Ad Hoc Expert Meeting on

Climate Change Impacts and Adaptation: A Challenge for Global Ports

29 – 30 September 2011

Climate Change – State of the Science

Presentation by

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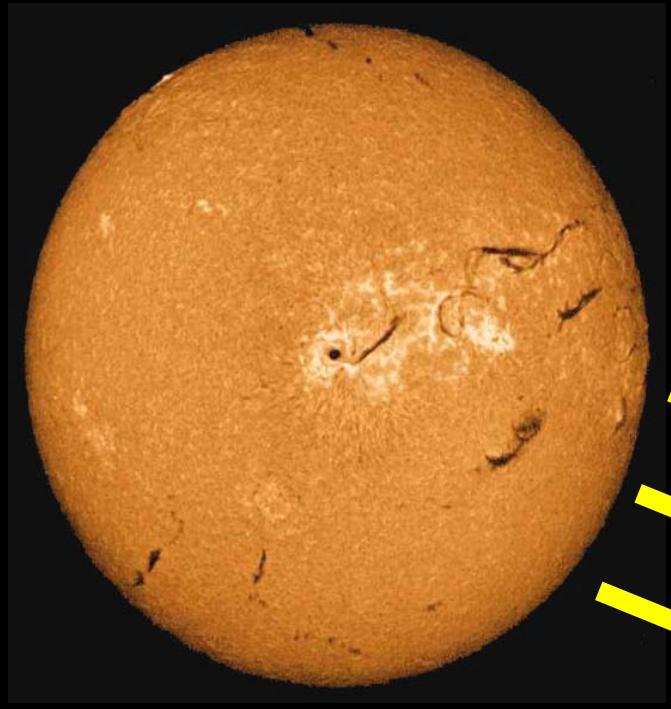
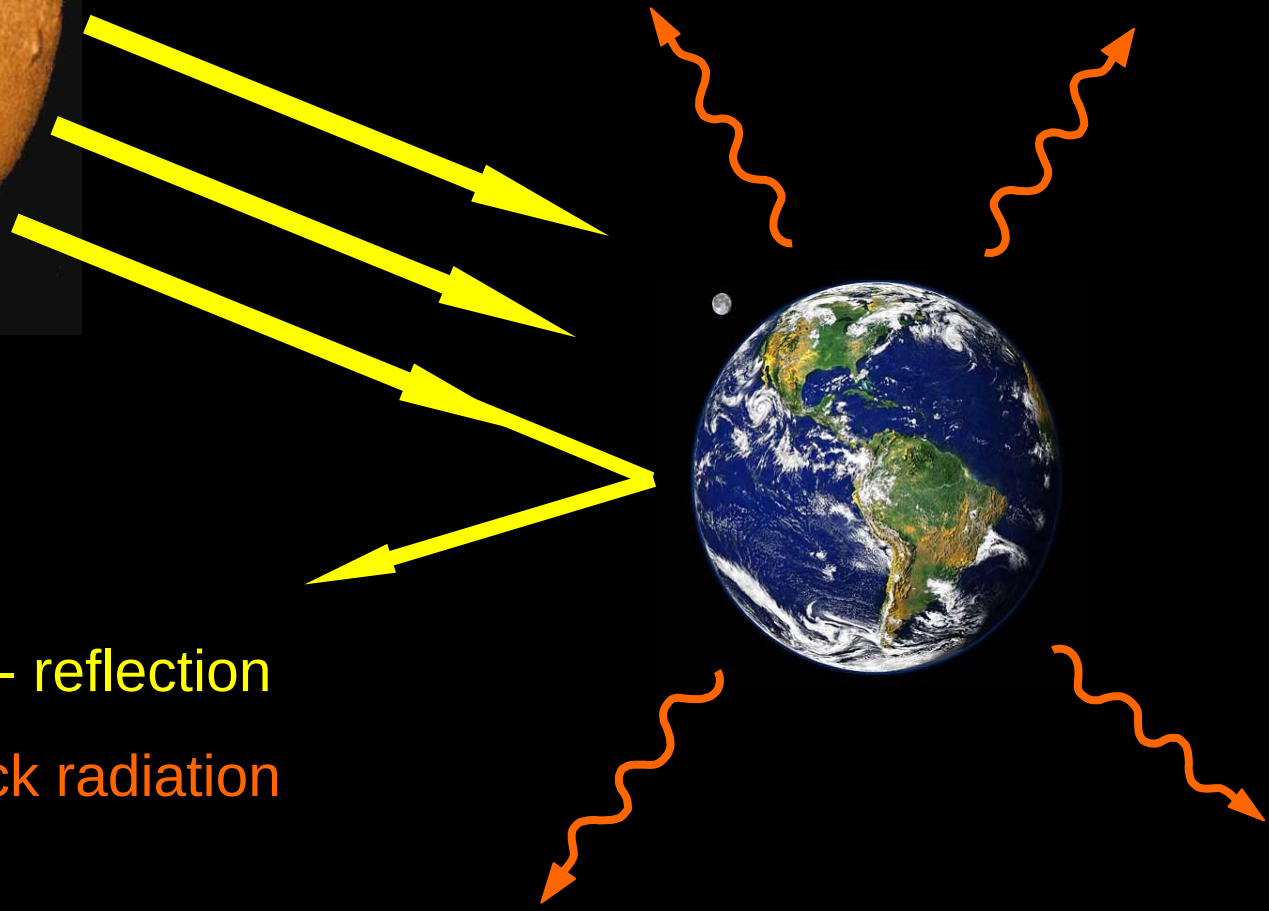
Prof. Stefan Rahmstorf, Potsdam Institute for Climate Impact Research

Foto: S. Rahmstorf

Global temperature results from a simple energy balance

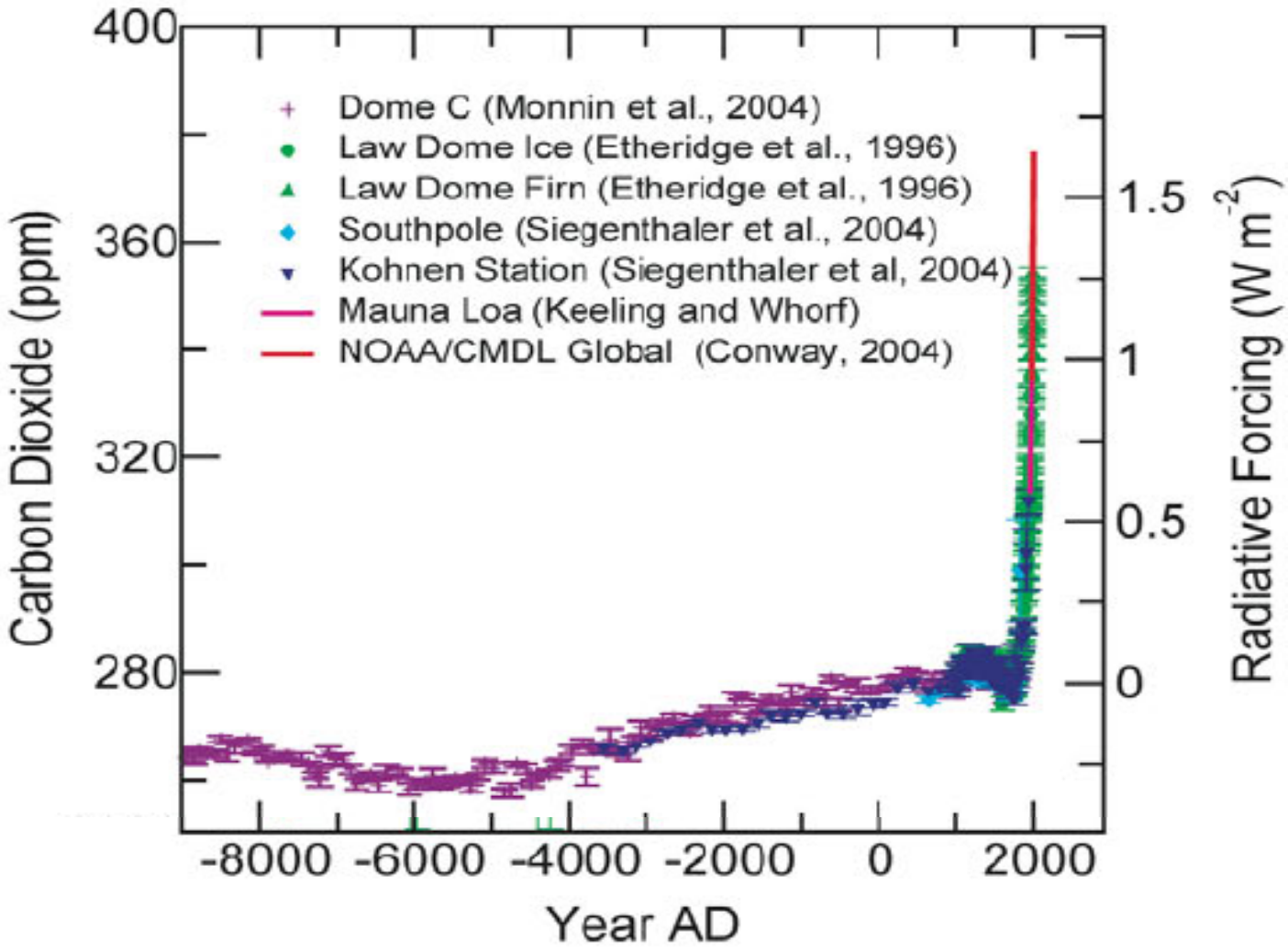




solar radiation - reflection

= back radiation

Rise of CO_2 concentration



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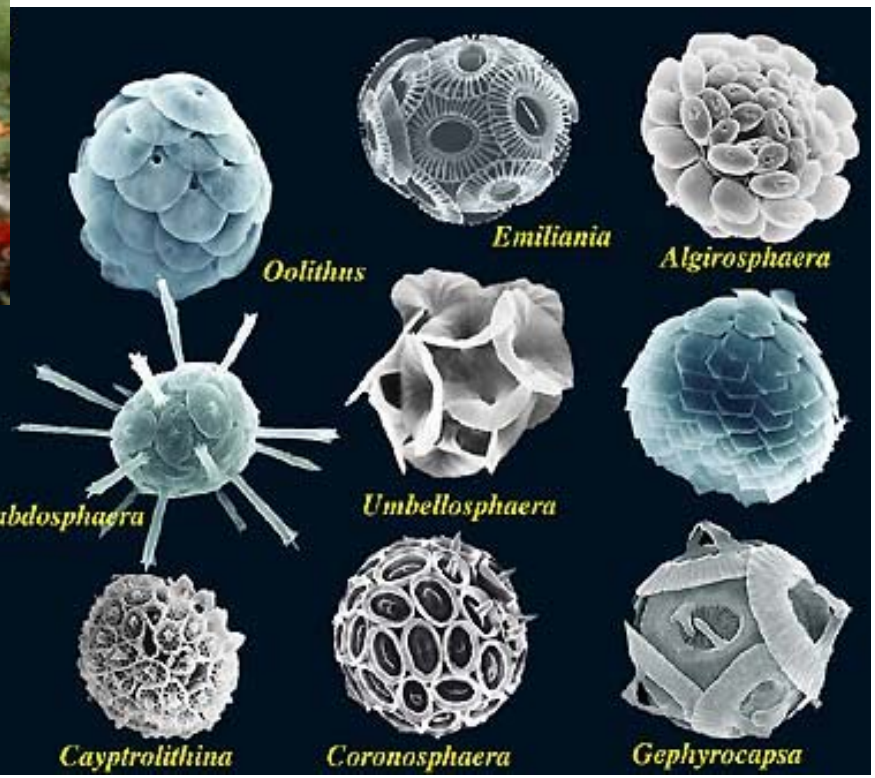
Oceans are getting acidic

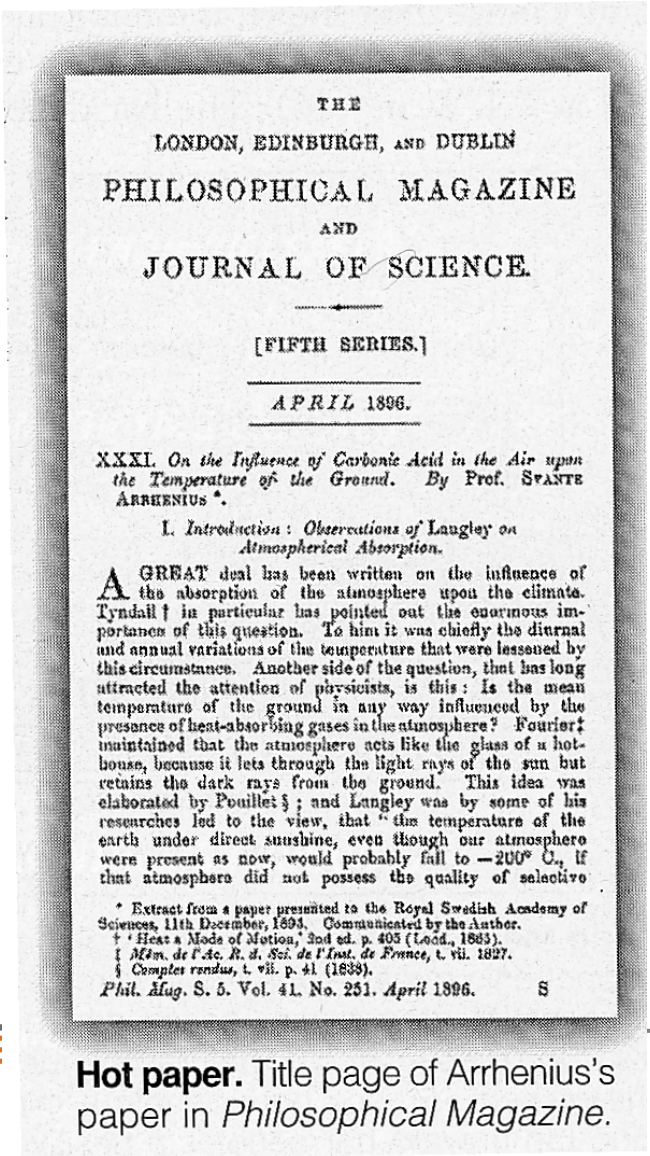
- Acidification by CO_2 threatens marine ecosystems

Plankton



Korallenriffe

CO_2 is a Greenhouse Gas



THE

LONDON, EDINBURGH, AND DUBLIN

PHILOSOPHICAL MAGAZINE

AND

JOURNAL OF SCIENCE.

[FIFTH SERIES.]

APRIL 1896.

XXXI. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.* By Prof. SVANTE ARRHENIUS *.

I. *Introduction: Observations of* Langley *on Atmospherical Absorption.*

A GREAT deal has been written on the influence of the absorption of the atmosphere upon the climate. Tyndall † in particular has pointed out the enormous importance of this question. To him it was chiefly the diurnal and annual variations of the temperature that were lessened by this circumstance. Another side of the question, that has long attracted the attention of physicists, is this: Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere? Fourier‡ maintained that the atmosphere acts like the glass of a hot-house, because it lets through the light rays of the sun but retains the dark rays from the ground. This idea was elaborated by Pouillet§; and Langley was by some of his researches led to the view, that "the temperature of the earth under direct sunshine, even though our atmosphere were present as now, would probably fall to −200° C., if that atmosphere did not possess the quality of selective

* Extract from a paper presented to the Royal Swedish Academy of Sciences, 11th December, 1895. Communicated by the Author.
† 'Heat a Mode of Motion,' 2nd ed. p. 405 (Lond., 1865).
‡ *Mém. de l'Ac. R. d. Sci. de l'Inst. de France*, t. vii. 1827.
§ *Comptes rendus*, t. vii. p. 41 (1838).

Phil. Mag. S. 5. Vol. 41. No. 251. *April* 1896. S

Hot paper. Title page of Arrhenius's paper in *Philosophical Magazine*.

Arrhenius 1896 (4-6 ºC)

"Climate Sensitivity"

3 ± 1 ºC

Human-caused forcing until now should have caused 0,7 – 0,9 ºC warming

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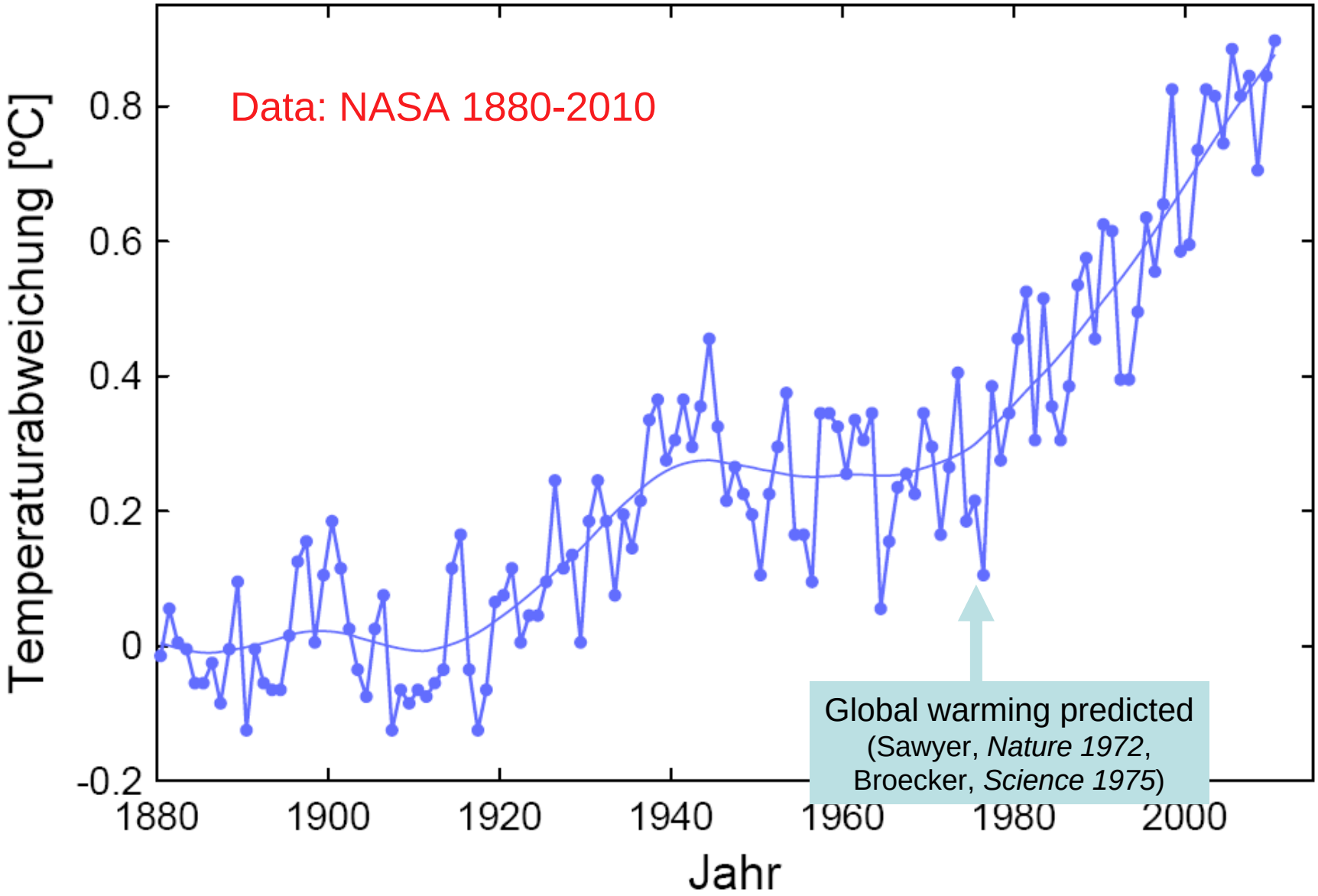
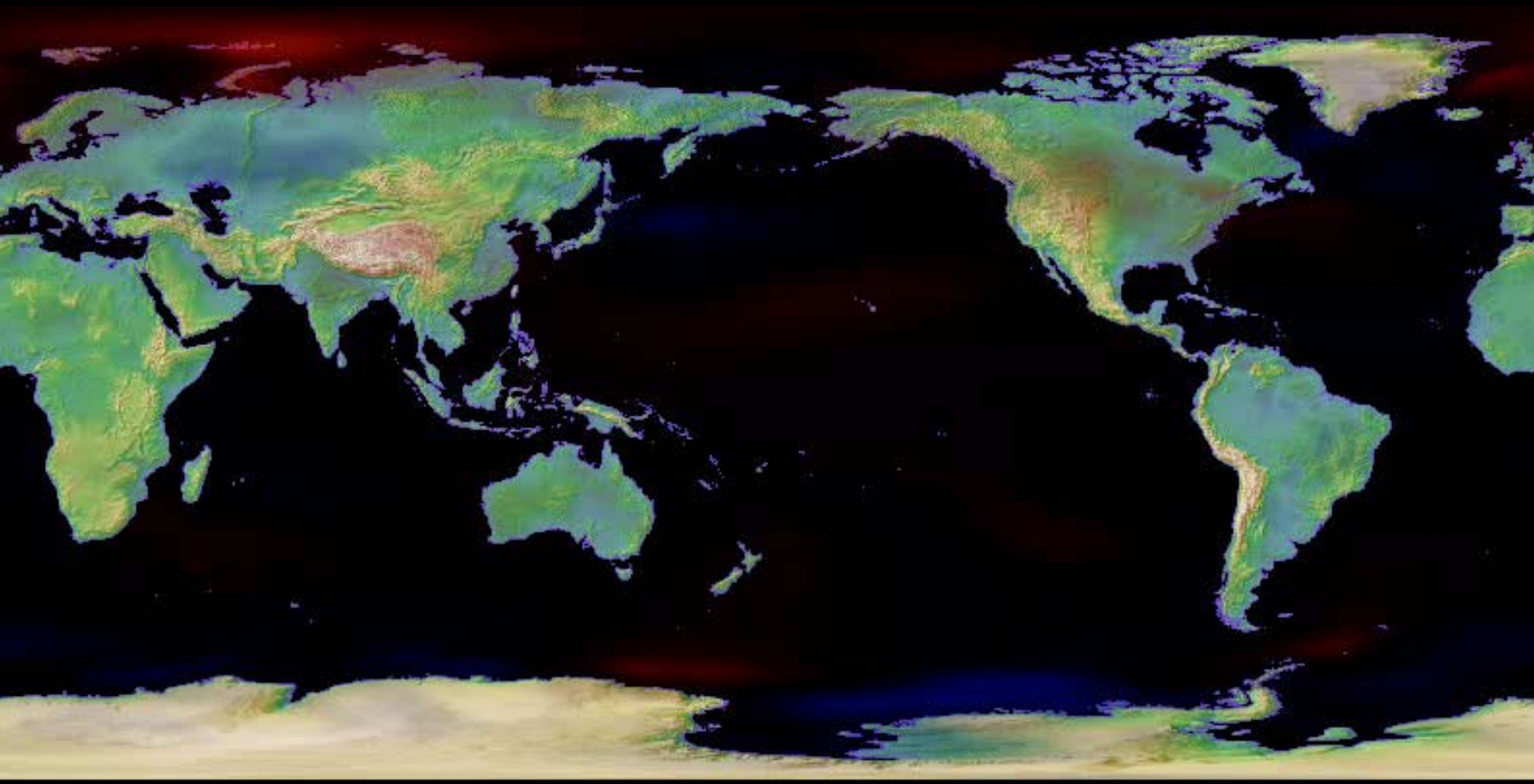
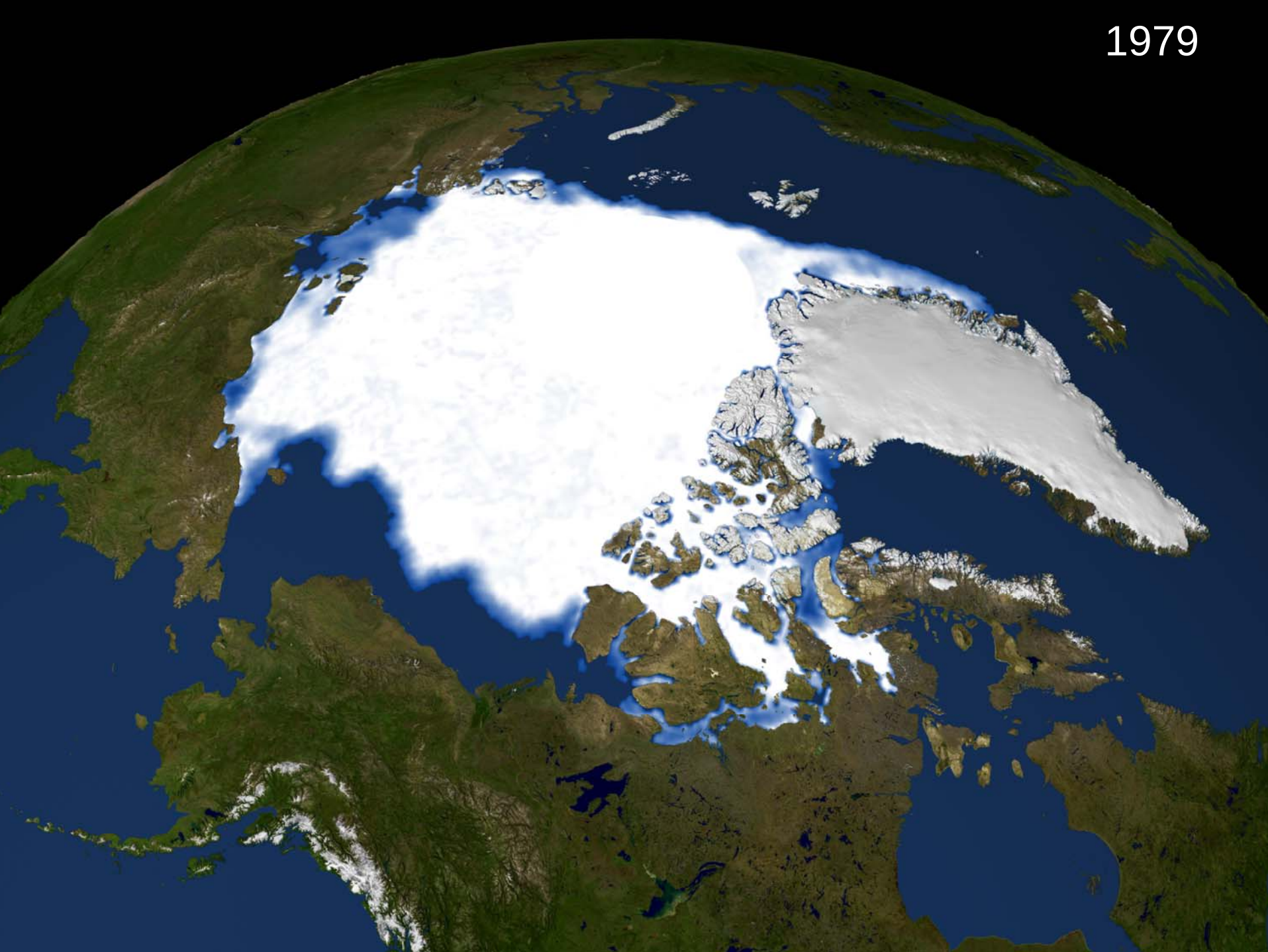
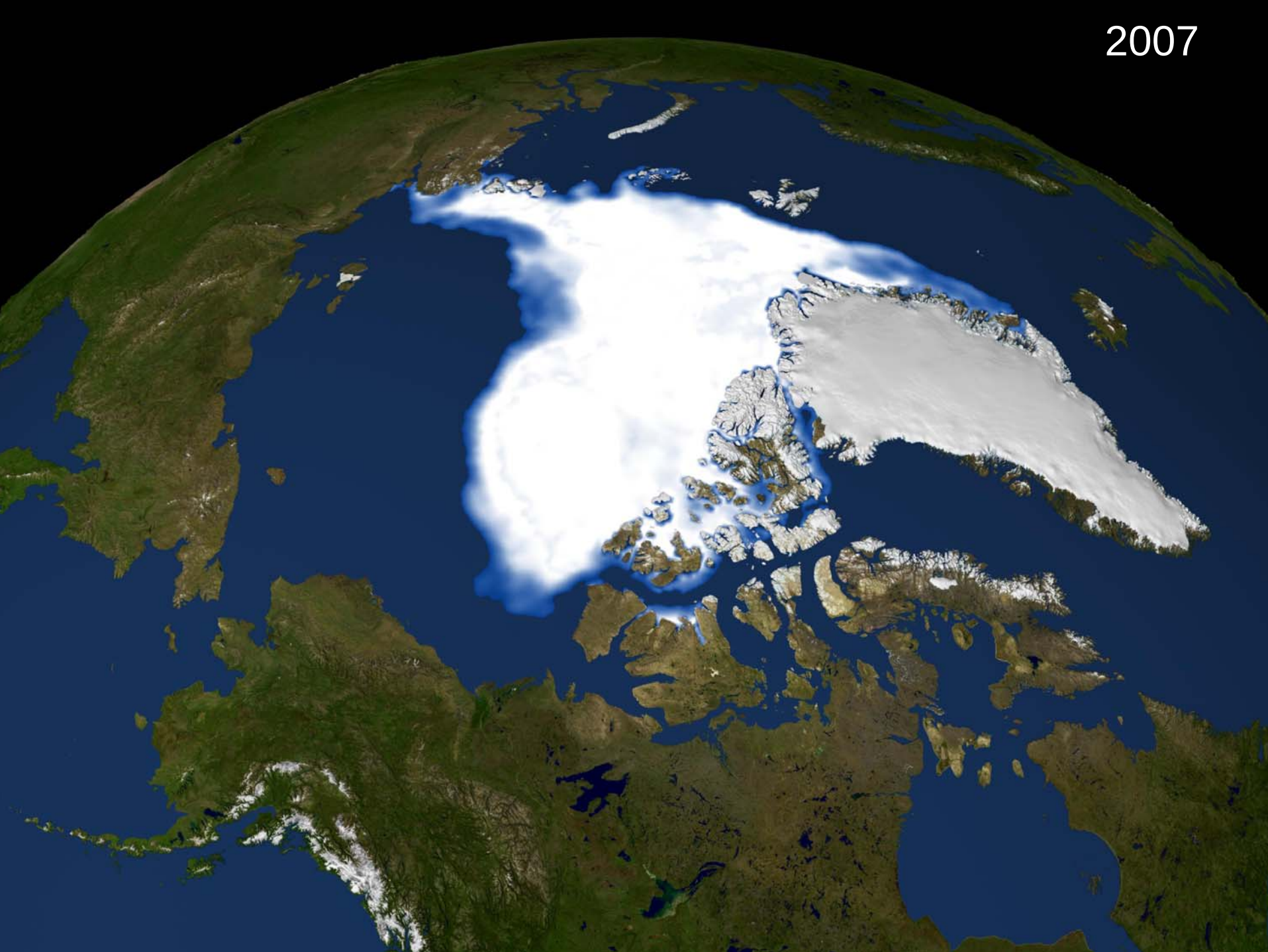
Earth is warming

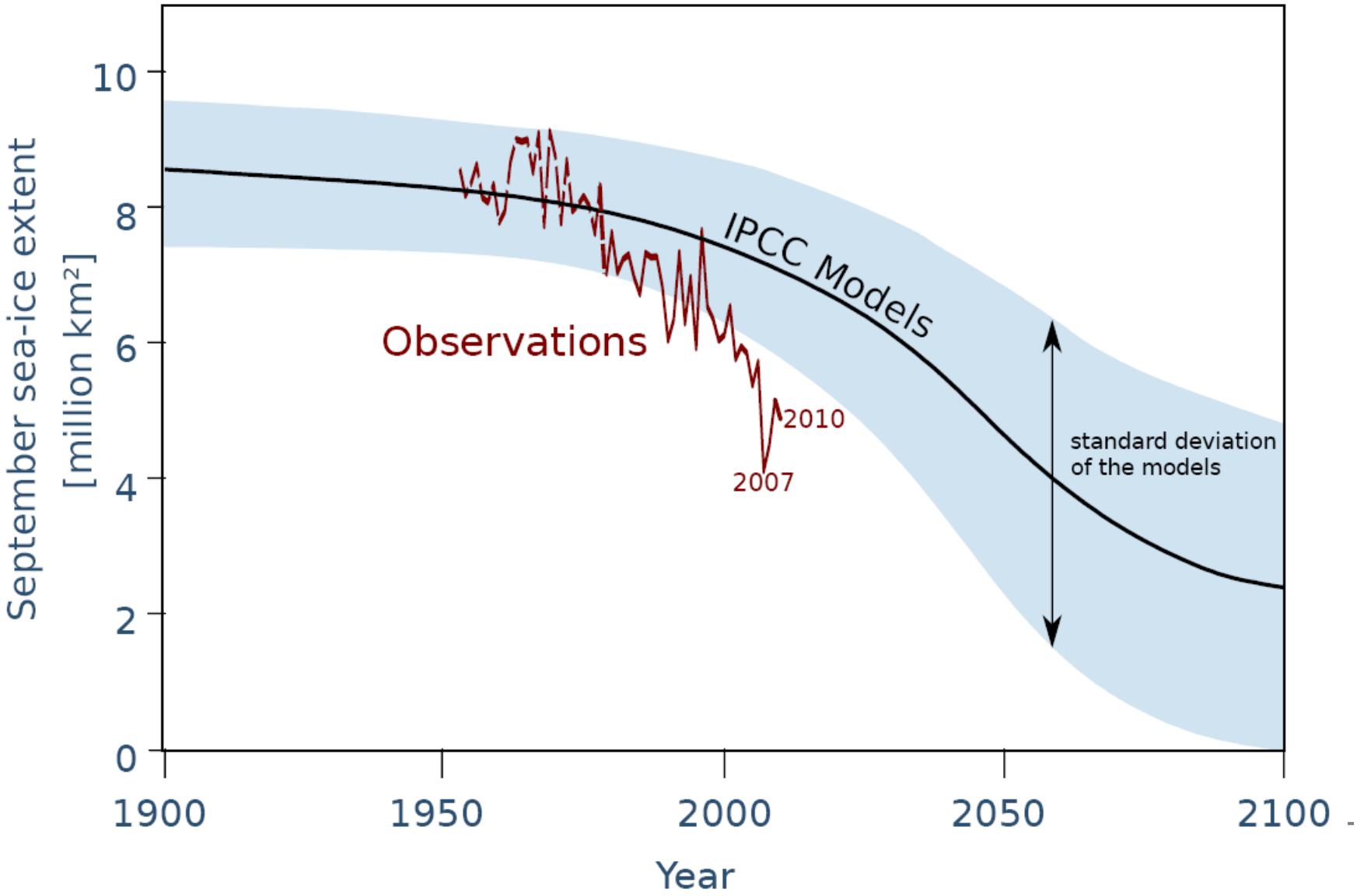



1950
-12
-6
0
+6
+12


1979


2007

Loss of Arctic Sea Ice



Greenland

Enough ice to raise global sea level by 7 meters

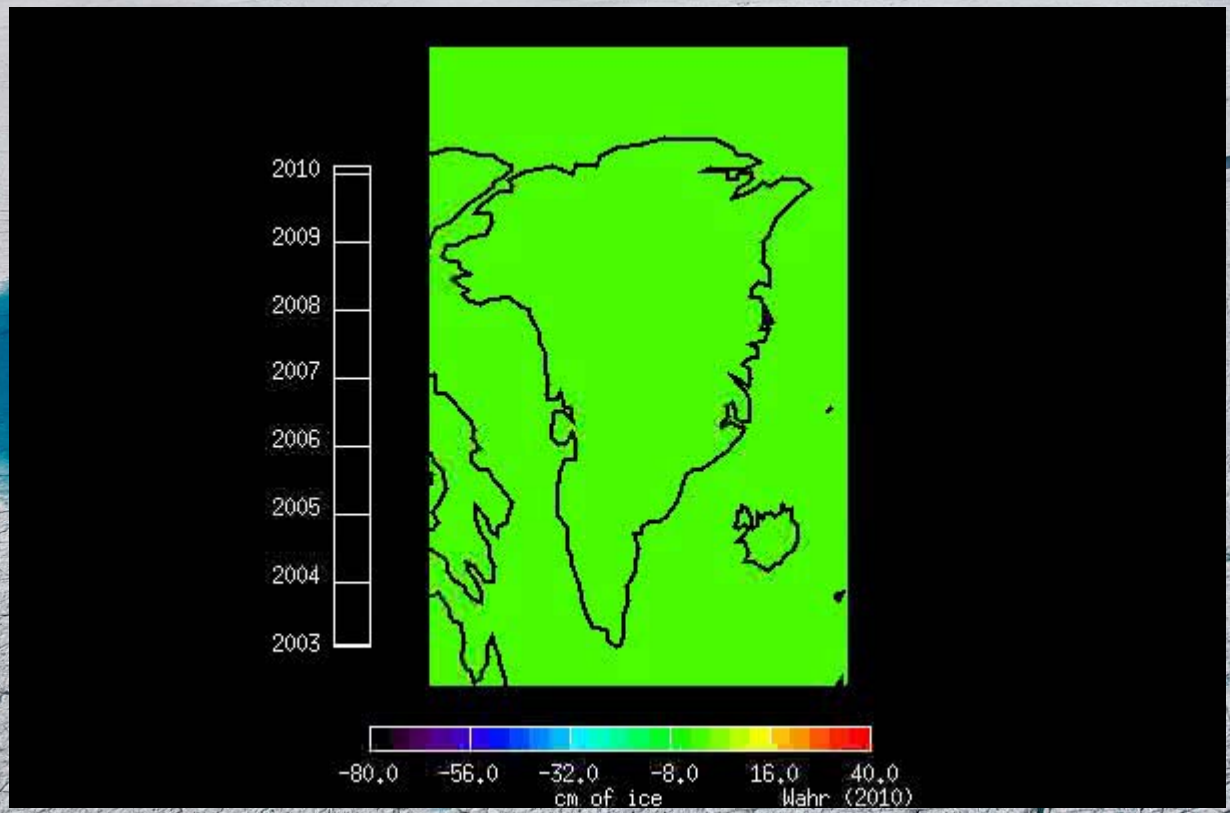


Photo: Ian Joughin

Sea Level Rise


Sizewell B nuclear power station, Great Britain

Sea Level Change (cm)

20
15
10
5
0

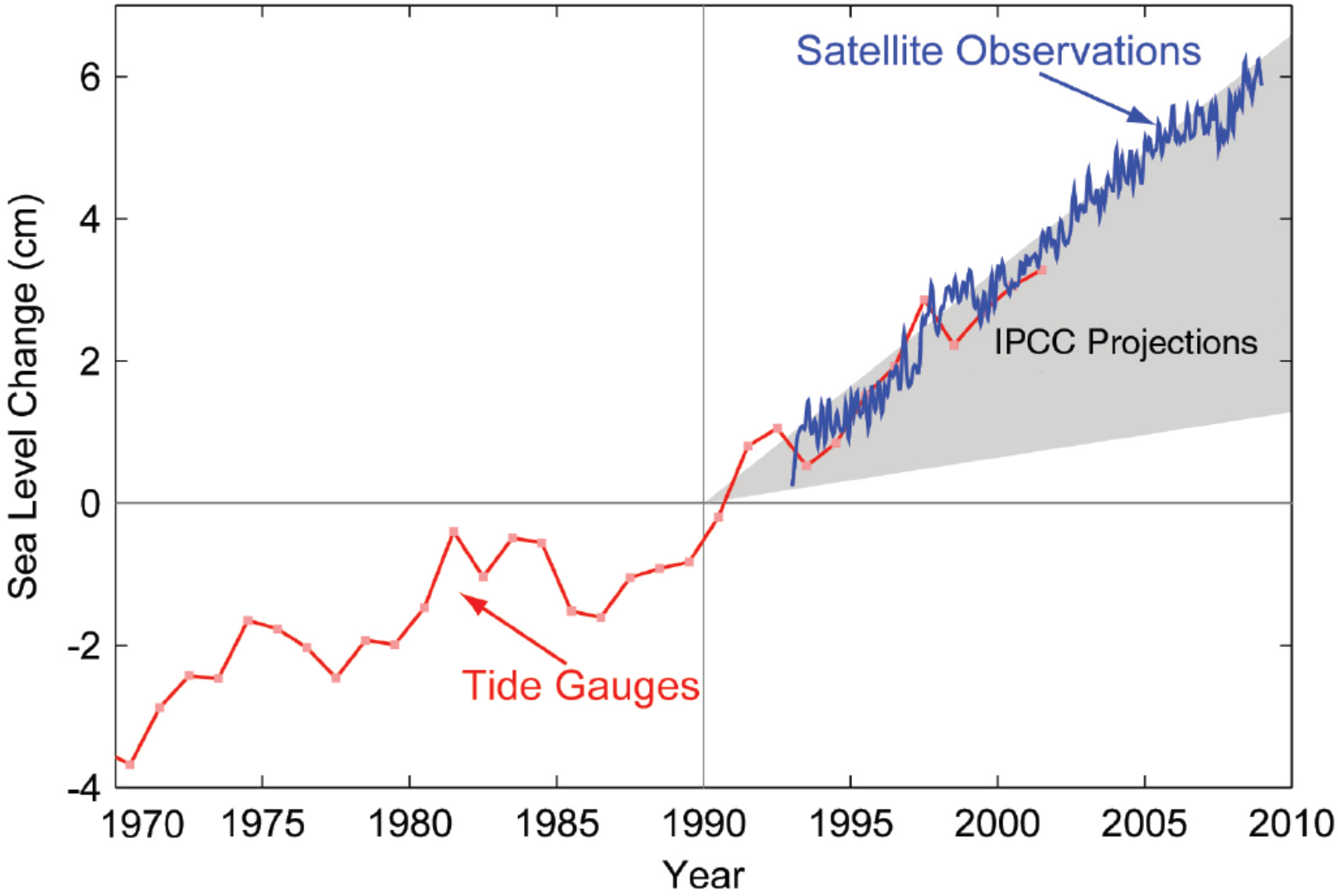
1880
1900
1920
1940
1960
1980
2000

Year

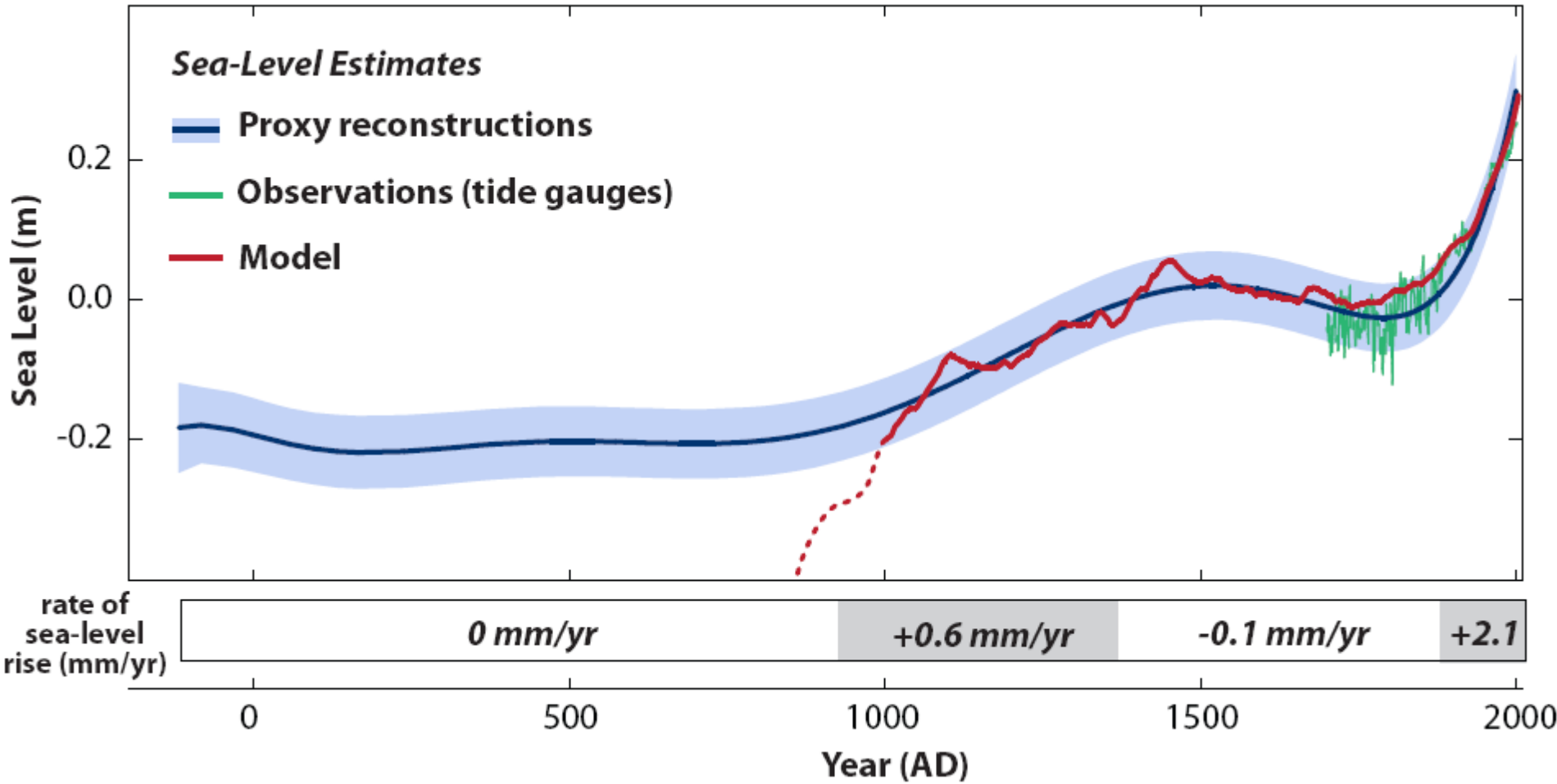
Tide Gauges

Gauges: Church & White
Satellite: Cazenave et al.

Rise faster than expected



2000 years of sea level



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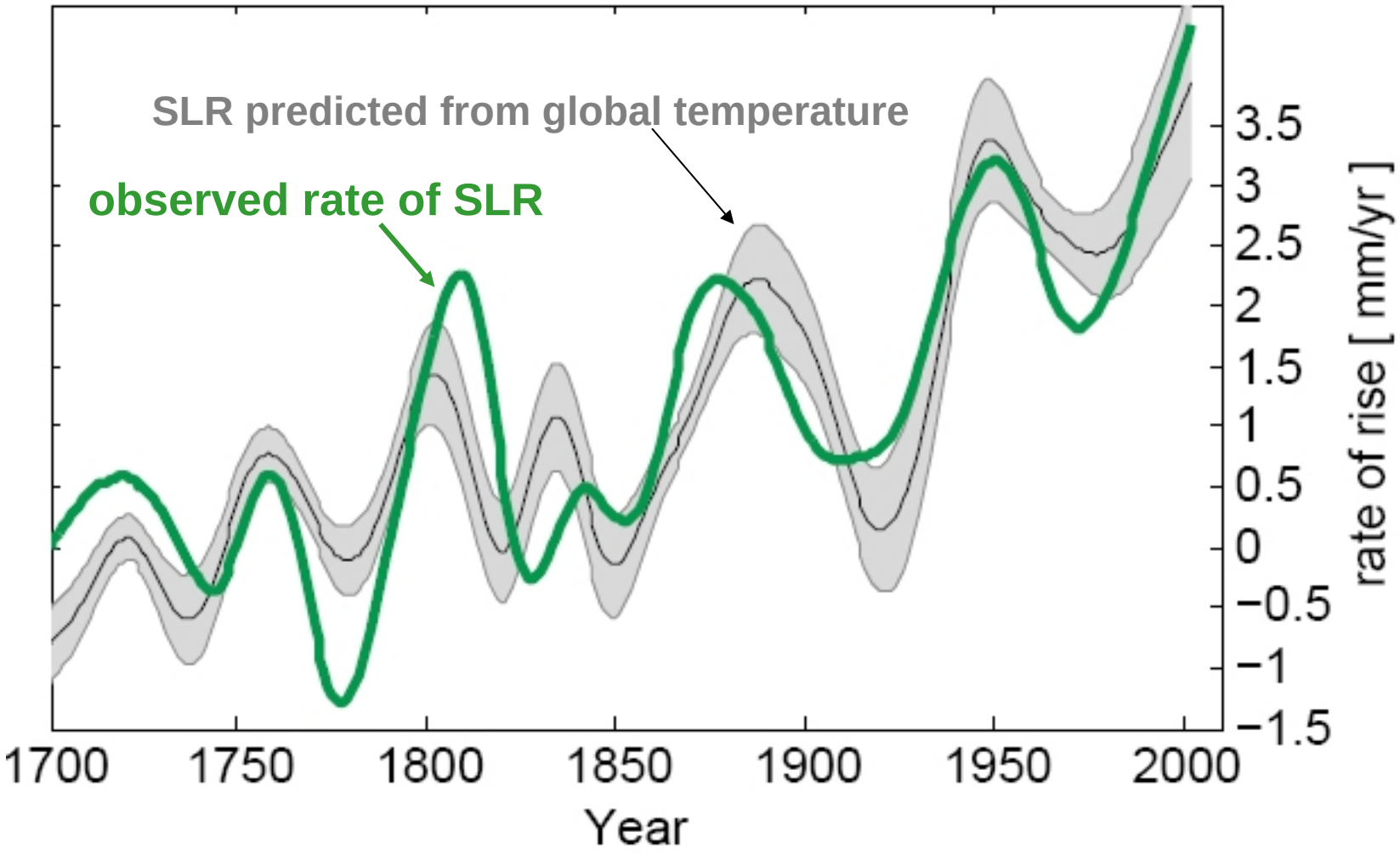
Kemp et al. PNAS 2011

Rate of rise correlates with warming



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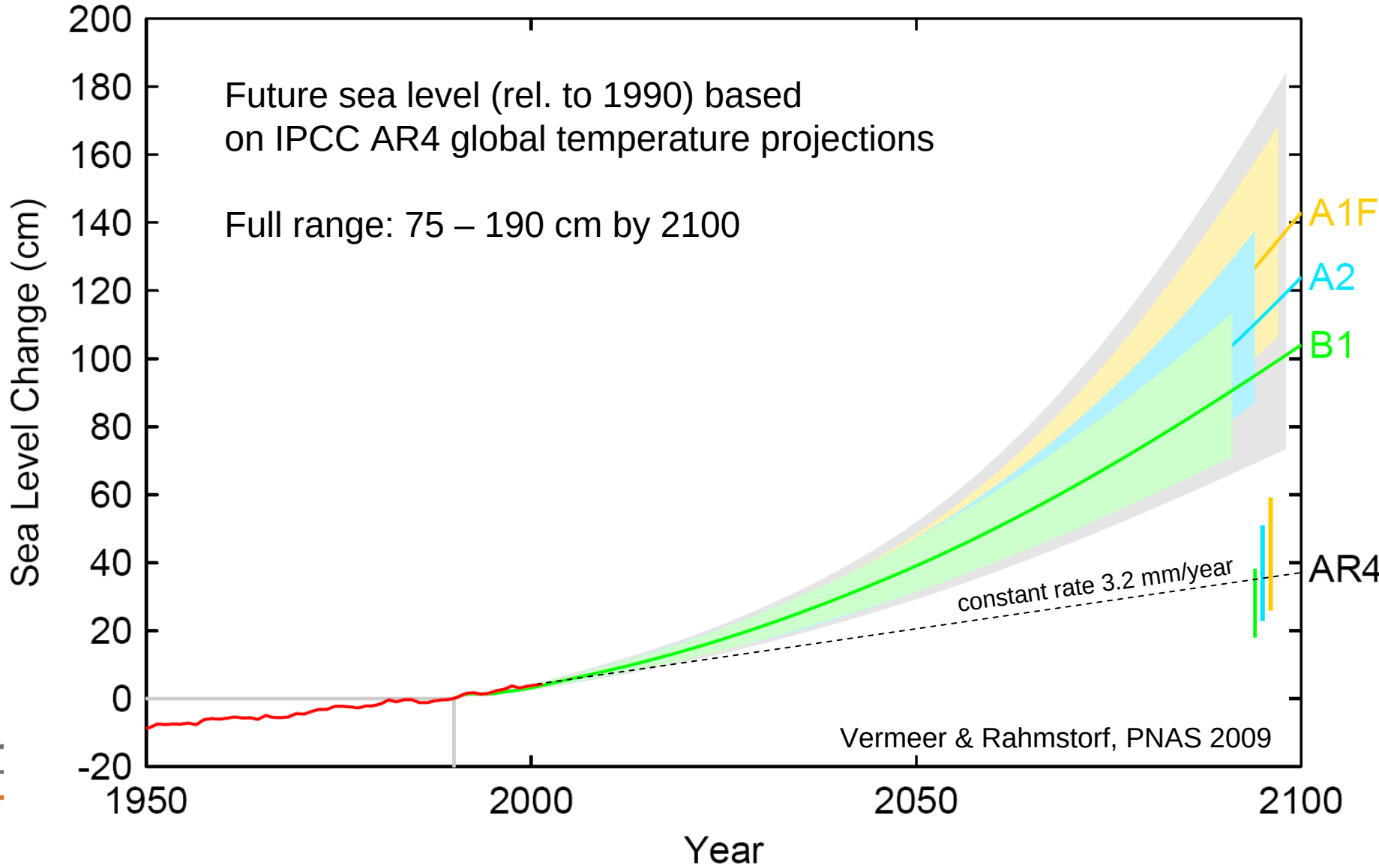
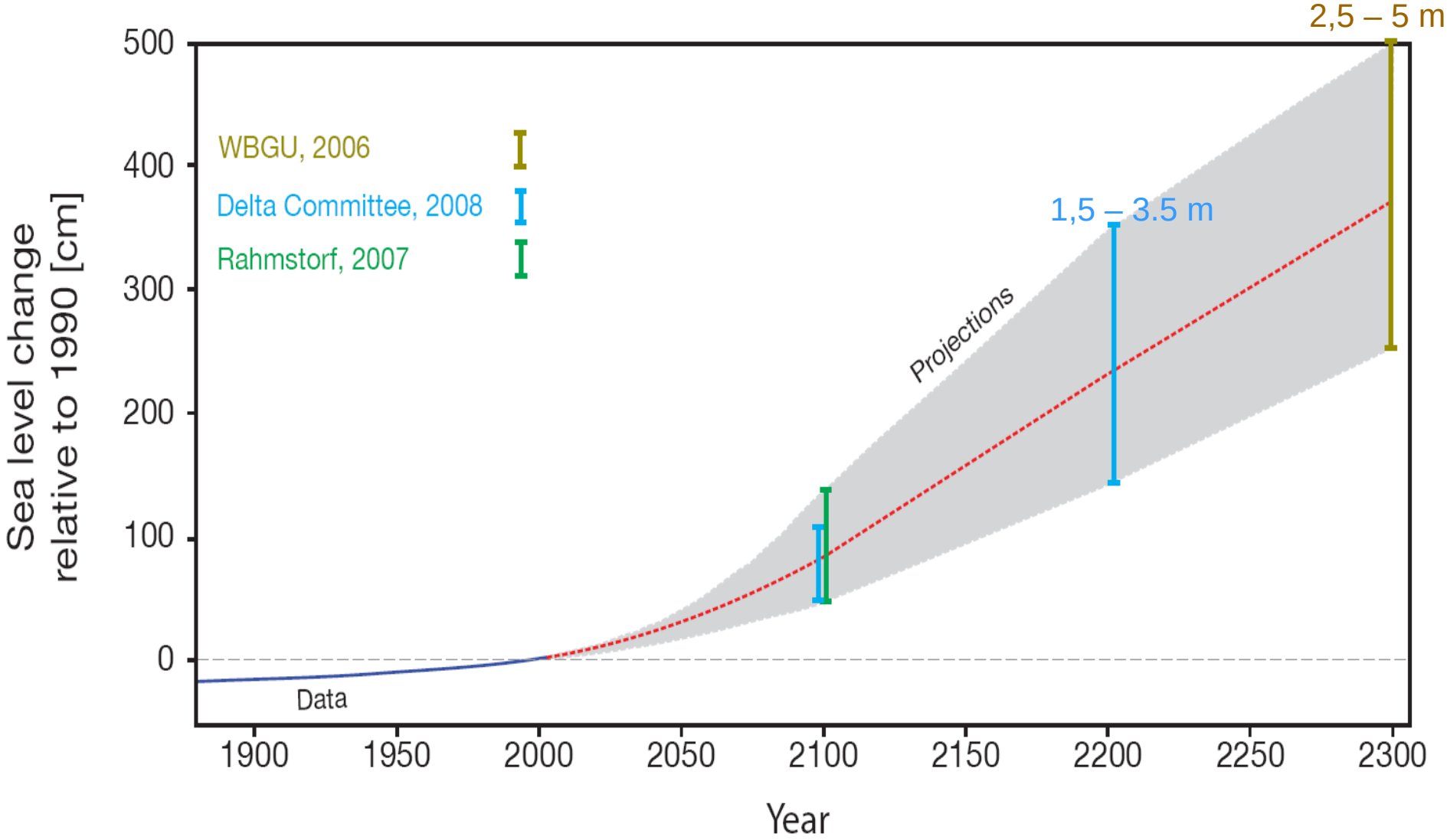
Future projections

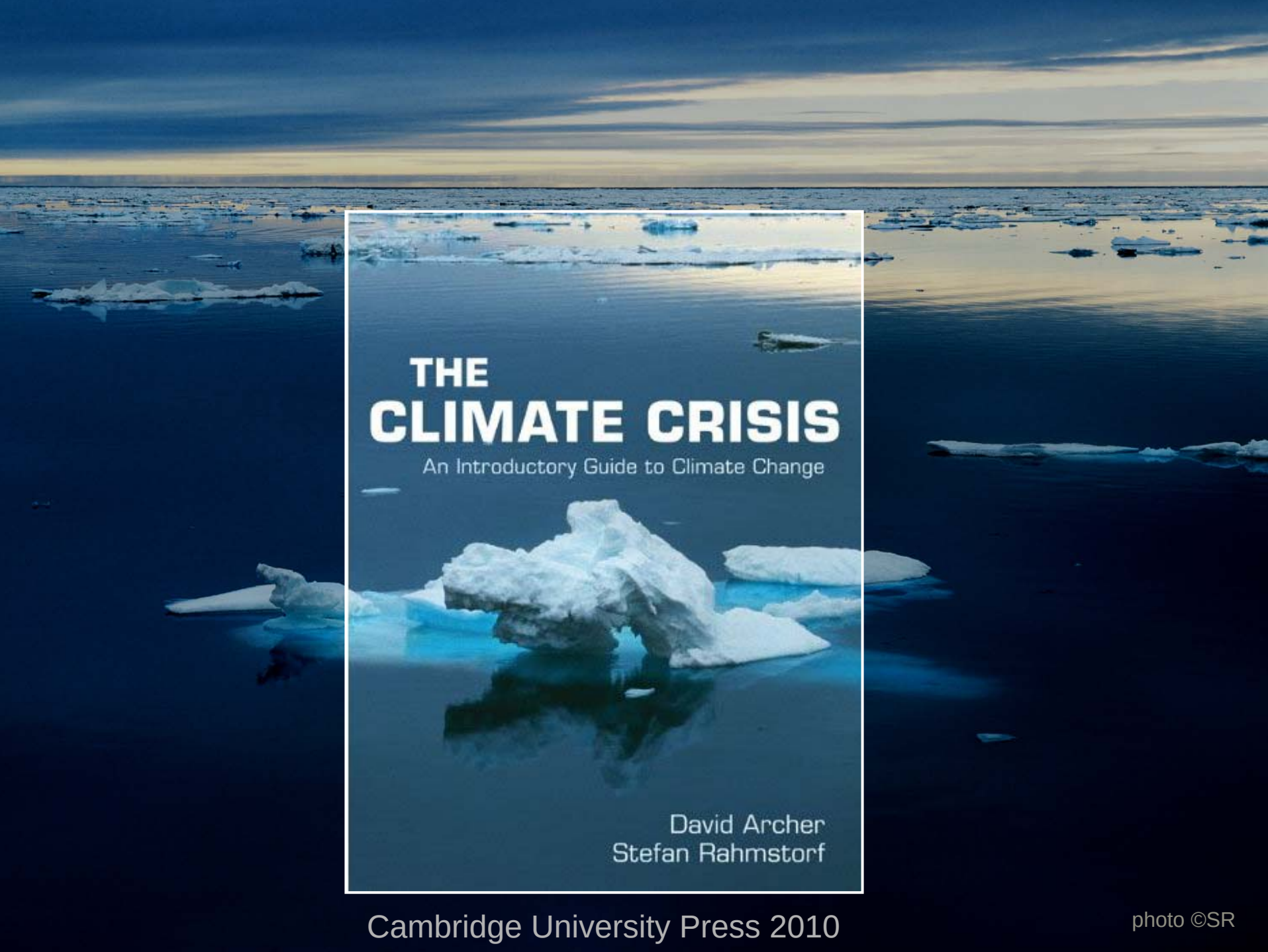


Longer term projections



Copenhagen Diagnosis (2009)

Graffiti by Banksy (photo: Romany WG)



Cambridge University Press 2010