On the short term forecasting of the ionospheric critical frequency $f_{oF2}$ up to five hours in advance using neural networks.

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Abstract. In this paper the use of neural networks (NNs) to forecast hourly values of the ionospheric F2 layer critical frequency $f_{oF2}$ at any point up to five (5) hours ahead is demonstrated. The inputs used for the NNs are Universal Time, day of the year, a 2 month running mean sunspot number ($R_2$), a 2 day running mean of the 3-hour planetary magnetiic $a_p$ index ($A_16$), solar zenith angle, latitude, magnetic dip angle, angle of magnetic declination and recent past observations of $f_{oF2}$; $F_{-4}$, $F_{-3}$, $F_{-2}$ and $F_{-1}$ at that point. The outputs of the NNs are $F_{+1}$, $F_{+2}$, $F_{+3}$, $F_{+4}$ and $F_{+5}$, representing the values of $f_{oF2}$ five hours ahead of $F_{-1}$. In this work data from 50 worldwide ionospheric stations spanning the period 1964 to 1986 has been used for training the NNs. In order to test for the predictive ability of the NN over inaccessible areas, two different NNs were trained. The first network (NNA) was trained without data from 10 stations selected for their remoteness from the rest of the stations, while all the data are included in the second network (NNB). The results obtained from these NNs are compared with the observed values of $f_{oF2}$ obtained from the test stations. This paper is the first application of NNs for global short-term predictions of $f_{oF2}$. The results obtained showed that short-term predictions of $f_{oF2}$ are best obtained by using past observations of $f_{oF2}$ itself, in addition to those inputs mentioned above. The performance of the NNs is measured by considering their root mean square (RMS) errors. A comparison of NNA with observed values for two excluded stations (Grahamstown and Tomsk) are as shown in figure 1 below.

![Graphs](image_url)  

Fig. 1. These graphs show the predicted and measured values of $f_{oF2}$ five hours ahead for four consecutive days in 1978 Grahamstown (day 307 – 310) and 1982 Tomsk (day 81 – 84).