New data confirms Arctic ice trends: Sea ice being lost at a rate of five days per decade

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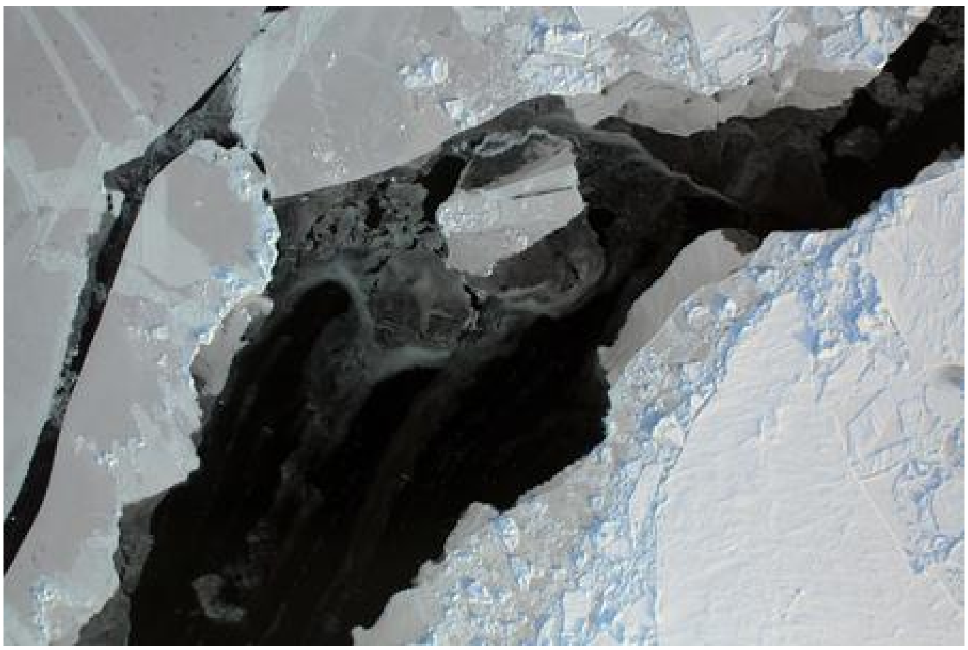


Satellite image of Arctic sea ice breaking up. Credit: NASA/Goddard Space Flight Center

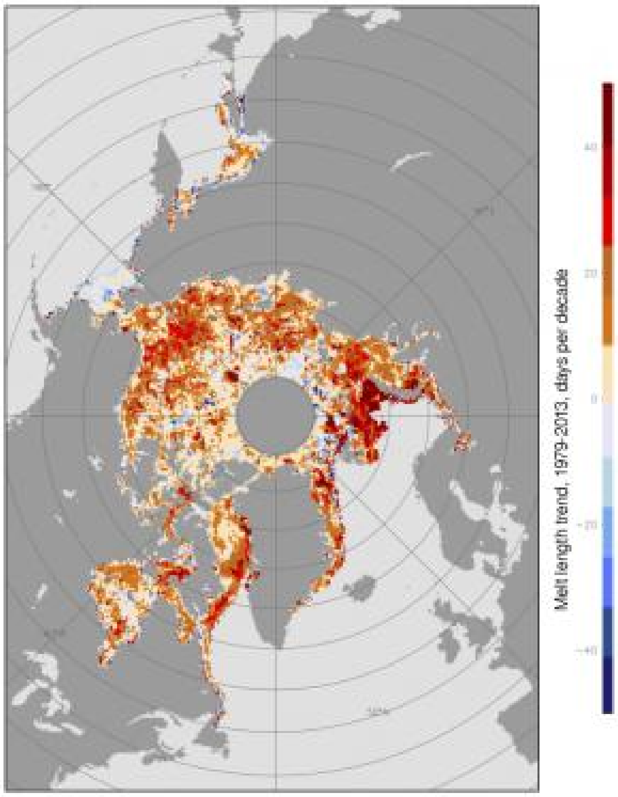
(Phys.org) —The ice-free season across the Arctic is getting longer by five days per decade, according to new research from a team including Prof Julienne Stroeve (UCL Earth Sciences). New analysis of satellite data shows the Arctic Ocean absorbing ever more of the sun's energy in summer, leading to an ever later appearance of sea ice in the autumn. In some regions, autumn freeze-up is occurring up to 11 days per decade later than it used to.

The research, published in a forthcoming issue of the journal *Geophysical Research Letters*, has implications for tracking climate change, as well as having practical applications for shipping and the resource industry in the Arctic regions.

"The extent of sea ice in the Arctic has been declining for the last four decades," says Julienne Stroeve, "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 ."

While temperatures have been increasing during all calendar months, trends in melt onset are considerably smaller than that of autumn freeze-up. Nevertheless, the timing of melt onset strongly influences how much of the Sun's energy gets absorbed by the ice and sea. This in turn is affected by how reflective the surface is. Highly reflective surfaces, such as ice, are said to have a high albedo, as they reflect most of the incoming heat back into space. Less reflective surfaces like liquid water have a low albedo, and absorb most of the heat that is directed at them.

This means that even a small change in the extent of sea ice in spring can lead to vastly more heat being absorbed over the summer, leading to substantially later onset of ice in the autumn. There is also a second effect, in that multi-year ice (which survives through the summer without melting) has a higher albedo than single-year ice that only covers the sea in winter. Since the 1980s, the proportion of the Arctic winter ice that is made up of multi-year ice has dropped from around 70% to about 20% today, so the changes are quite substantial



This map charts the change in the melt season over the past quarter century. Red areas see lengthened melt seasons, by up to 40 days over the entire period. In a handful of areas (shown in blue) the melt season has shortened. Credit: Julienne Stroeve (UCL Earth Sciences/National Snow and Ice Data Center)

These feedback effects, in which small changes in atmospheric temperature and sea ice lead to large changes in heat absorption, was what the team set out to study.

Stroeve's team analysed satellite imagery of the Arctic region, dating back over 30 years. The data breaks down the whole region into 25x25km squares, and the team analysed the albedo of each of these for each month for which they had data. This allowed them to update trends and add an extra 6 years onto the most recent analysis of its kind. The new data continues the trend towards longer ice-free periods previously observed.

"The headline figure of five days per decade hides a lot of variability. 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, while in one, the Sea of Okhotsk, the melt season is actually getting shorter."

The amounts of energy involved in these changes are enormous – hundreds of megajoules of extra energy accumulated in every square metre of sea. This is equivalent to several times the energy released by the atom bomb at Hiroshima for every square kilometre of the Arctic Ocean.

For organisations such as oil drillers operating in the Arctic region, a sophisticated understanding of when the sea will freeze up is essential. For climate scientists, this type of study helps them better understand the feedback mechanisms inherent in the Arctic climate. The results from this study are closely in line with previous work and therefore give added confidence that models of the complex Arctic climate are broadly correct.

More information: The research appears in a paper entitled "Changes in Arctic melt season and implications for sea ice loss", to be published in a forthcoming issue of the journal *Geophysical Research Letters*. onlinelibrary.wiley.com/doi/10 … 013GL058951/abstract

Provided by University College London

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