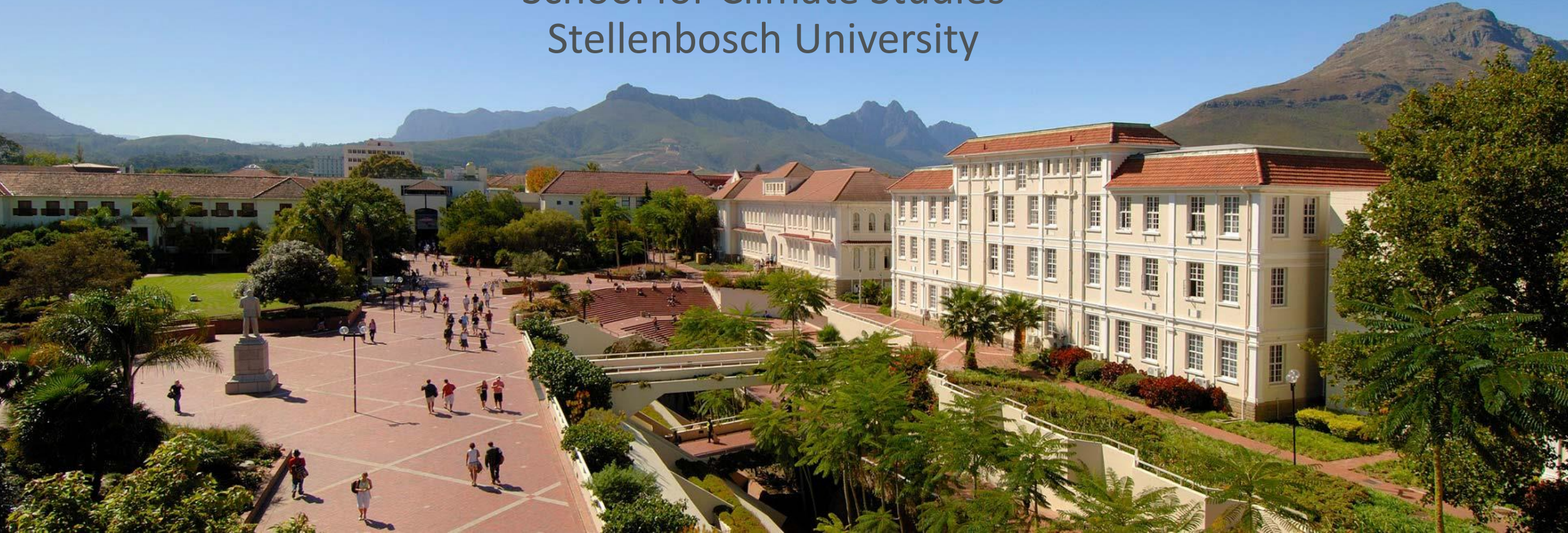


Creating a Sustainable Future in a Changing Climate

Guy Midgley
School for Climate Studies
Stellenbosch University



Origins Risks Scenarios

Born in the Ice age



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NASA's Goddard Space Flight Center/Ludovic Brucker



<https://science.nasa.gov/science-research/earth-science/climate-science/core-questions-an-introduction-to-ice-cores/>

<https://www.gpb.org/television/show/nova/season/49/ice-age-footprints>

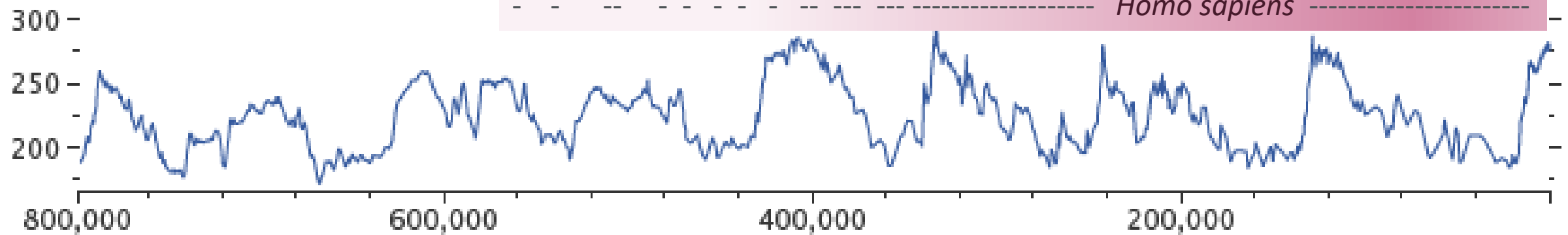
Born in the Ice age



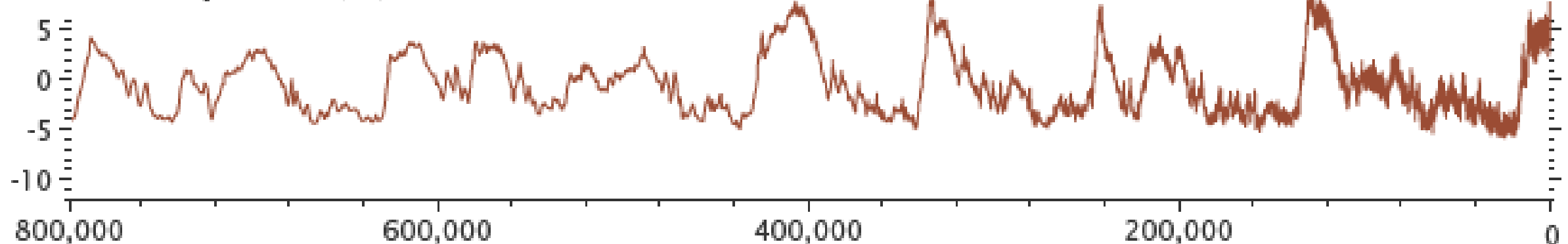
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Carbon Dioxide (parts per million)



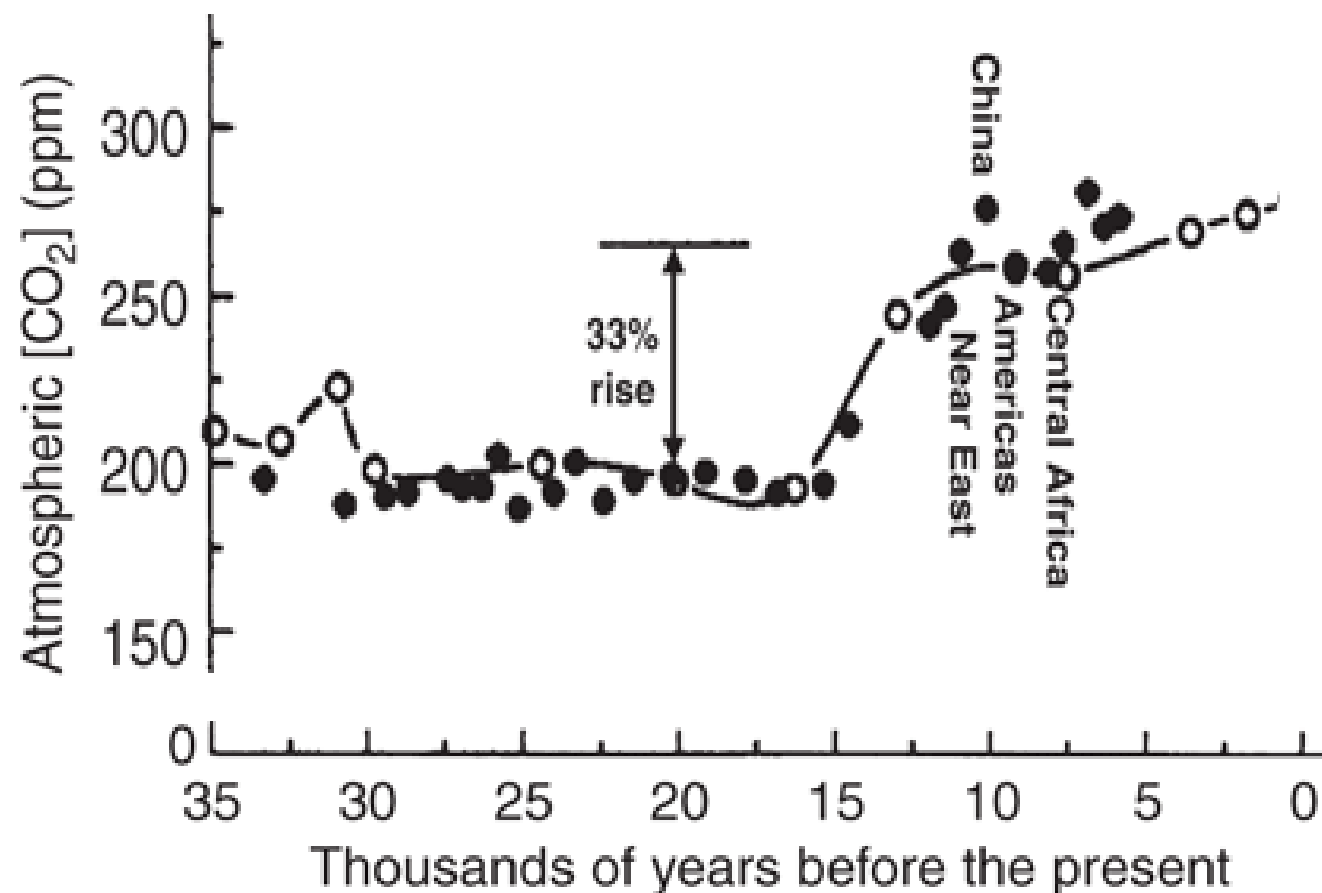
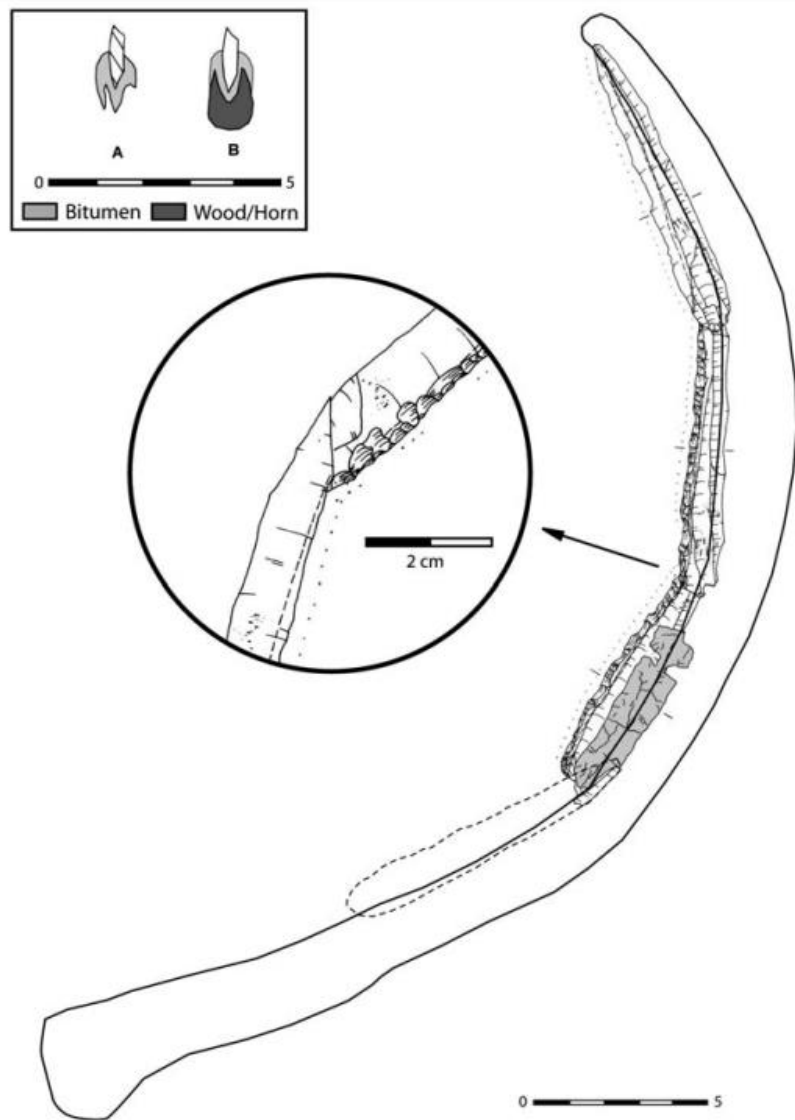
Antarctic Temperature (°C)



Date (Years Before Present)



<https://earthobservatory.nasa.gov/features/CarbonCycle/page4.php>



From Borrel and Molist. 2007. Tools and Hafting Systems at Tell Halula (Syria) during the 8th millennium cal. BC Paléorient, vol. 33.2, p. 59-77

From Sage RF. 1995. Was low atmospheric CO₂ during the Pleistocene a limiting factor for the origin of agriculture? Global Change Biology 1: 93–106

Wheat yield response to atmospheric CO₂ level

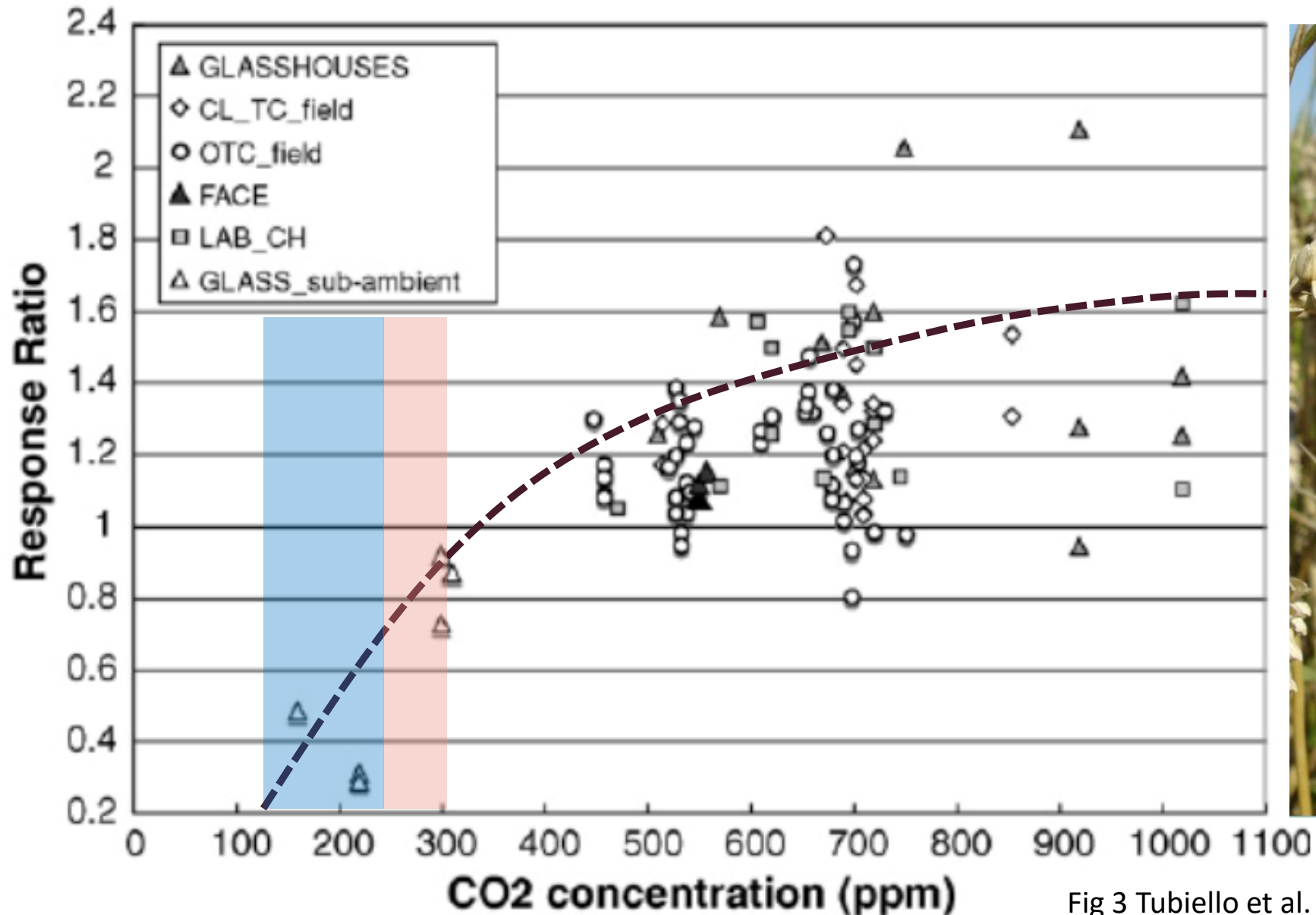
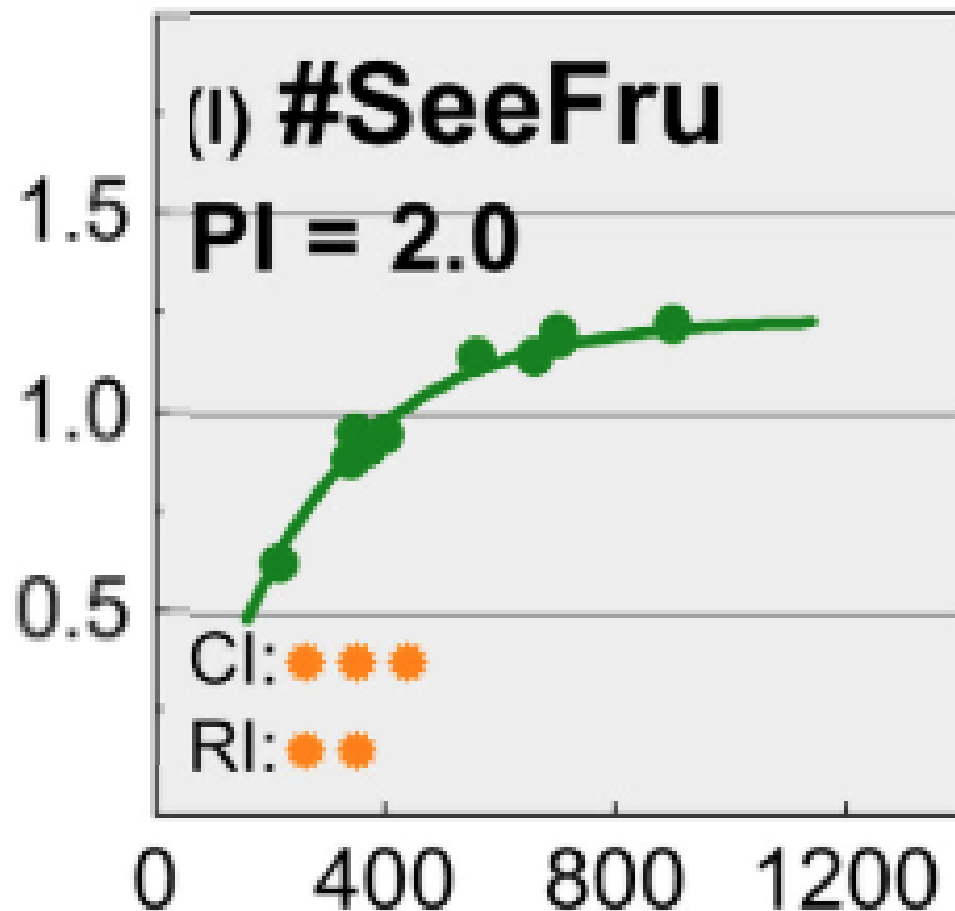


Fig 3 Tubiello et al. / Europ. J. Agronomy 26 (2007) 215–223

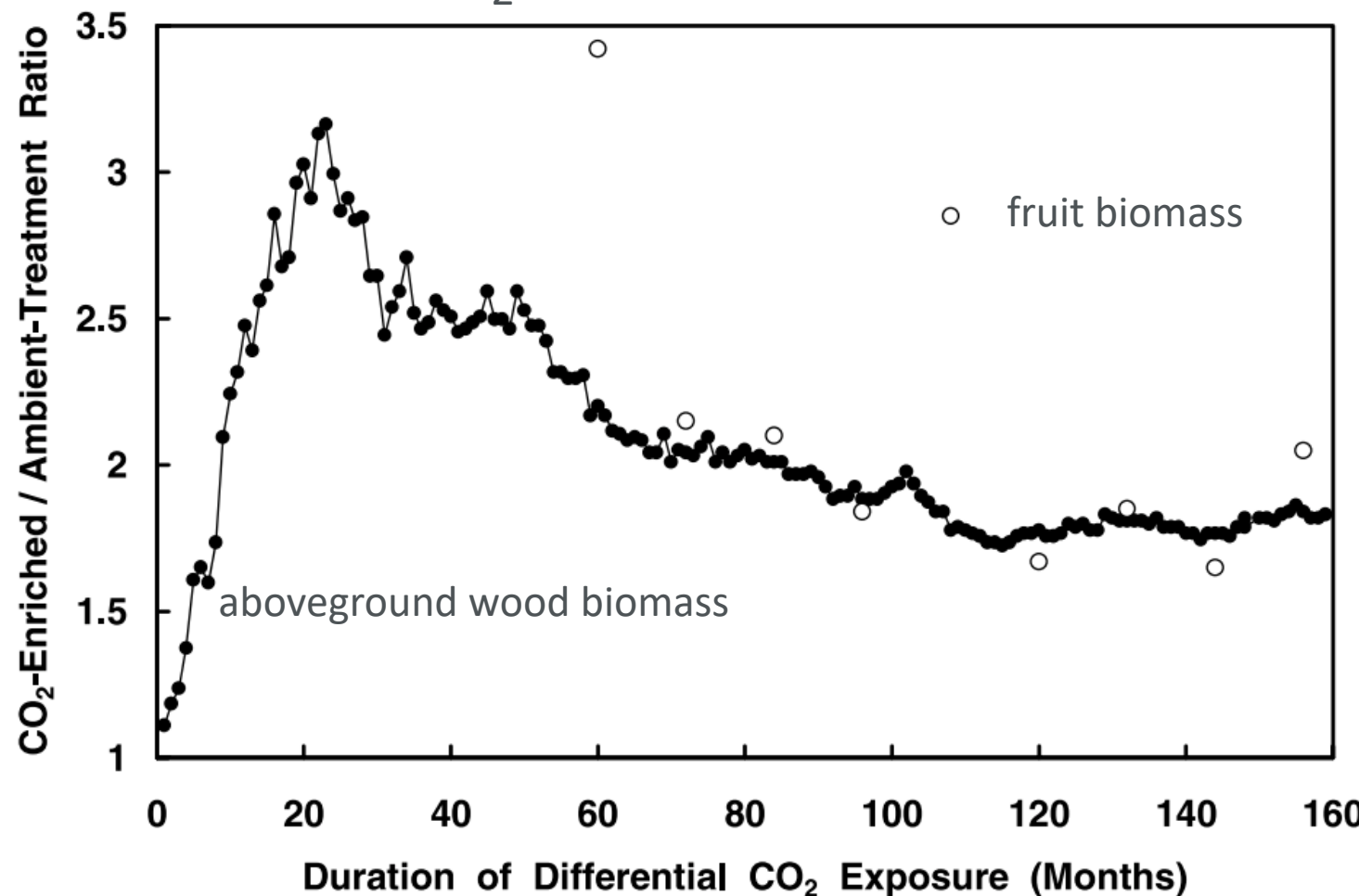
All: Seed/Fruit Production



From Poorter et al. 2022 New Phytologist

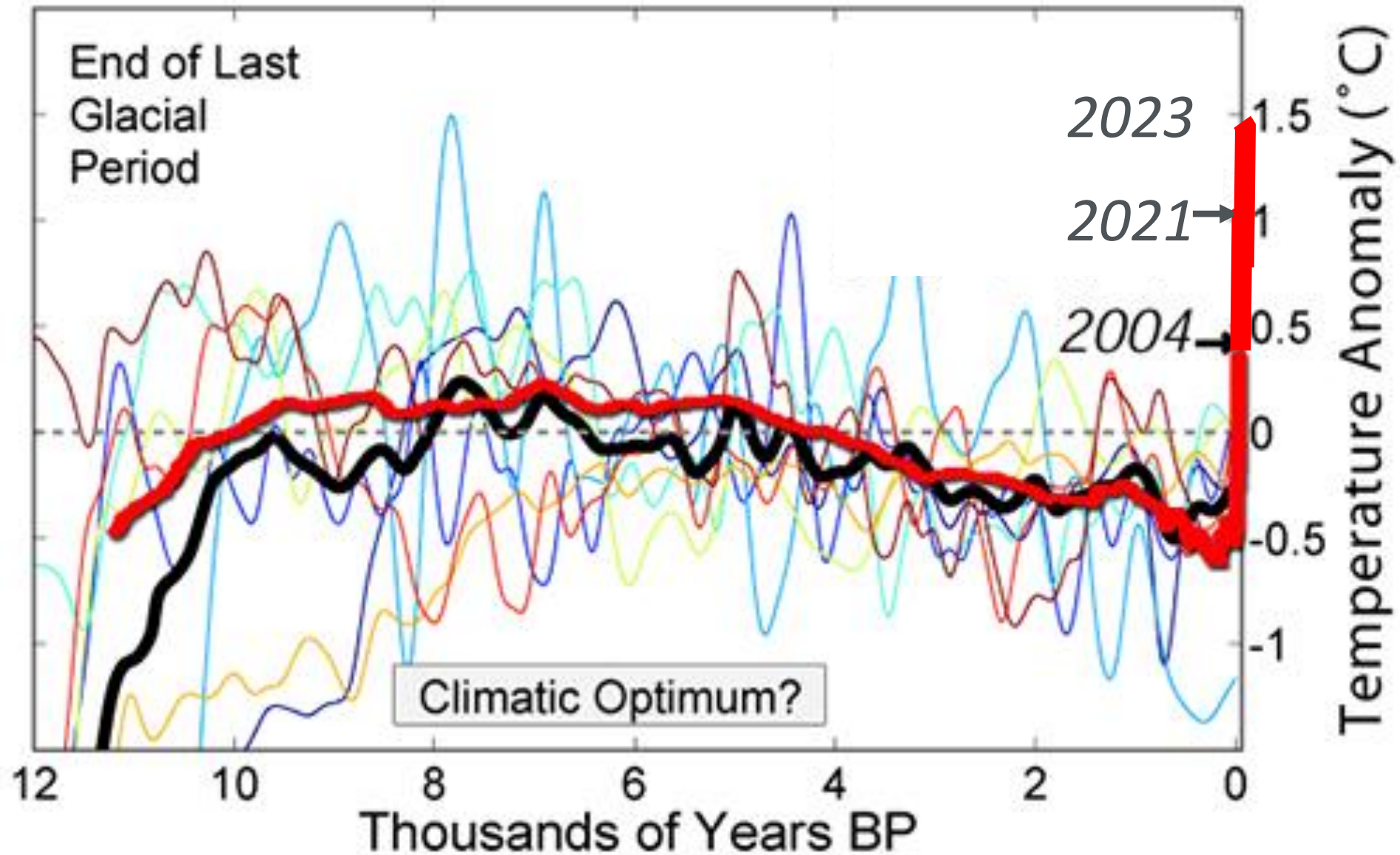
Sour Orange

300 ppm CO₂ enrichment (400 – 700)



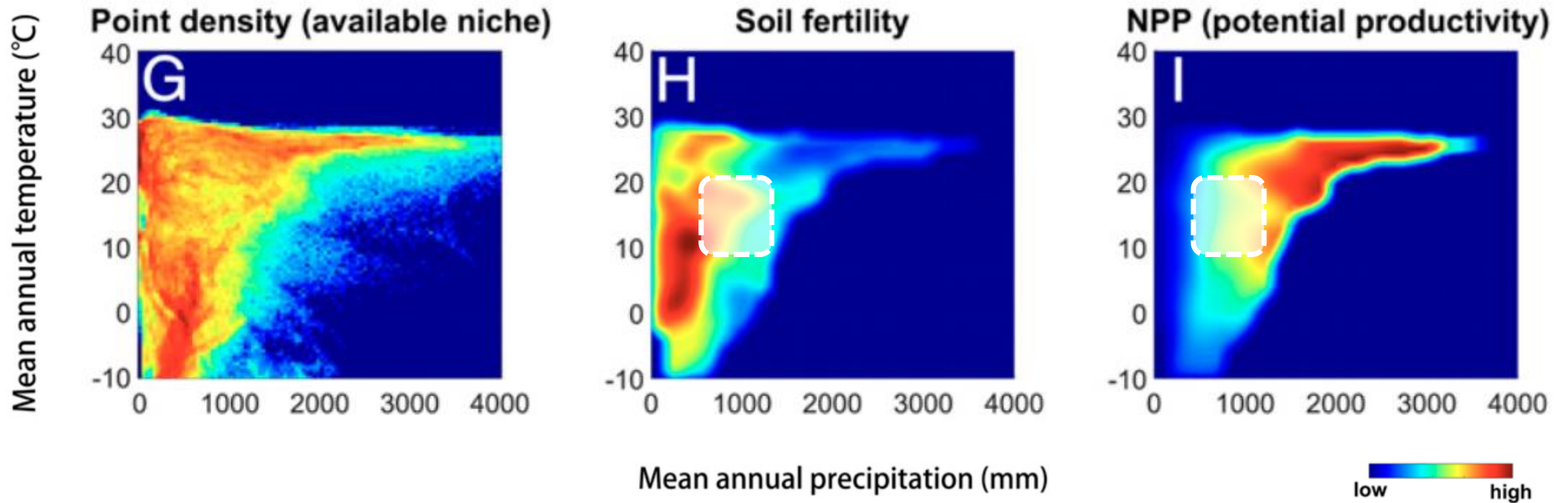
From Idso & Kimball. 2001. Environmental and Experimental Botany

Uncooling the planet

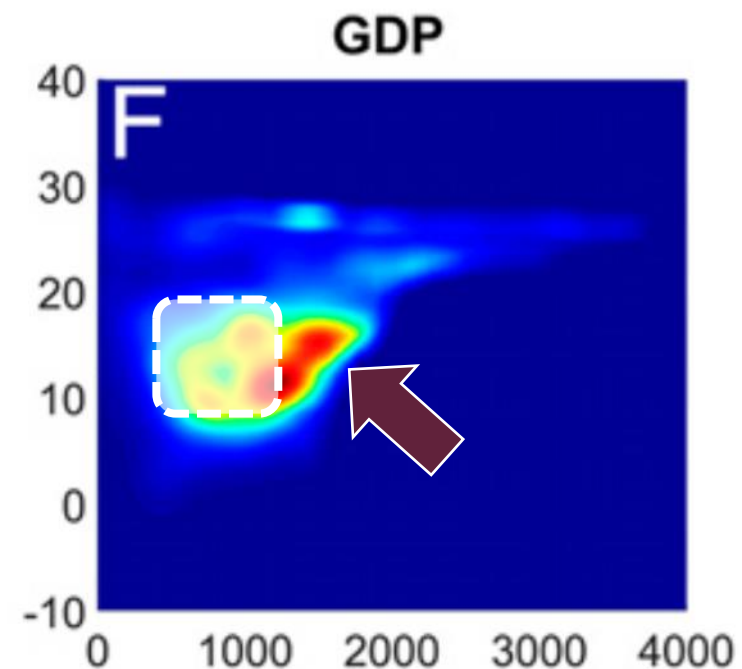
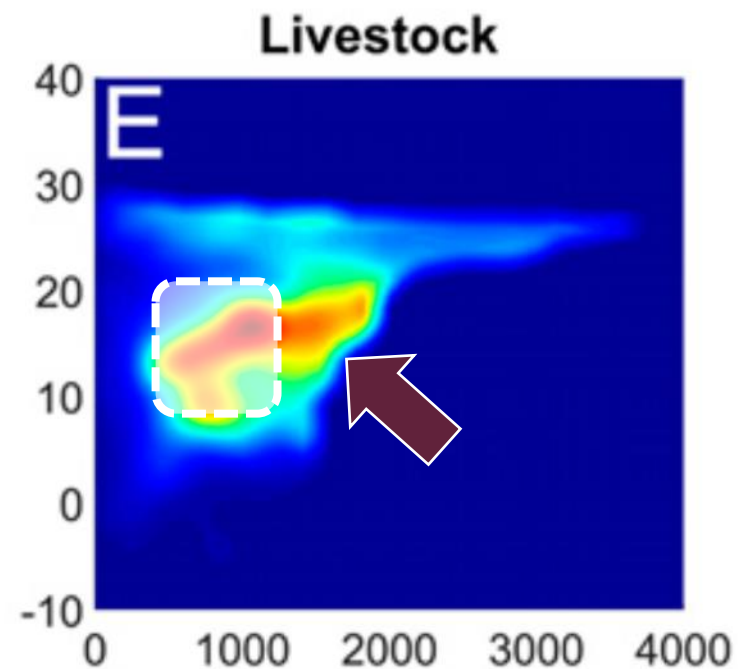
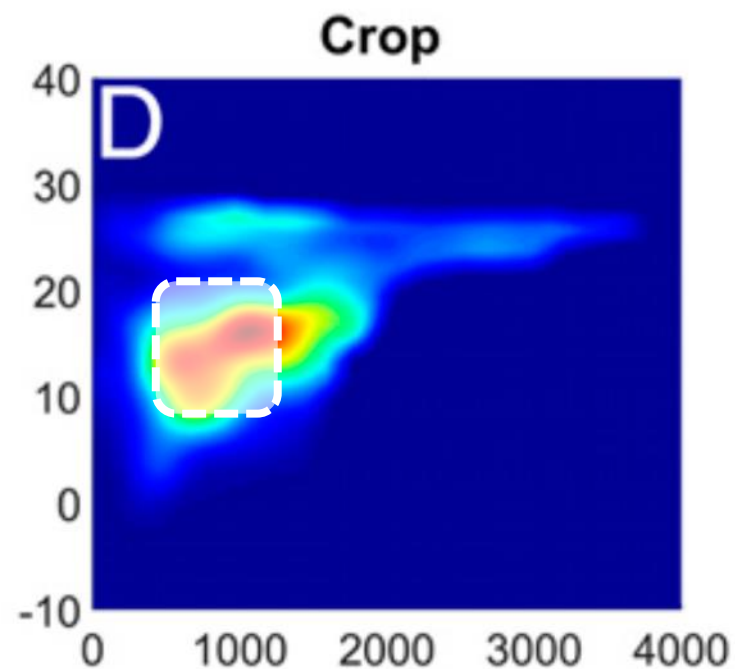
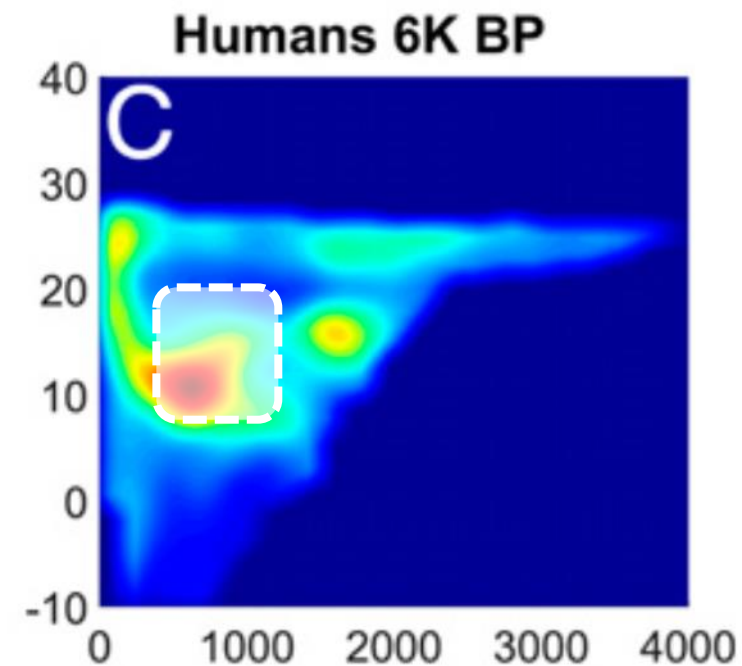
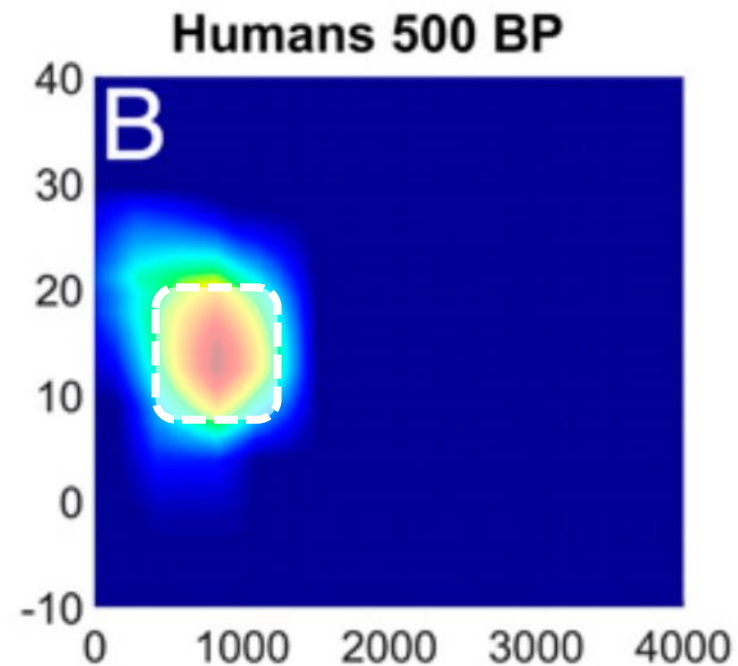
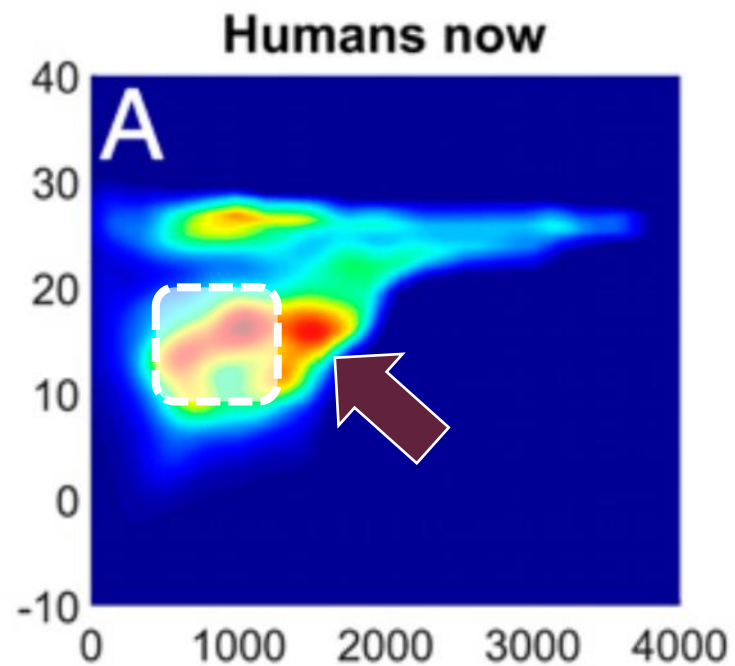


Marcott, S.A., Shakun, J.D., Clark, P.U. and Mix, A.C., 2013. A reconstruction of regional and global temperature for the past 11,300 years. *science*, 339(6124), pp.1198-1201.

Constraints: Climate, Agriculture and People



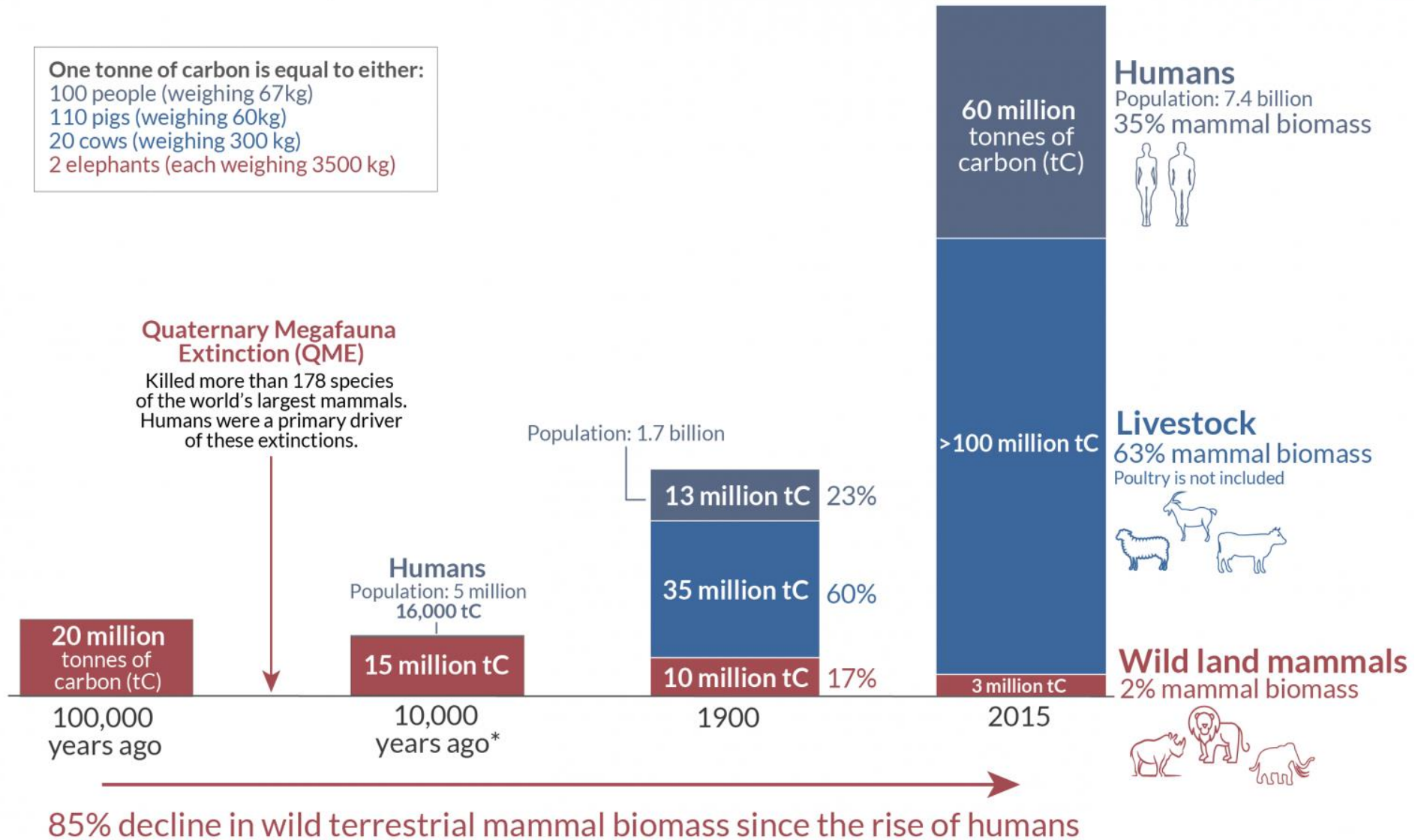
Xu, C., Kohler, T.A., Lenton, T.M., Svenning, J.C. and Scheffer, M., 2020. Future of the human climate niche. *Proceedings of the National Academy of Sciences*, 117(21), pp.11350-11355.



Changing distribution of the world's land mammals

Terrestrial mammals are compared in terms of biomass – tonnes of carbon.

One tonne of carbon is equal to either:
100 people (weighing 67kg)
110 pigs (weighing 60kg)
20 cows (weighing 300 kg)
2 elephants (each weighing 3500 kg)



*Estimates of long-run wild mammal biomass come with larger uncertainty. Biomass following the QEM event is estimated to be approximately 15 million tonnes.

Data sources: Barnosky (2008); Smil (2011) & Bar-On et al. (2018). Images sourced from the Noun Project.

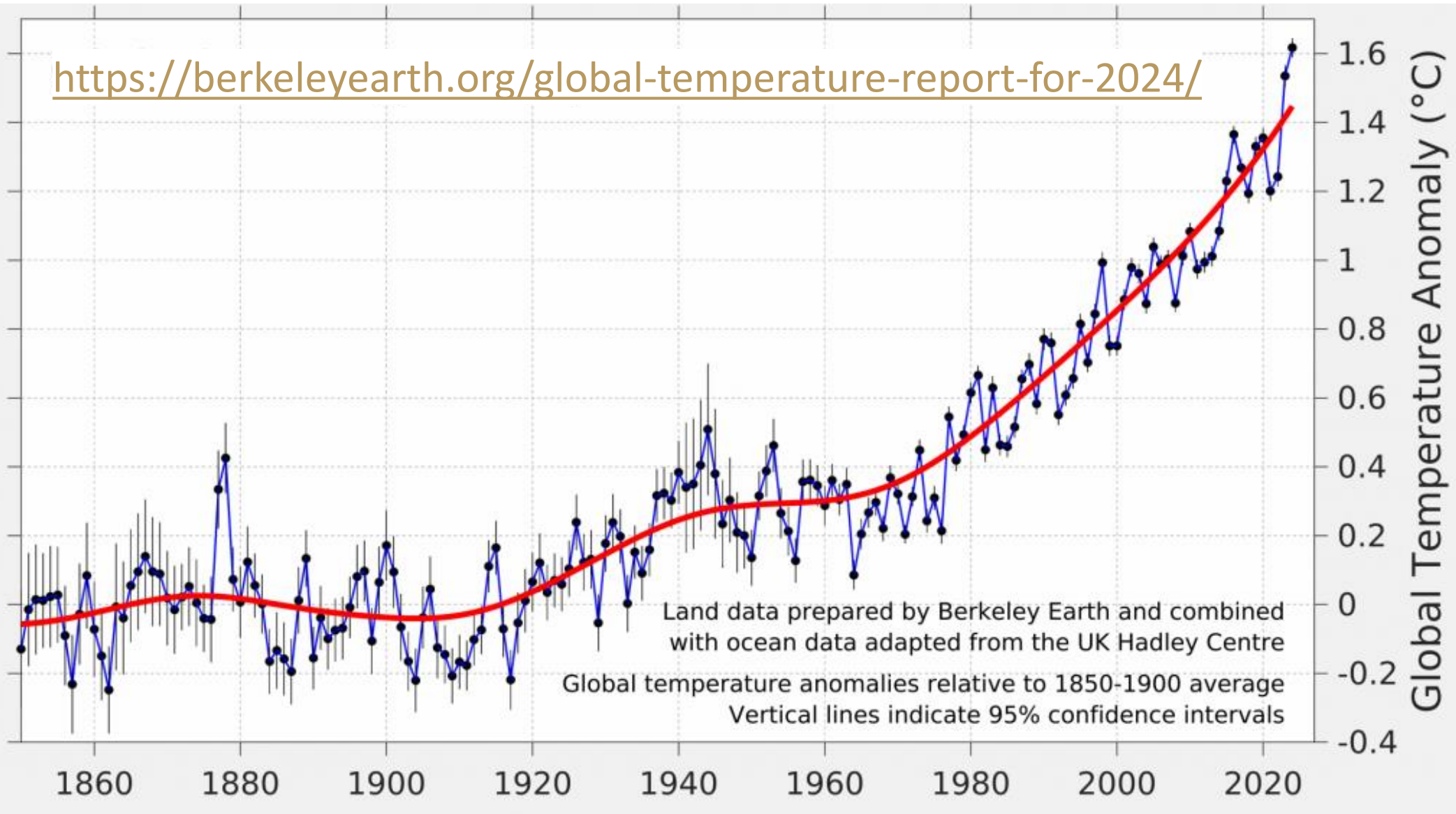
OurWorldinData.org – Research and data to make progress against the world's largest problems.

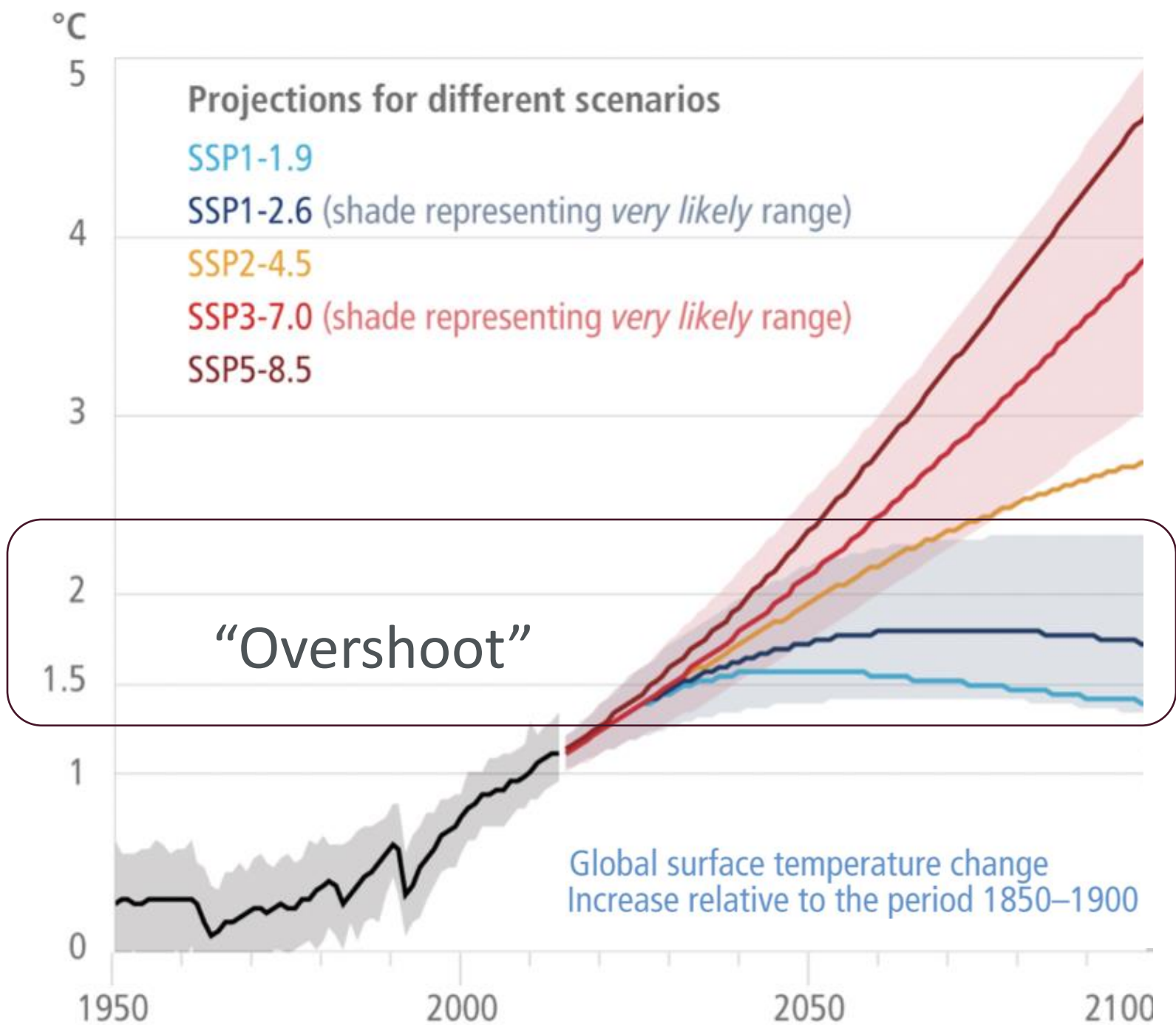
Licensed under CC-BY by the author Hannah Ritchie.

Risks

Global temperature trend 1850 - 2024

<https://berkeleyearth.org/global-temperature-report-for-2024/>





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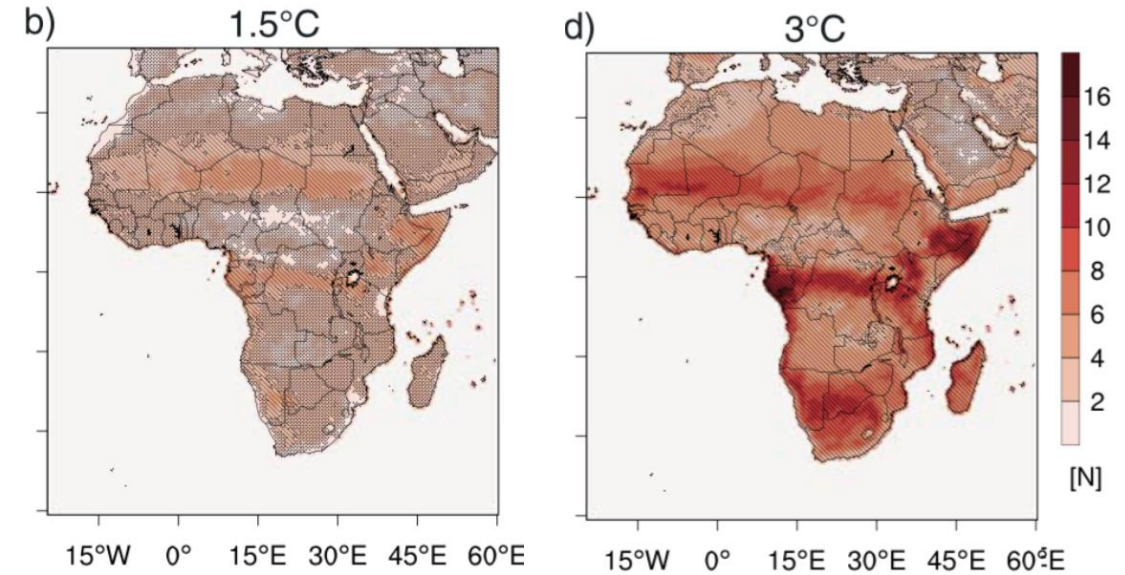
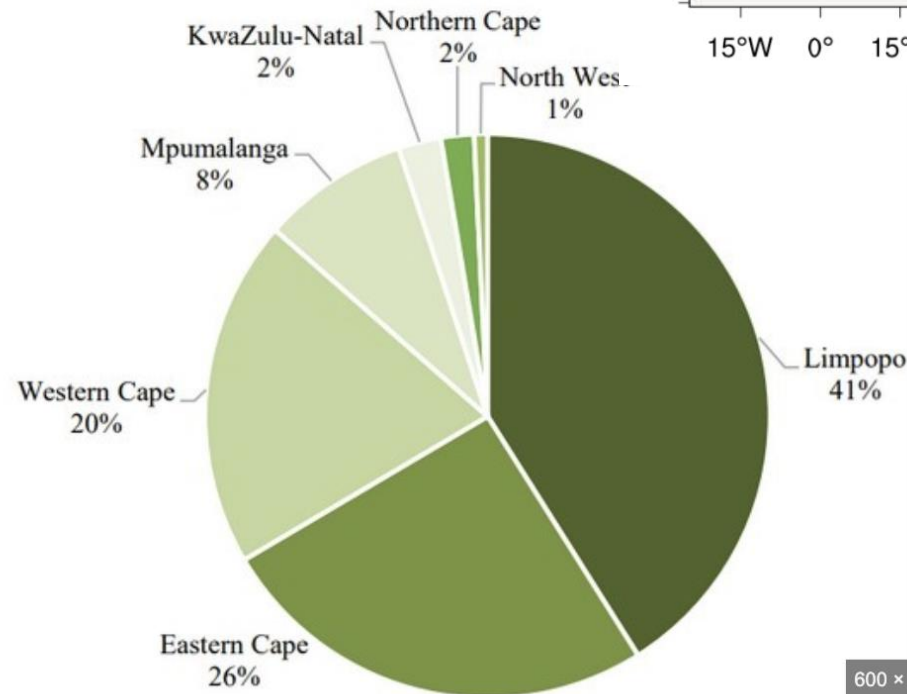
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Climate change related risks

- Supply side:
 - Optimal growing areas
 - Extreme events
 - Pests and diseases
 - Resources

- Demand side:



number of heatwave days per year

<https://www.freshplaza.com/north-america/article/9690002/south-africa-s-2024-25-citrus-production-and-exports-rise-as-more-fruit-shifts-to-processing/>

Climate change related risks

- Demand side:
 - Policy risks
 - Public perception
 - Market demand

Sector	PAM	Target	Leading Department
Agriculture	Conservation of Agriculture Resources Act, Climate Smart Strategic Framework, Climate Change Sector Plan	Update the key policies to incorporate climate mitigation and carbon sequestration, including supporting measures (including the Conservation of Agriculture Resources Act, Climate Smart Strategic Framework and Climate Change Sector Plan)	Department of Rural Development, Agriculture and Land Reform
	Conservation Agriculture Policy	Update policies with the following activities, where relevant: Nitrogen inhibitors in crops Updating fertilizer schedules Increase availability of soil sampling, standardise nitrogen testing. Feed changes in livestock subsector. Conservation agriculture Sharing best practices across Provinces for climate mitigation	
	Livestock emissions research programme	Identify emissions reduction technologies and opportunities in the livestock subsector	
	Agriculture Sector Implementation Plan	Develop a sector implementation plan to for applying climate mitigation activities	

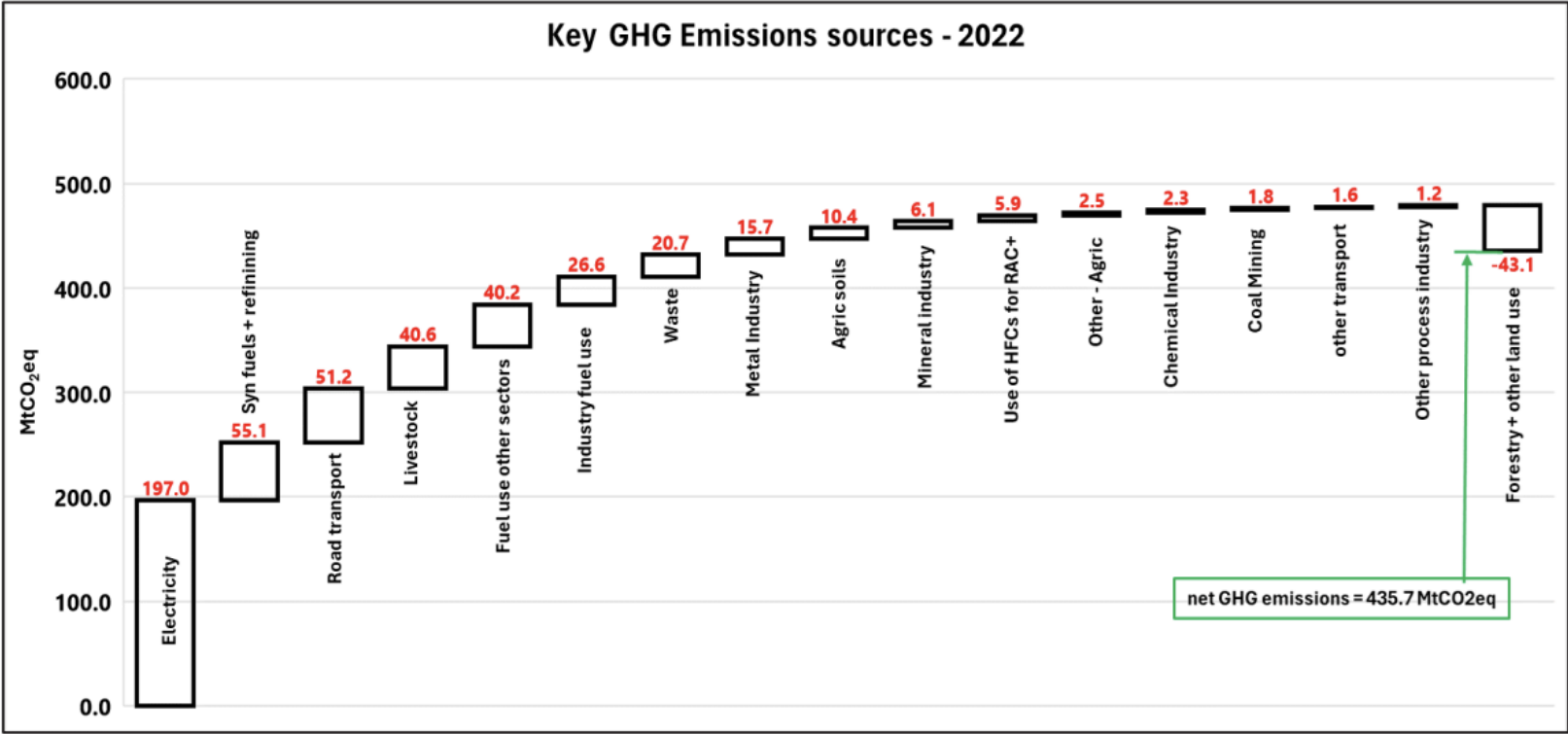


Figure 1-2: key GHG emissions sources based on the 2022 GHG emissions profile.

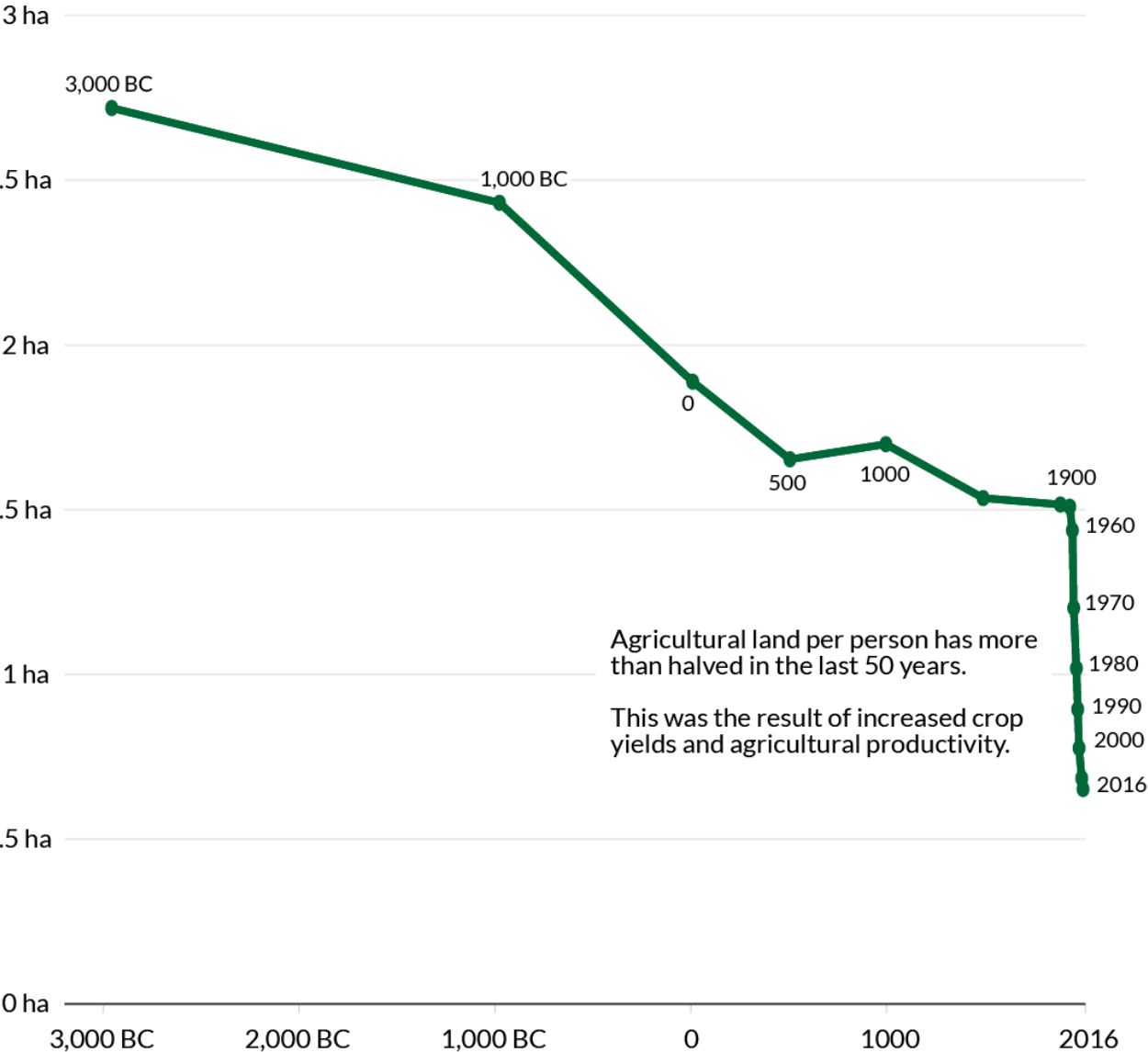
Climate change related risks

- Demand side:
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	Conservation Agriculture Policy	Provide training and capacity to extension officers to support smallholder farmers on zero cost climate change mitigation options	
	Livestock emissions research programme	Identify emissions reduction technologies and opportunities in the livestock subsector	
	Agriculture Sector Implementation Plan	Develop a sector implementation plan to for applying climate mitigation activities	

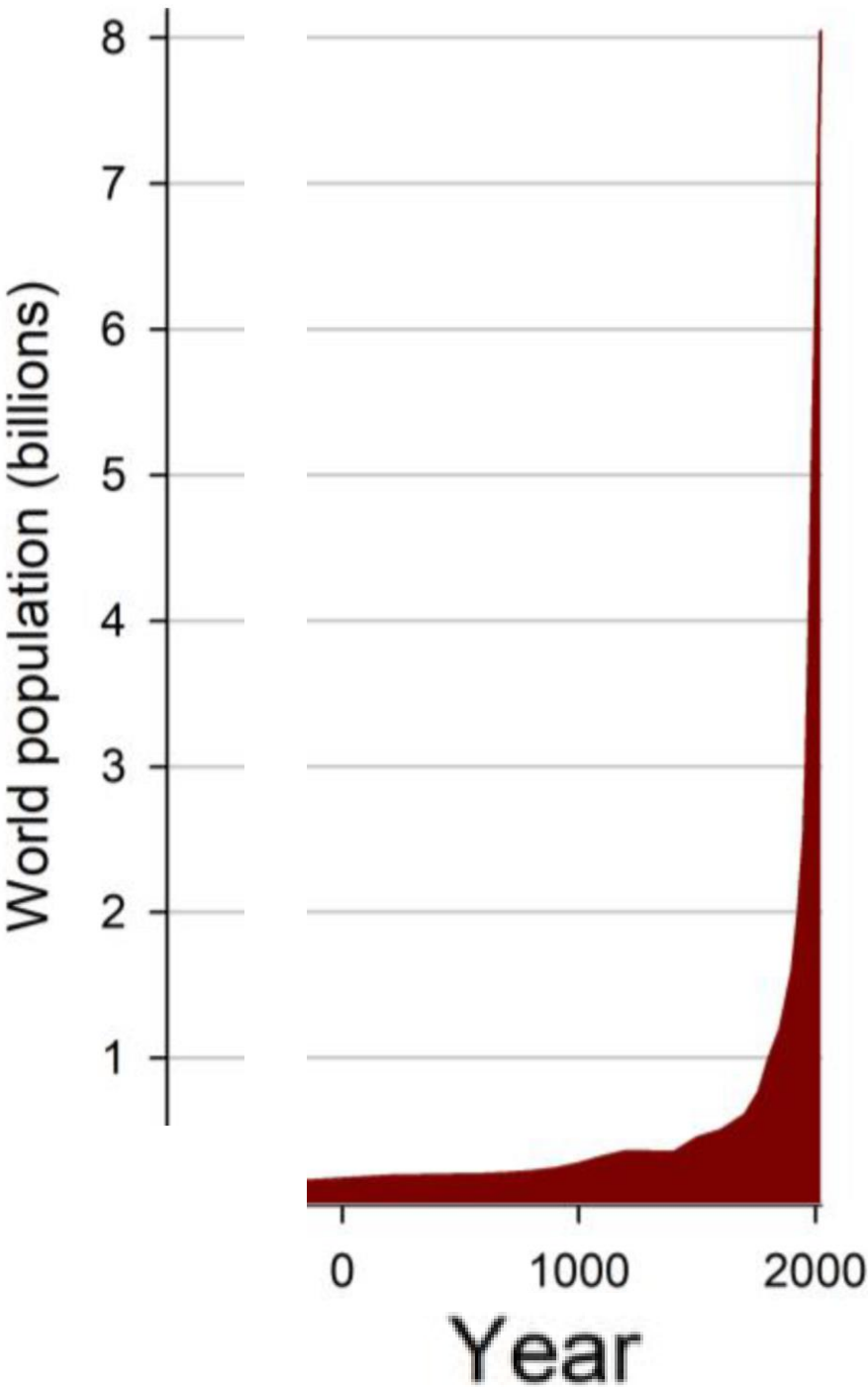
Scenarios

Global agricultural land area per capita in hectares of cropland and livestock pasture



Agricultural land per person has more than halved in the last 50 years.
This was the result of increased crop yields and agricultural productivity.

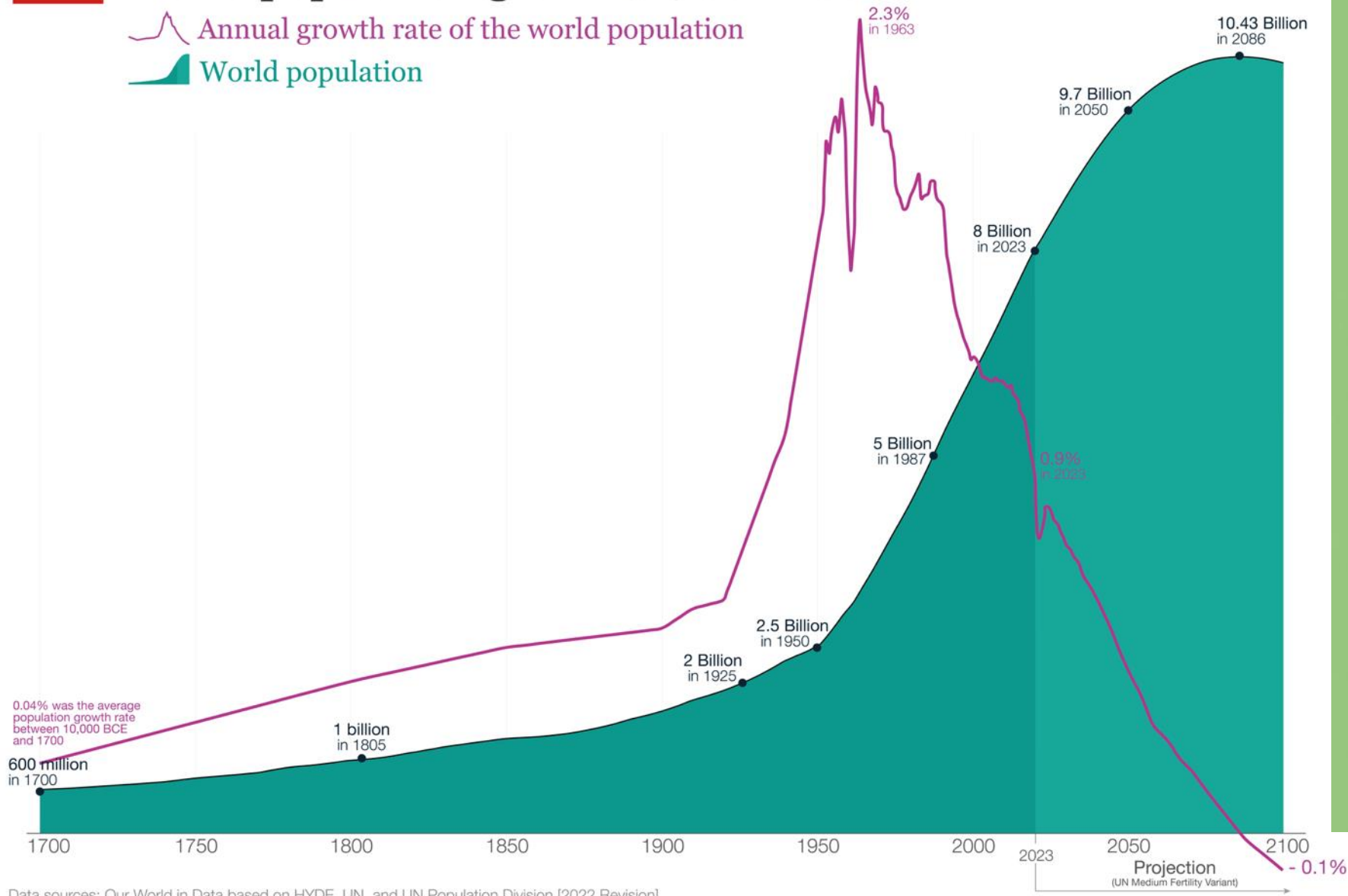
Data source: calculated from the History Database of the Global Environment (HYDE) and UN Population Division.



World population growth, 1700-2100

Annual growth rate of the world population

World population



Data sources: Our World in Data based on HYDE, UN, and UN Population Division [2022 Revision]
This is a visualization from OurWorldinData.org, where you find data and research on how the world is changing.

Licensed under CC-BY by the authors Max Roser and Hannah Ritchie.

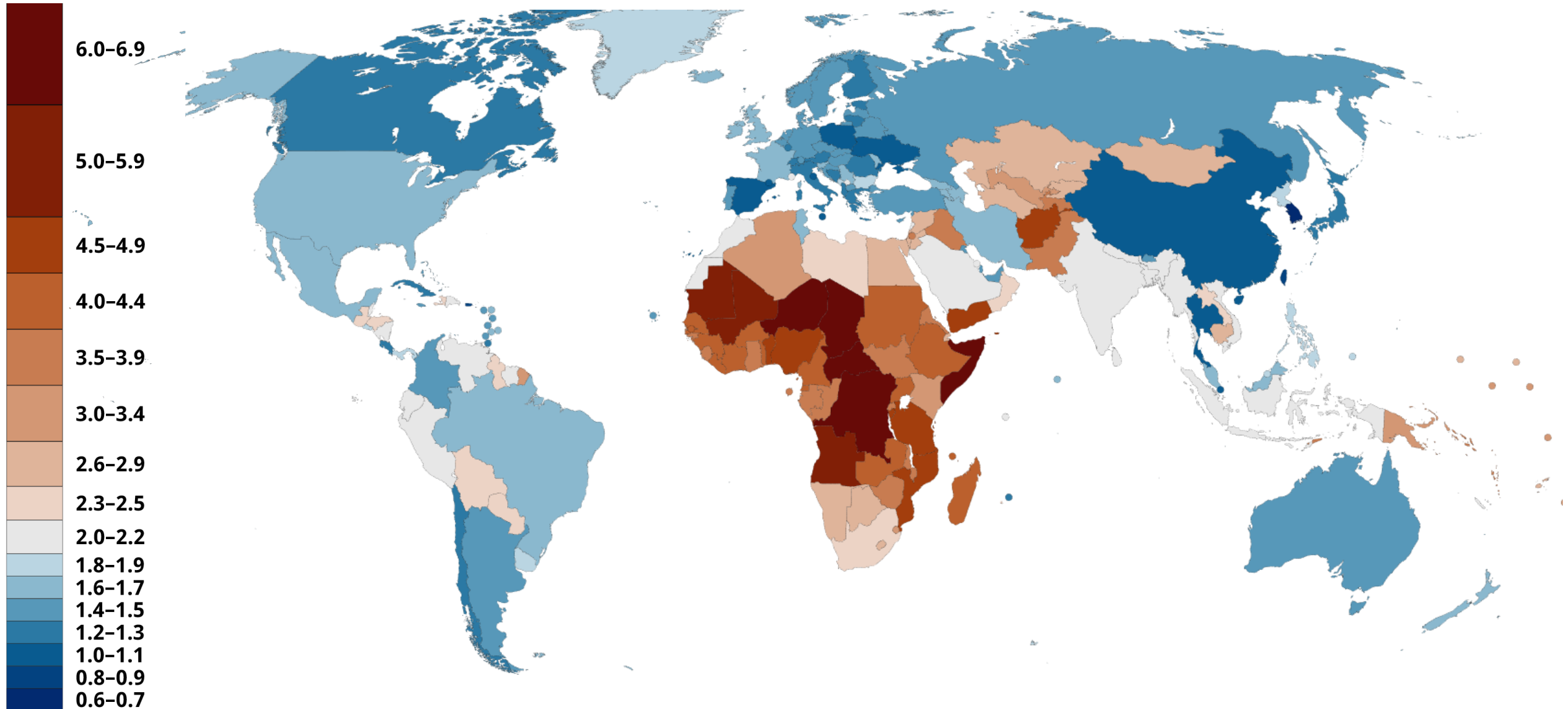
Slowdown

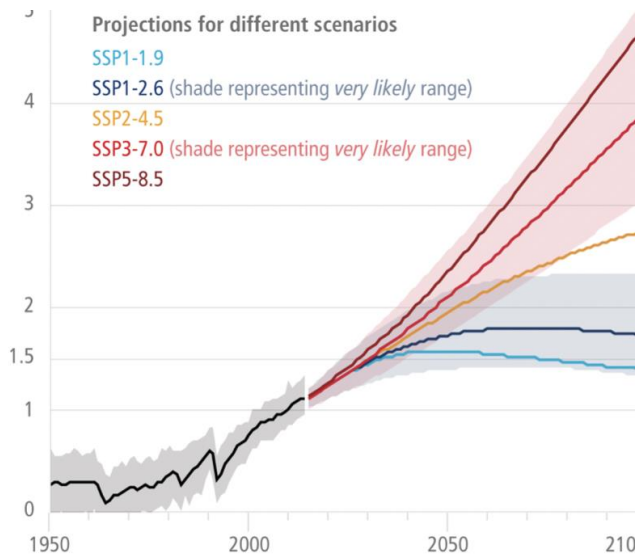
The End of the
Great Acceleration—
and Why It's Good for
the Planet, the Economy,
and Our Lives



Danny Dorling

By Korakys - Own work, CC BY-SA 4.0,
<https://commons.wikimedia.org/w/index.php?curid=92951369>





Adaptation

High

Low

High

Mitigation

Low

Origins Risks Scenarios

The School for Climate Studies



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@schoolforclimatestudies
<https://climate.sun.ac.za/>