



Climate Change in Wisconsin

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 UNIVERSITY OF WISCONSIN – MADISON

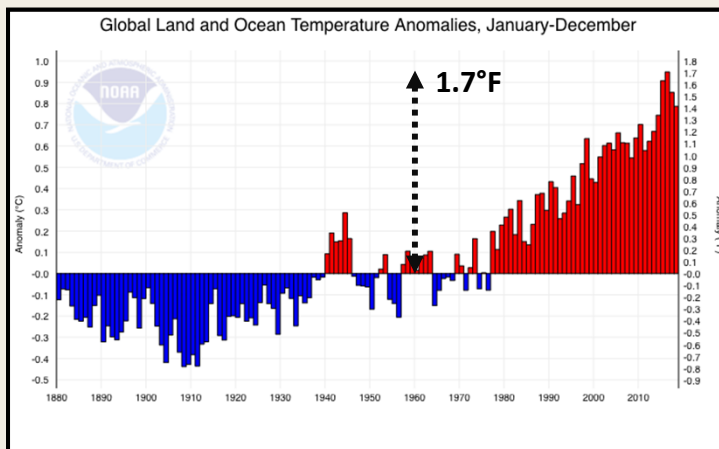


Objectives

- **Global Climate Change:** What we know and how we know it
- **Climate Change in Wisconsin:** What does it mean for Wisconsin?
- **Solutions:** What can we do?

GLOBAL CLIMATE CHANGE: What we know, and how we know it.

1. The world is warming.

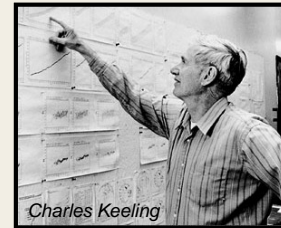
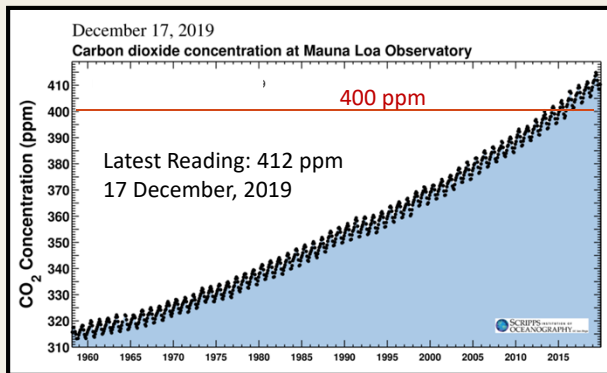


Global temperature has warmed by about 1.7°F from 1900-2000 average conditions

NOAA: https://www.ncdc.noaa.gov/cag/time-series/global/globe/land_ocean/ytd/12/1880-2016

2. Carbon Dioxide is increasing (it's us).

CO₂ and greenhouse gasses are increasing due to human emissions

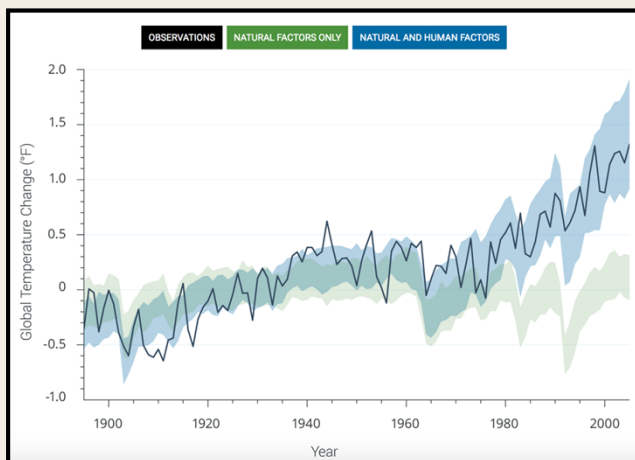


Greenhouse Gasses: "Trap" energy in lower atmosphere

Anthropogenic: Caused by human activity

<https://scripps.ucsd.edu/programs/keelingcurve/>

3. Recent warming is Anthropogenic

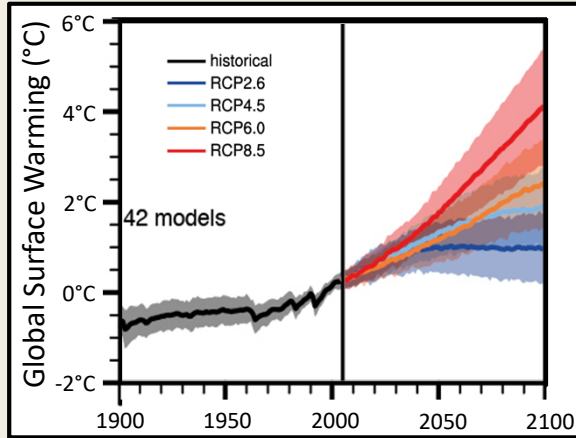


Anthropogenic: Human generated

Without Anthropogenic greenhouse gasses, models cannot reproduce the warming since 1950.

<http://nca2014.globalchange.gov/>

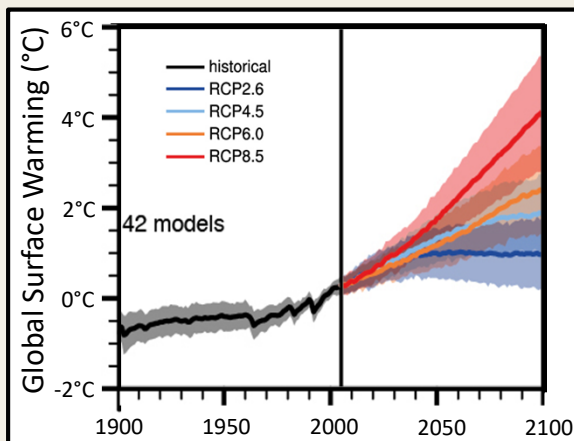
Global Climate Change: What's next



Global temperature will continue to warm by about 1.5°C (3°F) by 2050, 2°-4°C (3.5°-7.5°F) by 2100

Image: IPCC WGI, 5th Assessment Report

Global Climate Change: Solutions



Mitigation:
Avoids “dangerous” amounts of climate change

Adaptation:
Some climate change is inevitable
Adaptation needed to minimize impacts

Image: IPCC WGI, 5th Assessment Report

GLOBAL CLIMATE CHANGE:
Questions?

LOCAL CLIMATE CHANGE:
What does climate change mean for
Wisconsin?

WICCI Overview



WICCI's mission is to generate and share information that can limit vulnerability to climate change in Wisconsin and the Upper Midwest.

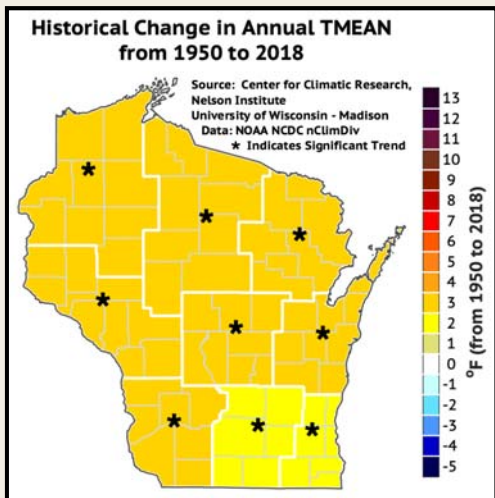
<http://www.wicci.wisc.edu>

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WICCI is seeking guidance from the Task Force:

- *Data / Information needs (existing information resources)*
- *Working group priorities (new information needed)*
- *Solutions strategies (science to back solutions)*

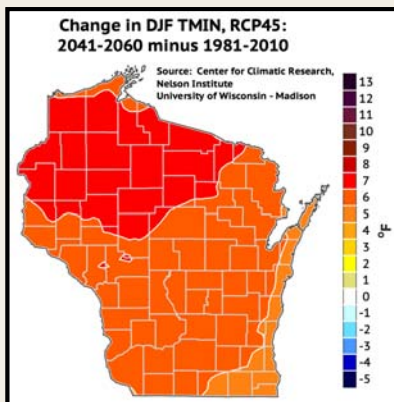
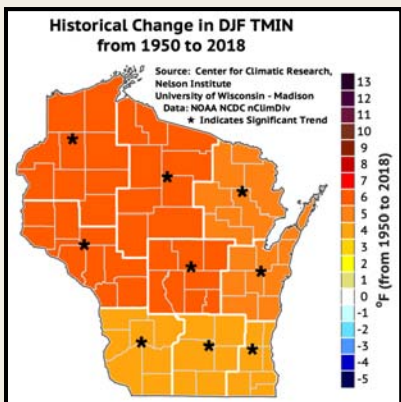
How is Wisconsin's CLIMATE CHANGING?



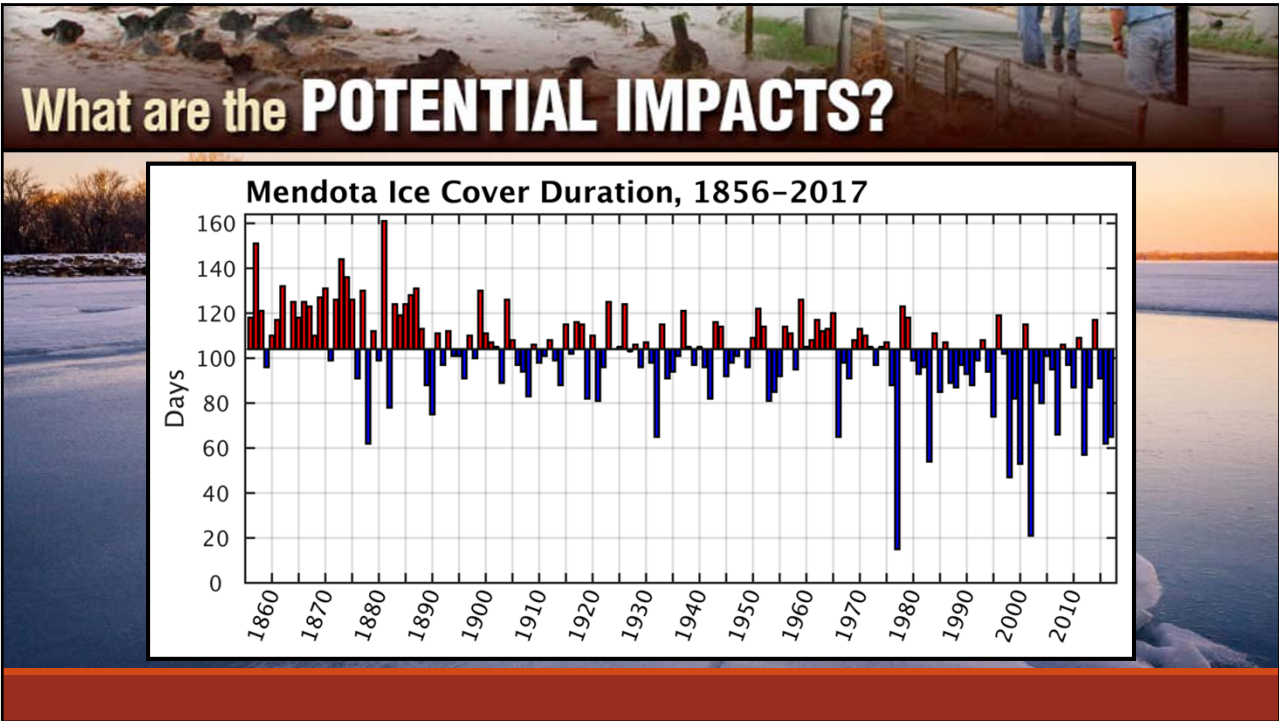
Wisconsin has warmed about 2-3°F since 1950.
(Wisconsin will warm by another 2-8°F by 2050)

Image Credit: David Lorenz

How is Wisconsin's CLIMATE CHANGING?



Winter warms more than summer
WI winters will warm by 3-10°F by 2050



What are Wisconsin's possible ADAPTATION STRATEGIES?

Climate Wisconsin 2050

Wisconsin's climate is changing, and our lakes will continue to experience direct and indirect impacts from these changes. This publication provides guidance on how climate changes will alter our lake ecosystems, and how lake managers can prepare for and adapt to those changes.

Scenarios of a State of Change: Lakes

Wisconsin has 15,074 documented lakes, ranging in size from one-acre lakes to the 13,718-acre Lake Winnebago. Almost 3 percent of Wisconsin - nearly a million acres - is lakes. These lakes are integral to the cultural identity of our state.

However, Wisconsin's climate is changing, and warmer temperatures and changes in precipitation will drastically impact our lakes.

Look inside for a snapshot of what we can expect from Wisconsin's climate and weather by the year 2050, and how lake managers can adapt to these changing conditions.

How is Wisconsin's CLIMATE CHANGING?

Historical Change in JJA TMEAN from 1950 to 2018

Source: Center for Climatic Research, Nelson Institute
University of Wisconsin - Madison
Data: NOAA NCDC nClimDiv
* Indicates Significant Trend

°F (from 1950 to 2018)

Change in JJA TMAX, RCP45: 2041-2060 minus 1981-2010

Source: Center for Climatic Research, Nelson Institute
University of Wisconsin - Madison

°F

Less warming during summer days

WI summers will warm by 1-7°F by 2050

What are the POTENTIAL IMPACTS?



Photo: Matt Mitro

Warmer Summers → Reduced brook trout habitat

What are Wisconsin's possible ADAPTATION STRATEGIES?

DNR Driftless Area Master Plan

- Trout fishing → \$1B annually
- Tourism provides 470 jobs in Vernon Co.
- Investment to restore 450m of streams



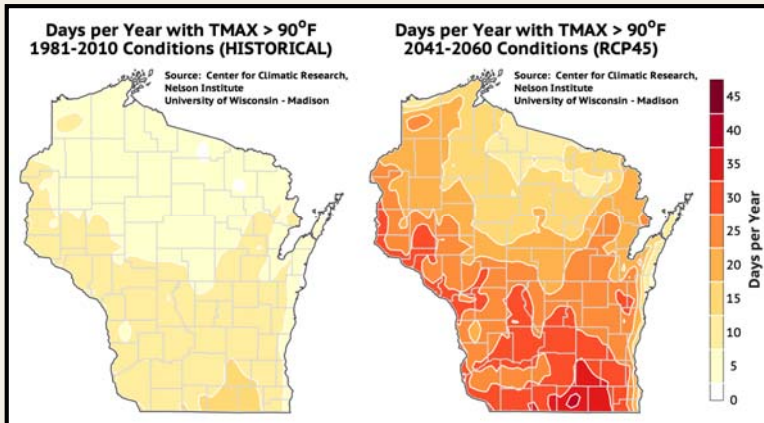
The Driftless Area encompasses part or all of 23 counties in Wisconsin. To provide information at a meaningful scale, the Driftless Area is divided into eight Planning Regions that have similar types of aquatic and landscape features. Information for each Planning Region is presented by watershed and sub-watershed in a nested spatial structure. Sub-watersheds are comprised of catchments, which encompasses the land area that drains into each stream reach.

Information in this RPA ranges from fish abundance to habitat quality to human population density. In an effort to present the information simply and consistently, each watershed and sub-watershed is evaluated for how well it "performs" for a particular metric, relative to the other watersheds and sub-watersheds. These scores are then presented in a "report card" format.

Thus, the report card has "students," which are the watersheds (94) or sub-watersheds (441) and "subjects," which are habitat quality, the size and number of fish present, amount of public access, and the other topics being evaluated. The "students" are graded relative to the entire Driftless Area with A, B, C, D, and F's assigned. The maps in the RPA depict assessment grades at the finer sub-watershed scale, while the tabular report card is presented at the broader watershed scale.

The benefit of this approach is that it identifies the best or most pressing opportunities for future management and protection efforts. The downside is that in cases where all or most of the "students" perform well, grading on a curve gives the impression that some watersheds or sub-watersheds are poor or falling when in reality their performance is fine, but just not as high as the other "students." Similarly, in cases where few, if any, watersheds are functioning well, the best performers get high grades, despite poor performance.

How is Wisconsin's CLIMATE CHANGING?

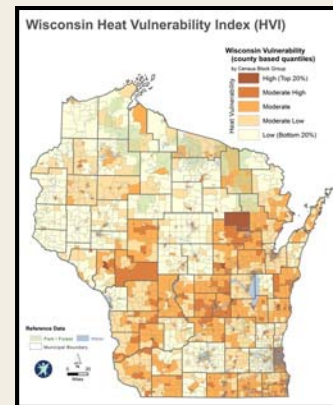


Frequency of extreme heat triples by mid-century

What are Wisconsin's possible ADAPTATION STRATEGIES?

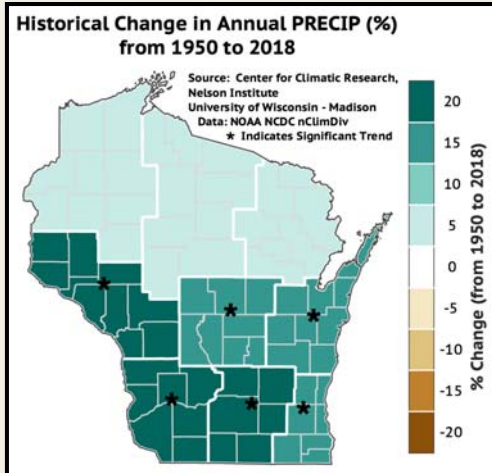
DHS Building Resilience Against Climate Effects (BRACE):

- Environmental health
- Toolkits
- Vulnerability Indices



<https://www.dhs.wisconsin.gov/climate/index.htm>

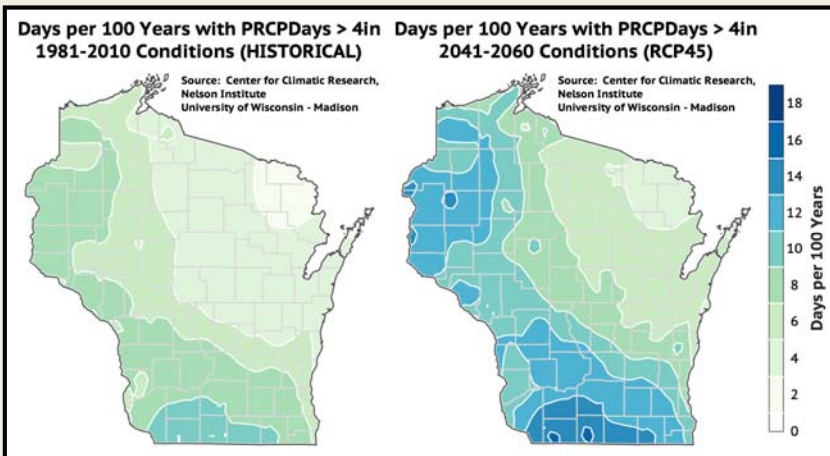
How is Wisconsin's CLIMATE CHANGING?



Wisconsin has become 10-20% wetter since 1950.
(Precipitation will likely increase by 2050 - especially winter / spring)

Image Credit: David Lorenz

What are the POTENTIAL IMPACTS?



Increased frequency of extreme precipitation

What are the **POTENTIAL IMPACTS?**

Impacts to Agriculture

More summer extreme heat

- Loss of dairy yield
- Increased miscarriage
- Cooling infrastructure

Increased extreme precipitation

- Reduced yield due to flooding
- Increased cost for feed transport

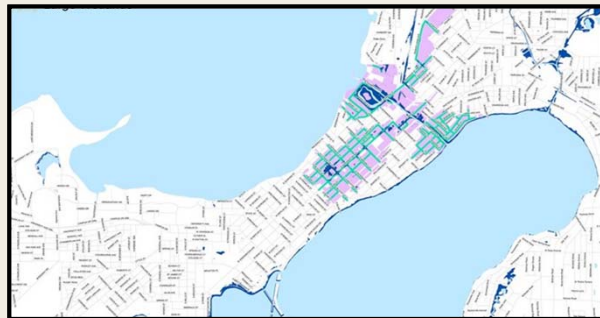


<https://fyi.extension.wisc.edu/fieldcroppathology/2016/07/22/corn-rusts-in-wisconsin/>

What are Wisconsin's possible **ADAPTATION STRATEGIES?**



Model Simulation, 2014



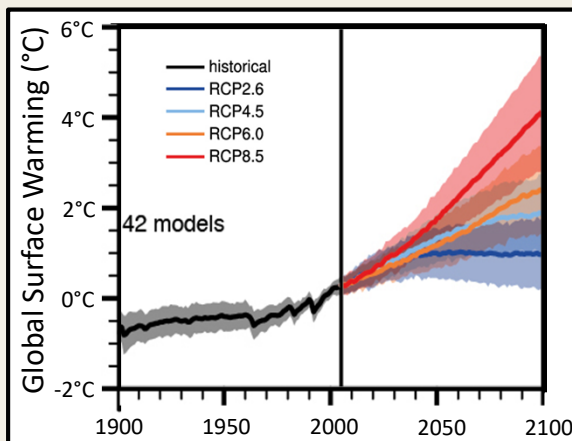
Isthmus Flooding, September, 2018

<https://toolkit.climate.gov/case-studies/using-demonstration-storms-prepare-extreme-rainfall>

SOLUTIONS

What can we do?

Global Climate Change: Solutions



Mitigation:

Avoids “dangerous” amounts of climate change

Adaptation:

Some climate change is inevitable

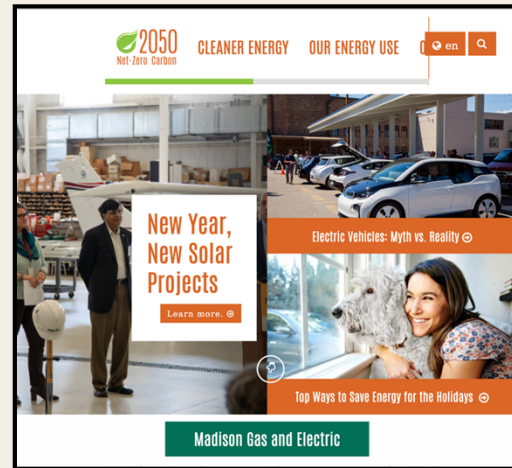
Adaptation needed to minimize impacts

Image: IPCC WGI, 5th Assessment Report

Win-win (-win-win ...) Opportunities

Renewable Energy

- Reduce greenhouse gasses
- Market stability (MGE)
- Create jobs (162,000 potential)
- Improved health (reduced pollution)



<https://www.energy2030together.com/en/>

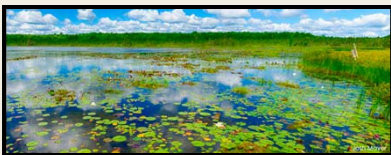
Using Nature



Forests: Reforestation and Management



Agriculture: Land conservation, "carbon farming"



Wetlands: Conservation, management

Fargione, J. E., and Coauthors, 2018: Natural climate solutions for the United States. *Sci. Adv.*, 4, doi:10.1126/sciadv.aat1869.

Urban Opportunities



Urban: Green infrastructure builds resilience and improves function



<https://www.climatecentral.org/>

Strength in Diversity



Elijah Furquan
Spoken Word Artist - Milwaukee, WI



Kyle Niedfeldt Zenz
Bangor, WI

GLIFWC Climate Change Program; www.climatewisconsin.org

WICCI Objectives:

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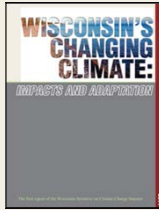
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- *Working group priorities (new information needed)*
- *Solutions strategies (science to back solutions)*



The Wisconsin Initiative on Climate Change Impacts
 ENABLING CLIMATE ADAPTATION IN WISCONSIN

<http://www.wicci.wisc.edu>

Resources:



Wisconsin Initiative on Climate Change Impacts:

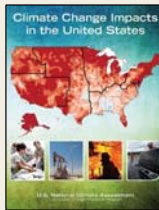
<http://www.wicci.wisc.edu>

Center for Climatic Research Data Pages:

<http://nelson.wisc.edu/ccr/resources/visualization-and-tools.php>

National Climate Assessment (2014):

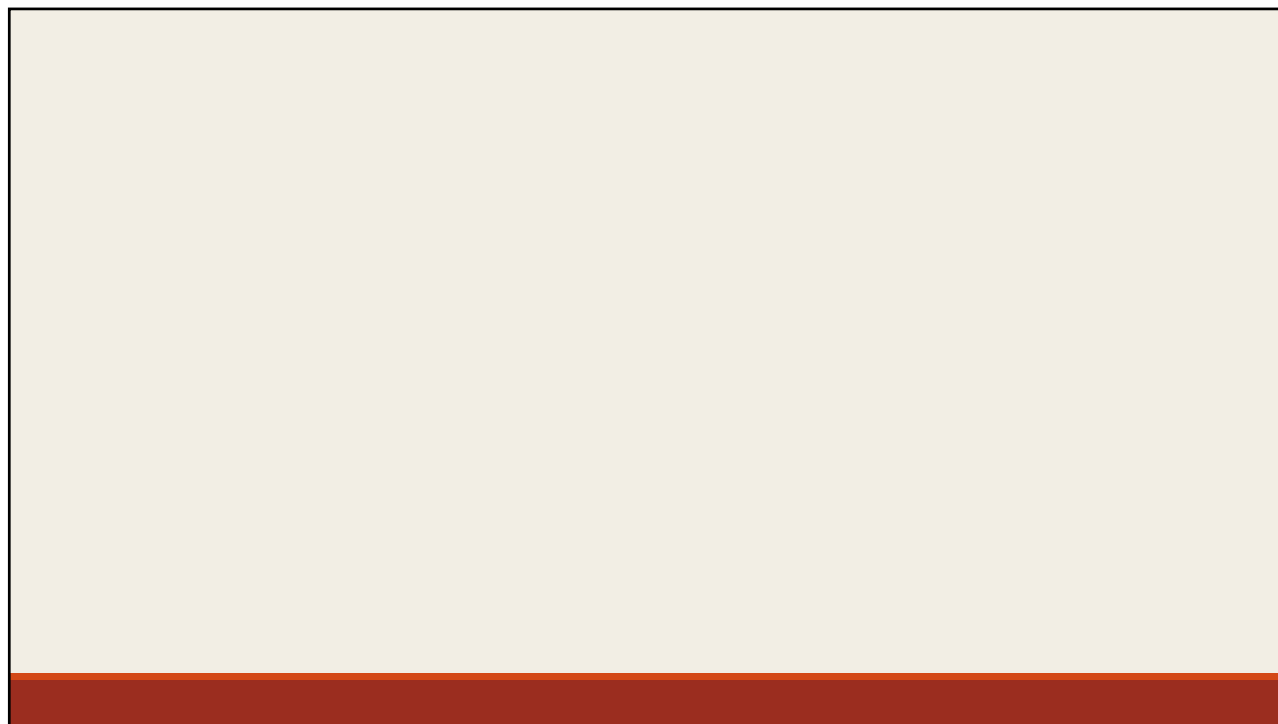
<http://nca2014.globalchange.gov/>



Project Drawdown:

<https://www.drawdown.org/>

References

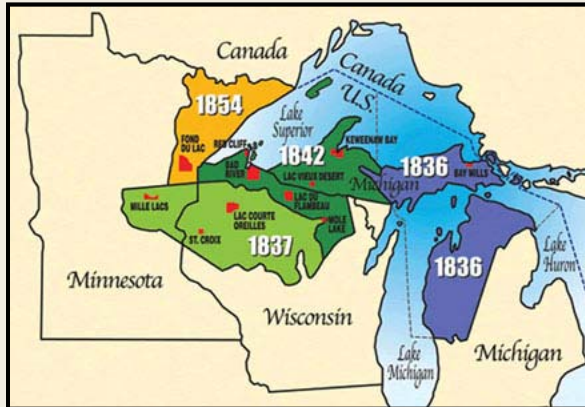


The Wisconsin Initiative on Climate Change Impacts

ENABLING CLIMATE ADAPTATION IN WISCONSIN AND THE UPPER MIDWEST

<http://www.wicci.wisc.edu>

Climate Change and Tribal Resources

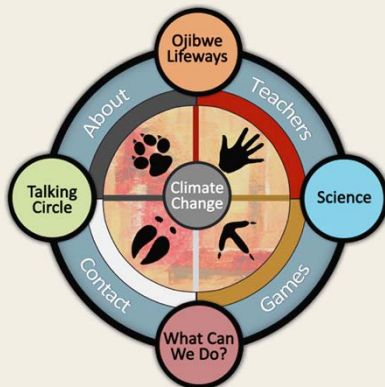


Ceded Territories (GLIFWC)

Ceded Territory treaties stipulate that the intrinsic natural resource quality and ecology of ceded lands must be preserved and made available to tribal communities for maintaining their traditional lifestyle.

Meg Gordon, WICCI Website

Climate Change and Tribal Resources



G-WOW

“Gikinoo’wizhiwe Onji Waaban” (Guiding for Tomorrow), or G-WOW

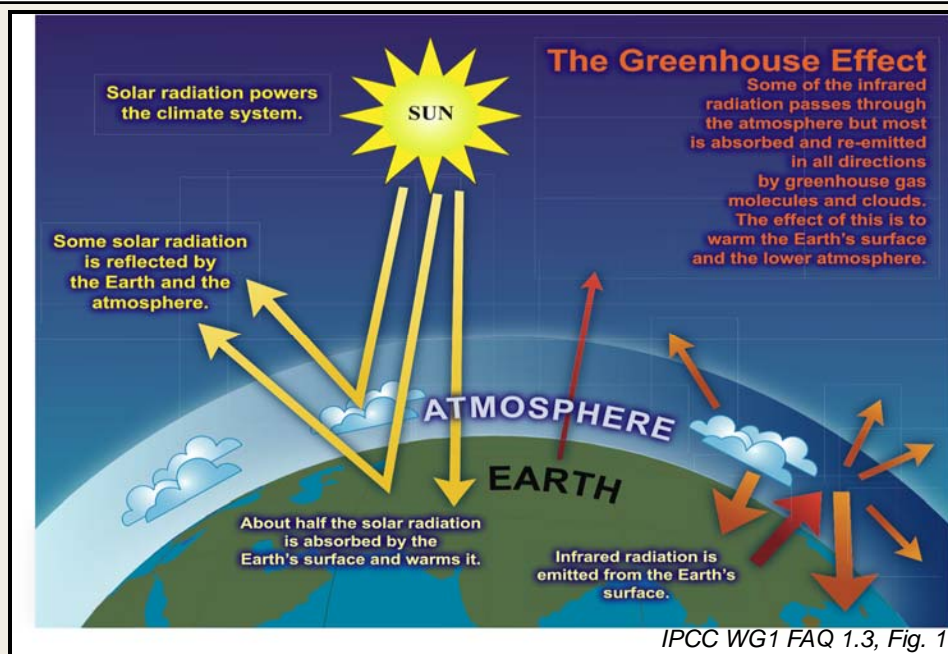
A service learning curriculum that integrates place-based evidence of climate change with science and promotes action

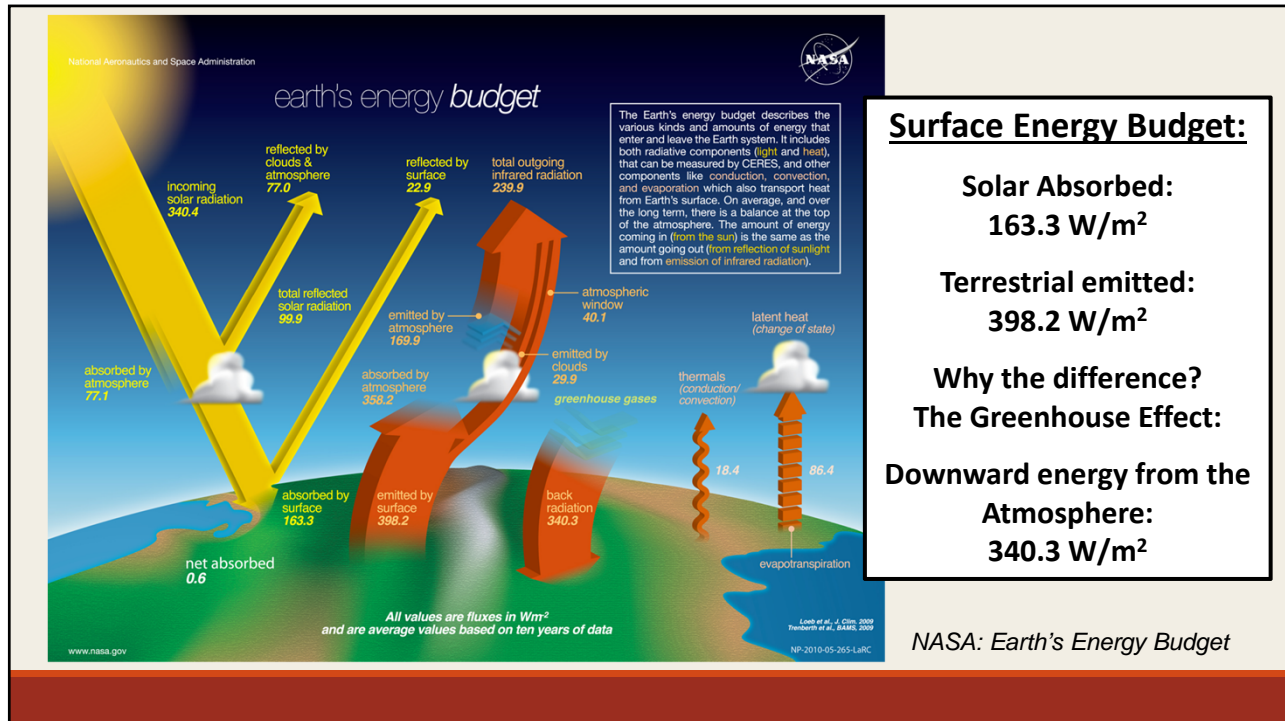
<http://www.g-wow.org/en-us/default.aspx>

Cat Techtmann, UWEX

Climate Change and Tribal Resources

- *GLIFWC Climate Change Conservation priorities:*
 - Lake superior lake trout depth/temp study
 - Lake superior fish diet study
 - Walleye study
 - Phenology study
 - Seed bank pilot project
 - Vulnerability assessment for ceded territories
- *Oneida Hazard Management*
- *Red Cliff / Oneida / Ho-Chunk Climate Change Online Trainings*
 - Tribe-led project to provide trainings on climate impacts



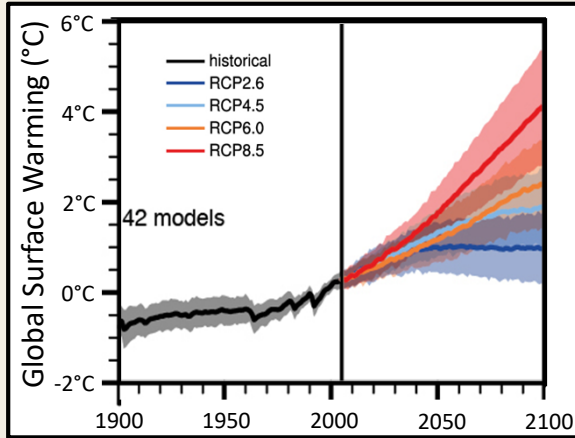


IPCC AR5 Attribution Statement:

It is *extremely likely* that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in greenhouse gas concentrations and other anthropogenic forcings together.

IPCC AR5 Summary for Policy Makers

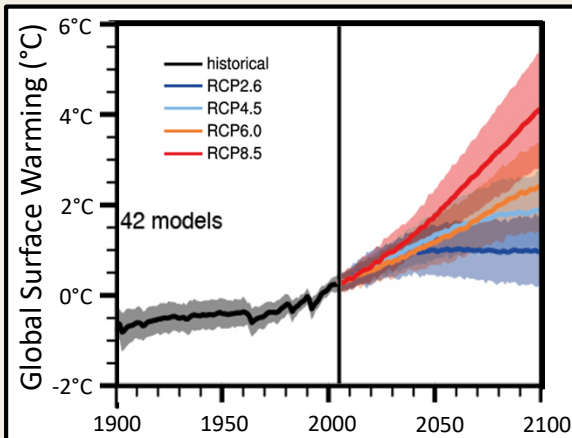
Global Climate Change: What's next



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Image: IPCC WGI, 5th Assessment Report

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Avoids “dangerous” amounts of climate change

Adaptation:

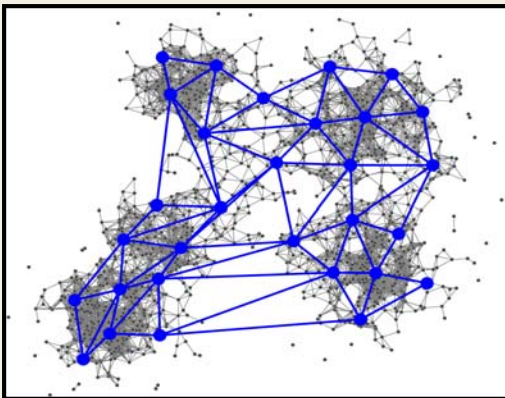
Some climate change is inevitable

Adaptation needed to minimize impacts

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GLOBAL CLIMATE CHANGE: Questions?

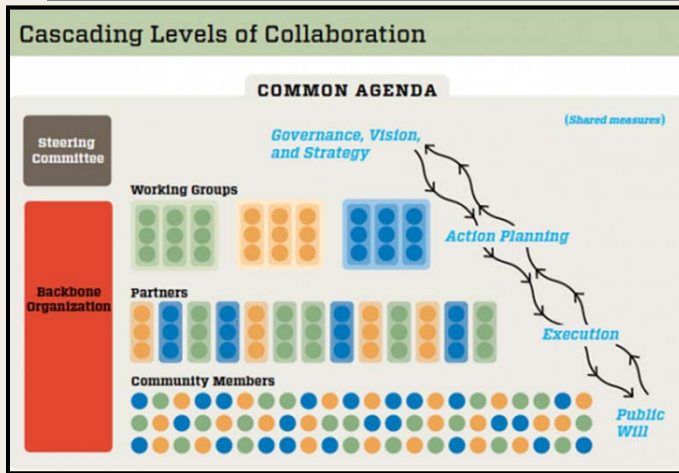
WICCI Overview



In [Complex Adaptive Systems], sustainable management comes close to initiating a “coevolutionary dialogue” where a continuous learning process is driven by the mutual and reciprocal interactions among the interlinked sub-systems and agents. Alongside this “dialogue”, the ability to form new relations and new emerging properties enhances the chances of adaptive change and social–ecological resilience.

Rammel et al. (2007)

WICCI and “Collective Impact”

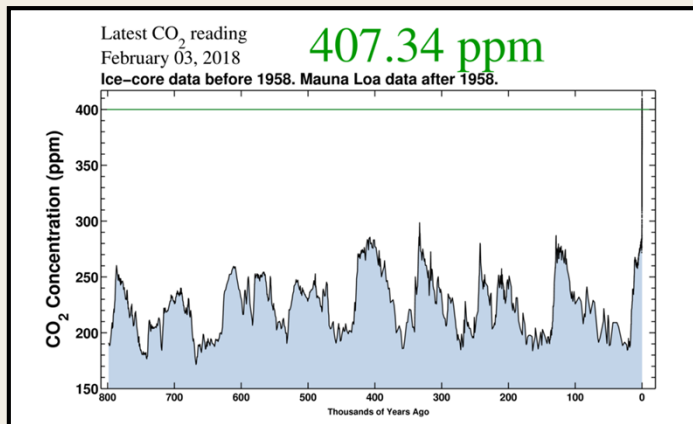


Collective Impact Conditions:

- Common Agenda
- Shared Measurement
- Mutually Reinforcing Activities
- Continuous Communication
- Backbone Support

Kania and Kramer, 2013

Global Climate Change: What we know




<https://icedrill.org/equipment/disc.shtml>

Car

CO₂ c

CO₂ Concentration (ppm)



US Ice Core Drilling Program: <https://icedrill.org/>

5. Why? The Greenhouse Effect

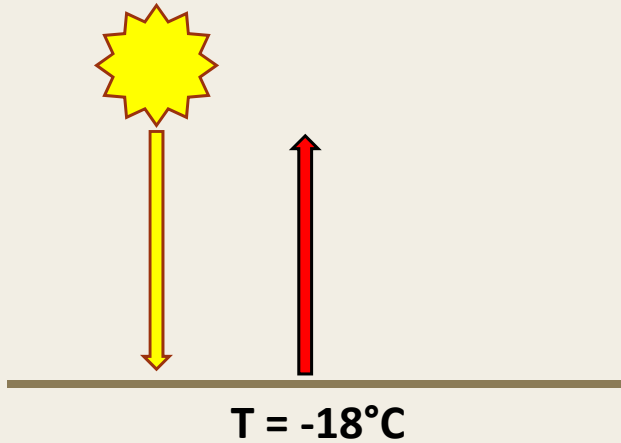


$T = -18^{\circ}\text{C}$

Without an atmosphere:

1. Earth receives energy from the sun, warms up

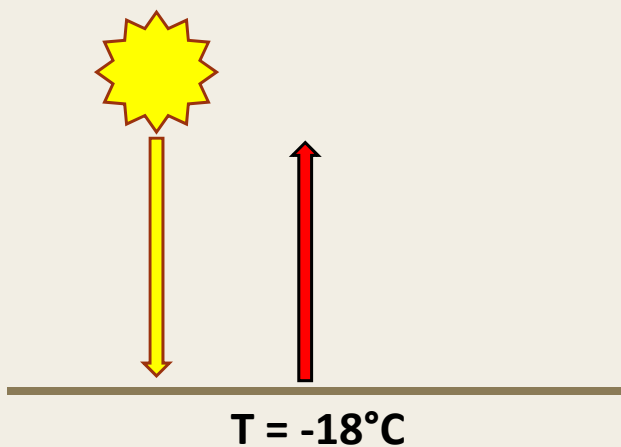
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Without an atmosphere:

1. Earth receives energy from the sun, warms up
2. As Earth warms, it emits energy (radiation) too, until it emits as much as it receives.

5. Why? The Greenhouse Effect

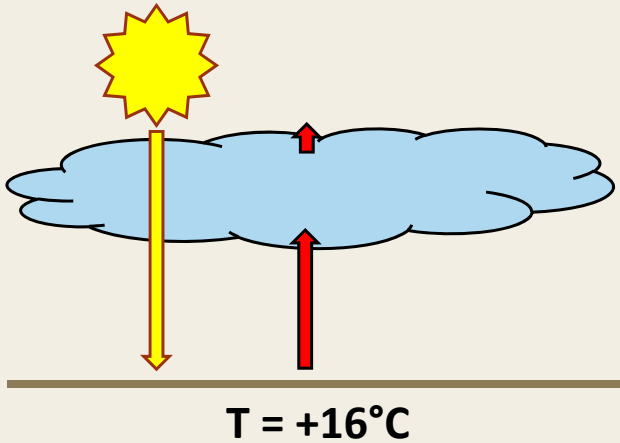


Without an atmosphere:

1. Earth receives energy from the sun, warms up
2. As Earth warms, it emits energy (radiation) too, until it emits as much as it receives.

Problem: If this was everything then Earth would be at -18°C

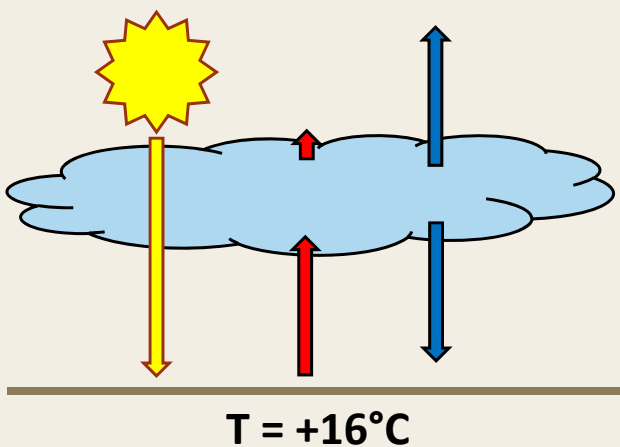
5. Why? The Greenhouse Effect



With an atmosphere:

3. Earth emits radiation, most of which is absorbed by the atmosphere -> the atmosphere warms!

5. Why? The Greenhouse Effect

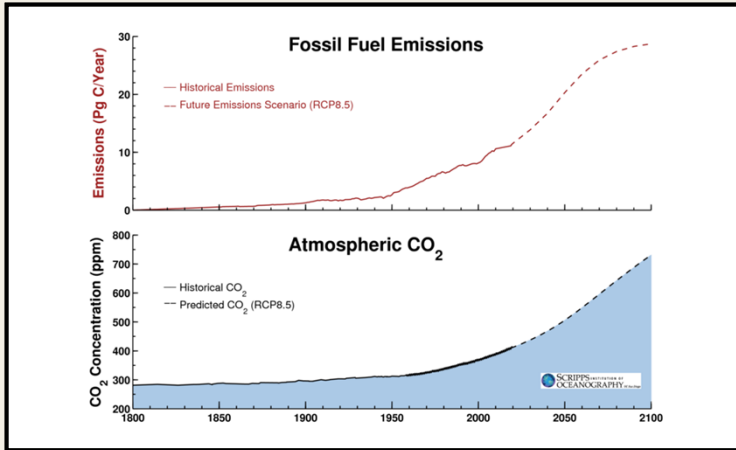


With an atmosphere:

4. As the atmosphere warms, it emits radiation in BOTH directions
5. Some of that radiation returns to Earth, providing an ADDITIONAL source of energy

**Earth's temperature:
about +16°C**

Global Climate Change: What's next

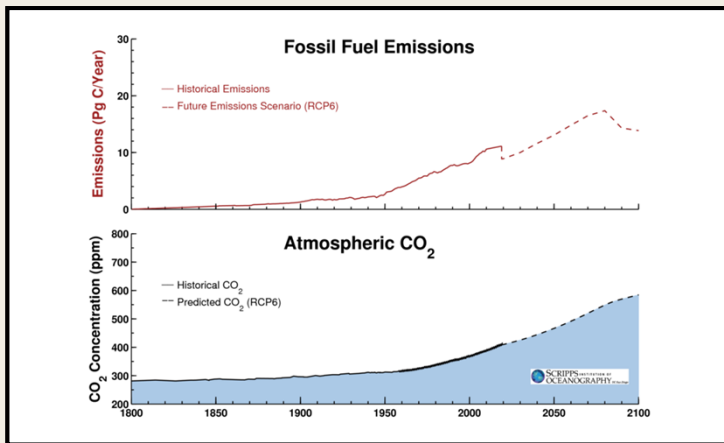


Emissions: Rate (per year) at which we are adding CO₂ to the climate system

Concentration: How much CO₂ is in our Atmosphere

Image: IPCC WGI, 5th Assessment Report

Global Climate Change: What's next

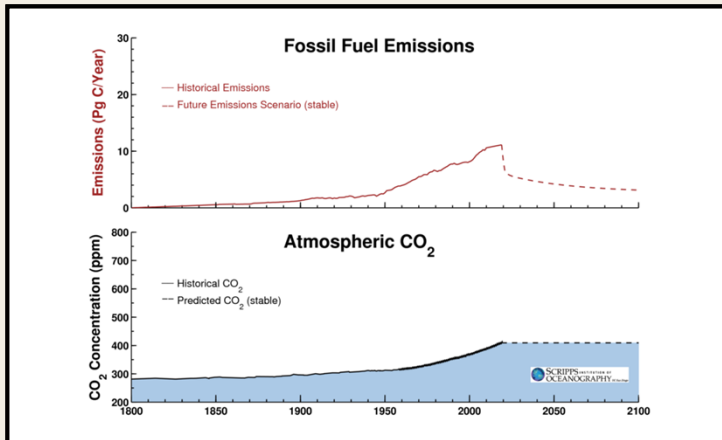


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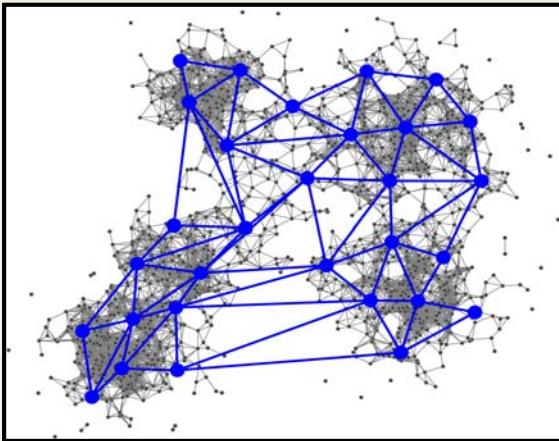


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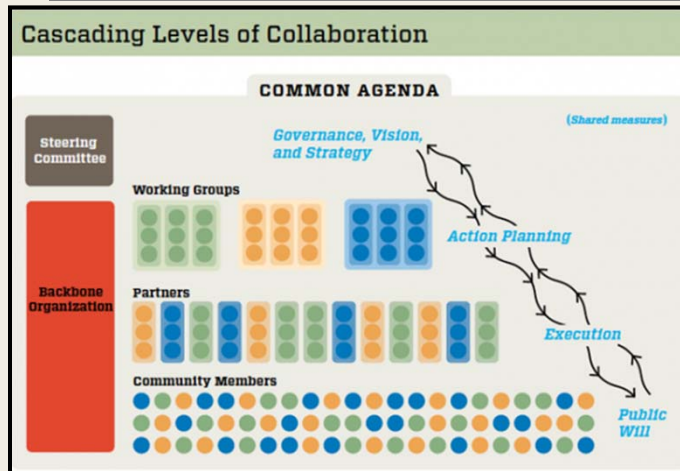


WICCI is:
An open, decentralized network

WICCI Engages:
Citizens, private and public decision-makers, scientists

WICCI Enables:
Planning, investment, other adaptation activities

WICCI and “Collective Impact”



Collective Impact Conditions:

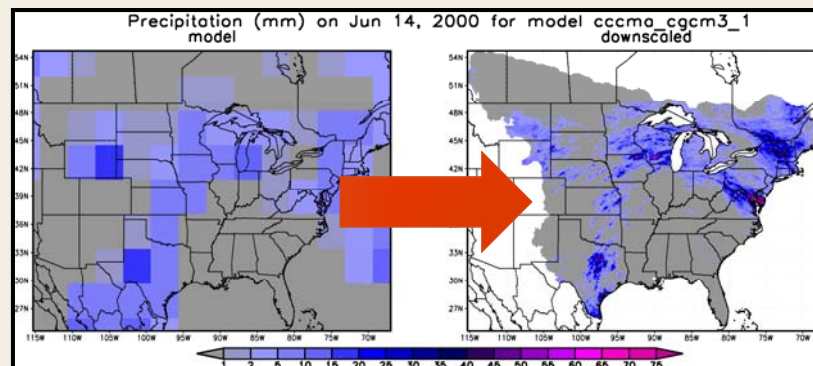
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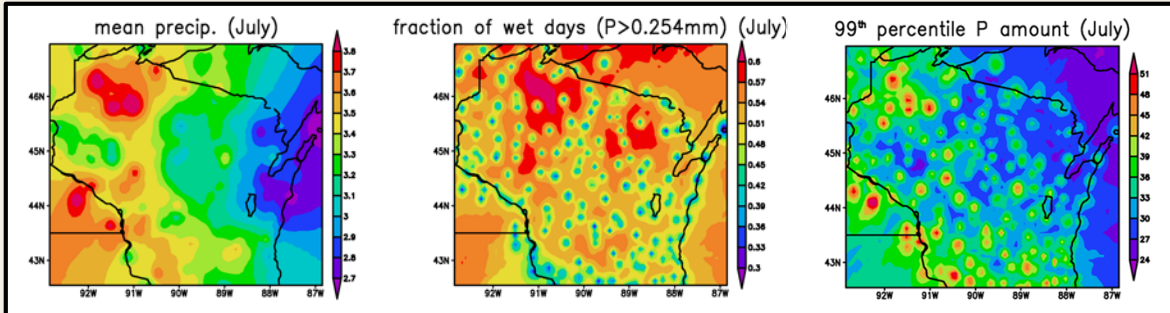
Image: Kania and Kramer, 2013

Global to Regional Projections

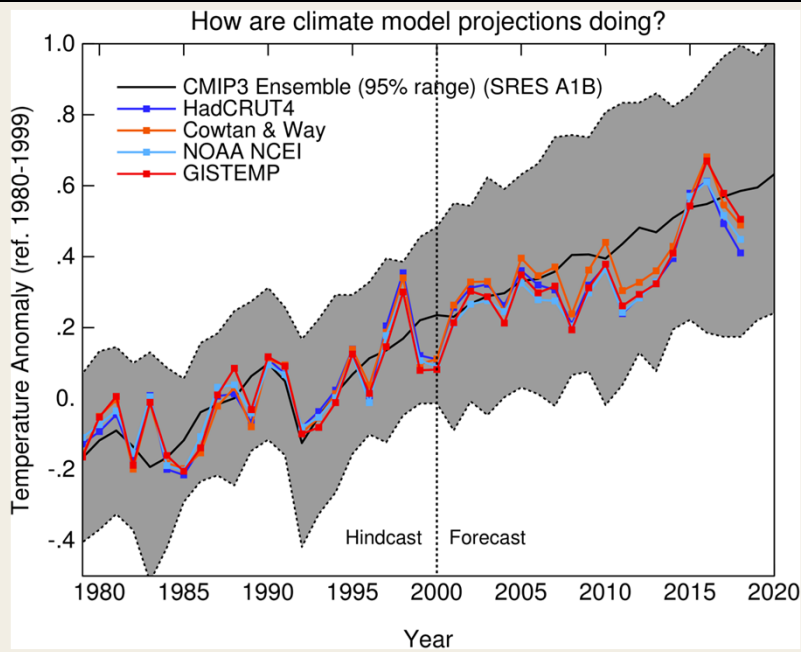
Problem: Climate models have coarse spatial resolution.

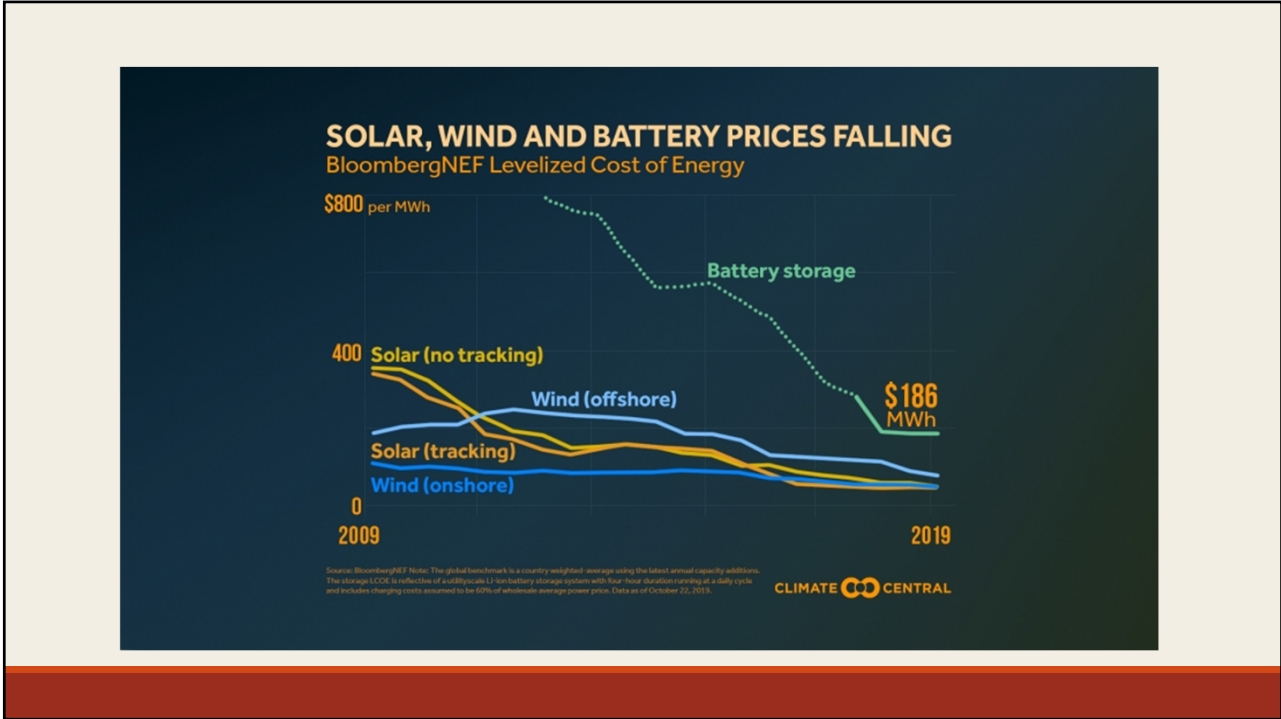
Downscaling: Focus global projections to a scale relevant to climate impacts.





Regional Climate Data: Method Matters!





Using Nature



SILVOPASTURE

Silvopasture is an ancient practice that integrates trees and pasture into a single system for raising livestock. Research suggests silvopasture far outpaces any grassland technique for counteracting the methane emissions of livestock and sequestering carbon under-hoof. Pastures strewn or crisscrossed with trees sequester five to ten times as much carbon as those of the same size that are treeless, storing it in both biomass and soil.

Carbon aside, the advantages of silvopasture are considerable, with financial benefits for farmers and ranchers. Livestock, trees, and any additional forestry products, such as nuts, fruit, and mushrooms, generate income on different time horizons. The health and productivity of both animals and the land improve. Because silvopasture systems are diversely productive and more resilient, farmers are better insulated from risk.

Silvopasture often runs counter to farming norms and can be costly and slow to implement. Peer-to-peer education has proven effective for spreading it. As the impacts of global warming progress, appeal will likely grow, because silvopasture can help farmers and their livestock adapt to erratic weather and increased drought. That is the climatic win-win of this solution: Silvopasture averts and sequesters emissions, while protecting against changes that are now inevitable.

9th best solution for reducing carbon emissions
(from *Project Drawdown*)