What can we learn about the 1.5°C global warming target from the past?

H. Fischer, D. Baggenstos, M. Baumgartner, J. Beck, B. Bereiter, M. Bock, O. Eicher, S. Eggleston, T. Erhardt, M. Häberli, T. Kellerhals, L. Mächler, A. Schilt, J. Schmitt, B. Seth, J. Strähl and many more

Climate and Environmental Physics, Physics Institute & Oeschger Centre for Climate Change Research, University of Bern

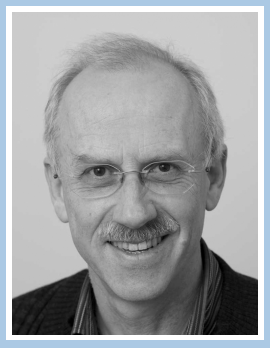
Swiss Global Change Day, Bern, 2016

PAGES PAST GLOBAL CHANGES

QUIGS

PALSEA

http://www.pages.unibe.ch/



Christoph Ritz, ProClim

Thanks for the invitation

Thanks for everything!

PAGES Zaragoza 2017
5th Open Science Meeting

PAGES Morillo de Tou 2017
3rd Young Scientists Meeting

open call for session until 1st of May 2016

"Whatever can happen, will happen"
Murphy's Law, Version 1

"Shit happens!"
Murphy's Law, Version 2

"The present is the key to the past"
Charles Lyell, 1830
rephrased from
James Hutton, 1788

What can we learn about the 1.5°C global warming target from the past?

"What has happened, may happen (again)"
Jerry McManus

"The past is the key to the future"
Bruce Doe, 1983

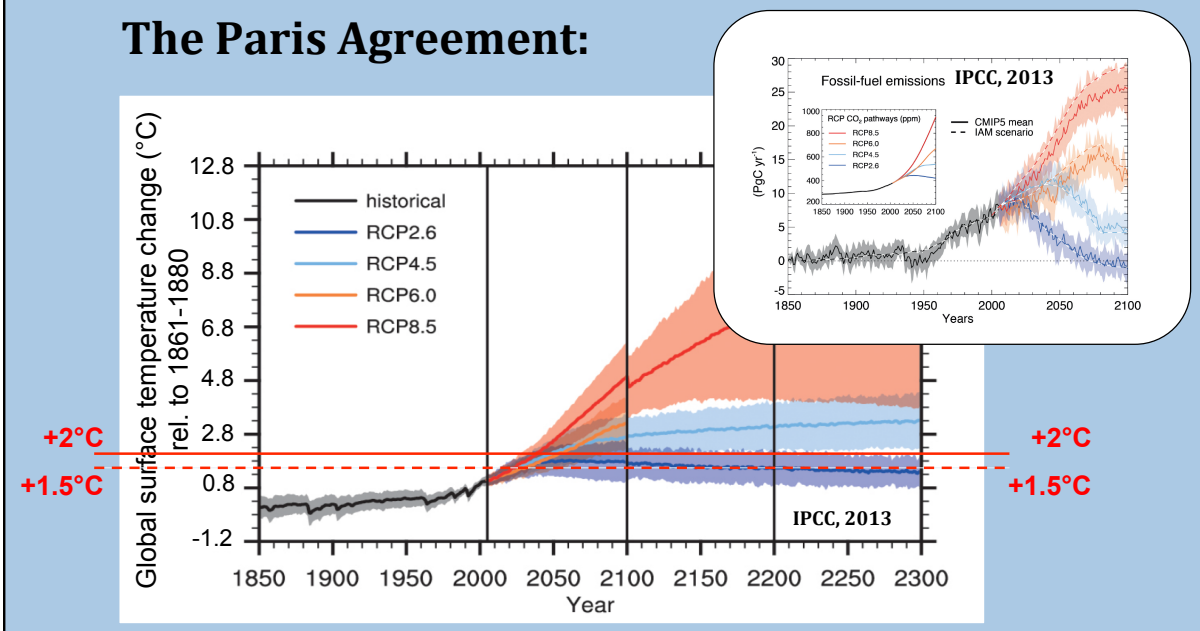
Disclaimer

- none of the past climate analogues resembles the current anthropogenic warming in all aspects
- the current warming is occurring on much shorter time scales than previous interglacial warming

- CO_2 wasn't as high as today likely for the last 2.7 Myr (probably for the last 27 Myr)
- warmer periods in the late Quaternary were warm for different reasons

=> assume that the response of Earth System components to a warming is independent of its cause

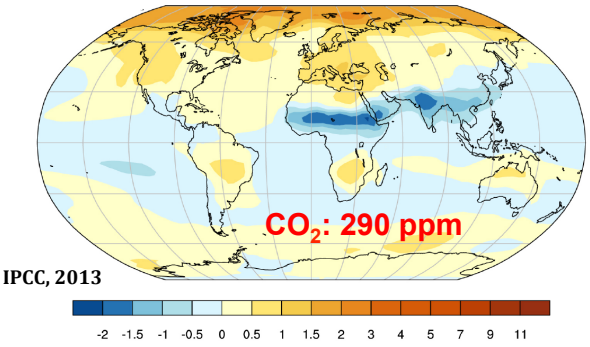
The Paris Agreement:



follow RCP2.6 in order to stay safely within the 1.5-2.0°C target

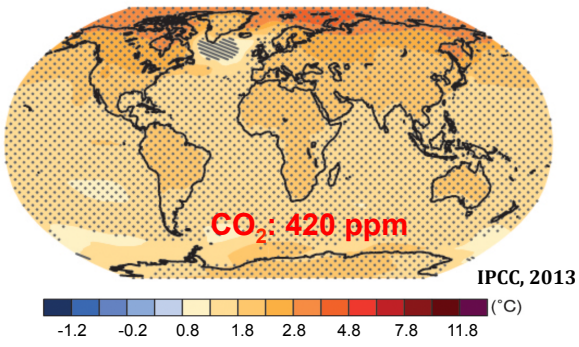
Climate at the end of 2100 for RCP2.6

Last Interglacial 128-125 kyr



Annual surface temperature change (°C) rel. to 1861-1880

RCP2.6: 2081-2100



Annual surface temperature change (°C) rel. to 1861-1880

good correspondence of LIG with RCP2.6 except in tropics (???)

Climate at the end of 2100 for RCP2.6

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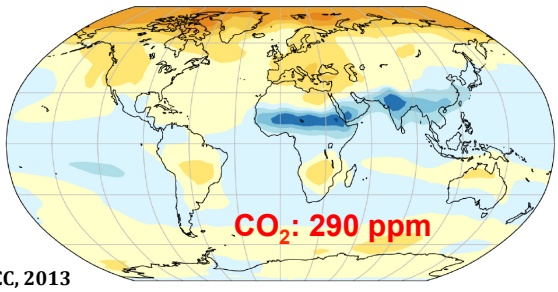
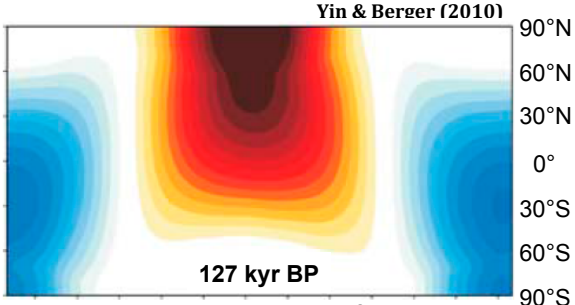


IPCC, 2013

Annual surface temperature change (°C)
rel. to 1861-1880

Yin & Berger (2010)



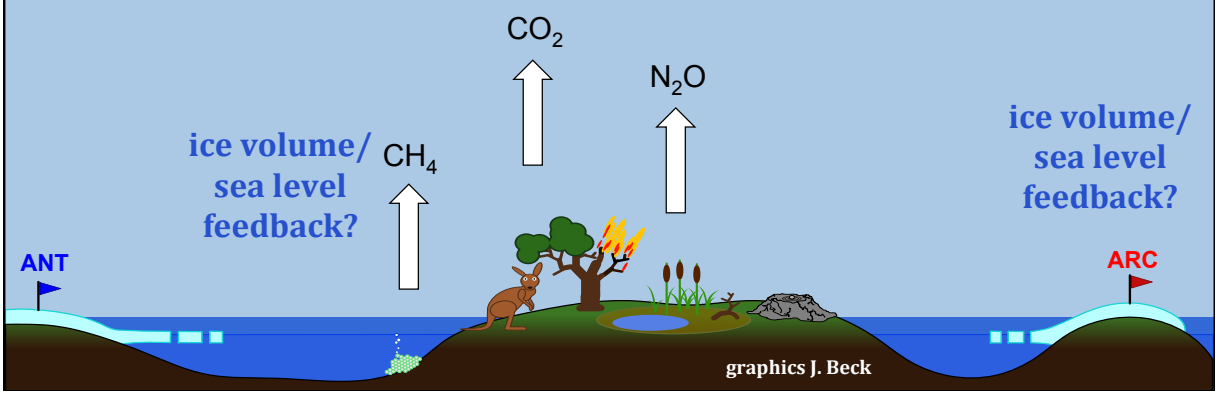
ΔS (W/m^2) rel. to present

good correspondence of LIG with RCP2.6 except in tropics (???)

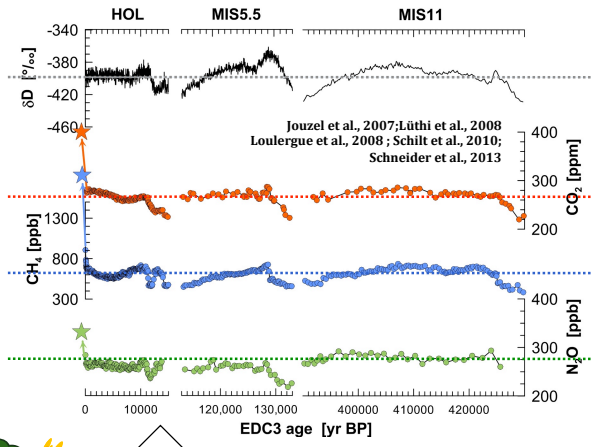
=> Last Interglacial: a reasonable analogue for a 2°C warming

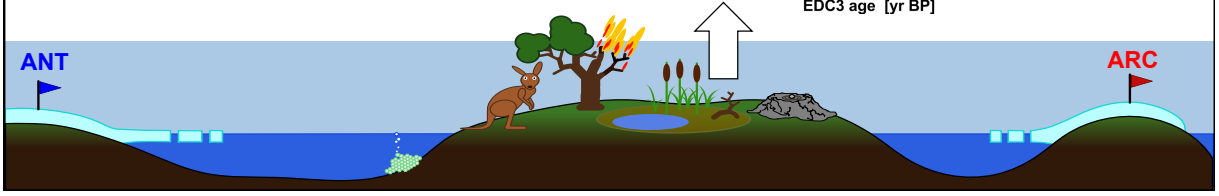
Feedbacks in the Earth System???

runaway greenhouse gas feedback?



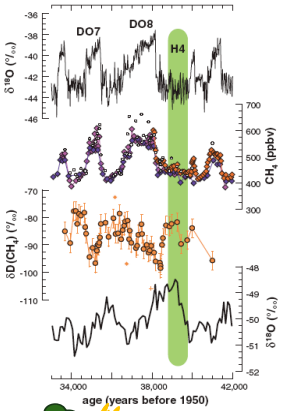
Runaway greenhouse gas feedback?

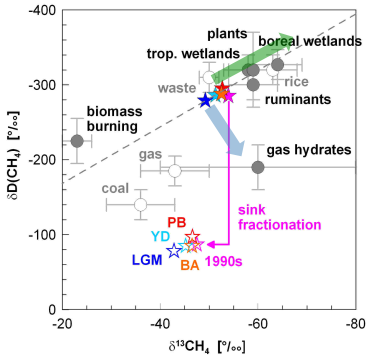




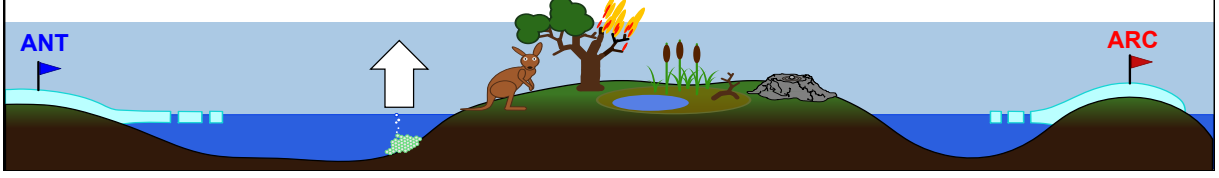
Clathrate gun: a non-starter

DO events



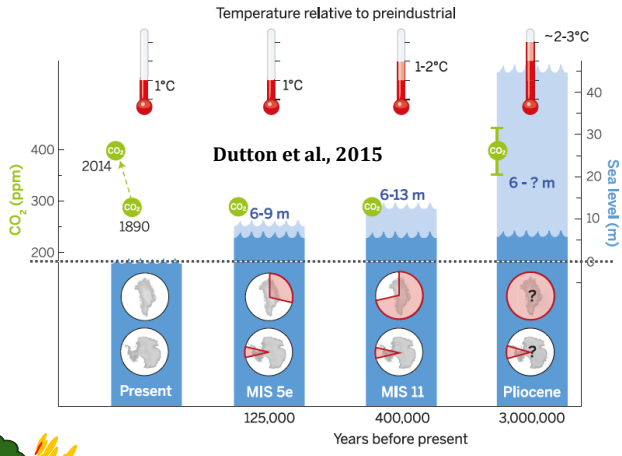


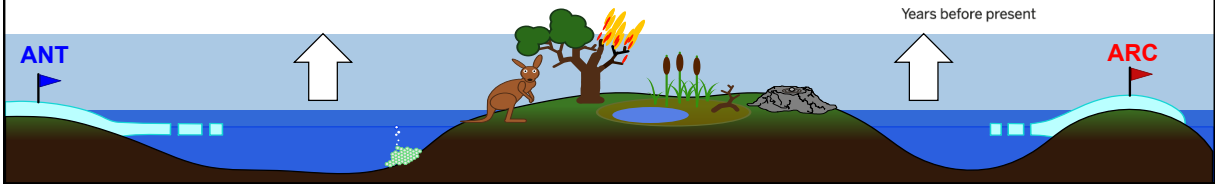
Bock et al., Uni Bern, in prep.;
Bock et al., 2010



Sea level changes - the Sword of Damocles

fossil coral reefs, geomorphological features, forams as sea level indicator (here Barbados)

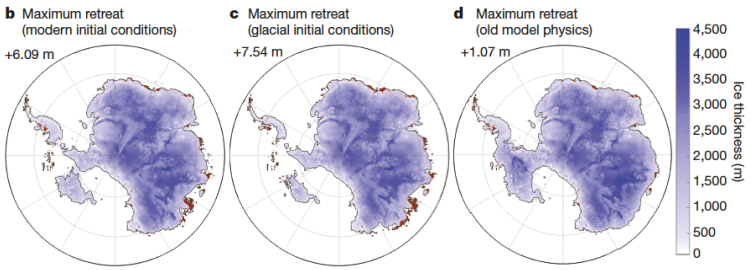




Sea level changes – the Sword of Damocles

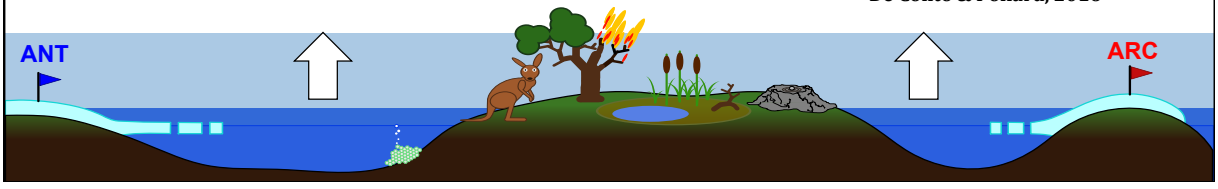
- ice sheet response of LIG and the future not the same
- however, LIG sea level the most important validation for ice sheet models
- only recently, ice sheet models sensitive enough

LIG: 2 m Greenland, >4 m Antarctica

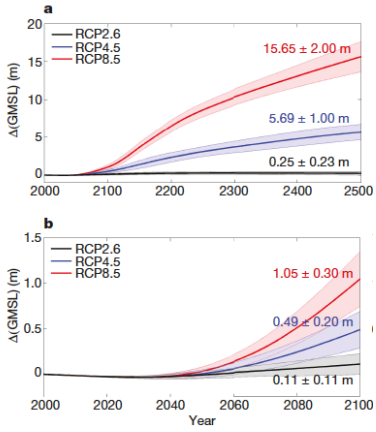


new: +6.0 m new: +7.5 m old: +1.0 m

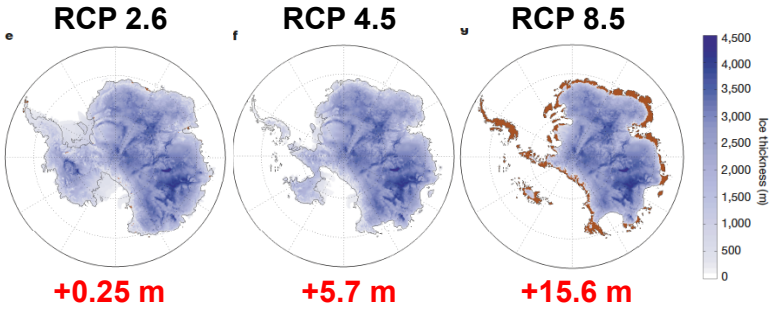
De Conto & Pollard, 2016



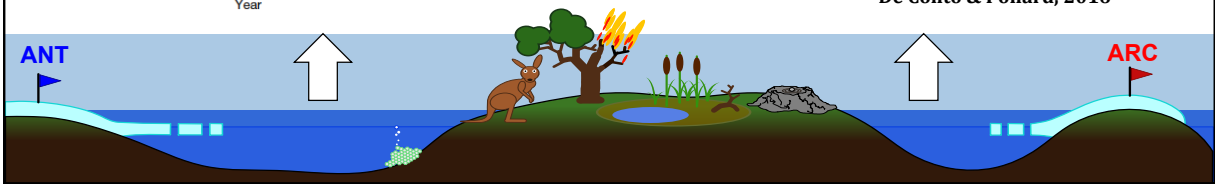
Sea level changes - the sword of Damocles



Future by 2500:



De Conto & Pollard, 2016



Take home messages

Global warming below 2°C will avoid:

- **a runaway greenhouse gas feedback**

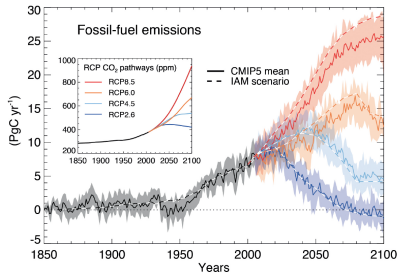
(medium to high confidence)

- **disintegration of large ice sheets**

(medium confidence)

- **disappearing Arctic summer sea ice**

(low confidence)



- **requires limiting CO_2 emissions to a strict mitigation pathway similar to RCP2.6**
- **following a less strict reduction pathway (such as RCP4.5) will likely lead to several meters of sea level rise by 2500 (medium confidence)**