Absorption At Night

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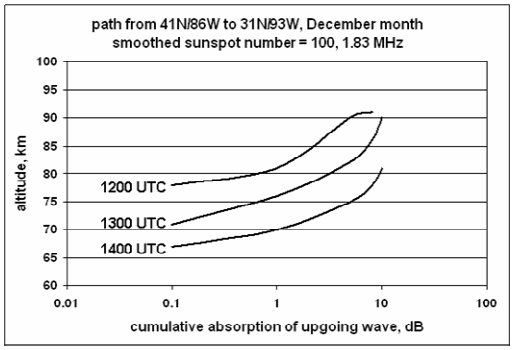
It is well known that the D region during the daytime causes a significant amount of absorption for electromagnetic waves on the lower bands (160m and 80m). The result of this is limited daytime distances via skywave (but it's not as limited as you might think – for example, on 160m stations with decent antennas running 1kW can routinely communicate out to 1000 km or so during the day).

At night, the D region electron density decreases significantly. Does this mean there isn't any absorption at night on the low bands? The answer is "No" – there is still absorption (albeit less), as the absorption process moves up in altitude at night to the lower E region.

The figure to the right shows this. It's the cumulative absorption of an up-going wave on 160m for a one-hop path that is parallel to the terminator. The top curve is at 1200 UTC when the path is in darkness. The middle curve is at 1300 UTC when the path is along the terminator. The bottom curve is at 1400 UTC when the path is in daylight.



Most of the absorption in the sunlit ionosphere (1400 UTC) occurs at D region altitudes (70-80 km). Most of the absorption in the dark ionosphere (1200 UTC) occurs at lower E region altitudes (80-90 km). Although the D region ionization is minimal at night, absorption in the lower E region still impacts propagation on the lower bands. This plot indicates that absorption levels out at around 10dB per hop on 160m in the dark ionosphere. In daylight it's still going up after 10dB.

Why does absorption move up in altitude at night? Absorption is proportional to the electron density times the electron-neutral collision frequency. The electron density decreases as altitude decreases, while the collision frequency increases as altitude decreases. Thus the product of these two functions roughly maximizes when they cross, and the maximum altitude for the most part follows the electron density as the collision frequency is fairly constant regardless of day or night. The following figures show typical products of electron density times collision frequency for day and night.