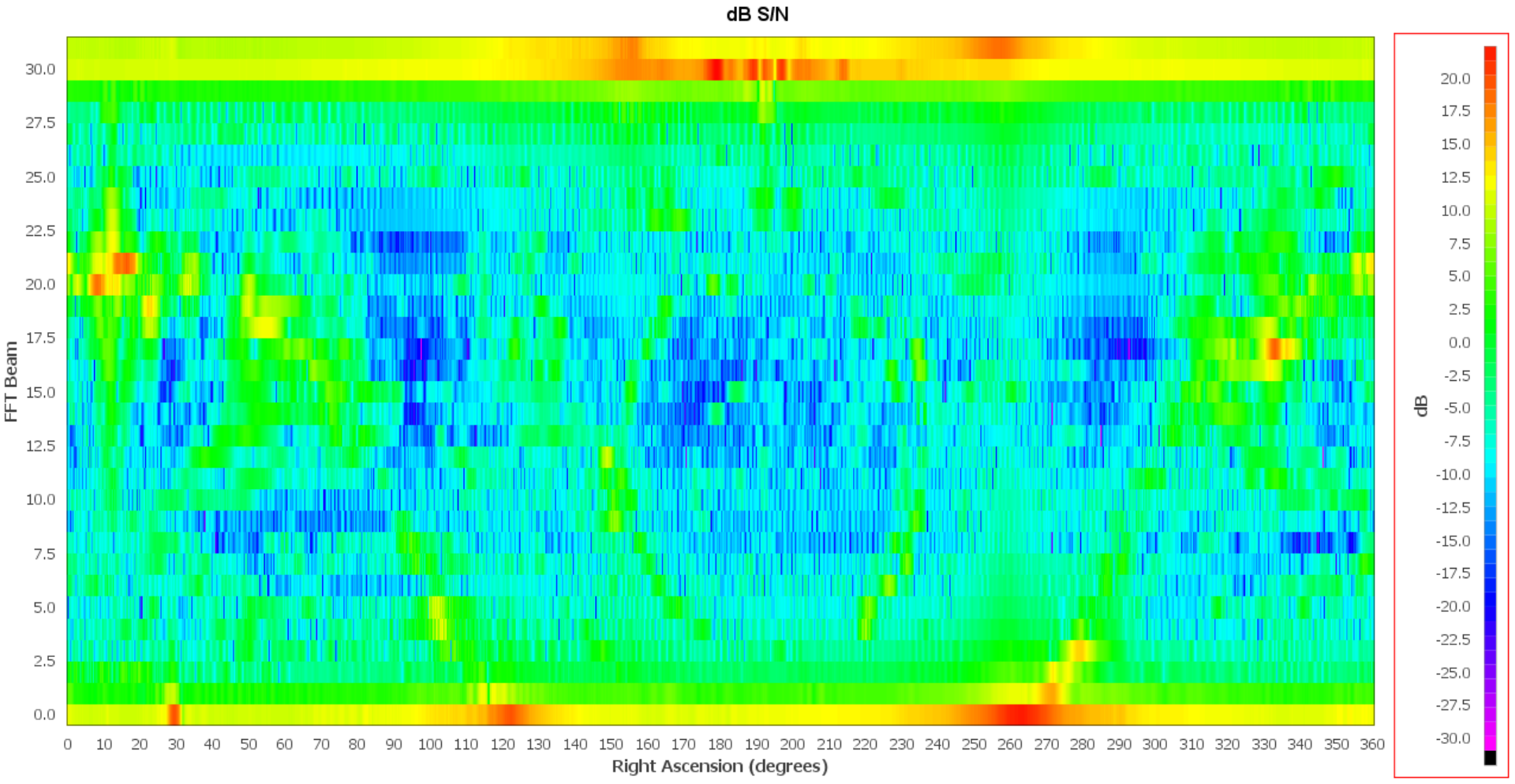
1 Day Scan - Visibility Magnitude – Y pol.



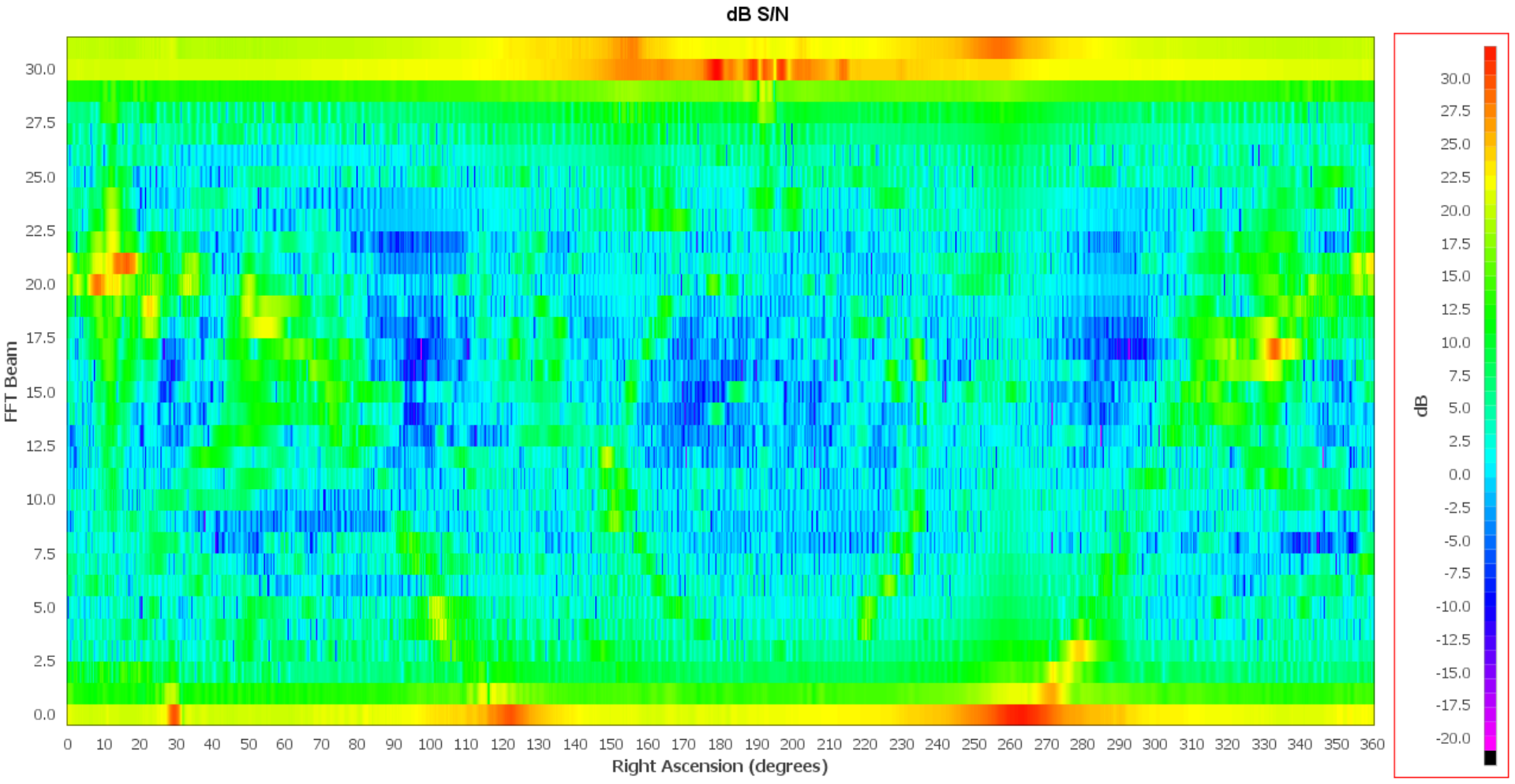
100 Day Scan - Visibility Magnitude – Y pol.



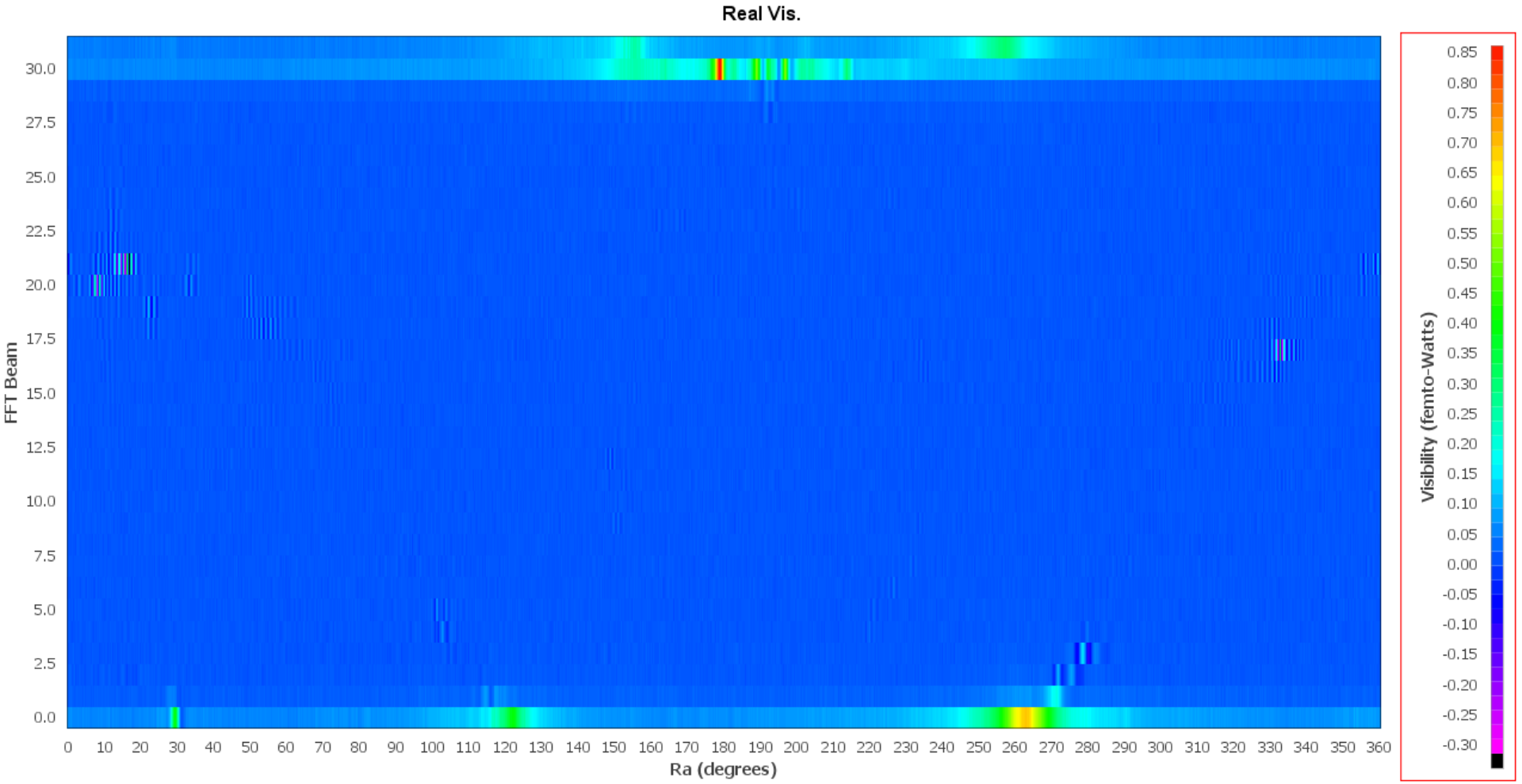
1 Day Scan - Visibility Signal/Noise – Y pol.



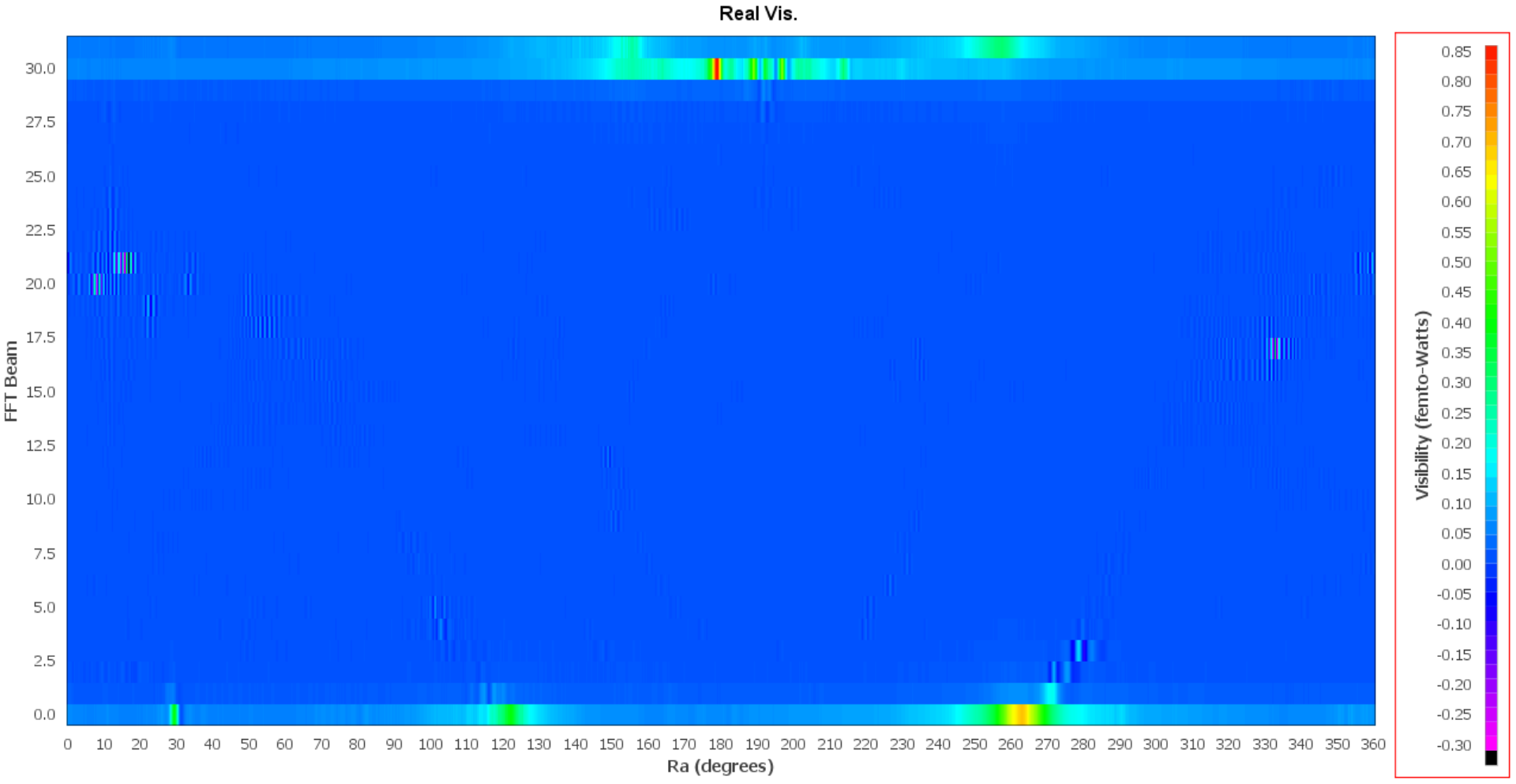
100 Day Scan - Visibility Signal/Noise – Y pol.



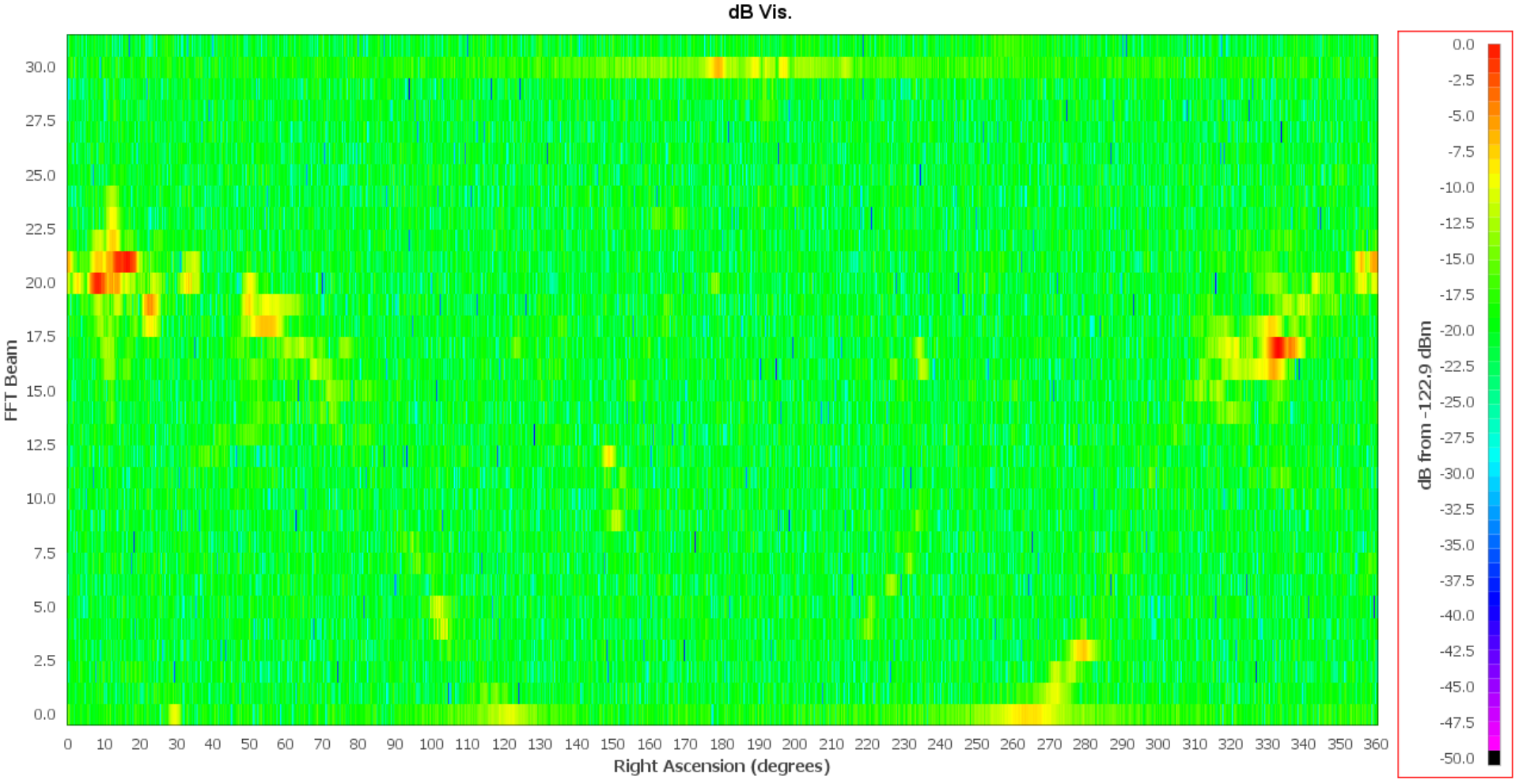
1 Day Scan – Real Part of Visibility– Y pol.



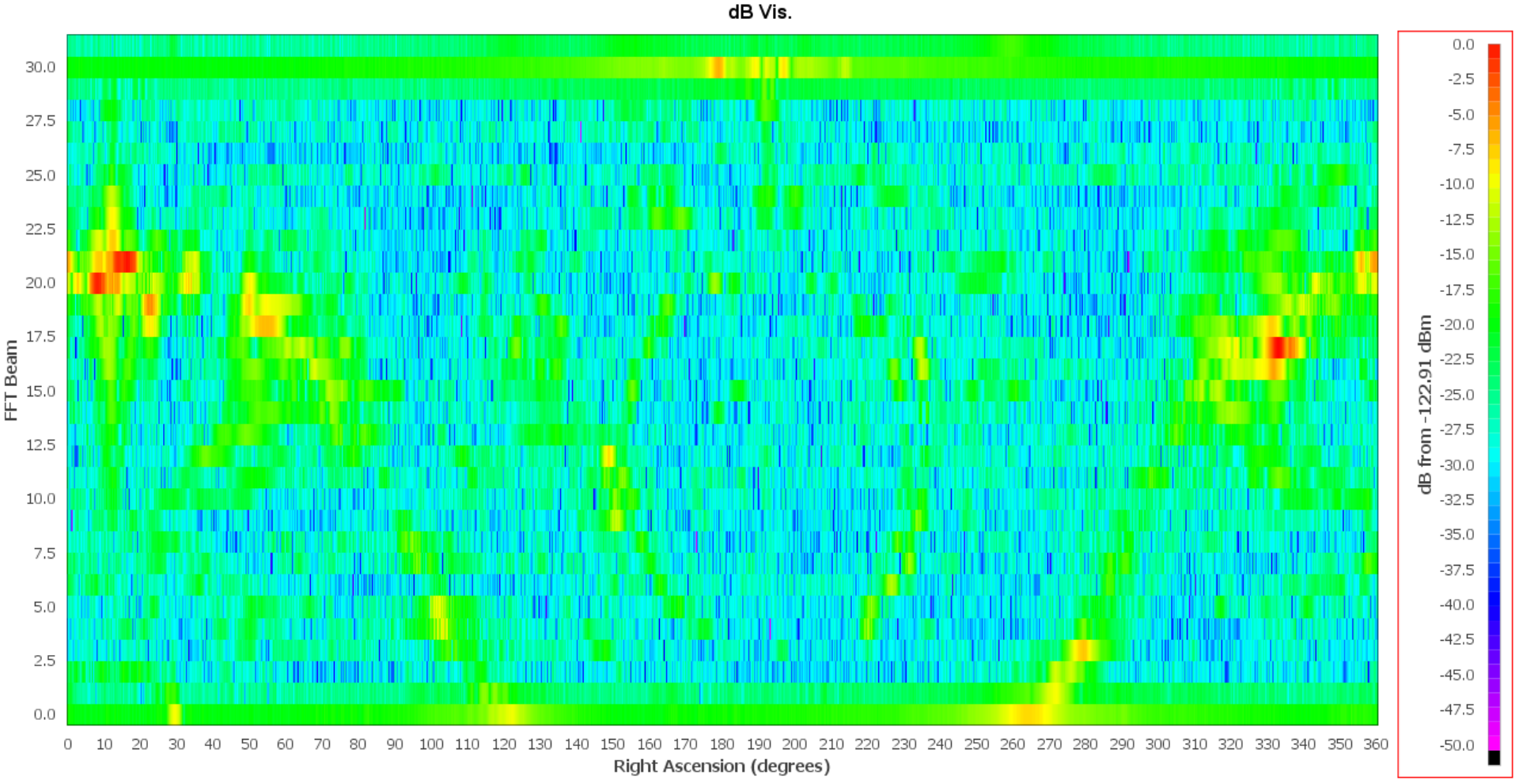
100 Day Scan – Real Part of Visibility– Y pol.



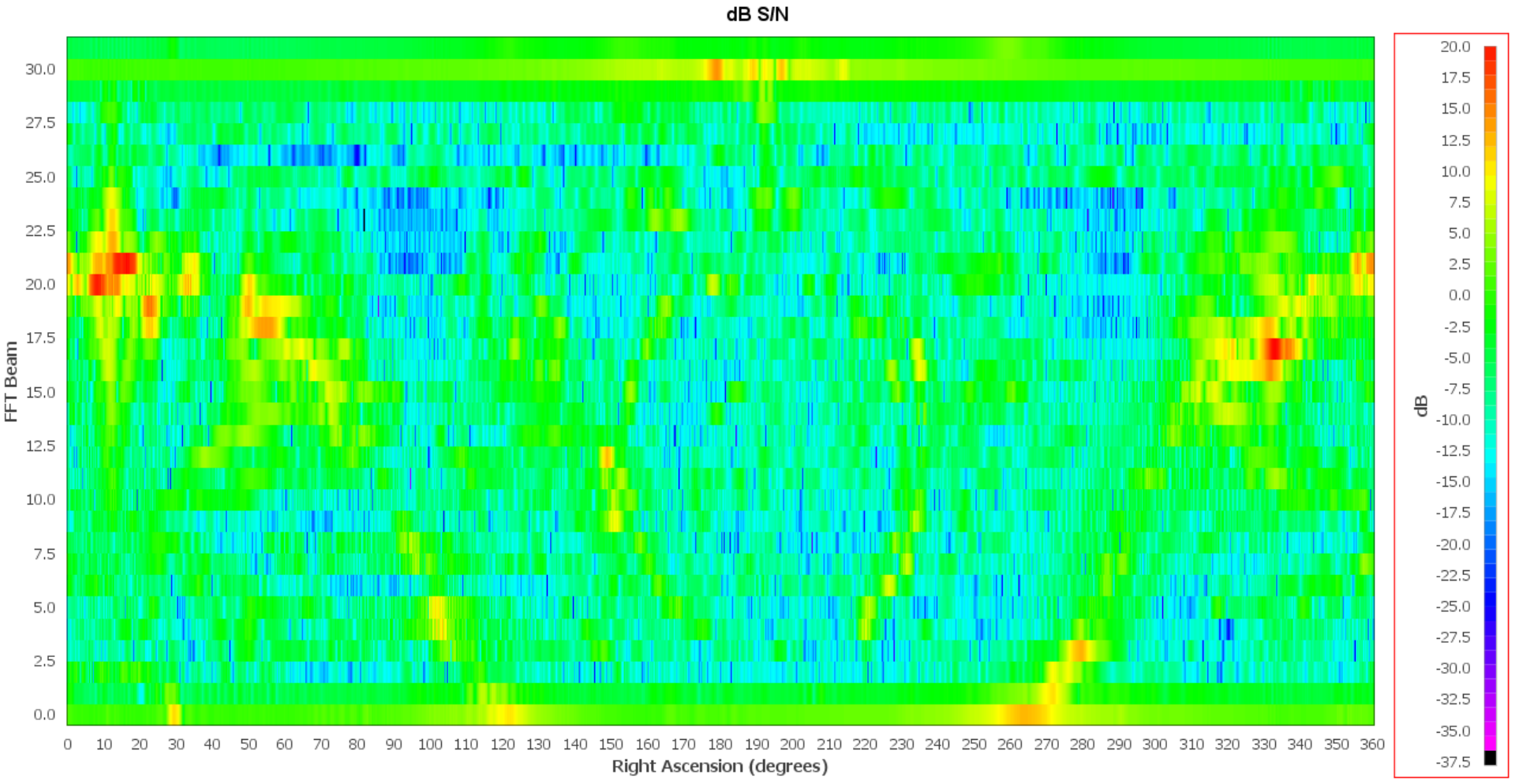
1 Day Scan - Visibility Magnitude – X pol.



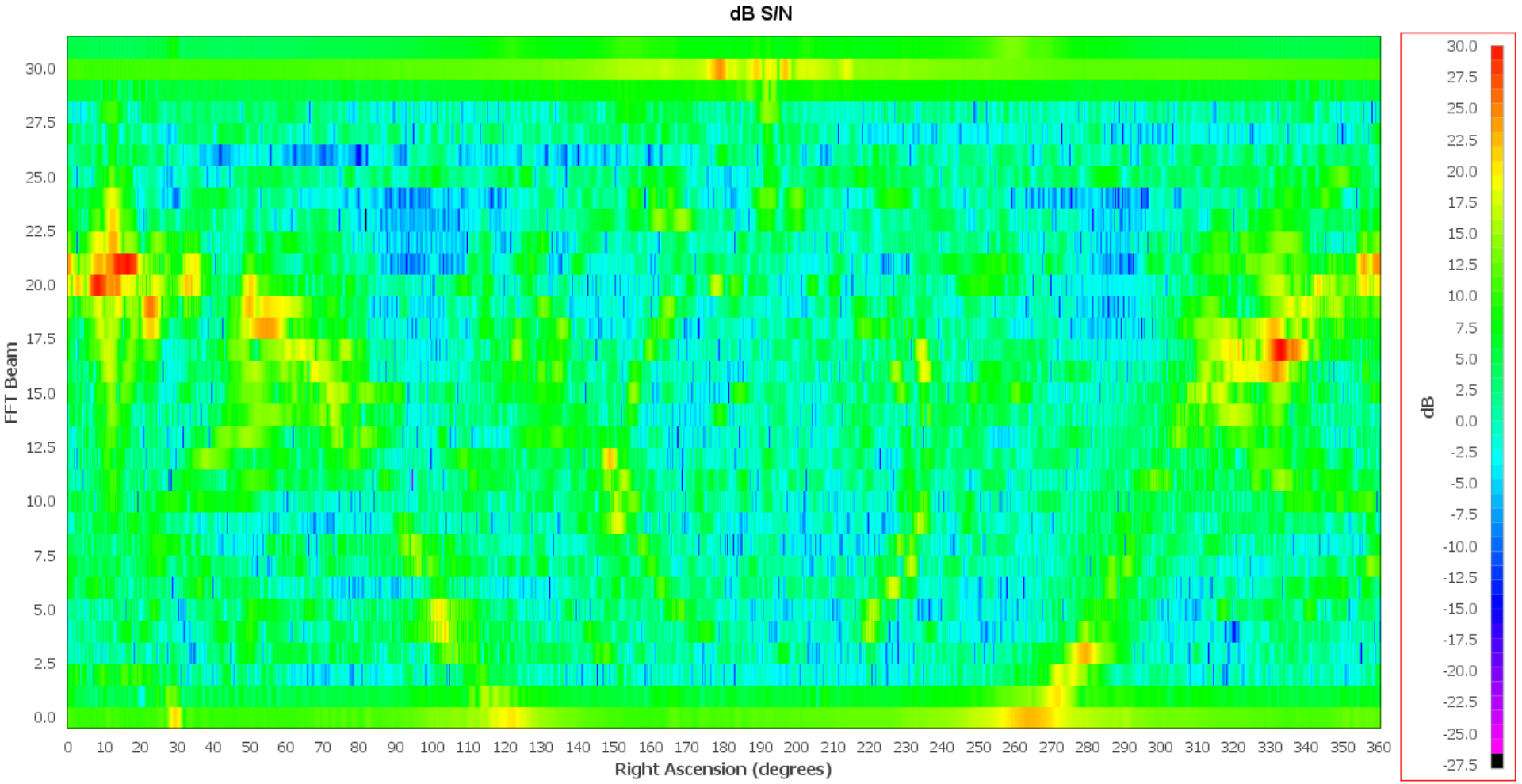
100 Day Scan - Visibility Magnitude – X pol.



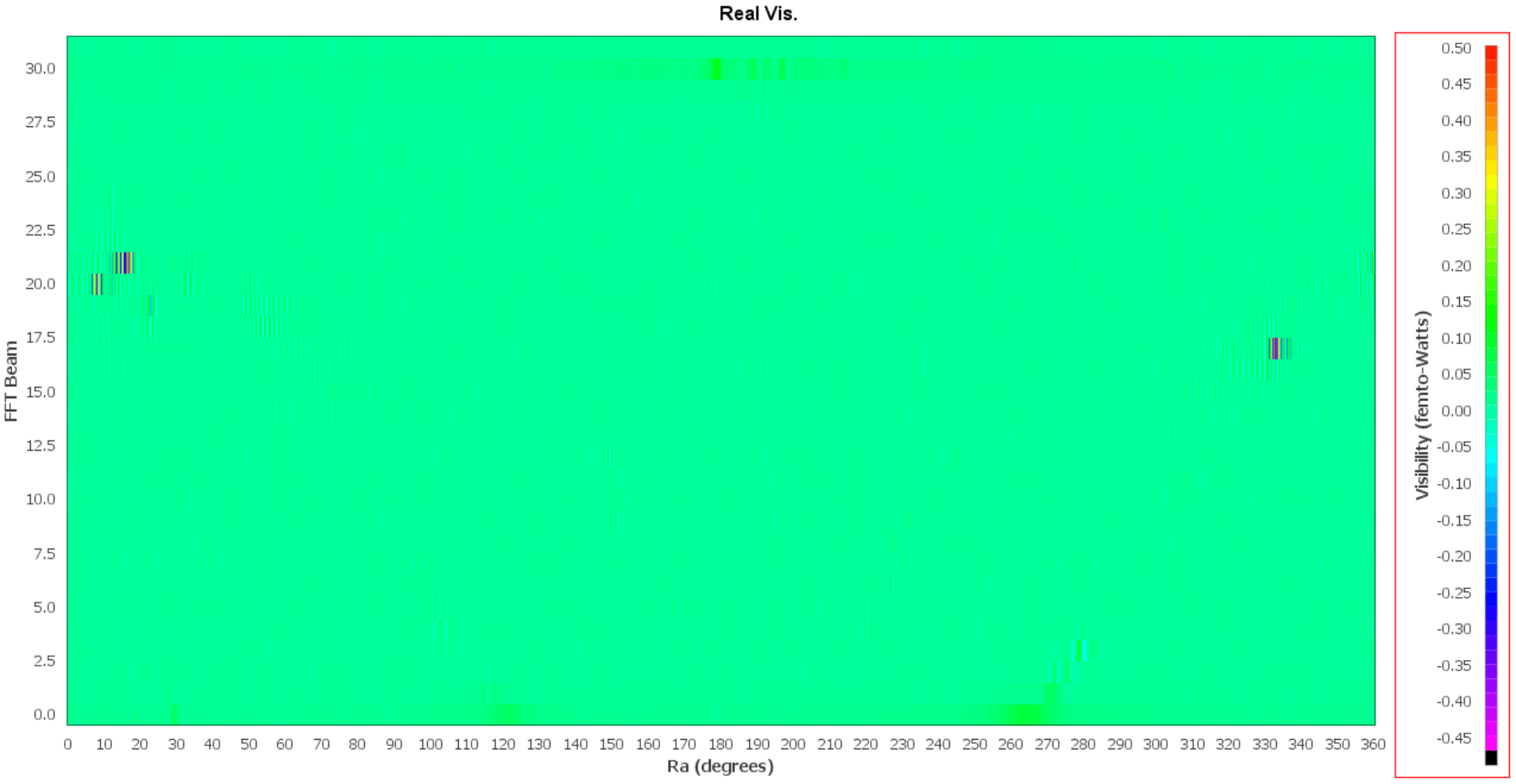
1 Day Scan - Visibility Signal/Noise – X pol.



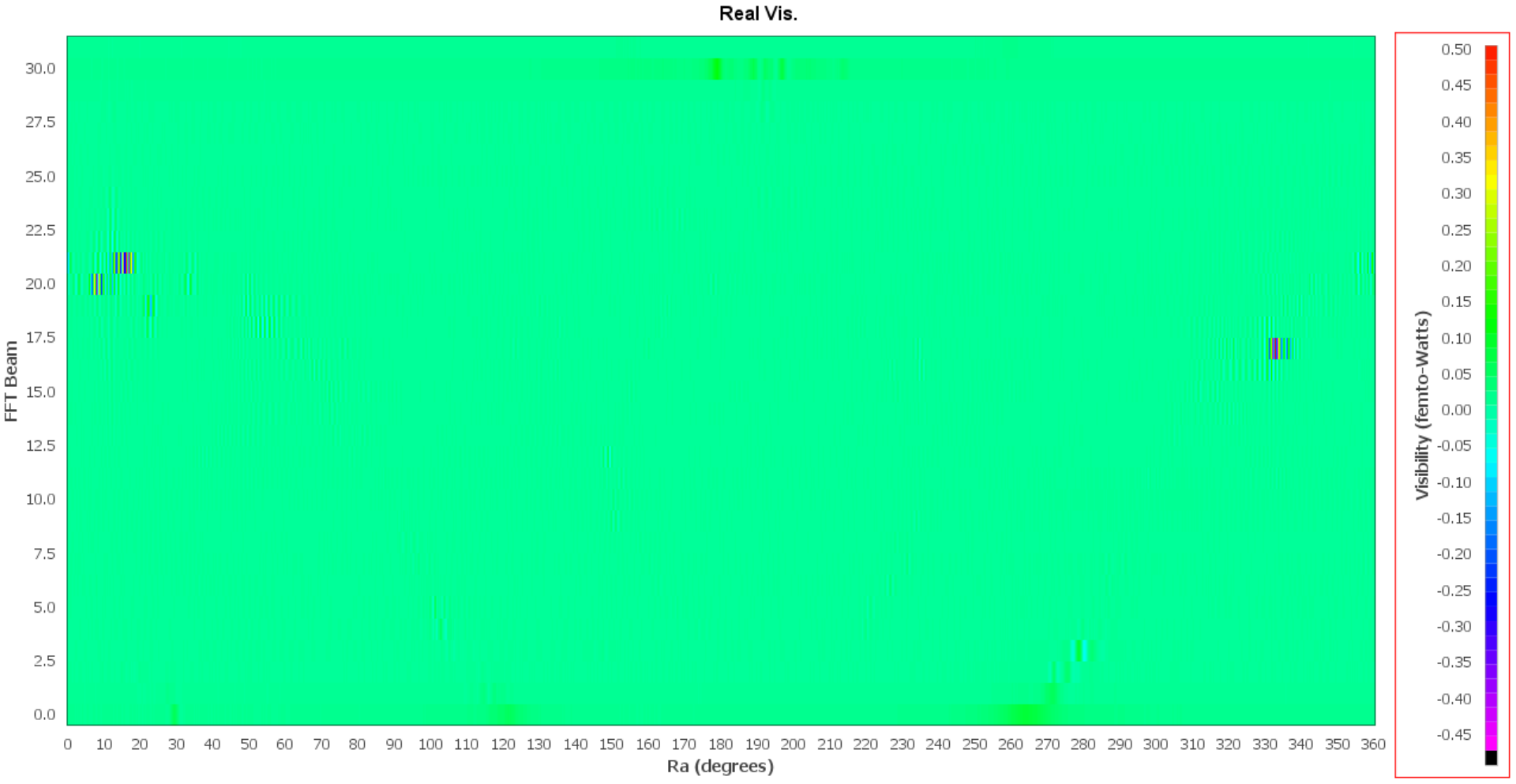
100 Day Scan - Visibility Signal/Noise – X pol.



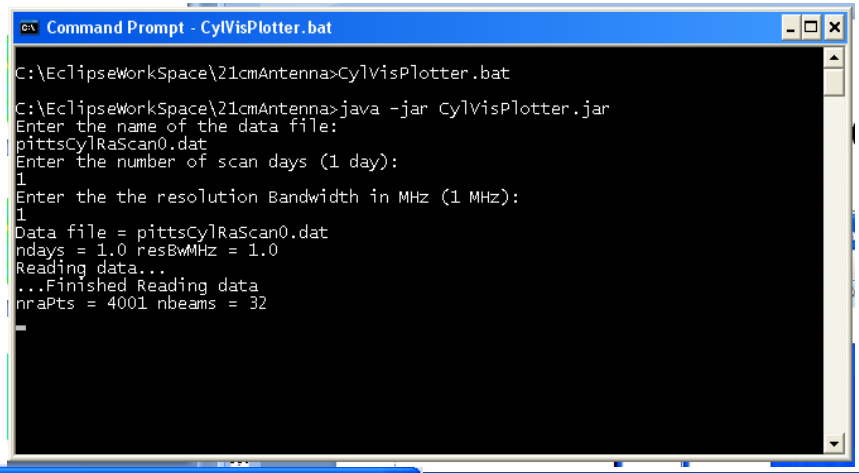
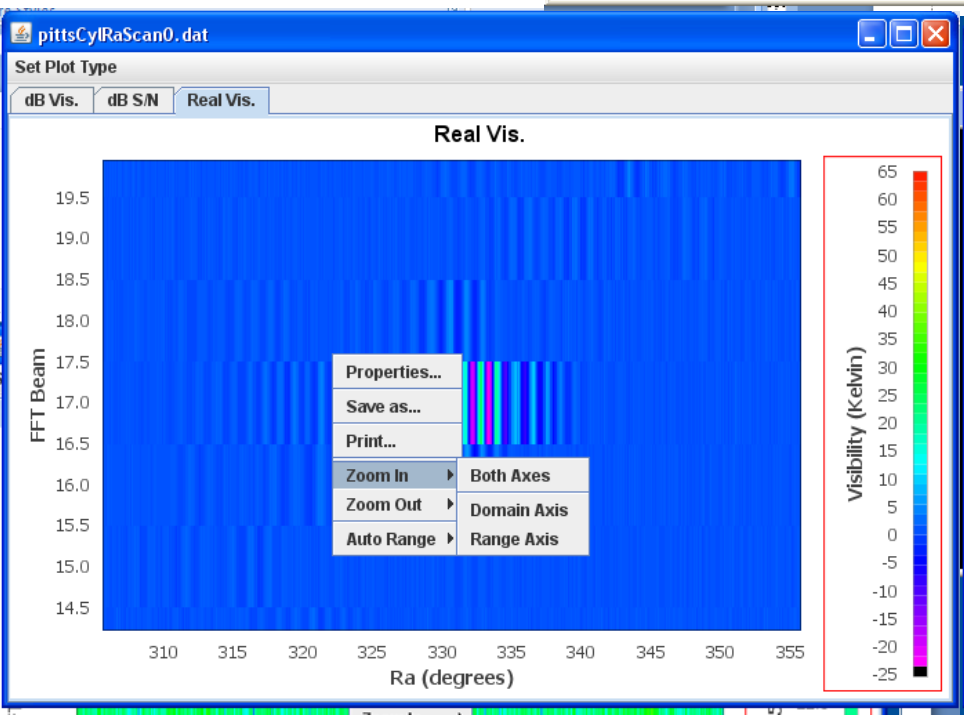
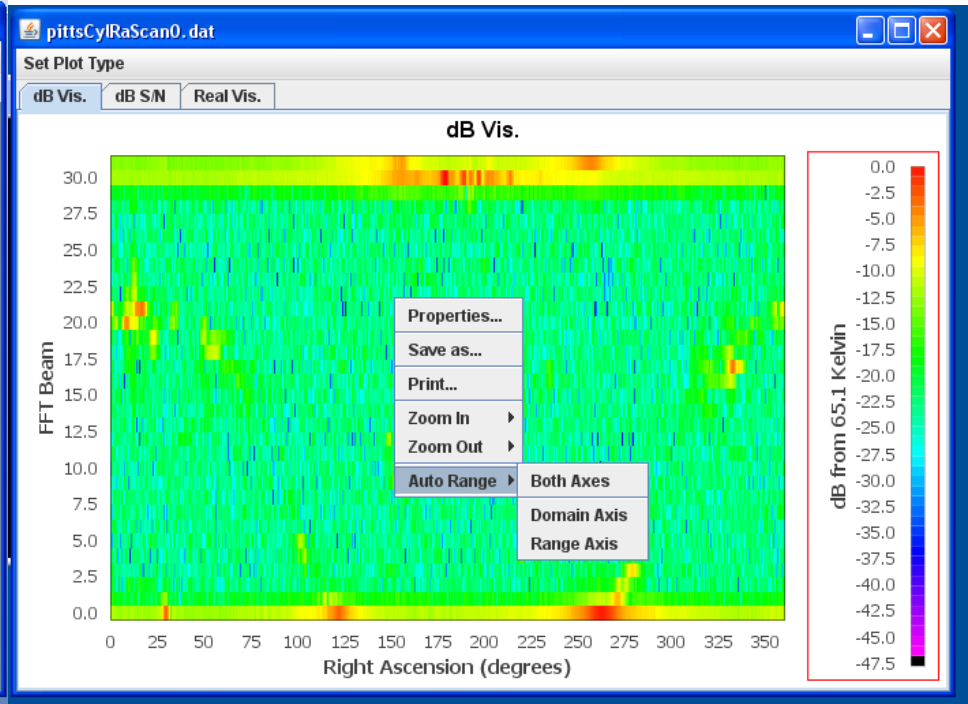
1 Day Scan – Real Part of Visibility– X pol.



100 Day Scan – Real Part of Visibility– X pol.



Data Viewer

- I have made a simple data viewer at:
  - http://crt21cm3.fnal.gov:8080/crt21cmData/
- Copy all files into a single directory
  - pittsCylRaScan0.dat = raw ascii Y polarization data
  - pittsCylRaScan1.dat = raw ascii X polarization data
  - CylVisPlotter.jar = java program file for data viewer
  - CylVisPlotter.bat = script file for running program
    - java -jar CylVisPlotter.jar

Data Viewer Screen Shots