SKYWAVE PROPAGATION MODELING USING ITU-R P.1147-4

9/14/2011 | Pierre Missud

Abstract

The latest addition to the long list of propagation models supported by ATDI tools follows the recommendation ITU-R P.1147-4 for predicting the sky-wave field strength at frequencies between about 150 and 1700 kHz. This model is useful to broadcast engineers for determining potential interference between LF and MF stations, especially at night.

The model is added to the ICS Map Server tool as an internal model and complements the ground-wave ITU-R P.368-9 already included along with world conductivity maps. Incorporating the model inside ICS Map Server allows for faster coverage and interference analysis calculations making interaction to the user transparent, fast and efficient.

Implementation

Eight terms, more specifically seven and an offset, need to be evaluated in order to determine the field strength at a given location from the transmitter. ITU-R P.1147-4 makes field strength predictions that depend on frequency and geomagnetic latitude and longitude. The determination of the cymomotive force required the digitizing of gain curves at various frequencies and distances. The ionospheric factor loss and slant propagation distance are reasonably straightforward as they are calculated from standard equations. Ionospheric propagation loss for MF/LF can predict the degree of ionization in the different layers to determine the amount of signal that is refracted, reflected or lost in-between the terminals. This ionospheric term includes effects of ionospheric absorption, focusing, terminal losses and loss due to multi-hop paths between transmit and receive terminal.

The polarization coupling loss requires the magnetic dip and magnetic declination at both sides of the path. The latest NOAA curves were rasterized to this effect and the model picks the angles from the created maps:

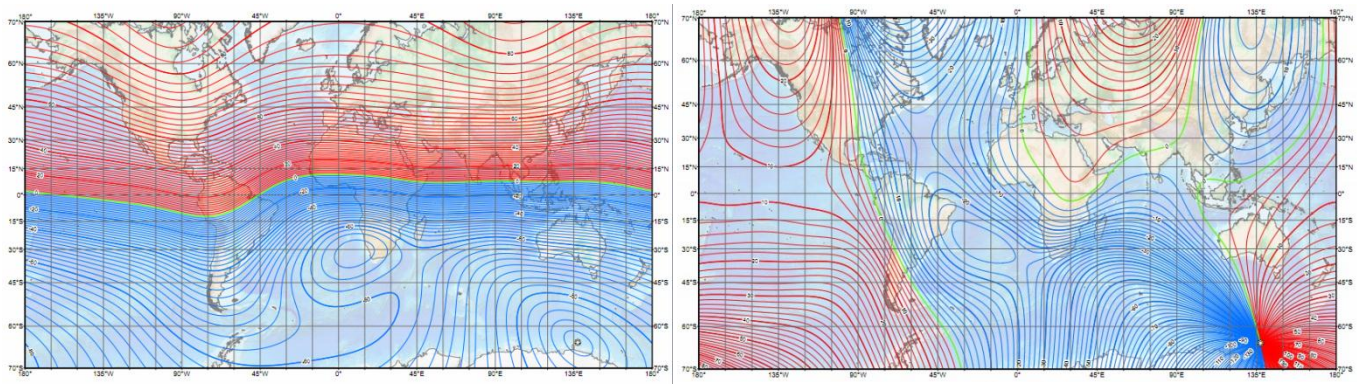

Figure 1: NOAA magnetic dip and magnetic declination curves

The hourly loss factor includes the sunrise / sunset times; the loss due to the effect of solar activity automatically uses the published twelve months smoothed international relative sunspot number. The Sea Gain is the additional signal gain, applied when one or both terminals is located near the sea. It uses the ITU-IDWM conductivity maps to identify the presence of land and sea and to calculate the correction factors accordingly.

Interface

The model is triggered by setting the model attribute to ITU-R P.1147-4 in the template file. The run is very fast and does not require user input other than the calculation distance.

```
<study name='path_loss' label='Skywave Path Loss Matrix' model='ITU-RP1147-4' nradials='720' ncores='1'/>
```

Figure 2: Model attribute to ITU-R P.1147-4 in ICS Map Server template file

The model uses parameters such as frequency, antenna height, and power as inputs and produces a classic path loss matrix that can be used to generate classic overlays. The ITU-CIRAF zones were also extracted and converted to standard vector lines, and are now part of the standard ICS Map Server distribution package.

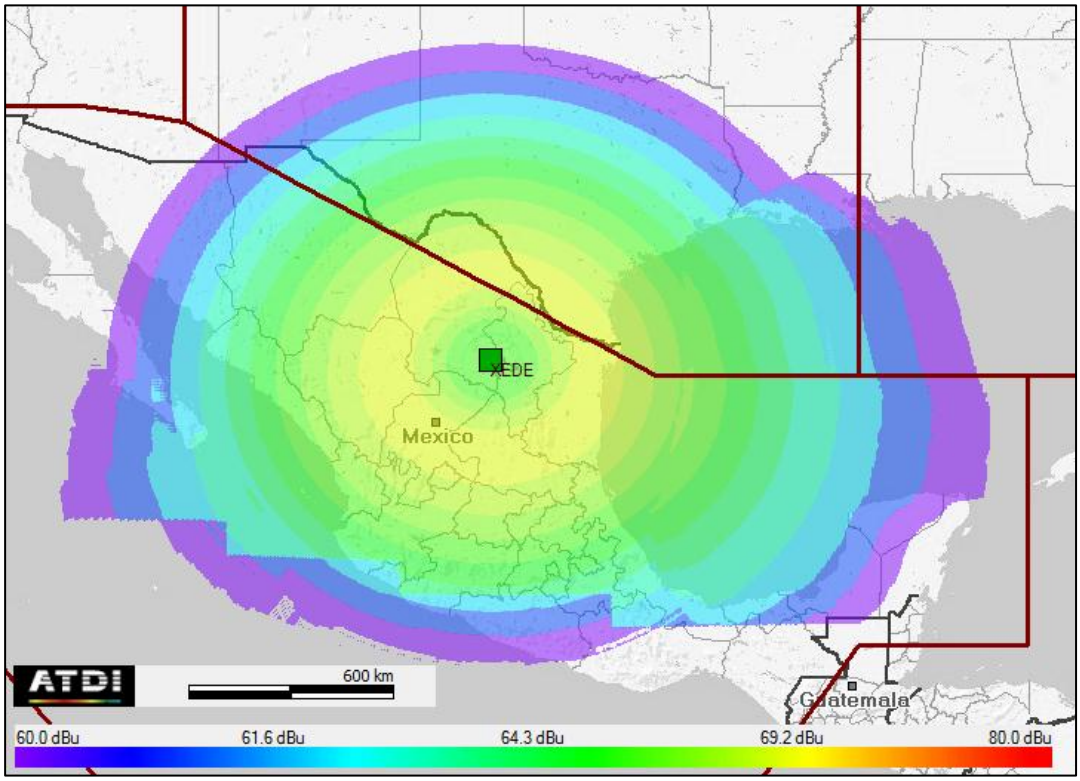

Figure 3: Coverage calculation using ITU-R P.1147-4

Conclusion

The addition of ITU-R P1147-4 to the model library completes the LF-MF-HF planning capabilities in the ATDI suite of software, in the same platform that is used across the whole radio spectrum. The added functionality is part of the default package and requires only an update from version 11.3 to be used.

For further information visit:
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