Developing a Solar Eclipse Simulation for Greater Good: 
*The Next Iteration*

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Introduction

- HamSCI held the Solar Eclipse QSO Party (SEQP) during the August 21, 2017 total solar eclipse.
- We developed an SEQP simulation program in MATLAB using the PHaRLAP ionospheric ray tracing package and the SAMI3 ionospheric model.
- Initially we focused on simulating user-submitted QSOs and RBN spots when the eclipse was over the US.
- US-US propagation changes were just one of many effects from the eclipse.
- We were filtering out a lot of the US-Europe data.
US-Europe RBN spots during SEQP
Say Hello to Simulation 2.0

A number of improvements have been made to the simulation:

- Increased simulation distance from 2,500 km to 10,000 km.
- Maximum number of “hops” increased from 3 to 10.
- The “best” ray is now highlighted.
- More verbose output results to allow for further processing.
- Can now simulate across oceans.
Why Simulation 2.0?

- Data collected from the RBN shows an SNR increase in the 5000-8000 km range.
- This rise in SNR has been attributed to cross-Atlantic contacts to Europe.
- Can we simulate this?

Figure from: Ionospheric Response to the 2017 Great American Eclipse as Observed by Amateur Radio Activity
CONUS to EU - Simulation Parameters

- Transmitters along East Coast of US.
- Receivers throughout Europe.
- 9 station pairs in total.
- Raytraced at 7 MHz and 14 MHz.
CONUS to EU - 14 MHz Ray Density

Eclipse

Control

Midpoint Obscuration at 300 km Altitude

Ray Density

Great Circle Distance [km]

N: 25881
K2MFF to GW8IZR - 7 MHz

Newark, NJ to Manchester, UK
K2MFF to GW8IZR - 7 MHz Raytraces

Top: Control
Bottom: Eclipse

21 August, 2017 19:39:00 UTC
K2MFF to GW8IZR - 7 MHz Path Loss

Path Loss = 20 \log_{10}(d) + 20 \log_{10}(f) + 32.45

$d$ is geometric path length in kilometers
$f$ is frequency in megahertz
Conclusions & Future Work

- Our simulation can now simulate long-distance communications such as those demonstrated here.
- Our naive method of path loss calculation is designed for line-of-sight radio communications and not suitable for over-the-horizon use.
- We want to implement ionospheric absorption and imperfect ground reflections in order to improve power loss calculations.
- We have yet to replicate the results shown in the RBN eclipse and control data.
- We can use population density data as a method of masking out areas where there are no receivers.
References

● “The results published in this paper were obtained using the HF propagation toolbox, PHaRLAP, created by Dr Manuel Cervera, Defence Science and Technology Group, Australia (manuel.cervera@dsto.defence.gov.au). This toolbox is available by request from its author.”


Thank You