Speaking of water: How stories can shape our climate future

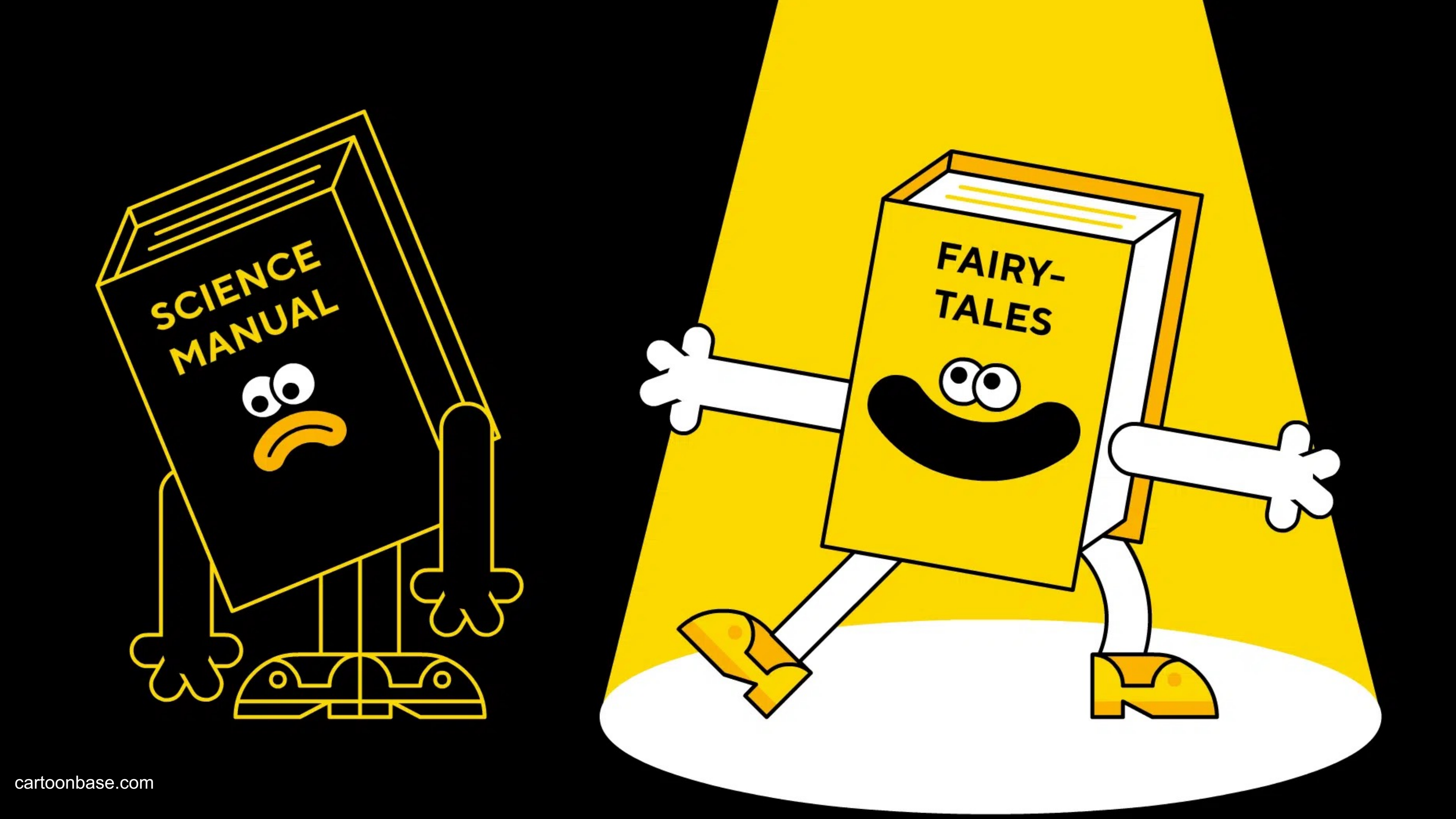
SCAN ME

Nicole Rice

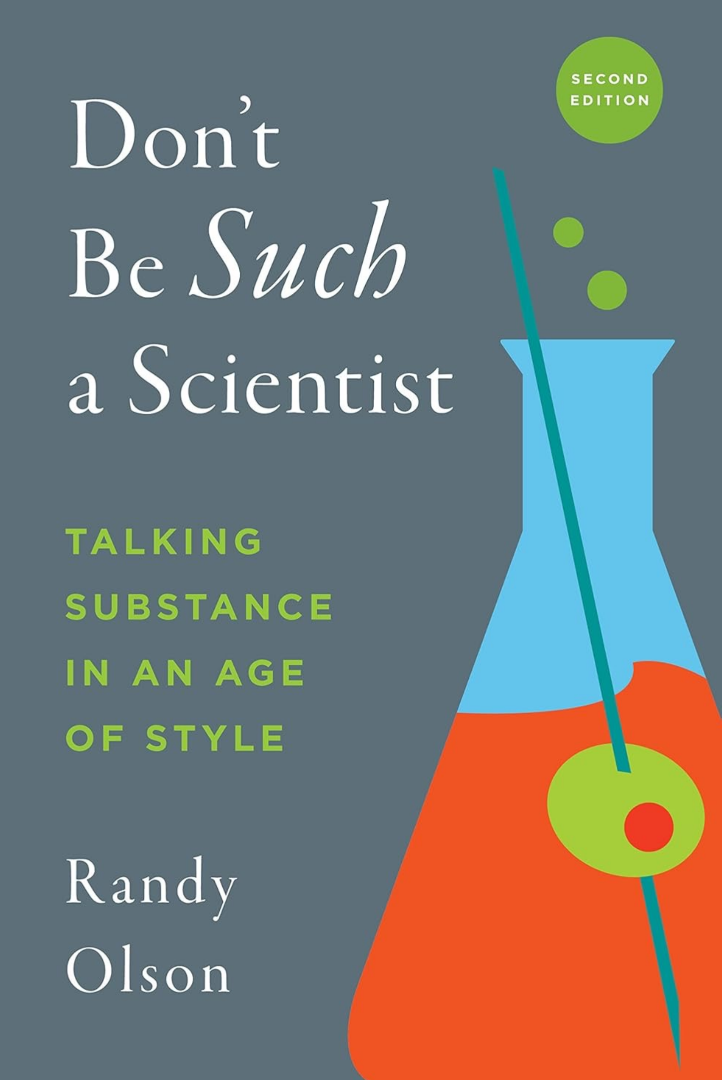
Government Communications and Public Affairs | Storytelling | Creative Direction | Community Relations | A Passion for Public Service

Enago Academy

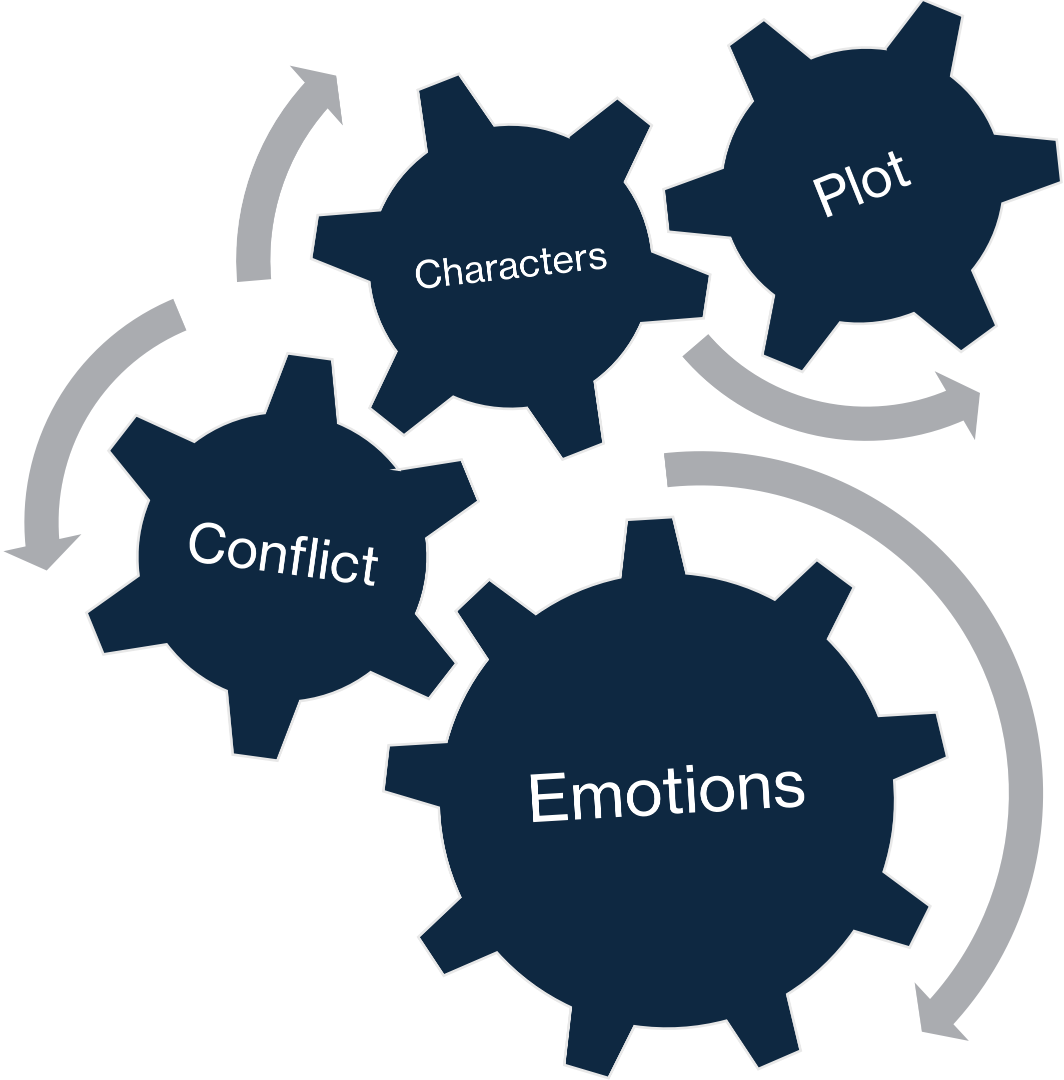
What is scientific storytelling?



cartoonbase.com



“Think of stories as fact wrapped in emotions”


Characters
Plot
Conflict
Emotions

There is a force at the core of science that drives it in a nonhuman direction. You see it over the ages. From the creation of robots to the destruction of humanity through war technology, science left to its own devices drifts in a direction that is not good. It doesn't happen with evil intentions, only through a lack of self-awareness. Science brings so much benefit to humanity, but it also needs voices to constantly pull it back from this nonhuman direction (and now more than ever, given the rapid onset of AI, artificial intelligence).

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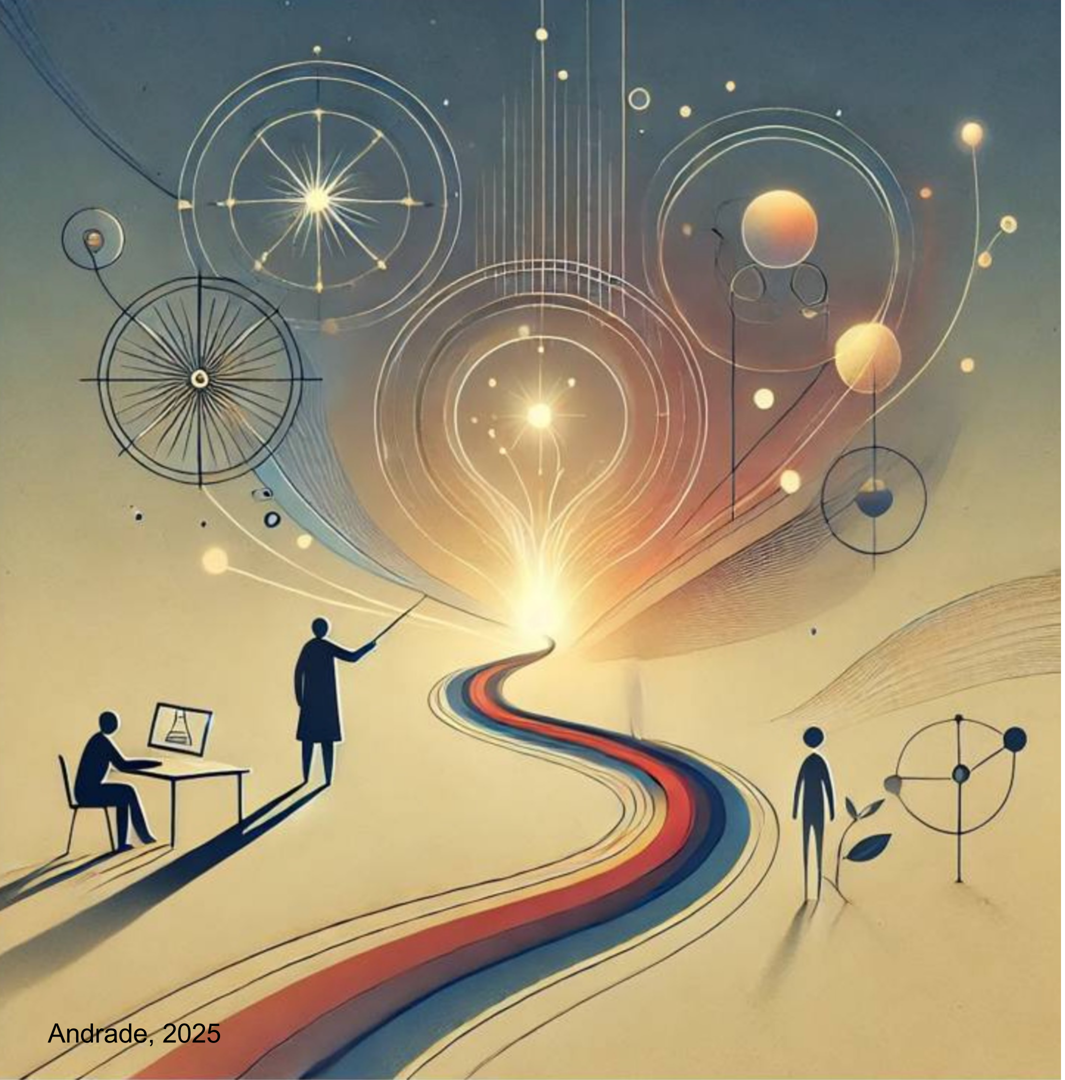


The art of storytelling in science

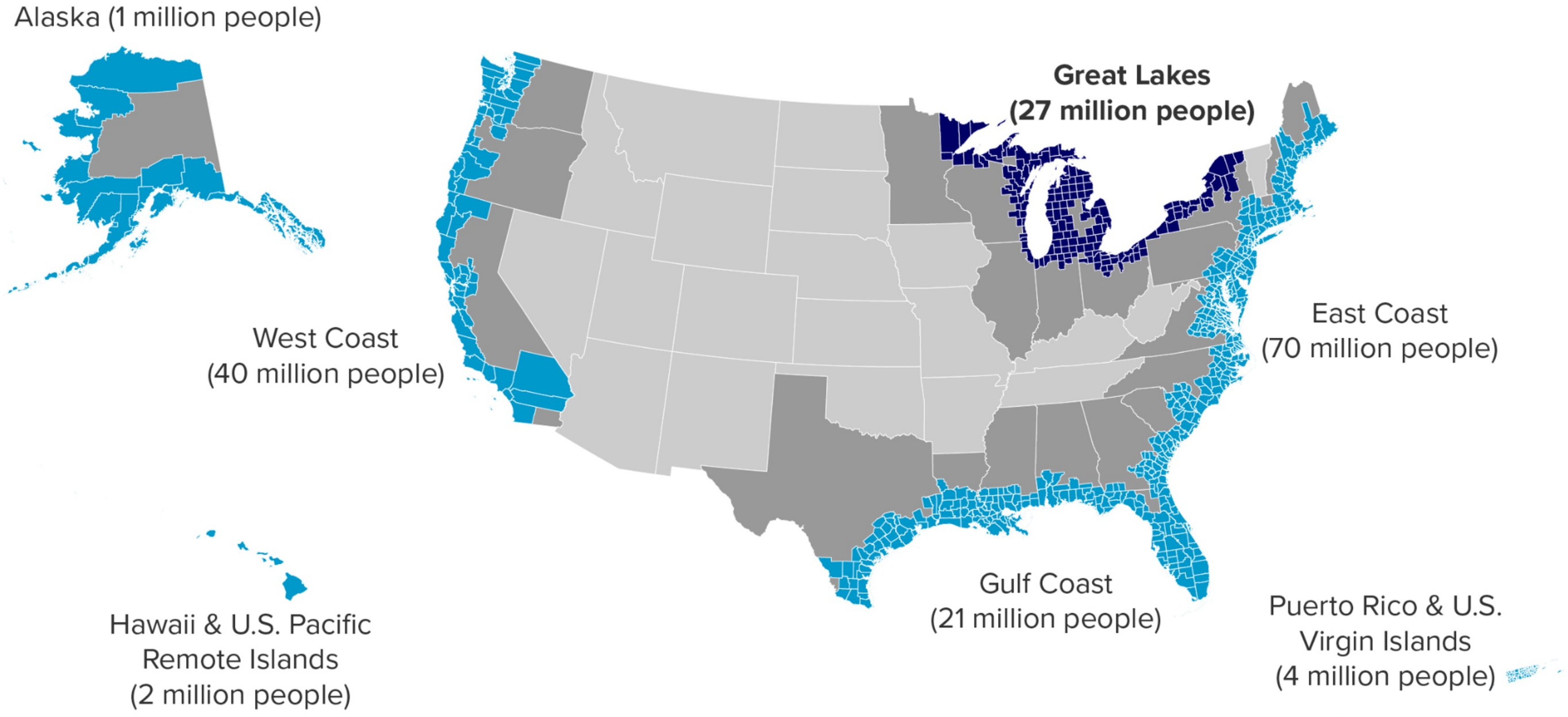
Roman Samborskyi, Dreamstime.com

…the more able an individual is to picture a narrative about climate change, the more accepting that individual is of the hero of the narrative, which then leads the individual to be more accepting of the solutions argued for in the narrative.

Jones, 2014

BOMBARDING
THE VIEWER WITH
COMPLICATED DEFINITIONS
WILL NOT IMPROVE
UNDERSTANDING

Setting the stage



Based on American Community Survey 5-Year Estimates for watershed counties (via NOAA NOS Office of Coastal Management), and 2010 U.S. Census data for some island areas. Rounded to the nearest million.

great lakes observing system


NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

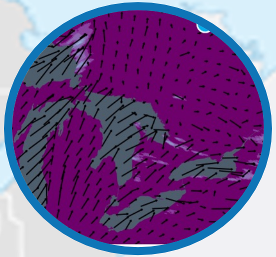
Storytime!

Research is essential to understanding & predicting dynamic change.

Observing Systems
Traditional & Emerging Tech

Ice Cover & Water Levels
Research & Modeling

Wind, Waves, Currents
Forecasting & Oil Spill Prediction

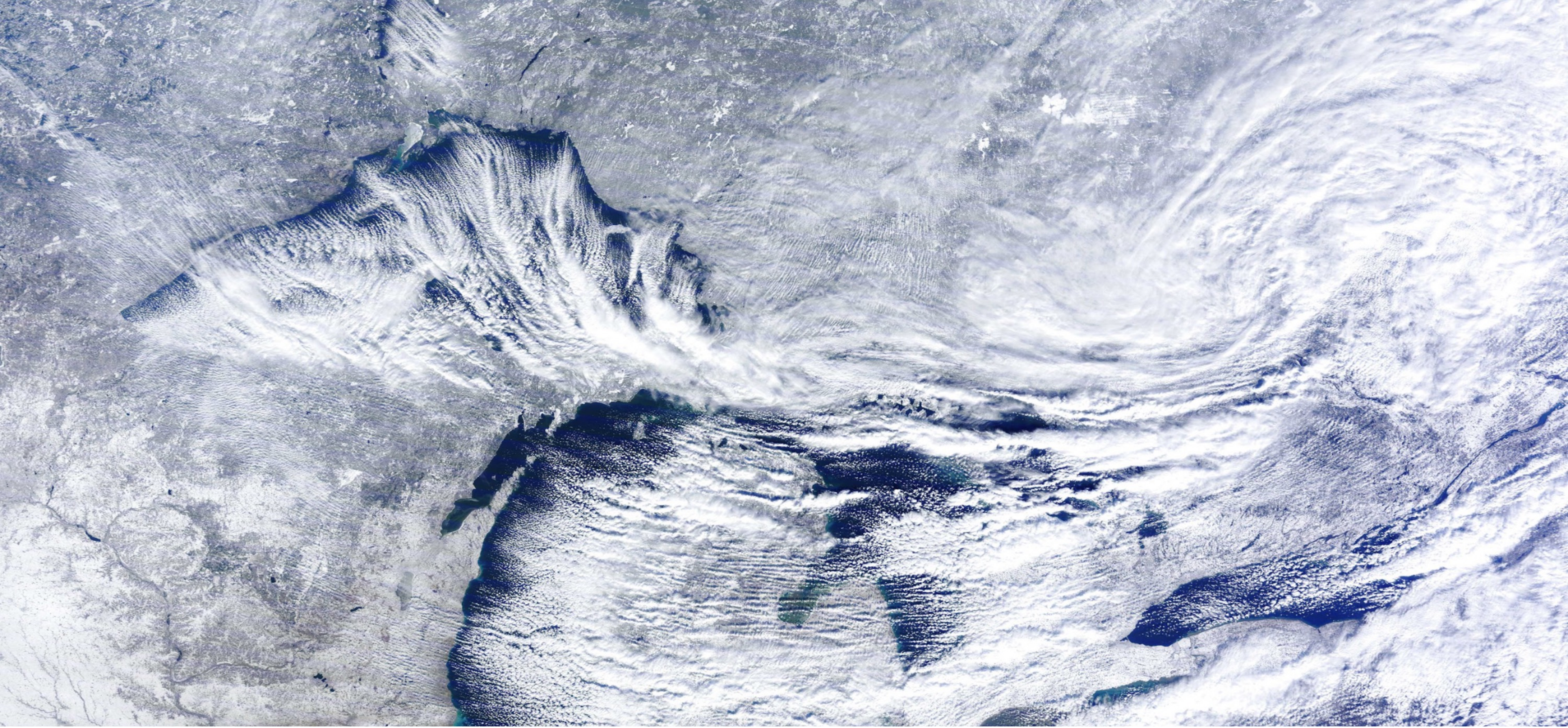


Atmospheric Science
Weather to climate time scales

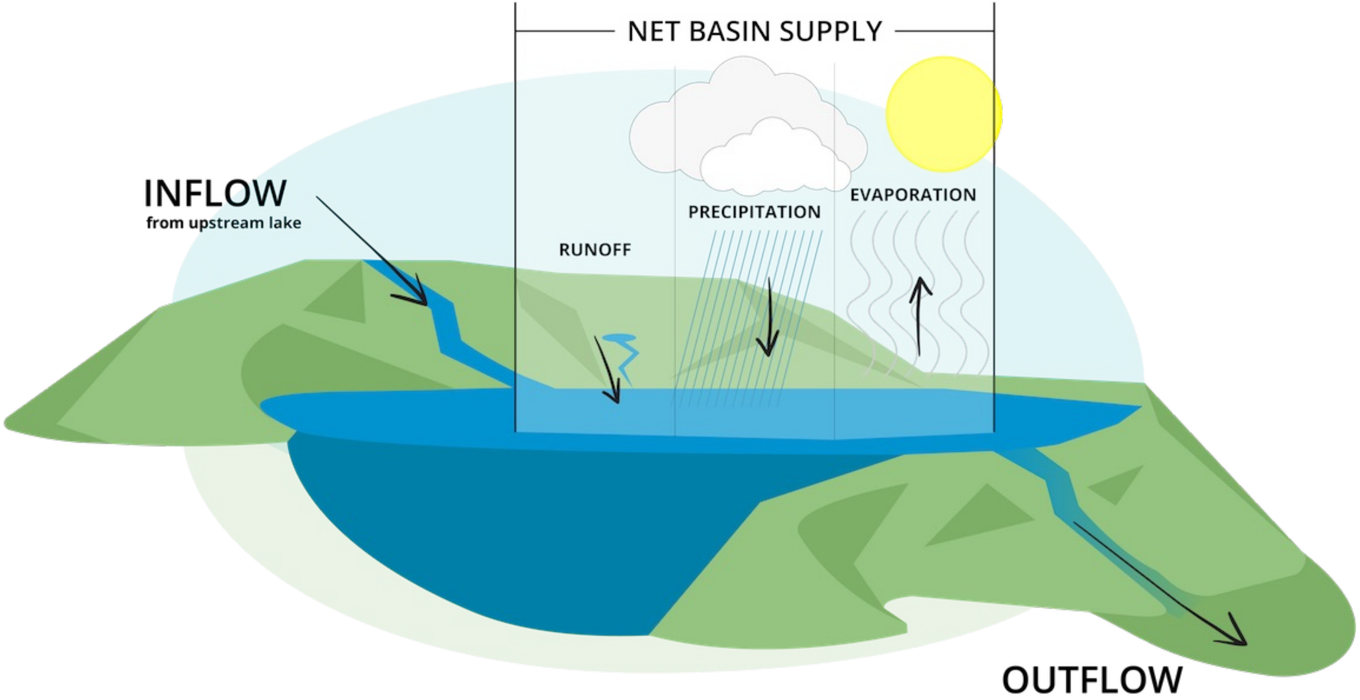
Invasive Species & Food Webs
Research & Modeling

Harmful Algal Blooms
Monitoring, Research, & Modeling

Converting real world observations to data supports studies and assessments, informs managers and stakeholders, experiments and models, and ultimately predictions and forecasts.



Analyzing components of the Great Lakes water cycle improves models for planning water management and operations.



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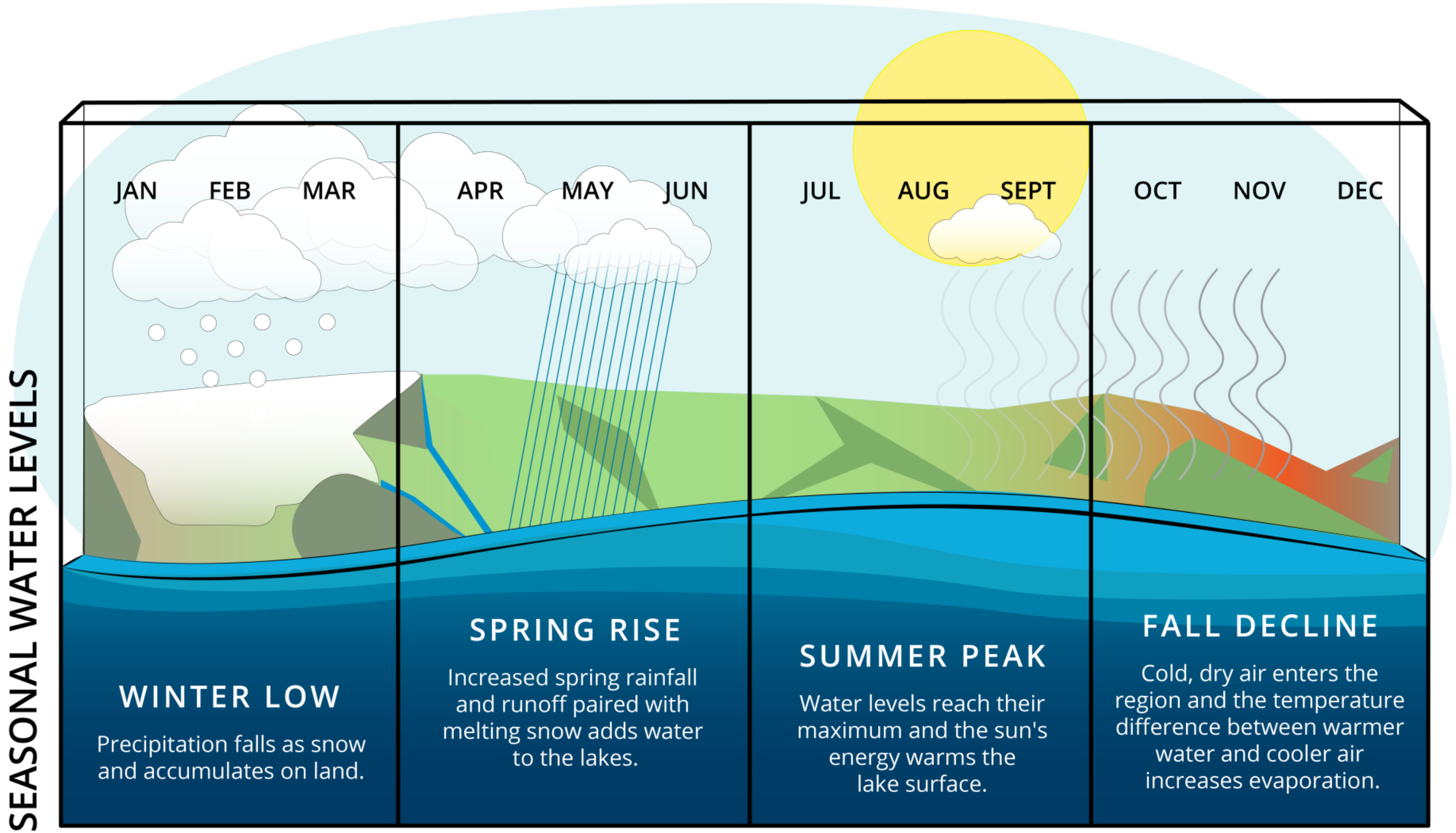

Seasonal and interannual variability in water levels can have major impacts on infrastructure, property, navigation, hydropower, and recreation.

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Lake Ontario-St. Lawrence River flooding 2017: Extra water on both sides of the dam

Updated 08/01/2017

During the first six months of 2017, more than twice the normal amount of water accumulated on Lake Ontario (1.3 meters, compared to the average of 0.6 meters), while the Ottawa river saw the highest flows (cumulatively) in more than 50 years, leading to widespread flooding across the Lake Ontario - St. Lawrence River system. The graphs below indicate where the additional water came from by comparing system inflows and outflows from 2017 (dark lines) to previous years (light lines).

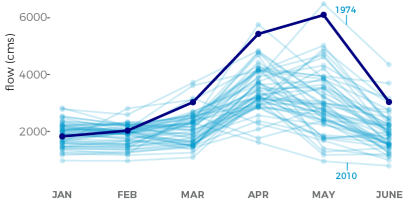
2017 [1,2,4]
previous years* [1,3,4]

Lake Ontario Jan - June water budget (m)

	average*	**2017**
inflow from Lake Erie	5.2	5.7
runoff	1.2	1.7
precipitation	0.4	0.6
evaporation	-0.2	-0.2
outflow to St. Lawrence R.	-6.0	-6.5
total	**0.6**	**1.3**

Ottawa River Flows

Excessively wet weather from April through June led to unusually high flows in the Ottawa River, contributing to high water levels in the St. Lawrence River.



Inflow from Upper Lakes

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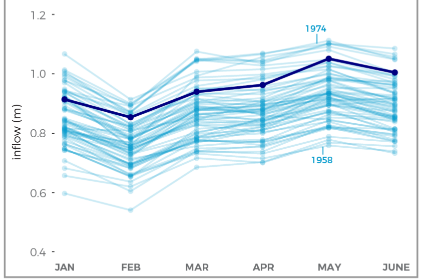
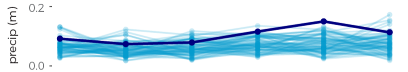
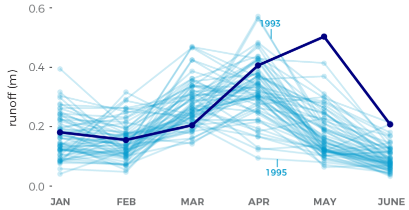


Rain/snow on Lake Ontario Basin

Lake Ontario saw two of the wettest months ever recorded in April and May of 2017. Water levels were impacted by **precipitation falling directly on the lake's surface...**

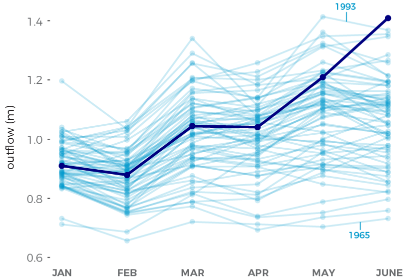


and by runoff (snow and rain that falls on the land and collects in rivers and streams, which then drain into the lake).



Outflow to St. Lawrence River

Variable ice conditions in the St. Lawrence River from January through March along with high Ottawa River flows (see above box) limited outflows from Lake Ontario, which are controlled through the Moses-Saunders Dam. **Still, from January to June, outflows removed half a meter (1.6 feet) more water than average from Lake Ontario.**



*Ontario inflow and outflow from 1950 - 2016, precipitation and evaporation from 1950 - 2015, runoff from 1950 - 2013, Ottawa flows from 1963 - 2016.

Data Sources: **(1)** USACE coordinated flow data, **(2)** Gronewold, A.D., J. Bruxer, D. Durnford, A.H. CLITES, J.P. SMITH, F. Seglenieks, S.S. Qian, T.S. HUNTER, and V. Fortin. DOI:10.1002/2015WR018209) (2016), **(3)** Hunter, T.S., A.H. Clites, A.D. Gronewold, and K.B. Campbell. (DOI:10.1016/j.jglr.2014.4.12.006) (2015), **(4)** Ottawa River Regulation Planning Board flow data

Environment and Climate Change Canada

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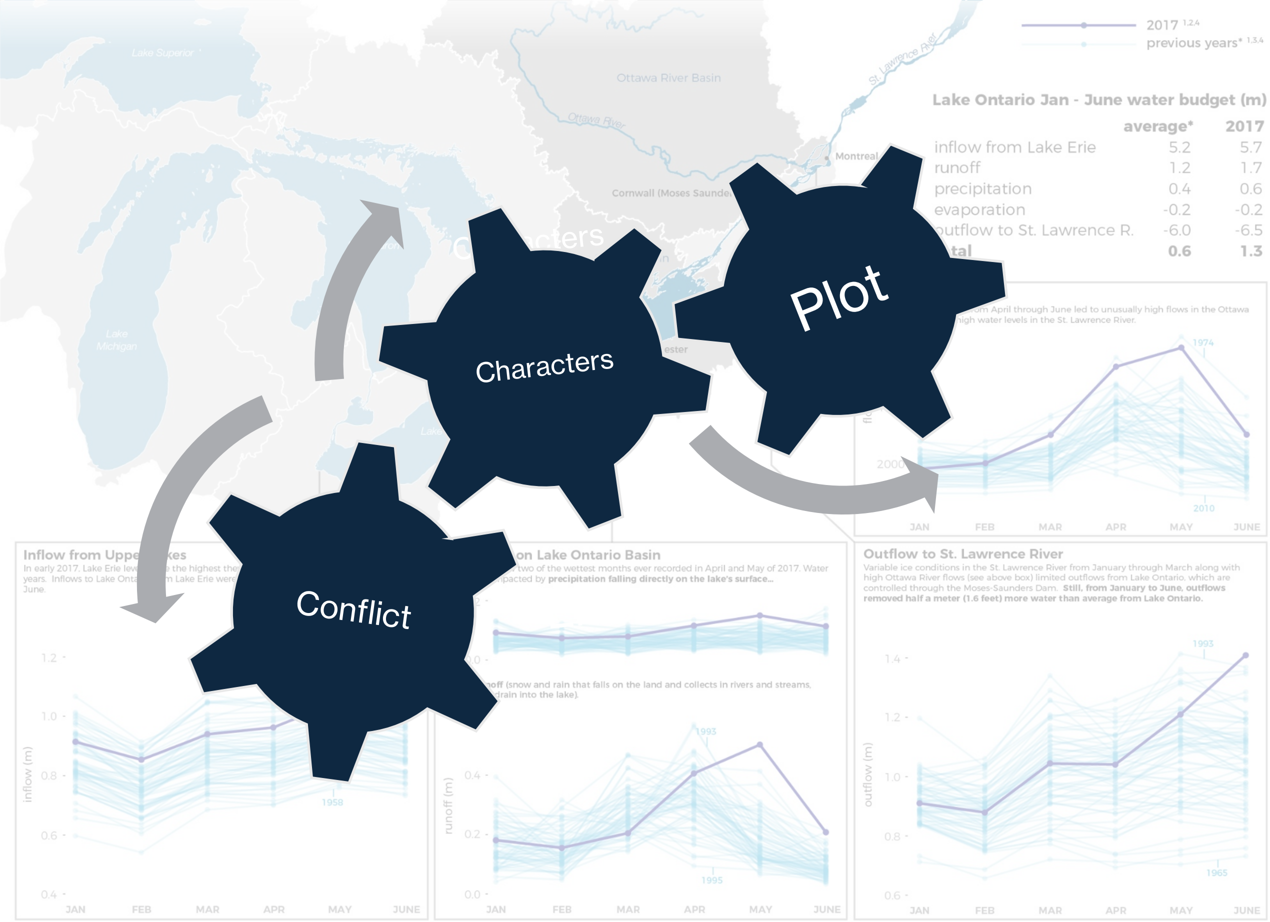

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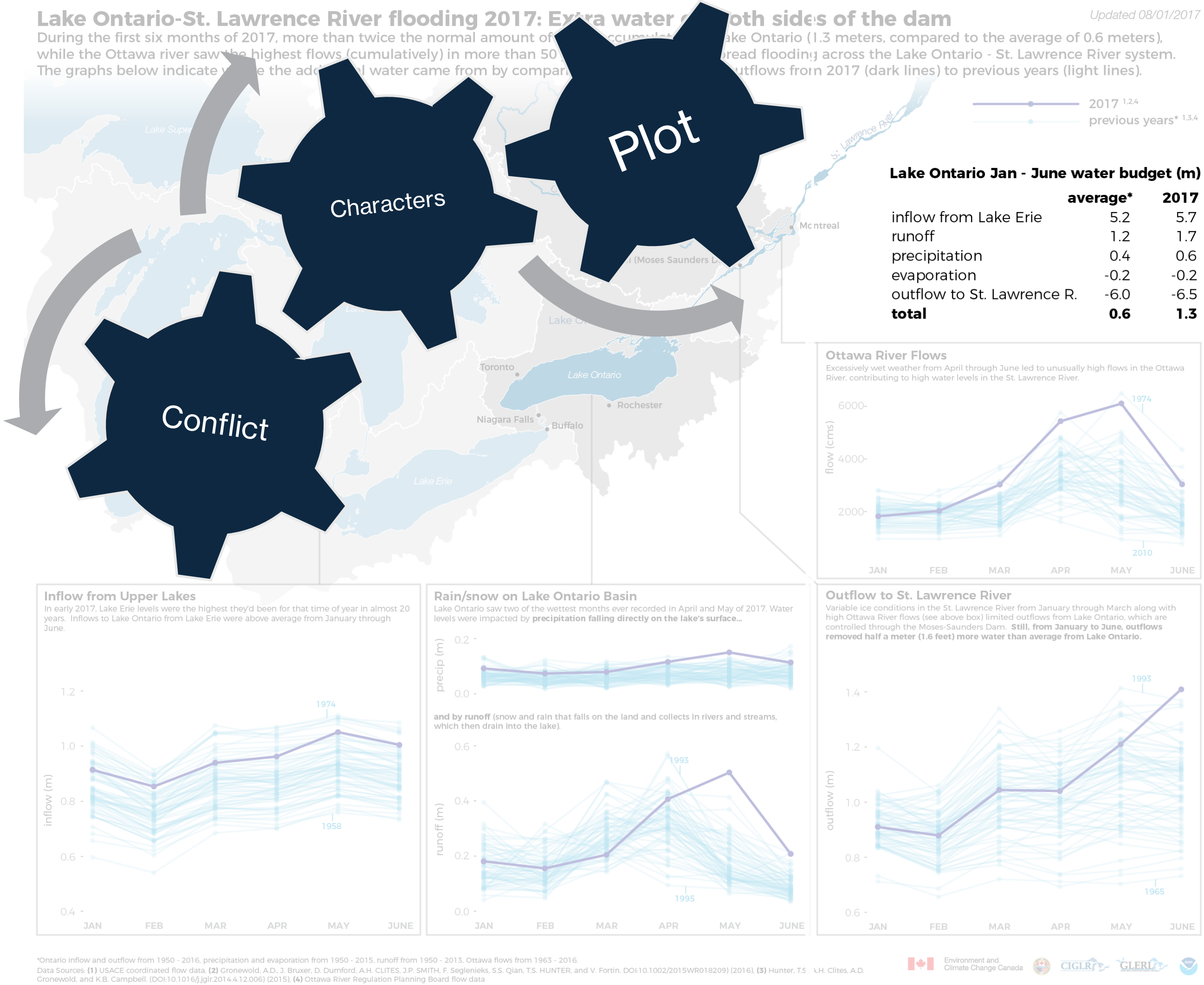

Lake Ontario-St. Lawrence River flooding 2017: Ex
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Updated 08/01/2017
Characters
Plot
Conflict
2017 1,2,4
previous years* 1,3,4
Lake Ontario Jan - June water budget (m)
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Montreal
Toronto
Lake Ontario
Rochester
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Buffalo
Lake Erie
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flow (cms)
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inflow (m)
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runoff (m)
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outflow (m)
JAN FEB MAR APR MAY JUNE
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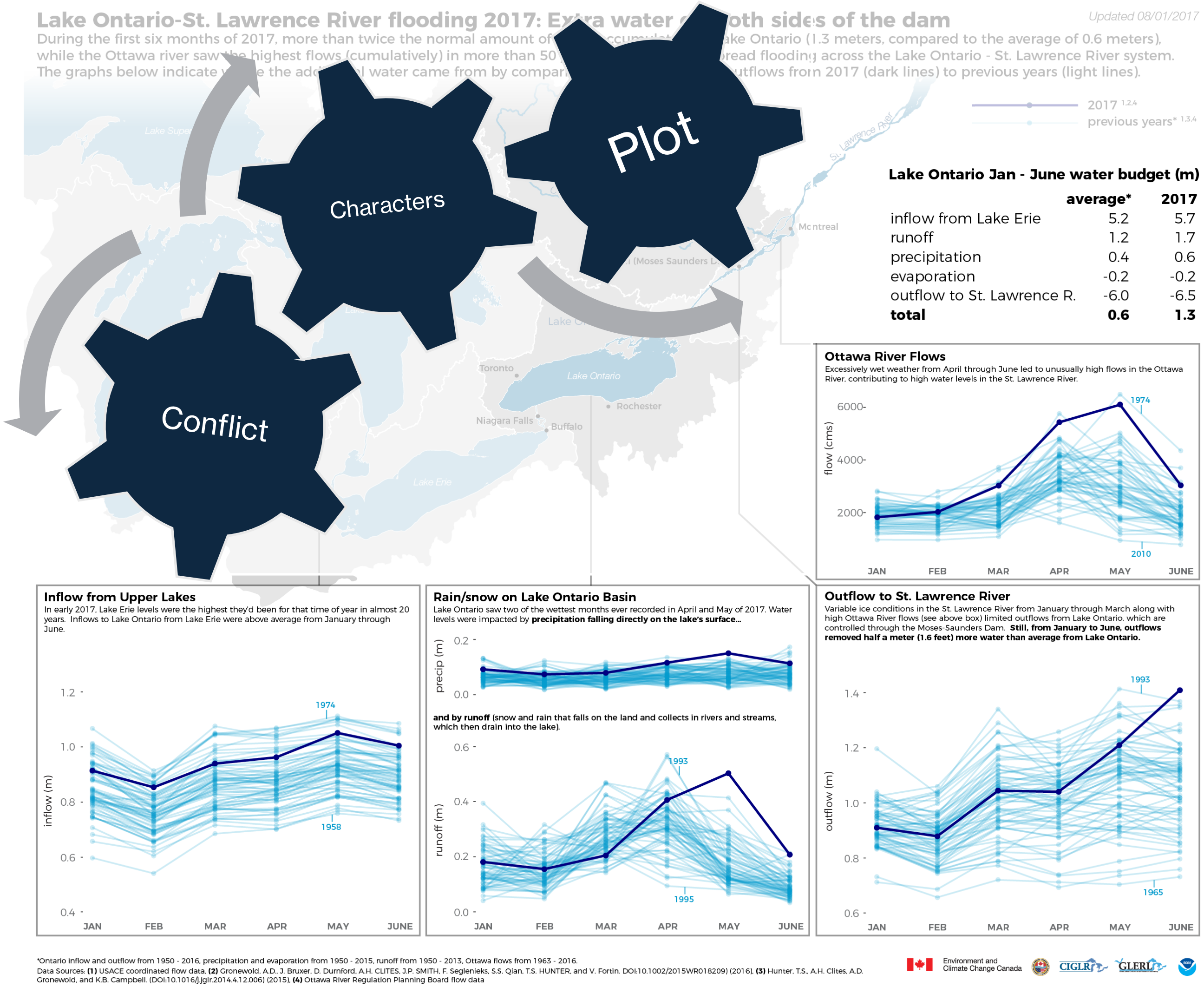
Environment and Climate Change Canada
CIGLR
GLERL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Plot
Characters
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2010
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1965
JAN FEB MAR APR MAY JUNE
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Environment and Climate Change Canada
CIGLR
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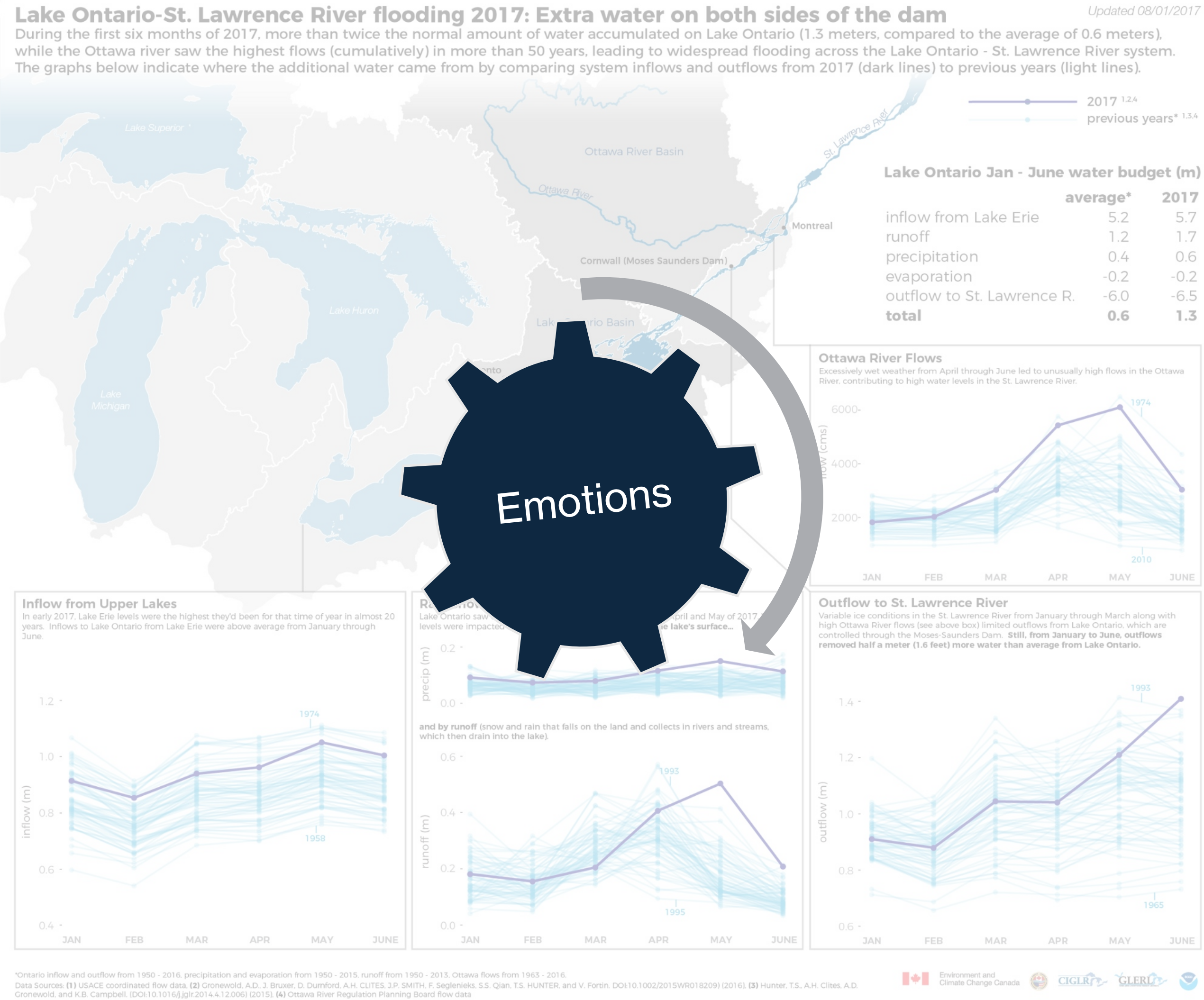
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2017
previous years*
Lake Superior
Ottawa River Basin
Ottawa River
St. Lawrence River
Montreal
Cornwall (Moses Saunders Dam)
Lake Huron
Lake Michigan
Lake Ontario Jan - June water budget (m)
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JAN FEB MAR APR MAY JUNE
inflow (m)
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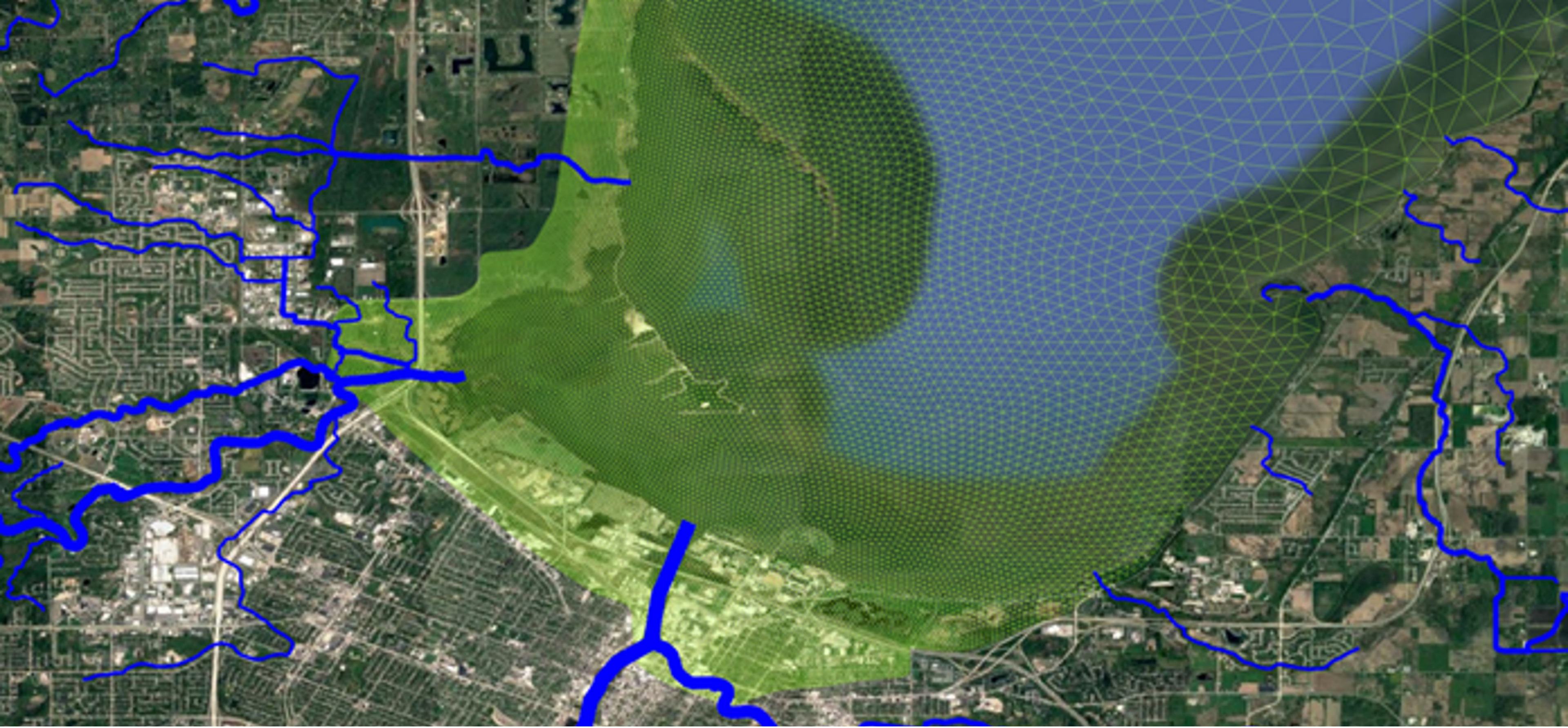
runoff (m)
outflow (m)
Environment and Climate Change Canada
CIGLR
GLERL

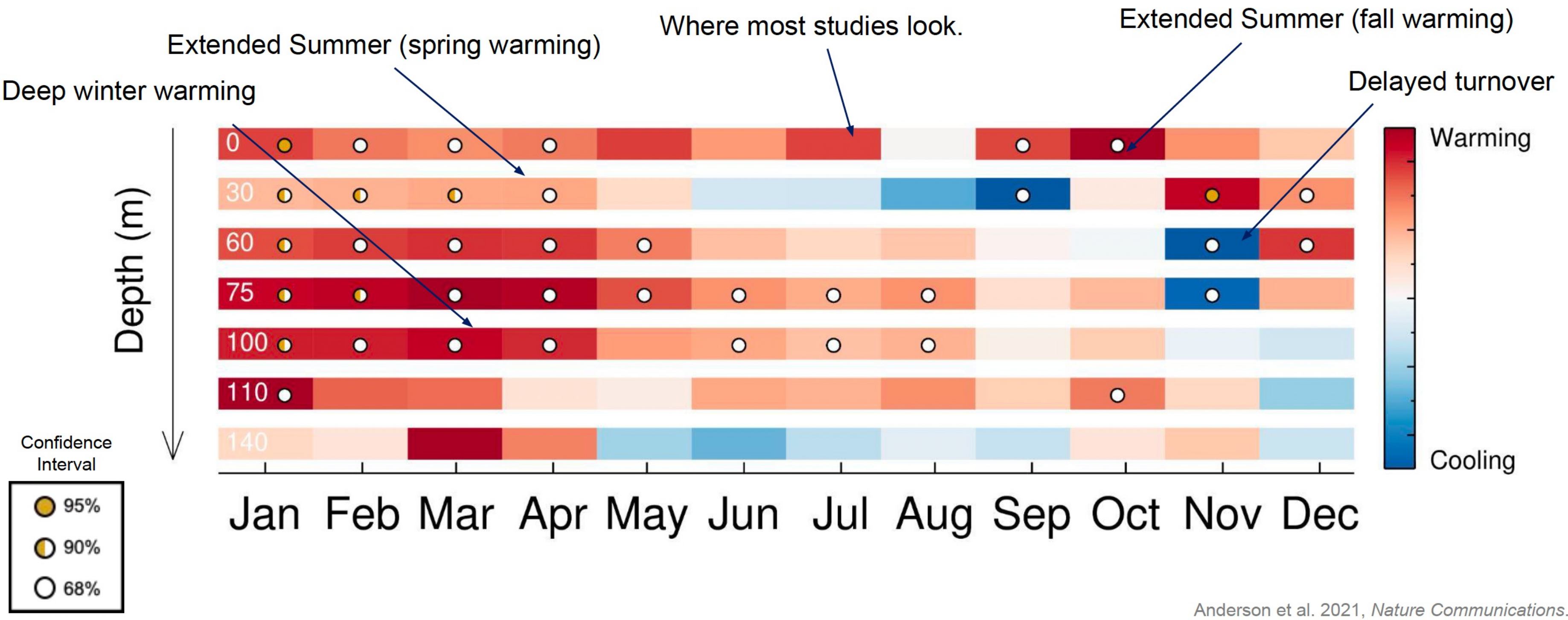
The New York Times

Ontario Spills Into Neighborhoods

Share full article

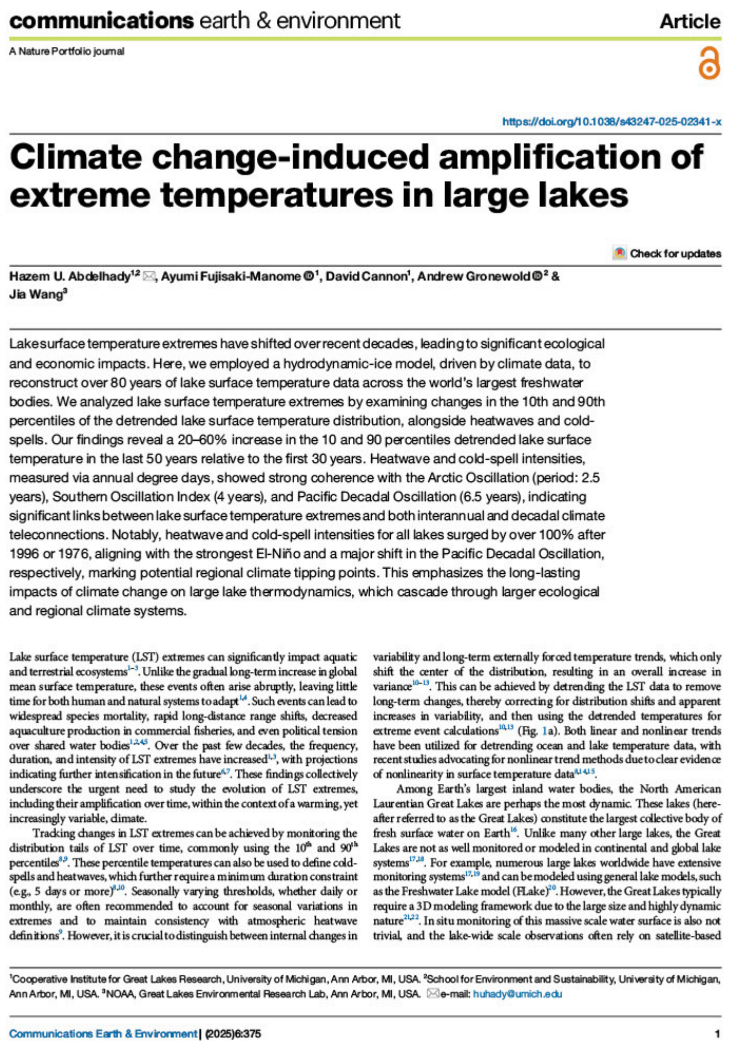


Extending hydrodynamic models to include the floodplain will increase flood preparedness and coastal resilience.



Anderson et al. 2021, *Nature Communications*.

Long term temperature trends: 30 years of Lake Michigan hourly temperatures show changes in subsurface climate trends.


communications earth & environment

Article

A Nature Portfolio journal

https://doi.org/10.1038/s43247-025-02341-x

Climate change-induced amplification of extreme temperatures in large lakes

Check for updates

Hazem U. Abdelhady[1,2] ✉, Ayumi Fujisaki-Manome[1], David Cannon[1], Andrew Gronewold[2] & Jia Wang[3]

Lake surface temperature extremes have shifted over recent decades, leading to significant ecological and economic impacts. Here, we employed a hydrodynamic-ice model, driven by climate data, to reconstruct over 80 years of lake surface temperature data across the world's largest freshwater bodies. We analyzed lake surface temperature extremes by examining changes in the 10th and 90th percentiles of the detrended lake surface temperature distribution, alongside heatwaves and cold-spells. Our findings reveal a 20–60% increase in the 10 and 90 percentiles detrended lake surface temperature in the last 50 years relative to the first 30 years. Heatwave and cold-spell intensities, measured via annual degree days, showed strong coherence with the Arctic Oscillation (period: 2.5 years), Southern Oscillation Index (4 years), and Pacific Decadal Oscillation (6.5 years), indicating significant links between lake surface temperature extremes and both interannual and decadal climate teleconnections. Notably, heatwave and cold-spell intensities for all lakes surged by over 100% after 1996 or 1976, aligning with the strongest El-Niño and a major shift in the Pacific Decadal Oscillation, respectively, marking potential regional climate tipping points. This emphasizes the long-lasting impacts of climate change on large lake thermodynamics, which cascade through larger ecological and regional climate systems.

Lake surface temperature (LST) extremes can significantly impact aquatic and terrestrial ecosystems[1–3]. Unlike the gradual long-term increase in global mean surface temperature, these events often arise abruptly, leaving little time for both human and natural systems to adapt[1,4]. Such events can lead to widespread species mortality, rapid long-distance range shifts, decreased aquaculture production in commercial fisheries, and even political tension over shared water bodies[1,2,4,5]. Over the past few decades, the frequency, duration, and intensity of LST extremes have increased[1,3], with projections indicating further intensification in the future[6,7]. These findings collectively underscore the urgent need to study the evolution of LST extremes, including their amplification over time, within the context of a warming, yet increasingly variable, climate.

Tracking changes in LST extremes can be achieved by monitoring the distribution tails of LST over time, commonly using the 10th and 90th percentiles[8,9]. These percentile temperatures can also be used to define cold-spells and heatwaves, which further require a minimum duration constraint (e.g., 5 days or more)[8,10]. Seasonally varying thresholds, whether daily or monthly, are often recommended to account for seasonal variations in extremes and to maintain consistency with atmospheric heatwave definitions[9]. However, it is crucial to distinguish between internal changes in variability and long-term externally forced temperature trends, which only shift the center of the distribution, resulting in an overall increase in variance[10–13]. This can be achieved by detrending the LST data to remove long-term changes, thereby correcting for distribution shifts and apparent increases in variability, and then using the detrended temperatures for extreme event calculations[10,13] (Fig. 1a). Both linear and nonlinear trends have been utilized for detrending ocean and lake temperature data, with recent studies advocating for nonlinear trend methods due to clear evidence of nonlinearity in surface temperature data[8,14,15].

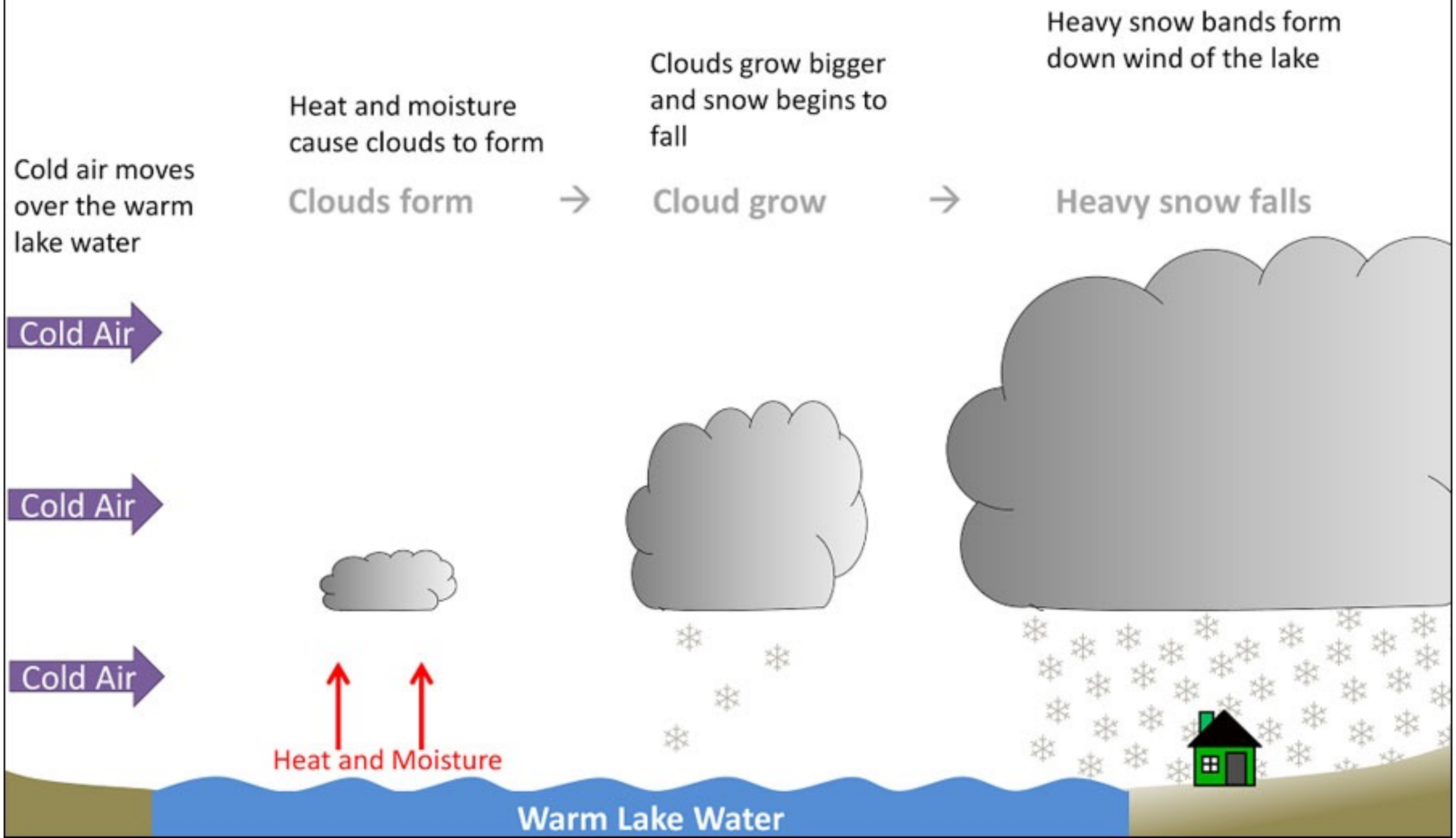
Among Earth's largest inland water bodies, the North American Laurentian Great Lakes are perhaps the most dynamic. These lakes (hereafter referred to as the Great Lakes) constitute the largest collective body of fresh surface water on Earth[16]. Unlike many other large lakes, the Great Lakes are not as well monitored or modeled in continental and global lake systems[17,18]. For example, numerous large lakes worldwide have extensive monitoring systems[17,19] and can be modeled using general lake models, such as the Freshwater Lake model (FLake)[20]. However, the Great Lakes typically require a 3D modeling framework due to the large size and highly dynamic nature[21,22]. In situ monitoring of this massive scale water surface is also not trivial, and the lake-wide scale observations often rely on satellite-based

[1]Cooperative Institute for Great Lakes Research, University of Michigan, Ann Arbor, MI, USA. [2]School for Environment and Sustainability, University of Michigan, Ann Arbor, MI, USA. [3]NOAA, Great Lakes Environmental Research Lab, Ann Arbor, MI, USA. ✉e-mail: huhady@umich.edu

The Great Lakes are experiencing more extreme temperatures, with heat waves and cold spells being amplified across the region, according to a new study.

NOAA is studying the relationships between ice cover, lake temperatures, and regional climate through models based on observations of variables, such as ice cover and surface water temperature.

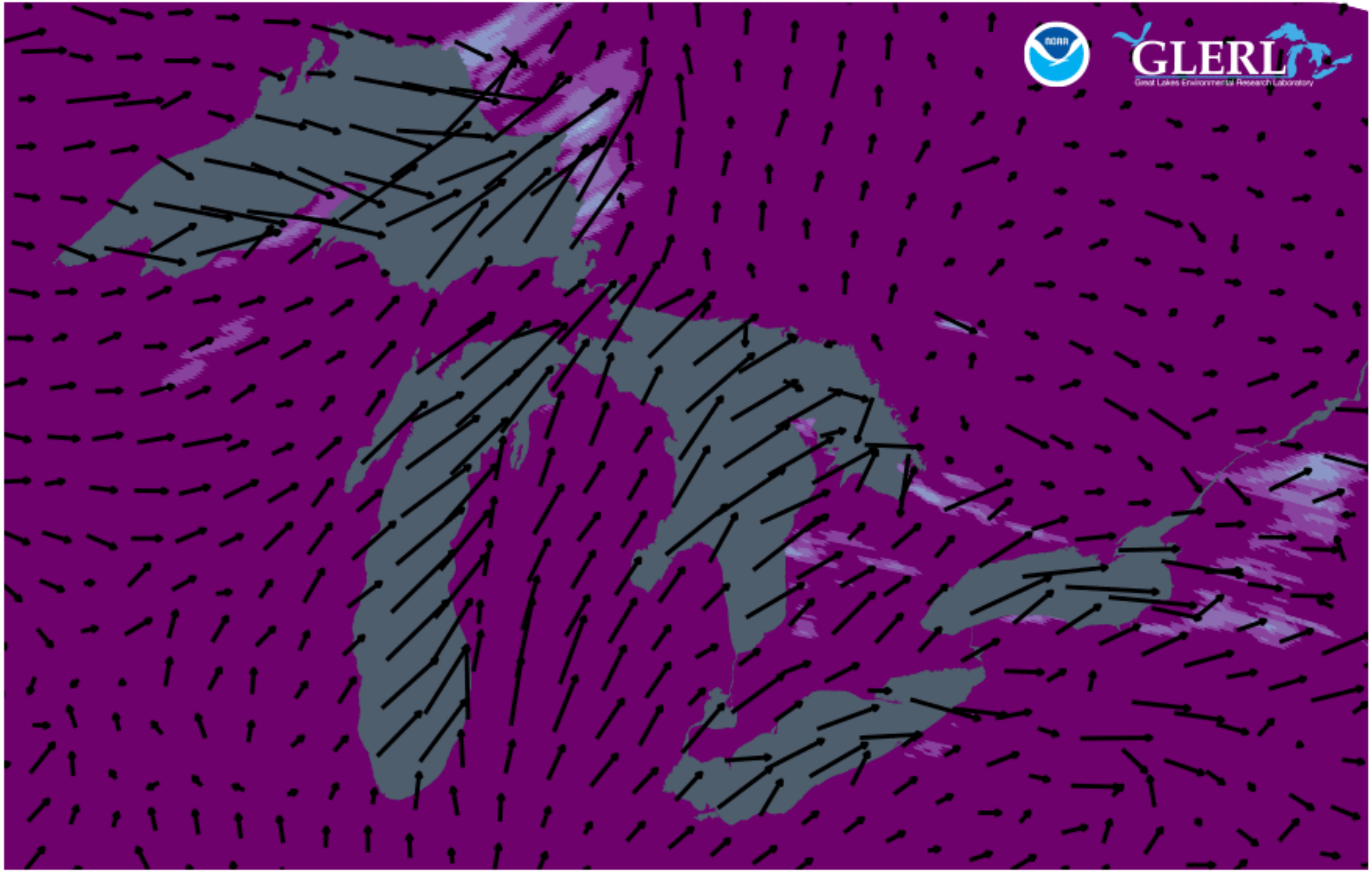
Lake effect snow forms when **cold air** moves over **warm water**

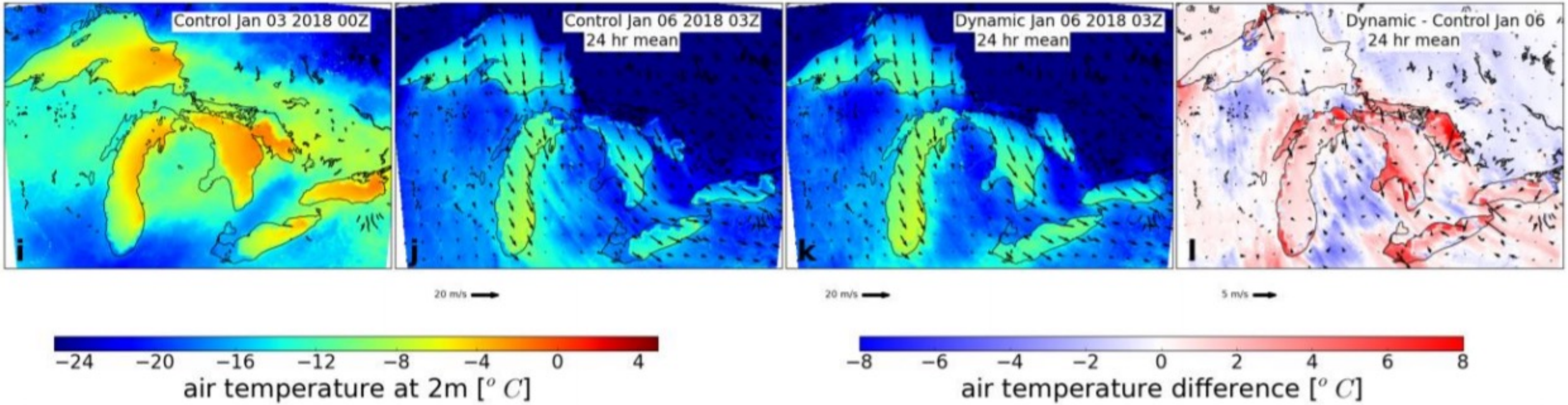



Buffalo,
NY

December 13, 2016

snow accumulation: low high





Rapid changes in Great Lakes temperatures and ice impact regional atmospheric conditions and lake-effect snow.

The Great Lakes are facing new challenges: harmful algal blooms, hypoxia, and a warming climate.


WTOL 11
WEATHER
NEXT 4 DAYS
SUNNY
MS LATE
DRY
PART
SATU
NDAY
protecting our
water

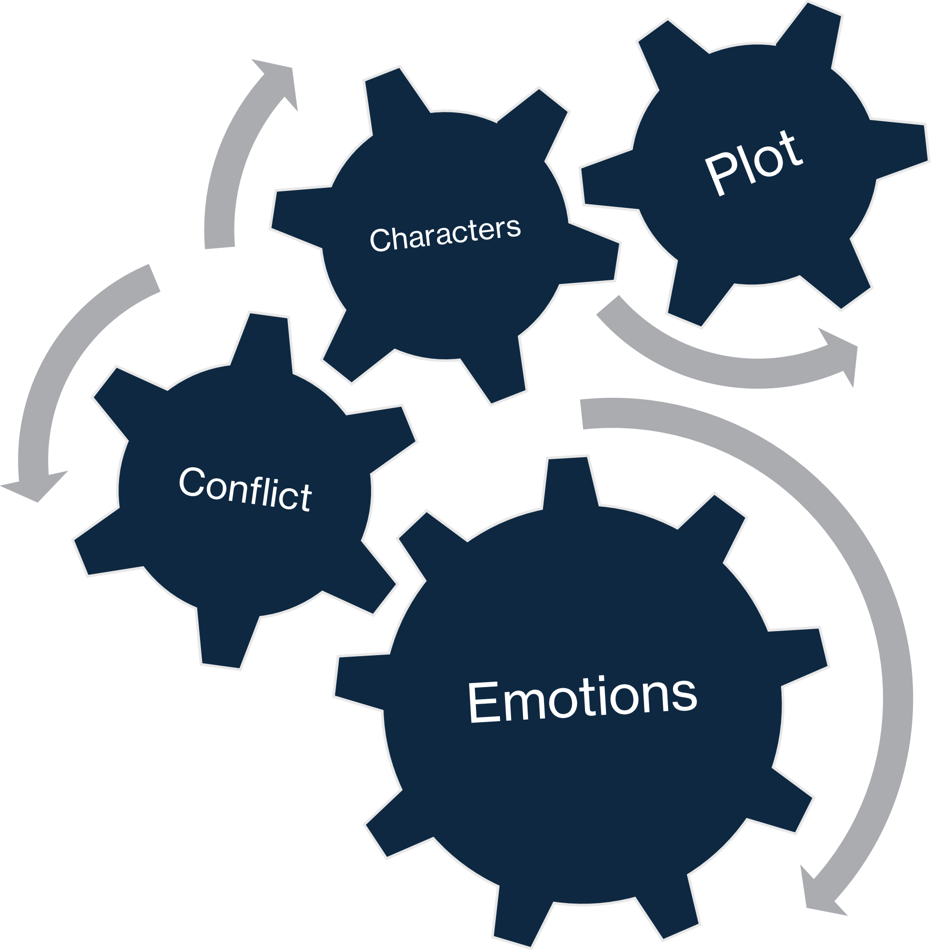
"...the warming that has already occurred is now impacting human health and our water resources." Gobler 2024

Collaboration between 16 federal agencies working with states, tribes, municipalities, universities, and NGOs.

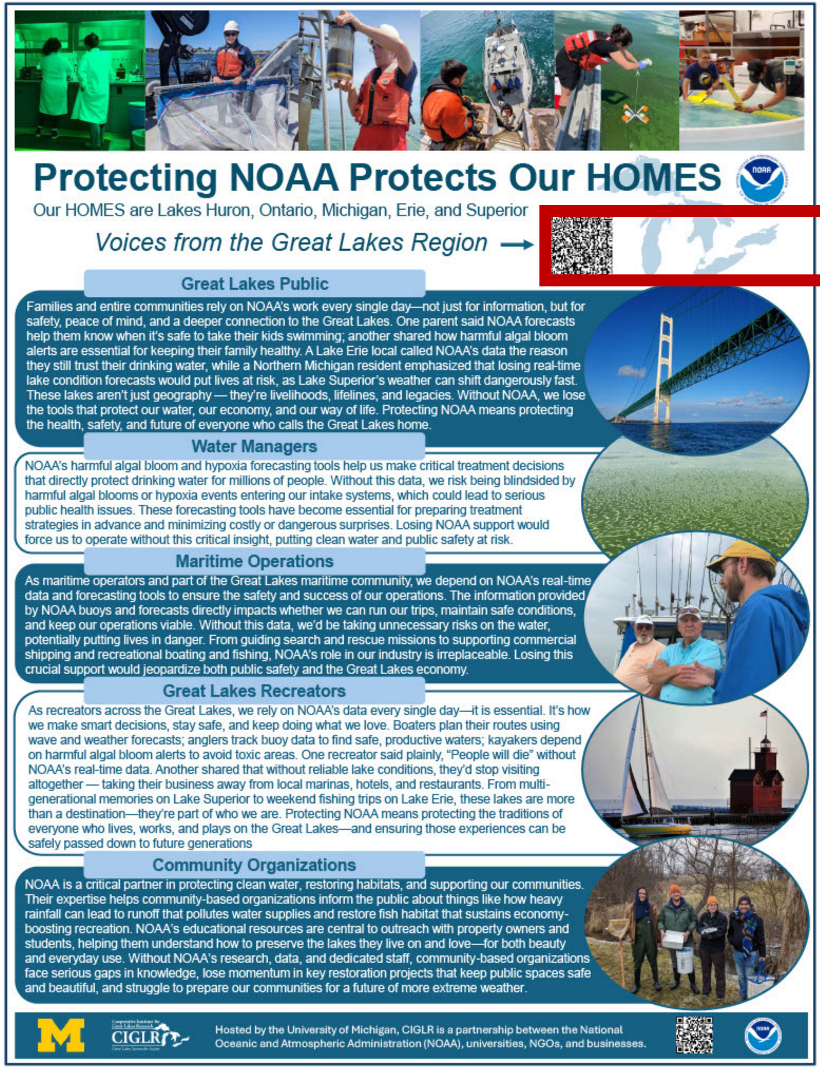
608 NOAA projects funded.

Nearly $5.7 billion allocated across all agencies since 2010.

Great Lakes Restoration Initiative



How can YOUR story shape our climate future?



Protecting NOAA Protects Our HOMES

Our HOMES are Lakes Huron, Ontario, Michigan, Erie, and Superior

Voices from the Great Lakes Region →

Great Lakes Public

Families and entire communities rely on NOAA's work every single day—not just for information, but for safety, peace of mind, and a deeper connection to the Great Lakes. One parent said NOAA forecasts help them know when it's safe to take their kids swimming; another shared how harmful algal bloom alerts are essential for keeping their family healthy. A Lake Erie local called NOAA's data the reason they still trust their drinking water, while a Northern Michigan resident emphasized that losing real-time lake condition forecasts would put lives at risk, as Lake Superior's weather can shift dangerously fast. These lakes aren't just geography — they're livelihoods, lifelines, and legacies. Without NOAA, we lose the tools that protect our water, our economy, and our way of life. Protecting NOAA means protecting the health, safety, and future of everyone who calls the Great Lakes home.

Water Managers

NOAA's harmful algal bloom and hypoxia forecasting tools help us make critical treatment decisions that directly protect drinking water for millions of people. Without this data, we risk being blindsided by harmful algal blooms or hypoxia events entering our intake systems, which could lead to serious public health issues. These forecasting tools have become essential for preparing treatment strategies in advance and minimizing costly or dangerous surprises. Losing NOAA support would force us to operate without this critical insight, putting clean water and public safety at risk.

Maritime Operations

As maritime operators and part of the Great Lakes maritime community, we depend on NOAA's real-time data and forecasting tools to ensure the safety and success of our operations. The information provided by NOAA buoys and forecasts directly impacts whether we can run our trips, maintain safe conditions, and keep our operations viable. Without this data, we'd be taking unnecessary risks on the water, potentially putting lives in danger. From guiding search and rescue missions to supporting commercial shipping and recreational boating and fishing, NOAA's role in our industry is irreplaceable. Losing this crucial support would jeopardize both public safety and the Great Lakes economy.

Great Lakes Recreators

As recreators across the Great Lakes, we rely on NOAA's data every single day—it is essential. It's how we make smart decisions, stay safe, and keep doing what we love. Boaters plan their routes using wave and weather forecasts; anglers track buoy data to find safe, productive waters; kayakers depend on harmful algal bloom alerts to avoid toxic areas. One recreator said plainly, "People will die" without NOAA's real-time data. Another shared that without reliable lake conditions, they'd stop visiting altogether — taking their business away from local marinas, hotels, and restaurants. From multi-generational memories on Lake Superior to weekend fishing trips on Lake Erie, these lakes are more than a destination—they're part of who we are. Protecting NOAA means protecting the traditions of everyone who lives, works, and plays on the Great Lakes—and ensuring those experiences can be safely passed down to future generations

Community Organizations

NOAA is a critical partner in protecting clean water, restoring habitats, and supporting our communities. Their expertise helps community-based organizations inform the public about things like how heavy rainfall can lead to runoff that pollutes water supplies and restore fish habitat that sustains economy-boosting recreation. NOAA's educational resources are central to outreach with property owners and students, helping them understand how to preserve the lakes they live on and love—for both beauty and everyday use. Without NOAA's research, data, and dedicated staff, community-based organizations face serious gaps in knowledge, lose momentum in key restoration projects that keep public spaces safe and beautiful, and struggle to prepare our communities for a future of more extreme weather.

Hosted by the University of Michigan, CIGLR is a partnership between the National Oceanic and Atmospheric Administration (NOAA), universities, NGOs, and businesses.

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Climate Action in 2025 and Beyond: Creating a Resilient and Just Future in Michigan and Across the Globe [LIVE STREAM LINK BELOW]

Rackham Amphitheatre | Tuesday January 14, 2025 | 4:30 pm
915 E Washington St.
Ann Arbor, MI

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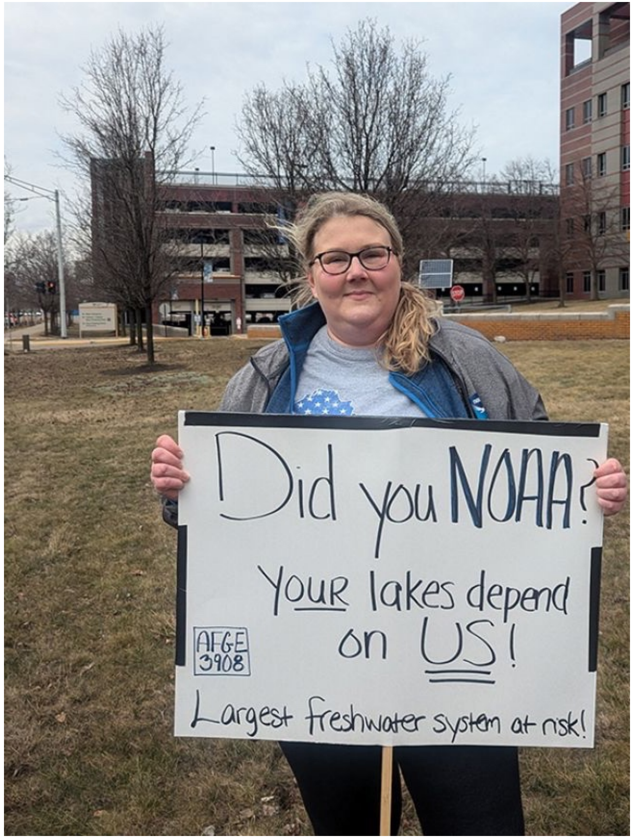
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