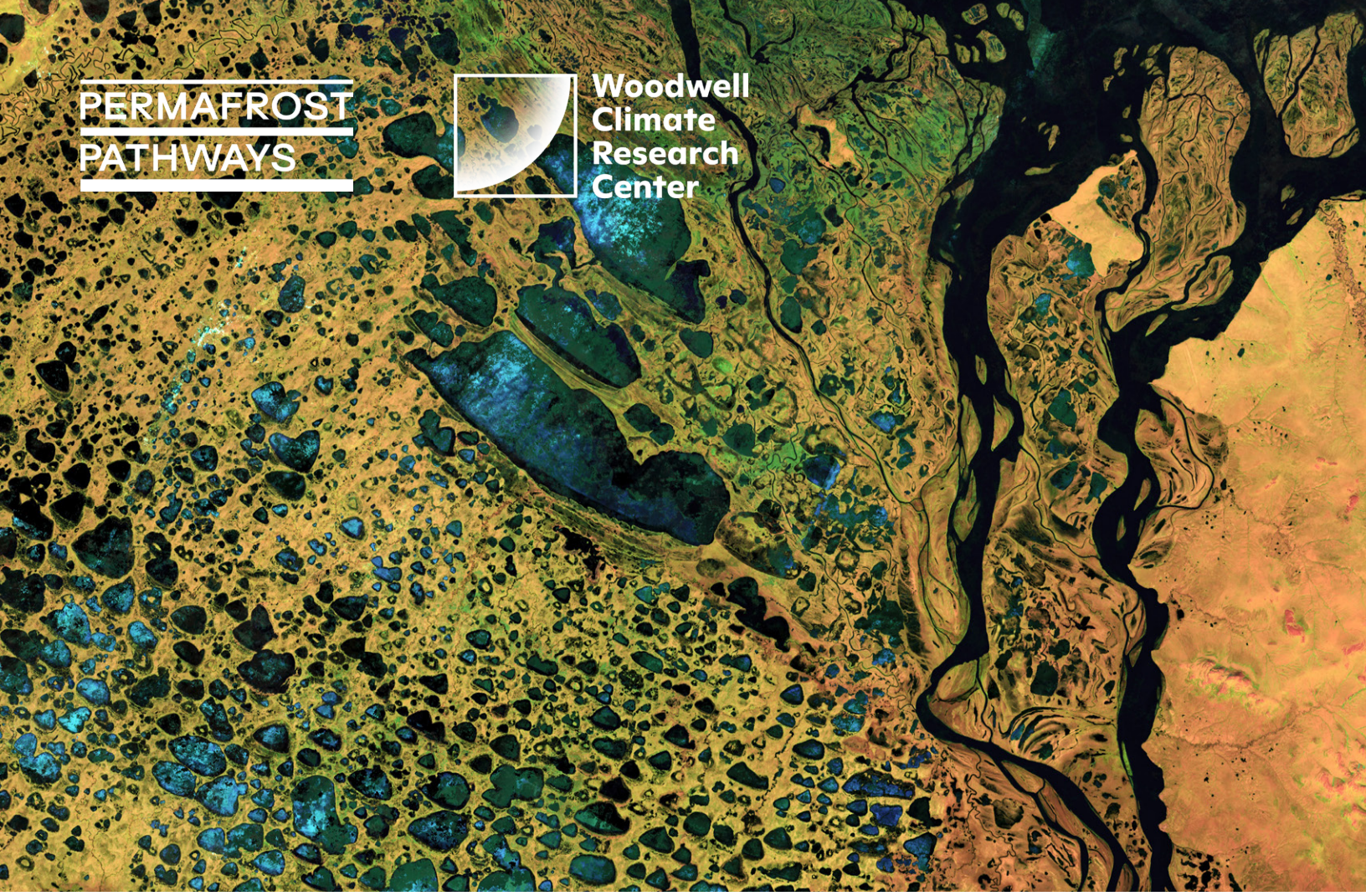

Arctic change in maps

Contributed by

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Senior Geospatial Analyst,
Woodwell Climate Research Center

Christina Shintani M.S.
Cartographer, Woodwell Climate
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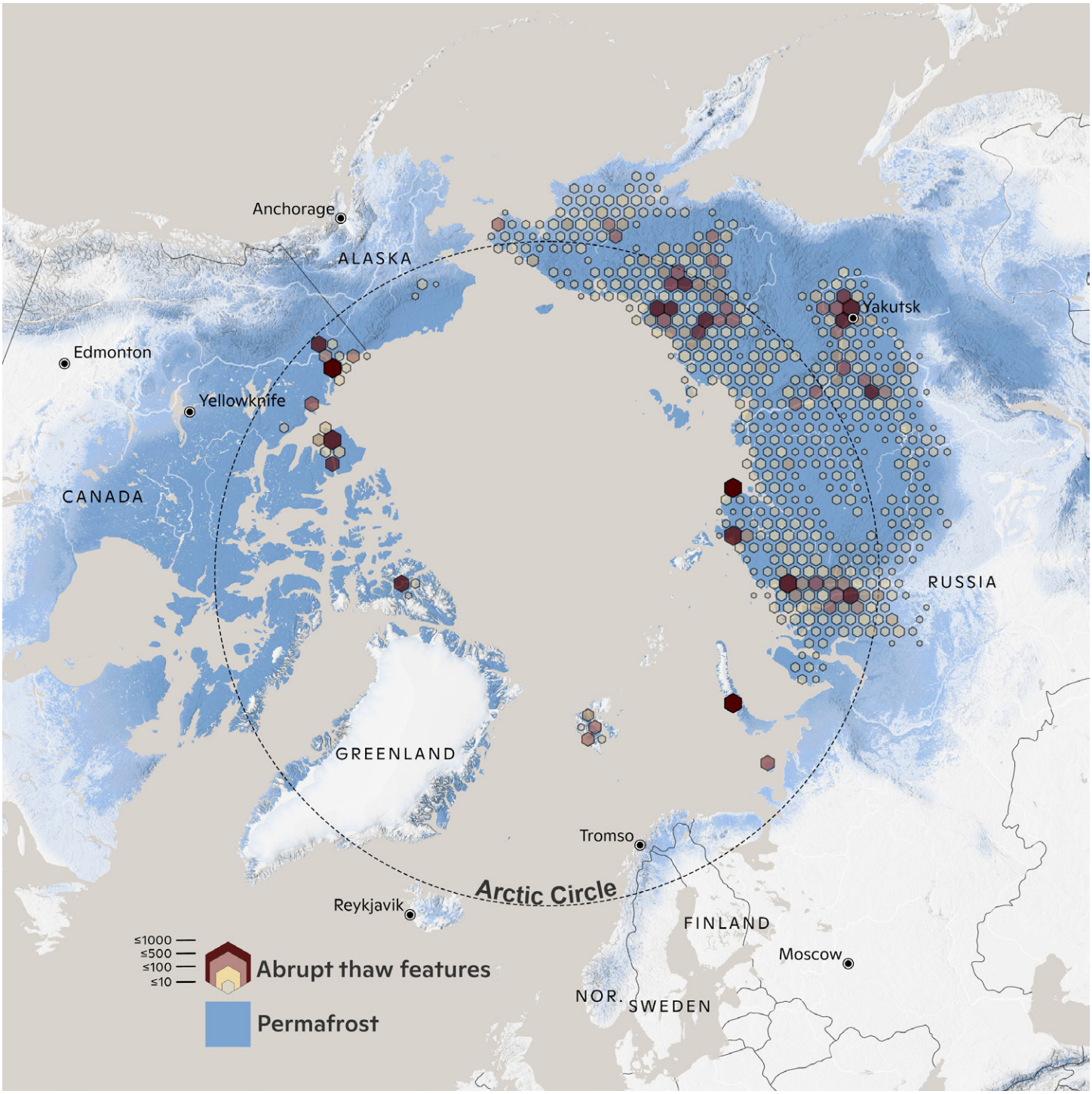
Above: Kolyma River, Russia.
Map by Greg Fiske / Woodwell Climate
Research Center

Cartographers at Woodwell Climate Research Center capture a year of Arctic beauty and change

Explore these 15 maps by award-winning Woodwell Climate cartographers Greg Fiske and Christina Shintani. Each tells a story about the immense beauty of the high north, the dramatic changes unfolding as the Arctic continues to warm up to four times faster than the rest of the world, and the equitable solutions being developed to address climate impacts in the region.

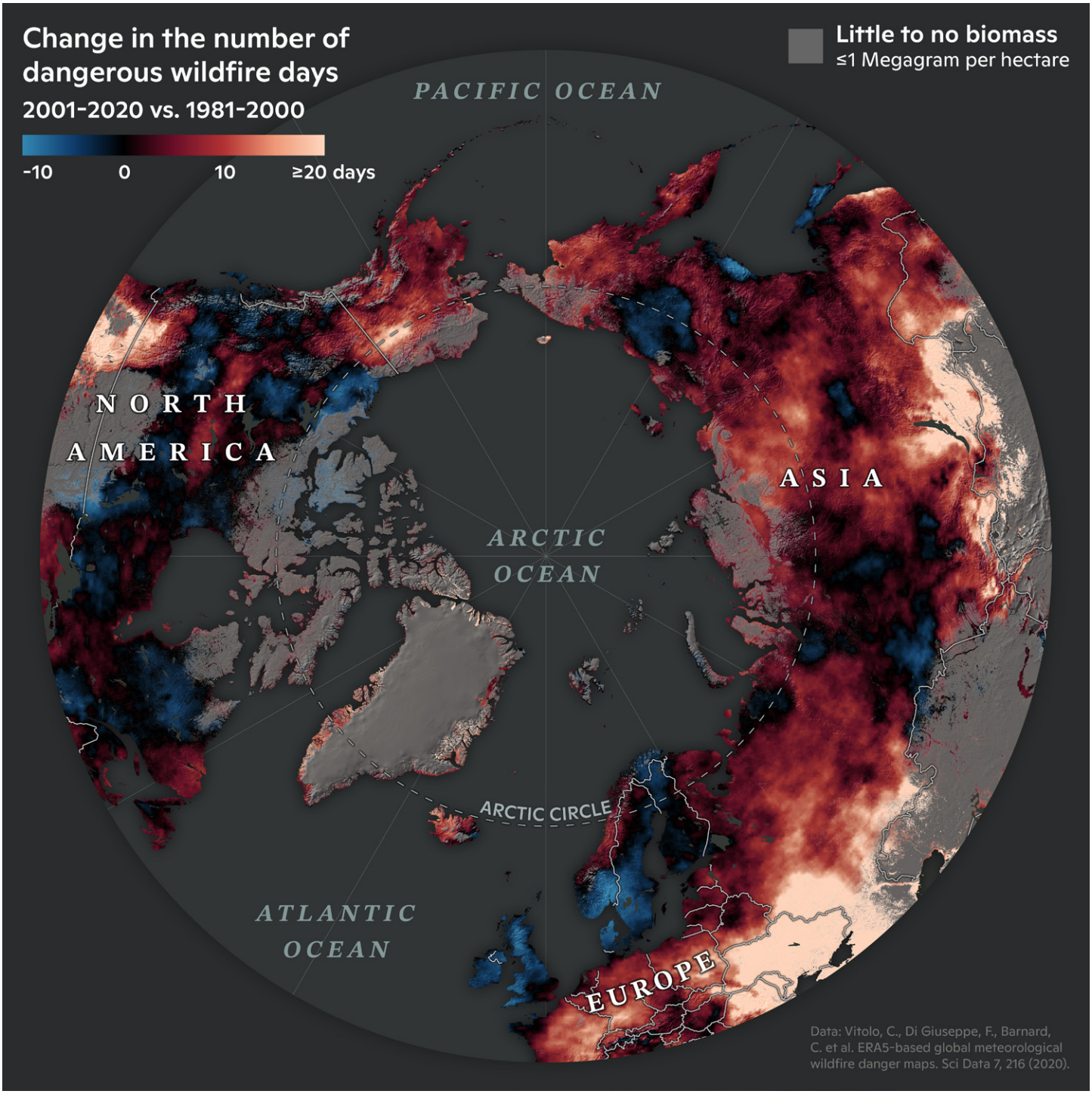


Abrupt permafrost thaw across the Arctic

1

When permafrost that contains a lot of ice begins to thaw, it causes dramatic and abrupt ground collapse. Known as abrupt thaw, this process has the potential to double the warming impact of permafrost thaw on the Earth's climate. To help better understand the impacts that abrupt thaw could have on our global climate, researchers for the Permafrost Pathways project at Woodwell Climate are using the features in this map to train a deep learning model that will identify new and changed features across the circumpolar Arctic.

Map by Greg Fiske and Yili Yang / Woodwell Climate Research Center

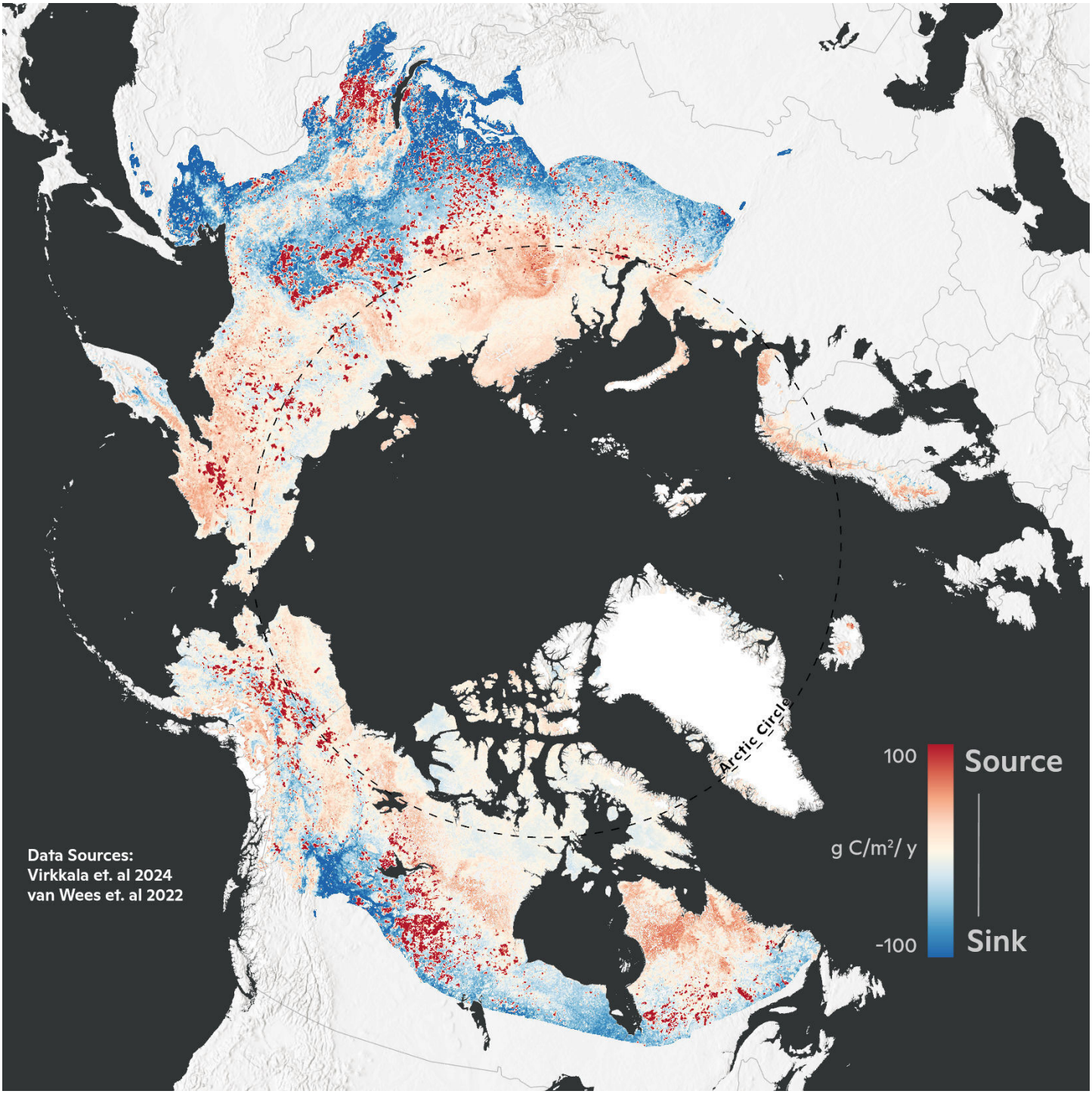


2

Change in dangerous wildfire days

As northern latitudes warm up to four times faster than the rest of the globe, fire seasons in the boreal region have lengthened, and the number of fire-risk days have increased. Climate and health risks from Northern wildfires include large-scale carbon emissions that can accelerate climate change, poor air quality and disproportionate health risks to local communities, particularly Indigenous communities, due to smoke, altered boreal forest ecosystem composition, and permafrost degradation. 2024 was the second-highest year for wildfire emissions north of the Arctic Circle.

Map by Christina Shintani / Woodwell Climate Research Center

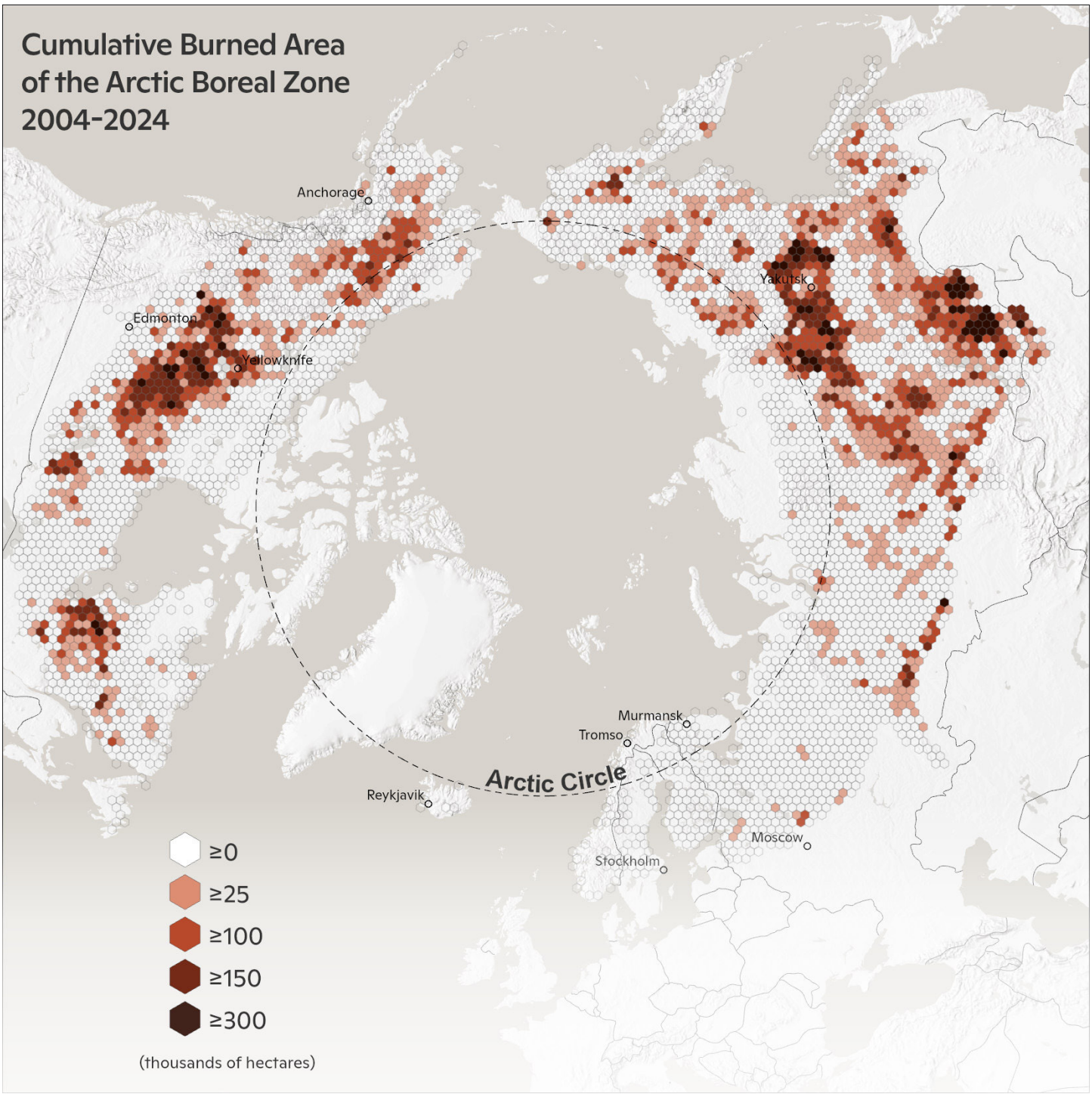


3

Pan-Arctic carbon sources and sinks

While the Arctic has been a carbon sink for thousands of years—storing more carbon than it releases—new research led by Permafrost Pathways scientists at Woodwell Climate found that one-third of the Arctic tundra is now a carbon source.

Map by Greg Fiske / Woodwell Climate Research Center

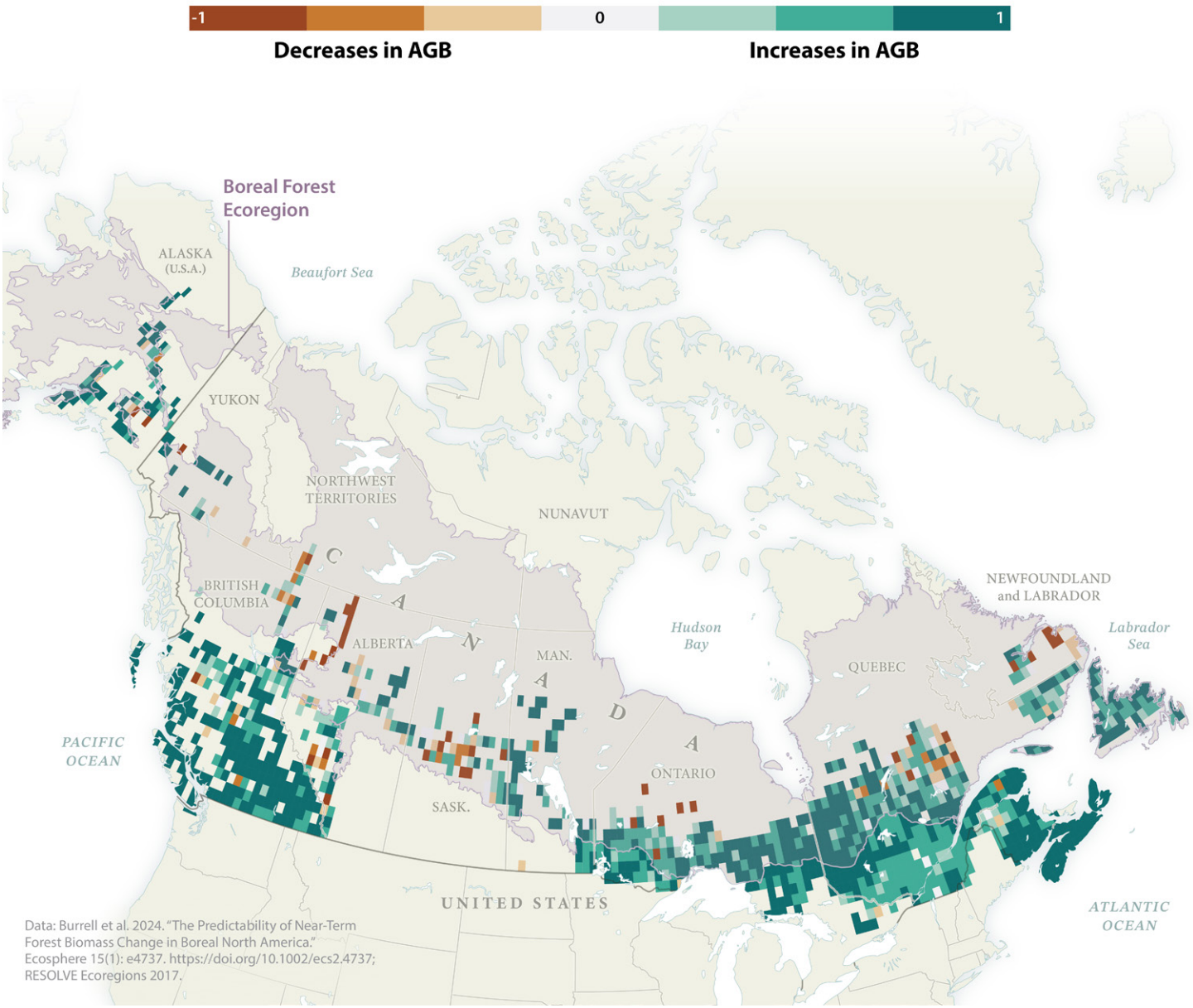


Cumulative burned area of the Arctic-Boreal zone

4

This map of cumulative burned area in the Arctic-boreal zone took center stage at the 2024 Arctic Circle Assembly. Collaborator Edward Alexander from Gwich'in Council International joined a panel conversation with Sen. Lisa Murkowski, spotlighting wildfire in the North, management approaches, and Indigenous-led solutions. Sen. Murkowski cited statistics from Woodwell Climate's research, noting a pilot project led by Dr. Brendan Rogers and Dr. Peter Frumhoff on fire suppression as a promising solution.

Map by Greg Fiske / Woodwell Climate Research Center

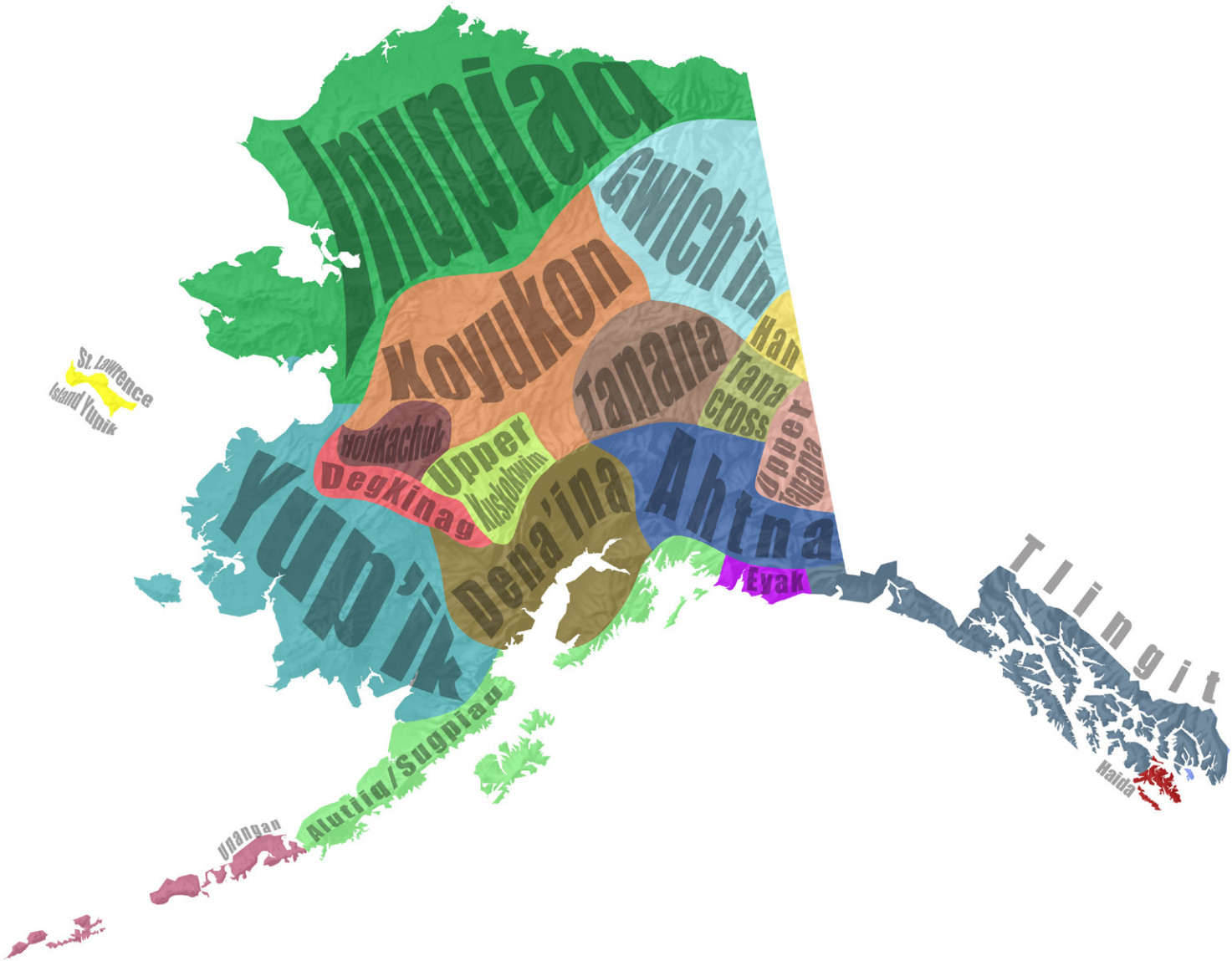


5

Predicted change in aboveground boreal biomass by 2030

Decreases in aboveground biomass (AGB) are seen in areas that are susceptible to drought, which have shown early warning signals of tree mortality from remotely sensed imagery. Increases in aboveground biomass are seen in younger tree stands and faster-growing temperate forests.

Map by Christina Shintani / Woodwell Climate Research Center



Alaska Native languages and cultures

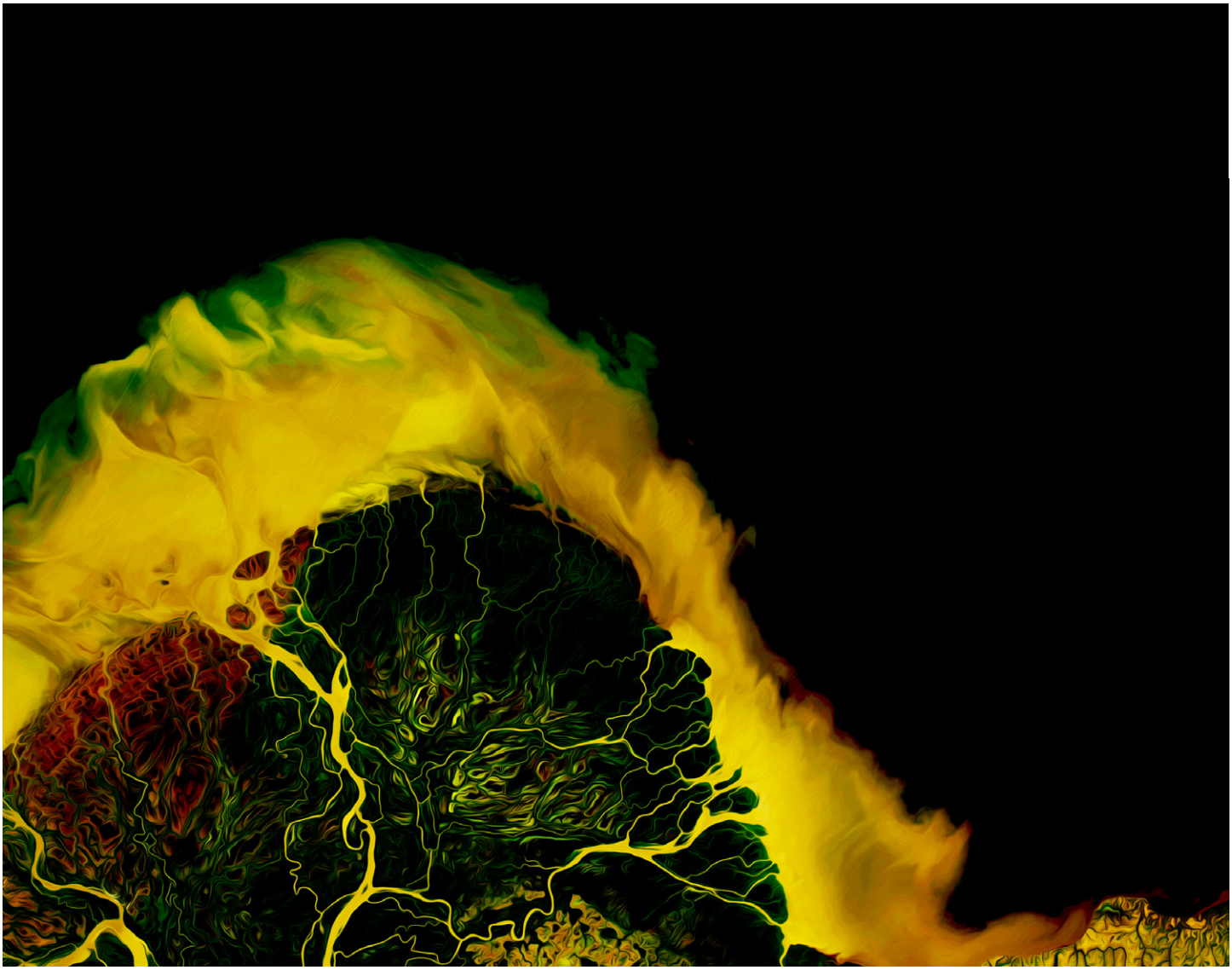
6

Alaska is home to 229 Tribes and 11 Native language families with at least 20 distinct languages, reflecting the diverse cultural heritage of Alaska Native peoples.

Permafrost Pathways has been working with Alaska Native partners to build GIS capacity within communities.

Data source: https://scholarworks.alaska.edu/handle/11122/1142

Map by Greg Fiske / Woodwell Climate Research Center

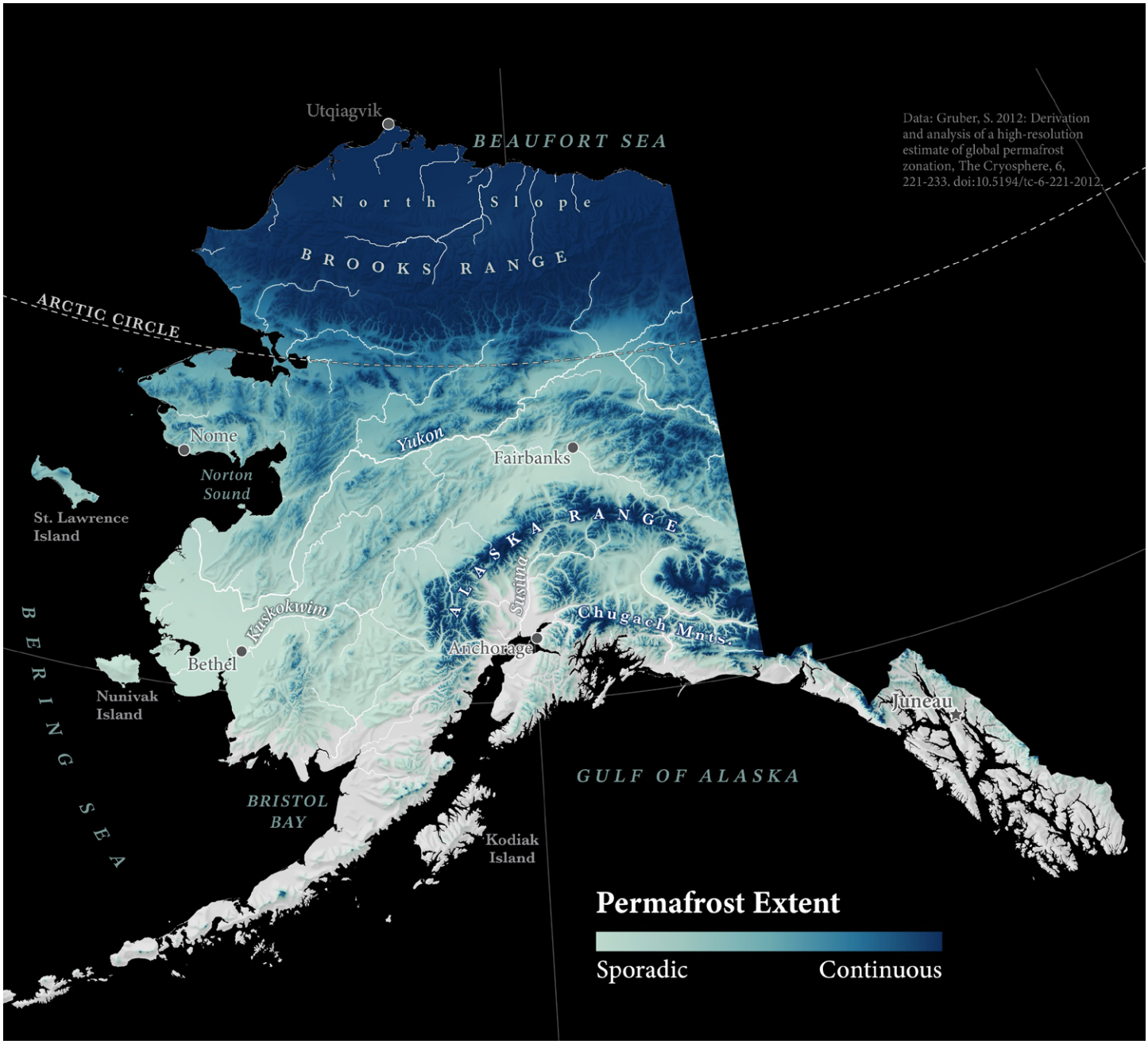


Yukon-River Delta, Alaska

7

An artistic rendition of the Yukon River Delta in Alaska. By combining satellite imagery bands 4 (red), 3 (green), and 1 (coastal aerosol band) from the Sentinel2 platform (Copernicus Sentinel-2 mission, ESA), we are able to see sediment within the water. The sediment in this image was recolored to a fire-like yellow to stand out from the surrounding land and deep ocean. This map was on display as part of the "In Flux: Perspectives on Arctic Change" art exhibit at Highfield Hall in Falmouth, Massachusetts.

Map by Greg Fiske / Woodwell Climate Research Center

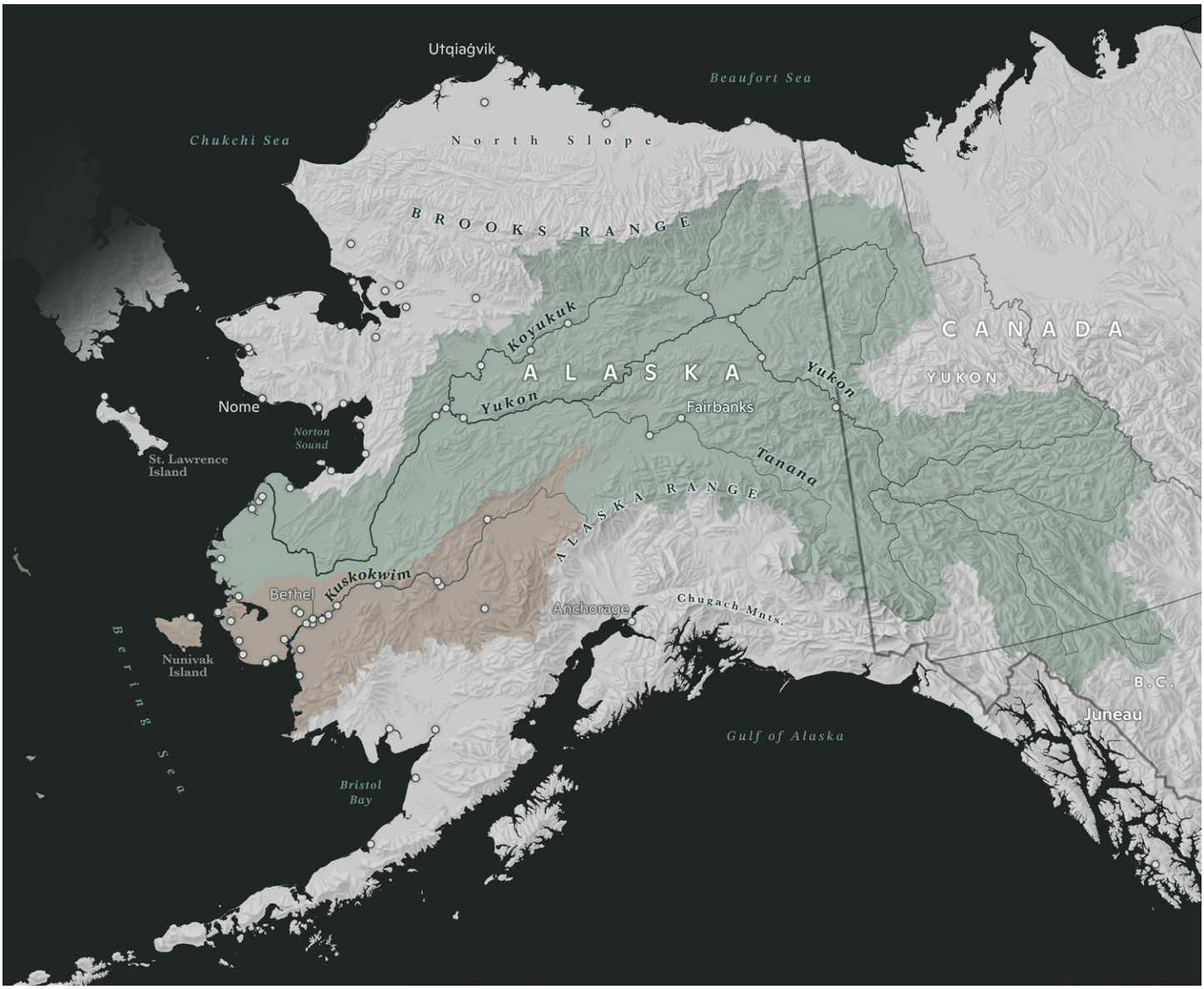


8

Current permafrost extent in Alaska

80% of Alaskan lands are within the permafrost region. Pan-Arctic warming is causing permafrost to thaw, destabilizing the ground, and contributing to flooding and erosion. Slow-onset processes like coastal and riverine erosion, and extreme weather events like storms, floods, and wildfires can accelerate permafrost thaw and contribute to usteq—the Yup'ik word for catastrophic ground collapse.

Map by Christina Shintani / Woodwell Climate Research Center



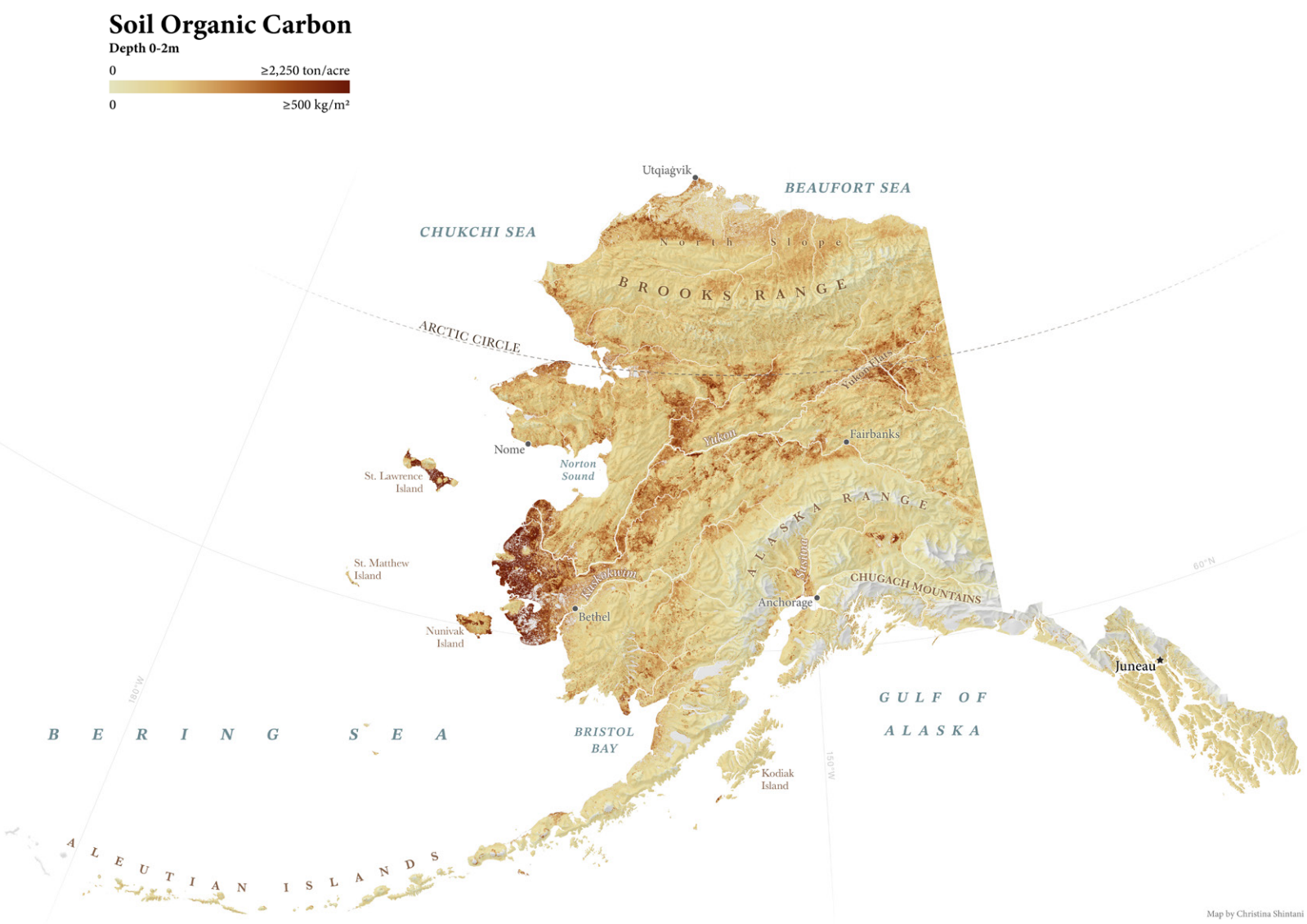
Yukon and Kuskokwim River watersheds

9

This map, which shows the Yukon (green) and Kuskowim (brown) River watersheds was created as part of a special StoryMap project by Permafrost Pathways and Native Movement. The StoryMap resource takes you on a journey through the impacts that climate change is having on salmon in the Yukon and Kuskokwim River watersheds, the need for Alaska Native-led management solutions, and how you can help to support sustainable Indigenous-led fisheries governance in Alaska.

VIEW THE STORYMAP:

Map by Christina Shintani / Woodwell Climate Research Center



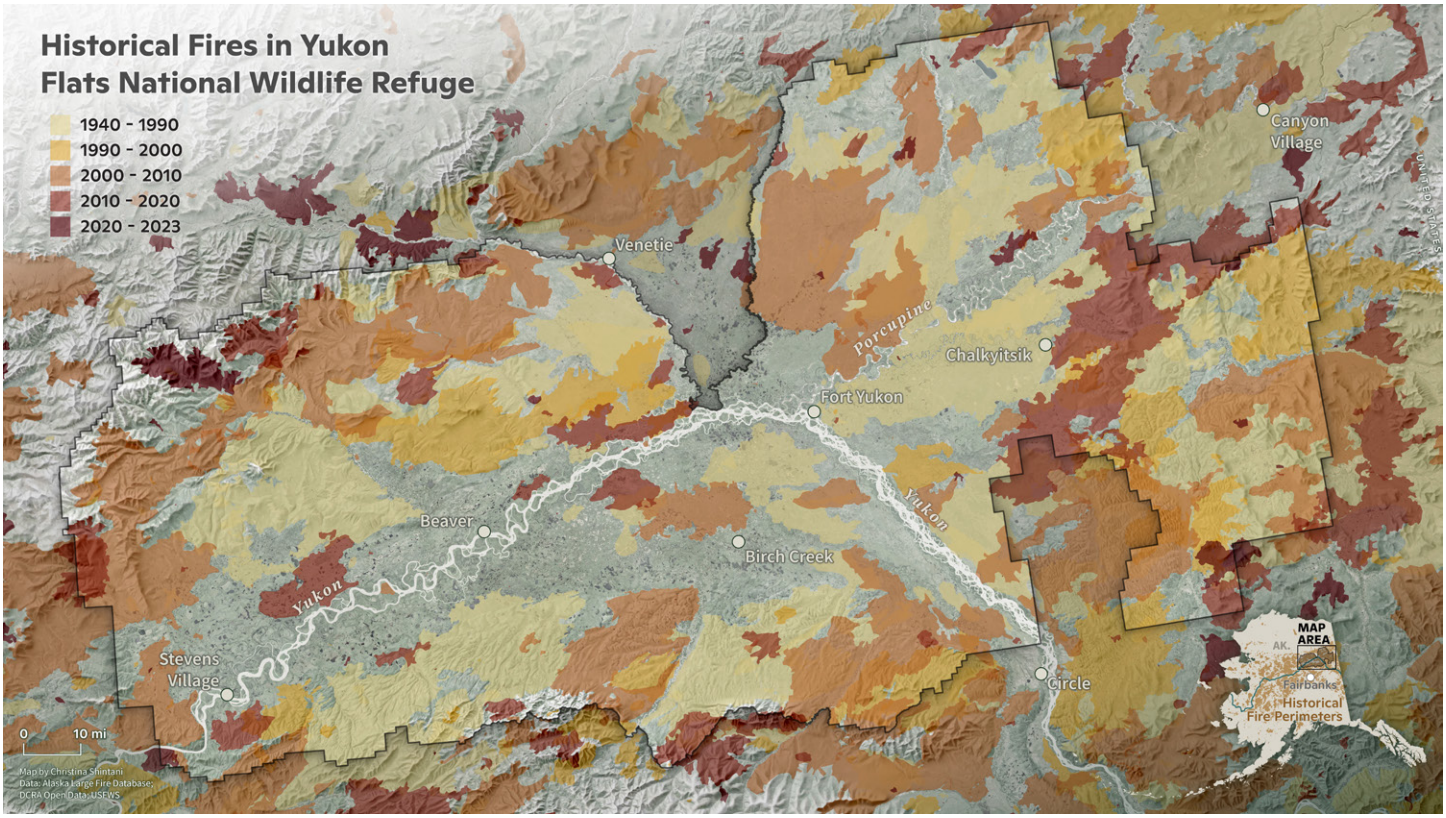
10

Soil organic carbon in Alaska

This map represents the organic carbon locked in Alaskan soils. Thawing carbon-rich permafrost is an important contributor to climate change that is currently not well represented in global climate models. Regional soil carbon mapping like this helps to inform global carbon budgeting and monitoring, as well as community adaptation decision-making.

Data source: https://zenodo.org/records/2536040

Map by Christina Shintani / Woodwell Clmate Research Center

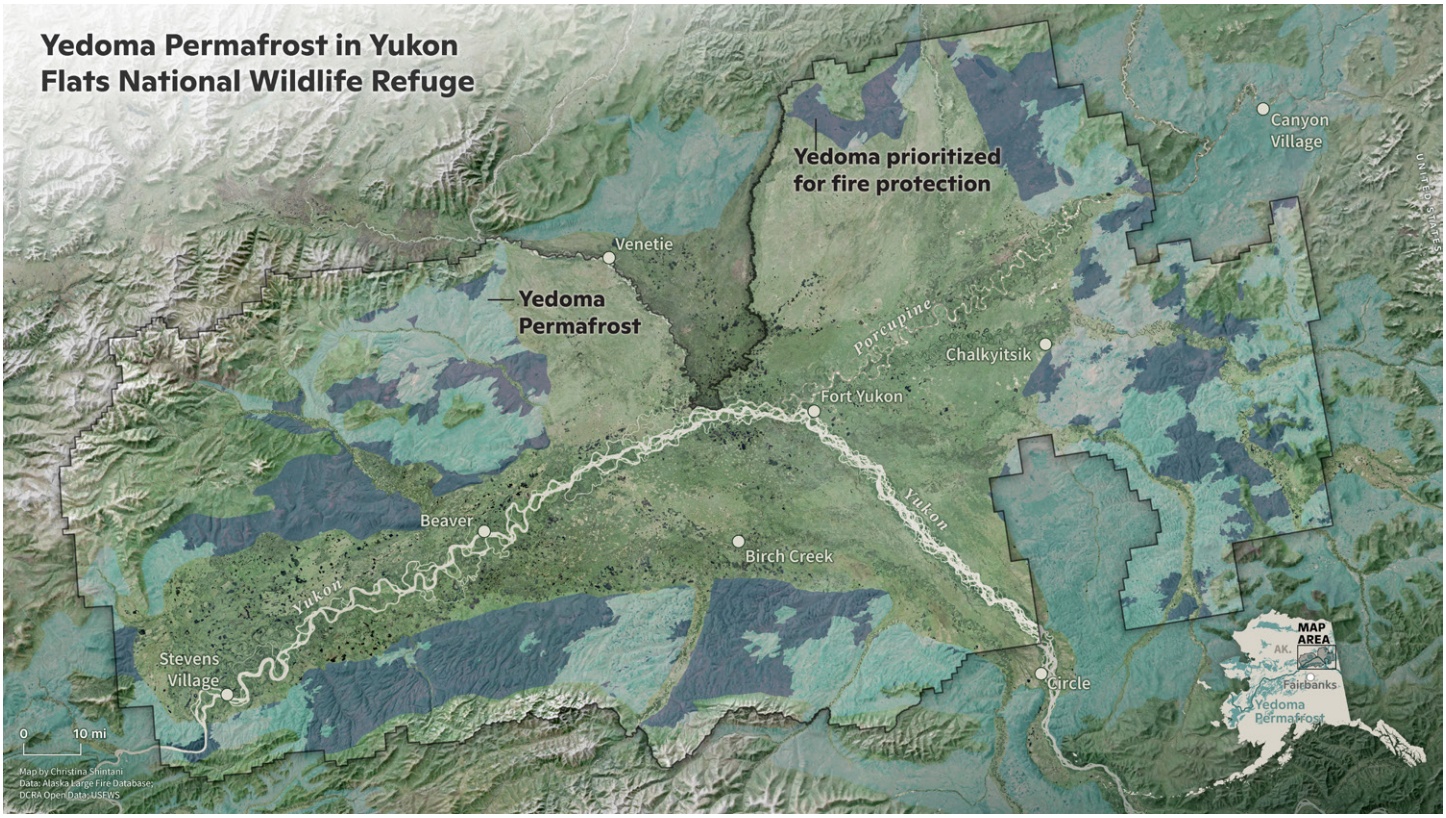


11

Historical fires in Yukon Flats National Wildlife Refuge

Historical fire activity in the Yukon Flats National Wildlife Refuge from 1940-2023.

Map by Christina Shintani / Woodwell Clmate Research Center

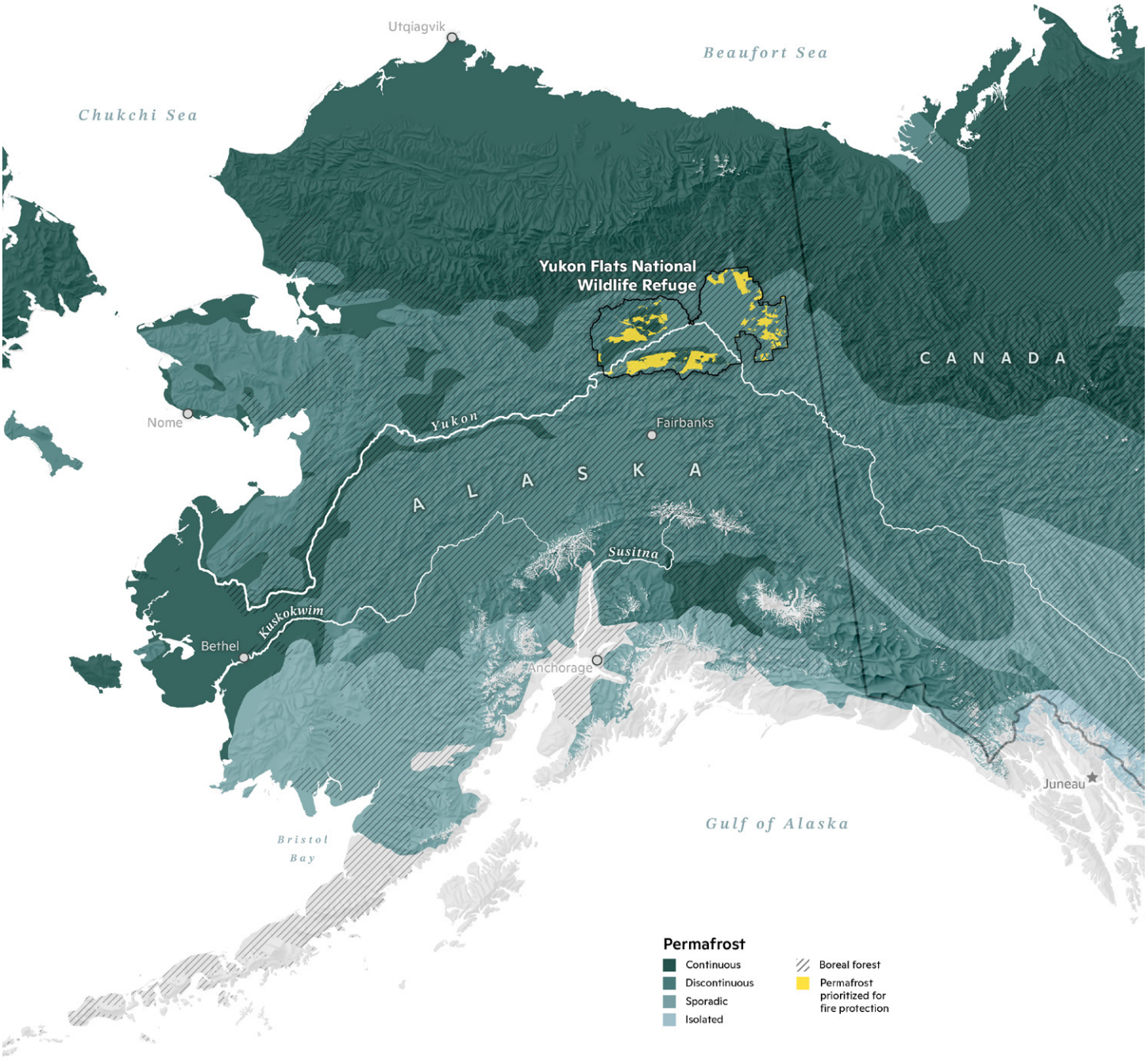


Protecting permafrost in the Yukon Flats National Wildlife Refuge

12+13

In January 2023, as a direct response to research and collaboration with researchers from Permafrost Pathways and Woodwell Climate Research Center, the U.S. Fish and Wildlife Service enhanced the fire suppression status of 1.6 million acres of Yedoma permafrost-rich land on the Yukon Flats National Wildlife Refuge. The decision was made in consultation with the Alaska Fire Service and Indigenous communities within the refuge.

Maps by Christina Shintani / Woodwell Clmate Research Center



Map by Christina Shintani, Woodwell Climate Research Center
Data: Brandt, J.P. 2009. The extent of the North American boreal zone. Environmental Reviews 17:101-161.; Brown et. al 1997; USFWS

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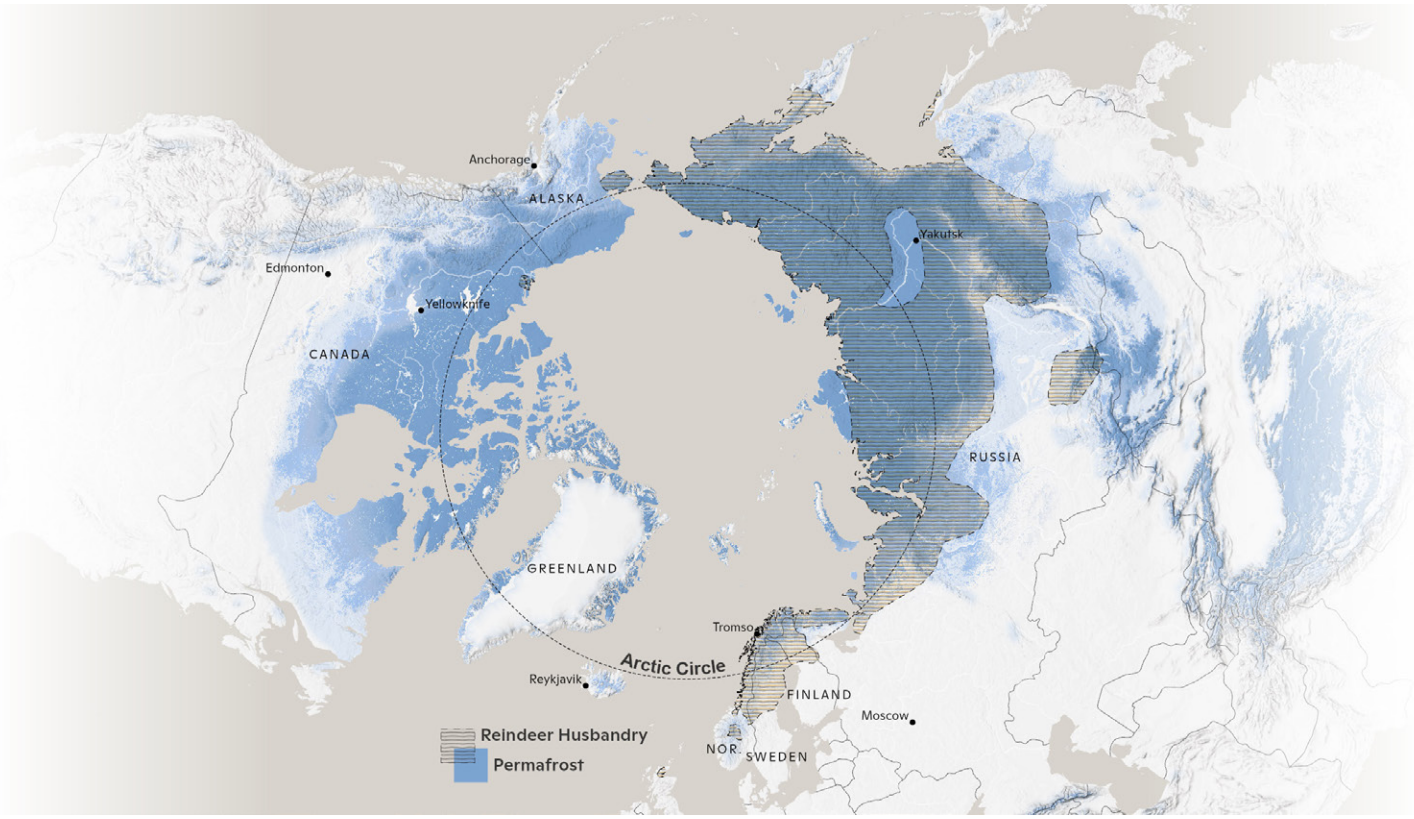
Maps by Christina Shintani / Woodwell Clmate Research Center



14

Reindeer husbandry and permafrost

Reindeer husbandry lands span much of the permafrost region across Eurasia. Today, about 100,000 people across nine countries participate in reindeer herding with about 2.5 million semi-domesticated reindeer. Reindeer herding peoples, such as the Sámi, have practiced subsistence ways of living across the Arctic region since time immemorial. The intimate relationship between reindeer and Sámi people is ancient, and their health, well-being, and futures are mutually dependent on one another.

Map by Greg Fiske / Woodwell Clmate Research Center

15

Reindeer migratory routes

Reindeer and Sámi reindeer herders face profound challenges as they grapple with pasture loss, land use conflicts, and the impacts of Arctic climate change such as permafrost thaw and land degradation which affect migratory routes. Sámi who practice reindeer husbandry are forced to adapt to these threats while trying to maintain their traditional lifeways in the Arctic.

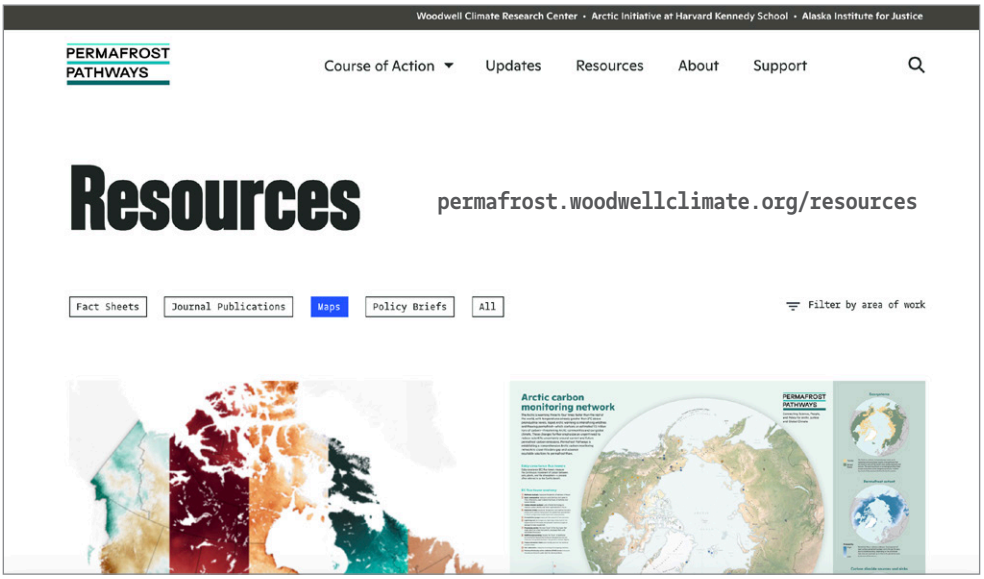
Map by Greg Fiske / Woodwell Clmate Research Center

More about our mapping work

Arctic Indigenous mapmakers are reclaiming the past, shaping their future

Co-production and flood mapping in the Native Village of Kuigilnguq

View and download our maps



permafrost.woodwellclimate.org

PERMAFROST PATHWAYS

Connecting Science, People, and Policy for Arctic Justice and Global Climate

Permafrost Pathways was launched in 2022 with funding through the TED Audacious Project—a collaborative funding initiative catalyzing big, bold solutions to the world's most urgent challenges. Led by Woodwell Climate Research Center, Permafrost Pathways harnesses the combined expertise of leading research institutions and on-the-ground organizations specializing in climate science, policy, and environmental justice to inform and develop adaptation and mitigation strategies to address permafrost thaw.