Cyclone did not cause 2012 record low for Arctic sea ice

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A huge Arctic cyclone in August was not responsible for the historic minimum seen soon after in Arctic sea-ice extent.

It came out of Siberia, swirling winds over an area that covered almost the entire Arctic basin in the normally calm late summer. It came to be known as "The Great Arctic Cyclone of August 2012," and for some observers it suggested that the historic sea ice minimum may have been caused by a freak summer storm, rather than warming temperatures.

But new results from the University of Washington show that the August cyclone was not responsible for last year's record low for Arctic sea ice. The study was published online this week in Geophysical Research Letters. "The effect is huge in the immediate aftermath of the cyclone, but after about two weeks the effect gets smaller," said lead author Jinlun Zhang, an oceanographer in the UW's Applied Physics Laboratory. "By September, most of the ice that melted would have melted with or without the cyclone."

Recent research showed that the Arctic cyclone was the most powerful ever seen during the month of August, and the 13th most powerful of all Arctic storms in more than three decades of satellite records.

"The storm was enormous," said co-author Axel Schweiger, a polar scientist in the Applied Physics Laboratory. "The impact on the ice was immediately obvious, but the question was whether the ice that went away during the storm would have melted anyway because it was thin to

begin with."

The UW team performed the climate scientist's equivalent of a forensic exam: They ran a computer simulation of last summer's weather and compared it against a second scenario that was identical except that there was no cyclone.

Results showed the storm caused the sea ice to pass the previous record 10 days earlier in August than it would have otherwise, but only reduced the final September ice extent by 150,000 square kilometers (almost 60,000 square miles), less than a 5 percent difference. By comparison, the actual minimum ice extent was 18 percent less than the previous record set in 2007.

The study also revealed a surprising mechanism for the cyclone-related melting. Earlier discussions about the cyclone's effect had focused on winds breaking up the ice or driving ice floes into areas of warmer water. The results suggest that neither process led to much increase in melting.

Relatively recent research shows that in the summertime, thin ice and areas of open water allow sunlight to filter down to the water below. As a result, while a layer of ice-cold fresh water sits just beneath the sea ice, about 20 meters (65 feet) down there is a layer of denser, saltier water that has been gradually warmed by the sun's rays.

Blowing on polar water is less like blowing on a cup of tea and more like blowing on a layered cocktail. When the cyclone swept over the drifting ice floes, underside ridges churned up the water to bring sun-warmed seawater to the ice's bottom edge. The model suggests that during the cyclone there was a quadrupling of melting from below, and that this was the biggest cause for doubling ice loss during the three-day storm.

"We only looked at one big storm. If we want to understand how storms will affect the ice cover in the future we need understand the effect of storms in different conditions," said co-author Ron Lindsay.

More sunlight reaches the water in a year with unusually thin summer ice, such as 2012, so this process is a potential multiplier effect for sea-ice melting.

The results are of interest beyond understanding climate change. As sea ice thins and melts, economic and political concerns require better sea-ice forecasts to protect ships and instruments that might travel in those waters.

"One thing we are working on, and that needs to be included in future computer simulations, is how bigger waves created by wind blowing over more extensive open water help break up the sea ice into floes, and how these smaller floes respond to warm water," said co-author Mike Steele.

Provided by University of Washington

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