Climate Extremes: Heatwaves, Changes in Ice, Drought, Floods

-Sea Ice Anomalies-

Zachary M. Labe; *Postdoc at Princeton University & NOAA GFDL*

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NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

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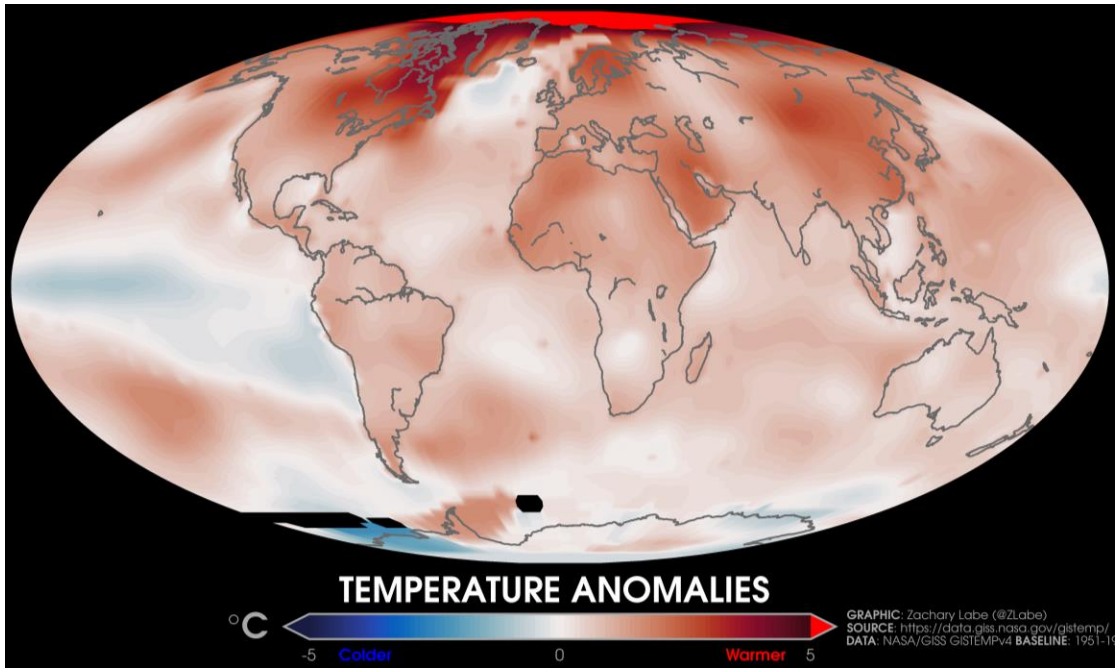
THE CLIMATE IS CHANGING IN REAL-TIME.

Considering a global view of temperatures relative to average – placing weather in the context of climate



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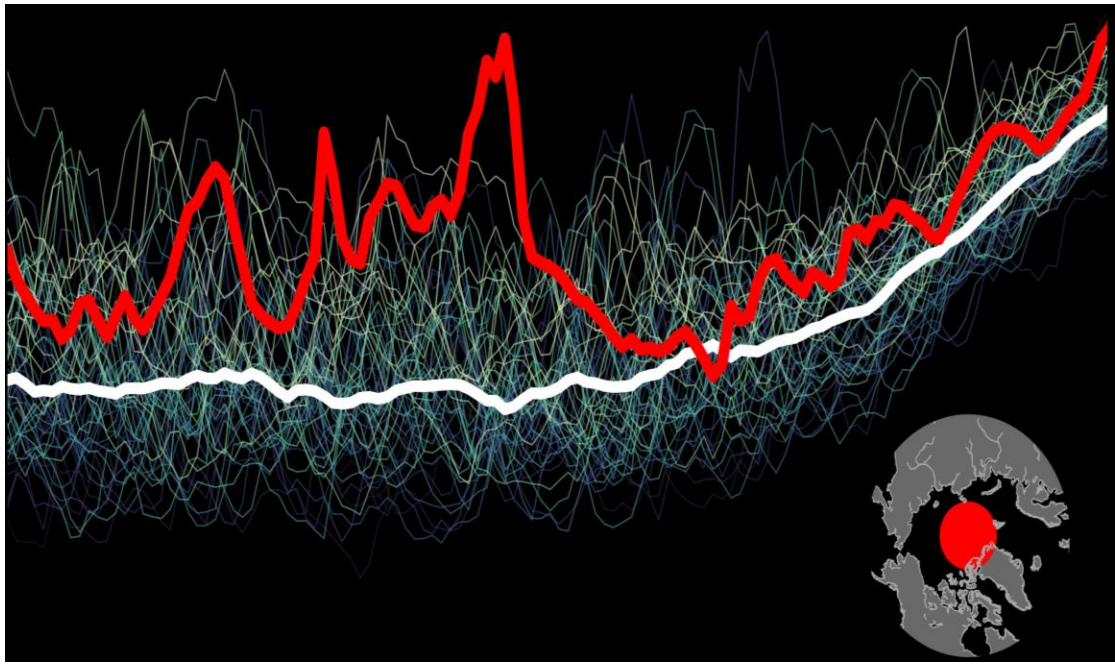
THE ARCTIC IS CHANGING IN REAL-TIME.

Daily Arctic temperature in 2018 (red) compared to every year since 1958 in the month of February. Average is shown by the white line.



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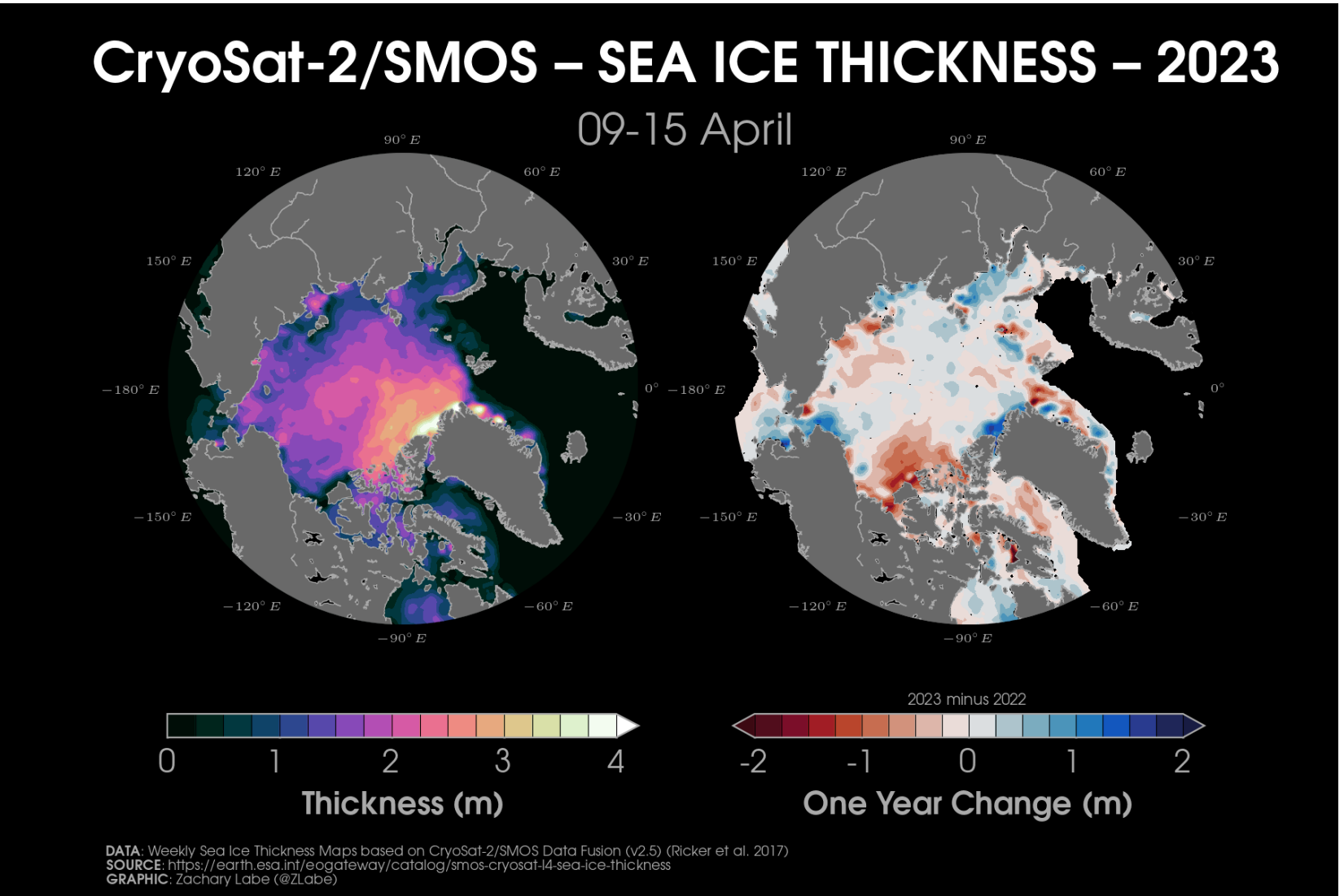

Monitoring Arctic sea ice anomalies in real-time

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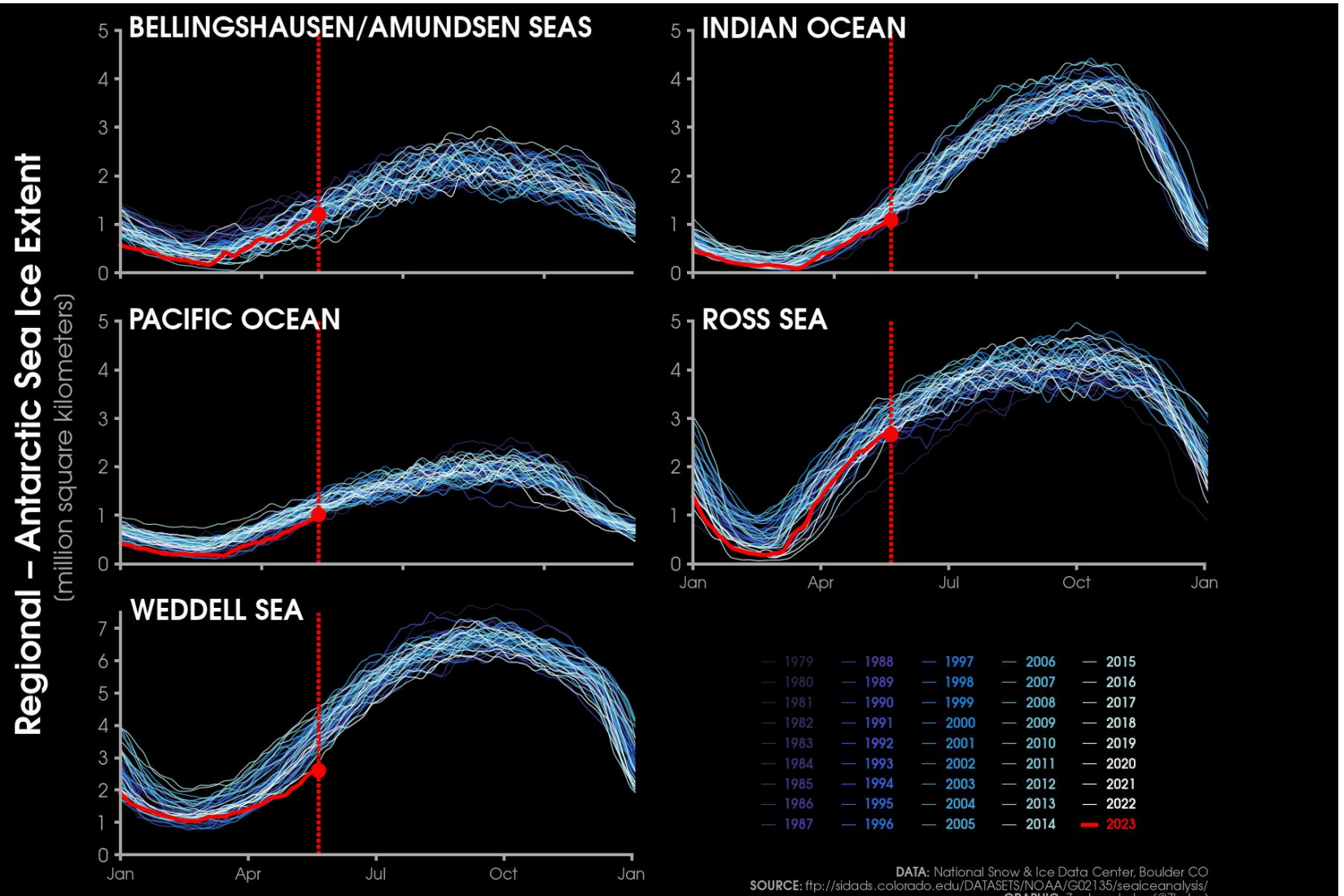

Monitoring Antarctic sea ice anomalies in real-time

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THIS IS AN OPPORTUNITY TO COMMUNICATE.

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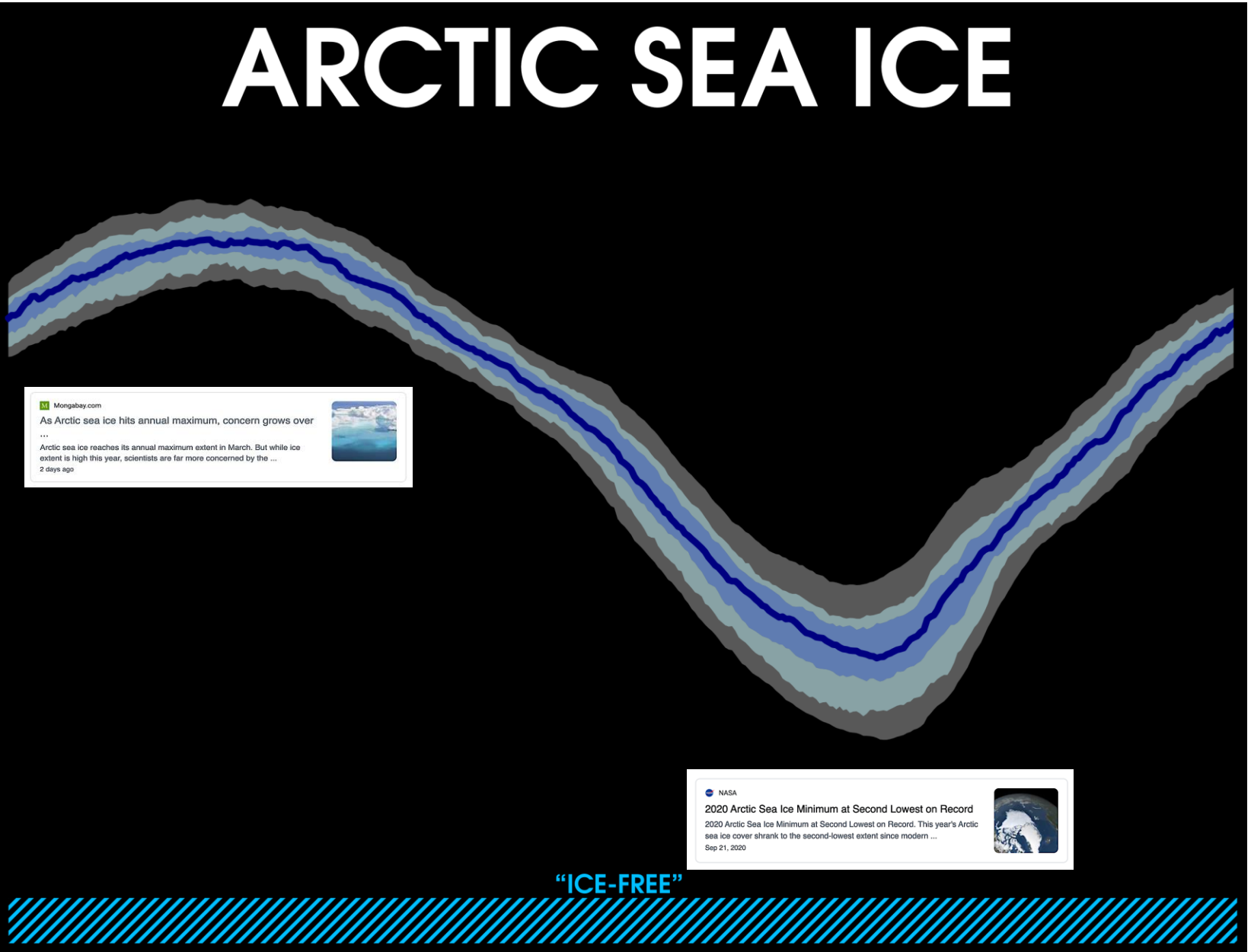

Seasonal cycle of Arctic sea ice

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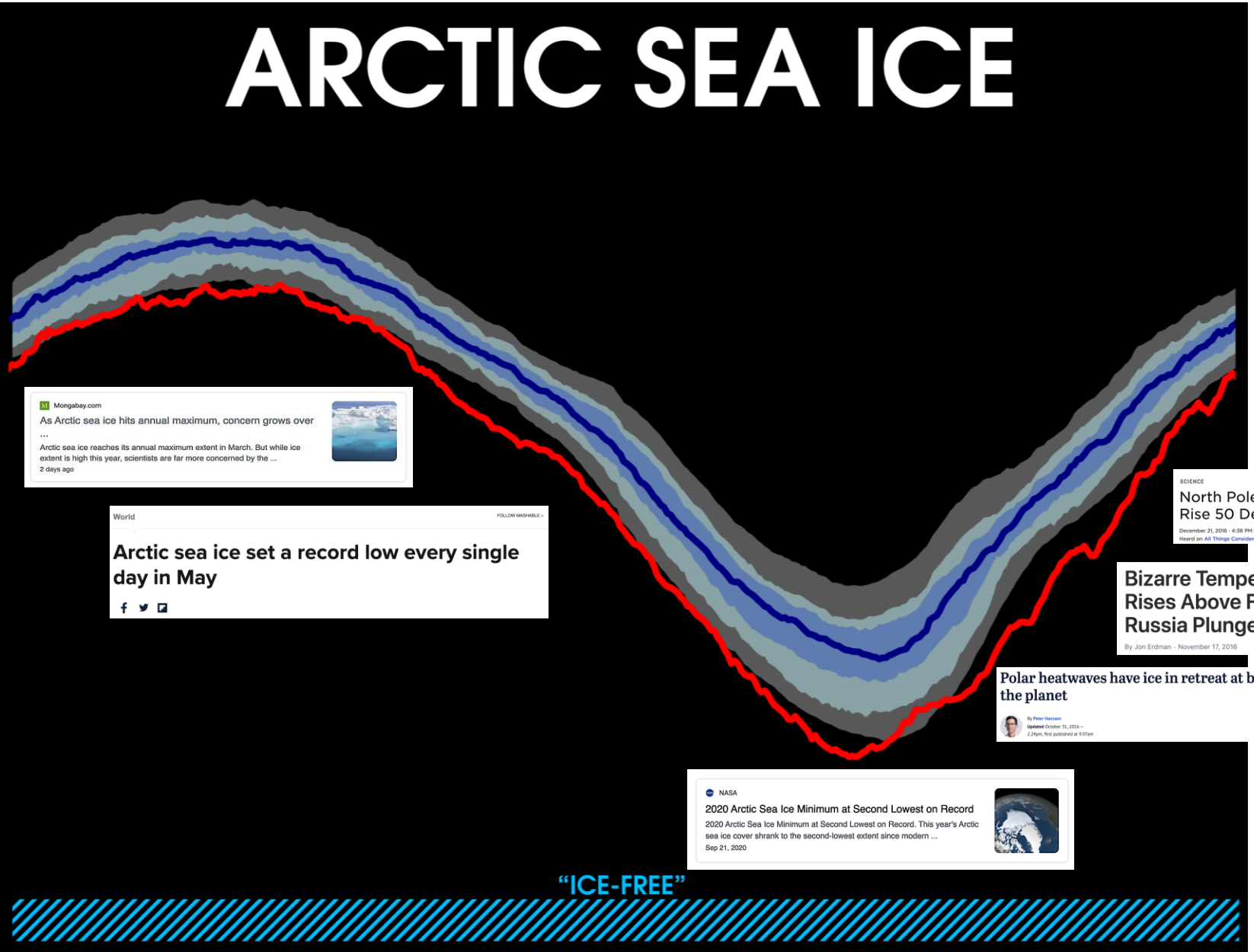

Seasonal cycle of Arctic sea ice

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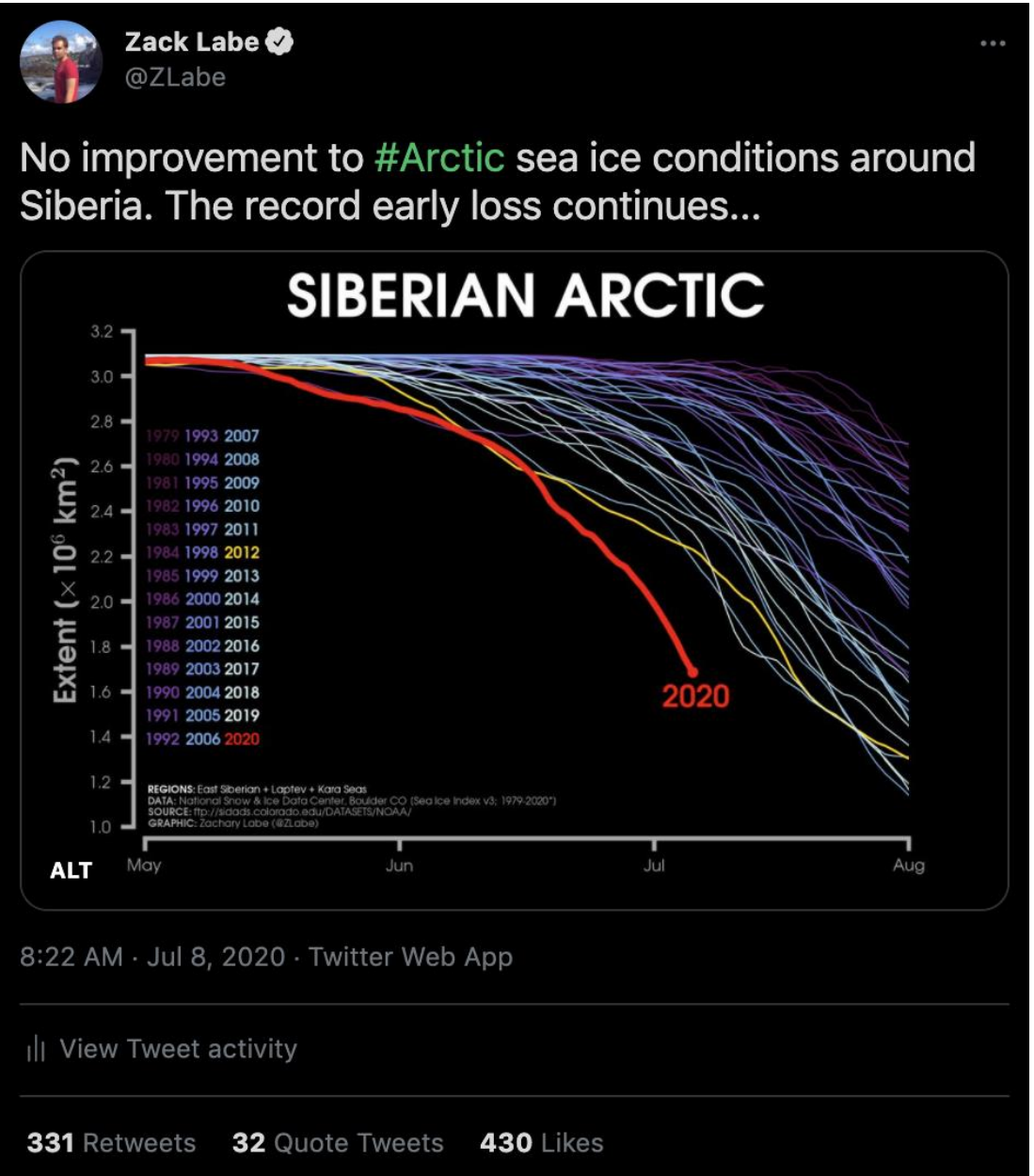

START A CONVERSATION.

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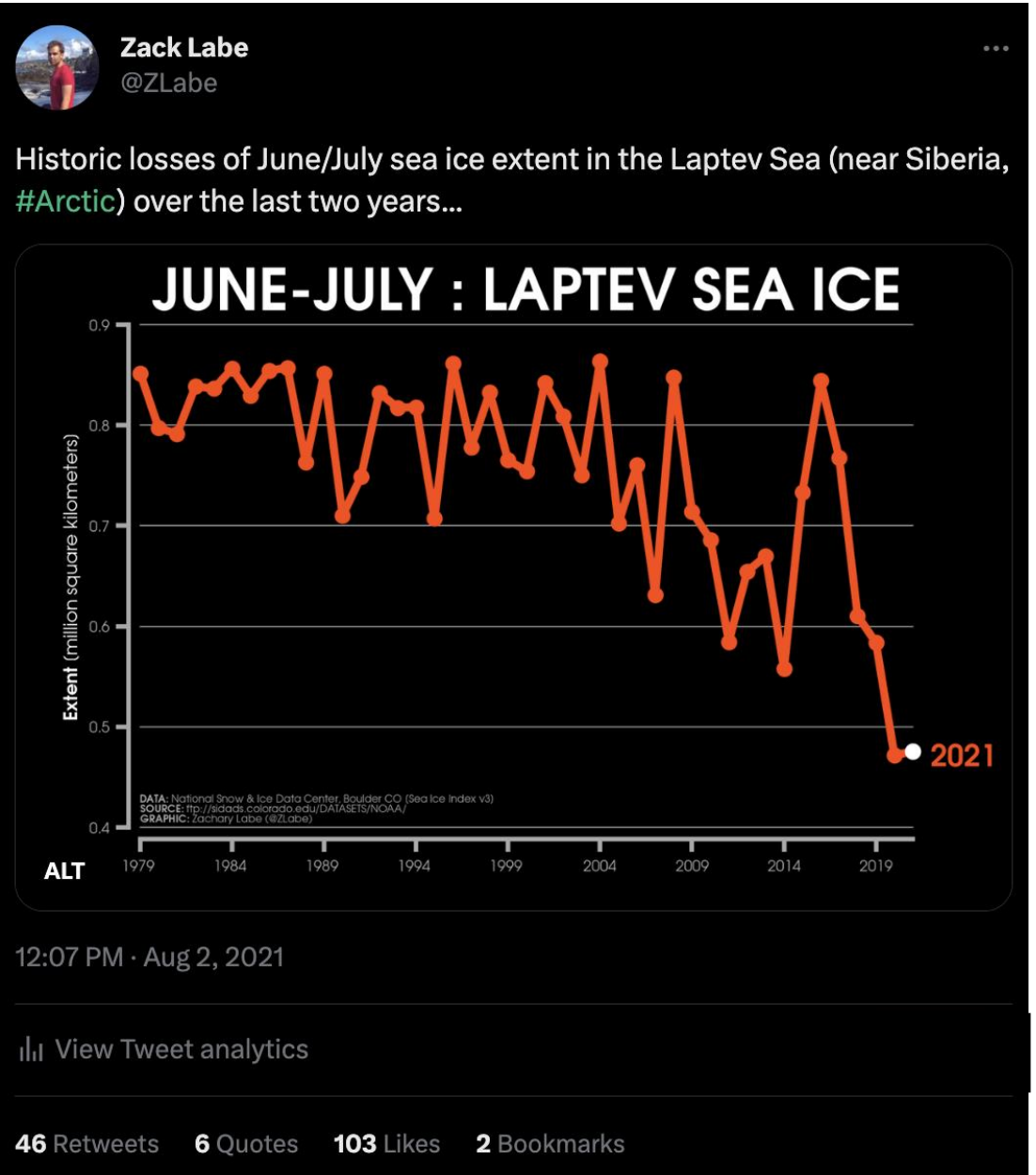

START A DATA CONVERSATION.

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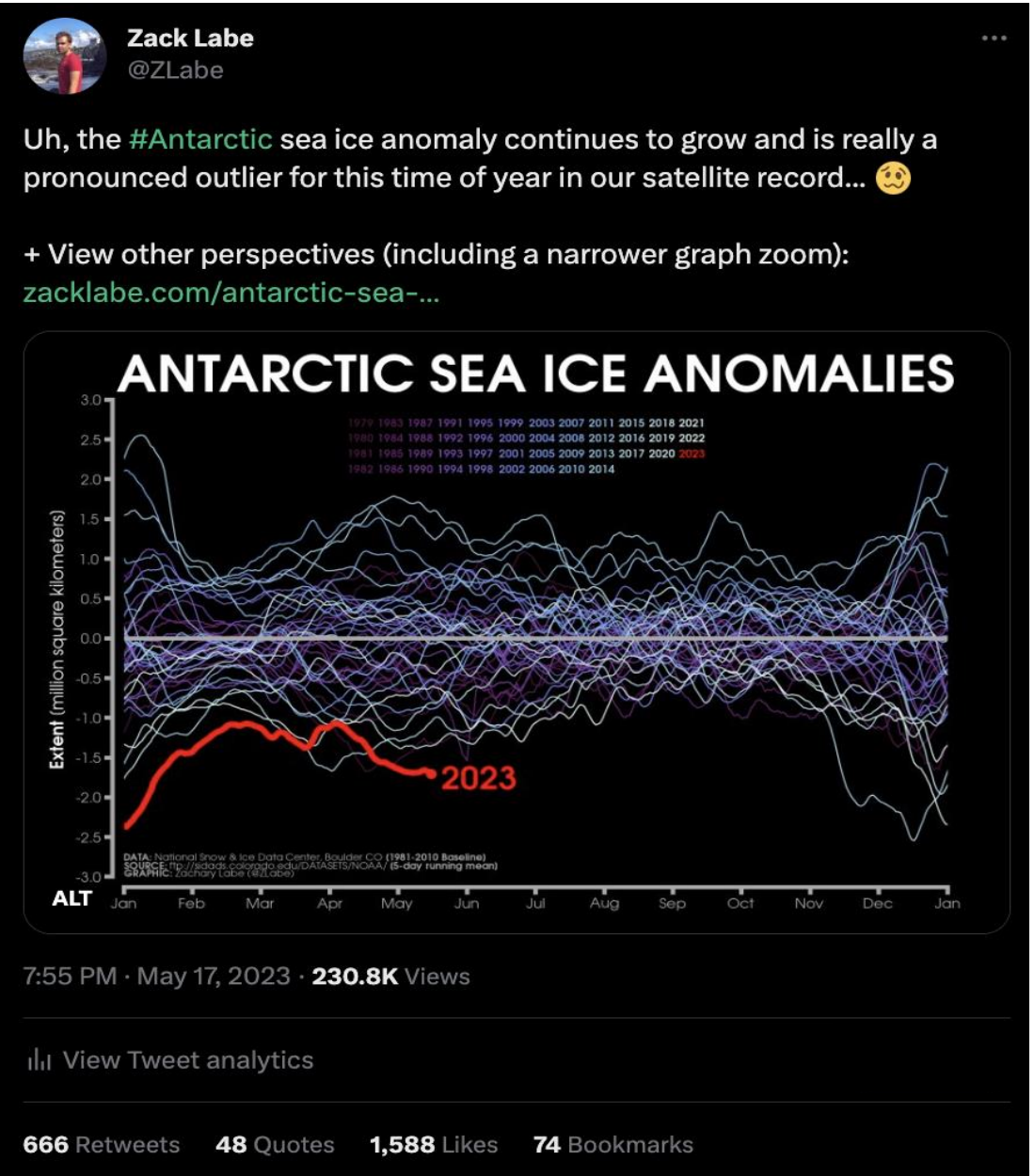

Example of an ongoing anomalous sea ice extreme event

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Community observations winter 2018

What did communities experience?

Throughout the Bering Strait there was a lack of, or late development of, shorefast ice. With little to no sea ice, communities had limited protection from the ocean. Flooding, loss of power, damage to infrastructure, and build-up of ice on shore occurred during storms.

Little Diomede... A large late February storm caused considerable damage on Little Diomede Island. As a result of the storm, the community lost power and ice rubble covered beaches, the helipad, and damaged the water treatment plant.

Photo by Carla Ahkvaluk, February 20

Shishmaref... Freeze-up was unusually late in Shishmaref. Even when the surrounding area appeared to have ice, there was a stretch of open water around the community into mid-January. After the ice finally formed, it repeatedly broke up during storms allowing surf to push large ice chunks onto beaches.

Photo by Sharon Nayokpuk, February 22

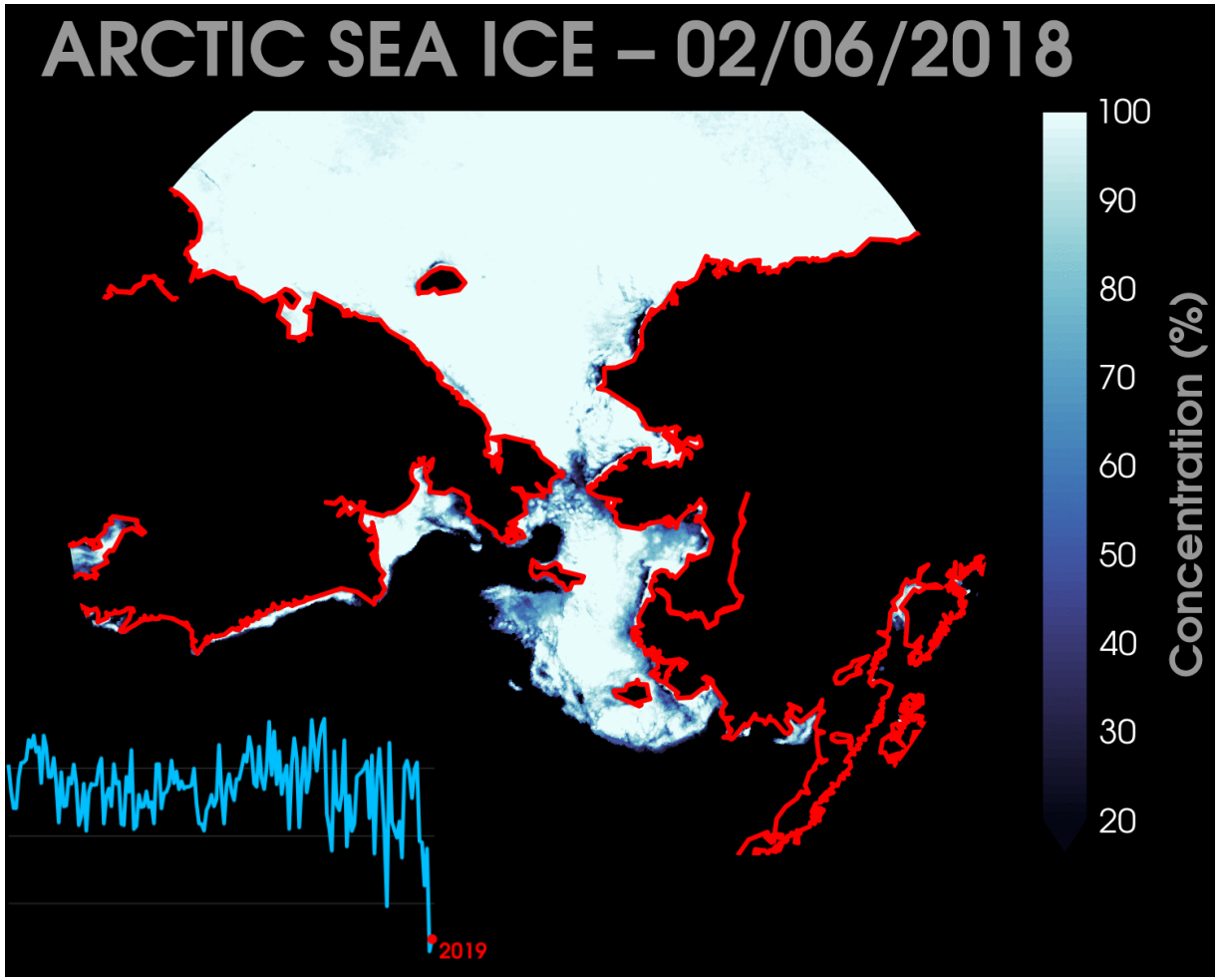
Gambell... Near Gambell, vast stretches of open water extended all the way to Russia until mid-March. During this time, local experts and Sea Ice for Walrus Outlook contributors reported a lack of walrus in the area.

Photo by Clarence Irrigoo Jr., February 8

Savoonga... After February's lack of ice, winds shifted abruptly on March 9 bringing sea ice back to Savoonga. Even as ice returned, local resident Aqef Waghiyi reported that "it is all broken up... no flat pieces and it is real rough. There are patches of open water... biggest open patch in front of town is maybe as big as a football field."

Photo by Savoonga IRA, February 14

[International Arctic Research Center [IARC; University of Alaska, Fairbanks]



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THE RECORD LOW BERING SEA ICE EXTENT IN 2018: CONTEXT, IMPACTS, AND AN ASSESSMENT OF THE ROLE OF ANTHROPOGENIC CLIMATE CHANGE

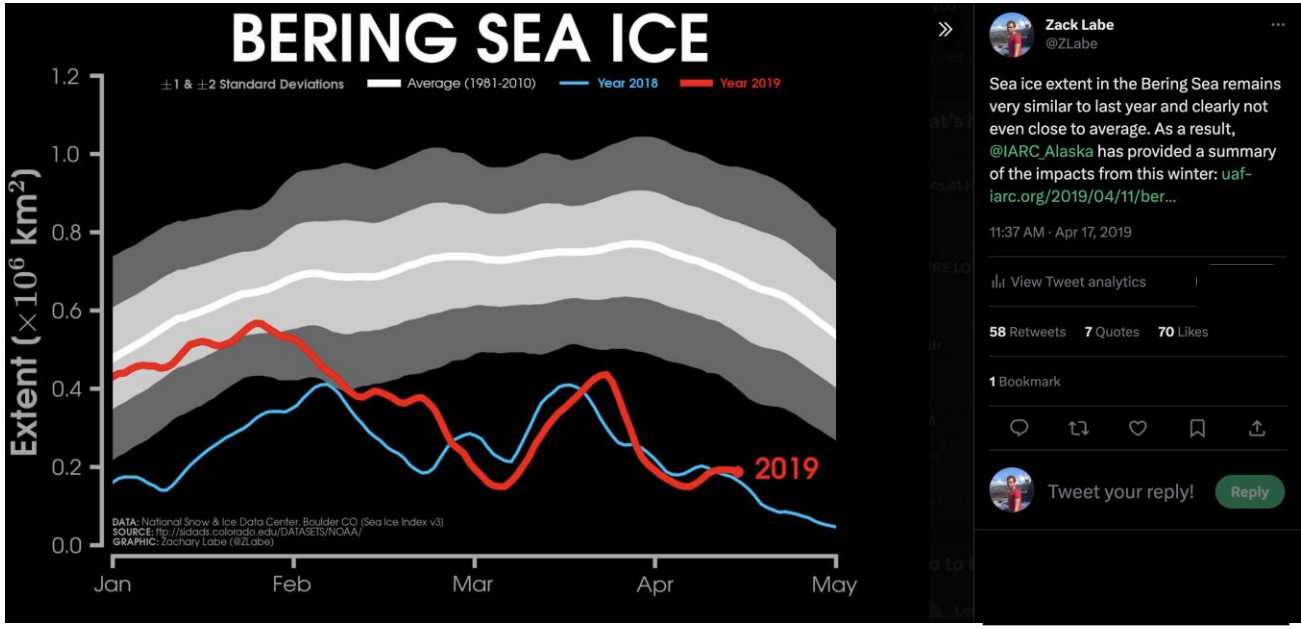
RICHARD L. THOMAN JR., UMA S. BHATT, PETER A. BIENIEK, BRIAN R. BRETTSCHNEIDER, MICHAEL BRUBAKER, SETH L. DANIELSON, ZACHARY LABE, RICK LADER, WALTER N. MEIER, GAY SHEFFIELD, AND JOHN E. WALSH

Record low Bering Sea sea ice in 2018 had profound regional impacts. According to climate models, human-caused warming was an overwhelmingly likely contributor, and such low levels will likely be typical by the 2040s.

During the 2017/18 Northern Hemisphere cold season, sea ice extent in the Bering Sea was less than any winter in the observed or reconstructed past. The eastern and northern Bering Sea covers a shallow and expansive continental shelf that has historically exhibited 40%–100% ice cover at its annual winter maximum. This sea ice provides many important ocean climate and ecosystem services. For example, winter ice insulates warmer ocean waters from extreme cold in the atmosphere. During spring, algae growth on the undersurface of sea ice initiates the annual onset of biological productivity (Szymanski and Gradinger 2016). The seasonal ice cover is critical to the regional climate, marine ecosystems, societal expectations, and economics through maintenance of a thermal barrier that separates two distinct temperature-adapted marine ecosystems in the northern and southern portions of the Bering Sea shelf (Schumacher et al. 1983; Mueter and Litzow 2008). We utilized remote sensing derived ice extent products for ice context; governmental and academic investigations, media, and public reports for impacts; and the Community Earth System Model's Large Ensemble Project (CESM-LENS) for assessment of the relative likelihoods of current low ice extent.

AFFILIATIONS: THOMAN—Alaska Center for Climate Assessment and Policy, University of Alaska Fairbanks; BHATT—Department of Atmospheric Sciences, Geophysical Institute, and International Arctic Research Center, University of Alaska Fairbanks; BIENIEK, BRETTSCHNEIDER, LADER, AND WALSH—International Arctic Research Center (IARC), University of Alaska Fairbanks; BRUBAKER—Alaska Native Tribal Health Consortium, Anchorage, Alaska; DANIELSON—College of Fisheries and Ocean Sciences, University of Alaska Fairbanks; LABE—Department of Earth System Science, University of California Irvine; MEIER—National Snow and Ice Data Center

OBSERVATIONS AND HISTORICAL CONTEXT. *Sea ice cover.* Mean Bering Sea ice extent (SIE) for January through April for the 40-yr satellite-derived passive microwave record in the National Snow and Ice Data Center's Sea Ice Index version 3 (Fetterer et al. 2017) shows that 2018 was the lowest of record (Fig. 1a), with the greatest anomalies compared to a 1981–2010 baseline north and west of St. Matthew Island (Fig. 1b). Analysis of late winter Bering Sea ice extent 1956–80 (Pease et al. 1982) and reconstructed



[Thoman et al. 2019, *BAMS*]

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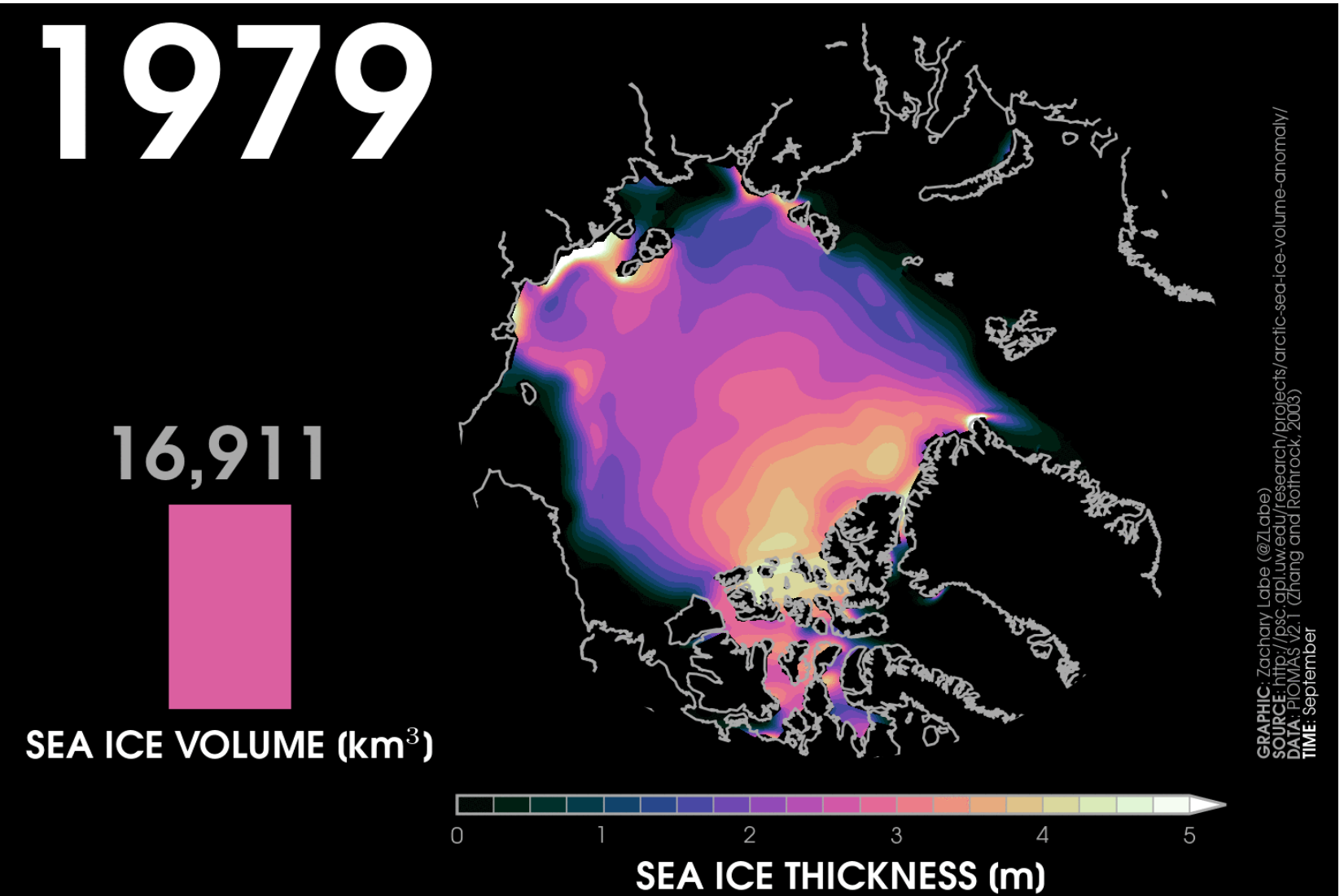

Simulating the present

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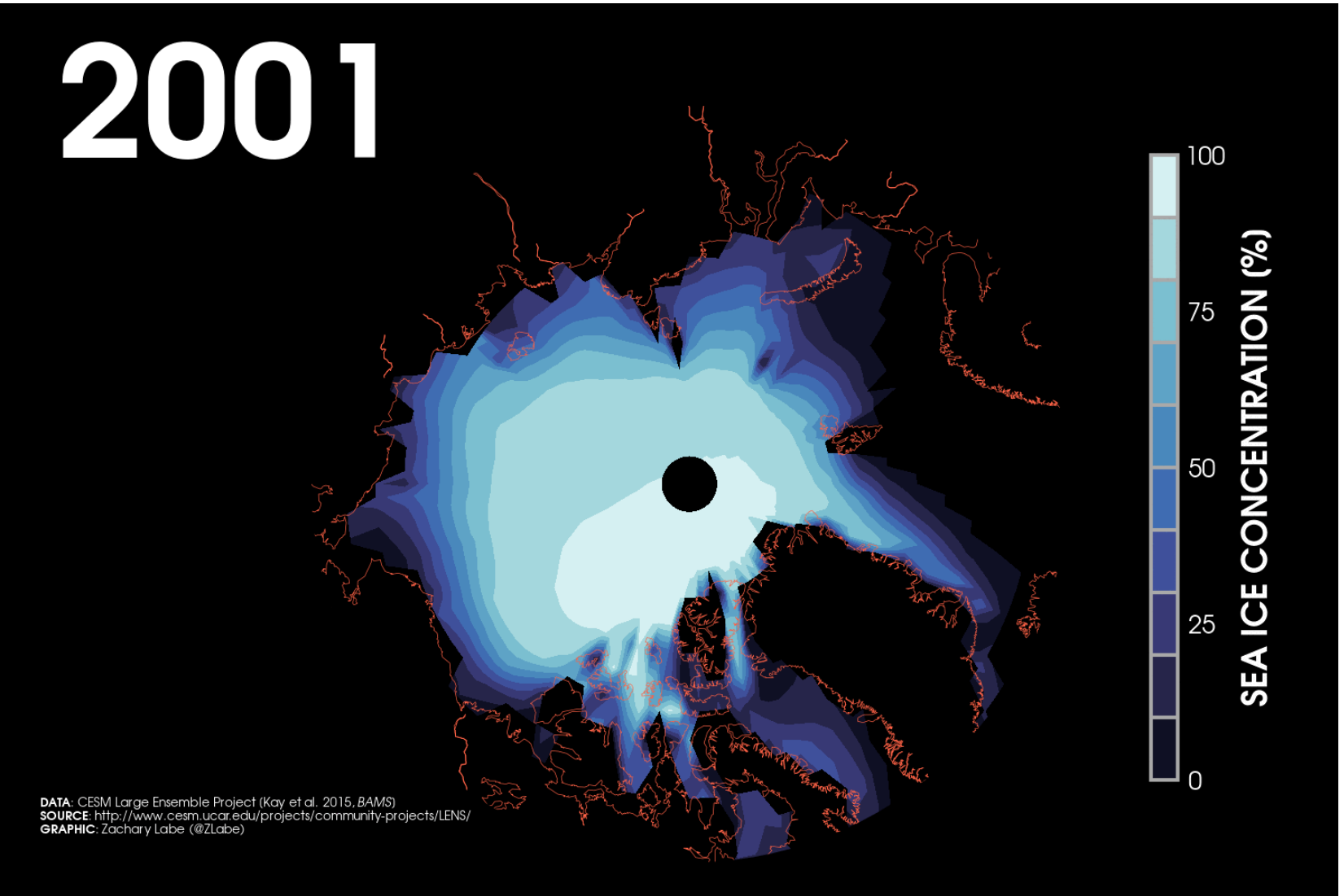

Simulating the future

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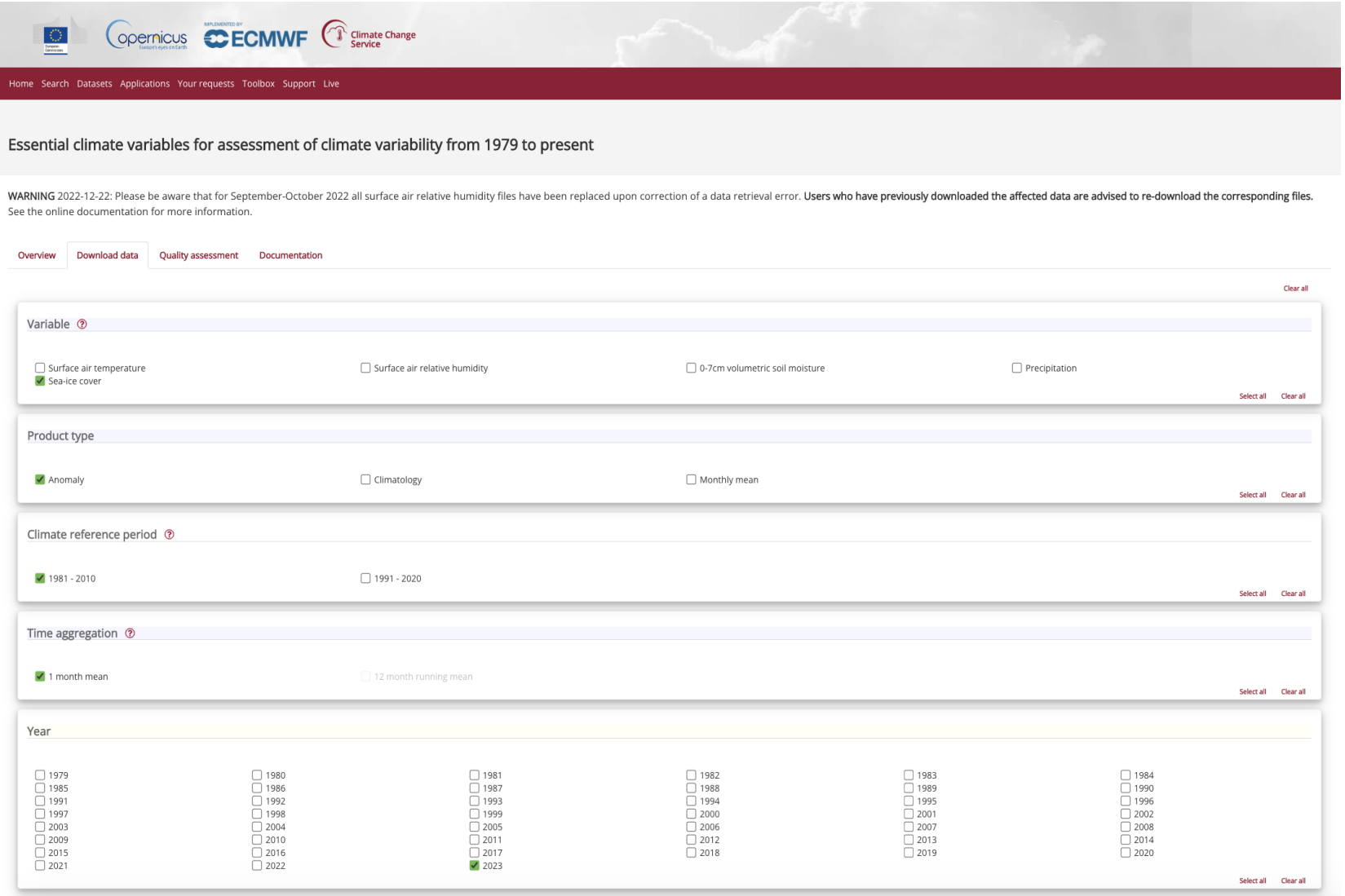

Getting started!

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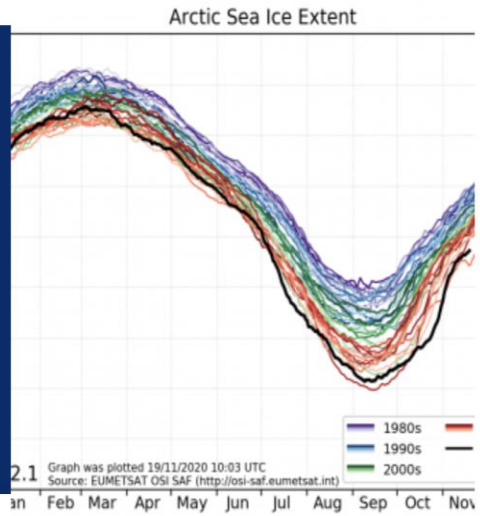

Sea-ice index

NEAR REAL TIME PRODUCT

Demonstrational : we invite users to give feedback on the index before we make it operational.

The Sea Ice Index is a climate indicator of sea-ice coverage. The index covers both the sea-ice extent and area over the last 40+ years and is continuously updated to present time. It consists of an updated series of graphs (.png) visualising the trends and evolution of sea ice at hemispheric, global and regional scales. In addition, the data files (.txt and .nc) are available for users who are interested in analysing and plotting the data themselves. The Sea Ice Index is derived from the OSI SAF Global Sea Ice Concentration data, with R&D input from ESA CCI.

Identification

Acronym :	SIIN	Identifier :	OSI-420
OSI SAF producer :	Norwegian Meteorological Institute	Citation :	See at bottom

Characteristics

Information

Description →

Quicklook →

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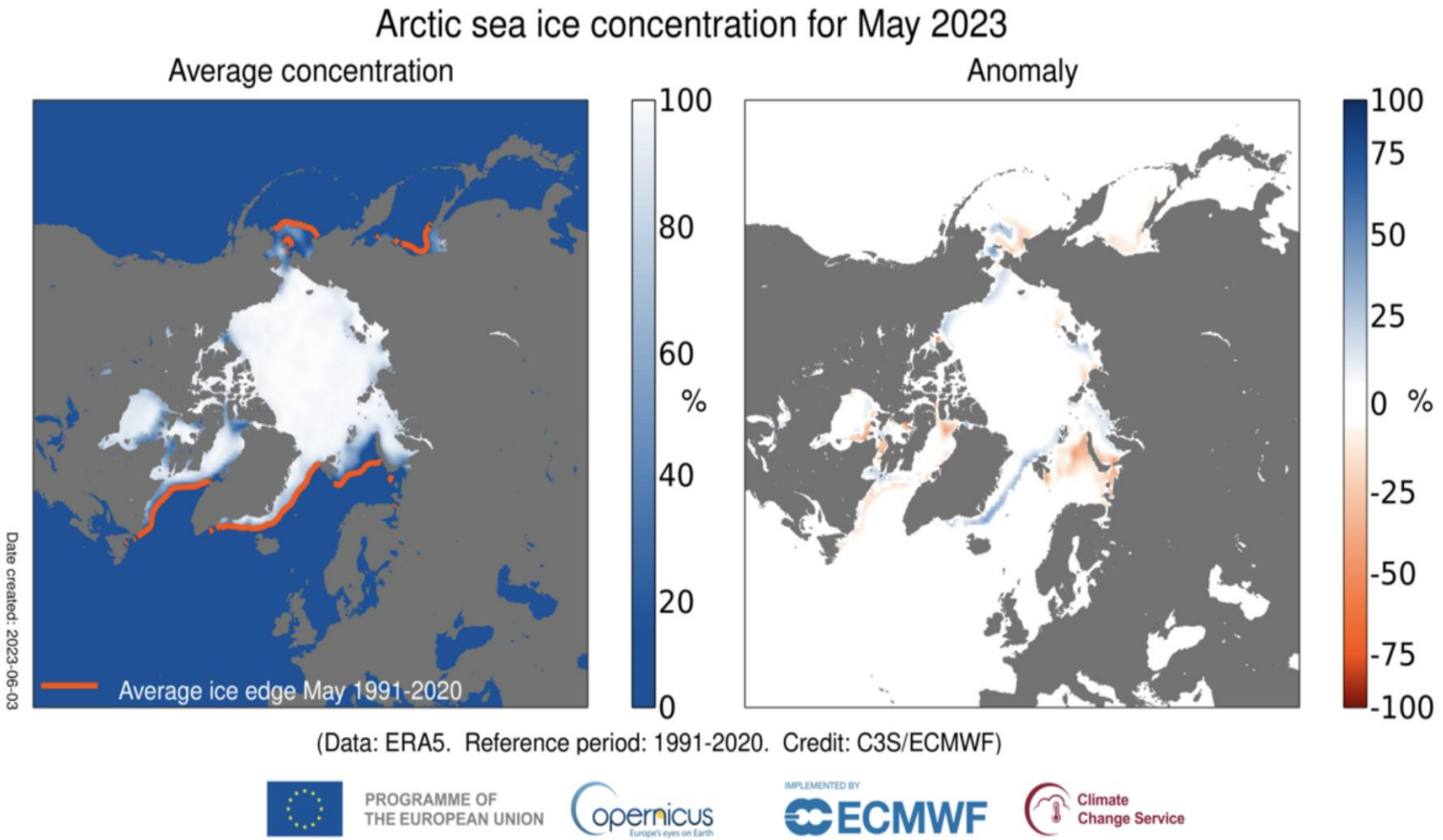
1991-2020 | 1981-2010



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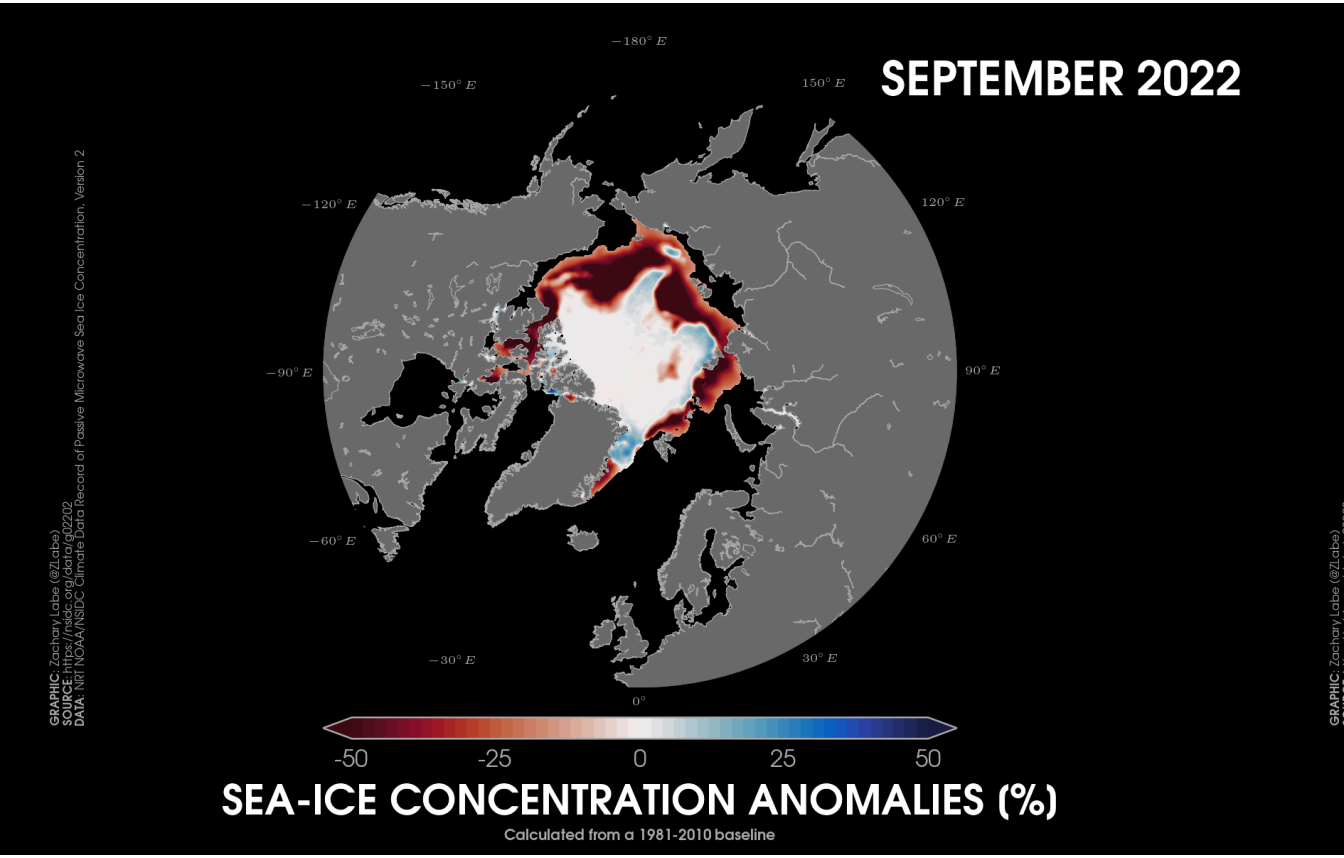
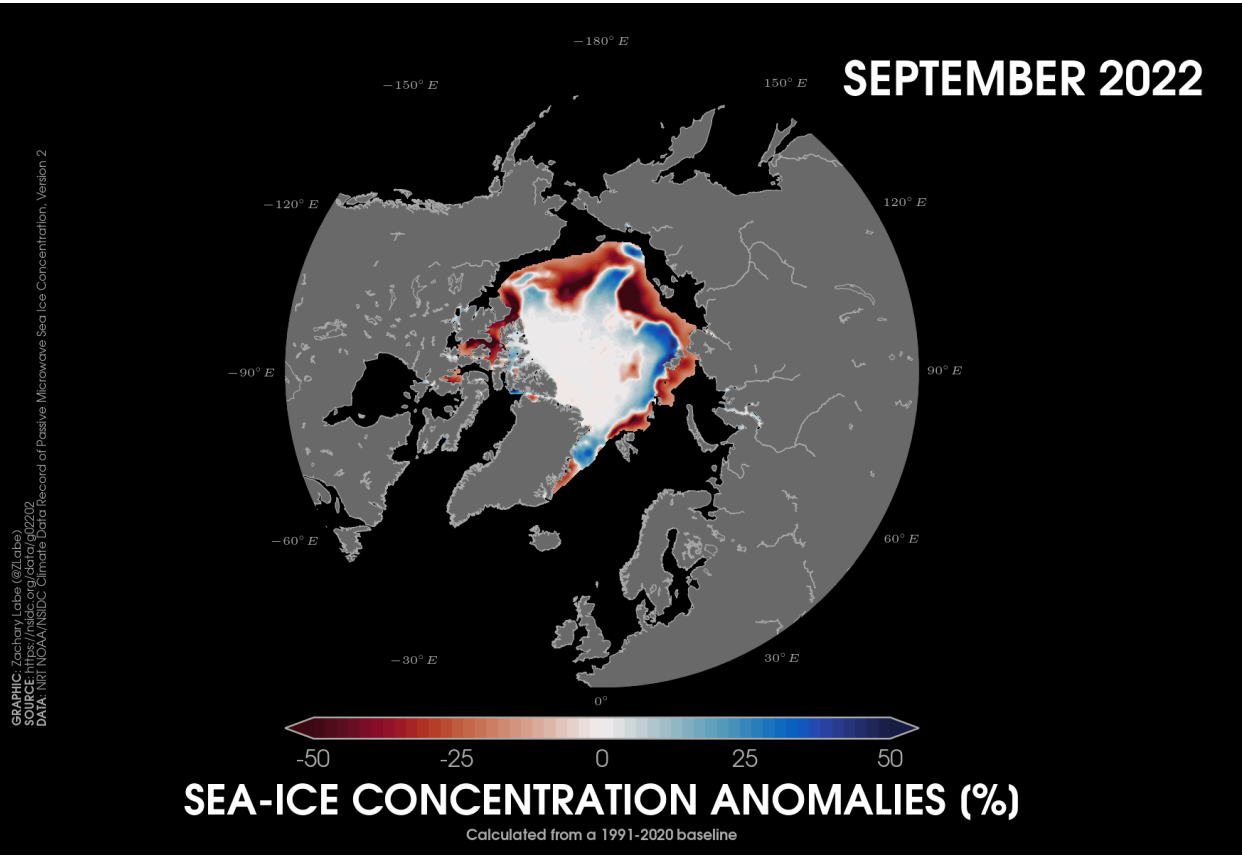
1981-2010



1991-2020



Changing baselines is very confusing for science communication, especially around climate change!

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WHY DO YOUR BASELINES/REFERENCE PERIODS CHANGE?

I know – baselines are confusing and often misinterpreted. In fact, a day doesn't go by without someone accusing me of being involved with a conspiracy due to my choice of climate baseline. My wish is that users would instead focus on the overall long-term trend that is displayed in each graphic, but I realize that is not a sufficient answer to the baseline issue. So here we go.

One reason is that datasets are available over different time periods. For example, NASA/GISS GISTEMPv4 is available from 1880 to present. That means this dataset literally doesn't exist prior to 1880, and I can't compare temperature anomalies with an earlier pre-industrial baseline (like 1850-1900). Another dataset I commonly use is ECMWF ERA5, which is available from 1979 (or sometimes 1940/1950 in its back extension form). This again means that I cannot compare these climate variables with earlier baselines, because the data is not available!

Another reason is that some scientific institutions stick with one set baseline for creating their data: NASA GISS GISTEMPv4 uses 1951-1980, Met Office HadCRUT5 uses 1961-1990, Berkeley Earth uses 1951-1980, NSIDC sea ice uses 1981-2010, and so on. In these cases, I usually stick with the convention for each dataset.

I also select baselines for addressing different science questions. If the data is readily available from 1850, sometimes it may be interesting to compare their anomalies with a pre-industrial baseline of 1850 to 1900. This pre-industrial baseline is consistent with the one used by the UNFCCC Paris Climate Agreement. In other cases, it may be interesting to use a more recent baseline. This is often used for discussing regional weather, where a more recent period (like 1991-2020) is more relatable for talking about colder or warmer daily

Changing baselines is very confusing for science communication, especially around climate change!

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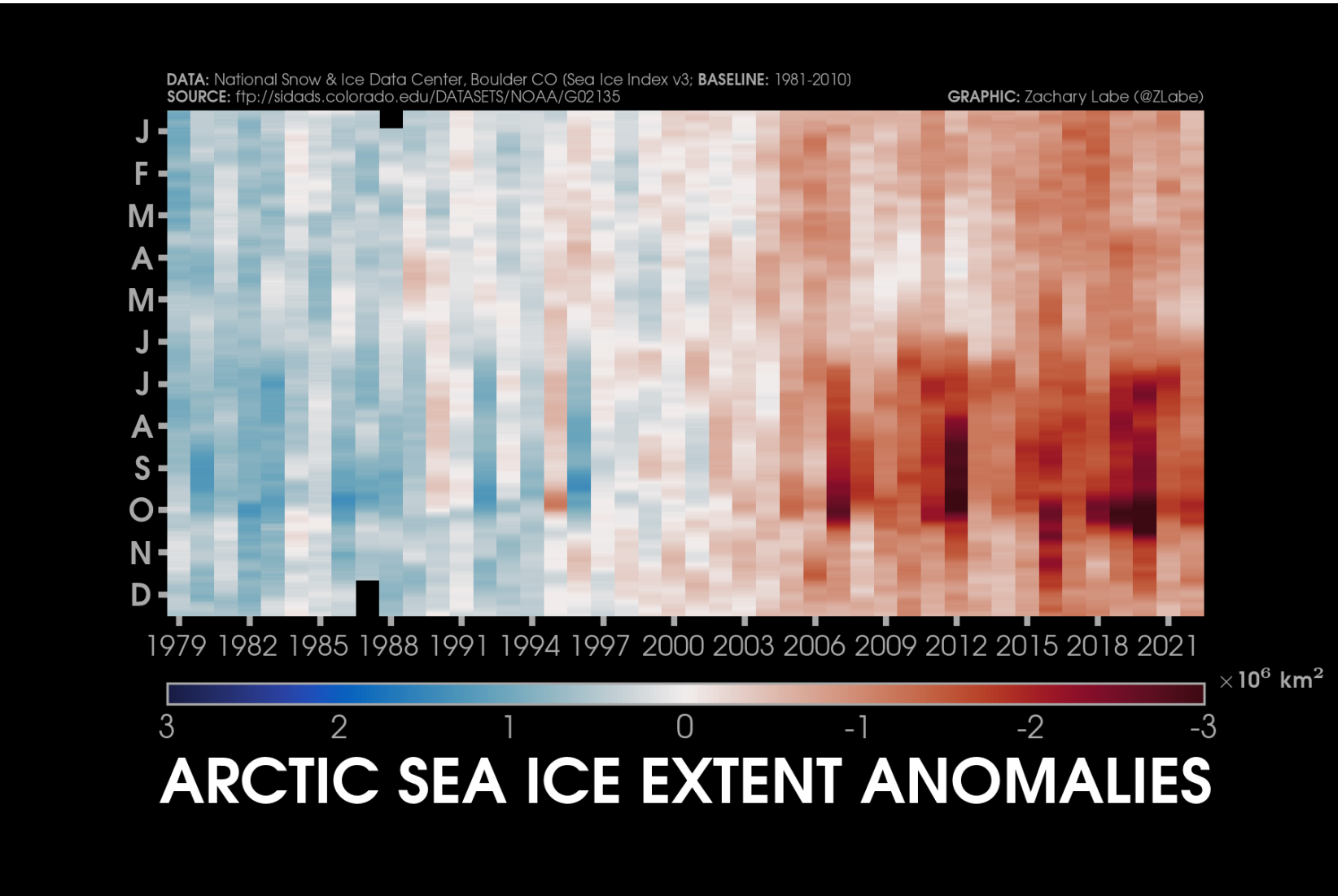
Accessibility in Visualization Storytelling



No jargon

Tell a story

Alternative text

Color contrast ratio

Label data directly

Avoid flashing GIFs

Include figure titles

Avoid data overlays

Provide data references

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We need scientists.
We need educators.
We need innovators.
We need communicators.

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Questions!

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Zachary Labe | 13 June 2023 | zachary.labe@noaa.gov

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