Regional Emergency Communications

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W8CX

Alpena RACES

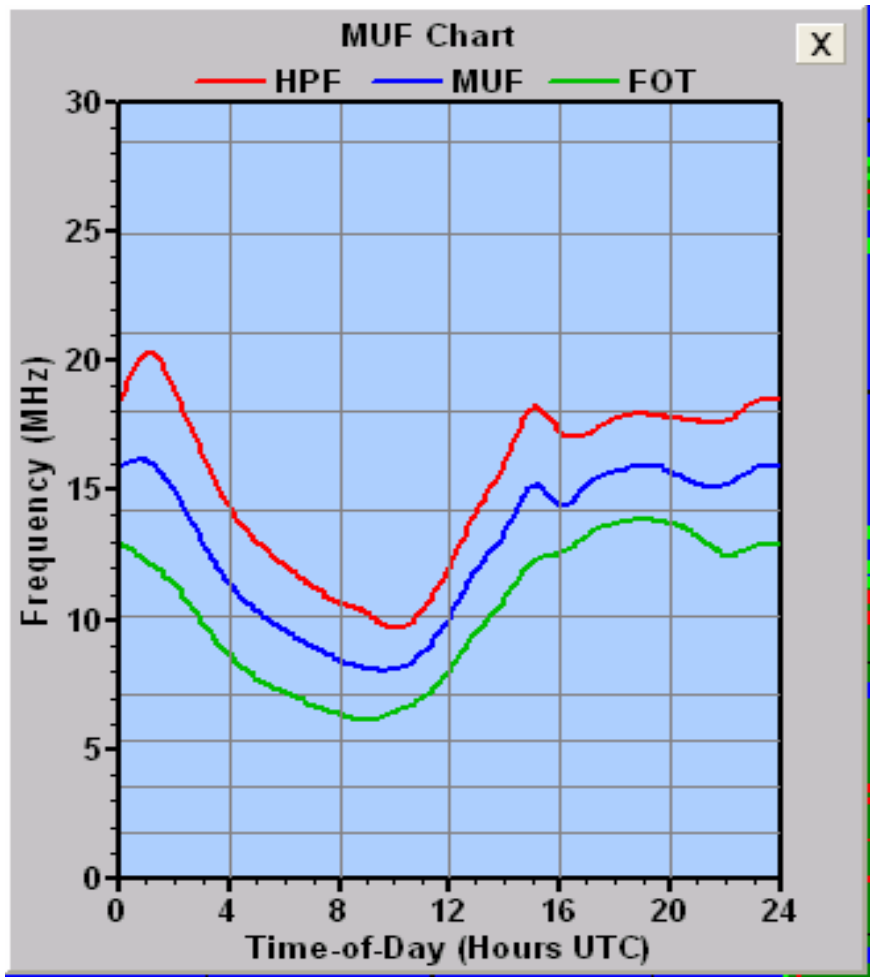
Regional Communications Needs

- 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

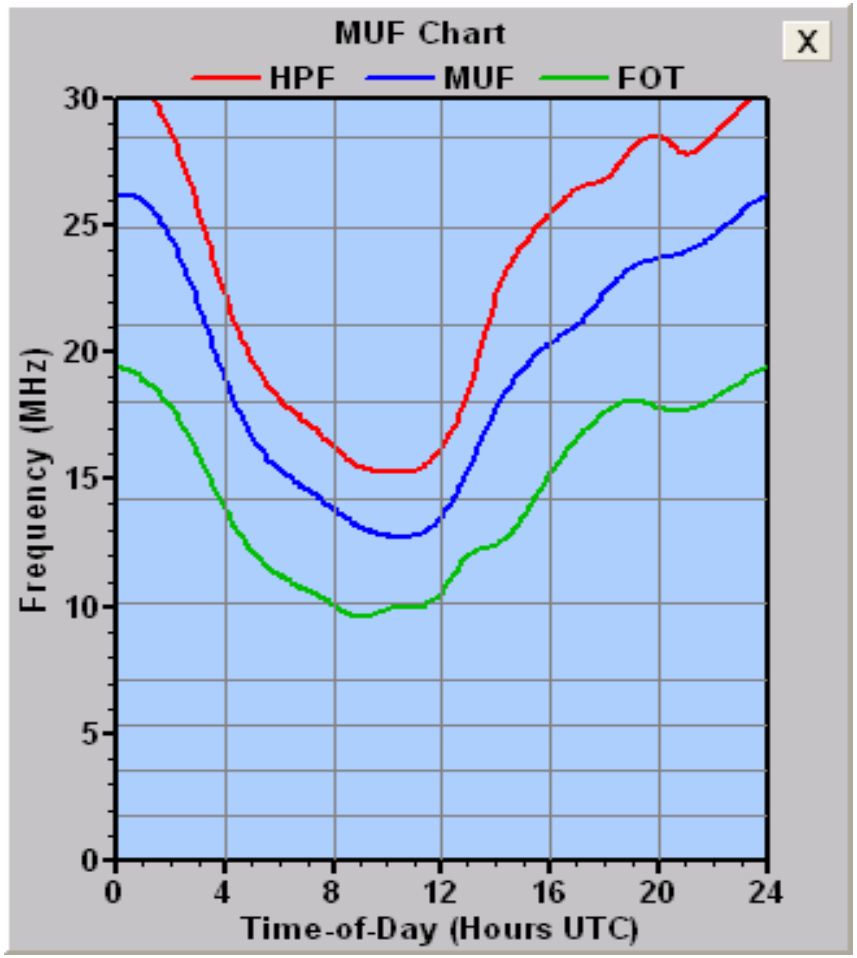
- 2 meter linked repeater systems
- 2 meter shared repeater
- 2 meter packet
- 6 meter or 10 meter shared repeater
- 10 meter SSB, digital modes, FM (g/a/e)
- 160-20 meters SSB, digital modes
- Did I forget something currently in use?
- Which of these guarantees coverage?

MUF



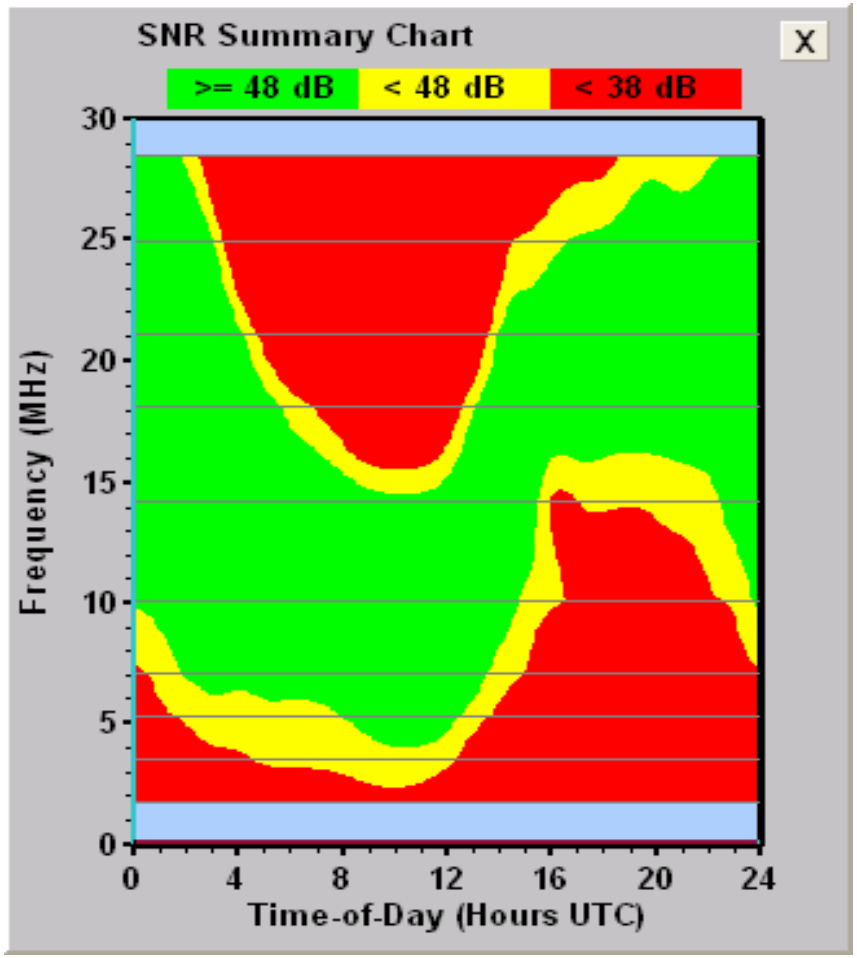
- Maximum Usable Frequency (Blue)
- 10% likelihood (Red)
- 90% likelihood (Green)
- At sun spot maxima the MUF can be as high as 70 MHz
- Chart shows April's average values for CW and 200W power, sun spot number of 12
- Subtract 4 hrs local

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 of 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

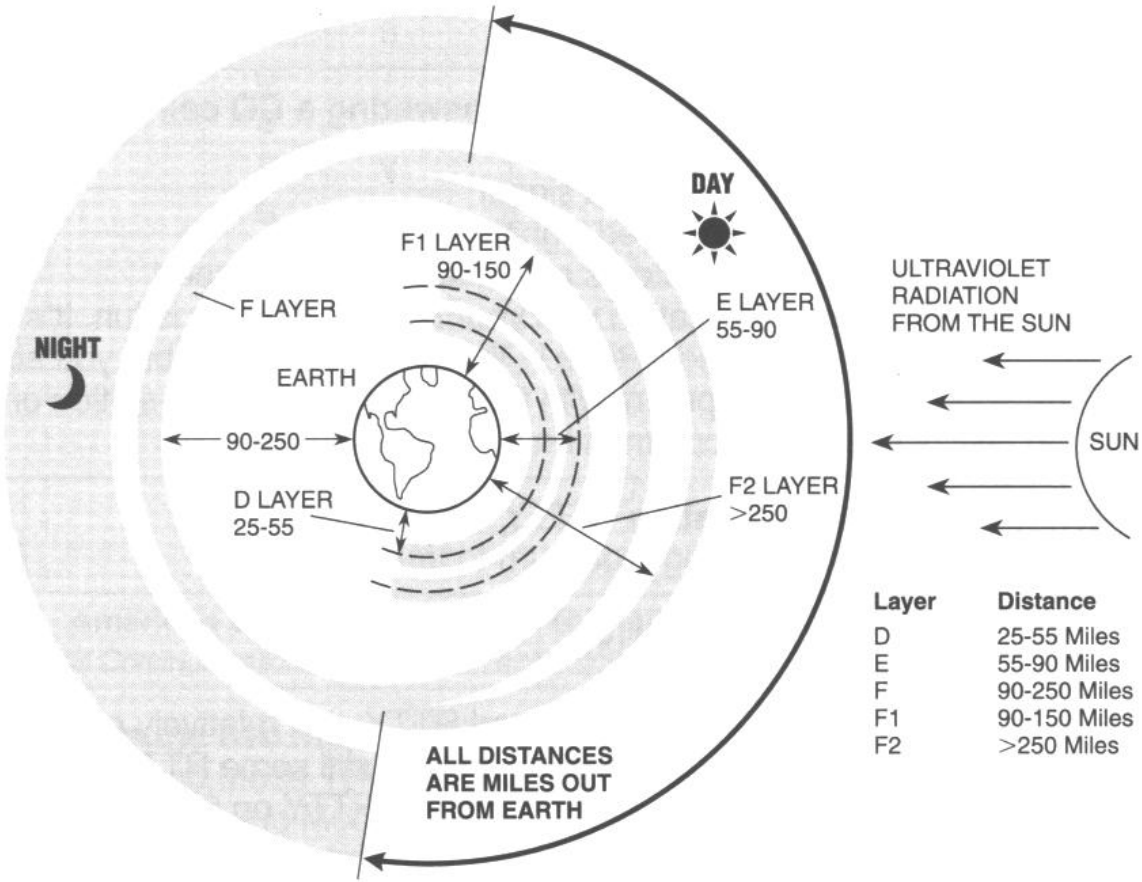
VHF Daytime Propagation

- 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

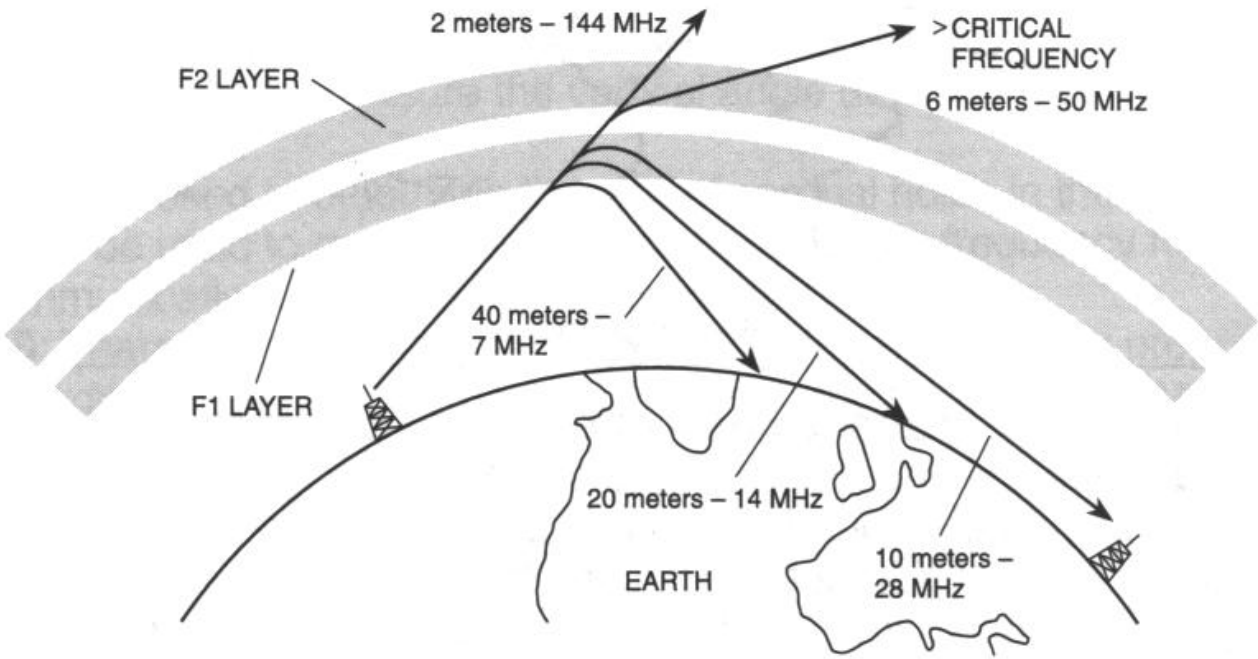
- D layer disappears after sunset and F1 and F2 layers recombine
- E layer loses ionization and becomes porous, allowing 160 and 80 meter signals to bounce off F layer for long distance communication, with some sporadic ion clouds of increased density (sporadic E)
- MUF falls

Day/Night Propagation

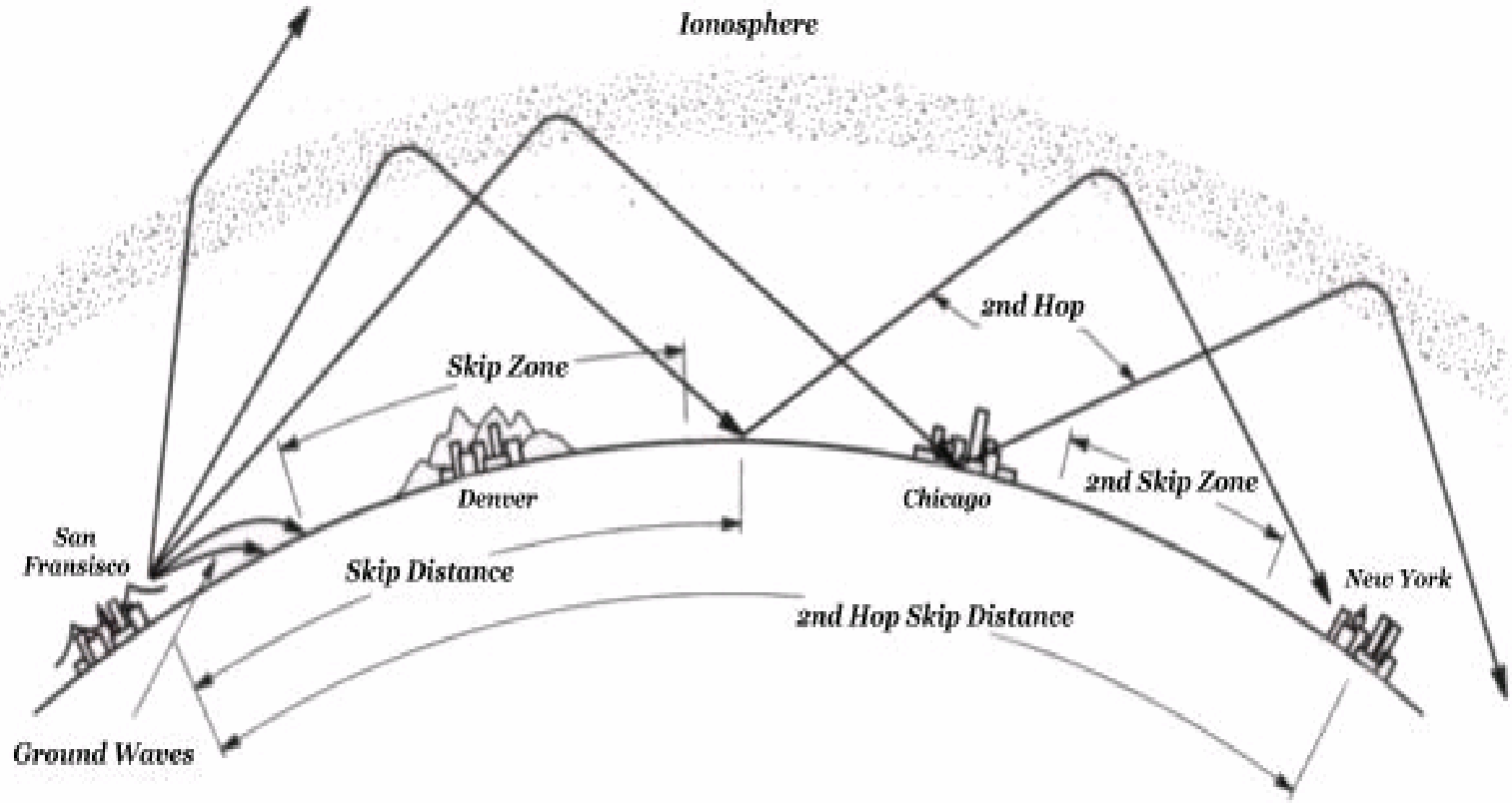


Layer	Distance
D	25-55 Miles
E	55-90 Miles
F	90-250 Miles
F1	90-150 Miles
F2	>250 Miles

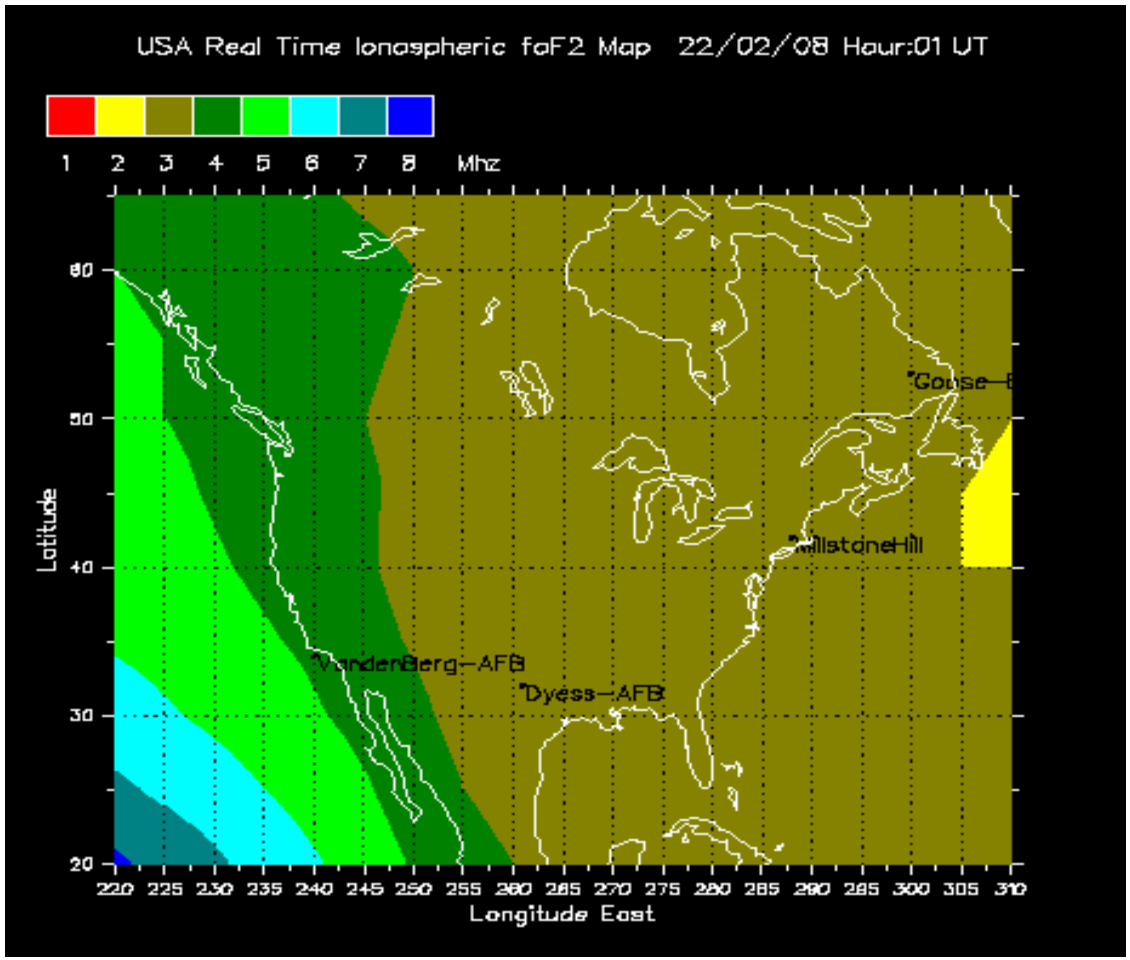
Critical Frequency (foF2)



Skip Zone

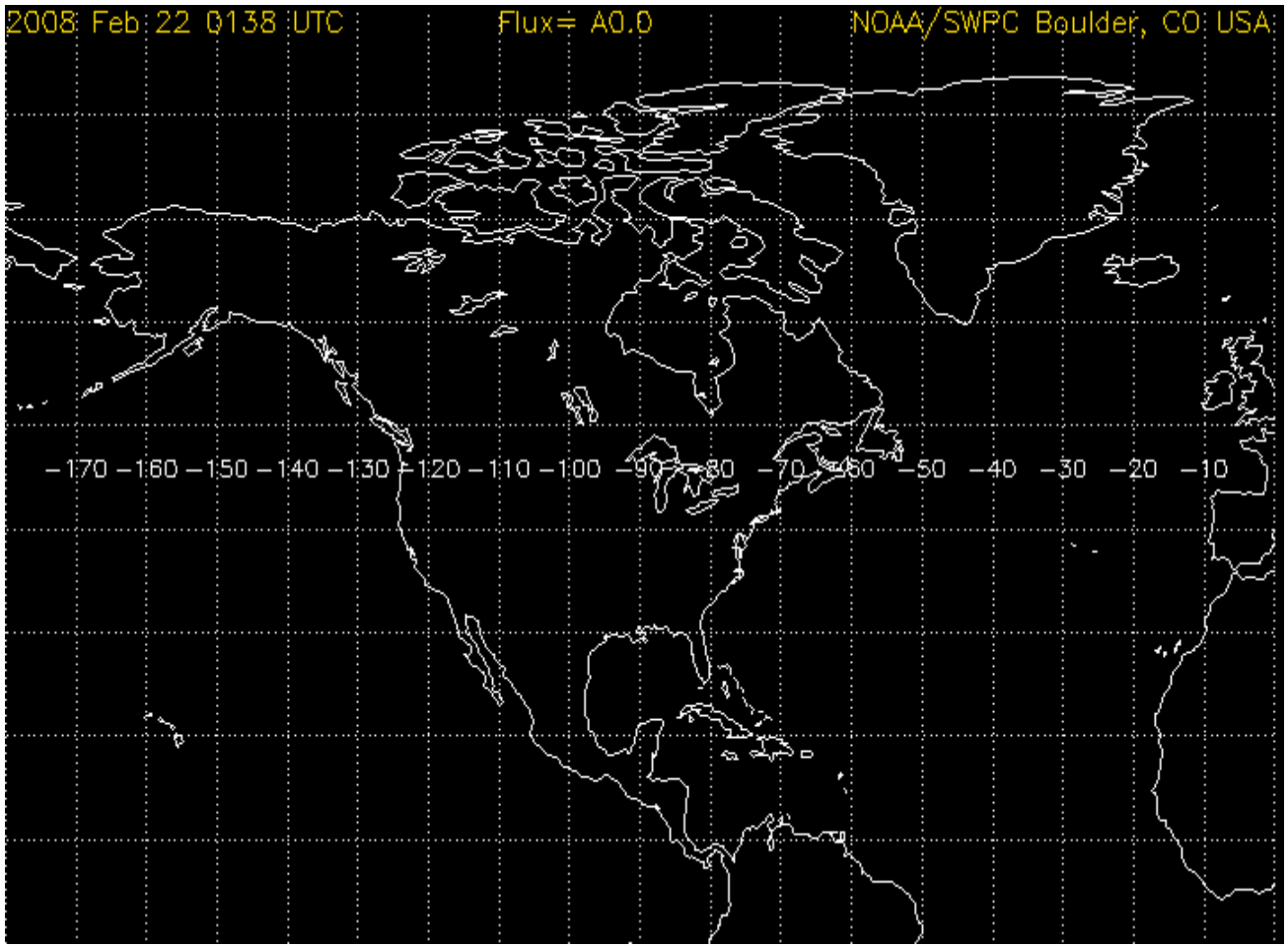

Ionosphere
2nd Hop
Skip Zone
Denver
Chicago
2nd Skip Zone
San Fransisco
Skip Distance
New York
2nd Hop Skip Distance
Ground Waves

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

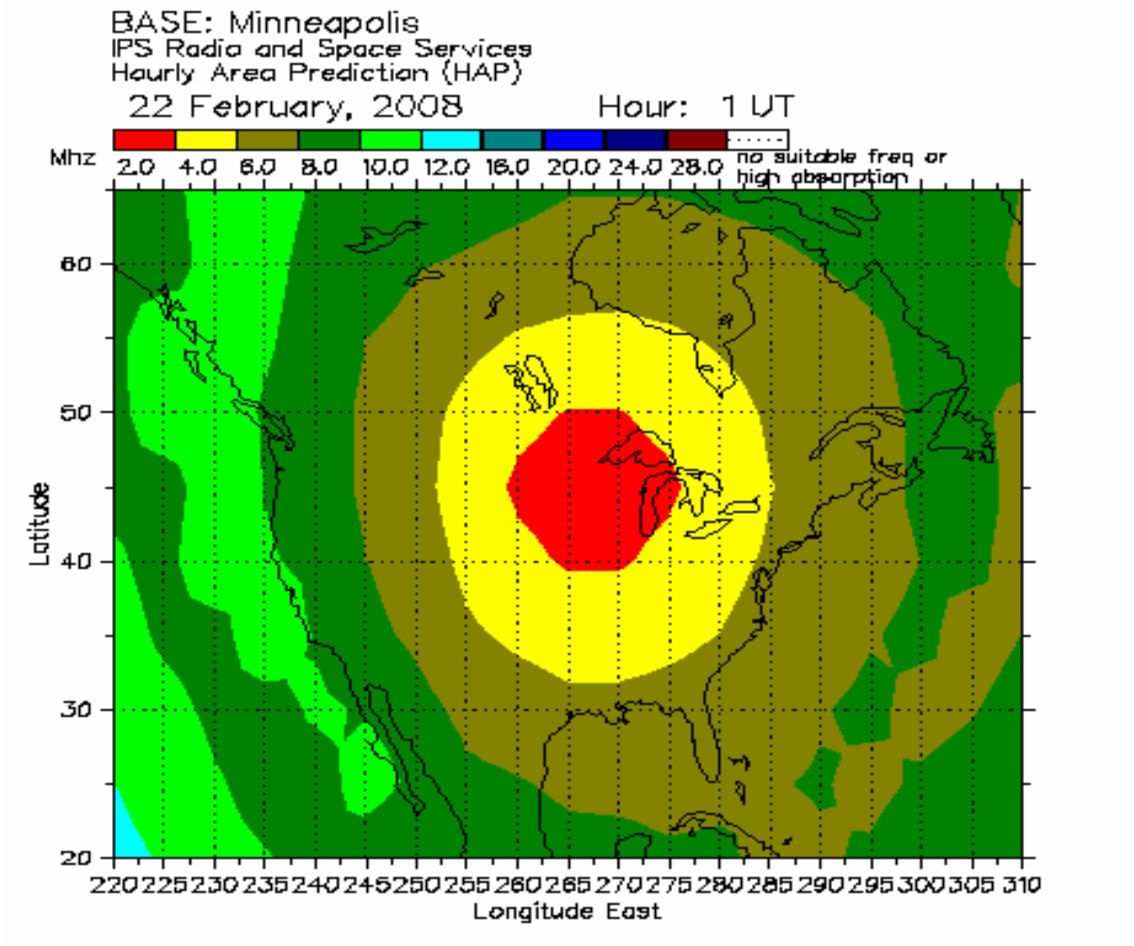


http://www.swpc.noaa.gov/dregion/dregion_q1.html

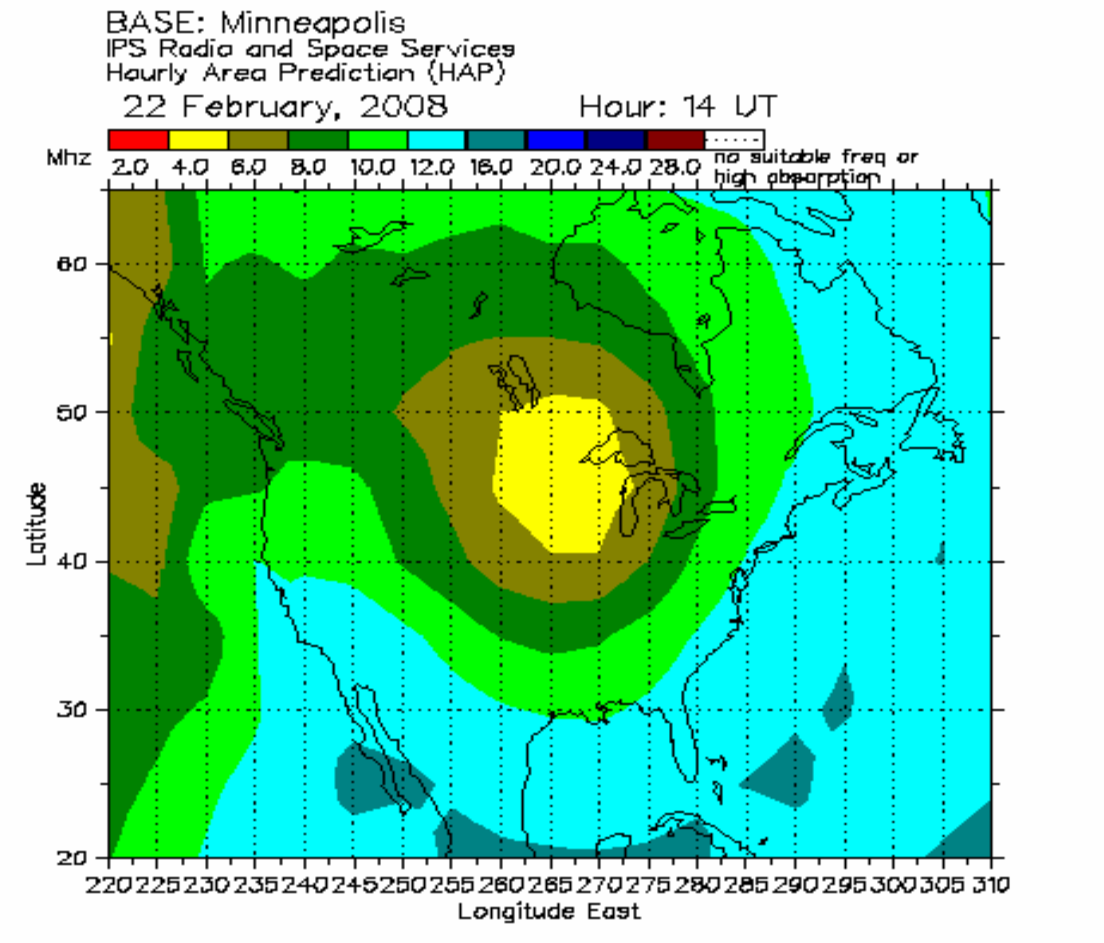
D Region Absorption



http://www.ips.gov.au/HF_Systems/4/1/1 (9 pm local)

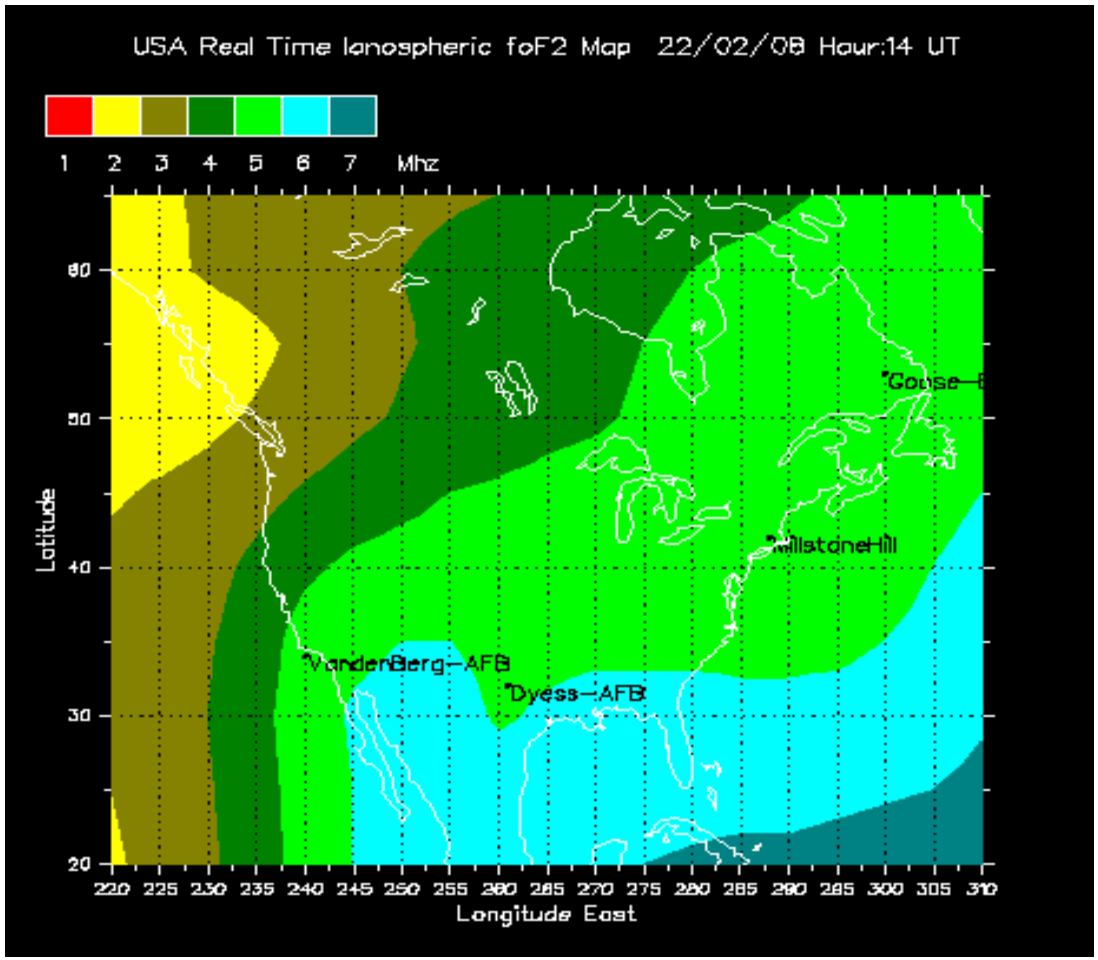


Mobile to Base Comms, Best Freq. (Base in Minneapolis)



Real Time foF2 (10 am local)

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



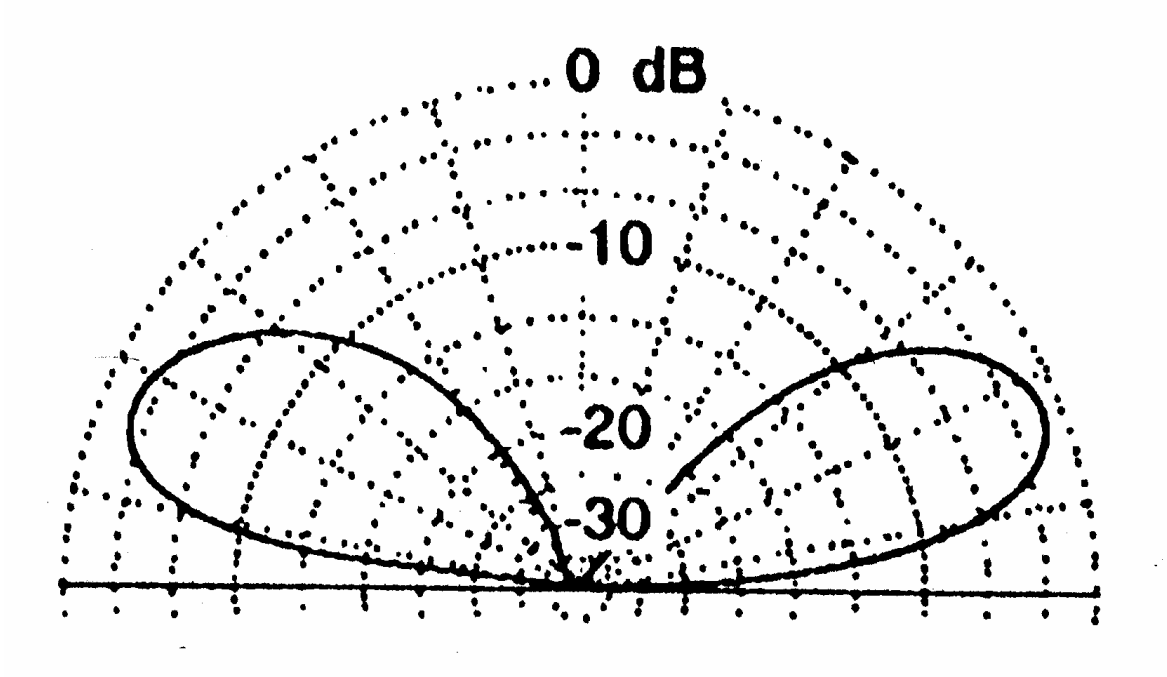
Calling Protocols

- 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

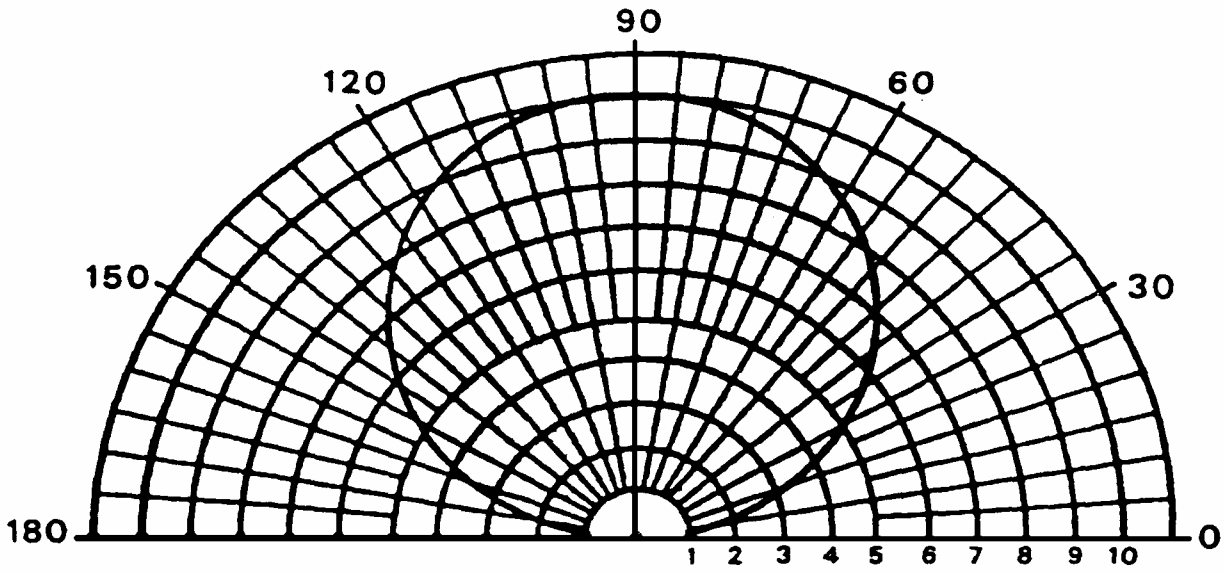
60 Meters

- 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 0.5 lamda



Dipole at 0.25 lamda



NVIS Antenna Heights

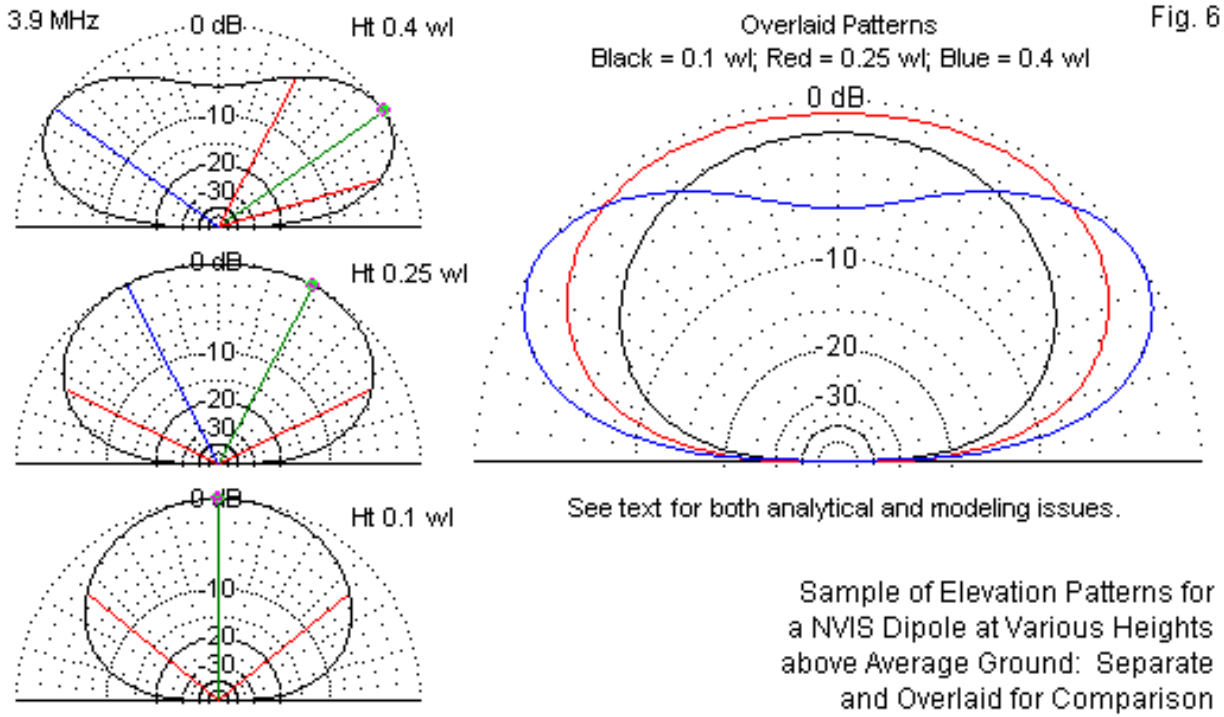


Fig. 6

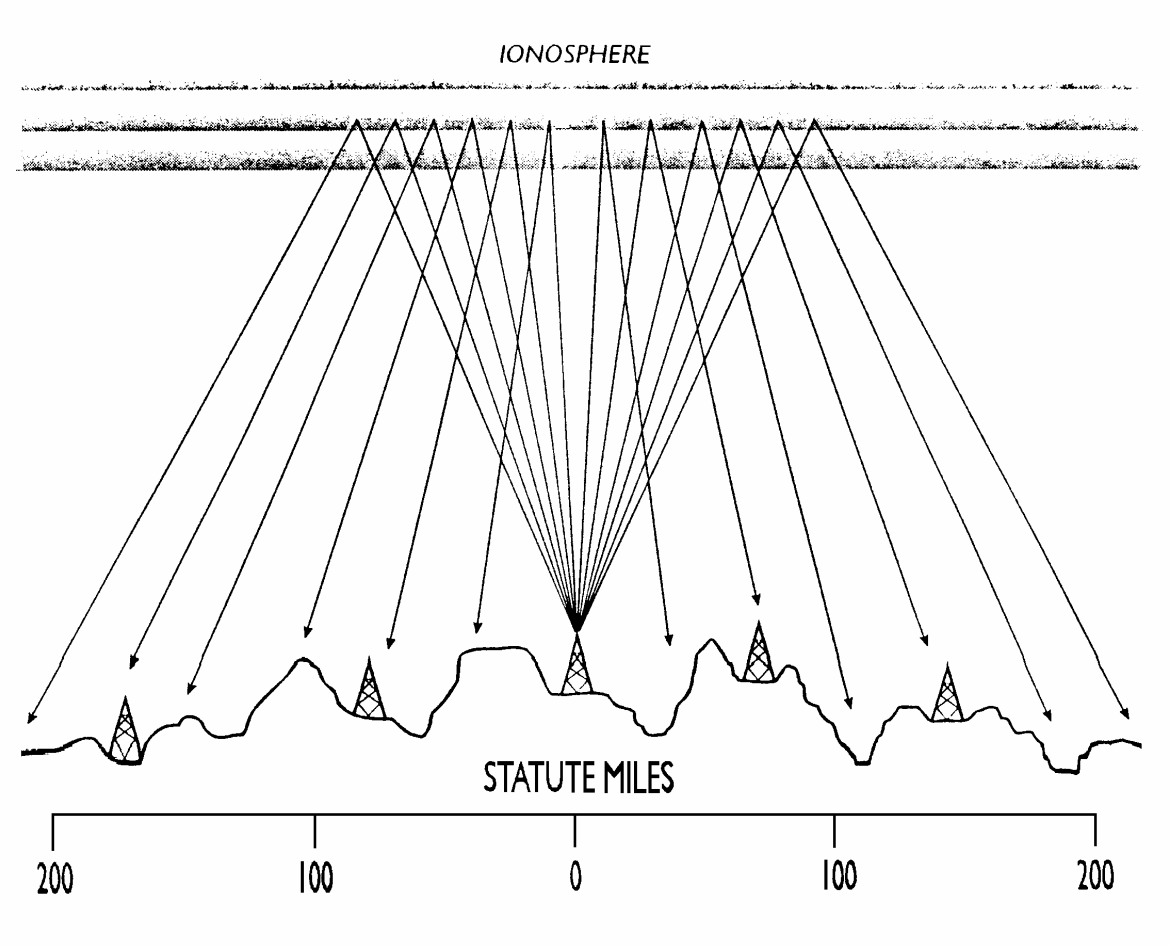
See text for both analytical and modeling issues.

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

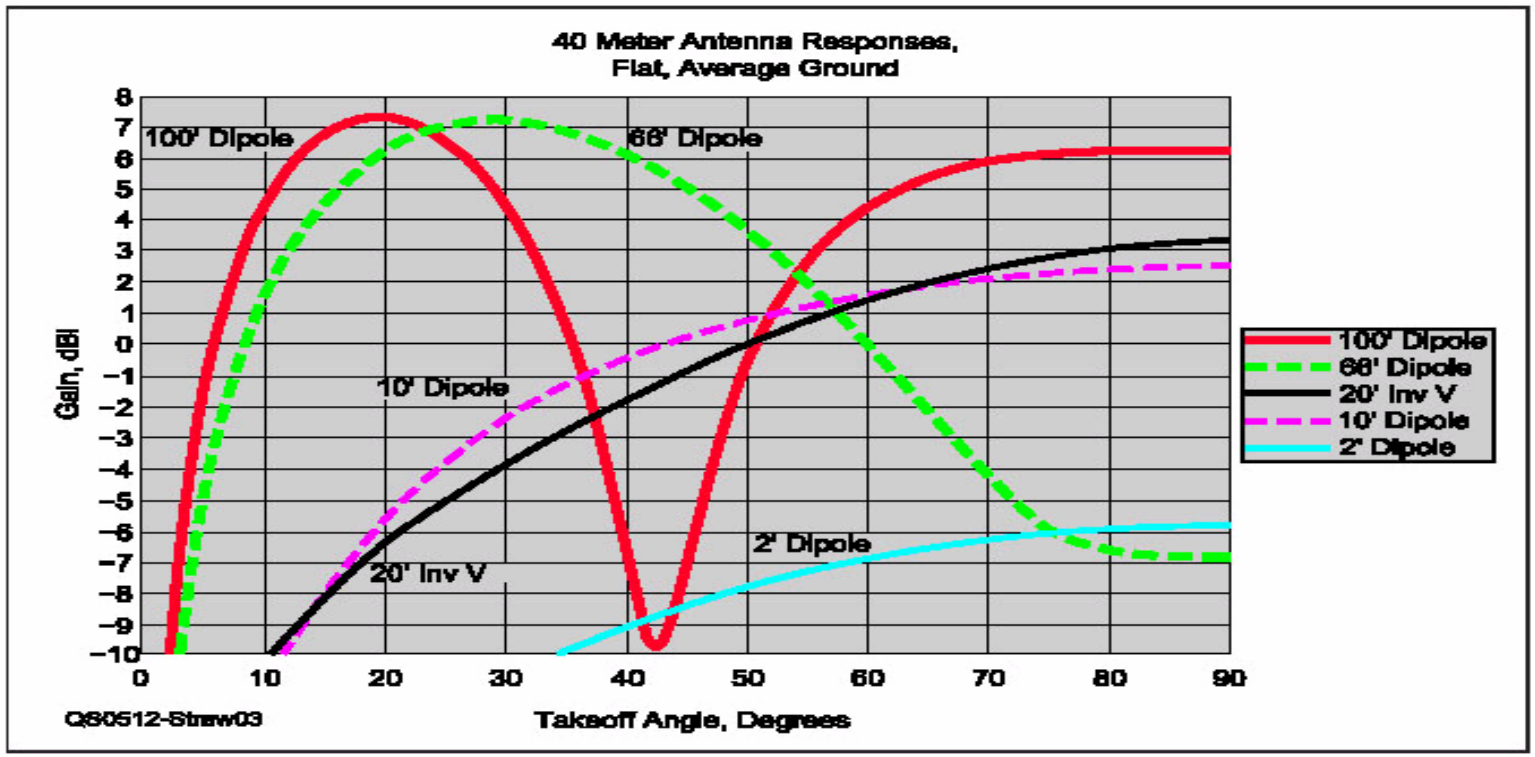
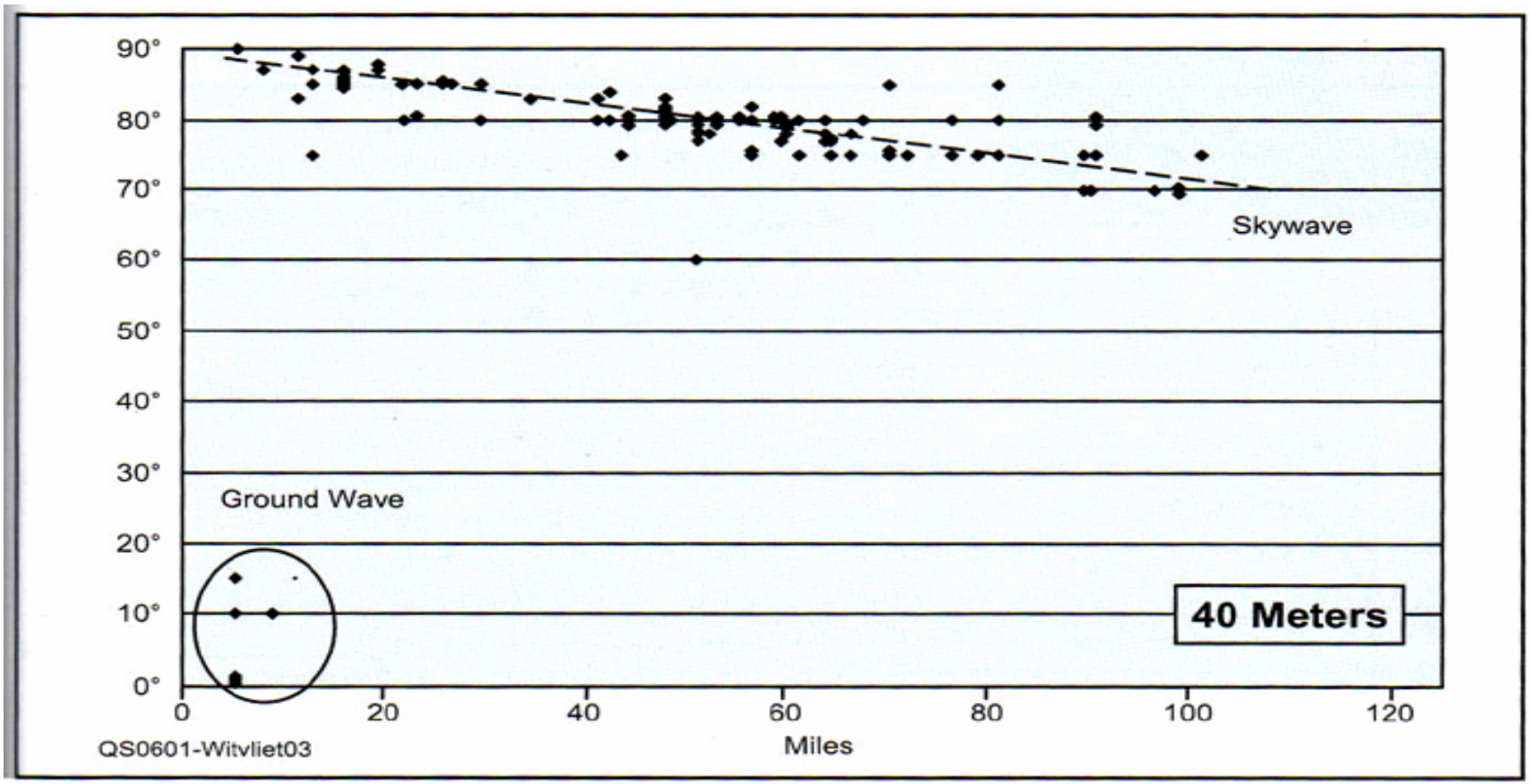


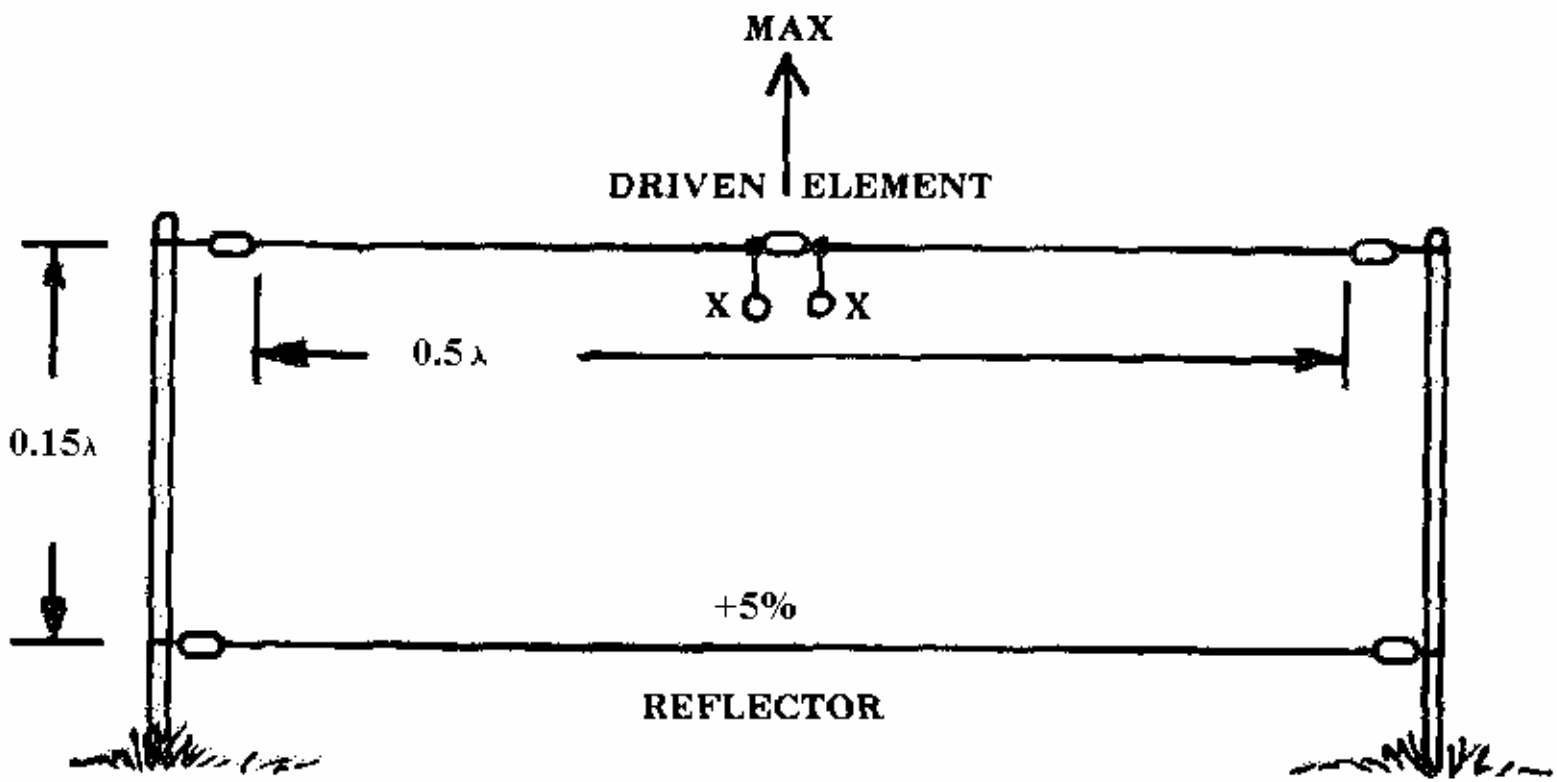
Figure 3—Elevation plots for different 40 meter antennas above flat ground with average ground characteristics (5 mS/m conductivity and dielectric constant of 13). The 10 foot high flattop dipole and the 20 foot high Inverted V dipoles both have close to the same characteristics. Note that there is a 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

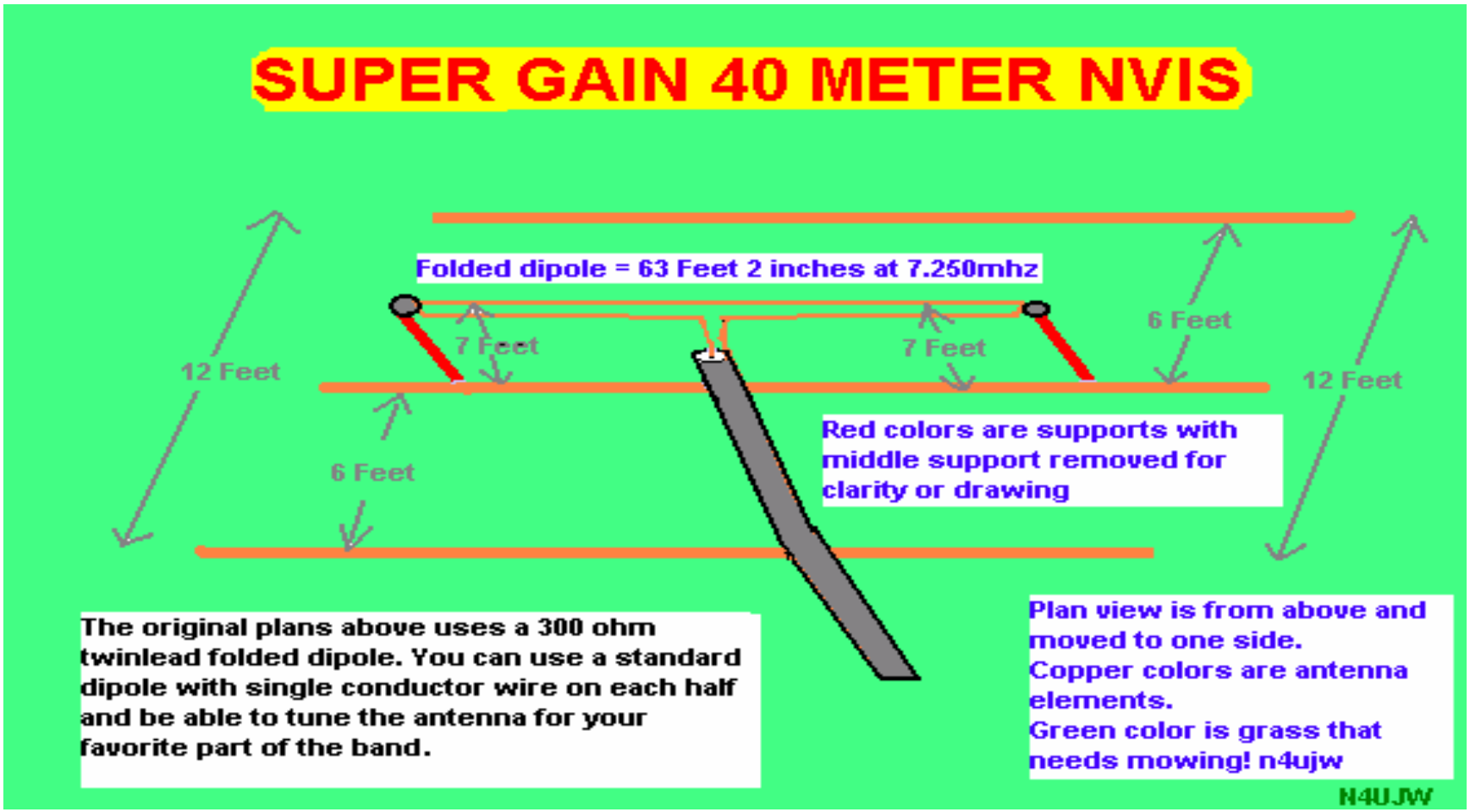


Elevation angle of Dutch stations as a function of the distance, on 40 meters.

NVIS Dipole with Reflector

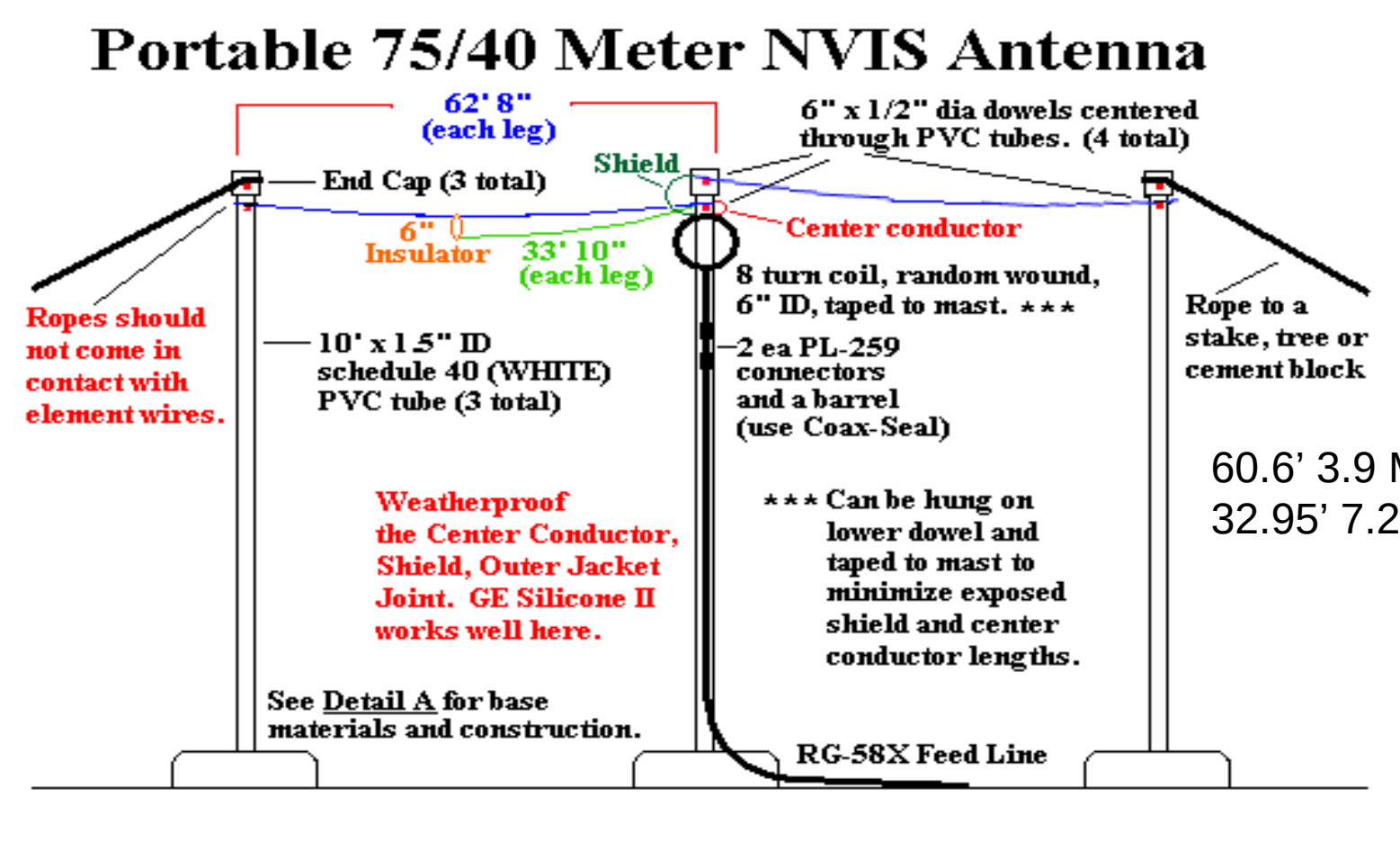


40 Meters Design



NVIS 40M antenna

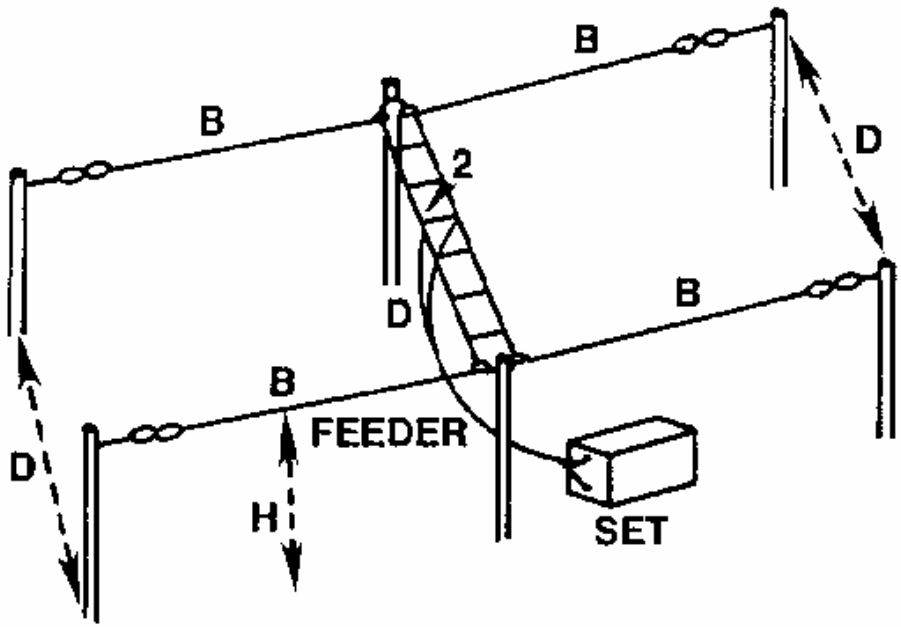
http://www.starc.org/technotes/75-40%20meter-nvis.html



60.6’ 3.9 MHz
32.95’ 7.2 MHz

NVIS “Jamaica” Base Array

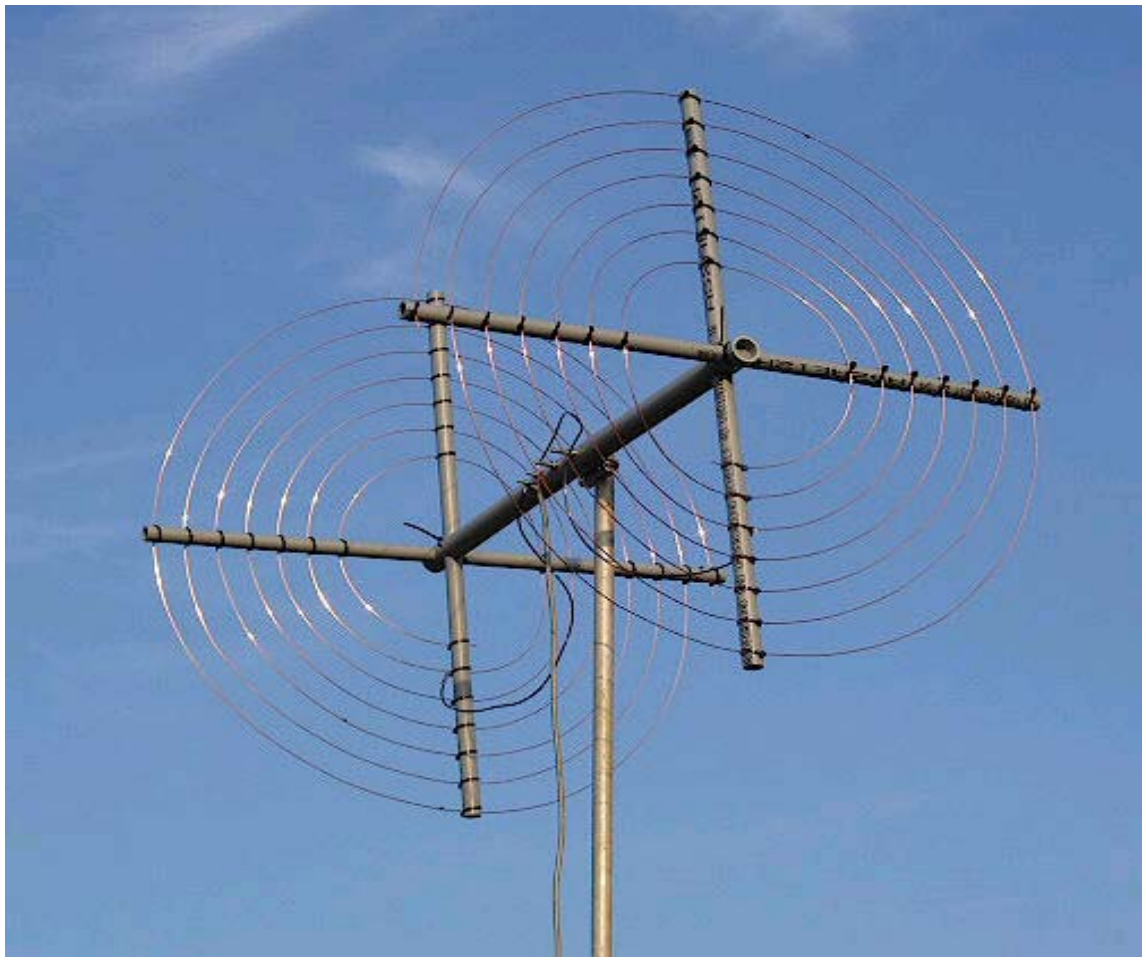
High gain fixed antenna for EOC, 12 db with ground level 1.5 lambda square planar reflector



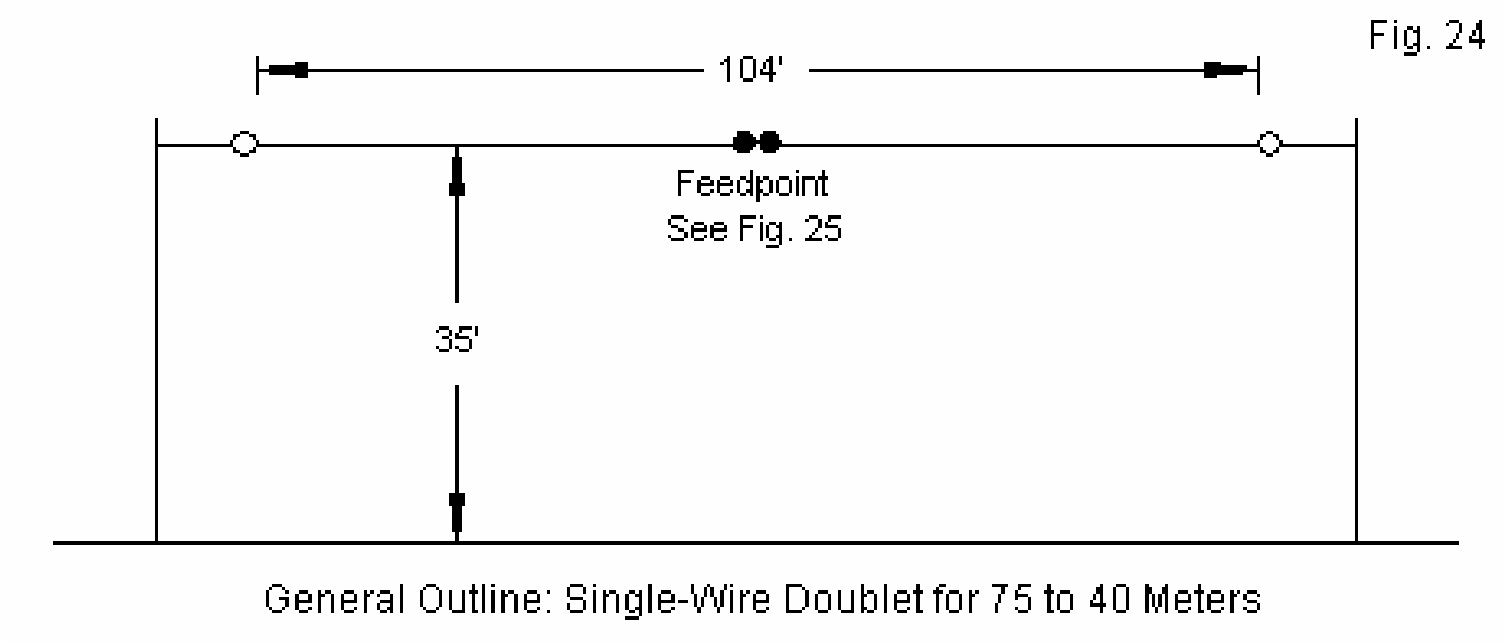
B=1/2 λ
D=1/2 λ
H=1/8 TO 1/4 λ

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



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

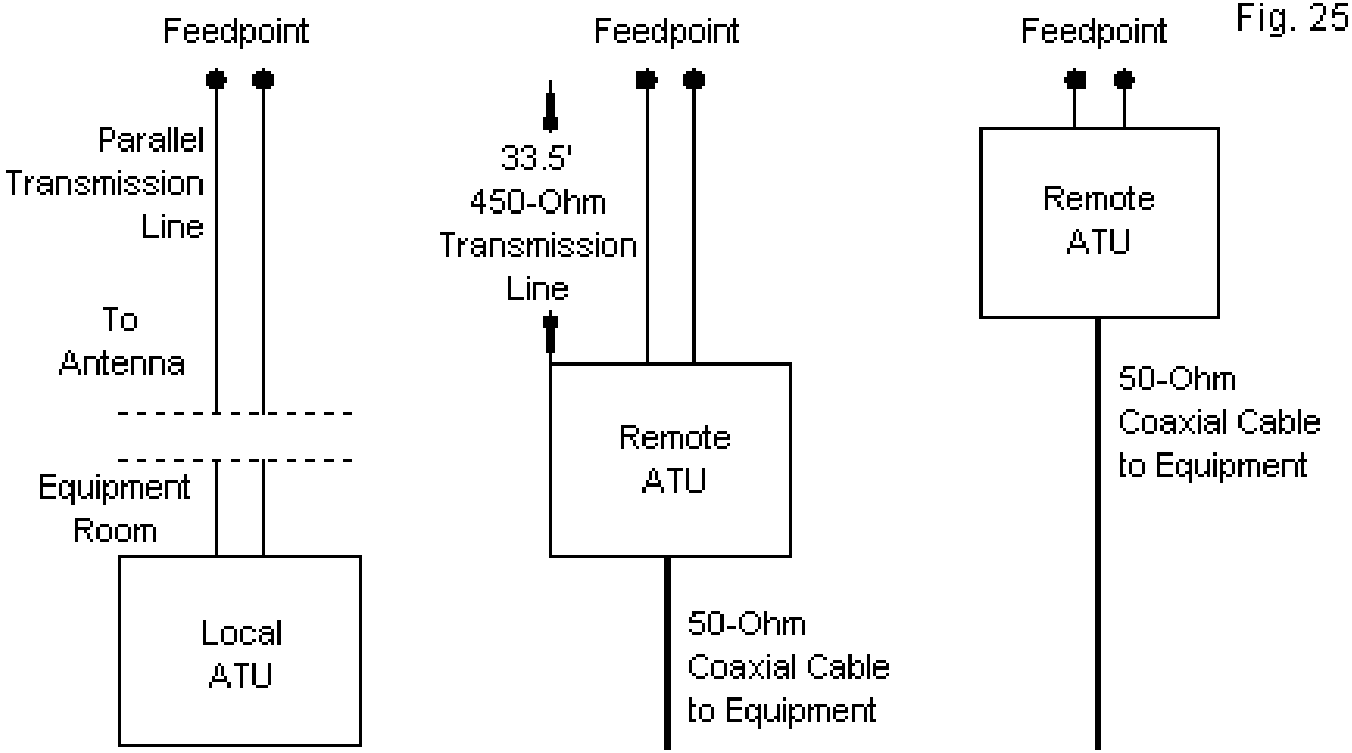
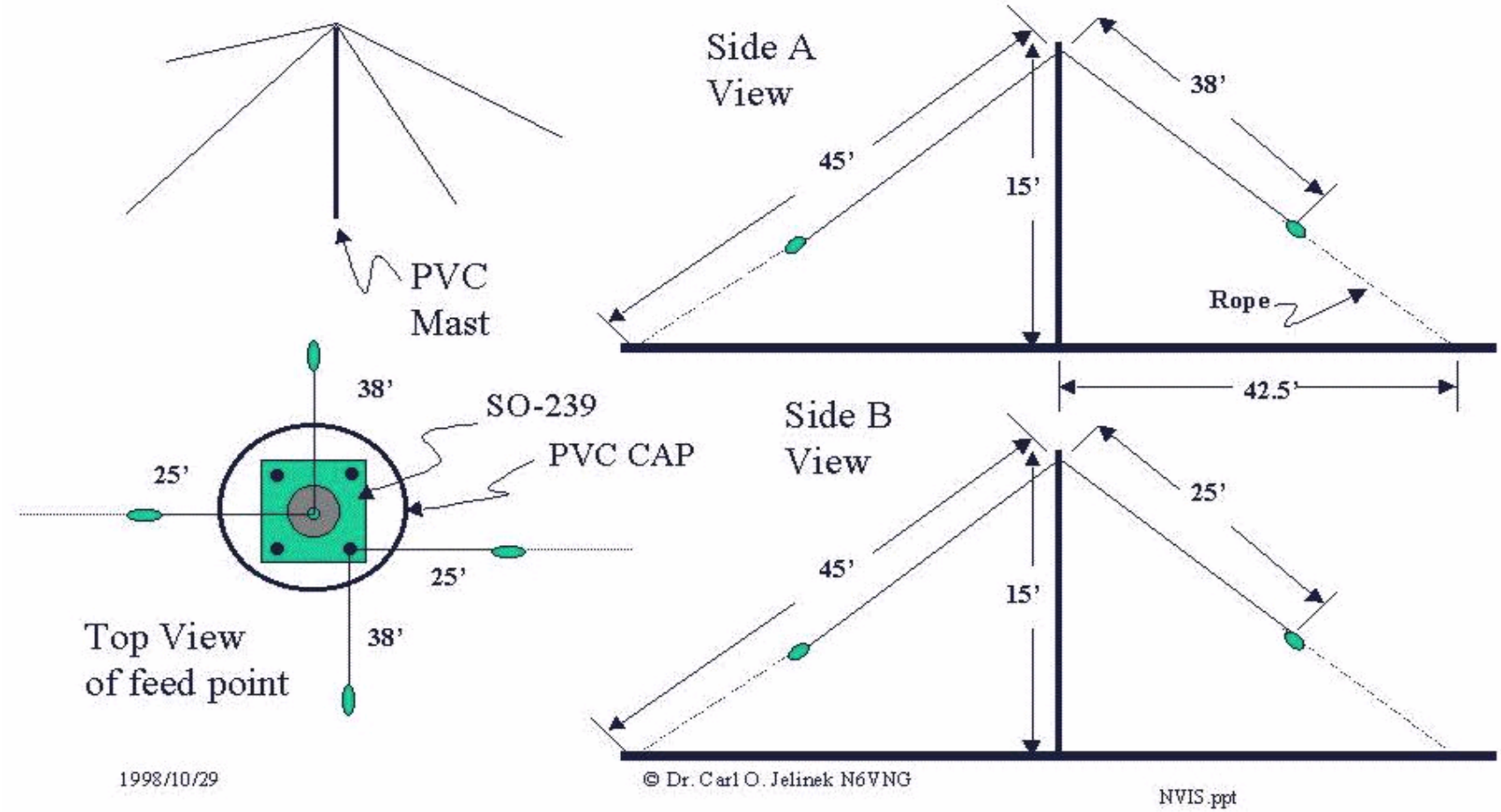


Fig. 25

Alternative Methods of Feeding the 75-40-Meter Doublet

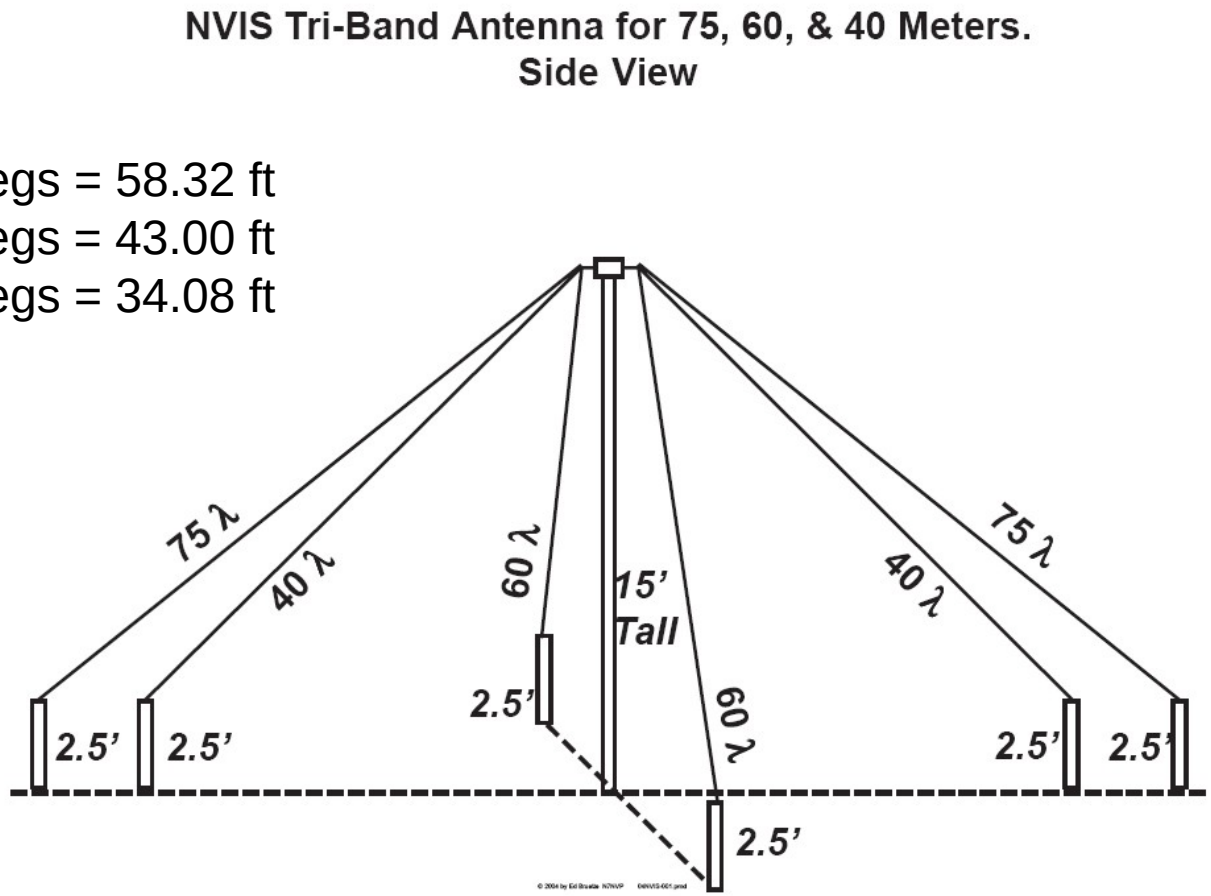
Dual Bander

Inverted V antennas are down 3db from dipoles or loops

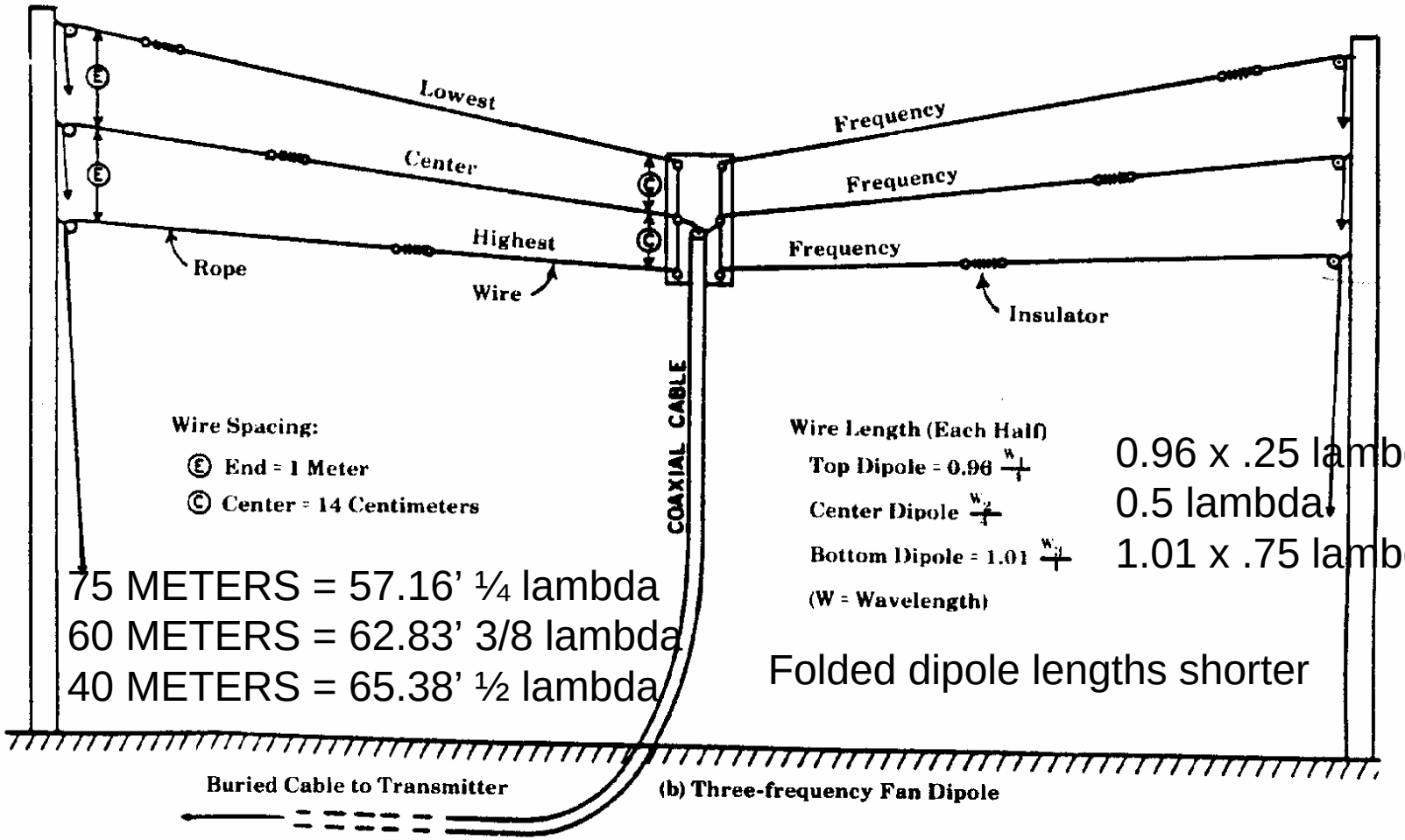


Tribander

75 Mtr legs = 58.32 ft
60 Mtr legs = 43.00 ft
40 Mtr legs = 34.08 ft



NVIS Fan Dipole Tribander



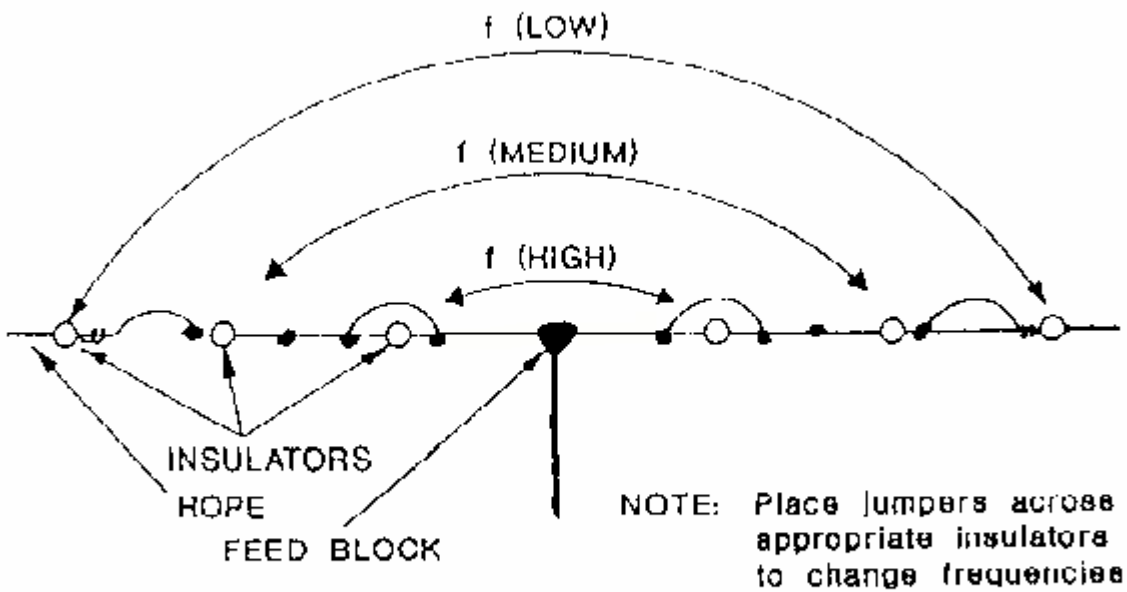
0.96 x .25 lambda
0.5 lambda
1.01 x .75 lambda

75 METERS = 57.16’ ¼ lambda
60 METERS = 62.83’ 3/8 lambda
40 METERS = 65.38’ ½ lambda

Folded dipole lengths shorter

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.

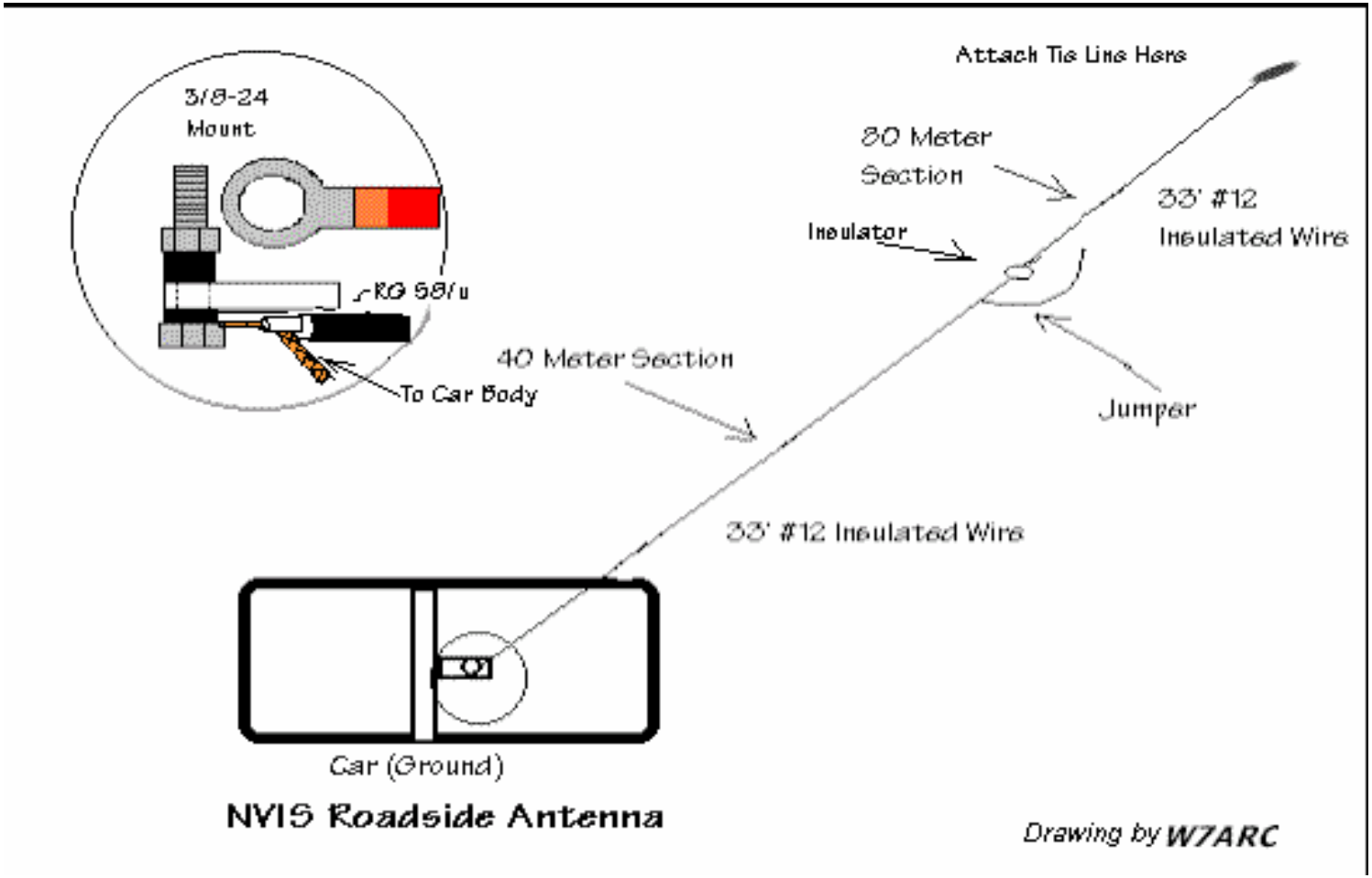
NVIS Jumpered Tribander



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

75/60/40 Meter RACES

Mobile NVIS


3/8-24
Mount
RG 58/u
To Car Body
Attach Tie Line Here
80 Meter
Section
Insulator
33' #12
Insulated Wire
40 Meter Section
Jumper
33' #12 Insulated Wire
Car (Ground)
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 GM0MEN

* Near Vertical Incidence Skywave