Newcomers and Elmers Net 7-27-14 Robert AK3Q
VHF/UHF Propagation

A vertical antenna, like the one on a handheld radio, sends out waves parallel to the ground- think of a placing a donut over your index finger while pointing your finger straight up in the air
-- the radiation pattern of a vertical antenna (your finger) goes in the direction of the donut, perpendicular to your finger
-- for a horizontal antenna, think of the same donut/finger combination, but this time with your finger pointing at someone in front of you
-- some of the signal would go up, so would go to the side, and some would go into the ground
-- most VHF/UHF is vertically polarized

-- FM signals are considered "line-of-sight" because they travel through the atmosphere without a lot of refraction (except as noted below), meaning they do not usually curve back down to earth.
-- FM signals break free from the atmosphere and travel on into space except when certain conditions exist which are favorable to refraction.
-- "Line-of-sight" is something of a misnomer in that FM signals will actually travel a bit further than the true line-of-sight, but not much more. About 10-15% under normal conditions.
-- For my purposes here I will use the conventional line-of-sight language to refer to the signal path. This is most of our signal path in the amateur VHF/UHF bands
-- However, our old friend *propagation* really comes into play with FM signals since some form of scatter or reflection/refraction is happening almost continually.
-- Temperature changes have a huge impact on the distance signals may travel, as well as seasonal highs and lows which affect the MUF (Maximum Useable Frequency).
-- The normal FM radio signals which may be relied upon day or night at any given location are usually unaffected by weather as the power levels and the close proximity of the signals allow for clear reception. -- Weaker or more distant signals can be affected by a number of different atmospheric issues, and this is where things can get exciting, or annoying, depending on your perspective.
-- We often refer to bands being open when signals travel a long way; in the case of VHF/UHF signals, an open band usually means some form of skip or scatter is taking place
-- this can be an annoyance if another repeater is coming in over your local one, or causing interference

--one way to fight this interference is to make sure you set your receive PL tone on as well as the transmit to block the other signal

Tropospheric Scatter

Tropospheric scatter occurs regularly under a number of conditions, almost year-round, as signals are scattered about due to slight changes in temperature and humidity/barometric shifts.
-- As the term implies, signals are scattered in all directions including forward—these are the bits of the signal which allow for greater than line-of-sight reception.
-- Common reception distances can be 25-50 miles, sometimes out to 100-200 miles on a good day.
-- Reception is weaker, of course, since only a portion of the signal is being received, and the signals flutter a bit.
-- Unlike other forms of propagation such as skip and ducting, tropo-scatter tends to extend a signal's reach rather than allowing a signal to jump over a particular region.
-- It is worth noting this tropospheric scatter works well for transmitting as well as receiving, and VHF/UHF communications are extended far beyond line-of-sight.
-- This can make for some exciting loggings.
-- Adding height can significantly increase distance, so even if your base station is limited, get a portable station together and try finding some high ground like a hilltop or the roof of a tall building.
-- With scatter effects the increase in height multiplies the distance your signal can travel.

Tropo-scatter is affected by several things:

- free space loss from transmitter to the horizon
- scatter loss as signal interacts with troposphere
- free space loss from the horizon to receiving antenna:

Tropospheric scatter happens every day, and this means FM DXing (as well as Amateur FM work) is always possible to one degree or another.
-- No doubt you may have experienced this effect even though you might not have known it at the time.
-- Even as seasons change tropo-scatter still happens, and while one region of the world may slow down for DX, another region is opening up.

Two other aspects to tropo-scatter are worth mentioning. First, scatter is relatively frequency-independent above 30MHz.
-- This means whenever VHF or above frequencies are used tropo-scatter is available to enhance DX.

-- Second, polarization remains relatively constant during scatter, so antennas which are both either vertically or horizontally polarized will work best

Scatter Sound Quality

The quality of the signal reaching your antenna is dependent on a number of factors, including the scatter angle and the amount of phasing which occurs at your location.

-- What does that mean? Signals arriving at different times or from different directions will be slightly out-of-phase, meaning there is a slight time delay or a slight conflict between signals of different polarizations.

-- The greater the scatter effect the more distortion one is likely to hear.

-- Often the signal is not so much distorted as it may sound a bit hollow.

-- Some fading is inevitable especially with more distant signals. Slow fading is likely caused by small shifts in the atmosphere, while rapid fading is more likely due to small but rapid movements of the scattering materials in the atmosphere.

-- Even a plane flying overhead between the signal and your radio can cause fading!

-- Even under normal propagation conditions, no scatter needed, something as simple as foliage will change your reception/transmission capabilities

-- you will find you can hit repeaters in winter that you can't hit in summer, just because the trees are bare

-- Be sure to keep a log book handy and take good notes. You'll learn a fair amount about propagation as you do, and these lessons will serve you well in all parts of the radio hobby.

While tropo-scatter can be active all year long, warmer months tend to work best, probably because the tropopause (the highest layer of the troposphere) is higher in warmer months, and there is also likely to be more humidity as well.

-- The area of the tropopause is where most scattering occurs, so it follows if this is higher then the DX will be longer as a general rule.

Knowing what is going on in the atmosphere around you regardless of your proximity to the equator.

-- Storm fronts can cause heightened tropospheric activity, as can changes in the Jetstream and turbulence caused by other weather factors.

-- If you live near an airport you may find this information is available through their weather services, or you can check online at: http://www.dxinfocentre.com/tropo.html

As a side note, you might find 70 cm a better band than 2 meters for scatter partly because the noise floor is lower for UHF and therefore receivers "hear" better.
-- Also 70-cm antennas usually have better gain than 2-meter antennas, and since the signal itself is smaller it can be scattered more easily.
-- Just my little plug to beef up our usage of the 440 band!

Tropospheric Ducting
Tropospheric ducting has some of the same characteristics of scatter, but with some significant differences as well.
-- Think of ducting as a hallway or corridor or tunnel by which radio signals can travel long distances like an express route.
-- The signal rides along the tunnel until conditions allow it to return to earth again.
-- Temperature inversions are the primary cause of ducting, as the warmer air caught over cooler air allows signals to travel along the inversion for 500 or more miles. Rare instances of 1,000+ mile ducting have been recorded, but these are very rare.
-- Another way to think of ducting is think of thermal layers in the ocean. Submarines rely on thermal layers to mask their movements. -- By going through several thermal layers a submarine may avoid detection from a surface ship or another submarine sailing in a different thermal layer.

Sporadic-E Skip
Sporadic-E Skip is another propagation condition which can greatly enhance FM and SSB DX.
-- Hams familiar with this effect often see great 6 and 2 meter skip conditions during Spring and Summer months, also 440
-- Sporadic-E Skip occurs in the "E" layer of the atmosphere, and allows for single or multi-hop reception over great distances.
-- Single-hop reception is common out to around 1500 miles, while multi-hop reception is common out to 2400 miles and more.
-- Unlike scatter, E Skip signals actually bounce over whole regions such that there will usually be a dead zone between where the signal falls off naturally from line-of-sight distances, only to bounce out to a thousand miles or more.

-- The part of the signal which enters the "E" region of the atmosphere is the part which is reflected back to earth; the rest of the signal behaves normally.

Often Tropospheric Scatter is mislabeled E-Skip or ducting, and it can be a bit confusing due to the distances involved.
-- To help clarify things, just keep in mind Scatter adds a moderate boost to a regular signal's reception capability, while both ducting and E-Skip add significantly to its distance reception.
-- Ducting occurs most commonly as a result of extreme temperature inversions, and reception of ducting signals requires both the transmitting antenna and the reception antenna be in the duct or along its path.
-- If the receiving antenna is below the duct (or above it) the signal is usually unreadable. With E-Skip, the receiving antenna just needs to be in the path of the Skip—there is no layer effect on the signal.

Some Keys To Success With Skip, Scatter and Ducting
-- The biggest key to working Sporadic-E openings is just to be available.
-- Watch ham radio prediction sites or check out DX cluster sites for current conditions and then turn your radio on!
-- Also, don't assume Skip, Scatter, or Ducting isn't happening just because no one is talking about it—you may be the first one to start the ball rolling.
-- There is no substitute for simply listening at every opportunity. You can't work them if you can't hear them.
-- Too often I only get to read about the great openings others have found after the fact because I didn't take the time to give a listen when I had a few spare moments.
-- Well, I'm learning to listen more often, believe me!

Since Scatter happens almost all year long, concentrate first on regions where you are most likely to be successful.
-- If you have lots of buildings—try to point your radio wherever there is less congestion as you start to get a feel for FM DXing conditions.
-- After you have some good success with closer-in signals, try for harder, more challenging ones.
-- These may be more distant stations or simplex stations. There are resources on the Internet or books which list repeaters by call sign and location, so find out what stations are in your general area and try to work them.

As you get more experienced you will be able to pull out weaker and more distant signals, and soon your log will be filling up with stations 100’s of miles away.
-- just keep in mind the signals are not going to be loud and clear like our local repeaters—you may need to open the squelch or use headphones at times to really hear a distant station
-- To start, I would recommend getting a list of active repeaters and program some into a bank of memory channels which you can scan separately to listen for openings
-- for example, you might program some repeaters in central Indiana if you live around here, or south into KY, or north into Columbus, etc.
-- find repeaters which are 50-100 miles out, and maybe up to 200 miles away
-- you can also do this with police and fire frequencies since many are still on VHF or UHF 400 MHz bands