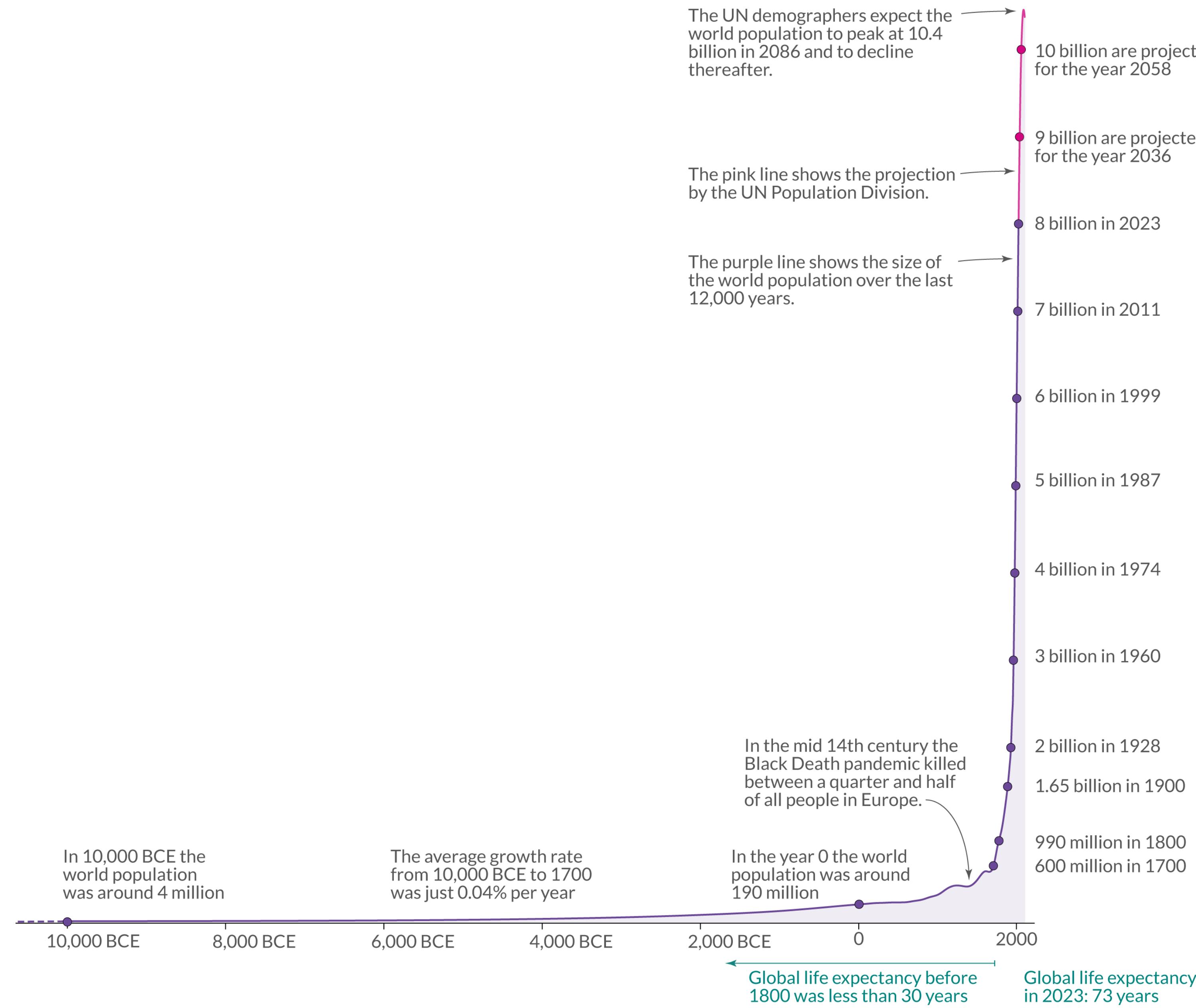


# **Exponential growth**

**Evolution & Ecology**

**Jacopo Grilli, Ciudad de Guatemala, 26/11/2025**

# The size of the world population over the long-run



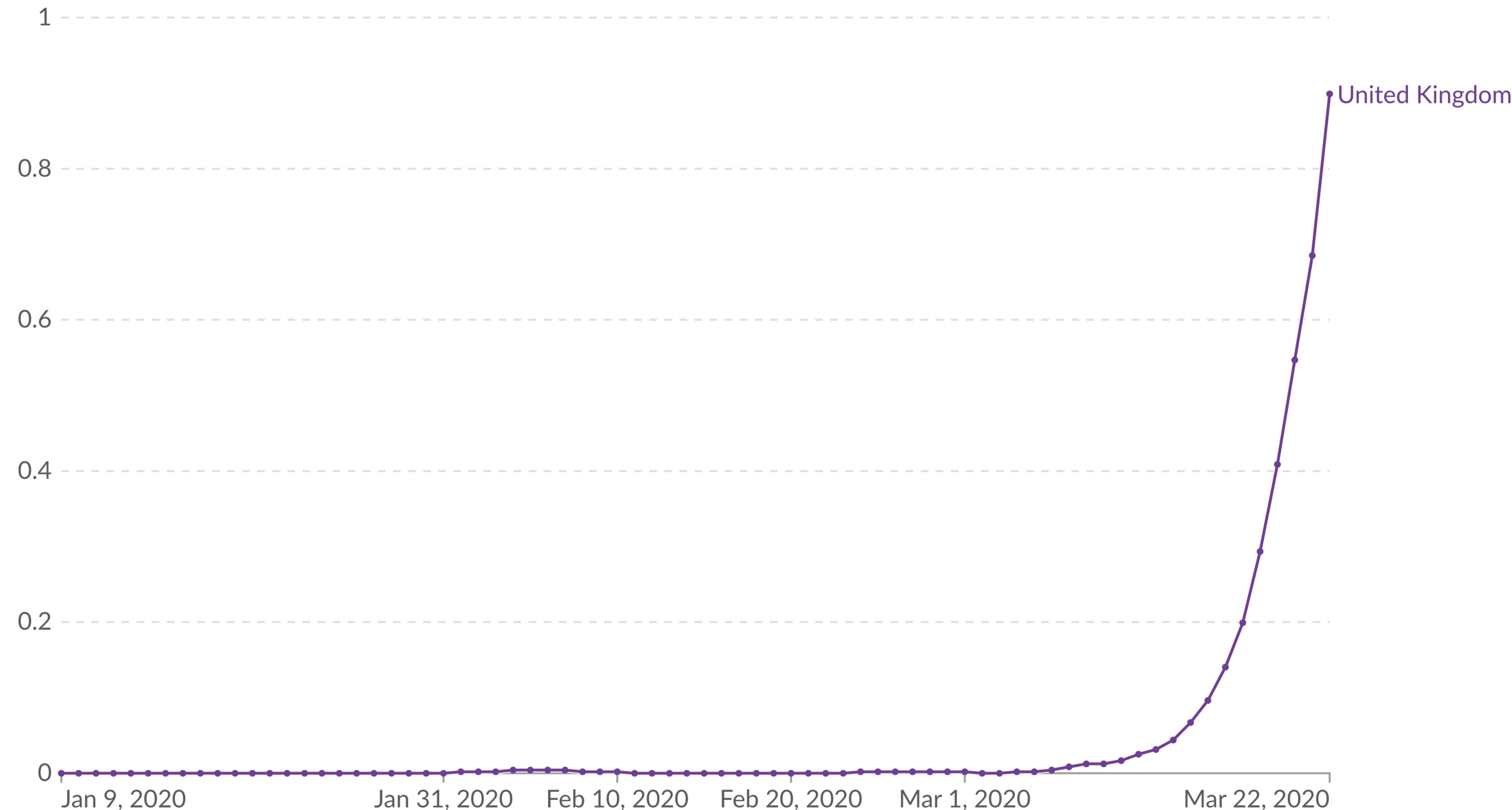
Based on estimates by the History Database of the Global Environment (HYDE) and the United Nations.

This is a visualization from [OurWorldInData.org](http://OurWorldInData.org).

Licensed under CC-BY-SA by the author Max Roser.

# Daily new confirmed COVID-19 deaths per million people, Jan 9, 2020 to Mar 22, 2020

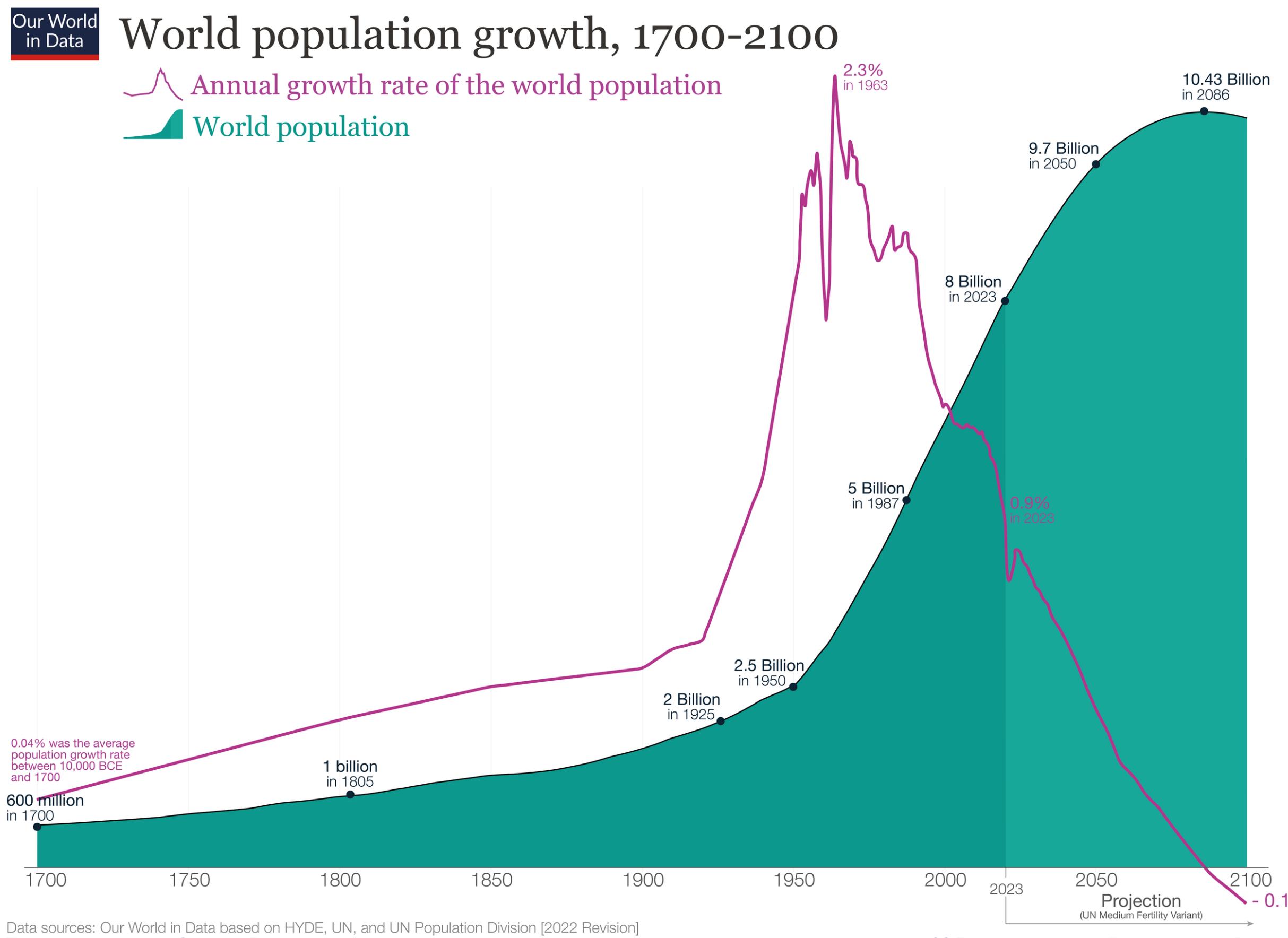
7-day rolling average. Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.



# Deterministic exponential growth

# What fraction ever-lived human is alive?

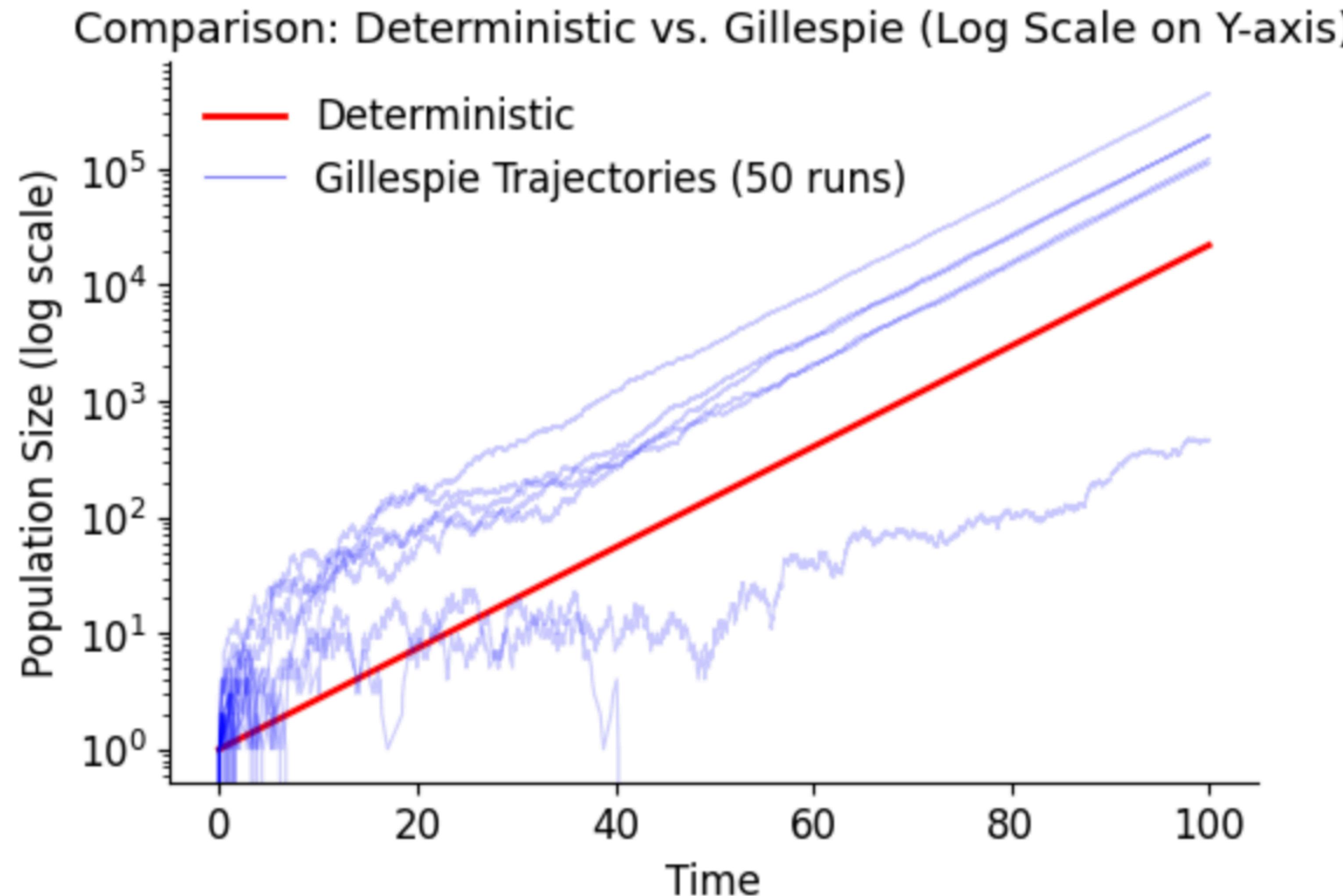
*Homo sapiens* appearing around 190,000 B.C.E.



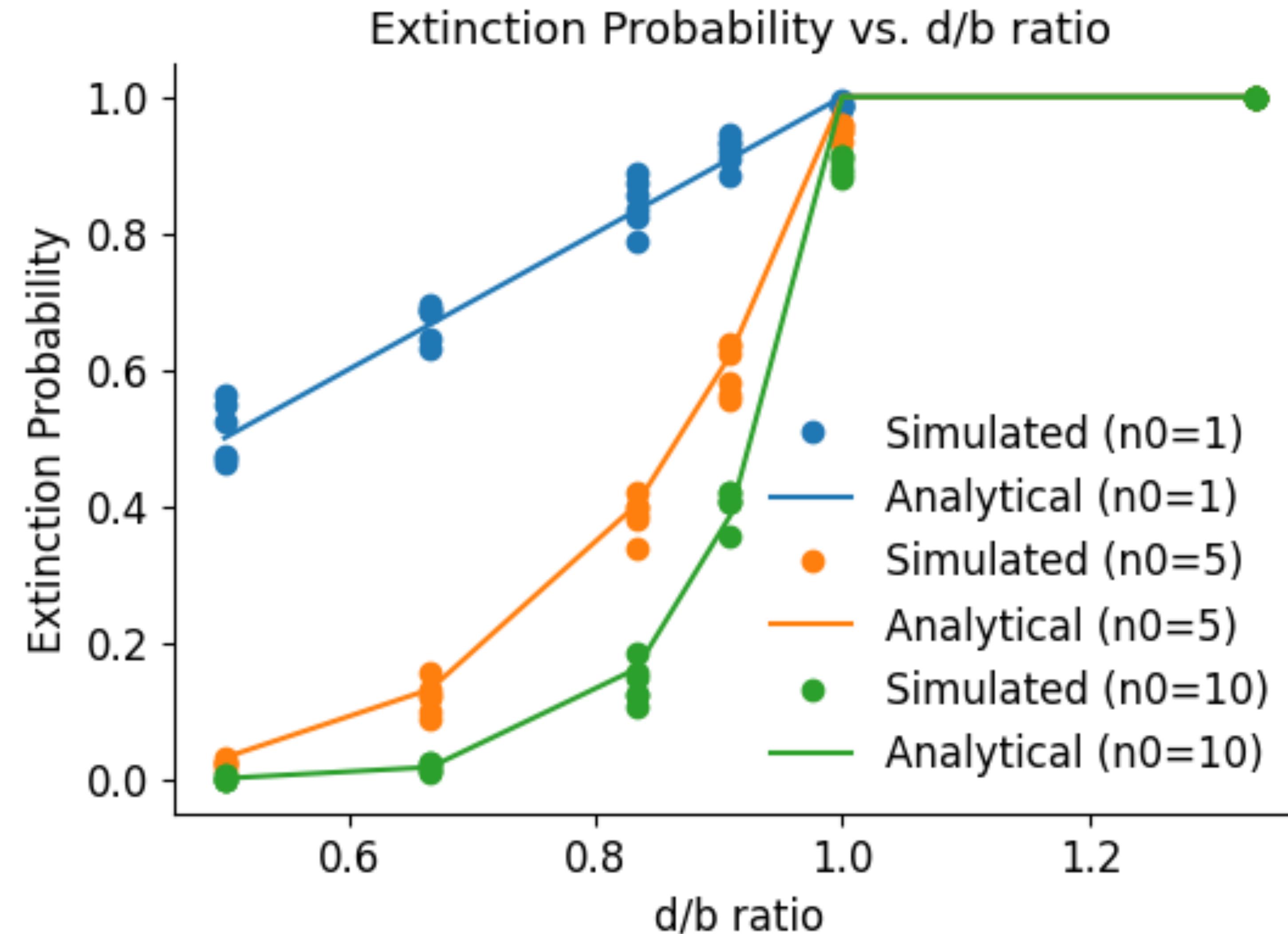
data in the notes

# Birth-death process

# Trajectories differ from the average

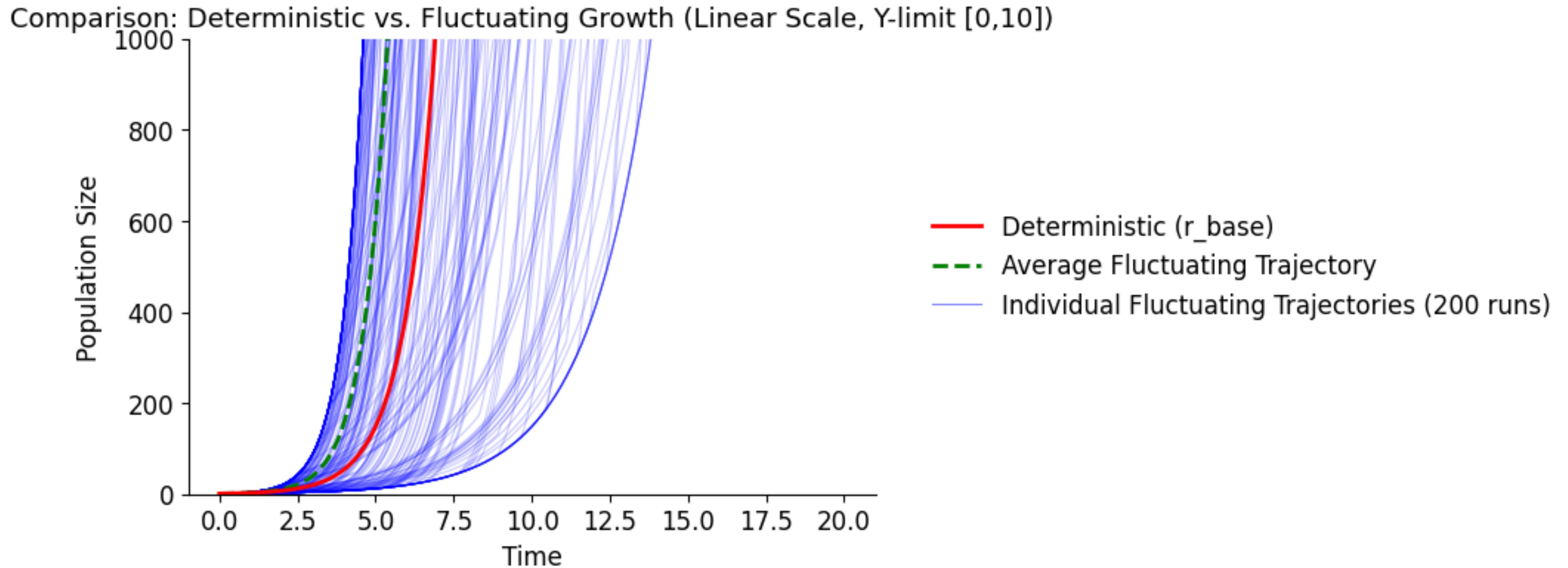


# Extinction probability



# **Exponential growth in random environments**

# The average is not the typical



# The average is not the typical

Comparison: Deterministic vs. Fluctuating Growth (Log Scale on Y-axis)

