Ionospheric response to annular and partial solar eclipse of 29 April 2014 in Antarctica and Australian Regions

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Received 2 May 2015; accepted 4 May 2015; published 15 May 2015.

An annular and partial solar eclipse was observed on 29 April 2014 over Australian and Antarctic regions. In this study we have analyzed the ionospheric response of this solar eclipse event. We have done a comprehensive study to find out the changes that occurred in various ionospheric parameters during the solar eclipse event over Australia and Antarctic region. We selected four Australian stations Brisbane (27.5°S, 152.9°E), Canberra (35.3°S, 149.1°E), Hobart (42.9°S, 147.3°E) and Perth (31.955°S, 115.859°E) as well as one Antarctic station Mawson (70.6455°S, 131.2573°E). We have studied the changes in the E and F ionospheric layers using the ground based observations at these stations. From our analysis we found that there occurred a decrease in the critical frequencies of sporadic E (f_oE_s) and F (f_oF2) layers during the time eclipse was in progress at all the four Australian stations while as at Antarctic the value of f_oF2 recorded an enhancement. At the same time an increase in the corresponding heights of these layers ($h'E_s$, $h'F2$) was also observed.
KEYWORDS: Annular solar eclipse; ionospheric parameters; sporadic E; critical frequency.

Citation: Atulkar, Roshni, Parvaiz A. Khan, Hussain Jeevakhan, and P. K. Purohit (2015), Ionospheric response to annular and partial solar eclipse of 29 April 2014 in Antarctica and Australian Regions, *Russ. J. Earth. Sci., 15,* ES2002, doi:10.2205/2015ES000549.

1. Introduction

Solar eclipse is one of the important solar terrestrial events which have a direct impact on Earth's ionosphere. A solar eclipse provides us with a rare opportunity to study the ionospheric effects associated with an accurately estimated variation of solar radiation during the eclipse period. The ultraviolet radiations from the sun are blocked during solar eclipse, the ions and electrons start to recombine, therefore, the number of electrons and ions decrease. Hence compared to a normal day the loss rate of plasma on an eclipse day dominates over production rate. Thus, during solar eclipse lower electron density in the ionosphere is expected.

A comparative study of the different ionospheric parameters has revealed very interesting features. The temporal variation of $h'F$, f_oF2 and f_oF1 on the eclipse day has also been carried out by many workers earlier. It has been found that $h'F$ shows an oscillatory behavior during the course of the eclipse. In comparison with temporal variation of f_oF2 on the control days it drops by about 15% on the eclipse day. On the other hand f_oF1 decreases by as much as 50% on the eclipse day with no time lag between the time of maximum obscuration and the time of maximum decline of f_oF1 [*Rama Rao et al.*, 1997].

Reduction of 20% was noticed both in $f_{\min}$ and in the $F1$ layer critical frequency during total solar eclipse of 11 August 1999. The signal strengths of the oblique incidence paths also point to eclipse associated decreases in ionization in the D and lower E-region [*Chandra et al.*, 2007]. Sporadic E is a thin layer with dense patches of ionization around E region altitudes, sporadic E is generally observed between height of 95 km and 120 km. The E_s structure and the related winds and wind shears for the formation of E_s at magnetic equator (Thumba, dip 2°N) were studied in detail by [*Sridharan et al.*, 1989]. [*Chen et al.*, 2010] described the observations of sporadic E (E_s) layer behavior over east China during the total solar eclipse. Sequential sporadic E layers at low latitude in the Indian sector were presented by [*Jayachandran et al.*, 1999] by comparing (Waltair, dip 20°) with (Thumba, dip 2°N) and (SHAR dip 10°). They provided the experimental evidence for the wind shear theory for the formation of descending night time sporadic E layers by using three ionosonde data. They concluded that the night time descending sporadic E layers are produced by the combined effect of the equator ward propagating gravity wave and the increased pole ward neutral wind which brings the ionization downward through the field-line [*Veenadhari et al.*, 2002]. The E_s consistently occurs around 100 km and the ordinary critical frequency of E_s layer (f_oE_s) is un-

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