The evolution of Plio-Pleistocene climate and potential thresholds for "catastrophic" climate change

G.L. FOSTER[1], T. CHALK[1], N.S. LORD[2], E.J. ROHLING[1,3], D.J. LUNT[2], J. TIERNEY[4]

[1]School of Ocean and Earth Science, University of Southampton, National Oceanography Centre Southampton, UK
[2]School of Geographical Sciences, University of Bristol, Bristol, UK
[3]Research School of Earth Sciences, Australia National University, Australia
[4]Department of Geosciences, University of Arizona, US

The evolution of Earth's temperature through time is a key variable of the climate system, and the nature, magnitude and patterns of temperature change during the geological past can provide unique insights into how the Earth System functions in different climate states. Yet most global scale palaeoclimate reconstructions tend to focus on discrete intervals of time meaning the details of the evolution of the climate system and any associated thresholds are obscured. Here we use a network of sea surface temperature records to reconstruct the continuous evolution of the global mean surface temperature (GMST) over the last 3.5 million years, encompassing the onset and intensification of Northern Hemisphere Glaciation (iNHG). On the whole, climate change over the last 3.5 Myr is well-correlated with radiative forcing from CO_2 and land-ice change, with all the data adequately being explained by an equilibrium climate sensitivity of 2.7 ± 0.42 ^oC per CO_2 doubling. Our record of GMST also reveals that during those late Pliocene interglacials with similar to modern insolation, GMST from around +2.5-6.0 ^oC warmer than the pre-industrial (95% confidence) were associated with complete collapse of the West Antarctic Ice Sheet (Naish et al. 2009), >50% loss of the Greenland Ice Sheet (Bierman et al., 2016) and at least some portion of the East Antarctic Ice Sheet (Bertram et al., 2018). This finding places attempts to limit anthropogenic global warming to <2 ^oC into important context and suggests that failure to achieve these targets risks catastrophic long-term sea-level rise.

Bertram, R.A. et al. (2018) *Earth and Planetary Science Letters*, 494, 109-116.
Bierman, P.R. et al. (2016) *Nature,* 540, 256-260
Naish, T. et al. (2009) *Nature,* 458, 322-328.