



# CHAPTER 10

## THE AUGUST SEA ICE EXTENT OF THE KARA SEA HAS DECREASED BY ALMOST 100 PERCENT DURING THE PAST 40 YEARS

Beginning in 1956, and through 2012, Russia built three mega reservoir hydroelectric dams on the Ob–Irtysch rivers and eight on the Yenisei–Angara rivers, all of which flow into the Kara Sea.

In August 1980, a portion of the Kara Sea was ice-free according to the Sea Ice Extent Map by National Snow and Ice Data Center (NSIC/DC) in figure 6.

The Kara Sea’s Sea Ice Extent Maps for August 1990, 2000, 2010 and 2020 are in figures 7–10, and they reveal that the total extent of Arctic sea ice has shrunk 36 percent from 8.0 million square kilometers (3 million square miles) in 1980 to 5.1 million square kilometers (2 million square miles) in 2020.

I believe a more accurate description would be that the sea ice extent along the Siberian coast has decreased by almost 100 percent in the last 40 years.

I suggest the reader take note of the following in figures 6-10:

1. The colossal loss of sea ice over the past 40 years is mostly concentrated along the Siberian coastline.
2. The reduction of sea ice becomes greater each decade between the Kara Sea and Laptev Sea.

*“According to Roshydromet [Russia’s state agency on meteorology and environmental monitoring] the Kara Sea has experienced the most dramatic boost in air temperature over the last 20 years. Since 1998, the average temperatures in the area have increased by as much as 4.95 degrees Celsius, 9 degrees Fahrenheit” (Staalensen, 2018)*

Also warming the Laptev Sea is:

*“A large dam and hydroelectric power station on the Vilyuy River, the longest tributary to the Lena River, which discharges into the Arctic’s coastal Laptev Sea, which borders the Kara Sea, the reservoir started filling in 1969 and was full by 1973. It is 280 miles long with a total capacity of 35.9 cubic kilometers.*

*The large reservoir formed by the dam has caused the winter temperature of the Vilyuy River to increase by 5 to 6 degrees Celsius (9 to 10.8 degrees Fahrenheit) ...”* (Wikipedia: Laptev Sea)

Between 1974 and 1982, Russia built the Kolyma Hydroelectric Station on the Kolyma River, which flows into the Chukchi Sea. Between 2005 and 2012 Russia built the Boguchany Hydroelectric Dam on the Angara River, which flows into the Yenisei River and then into the Kara Sea. (Wikipedia: Kolyma Hydroelectric Station)

Russia is not the only country building mega reservoir dams along its northern rivers. In addition to the mega dams built by Hydro-Quebec in Canada’s north, BC Hydro completed two mega reservoir dams on the Peace River. First the W. A. C. Bennett Dam in 1968, and then the Peace Canyon Dam in 1980. The Peace River is a large tributary to the McKenzie River, which flows into the Beaufort Sea.

## Sea Ice Extent, Aug 1980

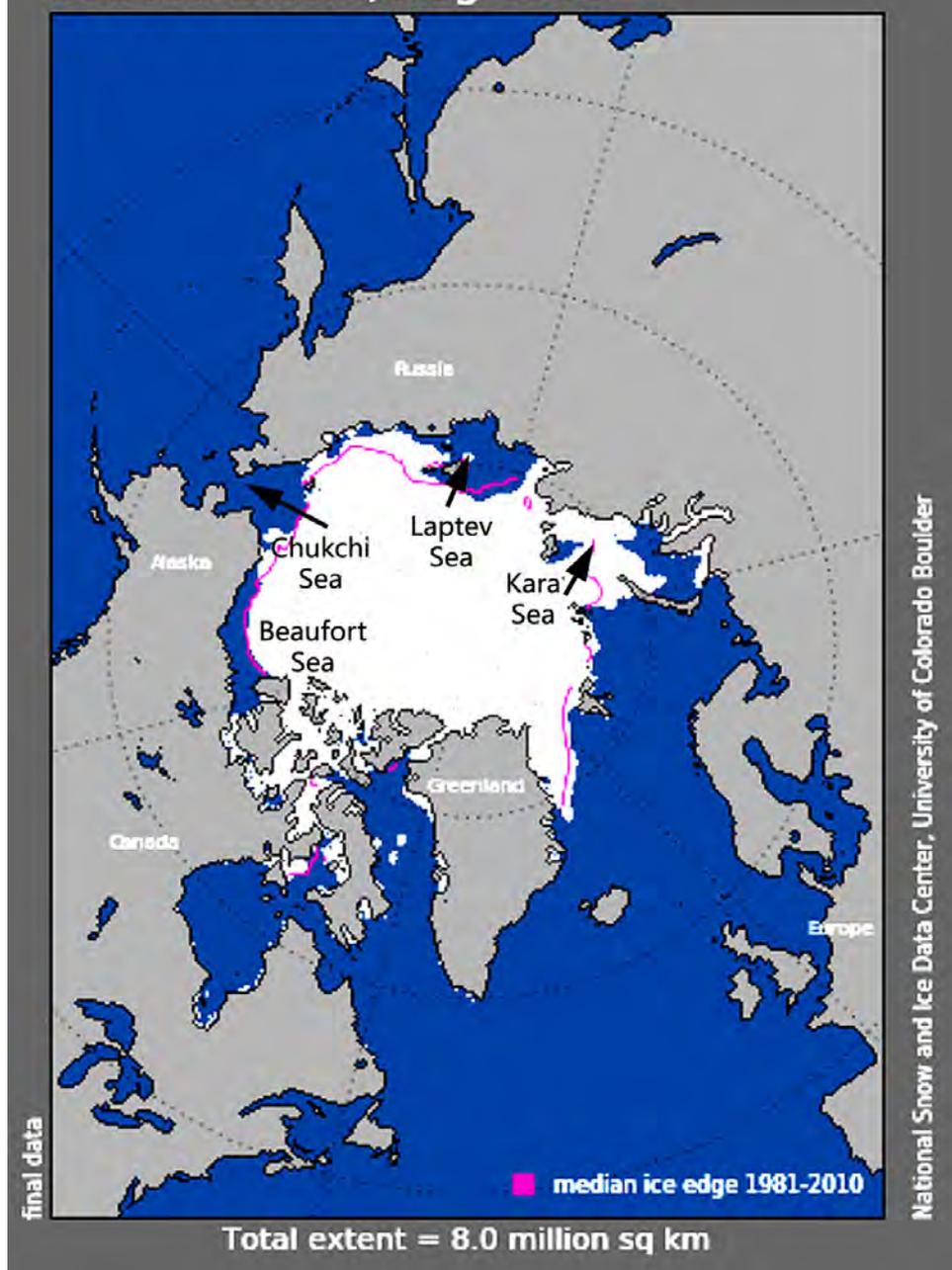


Fig. 6: Sea ice extent in August 1980 (National Snow and Ice Data Centre)

## Sea Ice Extent, Aug 1990

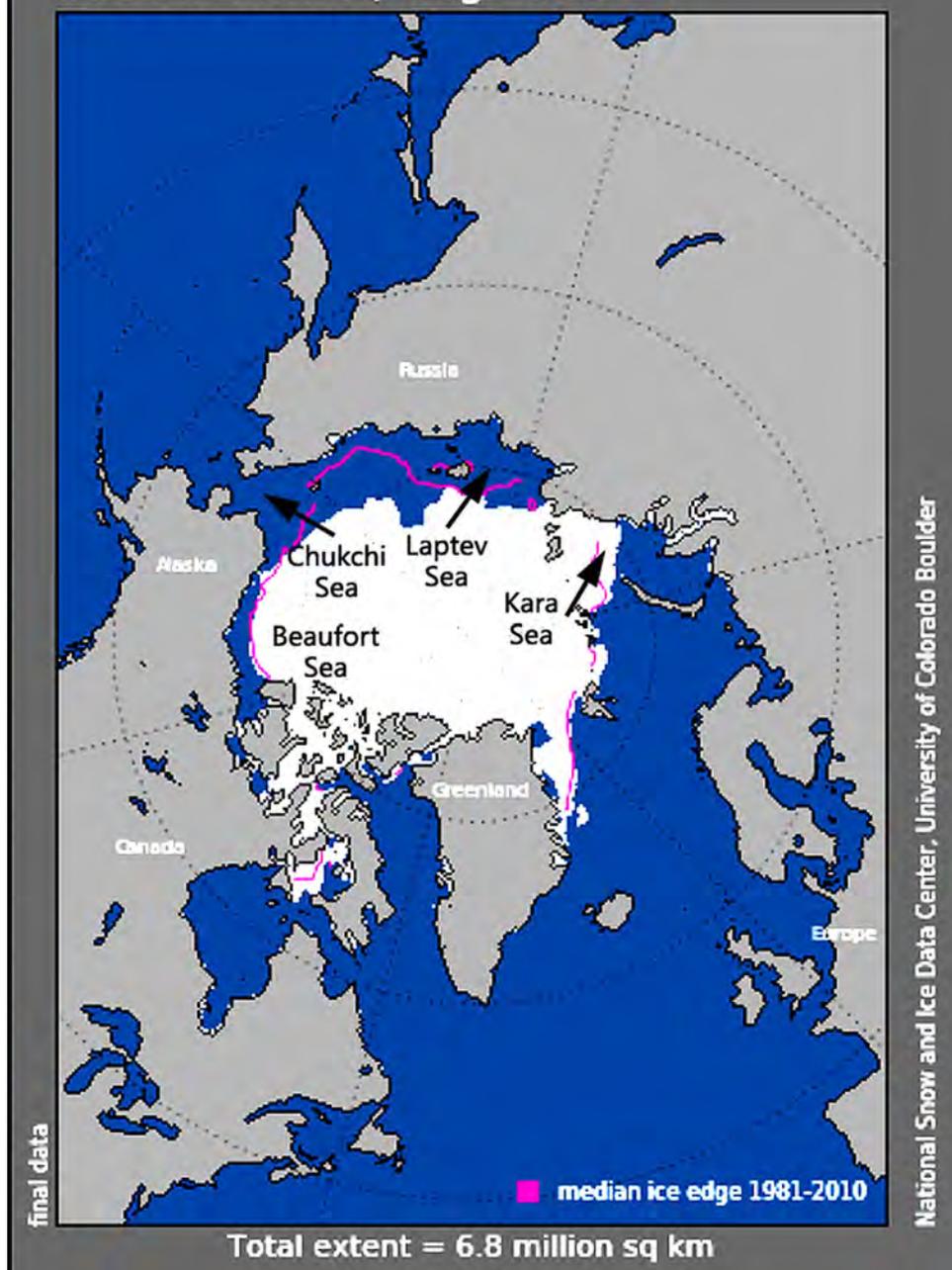


Fig. 7: Sea ice extent in August 1990 (National Snow and Ice Data Centre)

## Sea Ice Extent, Aug 2000

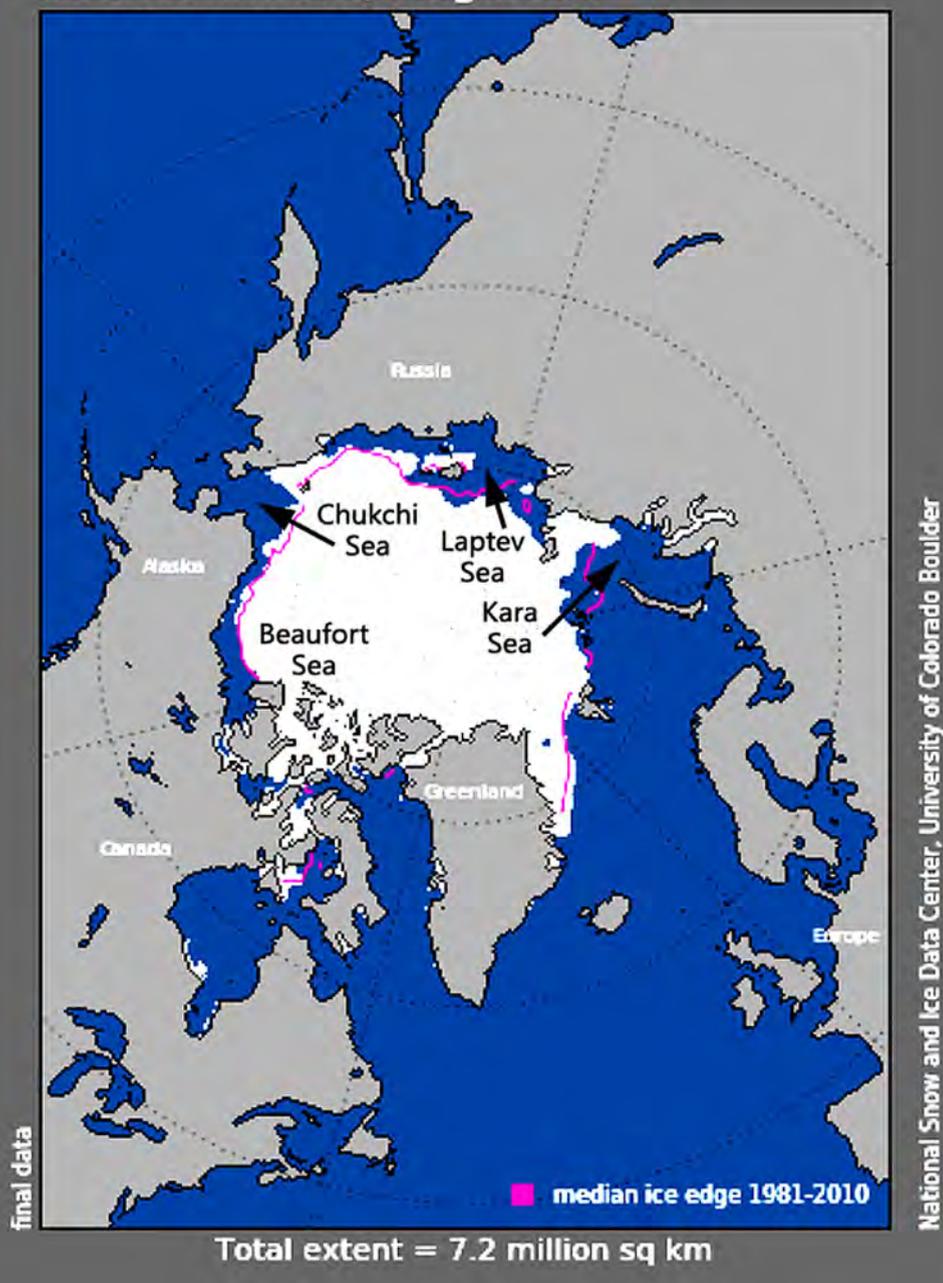


Fig. 8: Sea ice extent in August 2000 (National Snow and Ice Data Centre)

## Sea Ice Extent, Aug 2010

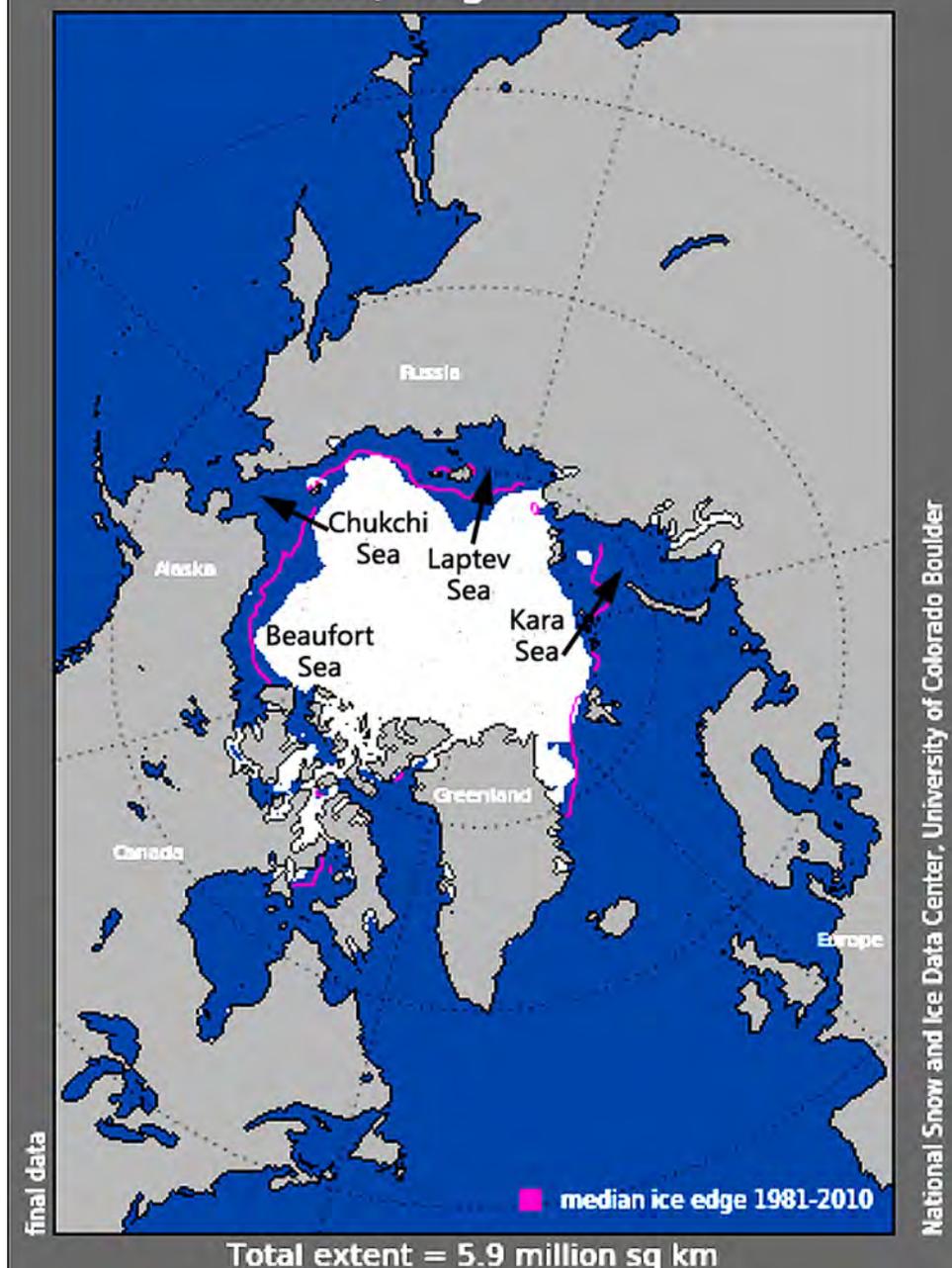


Fig. 9: Sea ice extent in August 2010 (National Snow and Ice Data Centre)

## Sea Ice Extent, Aug 2020

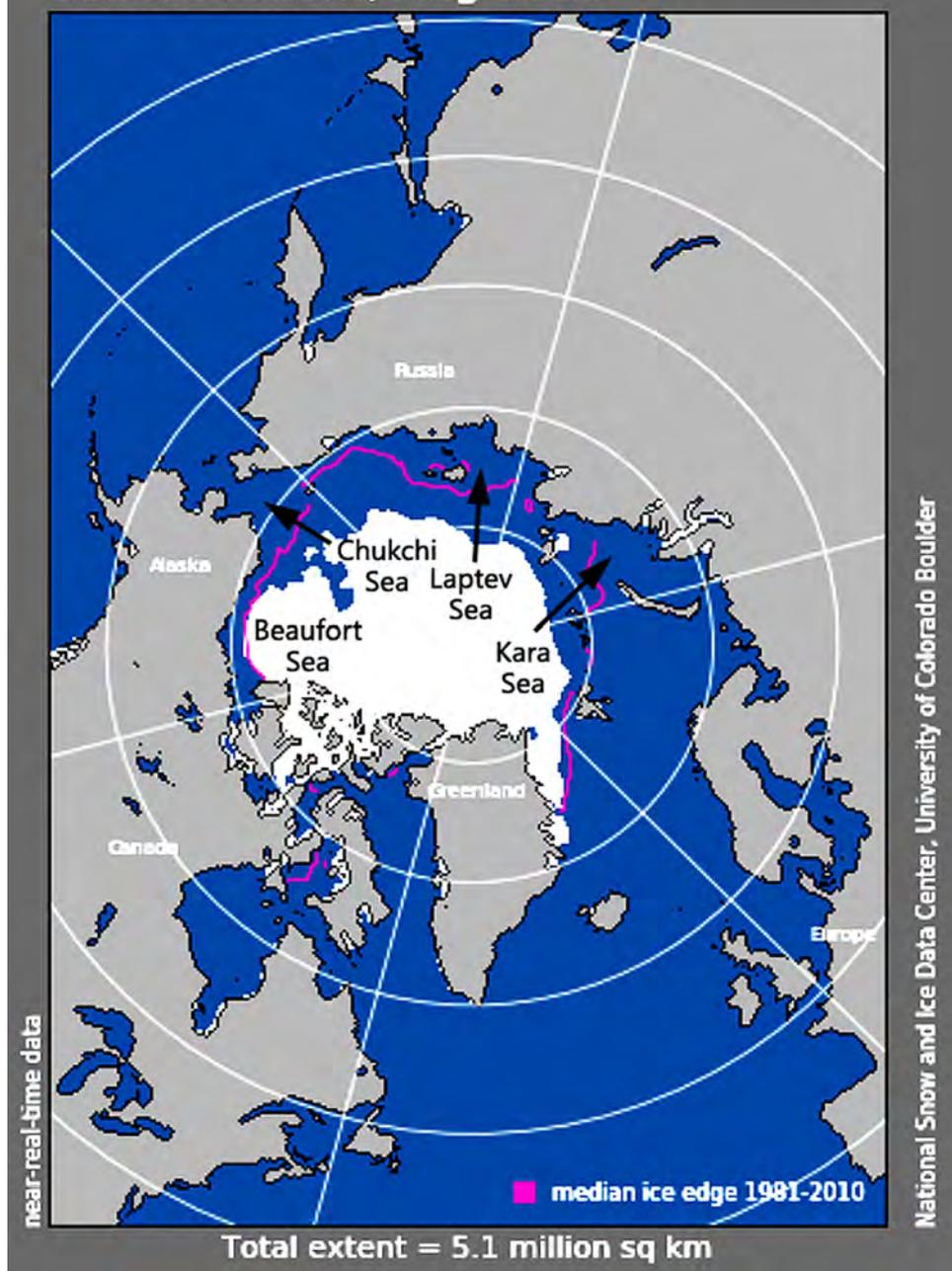
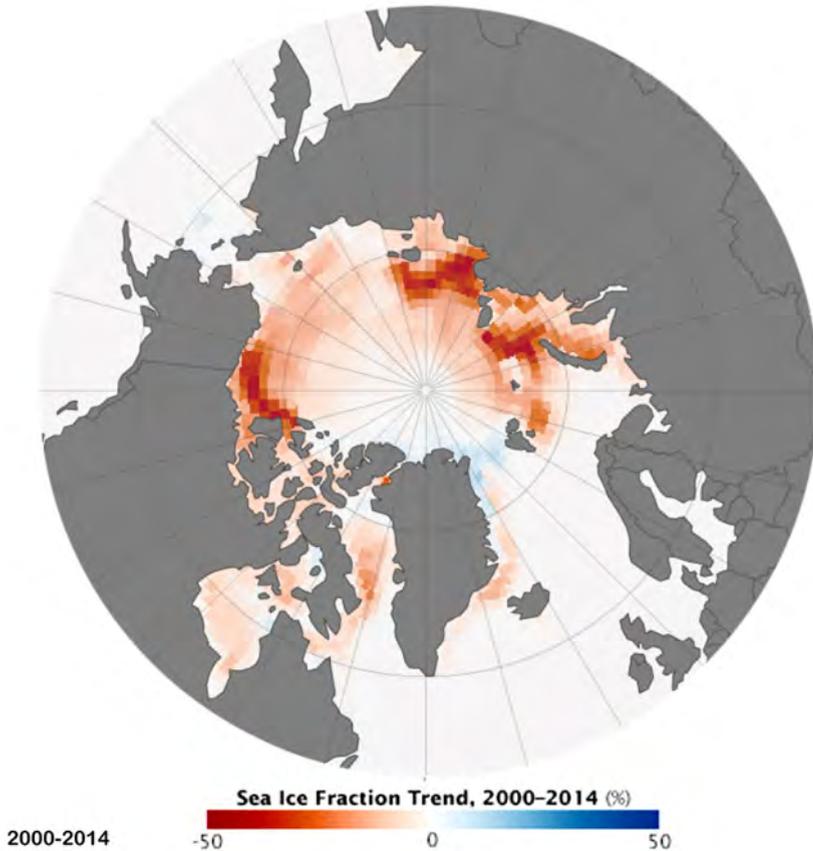


Fig. 10: Sea ice extent in August 2020 (National Snow and Ice Data Centre).

The three areas shaded in the darker red on the map below in figure 11 are the Kara, Laptev, and Beaufort seas.



**Fig. 11:** Map depicting warming from 2000 to 2014. The highest rate of warming is in the Kara, Laptev and Beaufort Seas (NASA Sea Ice Fraction Trend)

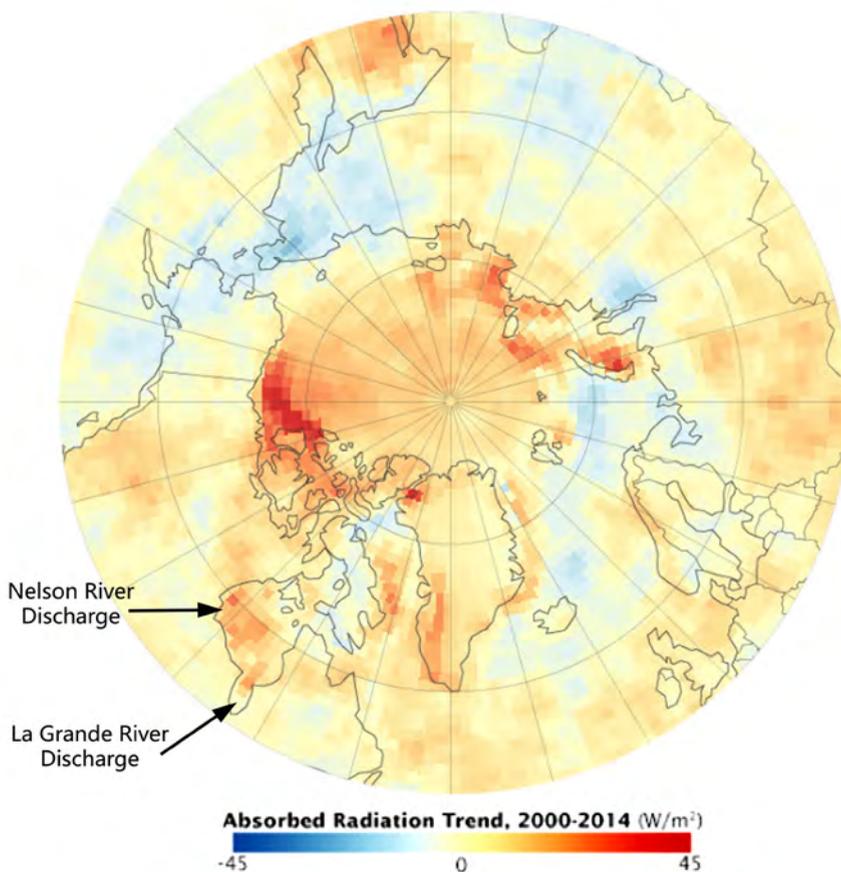
The Ob–Irtys and Yenisei–Angara rivers flow into the Kara Sea; the Lena-Vilyuy rivers flow into the Laptev Sea; and Mackenzie–Peace rivers flow into the Beaufort Sea. Mega reservoir hydroelectric dams engineered for massive impounding capabilities have diverted (stored) the spring run-off on these large Canadian and Siberian rivers and, as I describe in Chapter 8, one of the domino effects of the impounding of these rivers is accelerated warming of the seas they flow into.

This is an extreme loss of energy and physical presence of the natural spring freshet. This vital spring flow is now sacrificed to enable mega reservoir dams to increase river flows for hydroelectric generation in winter.

The resulting reduction in the spring run-off from the construction of these mega reservoir hydro dams has changed both the salinity and temperature balance of the downstream coastal seas. Compounding this diversion of the spring run-off is the amount of water lost to evaporation from these mega reservoirs and warmer river temperatures.

In the 1970s, scientists hypothesized that a diversion of only five percent of the freshwater flow of the Ob and Yenisei Rivers into the Arctic could change the salinity and temperature balance of the Kara Sea and the Arctic. They warned that this could be enough to reduce the polar ice cover and cause Arctic warming, with possible hemispheric ramifications. (Gribbin, 1979)

According to the NASA map in figure 12, portions of these three coastal seas are now experiencing an absorption rate of solar radiation that is five times greater than the rest of the Arctic Ocean.



**Fig. 12.** Map depicting absorption radiation trends between 2000-2014 (NASA)

Please note in figure 12, the red areas in Canada, around James Bay at the mouth of the La Grande River, and in Hudson Bay at the mouth of the Nelson River.

The following is part of the narrative which appeared with the two maps in figures 11 and 12 on the NASA Earth Observatory website:

*“NASA satellite instruments have observed a marked increase in the amount of solar radiation absorbed by the Arctic since the year 2000, a trend that aligns with the steady decrease in Arctic sea ice during the same period.*

*While sea ice is mostly white and reflects sunlight, ocean water is darker and absorbs more of the Sun’s energy. A decline in Arctic albedo (reflectivity) has been a key concern among scientists since summer Arctic sea ice cover began shrinking in recent decades. As more solar energy is absorbed by the ocean, air and icy land masses, it enhances the ongoing warming in the region, which is more pronounced than anywhere else on the planet.*

*The maps above show the net change in solar radiation absorbed by the atmosphere over the Arctic from 2000 to 2014, as well as the net change in sea ice cover over the same period. Shades of red depict areas absorbing more sunlight (fig. 12) and areas with less ice cover (fig. 11). The radiation measurements were made by NASA’S Clouds and the Earth’s Radiant Energy System (CERES) instruments, which fly on multiple satellites. Measurements of sea ice cover were compiled from multiple satellite missions by the National Snow and Ice Data Center. Since the year 2000, the rate at which the Arctic absorbs solar radiation in June, July and August has increased by 5 percent, said Norman Loeb, principal investigator for CERES and a climate scientist at NASA’s Langley Research Center. **While a 5 percent increase might not seem like much, consider that the global rate has remained essentially flat during that same time. No other region on Earth shows a trend of change.***

*When averaged over the entire Arctic Ocean, the increase in absorbed solar radiation is about 10 Watts per square meter. This is equivalent to an extra 10-watt light bulb shining continuously over every 10.76 square feet of Arctic Ocean for the entire summer. Regionally, the increase is even greater, Loeb noted. Areas such as the Beaufort Sea, which has experienced some of the most pronounced decreases in sea-ice coverage, show a 50 watt per square meter increase.*

*As a region, the Arctic is showing more dramatic signs of climate change than any other part of the planet. These include a warming of air temperatures at a rate two to three times greater than the rest of the planet, and the loss of September sea ice extent at a rate of 13 percent per decade.*

*The CERES radiation budget measurements could ultimately become another sign of dramatic climate change, but for now scientists caution that they have obtained just the bare minimum of a data record needed to discern what is happening over the long term. “We need a long time series to detect climate change signals over the internal variability,” said Jennifer Kay, an atmospheric scientist at the Cooperative Institute for Research and Environmental Science at the University of Colorado. “For example, observed sea ice loss over the last 30 years cannot be explained by natural variability alone. Fifteen years is long, but climate is often defined as the average over 30 years, so we are only half-way there with the CERES observations.” (NASA Earth Observatory; emphasis by S. Kasprzak)*