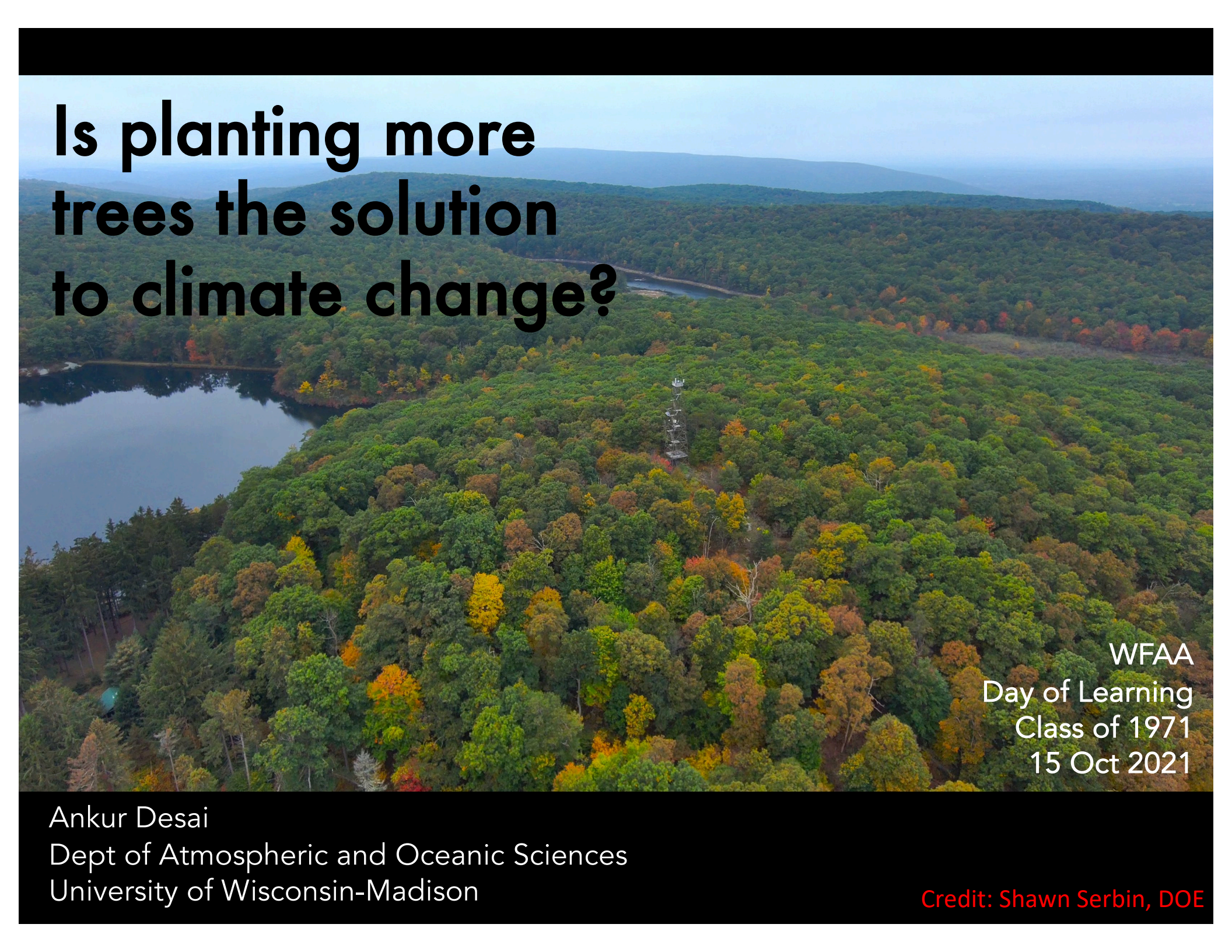


Is planting more trees the solution to climate change?

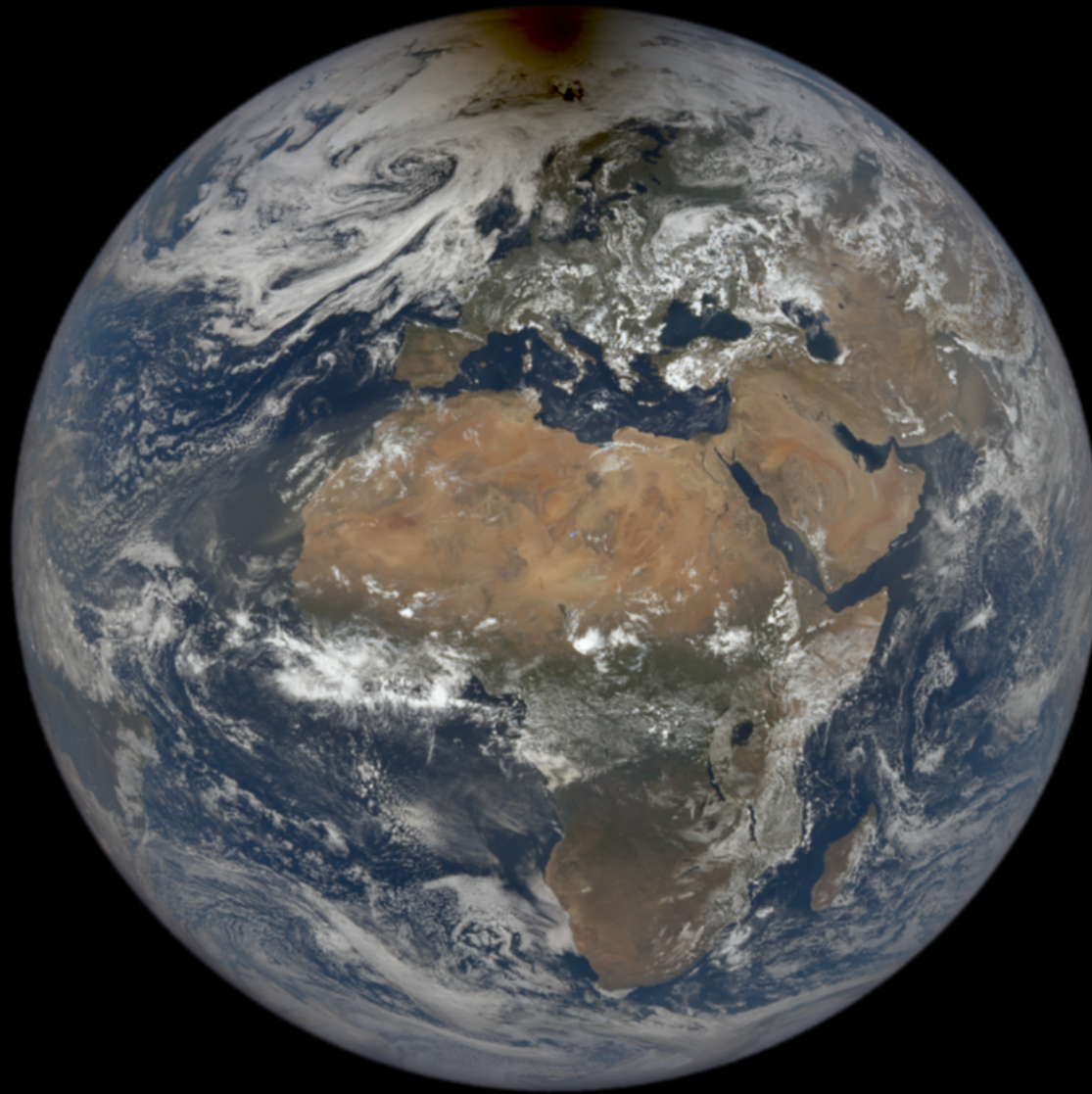
An aerial photograph of a vast forest landscape. In the foreground, a dense forest of trees with green and yellow foliage covers a hillside. A small, dark, lattice-like tower stands prominently in the middle of the forest. To the left, a calm lake reflects the surrounding greenery. In the background, rolling hills and mountains are visible under a hazy, overcast sky.

WFAA
Day of Learning
Class of 1971
15 Oct 2021

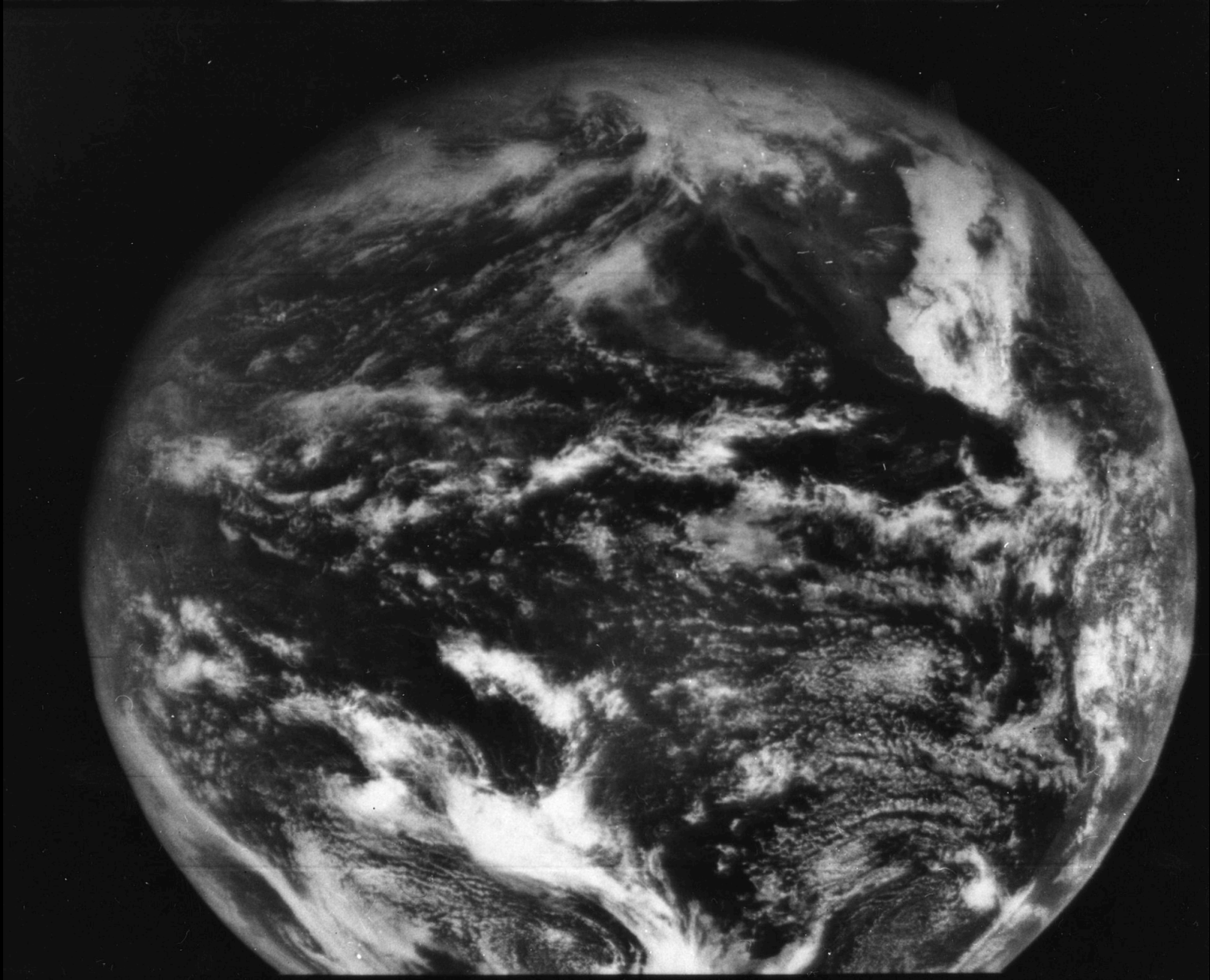
Ankur Desai
Dept of Atmospheric and Oceanic Sciences
University of Wisconsin-Madison

Credit: Shawn Serbin, DOE

From more than a million miles away...



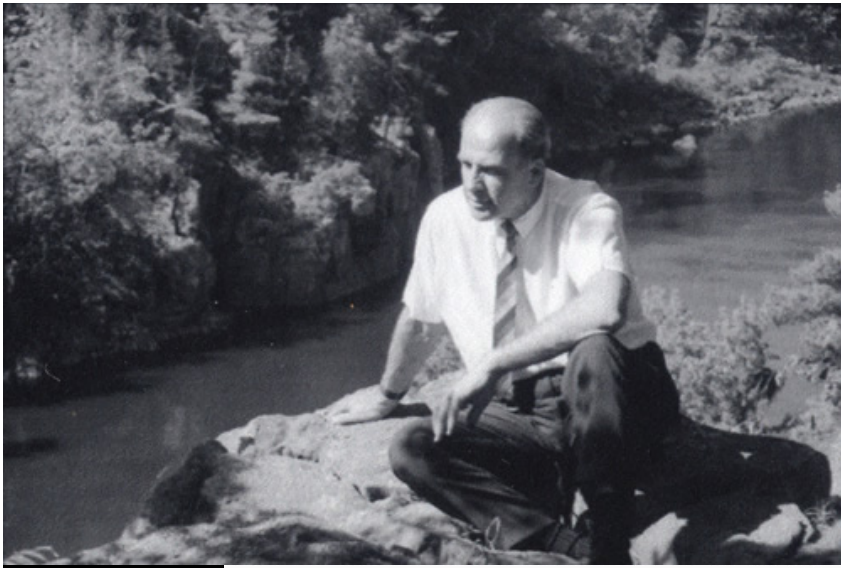
NASA EPIC



ATS-1 1966



NASA ISS



New York Times

LA
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67-46

YORK, THURSDAY, APRIL 23, 1970

Millions Join Earth Day Observances Across the Nation



Thongs jamming Fifth Avenue yesterday in response to a call for the regeneration of a polluted



Credits: NYTimes, Nelson Earth Day, WI Historical Soc

From 1970s to 2010s:

33% decline in ozone pollution

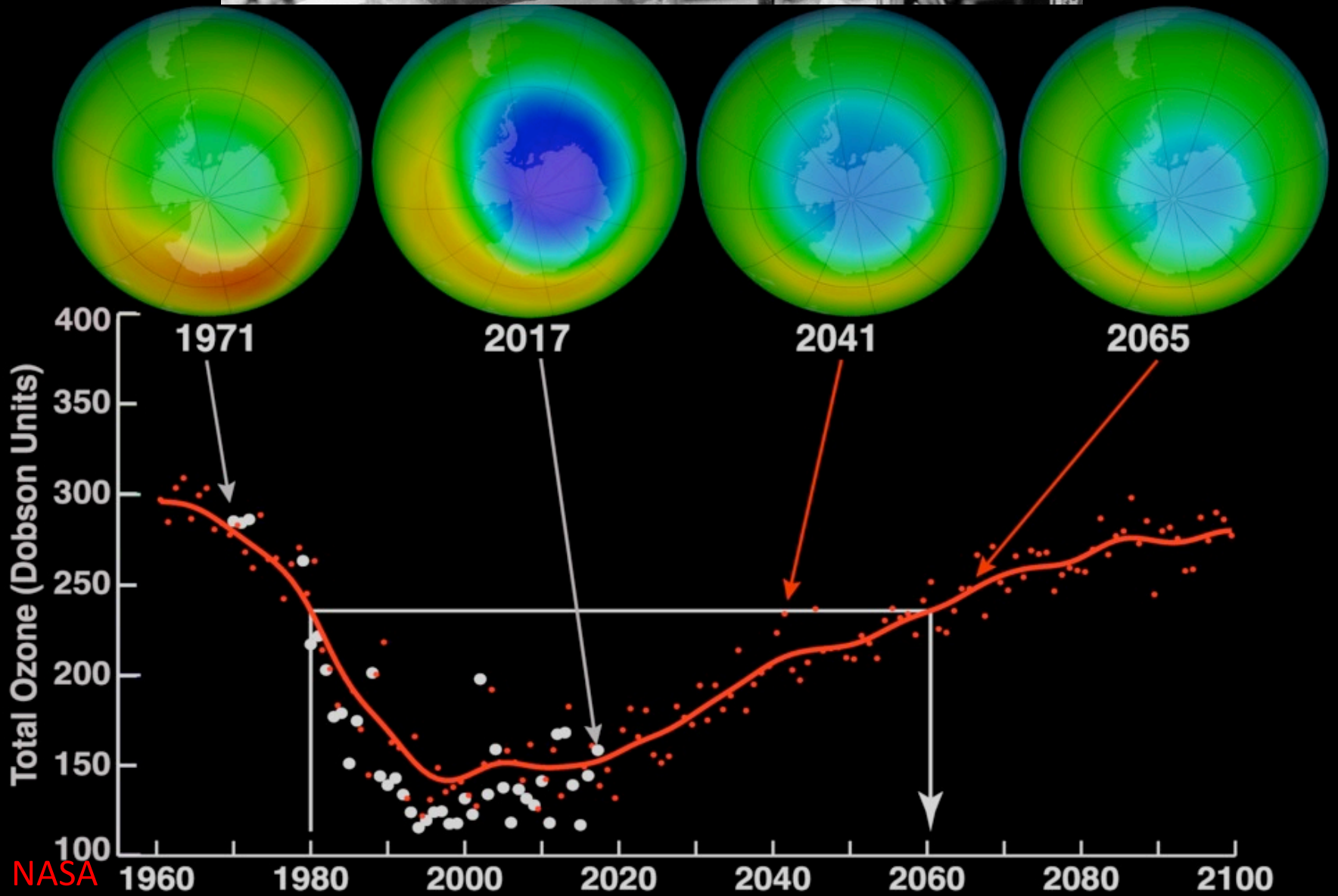
64% reduction in nitrates

98% reduction in lead

Remember acid rain?

(US EPA)





Credits: NASA



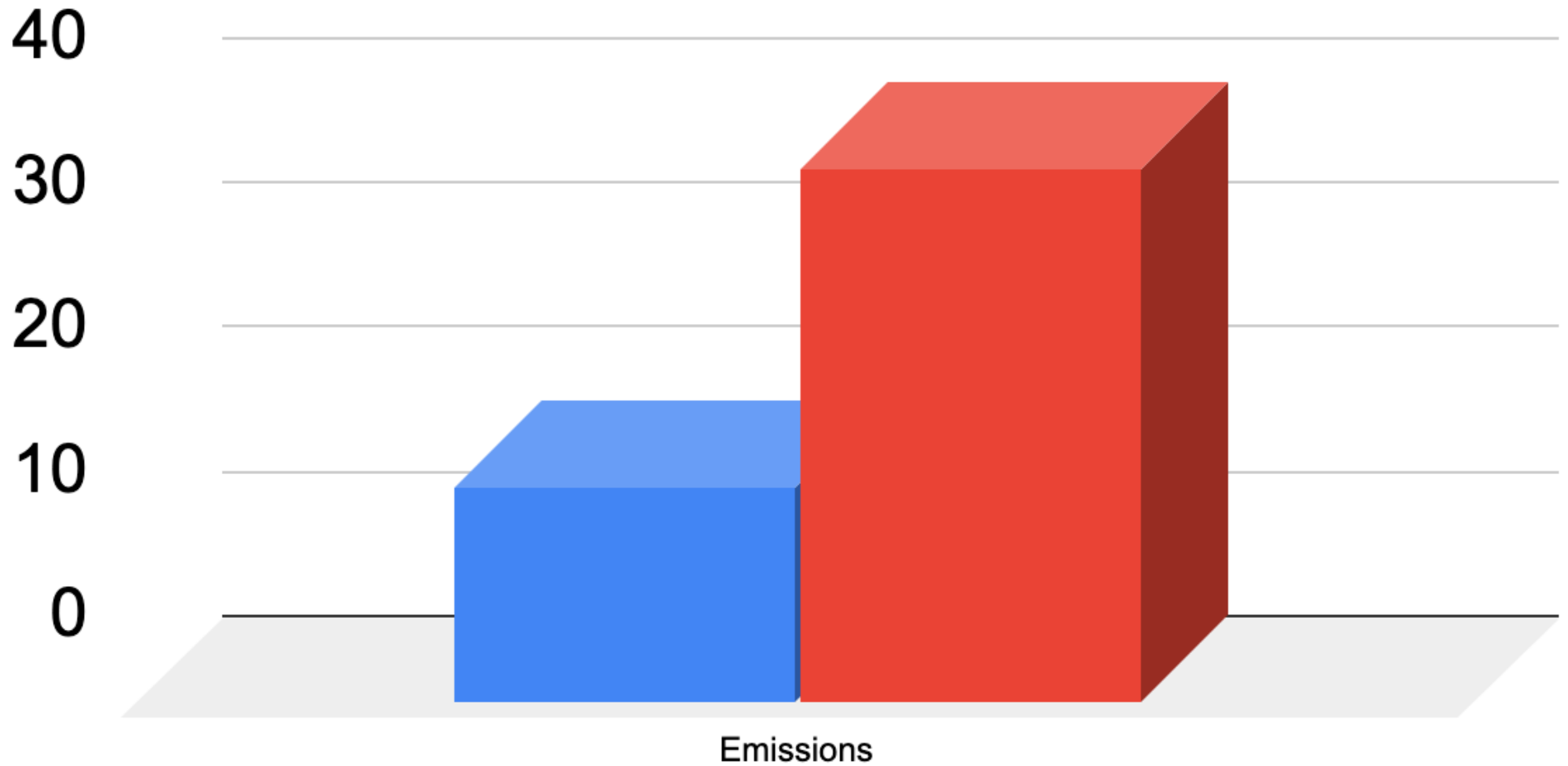
The continued release of CO₂ to the atmosphere from burning fossil fuels would "almost certainly cause significant changes" and "could be deleterious from the point of view of human beings [...] and marked changes in climate, not controllable through local or even national efforts.



U.S. President's Science Advisory to President Lyndon B. Johnson 1966

Emissions - billions of tons of carbon dioxide per year

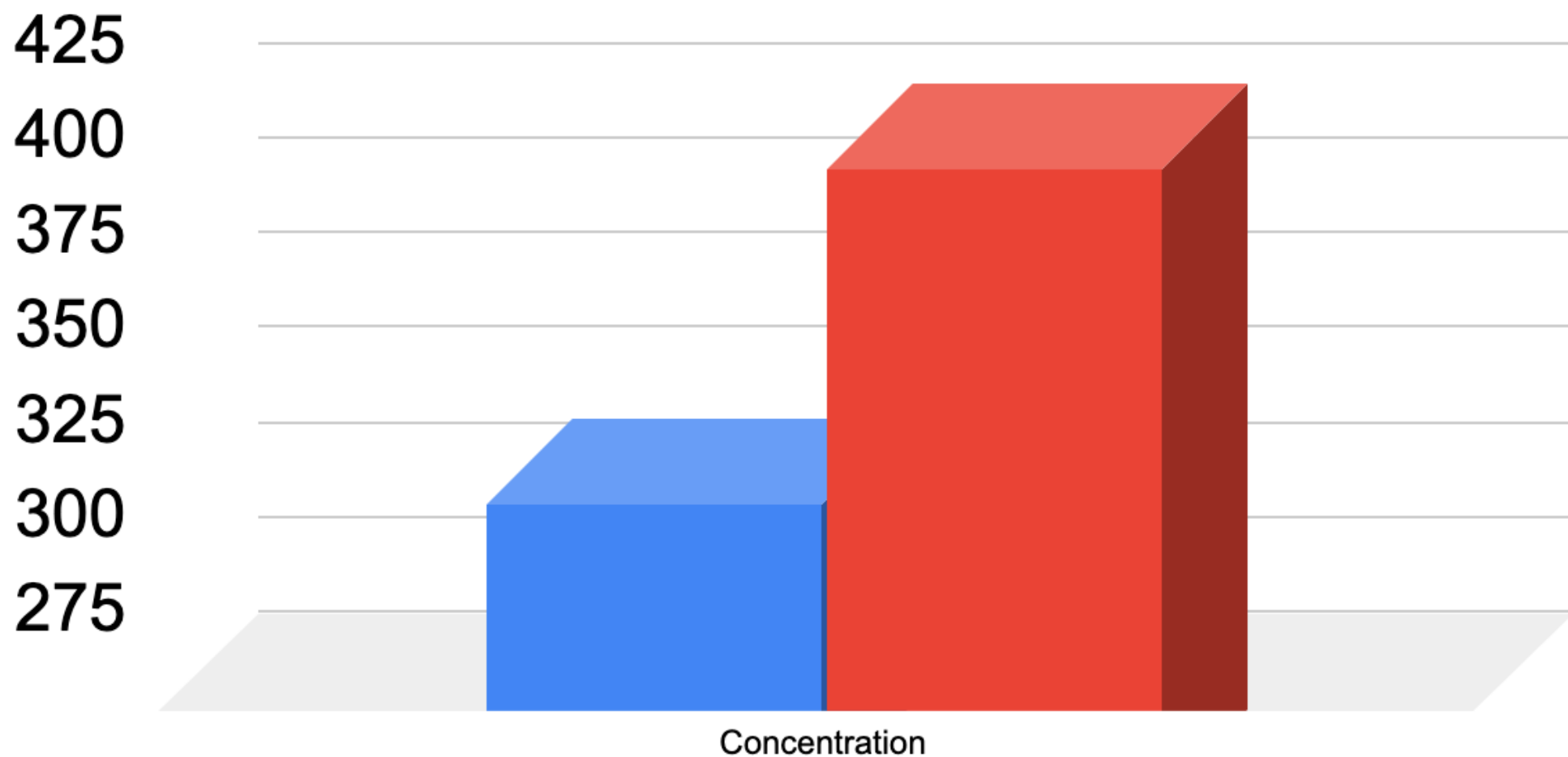
■ 1970 ■ 2020

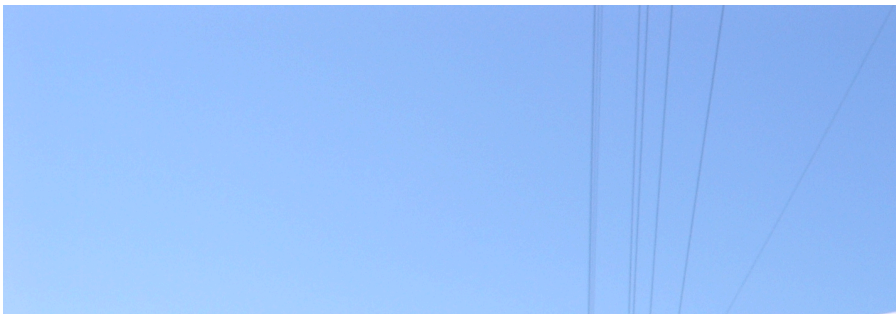


Source: Global Carbon Project

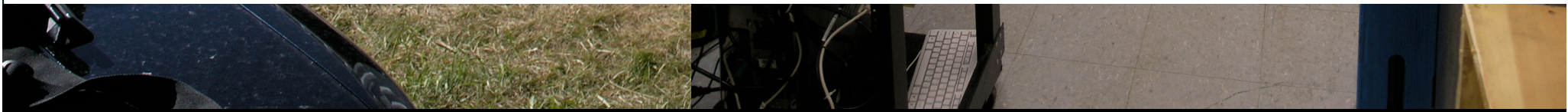
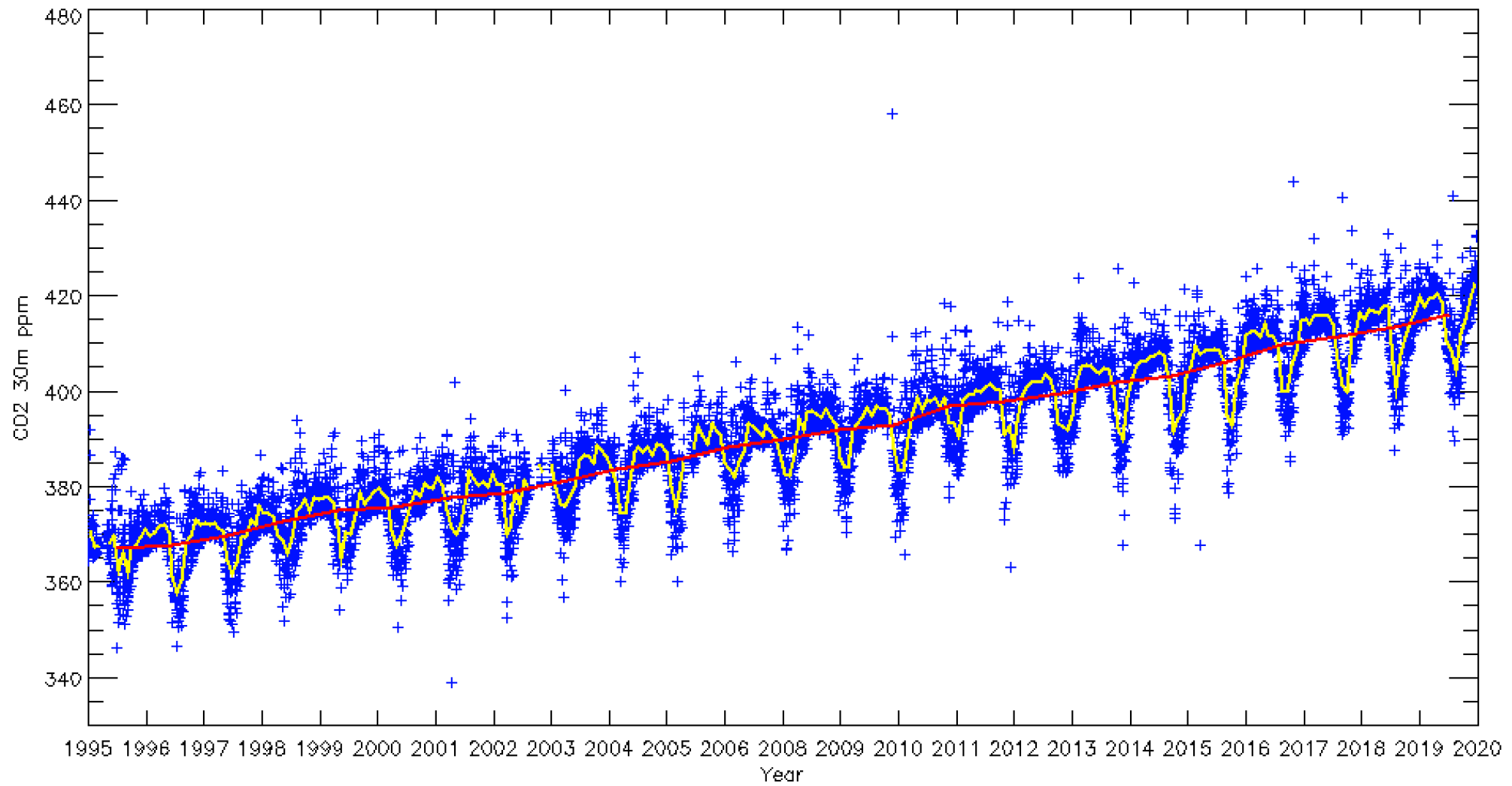
Carbon dioxide concentration in parts per million

■ 1970 ■ 2020



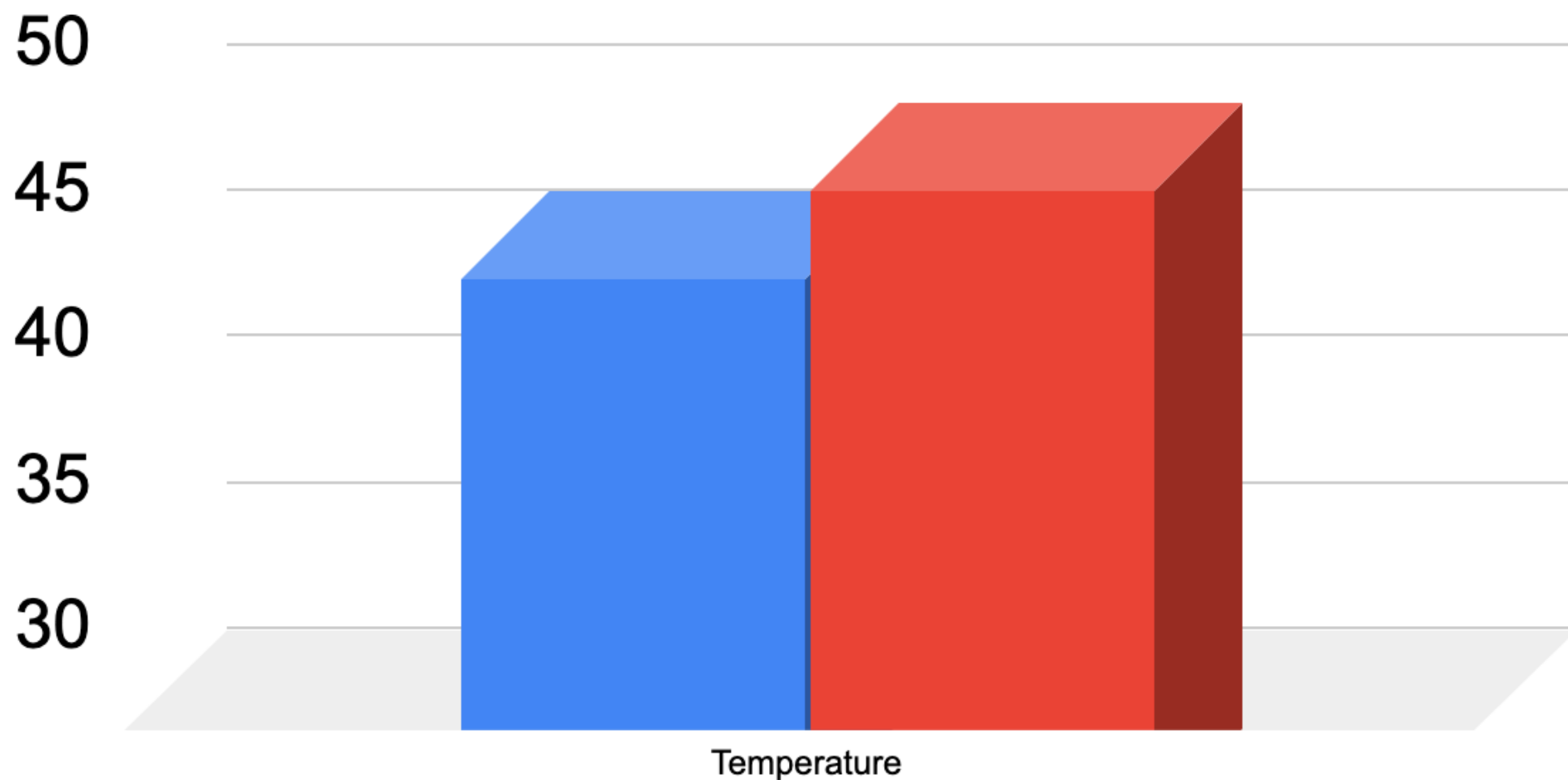


Park Falls



Madison Average Annual Temperature Degrees F

■ 1970s ■ 2010s



Source: Midwest Regional Climate Center

Lake Mendota Days of Ice Cover

■ 1970s ■ 2010s

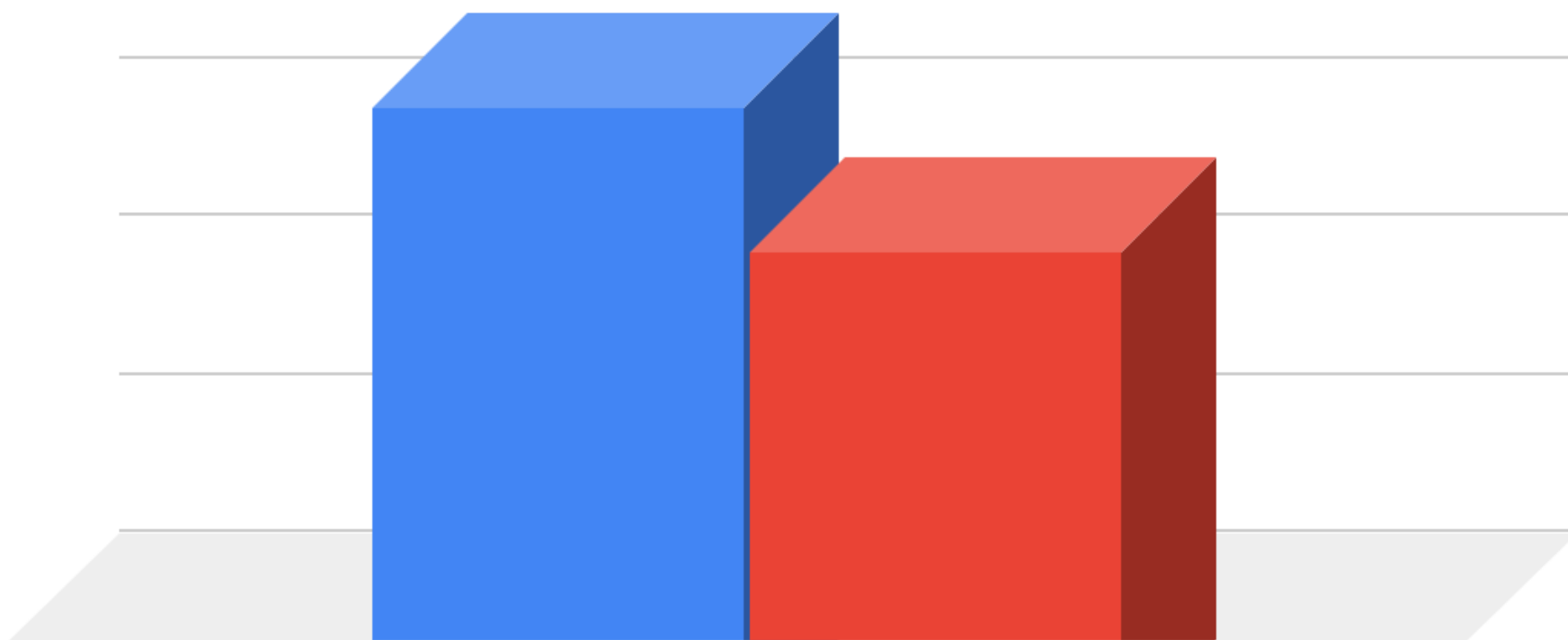
125

100

75

50

25



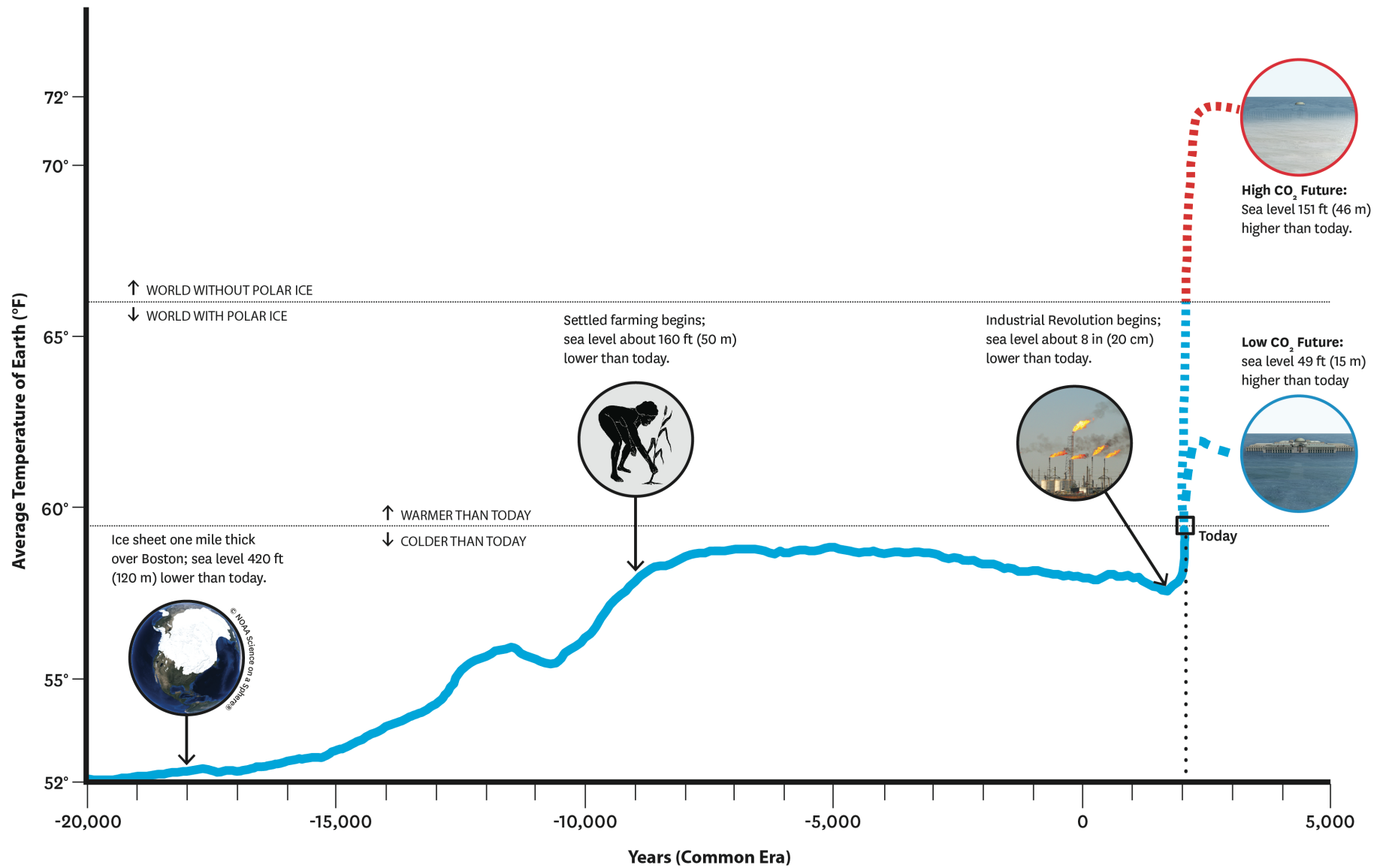
Ice days





Global Temperature

Since the Last Ice Age





downerwoods - NetCam SC IR - Fri Oct 08 2021 12:35:06 CST - UTC-6

Camera Temperature: 48.5

Exposure: 48



umichbiological - NetCam SC - Fri Oct 08 2021 14:00:06 EST - UTC-5

Camera Temperature: 47.5

Exposure: 199



hillhaft - NetCam SC IR - Fri Oct 08 2021 17:30:05 UTC - UTC-0
Camera Temperature: 37.5
Exposure: 2400



Tapajos Cam Fri Jun 18 11:11:45 2010
Exposure: 66



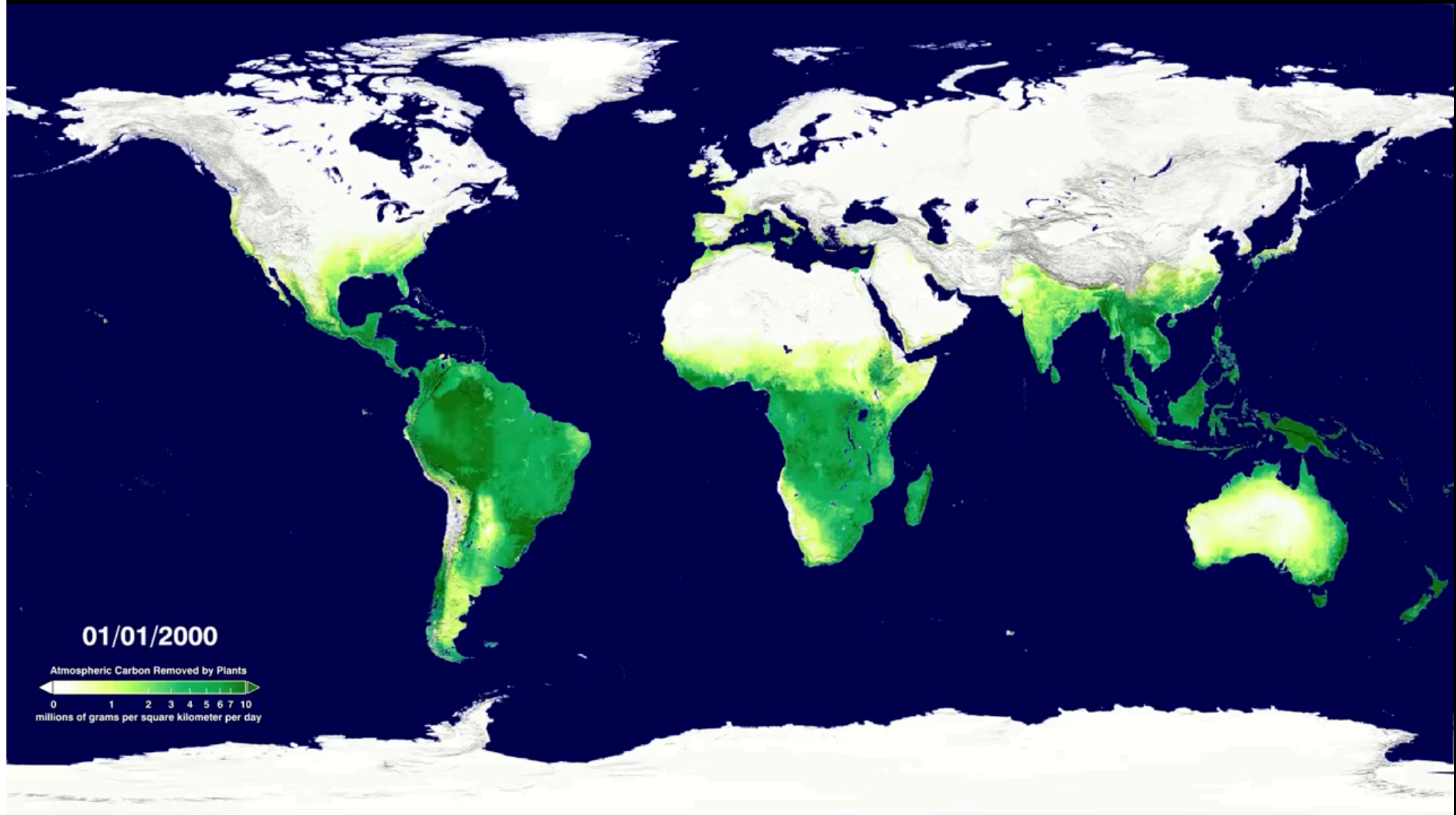
eucflux - NetCam SC IR - Thu Sep 02 2021 14:03:05 BRT - UTC-3

Camera Temperature: 57.0

Exposure: 120



Photosynthesis from space!



So, can nature save us from ourselves?

MODIS GPP (NASA)

University of Wisconsin-Madison Department of Atmospheric and Oceanic Sciences

Who We Are

Since 1948 we have grown into one of the leading departments in our field of Atmospheric and Oceanic Sciences. We have strong graduate and undergraduate programs which are nationally recognized. We graduate about 15 Ph.D. and M.S. students each year; our graduates are active in research labs and universities around the world. We graduate approximately 20 B.S. students each year; they choose options allowing a focus on weather systems or general atmospheric science.

Our faculty of 15 has long maintained breadth and special strength in three areas:

- Climate systems, including the ocean
- Satellite and remote sensing
- Weather systems, including synoptic-dynamic



Space Science and Engineering Center
University of Wisconsin-Madison

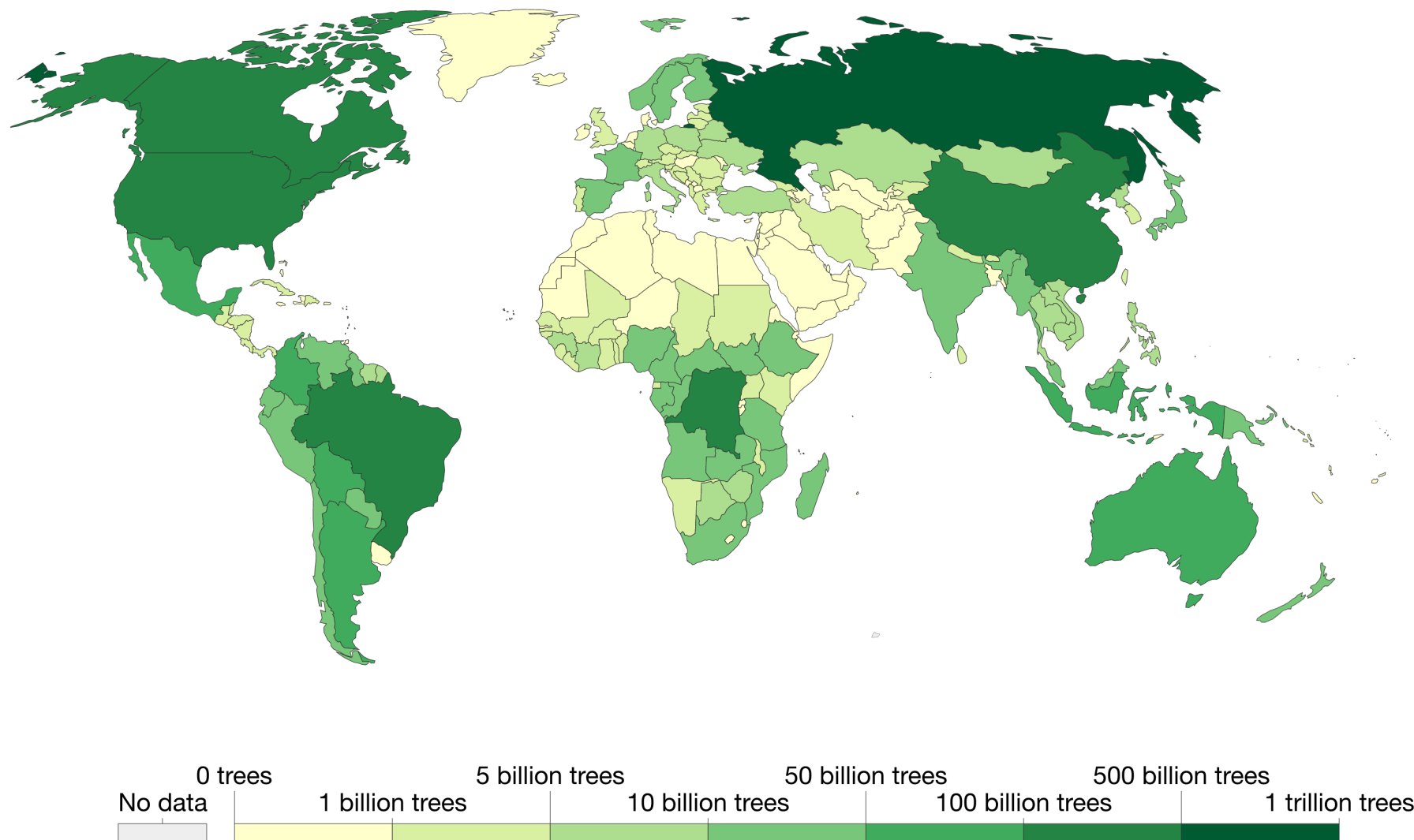


Center for Climatic Research
NELSON INSTITUTE
UNIVERSITY OF WISCONSIN-MADISON





Number of trees, 2014



Source: Crowther et al. (2015). Mapping tree density at scale. Nature.

Note: A tree is defined as a plant with woody stems larger than 10 cm diameter at breast height (DBH).

OurWorldInData.org/forests • CC BY

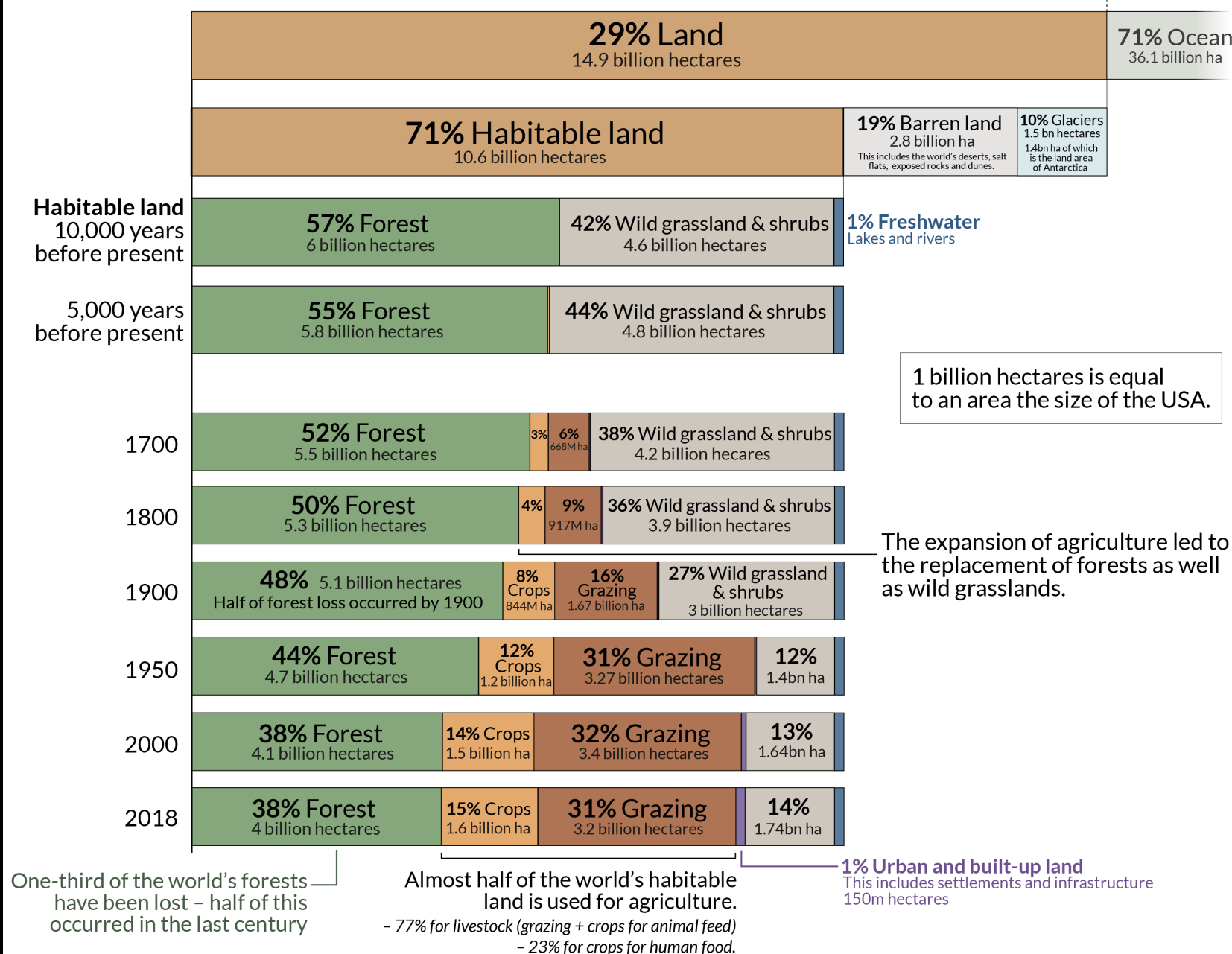
Earth home to 3 trillion trees, half as many as when human civilization arose

New study provides a better tree count, but not a better understanding of forests

2 SEP 2015 • BY [ELIZABETH PENNISI](#)



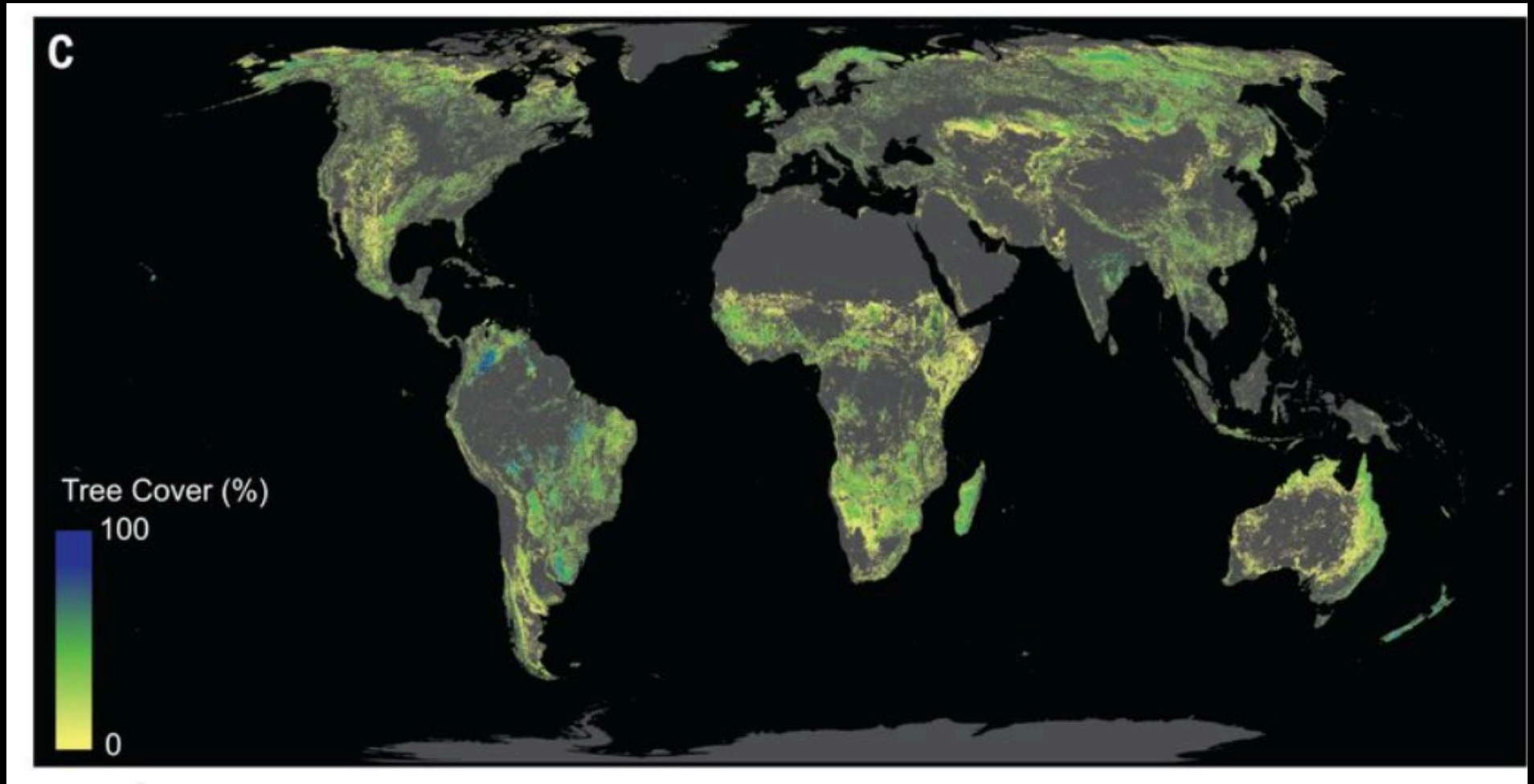
The world has lost one-third of its forest since the last ice age

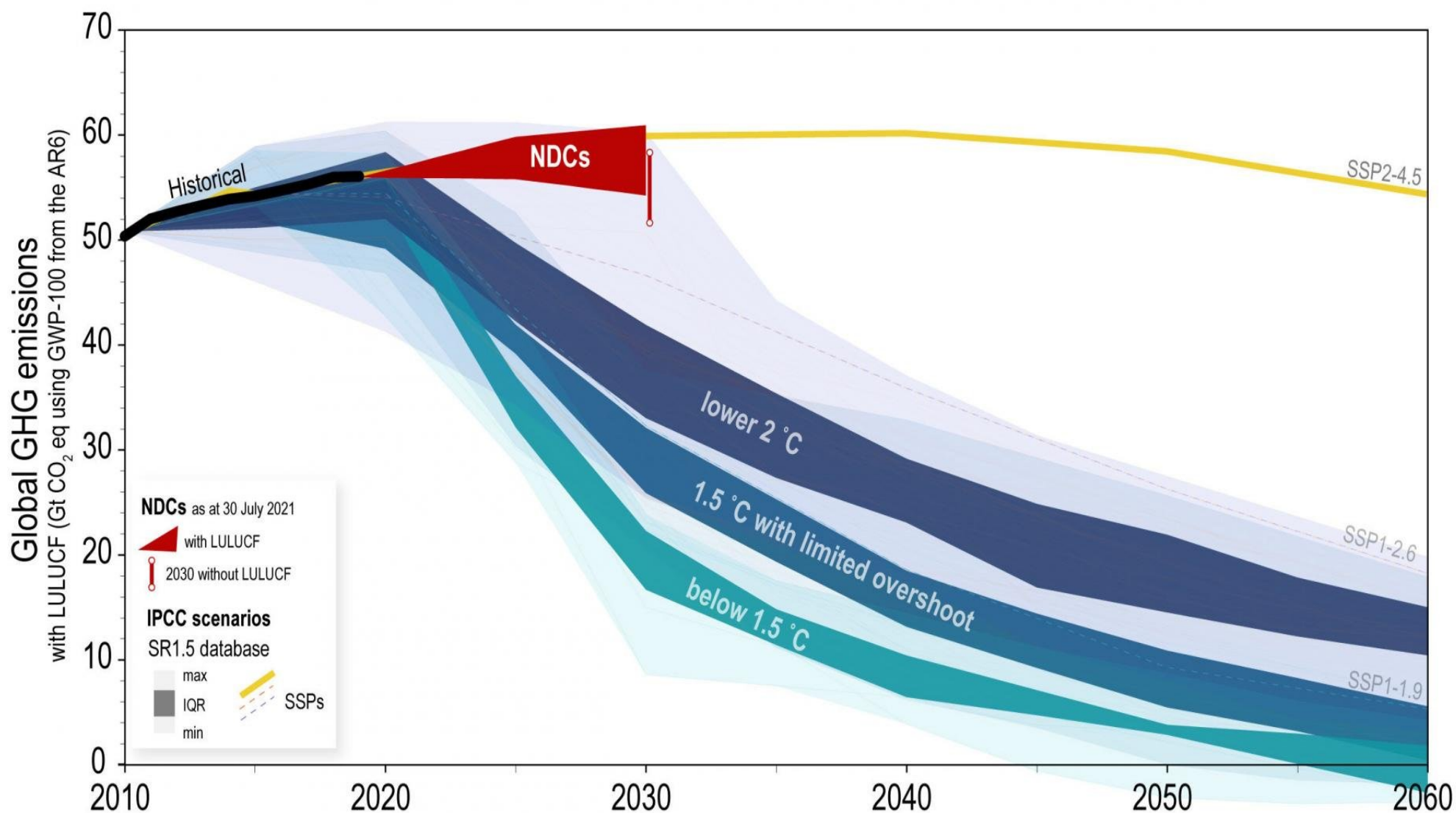


Data sources: Forests data from UN Food and Agriculture Organization (FAO); and Williams, M. (2003). Deforesting the earth: from prehistory to global crisis. Agriculture data post-1950 from UN FAO; pre-1950 data from The History Database of the Global Environment (HYDE)

The global tree restoration potential

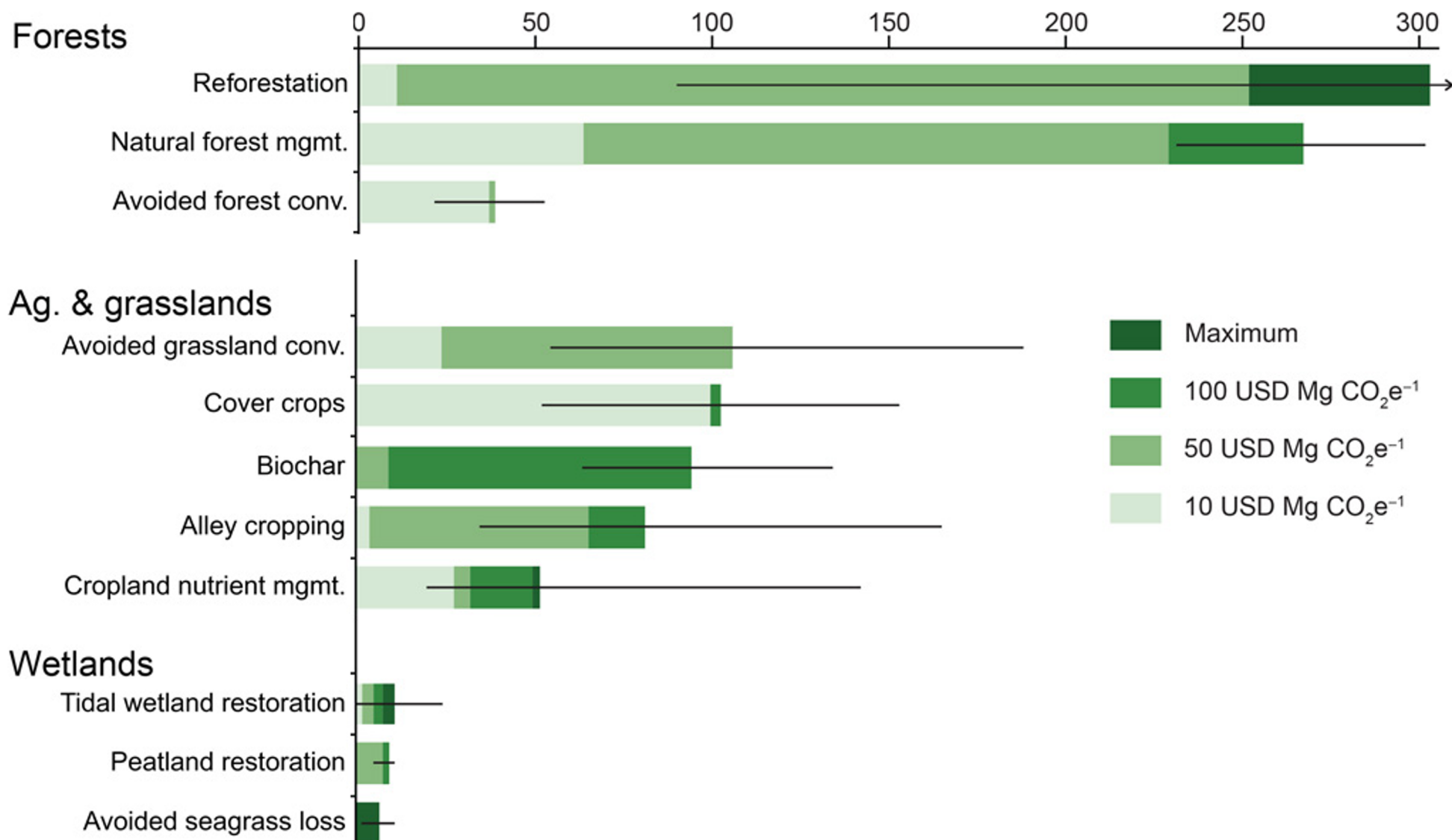
Jean-Francois Bastin^{1*}, Yelena Finegold², Claude Garcia^{3,4}, Danilo Mollicone²,
Marcelo Rezende², Devin Routh¹, Constantin M. Zohner¹, Thomas W. Crowther¹





Global Carbon Project 2019: Over 1000 scenarios from the IPCC Fifth Assessment Report are shown
Source: [Fuss et al 2014](#); [CDIAC](#); [Global Carbon Budget 2014](#)

Nature-Based Climate Solutions





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[WHERE WE WORK](#)

[DRIVING CHANGE](#)

[NEWS](#)

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An aerial photograph of a tropical landscape. A wide, muddy brown river flows through the center of the image. On either side of the river, large areas of forest have been cleared, leaving behind green, grassy fields and patches of bare earth. The remaining forest is dense and green, with many tall, thin trees visible. The overall scene depicts the impact of deforestation on a natural environment.

PROTECT. RESTORE. END DEFORESTATION.

Read our 2016-2020 Impact Report [↓](#)

A Billion Begins with One

Planting a billion trees can help us curb the effects of climate change. It's a big number, but we know we can do it with your help.

[PLANT YOUR TREE TODAY](#)



U.S. Department of the Interior



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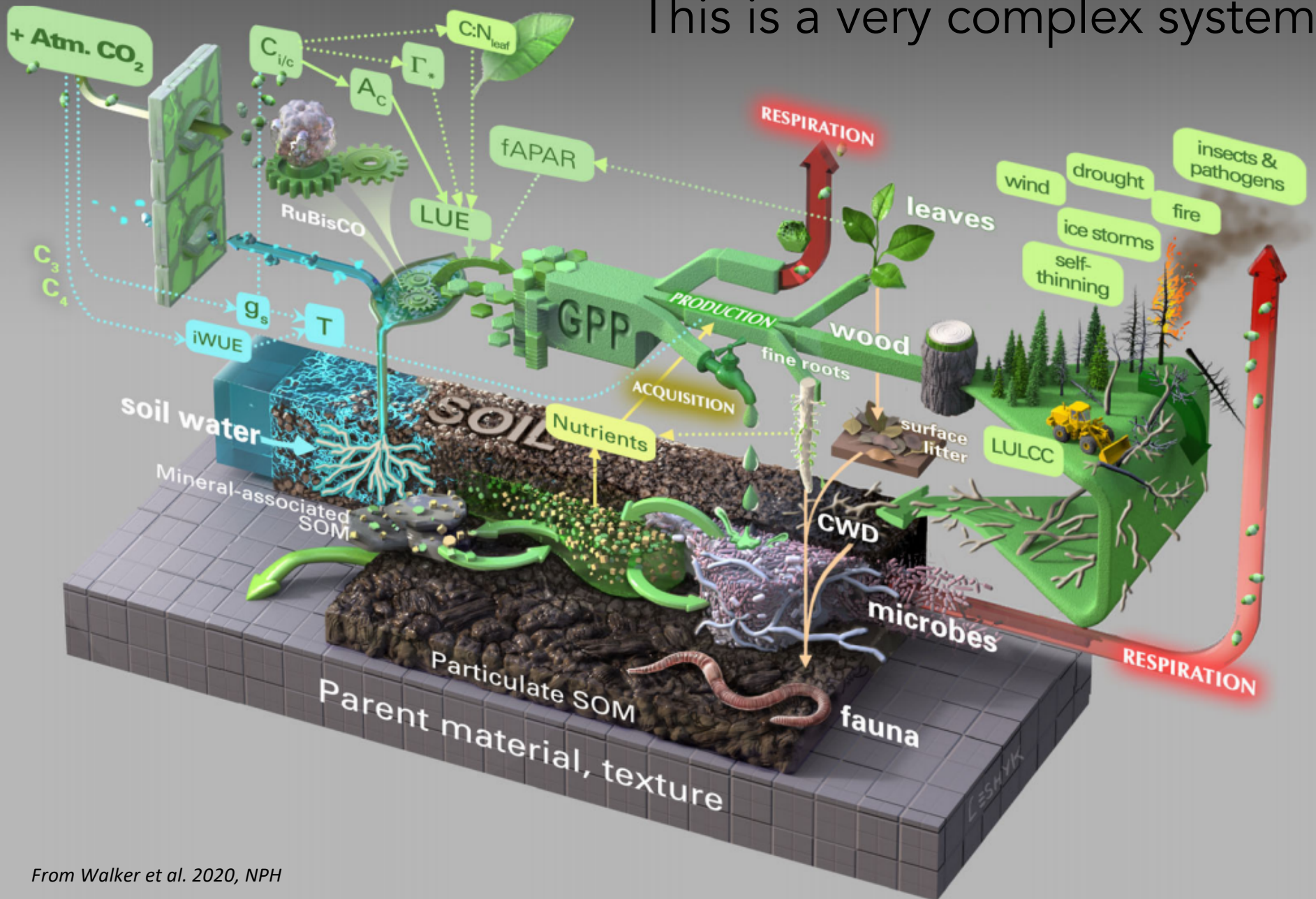
Sha

Trump Administration Furthers Commitment to One Trillion Trees Initiative

10/13/2020

Last edited 9/29/2021

This is a very complex system



From Walker et al. 2020, NPH



Tansley review



Flux towers in the sky: global ecology from space

Author for correspondence:

David Schimel

Tel: +1 626 773 0943

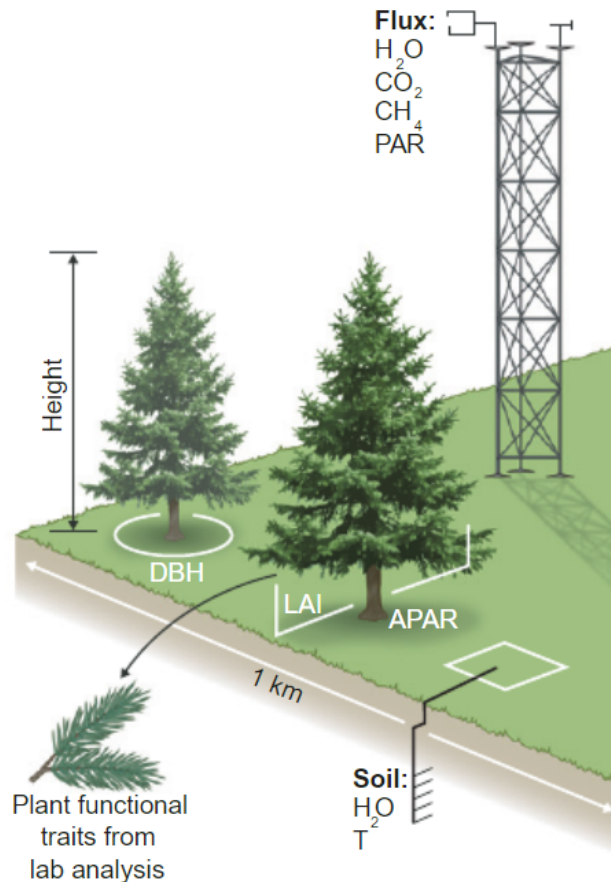
Email: dschimel@jpl.nasa.gov

David Schimel , Fabian D. Schneider  and JPL Carbon and Ecosystem Participants*

Jet Propulsion Lab, California Institute of Technology, Pasadena, CA 91101, USA

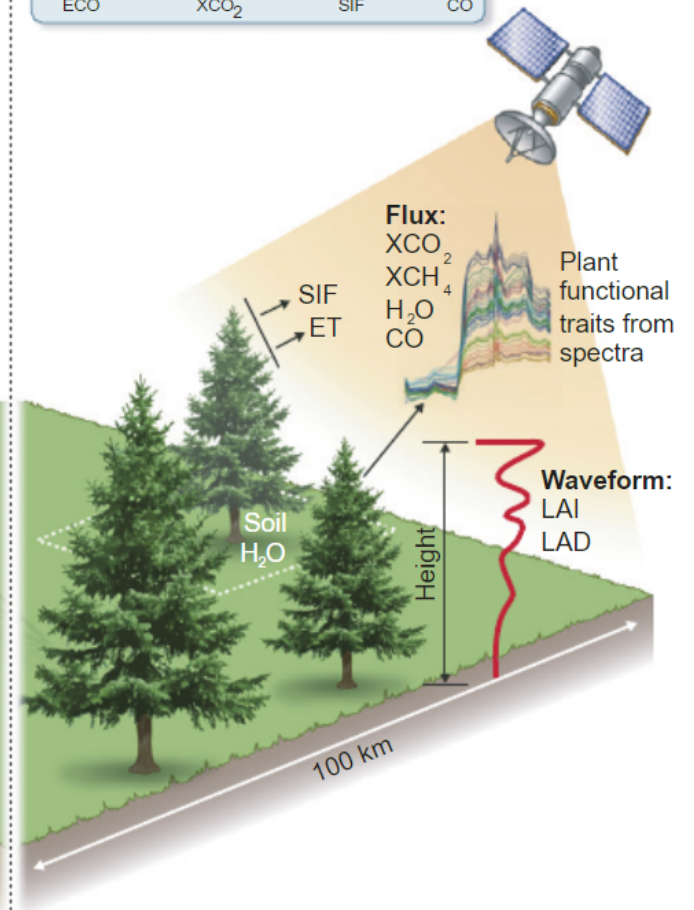
In situ

Carbon equation
 $GPP = NEE_{EC} - R_{ECO} \text{ (night)}$



Space

Carbon equation
 $R_{ECO} = NEE_{XCO_2} - GPP_{SIF} - Fire_{CO}$



Credits:

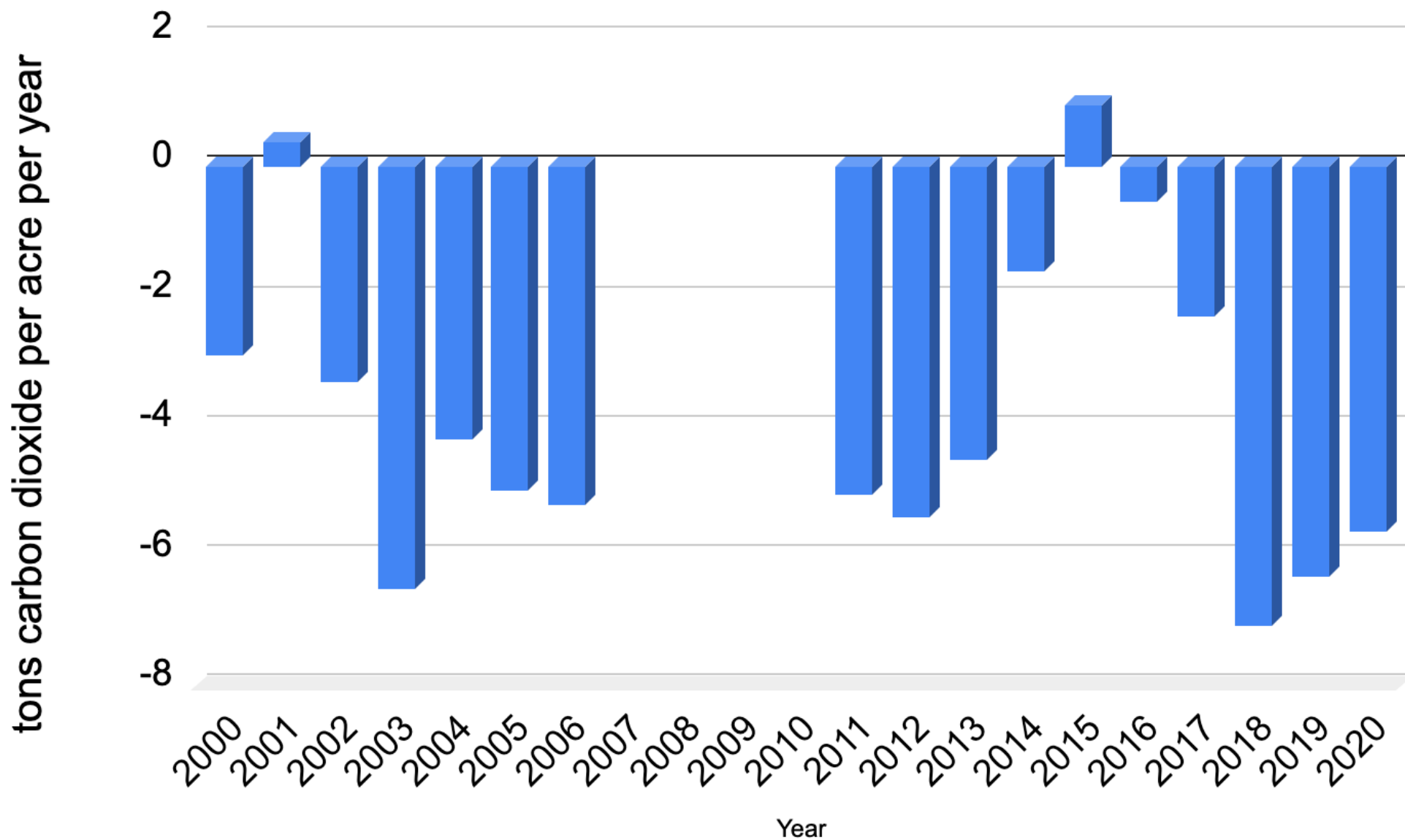
Kim Novick (U Indiana)

Stefan Metzger (Battelle/NEON)

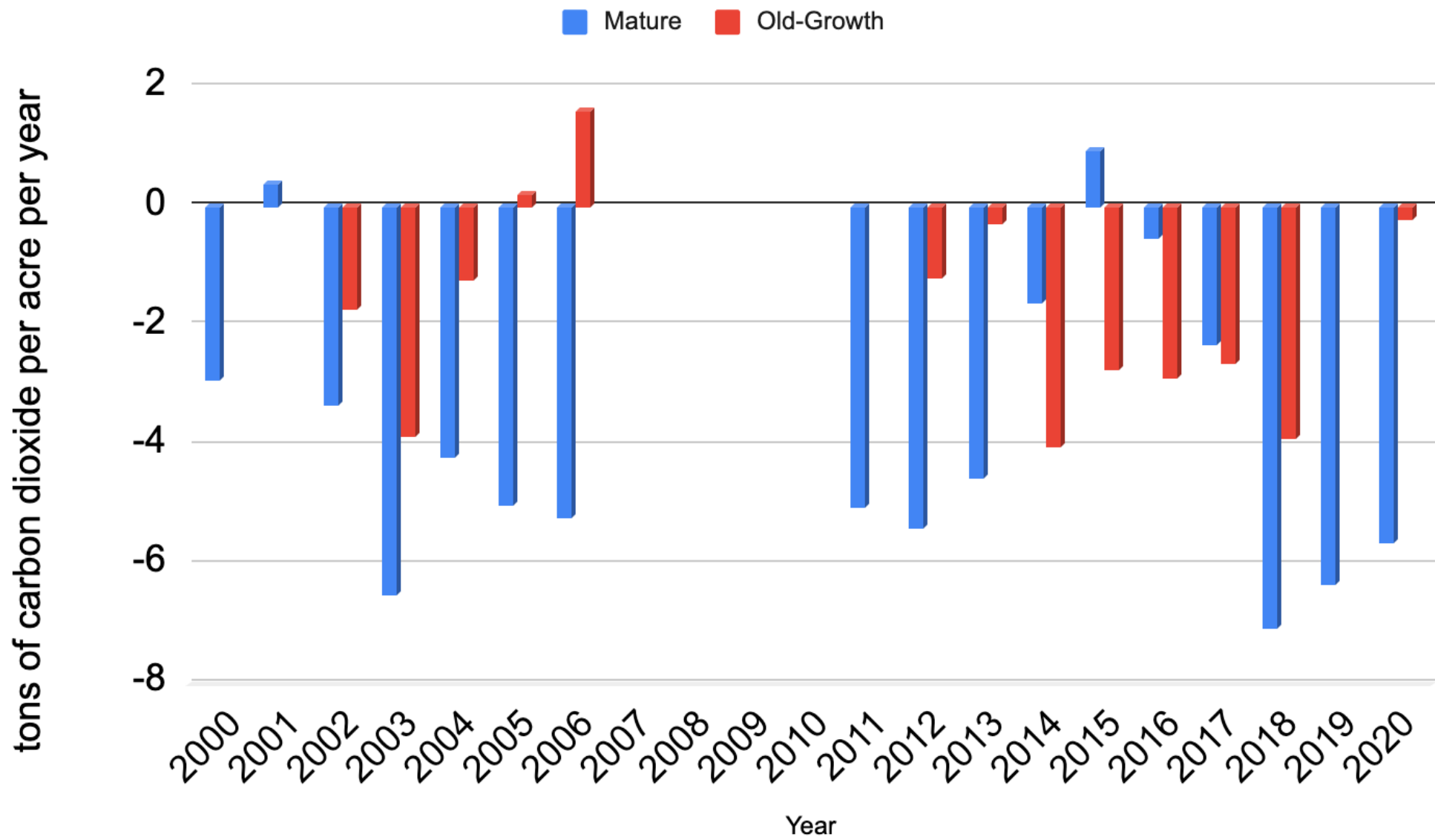
Susi Wiesner (USDA)



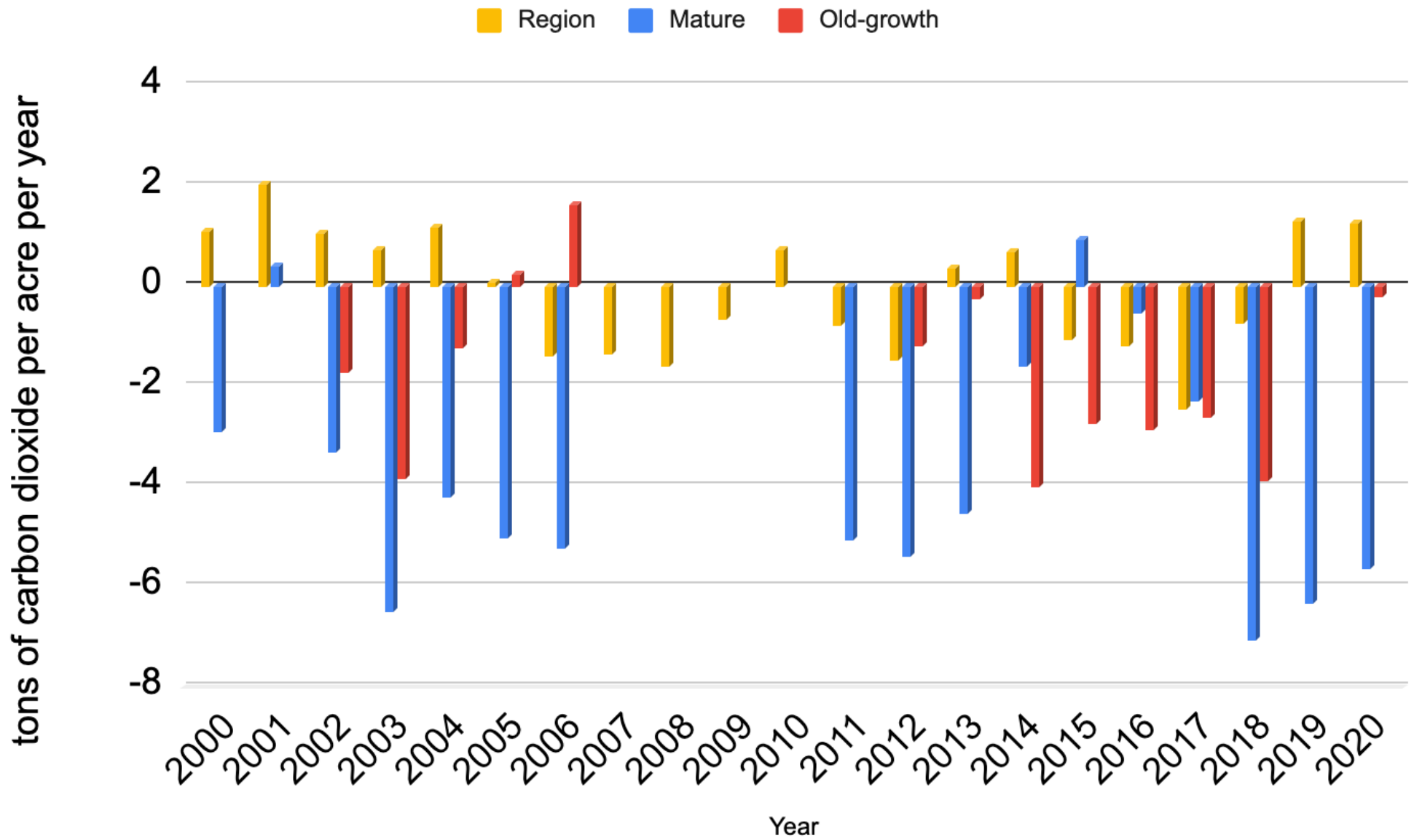
Negative number = taking carbon dioxide out of the air

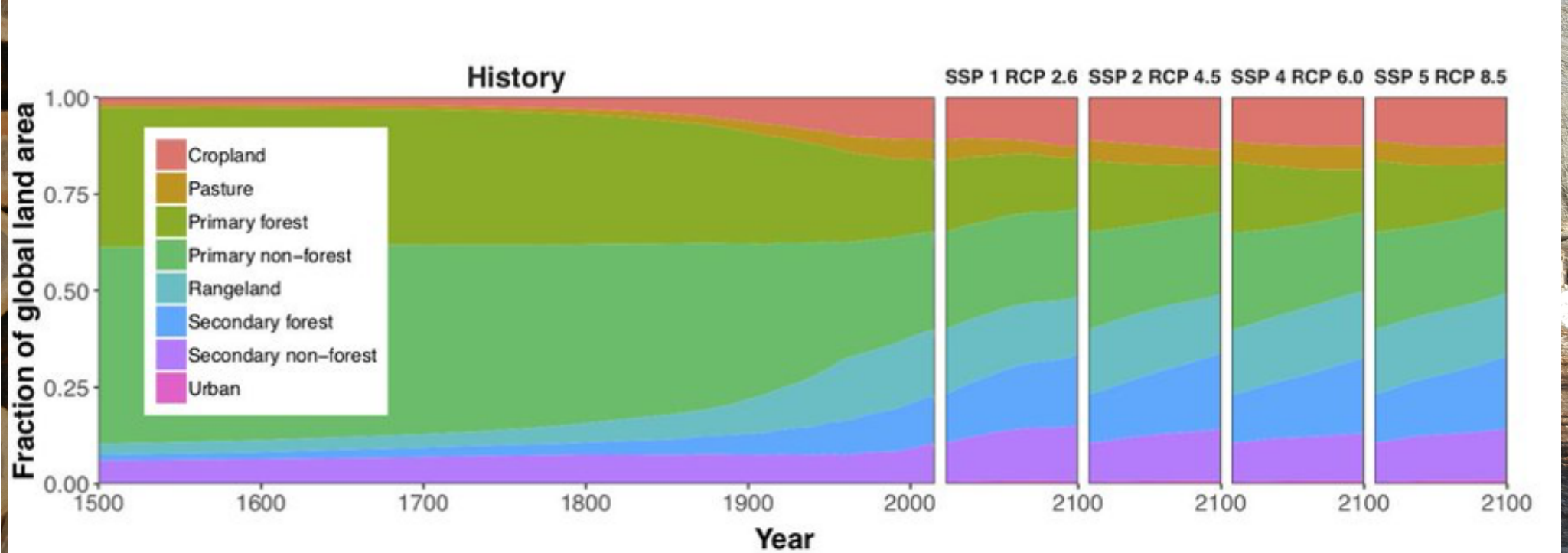
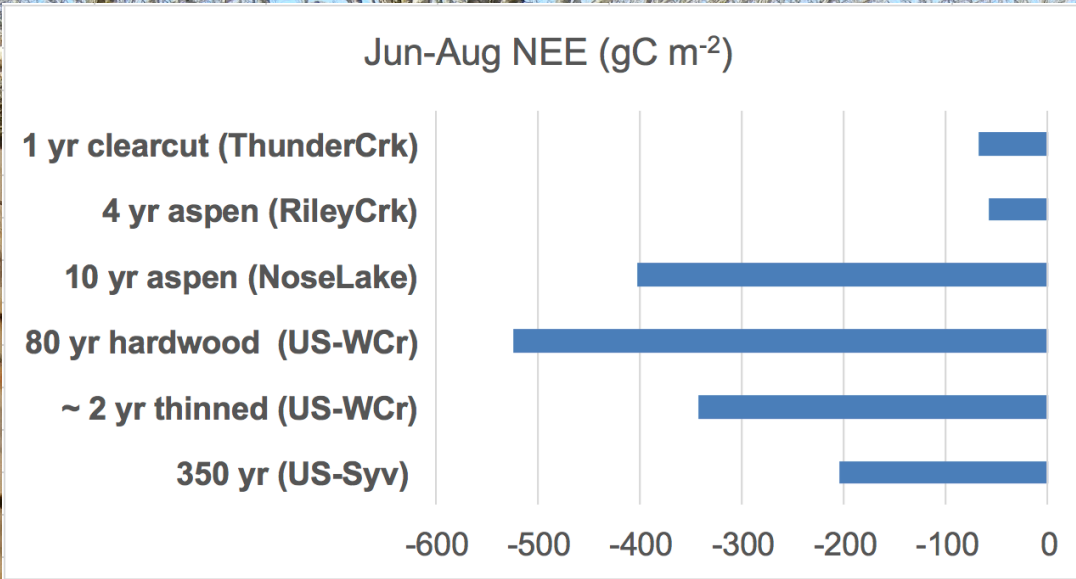










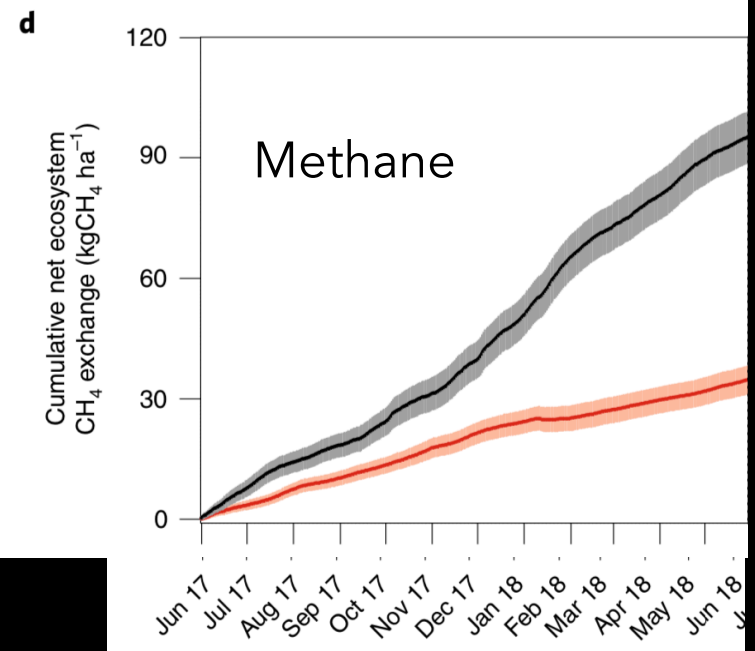
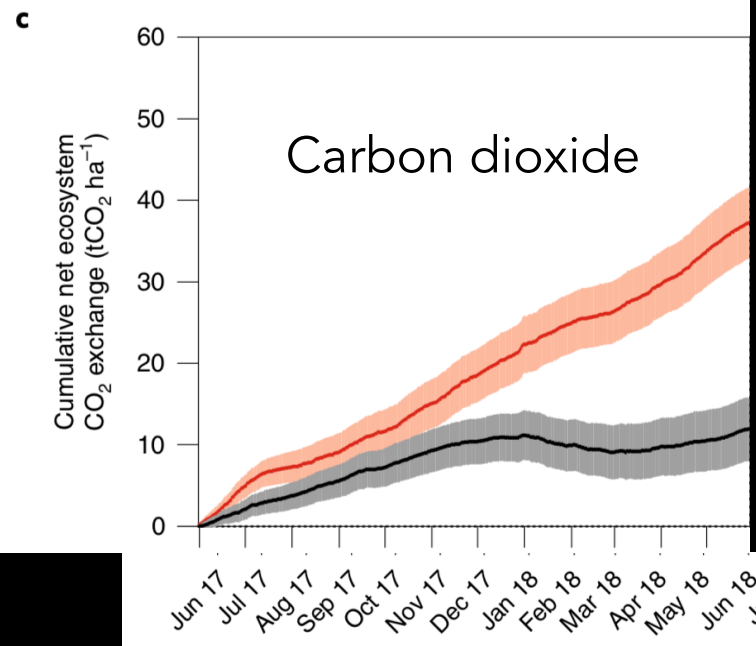


B. Bond-Lamberty
Photo: J Thom



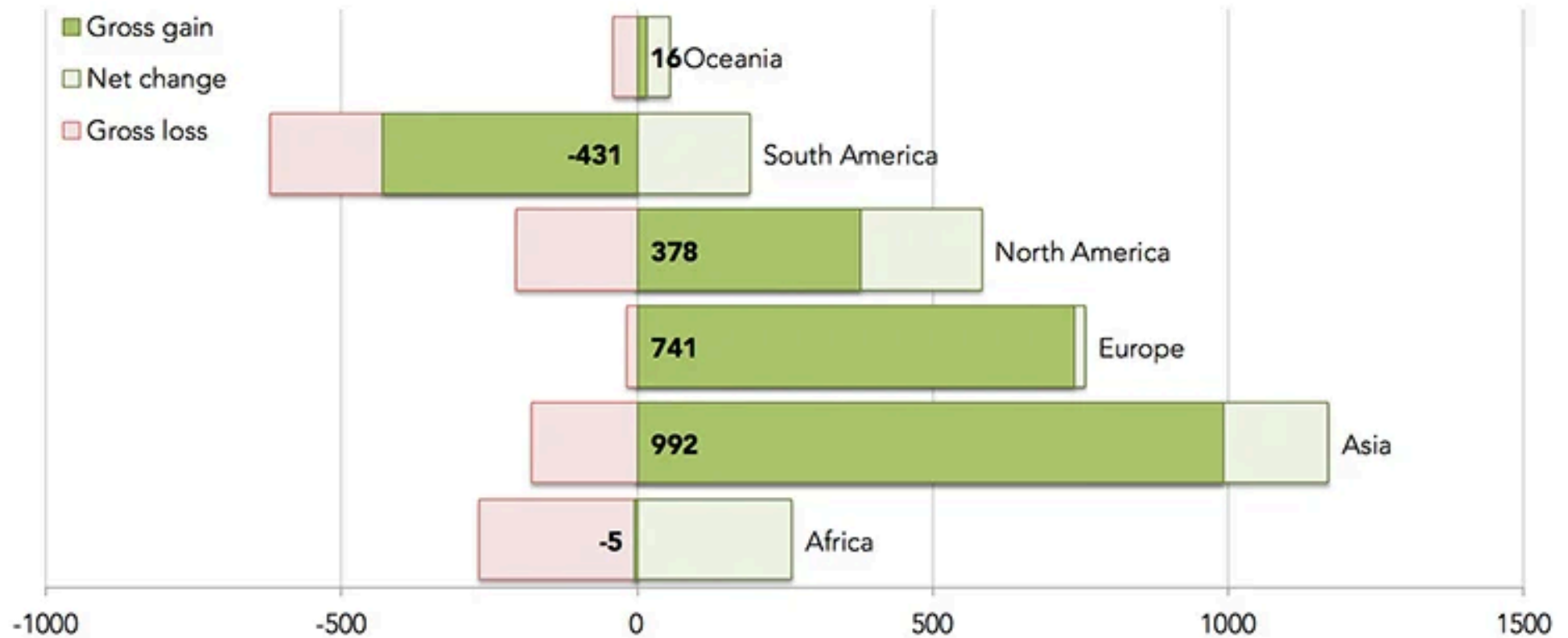
— Intact peatland

— Degraded peatland



Deshmukh et al., 2021

Tree canopy cover loss/gain 1982-2016 (1000 sq km)



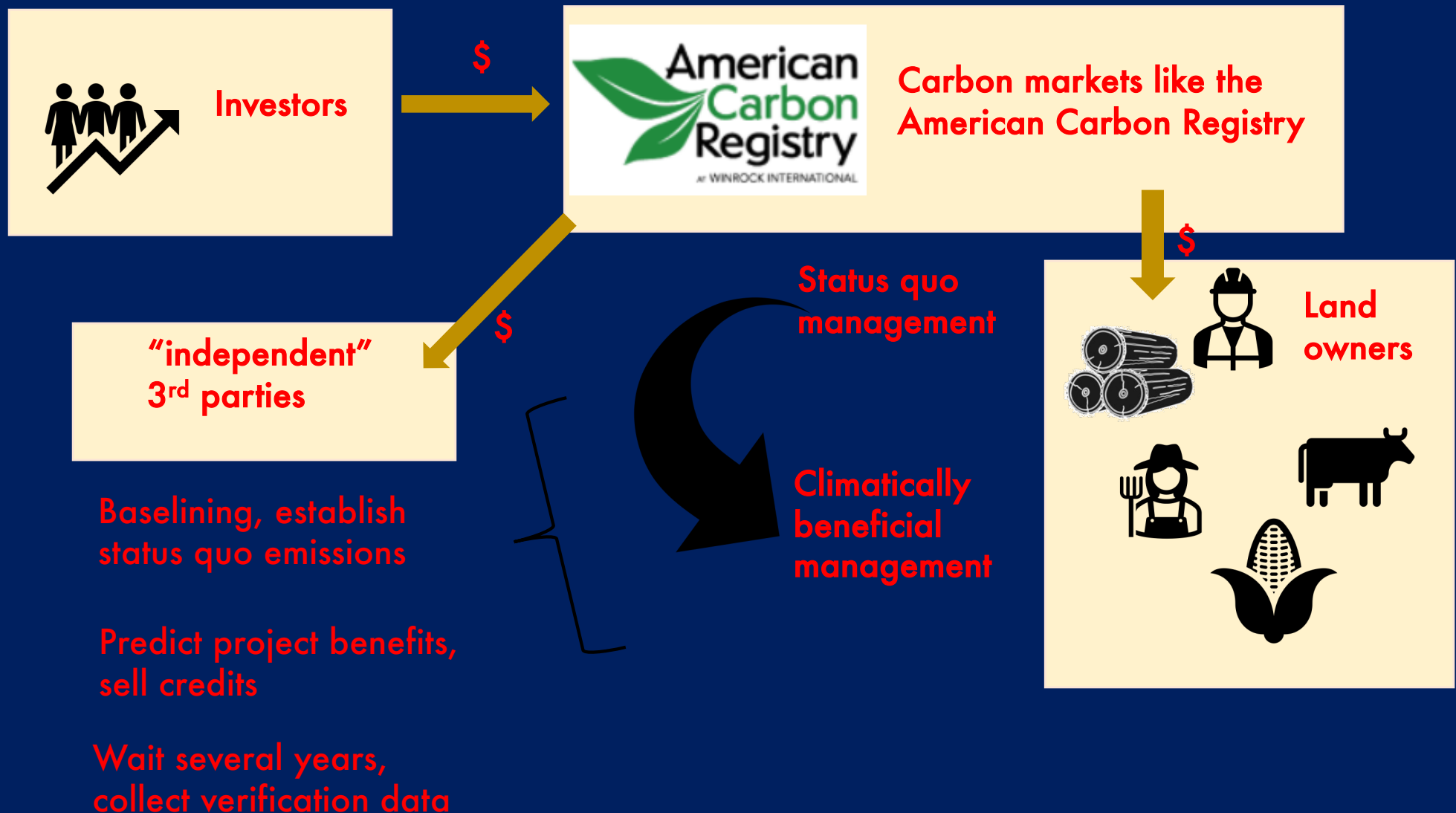
MONGABAY USING SONG ET AL 2018



<https://www.nytimes.com/2020/01/10/world/australia/australia-wildfires-photos.html>



Right now, private carbon markets are the primary tool for implementing nature-based climate solutions. Most are voluntary (as opposed to compliance based).



Credits:

Kim Novick (U Indiana)

Stefan Metzger (Battelle/NEON)

Susi Wiesner (USDA)

Bottom Line:

- Preventing deforestation and reforesting some areas can increase removal of carbon dioxide from the atmosphere and support ecosystems and society
- However, not all tree planting is equally good, considering risks, and in some cases negative effects on water supplies or local land rights and subsistence exist
- The worst effects of climate change will be primarily solved by reducing fossil fuel emissions and addressing the needs of the most vulnerable

Continued research and partnerships, embodying with Wisconsin Idea, and over a century of work, particularly in last 50 years, by our faculty, staff and students, carry forward the legacy of Earth Day and your advocacy for the environment from 1971 into the future

Willow Creek - NetCam SC IR - Fri Oct 08 12:35:50 2021
Temperature: 46.0 °C internal, -1.0 °C outside
RH: 0%, Pressure: 961.0 millibars
Exposure: 600

Thank you!

Ankur Desai

desai@aos.wisc.edu

[@profdesai](https://flux.aos.wisc.edu)

