NVIS

Near Vertical Incidence Skywave.

An HF Strategy for ARES .

Winnipeg Amateur Radio Club, Hamfest 2008, in conjunction with the Radio Amateurs of Canada (RAC) Annual General Meeting.

August 8th to 10th 2008.

NVIS "Cloudwarming"

- NVIS, pronounced "*NEH*-vis".
- It's been used for generations.
- You've probably used it on 80 meters.
- Your low-band signal goes straight-up and comes back and showers the general area.

How Long Have we used NVIS?

- Developed during WW2.
- Proven in Vietnam and Op. Desert Storm.
- Used daily by Hams, but we just don’t call it by its right name!
- Enjoying a “re-birth” due to new HF access.

Why NVIS is important for ARES Operation.

- NVIS uses HF, not VHF.
- No dependence on VHF/UHF Repeaters.
- Each HF Mobile is independent.
- Massive area coverage from 1 station.
- Not restricted to “line of sight” operation.
- Low power HF operation…(5 Watts!).
- Day / Night & all-season availability.

Why the Ionosphere is important.

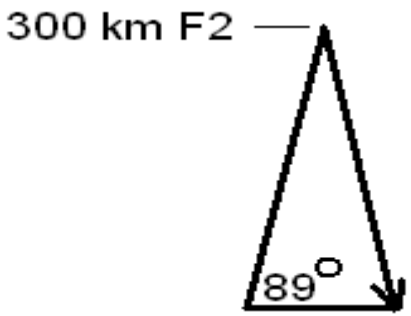
- The height of the F2 layer of the ionosphere is about 300km above the Earth and acts as an “HF Reflector”…(refraction, actually).
- Your HF signal is shot straight-up and comes back down in a huge area.
- The dB losses for the trip up and back are so low that modest antennas and low power can achieve an S9 signal !

Your NVIS Signal “Showers” the Area, out to about 1000 km.

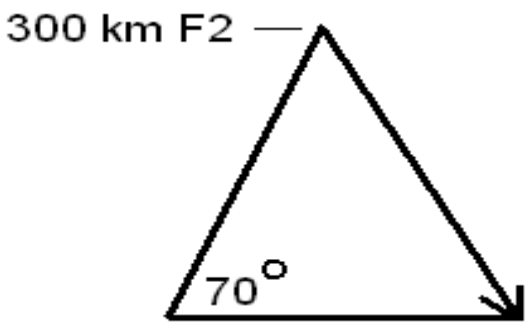
How do we shoot a signal “straight-up”, so that it will “shower” the area?

- Use a horizontal antenna…(no vertical whips!)
- Keep the antenna low to the ground.
- About 0.05 to 0.20 wavelengths high.
- Use 160m, 80m, 40m as required.
- Our American Friends can also use their new 60m band as well.

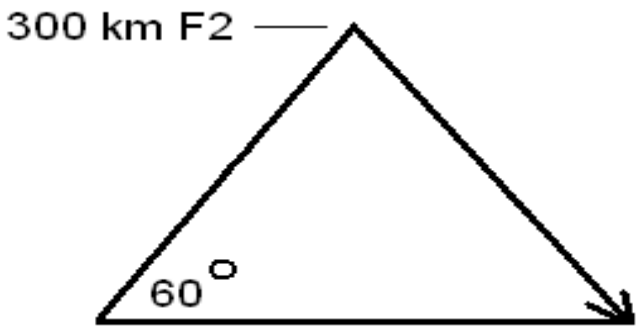
4 NVIS Launch Angle Examples.



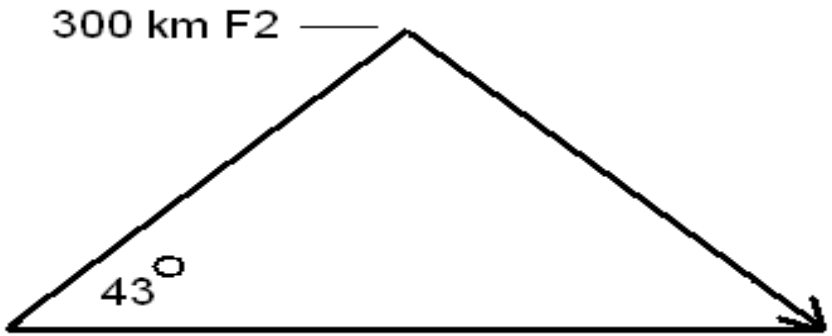
10 km, 6 miles



209 km, 130 miles

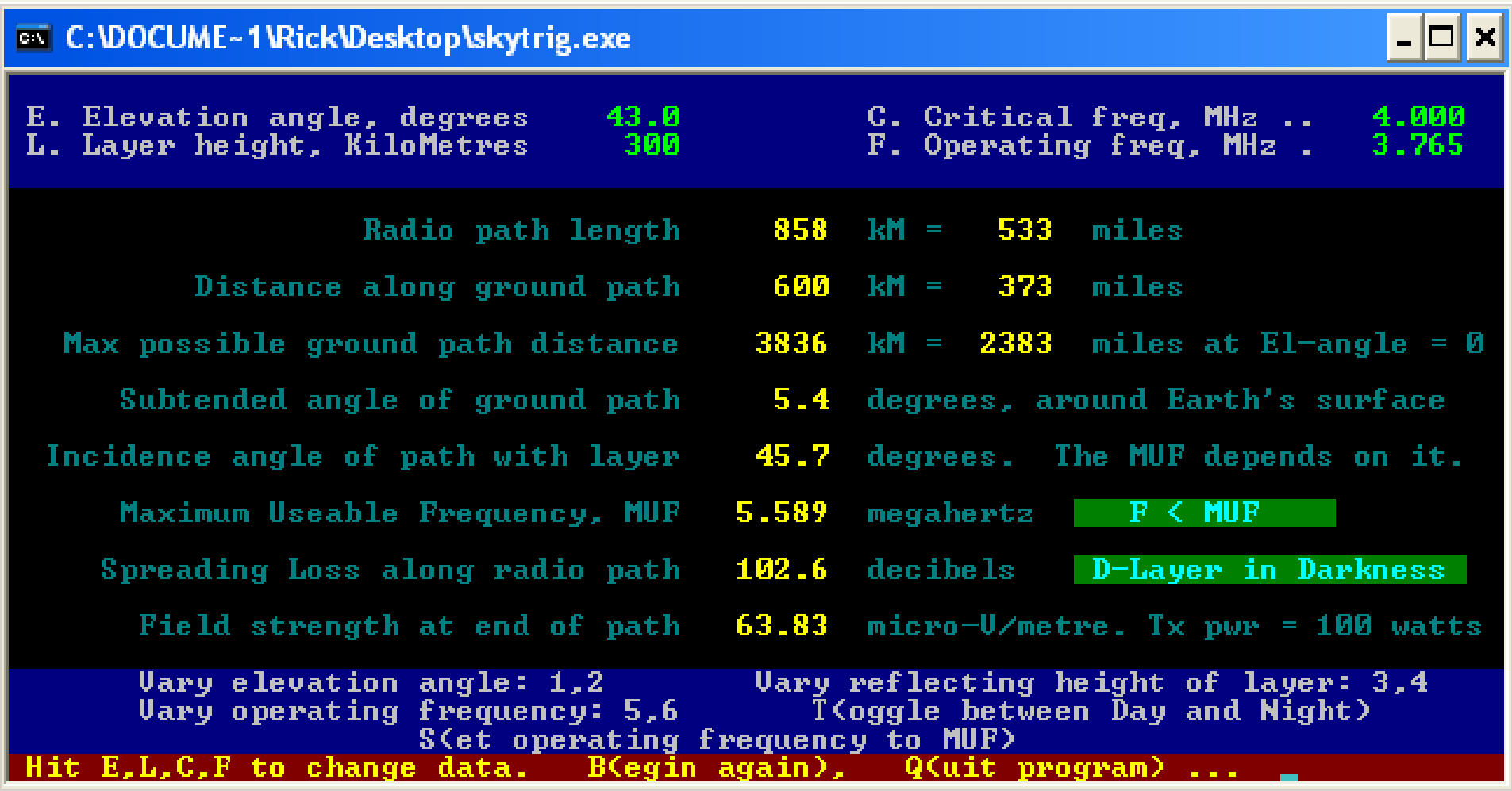


328 km, 204 miles



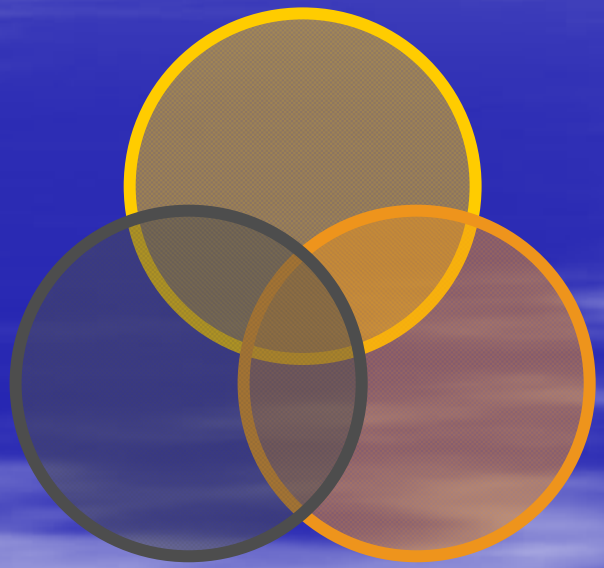
600 km, 373 miles

“Skytrig” Path Calculation



NVIS Is A "*Technique.*"

WHAT ANTENNA HEIGHT ?



WHAT POWER LEVEL ?

WHAT FREQUENCY ?

What Power Level ?

- The usual “barefoot” (100 Watt) Rig is more than enough. In fact, 5 Watts is plenty!
- A QRP (5 Watt) Rig will give you an S9 to S9+ signal to a similar NVIS Station.
- The worst- case path loss is in the 99 dB to 111 dB range for 1000 km. This means that low power rigs can handle the job. This is good news for portable ARES ops.

Example: A 5-Watt rig over a 1000 km ground path via the ionosphere F2 Layer at a 300 km height.

Freq. MHz	Path Loss dBm	Received Power dBm	Urban Noise Level dBm	Signal to Noise Ratio
1.875	-99.4	-62.4	-84	+ 21.6
3.750	-105.4	-68.4	-93	+ 24.6
7.150	-111.0	-74.0	-101.5	+ 27.5

This example assumes that both the transmitting antenna and the receiving antenna are isotropic radiators with Gain = 0 dBi. Also assumed is that any transmission line losses are 0 dB at both ends of the link.

What Antenna Height ?

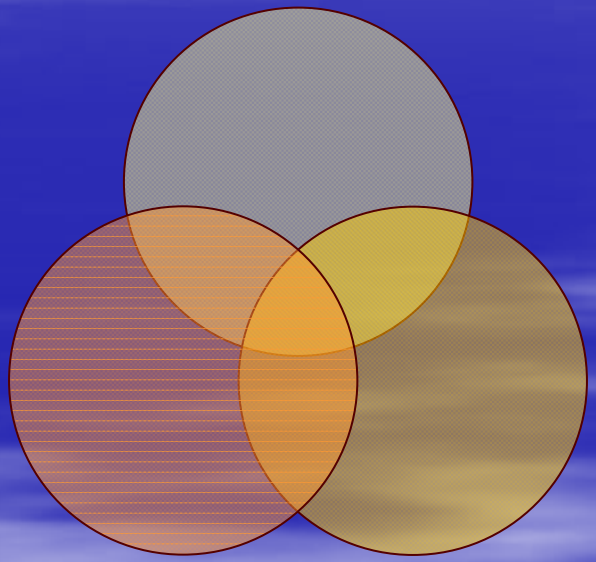
- A Horizontal…(*not vertical !*) antenna, about 0.05 wavelengths to 0.25 wavelengths above the ground is required. Higher is *not* better.
- Depending on the ground conductivity below your NVIS Antenna, a 0.2 wavelength height is about optimum.
- Lowering your NVIS antenna actually *improves* your Signal to Noise Ratio.

What Frequency ?

- Ah, yes! Here's where the "*Technique*" part comes in.
- One of the three "Low Bands" (160m, 80m, 40m) is going to be your correct choice.
- Again, our American Friends can also use their 5 new channels at 60m .
- NVIS techniques are restricted to the "Low Bands", so forget about 20m., 15m etc.

What Frequency ?

IS IT DAYTIME OR NIGHTTIME ?



SOLAR FLUX ?

FOF2 ?

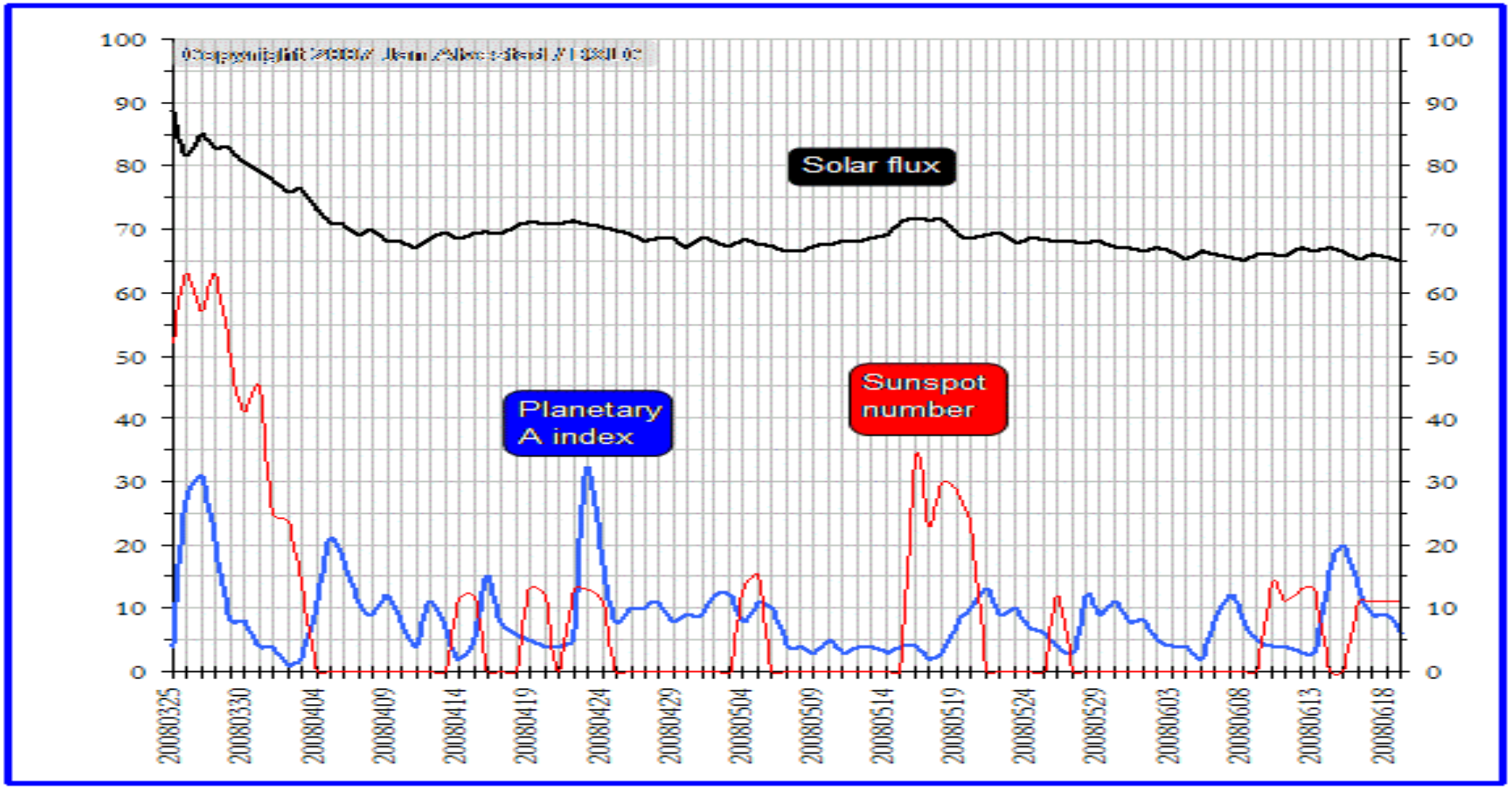
Is it Daytime or Nighttime?

- 160m is useless during the daytime, due to D-Layer Absorption. *Use 160m at night!*
- 80m is adequate during the daytime. Better around dusk and dawn and nighttime.
- 40m is your best bet for daytime.

SOLAR FLUX ?

- You can pick up the latest “Solar Terrestrial Indices” from the Internet, or from WWV at 18 minutes after every hour.
- The Solar Flux is the amount of energy received from the sun on the 10.7 cm band.
- Solar Flux is a measure of Sunspot Activity, and hence a measure of propagation.

Solar Flux.


Solar flux
Planetary A index
Sunspot number
100
90
80
70
60
50
40
30
20
10
0
20080325
20080330
20080404
20080409
20080414
20080419
20080424
20080429
20080504
20080509
20080514
20080519
20080524
20080529
20080603
20080608
20080613
20080618

FOF2 ?

- FOF2 is the *Critical Frequency* of the F2 Layer. This is the highest frequency that the F2 Layer will return to earth when RF strikes it vertically……that is, “Straight-Up”.

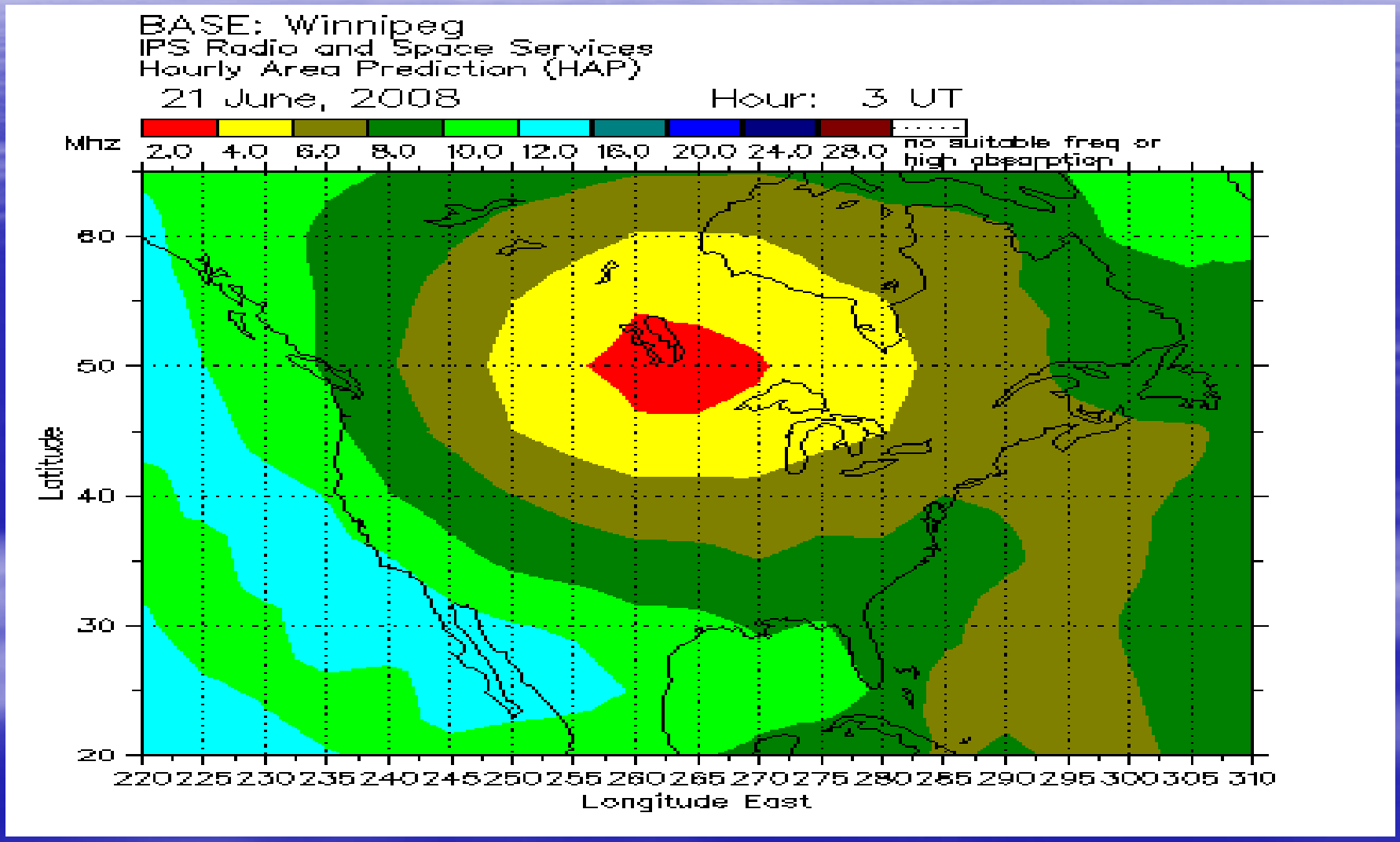
- You can get the latest hourly FOF2 from the Internet.

Introducing the HAP Chart.

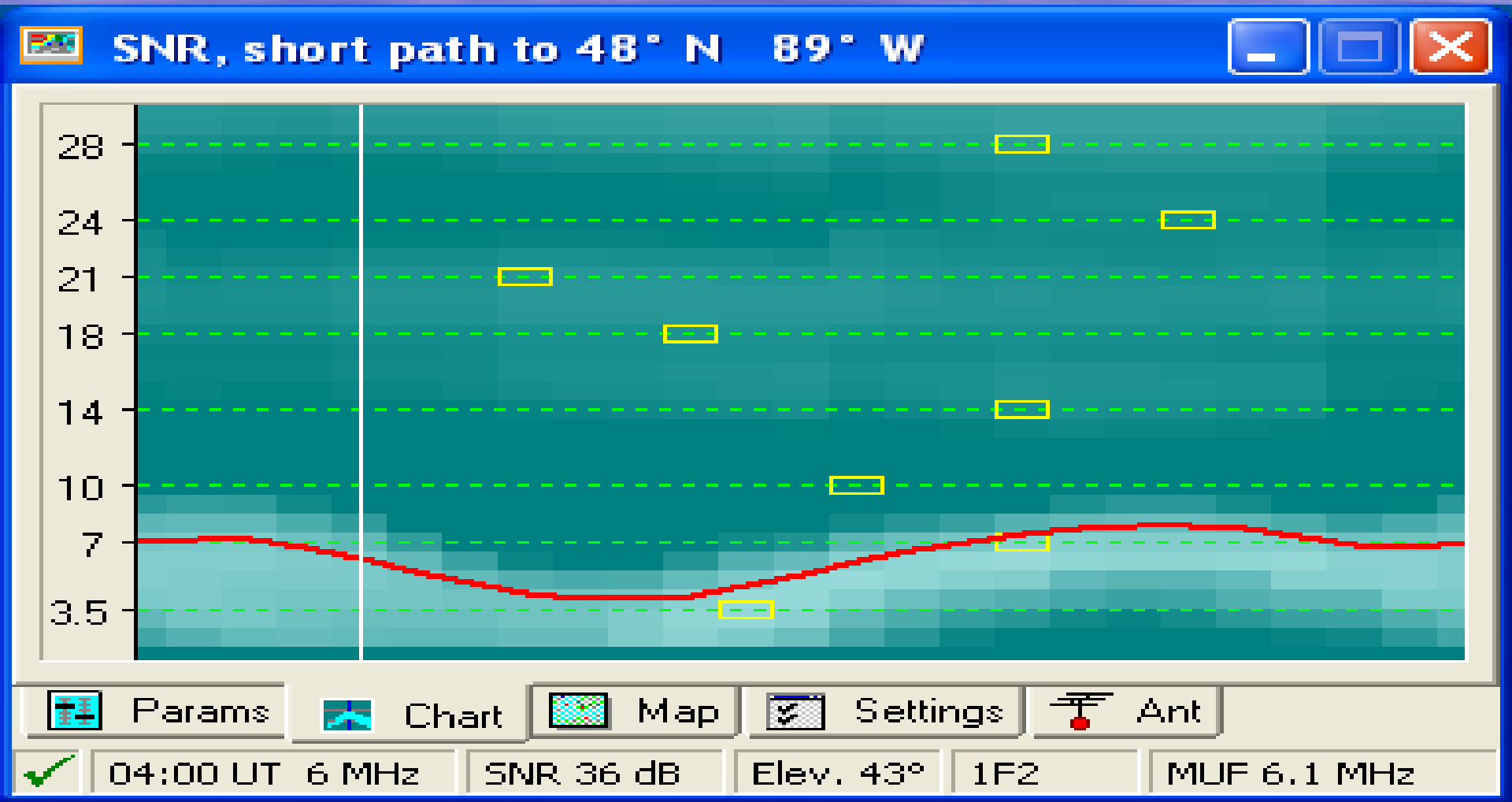
- Hourly Area Prediction charts are available from the Internet. A HAP Chart plots the FOF2, or *Critical Frequency.* This is a *crucial* piece of information for NVIS ops!

- The FOF2 varies during the day, night, seasons, and Sunspot Cycle. To establish reliable NVIS Communication, you need to know its value.

Winnipeg HAP Chart.



Winnipeg MB to Thunder Bay ON
Maximum Useable Frequency ,MUF



Link Establishment.

WHAT TIME ?

WHAT FREQUENCY ?

WHAT MODE ?

What Time ?

- Establish *written* time protocols!
- As an example from Blaine Osepchuk, VE6BKO from Edmonton ARES:
- “ Use 1.844 MHz (LSB) for nighttime NVIS from 2 hours after dark until 2 hours after sunrise”.

What Mode?

- Establish *written* Mode Protocols!
- Example from VE6BKO:

"1.844 MHz (LSB)"
"3.765 MHz (LSB)"
"7.055 MHz (LSB)"

(This example is using the usual Lower Side Band protocol for the 40m, 80m and 160 m bands. Our American friends use USB on their 5 new channels on the 60m band.)

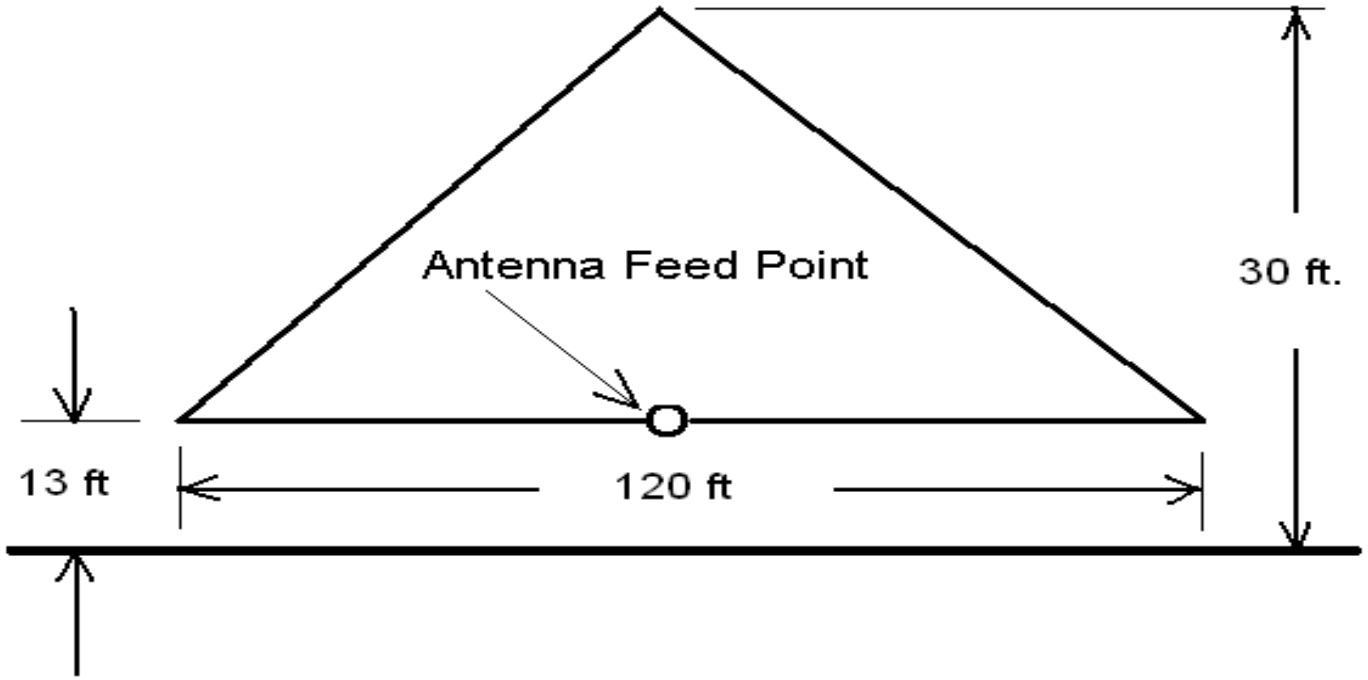
What Frequencies?

- Establish *written* Freq. Protocols!
- “Use the highest frequency for the link”
- “Freq. busy? Move up 3 kHz, and call or listen for 2 minutes.”
- “Busy or nothing heard? Move up 3 kHz and call or listen for 2 Min.”
- “Still nothing heard? Return to original frequency, and start over. Do not continue to move up the band.”

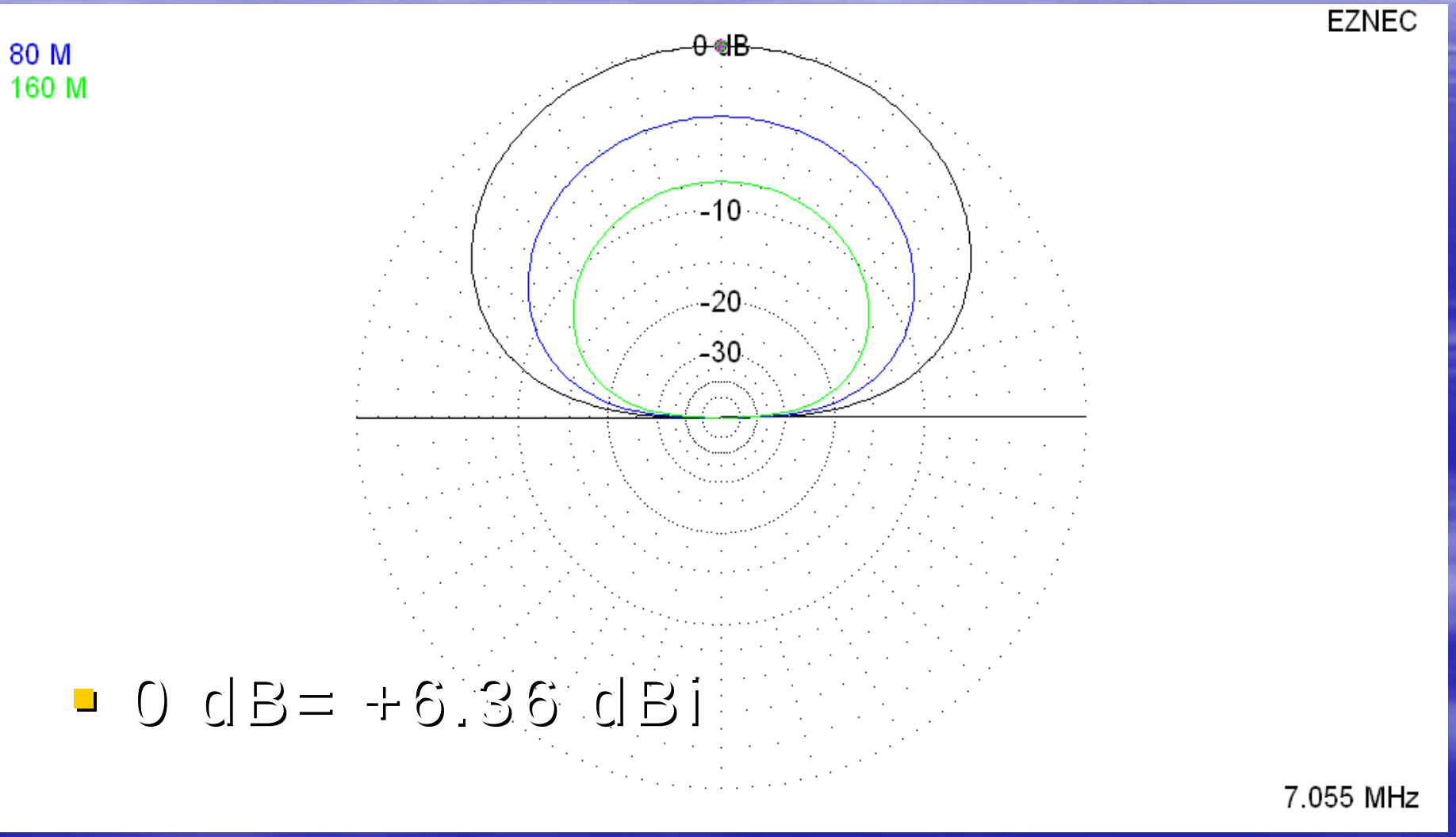
NVIS Antennas.

- ARES ops will need simple Dipoles and Inverted Vees.
- Base Stations can use more “real estate” to add 3 to 6 dB, by using a gain antenna.
- Remember that we need an antenna that works well over the 160m, 80m and 40m bands. Usually, this means 3 antennas fed from a common transmission line.

Dr. Marc Tarplee, Ph.D, N4UFP 3-Band NVIS Loop.

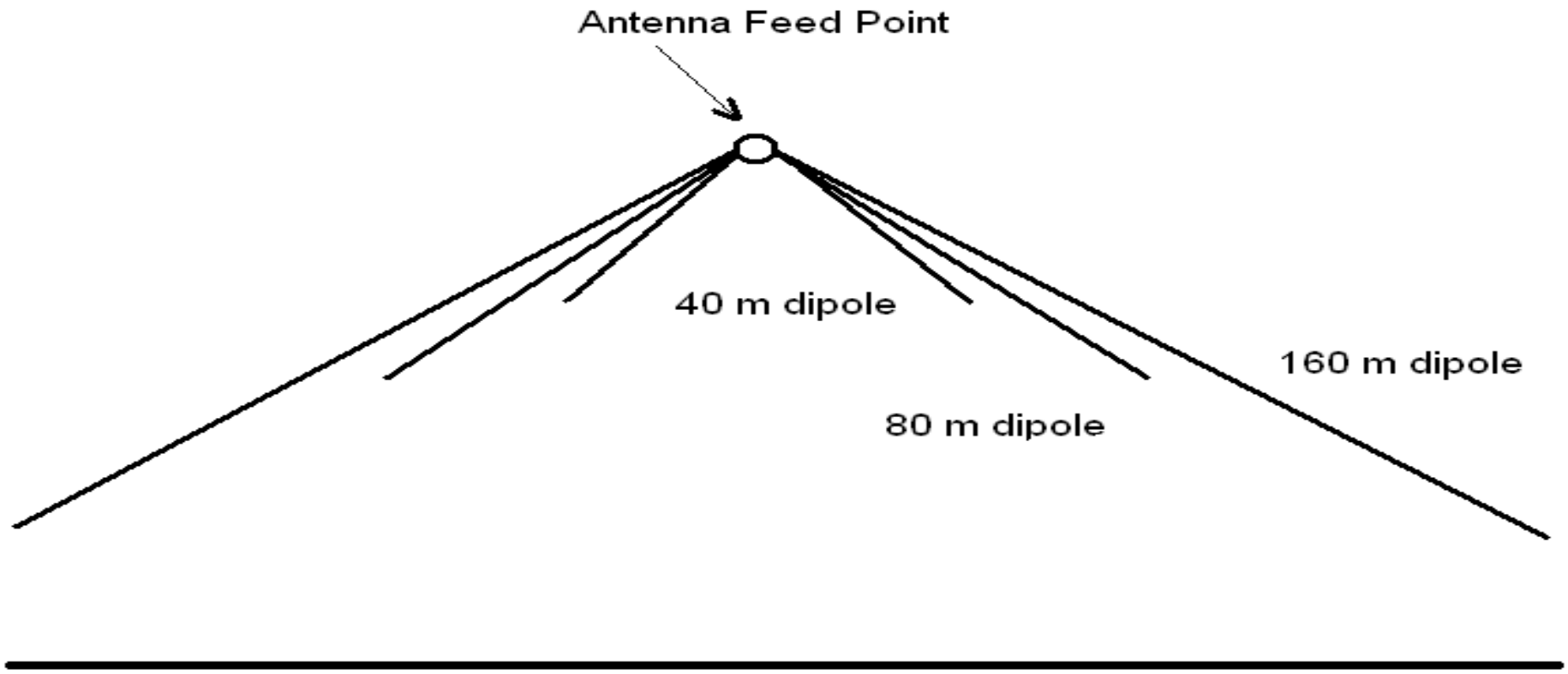


Tarplee NVIS Loop Elevation Plots.



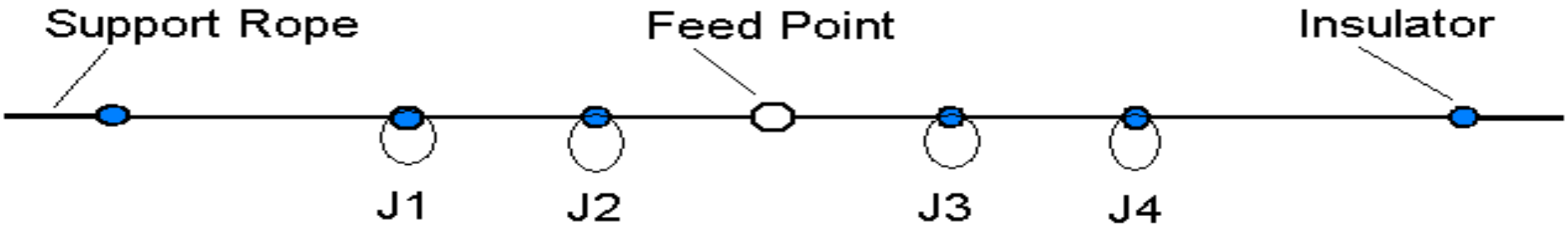
- 0 dB= +6.36 dBi

NVIS 3-Band “Fan” Dipole.



NVIS 3-Band "Jumpered" Dipole.

40m: no jumpers.
80m: jumpers J2 and J3, only.
160m: jumpers J1, J2, J3, J4



Advantages: Full-size dipoles on each of the 3 bands.
Resonant lengths allow easy SWR Matching.

Disadvantages: The antenna must be lowered to change frequencies.
No rapid QSY allowed.

Getting your feet wet with NVIS.

- Try experimenting on 80 meters, with a low horizontal dipole or inverted vee, with the apex at, say, 25 to 40 feet.
- Get a list of the nearby (Provincial or State) 80m nets to your QTH, and listen to the check-ins. Observe the wide area coverage.
- Check the internet for the hourly FOF2, and become more “propagation savvy”.

NVIS “Re-Cap.”

- NVIS is a *Technique*…(*not an antenna!*).
- Equipment and power levels are straight forward and usual for HF Operation.
- The unique things about NVIS are the very low horizontal antennas, and the need to operate close to the F2 Critical Frequency.
- NVIS techniques could be the “Silver Bullet” for ARES HF Operation.

Internet References.

SkyTrig: R.J. Edwards, G4FGQ, (SK): http://www.wireless.org.uk/g4fgq/page3.html

Solar Terrestrial Activity Report: http://www.dxlc.com/solar/

Australian Government: Ionospheric Prediction Service: HAP Charts: IPS Radio & Space Services
http://www.ips.au/hf_systems/4/1

ARES Edmonton AB: Blaine Osepchuk, VE6BKO
http://members.shaw.ca/ve6bko/overview.html
http://members.shaw.ca/ve6bko/update01.html

Dr. Marc C. Tarplee, Ph.D., N4UFP: Near Vertical Incidence Skywave (NVIS).ppt
http://www.arrl-sc.org/tech_presentations_by_n4ufp_tc.htm

EZNEC: Antenna Software by W7EL, Roy Lewallen, P.E., W7EL
http://www.eznec.com

HamCap 1.5 Alex Shovkoplyas, VE3NEA
http://www.dxatlas.com/hamcap/

RAC/TCA Amateur Radio Calculators: Professor Emeritus David Conn, Ph.D., P.Eng., VE3KL
"Field Strength" and " Received Power and Path Loss"
http://www.rac.ca/tca/tcacalculators.htm

NVIS

- Thank you!
- Questions ???
- 73 de Rick Lord, P. Eng., VE4OV