Accessory minerals (to 5%) are presented by epidoty, diopside, apatite, chlorite, and grenades. Also, there are carbonized vegetable fragments and the remains of clamshell of various forms (fig.1, B).

Organic substance study is the most important aspect of hydrochemical, hydrobiological and geological research, and organic carbon is its most presentable characteristic. In the studied sampling material the C_{org} content varies from 0,03 to 1,61%. The organic carbon distribution map is built to reveal the trends of C_{org} content and distribution in the surface of the north Laptev Sea's bottom sediments (fig.2).

Based on the obtained data, it has been found that depositions of pelitic sediments are inclined to the lower areas, whereas in contrast, the psammit depositions are limited to the shallow areas.

The concentration of north Laptev Sea's pelitic sediments with organic carbon is revealed. The probable reason of this process is the increased occlusion of C_{org} by fine pelitic fraction.

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NUMERICAL MODEL OF ATMOSPHERE MEDIUM WITH BLACK CARBON PARTICLES IN ARCTIC FOR DETERMINING OPTICAL RADIATION EXTINCTION

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Introduction

Nowadays, the problem of global warming and the melting of Arctic ice is given a large amount of attention. According to the estimations for year 2012, the volume of ice in Arctic has decreased by approximately 40% compared to the mean value for years 2007-2011 [5]. It is believed that black carbon is one of the highest contributors to the global warming effect. The black carbon is a component of the aerosol in atmospheric Arctic environment. Its particles can be transported by air masses for significant distances and often deposit within Arctic. Black carbon reduces the transmission of solar radiation and cause heating of the atmosphere. However, the behavior of the atmospheric black carbon particles have not been thoroughly researched yet.

Estimating the microphysical parameters for atmospheric black carbon can allow to determine the changes in the Arctic air masses movements, monitor the soot emissions, find the source of pollution and take proper preventive measures. Optical methods, based upon determining the properties of radiation passed through a medium, are the most effective techniques for studying these parameters. In this work we've developed a numerical model of an atmospheric medium including various volumetric scatterers. This model was used to calculate the extinction and transmission function for Arctic atmosphere medium containing randomly oriented black carbon particles.

Methods of calculations

To study the properties of the incident radiation passed through a medium, a numerical model has been developed. The extinction coefficient can be considered as a result of the radiation extinction simulation. The coefficient can be calculated as following:

$$\alpha_{ext} = C\langle S_{ext}\rangle, \qquad (1)$$

where $\langle S_{ext}\rangle$ is the average extinction cross-section, C is the volume concentration of particles. The transmission function for a layer of medium is defined as follows:

$$T = \exp(-\alpha_{ext} \cdot h), \qquad (2)$$

where h is the layer thickness.

To calculate the extinction cross-section, the discrete dipole approximation (DDA) method was used [4]. The advantage of this method is that it can be used for arbitrary particle shape, while currently the most frequently used methods only involve the solution for sphere and coated sphere particles.

Results of calculations

As a model for this research, we've selected an atmosphere medium in Arctic conditions [1] with randomly oriented elliptical soot particles. The calculations of the extinction coefficient and the transmission function included the wavelength range λ varying from 0.5 to 1.0 μm, because at this range the absorption index for soot is considerably higher compared to dust [3]. The refraction $n = n(\lambda)$ and absorption $\chi = \chi(\lambda)$ spectral dependency indices for black carbon were used from the open-access HITRAN-2012 database [2]. In this case, a stands for ellipsoid semi-minor axis, while its semi-major axis is equal to $1.5 \cdot a$. Fig. presents the calculation wavelength dependencies of the extinction coefficient for elliptical black carbon particles of different sizes and concentrations.

The figures *a* and *b* show that raising the particle size increases the extinction coefficient and modifies the curve shape, while reducing the transmission function. The features of the wavelength dependences $\alpha_{ext}(\lambda)$ and $T(\lambda)$ are primarily determined by the spectral functions $n=n(\lambda)$ and $\chi = \chi(\lambda)$ for black carbon. According to (1), the extinction coefficient has a linear dependence on the particle volume concentration. Therefore, increasing C values leads to proportional increase in corresponding α_{ext} values.

Conclusion

The numerical model for studying the optical radiation extinction by atmospheric medium with soot particles in Arctic conditions has been developed. We presented a numerical study of the solar radiation extinction coefficient and the transmission function.

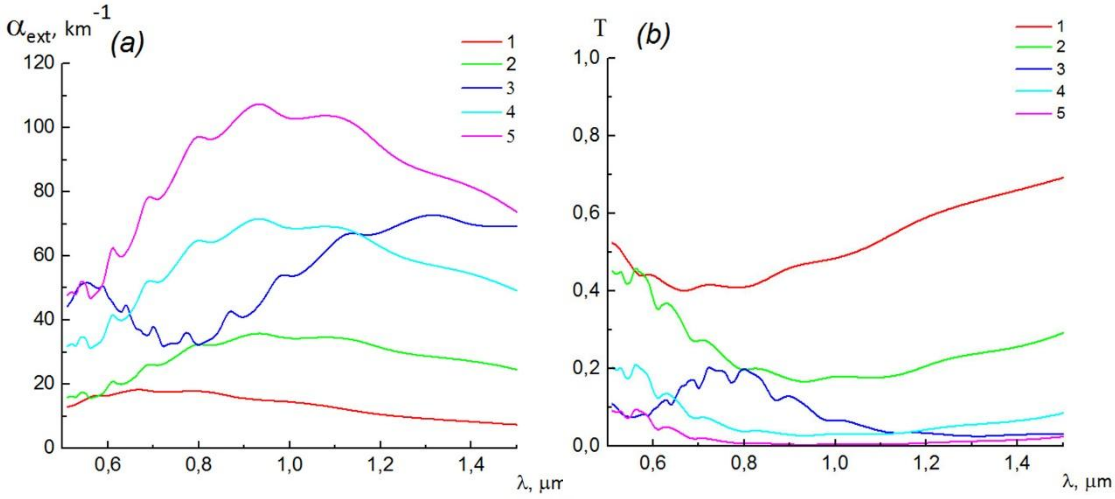

Fig. The wavelength dependence of the extinction coefficient (a) and transmission function (b), h = 100 m; 1 – a=0.5 µm, C=5·10^3 l^{-1}; 2 – a=0.7 µm, C=5·10^3 l^{-1}; 3 – a=1 µm, C=5·10^3 l^{-1}; 4 – a=0.7 µm, C=10^4 l^{-1}; 5 – a=0.7 µm, C=1.5·10^4 l^{-1}.

The wavelength dependence features of the studied optical properties can be used to locate the soot particles and estimate their microphysical parameters.

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ARCTIC DRILLING CHALLENGES

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Over the last decades, the world demand for hydrocarbon resources and their depletion in easy-accessible field has intensified exploration and development in the areas covered by seas and oceans leading to growth of oil production.

According to an assessment by the U.S Geological Survey, the Arctic holds an estimated 13% (90 billion barrels) of the world's undiscovered conventional oil resources and 30% of its undiscovered conventional natural gas resources [1]. However, oil-drilling operations in the region are extremely challenging as both high-cost and high-risk.

Although this is a fragile region, many major oil companies are approaching the Arctic to explore its untouched resources as there are some promising aspects for facilitating oil-drilling operations such as increasing technology developments and melting of sea ice due to global warming.