

“Run the Bands” Exercise

28 February 2026

AI
VO1NO

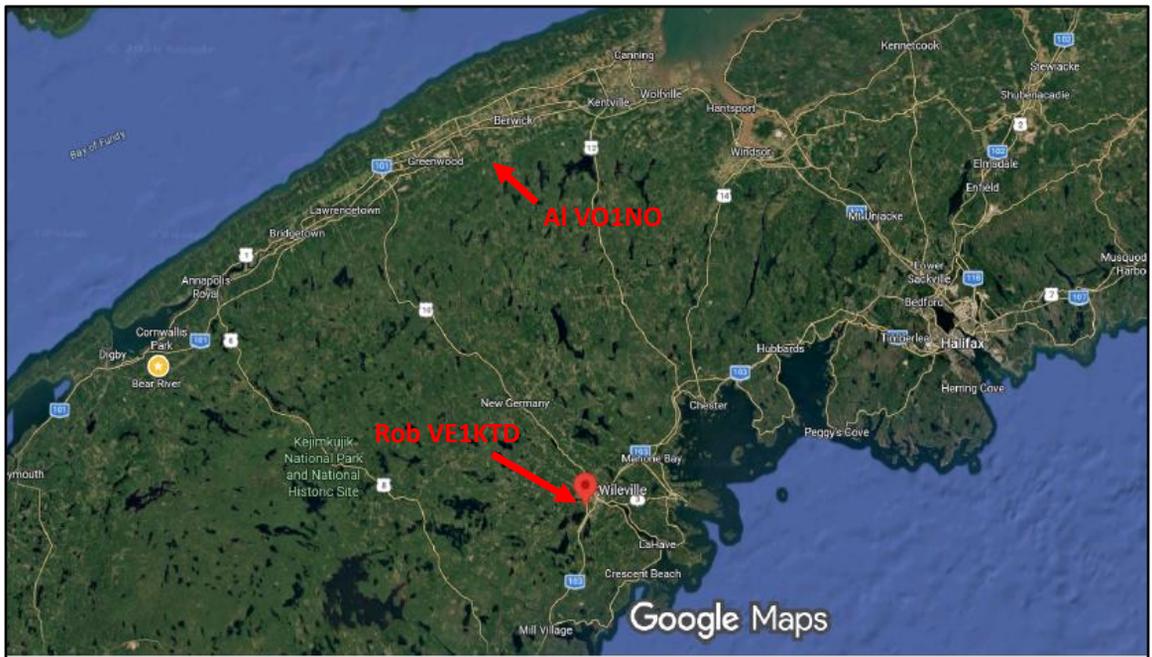
Objectives

- To assist operators in making mults for the KCARC February Challenge;
- To give new/inexperienced operators the opportunity to make QSOs on several different HF bands; and
- To determine/confirm our ability to communicate throughout the region using simplex instead of repeaters.

The Participants

- Rob VE1KTD in Wileville
- Will VA1HEL in Currys Corner
- Jeff VE1KEO in Avonport
- Chris VE1BOF in Kingston
- Al VO1NO in Nicholasville





Procedure

- Communications established on the VE1AEH Repeater (147.180 MHz).
- Rob VE1KTD linked into VE1AEV via VE1LUN.
- Announced a 10M frequency on VE1AEH, and then went to that frequency to determine if communications could be established.
- Then returned to VE1AEH to coordinate moving to 12M, and so on.
- Finally, tried 2M Simplex on 146.52 MHz.

Results

- Upper HF bands were not useful for communicating:
 - Ground wave range decreases rapidly with increasing frequency.
 - 20M and upwards in frequency cannot use NVIS (Near Vertical Incidence Skywave) propagation – above Critical Frequency.
- 80M was not quite as useful as had been anticipated, but this is probably due more to the antennas and power levels used:
 - Al VO1NO used a quarter wavelength vertical, with a low angle of radiation – good for DX, but not NVIS.
 - Jeff VE1KEO does not have an 80M antenna.
 - Rob VE1KTD used an FT-817ND with max output of 5 watts.

Results

- Results on 2M were disappointing as well.
 - Antennas and power levels played some part in this, but biggest factor is the terrain. There is high ground between most of the participants.
- The only band that enabled most participants to communicate with each other was 40M, and even then, some signals were weak.
 - Propagation a combination of ground wave and NVIS.
 - Antennas and power levels were not ideal for clear, reliable communications.

UISP Design Center

Search for devices, sites or an address

You are using UISP Design Center in Guest mode, which limits the number of simulations you can run. Sign in for the best experience.

| Name | Capacity | Link Status | Name |
|------------------------------------|---------------------|---------------------|------------------------------------|
| Maint | RF Noise | Link Obstructed | Station |
| Location: 44.974772, -64.34 0ft 3" | RF Noise | Noise Free | Location: 44.978348, -64.34 0ft 3" |
| Power: Auto | Capacity: 100 MHz | Distance: 33.18 km | Power: Auto |
| Antenna: 271°W | Height: 10 m | Antenna: 270°W | Antenna: 90°E |
| Tilt: -0.12° | Expected Signal: 10 | Expected Signal: 10 | Tilt: -0.35° |

UISP data is not available in this area.

REMO Support

- Although provincial TMR 2 system is very robust, Amateurs could be called on to provide communications support in widespread outage.
- Given that any disaster that takes out the TMR 2 system may also degrade our repeaters, we **MUST** be able to provide reliable simplex communications.
- We might also have to provide communications in remote areas where TMR 2 system coverage is poor (e.g.: forest fires, airplane crash).

Recommendations

- We should all strive to have efficient HF and VHF stations and antenna systems at home, in our vehicles, and in rapidly deployable configurations,
- We may need to use our home stations as relay hubs, especially given the valley's topography.
- We need to develop and test home and deployable NVIS antenna systems.

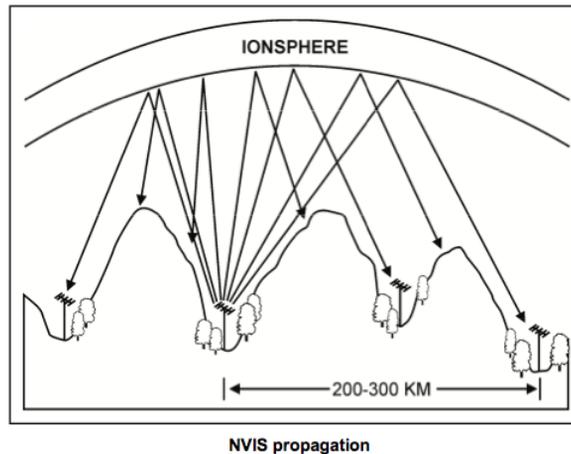
NVIS Antennas

- **Near Vertical Incidence Skywave**
- Skywave propagation 0 – 650 km.
- Signals travel **vertically or near vertically** before being refracted back to Earth.
- Suitable for 160, 80, 60 and 40M bands.
- Suitable for emergency communications and mountainous regions.

Near vertical incidence skywave, or **NVIS**, is a [skywave](#) radio-wave propagation path that provides usable signals in the distances range — usually 0–650 km (0–400 miles). It is used for military and [paramilitary](#) communications, broadcasting,^[1] especially in the tropics, and by [radio amateurs](#) for nearby contacts circumventing line-of-sight barriers. 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 650 km (400 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).

NVIS Propagation



Near vertical incidence skywave, or **NVIS**, is a [skywave](#) radio-wave propagation path that provides usable signals in the distances range — usually 0–650 km (0–400 miles). It is used for military and [paramilitary](#) communications, broadcasting,^[1] especially in the tropics, and by [radio amateurs](#) for nearby contacts circumventing line-of-sight barriers. 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 650 km (400 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.

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The most reliable frequencies for NVIS communications are between 1.8 MHz and 8 MHz. Above 8 MHz, the probability of success begins to decrease, dropping to near zero at 30 MHz. Usable frequencies are dictated by local ionospheric conditions, which have a strong systematic dependence on

geographical location. Common bands used in amateur radio at mid-latitudes are 3.5 MHz at night and 7 MHz during daylight, with experimental use of 5 MHz ([60 meters](#)) frequencies. During winter nights at the bottom of the sunspot cycle, the 1.8 MHz band may be required. ^[3] Broadcasting uses the [tropical broadcast bands](#) between 2.3 and 5.06 MHz, and the [international broadcast bands](#) between 3.9 and 6.2 MHz. Military NVIS communications mostly take place on 2–4 MHz at night and on 5–7 MHz during daylight. Optimum NVIS frequencies tend to be higher towards the tropics and lower towards the arctic regions. They are also higher during high sunspot activity years. The usable frequencies change from day to night, because sunlight causes the lowest layer of the ionosphere, called the [D layer](#), to increase, causing attenuation of low frequencies during the day ^[4] while the maximum usable frequency (MUF) which is the critical frequency of the [F layer](#) rises with greater sunlight. Real time maps of the critical frequency are available. ^[5] Use of a frequency about 15% below the critical frequency should provide reliable NVIS service. This is sometimes referred to as the [optimum working frequency or FOT](#).

NVIS is most useful in mountainous areas where [line-of-sight propagation](#) is ineffective, or when the communication distance is beyond the 50 mile (80 km) range of [groundwave](#) (or the terrain is so rugged and barren that groundwave is not effective), and less than the 300–1500 mile (500–2500 km) range of lower-angle [sky-wave propagation](#). Another interesting aspect of NVIS communication is that direction finding of the sender is more difficult than for ground-wave communication (i.e. VHF or UHF). For broadcasters, NVIS allows coverage of an entire medium-sized country at much lower cost than with VHF (FM), and daytime coverage, similar to [mediumwave \(AM broadcast\)](#) nighttime coverage at lower cost and often with less interference.

Ideal NVIS Antenna Pattern

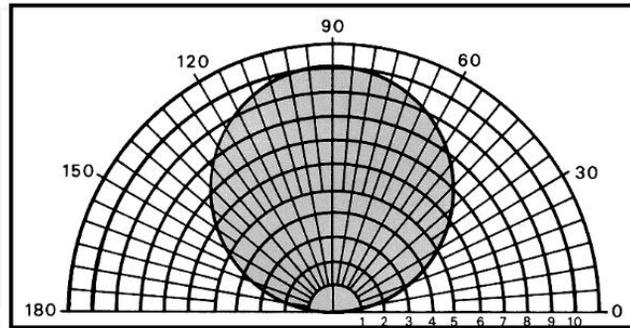
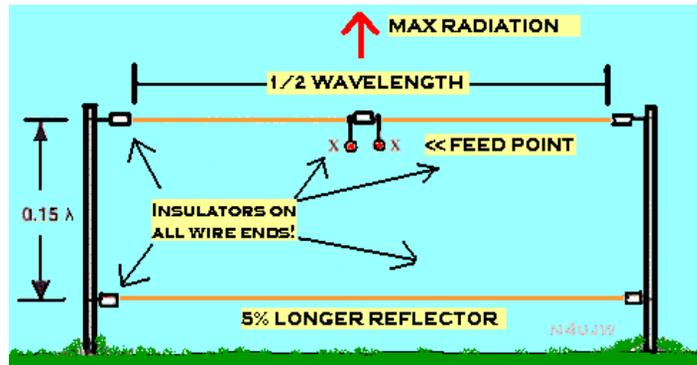


Figure M-4. Typical elevation plane pattern.

Simple NVIS Antenna



0.15 wavelength is 6 meters on 40M, and 12 meters on 80M

Antennas[[edit](#)]

An NVIS antenna configuration is a horizontally polarized (parallel with the surface of the earth) radiating element that is from 1/20th [wavelength](#) (λ) to 1/4 wavelength above the ground. Optimum height is about 1/4 wavelength, and high angle radiation declines only slightly for heights up to about 3/8 wavelength. ^[6] That proximity to the ground forces the majority of the radiation to go straight up. Overall efficiency of the antenna can be increased by placing a [ground](#) wire slightly longer than the antenna parallel to and directly underneath the antenna. One source says that a single ground wire can provide antenna [gain](#) in the 3–6 dB range. ^[7] Another source indicates 2 dB for a single wire and nearly 4 dB for multiple ground wires. ^[8] Ground wires are more necessary when using lower dipoles over poor soils as without them considerable energy goes into heating the ground.

Depending on the specific requirements, various antennas (i.e.

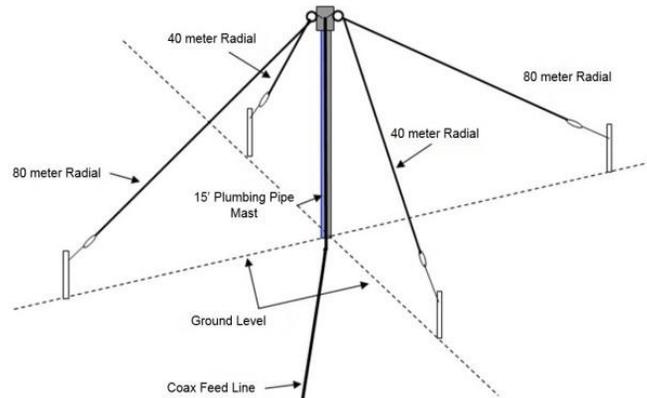
Sloper, [T2FD](#), [Dipole](#)) can be used for NVIS communication, with horizontal dipoles or inverted V dipoles at about 0.2 wavelengths above ground giving the best results on transmit and at about 0.16 wavelengths on receive, according

to military sources and an extensive study by Dutch researchers. [\[9\]](#) [\[10\]](#) Very low antennas are much inferior on transmit, less so on receive, where both noise and signal are attenuated.

Significant increases in communication will obviously be realized when both the transmitting station and the receiving station use NVIS configuration for their antennas. In particular for low profile operations NVIS antennas are a good option. [\[11\]](#)

For broadcasting, typical antennas consist of a dipole about 1/4 wavelength above ground, or arrays of such dipoles. [\[12\]](#) Up to 16 dipoles can be used, allowing strong signals with relatively low power by concentrating the signal in a smaller area. Limiting the coverage may be dictated by licensing, language or political considerations. Arrays of dipoles can be used to "slew" the pattern, so that the transmitter need not be in the center of the coverage footprint. Broadcast NVIS antennas usually use an extensive ground screen to increase gain and stabilize the pattern and feed impedance with changing ground moisture.

Dual Band NVIS Antenna



By "radial" they mean half of a dipole antenna in this illustration.

Shirley Antenna

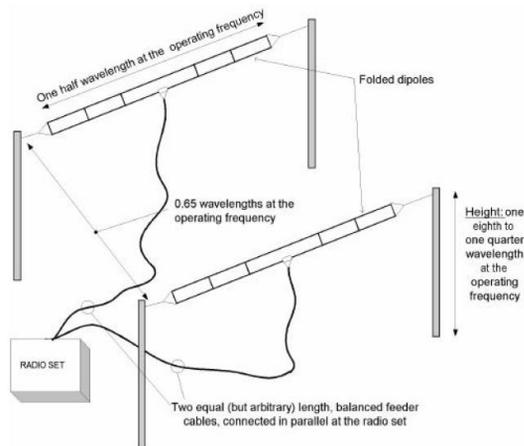


Fig.2 – a sketch

The Shirley aerial The Malayan emergency led directly to the development of perhaps the best known NVIS aerial, and one of the most efficient. This is the Shirley, which is actually two phased dipoles with the ground as a reflector; further details are given in the appendix. In some respects it is the reference aerial for NVIS work. [See Fig.2 – Ed] It was designed in about 1950 by (the then) Major John Shirley, a New Zealander who was by all accounts a most enterprising and engaging character. At the time, he was serving in the Royal Signals and on attachment to the Army Operational Research Group in Malaya. The problem was communicating with small units in the jungle. The base station, in these operations, were usually outside the main jungle and relatively static. In addition, the same frequency could be used day and night (E region propagation, possibly?) and the opposition was not thought to have much in the way of a signals intelligence capability. After some thought and research, the Shirley aerial was the result. In Shirley's own words, 'the results were spectacular'. Although troublesome to construct – a problem obviously shared with any multi-element system - the Shirley aerial remained in the Army's repertoire for many years, and probably still does. As well as being used in Malaya, a classic example of the system is given in The Vital Link3 , during the Kenyan emergency. Communication had to be established across 50-100 miles, the area including the 12,000 foot high and thickly forested Aberdare Mountains. Shirley aerials and the A510 were used 'with good

results.'

In its original and simplest form, the Shirley aerial seems to have comprised two half wave open dipoles, fed by twin mine detonating cable. An important factor

was ease of construction from readily available stores! In this configuration, the dipoles have a rather low input impedance and there must have been mismatches all

over the place. The whole system, however, could be resonated with the aid of the output tuning circuits in the transmitter. If necessary, the length of the feeders

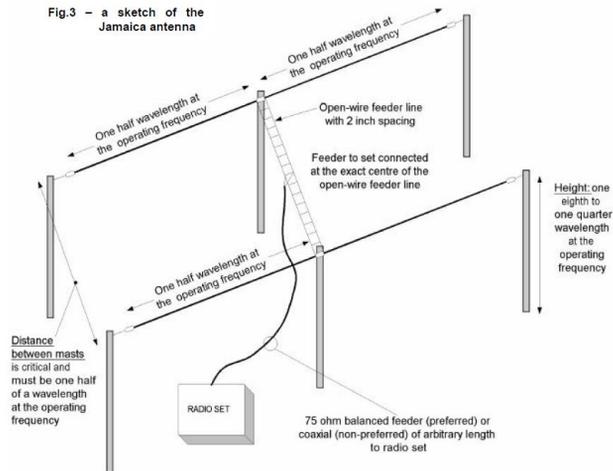
could be altered, by equal amounts, to enable this to be done.

A development of the original version is to raise the input impedance by using folded dipoles. 150Ω twisted feeder can then be used to give an approximate 75Ω

match. Again, it seems possible to use a variety of more or less ad hoc feeders - including lighting flex, which often has an impedance of about the right figure.

The ultimate stage, perhaps, is to make the whole thing out of 300Ω ribbon, with a balun transformer in the middle.

Jamaica Antenna



The Jamaica

A relative of the Shirley is the Jamaica, so called from its use on that island. In this case, the dipoles are full wave, but it is otherwise similar in design.

Questions?

