

# **CLIMATE BASICS:** It's REAL, It's US , It's HERE



**But... HOW do we *KNOW*?**

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**WELCOME  
to this  
HYBRID DOCUMENT**

It is both a scientific report and a  
Powerpoint presentation.

Feel free to use any or all of it for  
research or educational purposes  
*(all photos and charts are for public use).*



# **GLOBAL WARMING or CLIMATE CHANGE:**

What's the difference?

## **“GLOBAL WARMING”**

refers to rising global temperatures due to human activity, especially fossil fuel usage that releases heat-trapping CO<sub>2</sub>

## **“CLIMATE CHANGE”**

can refer to any aspect of climate, from wind to rain to temperature, that is changing as a result of global warming

# **#1. HOW do we know it's REAL?**

**A.LAWS OF PHYSICS**

**B.DIRECT MEASUREMENTS**

**C.OBVIOUS EFFECTS**

## 1A. “GREENHOUSE” PHYSICS

Solar energy warms the land and sea. Certain **greenhouse gases** can hold much of that heat-energy in the air like a blanket holds body heat.

Adding more **carbon dioxide (CO<sub>2</sub>)** to the atmosphere is like adding more blankets. **Methane** is also a greenhouse gas, but it quickly becomes CO<sub>2</sub> in the atmosphere.

The physics of this “**greenhouse effect**” has been well known since the 1800s.

## 1B. MEASURING TEMPERATURES

When data from thousands of **INDEPENDENTLY OPERATED** weather stations worldwide are combined, they clearly show strong average warming over the last century.

Additional minor warming due to urban growth near some stations (the “heat island effect”) and other possible sources of **error** are taken into account in the calculations.

**Satellite data** from both land and sea also confirm that the global warming is **REAL**, and not due to urban biases.

An aerial photograph of a vast, flat, light-colored landscape, likely a frozen lake or tundra, with dark silhouettes of trees and mountains in the distance under a blue sky with light clouds. Three white text boxes with black borders are overlaid on the image.

## 1C. THE EFFECTS ARE ALSO OBVIOUS:

**LAKE ICE IS SHRINKING:** lakes are freezing later and thawing earlier, on average

**GLACIERS ARE SHRINKING:** glaciers and ice sheets around the world are in retreat

**SEA LEVEL IS RISING:** partly because land-based ice is MELTING and draining into the sea, and partly because the warmer sea water is EXPANDING

## **#2. HOW do we know it's US?**

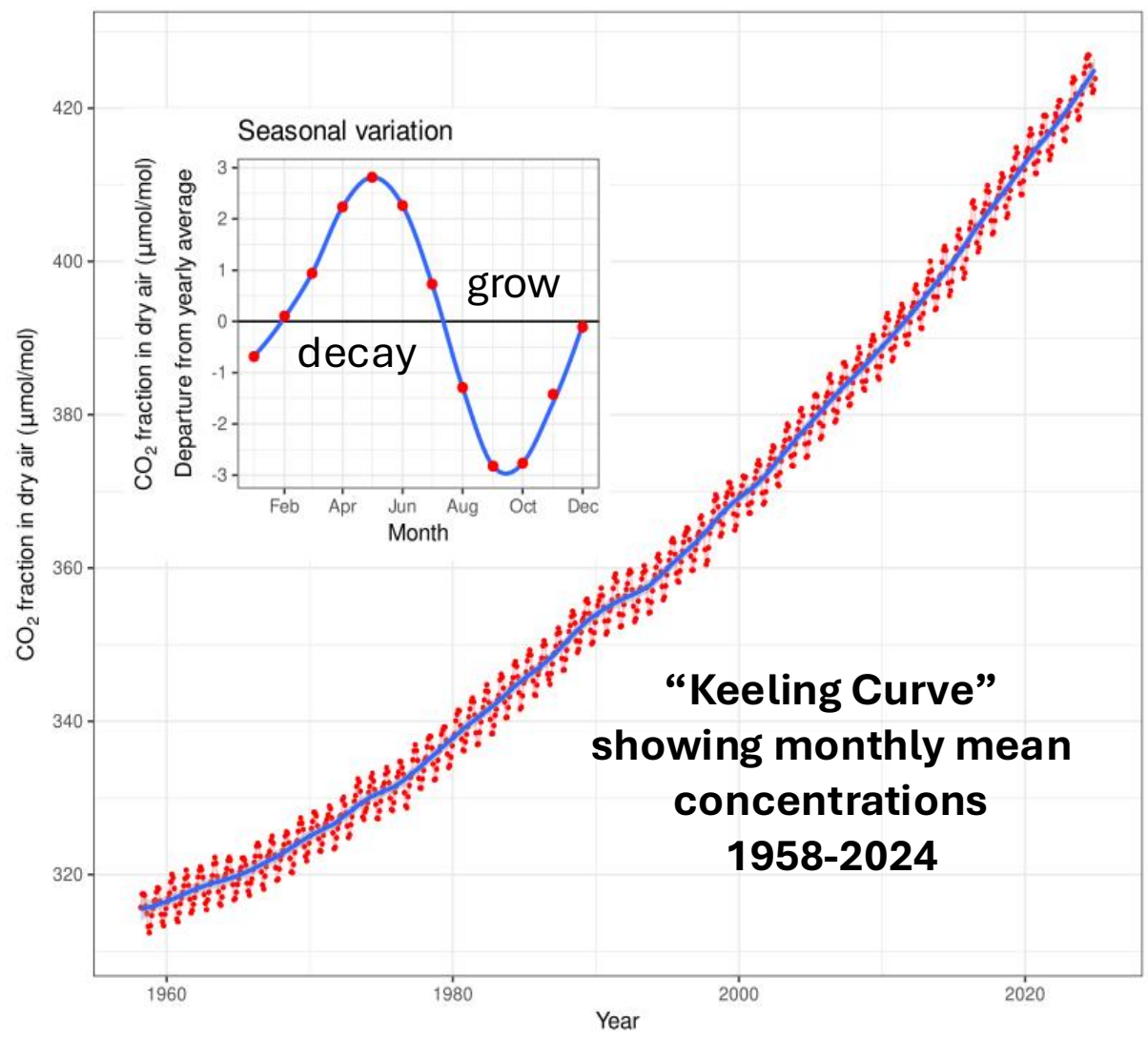
**A. ATMOSPHERIC MEASUREMENTS**

**B. MONITORING CLIMATE-DRIVERS**

**C. FOSSIL FUEL TRACERS**



# 2A. OUR CO<sub>2</sub> EMISSIONS ARE BUILDING UP



Careful measurements worldwide show that CO<sub>2</sub> concentrations are rising.

These measurements are so accurate that they also record ups and downs from seasonal decay and growth of plants and algae in each hemisphere.

Data from Pieter Tans, NOAA/ESRL and Ralph Keeling, Scripps Institution of Oceanography., CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=40636957>

## 2B. IT'S NOT DUE TO CHANGES IN THE SUN

We know it is **NOT** due to changes in the **SUN** because:

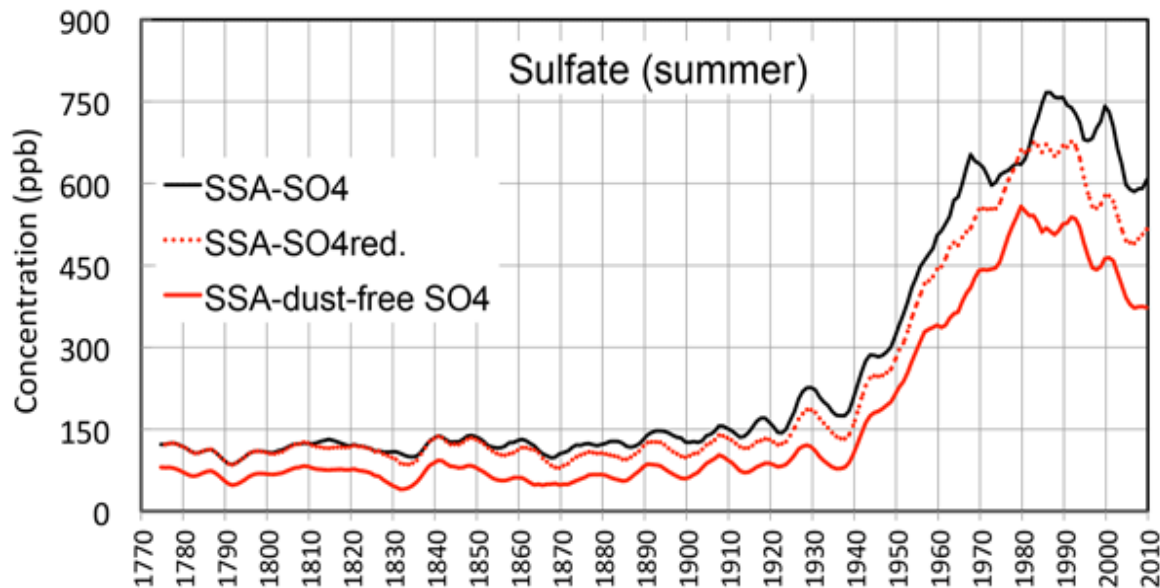
...The sun's energy output has NOT been increasing

... The stratosphere (atop the troposphere where we live) is NOT warming, so the extra heat is NOT coming from above

## 2B. IT'S NOT DUE TO CLEARER SKIES

Sulfur pollution from coal and oil blocks sunlight, so cleaning it up has caused some *additional* warming.

Ice core record from Mt. Elbrus, Russia



<https://acp.copernicus.org/articles/19/14119/2019/>

### HOWEVER:

Warming began long **before**  
the recent sulfur **reductions**  
and  
temperatures **before** the  
sulfur **buildup** were not as  
warm as they are now

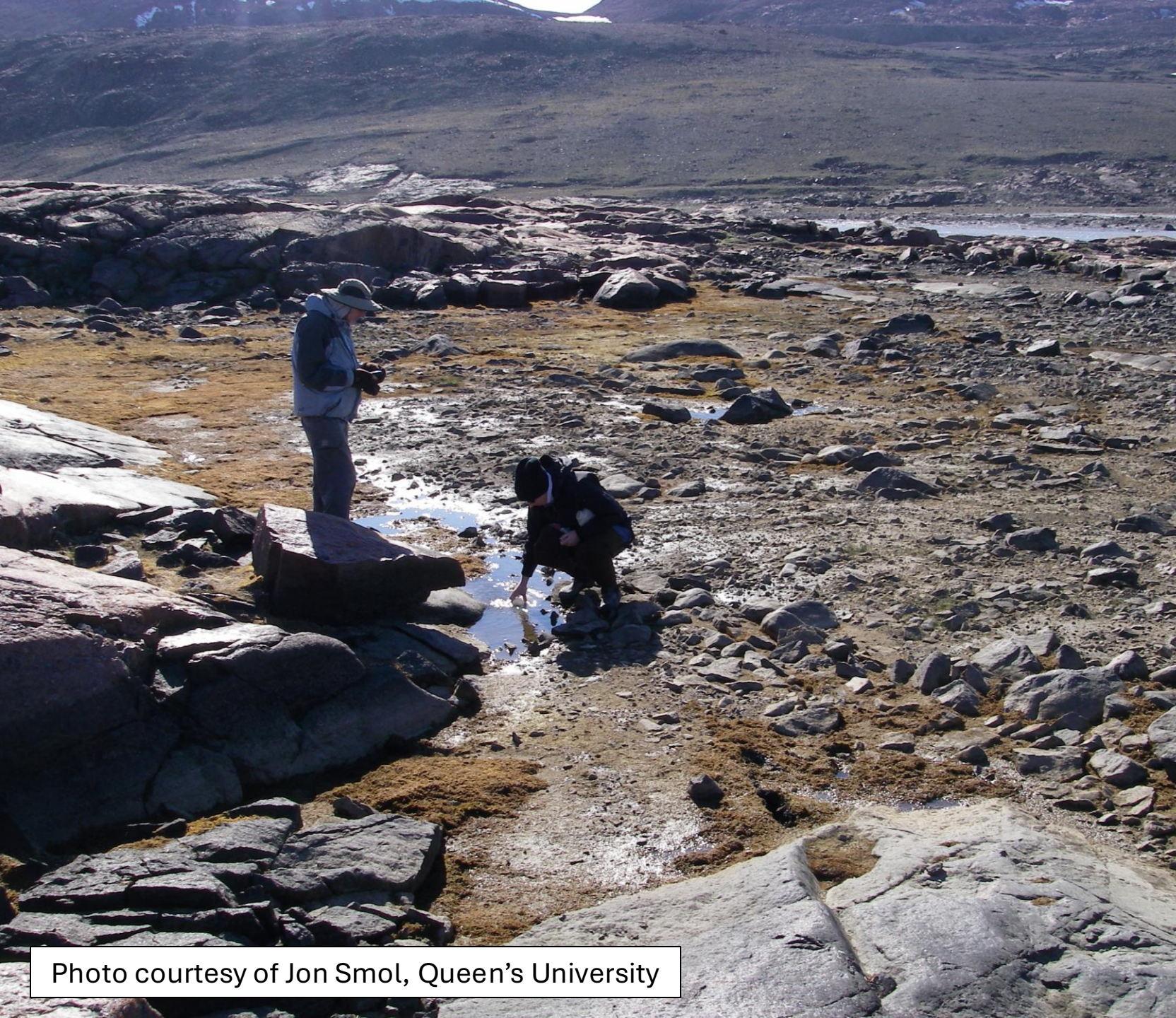


**2B. IT'S NOT DUE TO  
“NATURAL CYCLES”**

Lakes throughout  
the **ARCTIC**  
are losing their ice  
cover in summer.

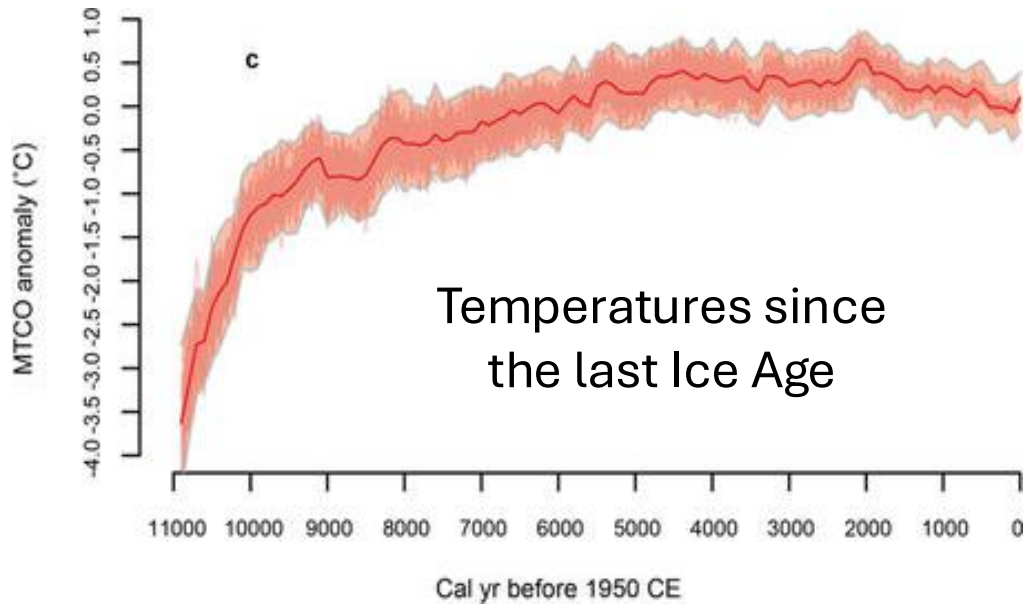
Cores of ancient  
sediment from such  
lakes show that this  
has **NEVER**  
happened before.

<https://www.pnas.org/doi/full/10.1073/pnas.0907094106>  
<https://www.nature.com/articles/s41598-024-82666-3>

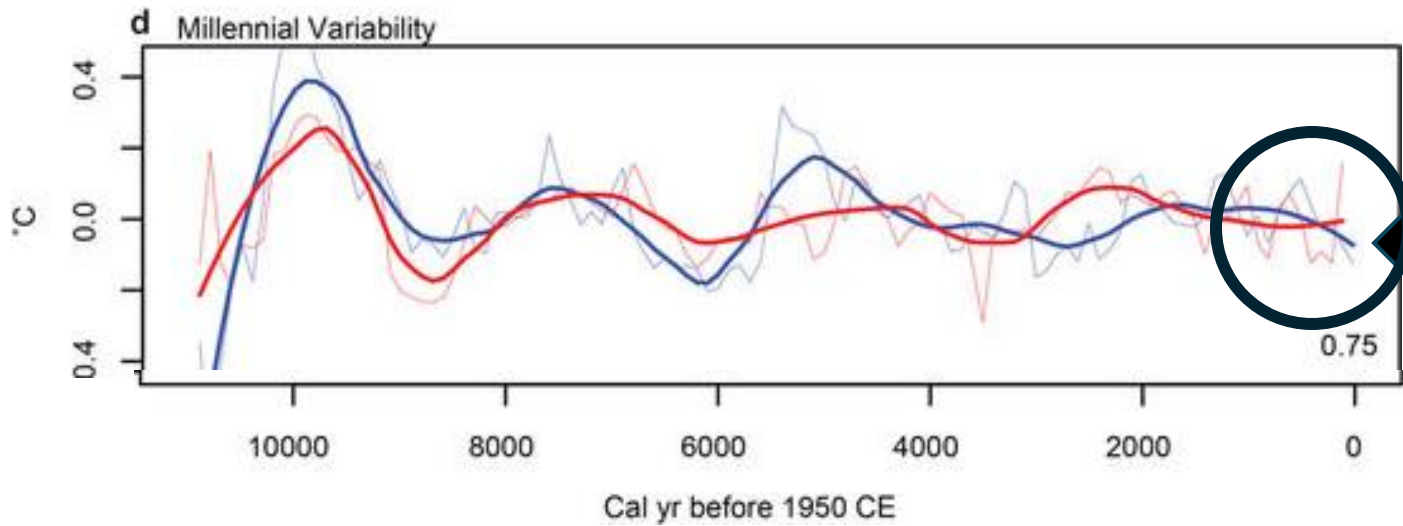


Without ice cover  
to block  
evaporation in  
summer, some of  
the lakes are now  
**DRYING OUT**, too.

Here, Canadian  
scientists are  
sampling the last  
remnant of a  
former study-lake.



This analysis of paleotemperatures shows what the natural cycles have **REALLY** been doing.



The red and blue cycle-lines are now essentially flat, so they do **NOT** explain MODERN WARMING

## 2C. THE CO<sub>2</sub> COMES FROM US

We know it mainly comes from **FOSSIL FUELS** because:

... **Oxygen levels** are declining at the same time, as the burning-processes consume oxygen as well as fuel

... **Carbon-13 isotopes** from the fossil fuels are increasing throughout the world's food webs, including our own bodies

... **the amounts** of fuel burned match the amounts of CO<sub>2</sub>

## **#3. HOW do we know it's HERE?**

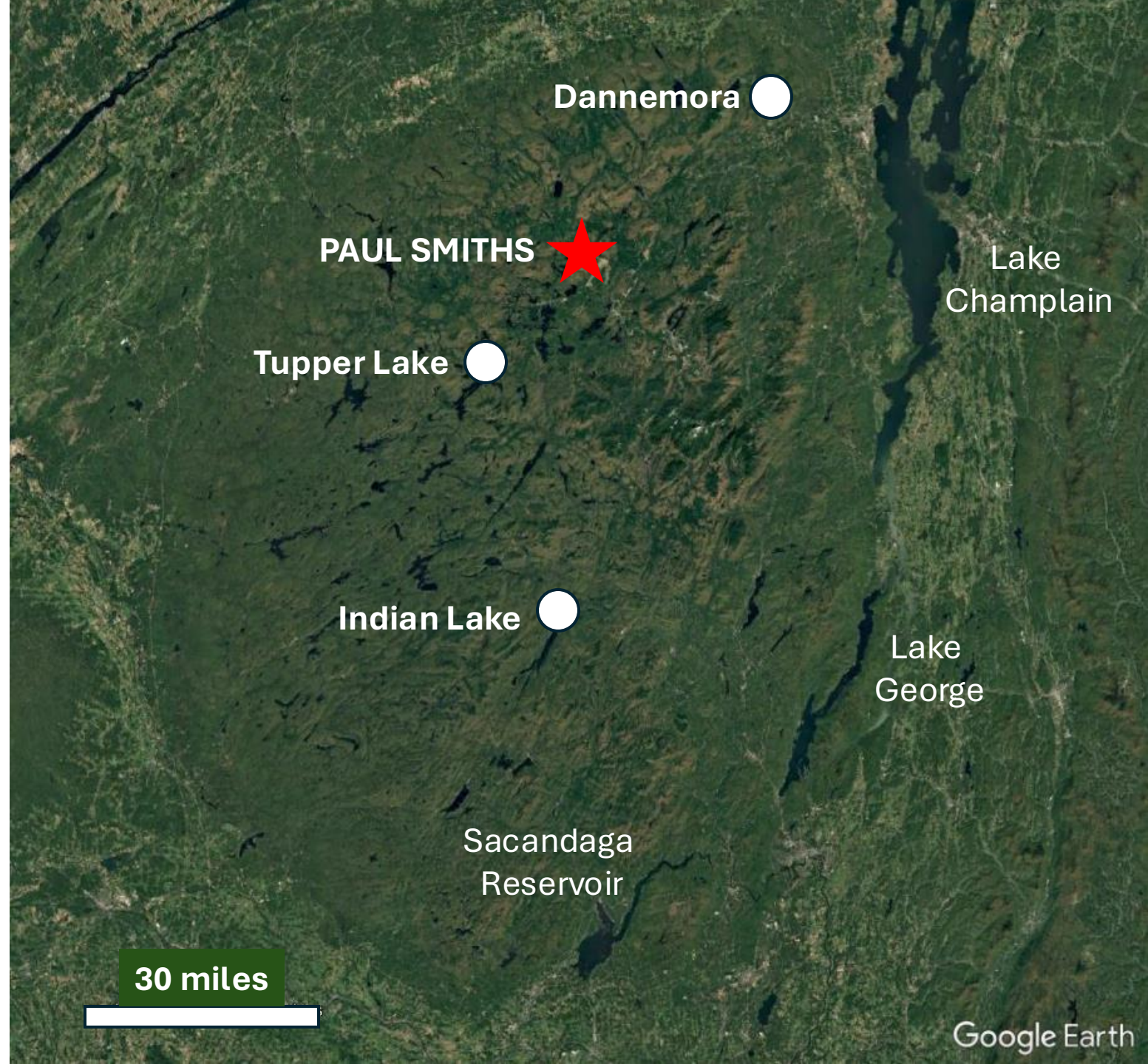
**A. LOCAL WEATHER RECORDS**

**B. LOCAL EFFECTS**

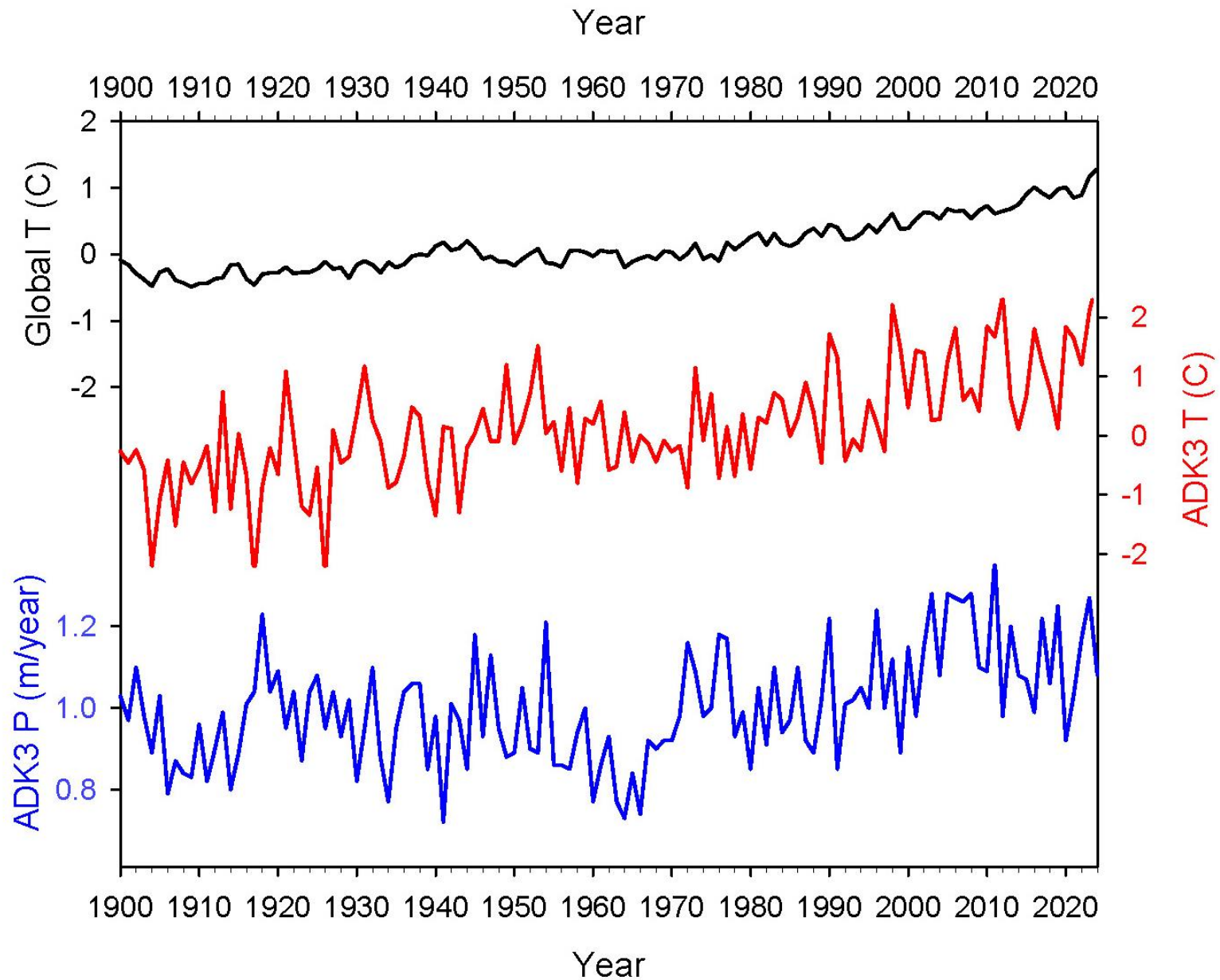


## 3A. ADIRONDACK WEATHER RECORDS

Temperature and precipitation data from USHCN weather stations in Dannemora, Tupper Lake, and Indian Lake are combined into a record that we call “**ADK3.**”



30 miles



Like most mid/high-latitude areas, the Adirondacks have been **warming** faster than the global average, especially in Winter and Fall.

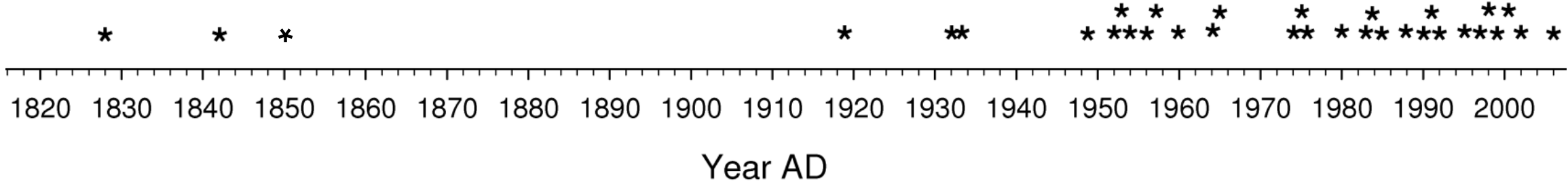
It has also become **wetter** overall.



# 3B. LOCAL EFFECTS

Adirondack lakes are freezing later in Fall and thawing earlier in Spring, with shorter ice-cover seasons overall  
 (Beier *et al.*, 2012)

**LAKE CHAMPLAIN**  
 \* = main basin UNFROZEN



**Monitoring at Paul Smith's College since 1990 shows that local birds, amphibians, and insects are appearing EARLIER in Spring.**



Weekly monitoring by students in our Biology 111 labs shows that Lower Saint Regis Lake **WARMED 2 degrees C** in October since the 1990s.





# RISING LAKE LEVELS

The surface level of **Bear Pond** now covers tree roots along the shore and a formerly vegetated island.



# TRADITIONALLY RELIABLE SOURCES of CLIMATE INFORMATION

**IPCC:** Intergovernmental Panel on Climate Change

<https://www.ipcc.ch/report/ar6/syr/>

**NASA:** National Aeronautics & Space Administration

<https://science.nasa.gov/climate-change/>

**NOAA:** National Oceanographic & Atmospheric Administration

<https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts>

**Peer-reviewed journals** such as *Science*, *Nature*, or *PNAS*

# TIPS for judging the **RELIABILITY** of an “**EXPERT**”

Do they have an advanced degree in **CLIMATE SCIENCE**?

SEARCH CLIMATE-DENIER CREDENTIALS ON DESMOG BLOG: <https://www.desmog.com/>

Do they have climate-related publications in major  
**PEER-REVIEWED** journals?

SEARCH BY NAME ON GOOGLE SCHOLAR: <https://scholar.google.com/>

Are their statements consistent with the **IPCC REPORTS**?

AR6 SYNTHESIS REPORT: <https://www.ipcc.ch/report/ar6/syr/>



## **MAJOR SOURCES of CLIMATE *DISINFORMATION***

Such sources attribute modern global warming to causes *other than* greenhouse gas-buildups, such as the sun, sulfur emissions, natural cycles, or “fake news.”

*Examples include:*

Breitbart, CLINTEL, Fox News, The Heartland Institute, the “Nongovernmental International Panel on Climate Change,” and the blog “Watt’s Up With That?”