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GEOMAGNETIC CONTROL OF IONIZATION'S VERTICAL DRIFT IN THE F-REGION OF THE IONOSPHERE

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SUMMARY

This note shows that experiment qualitatively corroborates that the 12-hour electric field component transferred from the dynamo-region may play a specific role in the occurrence of ionization's vertical drift in the F-region of the ionosphere.

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It has been shown in the works [1–4], devoted to the computation of horizontal and vertical ionization drifts in the F-region of the ionosphere that in the latter drift may be caused by the electric fields transferred from the dynamo-region. According to these works the vertical drift velocity is linked with the magnitude of the electric field emerging from the dynamo-region and also with the value and inclination of the Earth's magnetic field in the following manner:

$$v_{vert} = \frac{E_y}{H} \cos I,$$

where H is the intensity of the magnetic field; E_y is the intensity component of the electric field directed eastward; I is the magnetic inclination.

Brought forth below is the comparison of the value and direction of the vertical drift of ionization computed by formula (1) and determined by the frequency-dispersed method [5–7].

When computing v_{vert} for Alma-Ata, the distribution of variations was utilized of the magnitude and direction of the 12-hour component of the electric field for the latitude ~40°, brought out in the work [4] and estimated from the dynamo-theory of geomagnetic variations. The results of calculations are shown in Fig.1 (heavy solid line). The local longitude time is plotted

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(*) O GEOMAGNITNOM KONTROLE VERTIKAL NOGO DREYFA IONIZATSII V F-OBLASTI IONOSFERY

the abscissa and expressed in hours, and the value and direction of drift velocity in ordinates, whereupon the drift's upward direction is taken for the positive direction (relative to the plane of the horizon). It may be seen that the value of drift velocity varies from 1 to 4.5 m/sec. The drift's direction as a function of the time of the day is described by a clear semi-diurnal motion periodicity: from 0630 to 1230 and from 1830 to 0030 hours upward; from 0030 to 0630 and from 1230 to 1830 hours downward relative to the horizon plane. The amplitude maximum and minimum of v_{vert} correspond respectively to 0930 and 1530 hours. The results of measurements of v_{vert} obtained experimentally during the summer season of 1966 [6], are shown in Fig.1 by the thin curve. It was found that the value of the drift velocity varies from 0 to 30 m/sec, with its most probable value being 5 to 15 m/sec. The direction is characterized by the prevalent 12-hour motion periodicity.

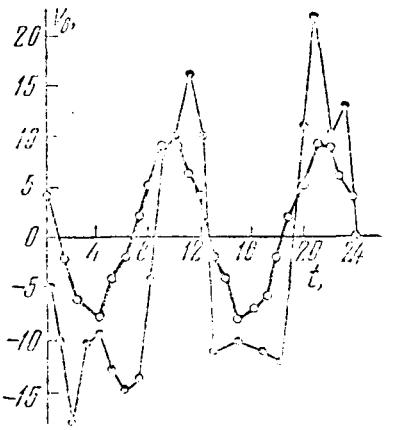

Fig.1

Comparison of the curve of daily variations shows the synchronism in the behavior of drift direction obtained theoretically and experimentally. There is only an insignificant divergence in the phases of the curves (by about 1 to 1 and one-half hour). As to the value, the theoretically anticipated drift velocity is 3 to 4 times less than the experimental one. This is apparently linked with a series of simplifying assumptions, admitted at the computation of the electric field and of the value of v_{vert} [4], and also with the precision in the determination of vertical drift velocity by the experimental method.

Therefore, experiment qualitatively confirms that the 12-hour component of the electric field, transferred from the dynamo-region, may play a specific role in the emergence of the vertical drift of ionization in the F-region of the ionosphere. On the other hand, according to calculations of [4], a significant 24-hour component of vertical drift ($v_{vert} = 10 - 20$ m/sec) must also be observed at the altitude of Alma-Ata; it is directed upward in daytime and downward at nighttime, relative to the horizon plane. The results of harmonic analysis of daily variations of v_{vert} give a value of the order of several meters. As to the direction, it agrees quite well with the direction expected from the dynamo-theory.

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**** T H E E N D ****

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REFERENCES

[1]. H. MAEDA. Proc. Intern. Conf. on Ionosphere, London Institute of Phys. and Phys. Society. 187, London, 1962, 1963

[2]. H. MAEDA. Rept. Ionosphere Space Res. Japan. 17, 79, 1959.

[3]. D. F. MARTYN. The Physics of the Ionosphere (London Physical Society), 163, 1955.

[4]. S. KATO. J. Geomagn. Geoelectr. 8, 24, 1956.

[5]. V. I. DROBZHEV. Geom. i Aeronomiya, 6, No.6, 1122, 1966.

[6]. V. I. DROBZHEV. Ib. 1968 (8) IN PRINT.

[7]. V. I. DROBZHEV. Sb. "Issl. Neodnorodnostey v ionosfere", NAUKA, 1968 (still in print).

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