

Beyond the *Epochal Anthropocene*

Earth Science for a Human-Transformed Planet



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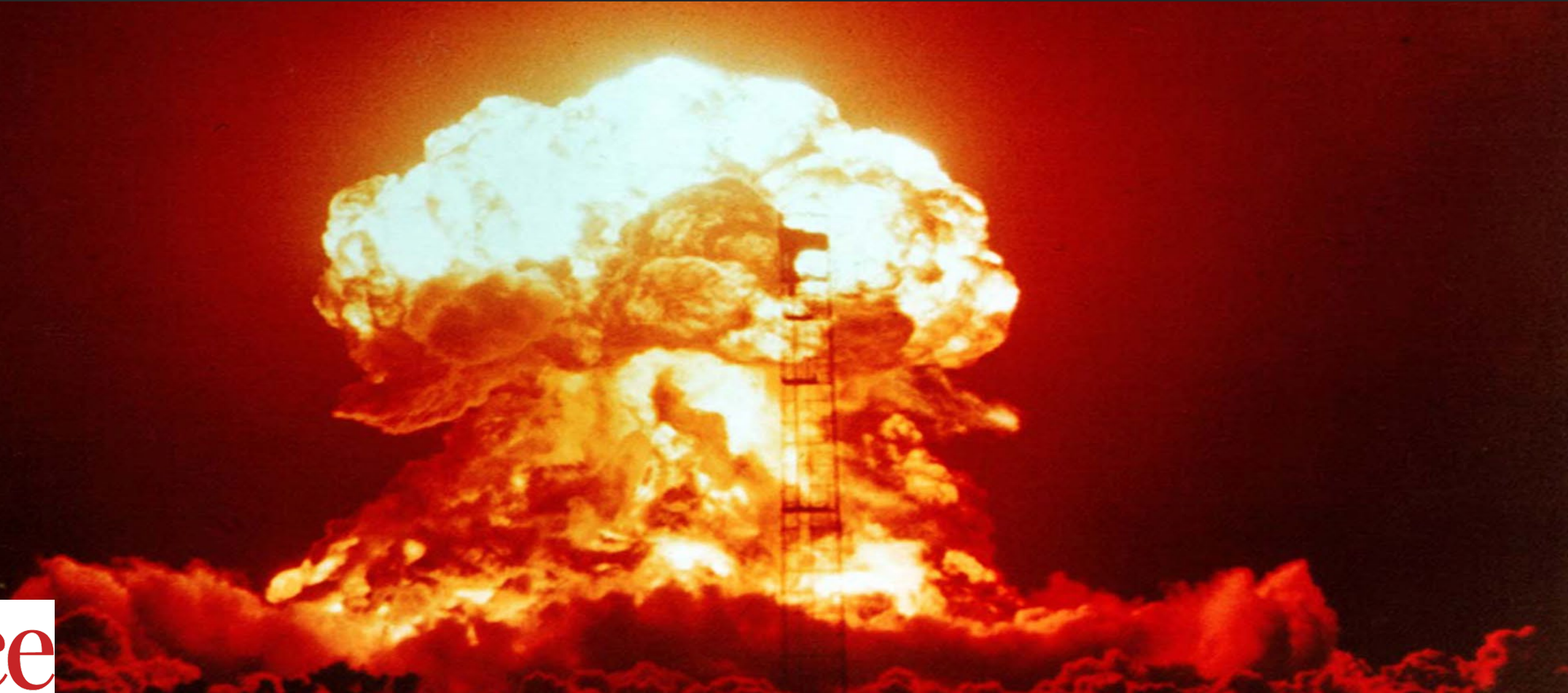
The Anthropocene is dead. Long live the Anthropocene

Panel rejects a proposed geologic time division reflecting human influence, but the concept is here to stay

5 MAR 2024 • 4:00 PM ET • BY [PAUL VOSEN](#)

Science
AAAS

<https://www.science.org/content/article/anthropocene-dead-long-live-anthropocene>



A Formal Epoch Definition in the Geologic Time Scale

Rejected March 5, 2024 by the Subcommission on Quaternary Stratigraphy (SQS)

Proposed July 11, 2023 by the Anthropocene Working Group (AWG; 2009 - 2024)

Anthropocene Epoch & Series

The current geological epoch, beginning in the calendar year **1952 CE**, defined by a marked upturn in $^{239+240}\text{Pu}$ in a sedimentary sequence in **Crawford Lake, Canada, marking the start of the Crawfordian Age/Stage** (Global Boundary Stratotype Section and Point; GSSP), and correlated with additional stratigraphic indicators in three stratal sequences.



International Commission on Stratigraphy
Subcommission on Quaternary Stratigraphy

<http://quaternary.stratigraphy.org/working-groups/anthropocene/>

Anthropocene
Working Group



"I feel this has been a missed opportunity to recognize and endorse a simple reality, that....

**our planet left its natural functioning state
in the mid-20th century"**

Martin Head
Brock University, Canada



<https://www.france24.com/en/live-news/20240322-no-human-era-in-earth-s-geological-history-scientists-say>

Definitions

The Anthropocene

Original (Crutzen and Stoermer 2000)

the current time, in which... “the global effects of human activities have become clearly noticeable.”

“To assign a more specific date to the onset of the “anthropocene” seems somewhat arbitrary, but we propose the latter part of the 18th century,”

Common usage (Oxford English Dictionary 2014)

“the current geological age, viewed as the period during which human activity has been the dominant influence on climate and the environment.”

Anthropocene

the human era



PLANETARY
CHALLENGES | OPPORTUNITIES



Anthropocene

Earth System

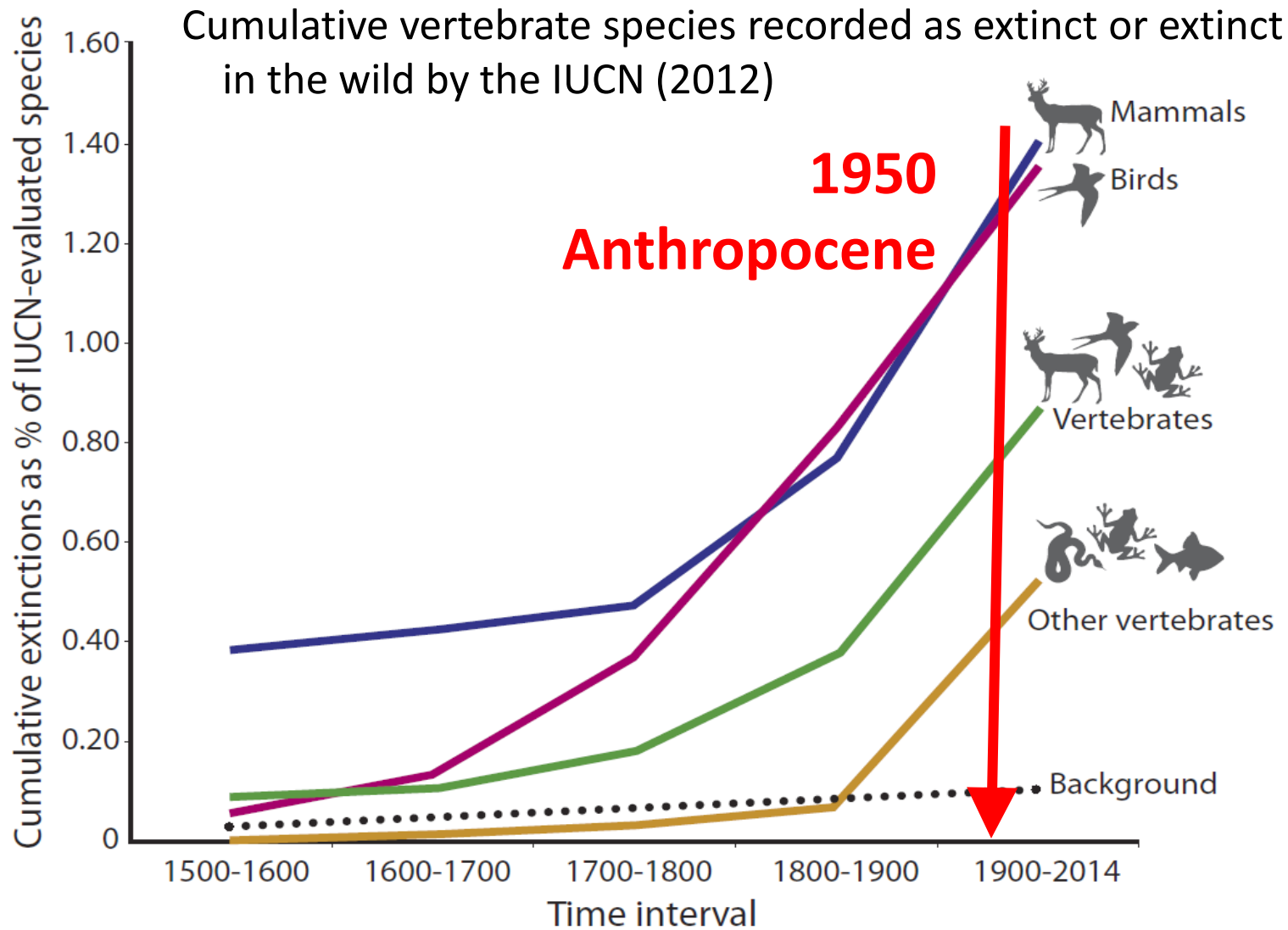
The Anthropocene Condition: Social change drives Earth system change



Ellis (2024)

The Anthropocene Condition: Evolving through Social-Ecological Transformations
Philosophical Transactions of the Royal Society B: Biological Sciences 379:20220255s

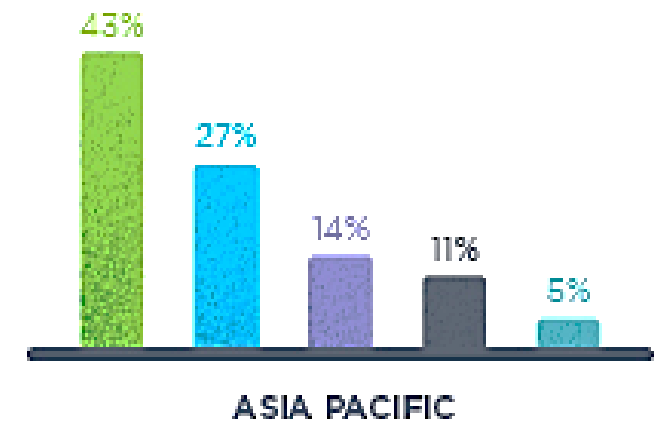
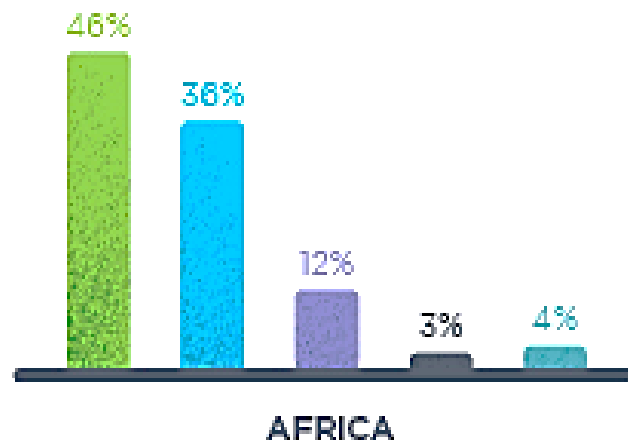
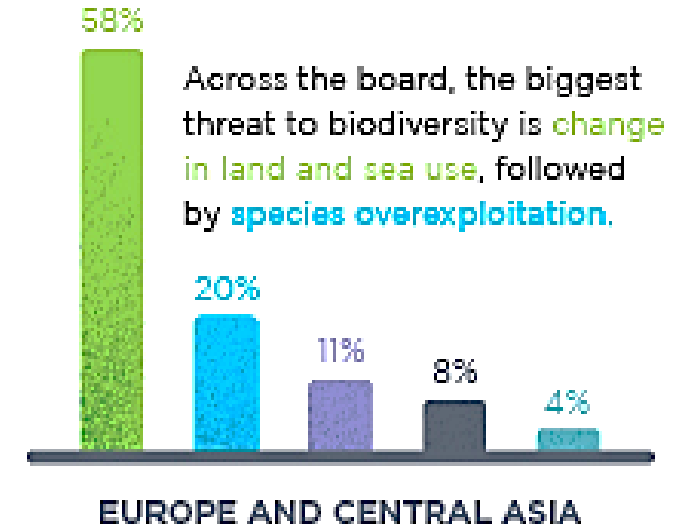
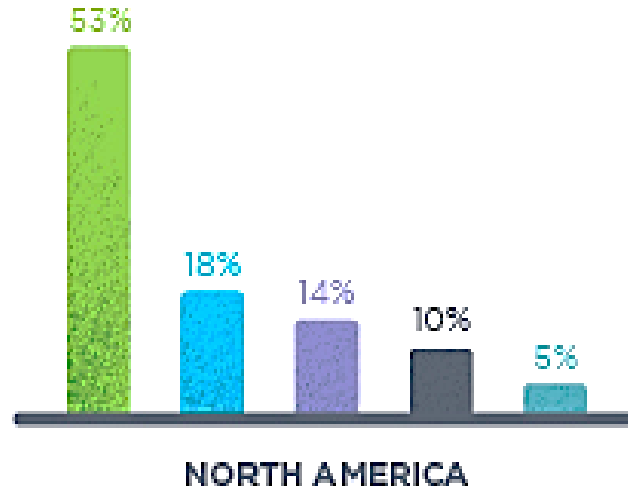
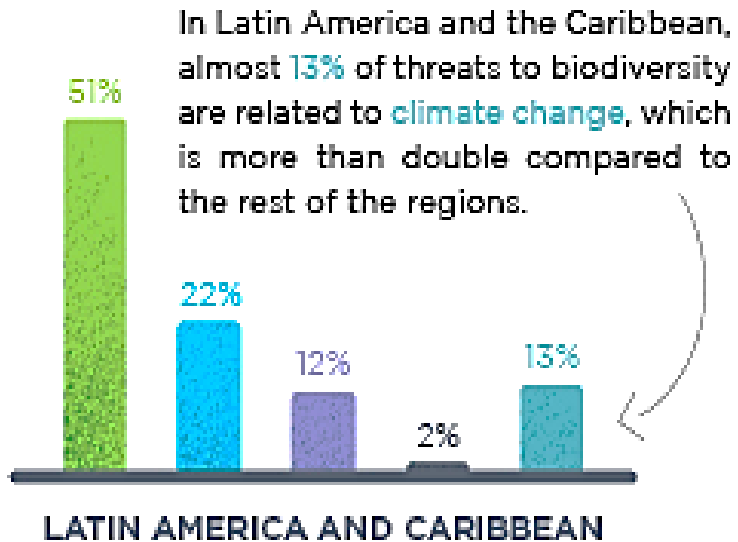
Entering the Sixth Mass Extinction [?]



Changes in Land & Sea Use

“The biggest threat to Earth's biodiversity”

- CHANGES IN LAND AND SEA USE
- SPECIES OVEREXPLOITATION
- INVASIVE SPECIES AND DISEASE
- POLLUTION
- CLIMATE CHANGE



Anthropocene : Crisis

Amazonia

Deforestation on the Amazon Frontier,

Rondonia, Brazil, May 28, 2009

Anthropocene : Archaeology



Amazonia

Geoglyphs >700 years BP

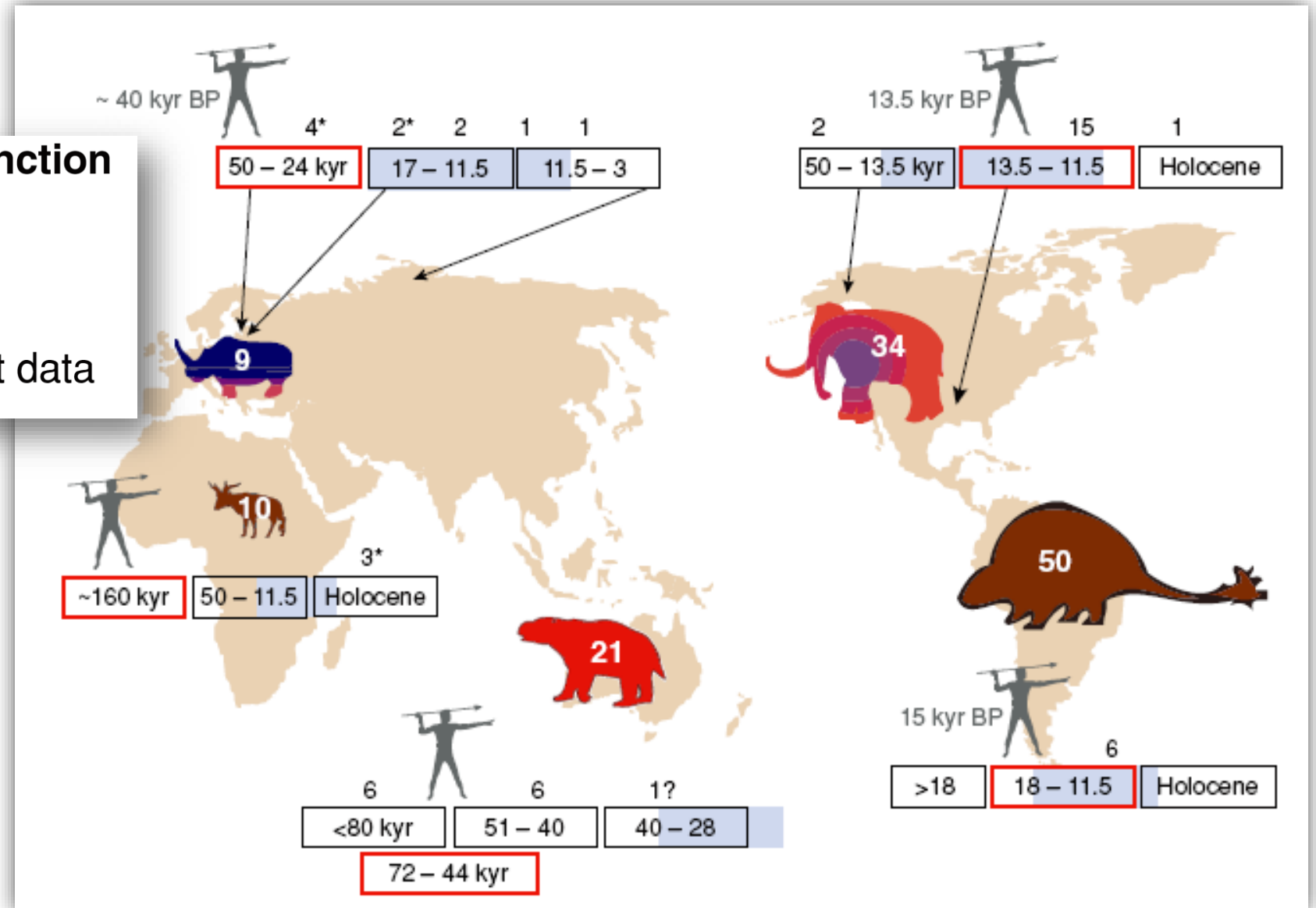
Near Acre, Brazil

<https://www.dronestagr.am/amazon-geoglyphs/>

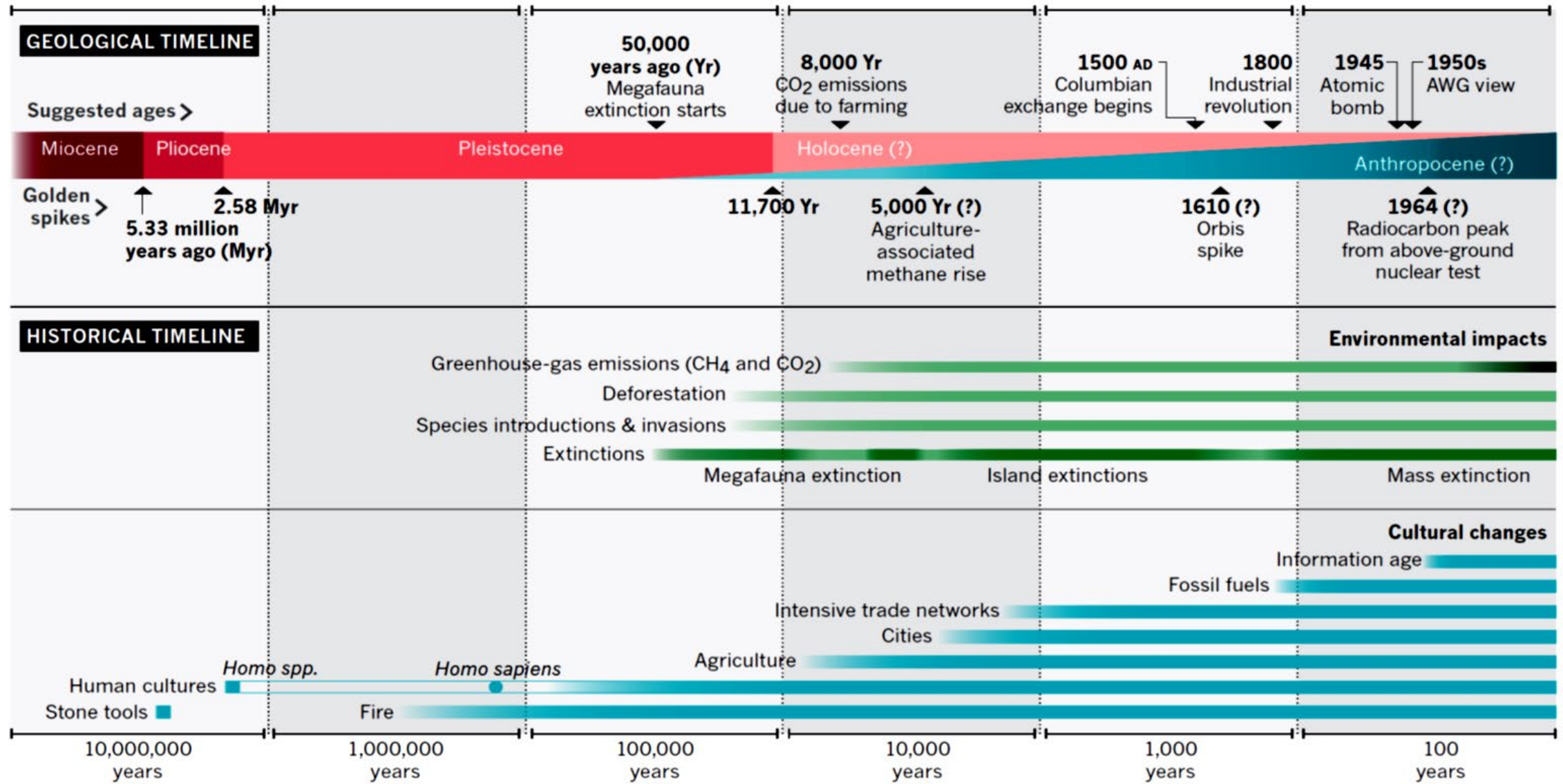
Megafaunal Extinctions: > 15 kyr BP

Causes of extinction

- Humans
- Climate
- Insufficient data



THE DEEP ROOTS OF THE ANTHROPOCENE

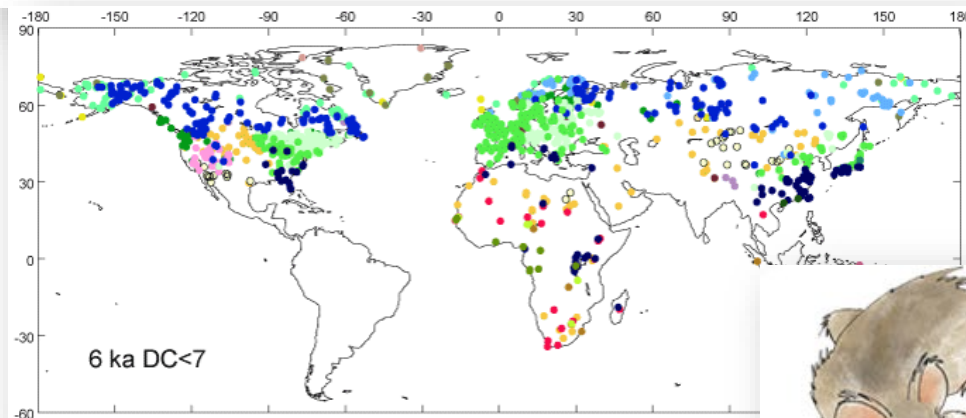


Deepening the Anthropocene International Empirical Projects



BIOME 6000 - Version 4.2

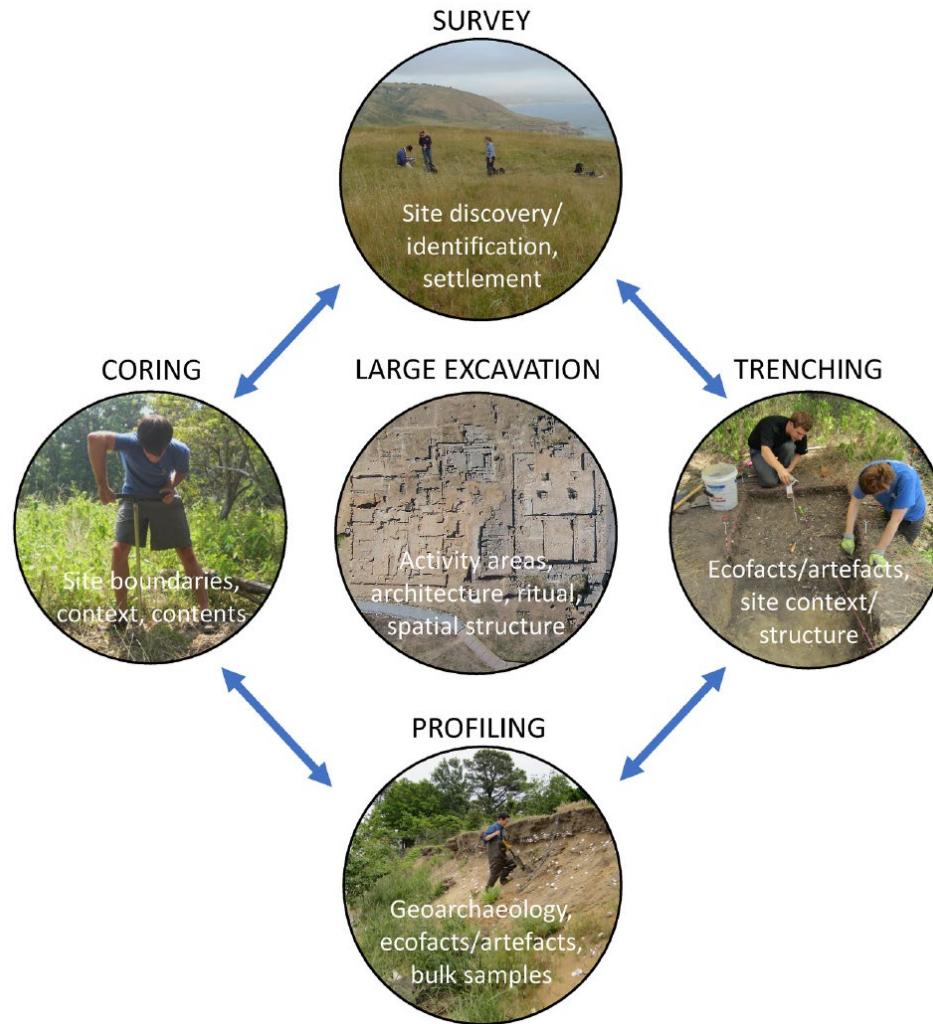
1: Vegetation maps for the Mid-holocene and last Glacial Maximum



NEOTOMA PALEOECOLOGY DATABASE



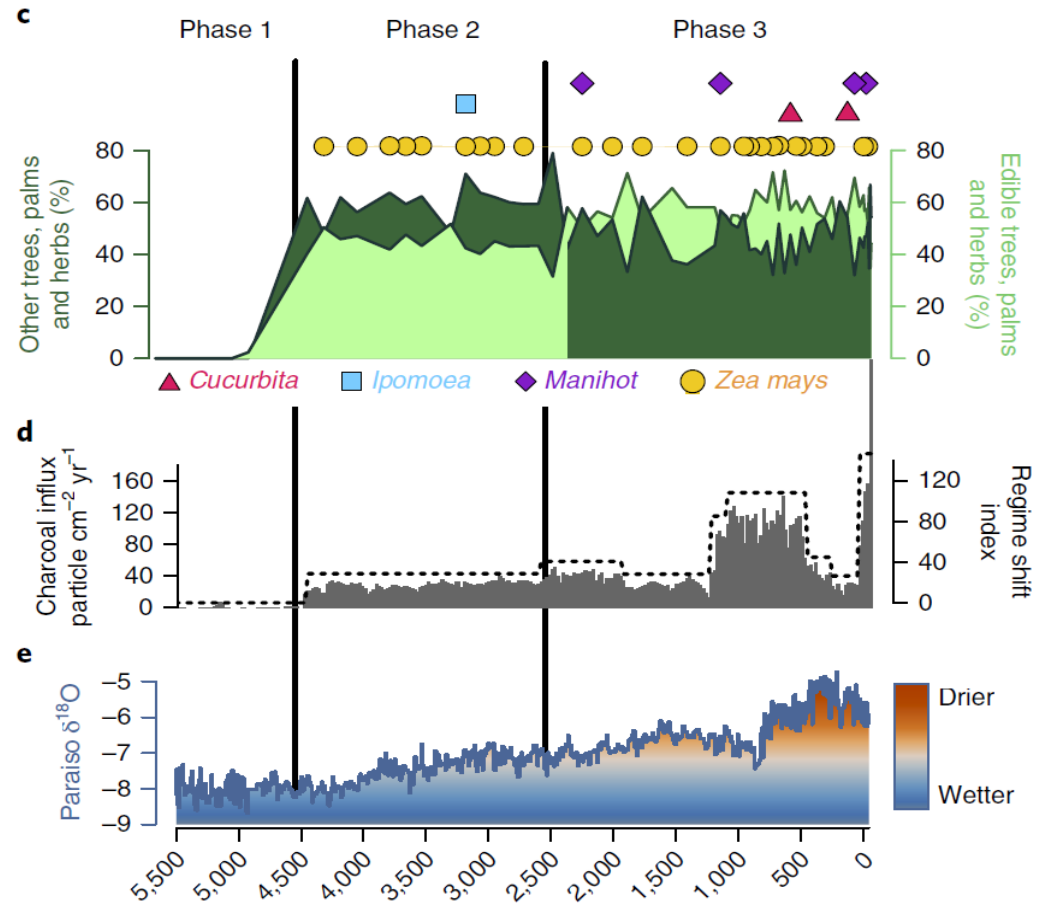
Coring, profiling, and trenching: Archaeological field strategies for investigating the Pleistocene-Holocene-Anthropocene continuum



Rick et al. 2022
Quaternary International 628:1-17.



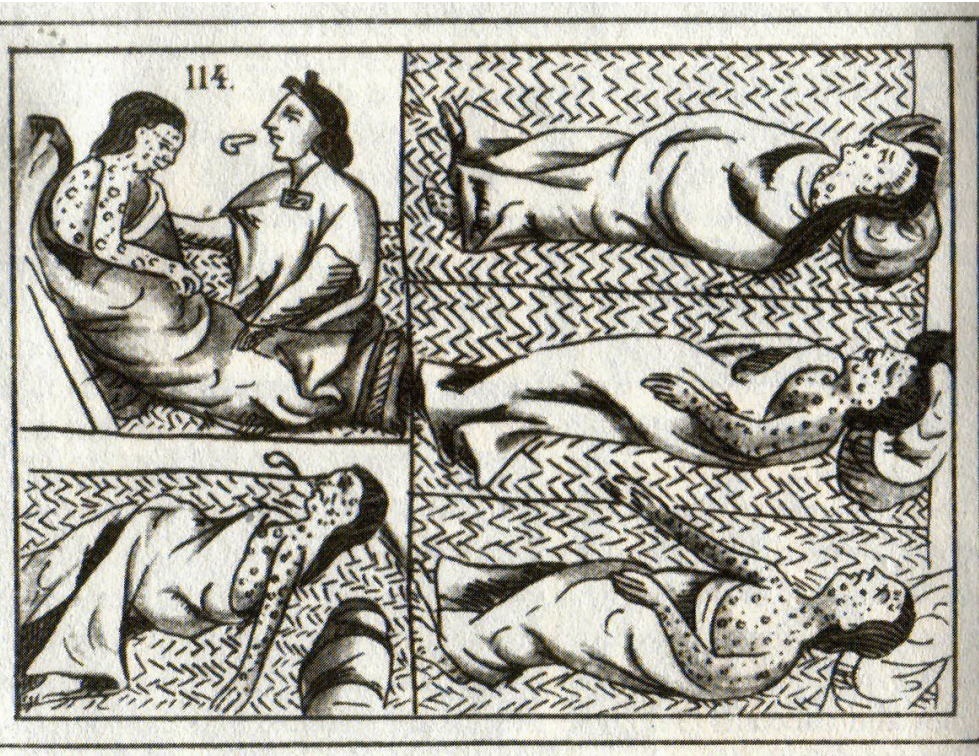
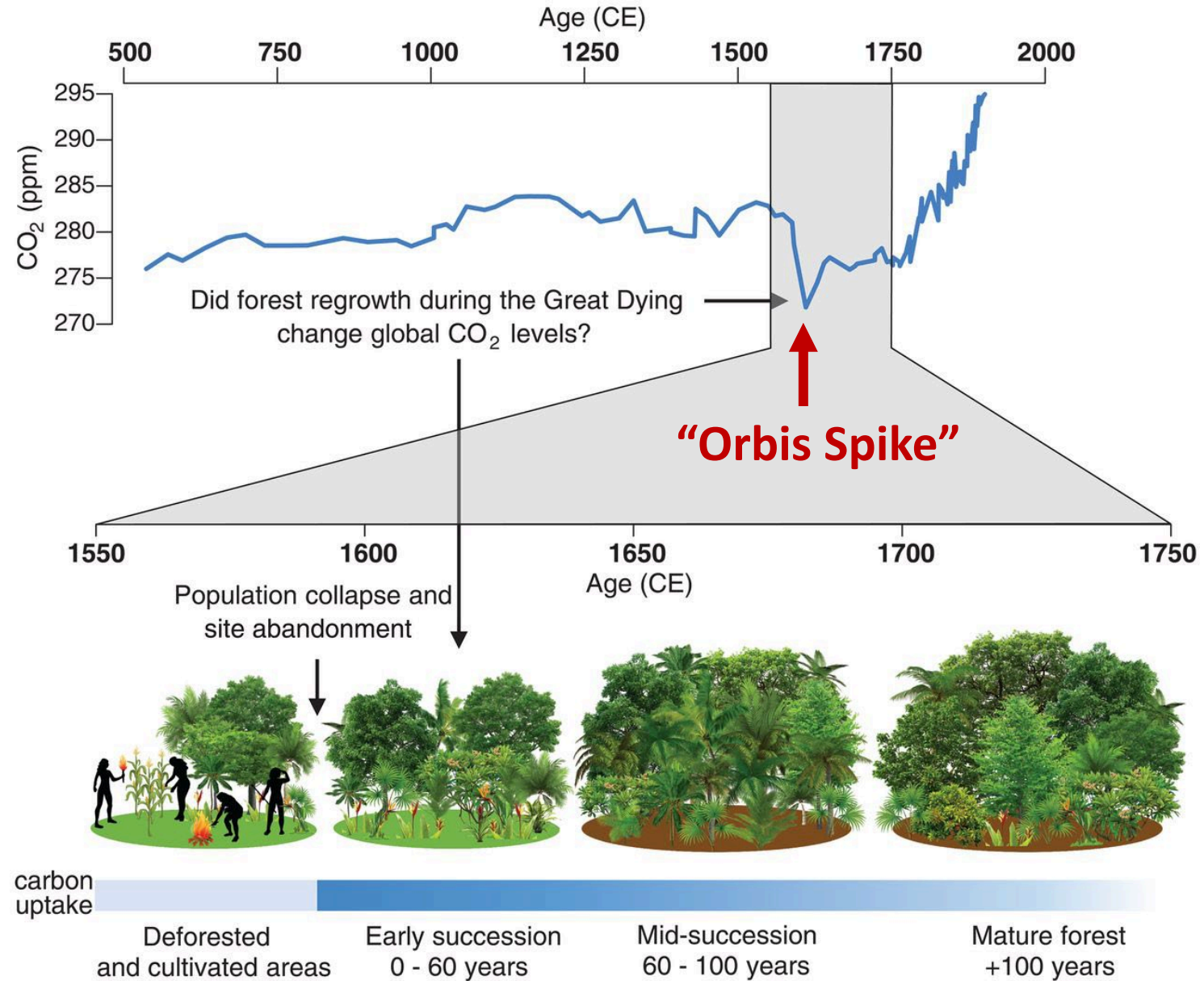
The legacy of 4,500 years of polyculture agroforestry in the eastern Amazon



The Great Dying

Pandemic & Colonization in the Americas

Lewis & Maslin. 2015. Defining the Anthropocene. *Nature* 519:171-180.



Koch et al. 2019. Earth system impacts of the European arrival and Great Dying in the Americas after 1492. *Quaternary Science Reviews* 207:13-36.

Bush et al. 2021. Widespread reforestation before European influence on Amazonia. *Science* 372:484-487.

Methane & Early Rice

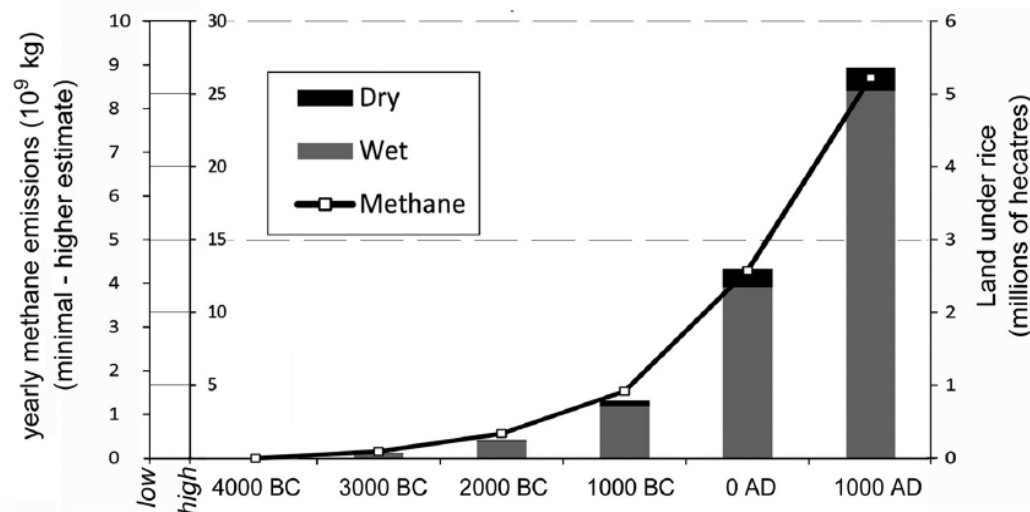
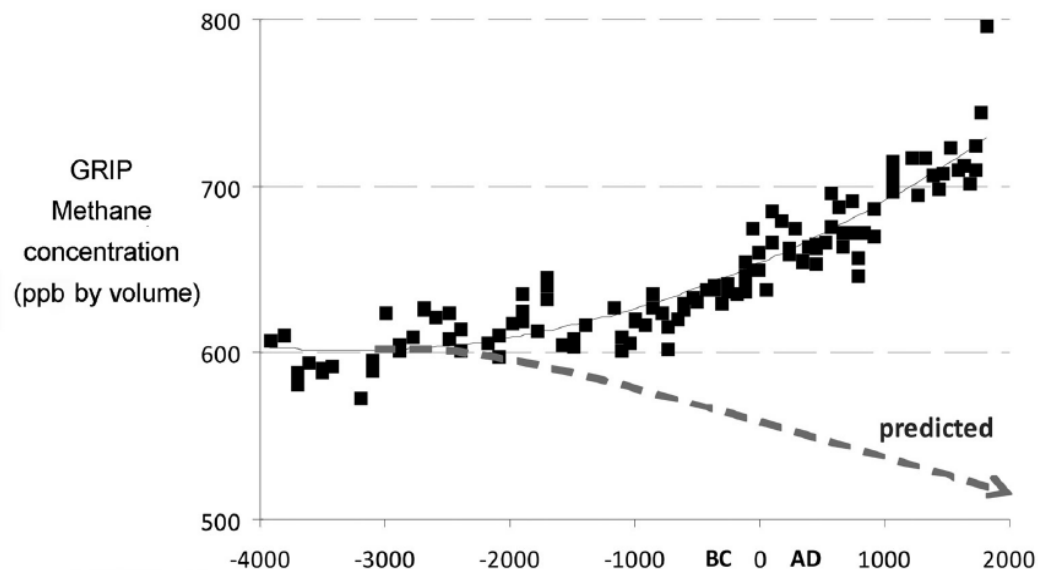
Constraints on the Late Holocene Anthropogenic Contribution to the Atmospheric Methane Budget

“both anthropogenic and natural sources are needed to explain LPIH changes in methane concentration.”

Science
AAAS

Mitchell et al. 2013.
Science **342**:964-966

Fuller et al. 2011. *The Holocene* 21:743-759.



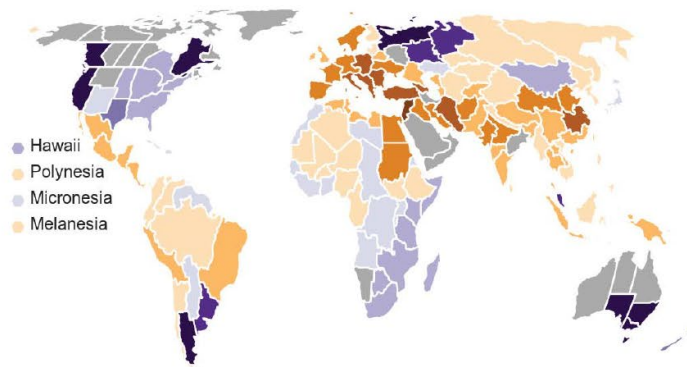
ARCHAEOLOGY

Archaeological assessment reveals Earth's early transformation through land use

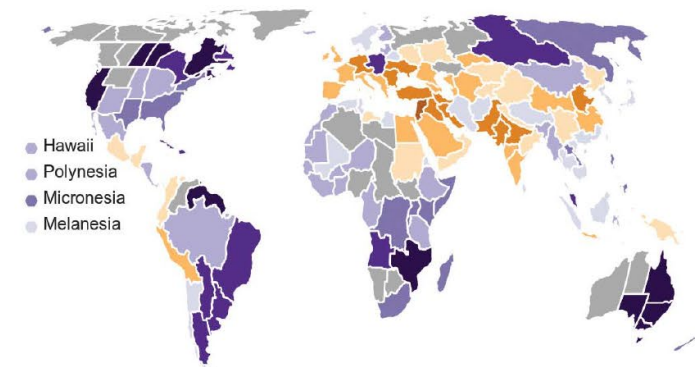
ArchaeoGLOBE Project*†



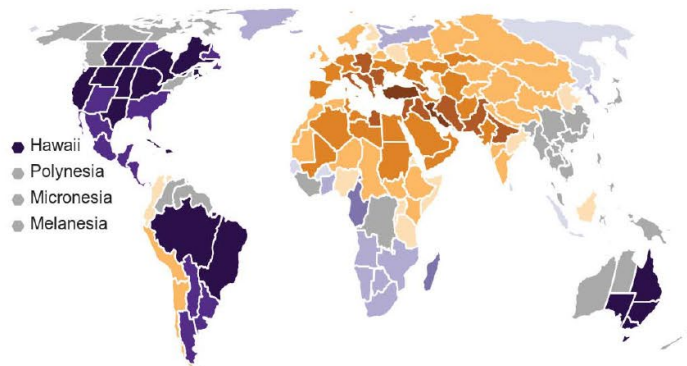
Extensive agriculture



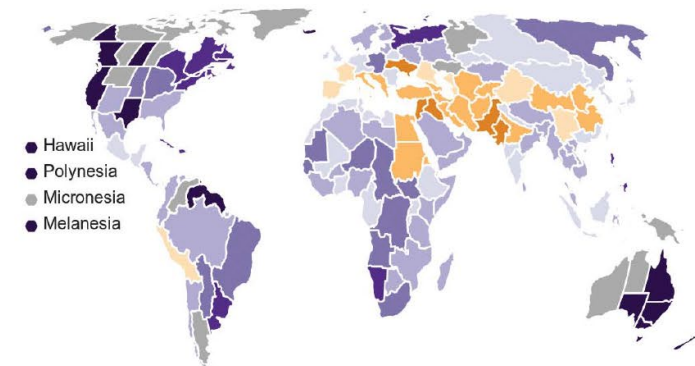
Intensive agriculture



Pastoralism

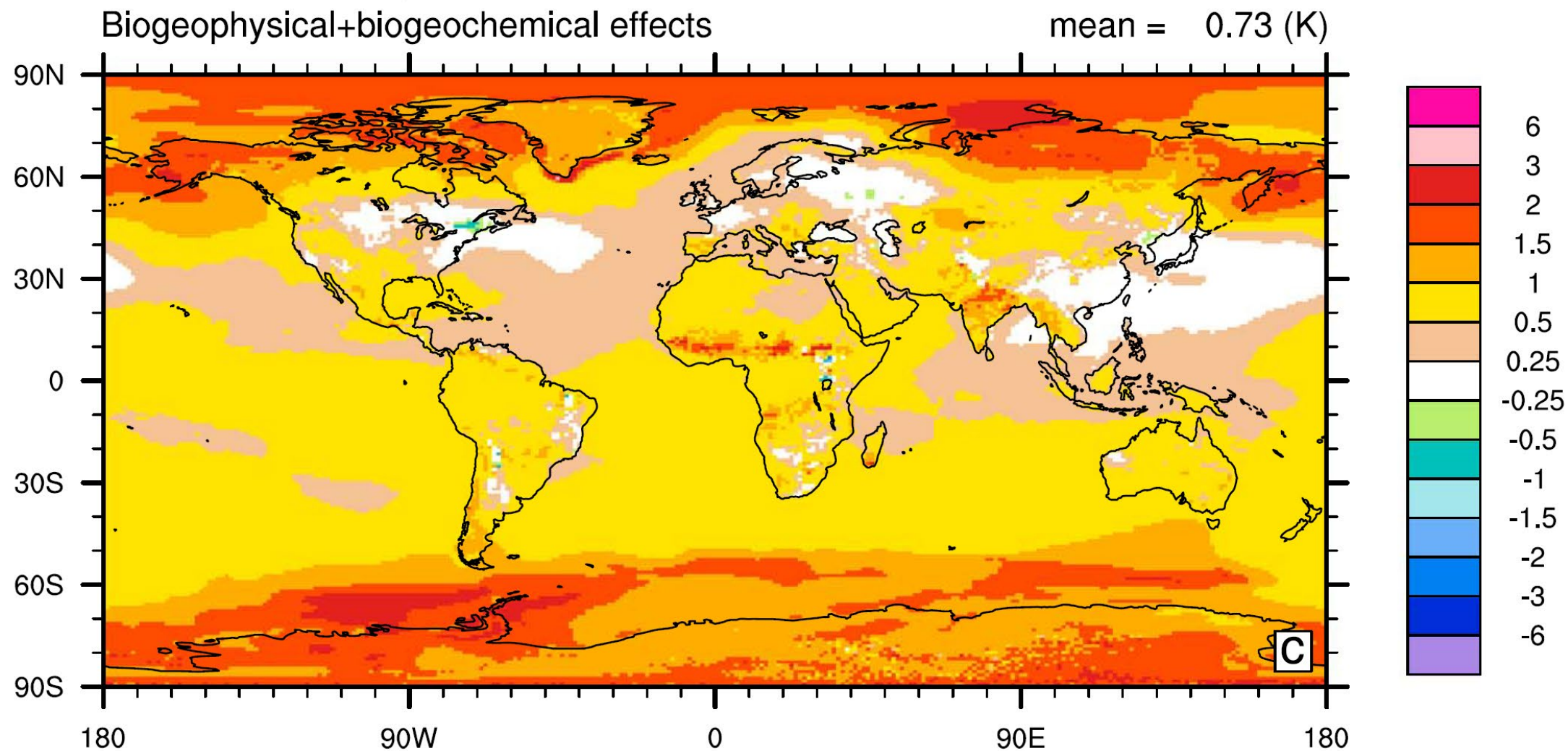


Urbanism



The Ruddiman Hypothesis: Early land use warmed the planet

Preindustrial Land Use: $\sim 0.7^\circ$ Global Climate Change



People have shaped most of terrestrial nature for at least 12,000 years

Anthromes 12K

Intensive

Dense Settlements

- Urban
- Mixed settlements

Villages

- Rice
- Irrigated
- Rainfed
- Pastoral

Croplands

- Residential irrigated
- Residential rainfed
- Populated
- Remote

Rangelands

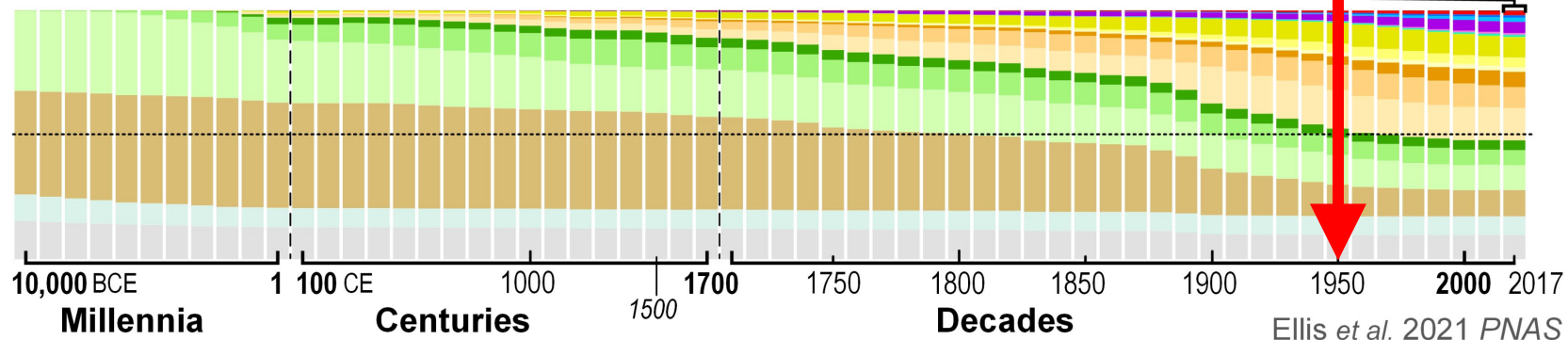
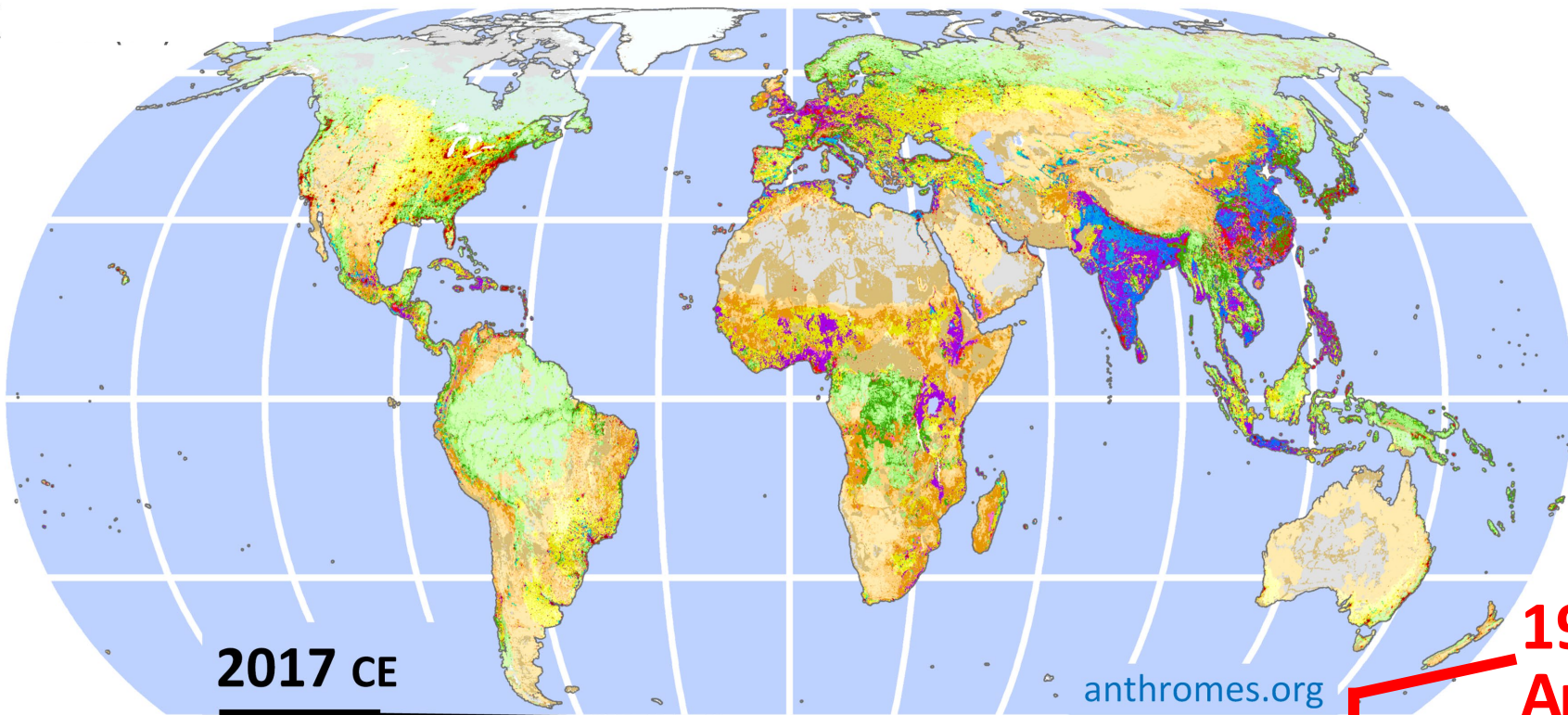
- Residential
- Populated
- Remote

Cultured

- Residential woodlands
- Populated woodlands
- Remote woodlands
- Drylands

Wildlands

- Woodlands
- Drylands
- Ice, uninhabited



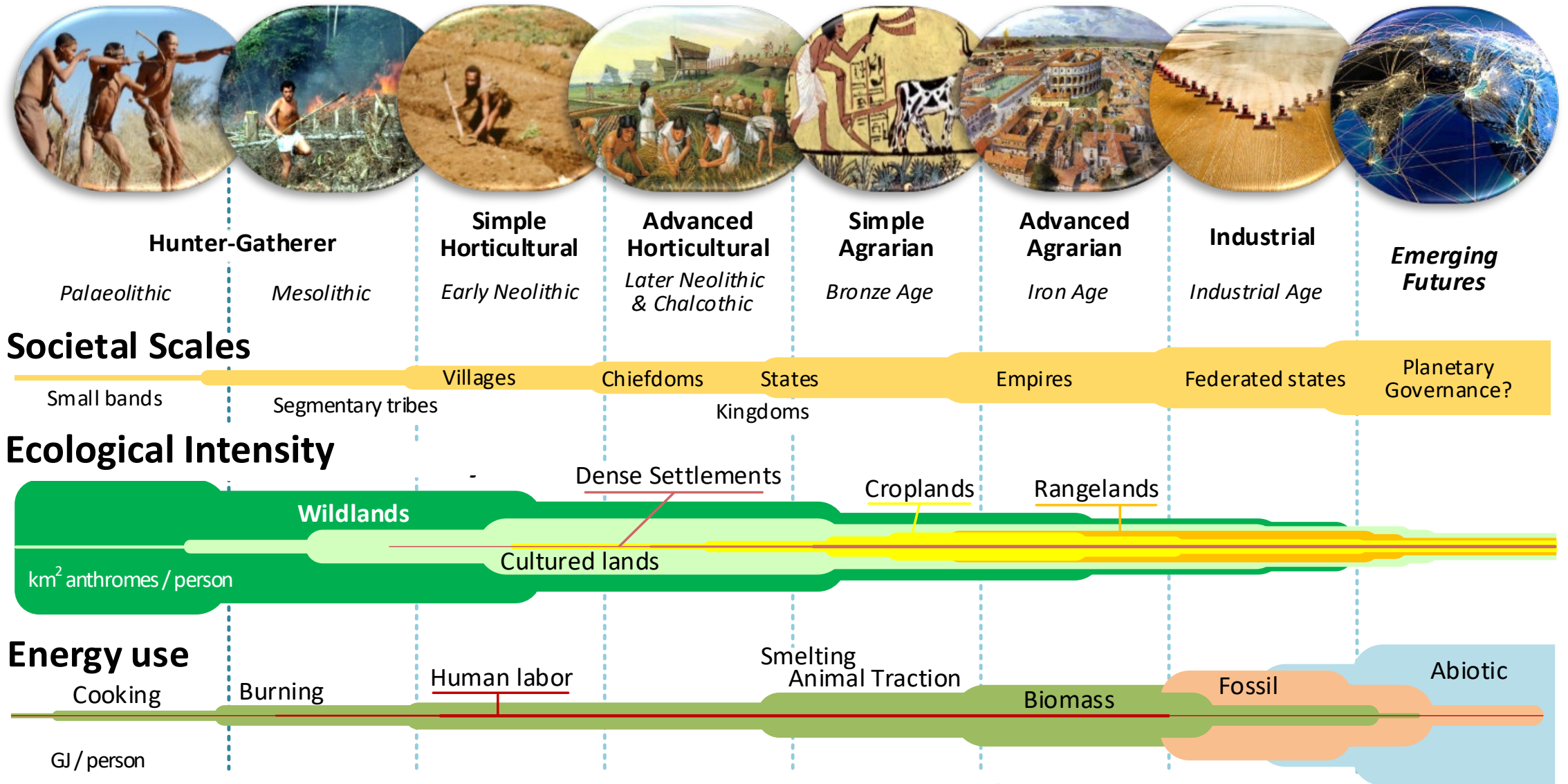
**1950
Anthropocene**

The First Law of the Anthropocene

Human societies reshape Earth's ecology.

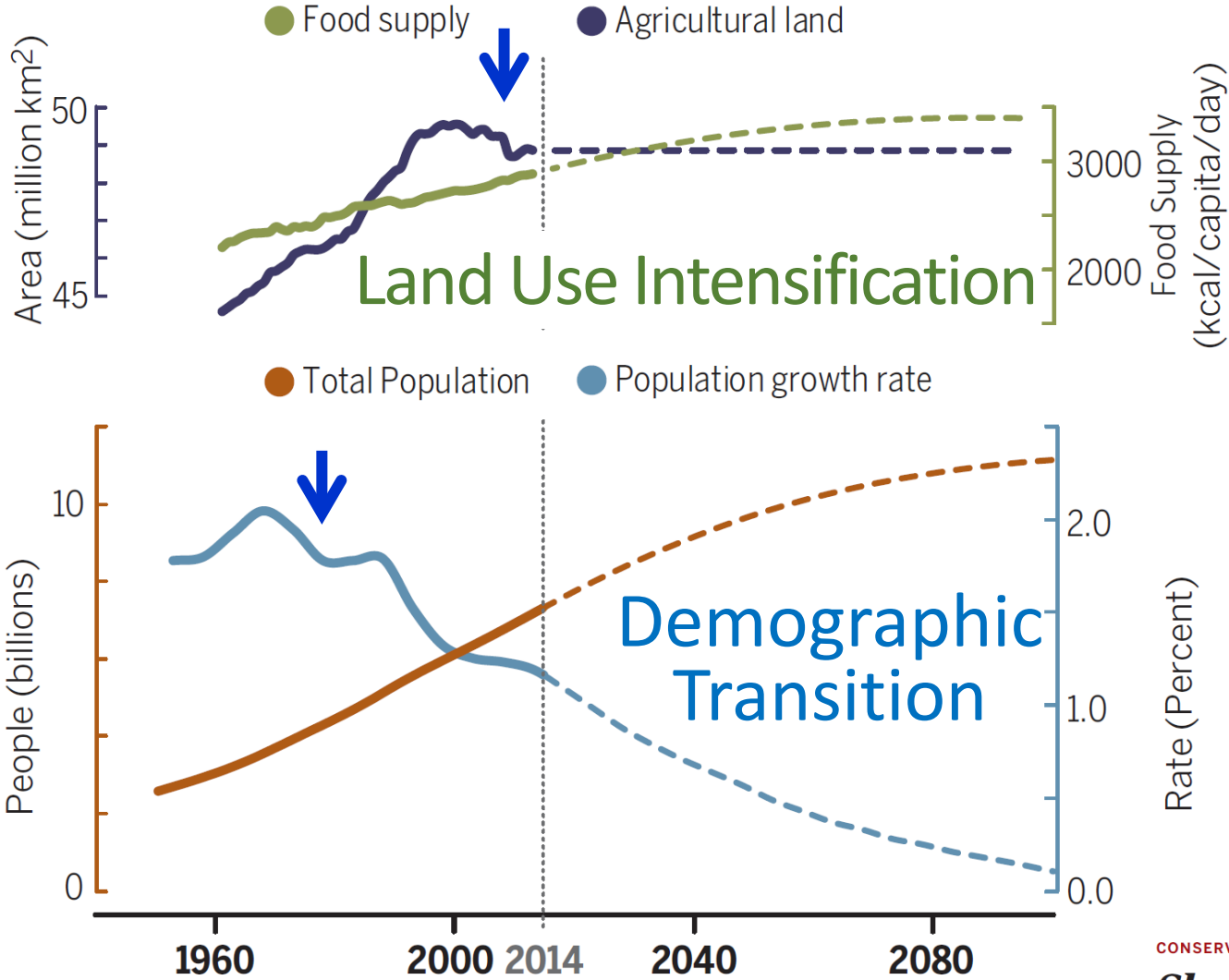
This reshaping will continue.

Anthropogenic Transformation Intensity

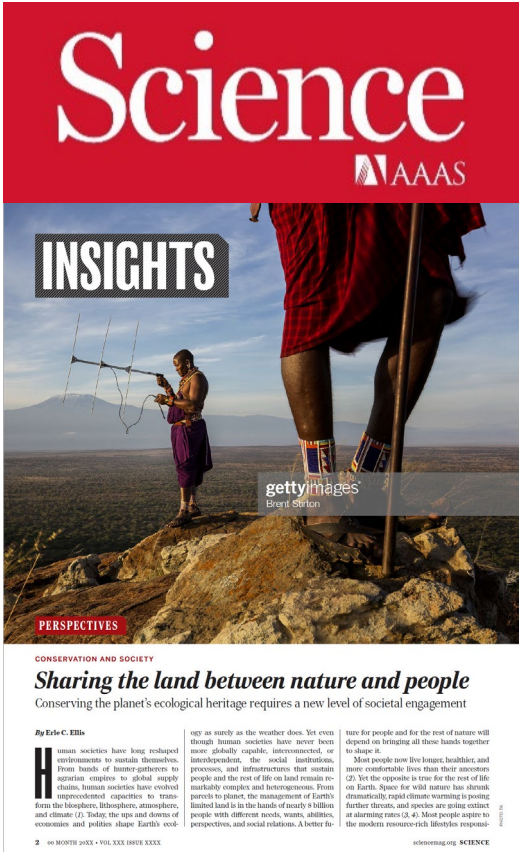


Recent global trends and future trajectories of land use and population

A Great Deceleration?



Data: FAO, UN



CONSERVATION AND SOCIETY

Sharing the land between nature and people

Conserving the planet's ecological heritage requires a new level of societal engagement

Ellis, E.C., 2019. *Science* **364**: 1226-1228

THE ANTHROPOGENIC PLANET

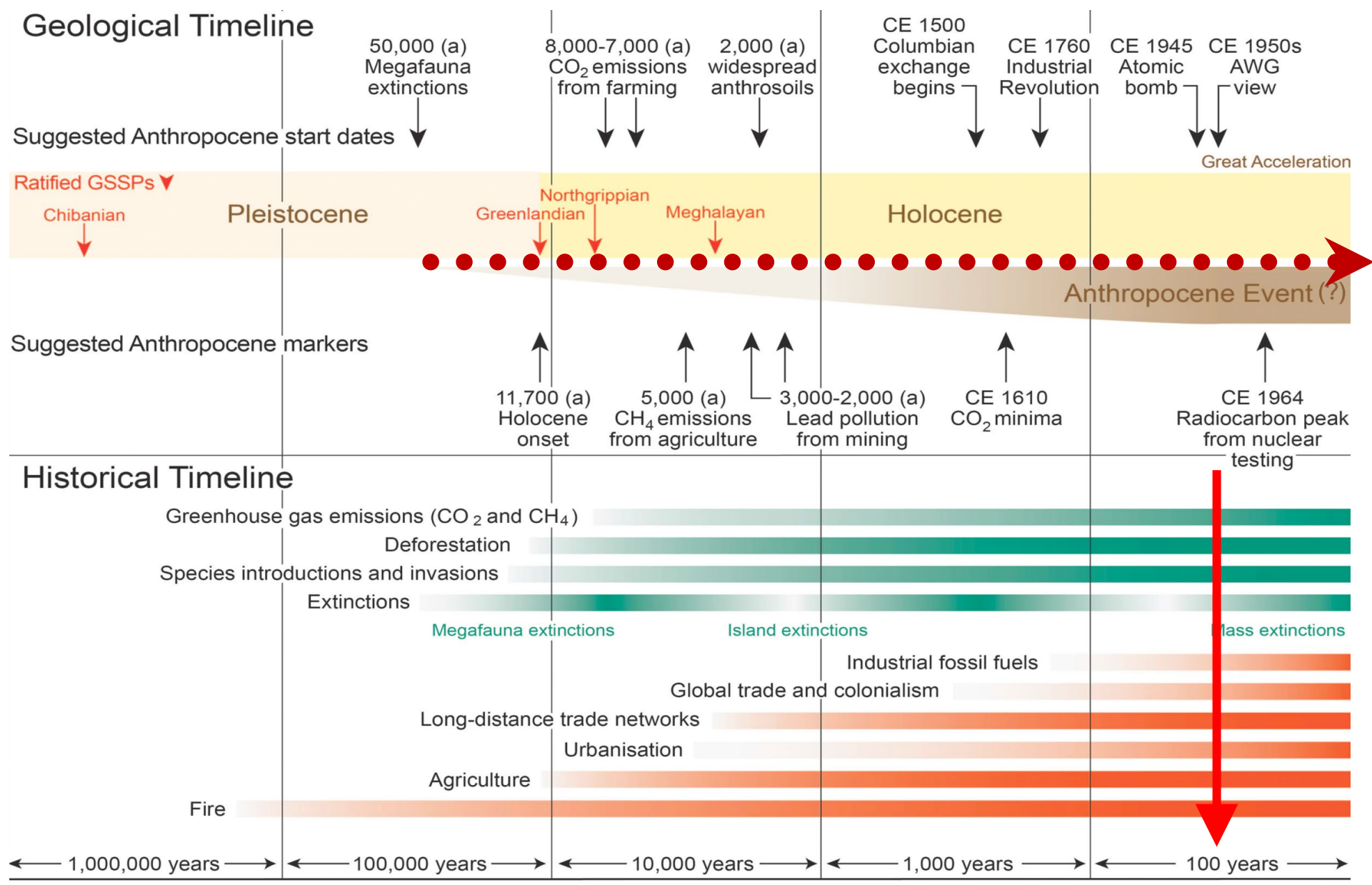




WELCOME
TO THE *Fabulous*
ANTHROPOCENE
EVENT

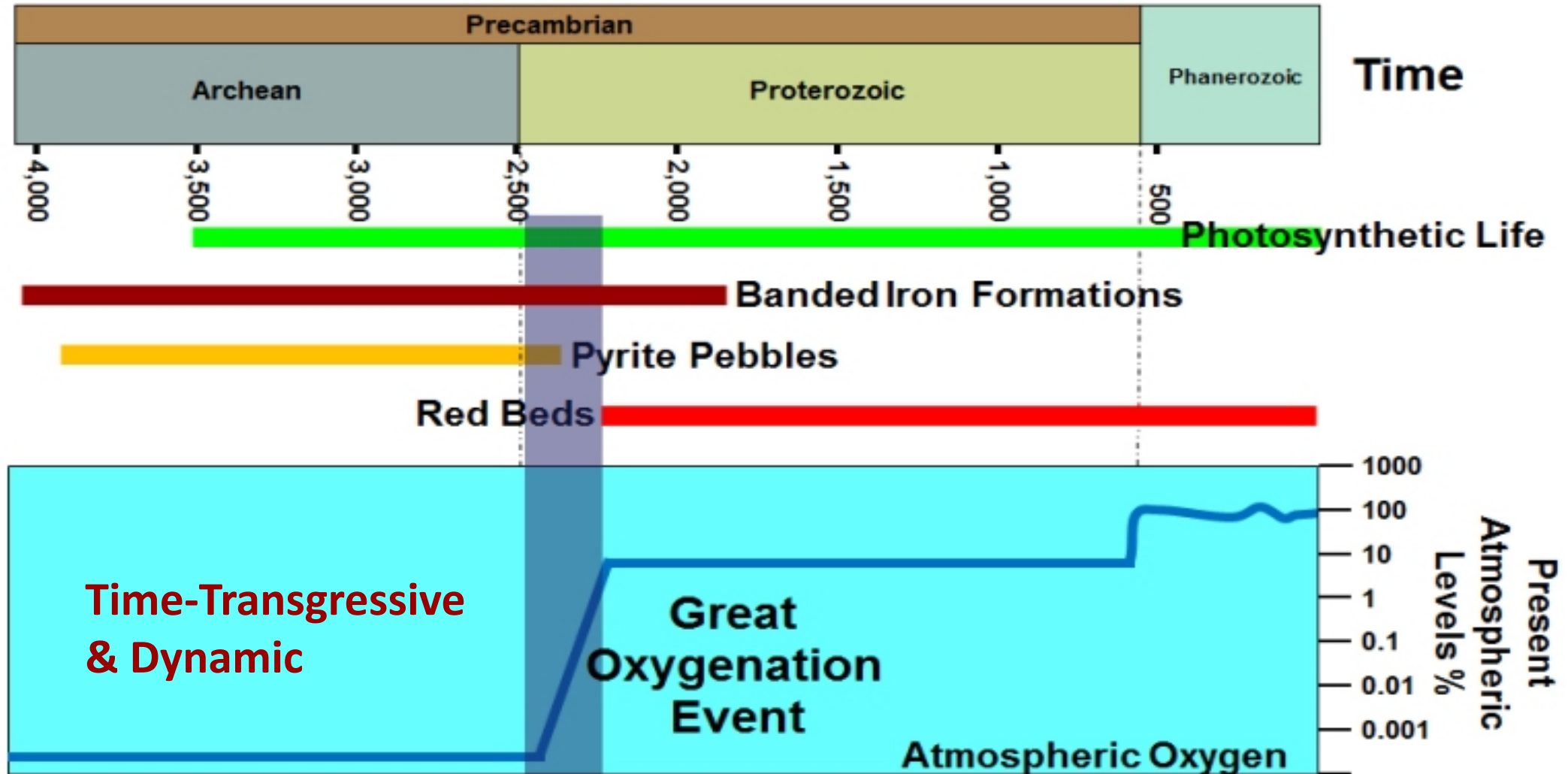
The Anthropocene Event

Fig 1. Gibbard *et al.* 2022



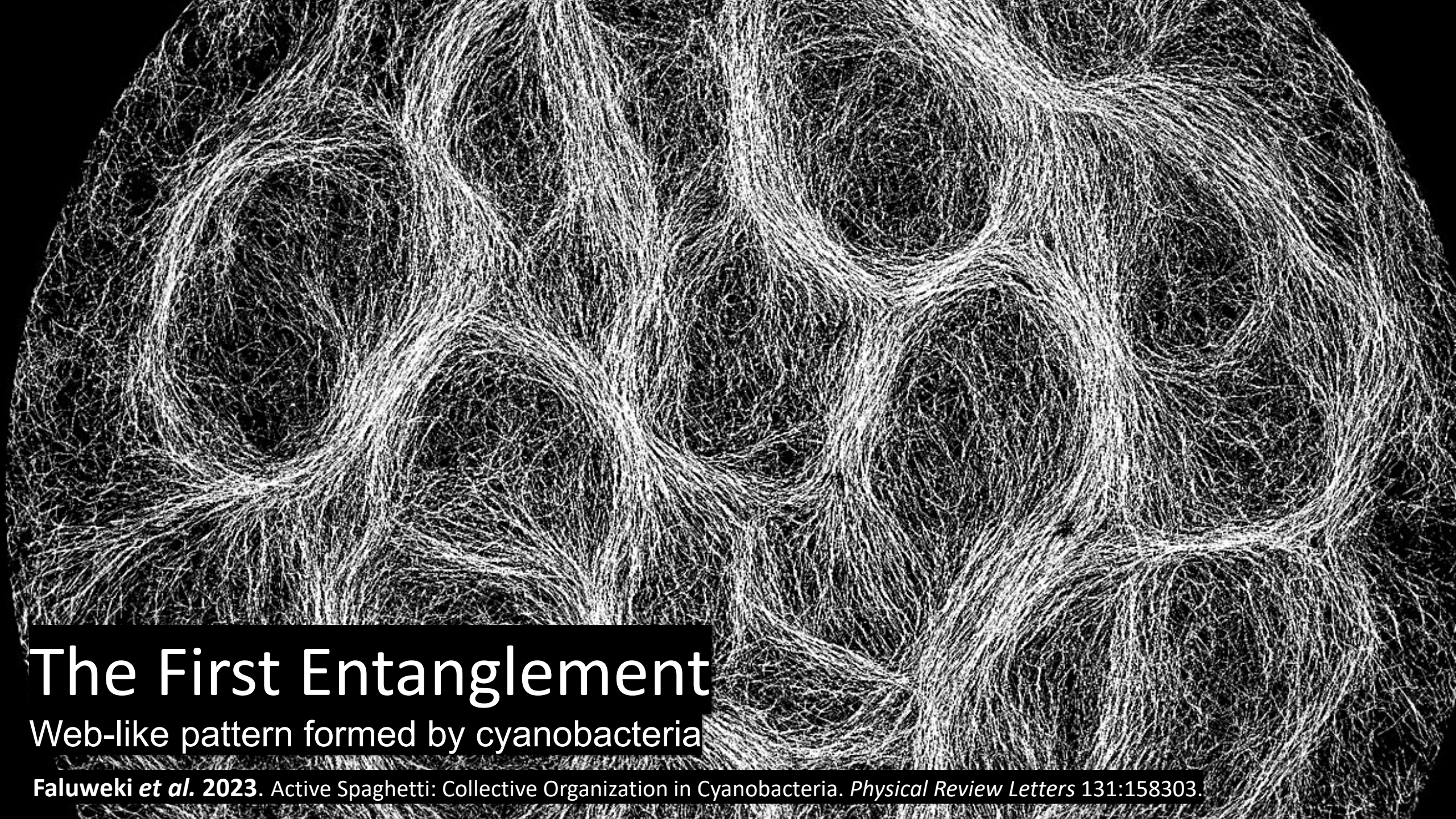
**1950
Anthropocene**

The Great Oxidation Event



Summary of the evolution of atmospheric oxygen and related geological features.

Percentage scale is logarithmic with modern level = 100%. (c) Alex Glass, Duke University



The First Entanglement

Web-like pattern formed by cyanobacteria

Faluweki *et al.* 2023. Active Spaghetti: Collective Organization in Cyanobacteria. *Physical Review Letters* 131:158303.

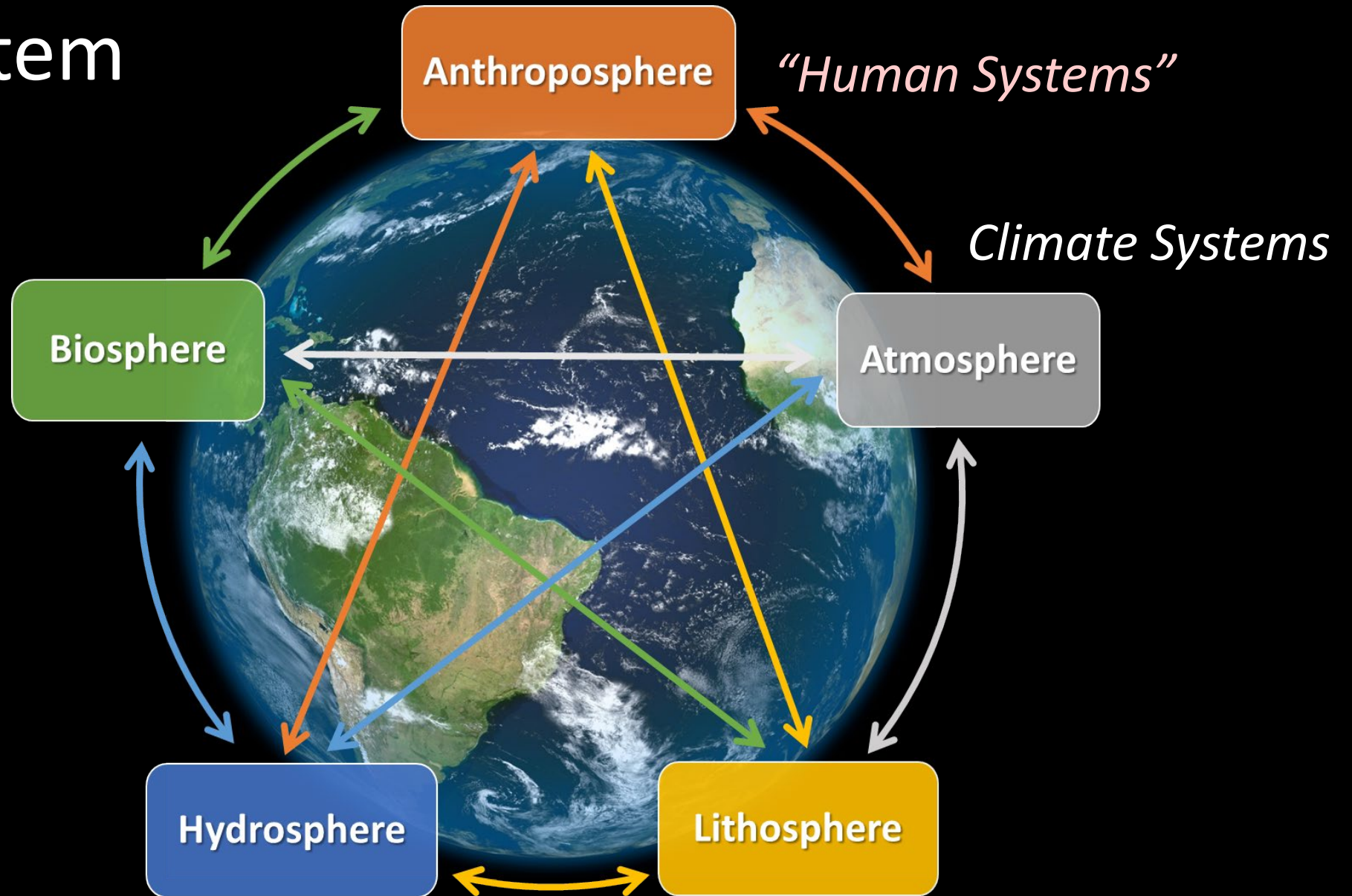


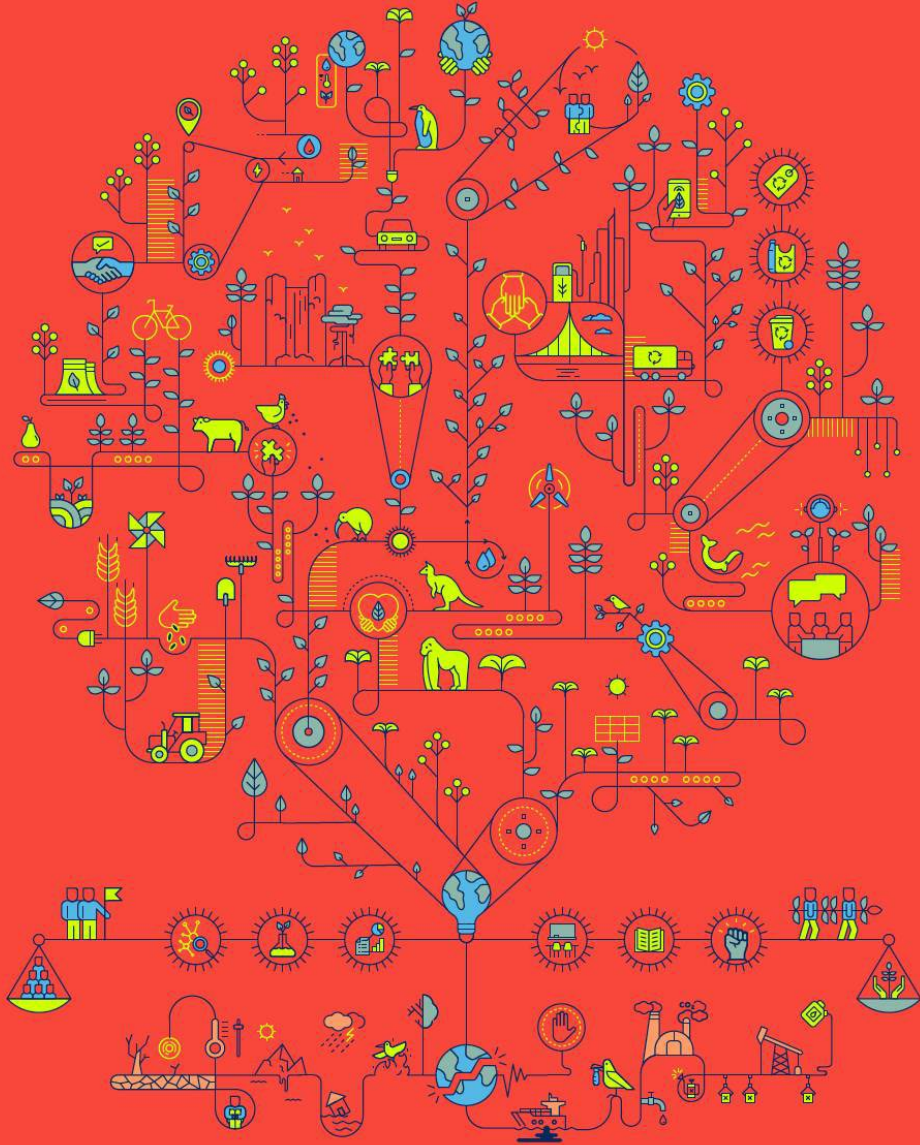
Anthropocene The Entanglement

Ian Hodder – Archaeologist
Danny Hillis – Technologist

Anthropocene

Earth System





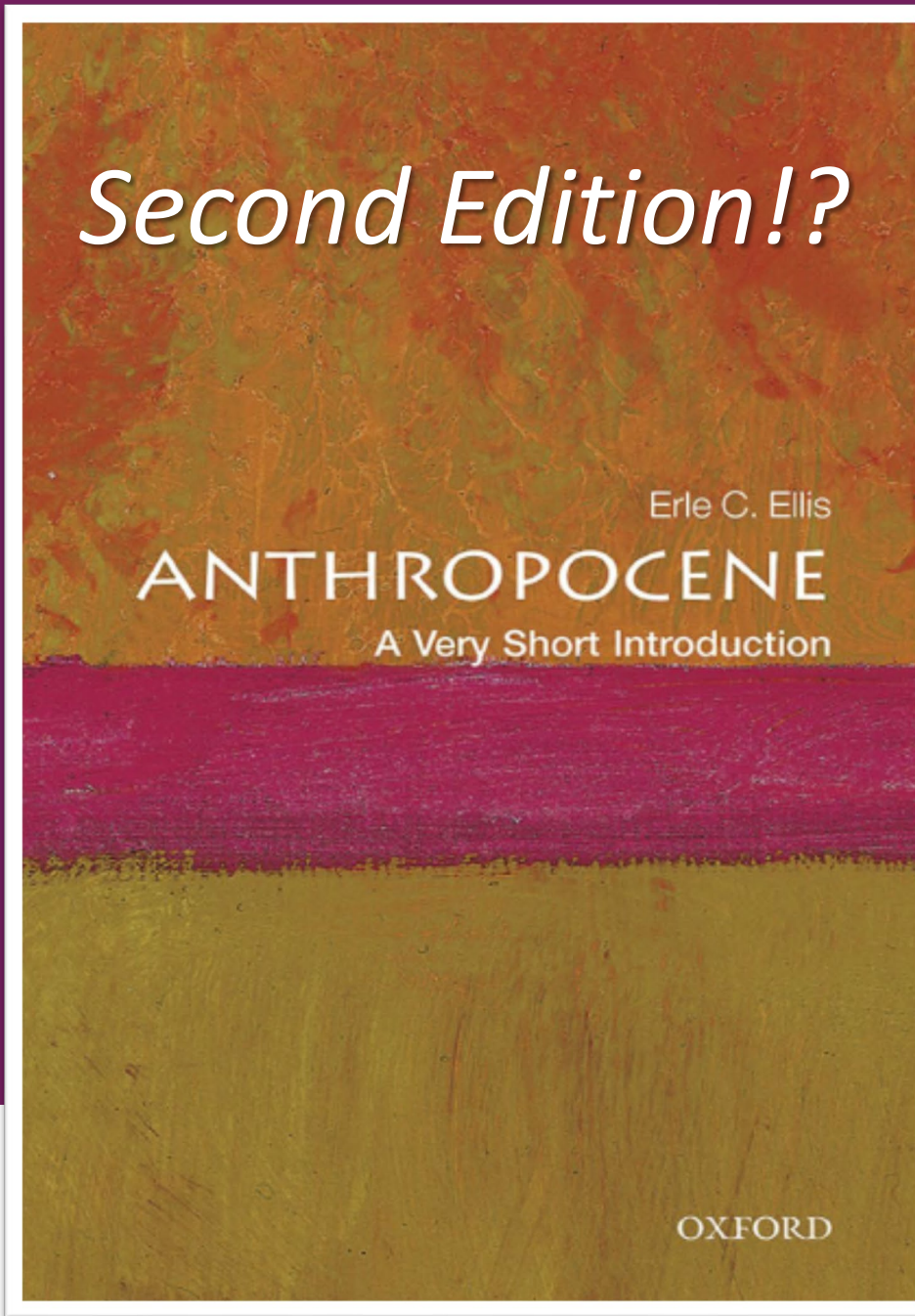
The Next Frontier: Human Development and the Anthropocene

OCTOBER 2, 2018

The report finds that even though the global population increased from 5 billion to 7.5 billion between 1990 and 2017, the number of people in low human development fell from 3 billion to 926 million—or from 60 percent of the global population to 12 percent—and that the number of people in high and very high human development more than tripled, from 1.2 billion to 3.8 billion—or from 24 percent of the global population to 51 percent.

The report lays out a stark choice for world leaders - take bold steps to reduce the immense pressure that is being exerted on the environment and the natural world, or humanity's progress will stall.

<https://hdr.undp.org/content/human-development-report-2020>



A New Addition to Oxford University Press's
Very Short Introduction Series

Erle C. Ellis

Anthropocene

A Very Short Introduction

Available in UK March 22, 2018
USA: May 2018



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The Anthropocene *Event*

The aggregated effects of human activities that have transformed, and continue to transform, the Earth system and influence biodiversity, thereby producing a substantial, characteristic and unique record in sedimentary strata and in human-modified ground.

(Gibbard et al. 2021)

“To assign a more specific date to the onset of the ‘anthropocene’ seems somewhat arbitrary, but we propose the latter part of the 18th century”

Crutzen and Stoermer (2000)

The Anthropocene Divide

Obscuring Understanding of Social-Environmental Change

“dividing geologic time based on a “step change” in the global significance of social-environmental processes contravenes the socially differentiated and diachronous character of human-environment relations.”