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A Charge Distribution in the Earth's Atmosphere

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Abstract: Earth's atmosphere is polarized: the negative charges are concentrated mainly in the lower atmospheric layers and the positive charges – in the upper layers of the atmosphere. It is believed now that the nature of force, which polarizes the atmosphere, is unknown. At same time, our calculations showed that force, which distributes the atmospheric charges, has the electromagnetic nature. Under action this force the positive charges are moved up and negative charges – down. Here we propose our calculations.

Keywords: Polarization of the Atmosphere, Atmospheric Charges, and Distribution of Atmospheric Charges, Evaporation

1. Introduction

In the earth's atmosphere the positive charges are moved up and the negative charges – down, generally, in [1–5]. For example, the water steam always has the positive charge, in [5–10]. At the same time, it is assumed that the nature of the force causing such a distribution of atmospheric charges is unknown, in [1–6]. (It should be noted that model of the isothermal atmosphere ignores the positive charge of particles, which rises, in [11].)

Here we offer a force, which, in our view, causes the polarization of the earth's atmosphere. In the calculations we used the physical constants from [12].

2. Main Body

During daily rotation of Earth, the earth's atmosphere crosses the horizontal lines of geomagnetic field (fig. 1). Therefore, in earth's atmosphere ever acts the Lorenz force, $\mathbf{F_L} = q\bullet[\mathbf{v}\bullet\mathbf{B}]$, which moves the positive charges upwards and negative charges – downwards.

The calculations show that magnitude of Lorenz force $\mathbf{F_L}$, which acts on the elementary charge on equator line, is equal to:

$$|F_L| = \pm e \bullet |v_e| \bullet \mu_0 |H| =$$

$$= \pm 1{,}602\bullet 10^{-19} A\bullet s\bullet 463 m\bullet s^{-1}\bullet 1{,}257\bullet 10^{-6} V\bullet s\bullet A^{-1}\bullet m^{-1}\bullet 27{,}06\ A\bullet m^{-1} =$$

$$= \pm 2{,}5\bullet 10^{-20}\ Kg\bullet m\bullet s^{-2} = \pm 2{,}5\bullet 10^{-20}\ N,$$

where: $\pm e$ (= $\pm 1{,}602\bullet 10^{-19}$ A•s) – the elementary charge (of proton or electron),

$|\mathbf{v_e}|$ (= 463 m•s^{-1}) – the linear speed of the earth's surface at the equator,

μ_0 (= $1{,}257\bullet 10^{-6}$ V•s•A^{-1}•m^{-1}) – the magnetic constant,

$|\mathbf{H}|$ (= 27,06 A•m^{-1}) – intensity of the geomagnetic field at the equator.

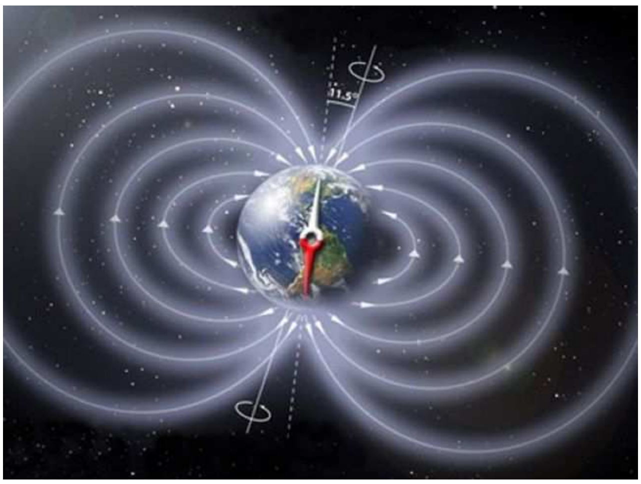

Fig. 1. *During daily rotation of Earth its atmosphere crosses the horizontal lines of the geomagnetic field.*

Herein the acceleration of proton in up direction at the equator is equal to:

$|\mathbf{a_{H+}}| = |\mathbf{F_L}|/m_{H+} =$

$= 2{,}5{\bullet}10^{-20}\,Kg{\bullet}m{\bullet}s^{-2}/1{,}67{\bullet}10^{-27}\,Kg =$

$= 4{,}175{\bullet}10^{7}\,m{\bullet}s^{-2}$,

where: $\mathbf{F_L}$ ($= 2{,}5{\bullet}10^{-20}\,Kg{\bullet}m{\bullet}s^{-2}$) – the Lorenz force acting on proton at the equator,

m_{H+} ($= 1{,}67{\bullet}10^{-27}\,Kg$) – the mass of proton.

At the same time, the acceleration of electron in down direction on the line of equator is equal to:

$|\mathbf{a_e}| = |\mathbf{F_L}|/m_e =$

$= 2{,}5{\bullet}10^{-20}\,Kg{\bullet}m{\bullet}s^{-2}/9{,}1{\bullet}10^{-31}\,Kg =$

$= 2{,}7{\bullet}10^{12}\,m{\bullet}s^{-2}$,

where: $\mathbf{F_L}$ ($= 2{,}5{\bullet}10^{-20}\,Kg{\bullet}m{\bullet}s^{-2}$) – the Lorenz force acting on electron at the equator,

m_e ($= 9{,}1{\bullet}10^{-31}\,Kg$) – the mass of electron.

The results we had obtained show that force, which distributes atmospheric charges, has an electromagnetic nature. Under action this force the positive charges are moved up and negative charges – down.

Define the mass of water m_w, which "can raise" one proton. For this purpose we form the equation:

$$|\mathbf{F_L}| = m_w{\bullet}|\mathbf{G}|,$$

where: $\mathbf{F_L}$ ($= 2{,}5{\bullet}10^{-20}\,Kg{\bullet}m{\bullet}s^{-2}$) – the Lorenz force acting on proton at the equator,

$\mathbf{G}$ ($= 9{,}81\,m{\bullet}s^{-2}$) – the gravity acceleration at the equator.

From this equation, we find:

$$m_w = |\mathbf{F_L}|/|\mathbf{G}| = 2{,}5{\bullet}10^{-20}\,Kg{\bullet}m{\bullet}s^{-2}/9{,}81\,m{\bullet}s^{-2} =$$

$$= 2{,}55{\bullet}10^{-21}\,Kg.$$

To determine the number of water molecules having a weight m_w:

$m_w/18\,D = 2{,}55{\bullet}10^{-21}\,Kg/18{\bullet}1{,}67{\bullet}10^{-27}\,Kg =$

$= 84830{,}34.$

Thus, in the earth's conditions one proton "can raise" a drop consisting of 84830 molecules of water.

Compose another proportion:

$$1{,}602{\bullet}10^{-19}\,A{\bullet}s \leftrightarrow 2{,}55{\bullet}10^{-21}\,Kg\ H_2O$$

$$\text{or: } 1{,}602{\bullet}10^{-19}\,C \leftrightarrow 2{,}55{\bullet}10^{-18}\,g.\ H_2O$$

Transform this proportion:

$$1{,}602{\bullet}10^{-19}\,C/2{,}55{\bullet}10^{-18} \leftrightarrow 2{,}55{\bullet}10^{-18}/2{,}55{\bullet}10^{-18}\,g$$

$$\text{or: } 6{,}28{\bullet}10^{-2}\,C \leftrightarrow 1\,g\ H_2O.$$

Thus, in the earth's conditions 1 g of water steam can carry a charge, of $+6{,}28{\bullet}10^{-2}$ C, theoretically. It is over that in the described experiments, in [5,10]. It is possible that not all the vaporized charges were taken into account.

3. Conclusions

During the daily rotation of Earth its atmosphere crosses the horizontal lines of geomagnetic field. Therefore in the earth's atmosphere acts a force of electromagnetic nature, which distributes the atmospheric charges. Under action this force the positive charges are moved up and negative charges – down.

This force is the fundamental reason for polarization of the earth's atmosphere and the negative charge of the earth's surface.

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