Empirical Model in the Characterization of High Frequency Propagation in the Arctic region

Abstract

The use of high frequency (HF) communication at high latitudes still forms the backbone of many systems, owing to the fact that there are few alternatives to HF radio for the merchant and fishing fleets, military forces (land, sea and air) and for the civil aviation industry for these latitudes. HF communication uses the ionosphere as a medium of propagation, but its variable nature can be a disadvantage to both the radio operators and users. The choice of a suitable usable frequency is thus dependent on the ability to predict the conditions of the ionosphere. Thus, HF propagation predictions can be inferred from the predicted conditions of the ionosphere. In fact, in most cases, the predictions of ionospheric conditions and HF propagation are often assumed to be identical. Hence, the need to develop ionospheric model(s) suitable for high latitudes to enable a relatively smooth operation of ionospheric-dependent radio communication.

Most of the available models, particularly the empirical ones were developed with little data at high latitudes. Data availability has improved over the years due technological advancement and continued research. For instance, the Canadian High Arctic Ionospheric Network (CHAIN) provides a wealth of data for the polar and auroral regions. Using CHAIN data, the performance of the Voice of America Coverage Analysis Program (VOACAP), Ionospheric Communication Enhanced Profile Analysis and Circuit (ICEPAC) and the recommendation 533 (REC533) propagation models was evaluated and some inconsistencies were identified for each of the models. An additional study of ionospheric variability in the arctic region revealed that the currently available International Telecommunication Union Recommendation (ITU-R) variability factors demonstrate notable differences from observations during the winter and equinoxes. A model for the critical frequency of the F2 layer was developed using both CHAIN and Space Physics Interactive Data Resource (SPIDR) data. The model results show an improvement compared to the available baseline International Reference Ionosphere (IRI) model.
Ph.D. Candidate

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April 11, 2017
9:00 a.m.

Forestry/Geology Bldg., Room 202

Exchanging Board:
Dr. P.T. Jayachandran (Physics) Supervisor
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BIography

Universities attended (with dates & degrees obtained):
2012 - 2017 PhD candidate, University of New Brunswick
2010 - 2011 MSc in Physics, Rhodes University
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Publications:


Conference Presentations:

R. Athieno, P. T Jayachandran and David R. Themens, A Neural Network foF2 model for a single station in the polar cap, Oral presentation at the Canadian Association of Physicists congress, June 13 17, 2016, University of Ottawa, Ottawa, ON, Canada.


Several other conference presentations