Newcomers and Elmers Net: Getting Ready for Skip Season
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Previously I have discussed some basics concerning propagation, including the components of the ionosphere which allow signals to be reflected around the earth, seasonal variations, and variable band conditions.
-- These topics form a basis for understanding propagation because they are relatively constant. The ionosphere reacts predictably most of the time, seasonal variations follow similar paths each year, and band characteristics remain fairly consistent, again in the most general of terms.

Where propagation gets really interesting is in the departures from the norm. In other words, why do some conditions produce unexpected results both helping or hurting signal transmission?
-- How can we use these special conditions to our advantage? And finally, how can we predict when these special conditions might show up?

Propagation is truly a lifetime study for those who get intrigued by these questions. Even if your goal is not to become a propagation expert, knowing the basics can help make any radio outing a better one.
-- If you are like me, your radio time is limited by pesky little things like life, and so I want to have a good idea of what I can expect to hear when I flip on the radio at any given time.

As always, I recommend just getting on the air even if you don't expect great conditions. Sometimes serendipity can turn an average radio day into an extraordinary one, and you never know when that will happen.
-- But I am also a believer in being able to make an educated guess as to what I am likely to be able to enjoy, and this is where studying propagation can help.

This time around I want to examine special propagation conditions which bring about unusual openings on bands which might otherwise be closed.

Some Special Propagation Conditions
Back in August '13 I discussed at some length the various layers of the ionosphere and how these layers have density.
-- While some signals are absorbed by the D layer, other signals are reflected by the E and F layers, allowing signals to be reflected back to earth, and indeed even make multiple hops along the way.
-- This atmospheric density can take some surprising turns at times, allowing for communication is some of the least expected ways.

Take for example an effect known as *E-skip* and *F2-skip* propagation. Both the E layer and the F2 layer can increase in density such that they reflect FM signals over a much longer distance than typical line-of-sight distance.
-- Signals which bounce off the F2 layer can travel 2000 miles or more, reflecting off this layer much like an HF signal.

A more common phenomenon is E-skip which can allow signals to travel up to several thousand miles or more. These are seasonal conditions, often very patchy, which open and close almost without warning.
-- Because they are seasonal, folks start looking for these opportunities during the late spring/early summer months of both hemispheres. In North America E-skip usually begins somewhere in May, peaks in June, and starts decreasing by July and August.
-- Oddly enough, there is another, shorter E-skip season during the winter months of late December/early January. These dense patches of ionization can allow for multi-hop reflections traveling 3000 miles or more.

While commonly confused with *Tropospheric Ducting* (discussed below), the two atmospheric conditions are very different. E-skip is more like normal HF signal propagation, but instead occurs in VHF frequency ranges where signals do not normally bounce off the atmosphere.
-- There have been recent reports of 220 MHz E-skip, unusual in that E-skip usually occurs with signals more in the 10 meter, 6 meter, and FM broadcast range.
-- While typical distances for short E-skip is around 500 miles, strong conditions can easily send signals out to 1500 miles or more.
-- TV signals can be affected by E-skip as well, though with most stations going digital, these opportunities are shrinking. However, even low-powered local stations which remain analog can take advantage of E-skip conditions, so don't throw out those analog TVs just yet!
-- Skip is possible with digital signals as well, but practical distances are much shorter since digital signals are mostly an all-or-nothing event. Still, since some skip conditions can produce very strong signals, it wouldn't hurt to let your TV or converter box scan for new signals every now and then. You just never know what might show up!

Tropospheric Ducting
Tropospheric Ducting, or *tropo* for short, is an atmospheric condition where signals get caught between two different density layers and travel along this "duct" some distance before fading out.
-- This ducting allows for signals to travel much beyond line-of-sight, while still following the curvature of the earth. Whereas a typical VHF signal would shoot out into space, the signal basically reflects around the duct until the duct runs out.

-- If your antenna is in or near the path of duct you can receive the signal; antennas too far below or above the duct will not.

Signals above 90 MHz are the most likely to be affected by tropo, and UHF signals can really benefit from this propagation aberration.
-- Tropo most commonly occurs during summer and fall months, but can occur any time there is a significant temperature inversion.
-- These occur quite regularly along large bodies of water and costal regions, but can also occur along stationary weather fronts such as when cool air is moving in behind warmer air.
-- Since these fronts can extend 500 miles or more, tropo can often be heard up to these distances. Some signals can reach up to 1000 miles under the right conditions.

A temperature inversion is where warmer air exists on top of a cooler air mass. This condition is called an inversion because typically the higher one goes up into the atmosphere the cooler the temperature becomes.
-- When there is a temperature inversion, the higher, warmer air causes RF signals to bend. While these conditions are somewhat unpredictable, keeping an eye on the local weather conditions can improve your chances of catching this phenomenon.
-- Clear, calm days where temperatures are inverting is your best chance. If the temperature inversion is the result of a storm there will likely be too much interference for signals to come through.

There is some evidence to suggest the range of frequencies which are affected by ducting is determined more by the strength of the duct than anything else.
-- The stronger the duct the more likely higher frequencies will be reflected, while weaker ducts carry lower signals (like 2 meters) better.

(There is an excellent article on observed ducting patterns by Andrew Martin (VK3KAQ), at www.df5ai.net/ArticlesDL/VK3KAQDucts2007V3.5.pdf. While the paper is somewhat technical at times, it is an excellent discussion of ducting characteristics at different altitudes as observed in Australia.)

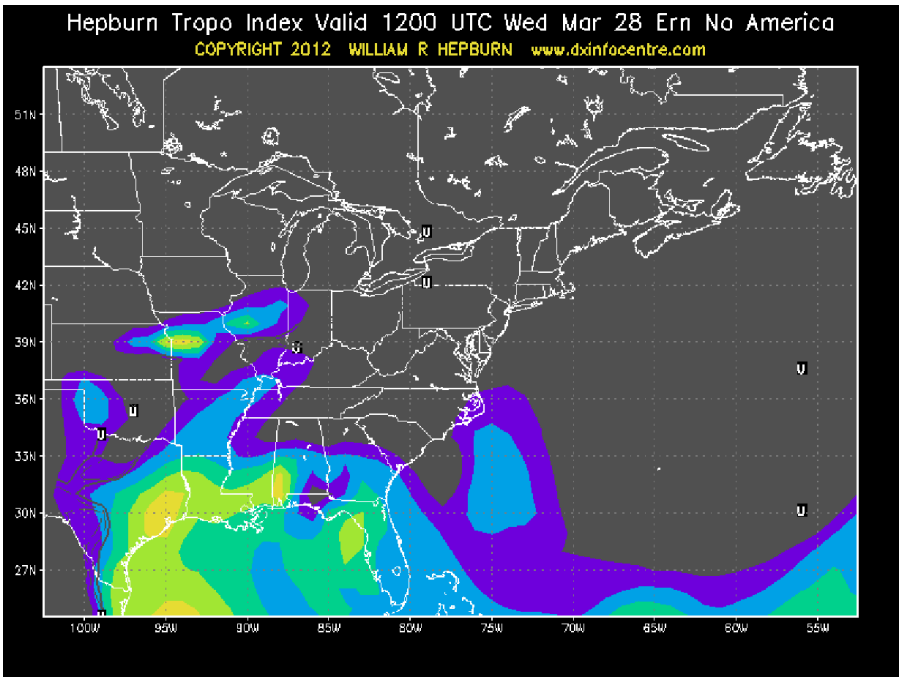
The distance a signal travels is also somewhat determined by the height of the duct above ground. Ducts close to ground are very short, but can often be seen over bodies of water or along valleys as almost fog-like conditions.
-- These disappear rapidly as the ground warms from the sun, while higher elevation ducts produced by weather fronts usually last for much longer periods of time. The ducts usually form overnight and last into the day.
-- Early morning is often the best time to take advantage of these conditions.

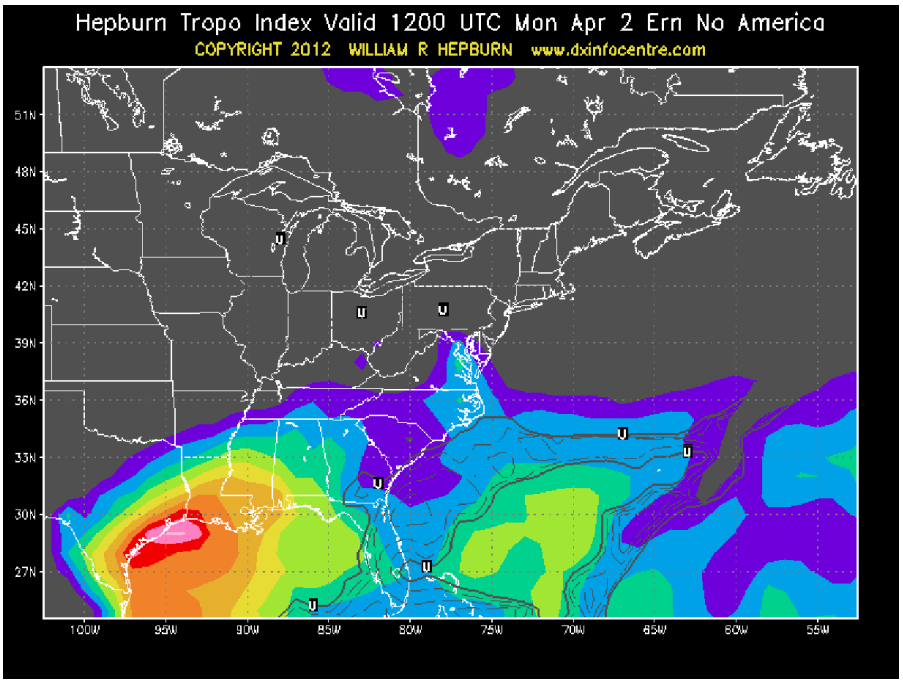
Tropospheric Scatter (TrS) and Enhancement (TrE)
Both *tropospheric scatter* and *tropospheric enhancement* are common occurrences, due in part to similar temperature inversions as ducting, but they may also happen due to other causes of density changes in the atmosphere.
-- Scatter is the most common and may be seen as fluttering distant VHF signals which are definitely beyond line-of-sight conditions. Enhancement is when these scattered signals are strengthened such that they come in much more solidly, and weaker stations not usually heard may come in enough to be recorded.

Dust, water vapor, or even volcanic ash can allow for TrE, and distances for both scatter and enhancement can go out to 500 km or more.
-- These opportunities come basically at night or before daylight, as sunlight quickly causes the earth to heat and the temperature inversions to disappear. Areas prone to fog such as valleys and coastlines are where this is most likely to occur.

Scatter is possible any time of year, but is more likely (and predictable) during warmer months, and being somewhat close to the equator can help quite a bit as well.
-- Whereas E-skip can really benefit 6 and 2 meters, tropo often gives a good boost to 440 MHz and above. Also since 440 MHz signals have a smaller waveform, they are more easily impacted by scatter.

A must-have site for tropo predictions is William Hepburn's Worldwide Tropospheric Ducting Forecasts: http://www.dxinfocentre.com/tropo.html
-- This site has more information than you can possibly digest in one or two readings, and the prediction maps (like the ones below) are available for 6 days out, as well as a 42 hour prediction map.





(Many thanks for the kind permission of the site owner to include these images)

There are a lot of other small (and large) propagation aberrations which can produce some very interesting conditions, such as backscatter, gray-line propagation, trans-equatorial propagation (TEP), and polar flutter, to name a few. I will save these for a future discussion, but as you can see, the propagation possibilities are almost endless!

An interesting service for amateur radio enthusiasts is an "E-skip" alerter sent by email, out of the Netherlands (http://www.gooddx.net/). You can receive email alerts whenever aurora or E-skip conditions are reported to the propagation logger service (see links on site above).

Closing Thoughts

While that about wraps things up for this time, keep in mind we are entering into some very interesting propagation opportunities both for terrestrial weather conditions as well as solar weather conditions. You don't need a lot of fancy equipment to have some fun—just a curiosity for learning about propagation and some effort in tracking where the propagation is occurring.