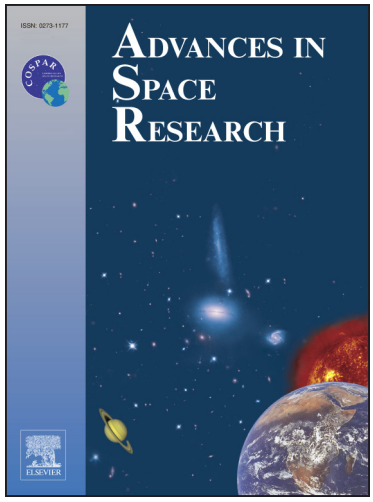

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Modelling the Variations of Reflection Coefficient of Earth's Lower Ionosphere Using Very Low Frequency Radio Wave Data by Artificial Neural Network

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Abstract

The ionized atmosphere lying from 50 to 600 km above surface, known as ionosphere, contains high amount of electrons and ions. Very Low Frequency (VLF) radio waves with frequencies between 3-30 kHz are reflected from the lower ionosphere specifically D-region. A lot of applications in long range communications and navigation systems have been inspired by this characteristic of ionosphere. There are several factors which affect the ionization rate in this region, such as: time of day (presence of sun in the sky), solar zenith angle (seasons) and solar activities. Due to nonlinear response of ionospheric reflection coefficient to these factors, finding an accurate relation between these parameters and reflection coefficient is an arduous task. In order to model these kinds of nonlinear functionalities, some numerical methods are employed. One of these methods is artificial neural network (ANN). In this paper, the VLF radio wave data of 4 sudden ionospheric disturbance (SID) stations are given to a multi-layer perceptron ANN in order to simulate the variations of reflection coefficient of D region ionosphere. After training, validation and testing the ANN, outputs of ANN and observed values are plotted together for 2 random cases of each station. By evaluating the results using 2 parameters of pearson correlation coefficient and root mean square error, a satisfying agreement was found between ANN outputs and real observed data.

Keywords: Artificial Neural Network, Ionosphere, Reflection Coefficient, VLF

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