

CAUSES AND CONSEQUENCES OF ARCTIC ICE MELTING

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The cryosphere consists of 2 % of the Earth water volume. But its role in formation of the Earth climate and the climate's changes is the most important [4].

Two circumstances become apparent when it comes to the Arctic basin influence on the Earth climate. Firstly, in this basin fresh waters are formed in the form of ice and so-called Arctic surface water flowing to North Atlantic. Depending on these waters intensity, essential changes in nature of circulation in the North of the Atlantic Ocean, as well as through the inter-oceanic circulation system in the World's ocean can be observed. Secondly, seasonal and interannual changes in the Arctic sea ice extent and its properties lead to changes of planetary albedo.

Snow cover and sea ice reflect the significant amount of solar radiation back into space cooling the atmosphere; it defines such a concept as albedo. This leads to changes in the energy amount received by the Earth's atmosphere, global meridional temperature gradients and zonal atmospheric circulation. The Arctic and Antarctic ice cap furthers the planetary climate cooling (in a larger degree the local climate) and a decrease of an ice cover reduces its cooling influence.

The first cause of the Arctic glaciers melting is a gradient of change of temperature with height. Air temperature with height goes down on average on 0.65 C each 100 meters. In the Arctic air rising from the Earth's surface has lower temperature and smaller humidity therefore it does not mix up with lighter air in the upper atmosphere. Due to this fact, heat remains concentrated at a surface [5].

The second factor influencing the Arctic fast warming is the Earth's surface albedo. The albedo is the value characterizing a surface reflectance of a body. While the Arctic ice melting it releases more dark surface waters or soils capable to absorb a larger amount of heat than snow or ice.

The third cause of ice melting is a process related to the Plank's law. Its key point is that, the colder temperature of the radiating surface is, the larger temperature rise is necessary to balance a process.

The following global processes have the same effect on the Earth's temperature change and Arctic ice melting have:

- cultivation of huge land mass causing changes of albedo, fast moisture loss, dust raising in the atmosphere;
- deforestation, especially tropical, influencing oxygen production, albedo change and evaporation;
- fossil organic fuel combustion and CO₂, CH₄ emission in the atmosphere;
- industrial waste dispersion to the atmosphere changing air components and increasing aerosol content. The last two processes increase greenhouse effect.

The special warning is caused by carbon dioxide, hydrochlorofluorocarbon, methane, nitrous oxide and ozone progressing increase which create greenhouse effect.

Ice movement. As shown in figure 1, in September, 2012 the rate of the Arctic ice melting broke all records. At the same time the rate of ice melting became slower in 2014. This fact allowed some volumes of one-year ice to live through the summer and become multi-year ice. From March 2013 to March 2014 the one-year ice volume reduced from 78% to 69%. It means that the considerable Arctic ice proportion in 2013 could endure a

summer melting. For the same period the two-year ice volume grew from 8% to 14%, and four-year ice from 7.2% to 10.1% [3].

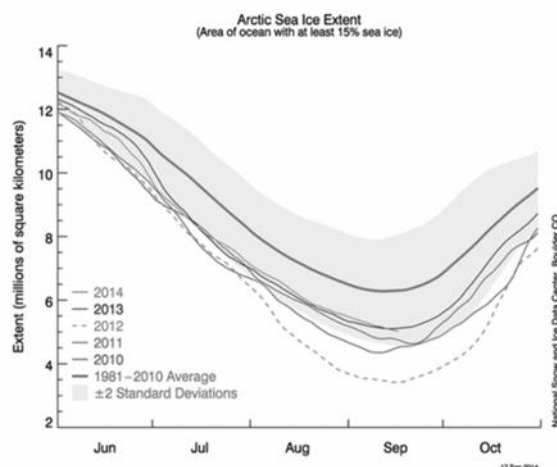


Fig. Arctic Sea Ice Extent

Taken as the whole by March 2014 multi-year ice volumes had been able to back to the mean value of 1981-2010s, but despite this fact, the annual Arctic report's authors consider that in the long term there is a tendency in its quantity decrease. Specifically, if in the 1980s the oldest ice consisting of 4 and more year ice was 26% of the total amount of the Arctic ice that by March 2014 its volumes decreased in two and a half times to 10%. If, in contrast, to speak about 7-8 year ice and more, such ice become more and more infrequent.

Current ice condition. Climatologists claim that those rates of the Arctic ice melting observed within last year indicate that in 2016 the planet is acing with the record rate of polar cap melting that can be seen today. According to the Helmholt's center representative Marcel Nikolaus, the Arctic ice coverage has formed very slowly this summer due to high temperature values. The ice coverage in the Arctic seas became minimal in the middle of February throughout the monitoring.

According to the monitoring results the ice area of the North Polar Region in the middle of the 2nd decade of February, 2016 was 14190 thousand sq.km. As the press service of Northern Territorial Administration for Hydrometeorological and Environmental Monitoring reports, this value is 6.8 % less than a norm and minimum for the whole period of monitoring [6].

The climatologist M. I. Budyanko offered a hypothesis that if there was no the Arctic ice coverage, under existing heat exchange conditions in the atmosphere and the hydrosphere, temperature in the Arctic would have to increase more than 40 C. It is possible to imagine what would be in other places of the Earth [1].

Scientists believe that if principal measures aren't taken to reduce greenhouse gas emissions, it will lead to average annual temperature rise of 1.4-5.8 degrees by the end of this century. Global warming consequences will increase hot weather periods which will become more extreme in its temperature condition and more longtime [2].

Global warming will cause the climate change on a global scale. According to scientists' comments, it will increase a number of floods caused by hurricanes. Besides, summer atmospheric precipitation will be reduced by 15-20% that will cause desertification of many agricultural territories. Due to the temperature and the World Ocean water level rise, natural zones' borders will begin to move to the North. What are predictable consequences of global warming for fauna? Penguins, seals and polar bears

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(доклады на английском и немецком языках)

which adapted to Arctic conditions will be forced to replace their habitat. In addition, many species of plants and animals will just disappear if they are not able to adapt to new habitual conditions.

What are consequences of global warming for mankind? In the short-term period of climate change people are threatened with drinking water problems; cultivation of agricultural grounds. Besides, they will lead to growth of infectious diseases. According to scientists' comments, about six hundred million people will be faced with starvation. By 2080 residents of China and Asia can experience ecological crisis caused by change of precipitation pattern and glaciers melting. The same process will lead to flooding of many small islands and coastal territories. In the flood-impacted zone, there will be about hundred million people, many of which will be forced to migrate. Scientists predict disappearance even of some states (for example, the Netherlands and Denmark). It is probable that under water there will be a part of Germany as well.

As for a long-term perspective of global warming, it can become the next stage of evolution of the human.

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**GAS HYDRATE DEPOSIT DEVELOPMENT IN THE ARCTIC:
GEOECOLOGICAL AND TECHNICAL CHALLENGES**

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In the 21st century, the prospects of global energy production are alternative and unconventional sources of energy. A remarkable example of alternative fuels is gas hydrate, which can be a reliable source of natural gas with competitive advantage to outperform the greatest hydrocarbon reserves, including those of coal and oil. Gas hydrate reserves are estimated at 250 trillion m³, which is twice as much as proven world reserves of coal, oil, and gas [5].

Gas hydrates are crystalline substances composed of low molecular weight gases (CH₄, C₂H₆, C₃H₈, C₄H₁₀), in which gas molecules are accommodated in hydrogen bonded water molecules in a cage-like structure (or clathrate) under particular pressure and temperature conditions: the temperature lower than 10 degrees °C and the pressure up to