

Elmers Corner: Grey-Line Propagation

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This is a topic we first discussed briefly on the *Newcomers and Elmers Net* (7 PM on Sundays on the 146.670 repeater – shameless plug!!), and is a worthy topic for us all to consider. Grey-line propagation can lead to some very interesting contacts, but it is something which is often either misunderstood or inadequately understood. Meaning we do not take advantage of it the way we should. The following comes from a discussion on Grey-line propagation by Steve Nichols GOKYA.

Some Basics

Worldwide communication using the HF bands is dependent on radiation coming from the sun. In general, and to grossly oversimplify reality, at LF (160, 80 and 40m) we need a night-time path between the two stations. At 28MHz, a daylight path is generally needed. But twice a day, at sunrise and sunset, the ionosphere undergoes dramatic changes, giving enhanced propagation in some directions.

In terms of radio propagation, the D and E layers are responsible for most of the absorption of radio waves that pass through them, but the absorption is frequency dependent. The D-layer can completely absorb signals on 160, 80 and 40 meters during the day, and can attenuate signals on 20m too. Hence the reason you don't hear much, if any, DX on the low bands during the day as sky-wave signals are absorbed before they can reach the E and F layers.

The ionosphere undergoes a dramatic change in ionization at the transition from day to night. The electron (and ion) density in the E-layer decreases by a factor of 200 to 1 and the F1 by nearly 100 to 1. At sunset, the D layer disappears rapidly.

Around the other side of the world other regions that are entering into daylight have yet to form any significant D layer and the E layer has not built up from its night-time low. Therefore, for a short period propagation between two regions simultaneously experiencing sunrise and sunset can be highly efficient. Signals on the lower bands can theoretically travel over great distances with little attenuation.

This is well documented with many examples of grey line propagation being logged on 160 and 80m over the years.

Many amateurs will be familiar with this so-called grey line propagation – propagation that occurs along a line separating night from day. The line is called the terminator but it is diffuse, due largely to the earth's atmosphere

that scatters the light over a large area. This is a key point: in radio terms, the radio terminator is not the same as the visual one. The latter refers to the point when we see the sunrise or sunset at ground level on the earth and the period of visual twilight that either precedes or follows. The former refers to the way the sun illuminates the ionospheric D, E and F layers.

The HF "twilight" zone –the region on earth between the loss of the D layer and where the sun starts/stops illuminating the F layer (roughly defined as being offset from sunset by 14.165 degrees longitude) can therefore be almost one hour before and after sunrise and sunset.

E layer illumination starts/finishes somewhere in between these two, but the average height is much closer to that of the D layer.

To confuse matters, these values are based on average D- and F- layer heights and the apparent heights of these can change too. So it is no good looking for grey line DX exactly at your visual sunrise/sunset – you could be out by up to an hour depending on the band, your respective locations, and the time of year.

And even worse, for signals at an angle to the terminator we are interested in where the first ionospheric refraction or hop actually occurs once you radiate a signal, which is likely to be many hundreds of miles to the east or west of you – where the sun may still be illuminating the F layer.

John Devoldere's book "ON4UN's Low-Band DXing". suggests that his own experience shows paths perpendicular to the terminator may enjoy the greatest signal enhancement. That is, on the low bands, as sunset occurs at the receiving station, you may get grey line enhancements at right angles to the terminator in the direction towards the dark side of the earth - not along the terminator.

He also points out that the width of the terminator will vary according to the season and your position on the earth, and cannot be thought of as a fixed entity - the grey line will be narrower at the equator and wider at the poles. So the time-span available for grey line conditions will also vary depending upon the time of year, and the locations of the two stations.

Likewise, the width of the grey line will depend upon frequency as D layer absorption is frequency dependent - you may still be able to work DX on 40m 24hours a day in mid-winter, while DX on 160m will fade out quite quickly after sunrise to the greater D layer absorption.

Either way, there is more to grey line and twilight propagation than meets the eye. The effects are different on every band, and the mechanism behind the propagation is probably different too. What we can say is that twilight propagation is not always best along the terminator and there may not be any enhancement at all on some bands. Some books would have you believe that you can just tune up on 20m at sunset and work ZL 59+20dB every day – Not happening!

Conclusion

The biggest takeaway here is to remember 1-2 hours before sunrise and sunset, and up to several hours after conditions can be unusual, often very good. Get on the air and try it! The propagation gods do strange things, some of which we can begin to understand, other things remain hidden to us mere mortals! Like how 5 watts from halfway around the world can break through a ferocious DX pileup ~ I have seen it happen, but this will likely always remain a mystery to me. But hey, that's part of the fun! Try out Grey-line propagation for yourself and enjoy a bit of mystery! 73, Robert