Detectability of D region Variations near the South Atlantic Anomaly

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Abstract

We verified our Brazil station's capacity to detect actual ionosphere variations near the South Atlantic Anomaly (SAA) by matching simulated detected sferics to simulated sferics. We did 2D FDTD simulations for wave propagation in earth-ionosphere waveguide with two kinds of upper boundaries, six typical near SAA D region disturbed profiles from a chemical model and typical exponential profiles. We found any of the simulated detected sferic (from six disturbed profiles) can match one certain simulated sferic (from exponential profiles). This result suggests that the ionospheric D region variations near SAA are detectable by our station.

1. Introduction

Energetic electron precipitation from inner radiation belt is a primary source of D region ionization in the vicinity of South Atlantic Anomaly (SAA) [*Abel et al.,* 1999]. We built a VLF/ELF signal detection station in Brazil to measure and study the ionospheric D region electron density profile variations near SAA caused by this precipitation. The disturbed electron density profiles will be derived from measured sferics which are electromagnetic waves launched by lightning, propagating in the earth-ionosphere waveguide and finally received by our station. This work is to verify the capacity of our station to detect the disturbed D region electron density profiles.

2. Method

Six typical near SAA D region ionization rate profiles [*Abel et al.,* 1999] caused by energetic electrons precipitation from the inner radiation belt are inputted into a simple chemical model [*Rodger et al.,* 1998] to generate six disturbed electron density profiles. These electron density profiles include disturbances in various ranges, and are treated as real disturbed D region electron density profiles near SAA in this work. In next step, we did 2D FDTD simulations for sferic wave propagation in earth-ionosphere waveguide with two sets of upper boundaries: the six disturbed electron density profiles and another set of two-parameter exponential electron density profiles. The output sferics from the FDTD model corresponding to six disturbed profiles are simulated detected sferics while output sferics corresponding to exponential electron density profiles are simulated sferics. We tried to find a good match for every simulated detected sferic among a series of simulated sferics. The exponential electron density profile corresponding to the best fitted simulated sferic for a certain simulated detected sferic is the derived electron density profile for the disturbed D region electron density profile corresponding to that simulated detected sferic.

3. Results and discussion

We found that any of the six simulated detected sferics can match one certain simulated sferic very well and thus the disturbed profile exponential parameters can be inferred from the best fitted simulated sferic. This result suggests that the ionospheric D region variations near SAA caused by energetic electron precipitation from inner radiation belt can be acquired by our station through sferic measuring and fitting to

a series of modeled sferics corresponding to a set of two-parameter exponential electron density profiles. And the ionospheric D region electron density profile lowering during a large magnetic storm should be obviously observable in our station. This will be a part of our future work.

4. References

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