Newcomers and Elmers Net 4-19-15

Jerry W1SCR

NEAR VERTICAL INCIDENCE SKYWAVE

You are probably hearing and reading the acronym NVIS a lot lately. I am going to try and explain what it is and why do we need it. I will also give you some direction in building your own.

The first NVIS antenna I built was a military knock off that I set up at an OH-KY-IN Field Day. It spurred the interest of an older, more experienced ham and he asked what it was. When I answered that it was an NVIS antenna, he asked what that stood for. Another passing ham yelled out, "Not a very good antenna!". It's true, that it looks like you don't know what you're doing when it is setup but upon completion I had a clear strong QSO with a ham using the identical antenna and QRP radio on a 12v battery. 5 watts to Missouri. Not bad.

So what is NVIS. In a nutshell, it's an antenna strung close enough to the ground to change the way it radiates.

Wikipedia, The poor man's Encyclopedia Britannica.

"**Near vertical incidence skywave**, or **NVIS**, is a skywave radio-wave propagation path that provides usable signals in the range between groundwave and conventional skywave distances—usually 30–400 miles (50–650 km). It is used for military and paramilitary communications, broadcasting,[1] especially in the tropics, and by radio amateurs. The radio waves travel near-vertically upwards into the ionosphere, where they are refracted back down and can be received within a circular region up to 400 plus miles from the transmitter.[2] If the frequency is too high (that is, above the critical frequency of the ionospheric F layer), refraction fails to occur and if it is too low, absorption in the ionospheric D layer may reduce the signal strength.

There is no fundamental difference between NVIS and conventional skywave propagation; the practical distinction arises solely from different desirable radiation patterns of the antennas (near vertical for NVIS, near horizontal for conventional long-range skywave propagation)."

It's like pointing a water hose straight up and having the water hit the ceiling and come down on you. Just try to visualize that, I would not suggest bringing the hose inside and experimenting.

When we are trying to log the DX Stations we use the ionosphere and our signal's take off angle to skip around the world. The area between the maximum ground wave distance, LOS or signals following the earth, and the shortest sky wave distance, the first hop of the skipped signal, where no communications are possible is called this skip zone. Unfortunately there are many good reasons to communicate within the skip zone like forest fire or some other natural or manmade disaster management. Local communications face other barriers , such as a high ridge, like the one I have around me here in St. Bernard. If I try to hit the WinLink Gateway in Hamilton on VHF, I have to overcome two 300ft ridges between me and the other station. Instead, I use 40m and an NVIS linearly loaded antenna and hit the Gateway beyond Hamilton in Richmond Indiana. If an NVIS antenna can give us a reliable signal in these dead spots up to 400 miles out, we could easily cover Ohio and surrounding states.

The NVIS Mode of operation was used by the German Panzer forces in WWII to communicate up to 400 miles. I saw a picture of a tank with a pipe structure on top that looked like the frame on a speed boat for the canvas top. It was the antenna. In the jungles of Vietnam it was used by American troops and they found additionally that a low level of ground wave and a vertical signal made radio detection of the originating operator very difficult.

What to consider:

1. Maximum Usable Frequency (MUF)

 The highest frequency at any given time and for any given set of circumstances that can be refracted off the ionosphere

 MUF is constantly changing

 Frequencies higher than the MUF will pass through the ionosphere and keep on going.

2. Critical Angle of Radiation

 The steepest angle at which a radio signal can be refracted by the ionosphere at any given time and for any given set of circumstances

 Critical Angle of Radiation is constantly changing

 Radio signals at angles greater than the Critical Angle of Radiation will pass through the ionosphere joining your signals above the MUF.

3. Vertical-Incidence Critical Frequency

 The MUF for local skywave high-angle communication

 Vertical-Incidence Critical Frequency is constantly changing

 Vertical-Incidence Critical Frequency averages between 2 and 13 MHz for the F-layer, ranging from 2 MHZ during nighttime at the lowest point of the solar cycle to 13 MHz during the daytime at the highest point of the solar cycle

Which bands should I use?

 Remember that Vertical-Incidence Critical Frequency averages between 2 and 13 MHz, so we can eliminate 20m band and all higher bands.

□ 30m is marginal, and 160m requires a huge antenna , so we can eliminate them as well.

□ That leaves us with the 80m, 60m, and 40m bands that are traditionally used for reliable NVIS operation.

What time is best for each band?

□ The D Layer exists during the daytime, then fades away after dark. Since the D Layer absorbs radiation in the upper MF and lower HF range, it makes 80m unreliable for NVIS operation during the daytime. After dark when the D Layer dissipates, 80m becomes reliable.

□ During the daytime 40m is reliable for NVIS operation. However, it is not reliable at nighttime.

How do we affect the angle of radiation?

ARRL:

"The vertical angle of radiation of a signal launched from an antenna is one of the key factors determining effective communication distances. The ability to communicate over long distances generally requires a low radiation angle, meaning that an antenna must be placed high above the ground in terms of the wavelength of the radio wave being transmitted."

We are not interested in long distances so the opposite is true for us. The ability to communicate over short distances (HF NVIS) generally requires a high radiation angle, meaning that an antenna must be placed low above the ground in terms of the wavelength of the radio wave being transmitted."

height for frequencies in the 40M to 75M range.

Cloud warmer Beam?

The height above ground is the single most argued subject with NVIS antennas. Because antennas are like real estate (location, location, location), I am going to sidestep the fight and go with what the military is recommending. After testing from many different locations, they tell us ten to fifteen feet works very well.

I have built several antenna configurations for NVIS and had many fail miserably. I used a resonate cut wire from a hill top overlooking Cincinnati only to be outperformed by a roof mounted Titan DX. By all rights that should not have happened. Was the first hop only 100miles away? So let's talk about their antennas that did work.

AS-2259/gr NVIS Antenna and all the knock off variations seen on the net.

It can be used with tactical HF radio communications equipment that tunes a 15-foot whip antenna. Examples of such equipment are the AN/GRC-106 and the IHFRs (AN/PRC-104A and AN/GRC-213/193A)

Frequency range 2.0 to 30.0 MHz. Polarizatio n Horizontal and vertical simultaneously. (slopper) RF power capacity 1000 watts pep or average. Input impedance Compatible with output of radios using 15-foot whips, such as the AN/PRC-47. Radiation pattern: Azimuth Omnidirectional. Elevation Near vertical incidence . Gain: Similar to a dipole mounted horizontally, 10 feet above same type ground. Physical Characteristics: Wind and ice Survives 60 mph wind with no ice. Height erected 15 feet. Land area required 60 by 60 feet. Erection time Two men, 5 minutes; one man 15 minutes. Packed weight Less than 14.7 pounds.

Barker and Williamson Folded Dipole

If you look on top of the Federal Building downtown you will see one of these.

They are non-grounded, true balanced antennas, and work without a ground. Use these for NVIS (short), medium and long range communications. The physical setup (height and configuration) will determine the type of propagation, and the distance of communication.

1000watts

No need for an antenna coupler/tuner.

Used a lot in frequency agile setups like Automatic Link Establishment.

Tune *any* frequency in the antenna's bandwidth, and have VSWR of 2:1 or better in HF. Why not, it terminates in a monster resistor.

Your mileage WILL vary!

Local soil conditions, surrounding structures, radio frequency interference sources, terrain (both send and receiving) radios, feed lines, connections……………can all play havoc with your operations. Two stations that appear to be the same will still get different results. So experiment, do not rely on the findings of others. A great opportunity would be to join us next weekend, April 25th, in Vine Street Park, Saint Bernard at 10:00am for the Ohio Statewide NVIS Day. Bring your plans, parts, antennas or just your curiosity down to the park.

You will find a lot of great info on the internet. In building an NVIS antenna just remember the fundamentals and “If it sounds too good to be true, it probably is”.

Sources:

Wikipedia

Texas Army MARS

W5JCK

ARRL

US ARMY

Experience

Questions?