

# Dramatic sea-ice melt caps tough Arctic summer

*From raging wildfires to melting ice in Greenland, the top of the world is screaming for help.*

BY ALEXANDRA WITZE

Chelsea Wegner was shocked when she landed in Anchorage, Alaska, in July, on her way to a research cruise in the Bering Sea. Smoke from wildfires across the state had darkened the skies, and Anchorage was in the midst of a heatwave that saw temperatures soar past 32 °C for the first time in recorded history.

Wegner, a marine biologist at the University of Maryland in Solomons, also knew that the unusual warmth had melted nearly all of the sea ice in the Bering Sea. “It was a really surreal moment,” she says.

Later, while sailing aboard a Canadian icebreaker off the coast of Alaska, Wegner watched walrus swimming in open water — without the ice floes they normally use as a platform on which to rest, give birth and nurse their young during the Arctic summer.

Any day now, scientists will tally the final numbers on this summer’s annual sea-ice melt. The ice seems to be headed for one of the lowest extents measured since satellite record-keeping began in 1979.

Here, *Nature* explores the myriad challenges that the Arctic is facing as an unprecedented summer comes to a close in the far north.

## SEA ICE SPIRALLED DOWN

Arctic sea ice freezes each winter after a long summer melt. But surprising warmth during the Arctic winter and spring hampered its build-up — setting the stage for this summer’s dramatic ice loss (see ‘To the wire’).

The dynamic was especially apparent in the Bering Sea. “From about January to May the sea ice in the Bering Sea just didn’t happen,” says Alice Bradley, a polar scientist at Williams College in Williamstown, Massachusetts. “We haven’t seen that before.” A low-pressure weather system hovered over the sea for much of February, funnelling warm air from the south and pushing the little ice that did manage to form into northern waters.

Throughout the spring and summer, Arctic sea ice melted away faster than usual in areas such as the Beaufort Sea and the central Arctic Ocean. Ice extent and volume hit record monthly lows in July, and by early August there was no sea ice within 240 kilometres of the Alaskan coast.

Researchers are still waiting for Arctic sea

ice to bottom out this year. The 2019 melt season doesn’t look likely to eclipse the record minimum of 3.387 million square kilometres measured on 17 September 2012, but it adds to evidence that sea ice is caught in a downward spiral.

For each of the past five years, September sea-ice extent has tracked well below the 1981–2010 median. And Arctic sea-ice volume is also dwindling rapidly. The level recorded in July — 8,800 cubic kilometres — is 47% below the mean value for 1979–2018.

Now the annual freeze is almost ready to begin. But much of the ice that forms will be the thin, ‘first-year’ variety that is especially vulnerable to melting away the next year.

## GREENLAND MELTED

Extreme heat also baked Greenland’s enormous ice sheet this summer. Temperatures across the island soared up to 12 °C hotter than the average in late July.

At Summit Station, a research camp at the highest point on the ice sheet,

temperatures darted above freezing on 30 and 31 July. Ice-core records suggest how rare this is: between the years 500 and 1994, the ice at Summit melted only eight times.

During the five-day heatwave, Greenland shed about 55 billion tonnes of ice — including an estimated 13 billion tonnes on 1 August alone. That’s the most in a 24-hour period since records began in 1950.

All told, about 60% of the surface of Greenland’s ice sheet melted at least a little this summer (see ‘Massive melt’). That’s second only to the summer of 2012, when about 98% of the ice sheet underwent some sort of surface melting.

Between water melting from the ice sheet’s surface and icebergs breaking off, Greenland probably contributed a little over 1.5 millimetres to global sea-level rise this year, according to polar scientist Xavier Fettweis at the University of Liège in Belgium.

When researchers eventually compare the mass lost during this summer’s melt with the mass gained during the winter’s snowfall, Greenland is likely to come out as having lost



Sea ice has been sparse this summer in the Chukchi Sea between Russia and Alaska.

YURI SMITUK/TASS VIA GETTY

at least as much in 2019 as it did in the extreme year of 2012.

### TEMPERATURES SOARED

July 2019 was the hottest month ever recorded worldwide, according to the European Commission's Copernicus Climate Change Service and the US National Oceanographic and Atmospheric Administration. Each of the last five Julys has ranked among the top five hottest months on record.

The Arctic portions of Alaska, western Canada and central Russia all experienced temperatures at least 2 °C warmer than average from January to July. Heat records fell in many southern Alaskan cities during the first week of July. And seabirds died by the thousands in July and August, mainly from starvation, in warmer-than-average waters off the state's coast; it is the fifth year in a row this has happened.

Alaska was still breaking temperature records in early September, with several towns in the state's far north setting record highs for the month.

In Sweden, the village of Markusvinså reported a temperature of 34.8 °C on 26 July — the hottest ever recorded in the part of the country above the Arctic Circle. And the heatwave that melted Greenland in late July wreaked havoc on western Europe before it got there, causing temperatures to climb past 40 °C in Belgium and the Netherlands for the first time in recorded history.

### FIRES FLARED

All that heat transformed northern forests into tinderboxes ready to light.

More than 1 million hectares burnt in Alaska this summer, mostly in the southern and central parts of the state. The fire season began unusually early, in April, and has lasted longer than usual. State officials had to extend the end of the official fire season for a month, from the end of August to the end of September, to ensure that they had enough firefighters to battle the ongoing blazes.

And more than 2.6 million hectares have burnt in Siberia since July, blanketing cities across eastern Russia in smoke (see 'Hazy outlook'). High temperatures, winds and thunderstorms helped to spark and spread the blazes. Russia declared a state of emergency in late July for several Siberian regions.

Many of the Alaskan and Siberian wildfires began dwindling in August, but they still rank among the longest-lived Arctic wildfires ever recorded. In June alone they emitted 50 million tonnes of carbon dioxide — roughly equal to the annual CO<sub>2</sub> emissions of Sweden, and more than the total emitted by all Arctic wildfires in the past nine Junes, according to the Copernicus Atmosphere Monitoring Service of the European Commission.

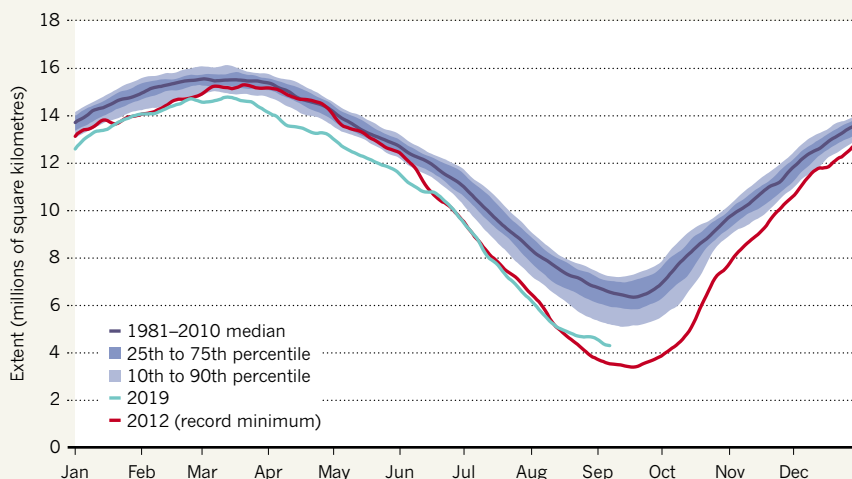
Even Greenland, which rarely sees wildfires, experienced several during its record heatwave this summer. ■

## ARCTIC TRANSFORMATION

The summer of 2019 saw dramatic changes across the Arctic, including a steep drop in the area covered by sea ice, widespread melting of the Greenland ice sheet and unusually frequent and intense forest fires in Alaska, Canada and Russia.

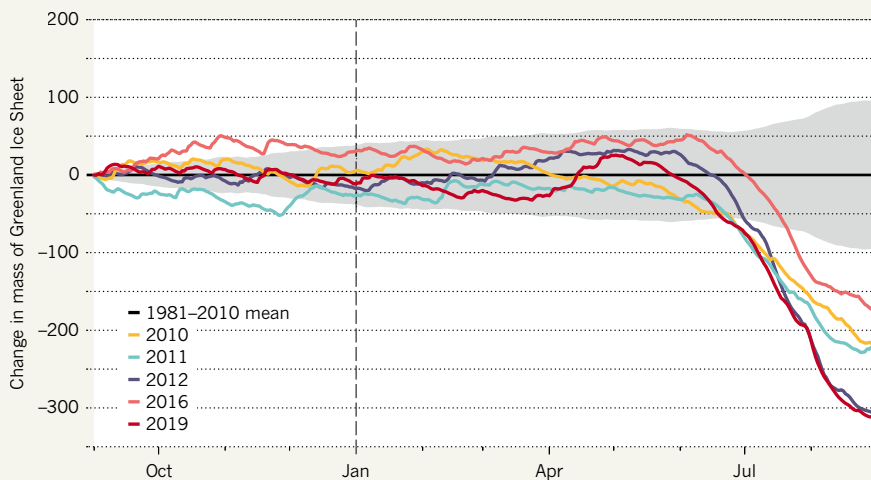
### TO THE WIRE

The area covered by Arctic sea ice this summer is on track to be declared one of the lowest since satellite record-keeping began in 1979.



### MASSIVE MELT

Greenland's vast ice sheet underwent unusual — and widespread — surface melting in the summer of 2019.



### HAZY OUTLOOK

High temperatures set the stage for intense wildfires in Siberia and other parts of Russia this summer.

