A Friends of Sebago Lake Presentation

- Promoting a discussion of the impacts of Arctic Mega Dams-

A tribute to the late Hans Neu and those who have risked their lives and careers and sacrificed to inform and to warn us about how
Arctic mega dams are driving climate change and devastating marine ecosystems.

Photo by Vadim Makhorov -Sayano-Shushenskaya Dam on Yenesei River Commissioned 1978 Height 794 feet Reservoir 199 Miles long surface area 240 square miles (Source: Wikipedia) . Used for FOMB presentation by permission of Steve Kasprzak, Arctic Blue Deserts

What is a mega dam?

Sayano-Shushenskaya dam on the Yenisei River.
Penstock tubes

Each 636 foot high penstock tube has the capacity to delivery enough water to produce about the same mega watts as all the hydro dams in Maine combined.

Each mega dam in Russia and Canada can produce about 7 to10 times the megawatts as all the dams in Maine.

TABLE VI

Summary of Annual Capacity in MW of Large and Major Reservoir Hydropower Stations and the Water Bodies They Discharge Into

	St. Lawrence	James and Hudson Bay	Labrador Sea	Arctic Ocean	Totals
1930-39					
1940-49	204				204
1950-59	2,047	2,334		662	5,043
1960-69	2,953			5,840	8,793
1970-79	3,363	2,200	5,428	9,840	20,831
1980-89	1,064	10,812			11,876
1990-99	469	6,116		7,300	13,885
2000-09	1,813	507			2,320
2010-19	1,305	829		2,997	5,131
	13,218MW	22,798MW	5,428MW	26,639MW	68,083MW

Courtesy of Arctic Blue Deserts -S.Kasprzak 2021

CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
MARINE SCIENCES BRANCH

MINISTÈRE DE L'ÉNERGIE DE MINES ET DES RESSOURCES
DIRECTION DES SCIENCES DE LA MER

ATLANTIC OCEANOGRAPHIC LABORATORY
BEDFORD INSTITUTE

LABORATOIRE OCEANOGRAPHIQUE DE L'ATLANTIQUE
INSTITUT de BEDFORD

Dartmouth, Nova Scotia
Canada

A STUDY ON MIXING AND CIRCULATION IN THE
ST. LAWRENCE ESTUARY UP TO 1964

by

H. J. A. NEU

DECEMBER 1970

AOL REPORT 1970-9

PROGRAMMED BY
THE CANADIAN COMMITTEE OF OCEANOGRAPHY

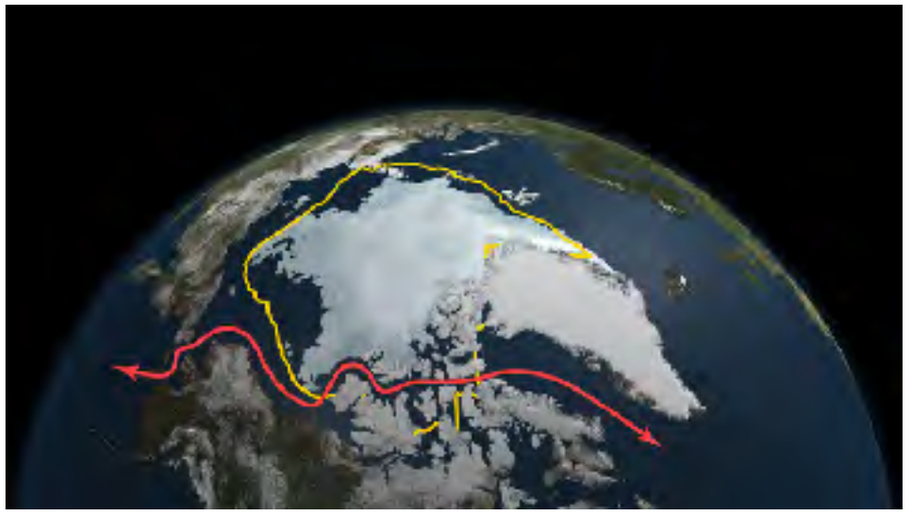
"Houston, we have a problem"

A Study on Mixing and Circulation in the Gulf of St Lawrence Estuary Up to 1964

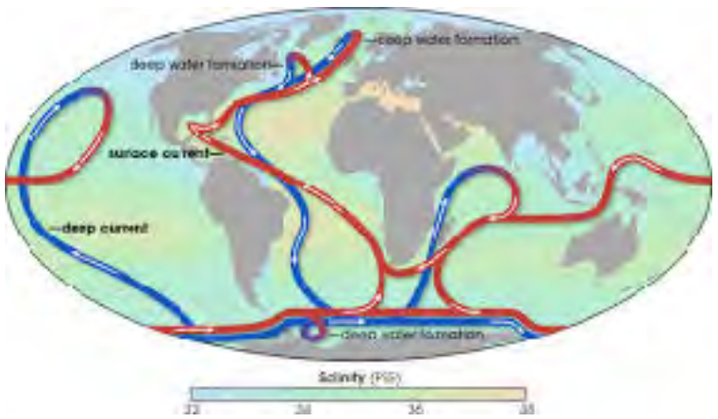
By
Hans J. Neu
December 1970

Abbreviated version of the unpublished 1964 study
Released after Manic 5 -Bourassa Dam was completed on the Manicougan River

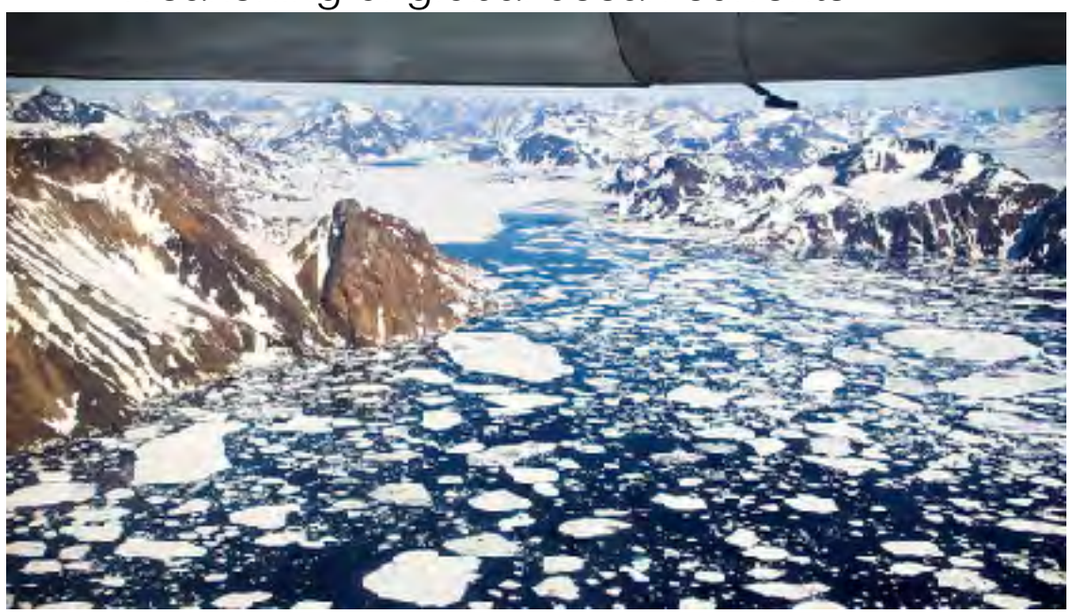
Neu's Early Recognition of Hydropower's Impact Connections



Arctic Sea Ice Disappearance

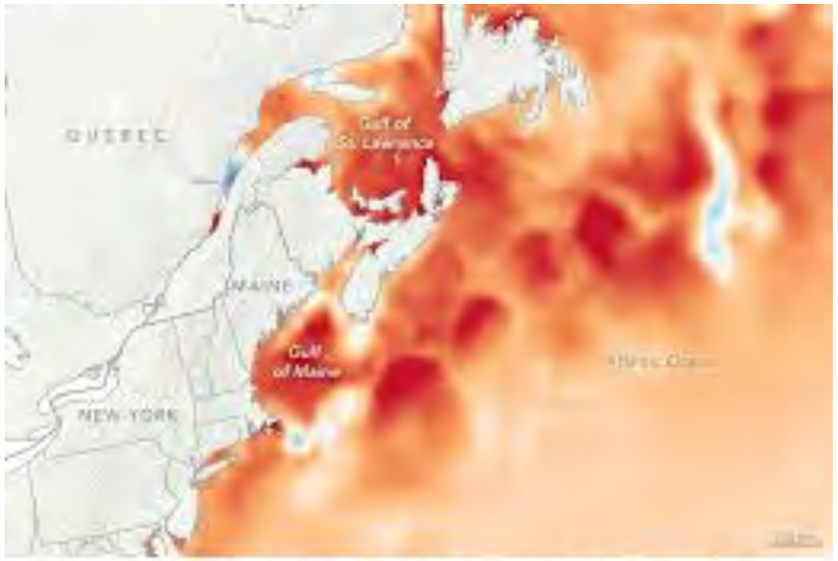


Weakening of global ocean currents



Greenland Glacier Melting

Greenland glacial melting and sea level rise



Warming Coastal Seas

Increasing intensity of weather events

NASA images
map-wikipedia

About Dr. Hans Neu ,

-German born and trained engineer, oceanographer,

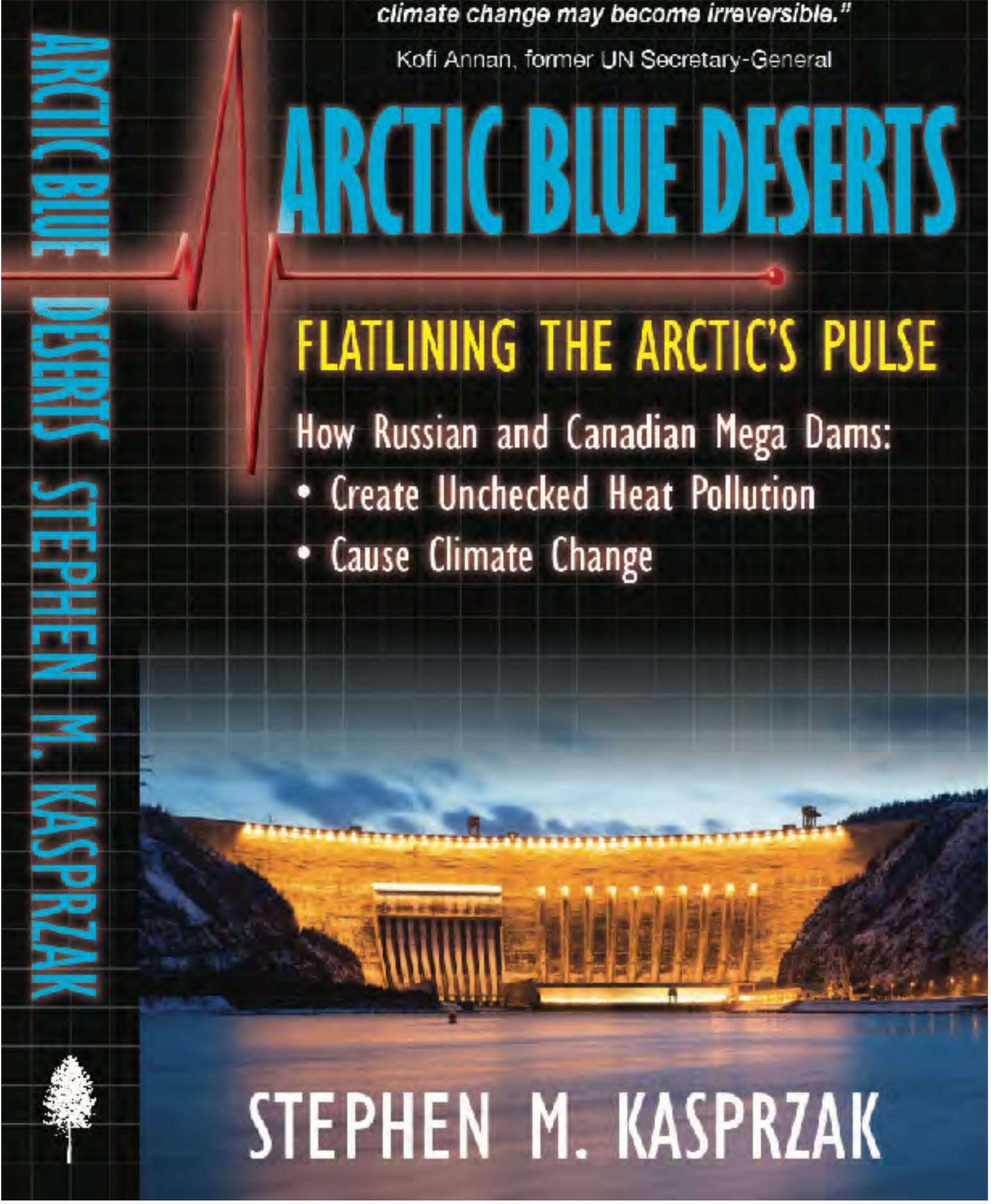
-worked as a mechanical engineer designing dams and processes of small low-head rivers[2].
-immigrated to Canada with his wife after World War II

-With the National Research Council (NRC) of Canada 1955-1964 and then the — Bedford Institute of Oceanography from 1964-1984.

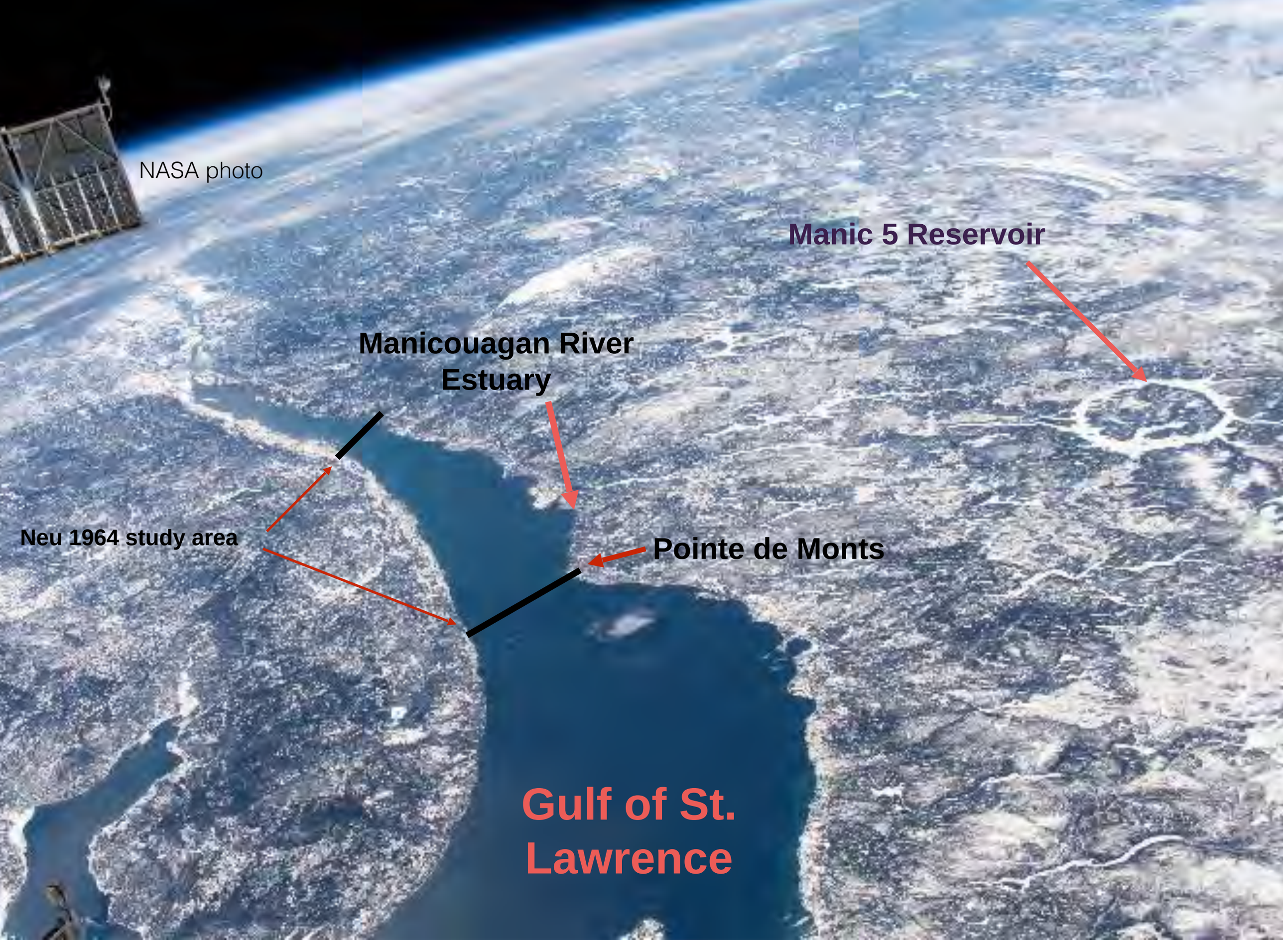
-Neu published three pioneering papers that spoke to his knowledge of large dam and flow regulation impacts : Runoff Regulation for Hydro-Power and its Effect on the Ocean Environment (1976)[10] and Man-Made Storage of Water Resources—A Liability to the Ocean Environment? Part I & II (1982)

-Neu's warnings of hydropower dam impacts were also cited in Silenced Rivers: The Ecology and Politics of Large Dams[12] by Patrick McCully and the subject of numerous Canadian newspaper articles.

https://friendsofsebago.org/history/



Arctic Blue Deserts is a tribute to the late Hans Neu.
Steve Kasprzak, the author, has reinforced the warnings of Neu and provided new information that corroborates his hypothesis and predictions. This book allows us to understand the complexities of oceanographic principles and why Neu became so adamant in his warnings about the rise of the mega dam age.

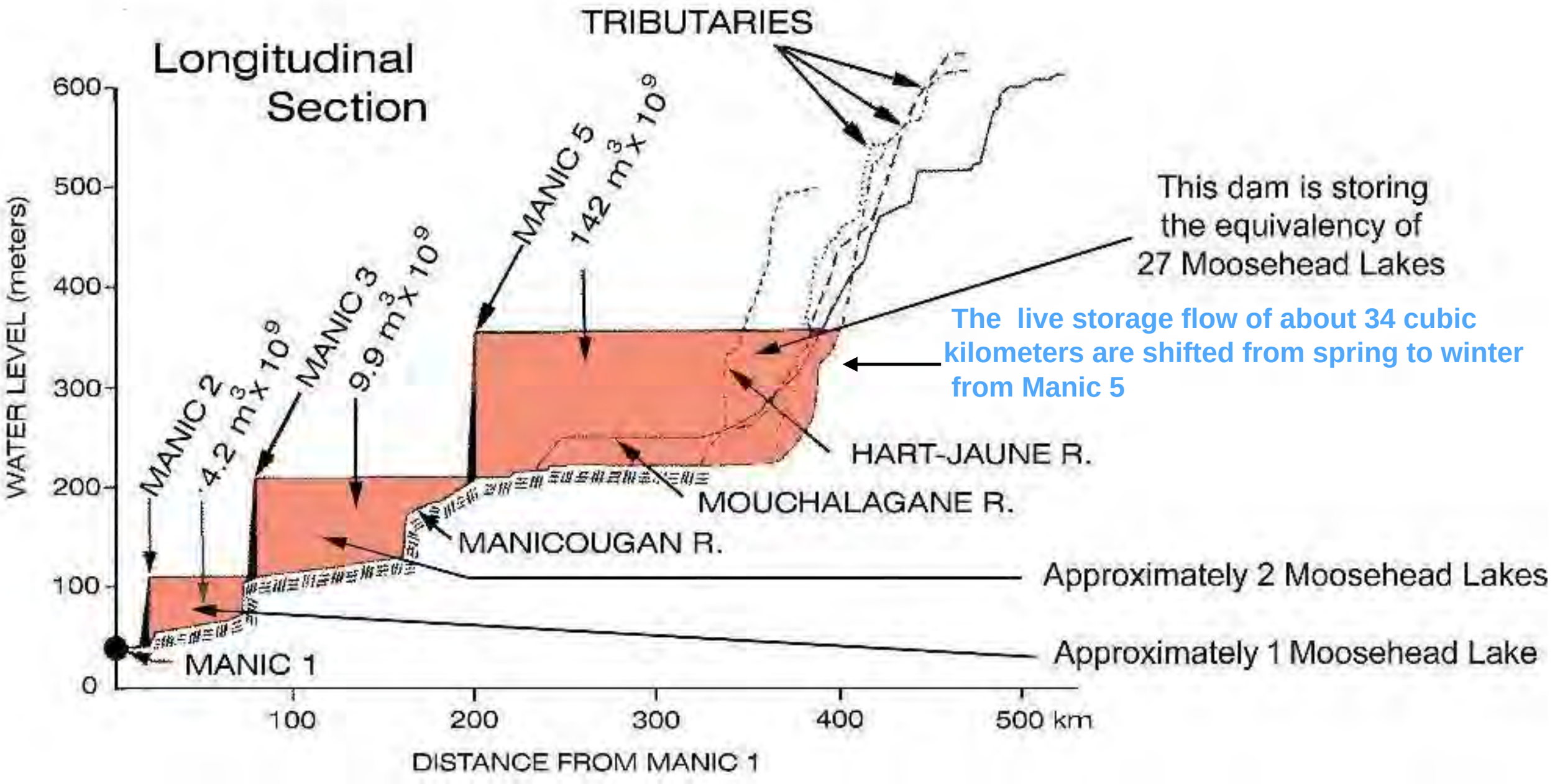

NASA photo
Manic 5 Reservoir
Manicouagan River Estuary
Neu 1964 study area
Pointe de Monts
Gulf of St. Lawrence

Daniel Johnson Dam Manic 5 Manicouagan River -Blue Deserts photo

Manic 5 Reservoir -Wikipedia NASA photo

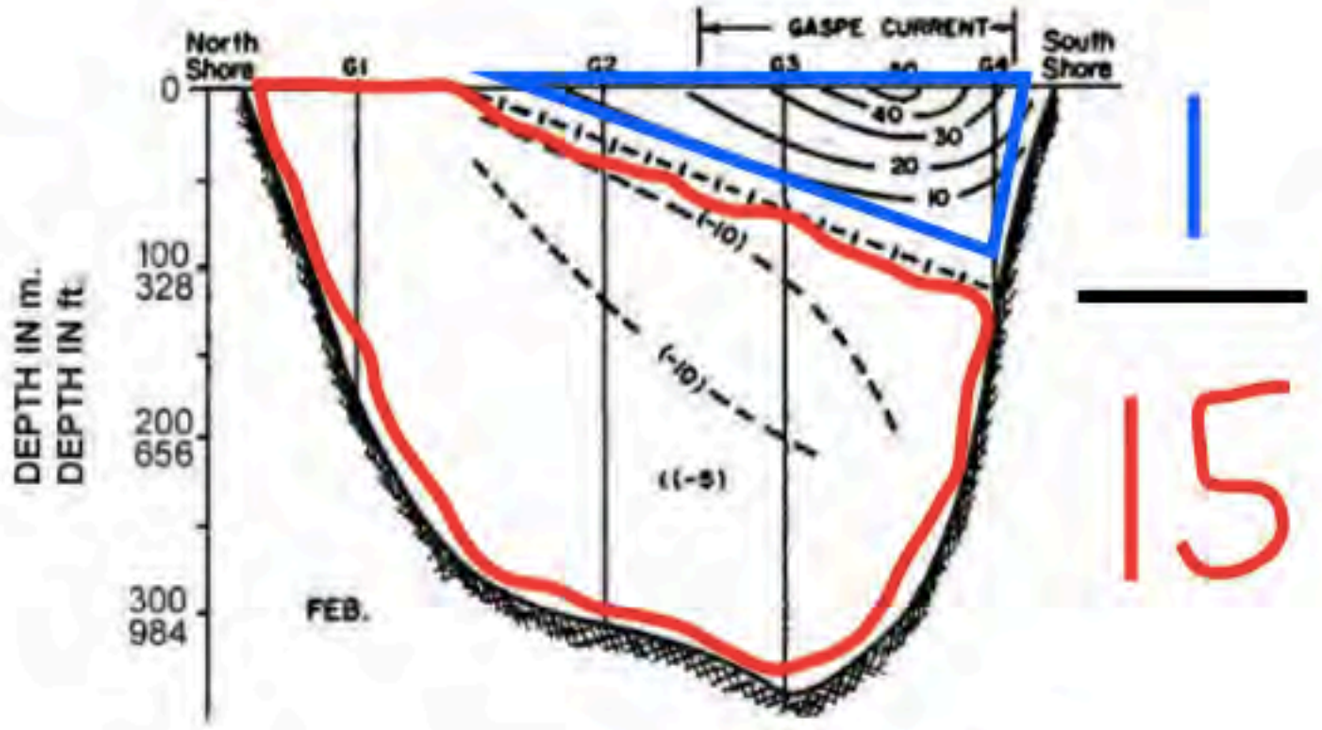
Before the Manicougan dams, in a few days, water could flow from the mountains to the Gulf of St. Lawrence. Now, thanks to dams, the water takes 8 years to fully circulate down the same distance. The thermal regime and chemistry of the freshwater entering the Gulf of St. Lawrence are greatly altered by this stagnation as they are in all mega dam reservoirs.

Manicouagan River 1919 5th rapids of 1st falls - wikipedia



Neu 1970
Enhanced for ABD

Hans Neu 1970- Cross section of St.Lawrence estuary at Pointe de Monts
Salt wedge estuary two way flow



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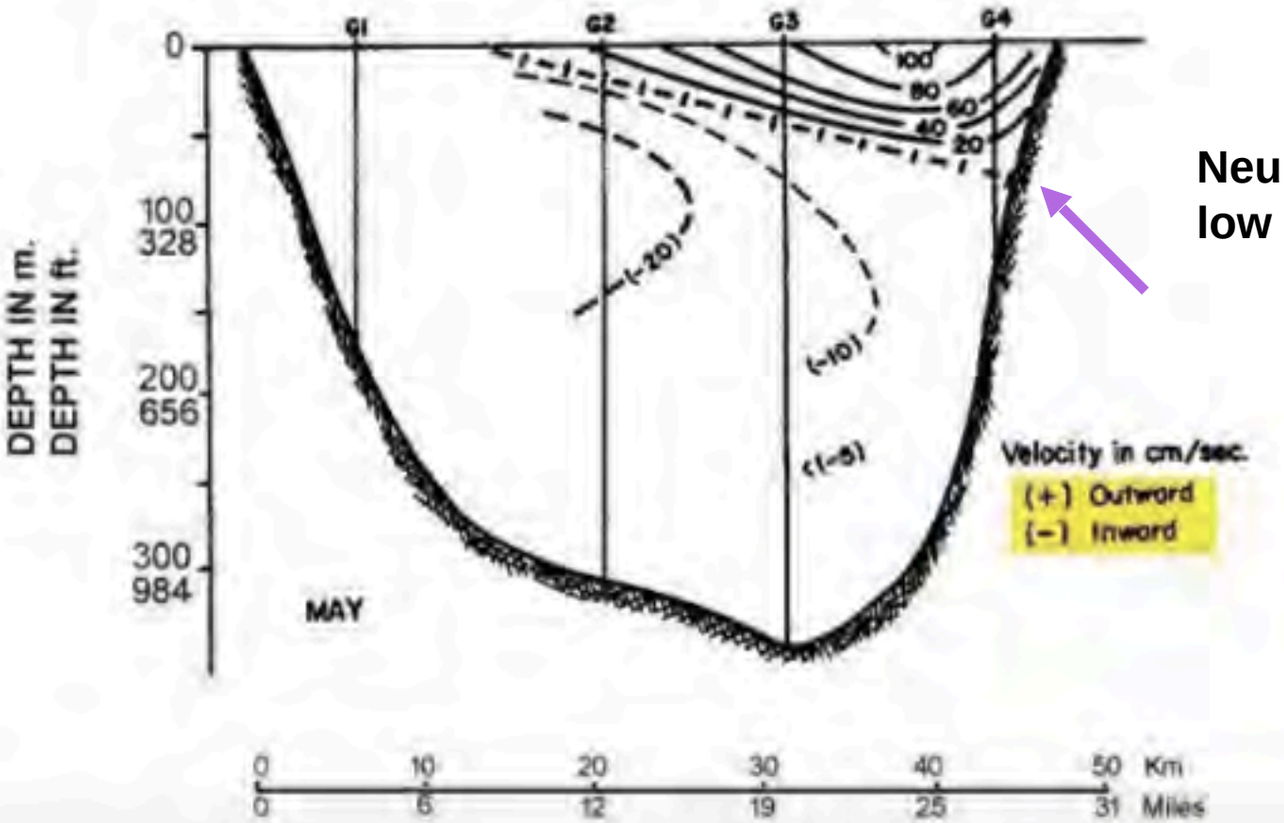


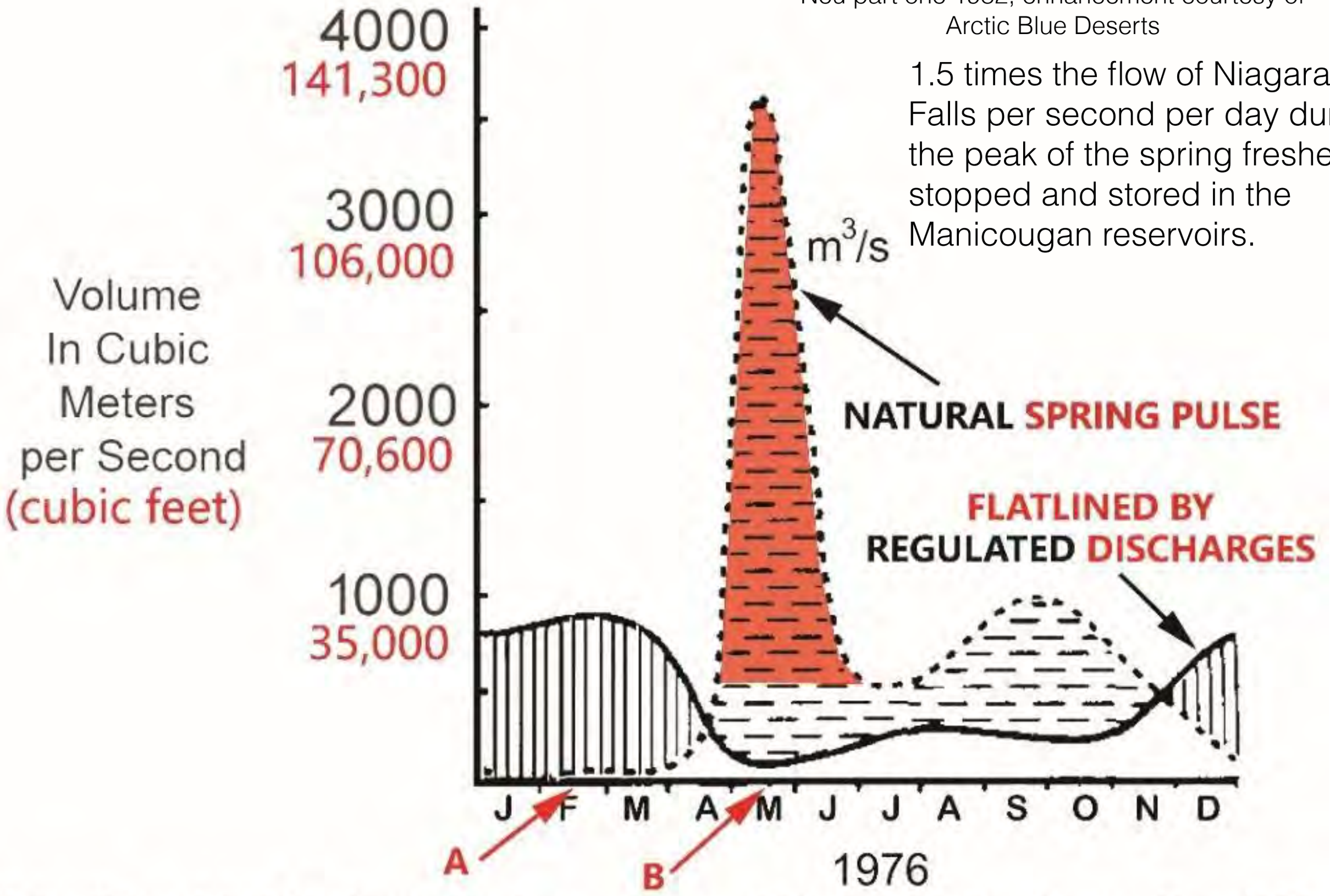
Neu measured the interface of low salinity and high salinity.

Niagara Falls, circa 1931. Average annual flow 85,000 cubic feet per second. Photo from U.S. National Archives and Record Administration via Wikipedia

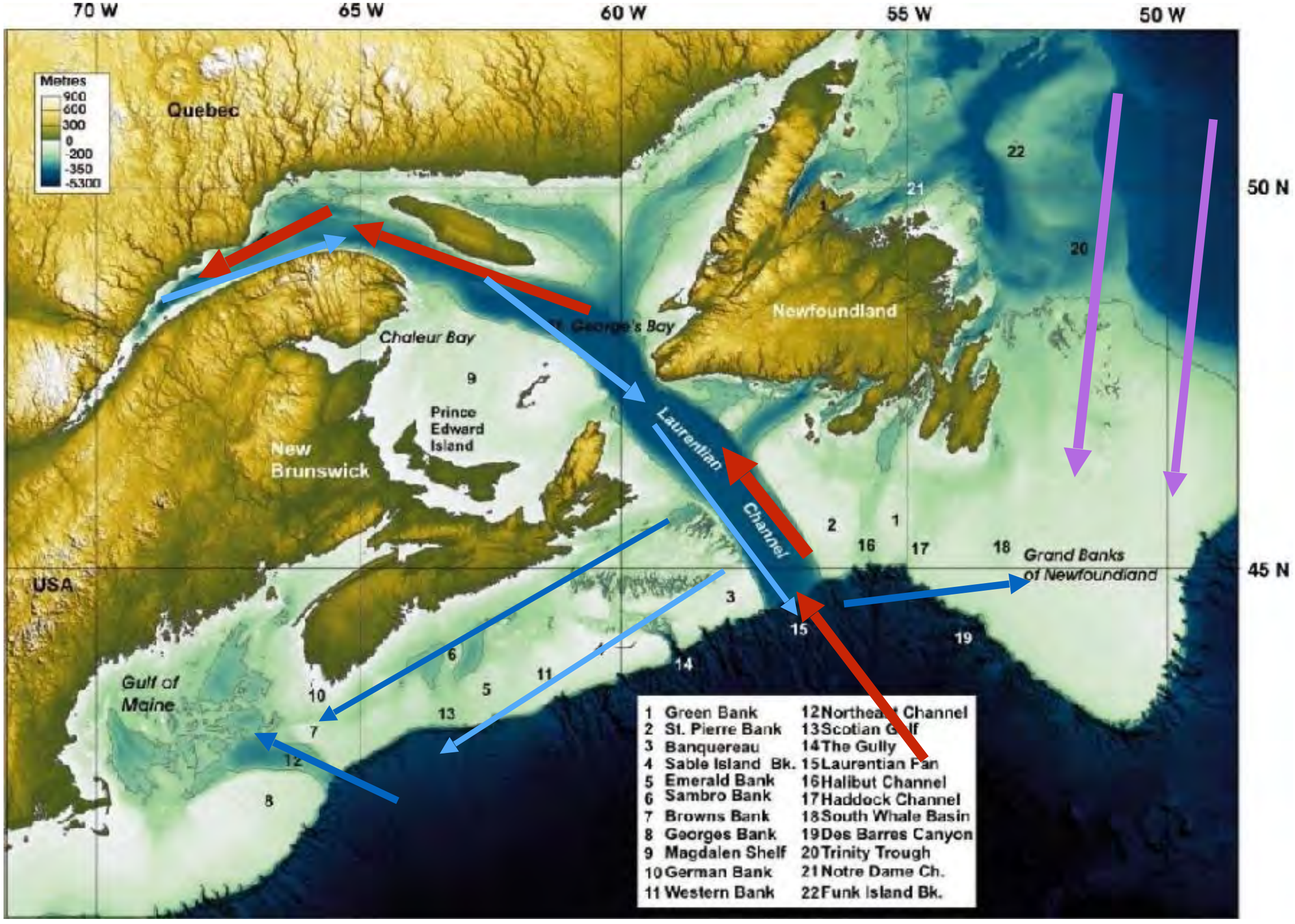
Kennebec River 9,111 cubic feet per second discharge into Merrymeeting Bay

Neu part one 1982, enhancement courtesy of
Arctic Blue Deserts

1.5 times the flow of Niagara Falls per second per day during the peak of the spring freshet is stopped and stored in the Manicougan reservoirs.



Natural/Regulated Discharge Manicougan River at Manic-5 Station Source: Neu, 1982
Emphasis and Words in Red by S. Kasprzak

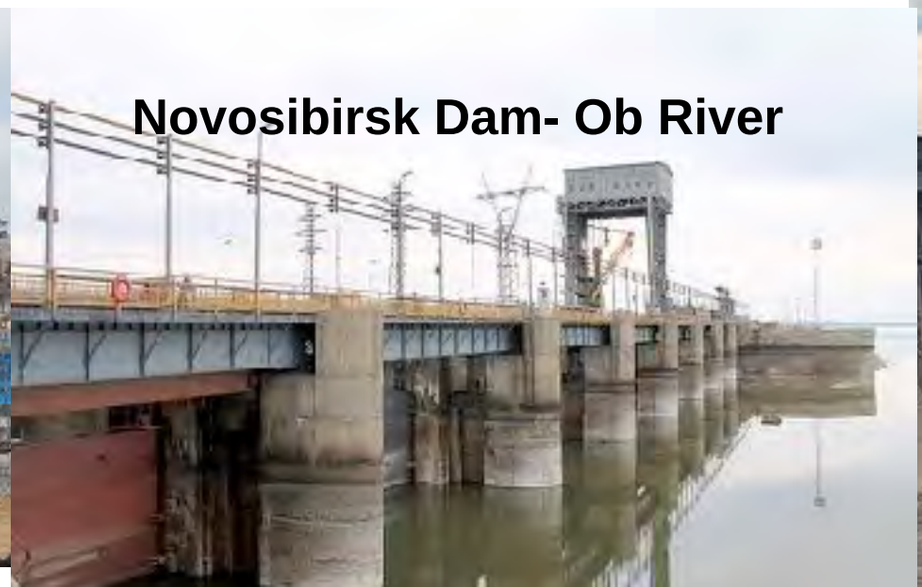


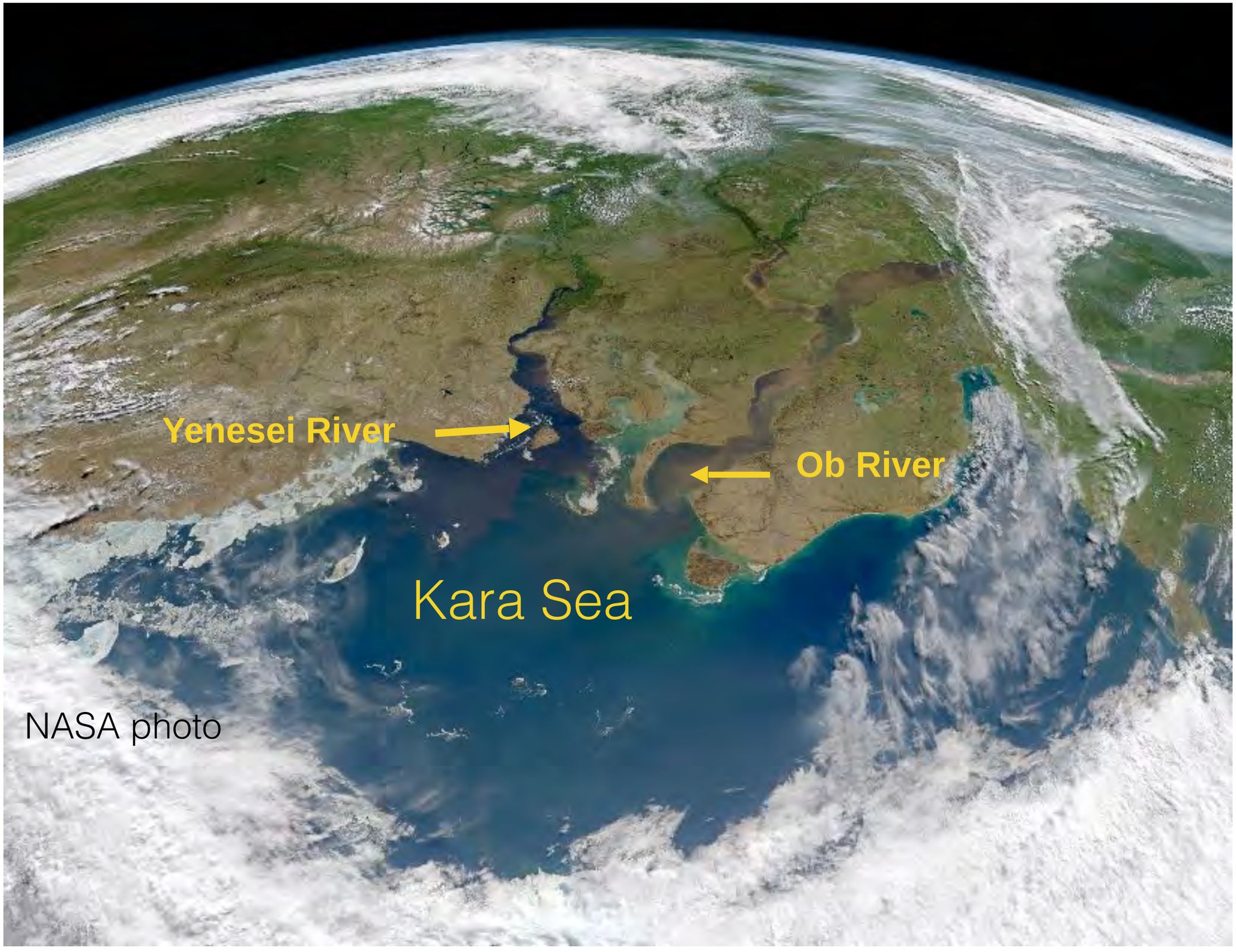
Blue- freshwater outflow.
Red - saltwater inflow
Purple- Labrador Current

<u>Neu calculated a 1 to 15 volume ratio</u>
of freshwater outflow to
saltwater inflow at Point De Monts 1964

Largest Arctic Dams in Russia
<u>Each</u> of these Russian dams produce about 7 to 10 times the megawatts of all the hydro dams in Maine combined

Photo credits-Wikipedia





A Conservative Estimate

The estimated pulse energy and volume of **26 Niagara Falls** flowing for each second of every day for the month of June **never reaches the Kara Sea in the spring** as it once did through geologic Arctic Ocean history

. S.Kasprzak,

ARCTIC BLUE DESERTS

Release of Heat pollution from mega dam reservoirs and flow regulation causes climate change in Central Siberia -

Miami Herald Sept 14, 1975

Huge Man-Made Lakes Warming Up Siberia

By JOHN DORNBERG
Special To The Herald

MUNICH, West Germany — Of Yevgeny Yevtushenko's many poems that often outraged him or got him in trouble with Soviet officialdom, one — "The Bratsk Power Station" — established him beyond doubt as a major contemporary Russian bard.

An epic work of more than 150 pages, it is an ode to one of the engineering marvels of the 20th Century: the hydroelectric plant and dam on the Angara River, north of Irkutsk, built largely by youthful volunteers.

The poem expresses — and the dam represents — what Yevtushenko's Pravda, the diary of the Communist Youth League, recently described as the "aggressive attitude toward nature" of young Russians.

THEY WERE taught, the paper said, "to struggle with nature, to tame and transform it."

Ten years after the completion of the Bratsk power station, with its annual output of more than 28 billion kilowatt hours of electricity, the evidence is mounting that perhaps they tamed and transformed it just a little too much.

The Bratsk dam and others like it along the Angara have warmed up Central Siberia by at least 10 degrees in the past 10 years.

The climatic changes have yet to be accurately researched and their environmental impact has only been hinted at, but Siberians, who take considerable pride in their cold, are expressing concern.

"WE USED to have winter temperatures as low as minus 67 degrees around here," an official of the city of Bratsk told a Western visitor recently. "Now it's a rare day on which the thermometer drops to 40 below zero."

A party official for Irkutsk Oblast, a region of 286,000 square miles — bigger than Texas — recently estimated that average winter temperatures in the province are now from six to 10 degrees higher than they were before completion of the dam and the vast 300-mile-long, 15-million-acre lake that has formed behind it.

In a region where there are not

> **"We used to have winter temperatures as low as minus 67 degrees around here. Now it's a rare day on which the thermometer drops to 40 below zero."**
>
> —An official of a Siberian city

14 frost-free days a year, even a two to three-degree rise in the average winter temperature could have highly beneficial effects, especially on agriculture. Were such an increase in pruning the annual vegetation period by only a few days it would be regarded as a tremendous gain.

BUT ON THE other hand, there are potential ecological disadvantages, the scope of which cannot yet be foreseen.

"The climate has certainly gotten a lot worse," the official in Bratsk admitted. "When it was colder, it was at least very dry and you didn't mind the cold. But since we've had the dam it has become very humid. And we also get a lot of wind now because we've cut so much timber to supply our big cellulose plant."

Climatologically, the explanation for the change is relatively simple.

Large land masses tend to warm up and cool off more slowly than large bodies of water. On a huge continental plateau such as Siberia, this results in relative climatic stability as well as in vast differences of temperature between summer and winter.

THE WEATHER OF coastal regions, on the other hand, is influenced primarily by the evaporation of huge masses of water from the oceans.

In effect, what the Russians have done in their drive to industrialize Siberia and exploit its enormous wealth of raw materials, is to create inland oceans which account for more humidity, more rain, less seasonal fluctuation in temperature and more frequent change in the weather.

Indeed, Siberians proudly call their lakes — both the natural and the man-made ones — "seas."

The 2200 square mile "sea" that has built up behind the Bratsk hydroelectric station is but one of four such man-made reservoirs along the Angara. Between them the four hydroelectric dams along the river produce 69 billion kilowatt hours of electricity annually.

WHATEVER THEIR feelings about it, however, and regardless of the potential ecological impact, Siberians are going to have to accustom themselves to Siberia getting warmer and warmer.

The Angara is the major tributary to the Yenisei River, and compared to the projects planned, under construction, or already completed along the Yenisei, the Angara systems will seem like ponds.

The recently completed dam at Krasnoyarsk, which houses what is currently the world's largest hydroelectric plant, already holds back the Yenisei in a lake half as large as the one at Bratsk. Three more power dams, two of them with an even greater capacity than Krasnoyarsk, are under construction or planned along the river.

BUT EVEN THE Yenisei systems will be eclipsed if Moscow pushes ahead with its plans for the Ob-Irtysh and the Lena.

Like the Angara, the Lena rises in Lake Baikal, but instead of westward, flows 2,600 miles northeast through Yakutia to the Arctic Ocean.

Soviet plans call for damming it up just north of the Arctic Circle for a single power station large enough to supply the annual electricity needs of the state of New York. The body of water that will form behind the dam could reach proportions close to those of Lake Erie.

The impact on climate cannot be foretold, but is certain to be infinitely greater than in Irkutsk Province.

AN EVEN more massive climatic impact will result if the U.S.S.R. pushes ahead with its scheme for damming up the Ob-Irtysh just above its estuary on the Arctic Ocean and diverting its waters south, through an intricate system of canals, into the Aral and Caspian seas.

From the Kremlin's viewpoint, the massive redistribution of water would have many benefits. It would facilitate Leonid Brezhnev's grandiose new virgin lands program by irrigating some 75,000 square miles of arid territory in Kazakhstan and Central Asia, help drain marshy Western Siberia, and slow the rate at which the levels of the Aral and Caspian are dropping.

An initial step was completed in 1972 with the 250-mile long canal that diverts water from the Irtysh to Karaganda, the metallurgical hub of Kazakhstan.

BUT THE scheme is fraught with ecological imponderables.

Some Western experts predict it would result in melting of the arctic ice cap and northward movement of climatic zones. Others predict the opposite effect: an extension of the polar cap and a decline in European and North American rainfall.

According to the most alarming prognosis, there would be a shift in global weight from the pole toward the equator, slowing down rotation and increasing the wobble of the earth on its axis.

Soviet experts tend to discount such fears and speak growingly, instead of more caviar from the Caspian and wine from the deserts of Central Asia. And if Siberia gets warmer, so what? Maybe that will attract more people to develop it.

But as one Siberian told a Western visitor recently: "Slushy winters and rainy summers are not what I came here for. Forty degrees below I could have in Moscow, too."

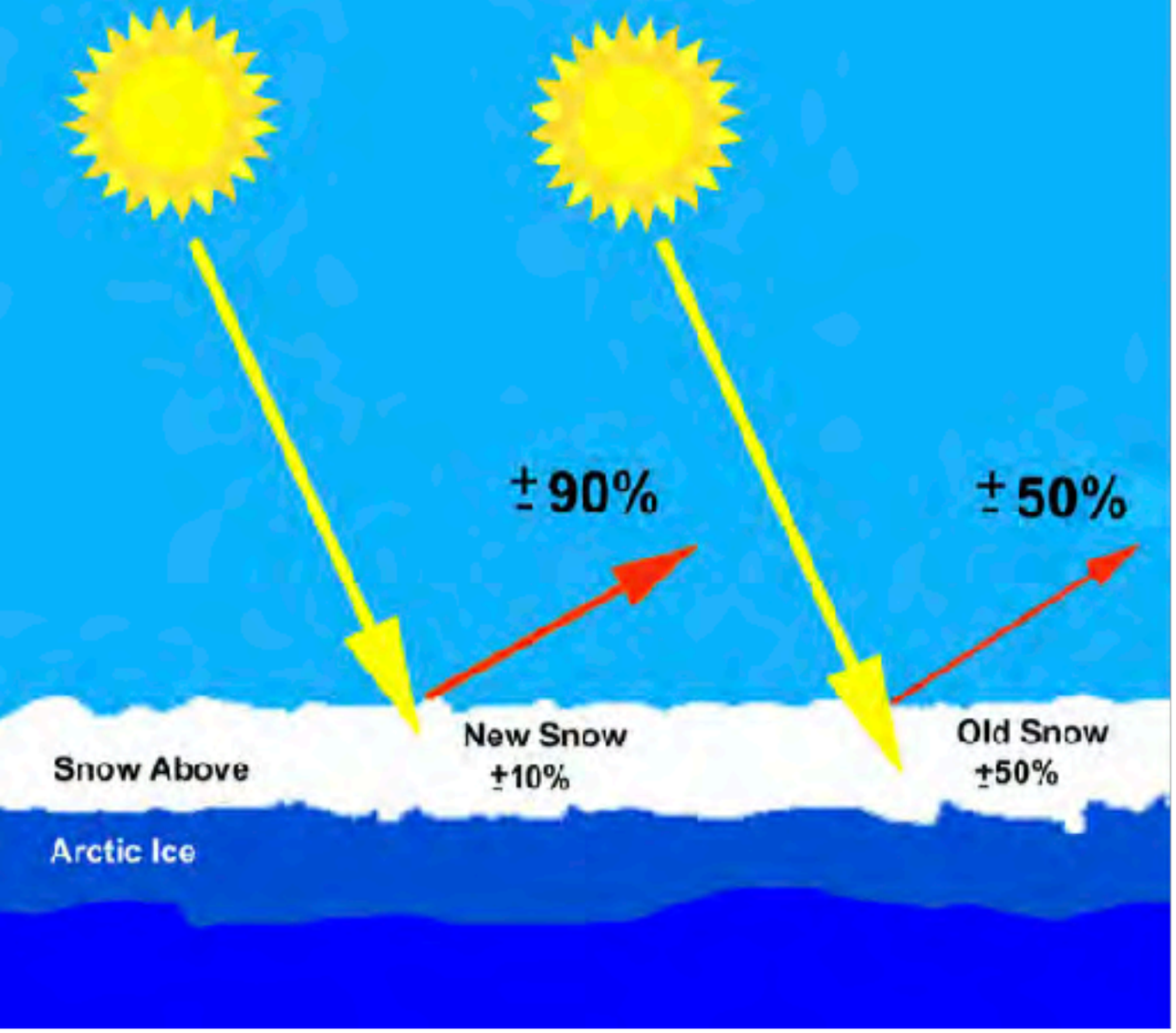
Miami Herald September 14, 1975

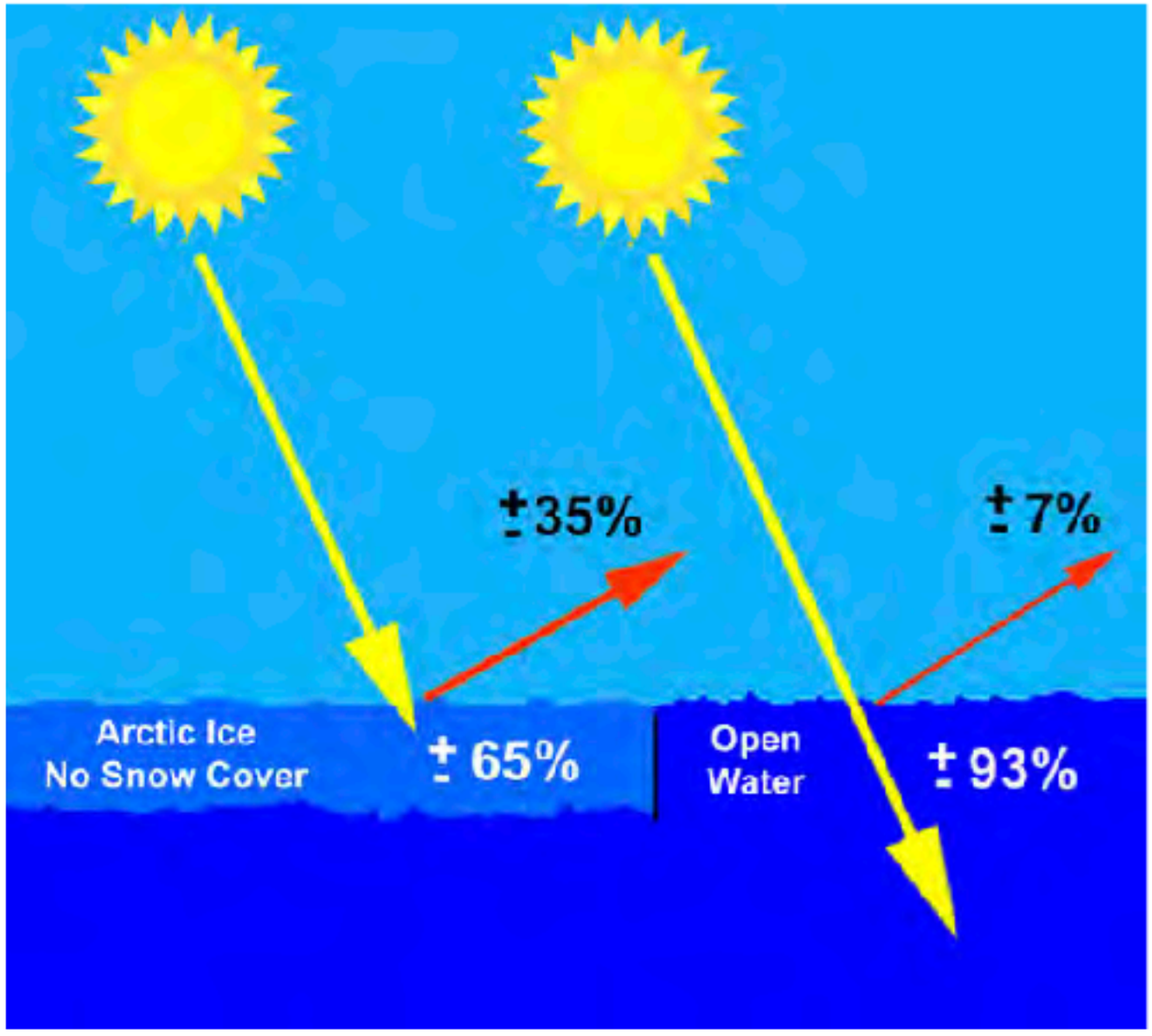
"We used to have winter temperatures as low as minus 67 degrees around here. Now, it's a rare day on which the thermometer drops to 40 below zero" - An official of a Siberian City

"In effect, what the Russians have done in their drive to industrialize Siberia and exploit its enormous wealth of raw materials, is to create inland oceans which account for more humidity, more rain, less seasonal fluctuation in temperatures and more frequent change in the weather."

"Whatever their feelings about it, however and regardless of the potential ecological impact, Siberians are going to have to accustom themselves to Siberia getting warmer and warmer."

" A Party official for Irkutsk Oblast, a region of 296,000 square miles-bigger than Texas- recently estimated that average winter temperatures in the province are now from six to 10 degrees higher than they were before completion of the dam and the vast 360 miles long 1.4 million acre lake that has formed behind it."





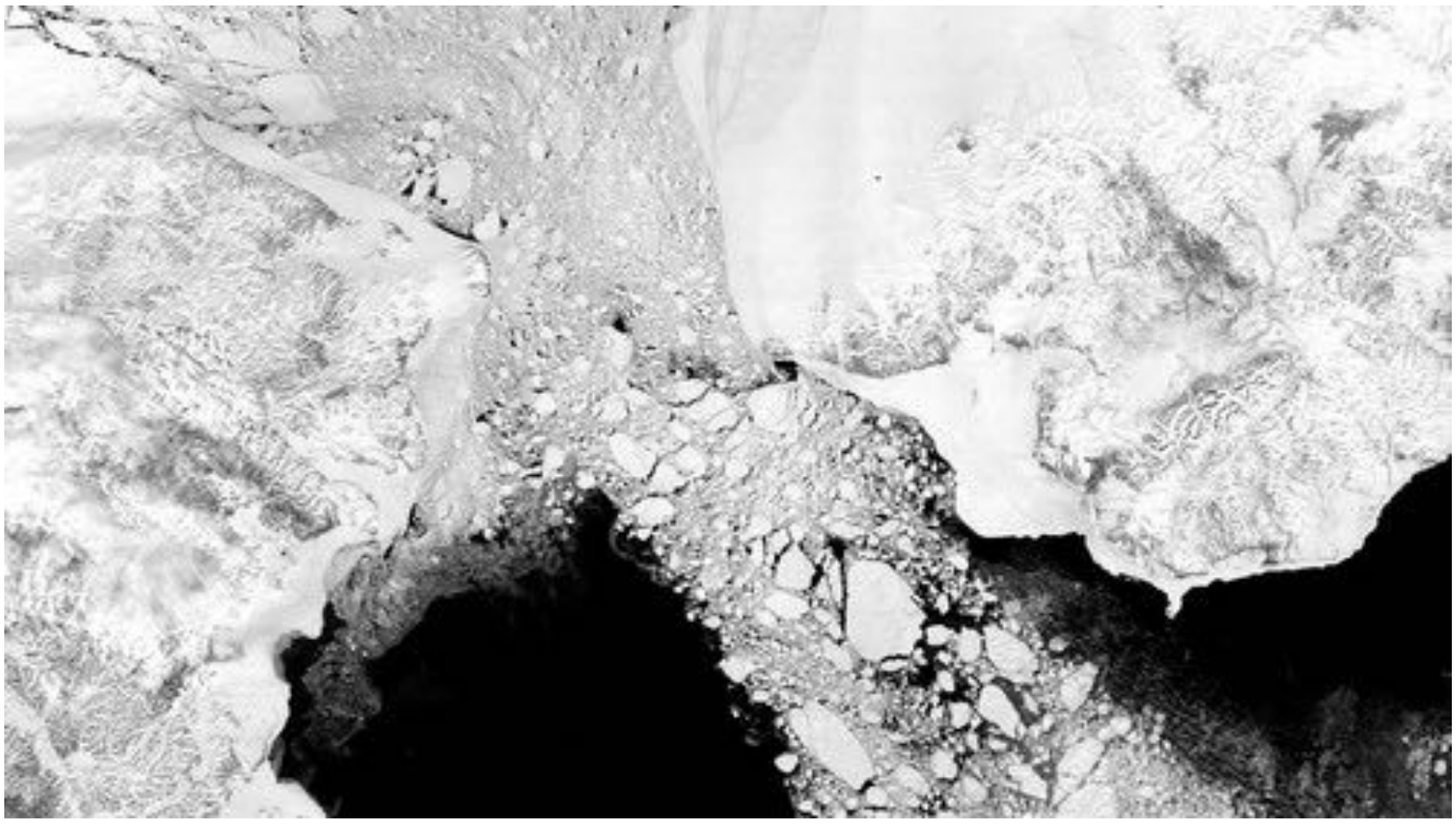
Albedo- Reflectivity of Sunlight

Comparison of Snow, Ice, and Open Water Albedo

Source: Robert Georgitis, Arctic Blue Deserts

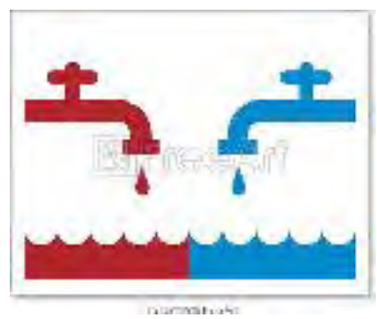
Peter Borisov - Russian Geographer

“The ocean is, of all the natural surfaces of the Earth, the best absorber of solar radiation. But the same surface in another state (ice and snow) is the best reflector. Although the temperature range on the surface of the ocean and the ground layer of the atmosphere is small, the water changes its state quite often and fast within this small range. This changeability sharply affects the climate.” P. Borisov *Can man change the climate* 1973 p67

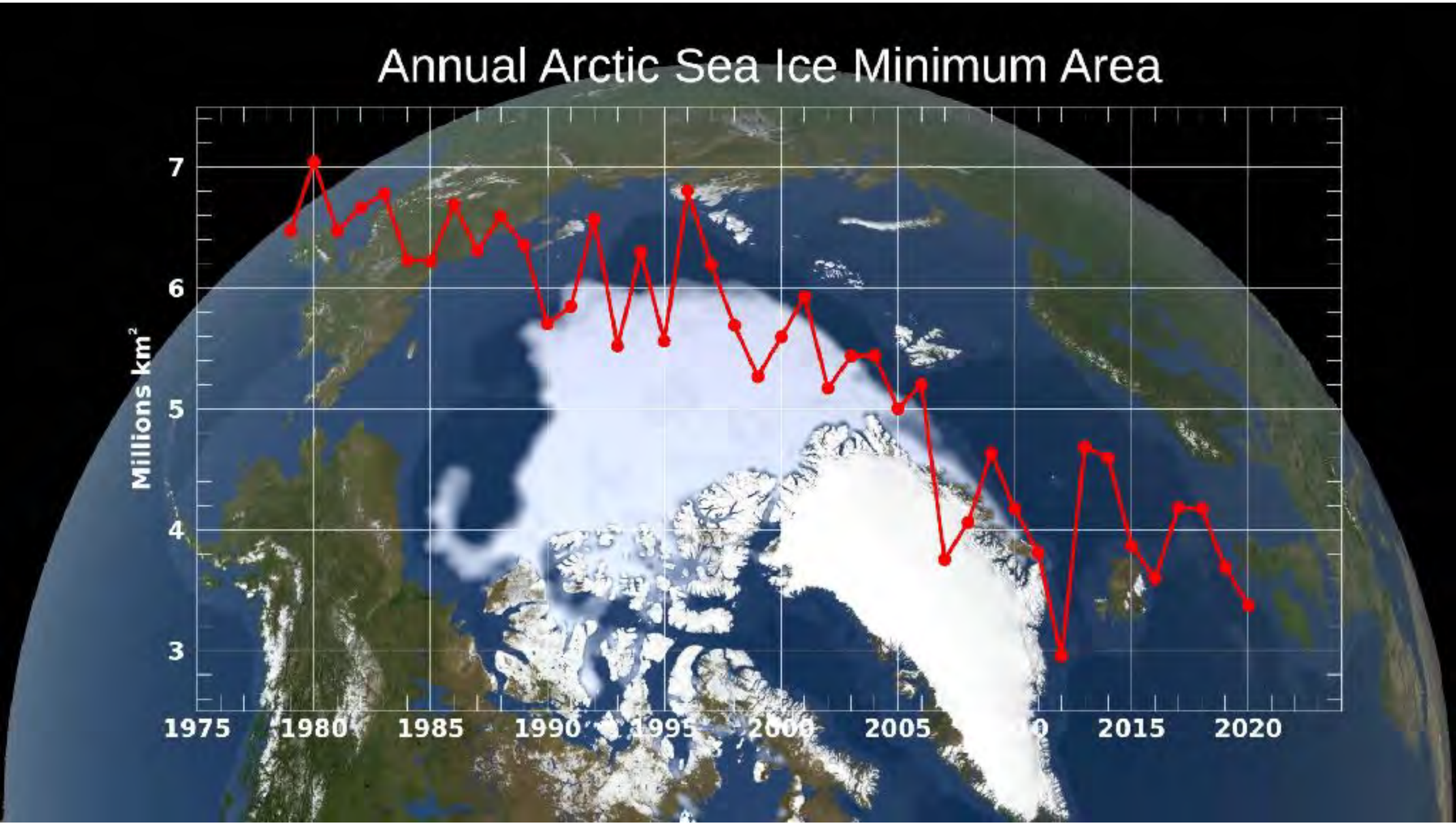


Bering Sea clogged with ice NASA GFSC

“Lastly, the north of the Atlantic Basin may be compared to a bathtub into which cold water is poured from two taps (the Labrador and East Greenland currents) and warm water (the Gulf Stream) though one. By regulating the taps we can change the thermal balance of the Atlantic and with it the climate of the surrounding continents. The recognition of the important role of the ocean currents in forming the climate has determined regional improvements of the climatic regime since the end of the last century by changing the direction of the warm and cold currents. At the same time we have devised to regulate and transfer the river run-off……” p76



WHOI -Cooke map



https://climate.nasa.gov/interactives/global-ice-viewer/#/3

Growing Earth Energy Imbalance in the Arctic

Climate is controlled by how much solar energy is absorbed by the earth and how much heat is lost to outer space by heat infrared longwave radiation. There is a growing Earth Energy Imbalance or EEI.

Satellite and Ocean Data Reveal Marked Increase in Earth's Heating Rate
June 15, 2021, NASA and NOAA geophysical research letter, Norman Loeb et. al. EEI is due to *"decreased reflection of energy back into space by clouds and sea ice and increases in well-mixed greenhouse gases and water vapor."*

Arctic is Absorbing More Sunlight, *Patrick Lynch, NASA Earth Observatory website, December 19, 2014.*

"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."* **-Key factors mentioned in report - more clouds, loss of albedo, more water vapor-**

“That imbalance roughly doubled between 2005 and 2019, the study found. “It is a massive amount of energy,” said Gregory Johnson, an oceanographer for NOAA’s Pacific Marine Environmental Laboratory and co-author of the study. Johnson said the energy increase is equivalent to four detonations per second of the atomic bomb dropped on Hiroshima, or every person on Earth using 20 electric tea kettles at once. “It’s such a hard number to get your mind around.”
Washington Post, Earth is now trapping an unprecedented amount of heat, Nasa says. by Tik Root June 21, 2021




Mega dams and their impact on the marine biosphere

"It has been estimated that under present conditions the **spring and summer runoff at the entrance to the Gulf of St. Lawrence has been reduced by between one third and one half.** This drastic alteration of the natural runoff has caused significant changes in the physics and dynamics of the waters of the Estuary, Gulf, and adjacent coastal region. **It is argued that such modifications produce a profound impact on the biological balance of the whole ecosystem, as well as changes in the seasonal heat budget.**" *Neu 1976*

"Of particular concern is the increased development of hydro-power-under construction or in the design stage-in Labrador, Ungava Bay, James Bay and Hudson Bay, which are bound to threaten the productivity of the Grand Banks of Newfoundland." *Neu 1982*

Bourassa Dam Reservoir
-La Grande River- NASA ph

Upper Churchill Falls dam turbine-
Labrador- Wikipedia

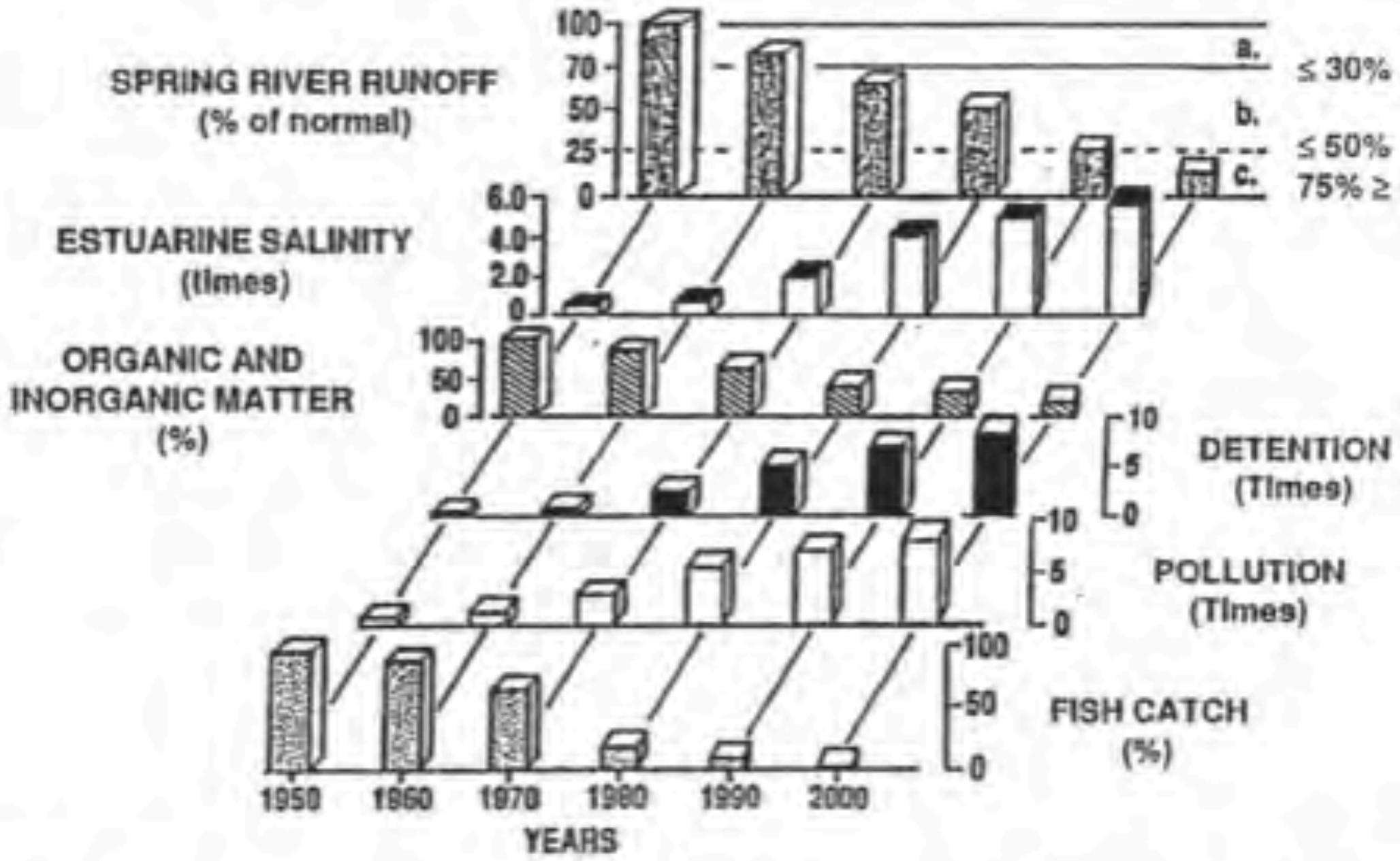


Figure 8. Conceptual chain reaction between spring river runoff and some major chemical, physical and economic parameters in the delta-estuary-sea economy.
a. Range of natural limitations in spring fresh water diversions ≤ 30% of normal.
b. Detrimental rate of spring diversions for living and non-living resources ≤ 50% of normal.
c. Range of residual spring runoff irrevocably damaging to environment and economics of ecosystems 75% ≥ of

Brief Summary of Michael Rozengurt Explanation of Impacts of Impounding the Spring Freshet Runoff.

The reduction of the river spring freshet by 40-60 percent specially in consecutive years is devastating to the coastal fishery.

Rozengurt explained that when you take 60% of the natural spring flow the " the lifeblood of the river ecosystem is gone". He said "It is as if you drained the blood from my body and expected me to go on living".

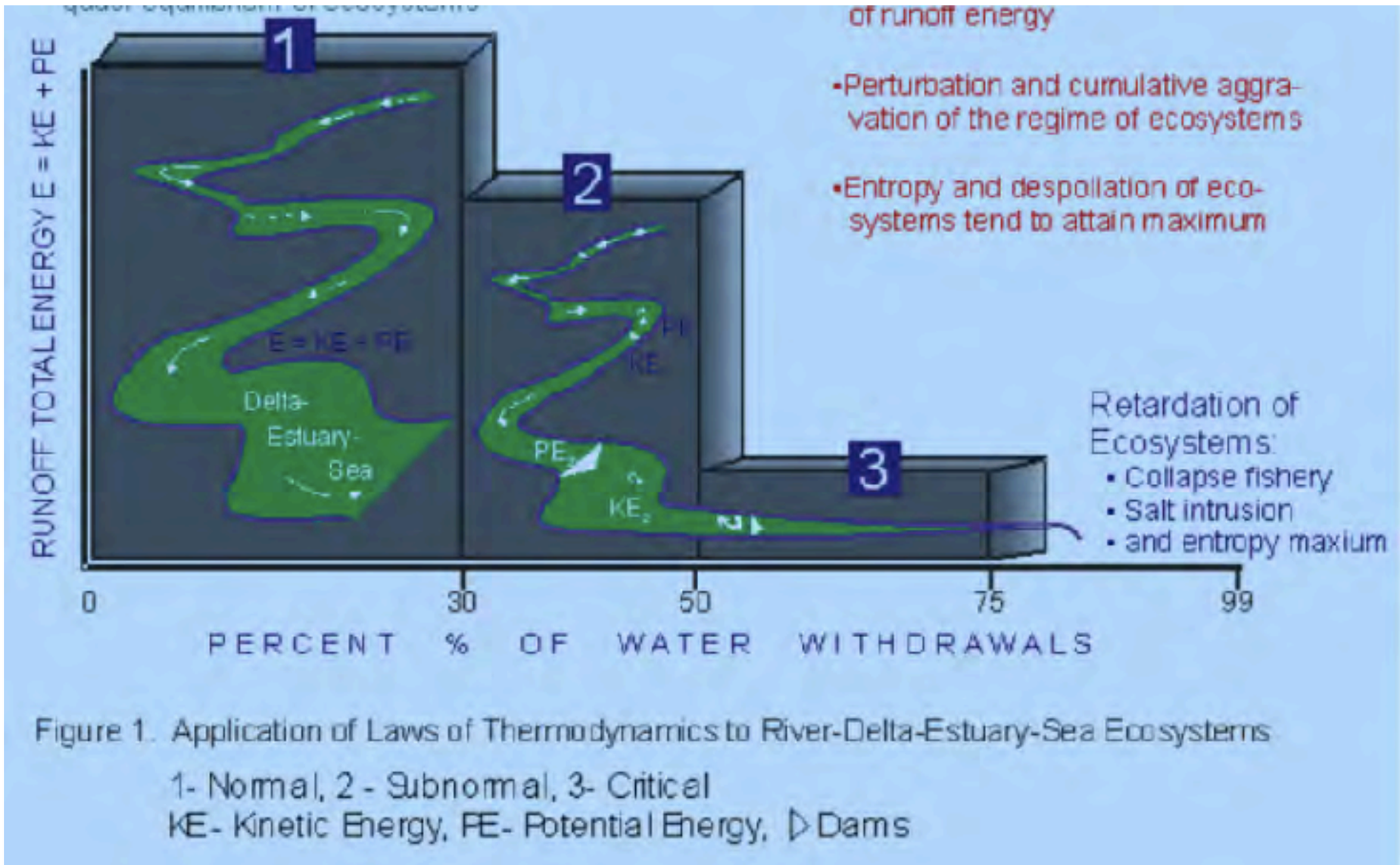
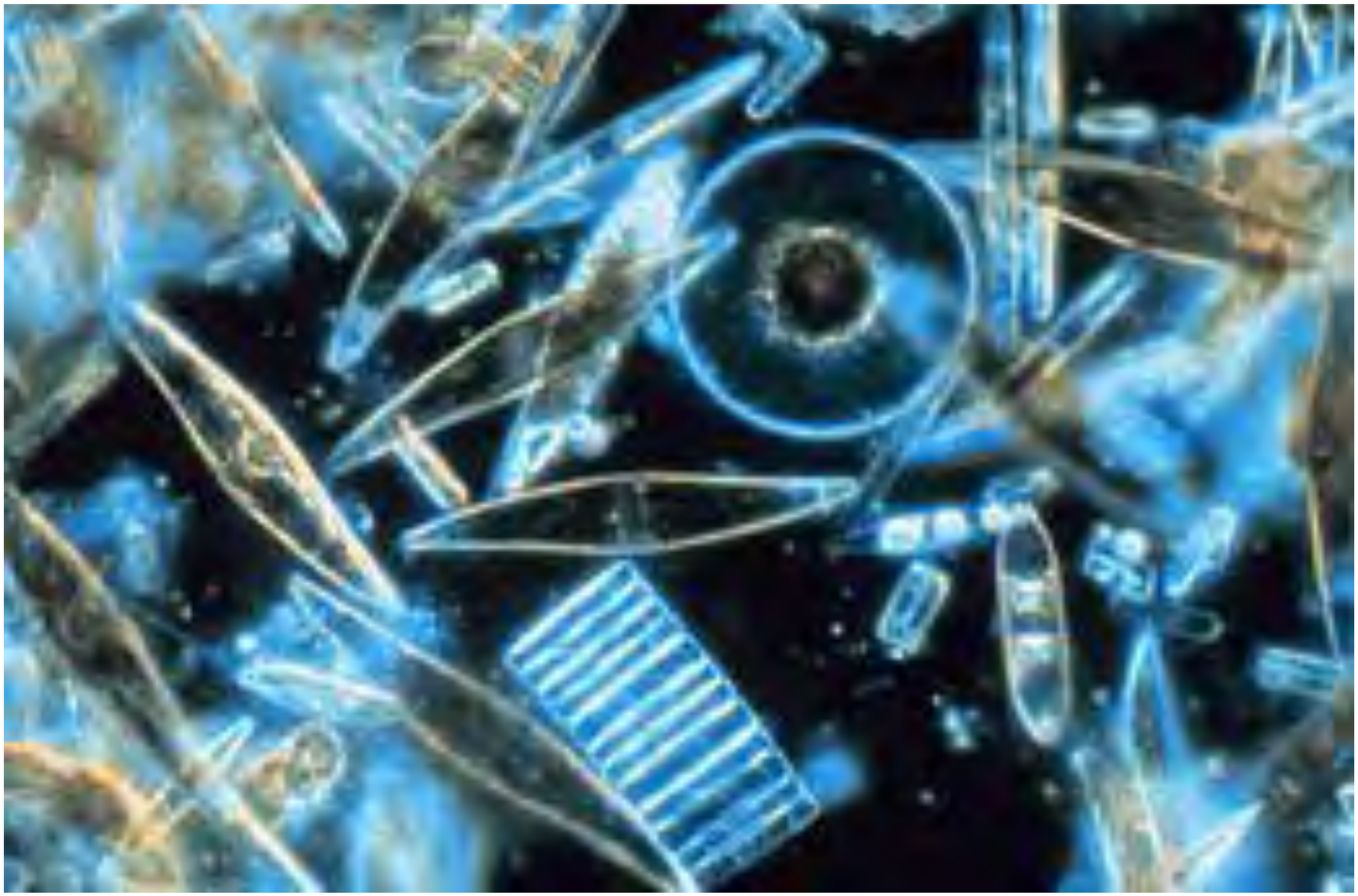


Figure 1. Application of Laws of Thermodynamics to River-Delta-Estuary-Sea Ecosystems

1- Normal, 2 - Subnormal, 3- Critical
KE- Kinetic Energy, PE- Potential Energy, ▷ Dams

Rozengurt 2003
Agonizing Coastal
Sea Ecosystems



Wikipedia

Dams and their flow regulation are adversarial to marine diatoms!

Diatoms are the most important foundation of the marine food chain and are one of nature's most powerful biological cooling mechanism for global climate.

Isaiah 40:6 — The New King James Version (NKJV)

6 The voice said, “Cry out!”
And he said, “What shall I cry?”
“All flesh *is* grass,
And all its loveliness *is* like the flower of the field.
https://biblia.com/bible/esv/isaiah/40/6

The late Bostwick Ketchum, a microbiologist at Wood Hole Oceanographic Institute revised Isaiah 40:6 to explain why diatoms are the gold foundation of the marine food chain ,—

"*All fish is diatom.*"

Diatom Information

- **Diatoms have a requirement for dissolved silica to construct their frustules (shells). Take in 6.7 billion metric tons of silica annually.**

- **Provide 20-25% of oxygen in atmosphere.**

- **Diatoms, are very sensitive to the timing, volume, and flow of freshwater.**

- **High responsibility for carbon silica pump that permanently sequesters carbon in ocean depths. Diatoms are responsible for about 1/4th of the primary production of planet Earth and half of the carbon flux to the deep ocean via the "biological pump"** (review in Tréguer et al., 2018)

- **Rivers deliver 80% of available silica to diatoms while current upwellings provide a substantial volume.**

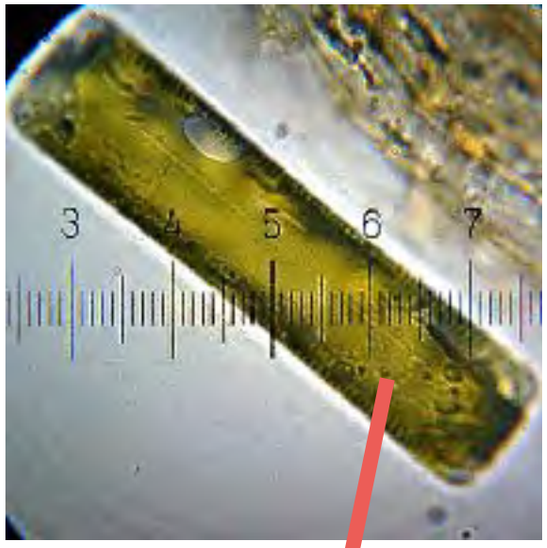
- **Marine diatoms dominate other phytoplankton in a nutrient rich well mixed ocean surface layer.**

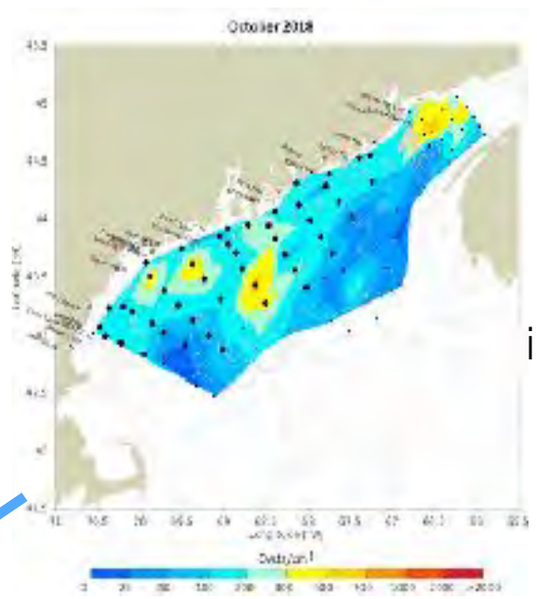
- **Diatoms through more recent past geologic history are a natural biological mechanism that has helped cool the climate.**

- **Silica availability controls diatom populations which determine atmospheric CO2 levels.**

Dams and flow regulation diminish diatom populations by disrupting the volume and timing of the delivery of nutrients, altering the coastal water temperature and salinity, dampening upwelling current energy and reducing mixing of surface layers which results in increased stratification. Non diatom phytoplankton dominate when ocean layers are stratified. A NASA study says that diatom populations in a 14 year period since 1998 have been falling 1 percent per year. https://svs.gsfc.nasa.gov/12009

Diatoms





2018 Gulf of Maine HAB NOAA map

Increased numbers and intensity of harmful algae blooms -silica, flow regulation?

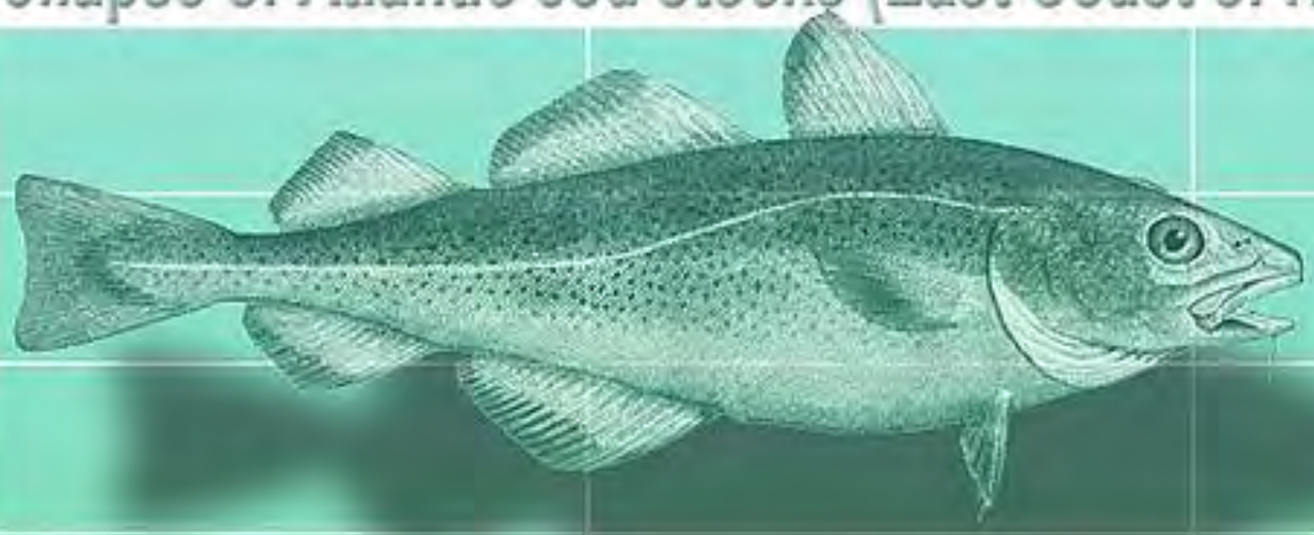
Calanus
Finmarchicus
WHOI
N. Copley photo Nasa

Northern Right Whale NOAA ph.

Atlantic Cod. NOAA ph.

Hydropower Impacts Marine Life- Complex Relationships

Collapse of Atlantic cod stocks (East Coast of Newfoundland), 1992.



Bureau of Reclamation Dept. of the Interior-1960 photo

Hungry Horse Dam- Reservoir (34 mile length)- South Fork Flathead River

Hungry Horse Dam releases have thermally altered the water temperature of the river producing “**extreme ecological disturbances** that have significantly reduced insect species diversity and biomass in comparison to unaltered river segments” (Stanford and Hauer, 1978). In this constant thermal regime **many species of insects presumably cannot complete their life cycles** (Graham, 1980). Stanford and Hauer (1978)… Eric Froines and Biby

A STUDY OF THE TEMPERATURE SELECTION AND UPPER LETHAL TEMPERATURE RESPONSES FOR TWO SPECIES OF SCULPIN, COTTUS COGNATUS AND COTTUS CONFUSUS, IN THE FLATHEAD RIVER BASIN OF NORTHWESTERN MONTANA

Before the dam, pre-1953, the unregulated river temperature varied through the seasons from 0 -18 degree C.. After completion, post-1953, the regulated river temperature remained near a consistent 7degree C throughout the year.

Their Big Lie-

“Maine’s Clean Energy Corridor: Big Benefits, Small Footprint.”

https://www.cleanenergymatters.org

The Central Maine Power and Hydro Quebec Corporate Playbook.

The Big Footprint of Mega Dams and Flow Regulation

Some of the impacts of this big footprint that should have been included in regulatory hearings for NECEC, fisheries policies, and climate change discussions.

From Sebago Lake we learned the impacts of flow regulation and dams:

- Beach erosion and loss
- Water quality degradation
- Fishery changes
- Lake wetland losses and degradation
- Groundwater flow changes and stagnation
- Heat pollution of the water
- Fragmentation of ecosystems
- Invasive species proliferation

-From mega dam opponent groups:

- Mercury pollution of food chain
- Methane releases from reservoirs
- Loss of biodiversity
- Sedimentation
- Destruction of valuable recreational lands
- Freshwater fishery destruction
- Loss of valuable forests
- Social culture losses and disintegration
- Loss of biodiversity
- Species extinction

From information gathering efforts by environmental organizations and the book, *Arctic Blue Deserts*

- Weakening of coastal and ocean currents
- Key initial direct driver for melting sea ice
- Increased humidity of Arctic air in fall and winter
- Key driver causing Earth's Energy Imbalance in the Arctic
- Amplifies impacts of fossil fuel emissions
- Harming natural C02 removing mechanisms
- Increases in intensity of weather events
- Heat pollution of rivers, oceans, and the atmosphere
- Melting of Greenland glaciers
- Sea level rise
- Destruction of valuable marine fisheries and mammals
- Reducing diatom populations
- Melting land and under sea permafrost
- Major driver of atmospheric CO2 increases
- Major driver of climate change especially in high latitude regions

Natural Resources Council of Maine photo of proposed NECEC route

notonecec.com

If the NECEC line is approved in the November 2, 2021 referendum on Question 1, more dams will be built in Canada.

Websites to order *Arctic Blue Deserts*

Say No to NECEC
https://www.facebook.com/groups/279944929428517/search/?q=Arctic%20Blue%20Deserts

https://arcticbluedeserts.com

https://www.friendsofmerrymeetingbay.org

Canada- https://www.grandriverkeeperlabrador.ca/about-us/

Information

https://friendsofsebago.org

http://northeastmegadamresistance.org

http://cybrary.fomb.org/fosl.cfm