

## **Elmers Corner: Getting Started With Radio Propagation Part 3**

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We are looking at various propagation conditions and influences as a means of better understanding why signals do what they do, and how they get from here to there. Last time around we looked at such things as solar flares and coronal mass ejections, along with geomagnetic storm activity and the effects of these anomalies on signals.

In this edition we will look at some of the more exotic solar conditions which affect propagation, but which are in some ways the most interesting because of their rarity.

### **Meteor Scatter**

Closely related to aurora propagation is meteor scatter, a condition where signals are bounced off the trails of meteors as they burn up in the atmosphere. The ionization trails serve to reflect RF signals and can last few seconds to several minutes. Meteor showers offer the best opportunity for using this type of propagation, and one does not need expensive equipment to work scatter signals.

As you might have guessed by now, *ionization* is the key to everything! Where there is ionization there is the possibility of propagation. And while bouncing signals off of meteor trails might seem like the stuff of science fiction, computer programs such as *WSJT* (see *Resources* below) can use digital protocols to allow fast communication between stations. VHF signals work best, and distances up to 1200 miles are common.

### **Scatter Propagation**

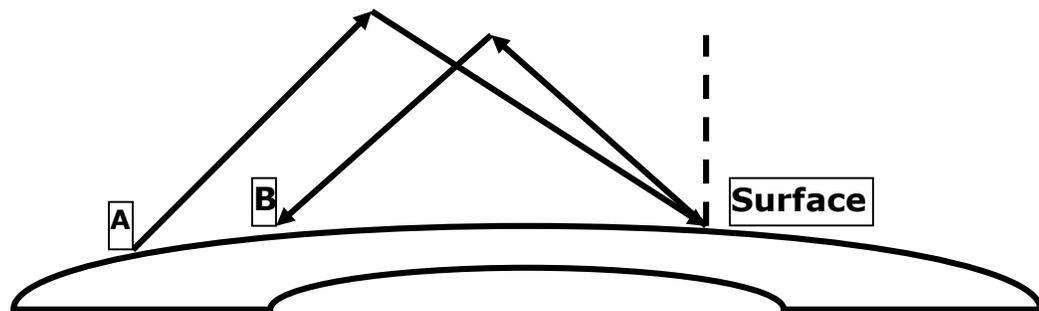
One of the most interesting and unpredictable modes of propagation is RF *scatter*, which refers to how signals bounce within the atmosphere. While the term *layers* is used to describe various levels of the atmosphere, if one thinks strictly of well-defined boundaries this would not really be accurate. Unlike geological strata which usually runs in consistent layers, the atmosphere has non-linear areas where signals are reflected at steep angles and even horizontally.

Weather conditions can cause tunnels or *ducts* to form which act as channels for RF waves. Even within the individual bands themselves there may be ionization inversions which impact signal reflection.

As the term implies, *scatter* often does exactly that—it scatters the signal in many directions at once, weakening the signal as it travels.

One often hears a bit of distortion as the signals are scattered because they are arriving at the radio from several directions at once. This is sometimes referred to as *multipath* reception/interference, and is common at higher VHF and UHF frequencies. When it happens in the HF range, this is usually a form of atmospheric scatter.

One such scatter mode is known as *backscatter*, where two stations normally too close to each other for contact are able to talk with one another because their signals are reflected back to them. Both stations must point their antennas in the same direction, toward an area where backscatter can occur. Typical ranges are between 60 and 2500 miles. Oceans are often used as the surface point for backscatter since it has such high reflectivity.



While A and B are too close to one another for normal contact, *backscatter* allows them to hear each other. Note both signals are traveling in the same direction and then get reflected back to each location.

Backscatter can also occur across the gray line where station A transmits at a high take-off angle and station B, in the nighttime section, transmits at a lower take-off angle. This type of propagation is hard to predict, of course, but it is one of the more interesting (and exciting) oddities of propagation.

### **Tropospheric Propagation And Ducting**

The troposphere is the lowest atmospheric layer, beginning at the ground and extending upward about 11 miles. This area contains most of the atmospheric mass and almost all of the water and other gasses. What makes this layer interesting for radio signals is that the boundary between the troposphere and stratosphere is a temperature inversion.

How does this inversion work? Normally warmer air is nearer to the surface of the earth, and cooler air increases with height. The convection process moves air along in currents and all is well. But sometimes an inversion occurs where the air temperatures invert and warmer air acts as a cap keeping cooler air closer to the ground. This can bring about smog and thunderstorms, as well as some rather interesting radio opportunities.

The warmer cap acts as a boundary for VHF and UHF signals in such a way as to reflect signals which would otherwise shoot out into space. This RF activity is known as *ducting*. This reflective activity allows signals to travel much further than they otherwise might.



Here are some typical meteorological conditions in which ducting can occur:

1. Warm dry air over a cooler surface, especially large bodies of water
2. Surface cooling under clear skies over land
3. High pressure or an oncoming high pressure system over a cool surface
4. Fronts with a strong thermal contrast
5. In cold down-drafts associated with cumulonimbus clouds (indicated by heavy showers or thunderstorms)

Keep an eye on weather maps and on William Hepburn's website listed in *Resources* below—he has a number of very useful prediction maps for where tropospheric ducting is likely to occur.

### **Beacons**

The last topic I want to address deals with using beacons as indicators of propagation conditions around the world. While most folks have used the time signals produced by WWV, CHU (Canada), and other countries to check HF propagation, many do not know about HF and VHF beacons which are in service 24 hours a day.

Marine vessels and aircraft have long used beacons for various purposes, but now Amateur radio operators have linked beacons world-wide to help with propagation forecasts and DX spotting. The idea is a simple one: if you can hear a beacon on a certain frequency, then you are likely to hear other stations transmitting on similar frequencies. I have provided several websites where lists of beacons may be obtained, and there are a number of individual amateurs who have web pages devoted to beacon monitoring. In fact, beacon monitoring has become something of radio sport itself, and many beacon operators love to get reception reports from around the world.

Like most of Amateur radio, supporting beacons is an act of love for the hobby—there is certainly no financial reward in it for those who spend their own money to set up such stations. Their work is their reward, and we all are the beneficiaries!

### **Wrap-up**

Spring and summer are ripe times for some good propagation effects. As you watch propagation banners, weather channels, and propagation sites on the Internet, you will begin to see patterns to what you hear on the air, and this will make you a better operator, but also better prepared to take advantage of some of these small “windows of opportunity.”

Don't get frustrated or feel overwhelmed—little bits of knowledge will seep in with all of your experiences, and you will find you know a lot more than you think over time. These articles are just designed to plant some seeds. Their watering and growth will come along the way!

73, Robert AK3Q

### **Resources**

#### **Tropospheric Ducting Resource Site**

[http://www.dxinfocentre.com/tropo\\_eur.html](http://www.dxinfocentre.com/tropo_eur.html)

#### **Meteor Scatter Software**

<http://physics.princeton.edu/pulsar/K1JT/>

#### **Beacons Lists And Information**

<http://www.keele.ac.uk/depts/por/50.htm>

<http://www.keele.ac.uk/depts/por/28.htm>

<http://www.newsvhf.com/beacons2.html>

<http://www.ncdxf.org/beacon/intro.html>