expenditure of labor, materials, and also depending on parameters of a concrete design, heatphysical characteristics and the thermal mode of peripheric massif.

The analysis of practice of use of oil and gas underground storages in Scandinavian countries having engineering-geological conditions close to conditions of the northwest region of Russia and also an assessment of specific conditions and experience of underground construction in the Russian Arctic allows to draw the following conclusions:

1. During creation of oil and gas transport and distributive systems in the European North of Russia inclusion in their structure of underground storages is expedient. It belongs also to the oil refineries and gas treatment and liquefaction facilities.

2. On the coast of the Kola Peninsula, the mainland of the Arkhangelsk region and on the islands of the Arctic Ocean the geological formations, certain massifs of rocks and the platform suitable for placement of underground tanks of oil and high-capacity gas can be chosen.

3. There are effective and approved technologies of construction and maintenance in a steady and safe state for a long time large-size underground construction in the conditions of the Arctic and Far North of Russia accepted from the economic and ecological point of view and for construction of underground oil and gas tanks in the considered region.

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DEVELOPMENT OF PROGRAM COMPLEX FOR STUDYING ARCTIC AEROSOL EXTINCTION

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Introduction

The influence of aerosols on climate has been a hot topic of discussion for the past decade. The estimates suggest that atmosphere aerosols account for at least 45 percent of the global warming that has occurred in Arctic [1]. As such, properly studying atmospheric aerosols in Arctic is essential for managing ecological situation, monitoring the movement of air masses locating the sources of pollution etc.

Optical methods that are based on determining the properties of a radiation transformed by a medium, are very effective for studying atmospheric aerosols. In this work we’ve developed a program complex that models the incident radiation extinction by aerosol with variable optical properties. The program was tested on experimental data collected by NASA aerosol network at monitoring station located at Arctic sea shore. The program complex is a convenient tool to estimate the properties of an Arctic aerosol, find useful dependencies and detect possible abnormalities, which is essential for scientific research process.

Methods of calculations

To study the properties of the incident radiation passed through a medium, a numerical model has been developed. Modelling the extinction process of radiant energy requires considering the dimensionless value such as extinction efficiency factor:

$$Q_{ext} = \frac{S_{ext}}{S_{sq}}, \qquad (1)$$

where S_{sq} is the area of particle geometrical projection on the detector surface crystal shadow. To compute the extinction characteristics for a system of particles, we need to define the extinction coefficient as following:

$$\alpha_{ext} = C \cdot \langle S_{ext} \rangle . \qquad (2)$$

Here $\langle S_{ext} \rangle$ is the average extinction cross-section; C is the volume concentration of particles.

For simulating light extinction by non-spherical particles, we used the discrete dipole approximation method (DDA). This method represents a particle as a set of dipoles with assigned optical properties, and solves the Maxwell equation for each dipole [2]. This method can boast with high precision and solving the task for arbitrary particle shapes, but often requires significant calculation resources.

Software complex development

To conveniently calculate the light extinction by a medium, it is necessary to consider a number of input parameters. Such include incident radiation wavelength, average particle size, complex refraction index for both particle and medium, particle number concentration etc. The software complex stores complex refraction indices in a database, allows calculating extinction values for varying incident radiation wavelength or radius and displays the resulting dependence in a form of graph.

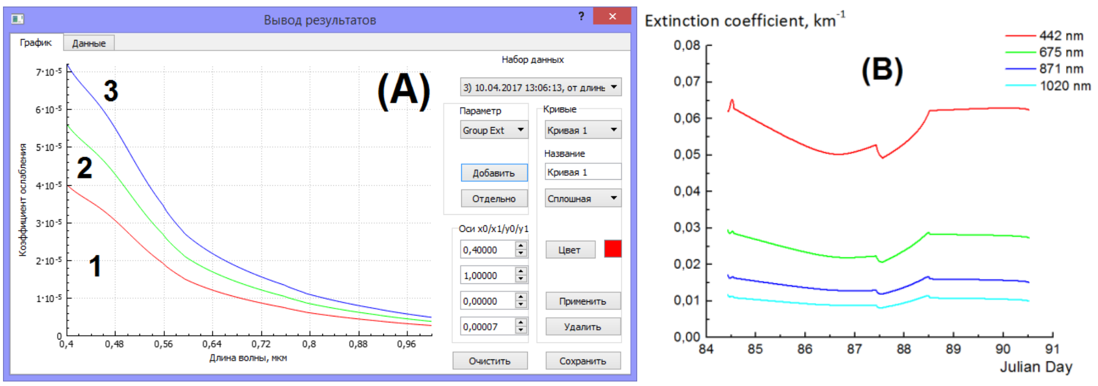

Figure. (A) Dependence of extinction coefficient (m^{-1}) on incident radiation wavelength for cubes of Arctic sea salt aerosol in accumulation mode (left), (1) C = 250·10^3 l^{-1}, (2) C = 350·10^3 l^{-1}, (3) C = 450·10^3 l^{-1}; (B) Arctic sea salt aerosol extinction coefficient measured by AERONET

Testing with experimental data

To properly evaluate the effectiveness of our numerical model, we have researched the prior information on aerosols in Arctic conditions. We simulated the incident radiation extinction by atmospheric sea salt Aerosol in arctic in accumulation mode, and compared it with similar data measured by AERONET open aerosol network run by NASA [3]. The results of simulation are shown in Figure (A). It is compared to the data measured by AERONET on NY_Alesund site in Figure (B).

The modeled extinction uses similar particle sizes and optical properties (Arctic sea salt aerosol in accumulation mode). After comparing coefficient values at different wavelength, it is noticeable that the values for second curve are the closest representative for measured values. That makes sense, since $350 \cdot 10^3$ l^{-1} is the most common number concentration for Arctic sea salt aerosol. This works as the basis for further investigations in this field.

Conclusion

In this work we've developed a software complex for modeling incident radiation extinction for sea salt aerosol in Arctic conditions. The software complex work was tested and compared with experimental data gathered by AERONET aerosol network. The acquired results show the software complex usability for studying and researching Arctic aerosols. Researches based on optical methods can be applied to a number of problems, such as managing ecological situation, detecting pollutions, investigating the effect on global warming and many more.

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RUSSIAN PETROLEUM INDUSTRY IN THE ARCTIC: IN THE STATE OF PRIRAZLOMNAYA FIELD

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Development of offshore oil and gas fields in the Arctic has been widely discussed all over the globe during the last decades. Unsurprisingly, as one of the world leaders in oil and gas production Russia pays much attention to the Arctic territory as well. There are many discovered fields in the Arctic and many to be discovered in the near future. This article describes Russian experience in offshore production in the state of Prirazlomnaya oil field.

The oil field was discovered on Pechora Sea shelf 60 kilometers off the shore in 1989. Water depth varies from 19 to 20 metres [1]. It is currently the only Russian Arctic offshore petroleum production project. However, Russian companies have many plans to develop other fields in the Barents, Kara and the Sea of Okhotsk. As for the strategy, the comprehensive approach is to expand the production area by developing group of closely located fields, which optimizes cost and creates conditions for the simultaneous development of large and relatively small offshore fields.