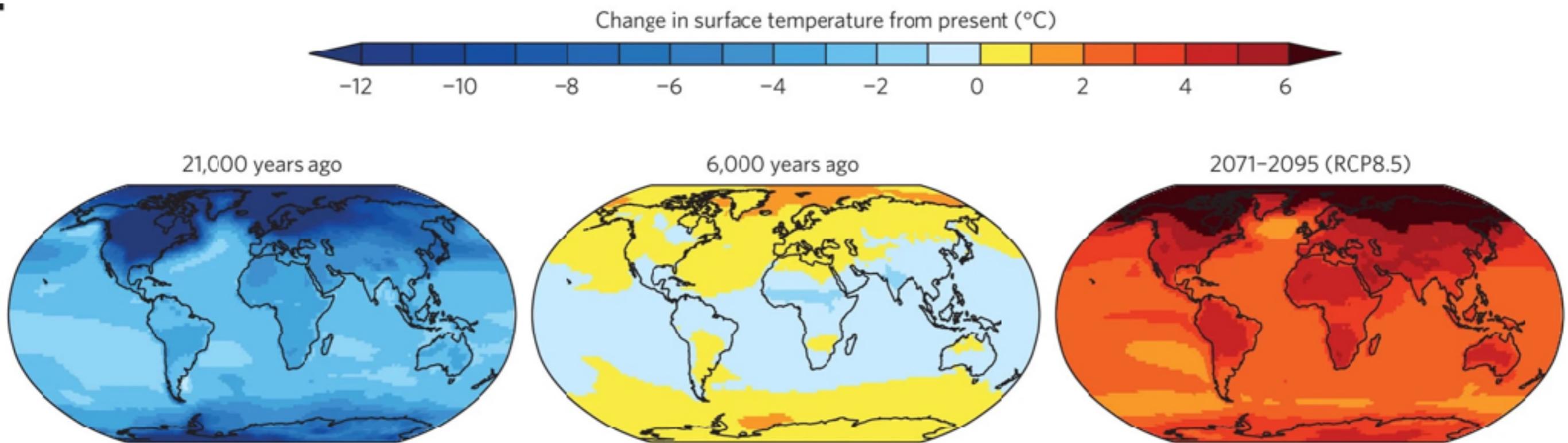


# Introduction to the Biosphere-Atmosphere system

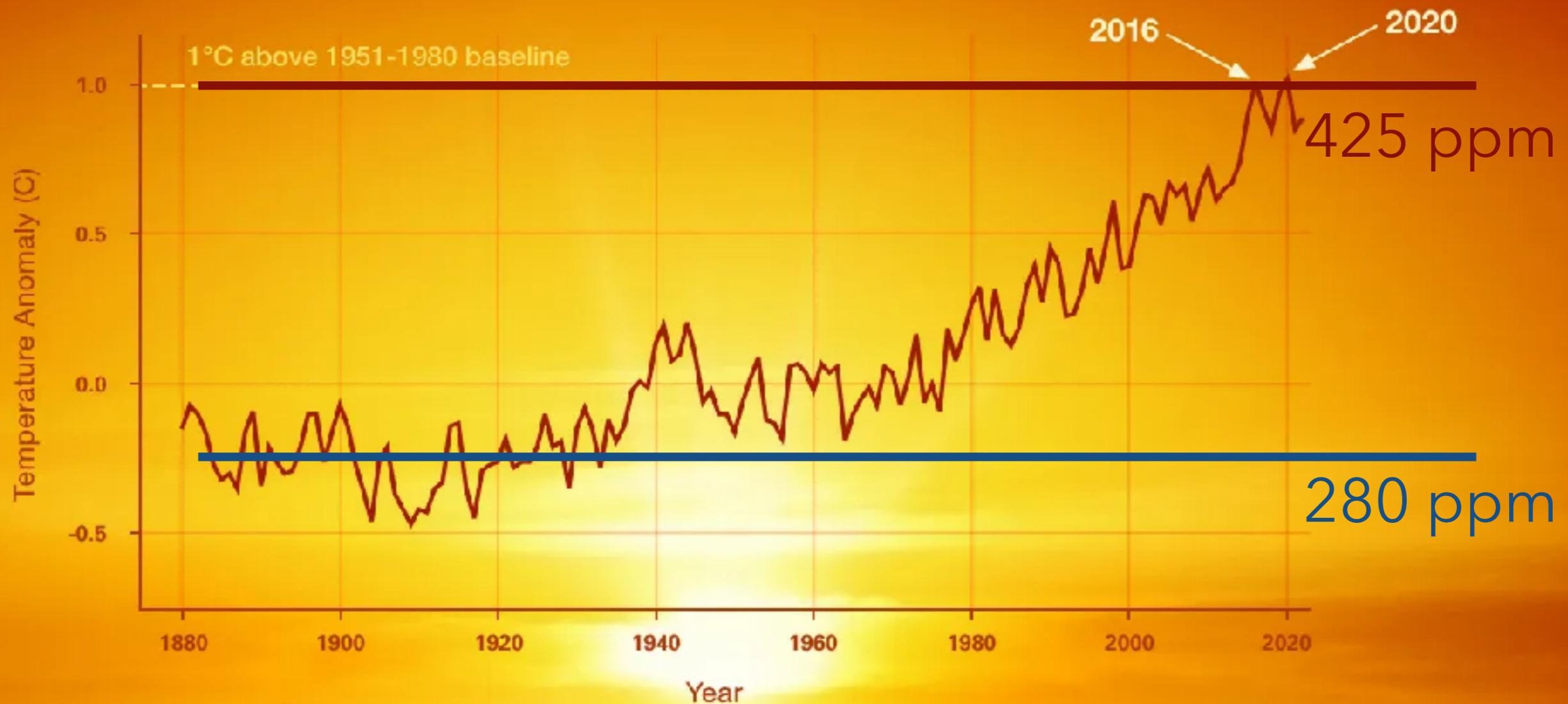
Lecture Autumn 2025

Steffen M. Noe

How can such a small amount of carbon dioxide in the atmosphere  
—only around 425 parts per million—cause so much warming?

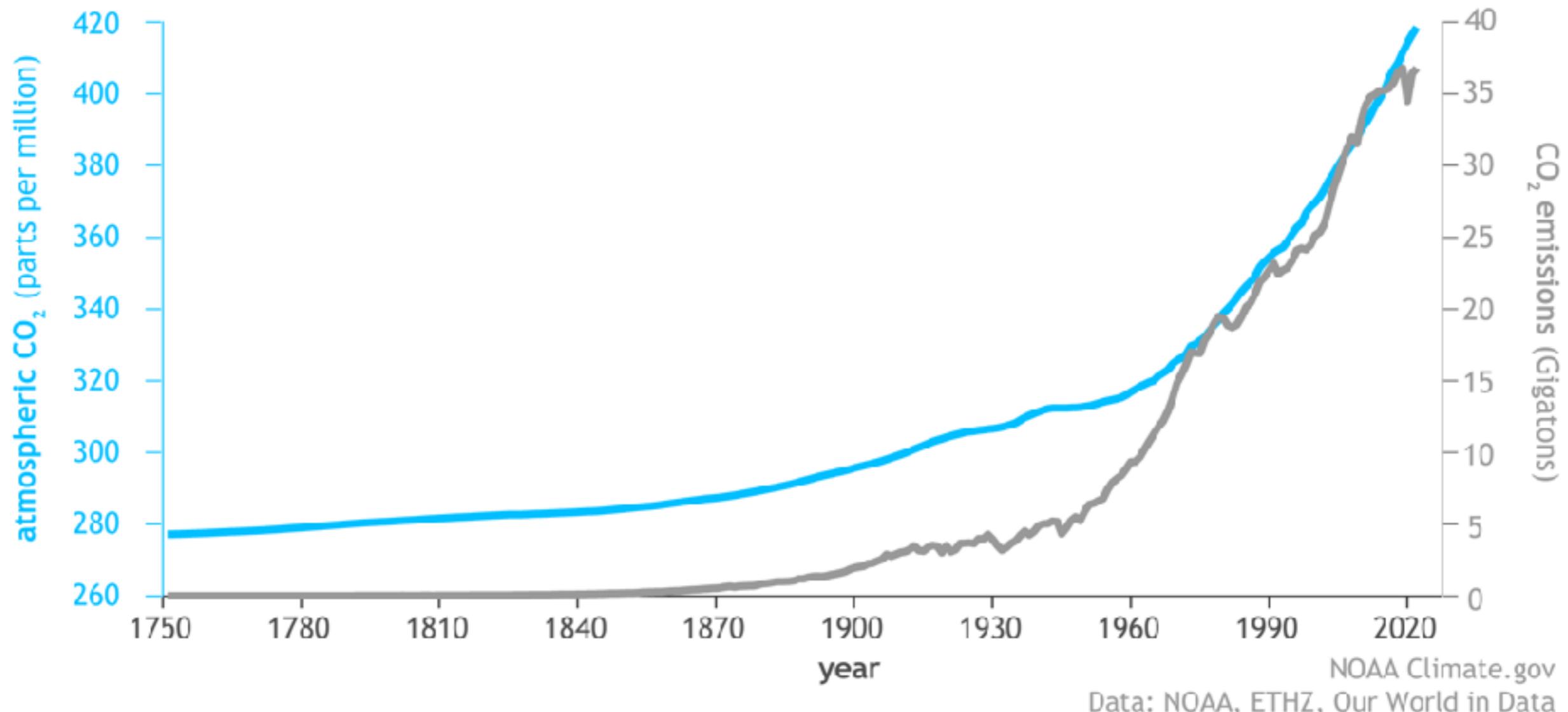


# Temperature anomaly by NASA data



# Pre-industrial to today

Global atmospheric carbon dioxide compared to annual emissions (1751-2022)



# The scale of the problem

pre-industrial (up to 1750 since the last ice age 10 000 years ago!) - **280 ppm**

today (August 2025) - **425 ppm**

This means that of every one million molecules in the atmosphere, 425 are CO<sub>2</sub>. It can be hard to imagine how a chemical compound that makes up such a small fraction of the atmosphere—less than 0.05%—can be responsible for so much global warming. Yet focusing on the fraction of CO<sub>2</sub> in the atmosphere can blind us to just how big a change this represents.

Small amounts of powerful substances have big effects.

First, we are more perceptive to the effects of small fractions than you might think.

**Consider your daily cup of coffee. Its power to raise your alertness, energy and heart rate comes from caffeine, which, by coincidence, is present at around 400 ppm.**

Let's check out what's the energy in a bread. It's carbohydrate, so carbon and water.

Link to the video: <https://www.dailymotion.com/video/x7uuskl>