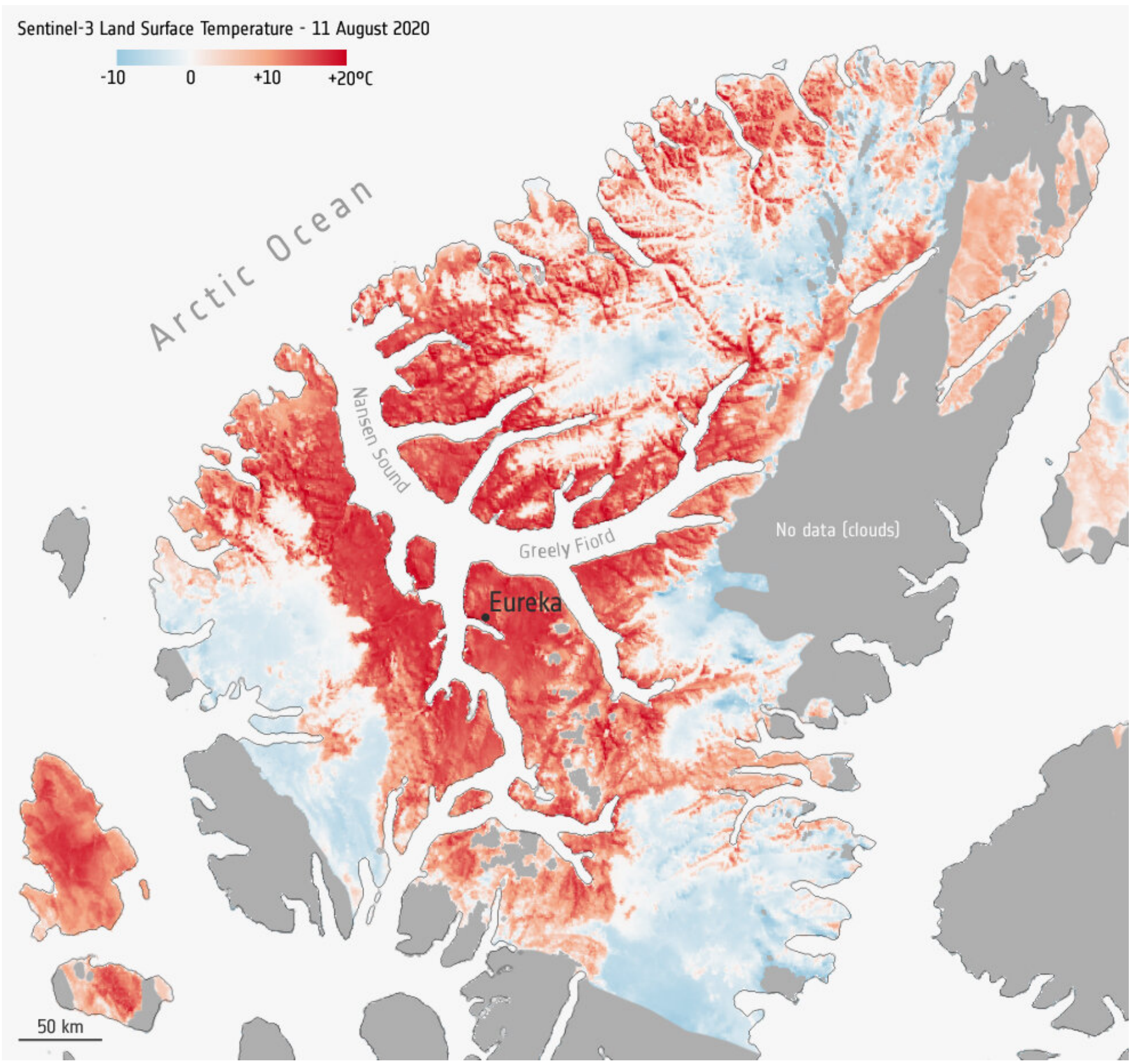
Monitoring the Arctic heatwave

August 27 2020



This map shows the temperature of Eureka in the Canadian territory of Nunavut on 11 August 2020. This map has been generated using data from Copernicus Sentinel-3's Sea and Land Surface Temperature Radiometer (SLSTR). While weather forecasts use air temperatures, the Sentinel-3 SLSTR instrument measures the amount of energy radiating from Earth’s surface. Credit: Copernicus Sentinel (2020), processed by ESA, CC BY-SA 3.0 IGO

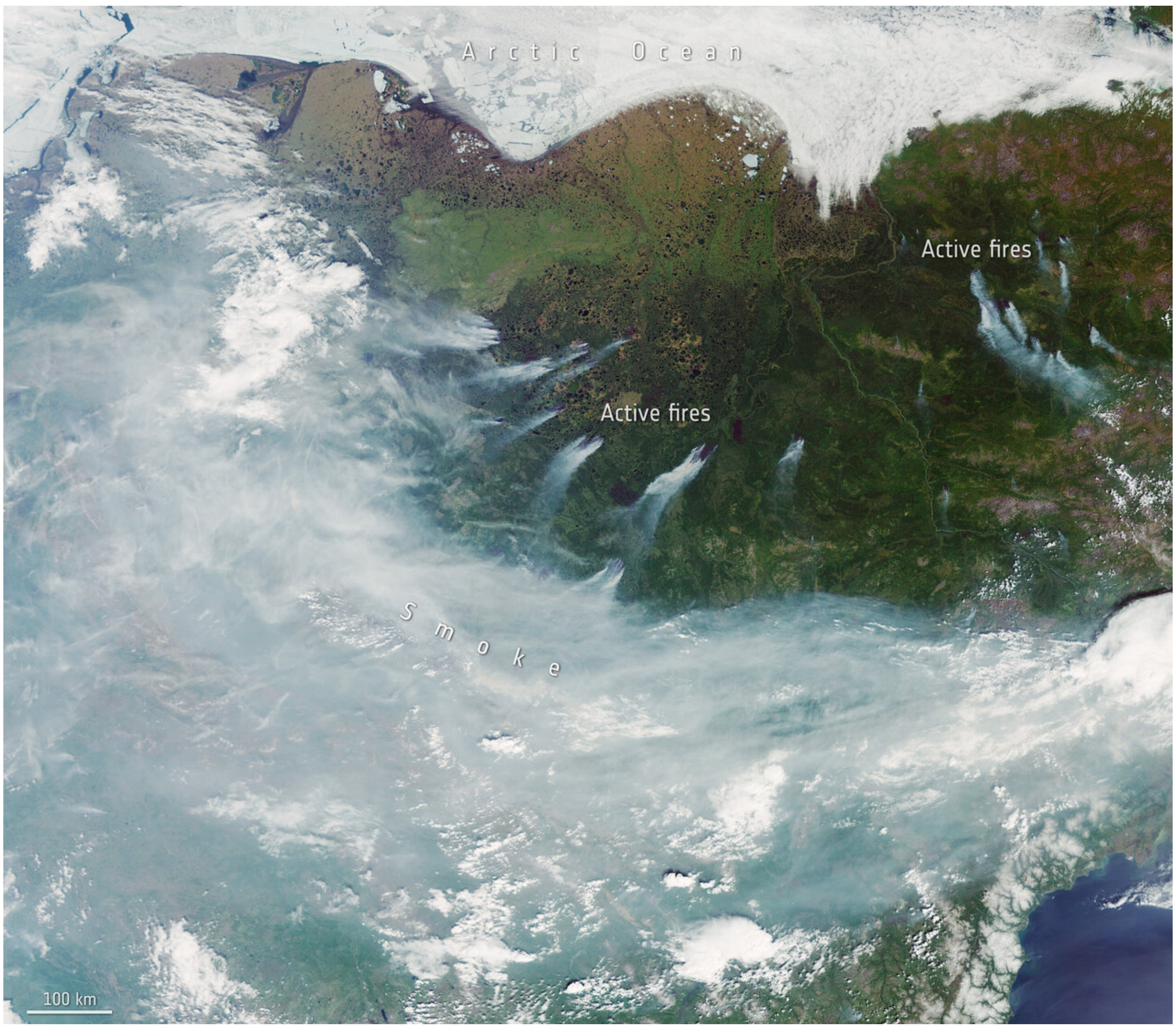
,Over the past months, the Arctic has experienced alarmingly high temperatures, extreme wildfires and a significant loss of sea ice. While hot summer weather is not uncommon in the Arctic, the region is warming at two to three times the global average—impacting nature and humanity on a global scale. Observations from space offer a unique opportunity to understand the changes occurring in this remote region.

According to the Copernicus Climate Change Service, July 2020 was the third warmest July on record for the globe, with temperatures 0.5°C above the 1981-2010 average. In addition, the Northern Hemisphere saw its hottest July since records began—surpassing the previous record set in 2019.

The Arctic has not escaped the heat. On 20 June, the Russian town of Verkhoyansk, which lies above the Arctic Circle, recorded a staggering 38°C. Extreme air temperatures were also recorded in northern Canada. On 11 August, Nunavut's Eureka Station, located in the Canadian Arctic at 80 degrees north latitude, recorded a high of 21.9°C—which were reported as being the highest temperature ever recorded so far north.

The image above shows the land surface temperature recorded on 11 August around Eureka. This map has been generated using data from Copernicus Sentinel-3's Sea and Land Surface Temperature Radiometer. While weather forecasts use near surface air temperatures, Sentinel-3 measures the amount of energy radiating from Earth's surface.

Although heatwaves in the Arctic are not uncommon, the persistent higher-than-average temperatures this year have potentially devastating consequences for the rest of the world. Firstly, the high temperatures fuelled an outbreak of wildfires in the Arctic Circle. Images captured by the Copernicus Sentinel-3 mission show some of the fires in the Chukotka region, the most north-easterly region of Russia, on 23 June 2020.



This image of Siberian fires was captured on 23 June 2020 by the OLCI instrument on board the Copernicus Sentinel-3 mission. Part of Sakha, Chukotka and the Magadan Oblast is pictured here. Sea-ice can be seen to the north while smoke dominates the bottom part of the image with a number of active fires visible in the centre. Credit: contains modified Copernicus Sentinel data (2020), processed by ESA, CC BY-SA 3.0 IGO

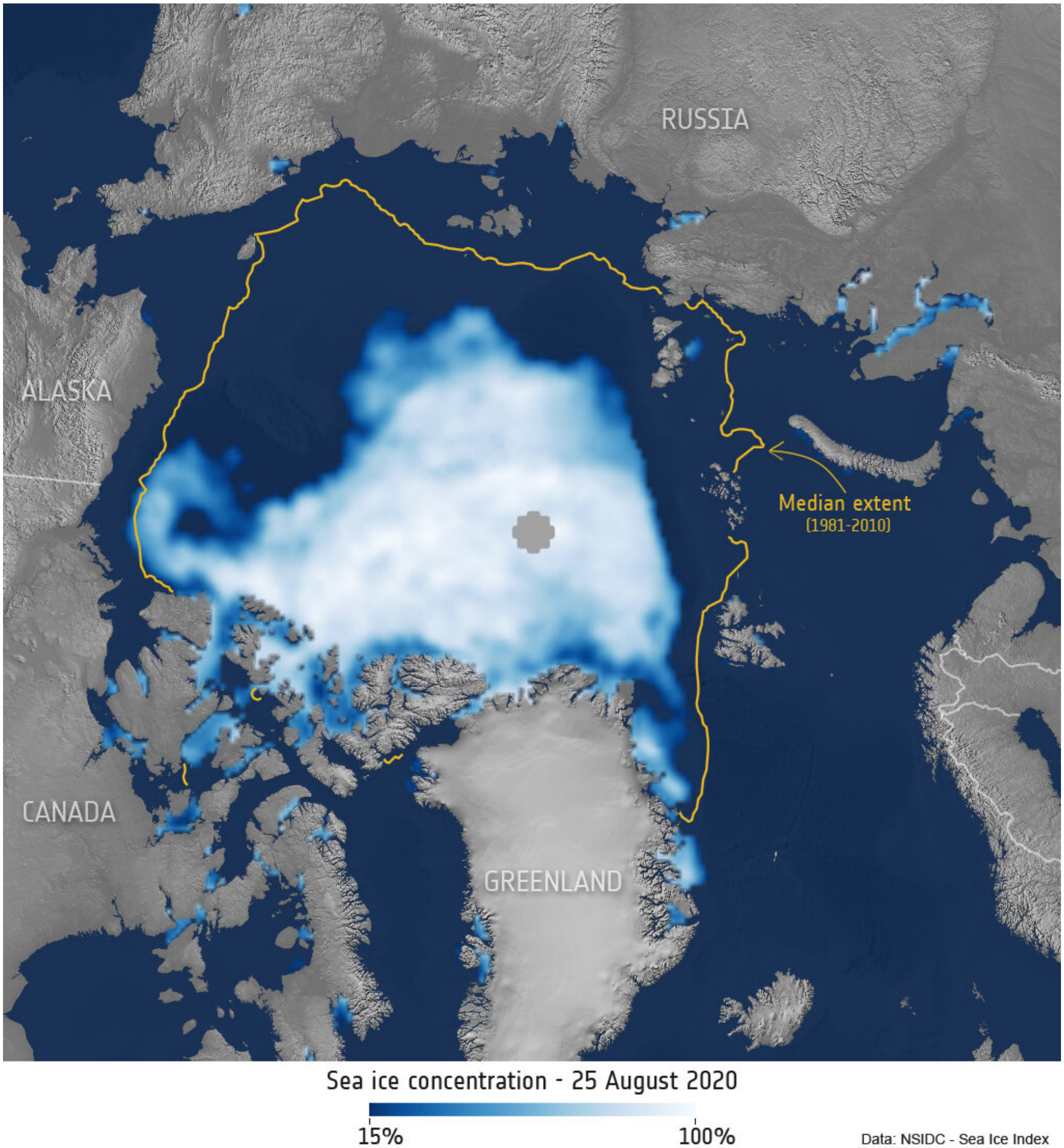
Wildfire smoke releases a wide range of pollutants including carbon monoxide, nitrogen oxides and solid aerosol particles. In June alone, the Arctic wildfires were reported to have emitted the equivalent of 56 megatonnes of carbon dioxide, as well as significant amounts of carbon monoxide and particulate matter. These wildfires affect radiation, clouds and climate on a regional, and global, scale.

The Arctic heatwave also contributes to the thawing of permafrost. Arctic permafrost soils contain large quantities of organic carbon and materials left over from dead plants that cannot decompose or rot, whereas permafrost layers deeper down contain soils made of minerals. The permanently frozen ground, just below the surface, covers around a quarter of the land in the northern hemisphere.

When permafrost thaws, it releases methane and carbon dioxide into the atmosphere—adding these greenhouse gases to the atmosphere. This, in turn, causes further warming, and further thawing of the permafrost—a vicious cycle.

According to the UN's Intergovernmental Panel on Climate Change Special Report, permafrost temperatures have increased to record-high levels from the 1980s to present. Although satellite sensors cannot measure permafrost directly, a recent project by ESA's Climate Change Initiative (CCI), combined in situ data with satellite measurements of land-surface temperature and land cover to estimate permafrost extent in the Arctic.

The thaw of permafrost is also said to have caused the collapse of the oil tank that leaked over 20 000 tonnes of oil into rivers near the city of Norilsk, Russia, in May.



This map shows the Arctic sea ice extent on 25 August 2020. The orange line shows the 1981 to 2010 median extent for that day. The grey circle in the middle indicates a lack of data. Credit: NSIDC/processed by ESA

The Siberian heatwave is also recognised to have contributed to accelerating the sea-ice retreat along the Arctic Russian coast. Melt onset was as much as 30 days earlier than average in the Laptev and Kara Seas, which has been linked, in part, to persistent high sea level pressure over Siberia and a record warm spring in the region. According to the Copernicus Climate Change Service, the Arctic sea ice extent for July 2020 was on a par with the previous July minimum of 2012—at nearly 27% below the 1981-2020 average.

ESA's Mark Drinkwater comments, "Throughout the satellite era, polar scientists pointed to the Arctic as a harbinger of more widespread global impacts of climate change. As these interconnected events of 2020 make their indelible marks in the climate record, it becomes evident that a 'green' low-carbon Europe is alone insufficient to combat the effects of climate change."

Without concerted climate action, the world will continue to feel the effects of a warming Arctic. Because of the Arctic's harsh environment and low population density, polar orbiting space systems offer unique opportunities to monitor this environment. ESA has been monitoring the Arctic with its Earth-observing satellites for nearly three decades. Satellites not only can monitor changes in this very sensitive region, but can also facilitate navigation and communications, improve Arctic maritime security, and enable more effective management of sustainable development.

ESA's Director for Earth Observation, Josef Aschbacher, adds, "Whilst the first generation of Copernicus Sentinels today offer excellent global data, their combined Arctic observation capabilities are limited in scope. As part of the preparation of Copernicus 2.0, three new high priority candidate missions: CIMR, CRISTAL and ROSE-L, and next-generation Sentinels are being prepared by ESA.

"Together with the Copernicus CO2M mission, these new missions will provide new pan-Arctic, year-round monitoring and CO_2 emissions data to support the EU Green Deal and further boost the Copernicus climate change monitoring and service capabilities."

Provided by European Space Agency

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