E SKIP IN DEPTH

Mel Wilson May 1975

Is there any way to predict how long an Es opening will last?

I don't know of any way to predict the duration of an intense Es occurrence. Until the mechanism of the phenomenon is understood, trying to predict its behavior is at best a precarious exercise! However, there are indications which can lead to an educated guess; that is, play the probability game. Such indicators would include the large scale weather conditions, the temporal occurrence, and the general intense Es occurrences to date. If I am correct in the assumption that intense Es is the result of turbulence within a large sheet of Es, then conditions (like the wind sheer theory) must exist, and a triggering mechanism must be present within the area of the Es sheet to cause the turbulence. A higher probability for a long duration of intense Es is present if large scale weather conditions indicate wide spread possible locations for "generators." The more generators that appear, the more intense Es is spread, and the longer the "band is open."

If the generators are strong, they will shed some long lived clouds which will drift for many hours. Often the more intense and strong generators will support quite high frequencies (FM and higher), and this is an indication that probably the conditions will last for a while. In some cases, it appears that a cloud can become more intense by passing through another turbulent area.

An understanding of propagation paths is a required prerequisite to any attempt to predicting where, or how long, an opening might last. The more precise one can observe existing conditions, and the manner in which they change, the better an educated guess becomes. Plotting of data combined with basic knowledge of the possible wave propagation paths can often result in quite accurate assessment of actual conditions.

If a model can thus be established, and the behavior watched carefully, predictions of duration and area coverage can be accomplished by a single observer. The radio amateurs on 50 MHz have a distinct advantage, since they can trade information and get two points of view.

It is useful to the TV/FM DXers to listen in on 50 MHz for such information. Recording devices, scanning receivers, and spectrum displays are useful to the single observer, since such techniques add information.

Is most Es purely Single hop or is it a cloud to cloud condition?

In any wide spread opening, the probability of a two cloud propagation path is high, especially as the higher frequencies are propagated. When the band at 50 MHz is just open, the chances are that all skip is single cloud. The data I have shows that with very few possible exceptions, all reported 144 MHz skip observed over the past 25 years has been cloud to cloud. By far the majority of FM propagation has been two cloud, and many of the 50 MHz and low TV paths have been cloud to cloud. When wide spread intense Es is present, the lower frequencies usually have more than one path open simultaneously, both cloud to cloud and single cloud. This causes very strong stations to have very deep fades. Very complex wave paths can develop in such conditions.

Why does Es peak in spring and summer and re-peak in December-January?

I don't believe anyone has yet figured this one out! I would think that the mechanism for triggering turbulence is present much of the time, at least on an annual basis, and therefore the difference between the solstice and equinox occurrence of Es must be a result of the basic establishment and behavior of the basic sheet of ionization. This probably is a very complex phenomenon. Some feel that the basic ionization generation must be a result of the energy from the sun (excluding aurora and meteors) and thus the zenith angle of the sun relative to the coupling magnetic field lines between conjugate points) between the hemispheres probably controls this formation. There is some evidence that the plas-mapause controls the boundary of Es in the temperate zone, (L = 4, approx 60 degrees mag latitude), and thus not too far out to give serious consideration to this form of coupling. When the sun is over the equator its coupling to the midlatitudes is minimum, and this could account for the minimum Es occurences during equinox. During our summer, the sun's angle is such as to directly couple with the northern hemisphere, and the effect should be greater than during our winter solstice when the proper zenith angle of the sun must be coupled through the magnetic lines from our conjugate point.]

About what percentage of the Es openings that reach TV channel 2 will reach channel 6? FM? Channel 7?

The general rule of thumb is that doubling the frequency reduces the probability to 1/10th. Thus if channel 2 is assumed 50 MHz, then 100 MHz will be propagated one-tenth the time that channel two is open, and 200 MHz will be open one-hundredth of the time. However, this assumes a single cloud propagation path. Since most higher frequency propagation paths are multi-cloud, the probability is higher than these figures. The MUF of a single cloud can be below the frequency propagated by a two cloud path. In practice, it is difficult to know of a possible propagation path for the highest frequency because of the geometric restrictions imposed, and unless the observer and the transmitter are in precise relative positions, it will go undetected. This seems to be the experience on the two meter ham band. I expect that this will change somewhat with the advent of many repeaters coming on the air and many more people listening, and many openings will be reported.

In the case of channel 7 stations, the probability of hearing them is not very good, since there are relatively few of them, and the propagation paths very restrictive. FM stations, on the other hand, are geographically well spread out, have a relatively high density, and transmit continuously, and openings are observed a high percentage of the time. It is interesting to note that since there are so many more FM stations (than say channel 2 stations, that an observer may hear FM stations) although not channel 2 stations.

This doesn't mean that the band is not open for channel 2, but there is no channel 2 station for the particular wave path. It is possible that no TV stations can be heard and only FM stations can be heard. (Such information is of great importance when plotting an opening).

What characteristics should be found in a good antenna system for Es DX?

There is no single good antenna for Es DX. The serious DXer must have more than one antenna, and depending upon what he wishes to accomplish must be able to change antennas rapidly (preferrably scan).

I would guess the minimum would be a good yagi, stacked as much as possible, and as high above ground as possible (height probably is not important as long as it is greater than 1000 feet), Of course it must be rotated. A second antenna lower, a small beam type with an excellent null. The high, sharp beam antenna is useful most of the time, because of its gain and its area coverage (low angle of radiation covers a larger geographical area). The lower smaller antenna is useful for higher angle of radiation (when clouds are closer) and the deep null is useful for cutting down interference. The smaller beam should be independently

rotated, and for local interference and also strong skip (if azmuthal angle is different) the smaller antenna can be electronically combined with the higher antenna to produce a null on the unwanted station. Beyond the minimum there are all kinds of special types, with polarization changes being the most useful, although it should be sampled fast.

How can a DXer recognize conditions favorable to "doublehop" Es?

The probability of successfully recognizing the possibility of double hop skip is directly related to ones understanding of transmission paths, and knowledge of conditions existing at the time. Plotting of conditions for propagation for an opening is most useful. This is the technique of drawing propagation paths as they are observed on a map, and trying to establish where the clouds started and where they are going. Listening to the radio amateurs on 50 MHz is most useful for finding the paths that are present but beyond ones own radio horizon. I believe that weather maps are very useful for guessing the direction and extent of possible intense Es. The place where skip starts is often along a front, very unstable air mass interfaces, and seem to favor low pressure areas. Once clouds are formed and drift off they may well drift into high pressure areas. Intense Es does not seem to form in stable high pressure areas, although on double skip remember that a ground reflection point can be in the high, so one can received through the area as long as a cloud is not required in the area. Thus the probability of double skip is higher if low pressure cells dominate the country, or the fronts are spaced properly for the observer. Of course when the band is wide open over a large area there is no need to recognizing conditions for double skip, its already there,'

Can meteor showers trigger an Es opening?

Meteors can well be the chief supply of metallic ion debris so important to the duration of Es, but I doubt very much that meteors could trigger an opening. Meteors do heat the ionosphere in an extremely small volume causing "ping" type VHF propagation, and dense shower can sustain propagation (sometimes double skip) for a relatively short duration. Meteor trails often produce field aligned scatter signal propagation and are very aspect limited. Although the energy released by the transit of the meteor through the E layer is small, some of the "over dense" meteors can extend the duration of propagation for many minutes. This mode of propagation is quite different from the intense Es.

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