ARctic Over-The-Horizon Radar ONtic (AROTHRON) Model for the High-Latitude Ionosphere

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An arctic ionosphere model has been developed for improved HF propagation simulations of ionospheric instruments including over-the-horizon radars (OTHR). The ARctic Over-The-Horizon Radar Ontic model, or AROTHRON, is a physics-based model solving for the 3D densities and velocities of 8 ions (X^-, H^+, N^+ O^+, N_2^+, NO^+, O_2^+, Fe^+) with quasi-neutral electron density assumed. Ti and Te are also solved. The chemistry, transport, and ionization processes are sufficient to obtain good electron density profiles for D, E, and F regions for quiet or disturbed conditions. The AROTHRON effort incorporates the Ionospheric Effects Model (IEM), which uses the background ionospheric state of plasma densities, drifts, neutral winds, and other parameters to calculate plasma turbulence characteristics over the grid of the ionospheric specification. The plasma turbulence definition can be used to inform HF propagation models of radar clutter and ionospheric backscatter conditions. The subgrid turbulence definitions are generated using empirical formulae from [1] and [2] for auroral clutter and ionospheric backscatter, respectively. A 2D description of turbulence is generated for comparison with the WBMOD climatological model [3] of RMS standard deviation of plasma density (SigNe) and the integrated turbulence strength CkL parameter. Comparisons with SuperDARN radars will be presented.

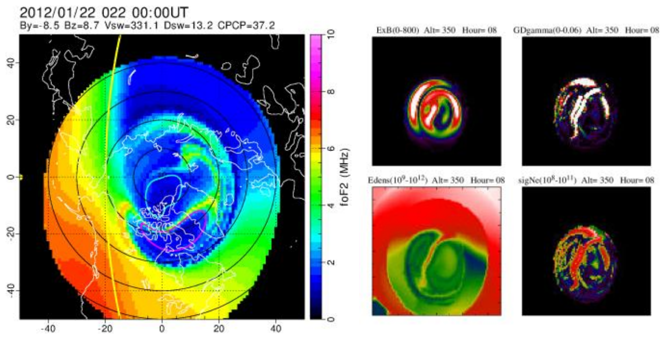

Figure 1. Left: peak plasma frequency of the F2 region (foF2) is on a geographic polar plot. The yellow line is the solar terminator with the dayside to the left. Right: four panels showing (clockwise from upper left) ExB drift magnitude, Gradient-Drift instability growth rate, SigNe $\equiv <\Delta Ne^2>^{1/2}$ and plasma density at UT= 0800.

References

[1] R. T. Tsunoda, M. Williams, and Y. Zambre (1991), “A Comprehensive E-Region Auroral Clutter (CERAC) model: Description, Results, and Validation,” Final Technical Report, SRI International, Menlo Park, CA, AF Rome Laboratory, RL-TR-91-225.

[2] A. D. M. Walker, R. A. Greenwald, and K. B. Baker (1987), “Determination of the fluctuation level of ionospheric irregularities from radar backscatter measurements,” *Radio Science*, *22*, 5, pp. 689-705, https://doi.org/10.1029/RS022i005p00689.

[3] A. W. Wernik, J. A. Secan, and E. J. Fremouw (2003), “Ionospheric irregularities and scintillation,” Advances in Space Research, 31, 4, pp. 971-981.

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