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On The Question Of The Mechanism And Assessment Of The Influence Of Pollution Of Snow - Ice Coatings On Glacier Melting

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Abstract – The article presents the results of theoretical studies of some mechanisms affecting melting of the ice coating of the planet. Some versions of increasing absorption of solar light energy in case of contamination and diffusion of particles of contamination into the thickness of ice coatings are considered.

Keywords – Mechanisms, Melting Ice Coating, Pollution Of Glacier Surface, Absorption Of Light Energy, Conductivity Of Formations.

I. INTRODUCTION

This article is a continuation of ongoing theoretical studies of some of the environmental problems associated with glacier pollution. It traces some of the mechanisms that affect the melting of the planet's ice cover. The effect of one of the many mechanisms can be viewed with reasonable consistency. In fact, any conclusions drawn from a separate consideration of the melting mechanisms are far from a correct (full) assessment of the current situation. The first preliminary model concepts and estimates were presented by us in [1,2].

II. MELTING MECHANISMS

At the same time, let us trace several mechanisms of the influence of pollution on the acceleration of the melting of the ice cover.

Let's choose several similar mechanisms. The similarity lies in their close relationship with pollution. Let's list them:

1. Pollution of the surface of glaciers and snow massifs lead to a significant increase in the absorption of light solar energy. Part of the light energy, according to the principle of reciprocity, is converted [3] into thermal electromagnetic energy. This thermal radiation penetrates into the thickness of the ice cover. It is partially absorbed by the ice or snow layer and partially absorbed by the soil.

2.Particles of impurities diffuse into the thickness of the coating. In particular, in the ice layer, they, together with ice particles, form a complex mosaic of clusters. Pollution greatly increases the conductivity of these formations. Clusters can often be closed.

(3) Separately, we note that it is closed clusters that have a significant effect on melting by at least two mechanisms:

a) they turn out to be sources of Joule heat

b) ponderomotive interaction of clusters leads to heating and loosening of glaciers.

This leads to oscillation of clusters and, accordingly, to loosening of the ice and, accordingly, to its additional cloudiness. Accordingly, this also leads to an increase in the absorption of electromagnetic thermal radiation.

4. Induction currents induced on clusters as a result of variations in the earth's magnetic field. It also contributes in the form of additional Joule heat [4].

III. SEQUENTIAL CONSIDERATION OF DIFFERENT MECHANISMS

Let's take some simplifications regarding the surface of the coatings. Let the contaminated particles of ice and snow have the shape of balls with the same size. Then the scattering cross section can be written in the form [1].

$$\sigma = \sigma_0 + i\sigma^I$$

here is σ_0 - the real part of the scattering cross section. It is responsible for scattering without absorption (hereinafter scattering), σ^I - a complex part, it is associated with the conductivity of the pollution. This part of the scattering cross section is responsible for the absorption of thermal and solar energy.

1. Let the incident radiation be repeatedly scattered by the particles of pollution. Each act of scattering is σ proportional, then the absorption power can be estimated as:

$$P = P_0\sigma + P_0\sigma^2 + \ldots + P_0\sigma^n$$

σ given its smallness, this expression can be written as follows:

$$P = P_0 \frac{\sigma}{1-\sigma}$$

And so the greater the pollution, the greater the absorbed power.

It is pertinent to recall here that pollution has been occurring since dry land. Dust and dirt particles are carried everywhere by air currents and air masses.

The earth's magnetic field carries charged particles to the poles. This drift of pollution has especially increased since the advent of the steam engine and blast furnaces.

2. Let us estimate the Joule heat of the clusters.

Let the cross section of a closed cluster S. Then the induction EMF is equal to:

$$\varepsilon = -S\frac{dH}{dt}$$

here, $H = H_3 + H_i$, H_3 - is the earth's magnetic field, H_i - is the induction field of the secondary currents caused by the thermal radiation of the surface. Joule heat of one cluster

$$q \approx \frac{\varepsilon^2}{R} \approx \sigma\varepsilon^2 \cdot 10^{-8} = \sigma \cdot 10^{-8}\left(S\frac{dH}{dt}\right)^2$$

If there are n clusters per unit volume, then

$$Q_n = n\sigma \cdot 10^{-8}\left(S\frac{dH}{dt}\right)^2$$

Let one cluster have 100 ice atoms. It can be assumed that during the existence of land and, accordingly, dust (add to this the 300-year industrial history with its dust emissions), almost the entire thickness of the cover is covered by cluster mosaics. Then the number of clusters per unit volume is approximately equal to:

~ 10^{21}. And so, Q_n for we have:

$$Q_n = 10^{21} \cdot \sigma \cdot 10^{-8}\left(S\frac{dH}{dt}\right)^2 = \sigma \cdot 10^{21}\left(S\frac{dH}{dt}\right)^2$$

If we take as the average cluster size $R \approx 300\overset{0}{A}$, then $S \approx 10^{-11}$, then

$$Q_n = 10^{21} \cdot \sigma \cdot 10^{-22}\left(\frac{dB}{dt}\right)^2 \approx \frac{\sigma}{10} \cdot \left(\frac{dB}{dt}\right)^2$$

This is the heat per cubic centimeter. The heat of a cubic meter is equal to:

$$Q = 10^5 \sigma\left(\frac{dB}{dt}\right)^2$$

Considering that this heat is released continuously, then it has a significant effect on the ice cover. This influence is due to the fact that the ice conductivity is of little importance. Accordingly, the heat that is released as a result of these reasons accumulates in the ice mass, exerting an ever-increasing influence.

3. Let us estimate the ponderomotive interaction of clusters, and, accordingly, the heat that is released in this case.

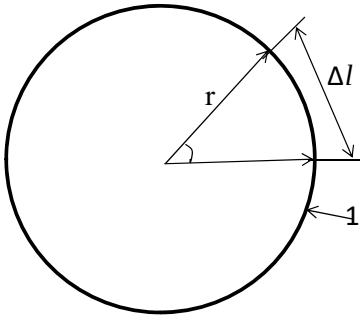
Let $i \approx \frac{1}{R}S\left(\frac{dB}{dt}\right)$ the induction current of the cluster $\frac{dB}{dt}$ be the average value of variations in the earth's field and slow variations in the thermal radiation field.

These currents create secondary magnetic fields near the clusters.

These currents $F_A = iBl$, create $l \approx 2\pi r$ secondary magnetic fields near the clusters. Consider the vibration of a cluster under the action of the Ampère force, here is the cluster length, r - is the average cluster radius. Let the cluster be in equilibrium on average, then (Fig. 1)

$$F_A - 2T\sin\frac{\alpha}{2} = iBl - \alpha T \approx 0$$

T – is the tensile force of the cluster per unit length.



Picture 1.

1-cluster, Δl - stretching of the cluster under the action F_A, α - changing the angle. For the tensile force T we get:

$$T = \frac{iBl}{\alpha}$$

on the other side

$$T = -k\Delta l$$

from here

$$k = \frac{iBl}{2\Delta l}$$

For the potential energy of unit cluster length, we obtain

$$\Delta W = \frac{k\Delta l^2}{2} = \frac{iBl\Delta l}{2\alpha}$$

Let us integrate this expression over the entire length of the cluster $dl = 2d\alpha$, taking this into account we have

$$\int_0^{2\pi} dW = \int_0^{2\pi} \frac{iBl}{2\alpha} rd\alpha = \frac{iBlr}{2} \ln 2\pi = \pi iBr^2 \ln 2\pi$$

It is seen that this energy is also close in order of magnitude to thermal energy. The peculiarity of this mechanism is that it leads to loosening of the ice cover. This in turn leads to a continuous increase in energy absorption. And at the same time to an increase in the frequency of ice splits and avalanches.

IV. Conclusions

At first glance, these mechanisms were energetically insignificant. But since the thickness of the ice and snow covers is large. And to everything else, this substance, which we are talking about, has a low thermal conductivity, then all this, although small, but continuously released heat plays a huge role in the melting of the cover. This is confirmed by what we have in real life. A detailed analysis and more accurate calculations of the effect of low thermal conductivity will be given in subsequent publications.

The article presents the results of assessing the impact of pollution on the melting of glaciers. Pollution causes various mechanisms of heat absorption and release in the ice and snow layers. Simultaneous accounting of them shows that catastrophic consequences are possible.

REFERENCE

[1] A.Artykov, Kh.G. Akhunov, S.Ubaidullaev. Assessment of the influence of some factors leading to an increase in the melting of ice cover of the earth's surface. // Bulletin of ASU. No. 3.2011. pp. 20-22

[2] Abdukakhor Artikov On Estimation Of The Influence Of Some Factors Leading To Increasing Melting Of Ice Coverings Of The Earth Surface International Journal of Progressive Sciences and Technologies (IJPSAT) Vol. 26 No. 1 April 2021, pp. 554-557

[3] S.M. Rytov, Yu.A. Kravtsov, V.I. Tatarsky. Introduction to Statistical Radiophysics, Moscow "Science". 1978.

[4] A. Ishimaru. Propagation and scattering of waves in randomly inhomogeneous media. Part 1. M. "Mir". 1981.p.279