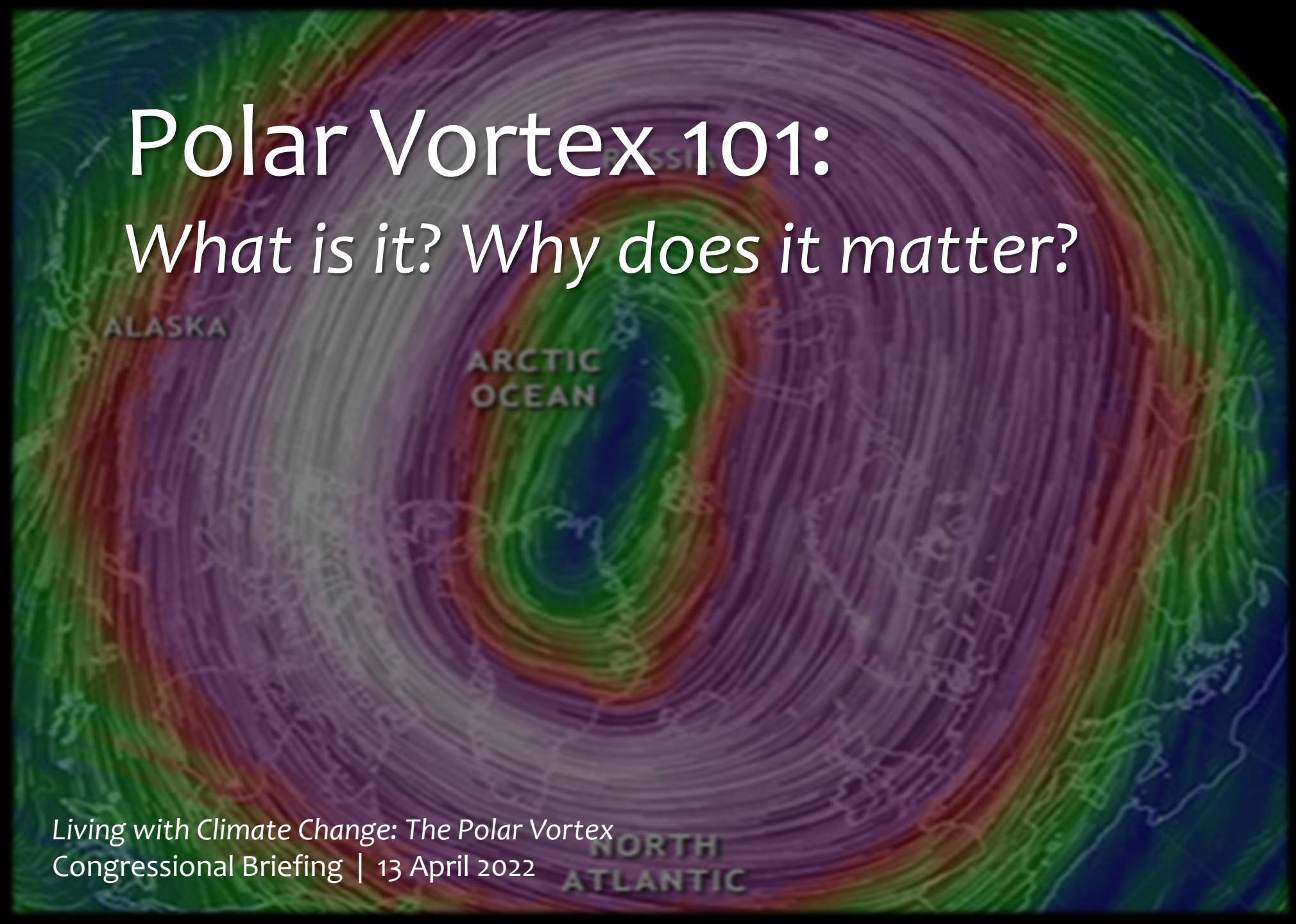
Polar Vortex 101:

What is it? Why does it matter?



Living with Climate Change: The Polar Vortex
Congressional Briefing | 13 April 2022

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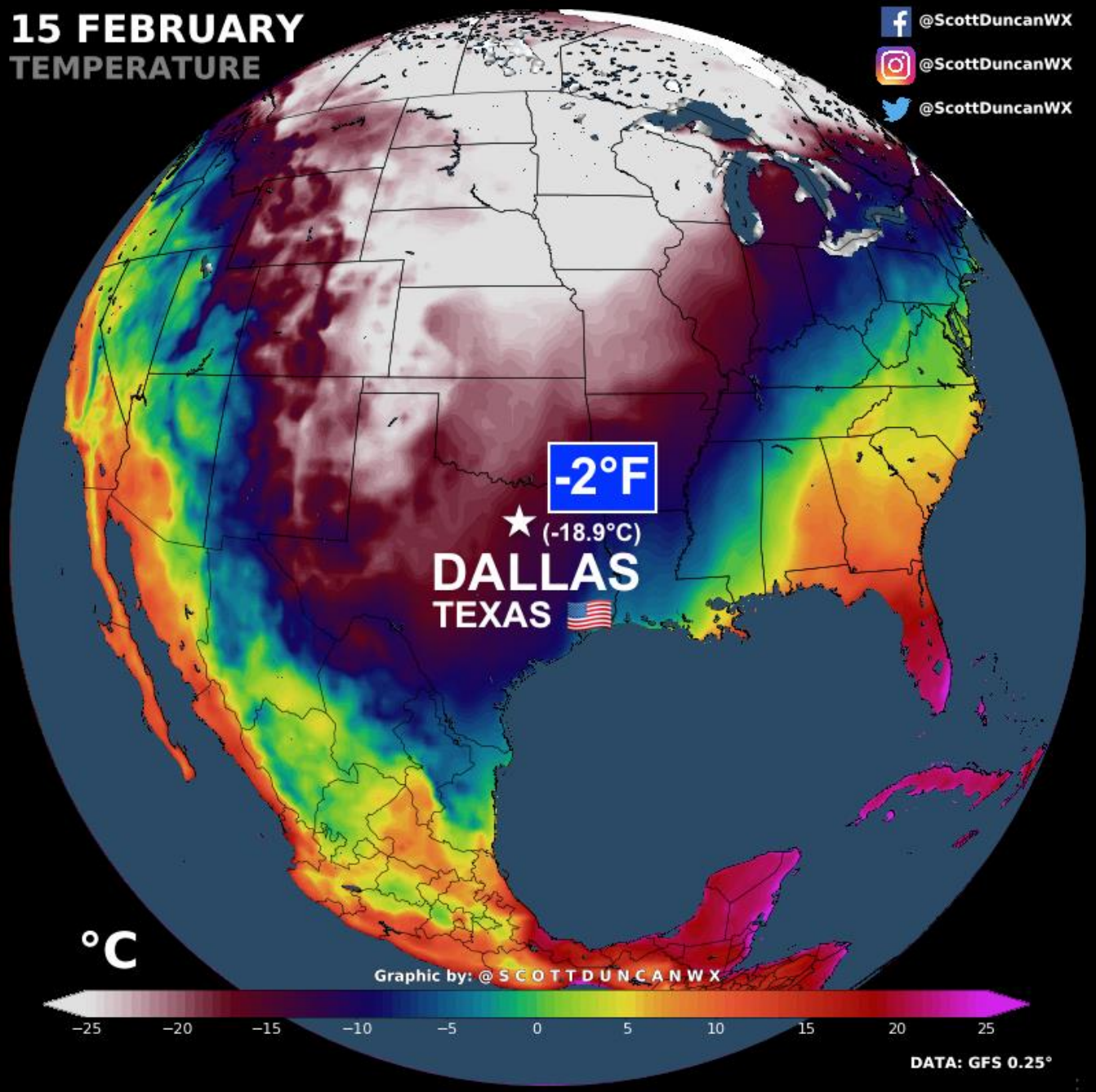
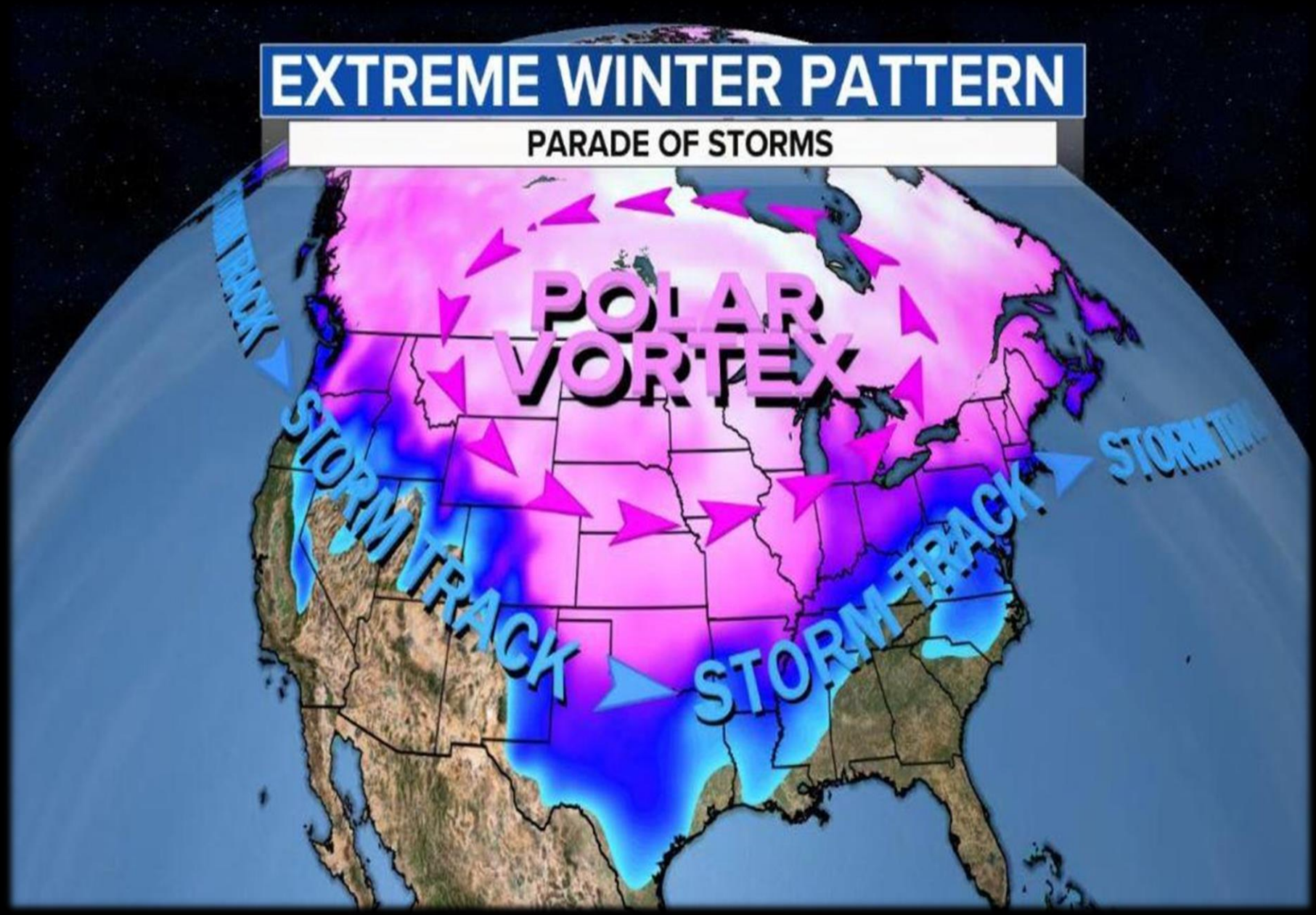
jfrancis@WoodwellClimate.org

Temperatures on 15 February 2021

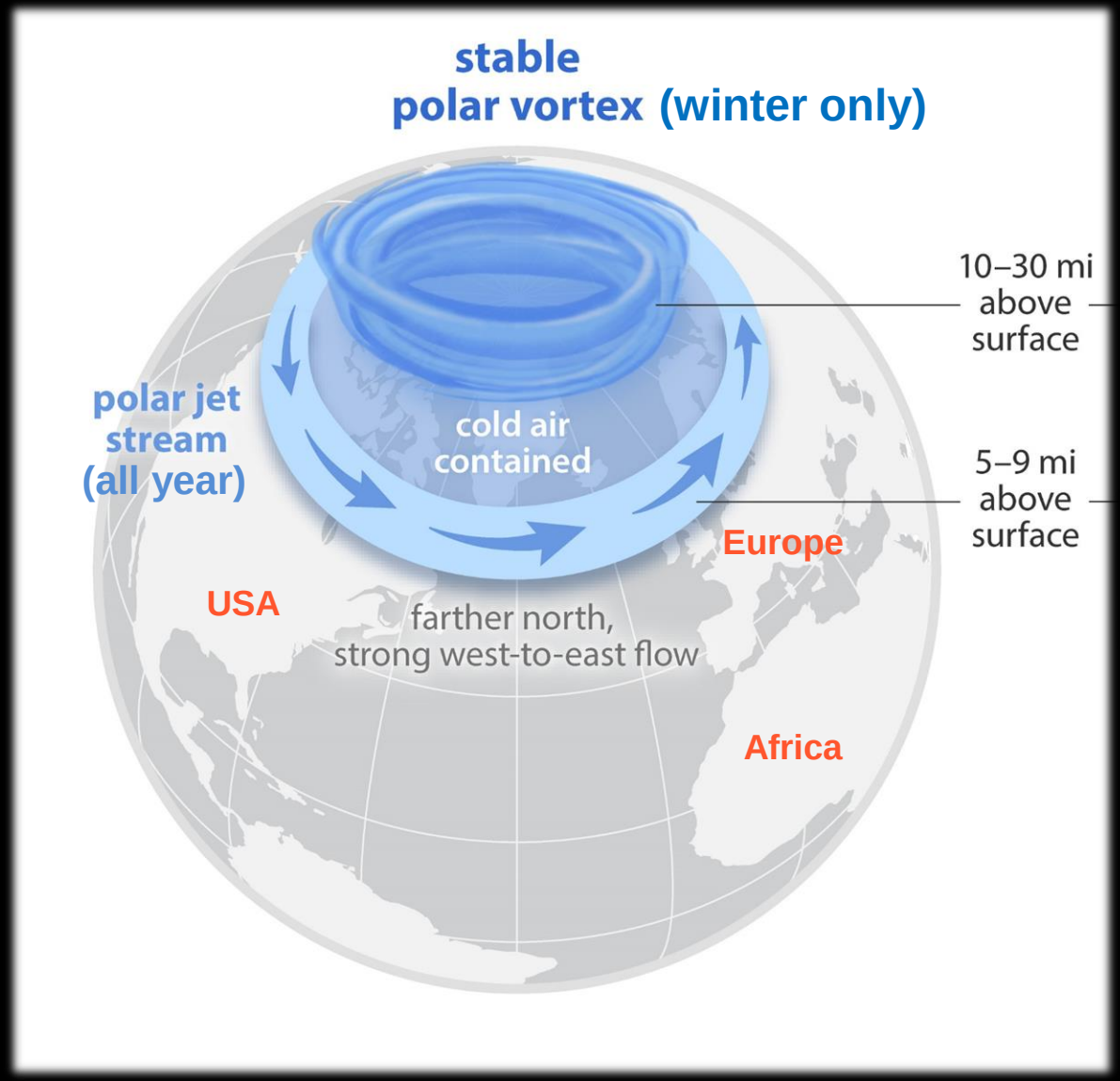


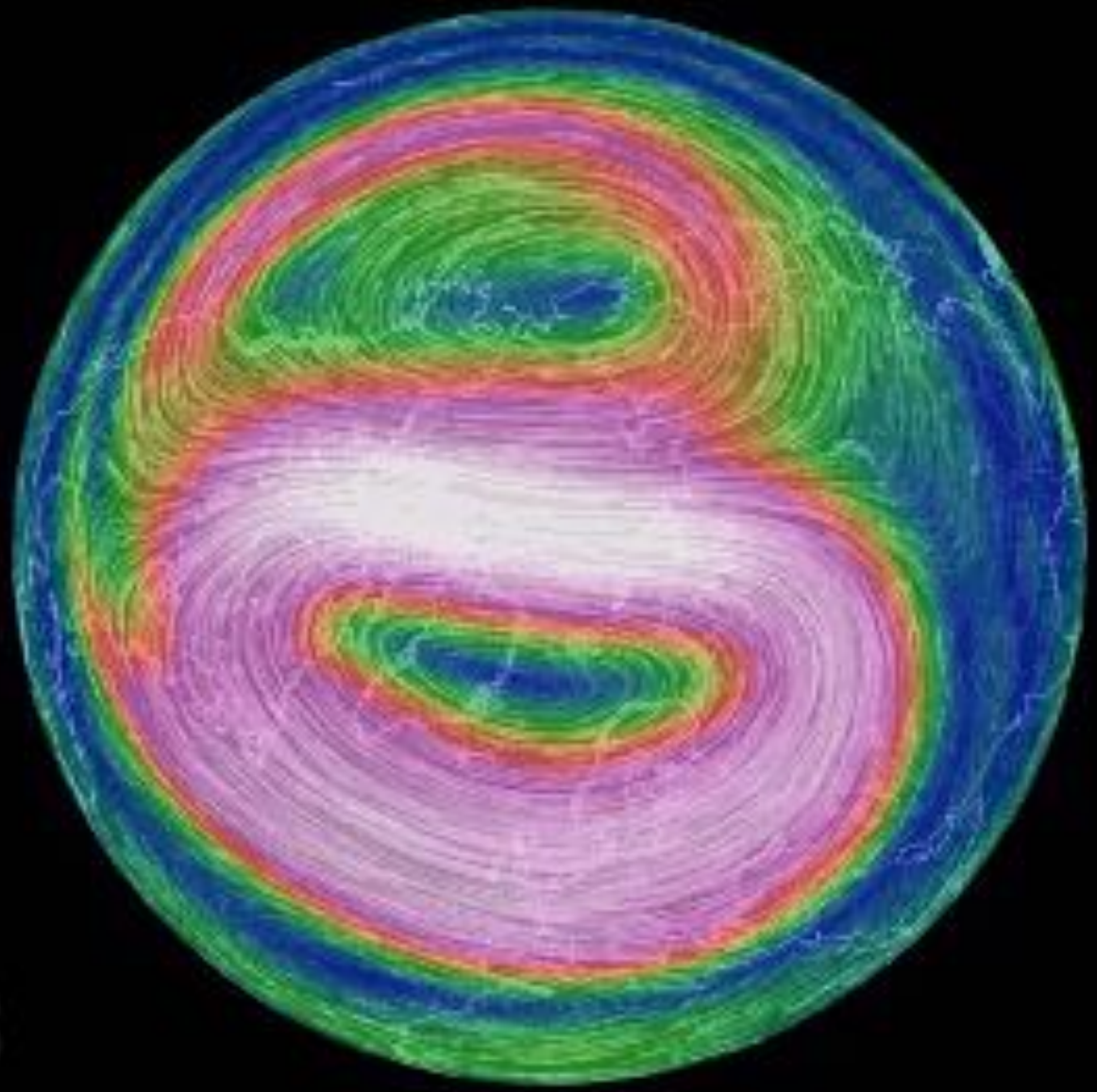
Why was this cold spell so severe?

Extreme jet stream + disrupted polar vortex



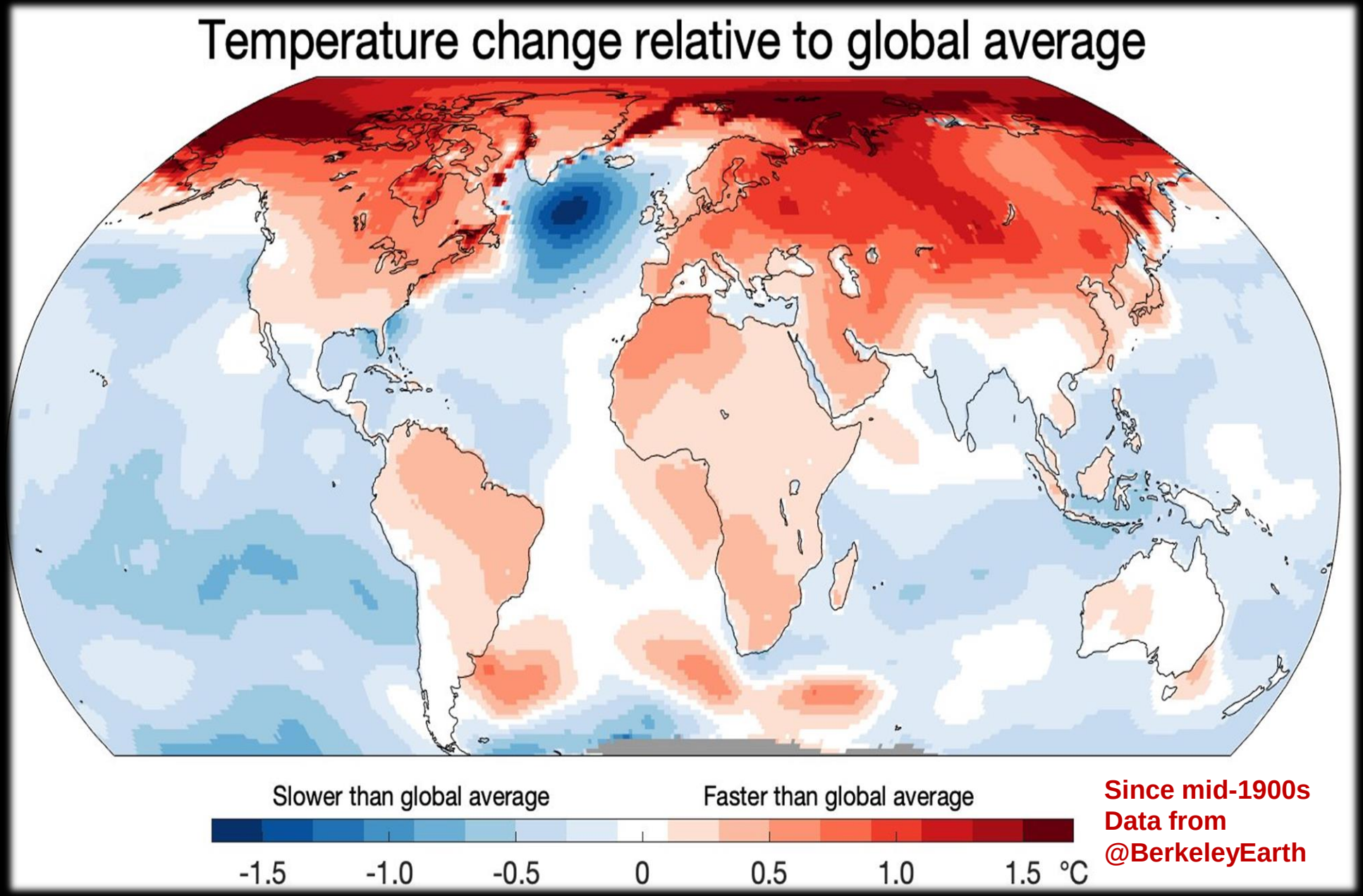
What is the polar vortex?





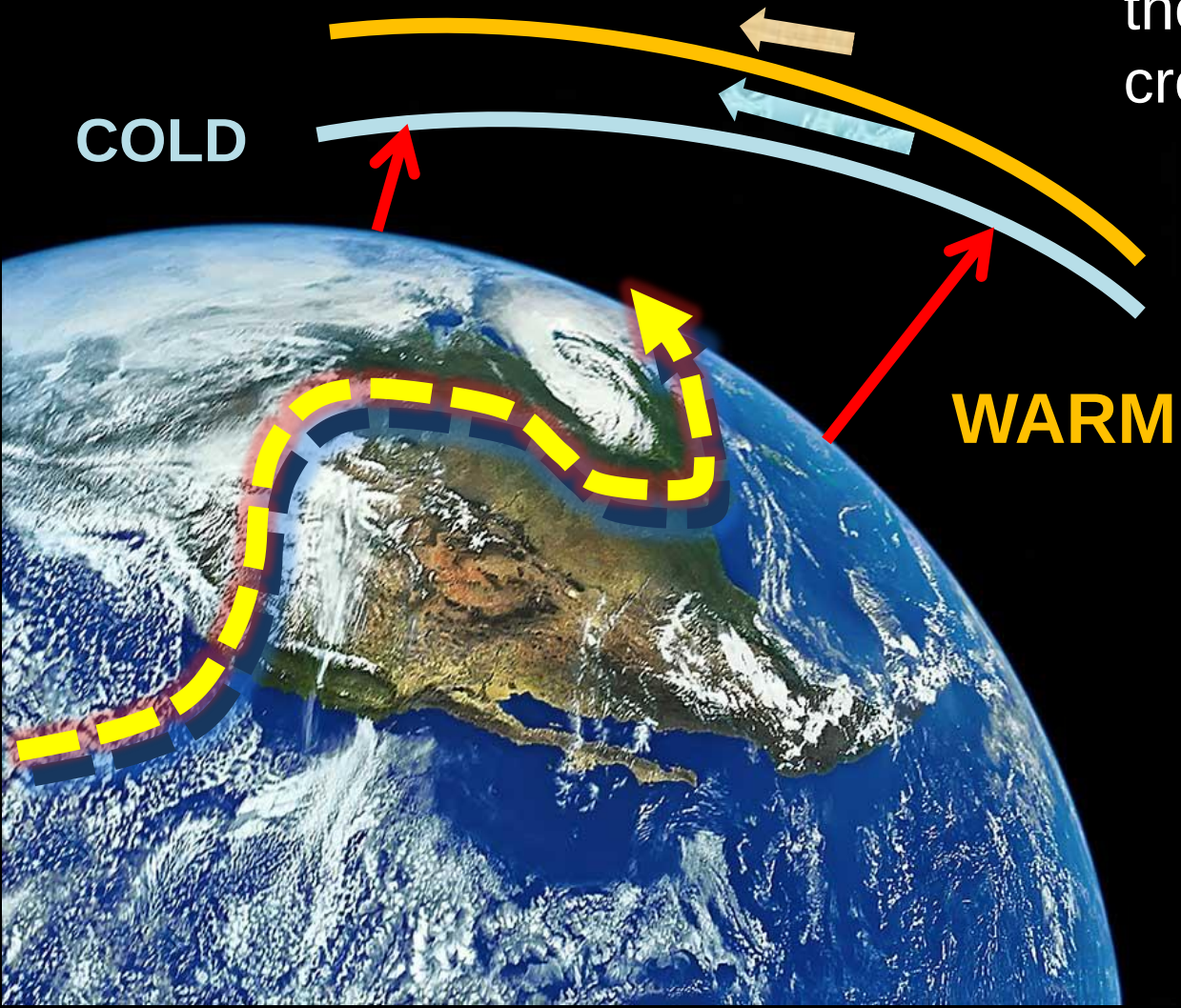
by S. Clark @simonoxfphys

Arctic warming greatly exceeds global-average warming



Plot by Ed Hawkins

Because warm air expands, the layer is thicker here (warm) than the Arctic.(cold)



Air flows down this “hill”, turns to the right as the Earth spins, and creates the *Jet Stream*

As the Arctic warms faster, the hill flattens…

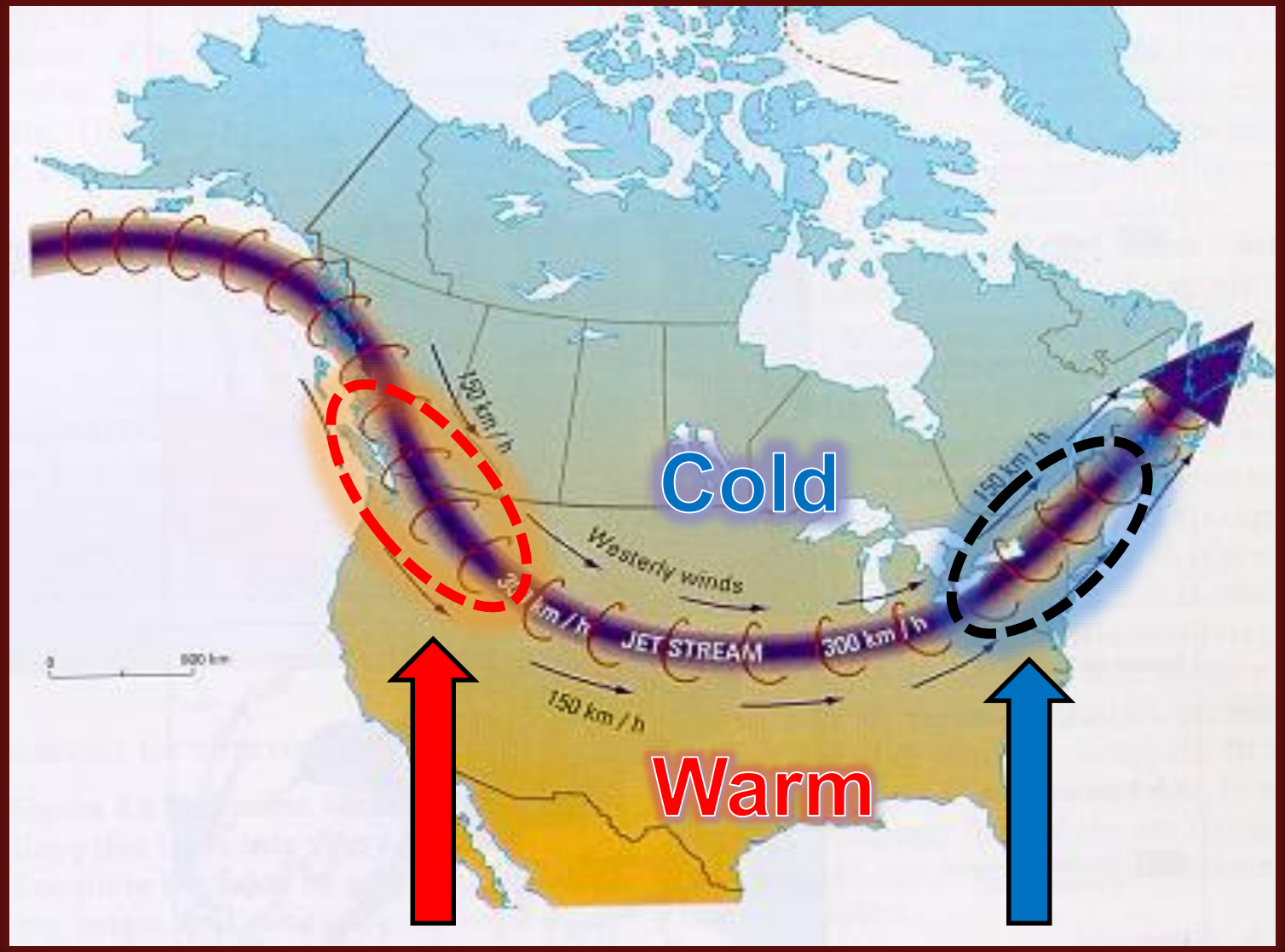
the west winds of the jet stream weaken,

And a weak jet meanders more.

Why do we care about these waves?

They make our weather…

and bigger meanders shift eastward more slowly, causing persistent weather conditions.

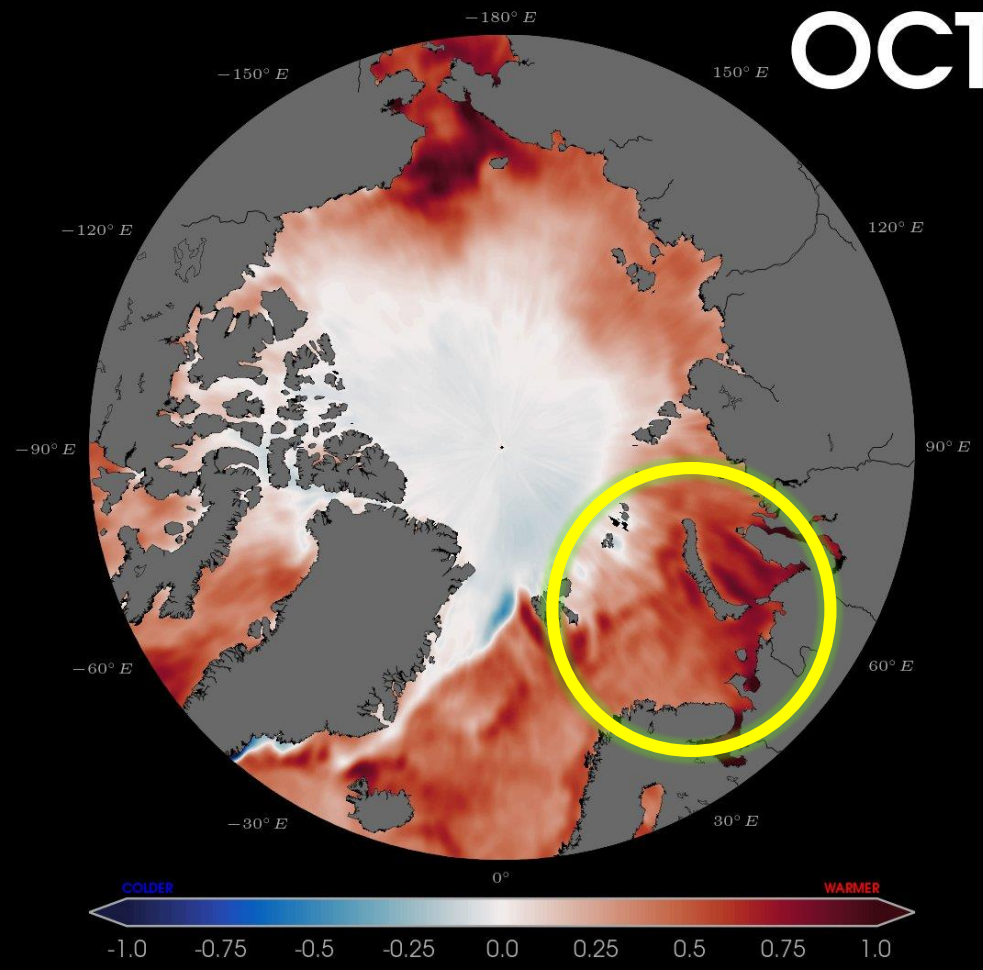


Surface temperature trends

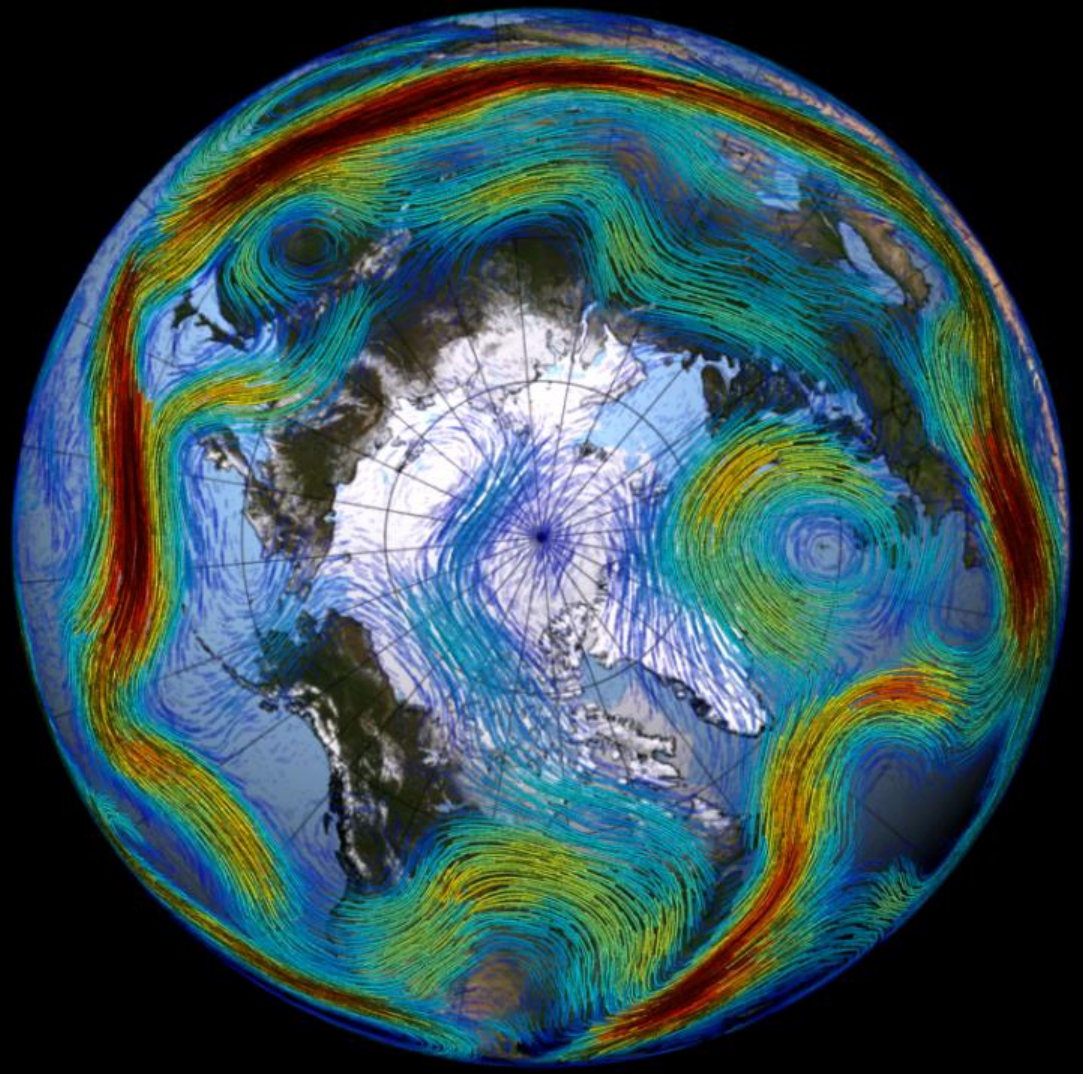
October 1982-2020

Strong, prolonged warmth here can disrupt the polar vortex

GRAPHIC: Zachary Labe (@ZLabe)
SOURCE: https://www.ncdc.noaa.gov/oisst/optimum-interpolation-sea-surface-temperature-oisst-v21
DATA: NOAA Optimum Interpolation (OI) Sea Surface Temperature (SST) V2.1



by Zack Labe @ZLabe



by NASA's Science Visualization Studio

Thank-you!

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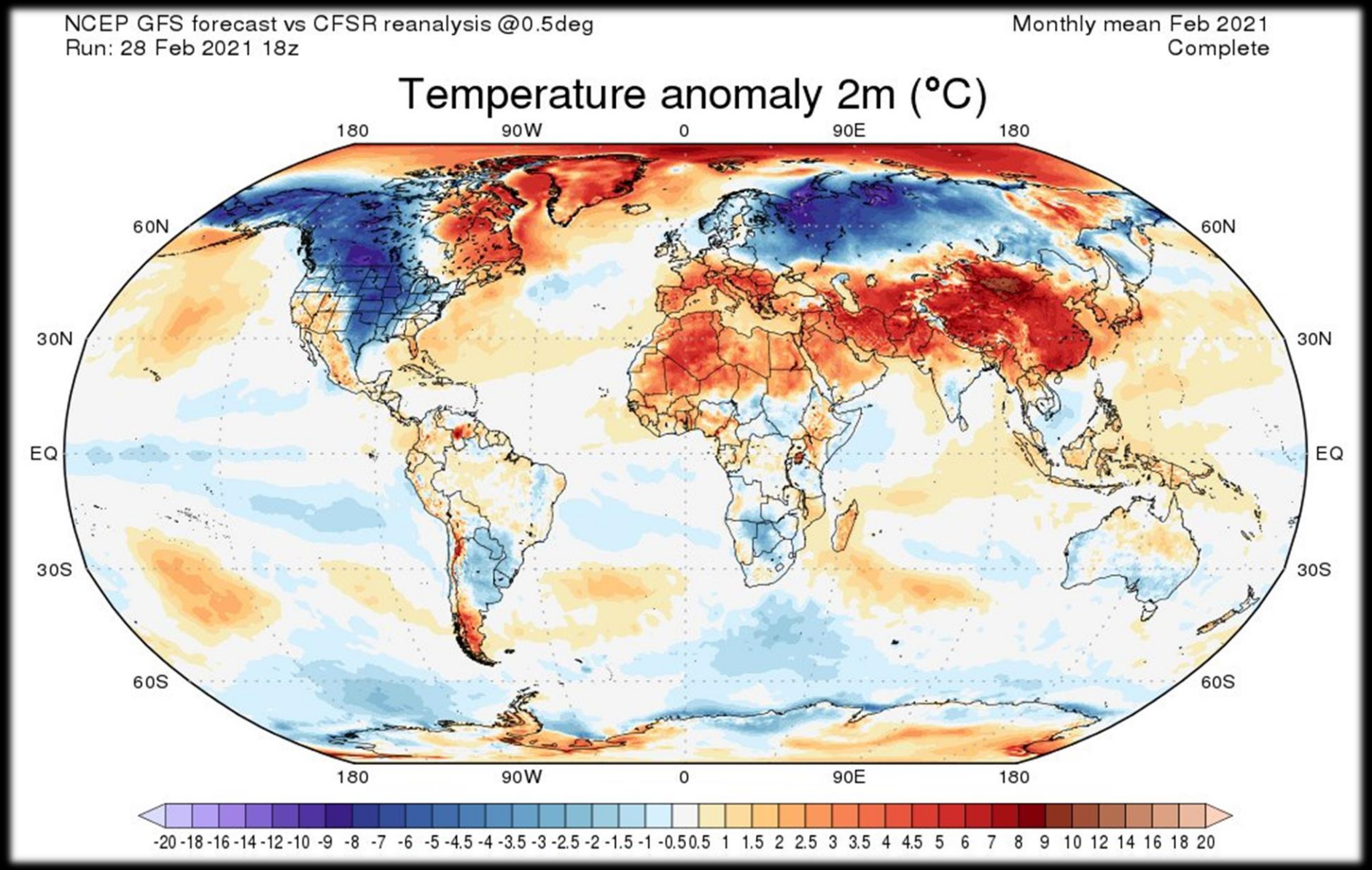
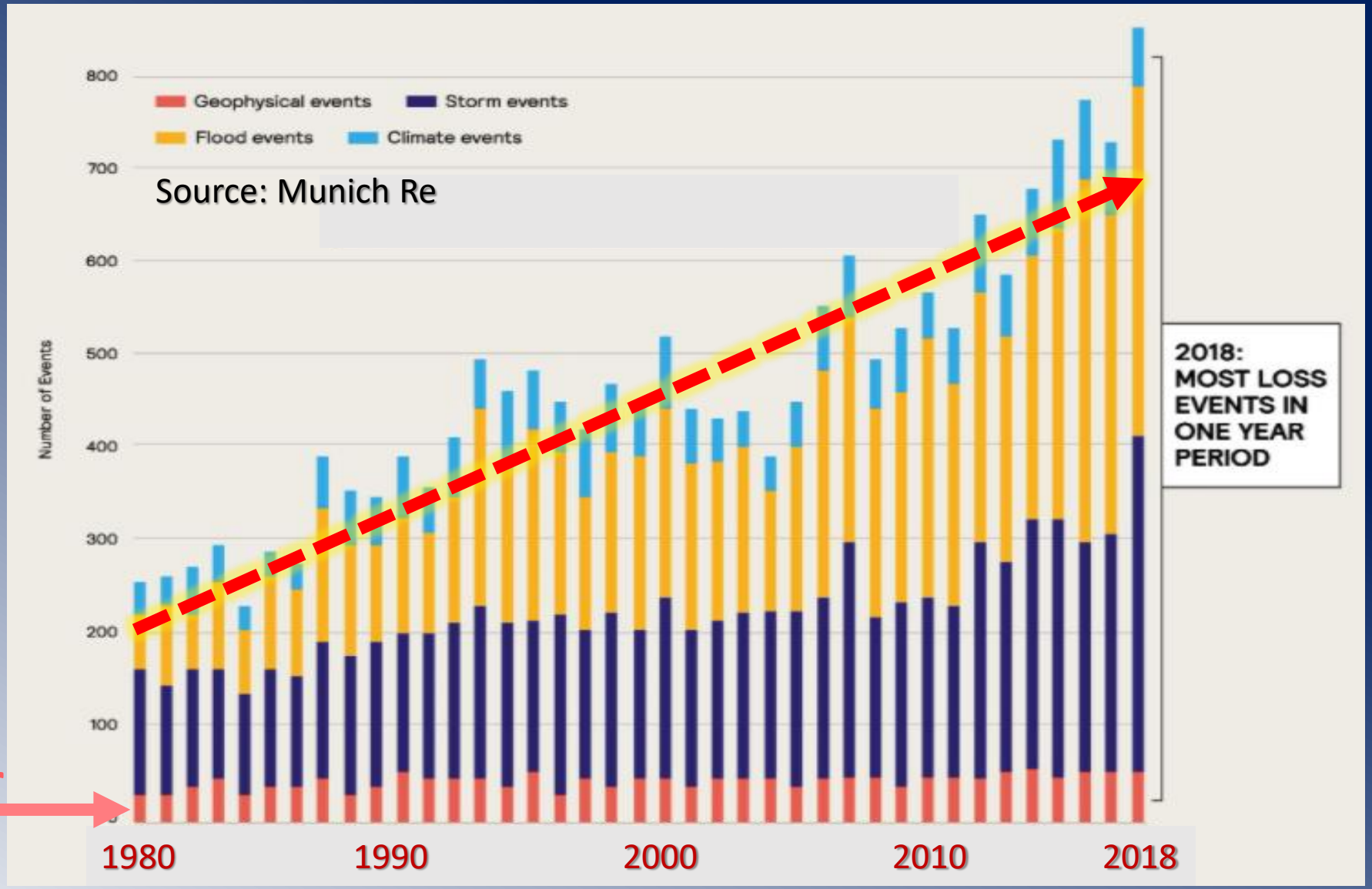
Extras

The Bigger Picture

Temperature differences from average



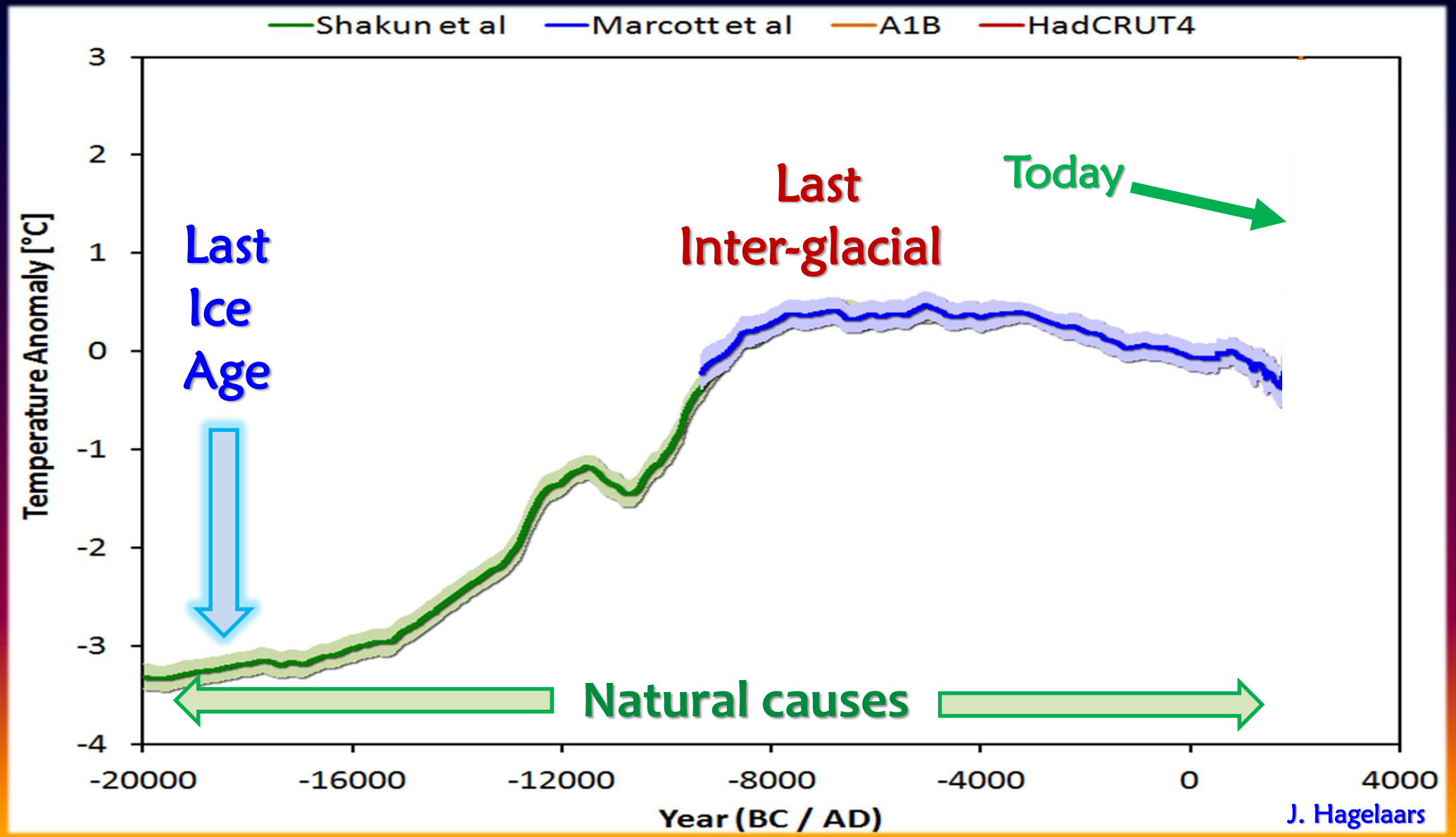
Weather-related extreme events have TRIPLED since 1980



Non-weather related

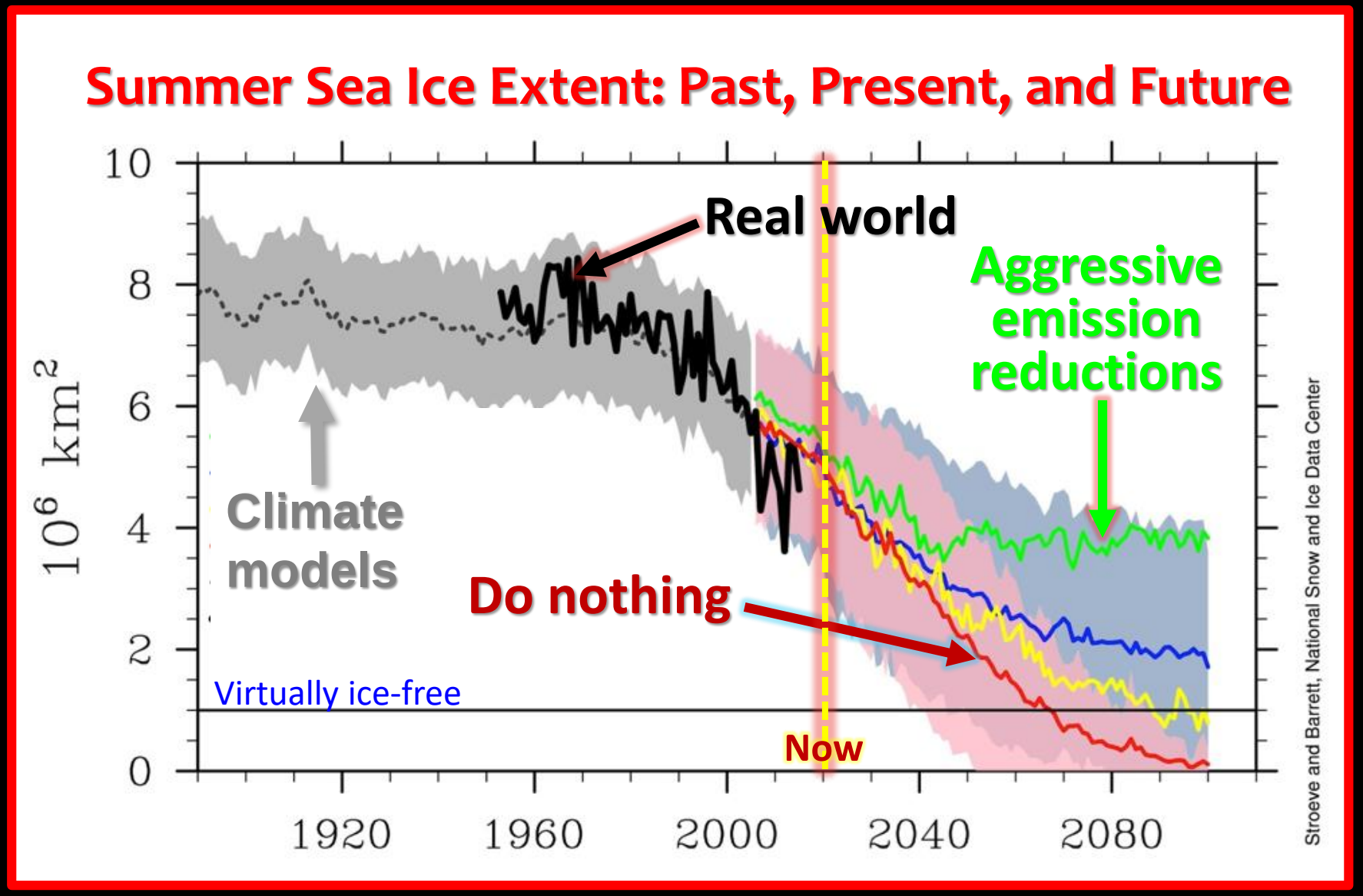
Woodwell Climate Research Center

20,000 Years of Global Temperatures



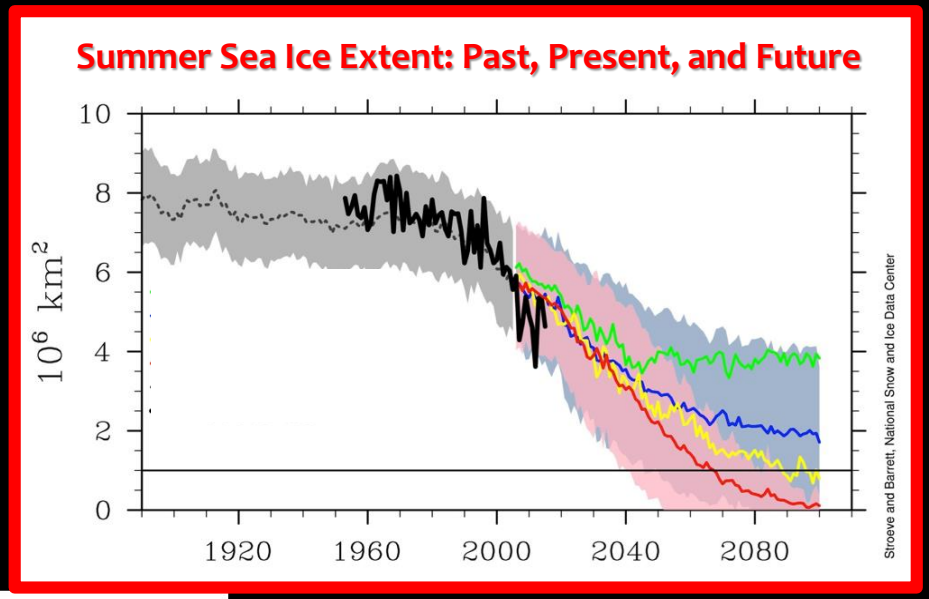
What does our future hold?

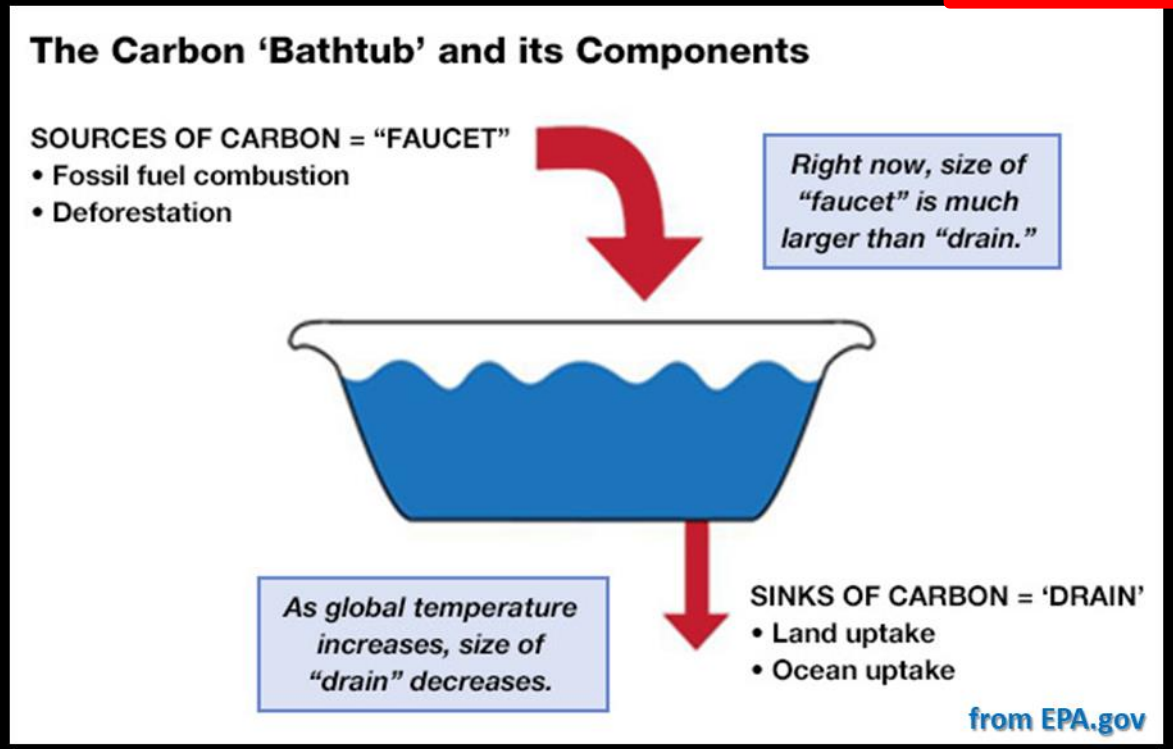
The sea ice story…



How can we stay on the green line?

- Emit less heat-trapping gases
- Create more gas absorbers



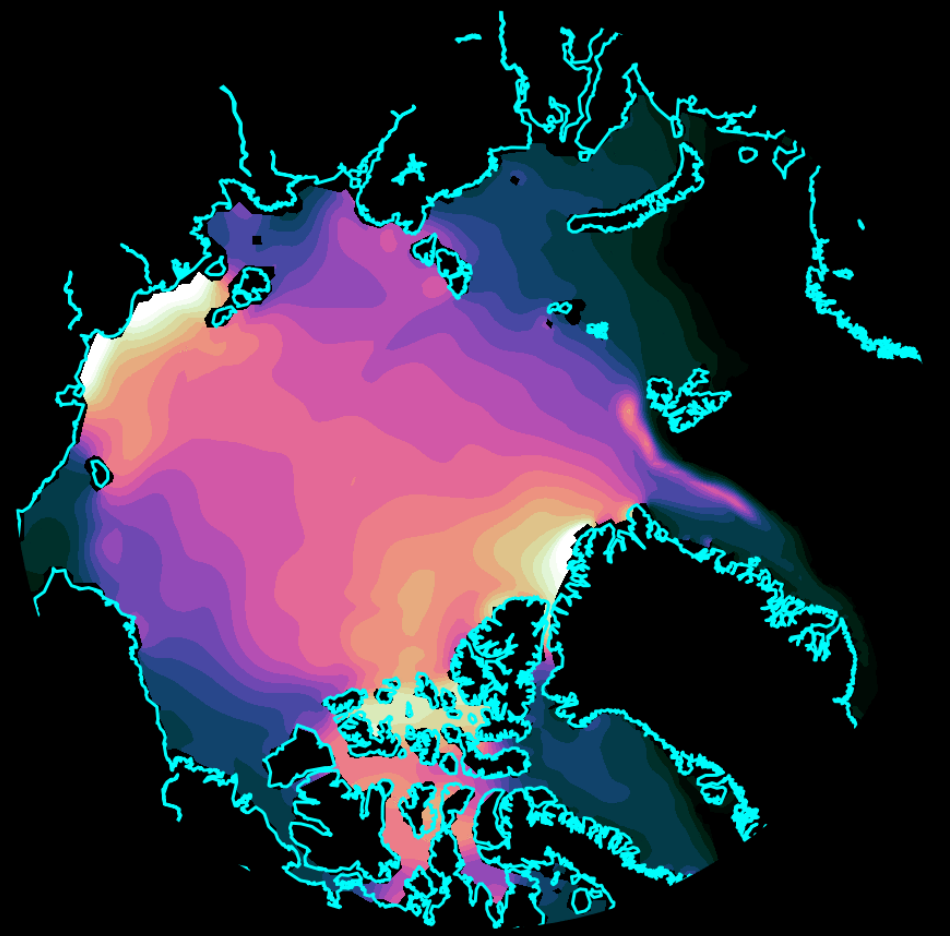


Arctic sea ice thickness and volume 1979-2021

1979

23,201

SEA ICE VOLUME (km^3)



GRAPHIC: Zachary Labe (@ZLabe)
SOURCE: http://psc.apl.uw.edu/research/projects/arctic-sea-ice-volume-anomaly/
DATA: PIOMAS V2.1 (Zhang and Rothrock, 2003) (DECEMBER)

Zack Labe @Zlabe

What happens in the Arctic doesn't stay in the Arctic

Half of the sea ice cover has disappeared,

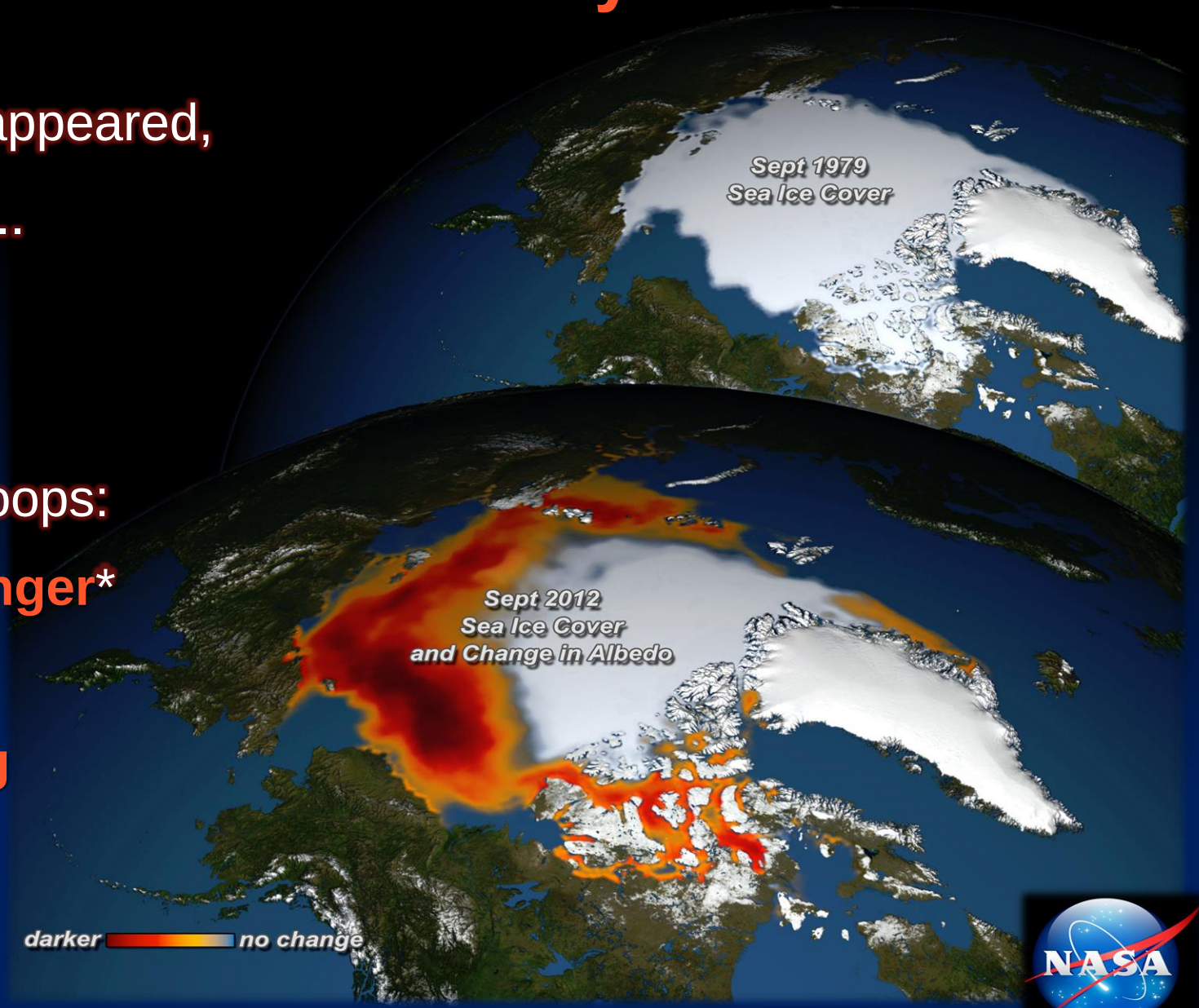
Ice volume has declined by **75%**...

In less than a generation.

The Arctic surface is **darker** now.

Sea-ice loss is **key** to feedback loops:

- Global warming 25-40% **stronger***
- Greenland melt **accelerating**
- Permafrost thaw **accelerating**
- Jet-stream winds **disrupted**



*Pistone et al (2014), Duan et al (2019)