

Laurea in Ingegneria per l'Ambiente ed il Territorio

# CAMBIAMENTI CLIMATICI E ADATTAMENTI NEGLI ECOSISTEMI E NELLE SOCIETÀ

## Docenti

Salvatore Pappalardo

Daniele Codato

Alessandro Ceppi (Politecnico di Milano)

## Supporto didattico

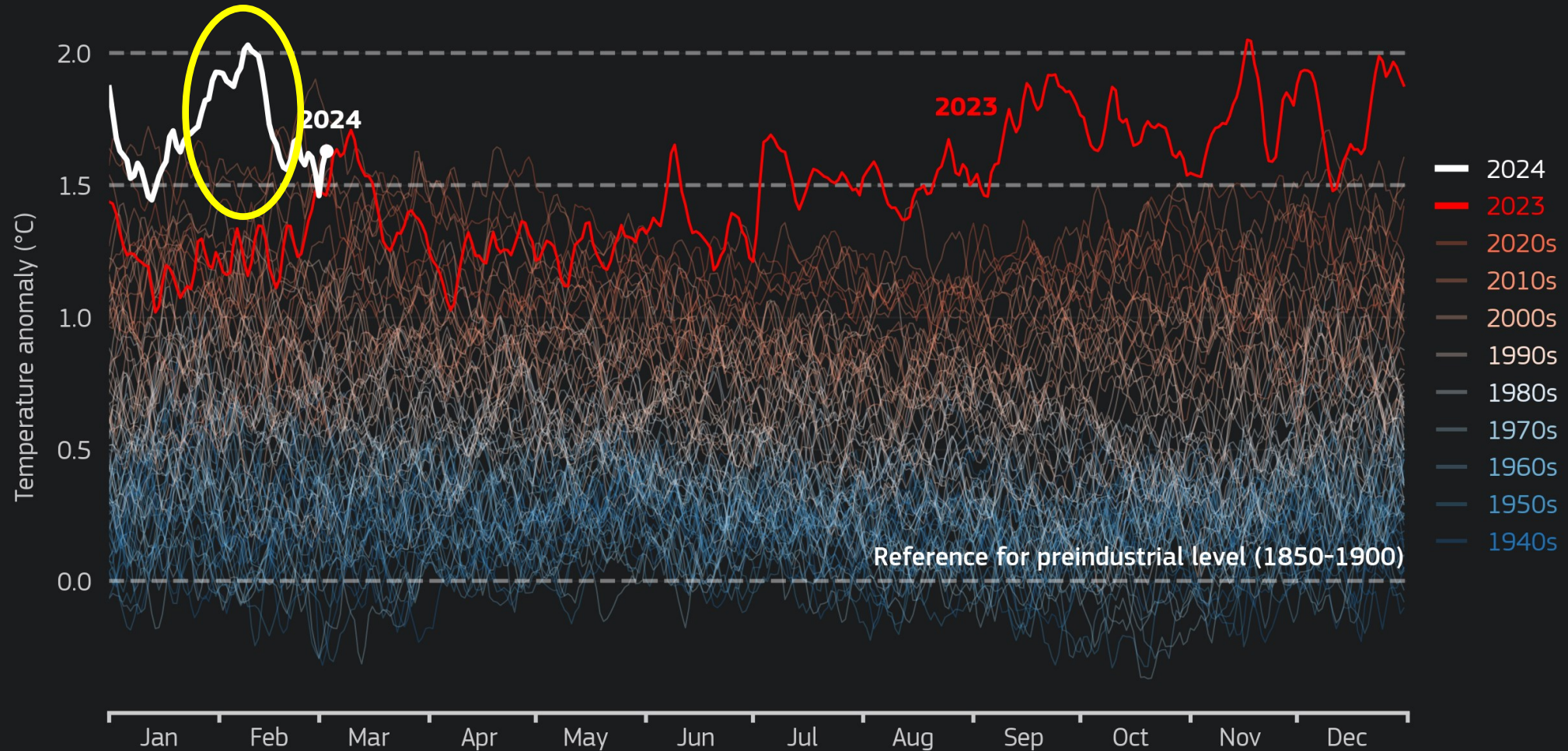
Edoardo Crescini

- 6 CFU
- 48 ore
- 102 ore di studio individuale



# Daily global surface air temperature anomalies

Data: ERA5 1940-2024 • Reference period: 1850-1900 • Credit: C3S/ECMWF



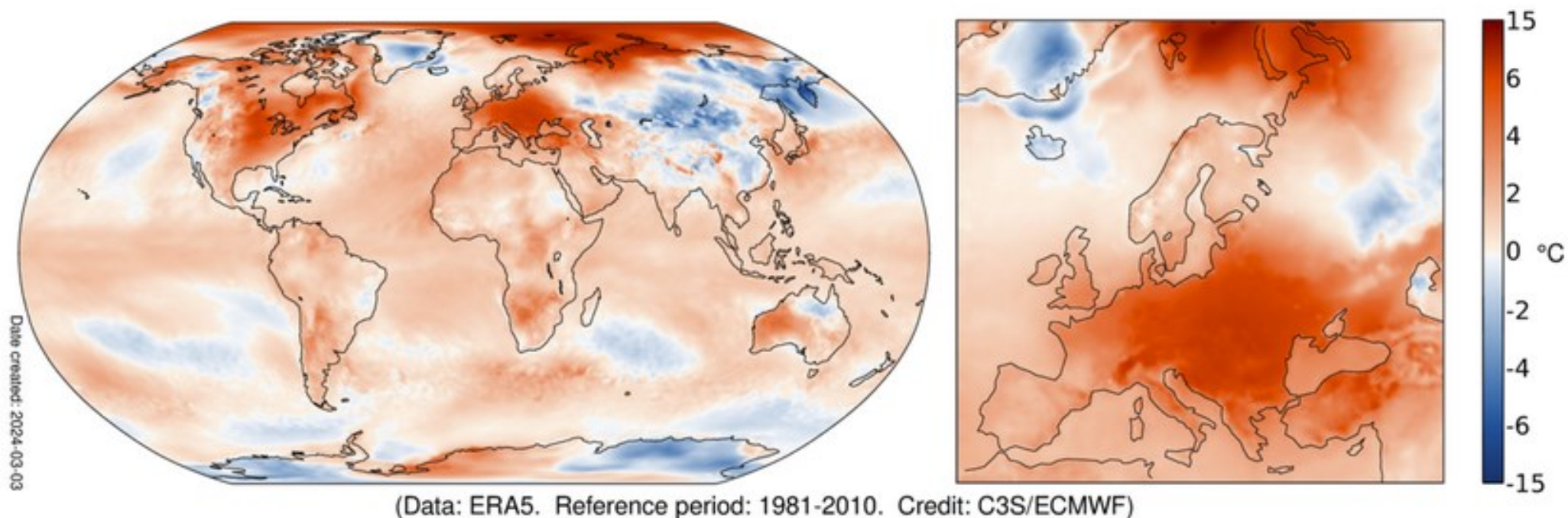
PROGRAMME OF THE  
EUROPEAN UNION



1991-2020

1981-2010

## Surface air temperature anomaly for February 2024

PROGRAMME OF  
THE EUROPEAN UNION

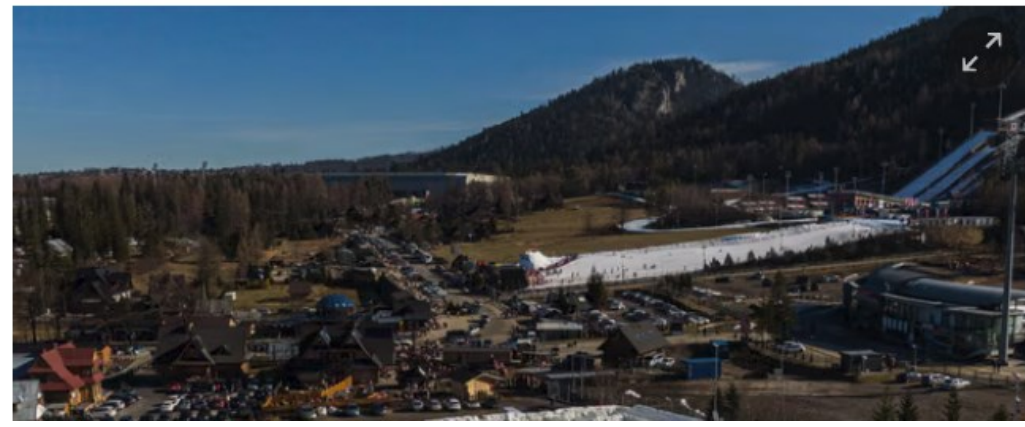
Surface air temperature anomaly for February 2024 relative to the February average for the period 1981-2010. Data source: ERA5. Credit: Copernicus Climate Change Service/ECMWF.

<https://climate.copernicus.eu/surface-air-temperature-february-2024>

World / Climate

## February was warmest on record globally, say scientists

Global average temperature for past 12 months highest on record at 1.56C above pre-industrial levels, data shows



## The planet just shattered heat records for the ninth month in a row

By Laura Paddison, CNN  
3 minute read · Updated 5:06 AM EST, Thu March 7, 2024



## Clima, febbraio 2024 il più caldo mai registrato: l'allarme di Copernicus

HOME / ATTUALITÀ

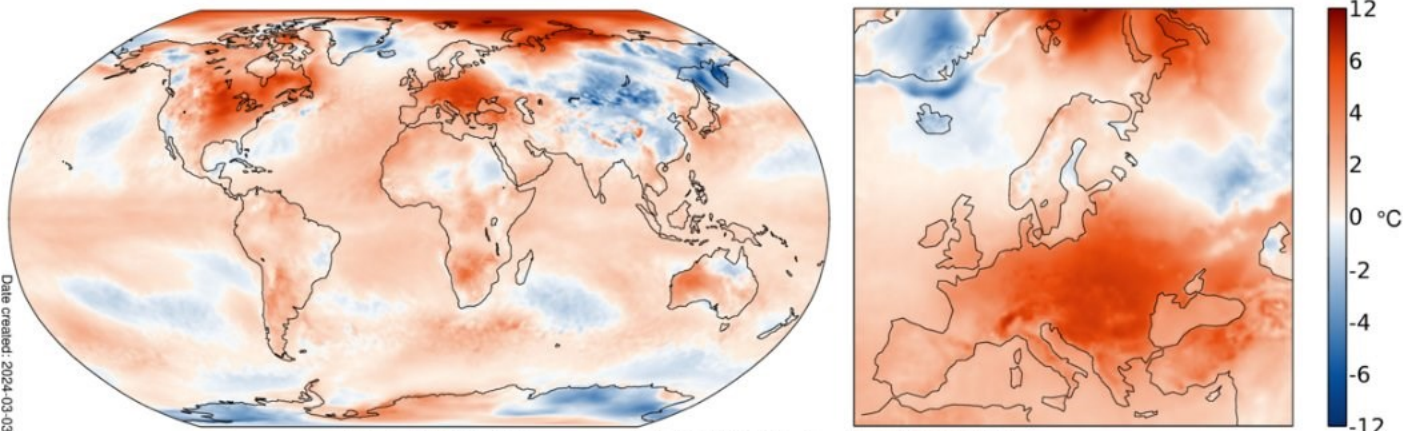
## Clima, febbraio 2024 batte tutti i record: il più caldo mai registrato

# FEBBRAIO 2024 È IL MESE DI FEBBRAIO PIÙ CALDO MAI REGISTRATO A LIVELLO GLOBALE

**+ 0,81°C** RISPETTO ALLA MEDIA PER FEBBRAIO DEL PERIODO 1991-2020

Dati Copernicus

Surface air temperature anomaly for February 2024



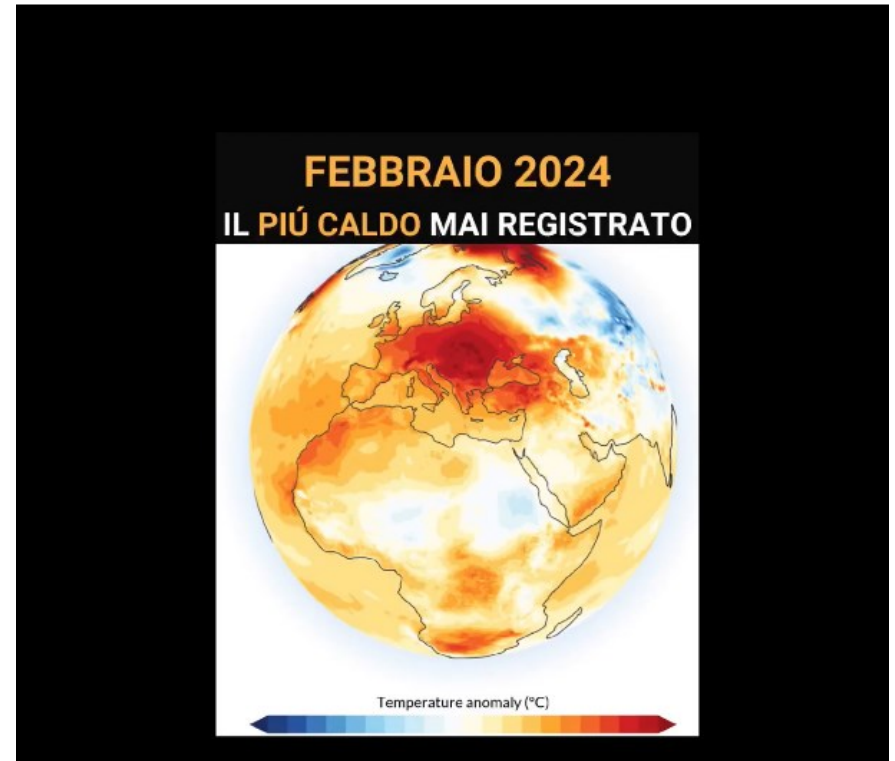
(Data: ERA5. Reference period: 1991-2020. Credit: C3S/ECMWF)

Chi ha paura del buio?  
2 g · 🌐

FEBBRAIO 2024 È IL FEBBRAIO PIÙ CALDO MAI REGISTRATO A LIVELLO GLOBALE!

Come ci si aspettava, Febbraio 2024 è risultato il mese di febbraio più caldo mai registrato a livello globale con una anomalia di ben 1,77 gradi centigradi al di sopra della media preindustriale!

Matteo



<https://www.facebook.com/NextSolarStorm>

Matteo Miluzio

# SCALA GLOBALE

# CLASSIFICA DEI MESI PIU' CALDI

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
	24	18	19	23	13	17	14	22	16	11	20	15	12	10	6	3	5	8	4	2	9	7	1	?
GEN	30	12	15	19	16	22	5	39	18	14	25	28	17	13	8	2	4	10	6	3	11	7	9	1
FEB	28	12	20	14	19	13	15	37	23	10	26	25	18	22	6	1	3	9	5	2	16	7	4	1
MAR	24	9	22	19	15	21	16	14	26	8	18	23	17	13	7	1	5	11	4	3	10	6	2	?
APR	26	19	22	18	14	27	10	24	17	7	15	13	23	9	11	2	5	6	3	1	12	8	4	?
MAG	20	16	19	26	17	23	13	22	15	12	21	11	18	5	9	2	4	8	6	1	10	7	3	?
GIU	23	21	24	27	16	14	19	25	15	12	18	17	11	13	6	7	10	8	4	3	5	2	1	?
LUG	18	14	22	36	15	23	19	17	9	13	11	20	16	21	10	6	8	7	2	5	4	3	1	?
AGO	22	21	18	25	20	12	19	24	14	15	11	16	13	7	9	2	6	10	4	5	8	3	1	?
SET	23	17	18	24	13	15	20	19	14	16	21	12	11	7	8	5	10	9	4	2	3	6	1	?
OTT	24	23	13	21	12	15	22	17	18	14	19	11	16	10	2	8	7	3	4	9	5	6	1	?
NOV	16	23	24	15	14	13	21	18	11	10	22	12	8	19	3	6	7	9	4	2	5	17	1	?
DIC	18	27	12	22	14	10	23	19	15	26	16	21	13	11	2	6	4	5	3	9	7	8	1	?

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024

DATI: NASA GISS SURFACE TEMPERATURE ANALYSIS (GISTEMP V4) | CREDITS: @GALSELO PER CHPDB <https://chpdb.it/> [climate dash/](https://climate-dash/)



Galselo Wrapsy  
@galselo

**FOLLOW YOUR DREAMS**  
IN A RIGOROUSLY LOGICAL AND METICULOUSLY DETAILED MANNER, EARLY BIRD GETS THE WORM.

**LISTEN TO YOUR HEART**  
BUT ONLY FOLLOW ITS ADVICE IF IT STANDS UP TO THOROUGH INVESTIGATION AND REPEATED TESTING

Segui

<https://twitter.com/galselo>

## Outline

### ‘La cassetta degli attrezzi’

- Crollo della biosfera
- Dei Sistemi
- Sistema climatico
- Biodiversità, Ecosistemi



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DEGLI STUDI  
DI PADOVA



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# Crollo della Biosfera



# Crollo della Biosfera

Gli attuali cambiamenti in termini di diminuzione di diversità e di popolazioni sono legati a processi intrinseci alla vita sulla Terra, prevalentemente da attività antropiche (M.A., 2005).

**Il 28% dei *taxa* attualmente conosciuti (42.100 specie) sono al momento minacciati di estinzione (IUCN Red List, 2022)**

142,500 specie nella Red List (IUCN)

- 40.000 minacciate di estinzione

- 41% anfibi
- 37% squali e razze
- 34% conifere
- 33% coralli
  
- cambiamento d'uso dei suoli (*land use change*)
- sovrasfruttamento delle risorse naturali
- introduzione di specie alloctone invasive (*alien species*)
- diffusione di agenti patogeni e contaminanti



***Anthropogenic  
direct drivers***

• **cambiamenti climatici globali**



THE IUCN RED LIST  
OF THREATENED SPECIES™

# More than 42,100 species are threatened with extinction

That is still 28% of all assessed species.

AMPHIBIANS

41%



MAMMALS

27%



CONIFERS

34%



BIRDS

13%



SHARKS &  
RAYS

37%



REEF CORALS

36%



SELECTED  
CRUSTACEANS

28%



REPTILES

21%



CYCADS

69%



AMAZING SPECIES



PLANTAE - MAGNOLIOPSIDA

GLOBAL

**Holly**

*Illex aquifolium*

— Stable



ANIMALIA - AVES

GLOBAL

**Dwarf Ibis**

*Bostrychia bocagei*

↓ Decreasing



ANIMALIA - MAMMALIA

GLOBAL

**Grey-faced Sengi**

*Rhynchocyon udzungwensis*

Unknown



ANIMALIA - REPTILIA

GLOBAL

**Antsingy Leaf Chameleon**

*Brookesia perarmata*

↓ Decreasing



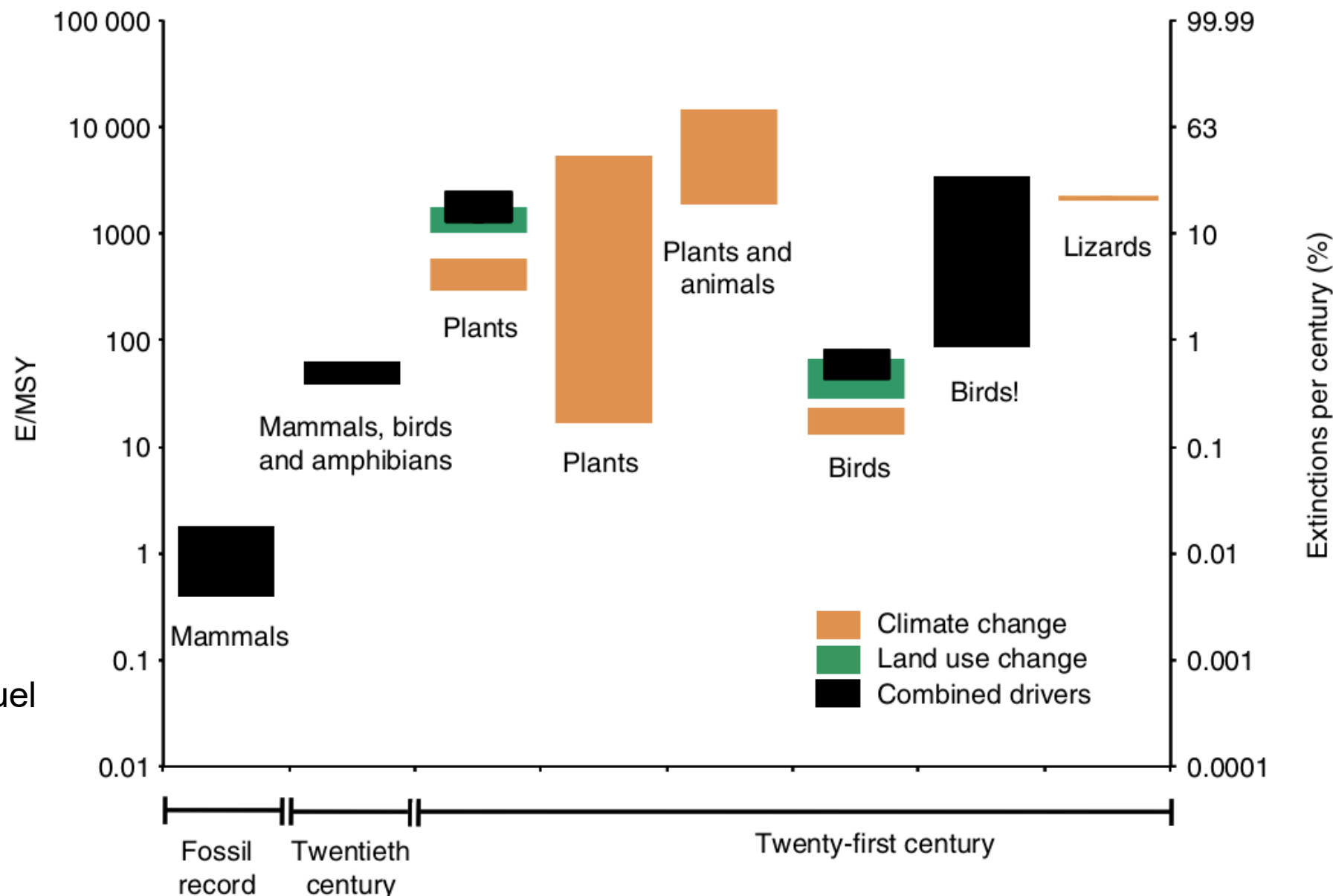
<https://www.iucnredlist.org/>

“The biodiversity of species and their rates of extinction, distribution, and protection”

(Pimm et al., 2014)

“Comparing Extinction Rates: Past, Present, and Future”

Vania Proenca & Henrique Miguel Pereira (2013)





## Vertebrates on the brink as indicators of biological annihilation and the sixth mass extinction

Gerardo Ceballos<sup>a,1</sup>, Paul R. Ehrlich<sup>b</sup>, and Peter H. Raven<sup>c</sup>

<sup>a</sup>Instituto de Ecología, Universidad Nacional Autónoma de México, 04510 Ciudad de México, México; <sup>b</sup>Center for Conservation Biology, Department of Biology, Stanford University, Stanford, CA 94304; and <sup>c</sup>Plant Science Department, Missouri Botanical Garden, St. Louis, MO 63110

Contributed by Gerardo Ceballos, March 22, 2020 (sent for review December 26, 2019; reviewed by Thomas E. Lovejoy and Jorge L. Soberon)

The ongoing sixth mass species extinction is the result of the destruction of component populations leading to eventual extirpation of entire species. Populations and species extinctions have severe implications for society through the degradation of ecosystem services. Here we assess the extinction crisis from a different perspective. We examine 29,400 species of terrestrial vertebrates, and determine which are on the brink of extinction because they have fewer than 1,000 individuals. There are 515 species on the brink (1.7% of the evaluated vertebrates). Around 94% of the populations of 77 mammal and bird species on the brink have been lost in the last century. Assuming all species on the brink have similar trends, more than 237,000 populations of those species have vanished since 1900. We conclude the human-caused sixth mass extinction is likely accelerating for several reasons. First, many of the species that have been driven to the brink will likely become extinct soon. Second, the distribution of those species highly coincides with hundreds of other endangered species, surviving in regions with high human impacts, suggesting ongoing regional biodiversity collapses. Third, dose ecological interactions of species on the brink tend to move other species toward annihilation when they disappear—extinction breeds extinctions. Finally, human pressures on the biosphere are growing rapidly, and a recent example is the current coronavirus disease 2019 (Covid-19) pandemic, linked to wildlife trade. Our results reemphasize the extreme urgency of taking much-expanded worldwide actions to save wild species and humanity's crucial life-support systems from this existential threat.

endangered species | sixth mass extinction | population extinctions | conservation | ecosystem services

that time, we numbered about 1 million people worldwide; now there are 7.7 billion of us, and our numbers are still rapidly growing (21). As our numbers have grown, humanity has come to pose an unprecedented threat to the vast majority of its living companions.

Today, species extinction rates are hundreds or thousands of times faster than the “normal” or “background” rates prevailing in the last tens of millions of years (8–10). The recent United Nations report on biodiversity and ecosystem services estimates that a quarter of all species face extinction, many within decades (11). When a species disappears, a wide range of characteristics is lost forever, from genes and interactions to phenotypes and behaviors (22–27).

Every time a species or population vanishes, Earth's capability to maintain ecosystem services is eroded to a degree, depending on the species or population concerned. Each population is likely to be unique and therefore likely to differ in its capacity to fit into a particular ecosystem and play a role there. The effects of extinctions will worsen in the coming decades, as losses of functional units, redundancy, and genetic and cultural variability change entire ecosystems (14, 23, 24). Humanity needs the life support of a relatively stable climate, flows of fresh water, agricultural pest and disease-vector control, pollination for crops, and so on, all provided by functional ecosystems (12, 28).

Examples documenting the ongoing biological annihilation are proliferating, each of them underlining the magnitude of the problem and the urgency of taking action. More than 400 vertebrate species became extinct in the last 100 y, extinctions that

## Extinction risk from climate change

Chris D. Thomas<sup>1</sup>, Alison Cameron<sup>1</sup>, Rhys E. Green<sup>2</sup>, Michel Bakkenes<sup>3</sup>, Linda J. Beaumont<sup>4</sup>, Yvonne C. Collingham<sup>5</sup>, Barend F. N. Erasmus<sup>6</sup>, Marinez Ferreira de Siqueira<sup>7</sup>, Alan Grainger<sup>8</sup>, Lee Hannah<sup>9</sup>, Lesley Hughes<sup>4</sup>, Brian Huntley<sup>5</sup>, Albert S. van Jaarsveld<sup>10</sup>, Guy F. Midgley<sup>11</sup>, Lera Miles<sup>8\*</sup>, Miguel A. Ortega-Huerta<sup>12</sup>, A. Townsend Peterson<sup>13</sup>, Oliver L. Phillips<sup>8</sup> & Stephen E. Williams<sup>14</sup>

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<sup>2</sup>Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire SG19 2DL, UK, and Conservation Biology Group, Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK

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<sup>5</sup>University of Durham, School of Biological and Biomedical Sciences, South Road, Durham DH1 3LE, UK

<sup>6</sup>Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag 3, WITS 2050, South Africa

<sup>7</sup>Centro de Referência em Informação Ambiental, Av. Romeu Tórtima 228, Barão Geraldo, CEP:13083-885, Campinas, SP, Brazil

<sup>8</sup>School of Geography, University of Leeds, Leeds LS2 9JT, UK

<sup>9</sup>Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Washington, DC 20036, USA

<sup>10</sup>Department of Zoology, University of Stellenbosch, Private Bag X1, Stellenbosch 7602, South Africa

<sup>11</sup>Climate Change Research Group, Kirstenbosch Research Centre, National

areas<sup>7–12</sup>. This ‘climate envelope’ represents the conditions under which populations of a species currently persist in the face of competitors and natural enemies. Future distributions are estimated by assuming that current envelopes are retained and can be projected for future climate scenarios<sup>7–12</sup>. We assume that a species either has no limits to dispersal such that its future distribution becomes the entire area projected by the climate envelope model or that it is incapable of dispersal, in which case the new distribution is the overlap between current and future potential distributions (for example, species with little dispersal or that inhabit fragmented landscapes)<sup>11</sup>. Reality for most species is likely to fall between these extremes.

We explore three methods to estimate extinction, based on the species–area relationship, which is a well-established empirical power-law relationship describing how the number of species relates to area ( $S = cA^z$ , where  $S$  is the number of species,  $A$  is area, and  $c$  and  $z$  are constants)<sup>13</sup>. This relationship predicts adequately the numbers of species that become extinct or threatened when the area available to them is reduced by habitat destruction<sup>14,15</sup>. Extinctions arising from area reductions should apply regardless of whether the cause of distribution loss is habitat destruction or climatic unsuitability.

Because climate change can affect the distributional area of each species independently, classical community-level approaches need to be modified (see Methods). In method 1 we use changes in the summed distribution areas of all species. This is consistent with the traditional species–area approach: on average, the destruction of half of a habitat results in the loss of half of the distribution area summed across all species restricted to that habitat. However, this

<https://www.pnas.org/doi/epdf/10.1073/pnas.1922686117>

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RESEARCH ARTICLE ENVIRONMENTAL SCIENCES

## Accelerated modern human-induced species losses: Entering the sixth mass extinction

GERARDO CEBALLOS, PAUL R. EHRLICH, ANTHONY D. BARNOSKY, ANDRÉS GARCÍA, ROBERT M. PRINGLE, AND TODD M. PALMER

<https://www.science.org/doi/10.1126/sciadv.1400253>

BIOLOGICAL  
REVIEWS

Biol. Rev. (2022), 97, pp. 640–663.  
doi: 10.1111/brv.12816

<https://www.nature.com/articles/nature02121>

Cambridge  
University Press

640

## The Sixth Mass Extinction: fact, fiction or speculation?

Robert H. Cowie<sup>1\*</sup>, Philippe Bouchet<sup>2</sup> and Benoît Fontaine<sup>3</sup>

<sup>1</sup>Pacific Biosciences Research Center, University of Hawaii, Honolulu, Hawaii 96822, U.S.A.

<sup>2</sup>Institut Systématique Evolution Biodiversité (ISYEB), Muséum National d'Histoire Naturelle, CNRS, Sorbonne Université, EPHE, Université des Antilles, 57 rue Cassier CP 51, 75005 Paris, France

<sup>3</sup>UMS 2006 Patrinat (OFB, CNRS, MNHN), Centre d'Écologie et des Sciences de la Conservation (UMR 7204), Muséum National d'Histoire Naturelle, 43 rue Buffon CP 135, 75005 Paris, France

<https://pubmed.ncbi.nlm.nih.gov/35014169/>

# Crisi climatica e ambientale

## Uomo e Ambiente: **economia** - **ecologia**

### Approccio corrente:

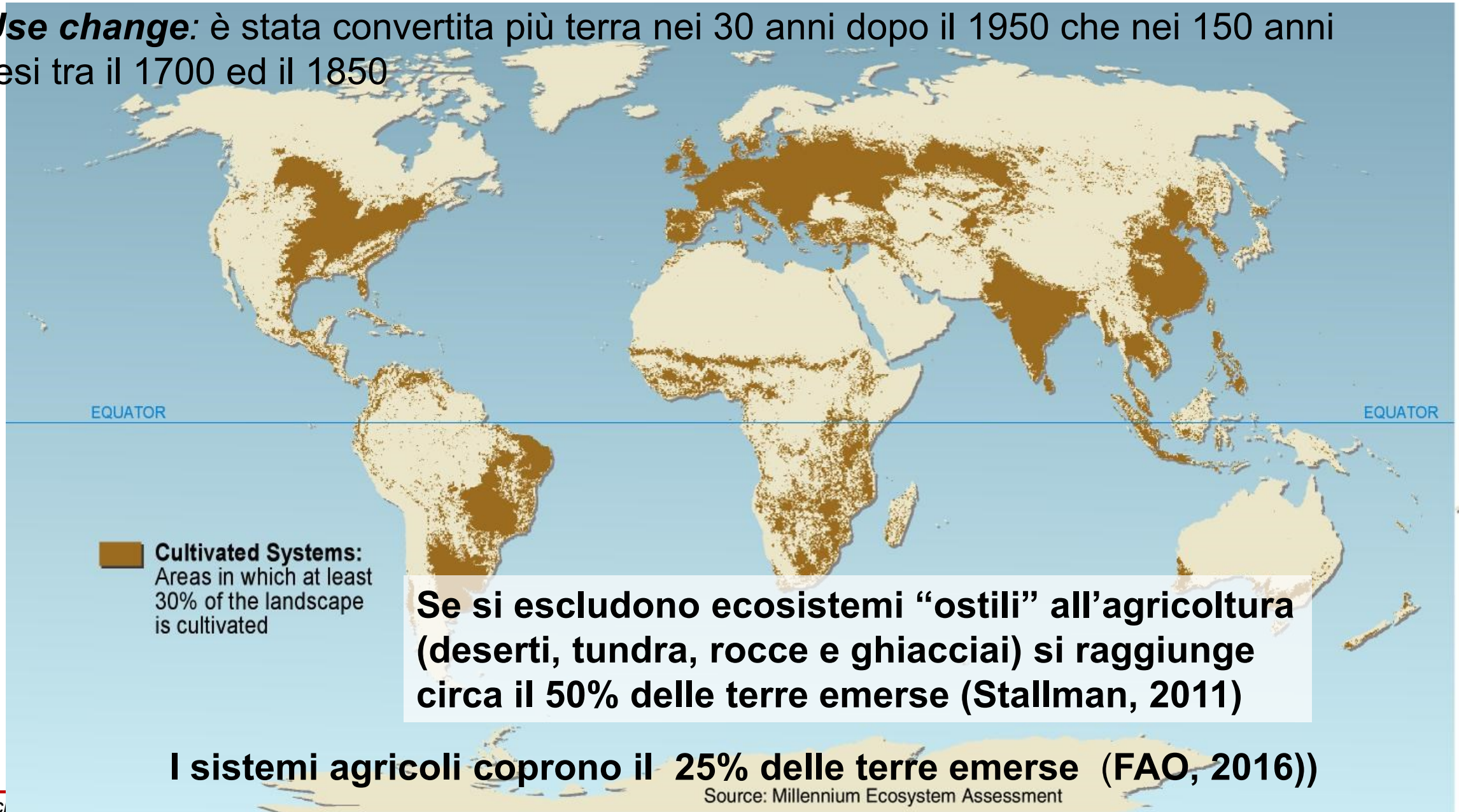
ambiente come una risorsa da essere utilizzata nel modo più efficiente possibile nell'attuazione dei programmi di produzione e consumo

### La crisi ambientale:

- dinamiche *LandUse/LandCover* **LULC** (deforestazione, espansione urbana, erosione suoli...)
- degradazione e distruzione degli habitat (frammentazione, riduzione/perdita biodiversità...)
- inquinamento (aria, suoli, acque)
- emissione di gas climalteranti

(Pignatti, 2006; Tamino 2009; Rifkin 2000;...)

**LandUse change:** è stata convertita più terra nei 30 anni dopo il 1950 che nei 150 anni compresi tra il 1700 ed il 1850



0 100 km

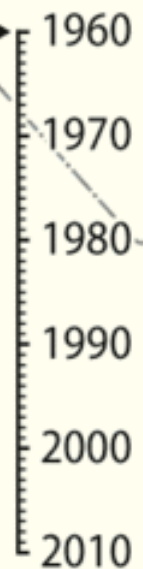
● Aral

Kasachstan

● Mo'ynoq

Usbekistan

● Nukus

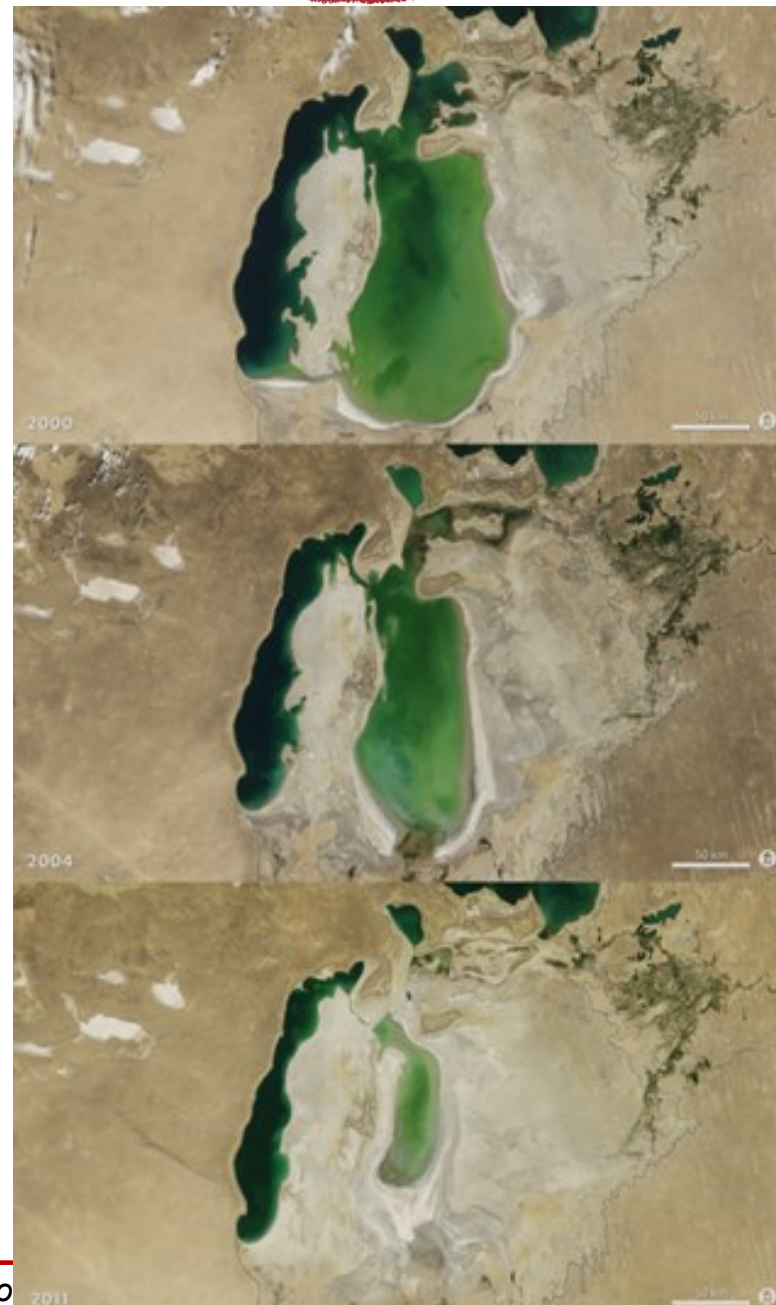


**68.000 km<sup>2</sup>**

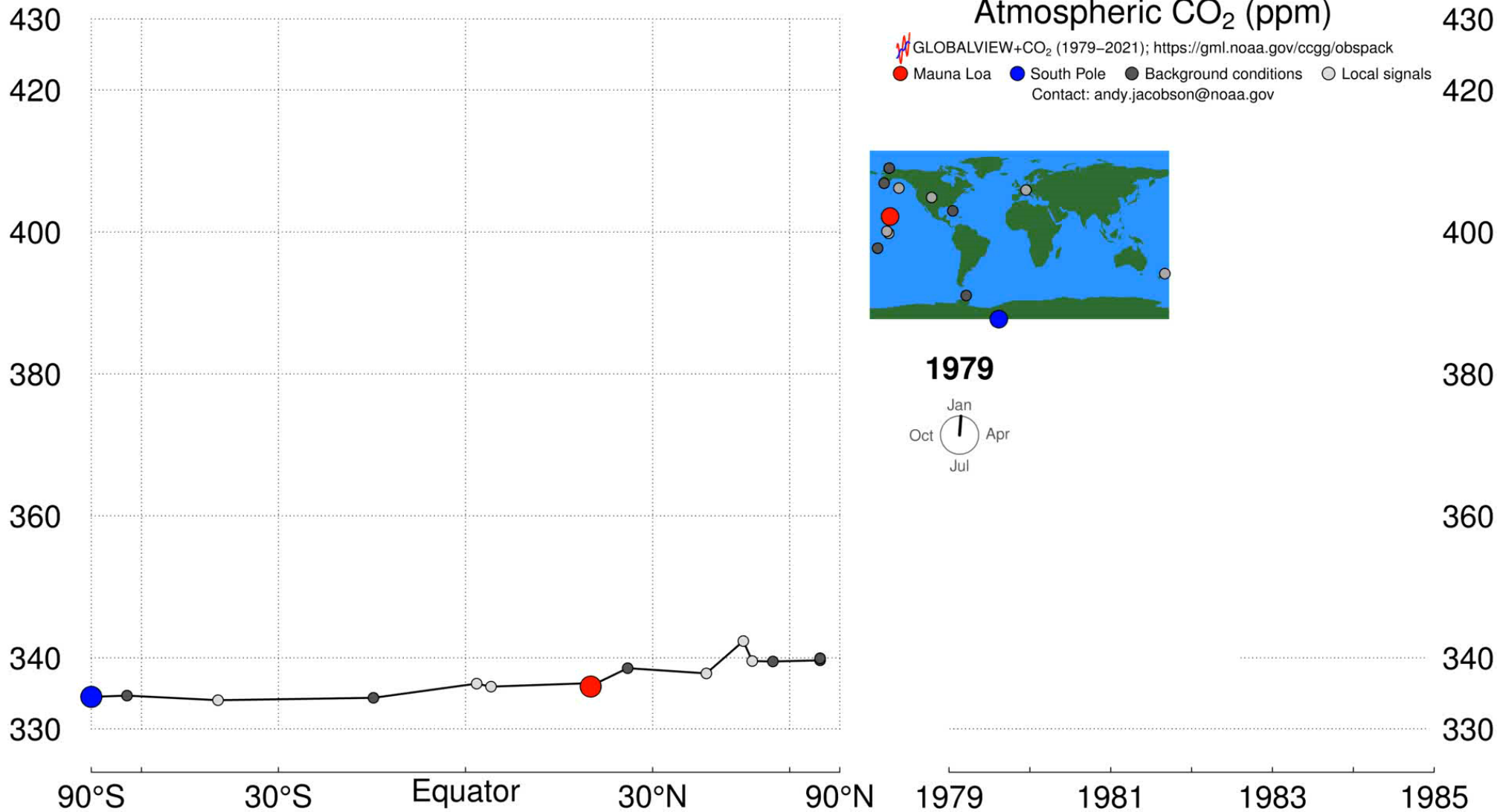
**3.300 km<sup>2</sup>**



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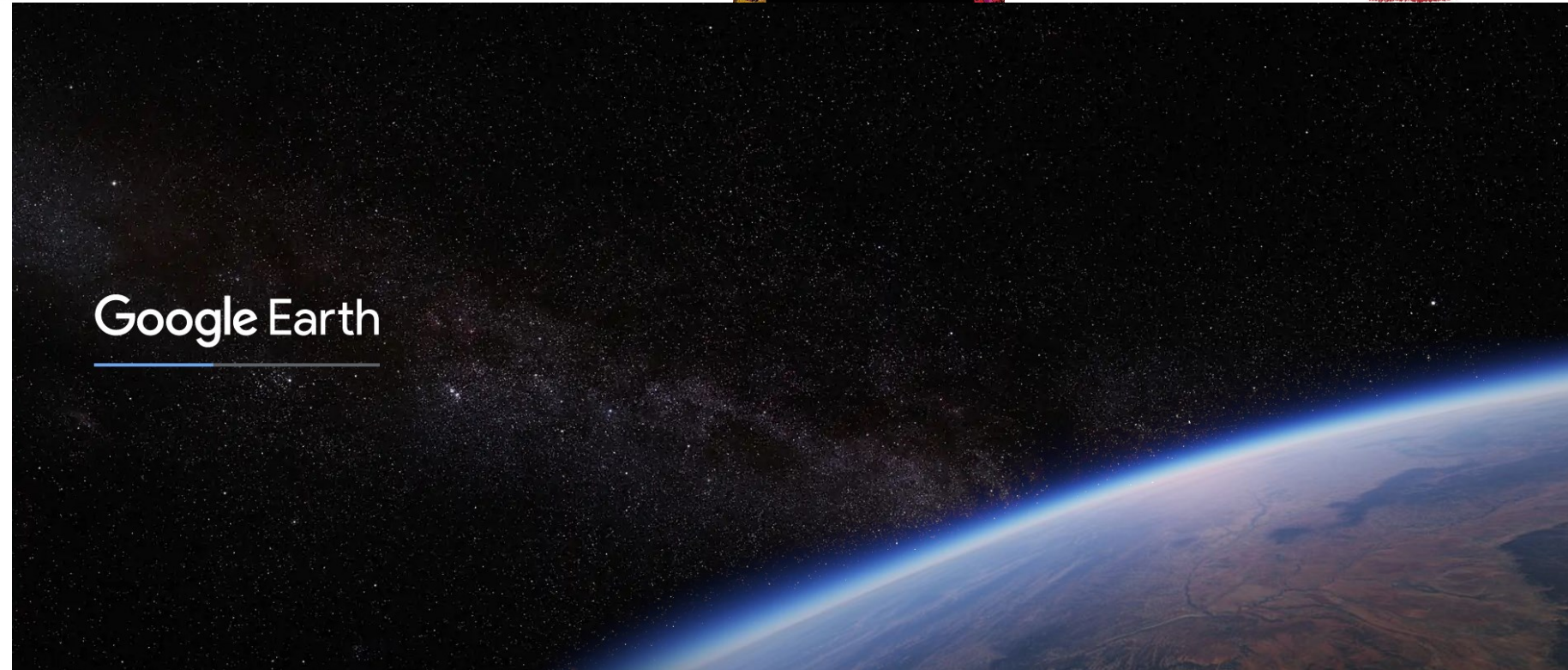
Time history of atmospheric carbon dioxide (updated January, 2022)



NOAA

<https://gml.noaa.gov/ccgg/trends/history.html>

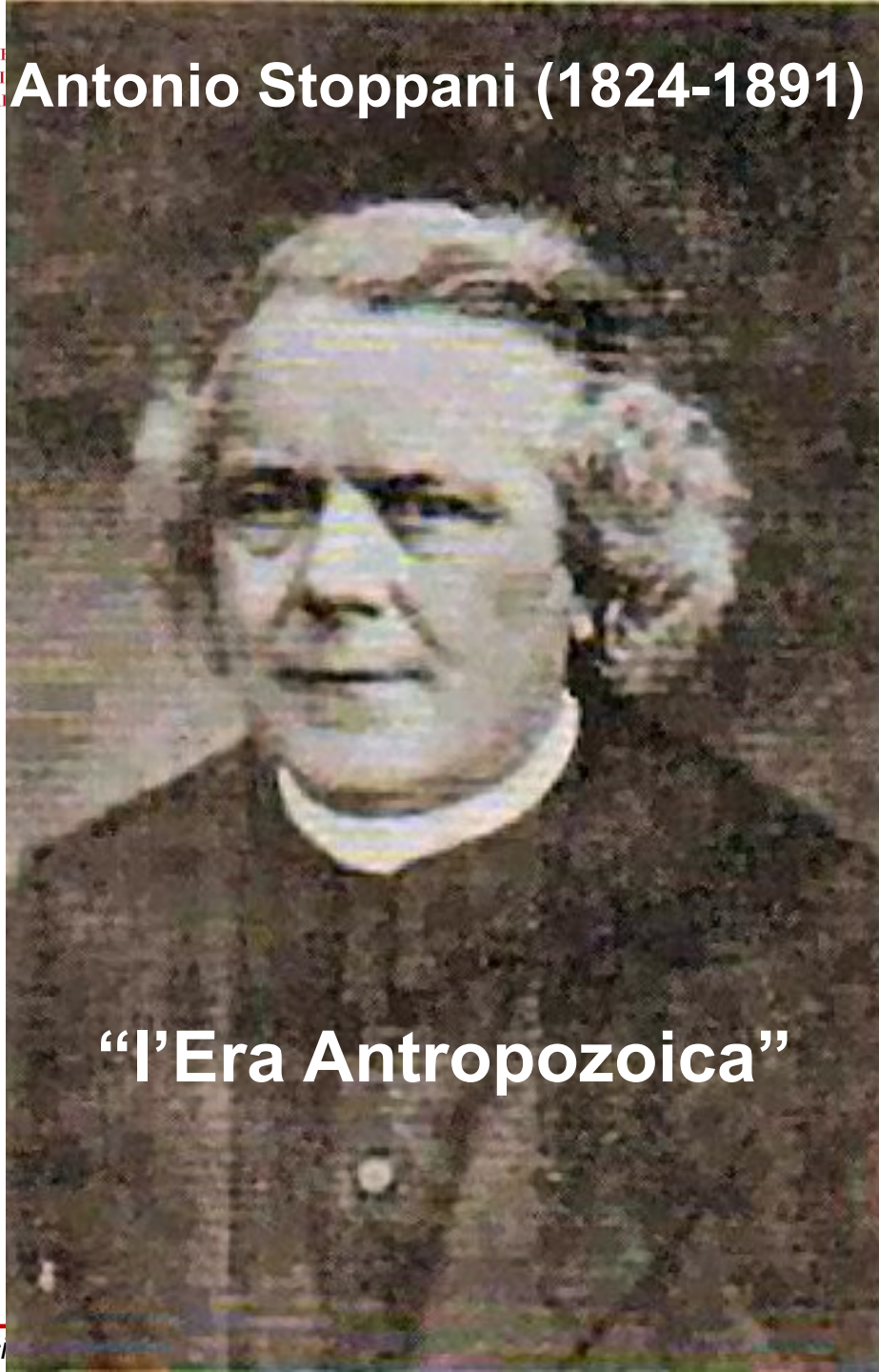




<https://earthengine.google.com/timelapse/>

<https://www.google.com/earth/about/gallery/>

# Antonio Stoppani (1824-1891)



**“l’Era Antropozoica”**

**“...una nuova forza tellurica che per magnitudo e ampiezza può essere paragonata alle più grandi forze della Terra.”**  
(Corso di Geologia, A. Stoppani, 1873)

“Stop using the word Holocene. We’re not in the Holocene anymore. We’re in the...the...”

**2000 IGBP  
Scientific  
Committee  
meeting,  
(Cuernavaca,  
Mexico)**



**...Anthropocene!**

“It was quiet in the room for a while.”

Paul Crutzen (Nobel Prize in Chemistry, 1995)

## concepts

# Geology of mankind

Paul J. Crutzen

For the past three centuries, the effects of humans on the global environment have escalated. Because of these anthropogenic emissions of carbon dioxide, global climate may depart significantly from natural behaviour for many millennia to come. It seems appropriate to assign the term 'Anthropocene' to the present, in many ways human-dominated, geological epoch, supplementing the Holocene — the warm period of the past 10–12 millennia. The Anthropocene could be said to have started in the latter part of the eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane. This date also happens to coincide with James Watt's design of the steam engine in 1784.

Mankind's growing influence on the environment was recognized as long ago as 1873, when the Italian geologist Antonio Stoppani spoke about a "new telluric force which in power and universality may be compared to the greater forces of earth,"

referring to the "anthropozoic era". And in 1926, V. I. Vernadsky acknowledged the increasing impact of mankind: "The direction in which the processes of evolution must proceed, namely towards increasing consciousness and thought, and forms having greater and greater influence on their surroundings." Teilhard de Chardin and Vernadsky used the term 'noösphere' — the 'world of thought' — to mark the growing role of human brain-power in shaping its own future and environment.

The rapid expansion of mankind in numbers and per capita exploitation of Earth's resources has continued apace. During the past three centuries, the human population has increased tenfold to more than 6 billion and is expected to reach 10 billion in this century. The methane-producing cattle population has risen to 1.4 billion. About 30–50% of the planet's land surface is exploited by humans. Tropical rainforests disappear at a fast pace, releasing carbon dioxide and strongly increasing species extinction. Dam building and river diversion have become commonplace. More than half of all accessible fresh water is used by mankind. Fisheries remove more than 25% of the primary production in seawalling

## The Anthropocene

*The Anthropocene could be said to have started in the late eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane.*

ozone-destroying properties of the halogens have been studied since the mid-1970s. If it had turned out that chlorine behaved chemically like bromine, the ozone hole would by then have been a global, year-round phenomenon, not just an event of the Antarctic spring. More by luck than by wisdom, this catastrophic situation did not develop.

Unless there is a global catastrophe — a meteorite impact, a world war or a pandemic — mankind will remain a major environmental force for many millennia. A daunting task lies ahead for scientists and engineers to guide society towards environmentally sustainable management during the era of the Anthropocene. This will require appropriate human behaviour at all scales, and may well involve internationally accepted, large-scale geo-engineering projects for instance to 'stabilize' climate at

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<https://www.nature.com/articles/415023a>

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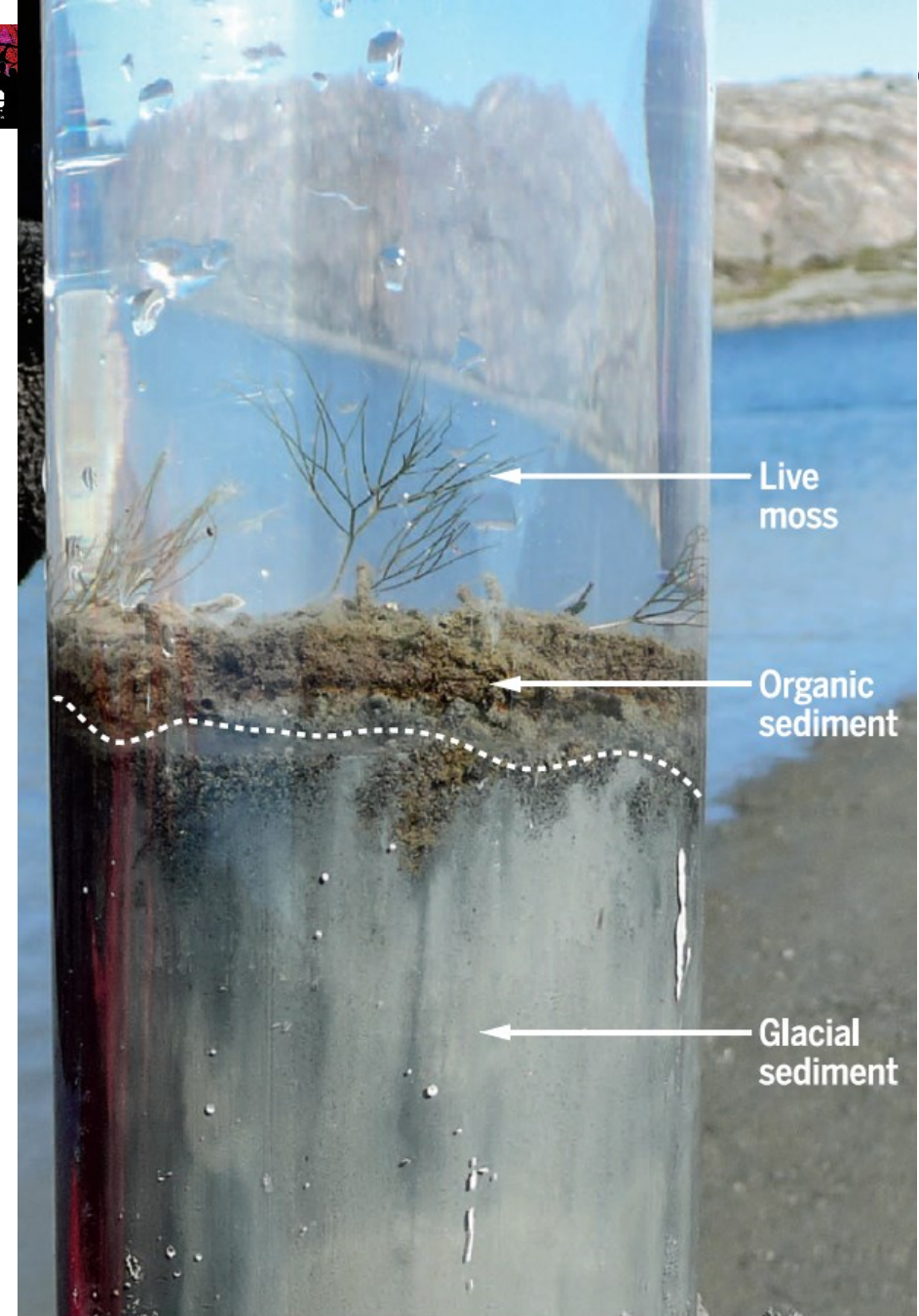
## The Anthropocene is functionally and stratigraphically distinct from the Holocene

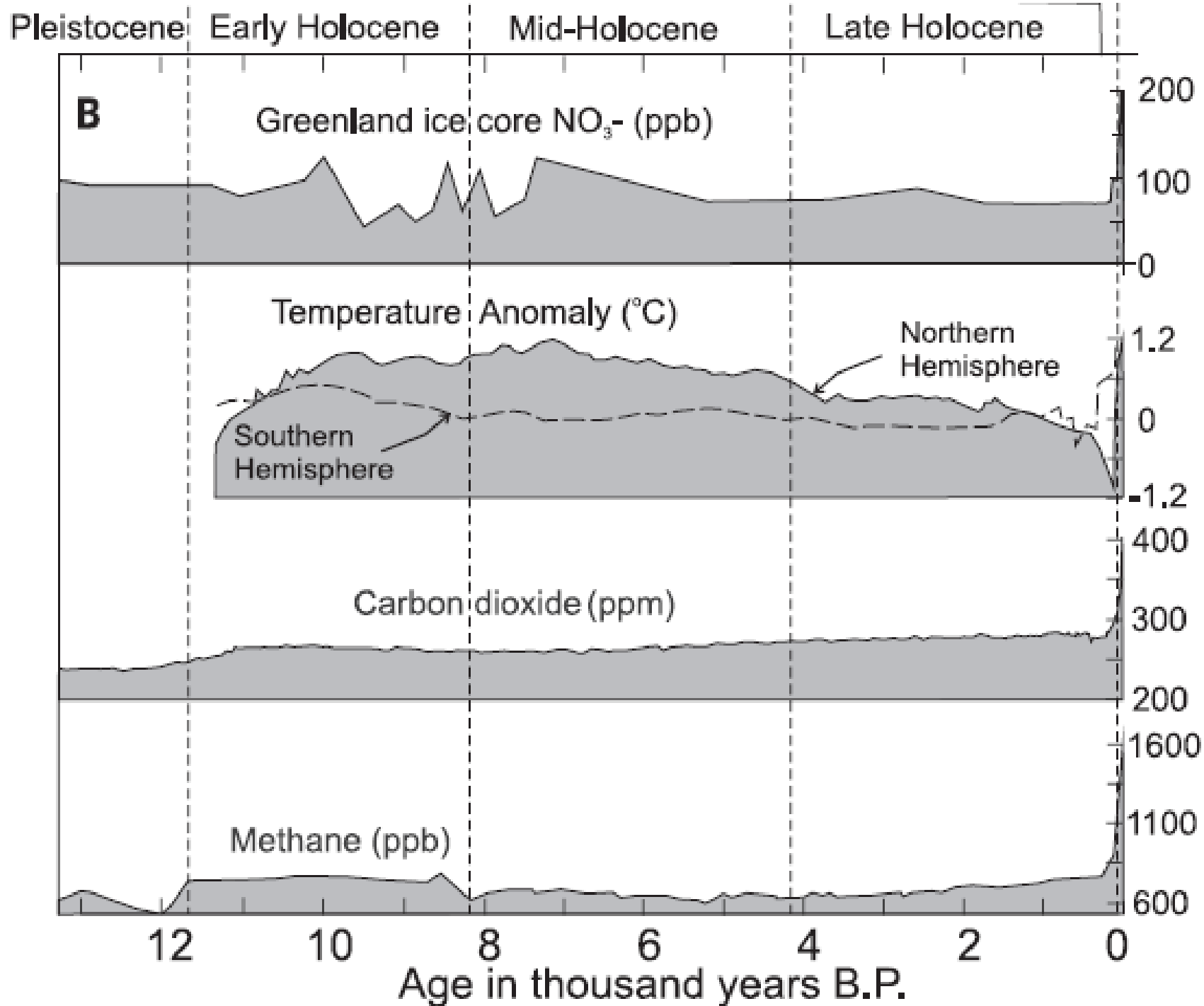
Colin N. Waters<sup>1,\*</sup>, Jan Zalasiewicz<sup>2</sup>, Colin Summerhayes<sup>3</sup>, Anthony D. Barnosky<sup>4</sup>, Clément Poirier<sup>5</sup>, Agnieszka Gałuszka<sup>6</sup>, Alejandro Cearreta<sup>7</sup>, Matt Edgeworth<sup>8</sup>, Erle C. Ellis<sup>9</sup>, Michael Ellis<sup>1</sup>, Catherine Jeandel<sup>10</sup>, Reinhold Leinfelder<sup>11</sup>, J. R. McNeill<sup>12</sup>, Daniel deB. Richter<sup>13</sup>, Will Steffen<sup>14</sup>, James Syvitski<sup>15</sup>, Davor Vidas<sup>16</sup>, Michael Wagreich<sup>17</sup>, Mark Williams<sup>2</sup>, An Zhisheng<sup>18</sup>, Jacques Grinevald<sup>19</sup>, Eric Odada<sup>20</sup>, Naomi Oreskes<sup>21</sup>, Alexander P. Wolfe<sup>22</sup>

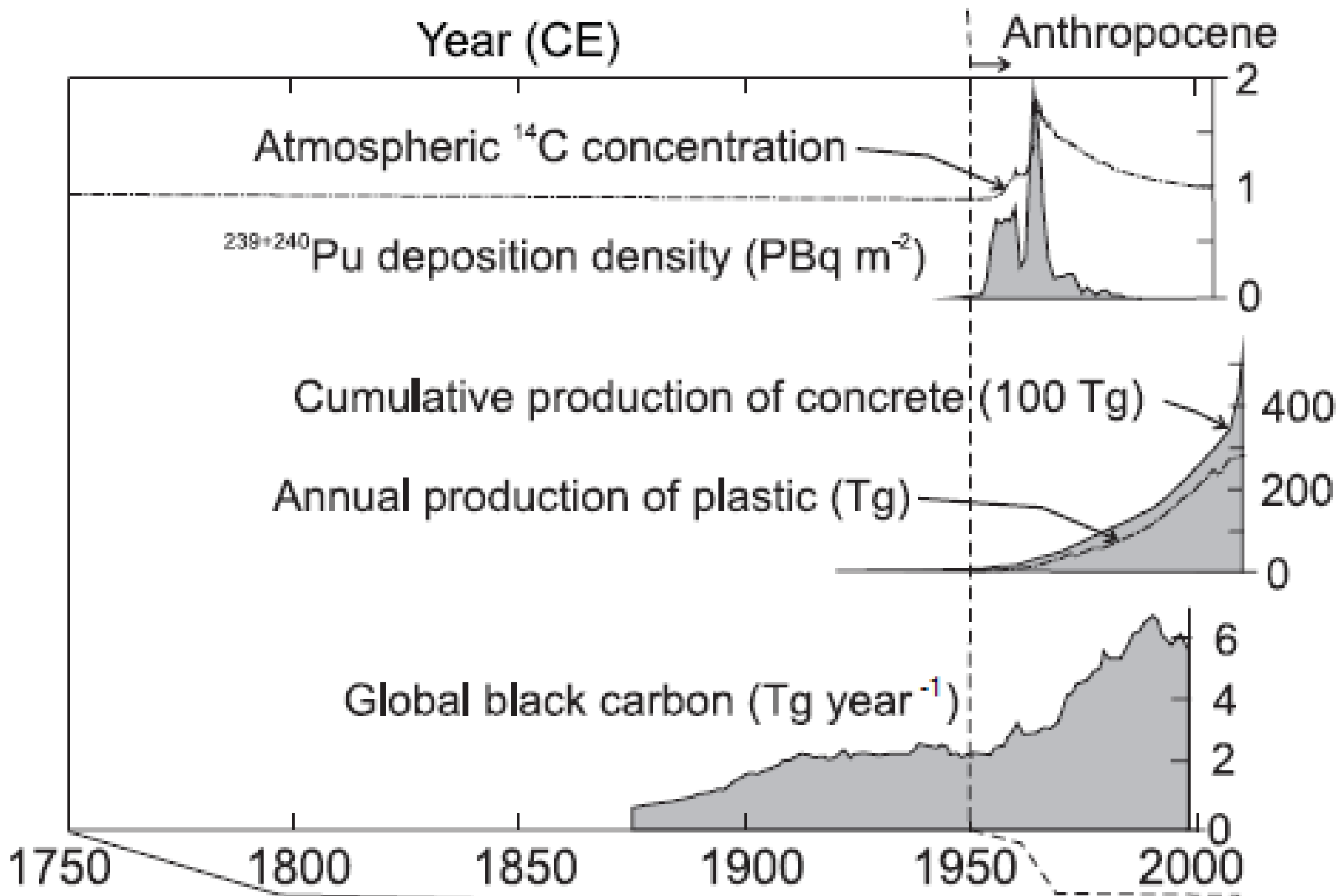
+ Author Affiliations

\*Corresponding author. E-mail: cnw@bgs.ac.uk

Science 08 Jan 2016:  
Vol. 351, Issue 6269, pp.  
DOI: 10.1126/science.aad2622





**A**

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Perspective | [Published: 11 March 2015](#)

## Defining the Anthropocene

[Simon L. Lewis](#) & [Mark A. Maslin](#)

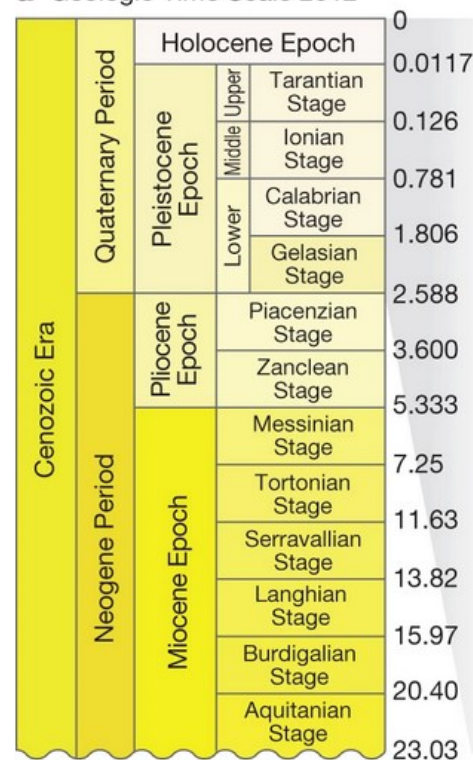
*Nature* **519**, 171–180 (2015) | [Cite this article](#)

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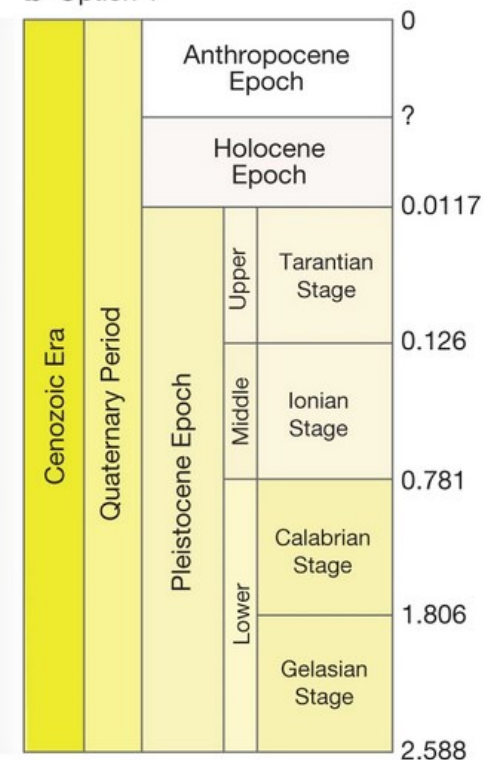
### Abstract

Time is divided by geologists according to marked shifts in Earth's state. Recent global environmental changes suggest that Earth may have entered a new human-dominated geological epoch, the Anthropocene. Here we review the historical genesis of the idea and assess anthropogenic signatures in the geological record against the formal requirements for

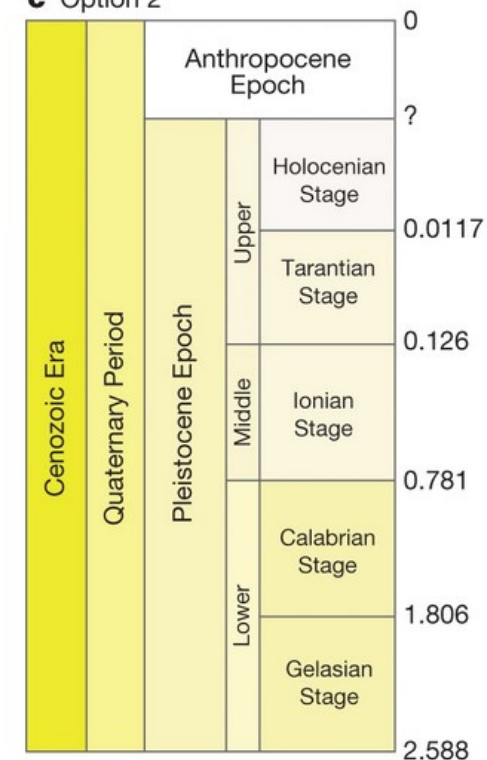
**a** Geologic Time Scale 2012



**b** Option 1



**c** Option 2



<https://www.nature.com/articles/nature14258>



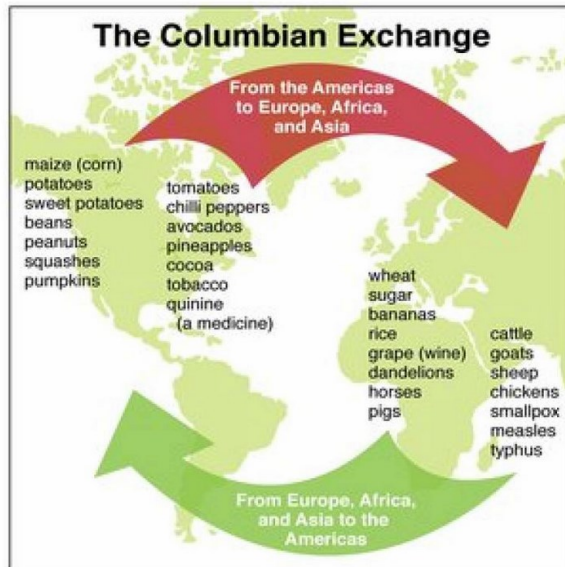


UCL Home » UCL News » Epoch-defining study pinpoints when humans came to dominate planet Earth

## Epoch-defining study pinpoints when humans came to dominate planet Earth

11 March 2015

The human-dominated geological epoch known as the Anthropocene probably began around the year 1610, with an unusual drop in atmospheric carbon dioxide and the irreversible exchange of species between the New and Old Worlds, according to new research published today in Nature.



<https://www.ucl.ac.uk/news/2015/mar/epoch-defining-study-pinpoints-when-humans-came-dominate-planet-earth>



Quaternary Science Reviews

Volume 207, 1 March 2019, Pages 13-36

## Earth system impacts of the European arrival and Great Dying in the Americas after 1492

Alexander Koch <sup>a</sup>, Chris Brierley <sup>a</sup>, Mark M. Maslin <sup>a</sup>, Simon L. Lewis <sup>a, b</sup>

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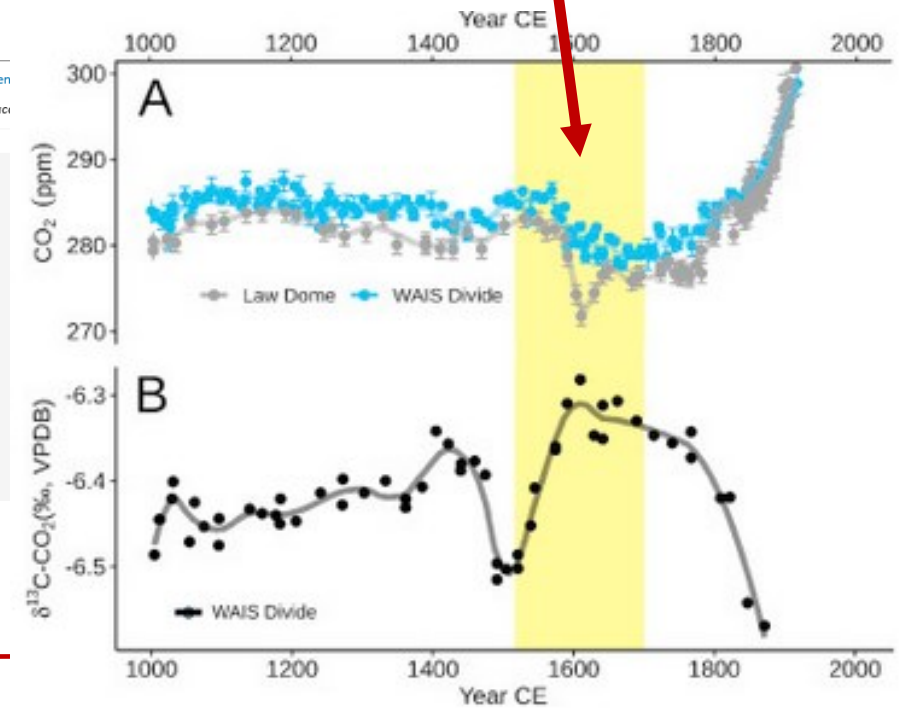
<https://doi.org/10.1016/j.quascirev.2018.12.004>

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### Highlights

- Combines multiple methods estimating pre-Columbian population numbers.
- Estimates European arrival in 1492 lead to 56 million deaths by 1600.
- Large population reduction led to reforestation of 55.8 Mha and 7.4 Pg C uptake.
- 1610 atmospheric CO<sub>2</sub> drop partly caused by indigenous depopulation of the Americas.
- Humans contributed to Earth System changes before the Industrial Revolution.



## Update 2024

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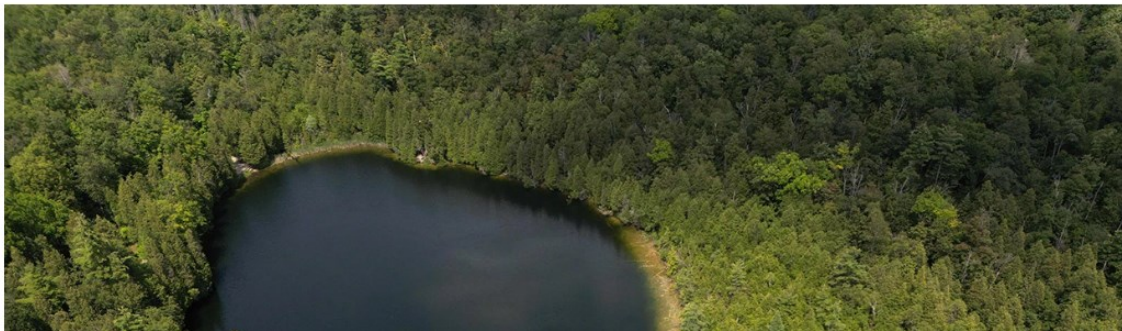
nature > news > article

NEWS | 06 March 2024 | Correction [06 March 2024](#)

# Geologists reject the Anthropocene as Earth's new epoch – after 15 years of debate

But some are now challenging the vote, saying there were 'procedural irregularities'.

By [Alexandra Witze](#)



<https://www.nature.com/articles/d41586-024-00675-8>

CAMBIAMENTI CLIMATICI | 9 MARZO 2024 | 10:17

## Cos'è l'Antropocene e perché gli scienziati hanno votato contro la sua esistenza

Un comitato di scienziati ha recentemente rigettato la proposta di formalizzare l'Antropocene come nuova epoca geologica. Ecco di cosa si tratta e perché l'hanno respinta.

A cura di [Andrea Centini](#)

La storia di Daniele: "Sono stato un moderatore di YouTube e ho visto l'orrore del web"



OPINIONI | CAMBIAMENTI CLIMATICI | 7 MARZO 2024 | 15:58

## Il paradosso dell'Antropocene: lo stiamo già vivendo ma per la scienza ancora non è iniziato

Una commissione di geologi mette fine (per ora) a un dibattito durato 15 anni: l'Antropocene ancora non è definibile come un'era geologica, anche se già lo stiamo vivendo.

A cura di [Fridays For Future Italia](#)

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