

– The soviets had done some pretty extensive work on exposure and exposure limits. One reference (National Academy of Science) puts the Soviet Union occupational limit at 50 V/m or 17 dBv/m. A more modern work (International Commission on Non-Ionizing Radiation 2020) puts the 8 MHz limit at 170 V/m or 22 dBv/m. The predicted levels seem to fall in line with these levels, and if the buildings provided a modicum of shielding, the levels are not remarkable

Scott Burnside

**Table 3.** Reference levels for occupational exposure to time-varying electric and magnetic fields (unperturbed rms values).

Frequency range	E-field strength E (kV m <sup>-1</sup> )	Magnetic field strength H (A m <sup>-1</sup> )	Magnetic flux density B (T)
1 Hz–8 Hz	20	$1.63 \times 10^5/f^2$	$0.2/f^2$
8 Hz–25 Hz	20	$2 \times 10^4/f$	$2.5 \times 10^{-2}/f$
25 Hz–300 Hz	$5 \times 10^2/f$	$8 \times 10^2$	$1 \times 10^{-3}$
300 Hz–3 kHz	$5 \times 10^2/f$	$2.4 \times 10^5/f$	$0.3/f$
3 kHz–10 MHz	$1.7 \times 10^{-1}$	80	$1 \times 10^{-4}$

**LIMIT 22 dBv/m**

# Duga Radar Array, Chernobyl, Ukraine

51°18'20.17"N, 30°04'02.60"E

Field Strength with  
10 MW Input Power

50 dBV/m

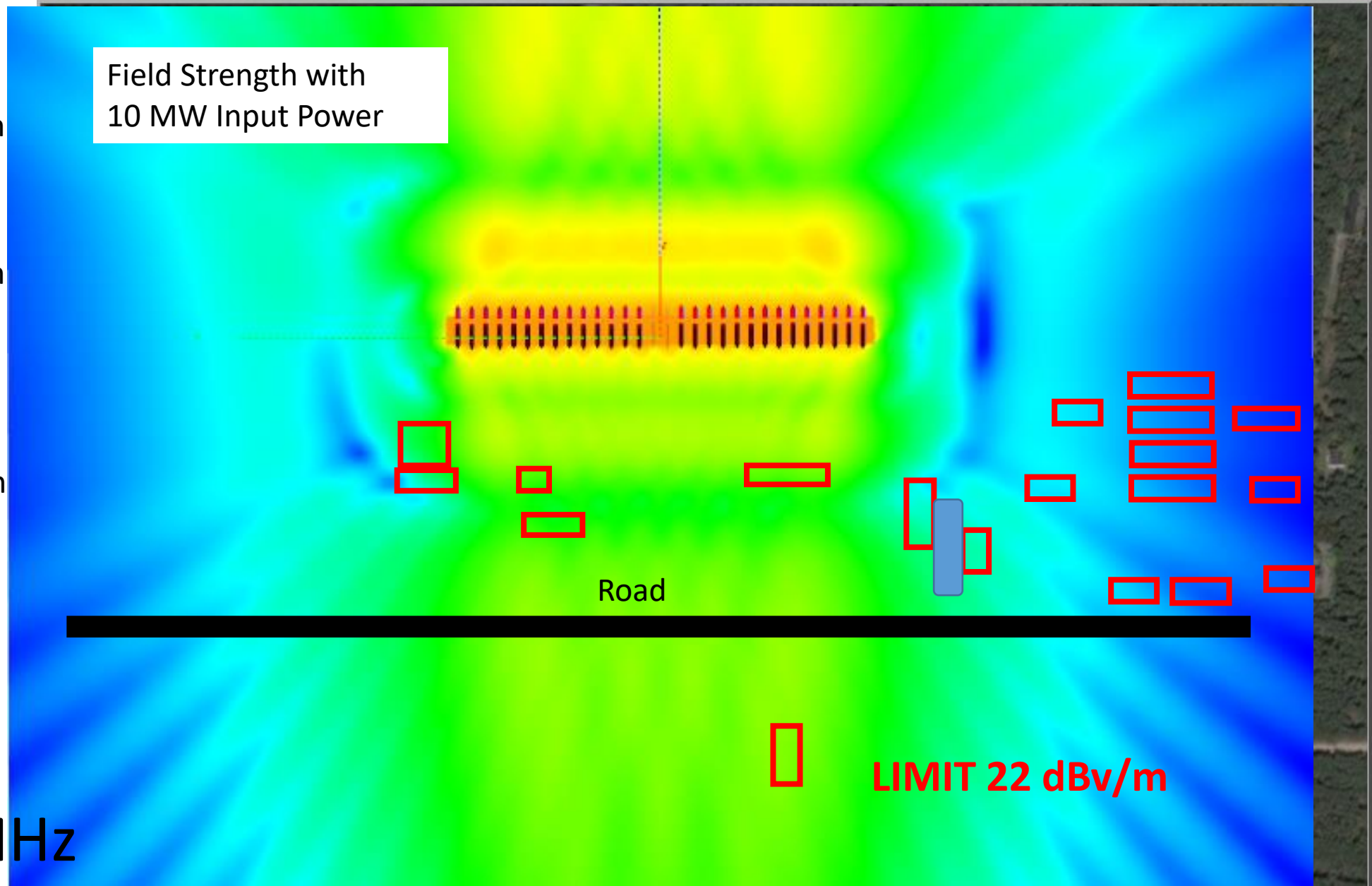
25 dBV/m

-10 dBV/m

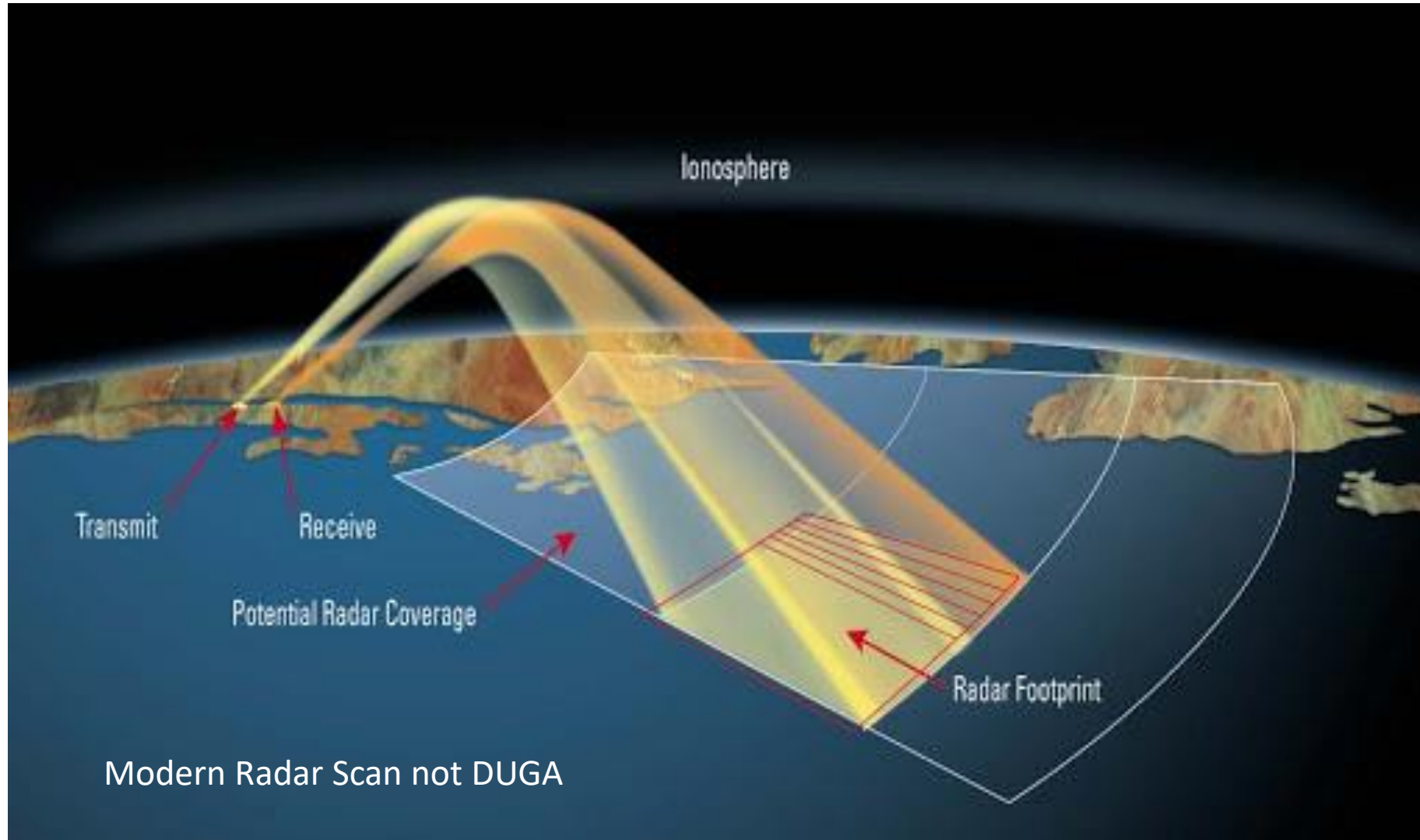
Road

LIMIT 22 dBv/m

8.26 MHz



## Somewhere Over the Horizon. Using the Ionosphere to Arc (DUGA) Your Beam to Search For Missile Launches – Let's lift our beam 30 Degrees



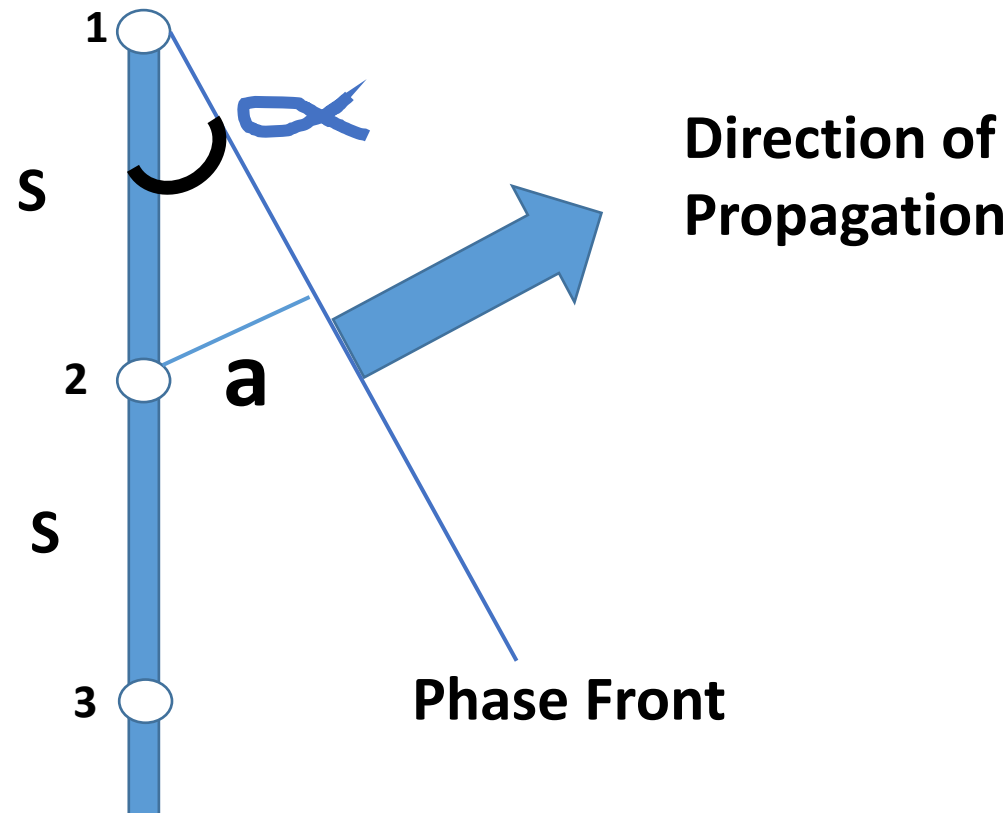
Note Transmit And Receive Sites are Separated by Distance (like 60 km for example)

# Steering the Beam Up to 30 Degrees

- Progressive Phase Shift for 8.26 MHz is 31.45 degrees to steer beam up to 30 degrees elevation

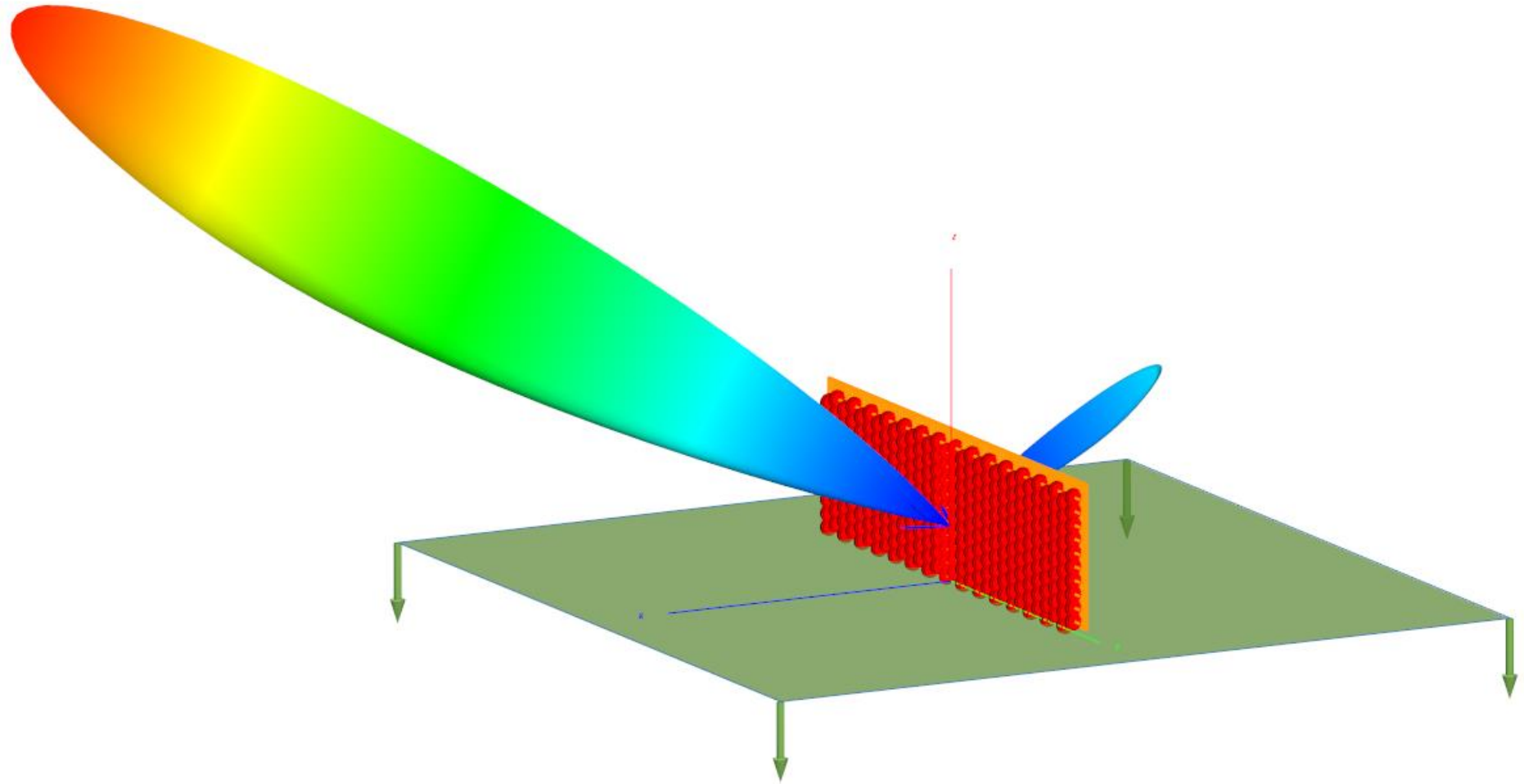
Alpha = 30 deg  
Frequency = 8.26 MHz  
Wavelength = 119.076 ft  
 $S = 20.8039$  ft  
 $\sin(\alpha) = a/S$   
 $a = S \cdot \sin(\alpha) = 10.4$  ft  
 $a/\text{wavelength} \cdot 360 = 31.45$  deg

Phase 1 = 0  
Phase 2 = 31.45  
Phase 3 = 62.9 etc.





**The Beam is Steered up 30 Degrees to hit the Ionosphere**  
**Linear Gain (not in dBi)**



**Linear Antenna Gain steered up 30 degrees at 8.26 MHz**

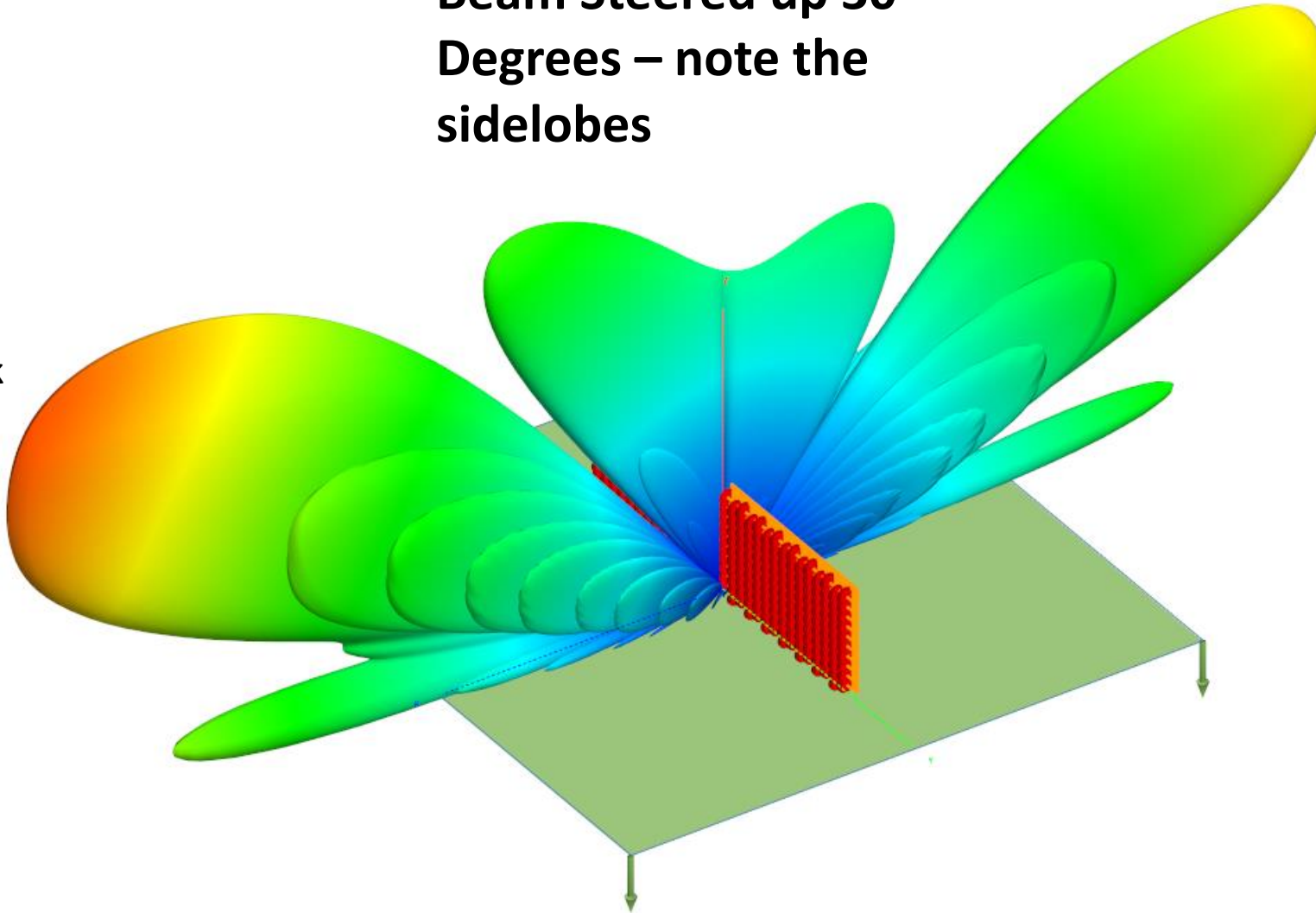


**8.26 MHz**




**Beam Steered up 30  
Degrees – note the  
sidelobes**

**Antenna Gain Peak  
26 dBi**



**Antenna Gain in dBi steered up 30 degrees at 8.26 MHz**

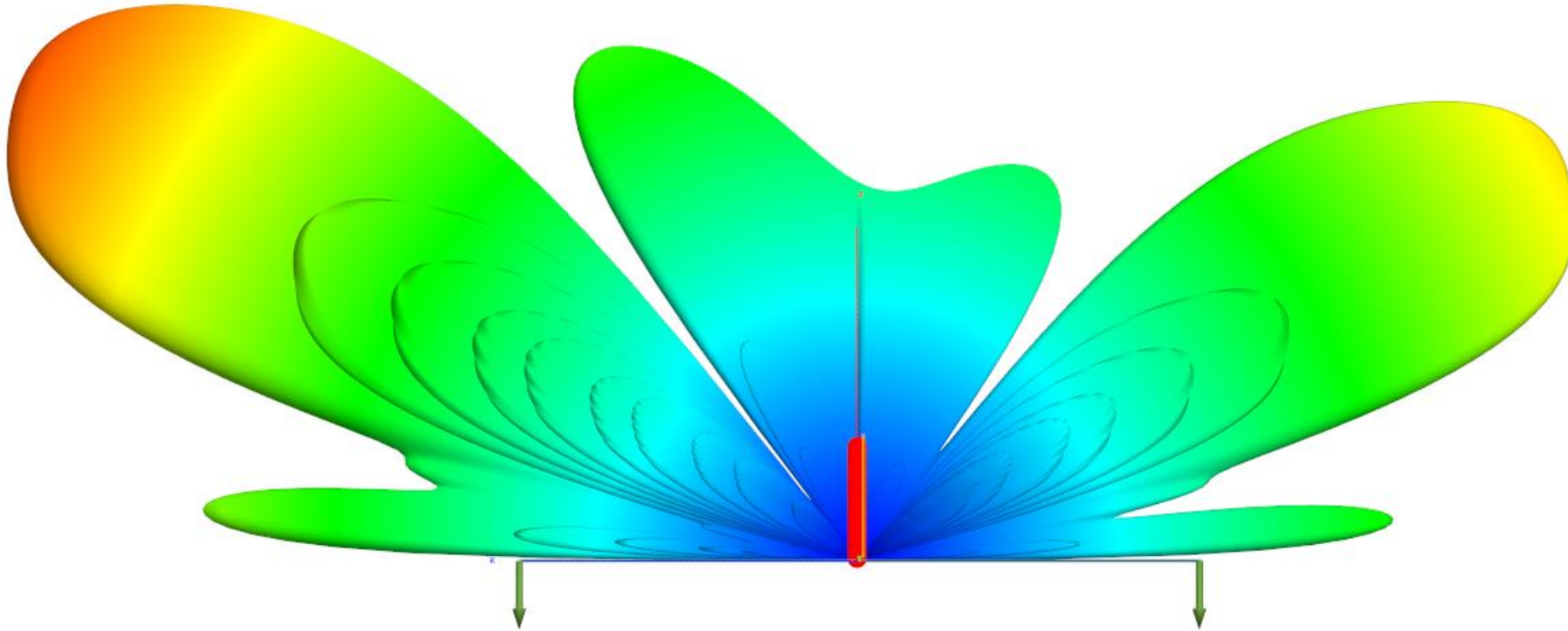
  
**8.26 MHz**





## Side View of Beam Steered up 30 Degrees

Antenna Gain Peak  
26 dBi



Antenna Gain in dBi steered up 30 degrees at 8.26 MHz

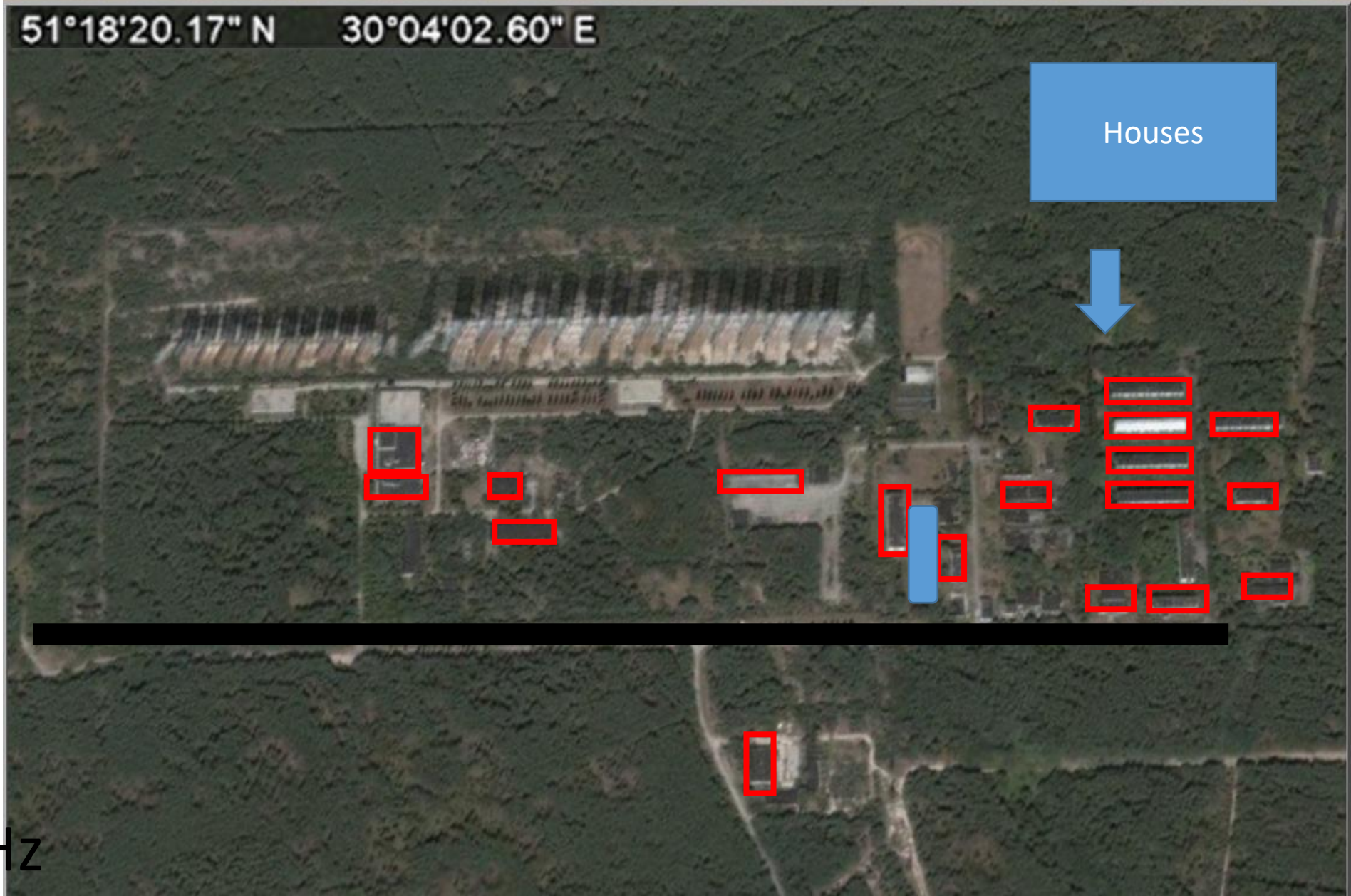
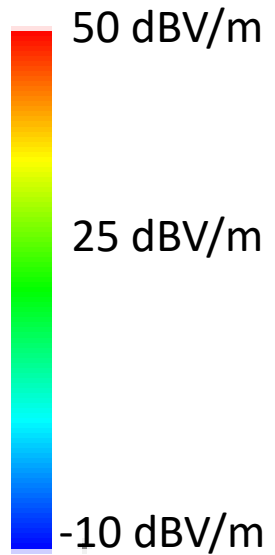


8.26 MHz

# Duga Radar Array, Chernobyl, Ukraine

51°18'20.17"N, 30°04'02.60"E

51°18'20.17" N 30°04'02.60" E



8.26 MHz



# Duga Radar Array, Chernobyl, Ukraine

51°18'20.17"N, 30°04'02.60"E

Safe

Field Strength with  
10 MW Input Power

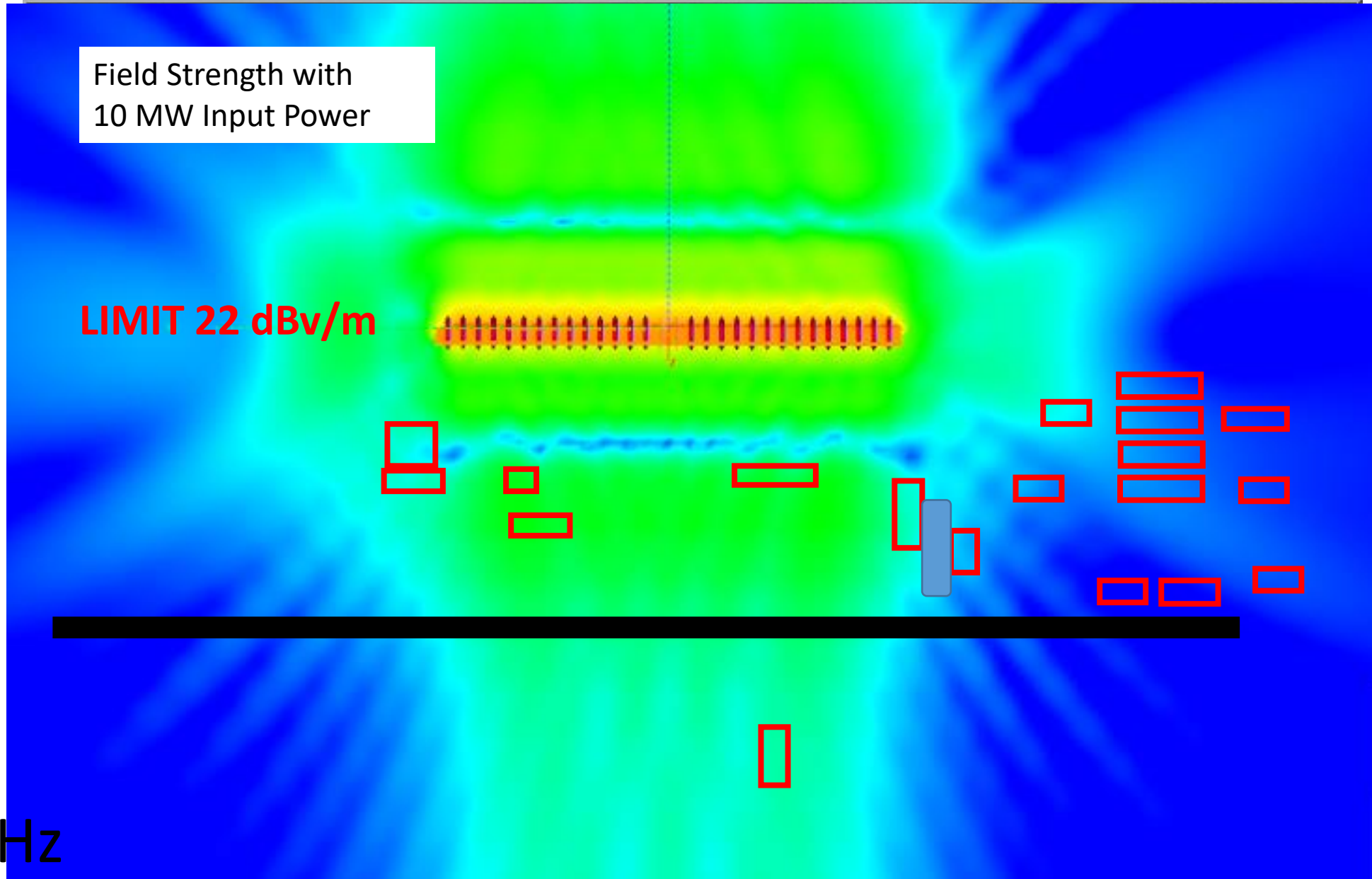
50 dBV/m

25 dBV/m

-10 dBV/m

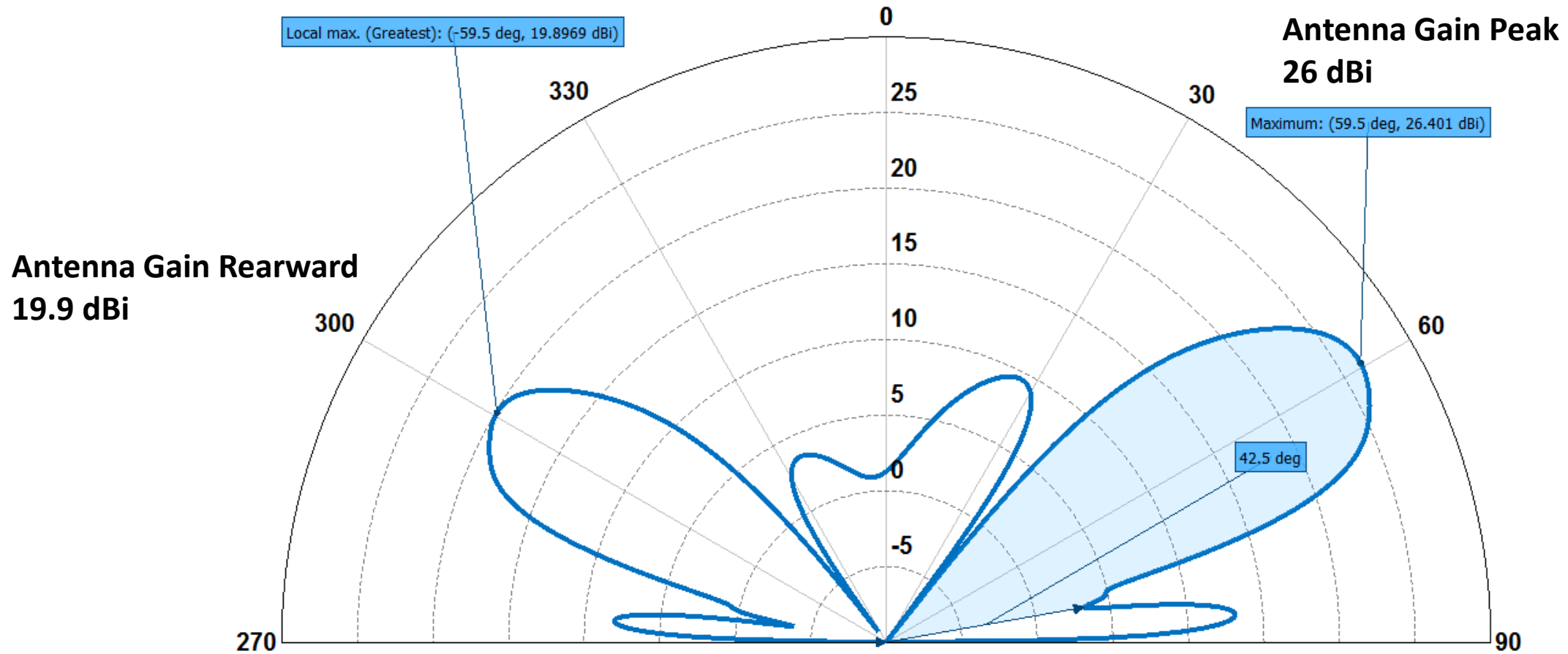
LIMIT 22 dBV/m

8.26 MHz



## Large Array Elevation Pattern Beam Steered up 30 degrees

— Antenna Gain Horizontal Pol



8.26 MHz

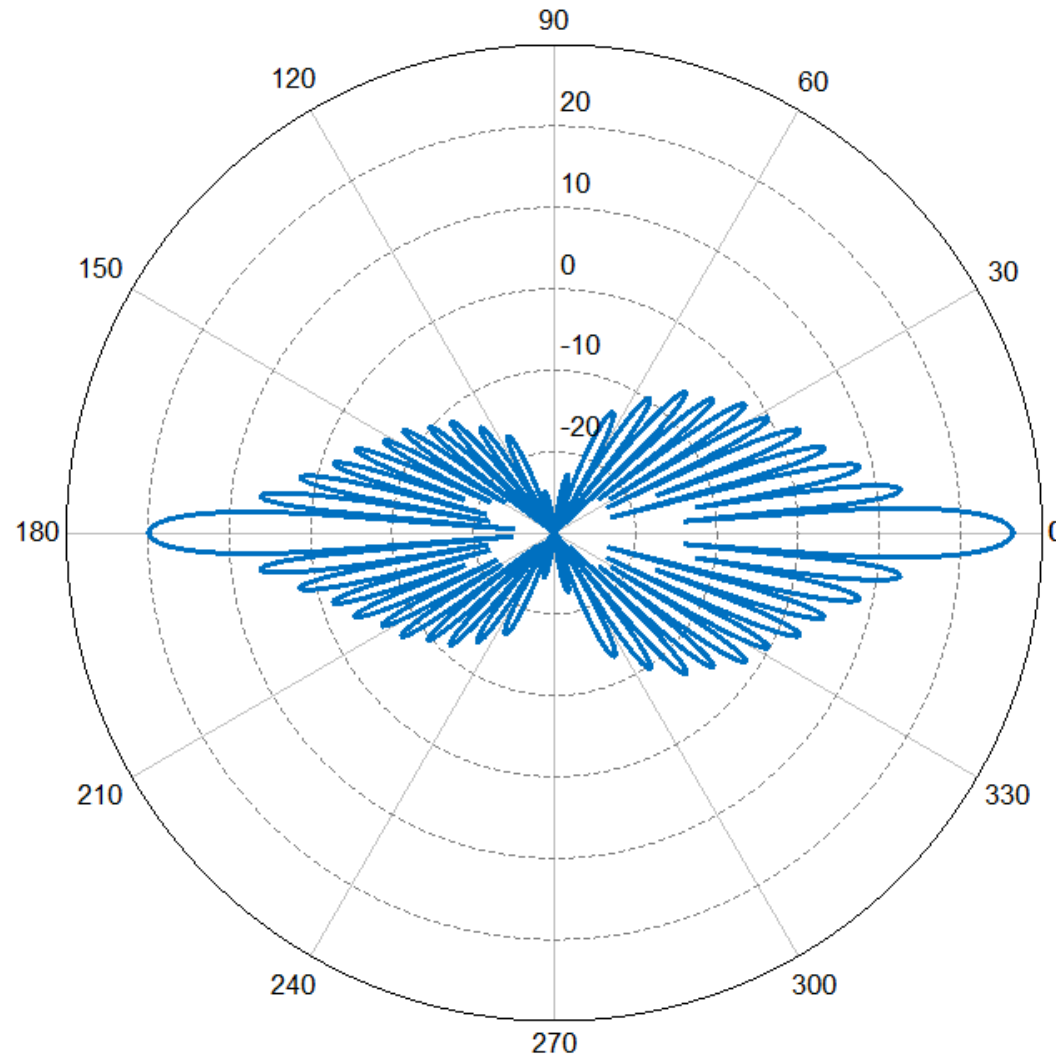
Phi Gain [dBi] (Frequency = 8.26 MHz; Phi = 0 deg) - Woodpecker\_Redo\_Low\_Nearfield\_Steered

## Large Array Azimuth Pattern Beam Steered

— Azimuth Pattern at Elevation 30.5 Degrees

Scale 30 to -30 dBi

Showing  
Sidelobes



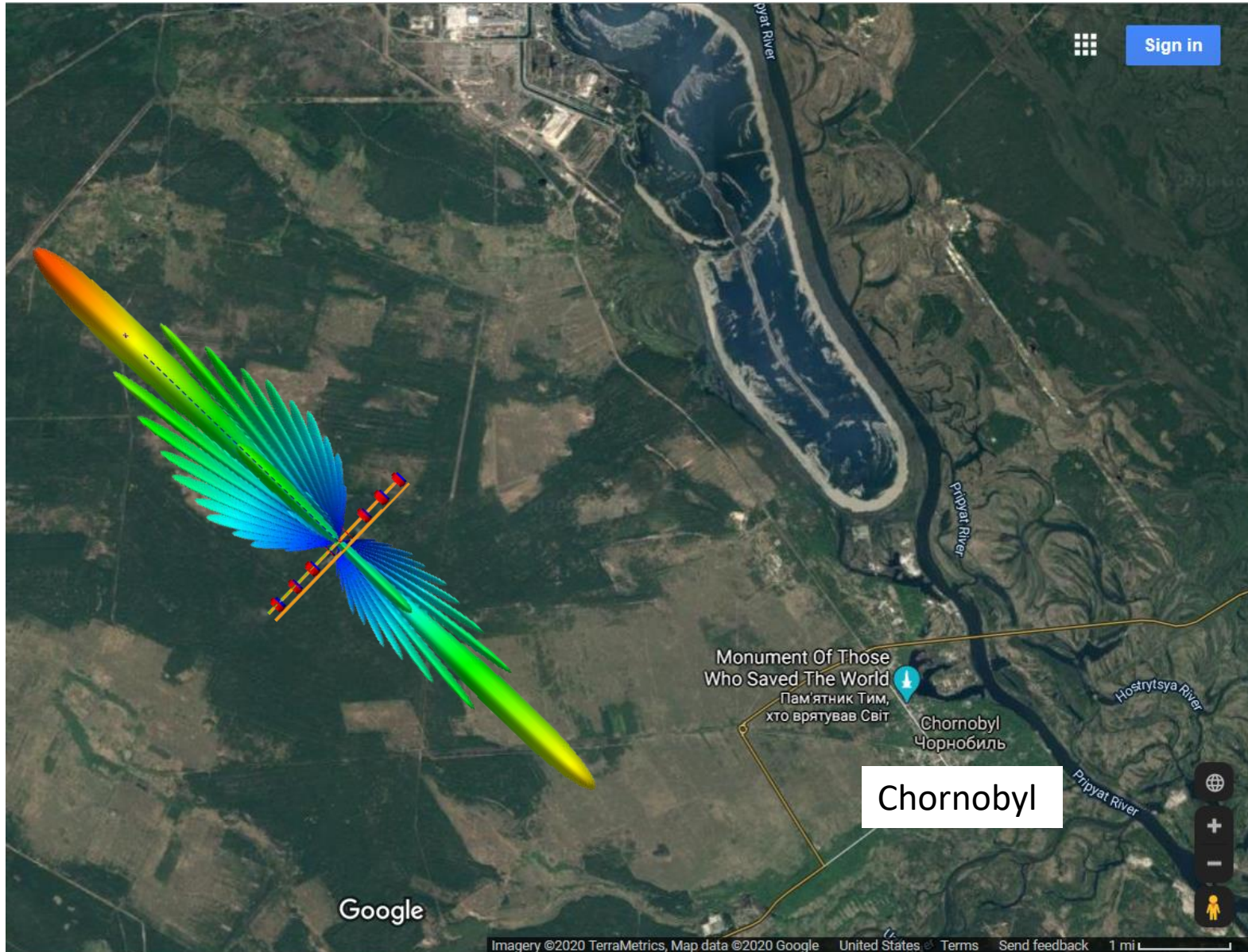
Antenna Gain Peak  
26 dBi

8.26 MHz

Phi Gain [dBi] (Frequency = 8.26 MHz; Theta = 59.5 deg) - Woodpecker\_Red0\_Low\_Nearfield\_Steered



## 8.26 MHz Antenna Pattern – Beam Steered up 30 Degrees

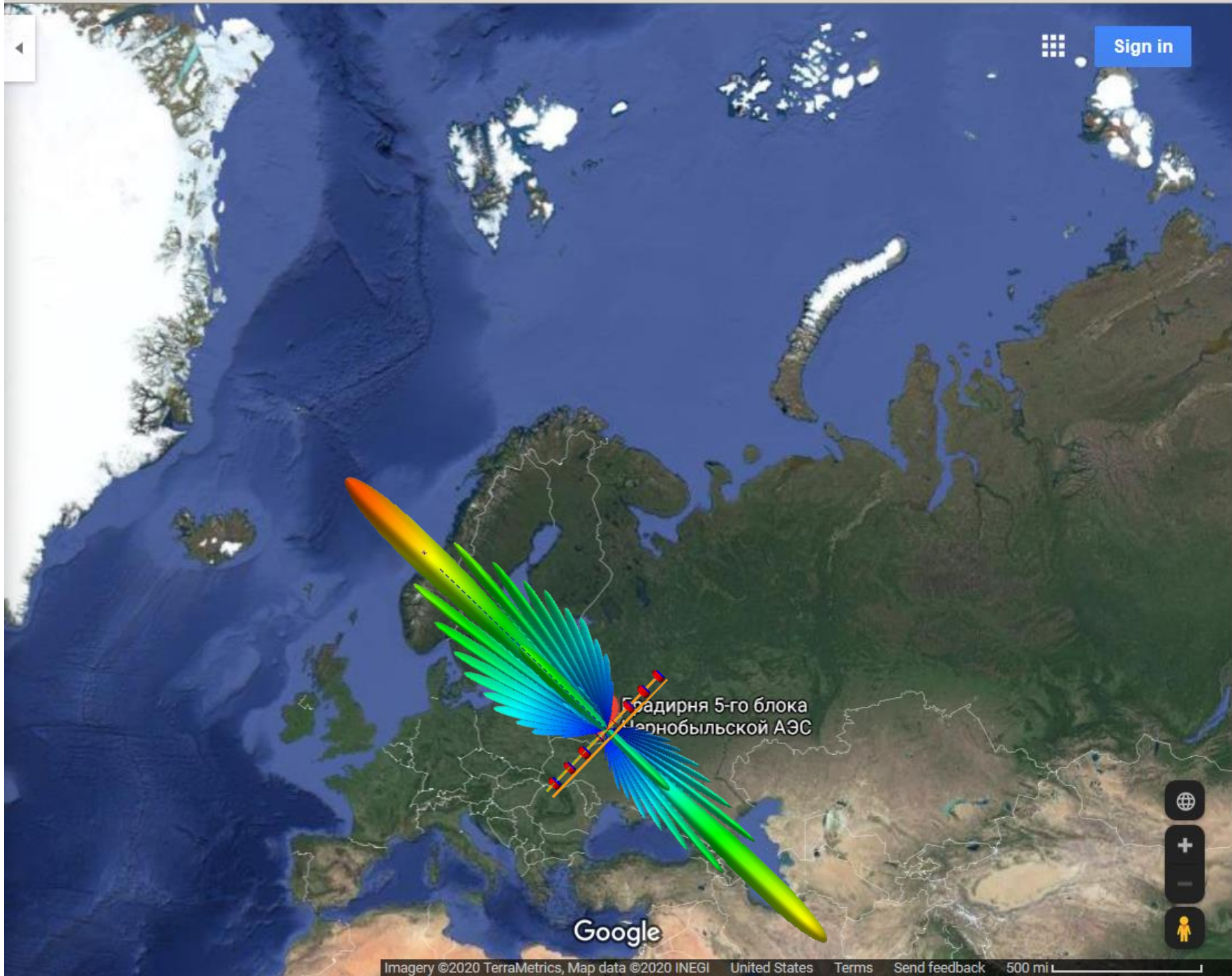


8.26 MHz



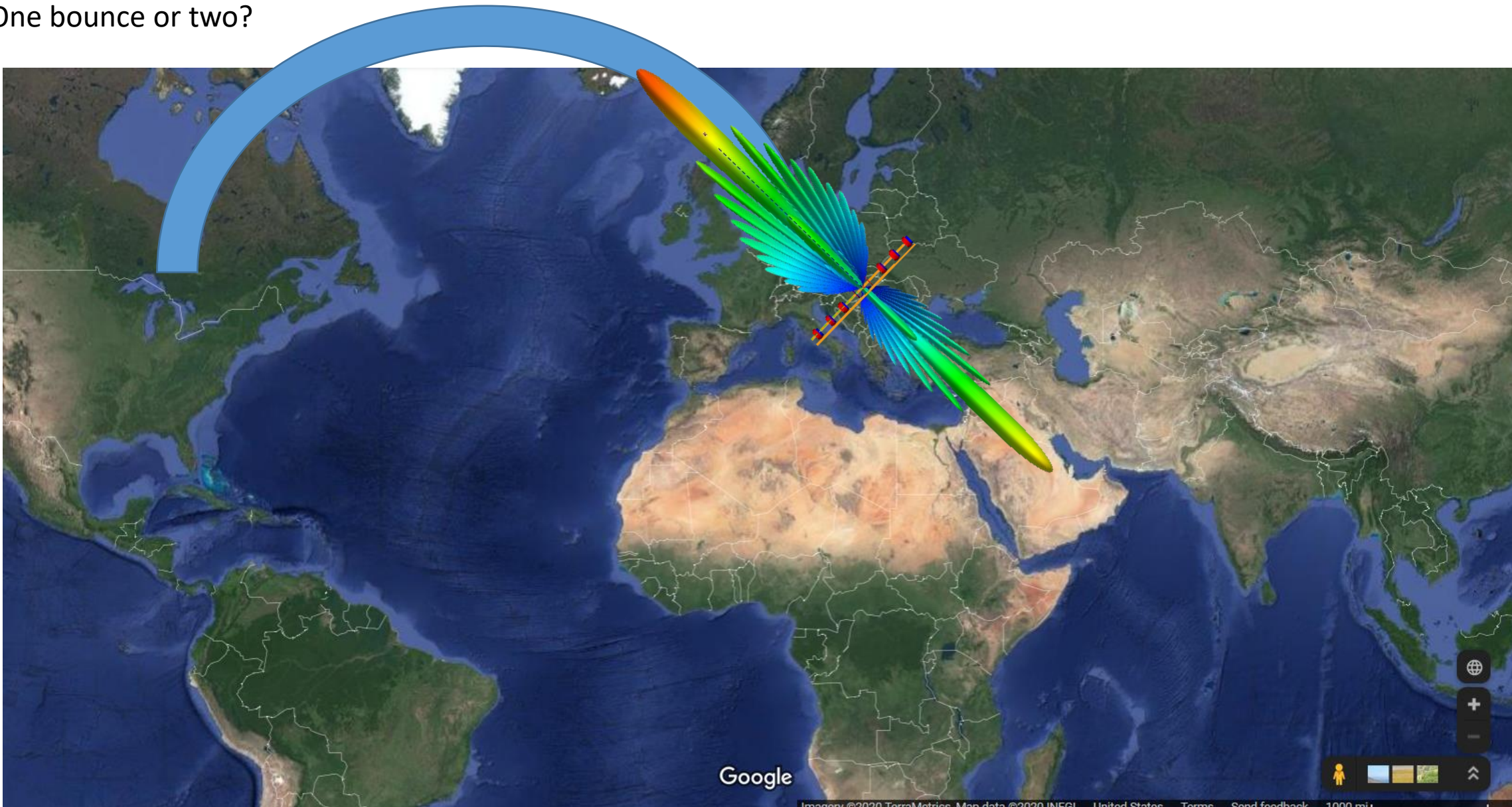
Global  
Interference  
Peck Peck Peck  
Peck ..... Caused  
Interference to  
Russia as well,  
even SOS signals  
were being  
drowned out

8.26 MHz





One bounce or two?

[illegible]

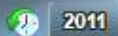


# Small Array Elements 10 Across and 18 High



Image Landsat / Copernicus  
Image © 2020 CNES / Airbus  
US Dept of State Geographer  
© 2020 Google

Google Earth



2011

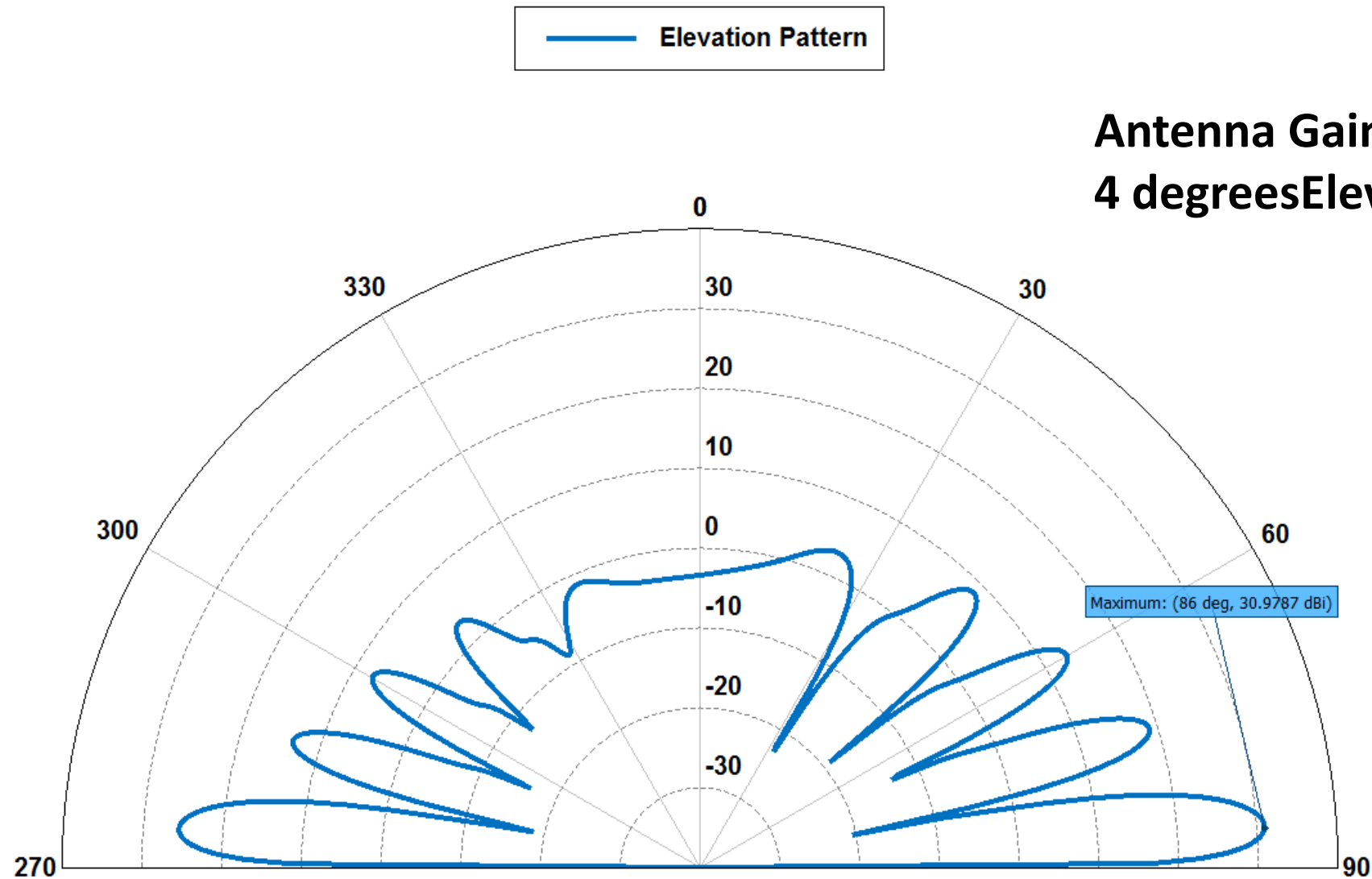
Imagery Date: 5/5/2017 51°18'13.74" N 30°03'42.06" E elev 580 ft eye alt 462 ft

# Dimensions (in Feet) from Photo – Scaled with top screen made to Equal 250 Meters

- Dipole length = 72.2 ft
- Spacing Adjacent columns = 39.4 ft
- Spacing for Elements on the same row = 78.7 ft
- Height = 333.2 ft
- Vertical spacing = per column 32.2 ft
- Vertical spacing = per alternating columns 16.1 ft



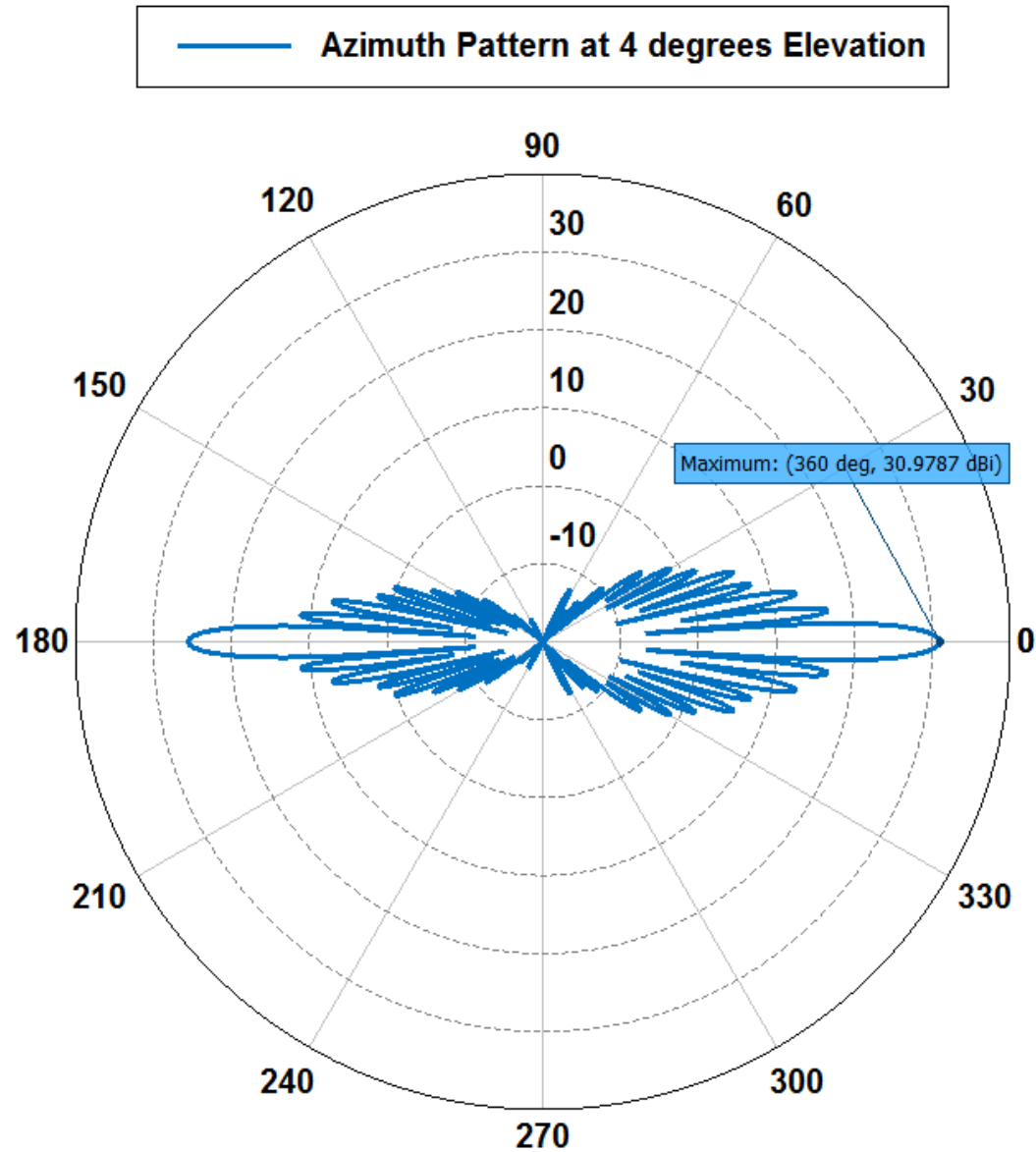
# Small Array 16.45 MHz Elevation Pattern for Uniform Illumination



Total Gain [dBi] (Frequency = 16.45 MHz; Phi = 0 deg) - Small\_Array

16.45 MHz

# Small Array 16.45 MHz Azimuth Pattern for Uniform Illumination

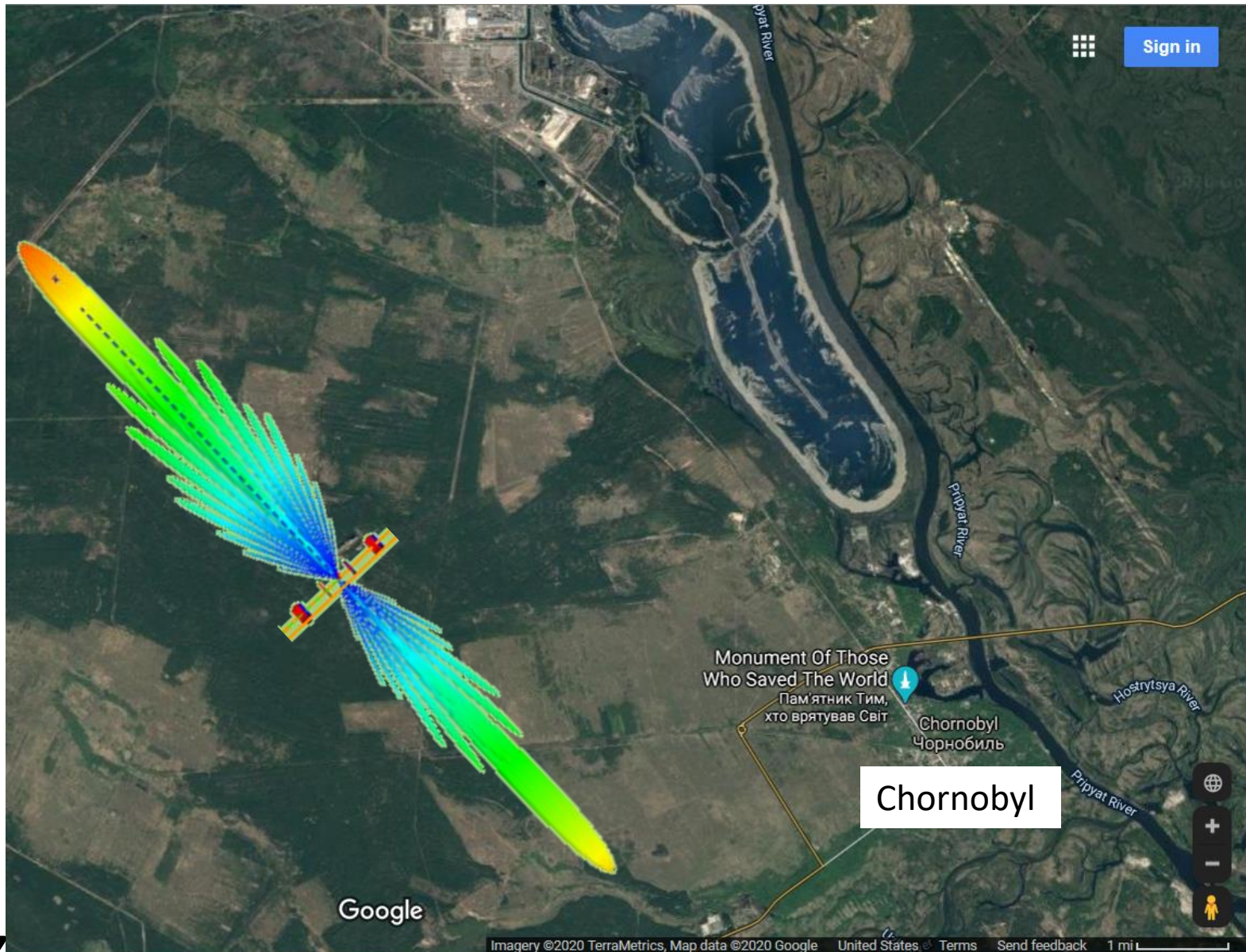


**Antenna Gain Peak 31 dBi  
4 degrees Elevation**

16.45 MHz

Total Gain [dBi] (Frequency = 16.45 MHz; Theta = 86 deg) - Small\_Array

## Uniform Illumination 16.45 MHz Antenna Pattern



16.45 MHz

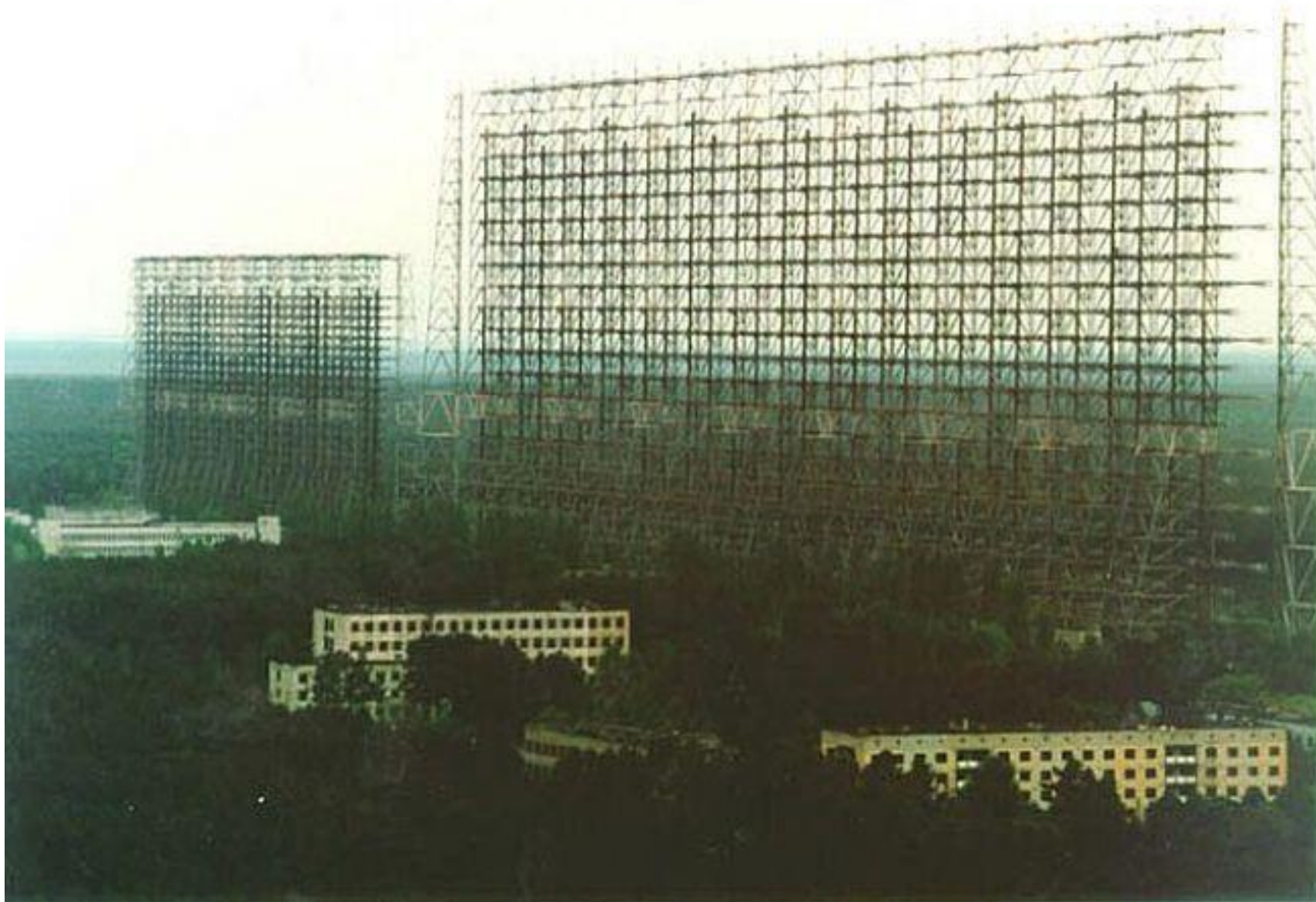


# **April 26 1986 Chernobyl Accident**





**Were People Getting Too Much RF Radiation?  
If so can we blame it on Chernobyl Power Plant Radiation?**



## Wild speculations



The radar was buried deep in a forest, with fake signs disguising its presence.

Clay Gilliland/Flickr

To confuse their "enemies," Soviet command often designated such installations with numbers or fake identities.

On Soviet maps, the Duga radar was marked as a children's camp (there's even a bizarre bus stop on the road to one facility decorated with a bear mascot from the 1980 Summer Olympics in Moscow).





SOURCE: HBO

Another theory revolves around the **Russian Woodpecker**, a 14,000 military radar installation in northern Ukraine. According to Fedor Alexandrovich, who appeared in a documentary named after the Cold War contraption, Chernobyl was staged by Moscow to cover up the failure of the Russian Woodpecker, which cost 7 billion rubles to build.

**Now it's time for Questions  
and Questions  
(there's more questions than  
answers)**



# Radar Professor Dr. Fedir Dubrovka comments from “The Russian Woodpecker” movie

- All the Duga Technology was unique
- It was made of semiprecious metals
- All the devices, the receivers and especially the transmitters ..
- These transmitters are two stories tall, so powerful
- Were talking about **mega-watts**
- For signal processing we need special computers
- Today computers are cheap. But these were custom built
- And cables, amplifiers, phase shifters ...
- It's nothing to sneeze at

## **Former Commander Volodymyr Musiyets (he's in the movie "The Russian Woodpecker")**

Some of what we know today about the Duga -- also known as Chernobyl-2 -- comes from Volodymyr Musiyets, a former commander of the radar complex.

"The Chernobyl-2 object, as a part of the anti-missile and anti-space defense of the Soviet military, was created with a sole purpose," he told the Ukrainian newspaper Fakty, "to detect the nuclear attack on the USSR in the first two-three minutes after the launch of the ballistic missiles."

The Duga radar was only a signal receiver, the transmitting center was built some 60 kilometers away in a town called Lubech-1, now also abandoned.

These top-secret facilities were protected with extensive security measures.

## Former Commander Volodymyr Musiyets (he's in the movie "The Russian Woodpecker")

Some of what we know today about the Duga -- also known as Chernobyl-2 -- comes from Volodymyr Musiyets, a former commander of the radar complex.

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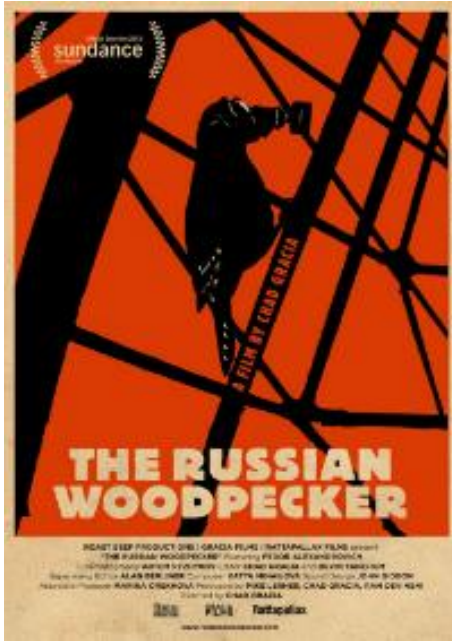
The Duga receiver, the transmitting center was built some 60 kilometers away from Lubech-1, now also abandoned.

These top-secret facilities were protected with extensive security measures.



LIER!





According to the Documentary Movie entitled “The Russian Woodpecker” the Duga 3 Array near **Chernobyl was due to be inspected by Russian reviewers in September 1986** after the nuclear accident. The conspiracy theory after many years was that the array did not work.

The explanation of why came from the Duga Deputy Commander Col Nikolai Shkurat, who said that the facility was going to a new frequency and that the **Aurora Borealis was blocking the signal** and protecting the United States. He said that previous to this new design, the Duga Antenna was able to detect every shuttle launch ever done by the Americans.

So in order to block the inspection of the antenna, a very high Diplomat in Moscow ordered the workers to perform the deadly tests at the nuclear power plant. The day workers refused to obey. However the night crew complied and the Chernobyl plant blew its top. The radiation closed down all the facilities around the nuclear power plant and this included the Duga. The politician that financed and promoted the building of the antenna was spared being killed which was the penalty for wasting 7 Billion Rubbles.



**Year 1972**

## **A Snippet from the Web Today's Forecast Failure**

Construction of the Duga began in 1972 when Soviet scientists looking for ways to mitigate long-range missile threats came up with the idea of building a huge over-the-horizon-radar, that would bounce signals off the ionosphere to peer over the Earth's curvature.

Despite the gigantic scale of the project, it transpired the scientists lacked full understanding of how the ionosphere works -- unwittingly dooming it to failure before it was even built.

Aurora Borealis  
Spectrogram  
versus Time of  
Day – Auroral  
Harmonic Roar  
discovered...  
**1993**

Arviat, NWT

April 24, 1995

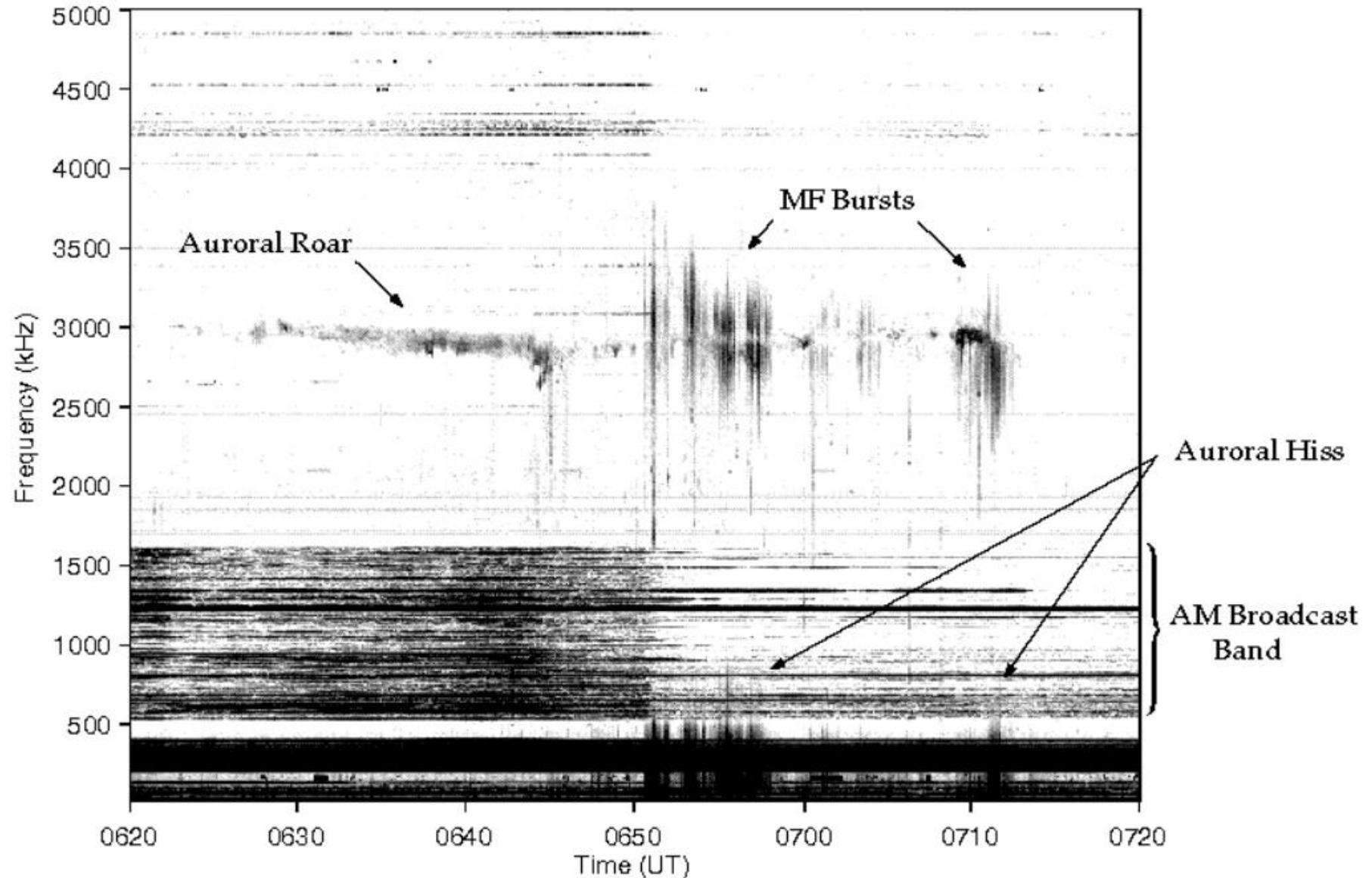


Figure 2. Spectrogram showing 3 types of emissions; auroral roar, MF bursts, and auroral hiss. Darker pixels indicate stronger signals.



# Copious Facts about the Northern Lights RFI

- **1 Auroral Roar – 2.8 to 3 MHz** discovered in late 70's
- **2 Harmonic Roar – 4 to 4.5 MHz** twin type Auroral Roar discovered 1993
- **3 MF Bursts – 3 MHz** (Medium Frequency Bursts) discovered 1994
- **4 Auroral Hiss – 700 kHz**

**Note that if the Duga 3 Array was moving to the 4.5 MHz region it would have been blocked by the Auroral Roar – It is possibly the reason the Duga 3 failed**

## Let's Guess the New Frequency

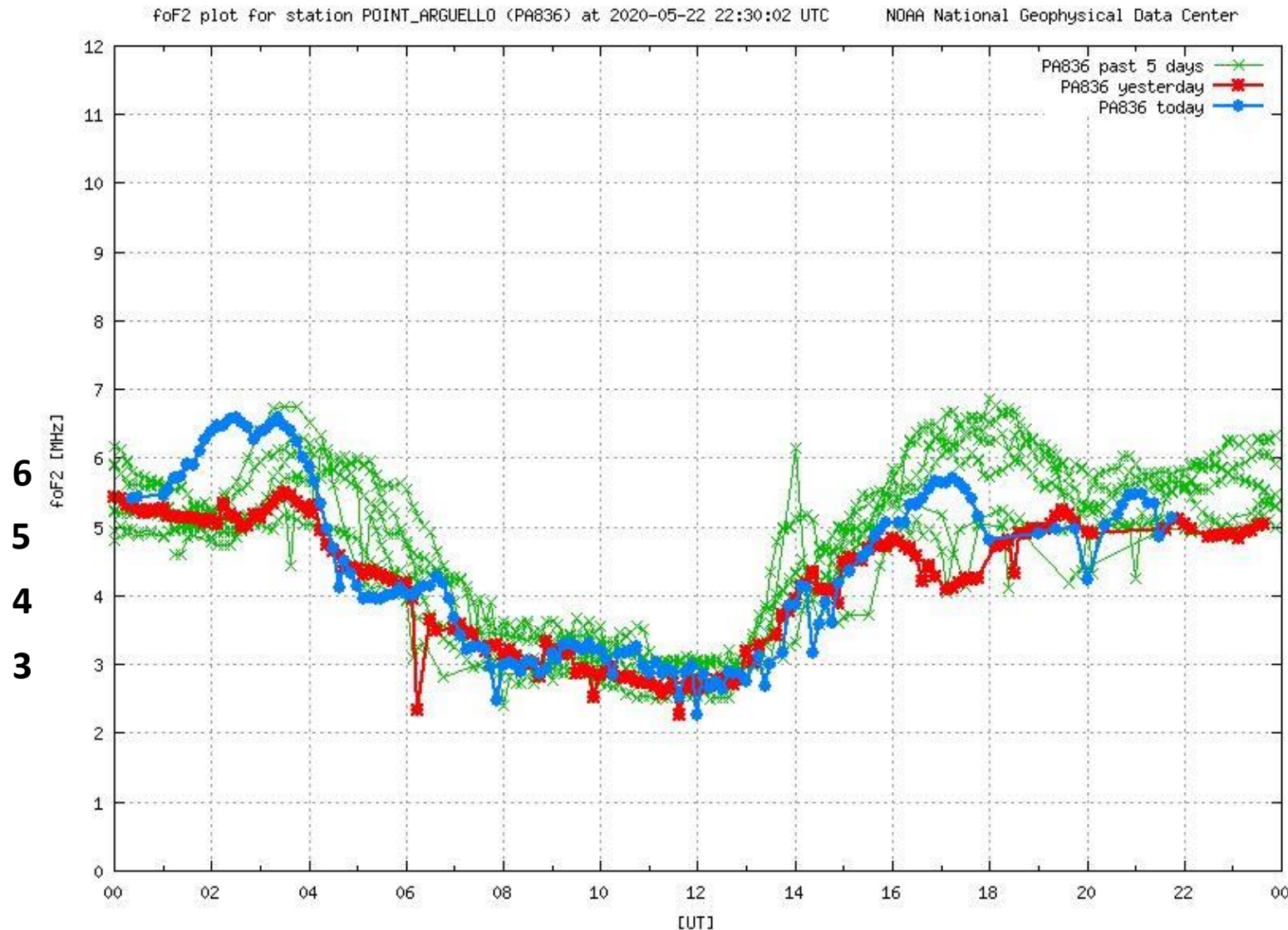
- Frequency 1 is 16 MHz
  - Frequency 2 is 8 MHz
  - Frequency 3 is probably around 4 MHz
- but**

**We discovered in 1993 that there is a twin type of auroral roar which occurs at higher frequencies, near 4-4.5 MHz, which we call "harmonic roar."**

What? I can't hear you.

# Today's Auroral Forecast Notice the Frequencies:

FREQUENCY  
MHz

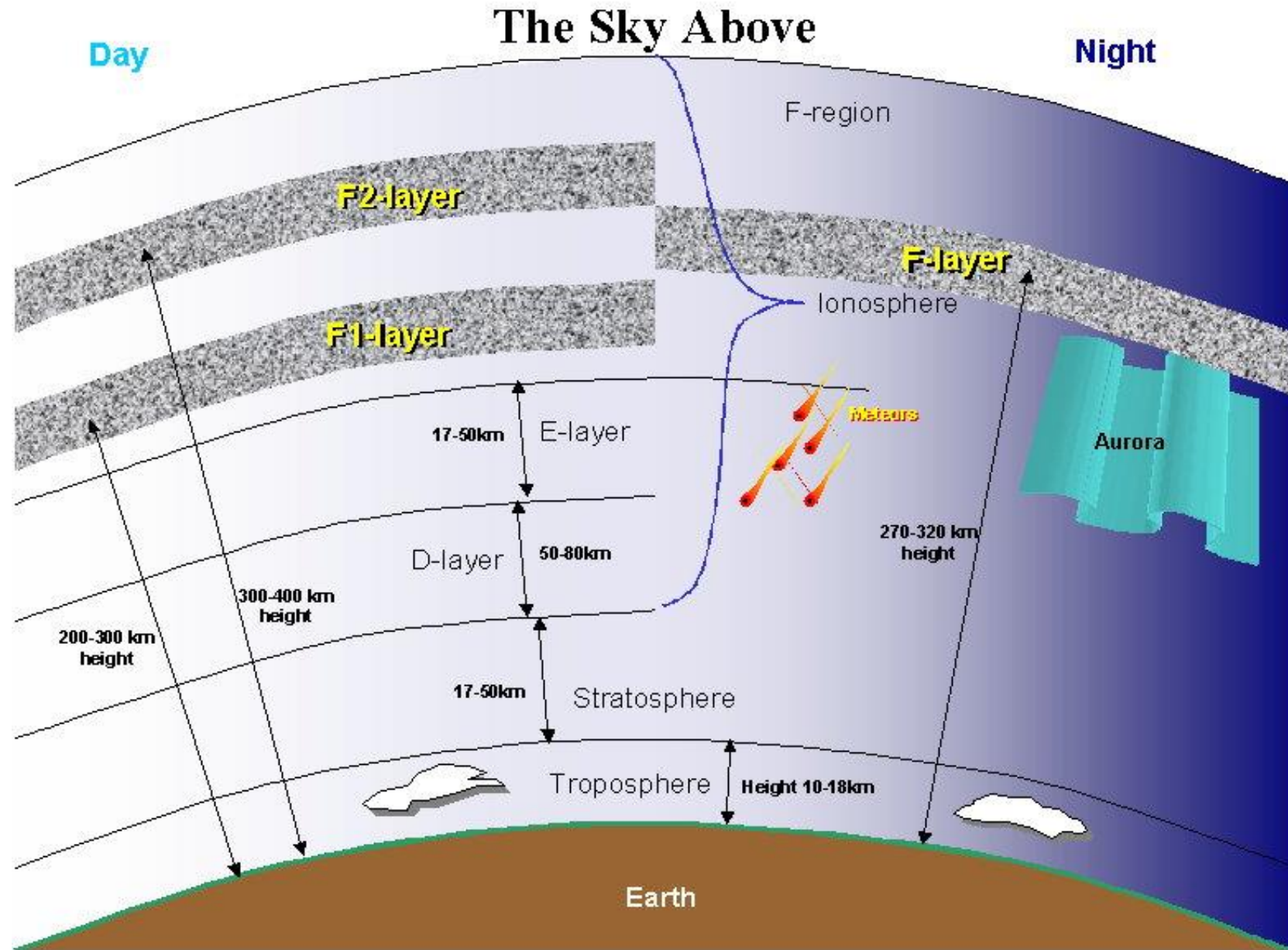


From  
Boulder  
Colorado for  
5/22/2020

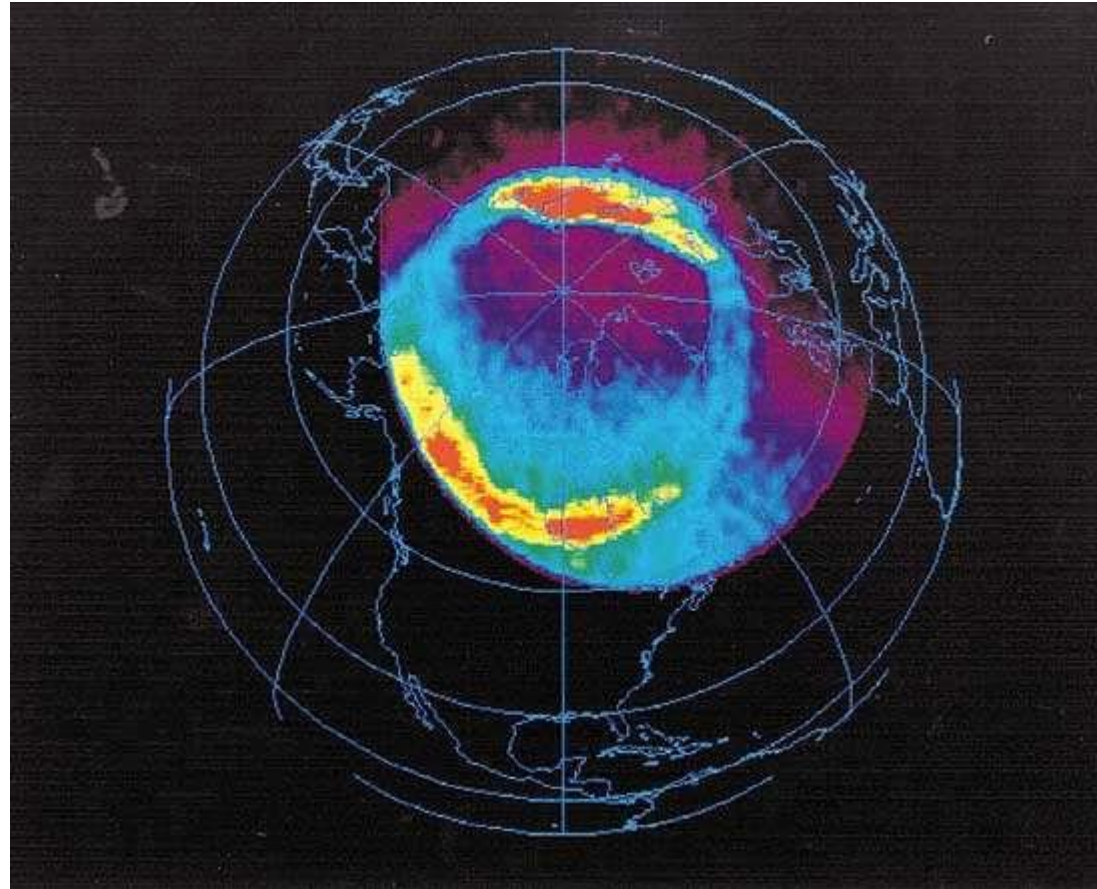
24 hrs



# Altitude of the Aurora and Ionosphere Layers



The Aurora Is Like the Top of An Apple Thus  
Disrupting Propagation over the North Pole



**The Soviets used whatever frequency was suitable at that particular time, operating often in the 3 MHz to 30 MHz range, without any regard for frequency allocation and planning. The signal became such a nuisance that some receivers such as amateur radios and televisions actually began including 'Woodpecker Blankers' in their circuit designs in an effort to filter out the interference.**

<https://www.amusingplanet.com/2017/12/the-russian-woodpecker.html>



## It Looks Like Someone Wanted to Do Some 60 Meter Antenna Work

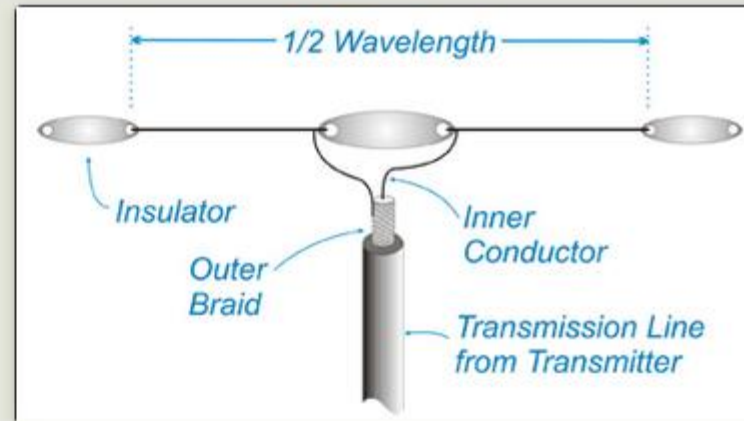
The basic construction of the dipole is two elements each 1/4 wavelength long, fed in the center by a transmission line (as shown in the figure below).

The total length of the dipole is given by

$$\text{Length (feet)} = 468 / \text{Frequency (MHz)}$$

For example, for the 10 Meter band, we might cut the dipole for the frequency of 28.4 MHz (right in the middle of the Technician phone band). Using the formula, we can calculate the total length of the dipole (a half wavelength).

$$\text{Length (feet)} = 468 / 28.4 = 16.48 \text{ feet}$$



**A Dipole at 4 MHz would  
Be 468/4 ft in Length  
Or 117 ft long**

**106.9 ft is the spacing  
between elements on the  
same row on the large  
array**

**A 102 ft dipole would fit  
and operate at 4.6 MHz**

**The movie was probably quite accurate in that the Harmonic Roar (not yet discovered) was too strong to receive the radar return – The Aurora Borealis killed the work being done at “The new frequency”**

The 60 Meter Dipoles were Hiding from the beginning of this presentation all along





The 60 Meter Dipoles were Hiding from the beginning of this presentation all along





Left Side

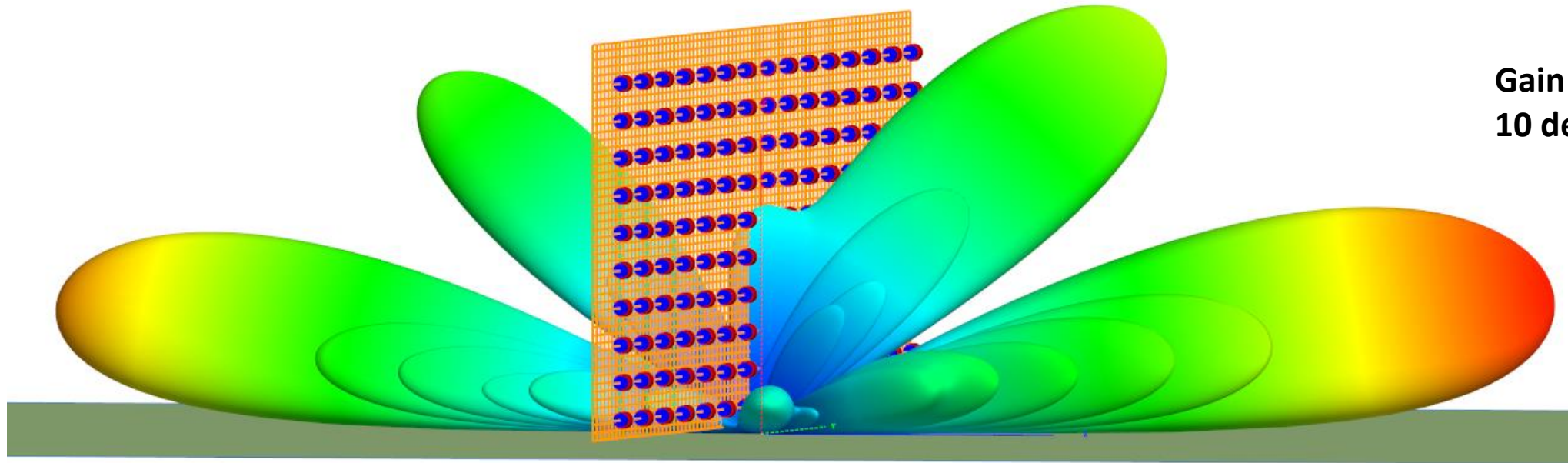
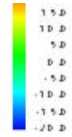








## 4.6 MHz BEAM NO ELEVATION STEERING



**Gain 23.7 dBi**  
**10 deg Elevation**

**15 Elements Across**  
**10 Elements High**  
**150 Elements**

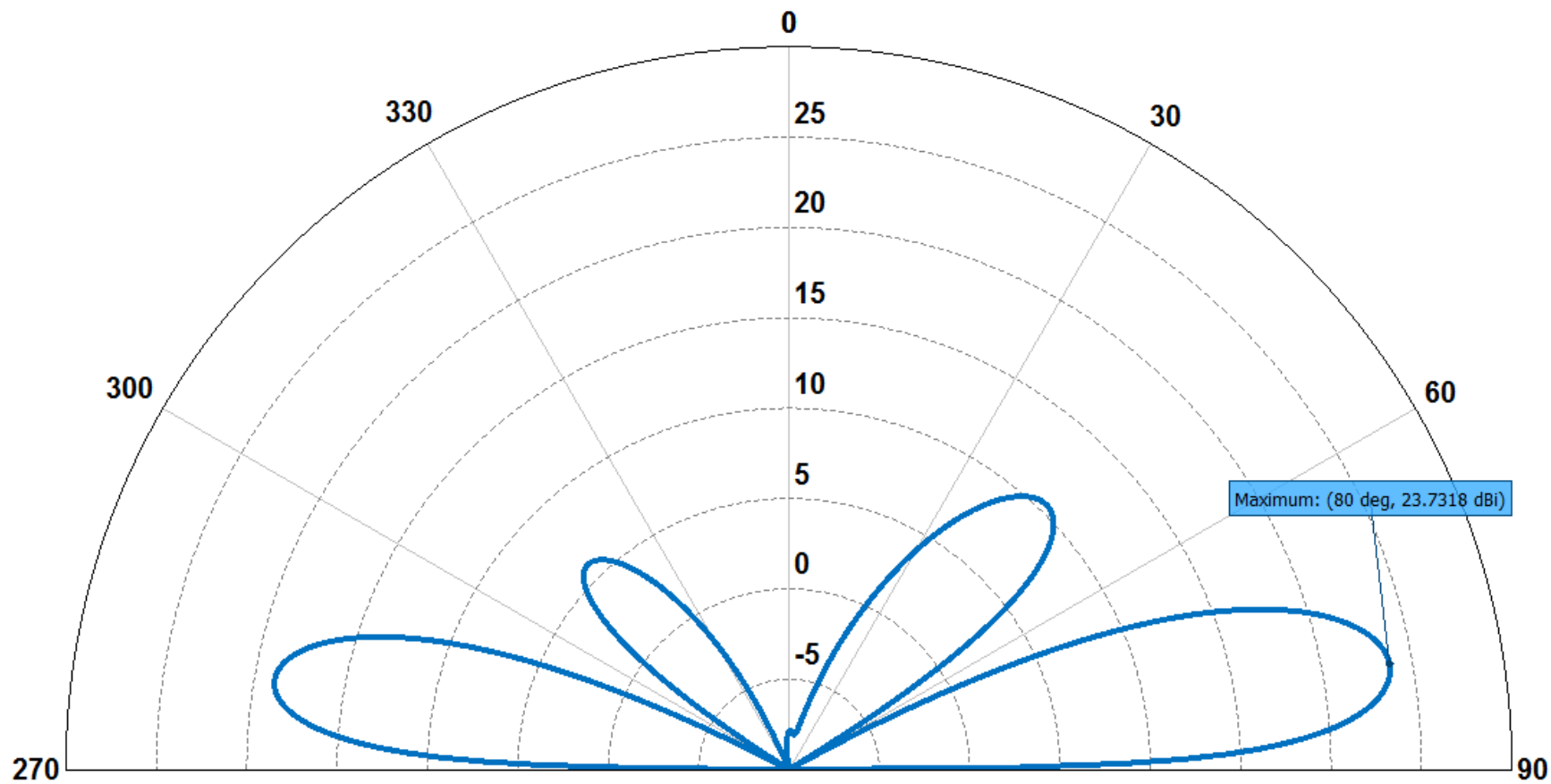
This is hypothetical

  
**4.6 MHz**



# 150 Element Array at 4.6 MHz

Elevation Gain Pattern Horizontal Pol



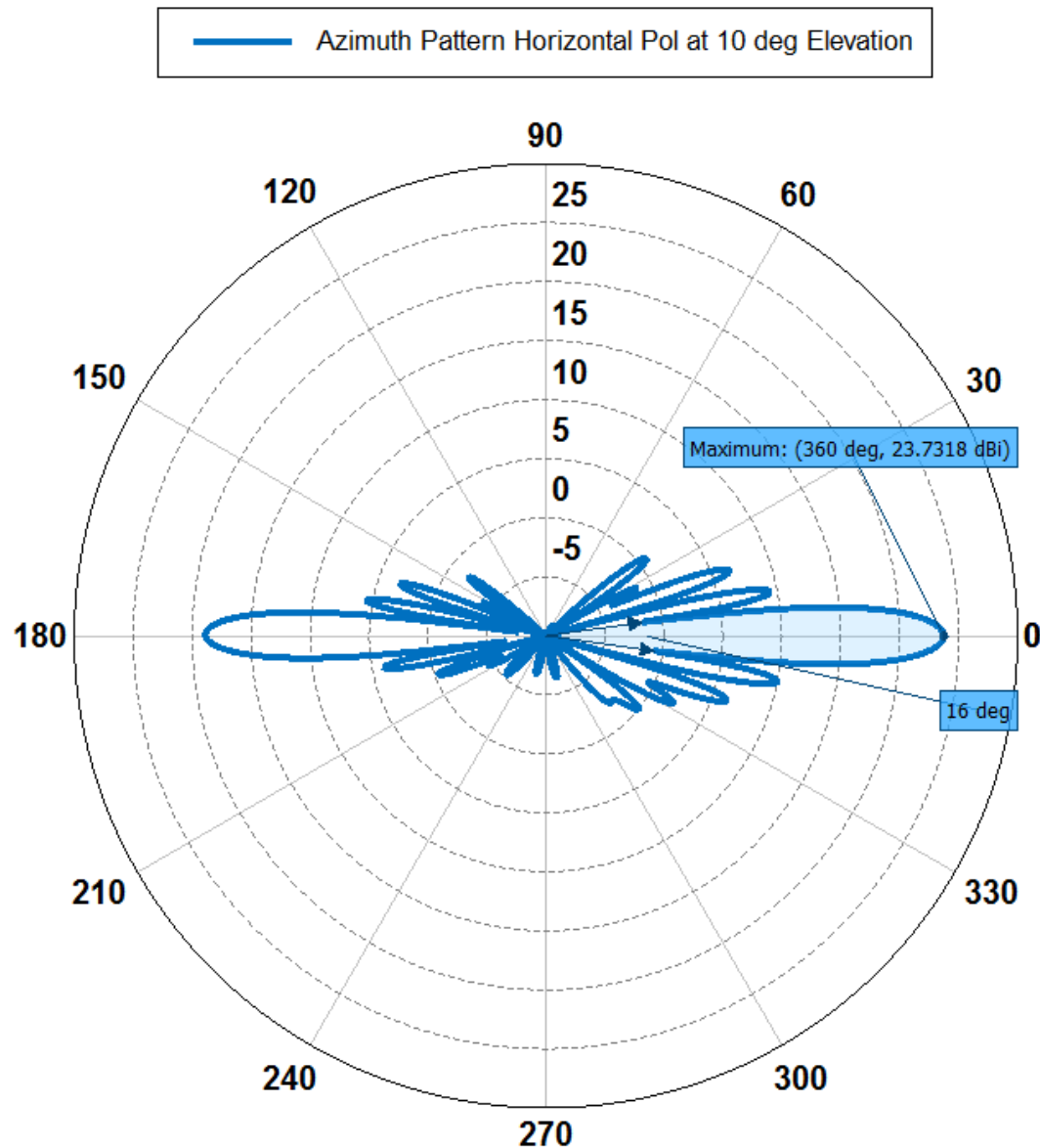
Gain 23.7 dBi  
10 deg Elevation

Total Gain [dBi] (Frequency = 4.6 MHz; Phi = 0 deg) - Woodpecker\_Redo\_4p6MHz\_Nearfield

This is hypothetical

4.6 MHz

# 150 Element Array at 4.6 MHz



Gain 23.7 dBi  
10 deg Elevation

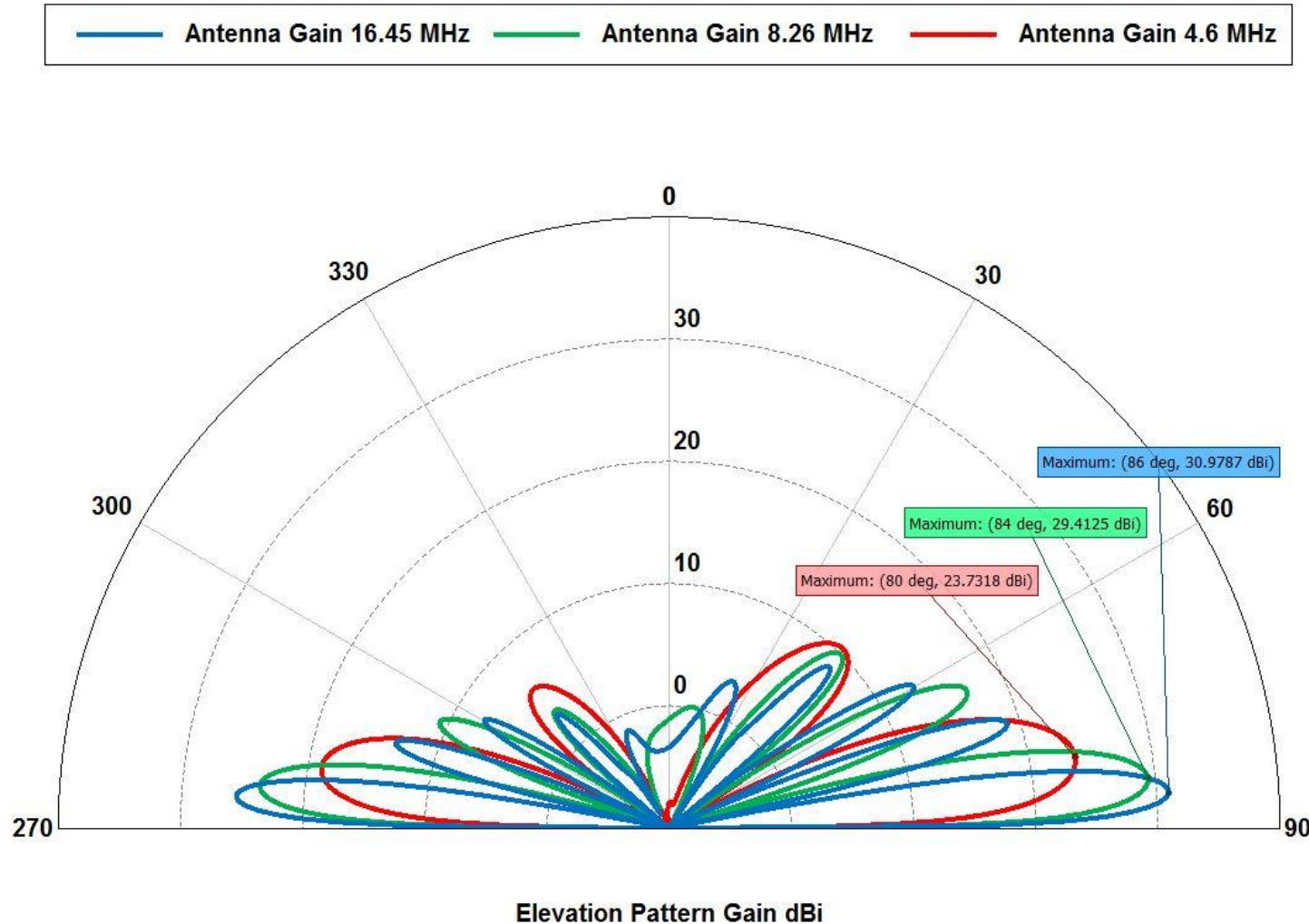
This is hypothetical

Total Gain [dBi] (Frequency = 4.6 MHz; Theta = 80 deg) - Woodpecker\_Redo\_4p6MHz\_Nearfield

4.6 MHz

# Elevation Scanning would have been aided with beams at 3 different Bands

Beam Scanning Using Low Mid and Hgh Frequencies



Gain 16 MHz 31 dBi Elevation 4 deg

Gain 8 MHz 29.4 dBi Elevation 6 deg

Gain 4 MHz 23.7 dBi Elevation 10 deg



# Conclusions

- Disinformation tried to hide that the Duga 3 Site was Transmitting and the site near Chernihiv was Receiving
- The big array was probably used for 8.26 MHz (plus the other hops in the group)
- The smaller array was probably used for the higher frequencies i.e. 16.49 MHz (plus the other hops in the group)
- A larger element was probably on the way to accommodate 4 to 4.5 Mhz
- Aurora Noise was preventing the new frequency from working (not discovered until after the outlay of material and design)
- An inspection was to occur later after the Chernobyl Explosion it would not have born good news to the designer
- Cage Dipoles have good bandwidth
- The Duga Array is one of the Prettiest!

# Salutations

- Thank you for attending!
  - Thank you Steve Stearns and Scott Burnside for collaborating!
  - This thing called Duga 3 was too big not to analyze!
- 
- Keith SnYder

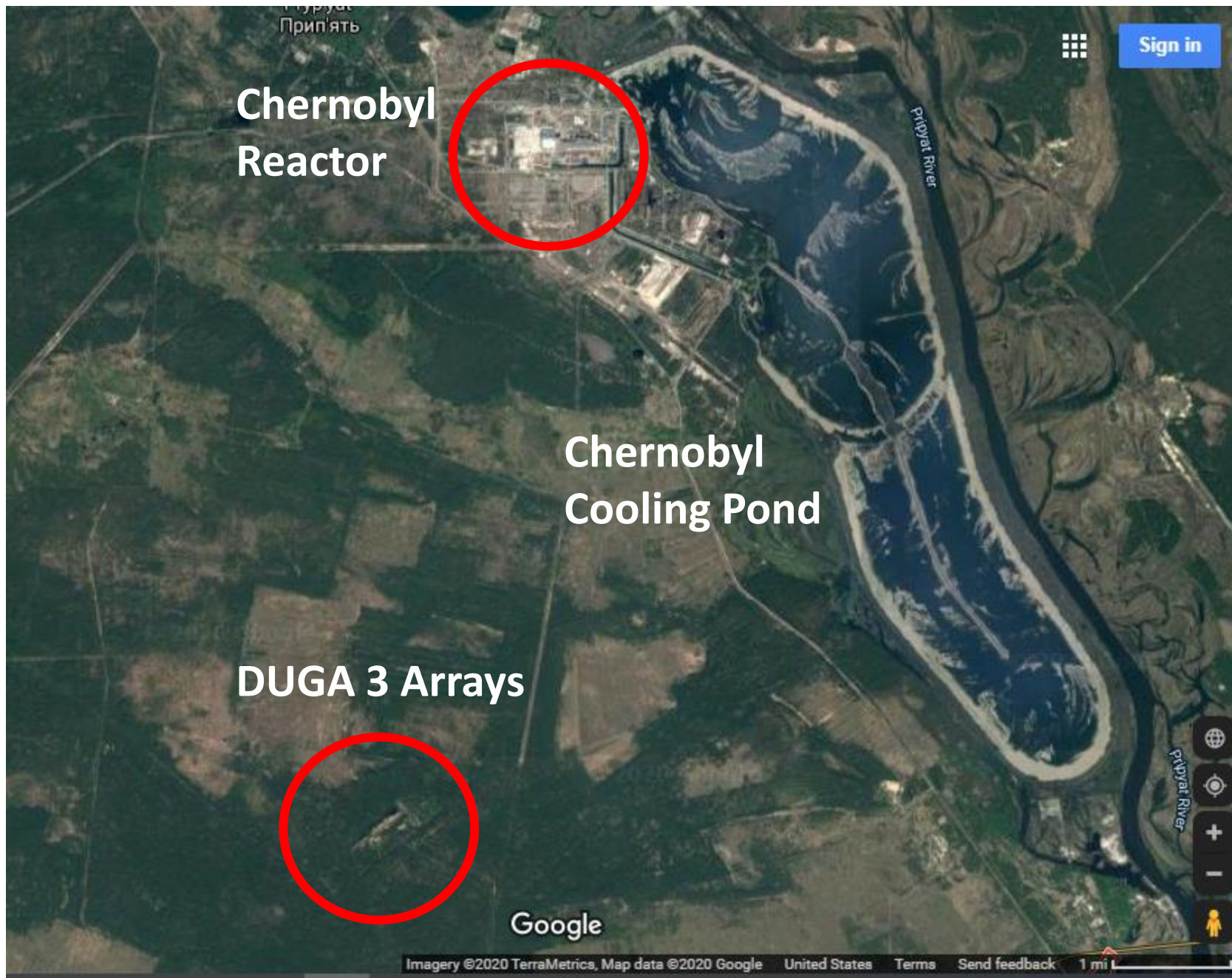
Snyder\_kas@mindspring.com

# How to Find the Woodpecker

## Take a Tour of the Chernobyl Nuclear Power Plant

- Using a Geiger Counter go North of Kiev
- Find the highest reading somewhere just North of Chernobyl
- That should be the burned out reactor
- Scurry South to the end of the Cooling Pond
- Travel 4 clicks West until you find the Gigantic Drive in Theater
- Bring a lounge chair for the sand









Metal Shield  
being built  
It will Slide over  
the top  
Of the Destroyed  
Nuclear Reactor



## Cage Dipole and Tourist



<https://www.ttlg.com/forums/showthread.php?t=136608>

















**ANOTHER.KIEV**  
Urban Exploration Adventures







# Antenna Status Display and Over the Horizon Display





Did they use this?  
Lights versus time?

## Duga Means ARC





## Front View Showing the Antenna Supports at the Top





## The Feed Line Gantry – A long way up and a long way down



## Over Sized Screen to Reflect Energy Forward





# Summary of Talking Points

- Big Array for 8 MHz and Possibly 4.6 MHz (experimental)
- Small Array for 16 MHz
- Sandy Soil Probably Intentional for the Dielectric Constant
- Reliable Nuclear Power Plant for a High Power Transmitter
- Possible 10 Megawatts Peak Power
- Transmitters Possibly 2 Stories Tall
- Antenna Patterns Look over the North Pole to the US
- Possible Link to Chernobyl Demise Mystery

# Summary of Talking Points

- Array Pointing is At the US no doubt
- Deception on the Transmit Site and Receive Site Apparent
- Deception with Duga 3 marked as a Boy Scout Camp on Map
- Cost was Outrageous – 2X the Chernobyl Nuclear Power Plant
- If the Aurora Borealis caused blockage then the new frequencies were in the 3 to 5 MHz range
- The Movie “The Russian Woodpecker” points to a designer who wanted to build Over the Horizon antenna since 1945 and was promoted to high position in Soviet power. Did not want to see failure of his antenna.



## Pave Paws Line of Sight Radar Array Antenna

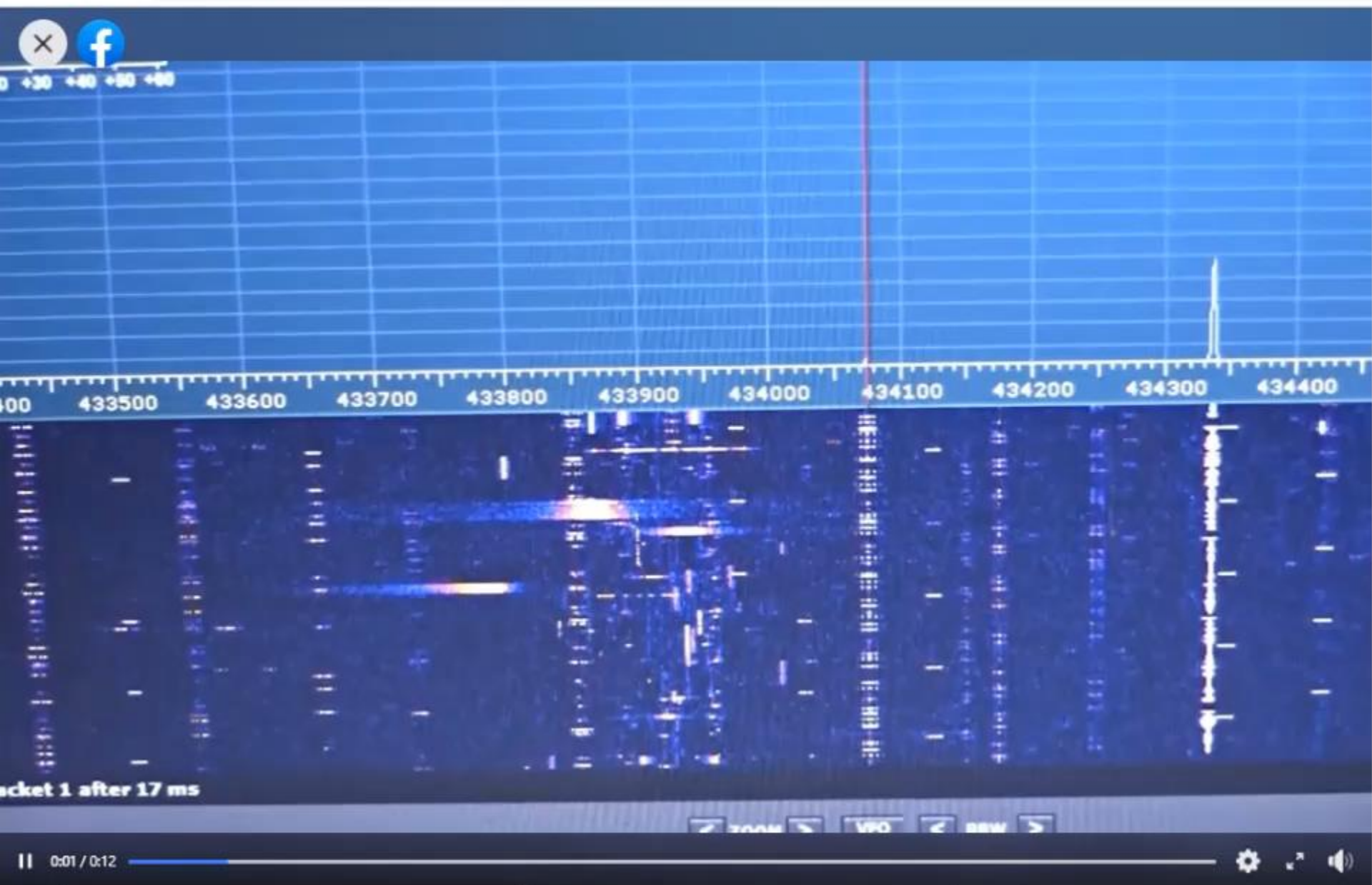


Front Face Tilted  
Up 20 degrees



The **Pave Paws** radar (AN/FPS-115) is an ultrahigh-frequency (UHF; 420–450 MHz) phased-array system for detecting submarine-launched ballistic missiles. It is supposed to detect targets with a radar cross section of 10 square metres at a range of 3,000 nautical miles (5,600 km).





Jack McEwen SDRPlay 14 hrs · 🌐

Another post regarding strange signals. Does anyone know what these pulsing signals are, spread across the spectrum?  
[See More](#)

1 Like 10 Comments

Like Comment Share

Comments [Hide](#)

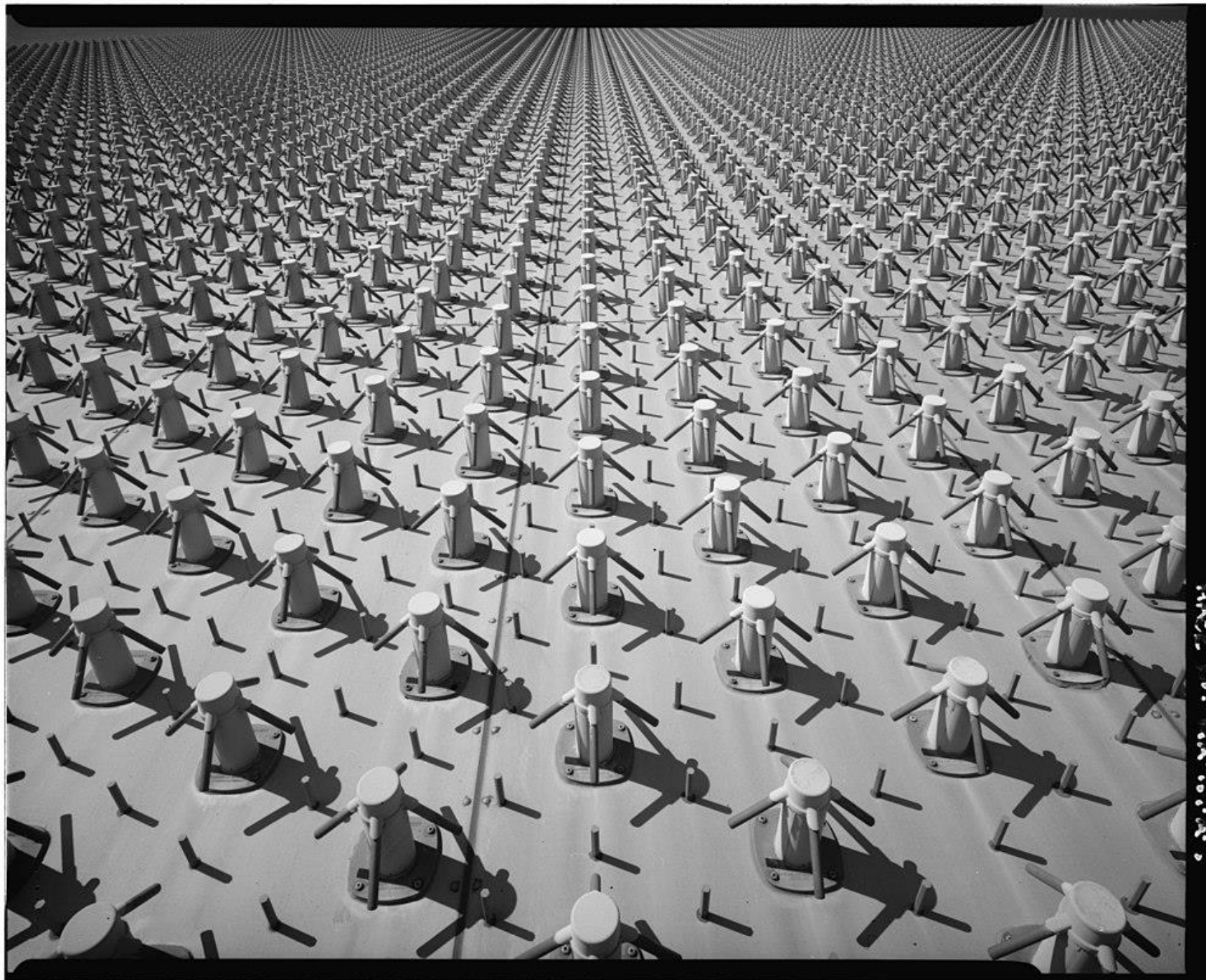
[View 5 more comments](#)



Like · Reply · 13h 4

Keith Snyder  
The Pave Paws radar operates from 420 to 450 MHz. It is the American Woodpecker. Line of sight radar.

Write a comment... 📷 📹 📺 📻





The radar operates in the [UHF](#) band between 420 - 450 MHz, just below the UHF television broadcast band, that is a wavelength of 71–67 cm, with [circular polarization](#). It is an active array ([AESA](#)); each of the 1,792 transmitting elements has its own solid-state transmitter/receiver module, and radiates a peak power of 320 W, so the peak power of each array is 580 kW. It operates in a repeating 54 millisecond cycle in which it transmits a series of pulses, then listens for echoes. Its duty cycle (fraction of time spent transmitting) is never greater than 25% (so the average power of the beam never exceeds 25% of 540 kW, or 145 kW) and is usually around 18%. It is reported to have a range of about 3,000 [nautical miles](#) (3,452 statute miles, 5,555 km); at that range it can detect an object the size of a small car, and smaller objects at closer ranges.

### **Duga 3 Miscellaneous Facts**

This RADAR system was an early warning anti-ballistic missile radar system that was put into operation in late 1971—based in Chernobyl. This RADAR's pulses were hopping between four broadcast time windows at four distinct frequencies: 16450, 16490, 16570 and 16390 kHz—one for each window.

In the “static” mode (Static information does not require a high refresh rate; that is Name, Call sign, Tonnage, Destination, ETA do not change and are forwarded), each pulse had a bandwidth of 40 kHz, and a length of 3 to 6 ms. The signal was typically broadcast for 10, 16 and 20 times per second and then followed by a 72 ms silent period.

In the “dynamic” mode (Dynamic information, is position, course, speed, heading, ROT, etc. is changing constantly), four frequencies that could have also been used on other areas of the HF band (8070, 8230, 8310 and 8260 kHz, for example) were all transmitted sequentially in each and every time window in intervals of 6 ms.

In the highly used 10 Hz mode, where the four frequencies were transmitted every 100 ms, the duration of each distinct frequency's transmission window was 7 ms, thus resulting in a 27 ms continuous broadcast followed by 72 ms of silence, all adding up to 100 ms. There were a number of transmission hopping and timing techniques that were used by the Soviets to avoid jamming of their transmit frequencies as well as to prevent spoofing of the received echoes. It was the power and range of this system that was a ‘thorn in the side’ to all shortwave listeners and amateur and commercial HF operators worldwide.



<a href="https://www.youtube.com/watch?v=Ux9ZhotNtrg">https://www.youtube.com/watch?v=Ux9ZhotNtrg</a>	Drone shots of Duga 3
<a href="https://www.youtube.com/watch?v=0l_4fzJv_i0">https://www.youtube.com/watch?v=0l_4fzJv_i0</a>	Climbing the Duga 3
<a href="https://www.cnn.com/travel/article/duga-radar-chernobyl-ukraine/index.html">https://www.cnn.com/travel/article/duga-radar-chernobyl-ukraine/index.html</a>	Cnn Report with Map
<a href="https://www.30-years-later.com/duga-radar-the-russian-woodpecker/">https://www.30-years-later.com/duga-radar-the-russian-woodpecker/</a>	30 Years Later with Polar Map
<a href="https://www.wia.org.au/newsevents/news/2008/20081221-1/index.php">https://www.wia.org.au/newsevents/news/2008/20081221-1/index.php</a>	** The Wireless Institute of Australia
<a href="https://www.messynessychic.com/2017/01/11/dont-trust-that-giant-abandoned-listening-device-in-chernobyl/">https://www.messynessychic.com/2017/01/11/dont-trust-that-giant-abandoned-listening-device-in-chernobyl/</a>	Fog
<a href="https://petapixel.com/2015/05/06/photos-of-the-colossal-duga-3-radar-system-built-by-the-soviet-union/">https://petapixel.com/2015/05/06/photos-of-the-colossal-duga-3-radar-system-built-by-the-soviet-union/</a>	Photos
<a href="https://www.atlasobscura.com/articles/the-top-secret-military-base-hidden-in-chernobyls-irradiated-forest">https://www.atlasobscura.com/articles/the-top-secret-military-base-hidden-in-chernobyls-irradiated-forest</a>	Back Shot
<a href="https://romanrobroek.nl/exploring-duga-city-secrets/">https://romanrobroek.nl/exploring-duga-city-secrets/</a>	The Arc in the Smaller Control Room
<a href="https://www.youtube.com/watch?v=Zotm8tZmqM4">https://www.youtube.com/watch?v=Zotm8tZmqM4</a>	The Russian Woodpecker - Trailer
<a href="https://www.youtube.com/watch?v=V0OD1griohc">https://www.youtube.com/watch?v=V0OD1griohc</a>	The Russian Woodpecker Interview of Film Director

<http://hamwaves.com/nvis/en/index.html>

<https://www.hsdivers.com/Ham/Mod8.html>

Aurora Frequency vs Time of Day from Boulder Colorado

Altitude of E and F Layers and Aurora