SORS: Exploring climate stabilisation under net zero emissions

Abstract

Under the Paris Agreement, signatory nations aim to keep global warming well below 2°C above pre-industrial levels and preferably below 1.5°C. This implicitly requires achieving net-zero or net-negative greenhouse gas emissions to ensure long-term global temperature stabilisation or reduction. Despite this requirement, there have been few analyses of stabilised climates and there is a lack of model experiments to address our need for understanding the implications of the Paris Agreement for the Earth system. In this presentation I'll discuss analyses that demonstrate the need for explicitly examining climate stabilisation scenarios for making policy-relevant climate projections. I will then describe a new set of experiments using the Australian Community Climate and Earth System Simulator earth system model (ACCESS-ESM-1.5) that enables analysis of climate evolution under net-zero emissions. We ran seven 1000-year long simulations were run with global temperatures stabilising at levels in line with the Paris Agreement and at a range of higher global warming levels. I'll provide a brief overview of the experimental design and show how these model simulations may be used to understand possible net-zero emissions climates. There are major consequences of delayed attainment of global net-zero carbon dioxide emissions for different aspects of the climate system. As the climate stabilises under net-zero emissions, we identify significant and robust changes in temperature and precipitation patterns including continued Southern Ocean warming and reversal of transient mid-latitude drying trends. Regional climate changes under net-zero emissions differ greatly including contrasting trajectories of sea ice extent between the Arctic and Antarctic. While Arctic sea ice extent is projected to stabilise under net-zero emissions, sustained Southern Ocean warming is associated with continued sea ice decline in the Antarctic. We also examine the El Niño-Southern Oscillation (ENSO) and find evidence of reduced amplitude and frequency of ENSO events under climate stabilisation relative to projections under transient warming. An analysis at specific global warming levels shows significant regional changes continue for centuries after emissions cessation. Our findings suggest substantial long-term climate changes are possible even under net-zero emissions pathways. We have more work underway to try and improve our understanding of the climate consequences of net zero emissions. We hope these simulations will be of use to the community and that they motivate further experiments and analyses based on other earth system models.

Short Bio

Andrew King is an Associate Professor in Climate Science at the School of Geography, Earth and Atmospheric Sciences at the University of Melbourne and a Chief Investigator in the ARC Centre of Excellence for the Weather of the 21st Century. Andrew is interested in climate change processes, projections under the Paris Agreement and net zero emissions pathways, and understanding climate extremes. He completed his PhD in Climate Science in 2015 at UNSW and since then has worked at the University of Melbourne. Andrew is a former ARC DECRA Fellow and will start an ARC Future Fellowship in mid-2025.

Speakers

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