HF bistatic ionospheric sounder data ingestion into NeQuick 2

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An accurate specification of the electron density distribution in the ionosphere is required for navigation and communication systems relying on electromagnetic waves propagating through this medium, for example, for GNSS. In this work data from an HF bistatic ionospheric sounder is ingested into NeQuick 2 empirical ionospheric model [1] to improve the representation of the ionosphere in the region. An ionosonde, acting as a source of HF signal, is located in Blissville, NB, Canada (45.6 N, 66.6 W) and the receiver is in Newton, MA, USA (42.3 N, 71.2 W), so that the ground path is ~520 km (Figure 1). The HF transmitter sweeps frequencies in the range from 1 to 12 MHz using phase coded pulse waveform. Both HF transmitter and the receiver have GPS-disciplined clocks, allowing to produce simultaneous vertical and oblique ionograms in the transmitter location and the midpoint of the path correspondingly. Data derived from oblique ionograms are ingested into NeQuick 2 model to obtain a set of effective parameters. These parameters are used to drive the model [2] and obtain vertical ionograms using numerical ray-tracing algorithm [3] at the transmitter location as well as in the vicinity of the receiver, at Millstone Hill, MA, USA (42.6 N, 71.5 W), where a Digisonde DPS-4D is installed. The results of the model output and measured vertical ionograms are compared in terms of the profile anchor points (foF2 and hmF2), as well as the profile shape/thickness. The improvement demonstrated by the proposed data assimilation technique suggests that increasing the density of the network of passive HF receivers can improve the ionospheric specification in the region paving the way for better performance of operational systems.

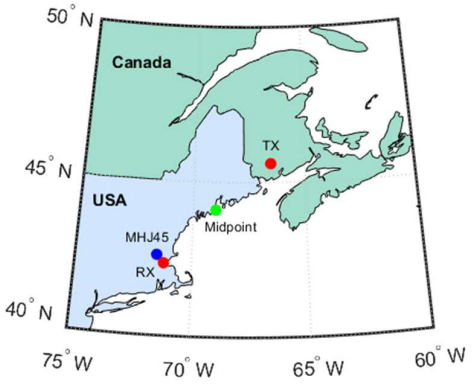

Figure 1. Experiment layout showing HF transmitter, receiver, midpoint, and the MHJ45 Digisonde locations.

References

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[3] A. Kashcheyev, B. Nava and S. M. Radicella, "Estimation of higher-order ionospheric errors in GNSS positioning using a realistic 3-D electron density model," in *Radio Science*, vol. **47**, no. 04, pp. 1-7, Aug. 2012, doi: 10.1029/2011RS004976.