Our melting Arctic: Sea ice cover declining at five days per decade

AllVoices

With every decade that passes, the ice-free season across the Arctic extends by five days, according to new research published by the Department of Earth Sciences at University College, London.

An analysis of satellite data show that each summer the Arctic Ocean is absorbing ever greater amounts of the sun's energy. As a result, each autumn sea ice in the polar region is forming later and later in the year. In some regions of the Arctic, the autumn freeze-up occurs up to 11 days later per decade than was previously the case.

The UCL research, to be published in a forthcoming edition of the journal Geophysical Research Letters, not only has implications for predicting the effects of climate change but also has practical applications, looking to the establishment of shipping routes through the Arctic and exploitation of resources in the polar regions.

The UCL findings come just a few weeks after University of California researchers, in a separate study [1], found that the albedo or reflective properties of Arctic ice — properties that determine how much light from the sun is reflected back into space — declined from 52 percent in 1979 to 48 percent in 2011.

In absolute terms, a decline of 4 percentage points may not sound much but the UC scientists estimated that, averaged over the whole world, this Arctic albedo decrease equated to climate forcing (or heating up) 25 percent as large as that due to changes in CO2 levels over the same period, and considerably larger than that suggested by previous climate models concerning the reflective properties of Arctic ice.

In terms of the pure energy involved in these changes, the amounts involved are colossal. For every single square meter of sea, hundreds of megajoules are accumulated thanks to the sun's rays not bouncing back into space. The amount involved equates to several times the energy released by the atomic bomb dropped on Hiroshima *for every square kilometer* of the Arctic Ocean.

Commenting on the latest UCL study, Julienne Stroeve, a professor at UCL Earth Sciences, said, "The extent of sea ice in the Arctic has been declining for the last four decades and the timing of when melt begins and ends has a large impact on the amount if ice lost each summer. With the Arctic region becoming more accessible for long periods of time, there is a growing need for improved prediction of when the ice retreats and reforms in winter."

The study demonstrates that it is not just a decrease in the quantity of Arctic ice

that’s feeding back to produce a lengthening ice-free season. The “quality” of the ice is also a contributory factor.

Although temperatures have been increasing during all calendar months, the trend for when seasonal melt starts (i.e., earlier in the year) is not as pronounced as for the delayed autumn freeze-up. Despite that, report the researchers, the timing of melt onset strongly influences how much of the Sun"s energy gets absorbed by the ice and sea.

This is where the albedo or reflective factor comes into play. Ice is highly reflective and consequently has a high albedo. Most of the incoming sunlight is reflected back into space. In contrast, liquid water has a low albedo and absorbs most of the sun’s rays directed at it. Absorbing energy, in the form of light, heats up the darker sea.

The rhythm of this process becomes apparent. A small change in the extent of springtime sea ice leads to vastly more heat being absorbed by the Arctic Ocean in the summer. Because the sea is warmer, the onset of the autumn freeze-up is delayed. Less winter ice is formed and come the following spring, there is less high albedo ice so the sea absorbs more sunlight.

The qualitative factor concerns what’s known as multiyear ice. This type of ice survives the Arctic summer without melting. Multiyear ice also has a higher albedo factor than single-year ice that only forms over the sea during winter.

The change since the 1980s is stark. About three decades ago, the more reflective multiyear ice accounted for 70 percent of overall Arctic winter ice. Today, it makes up a mere 20 percent.

The UCL research involved Stroeve"s team analyzing more than three decades of satellite imagery covering the Arctic region. The Arctic was subdivided into a grid, all squares measuring 25 kilometers.

The albedo of each of these 2km squares was then analyzed for each month data was available. By adopting this method, trends could be updated as well as adding a further six years data to previous analyses. The new data continues the trend toward longer ice-free periods than previously observed.

"The headline figure of five days per decade hides a lot of variability, “ according to Stroeve, “From year to year, the onset and freeze-up of sea ice can vary by about a week. There are also strong variations in the total length of the melt season from region to region: up to 13 days per decade in the Chukchi Sea [2] [off Alaska], while in one, the Sea of Okhotsk [3] [between the Kamchatka peninsula and eastern Russia], the melt season is actually getting shorter."

For those seeking to exploit the Arctic’s resources, oil companies being an example, the study provides essential information on when the Arctic Ocean is likely to freeze up. Whether such resources should be exploited at all, in the greater context of global carbon emissions, remains a matter of dispute brought to the fore by the last September arrest of Greenpeace protesters and seizure of their vessel [4] by the

Russian authorities.

For climate scientists, the study should assist in providing a better understanding of the feedback mechanisms inherent in the Arctic climate. The UCL research appears to bear out previous studies, suggesting an accelerated melt of Arctic sea ice has been underway for some time.

Sources:

University College London [5]

University of California [1]

PNAS [6]

NASA [7]

BBC News [4]

Links:
[1] http://eisenman.ucsd.edu/publications/Pistone-Eisenman-Ramanathan-2014.pdf
[2] http://en.wikipedia.org/wiki/Chukchi_Sea
[3] http://en.wikipedia.org/wiki/Sea_of_Okhotsk
[4] http://www.bbc.com/news/world-europe-24170129
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