

Comando Militar do Sul Painel sobre Meio Ambiente

Uma visão internacional e nacional
sobre o meio ambiente:

Aquecimento Global, Considerações e Estratégias



NELSON FERREIRA FONTOURA
PUCRS – INSTITUTO DO MEIO AMBIENTE

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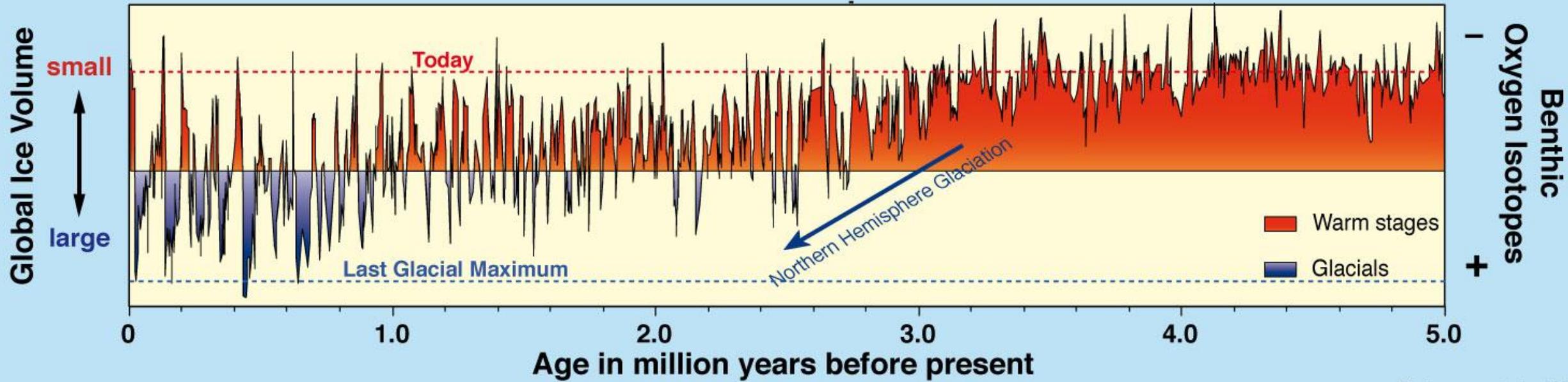
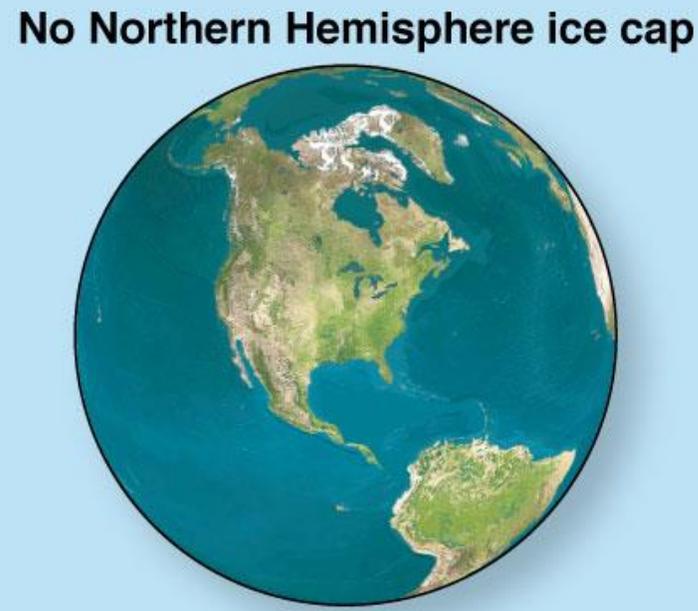
Climatic Change: Are We on the Brink of a Pronounced Global Warming?

Wallace S. Broecker¹

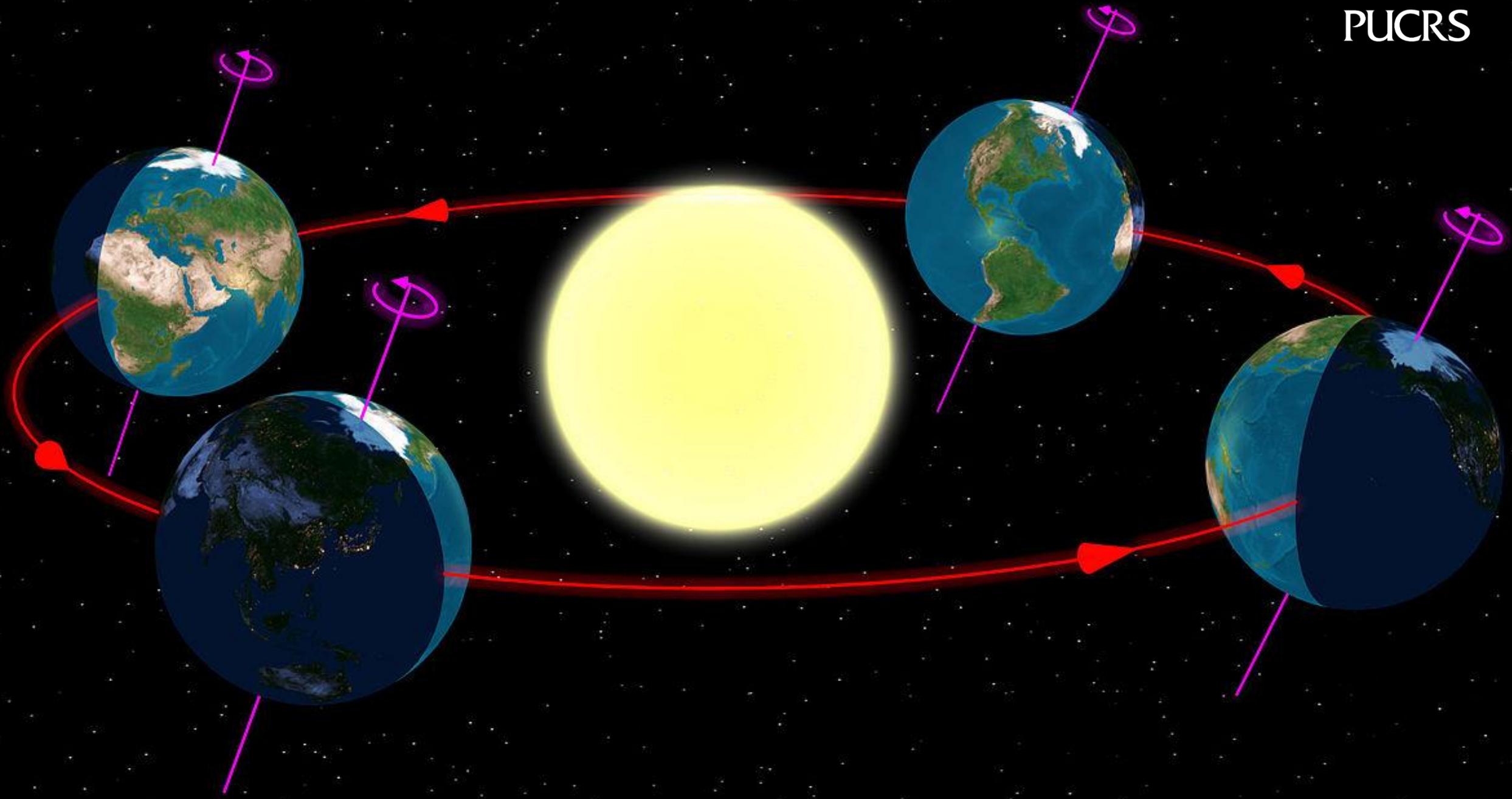
+ See all authors and affiliations

Science 08 Aug 1975:
Vol. 189, Issue 4201, pp. 460-463
DOI: 10.1126/science.189.4201.460

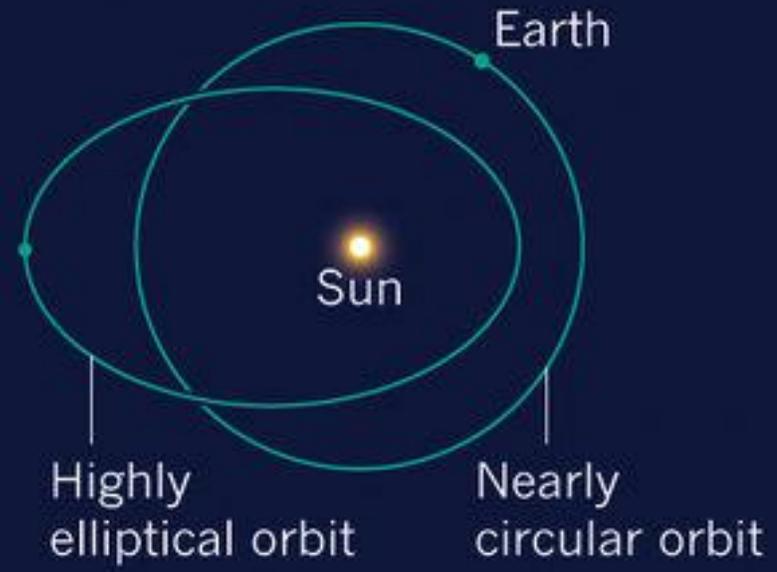
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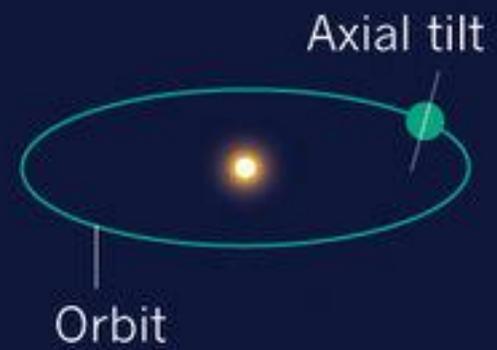
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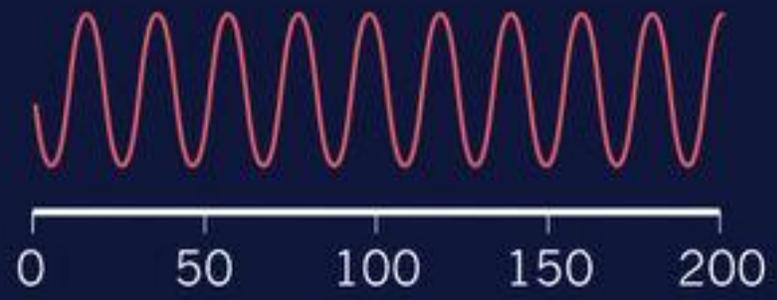
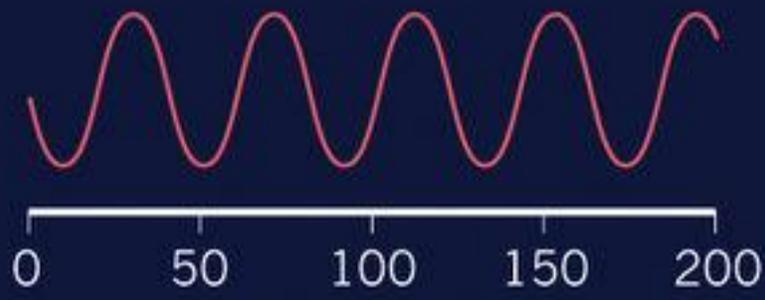
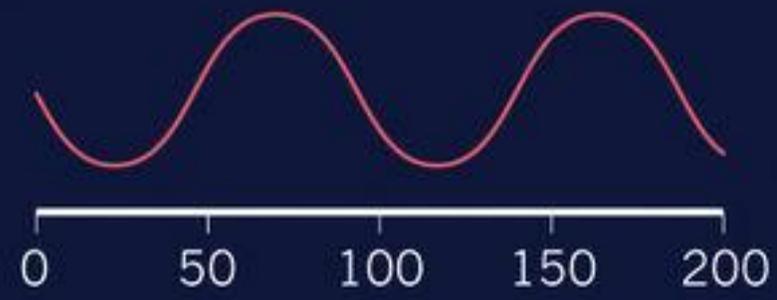
a Eccentricity



b Obliquity

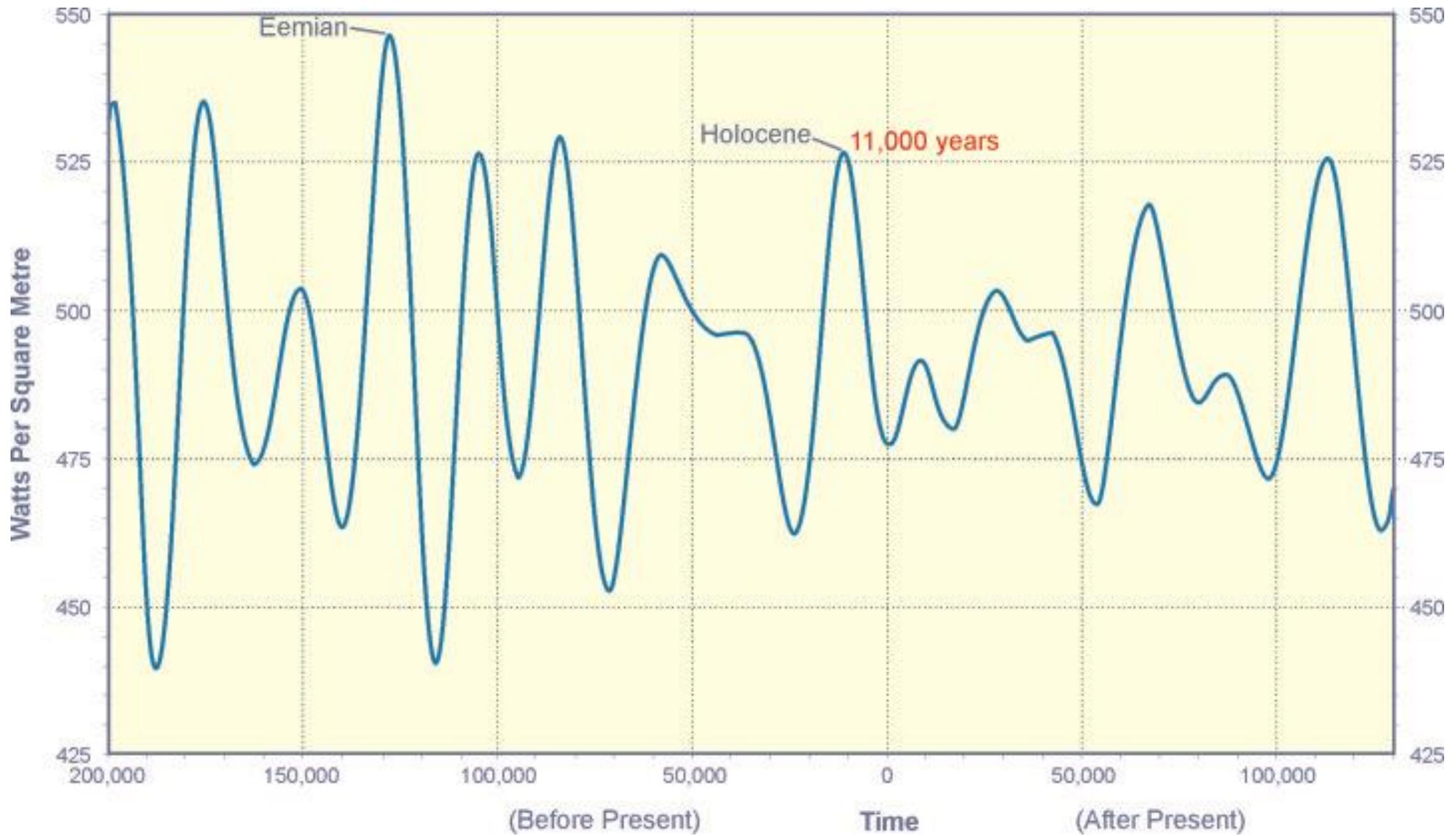


c Precession



Thousands of years

Milankovitch cycles. Nature 540, 208–210, (08 December 2016)



June Mid-Month Insolation at 65° North
(<https://wattsupwiththat.com/2009/02/23/ice-ages-and-sea-level/>)

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Solar Cycles 1749 - 2040

← Modern Warm Period →

<https://wattsupwiththat.com/2014/03/03/the-sun-wakes-up-highest-values-of-solar-cycle-24-observed-in-february-2014/>

Solar Cycle Amplitude (Wolf Number)

250
200
150
100
50
0

1749 1799 1849 1899 1949 1999

Dalton Minimum

End of Little Ice Age

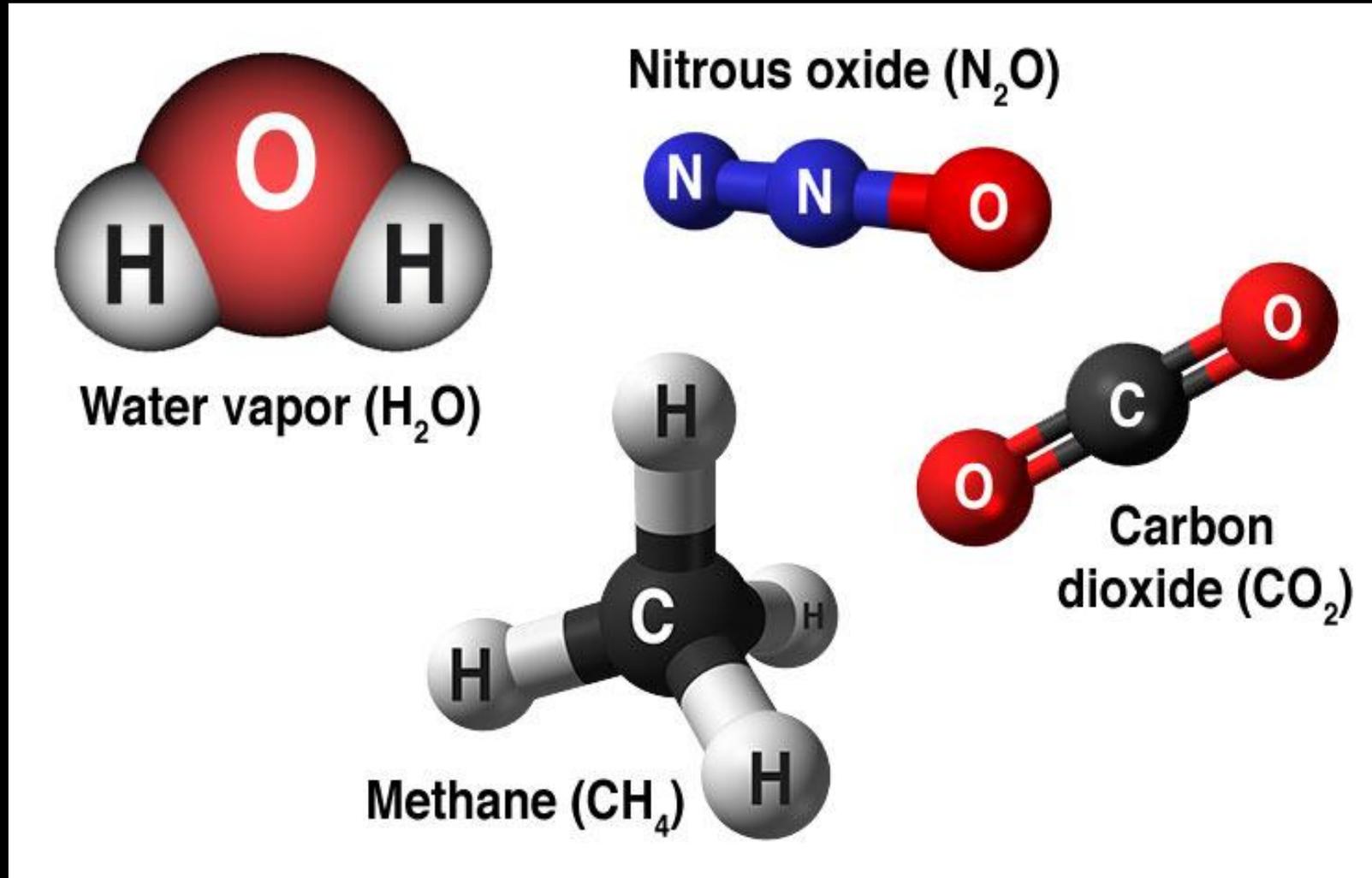
Projected

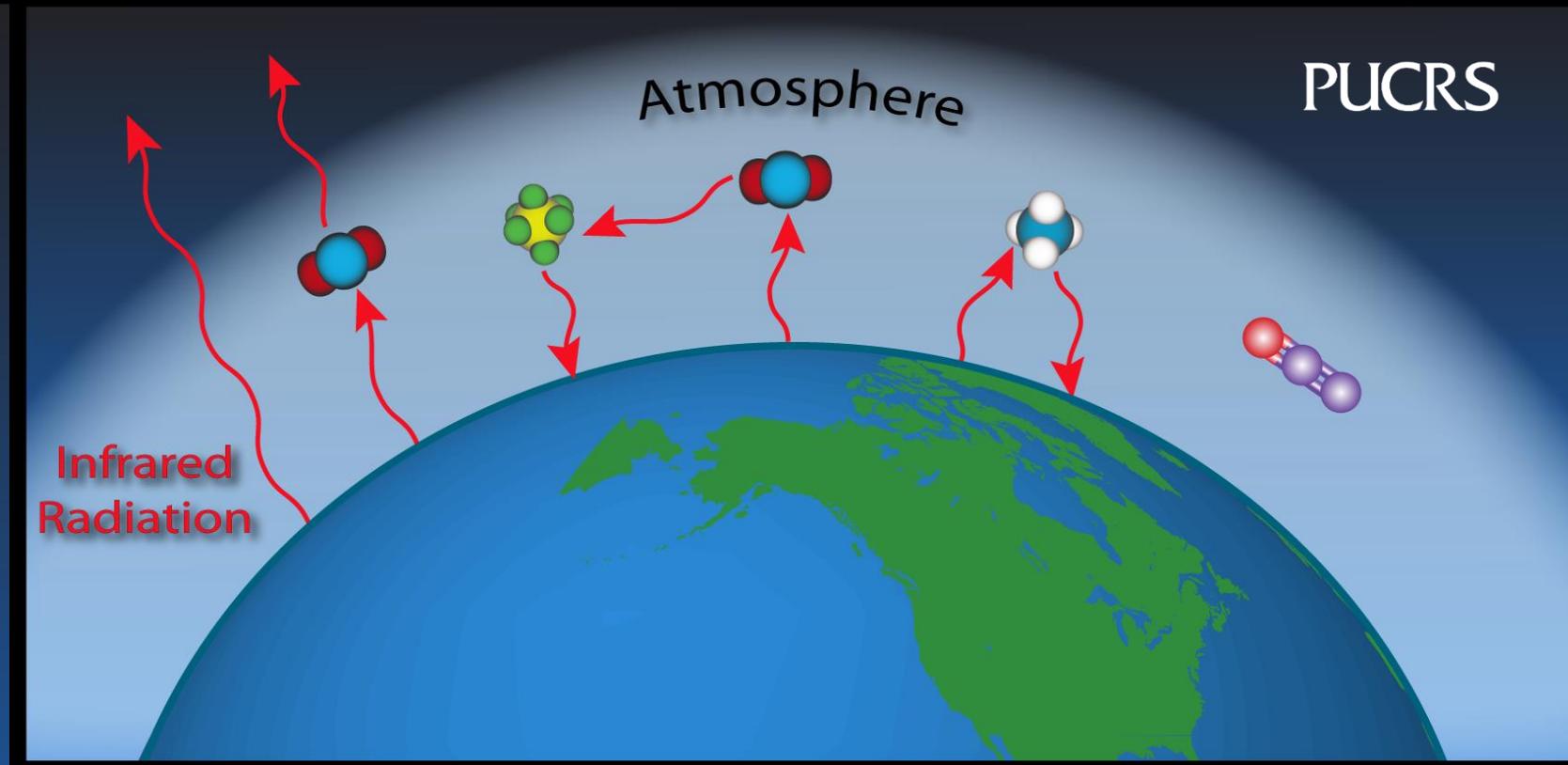
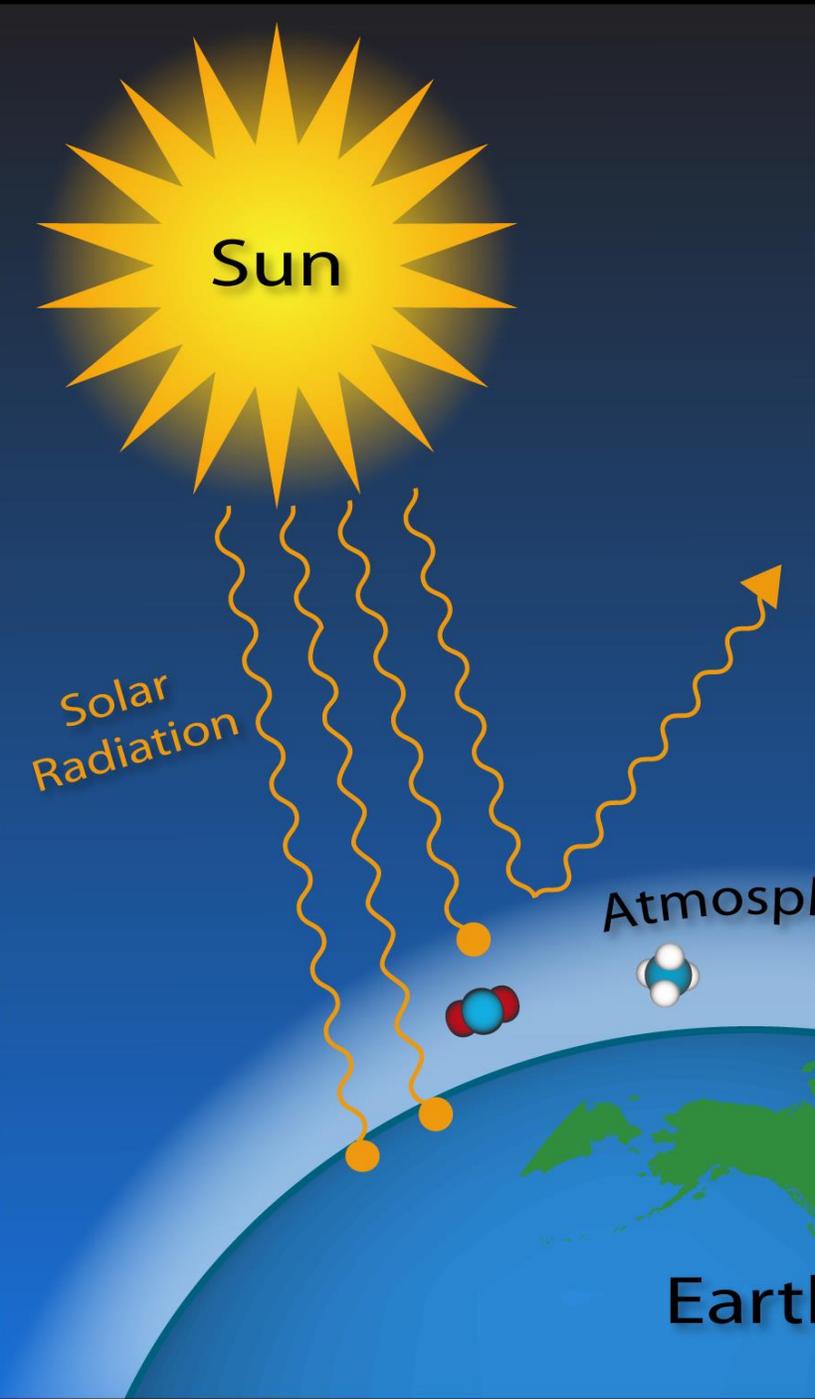
24

25

23

E os famosos gases estufa?



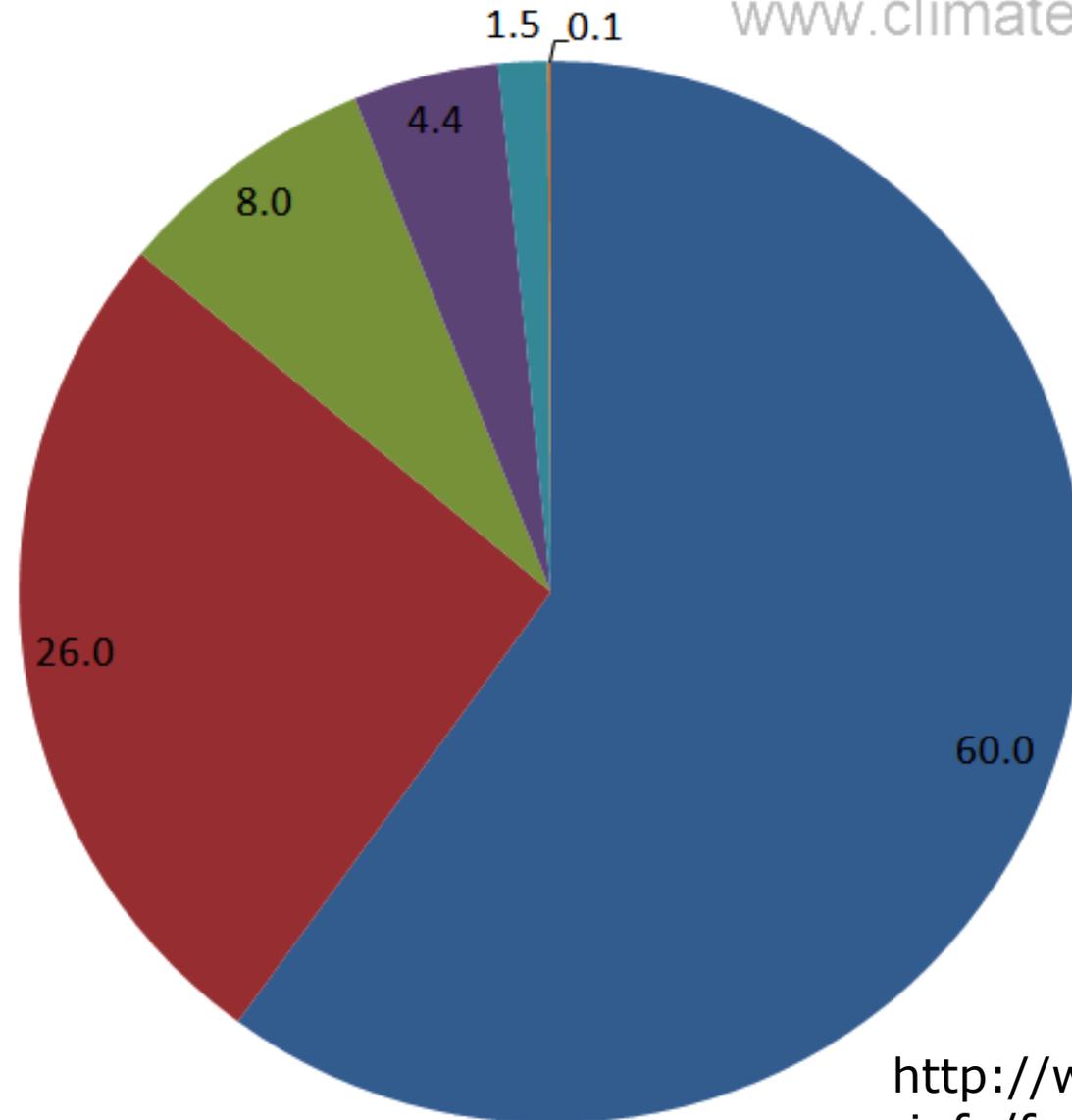


https://www.esrl.noaa.gov/gmd/ outreach/carbon_toolkit/basics.html

Percentage contribution to greenhouse effect

■ Water vapour and clouds ■ arbon dioxide (CO2) ■ Ozone (O3) ■ Methane (CH4) ■ N2O ■ Others

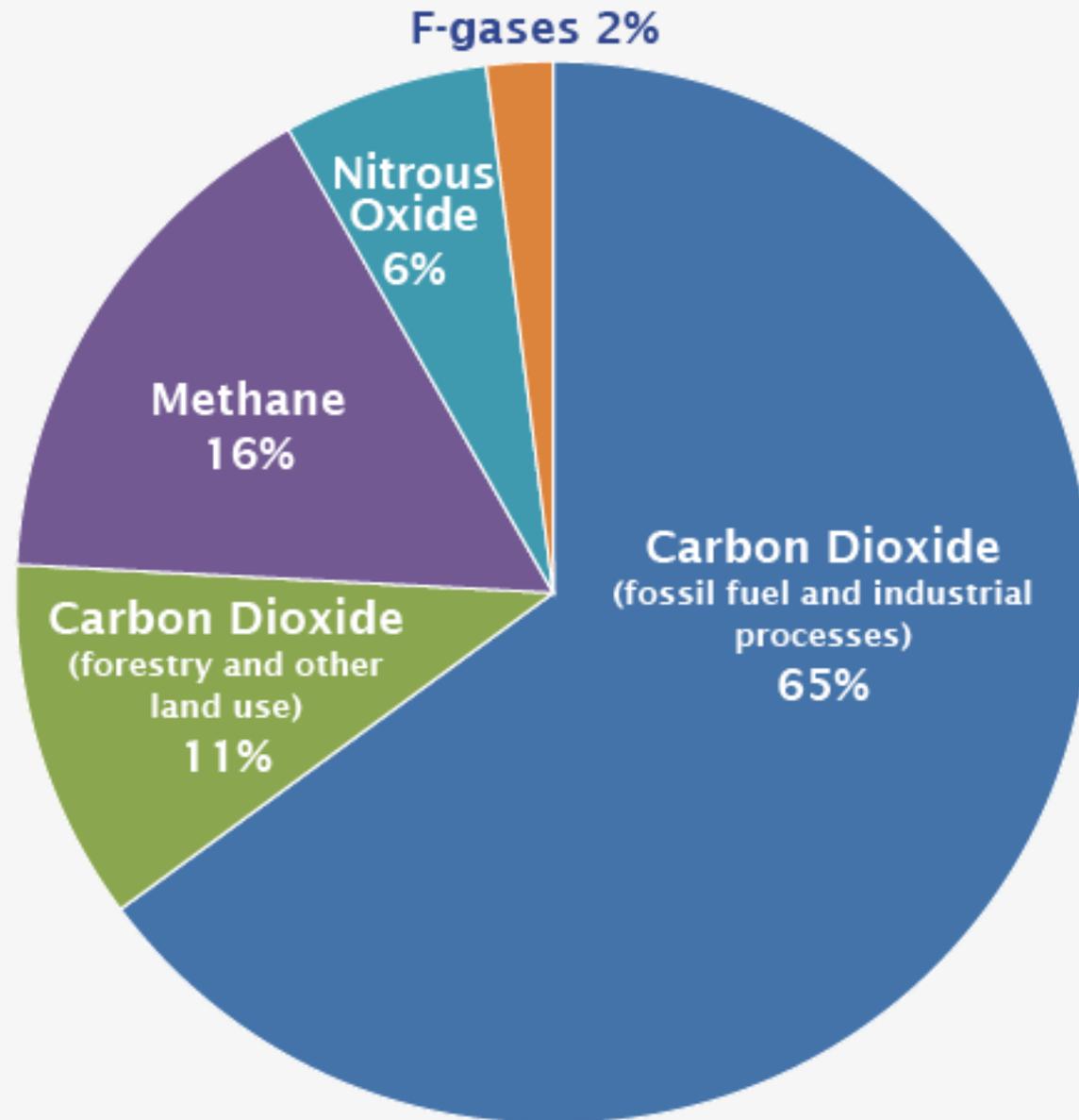
www.climatedata.info



<http://www.climatedata.info/forcing/gases/>

Global Greenhouse Gas Emissions by Gas

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<https://www.epa.gov/ggmissions/global-greenhouse-gas-emissions-data>

Carbon dioxide and the **temperature of our planet** from 800,000 years ago until the present day

The year "0" corresponds to the year 2020

Carbon dioxide concentrations are in units of parts per million

Temperature is the difference compared to the average temperature of the past 1000 years in units of degrees Celsius

Figure compiled from the following data sources

Ice core records from Antarctica: http://www.ncdc.noaa.gov/paleo/icecore/antarctica/domec/domec_epica_data.html

Current carbon dioxide measurements from NOAA: <http://www.esrl.noaa.gov/gmd/ccgg/trends/>

Current temperature from NASA: http://data.giss.nasa.gov/gistemp/graphs_v3/

In 2014, CO₂ is about 400 ppm

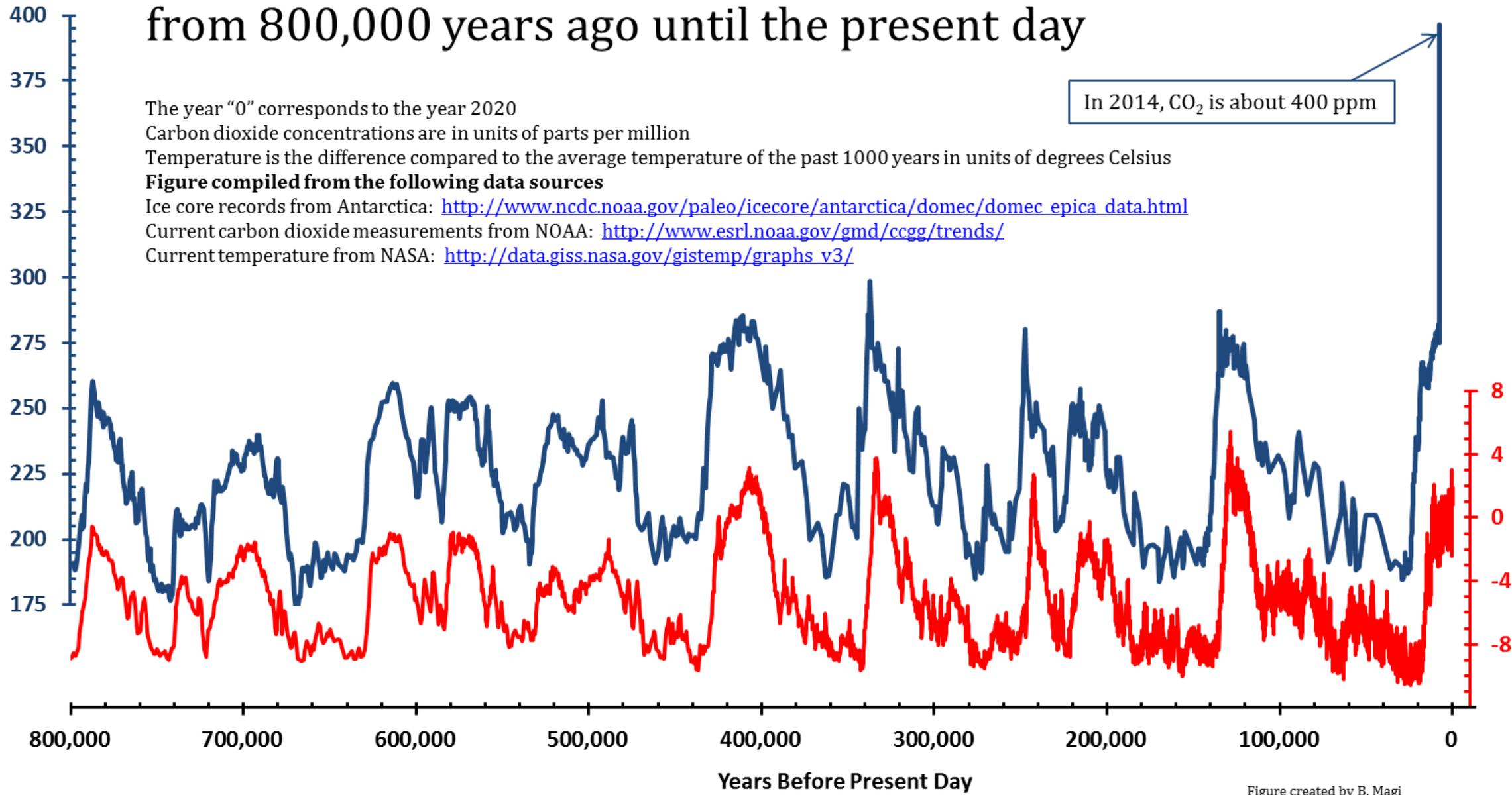
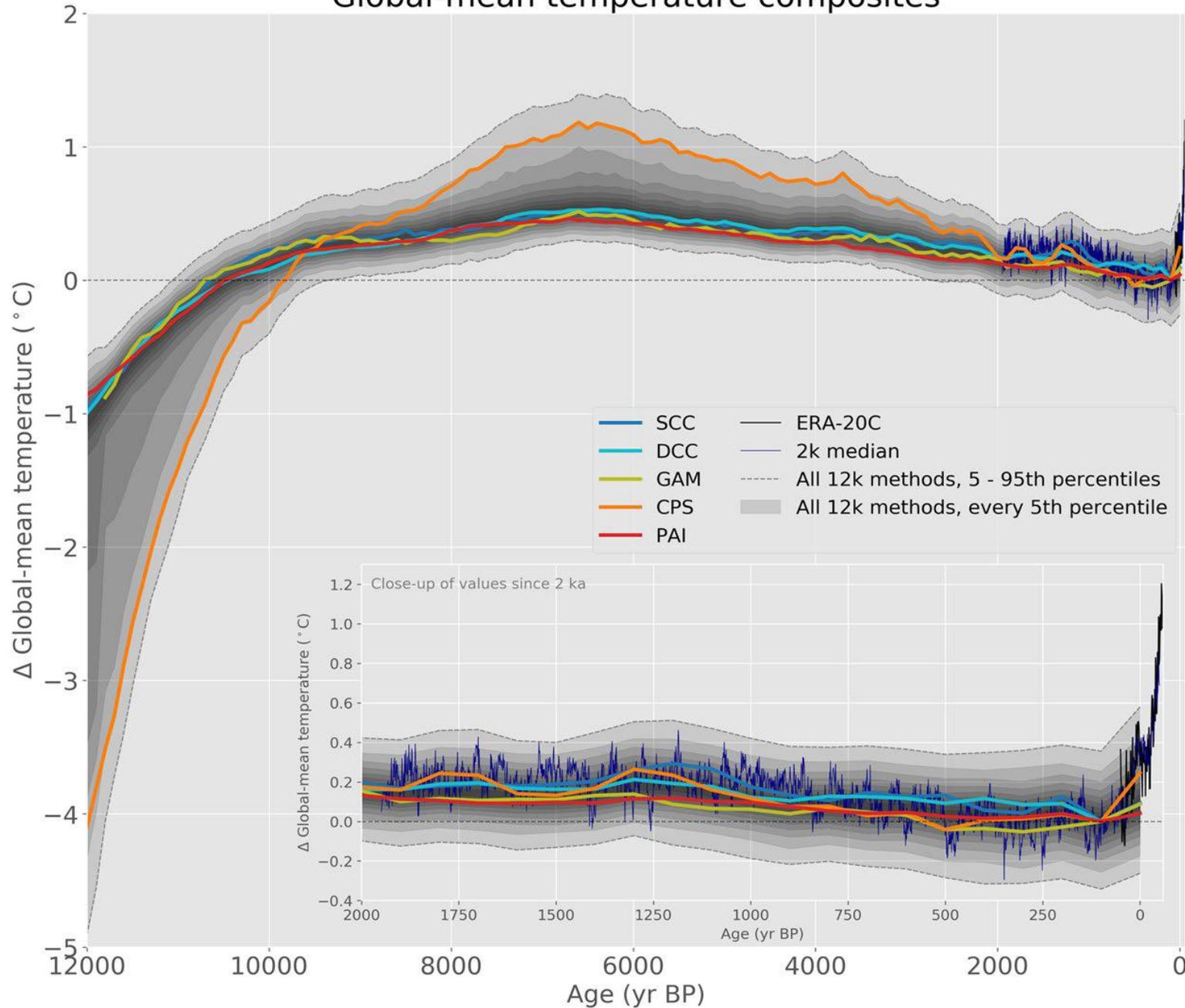


Figure created by B. Magi

Global-mean temperature composites



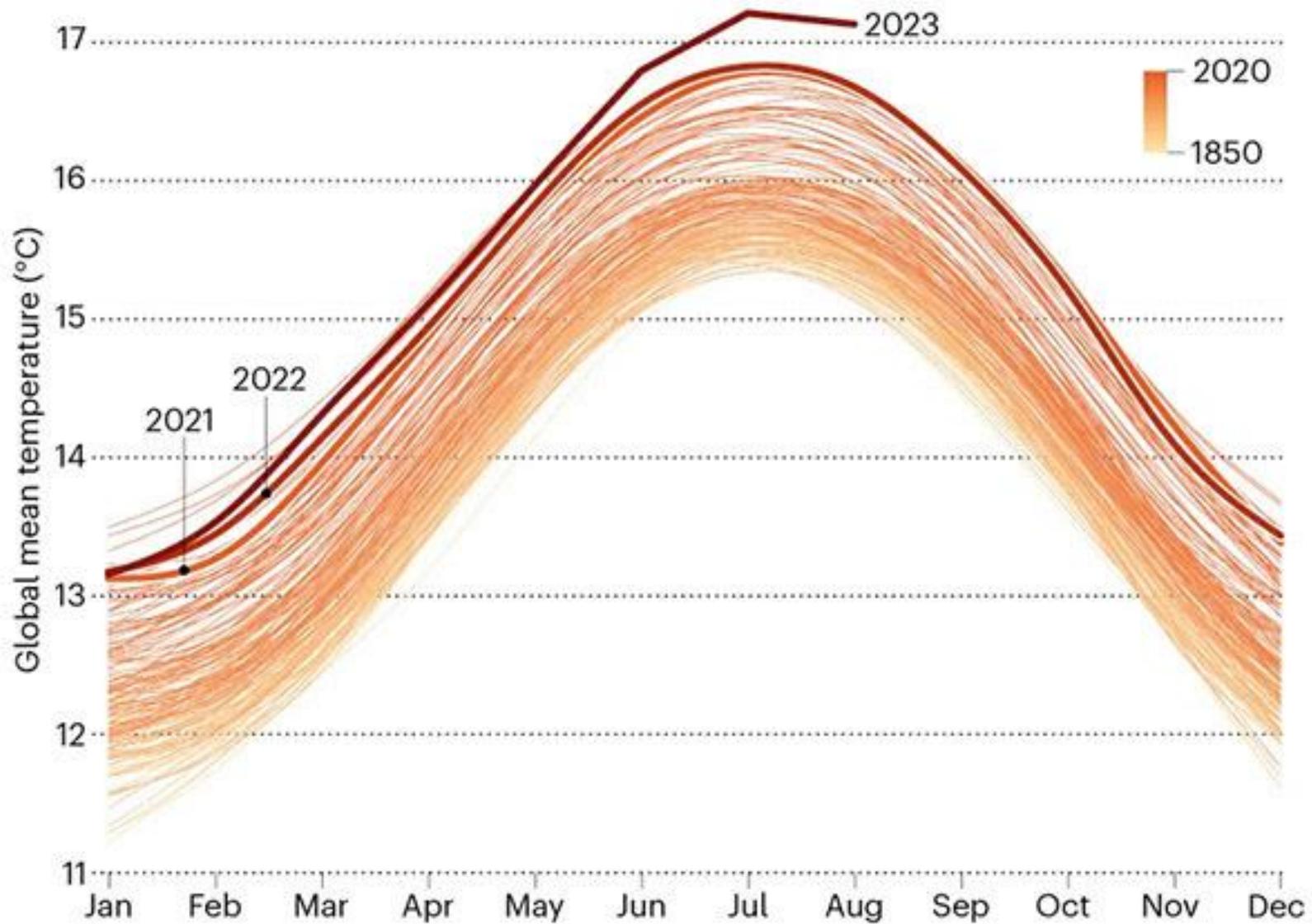
Kaufman, *et al.* Holocene global mean surface temperature, a multi-method reconstruction approach. *Sci Data* **7**, 201 (2020).

Fig. 3 Global mean surface temperature from the Temperature 12k database using different reconstruction methods. The fine black line is instrumental data for 1900–2010 from the ERA-20C reanalysis product²⁶. The inset displays an enlarged view of the past 2000 years.

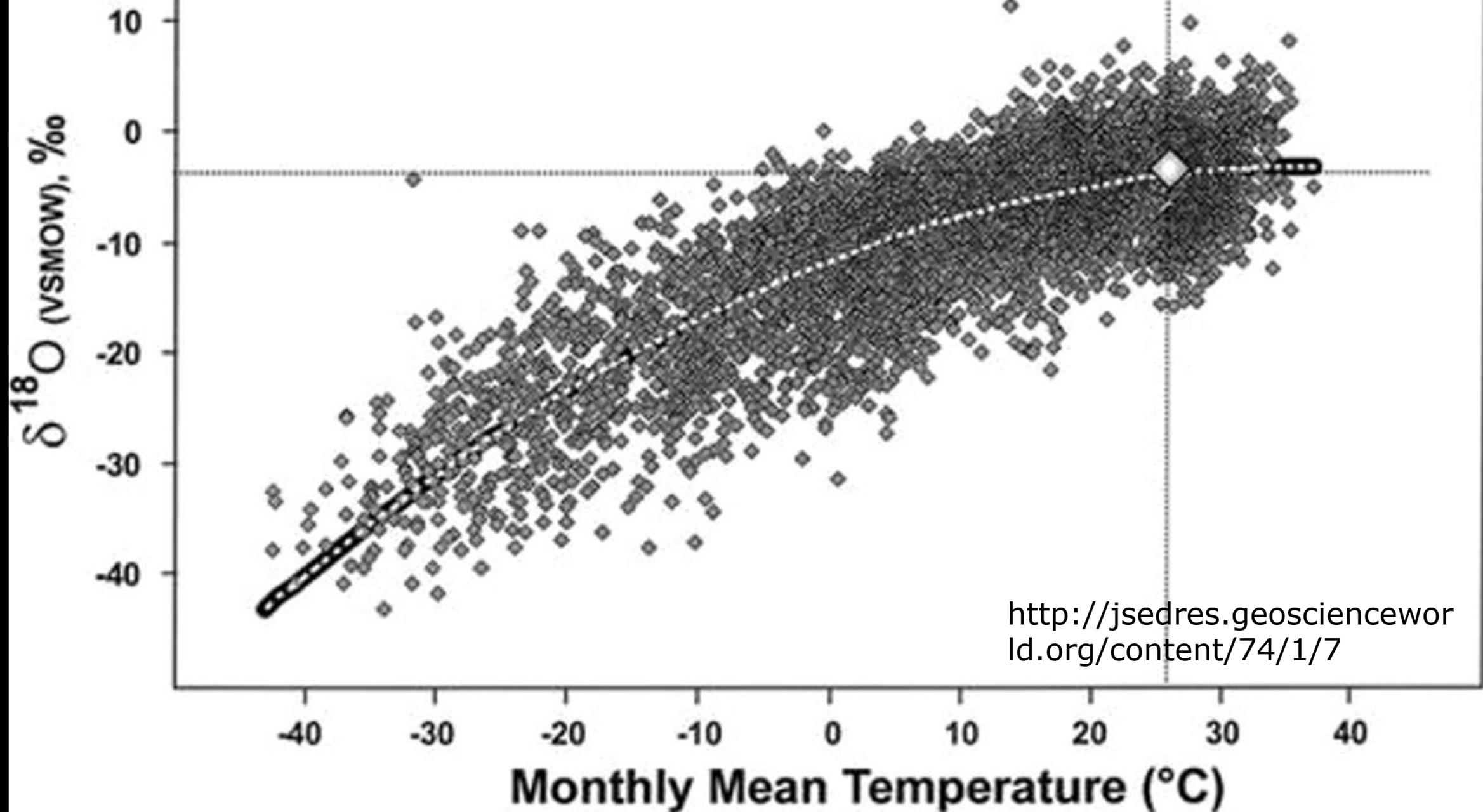
HEAT RISING

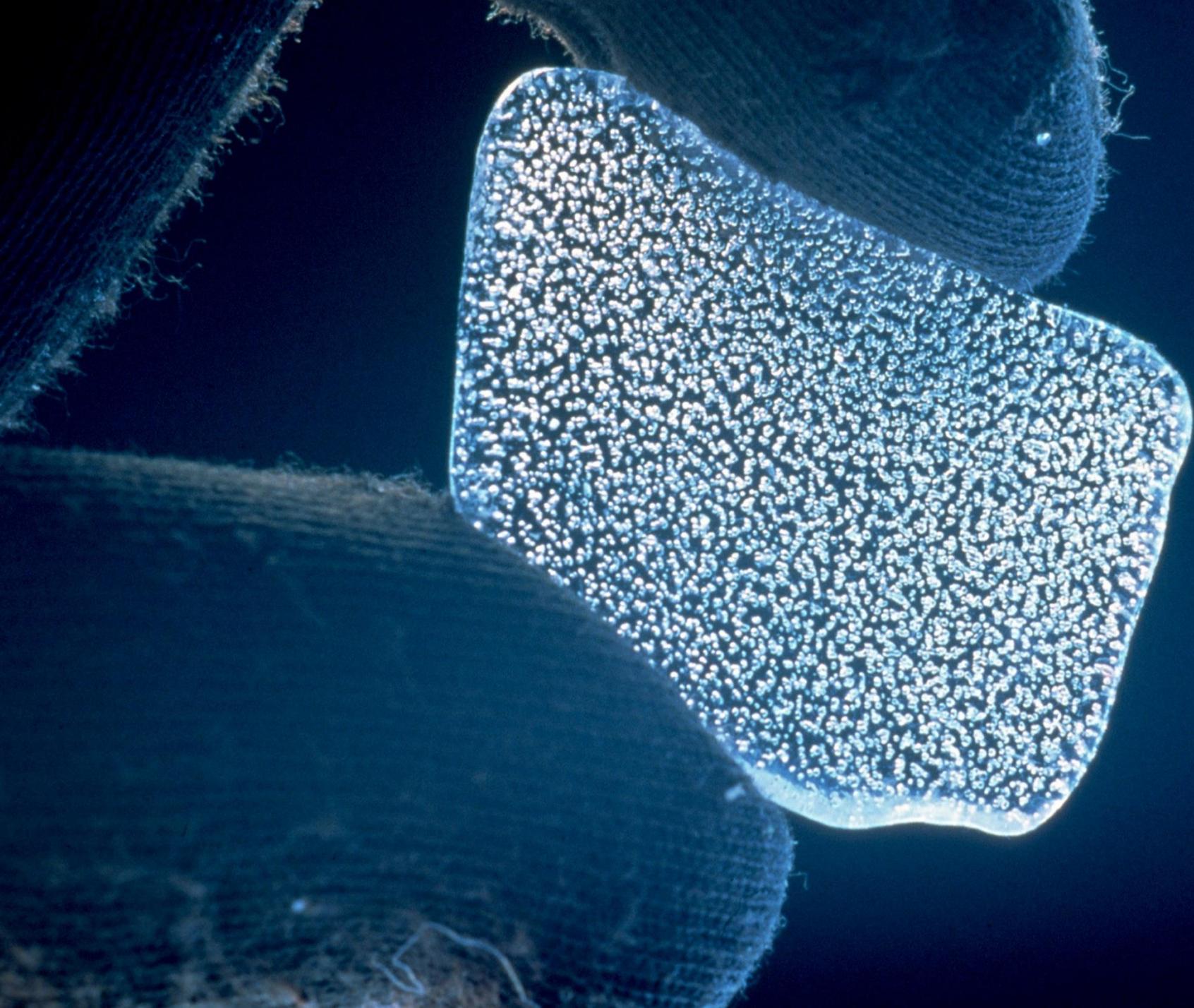
Nature, 25/09/2023

The global average temperatures in the past three months have set new records every month, often by a large margin.



$$\text{Precip } \delta^{18}\text{O} = (-0.0063 \text{ Temp}^2) + (0.4621 \text{ Temp}) - 11.384$$

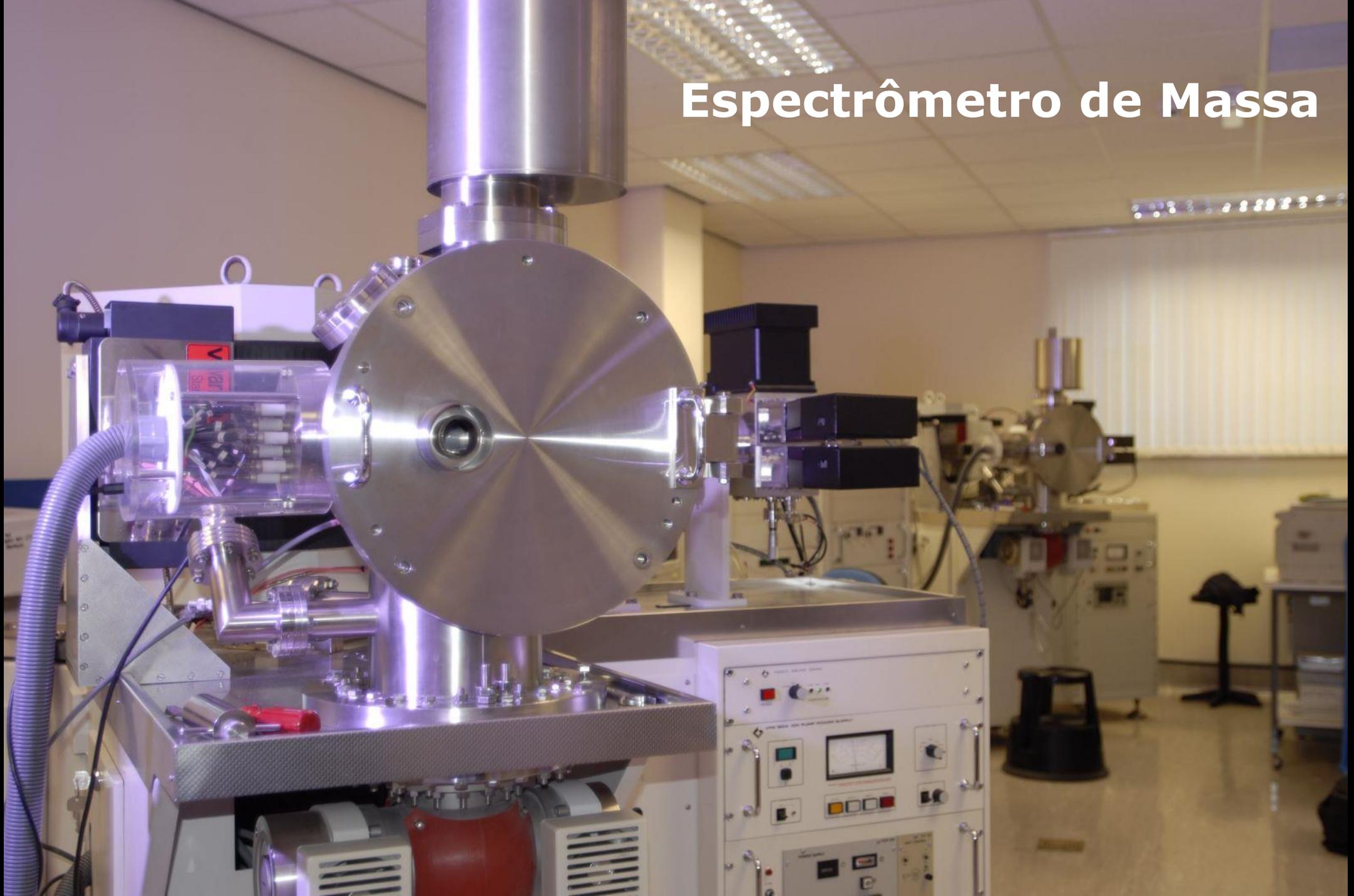








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Is Global Warming Causing More, Larger Wildfires?

Steven W. Running*

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Science 18 Aug 2006:
Vol. 313, Issue 5789, pp. 927-928
DOI: 10.1126/science.1130370

2006

Califórnia, 2021

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Pantanal, 2022

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Canadá, 2023



Ilha Maui, Havai, 2023



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Uncertainty in Hurricanes and Global Warming

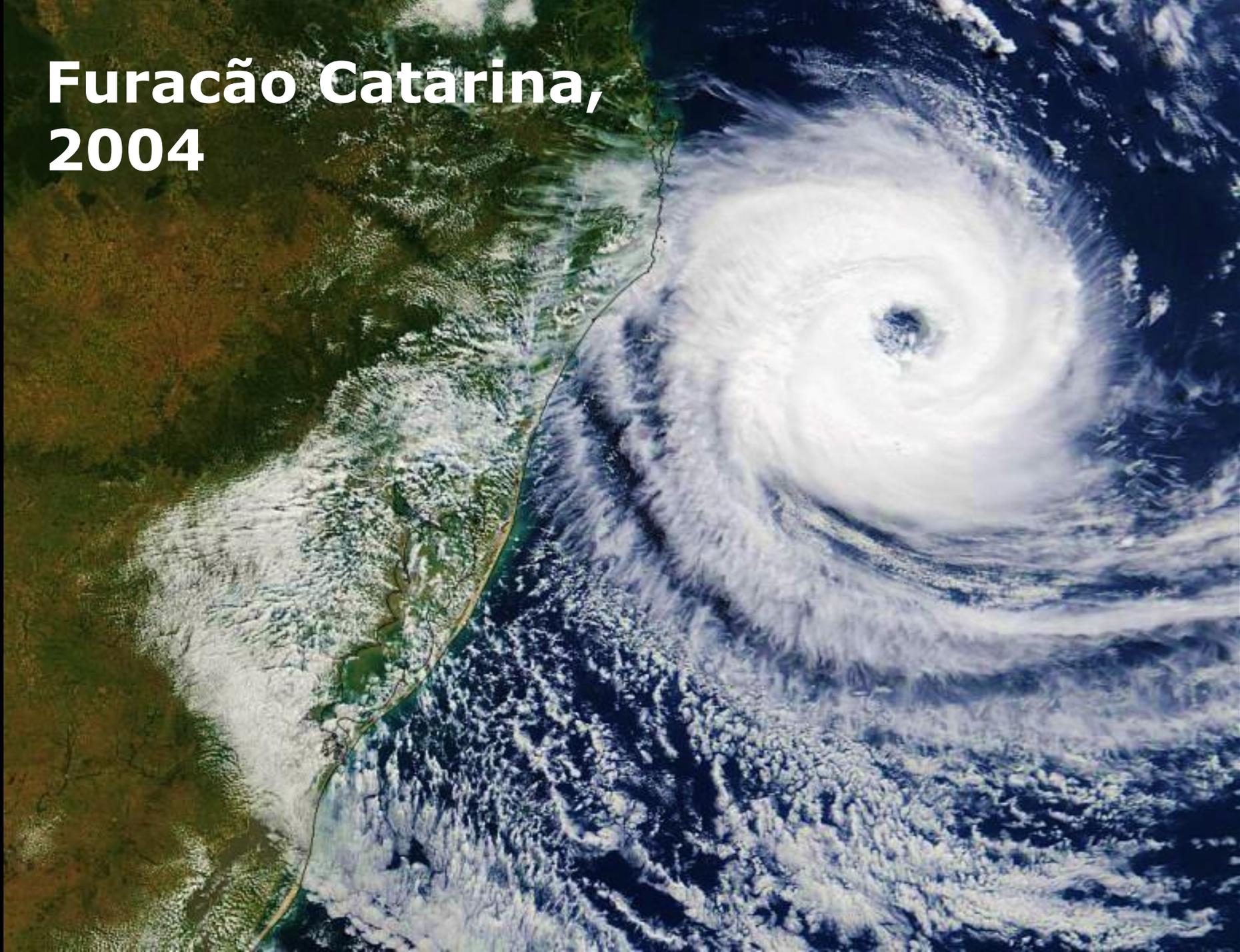
Kevin Trenberth*

+ See all authors and affiliations

Science 17 Jun 2005:
Vol. 308, Issue 5729, pp. 1753-1754
DOI: 10.1126/science.1112551

2005

Furacão Catarina, 2004





Ilha Grande, RJ, 2011

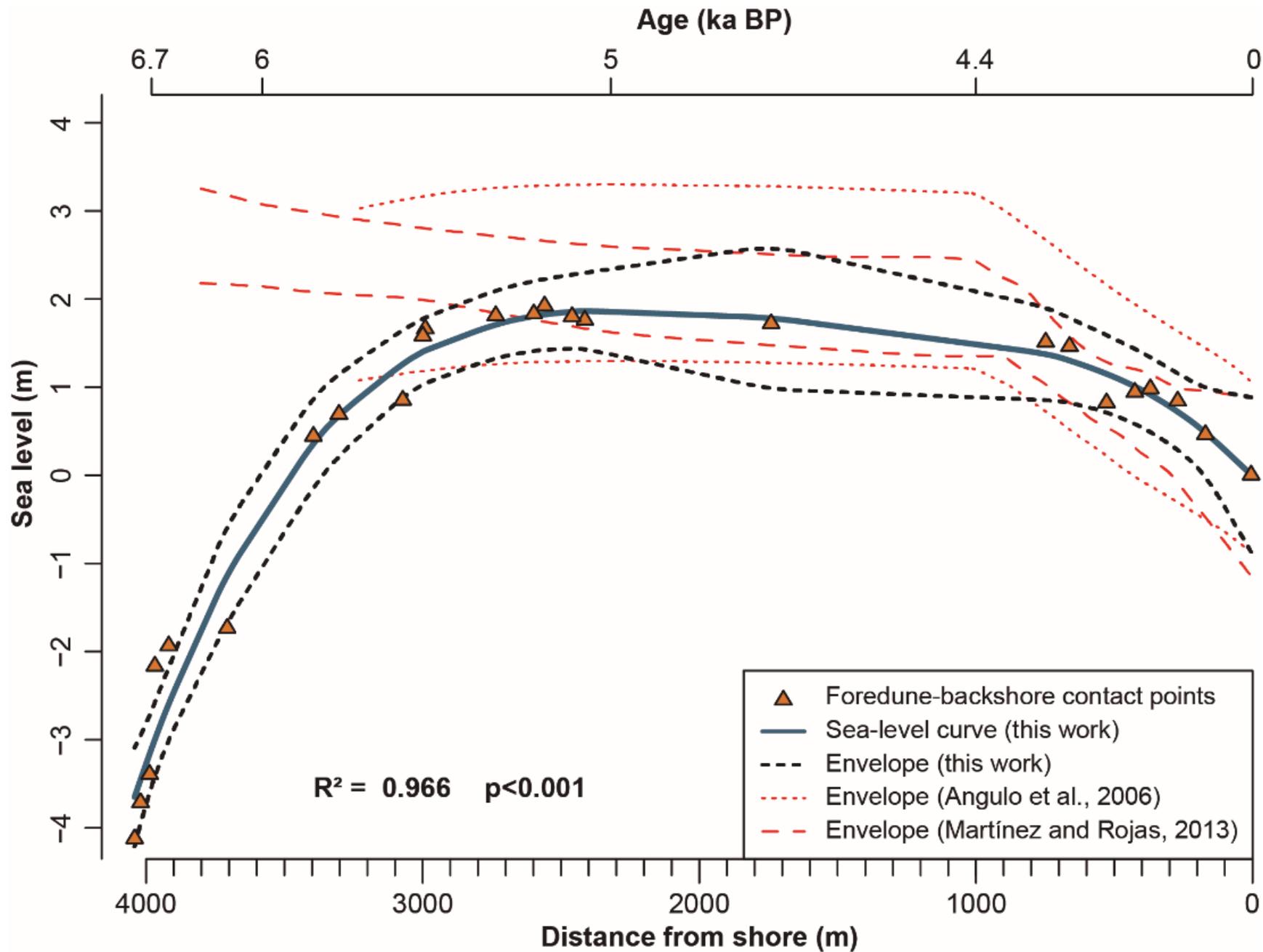
Bahia, 2022





Rio Grande do Sul, 2023





Barboza, *et al.* Holocene Sea-Level Changes in Southern Brazil Based on High-Resolution Radar Stratigraphy. *Geosciences* 2021, 11, 326.

Figure 6. The sea-level curve of the southernmost Brazilian coast, this work, based on 24 foredune backshore contact points identified by GPR at Arroio do Sal.

ARTICLE

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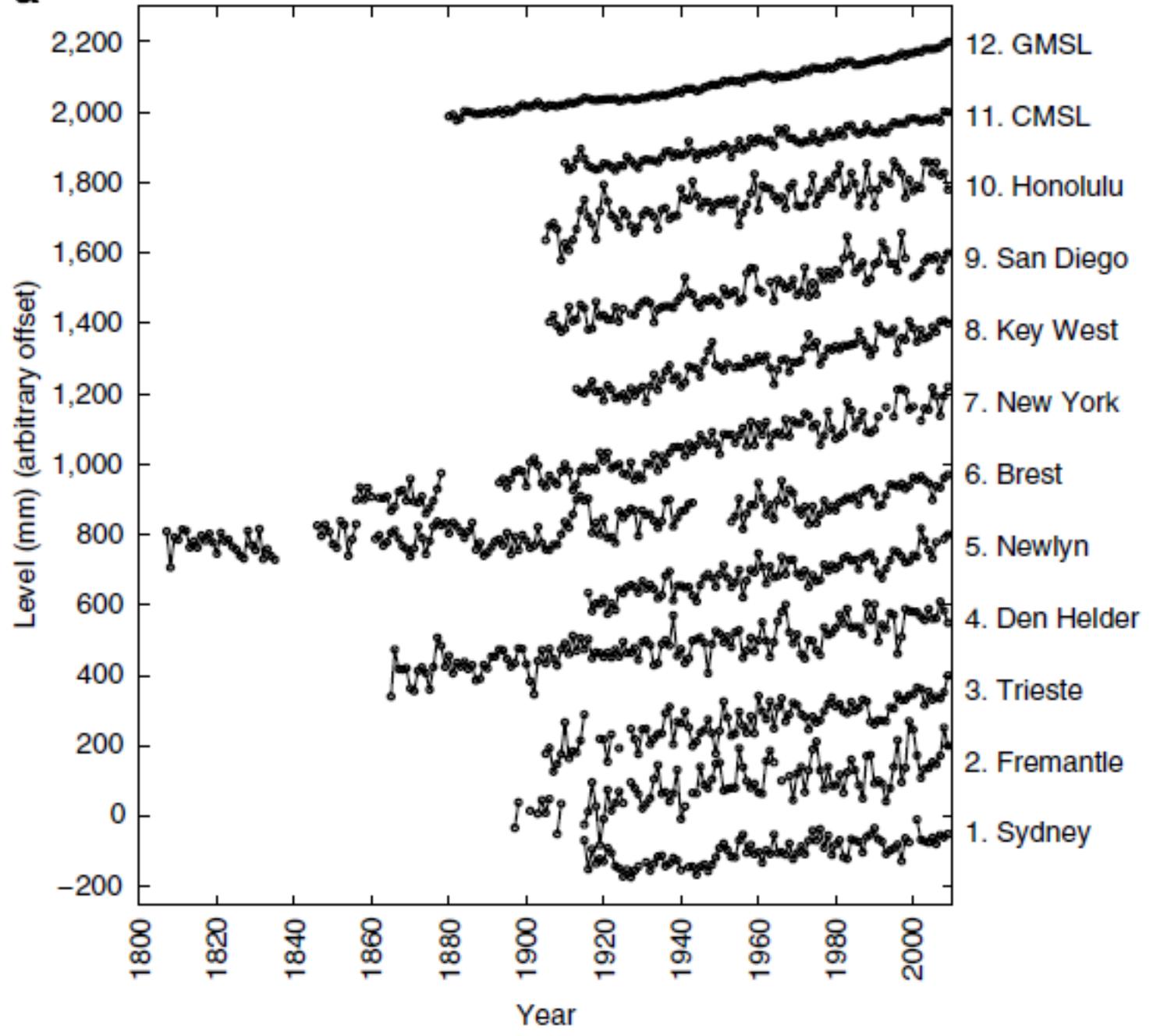
DOI: [10.1038/ncomms4635](https://doi.org/10.1038/ncomms4635)

[OPEN](#)

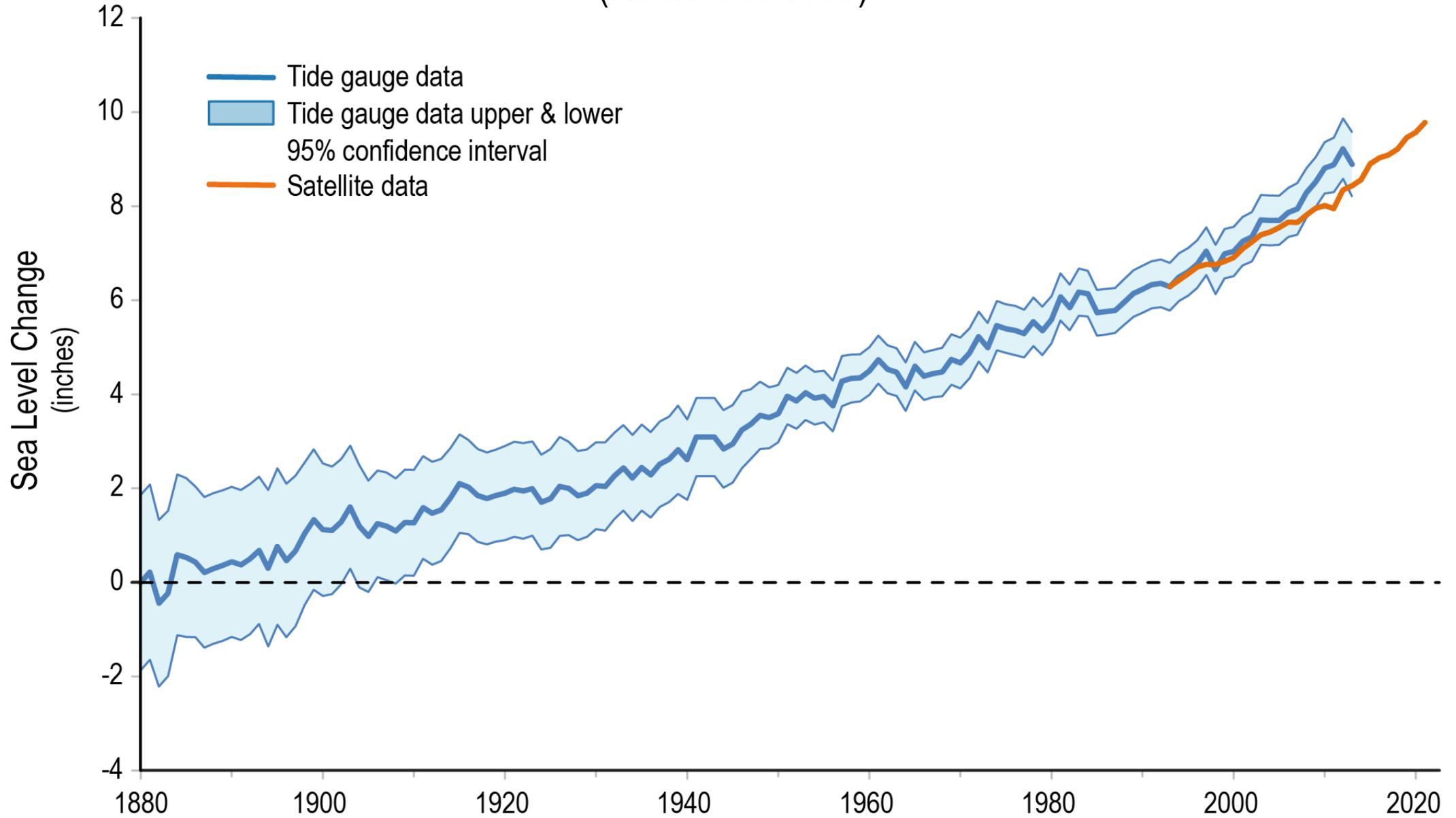
Timescales for detecting a significant acceleration in sea level rise

Ivan D. Haigh^{1,2}, Thomas Wahl^{3,4}, Eelco J. Rohling^{1,5}, René M. Price⁶, Charitha B. Pattiaratchi², Francisco M. Calafat⁷ & Sönke Dangendorf⁸

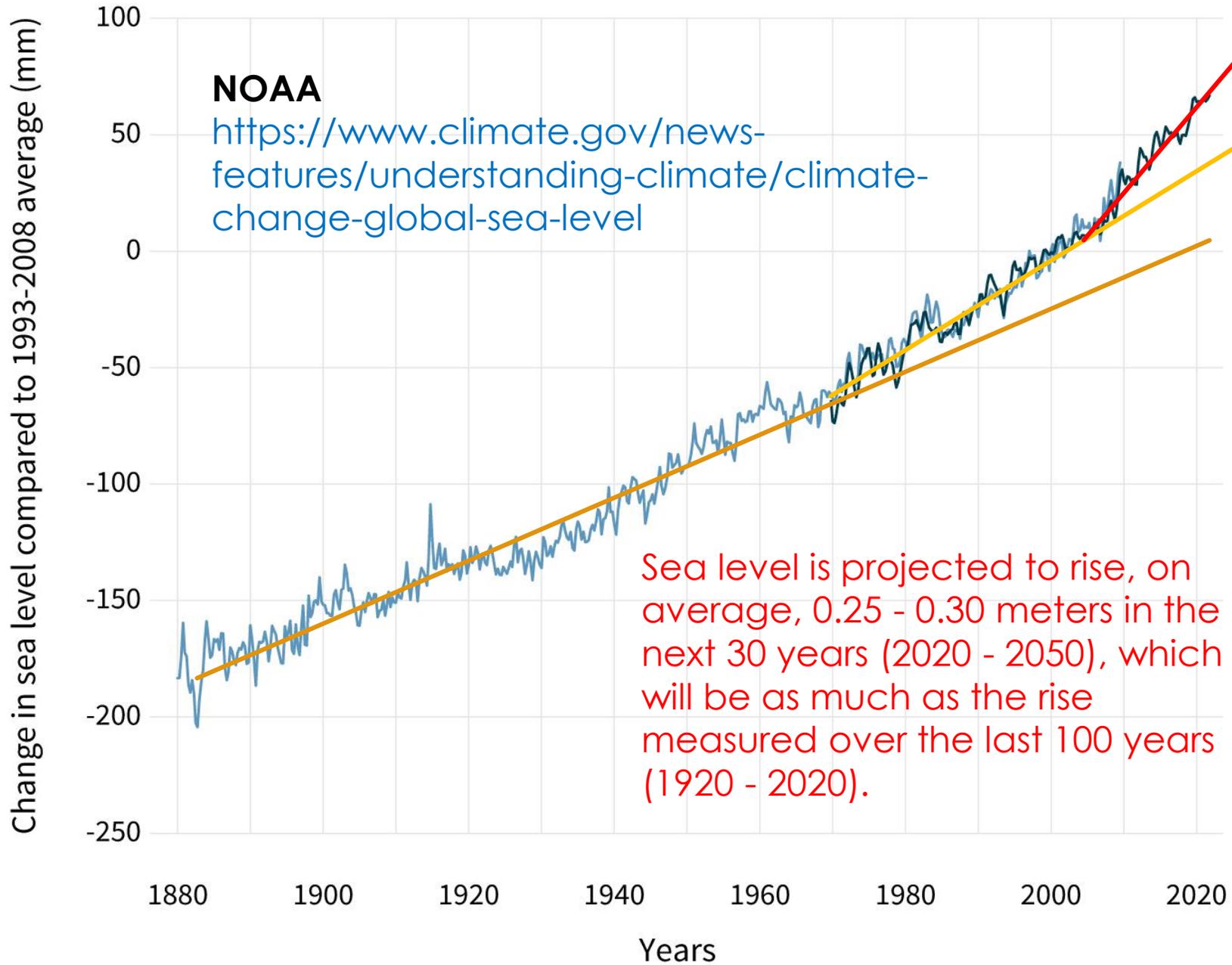
a



Global Average Sea Level Change (Relative to 1880)



GLOBAL SEA LEVEL



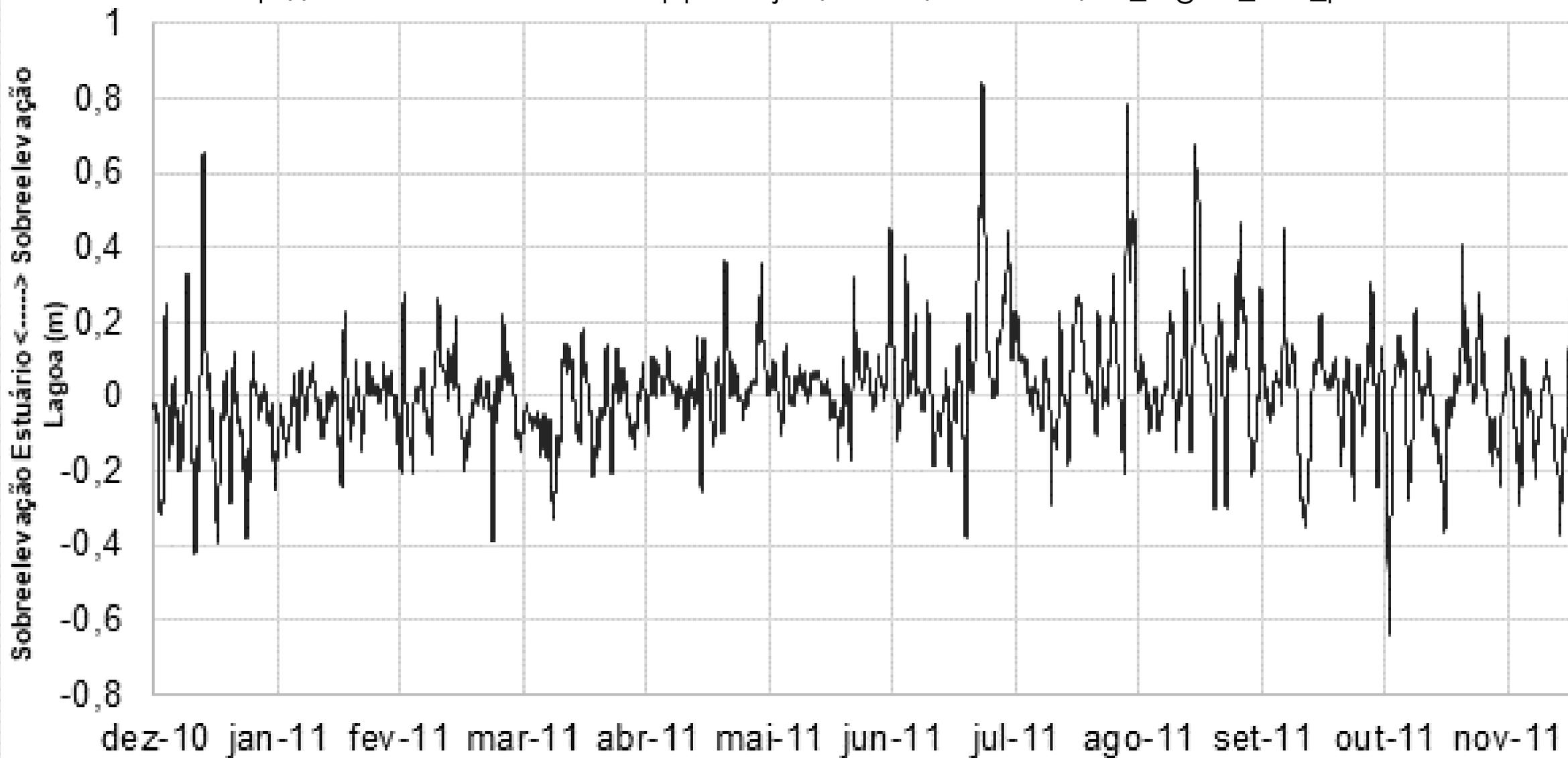


Figura 22. Diferenças de elevações entre um ponto ao sul, próximo de Ponta da Feitoria no limite do estuário de Rio Grande, e um ponto ao norte da Lagoa, nas proximidades de Itapuã.

O aquecimento global é um **fato**, e seus efeitos já fazem parte da **realidade**...

No último século a temperatura subiu cerca de **1,5°C**...

Este aquecimento é cerca de **30 vezes** mais rápido que no final da última era glacial.

O problema, então, não é apenas a mudança, **mas a velocidade da mudança.**

VAZÃO DO RIO DAS ANTAS SUPEROU ESTIMATIVA DE RECORRÊNCIA DE DEZ MIL ANOS

Vazão do Rio das Antas que levou à enchente catastrófica do Taquari superou cálculos probabilísticos mais pessimistas de engenharia



Autor: **METSUL.COM**

10/09/2023 - 18:05

Os desafios climáticos são uma **realidade**.

Eventos extremos serão mais frequentes.

Obras de infraestrutura devem dispor de **resiliência** e **redundância**.

▪

Barragem/Eclusa de Amarópolis (General Câmara)



Barragem/Eclusa de Amarópolis (General Câmara)



63,66 km

Crises sociais decorrentes de tragédias e desabastecimento serão mais prováveis.

As forças armadas deverão ser convocadas com maior frequência para a demandas de **segurança pública**.

Os **desafios** do futuro exigem planejamento e preparação do **Exercito Brasileiro**.









Muito Obrigado!