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Terrain Charts For Propagation Predictions

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Most DXers are aware that the presence of seawater or of mountains can significantly alter patterns of reception, especially reception of groundwave and very-low-angle skip signals (such as those from TA stations heard before East Coast sunset & those from TP stations heard after West Coast sunrise). Two equal-power omnidirectional co-channel groundwave stations the same distance from the DXer should have the same signal strength if the terrain to each station is identical. However, if one station is coming to the listener over salt water and the other is over lossy ground, the station with the over-water route will utterly overwhelm the other signal. Similarly, a station coming across flat farmland will easily dominate over a comparable station at the same distance but blocked by high mountains. In sizing-up the reception potentials of a given site, the DXer may want to prepare a chart of reception-enhancing and reception-diminishing terrain characteristics in the immediate vicinity of his location. In my chart, I chose 40 miles as the maximum distance of interest; from empirical observations in this area, the presence of mountains or water in the direction of propagation has little effect beyond 40 miles. The curvature of the earth is appreciable beyond this cut-off point; even groundwave does not appear to be influenced by terrain which is more than 40-50 miles from the receiver and transmitter ends of a path, although very large mountains or bodies of water may still have a noticeable effect.

Such a chart should indicate bearing (degrees east of north) versus distance (e. g. 0 to 40 miles). Potential DX targets may be listed for each 5° to 10° step in bearing. The line chart is developed by obtaining a map of the area, a drafting compass, and a protractor. Concentric circles may be drawn (for instance, every 3-mile distance multiple) by using the drafting compass. These are centered on the DXer's QTH. The protractor is used to scribe radial bearing lines every 15° starting from 0° (north). The polar plot thereby generated can be transformed into a linear plot on graph paper. The outlines of significant propagation-effecting terrain characteristics (mountains, ocean, etc.)can then be transferred to the linear chart. The sample chart accompanying this article shows the distances and bearings to the shoreline from my home in Billerica, MA. The land between here and the shore is relatively flat; soil is of the low-conductivity variety associated with the coastal plain.

There is a definite signal drop-off observed as one travels inland away from the coast when the station of interest is arriving over the water. A squared-distance relationship appears to be operative here for a given increment of signal loss. In other words, if you lose 6 db. on an over-water signal (arriving at a 90° horizontal angle to the coast) by travelling 1 mile inland, you would have to travel 4 miles inland (2^2) for the next 6 db. drop, 9 miles for the next 6 db. drop, etc. In the above case, we are dealing with a distant over-water groundwave signal (e. g. Virginia heard from Nantucket, path distance about 500 miles). With such a signal, a change of 9 miles distance would result in a negligible change in signal strength if there was no change in the medium over which the signal arrived: signal strength at 500 miles over water roughly the same as signal strength at 509 miles over water. In the above discussion of signal loss resulting from a change in receiver-to-transmitter path from 500 miles over water to 500 miles over water + 9 miles over land (at the receiver end of the path), the signal loss can be attributed solely to the 9 miles over land, land having a far lower ground conductivity than seawater. It is not because of the mere change in distance from 500 to 509; it is because the change in medium over which the signal passes.

I should hasten to say that my observations are just that, observations. In a serious study of coastal-enhancement, propagation physics would have to be applied carefully. Many parameters have to be considered - among them: type of receiving antenna used, signal frequency, horizontal angle of the signal path to the coastline, overwater distance to the station, overland distance, water depth, ground conductivity on overland portions of the signal path, shoreline slope/elevation, weather effects, and the vertical arrival angle of skip signals. The comprehensive study of coastal vs. inland DXing has been given little serious scholarly attention in the "DX press". My discussion in this article is an attempt to motivate more-knowledgeable propagation experts with appropriate physics backgrounds to come forth with accurate analyses of groundwave and skywave propagation and the effects of ground-conductivity variations along the transmitter-to-receiver path. It is known that a change from salt water to sandy soil along the signal route can cause errors in direction-finding attempts; refraction properties (similar to those encountered when light passes from water to air) might occur.

A full treatment of coastal-effects should certainly include loop-direction null data, a diagrammatic display showing signal drop-off (as a receiver is moved inland) of overwater groundwave signals from different distances & different horizontal angles to the shoreline, a signal-drop-off diagram for skip signals at different vertical arrival angles & at differing horizontal angles between path & shoreline, and a full analysis of sunset fade-in & sunrise fade-out times for a variety of skip stations. Fade times for given stations should be compared at coastal & inland receiving sites. Signal drop-off studies should be done for groundwave & skip stations at several different frequencies (e. g. 550, 750, 950, 1150, 1350, & 1550 kHz.). Some theorists have mentioned a "focusing effect" at the land/sea boundary which intensifies overwater signals as they arrive at the shore; in other words, if you were to go a mile out to sea, a signal decrease may occur relative to the level of that distant signal noted on the beach. Another concept often bandied about is that a signal travels farther over shallow (sea) water than over deep water: no hard formulae have been put forth to support or to refute this.

With the growing popularity of daytime DXing, it's about time that someone published a definitive work on groundwave/low-angle skywave mechanics, with an emphasis on the influence of terrain-characteristics.

COASTAL PROFILE CHART/ Billerica, MA. (Pinehurst section) G.C. 42.5N/71.2W.