

NVIS Antenna Communications

By W3CDG

NVIS – What does that mean?

- ▶ Near Vertical Incident Sky wave
 - A radio signal that has a high take off angle
- ▶ Reliable 200 – 300 Mile coverage (Or greater)
- ▶ Great for Emergency Communications

Advantages of NVIS

- ▶ NVIS covers the an area greater than that of the ground wave signals, and because of the high angles, terrain is less of a concern.
- ▶ Longer distance without a repeater or other infrastructure.
- ▶ Easy antenna setup, height isn't as much of a concern. 15 – 30' works great!

Time & Frequency

- ▶ During the Day
 - The E layer is densely ionized
 - MUF of the E Layer usually around 10 MHz
 - This allows the layer to reflect signals < 10 MHz
 - D Layer absorbs most signals < 4 MHz
- ▶ This makes 40 meters a good daytime NVIS Bands

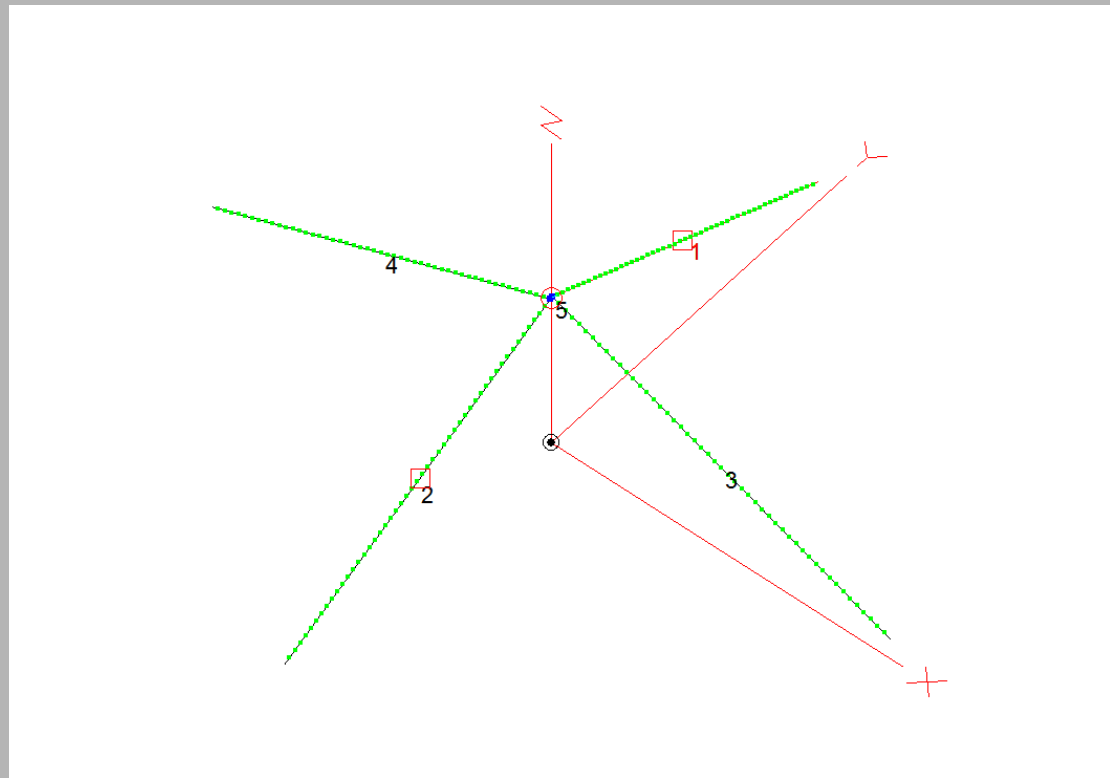
Time & Frequency

- ▶ After sunset, MUF of the E layer can drop below the 40 meter band due to the loss of the primary source of ionization
- ▶ However the D layer disappears at sunset
 - This is why 80 meters can be unreliable during the day, but good at night.

Antennas

- ▶ There are many different NVIS Antenna designs
- ▶ I've been modeling and focusing on a loaded Inverted V.

Consists of Full Sized 40 M legs crossed with Center loaded 80 M legs of approximately the same length



Loaded Inverted V



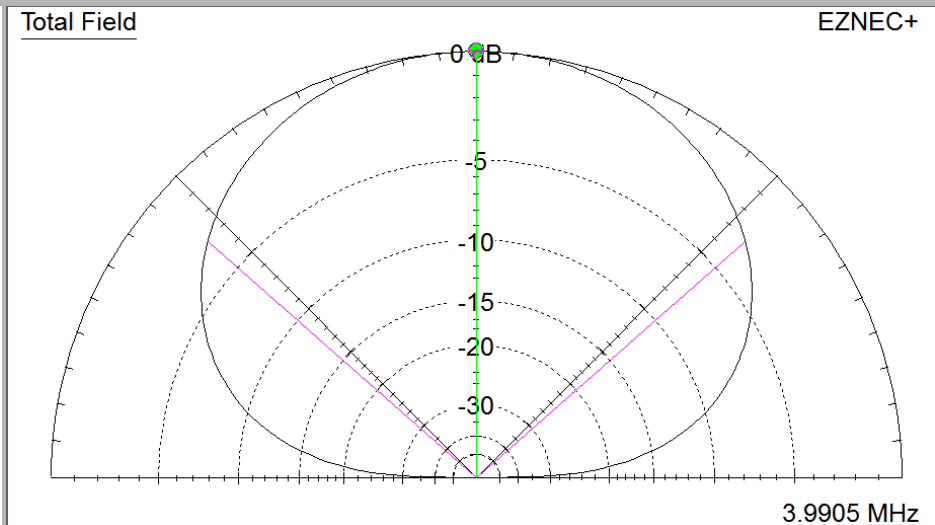
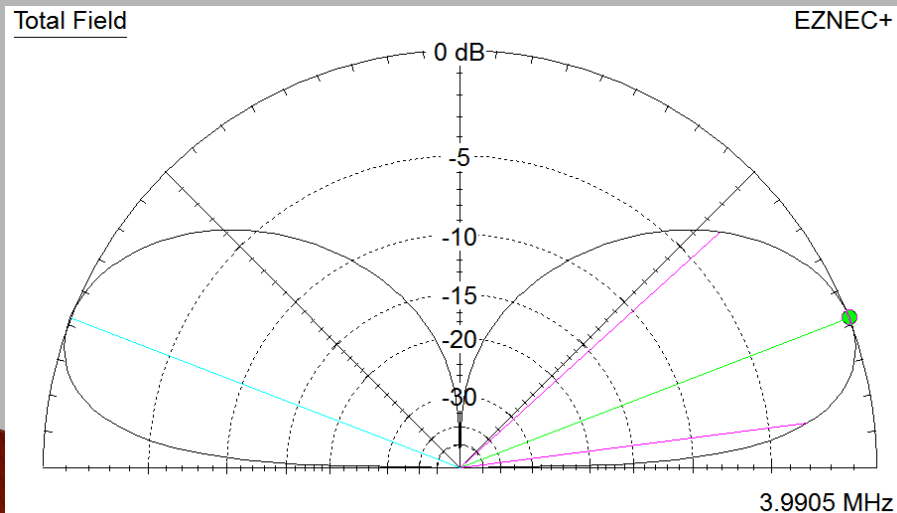
Pros:
Small Foot Print
Easy to deploy
Portable, light weight
Antenna is support,
No additional guy wires

Cons:
Coils are a compromise
Narrow Bandwidth on 80

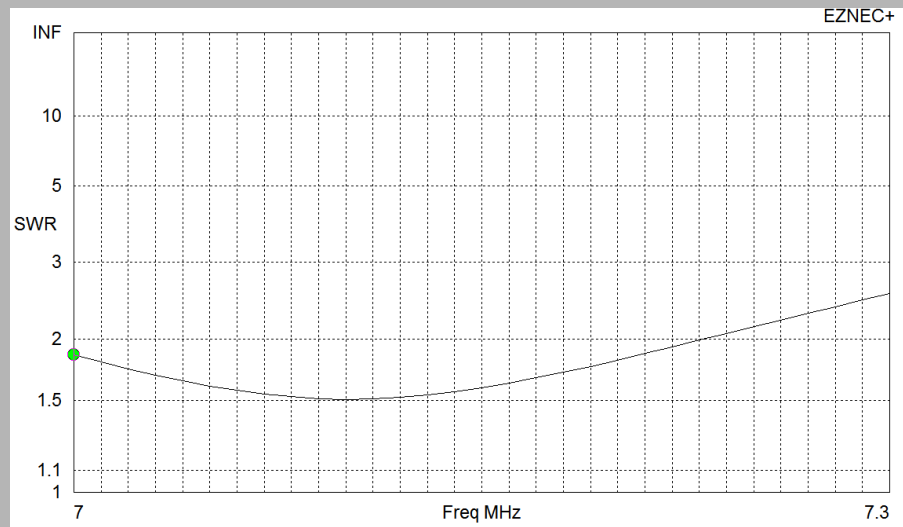


Loaded Inverted V

- ▶ Same Antenna / Different Heights
 - Take off angle and beam width
 - $\frac{1}{4} \lambda$: TOA = 21° , BW: 27.6°
 - NVIS (15 - 3 feet): TOA = 90° , BW: 138.7°

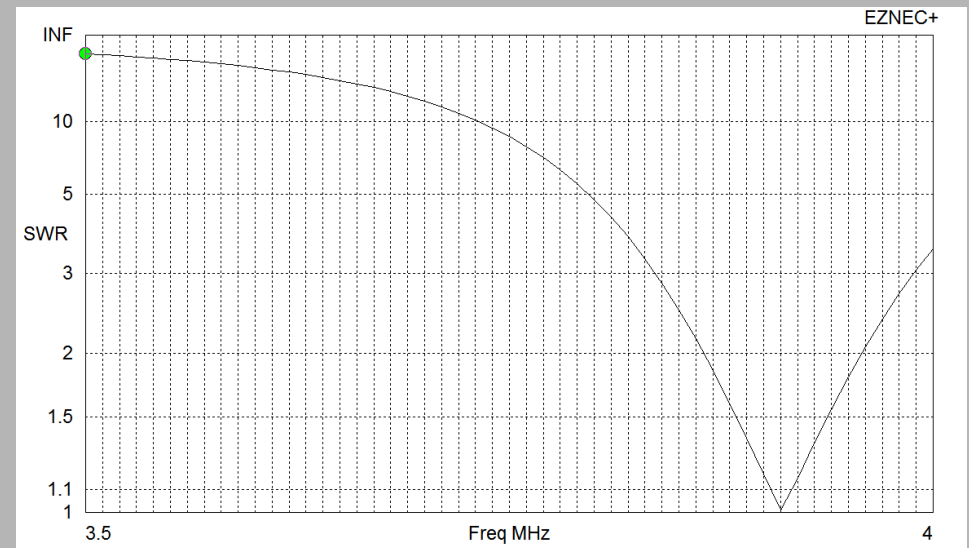


Loaded Inverted V – Models

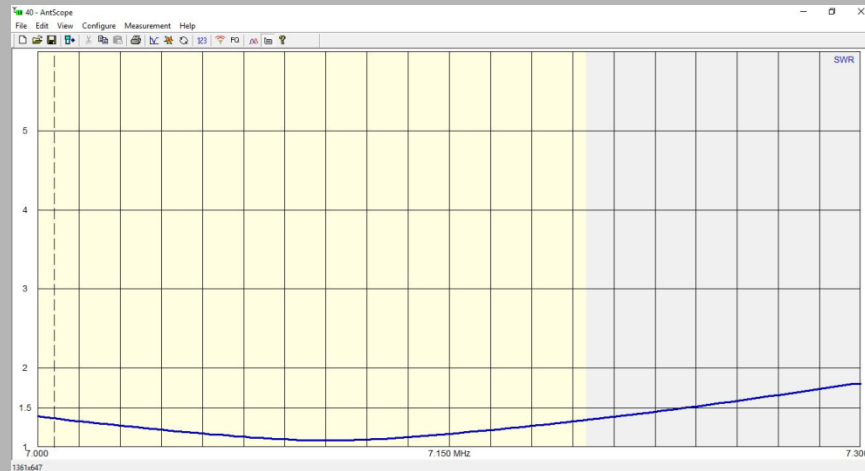


- ▶ 40 M SWR < 3:1 across the entire band
- ▶ Internal Tuners in most radios can handle this.

- ▶ 80 M is a loaded compromise
- ▶ 80M SWR bandwidth about 140 kHz

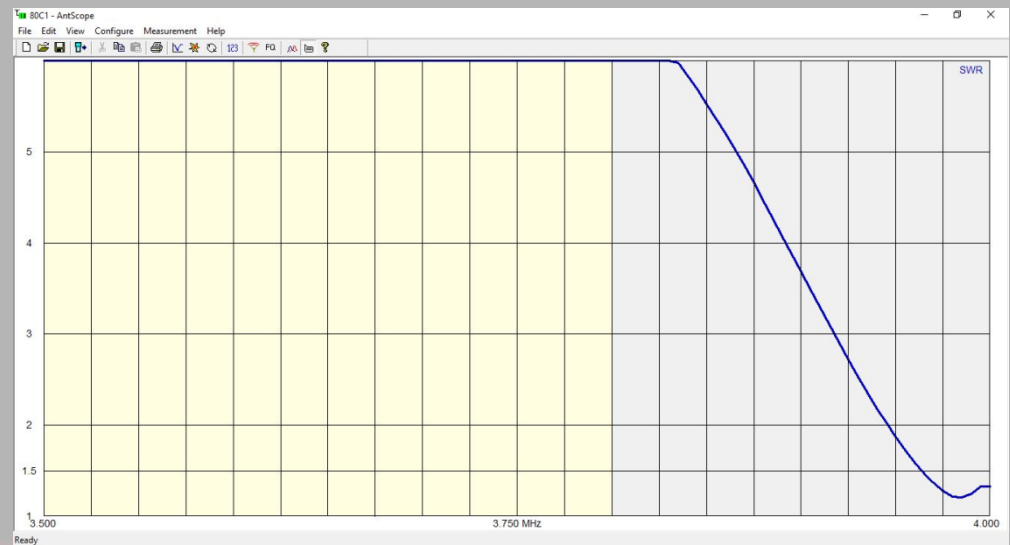


Loaded Inverted V – Real World



- ▶ 40 M SWR < 3:1 across the entire band
- ▶ Matches the Model pretty well!

- ▶ Tuned a little higher, but still matches the model!
- ▶ I love it when math matches the Real world!



Load Losses

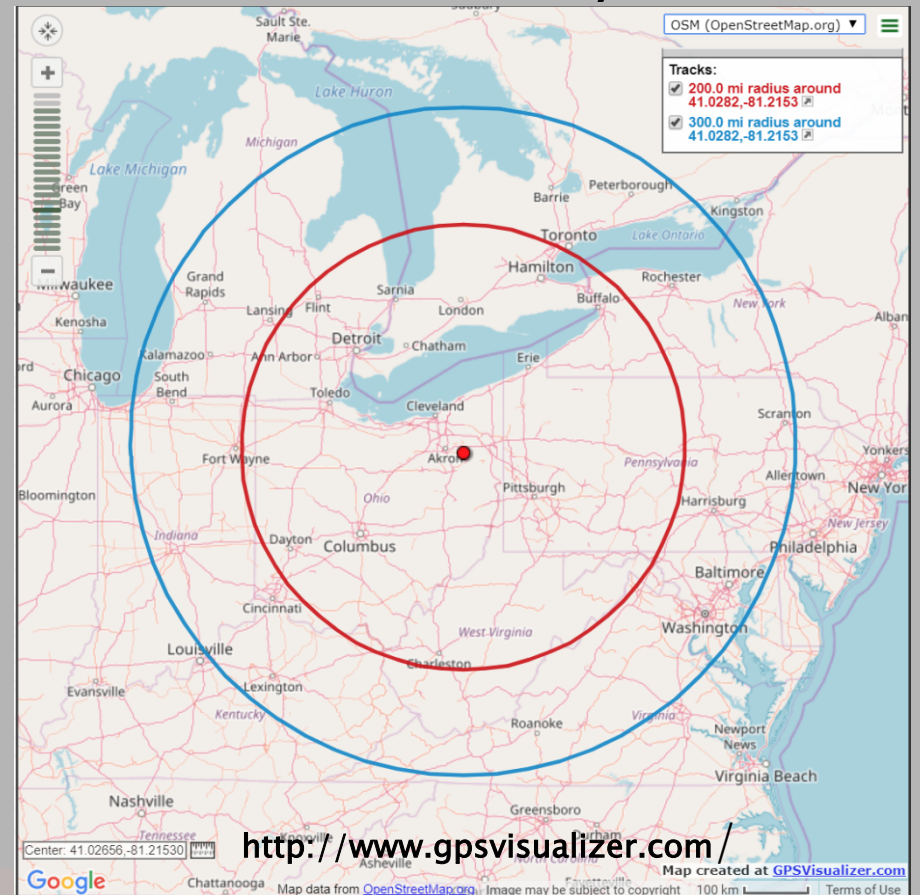
- ▶ Trading Size for Efficiency
 - 40m elements full size
 - 80m elements ½ size
 - Match length of 40m
 - 15.25 Watts lost in Coils

```
----- SOURCE DATA -----  
Frequency = 3.91 MHz  
Source 1      Voltage = 70.93 V at -0.56 deg.  
              Current = 1.415 A at 0.0 deg.  
              Impedance = 50.12 - J 0.4892 ohms  
              Power = 100.4 watts  
              SWR (50 ohm system) = 1.010 (50 ohm system) = 1.010
```

```
----- LOAD DATA -----  
Frequency = 3.91 MHz  
Load 1       Voltage = 1133 V at 266.14 deg.  
             Current = 1.332 A at 176.42 deg.  
             Impedance = 4.3 + J 851 ohms  
             Power = 7.625 watts  
Load 2       Voltage = 1133 V at 86.02 deg.  
             Current = 1.332 A at -3.69 deg.  
             Impedance = 4.3 + J 851 ohms  
             Power = 7.626 watts  
  
Total applied power = 100.4 watts  
  
Total load power = 15.25 watts  
Total load loss = 0.716 dB
```

NVIS Coverage

- ▶ The two circles show 200 and 300 miles centered on Portage County, OH.
- ▶ 300 miles covers all of Ohio and most of Pennsylvania
- ▶ HF Nets on Sat and Sun show this to be fairly reliable.



NVIS vs 6-BTV Examples

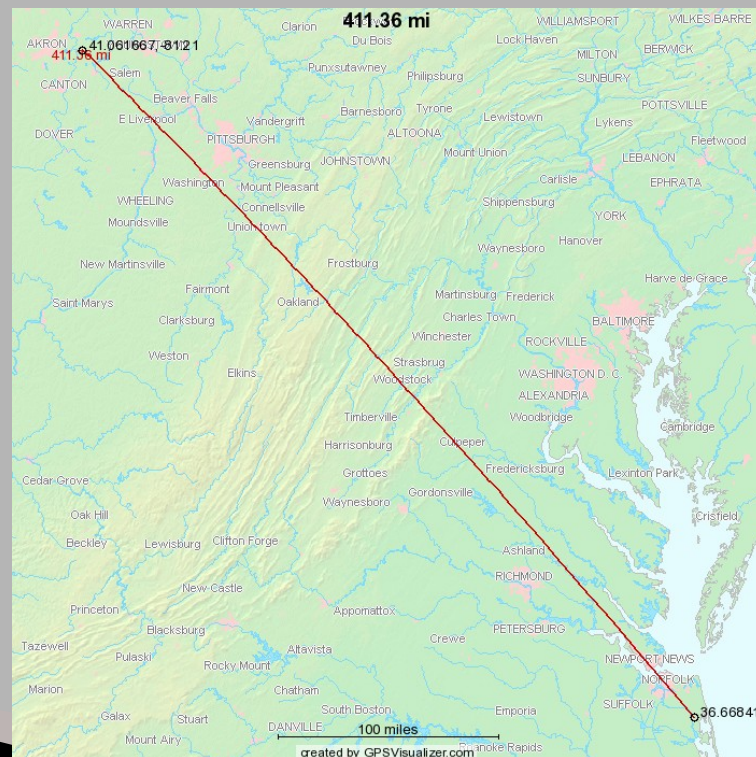
FT-8 40M

NVIS

235600 -3 0.3 896 ~ KD4UBM KN4DUF +04

BTV

235530 1 0.1 896 ~ KD4UBM KN4DUF +04



NVIS vs 6-BTV Examples

FT-8 40M

NVIS

235745 8 0.1 718 ~ OH1PH WY1G RRR

BTV

235715 10 0.1 718 ~ OH1PH WY1G -06



NVIS vs 6-BTV Examples

FT-8 40M

NVIS

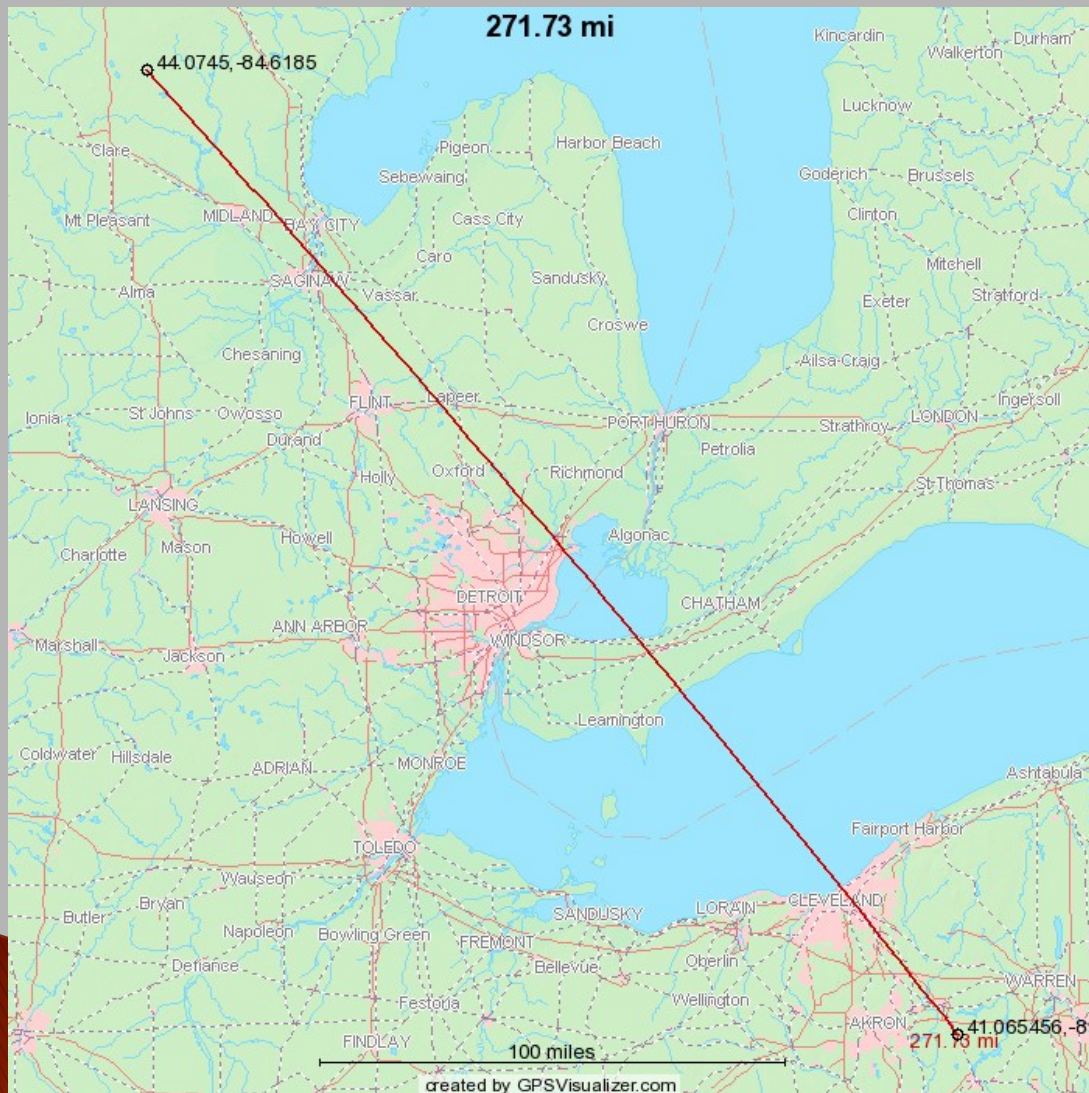
235400 -24 -0.1 1033 ~ LB4T I1BEP JN34

BTV

235430 -16 -0.1 1033 ~ LB4T I1BEP JN34

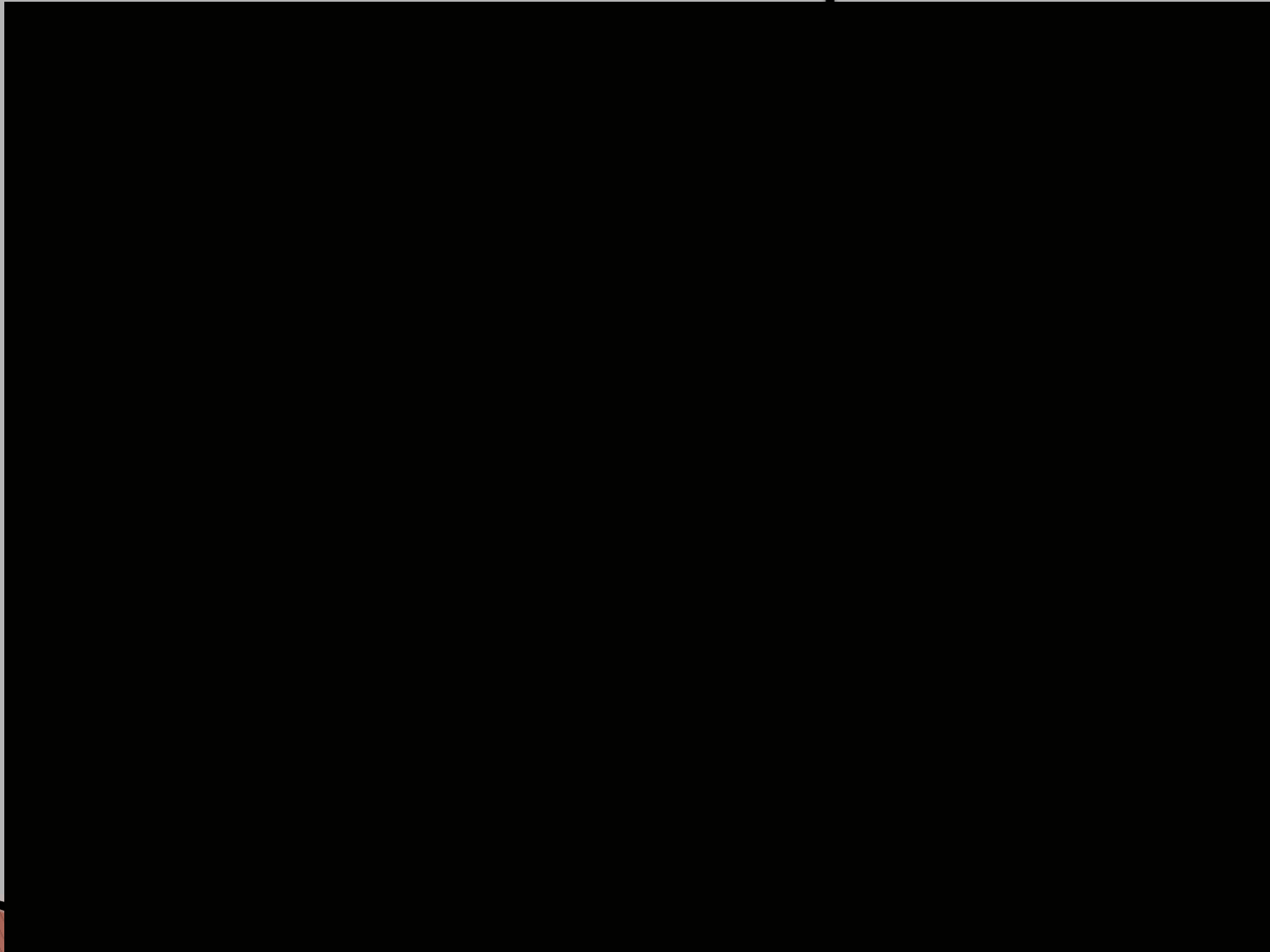


NVIS vs 6-BTV Examples



Listening to net control on
the Wolverine SSB net on
80 Meters

NVIS vs 6-BTV Examples



Questions?