

Regional Emergency Communications

John Walters

W8CX

Alpena RACES

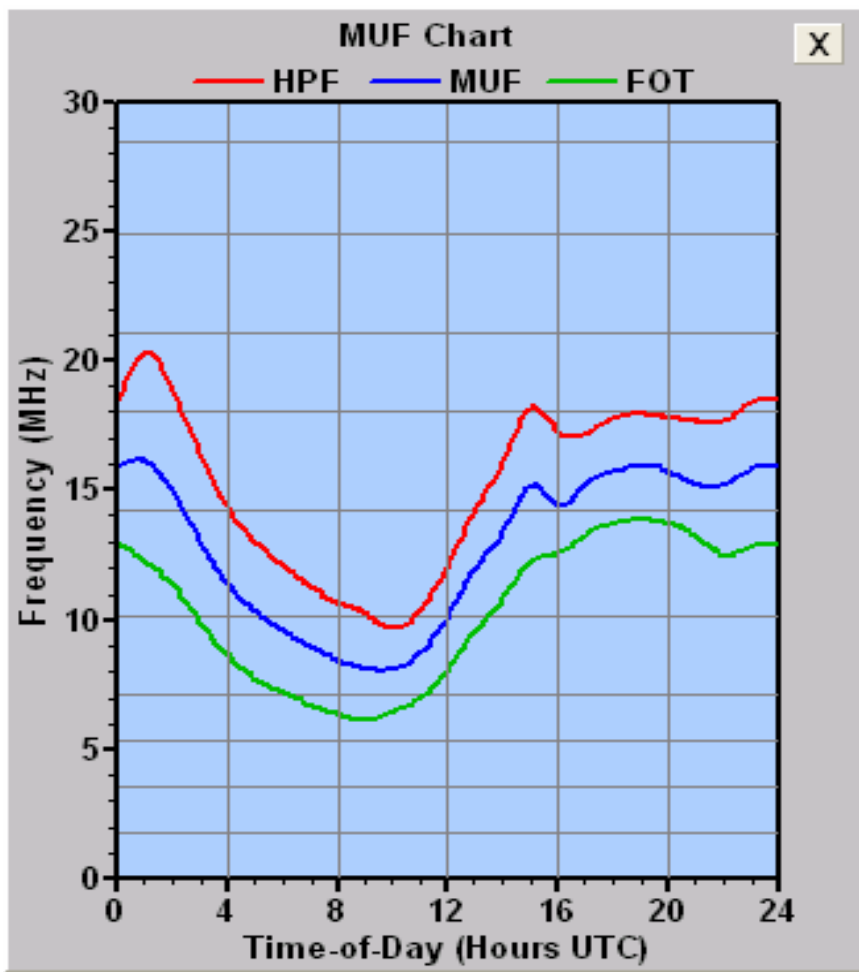
Regional Communications Needs

- 400 mile radius
- No skip zone; no dead spots
- No interference with or from broadcasters
- Reliable day/night coverage
- Field deployable
- Point to point as needed; no intermediation that might fail

Present or Possible Options

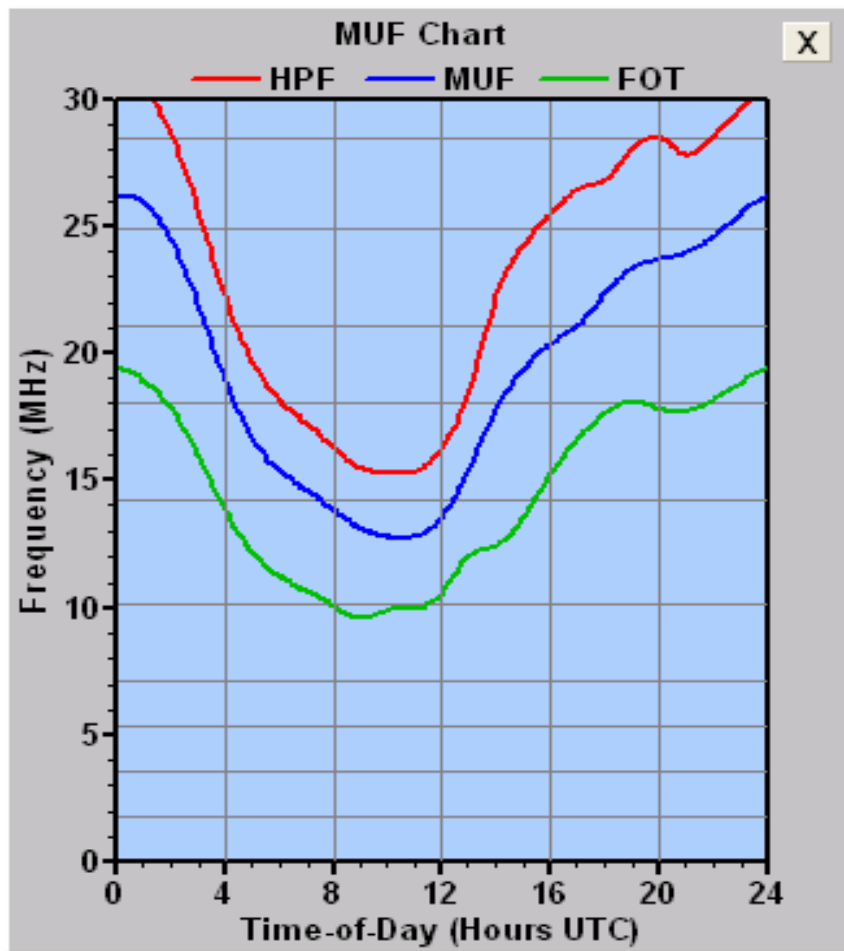
- 2 meter linked repeater systems
- 2 meter shared repeater
- 2 meter packet
- 6 meter or 10 meter shared repeater
- 10 meter SSB, digital modes, FM (g/a/e)
- 160-20 meters SSB, digital modes
- Did I forget something currently in use?
- Which of these guarantees coverage?

MUF



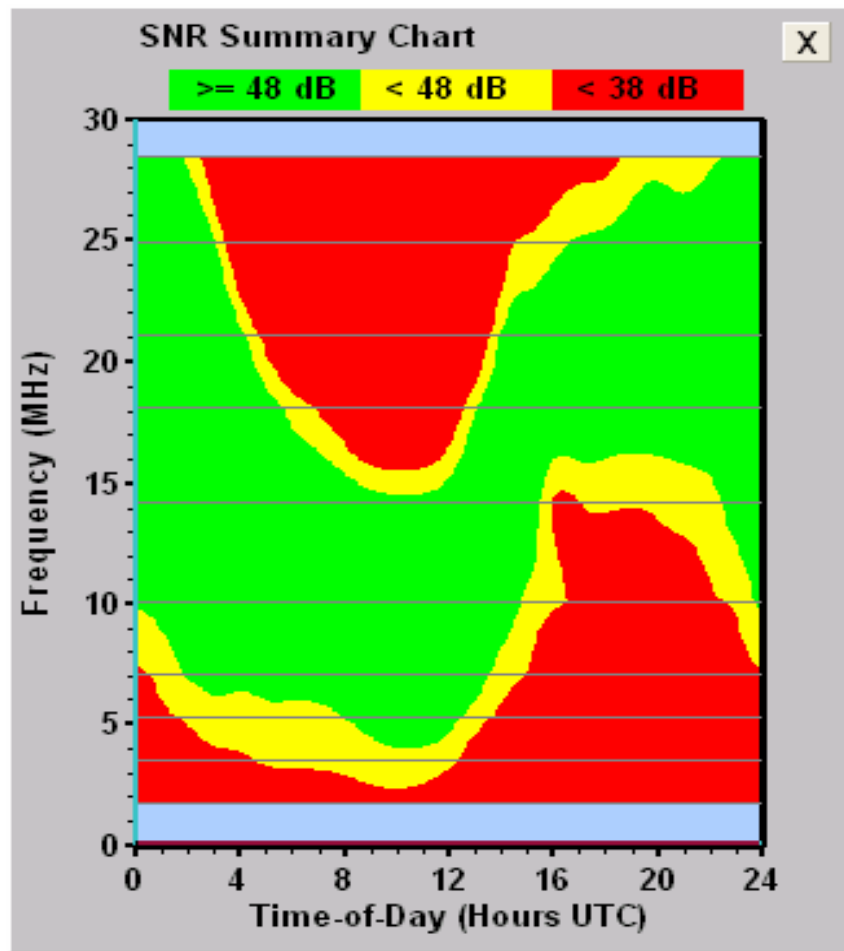
- Maximum Usable Frequency (Blue)
- 10% likelihood (Red)
- 90% likelihood (Green)
- At sun spot maxima the MUF can be as high as 70 MHz
- Chart shows April's average values for CW and 200W power, sun spot number of 12
- Subtract 4 hrs local

Sun Spot Activity Matters



- Chart shows April's average values for CW and 200W power, sun spot number of 130
- Subtract 4 hrs local

SSB Operation Windows



- Chart shows April's average values for CW and 200W power, sun spot number of 130
- 7-15 MHz operation favored at night and in morning
- 15-25 MHz operation favored in afternoon and evening
- Subtract 4 hrs local

Atmospheric Absorption

- During daytime, 160 and 80 meter signals are absorbed by the D layer, except in near vertical propagation off the E layer
- As frequency increases and the wave form shortens, the atmospheric D layer absorption is lessened and signals can bounce off higher layers (D does not bounce signals)
- High sun spot numbers mean high ionization of the E layer and high MUFs

Daytime HF Band Propagation

- 160 meters
 - Ground wave to 25 mi
 - Sky wave to 200 mi
 - Severe D absorption
- 80 meters
 - Ground wave to 20 mi
 - Sky wave to 250 mi
 - Severe D absorption
- 40 meters
 - Ground wave to 20 mi
 - Sky wave to 750 mi
 - Moderate D absorption
- 20 meters
 - Ground wave to 20 mi
 - Sky wave worldwide
- 15 meters
 - Ground wave to 20 mi
 - Sky wave worldwide but variable
- 10 meters
 - Ground wave to 20 mi
 - Sky wave variable
 - Line of sight 50-100 mi

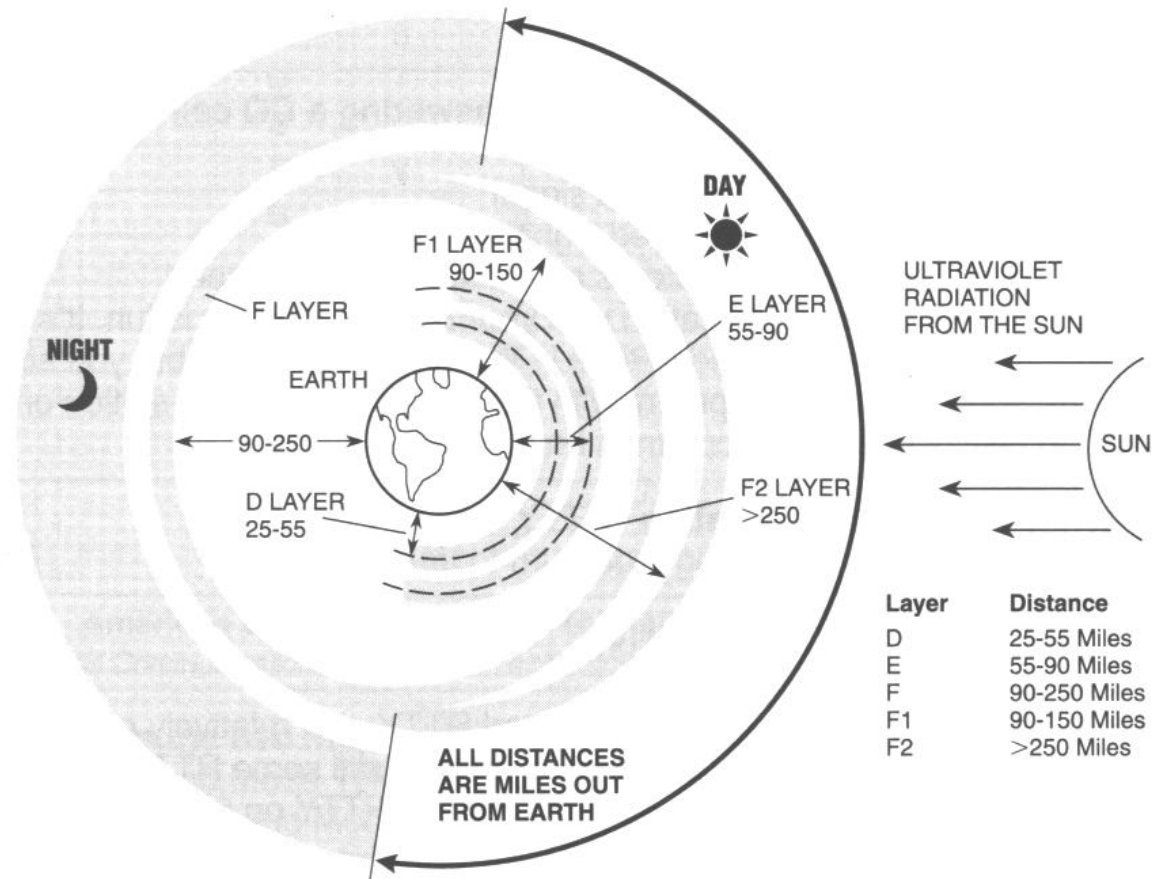
VHF Daytime Propagation

- No ground wave like HF has, but line of sight communications are fairly reliable up to 80 miles or more with 6 meters
- Line of sight communications are fairly reliable up to 50 miles with 2 meters, less consistent to 70 miles
- Line of sight communications are more local with 440 MHz, roughly county wide

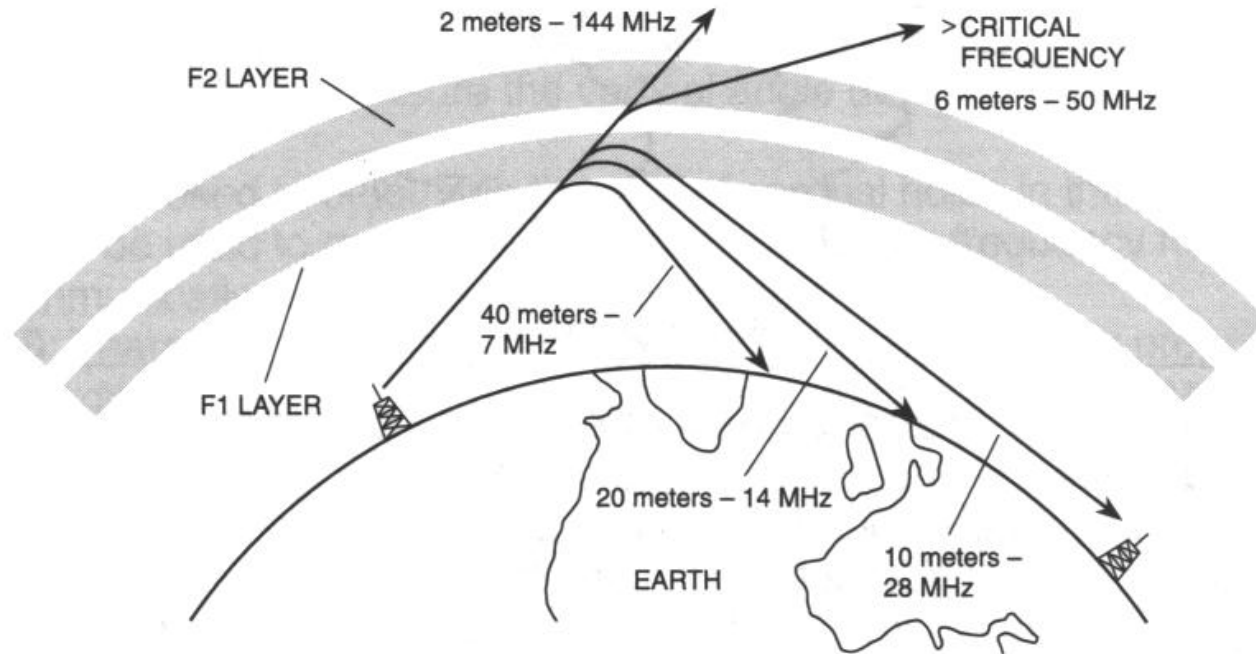
Nighttime Atmospheric Conditions

- D layer disappears after sunset and F1 and F2 layers recombine
- E layer loses ionization and becomes porous, allowing 160 and 80 meter signals to bounce off F layer for long distance communication, with some sporadic ion clouds of increased density (sporadic E)
- MUF falls

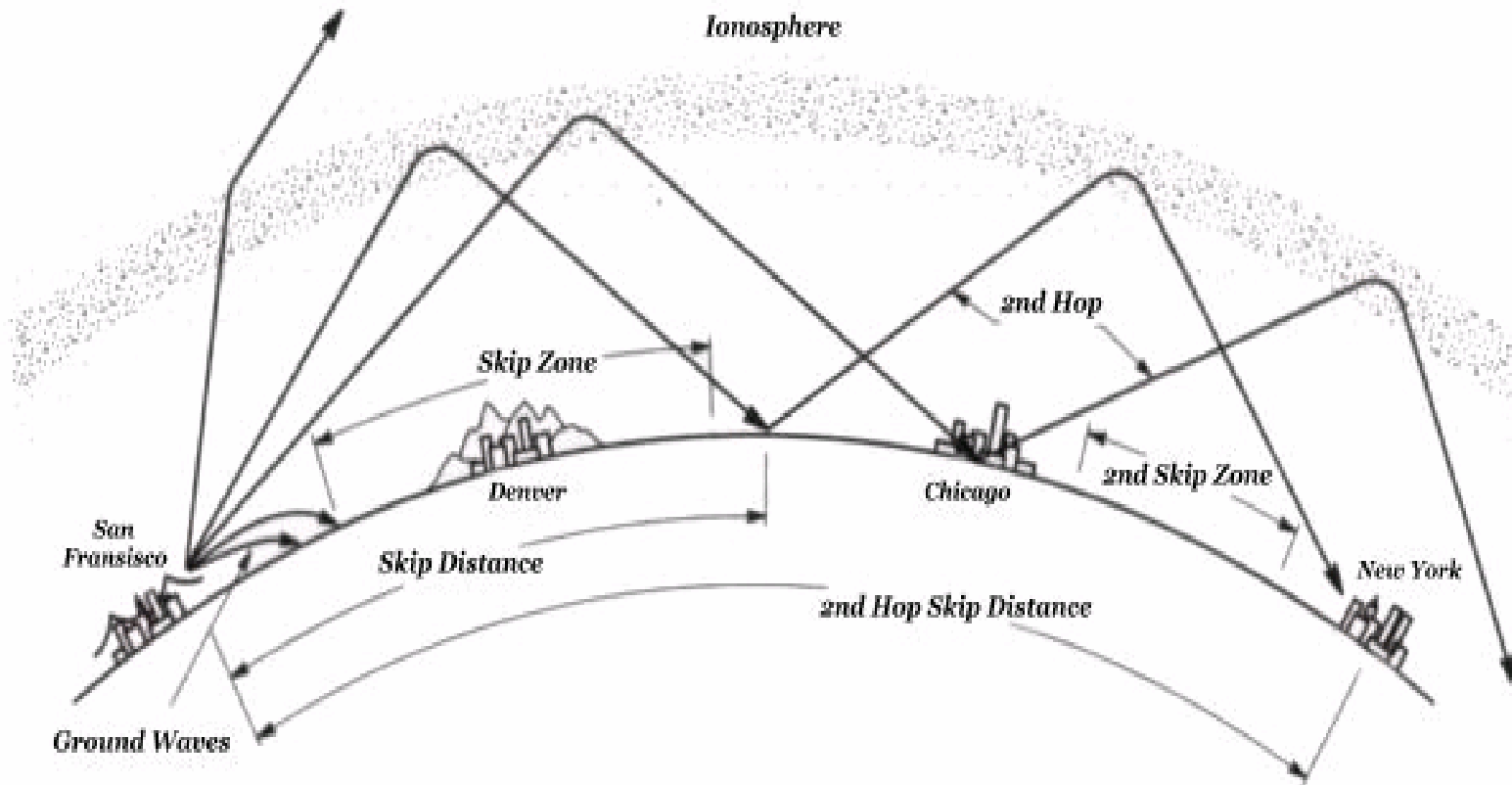
Day/Night Propagation



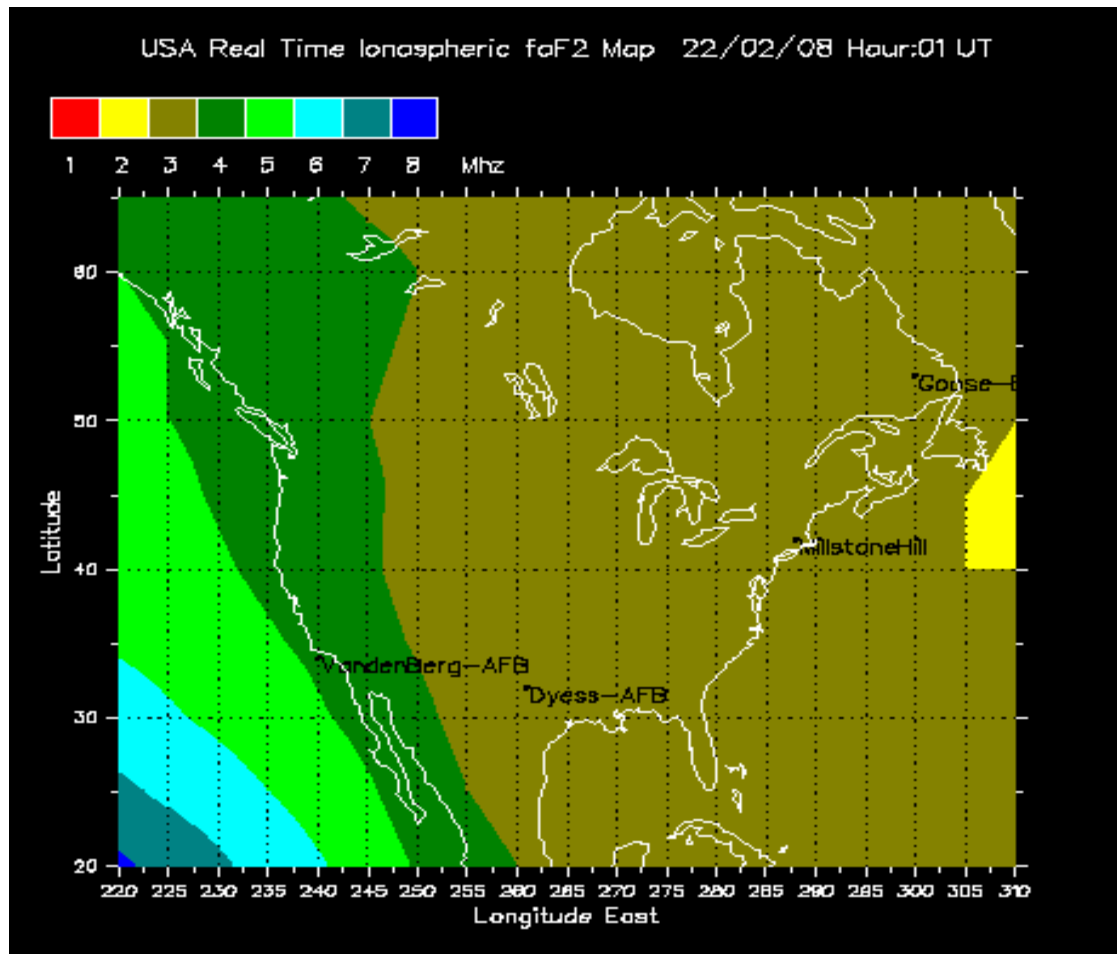
Critical Frequency (foF2)



Skip Zone

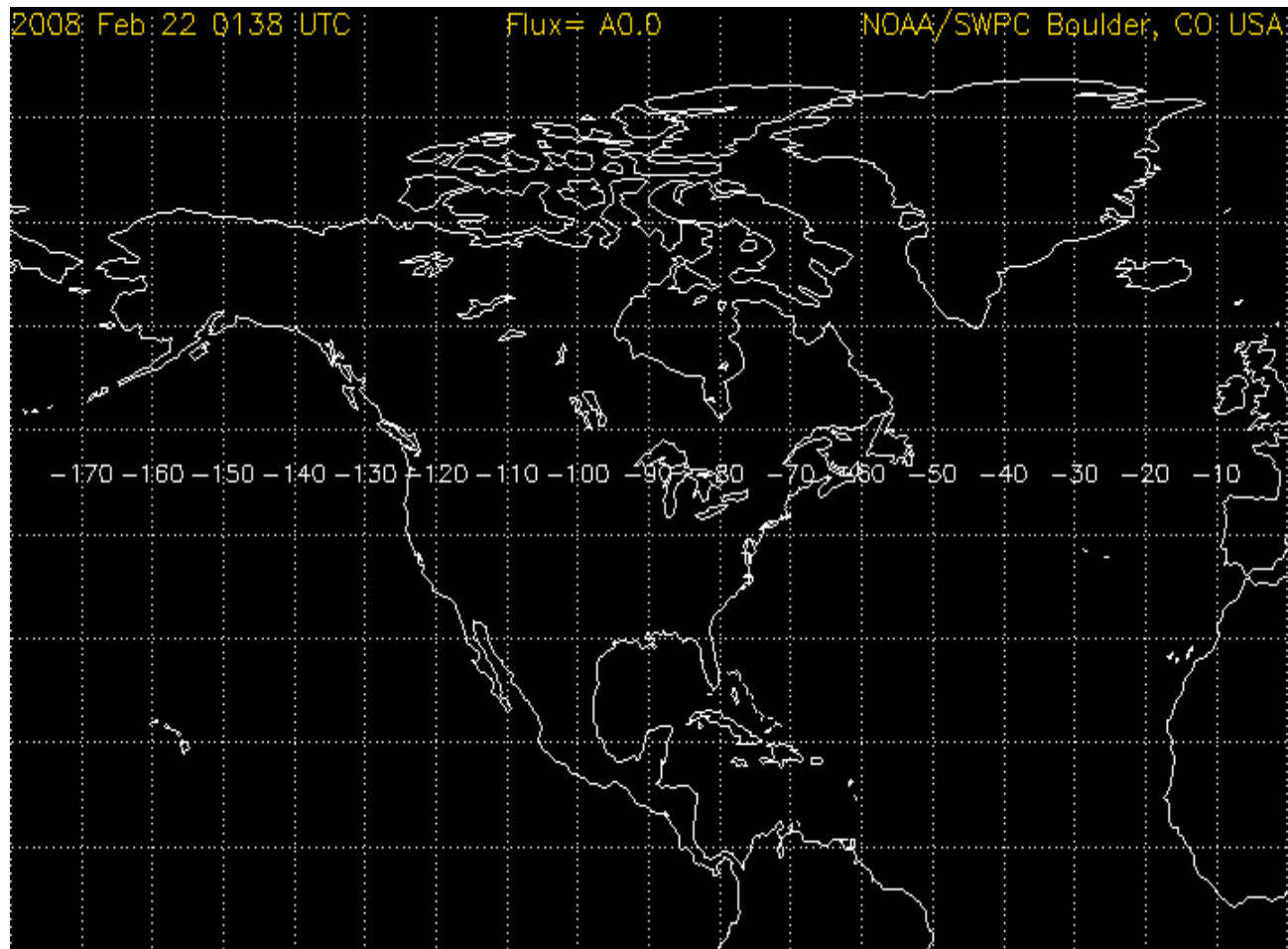


<http://www.ips.gov.au/Main.php?CatID=6&SecID=4&SecName=North%20America&SubSecID=3&SubSecName=Ionospheric%20Map>



http://www.swpc.noaa.gov/dregion/dregion_q1.html

D Region Absorption



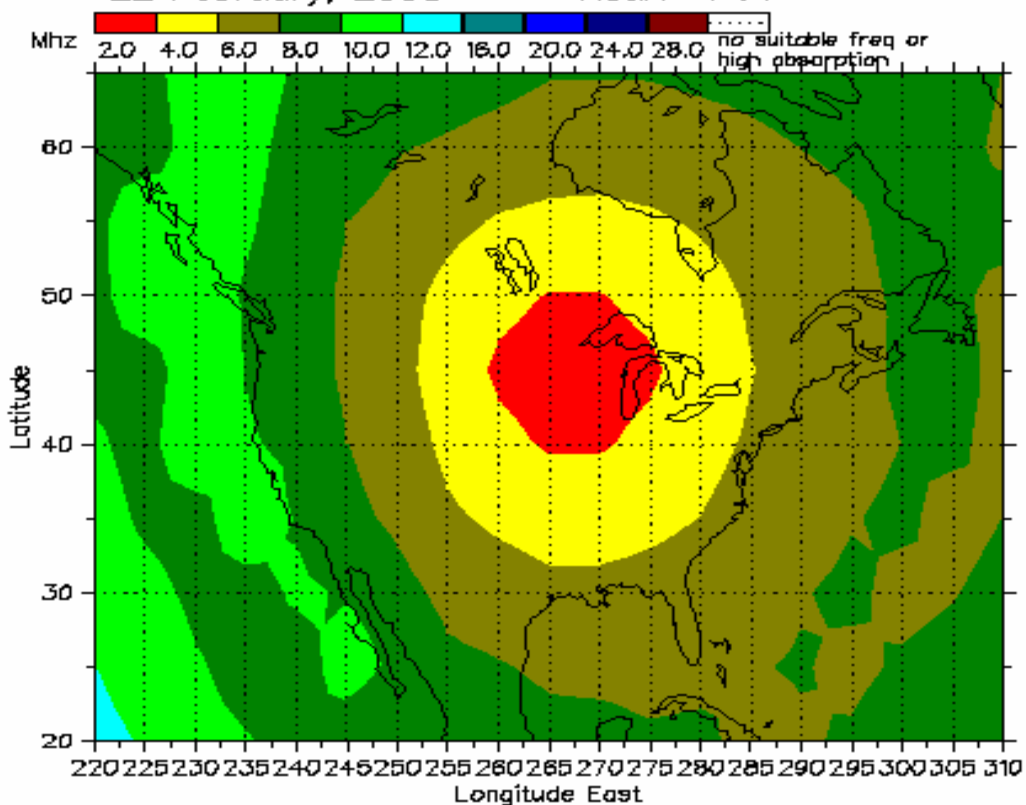
http://www.ips.gov.au/HF_Systems/

4/1/1 (9 pm local)

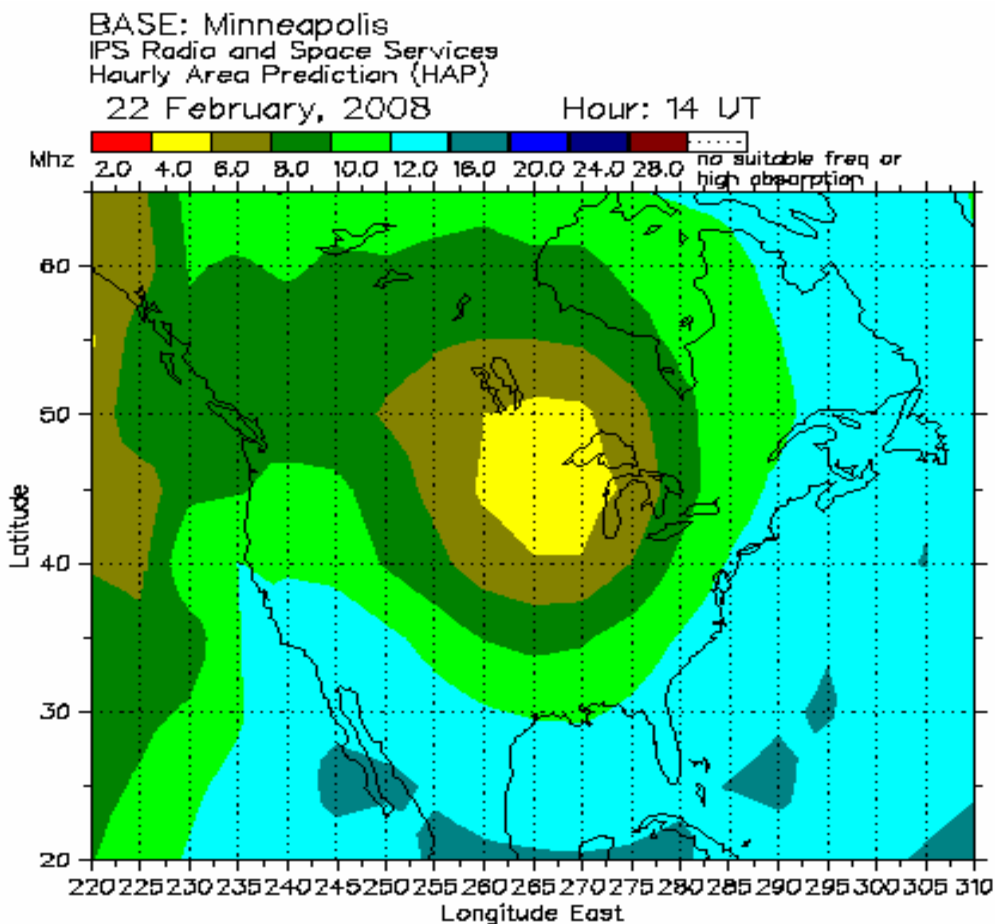
BASE: Minneapolis
IPS Radio and Space Services
Hourly Area Prediction (HAP)

22 February, 2008

Hour: 1 UT

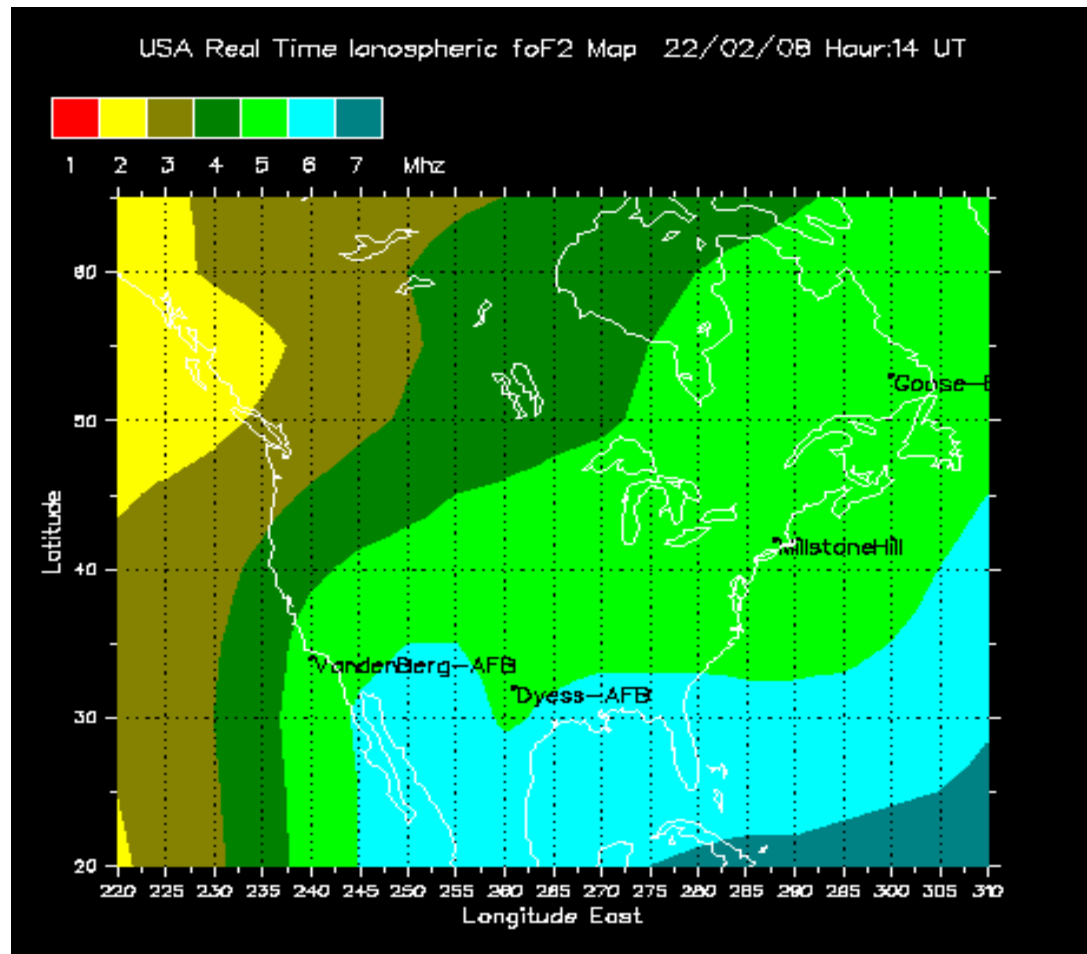


Mobile to Base Comms, Best Freq. (Base in Minneapolis)



Real Time foF2 (10 am local)

http://www.ips.gov.au/HF_Systems/4/3



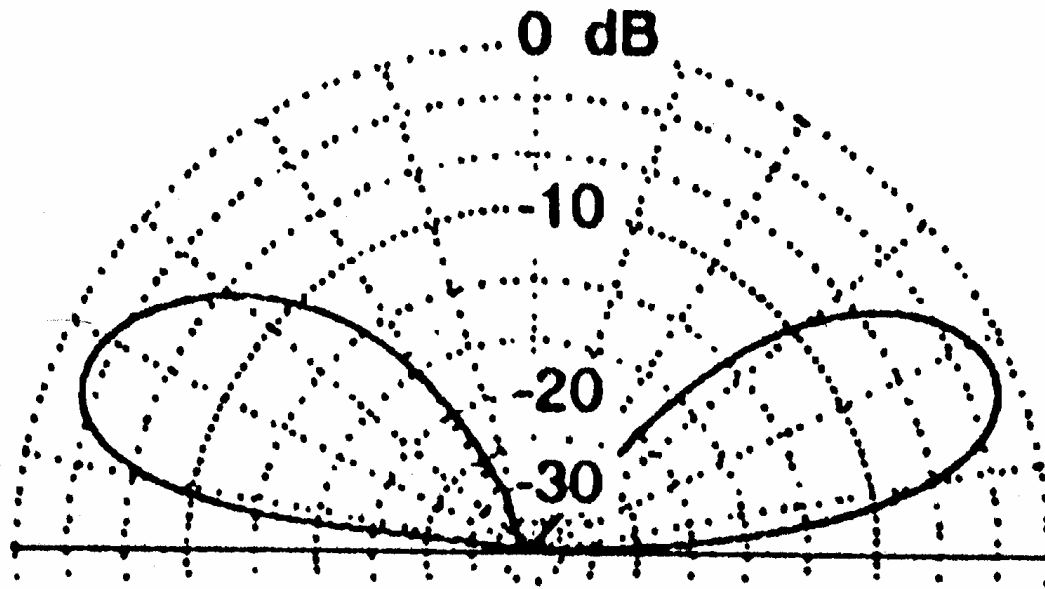
Calling Protocols

- 7232 after 10 am and before 8 pm summer, 6 pm winter
- 3932 after 8 pm summer, 6 pm winter, and before 10 am
- If calling frequency is occupied, move up 2 khz and listen/call for two minutes; repeat this step upward as necessary
- When shifting bands, call for six minutes before returning to original call frequency
- Set a secondary frequency in both bands, and have it monitored at all times for lost stations needing guidance
- Set 7232 to VFO A, 3932 to VFO B
- 28.432 USB would be good for simplex tri-county nets

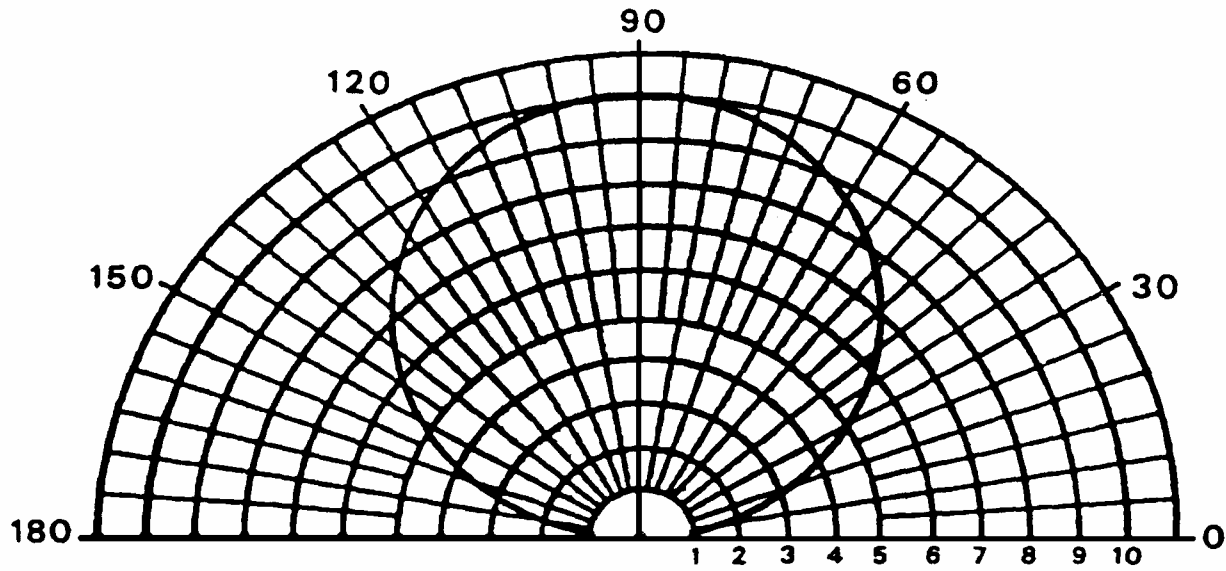
60 Meters

- Good at one hour each side of sunset and sunrise
- 5 discrete channels; 50 W output, USB phone only
- West Coast RACES groups use this band for statewide contacts

Dipole at 0.5λ



Dipole at 0.25λ



NVIS Antenna Heights

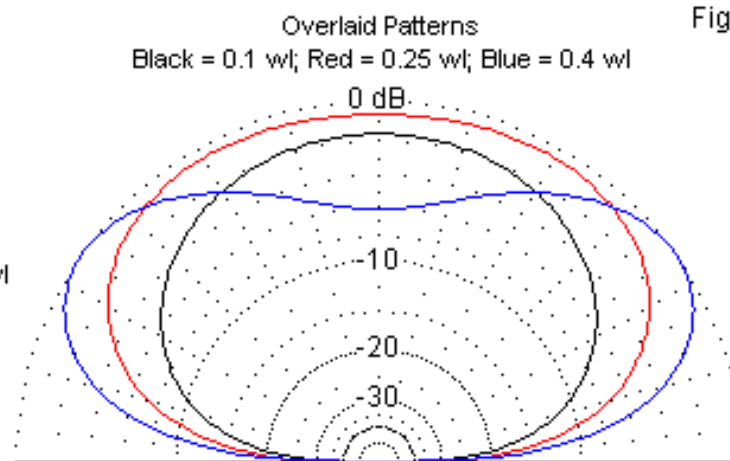
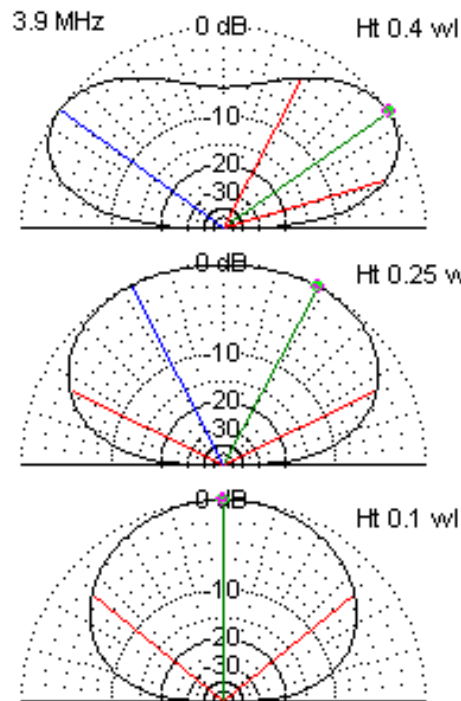


Fig. 6

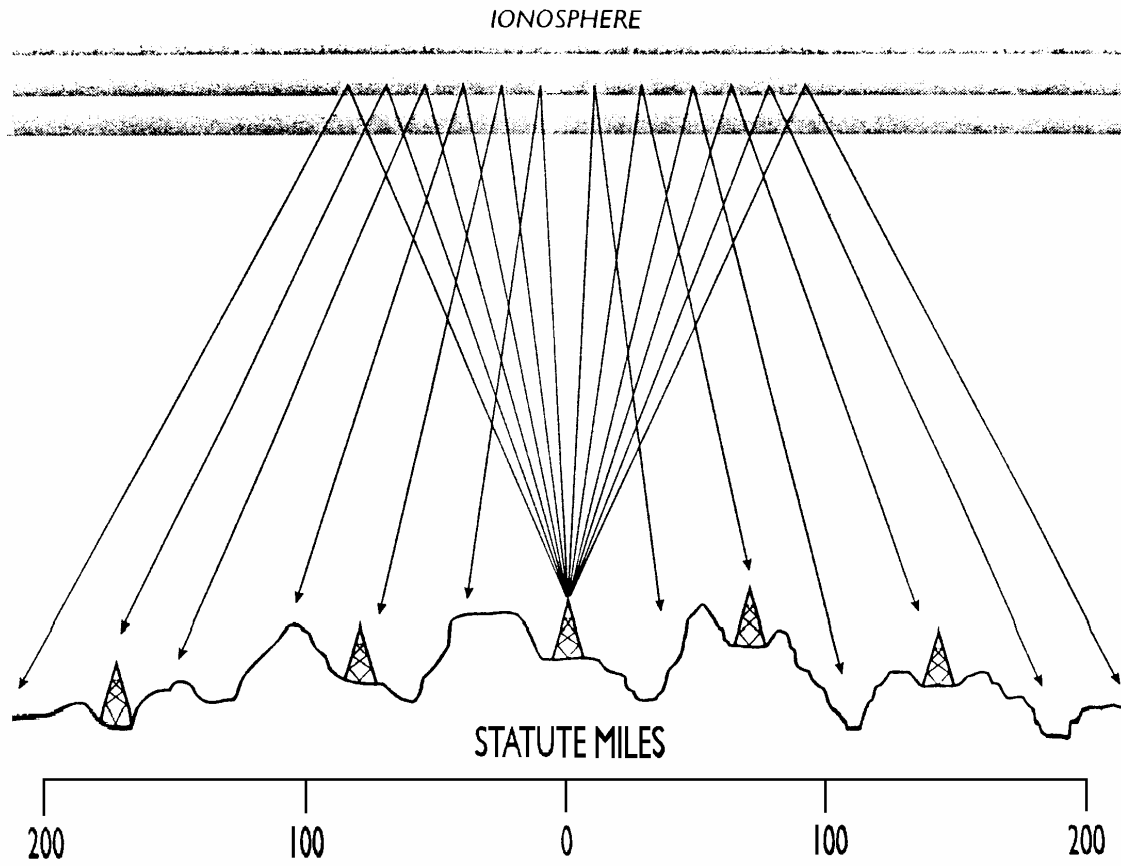
See text for both analytical and modeling issues.

Sample of Elevation Patterns for
a NVIS Dipole at Various Heights
above Average Ground: Separate
and Overlaid for Comparison

NVIS: Near Vertical Incident Skywave

- Requires HF under the MUF, typically 80, 60, or 40 meters in RACES/ARES common use
- Low height and vertical orientation create nulls toward near horizontal signals (broadcasters), height $.175 \lambda$ typical
- Enhanced point to point communications without intermediation, even without tuners
- All stations must employ NVIS together for best results
- Frequencies must stay above D absorption low and maximum usable frequency
- Use low power (keep signal reports at S9) to reduce ground wave multipath distortion; 10-20 W is plenty normally
- If the frequency is susceptible to local noise sources (thunderstorm static, scatter, broadcast, etc.), LOWER the antenna under 10 feet; you will get a bit weaker signal, but much lower noise floor, reportedly
- On dipoles, let the center connection point droop lower than the ends; height, $.10-.12 \lambda$; reflector, $.02 \lambda$, +5% length

NVIS



Antenna Height Limitations

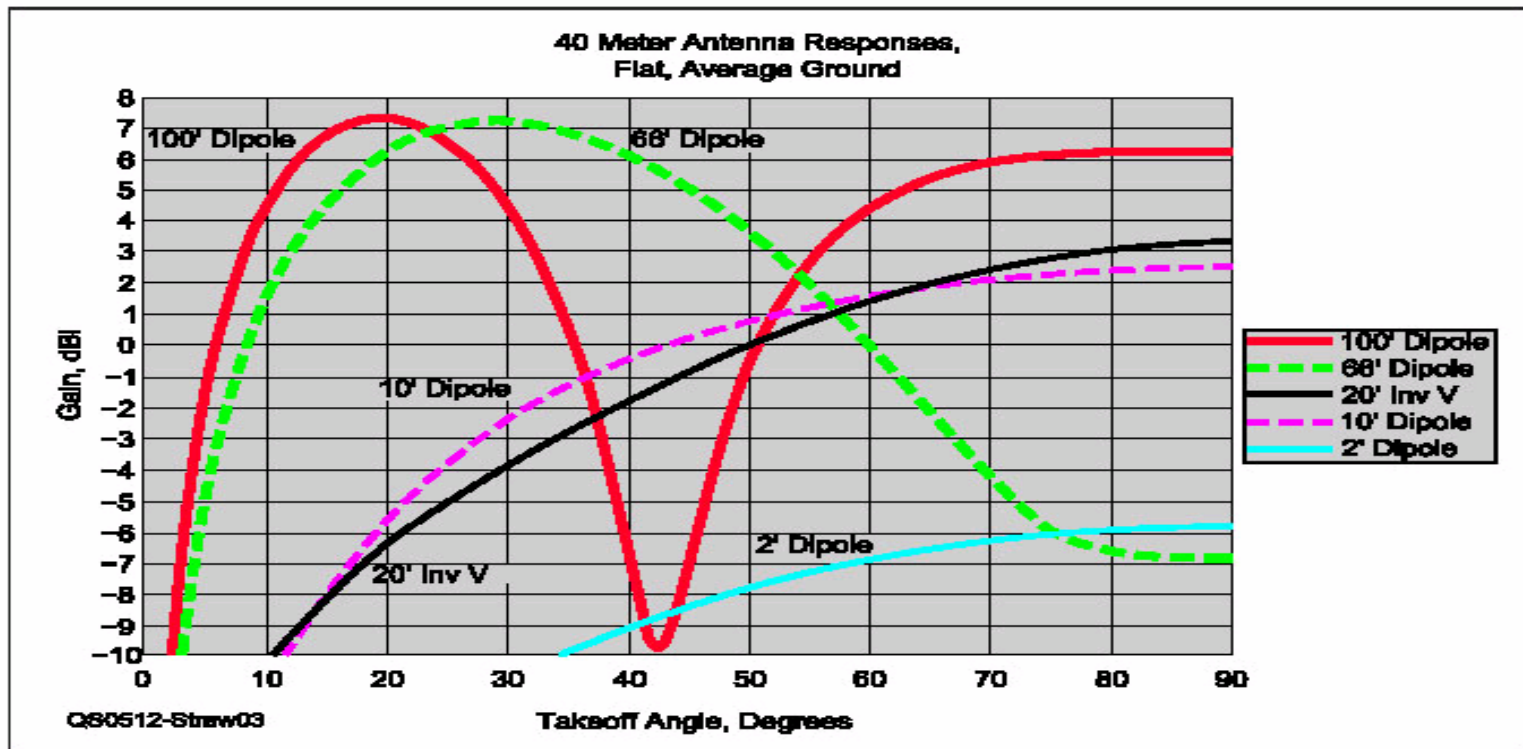
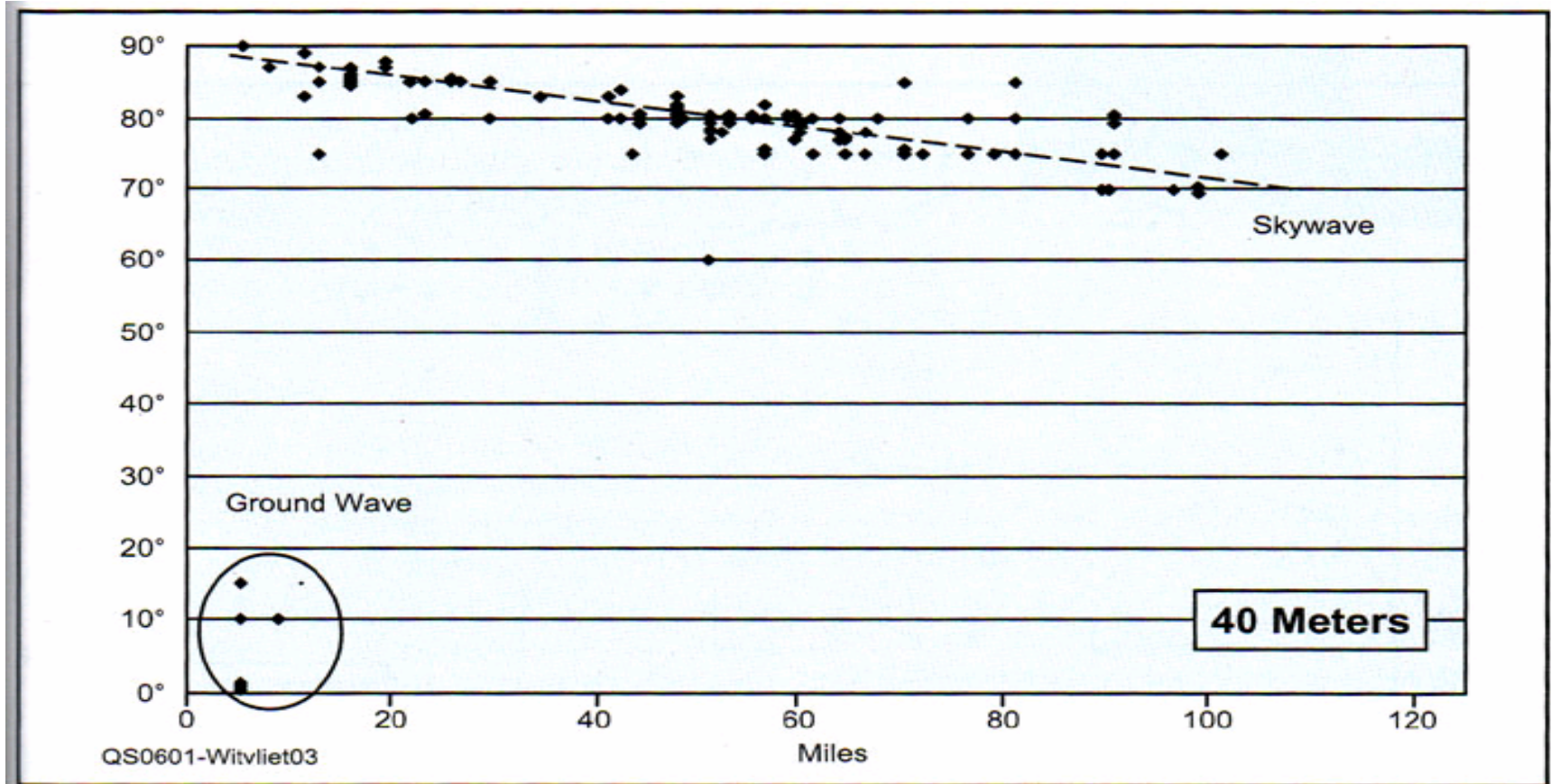


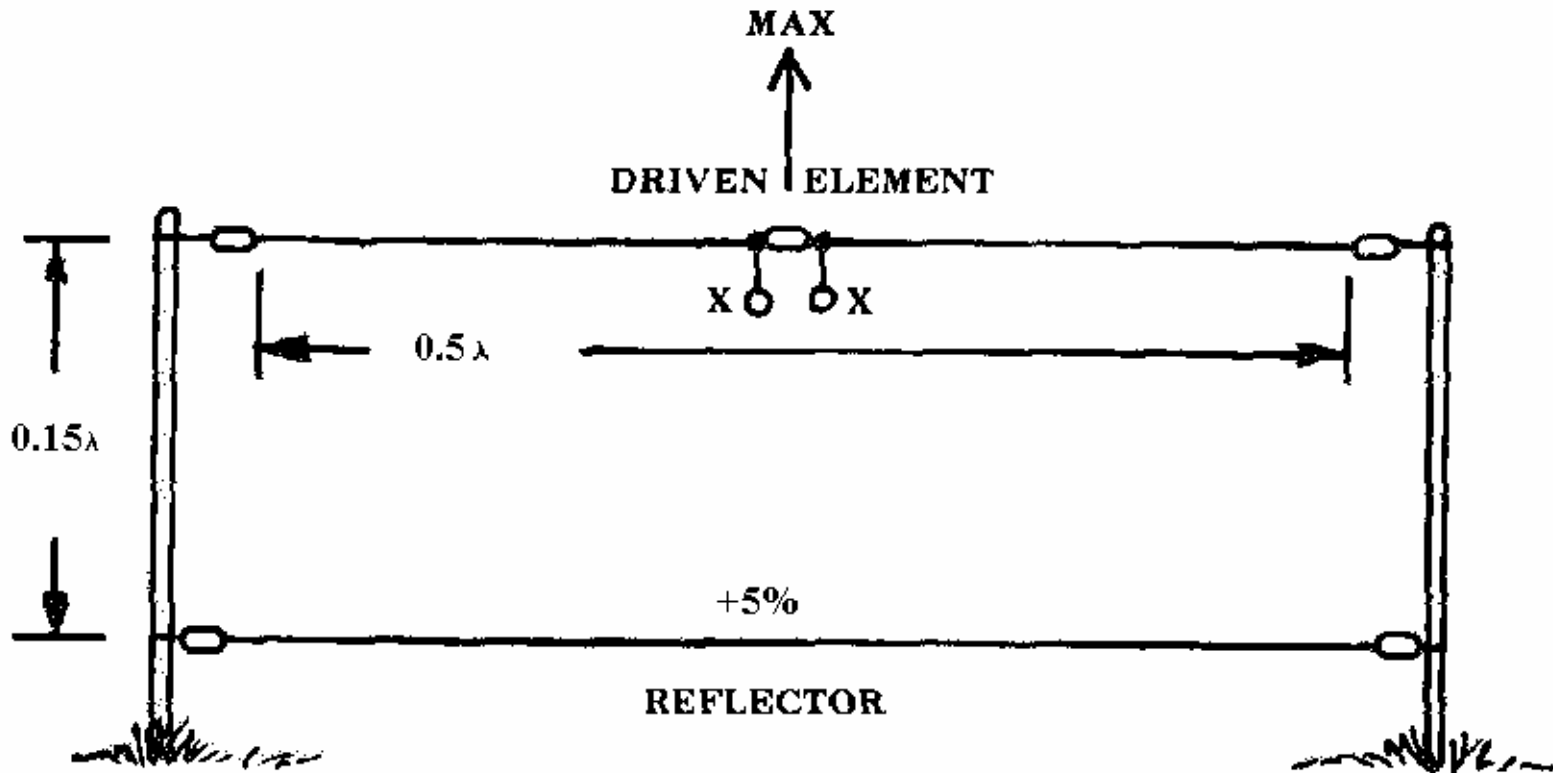
Figure 3—Elevation plots for different 40 meter antennas above flat ground with average ground characteristics (5 mS/m conductivity and dielectric constant of 13). The 10 foot high flattop dipole and the 20 foot high Inverted V dipoles both have close to the same characteristics. Note that there is a null in the response of the 100 foot high flattop dipole at a 42° elevation angle. The gain there is roughly that of a 2 foot high dipole!

Incident Angle of Skywave



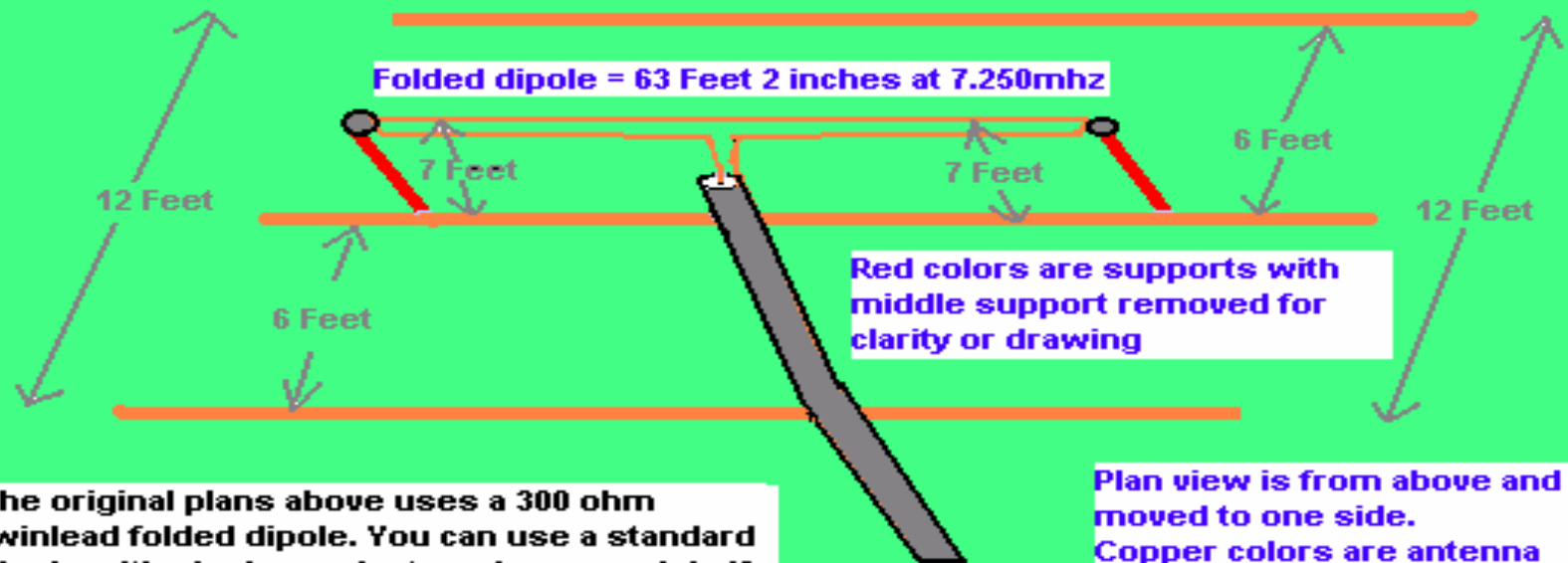
Elevation angle of Dutch stations as a function of the distance, on 40 meters.

NVIS Dipole with Reflector



40 Meters Design

SUPER GAIN 40 METER NVIS



The original plans above uses a 300 ohm twinlead folded dipole. You can use a standard dipole with single conductor wire on each half and be able to tune the antenna for your favorite part of the band.

Plan view is from above and moved to one side.
Copper colors are antenna elements.
Green color is grass that needs mowing! n4ujw

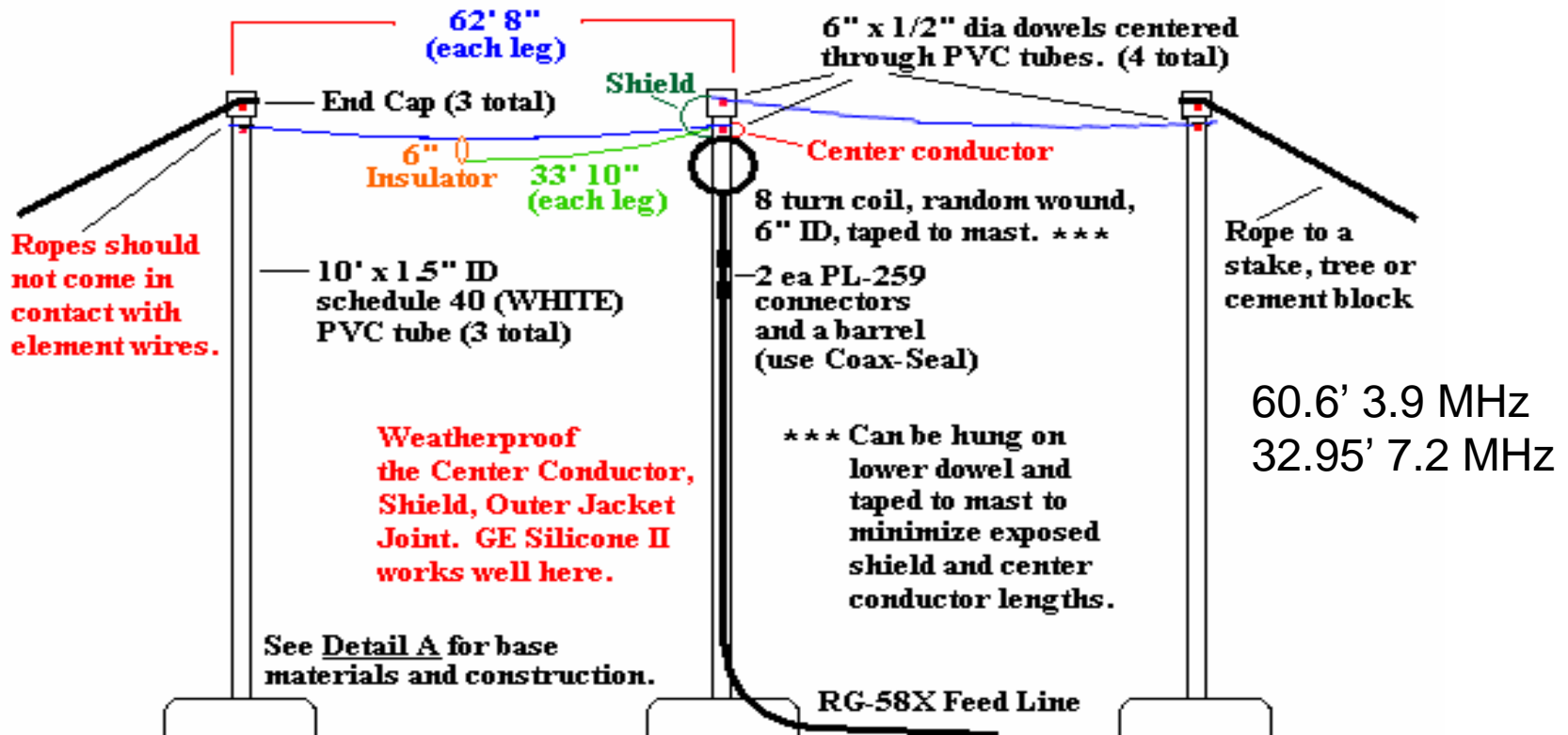
N4UJW

NVIS 40M antenna



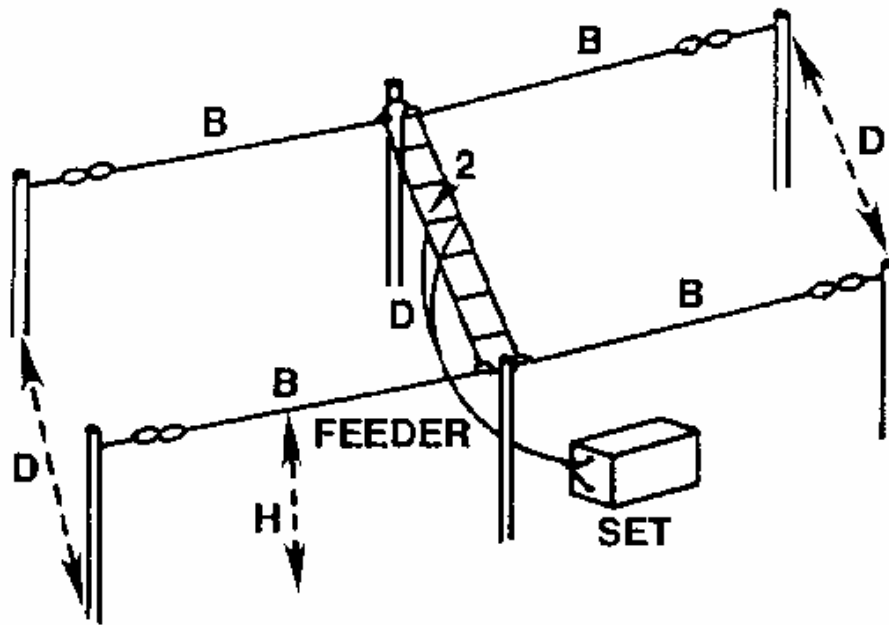
<http://www.starc.org/technotes/75-40%20meter-nvis.html>

Portable 75/40 Meter NVIS Antenna



NVIS “Jamaica” Base Array

High gain fixed antenna for EOC,
12 db with ground level 1.5 lambda
square planar reflector



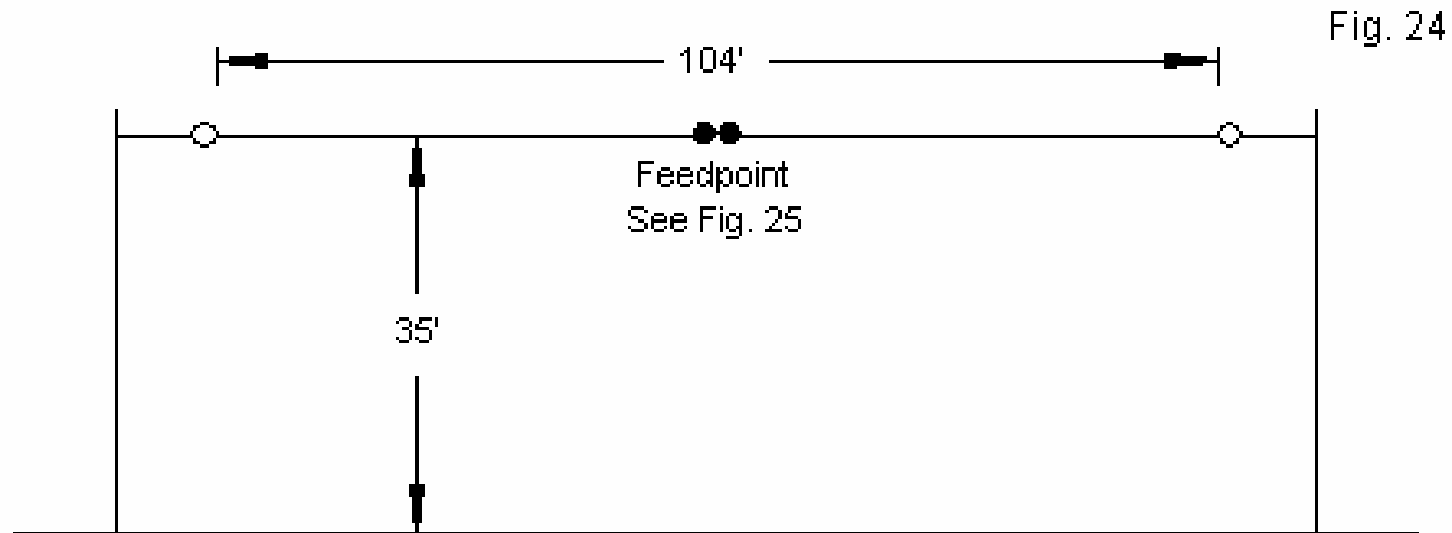
$$B = 1/2 \lambda$$
$$D = 1/2 \lambda$$
$$H = 1/8 \text{ TO } 1/4 \lambda$$

Figure 6. Jamaica antenna (Can be built from standard antenna kits AN/GRA-50; has four times the gain of the dipole antenna.)

Another 40 Meters Design (This must be aimed up)



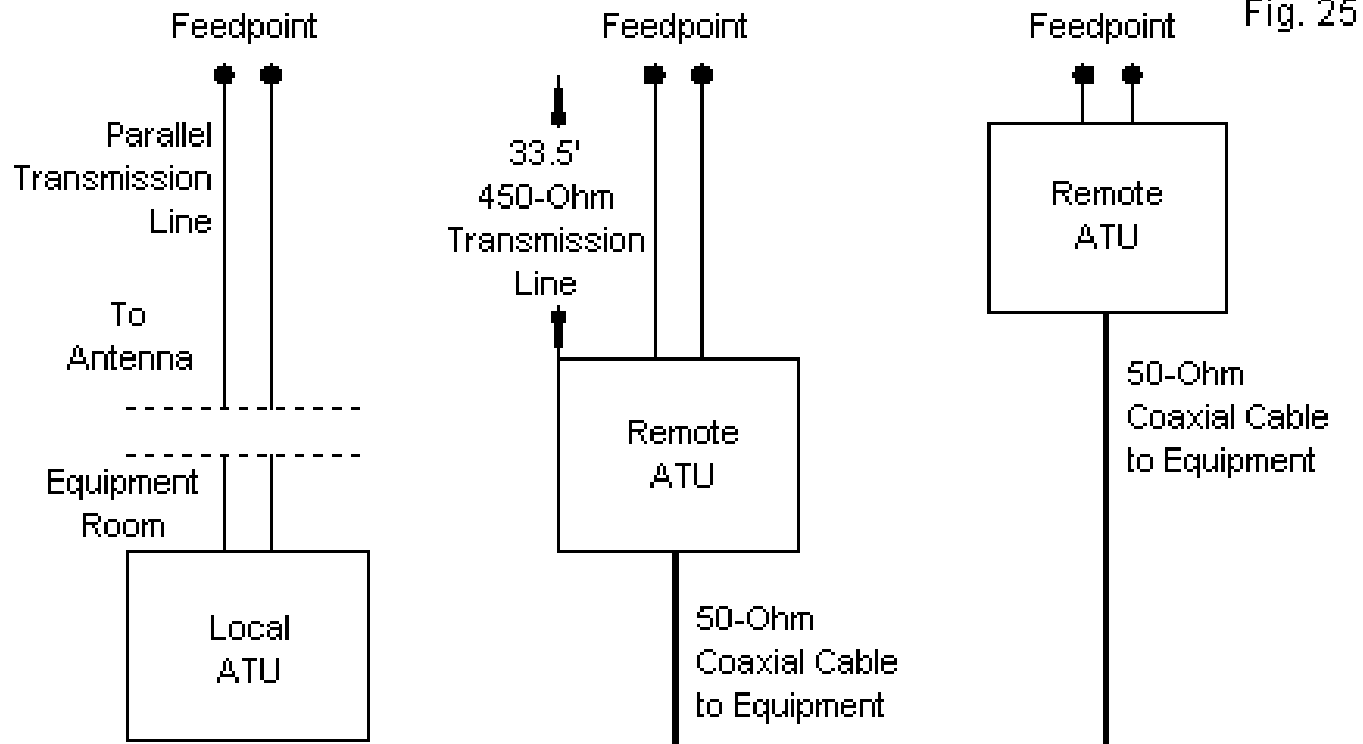
My Favorite for the Field



General Outline: Single-Wire Doublet for 75 to 40 Meters

Gain is 7 db at 35' when fed with balanced window line and using [tuner](#). It operates on 75/60/40 meters equally well. Suspend end guys in trees. Can be fed with coax if remote tuner is mounted at feed point on tower. A compromise uses 33.5' 450 ohm drop feed to remote tuner on ground.

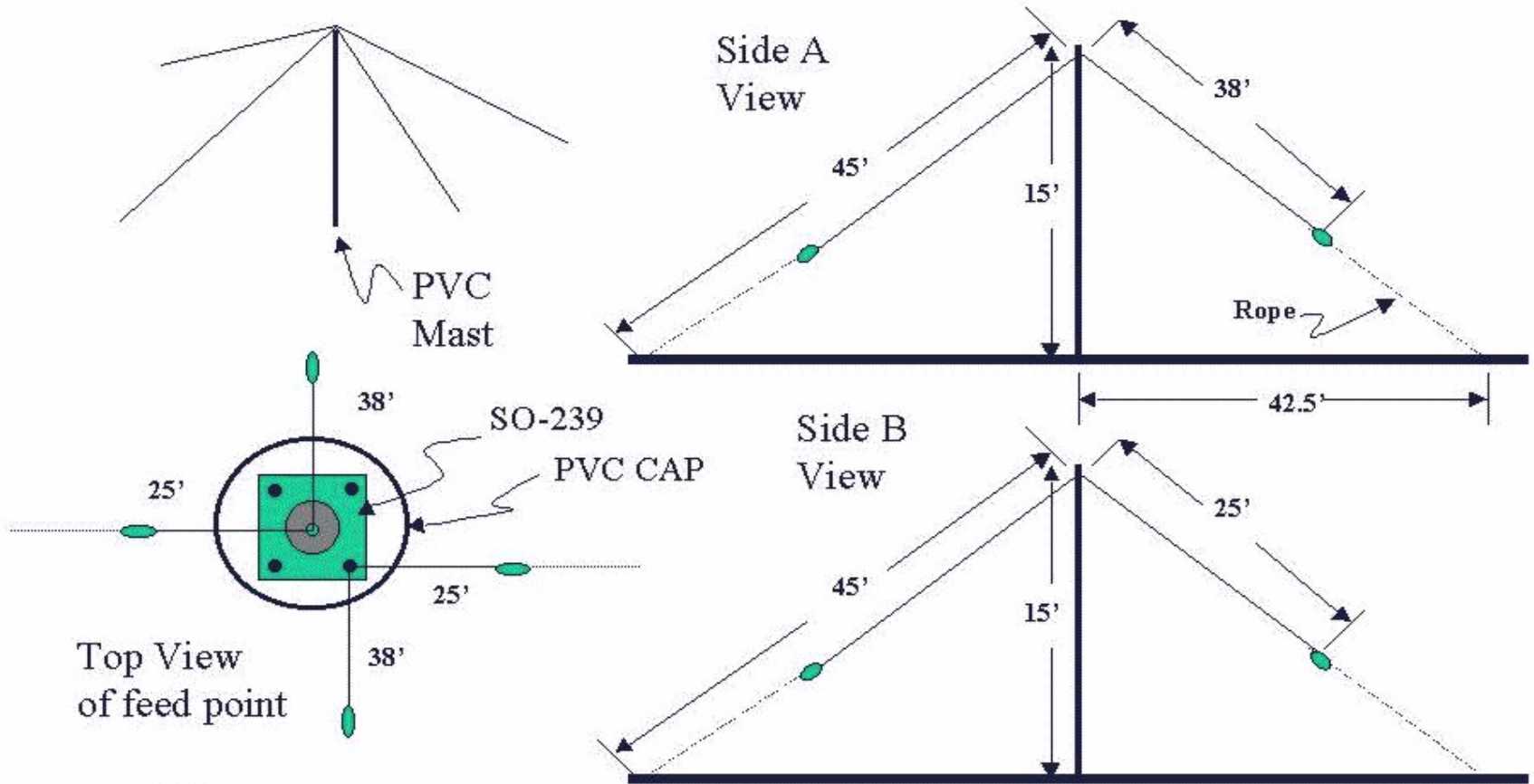
Doublet Feed



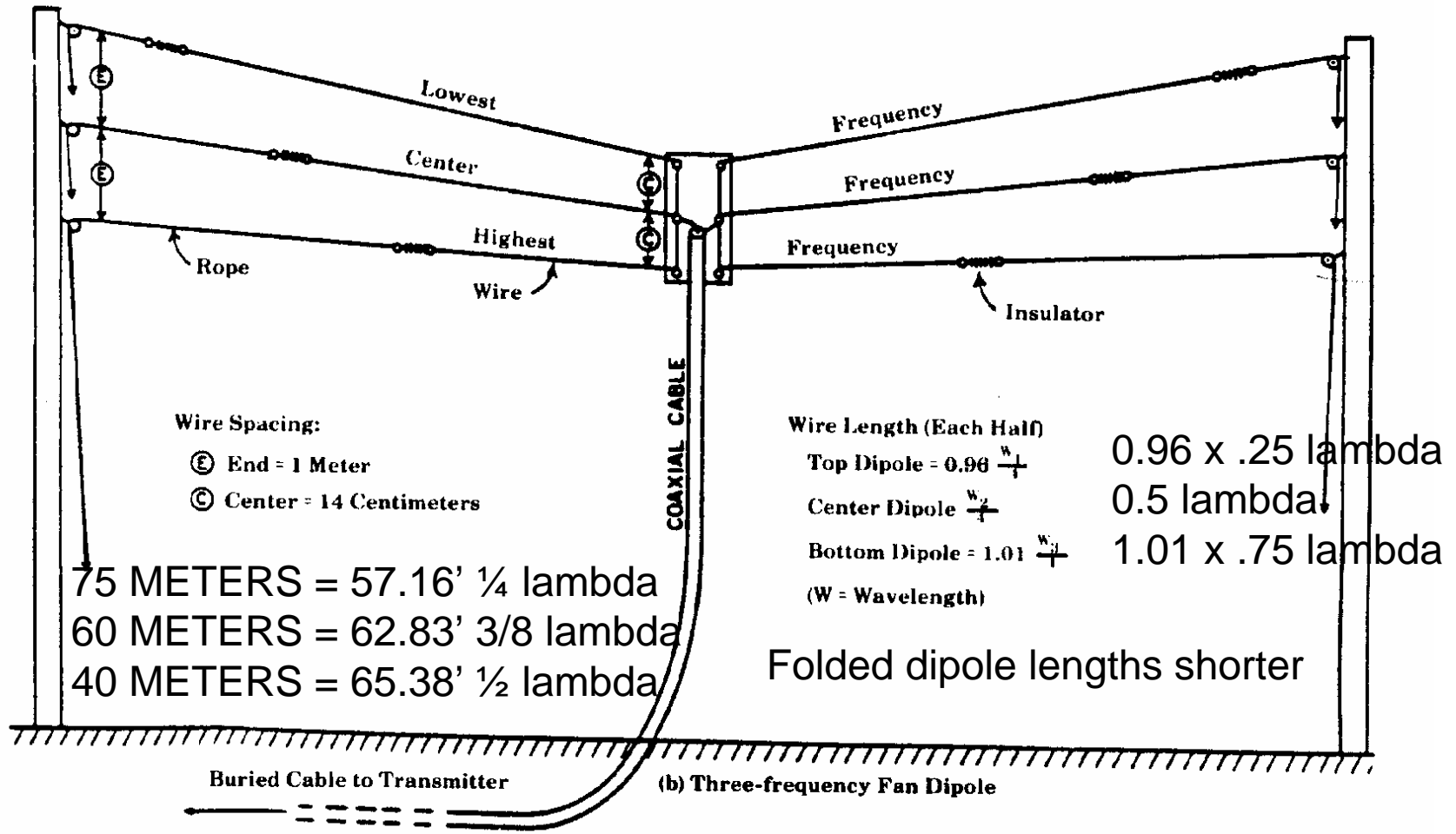
Alternative Methods of Feeding the 75-40-Meter Doublet

Dual Bander

Inverted V antennas are down 3db from dipoles or loops

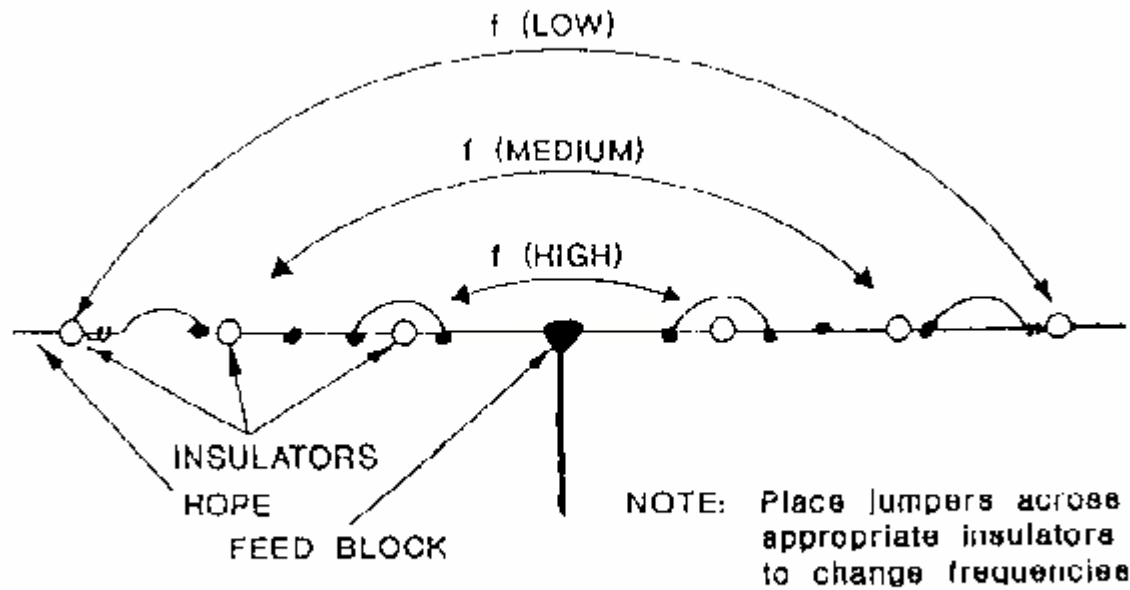


NVIS Fan Dipole Tribander



I would like to try this as a folded dipole at 20', no tuner, raised ends. It would not have the gain of the doublet, but simpler to erect in field.

NVIS Jumppered Tribander

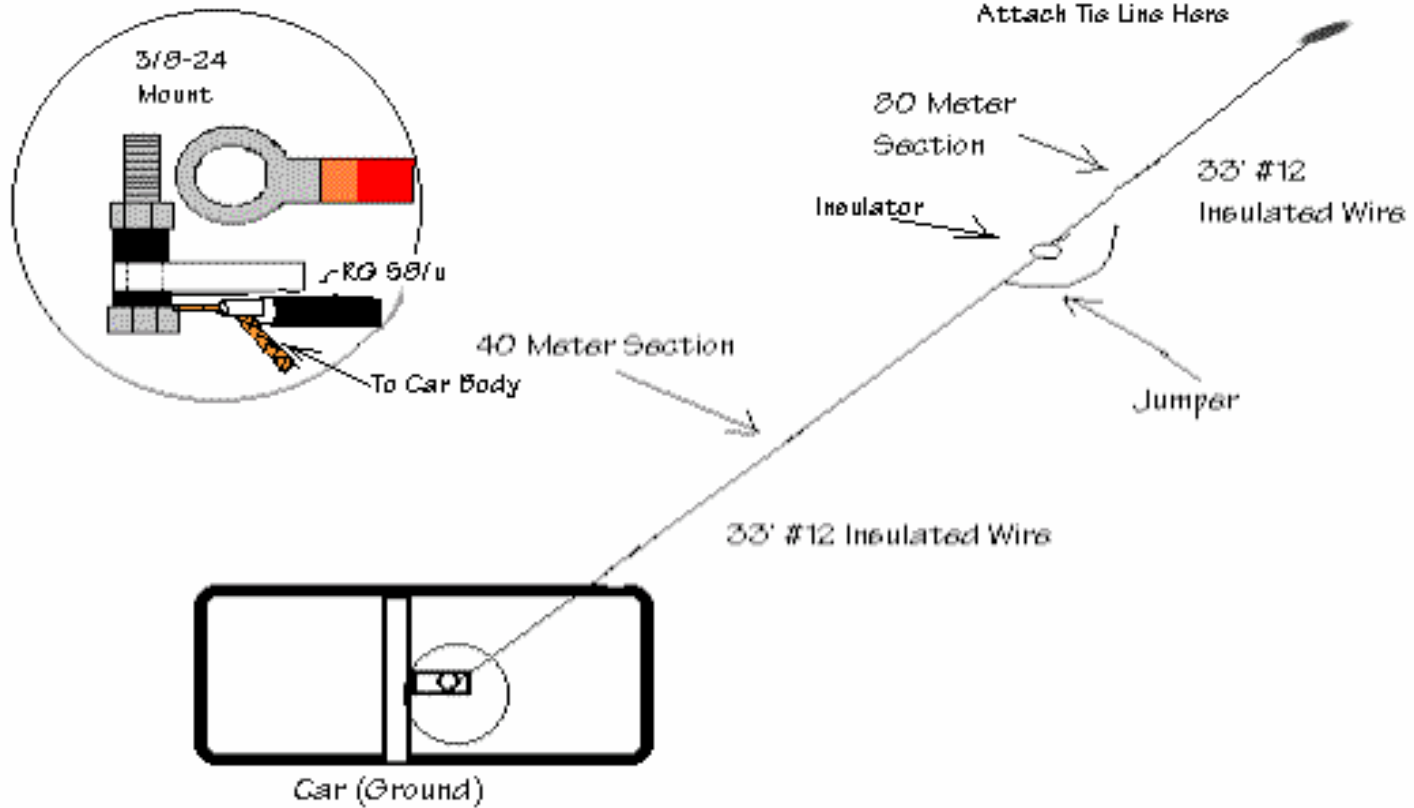


<http://www.eham.net/articles/5747>

75/60/40 Meter RACES



Mobile NVIS



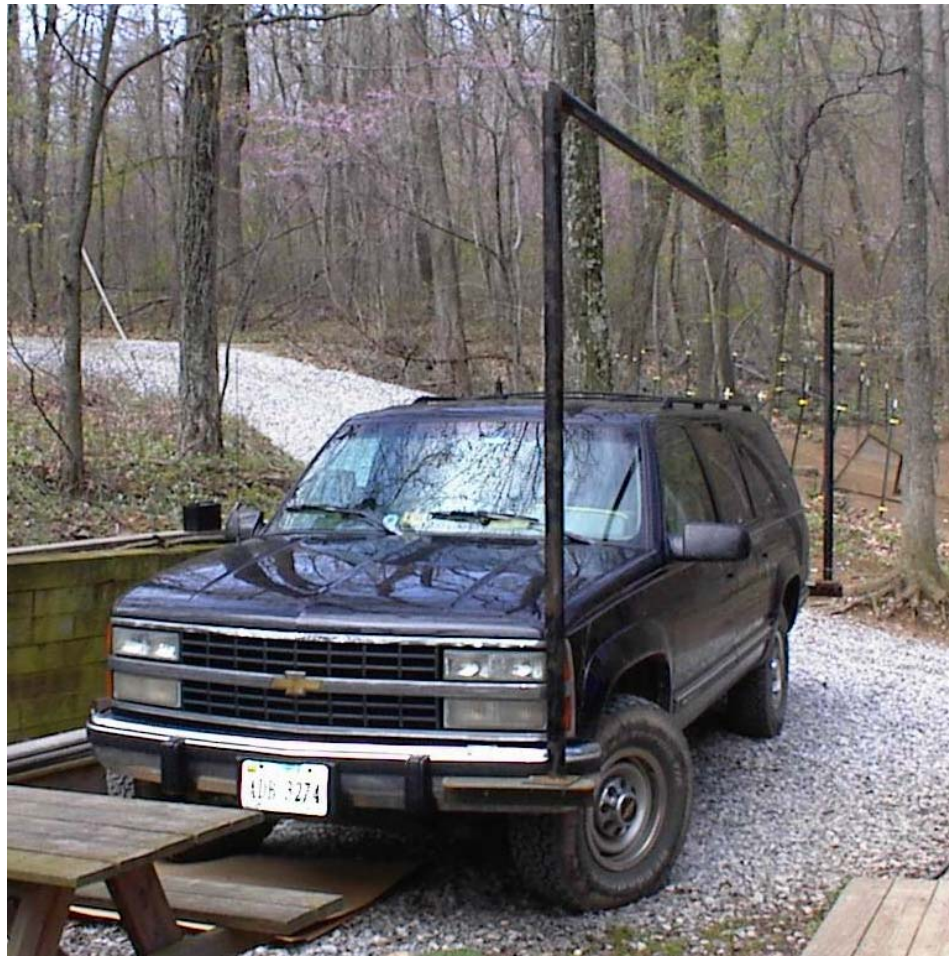
NVIS Roadside Antenna

Drawing by W7ARC

<http://www.eham.net/articles/4141>



Mobile Magnetic Loop NVIS WB3AKD



Q-MAC Roof Rack Mobile NVIS



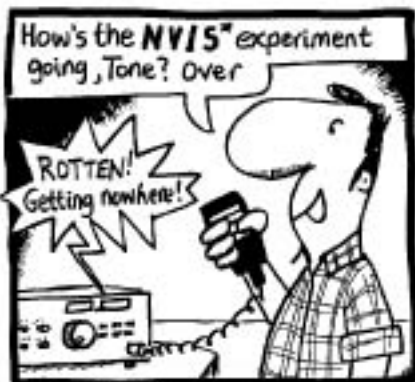
Alpena RACES Mobile EOC?



"TONE" BURST



by G.M. MEN



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Well, you've got to start by getting **HORIZONTAL** and **LOW**.



Yeah... well I've got that covered....

