

These presentation files have been put together to complement the ocean acidification resource:

The Ocean of Tomorrow

prepared by the NZ Marine Studies Centre.

Please do not print or re-use this presentation for any other purpose.

Unless otherwise stated, graphs are taken from the Intergovernmental Panel on Climate Change (IPCC) reports, 2008 – 2014.



www.marine.ac.nz

Part 4

But not just pH change!
Also sea-level rise and warming at
the same time.

Leading into activity 3B.

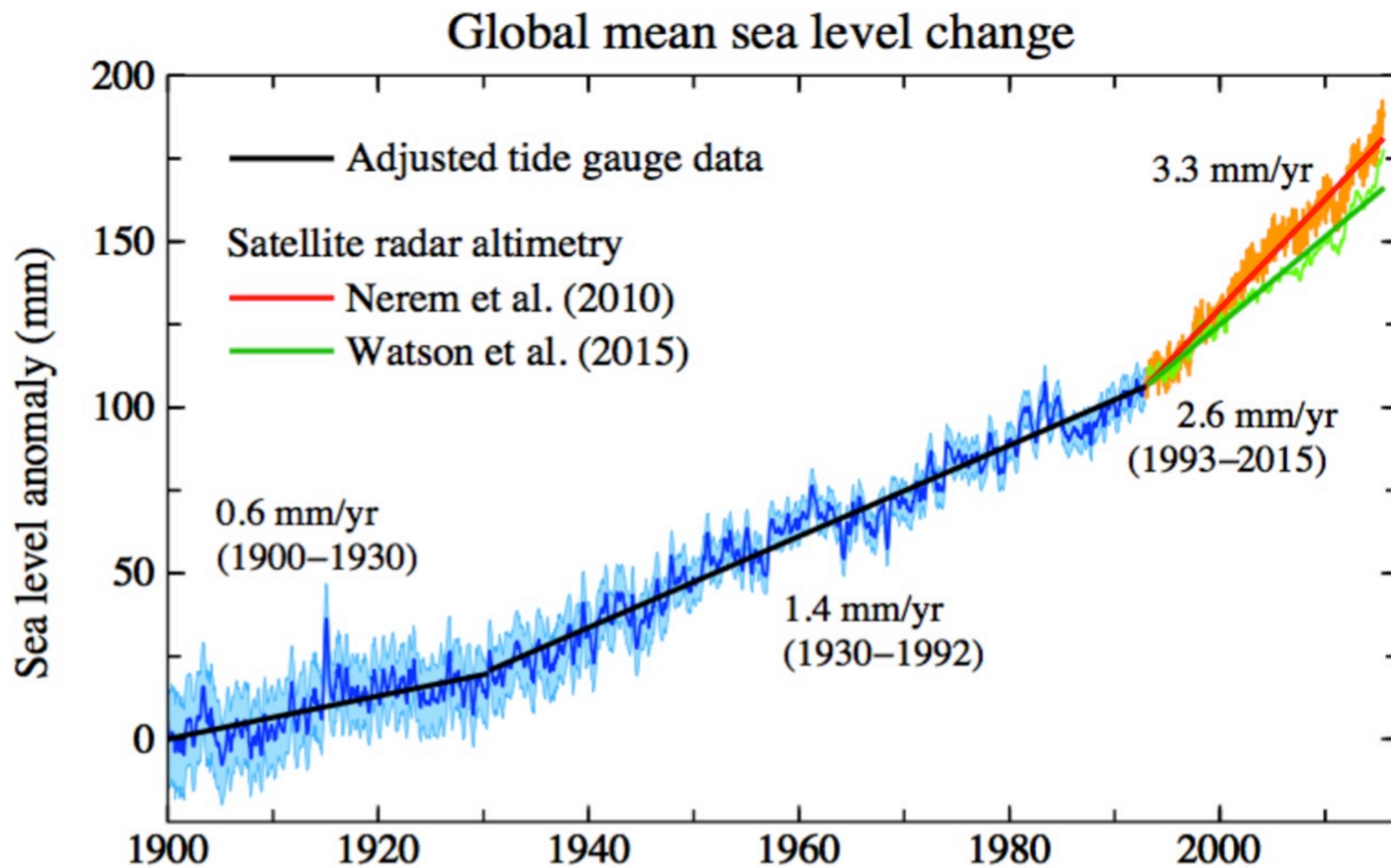
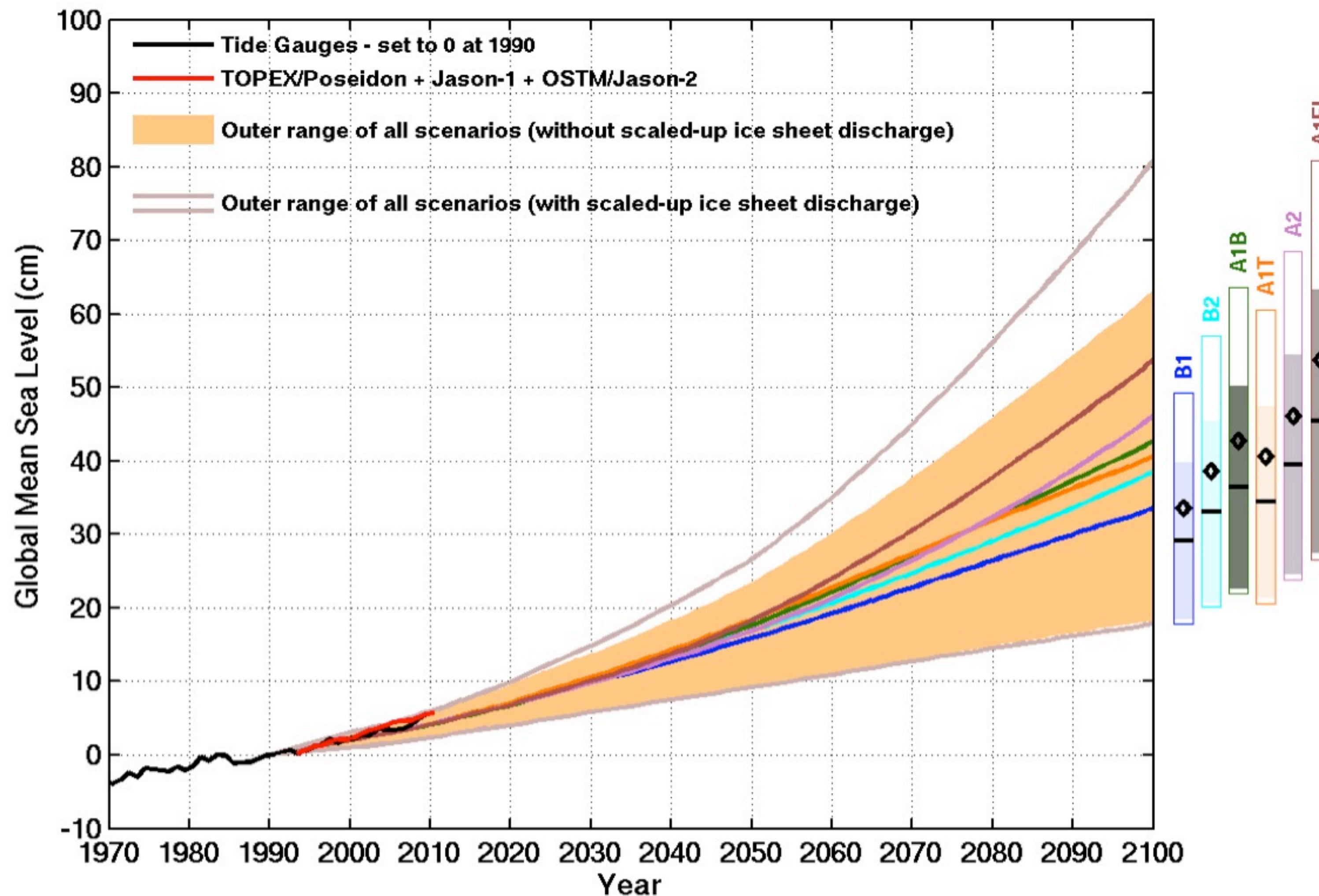


Figure 29. Estimated sea level change (mm) since 1900. Data through 1992 are the tide-gauge record of Church and White (2011) with the change rate multiplied by 0.78, so as to yield a mean 1901–1990 change rate of 1.2 mm year^{-1} (Hay et al., 2015). The two estimates for the satellite era (1993–2015) are from Nerem et al. (2010, updated at <http://sealevel.colorado.edu>) and Watson et al. (2015).

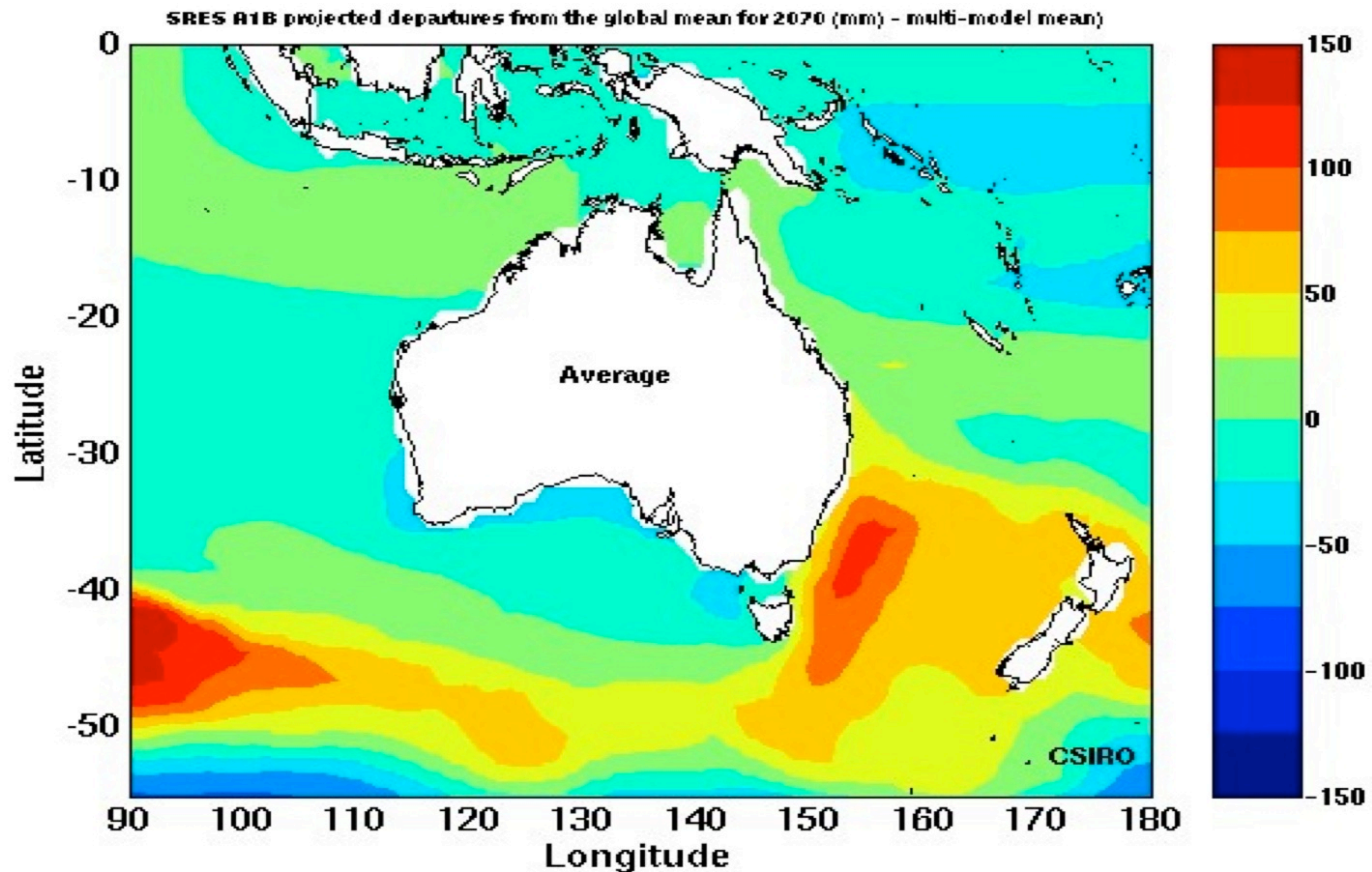
Future projections of sea-level rise.

Based on IPCC 4th assessment report from Church et al (2011)

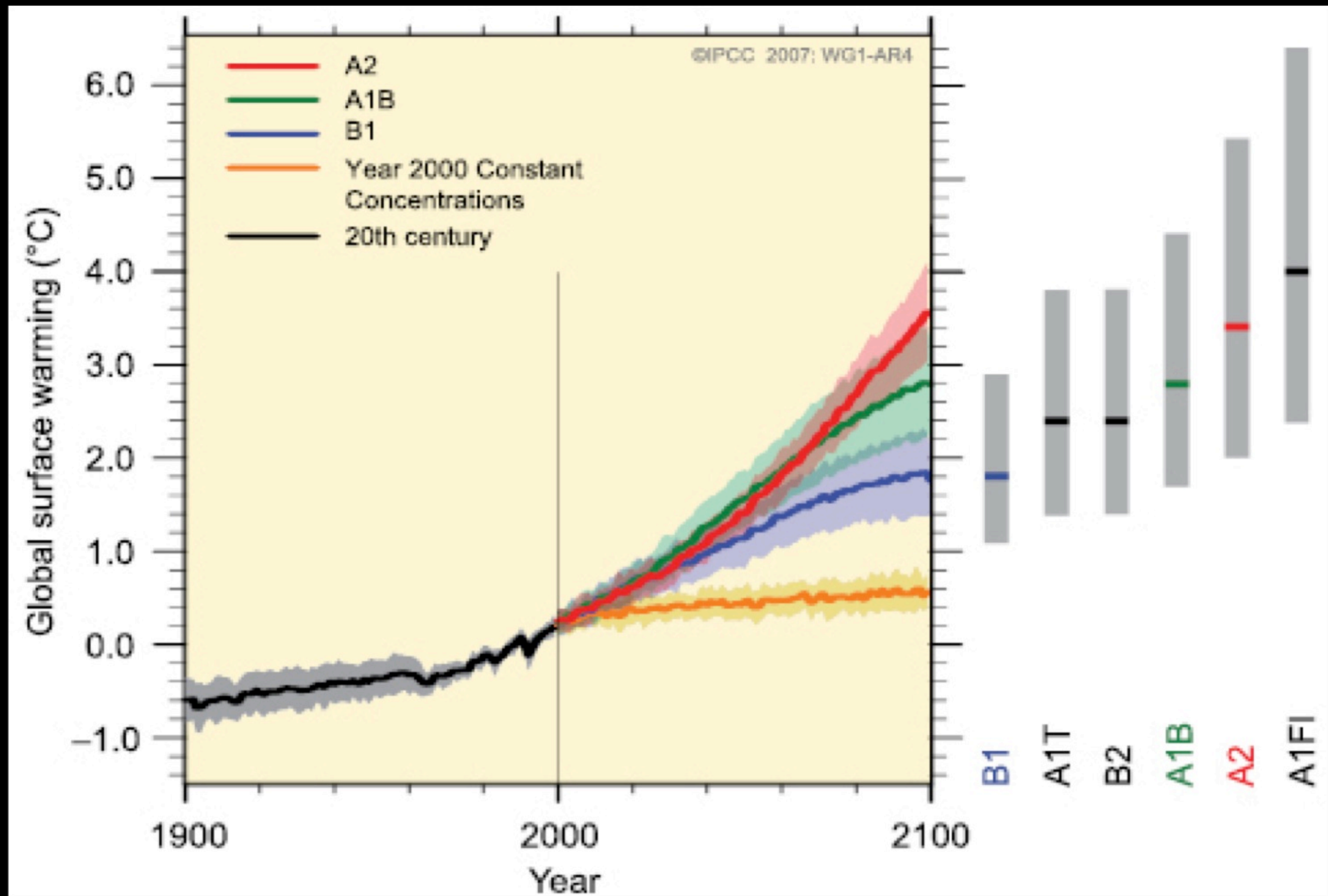


This figure shows projections of global-averaged sea-level rise for the greenhouse gas scenarios from the IPCC Special Report on Emission Scenarios (SRES) to 2100 with respect to 1990. The shaded region shows the full (5- to 95-percentile) range of projections, without scaled-up ice sheet discharge. The continuous coloured lines from 1990 to 2100 indicate the central value of the projections, including the scaled-up ice sheet discharge.

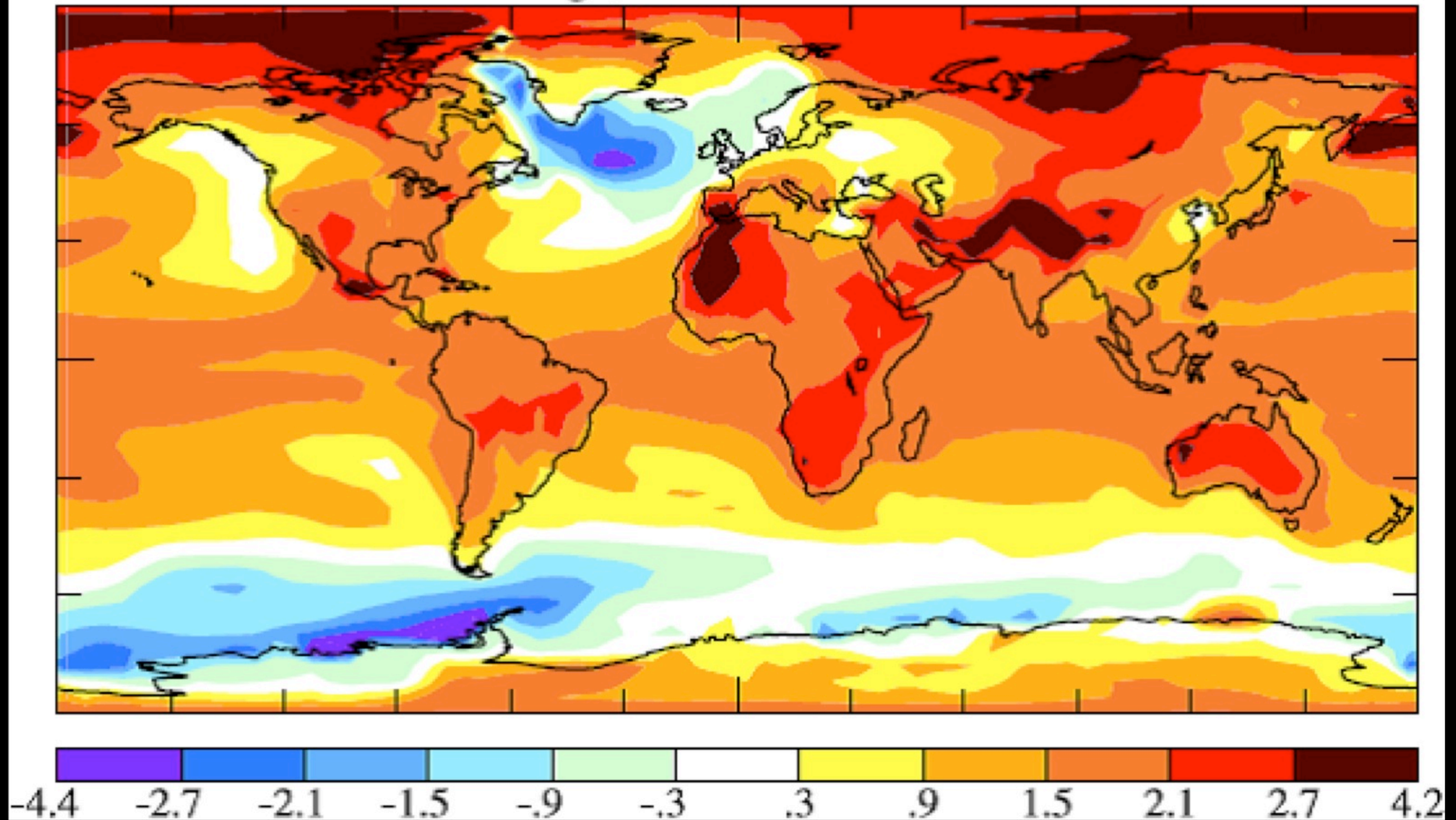
Localised differences in sea-level rise from projected global mean (2070) (NZ approx 50cm above 2000 level)



Predicted warming



2055-2060 Surface Air Temperature ($^{\circ}\text{C}$) Relative to 1880-1920
A1B + Modified Forcings, Ice Melt to 1 m 1.19



And remember the future pH predictions to add to this!

- Pre-industrial 280 ppm 8.16
- Present 400 ppm 8.05
- Double 560 ppm 7.91
- Triple 840 ppm 7.76

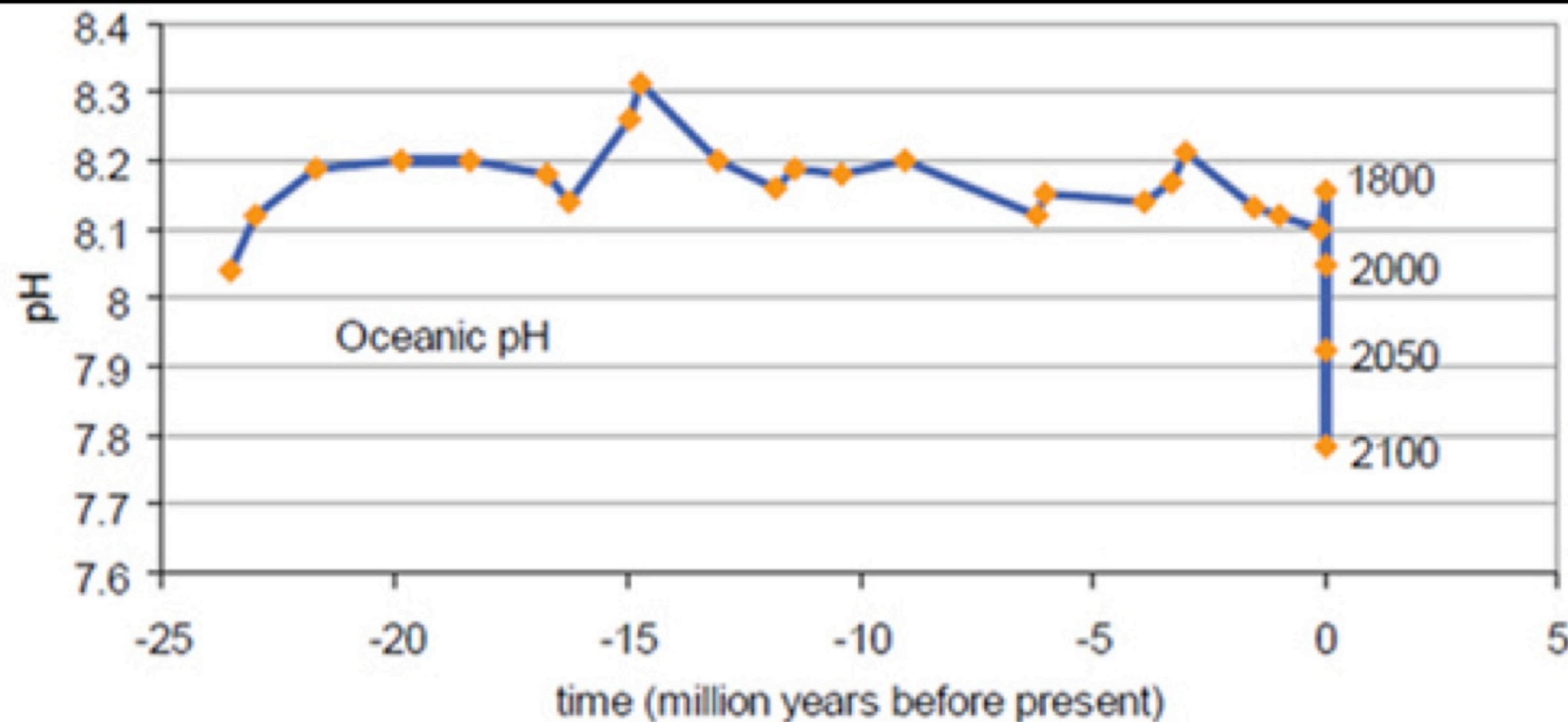
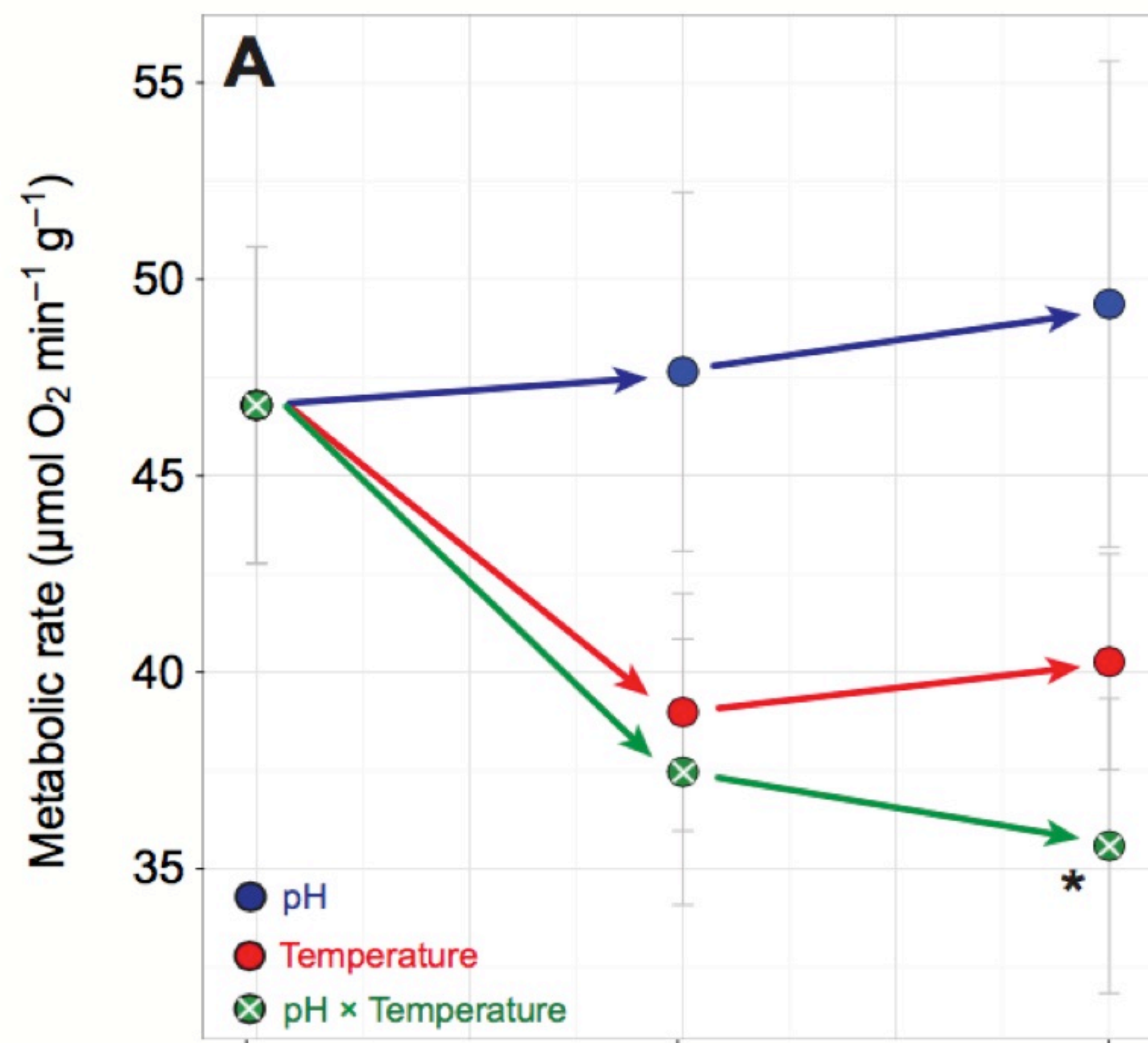


Figure 1. Past and contemporary variability of marine pH. Future predictions are model derived values based on IPCC mean scenarios (from Turley *et al*, 2006. Cambridge University Press, 8, 65-70).

- So ...
- Year 2100
- For Aotearoa
- A higher, warmer and more acidic ocean!
- Extremely rapid change compared to previous prehistoric changes.

Some experiments have shown the combined effect of seawater temperature increase AND increased acidity affect the energy available for behaviour, growth and reproduction more than a change in either one by itself

The Journal of Experimental Biology (2014) doi:10.1242/jeb.109801



More energy

Less energy

Activity 3B:

Investigation into synergistic effect of increased temperature and decreased pH on marine invertebrate behaviour

- What effect does decreased pH have on simple invertebrate behaviour?
- How does this effect compare to the effect of increased temperature?
- Does increased temperature and decreased pH have more of an effect on the behaviour?
- What do these results suggest about the future impact of increased sea temperature and increased ocean acidification?