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Results of Observations of the Ionosphere Response to a Partial Solar Eclipse on 11.08.2008 According to Data from a Network Oblique Sounding Paths in the Eurasian Region

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Abstract

We present preliminary results of a study the solar eclipse effect (on August 11, 2018) to the characteristics of HF signals according to oblique sounding of the ionosphere on extended radio paths in the Eurasian region.

1 Introduction

The reaction of the ionosphere to a solar eclipse is usually manifested in a decrease in the total electron content, in a decrease in the electron concentration in the vicinity of the maximum of the F layer and in an increase in the effective reflection heights [1] - a typical situation of night-time ionospheric conditions. Studies of the influence of the solar eclipse on the sporadic layer Es and the propagation of acoustic-gravitational waves are of great interest, as well [2].

This article presents the preliminary results of studies the effects of the solar eclipse on August 11, 2018 on the characteristics of HF signals according to oblique sounding of the ionosphere on extended radio paths in the Eurasian region.

2 Overview

A map of the Earth's surface coverage by the lunar shadow during a partial solar eclipse (SE) on August 11, 2018 is available in [3-4]. The largest phase of coverage in Russia occurred in the northeastern regions with a degree of Sun obscured within 12–53% depending on the location of the transmitters and receiving points and the distance between them.

To study the ionosphere response to the partial solar eclipse, the method of oblique sounding of ionosphere by the chirp signals was applied, and paths of various lengths and orientations were used. Chirp transmitters used for observations were manufactured by "SITKOM" LLC for diagnostics of the ionosphere and HF radio links with chirp signals [5]. Chirp transmitters are located at the following points: Lovozero, Murmansk reg. (68°N; 35.02°E), Norilsk (69.36°N; 88.36°E), Irkutsk (51.8°N; 104°E), and Khabarovsk (47.5°N; 134.5°E). The receiving of chirp signals was carried out in Vasilsursk, Nizhny Novgorod Region (56.1°N; 46.1°E) and Nizhny Novgorod (56.1°N; 44.1°E).

The ionosphere was observed from August 10 to 12, 2018. Control observations were carried out on August 10 and 12. The geomagnetic environment was quiet with a magnetic index Kp about 2-3.

3 Results

The influence of the solar eclipse was manifested, first of all, in a decrease in the maximum observed frequency (MOF) upon reflection from the F-layer of the ionosphere along the trajectories of oblique LFM soundings of various lengths.

Figures 1 and 2 provide the examples of time dependences of the MOF for different paths and propagation modes on the day of the eclipse (August 11, 2018) and on control days (August 10 and 12, 2018).

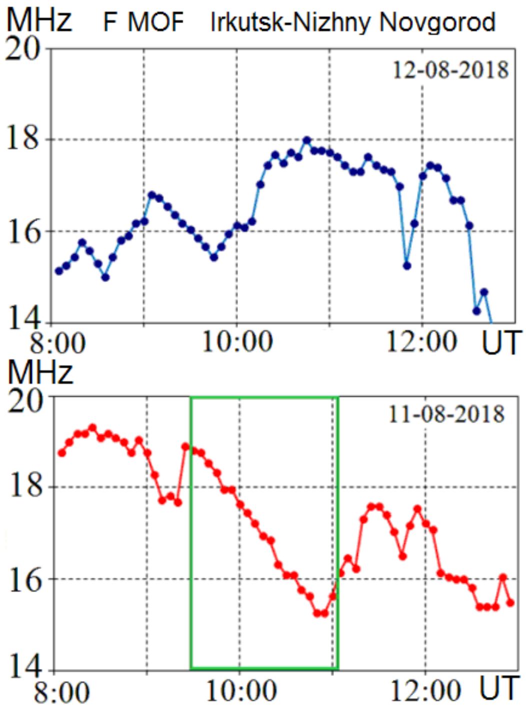

Figure 1. Dependence of the F MOF for the path Irkutsk – Nizhny Novgorod. The eclipse interval for the midpoints of the path at an altitude of 200 km is highlighted in a colored (green) rectangle.

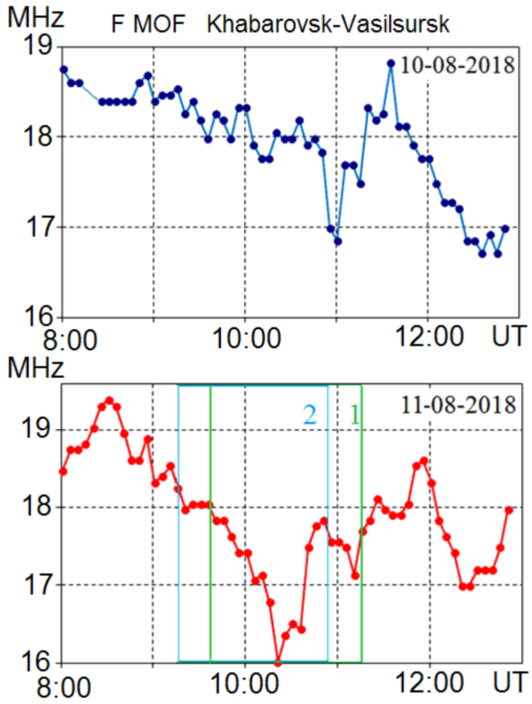

Figure 2. Dependence of the F MOF for the path Khabarovsk – Vasilsursk. The eclipse interval for the midpoints of the 1st and 2nd bounds is marked by green and blue rectangles, respectively.

According to the data obtained, a rather pronounced effect of a decrease in MOF by 8–10% was observed in all paths in the eclipse interval during propagation through the F layer.

An increase in Es MOF by 15% was observed on the Lovozero – Vasilsursk path (Figure 3).

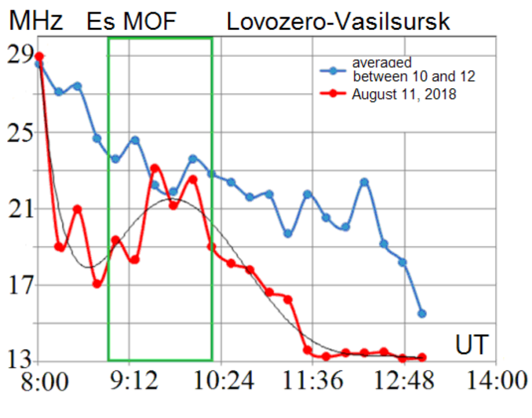

Figure 3. Dependence of the Es MOF for the path Lovozero – Vasilsursk. The eclipse interval for the midpoints of the path at an altitude of 110 km is highlighted in a colored (green) rectangle.

The enhancement of Es ionization during a solar eclipse was previously recorded in [6, 7].

The results of oblique sounding were used to detect acoustic-gravitational waves (AGW) and their ionospheric response in the form of traveling ionospheric disturbances generated at the heights of the ozone layer in the stratosphere during the motion of the moon's shadow in the Earth's atmosphere during a solar eclipse. The most conspicuous effect of AGW manifestation in the form of quasiperiodic variations of Es MOF and F MOF with periods of 30 and 50 min was noticeable during a solar eclipse on the Lovozero – Vasilsursk and Norilsk – Vasilsursk paths, respectively (see Figures 3 and 4).

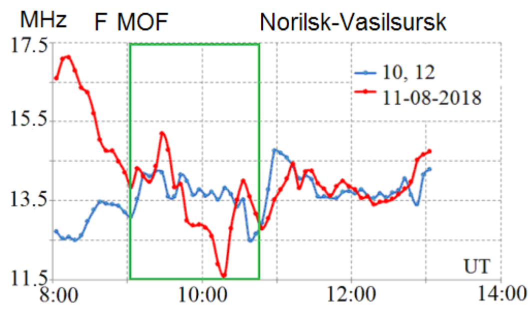

Figure 4. Dependence of the F MOF for the path Norilsk – Vasilsursk. The eclipse interval for the midpoints of the path at an altitude of 200 km is highlighted in a colored (green) rectangle.

4 Acknowledgements

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5 References

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