

Planning for Climate Change

Evidence-based Decision Making in a Belief-based World

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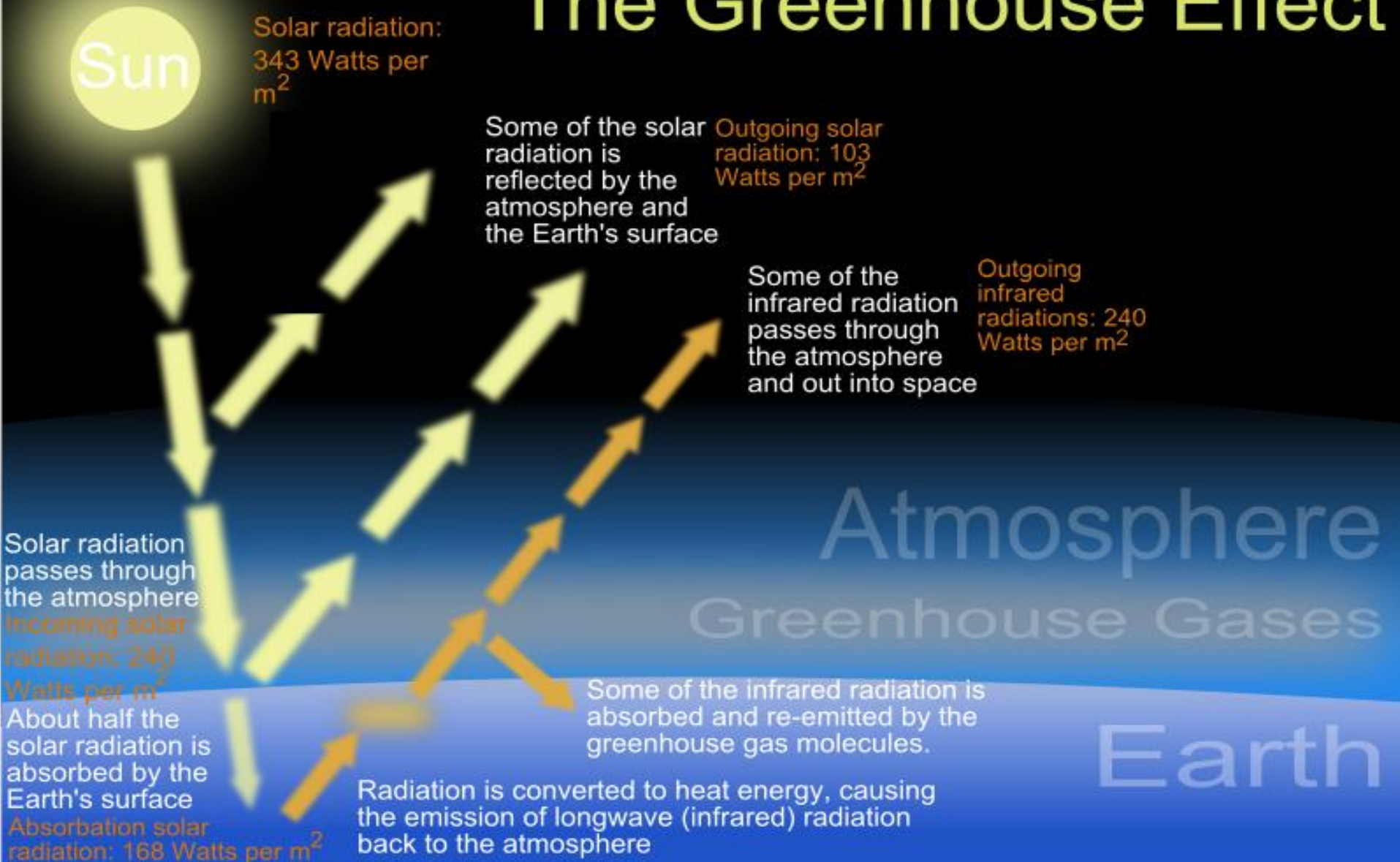
Human-Caused Climate Change: a “Road Map”

Decision Making: Evidence- or Belief-based?

- 1) Physical Processes
- 2) Atmospheric Chemistry
- 3) Evidence for Human-Caused Climate Change
- 4) Disinformation and Denial
- 5) Ethical/Political Challenges

Physics

The Greenhouse Effect



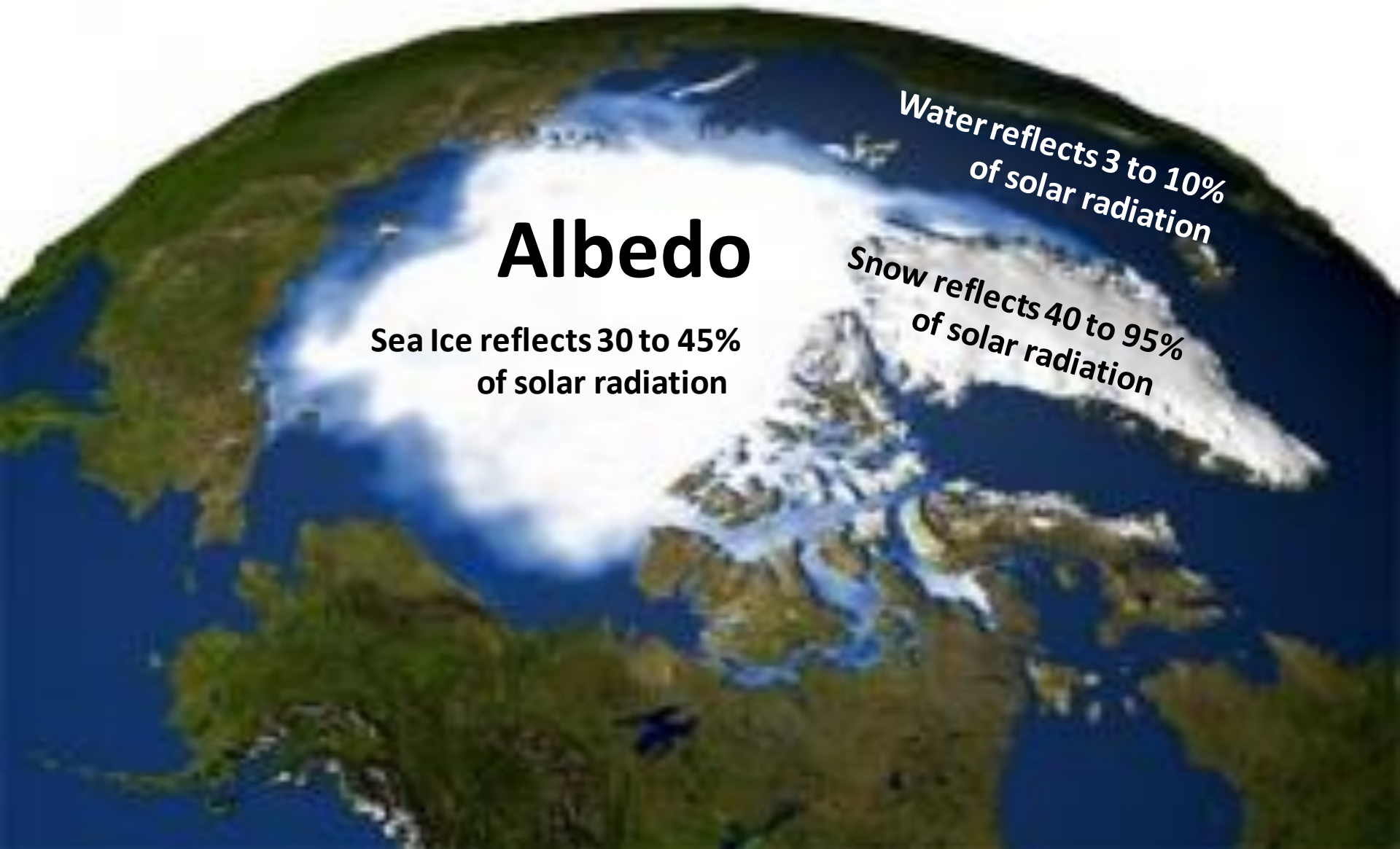
Physics

Albedo

**Sea Ice reflects 30 to 45%
of solar radiation**

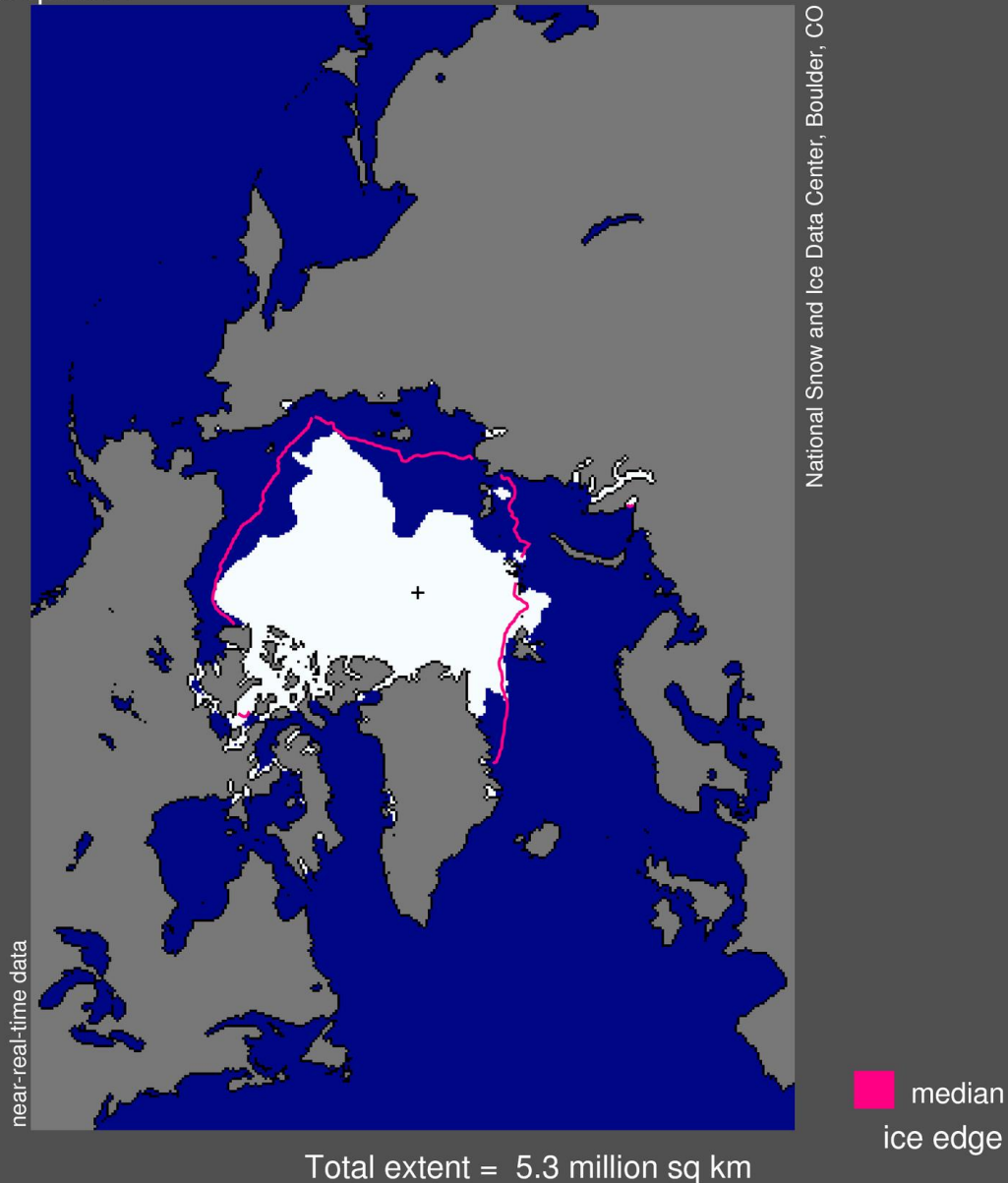
**Water reflects 3 to 10%
of solar radiation**

**Snow reflects 40 to 95%
of solar radiation**



Physics x Climate Feedbacks

Sea Ice Extent
Sep 2014



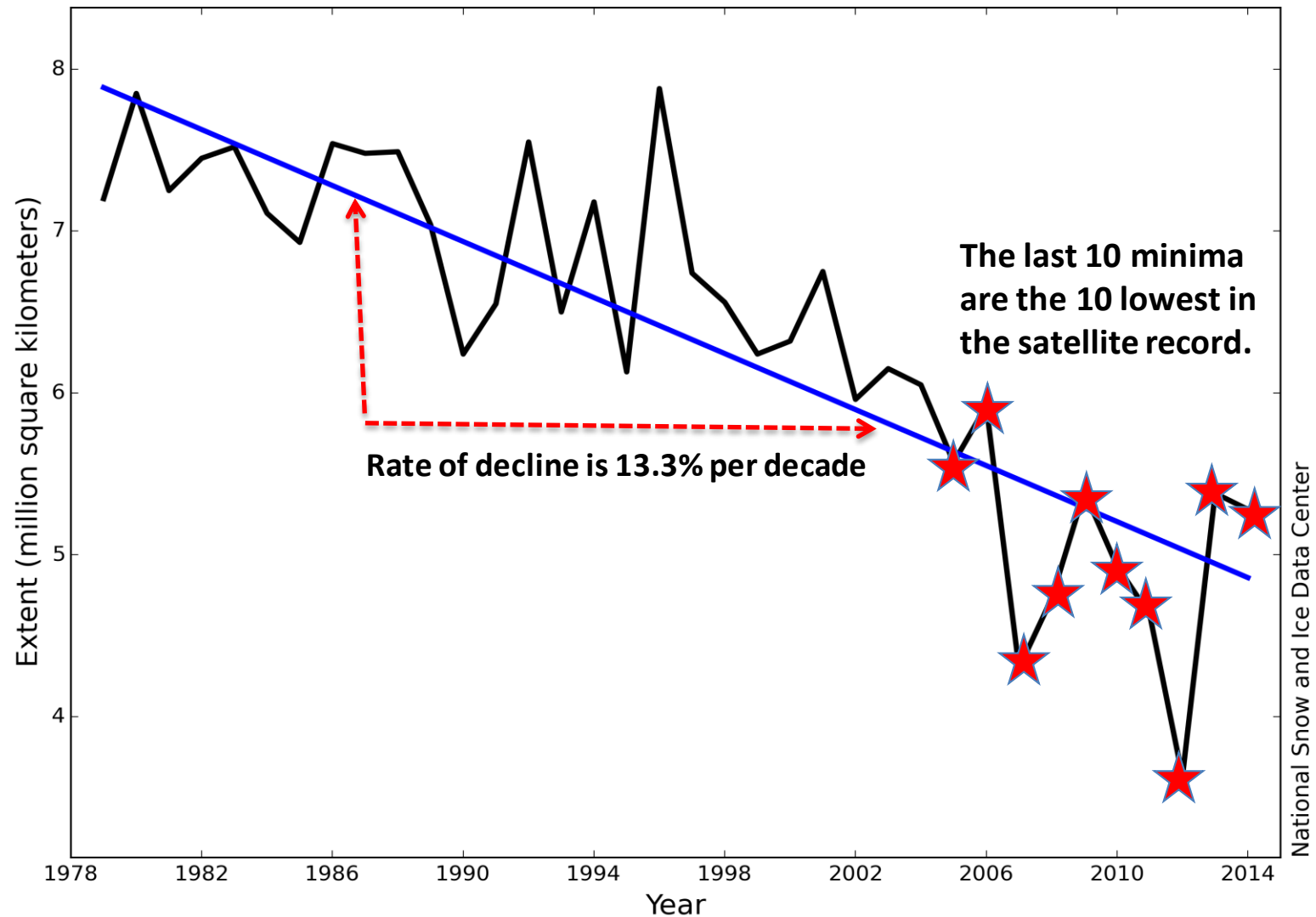
Satellite data show

- Arctic sea ice extent on Sept. 17, 2014 was 5.02M km² (1.94M miles²).
- This was the 6th lowest ice cover in the satellite record.
- It was 1.24 million km² (479,000 miles²) less than the 1981-2010 median extent for September (magenta line).
- This is ~2 x **Michigan land area**.
- September 2012 ice cover, the record lowest, was 3.61M km² (1.39M miles²).

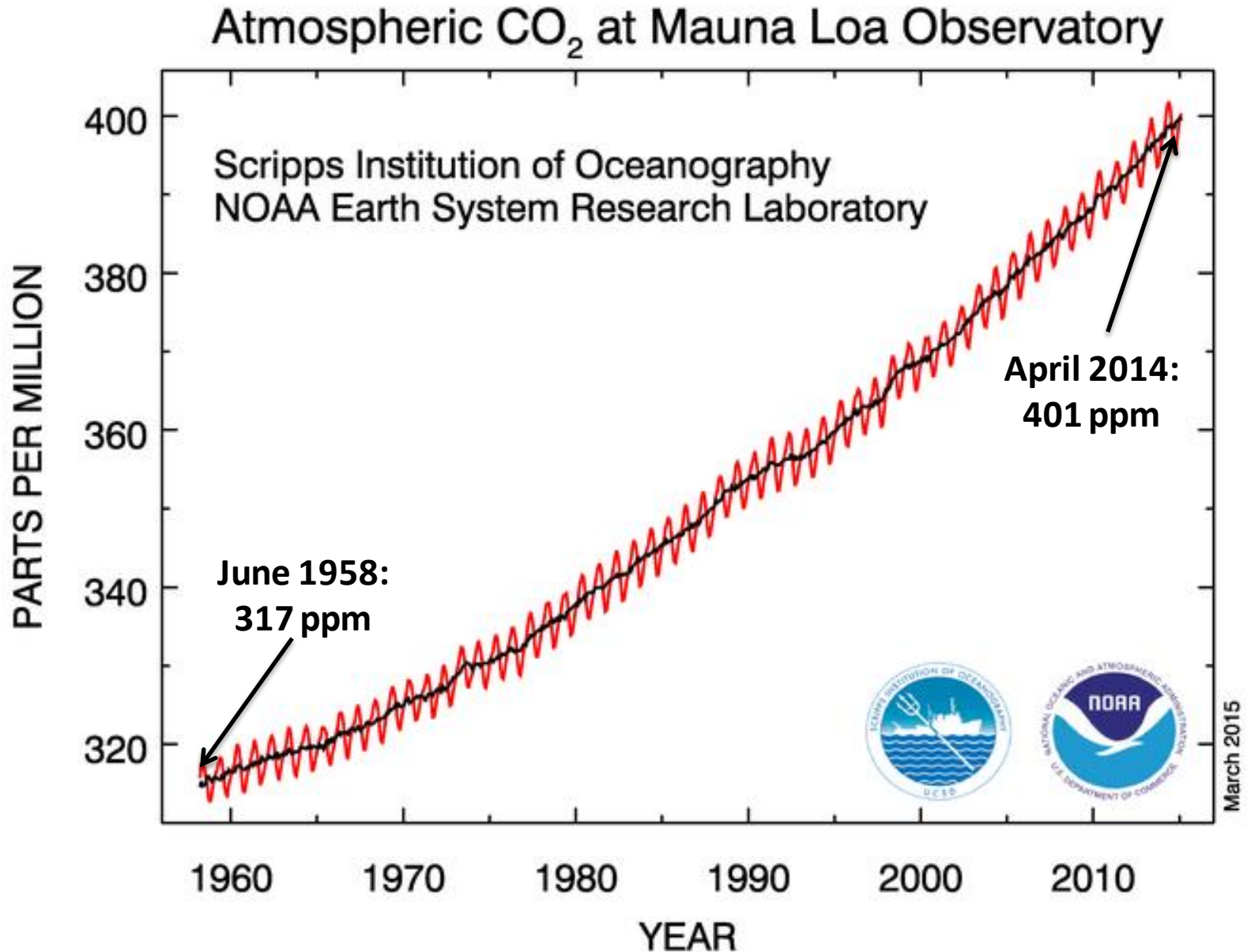
This is >4.5 x Michigan area

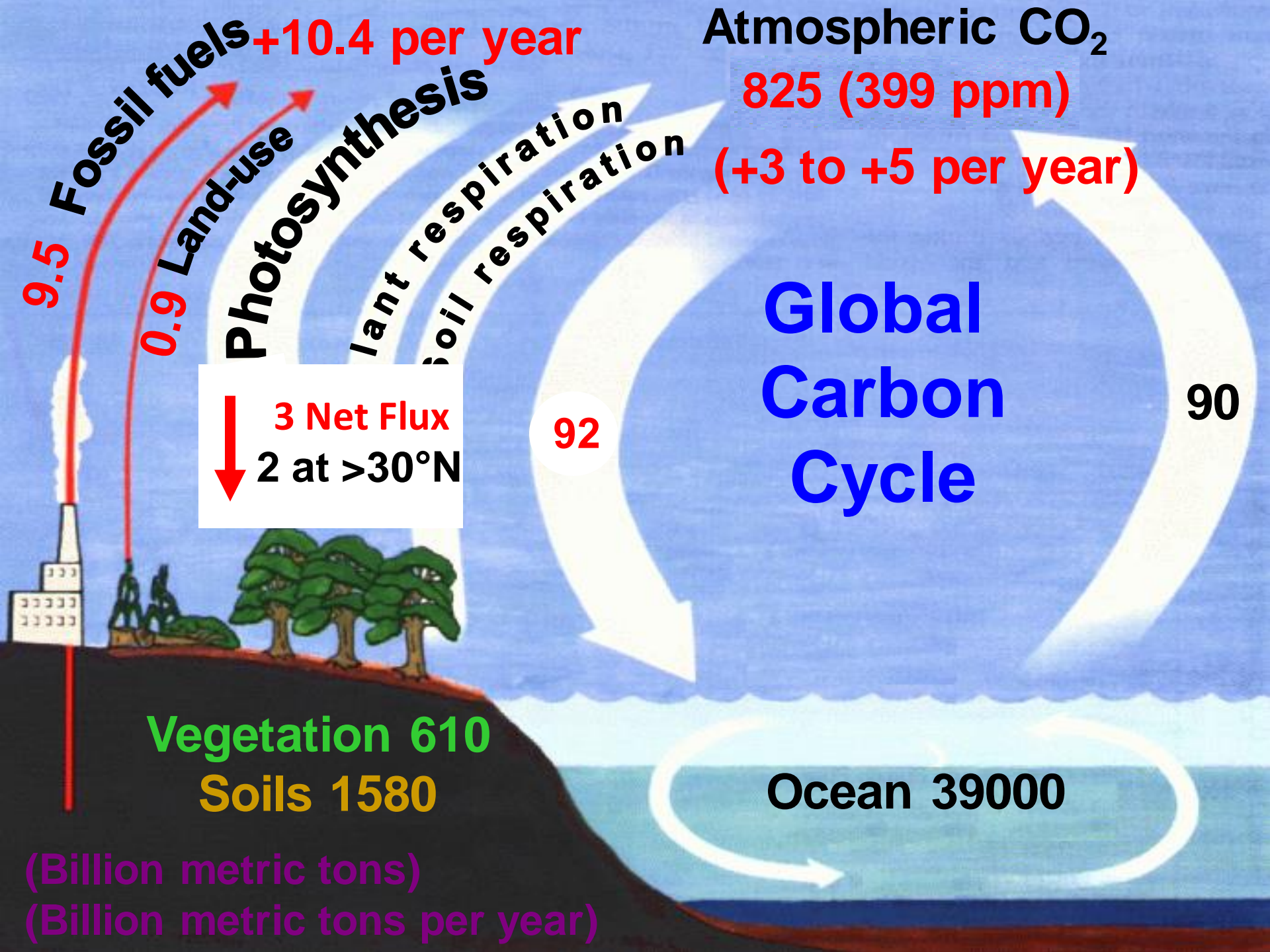
Climate

Average Monthly Arctic Sea Ice Extent
September 1979 - 2014



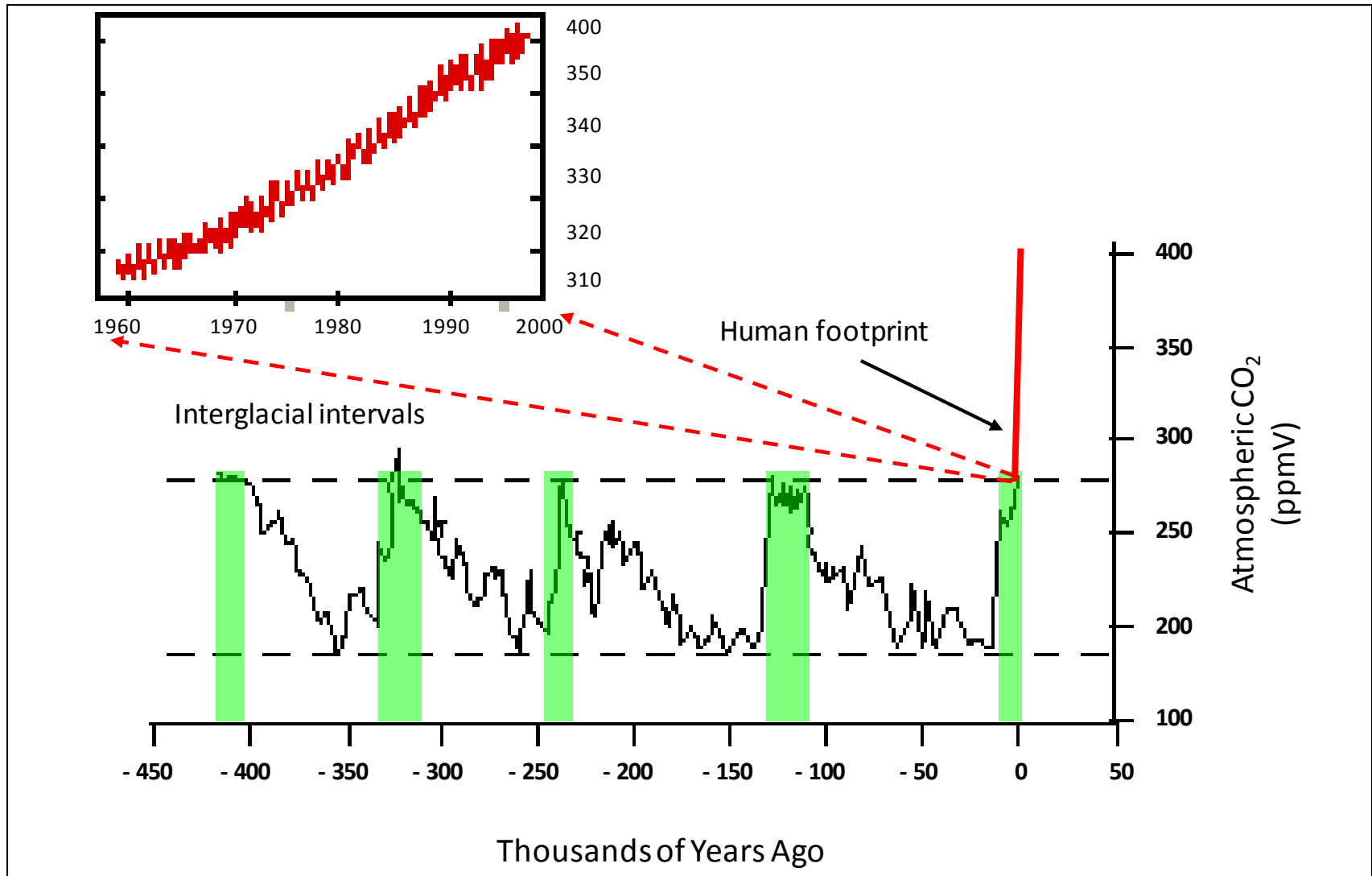
Chemistry: Atmospheric CO₂





Chemistry: Atmospheric CO₂

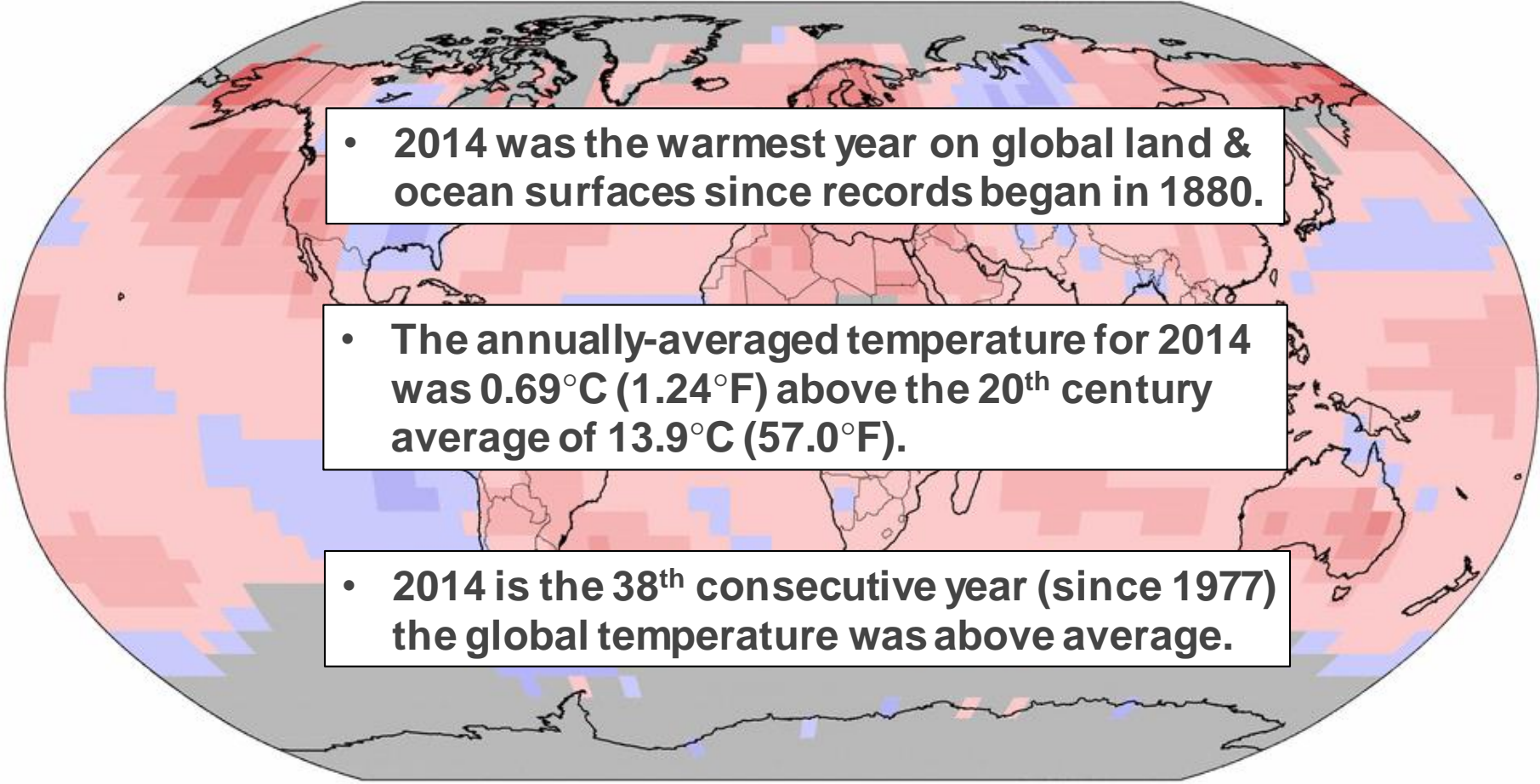
A 450 Thousand Year Record in the Vostok Ice Core

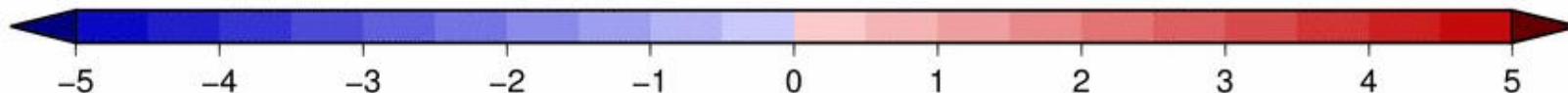


From Petit et al. 1999 (Nature 399, 429-436)

Land & Ocean Temperature Departure from Average Jan–Dec 2014 (with respect to a 1981–2010 base period)

Data Source: GHCN–M version 3.2.2 & ERSST version 3b

- 
- 2014 was the warmest year on global land & ocean surfaces since records began in 1880.
 - The annually-averaged temperature for 2014 was 0.69°C (1.24°F) above the 20th century average of 13.9°C (57.0°F).
 - 2014 is the 38th consecutive year (since 1977) the global temperature was above average.



NOAA's National Climatic Data Center
Mon Jan 12 19:34:34 EST 2015

Degrees Celsius

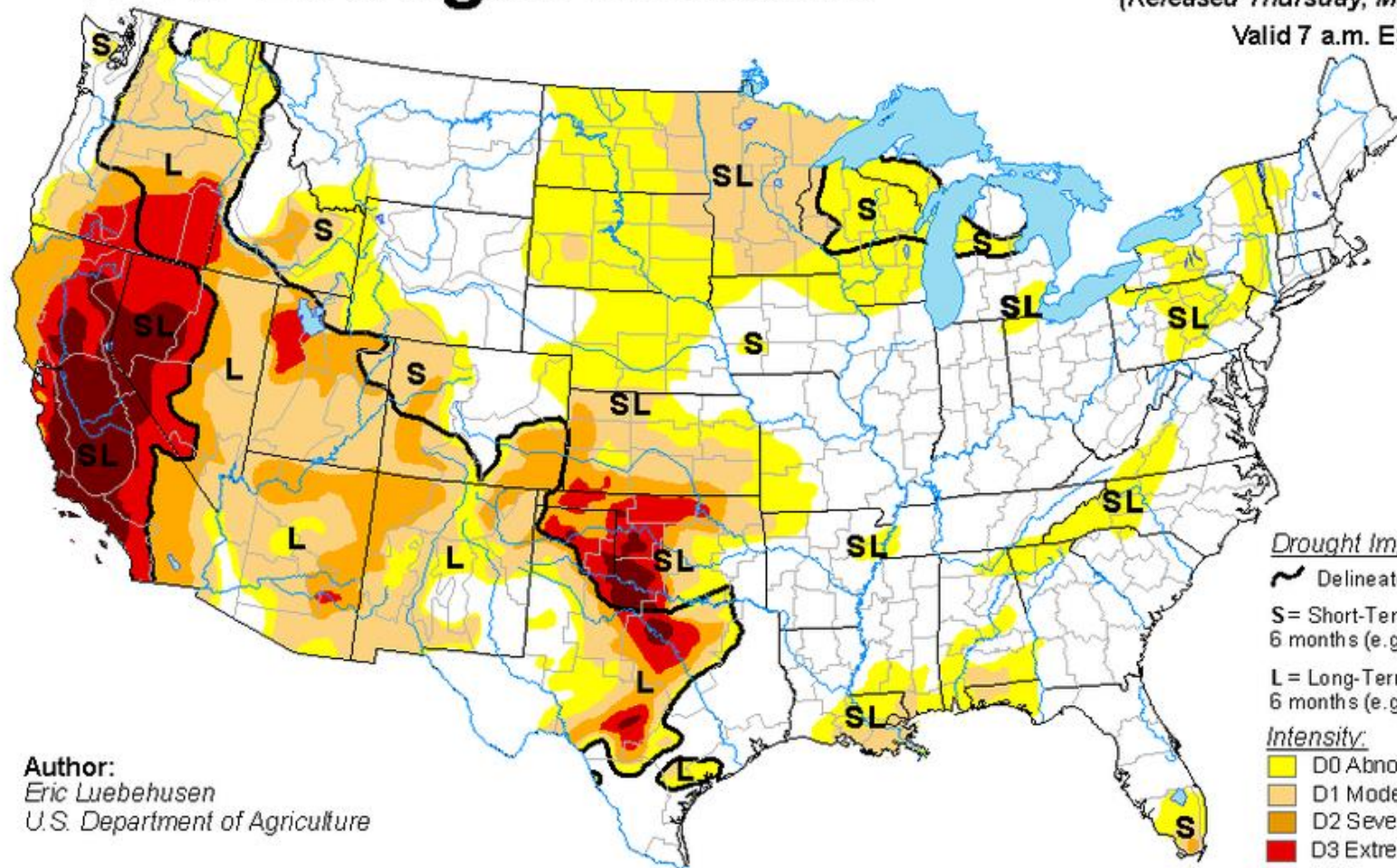
Please Note: Gray areas represent missing data
Map Projection: Robinson

U.S. Drought Monitor

March 24, 2015

(Released Thursday, Mar. 26, 2015)

Valid 7 a.m. EST



Author:
Eric Luebehusen
U.S. Department of Agriculture

Drought Impact Types:

~ Delineates dominant impacts

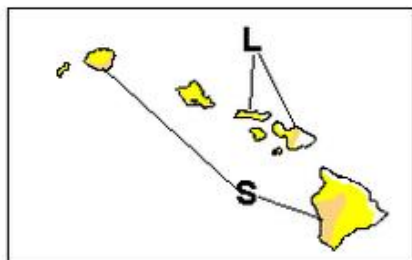
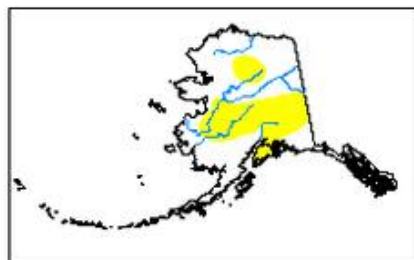
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

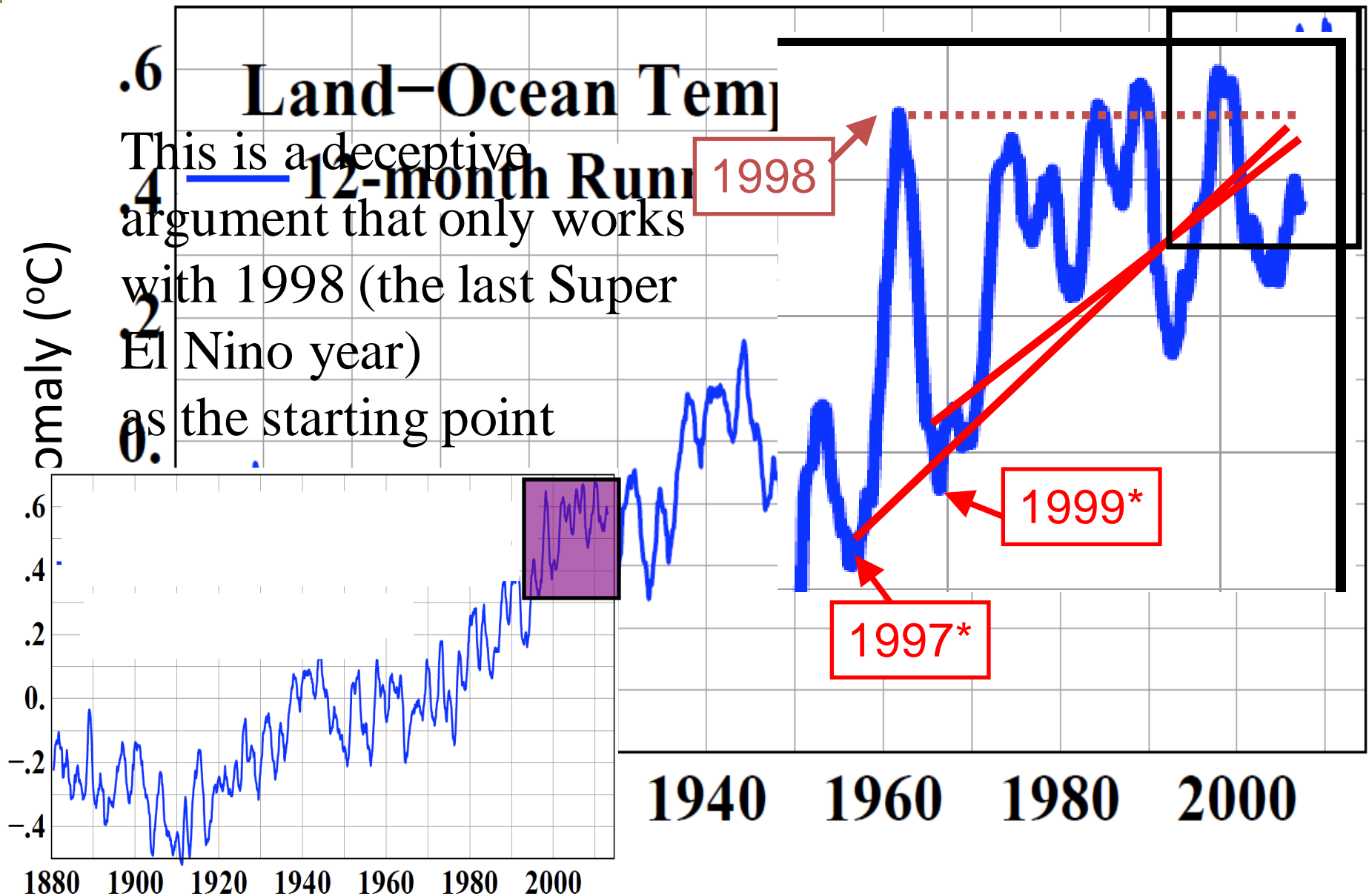
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



<http://droughtmonitor.unl.edu/>

Has Earth stopped warming?



Climate Change is Here: The Midwest

Temperature

- Climate is warming (esp. in winter)
- Extreme heat events are increasing (frequency & length)
- Growing season are several weeks longer

Precipitation

- Winter, spring increasing
- Summer, fall decreasing
- Drier soils, more droughts
- More extreme events

Health, Economy & Environment

- Heat-related mortality and morbidity will increase
- “Warm climate” diseases are increasing, e.g. lyme disease, West Nile virus
- Risks to crops are increasing
- Water management (urban and rural) is more expensive
- Key invasive species and plant pathogens are being facilitated by warming temperatures and longer frost-free seasons.

Donors Trust and Donors Capital Fund (tax-exempt charities)

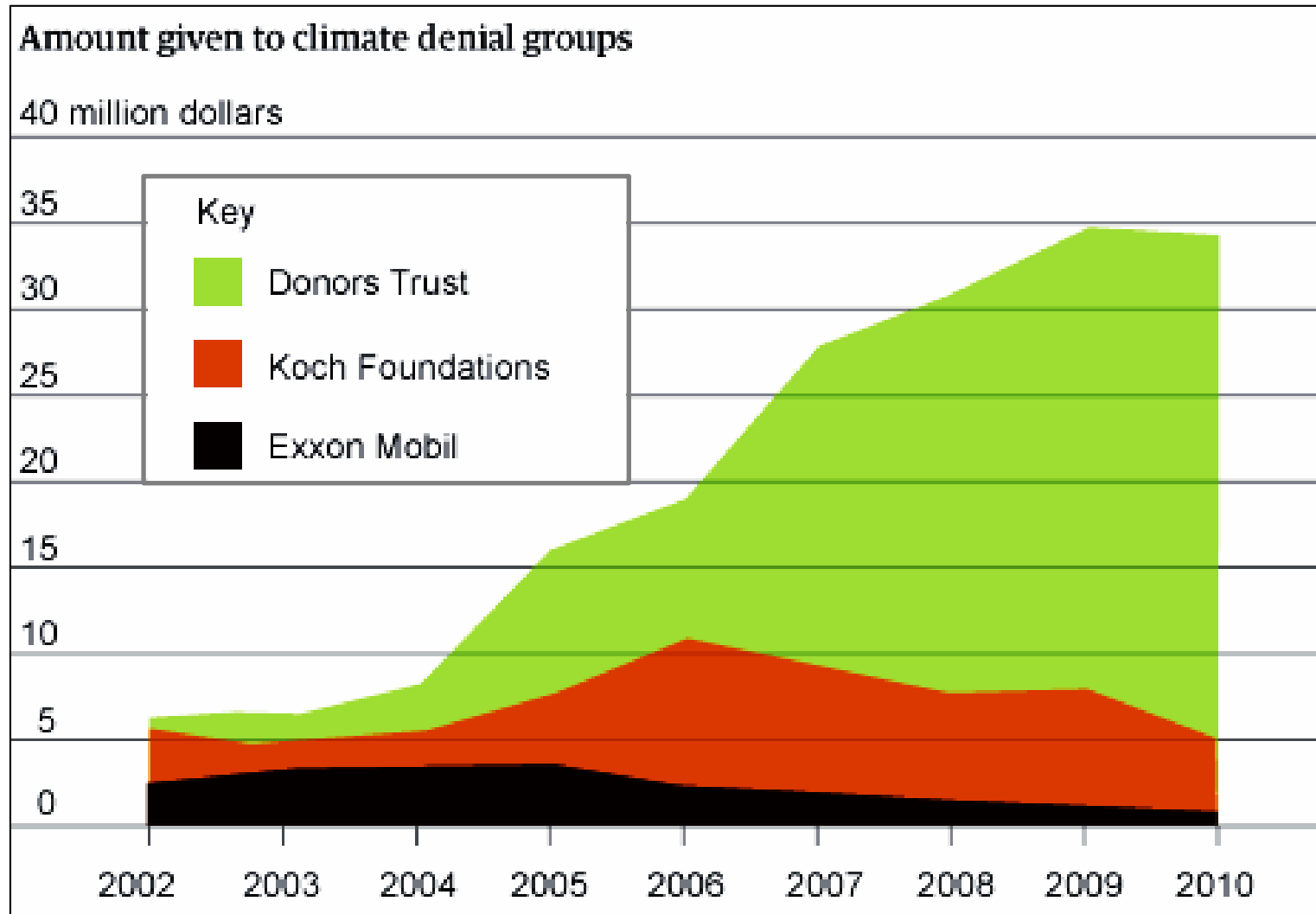


... over the past decade, have funded a campaign against wind farms.

Photograph: Alex Garcia/Getty Images.

Donors Trust: a 501(c)(3) “charitable organization”

gave \$118M to ~100 climate denial groups from 2002 - 2010



Is Evidence Enough?

- In Science, hypothesis are tested, rejected, re-tested... until evidence informs understanding. Theories and predictive models result.
- Rigorous testing and measurements have established understanding of the fact that fossil fuel emissions are heating up our planet.
- Measurements show increasing frequencies of extreme weather events that pose serious risks .
- Our challenge is to overcome the denial and distortion of climate science and understanding of climate change impacts by groups who manipulate public opinion and influence legislative processes to prevent adapting to and minimizing human-caused climate change.