Session: C32 Poster: W126A

Is the climate-carbon cycle response to CO2 emissions path dependent?

Kirsten Zickfeld[†]; Nathan Gillett; Vivek Arora
[†] Simon Fraser University, Canada
Leading author: kzickfel@sfu.ca

Recent studies with coupled climate-carbon cycle models suggest that global mean temperature change is proportional to cumulative CO2 emissions, independent of the timing of those emissions. This finding has prompted the suggestion that climate stabilization targets, such as the 2oC target adopted by the Copenhagen Accord, should be expressed in terms of cumulative emissions. Here we examine the simulated response of a range of global and regional climate variables to the same cumulative CO2 emissions (2500 PgC) released along different pathways using a complex Earth system model (CanESM1). We find that for a range of future emissions scenarios the century-scale response of most surface climate variables is largely independent of the emissions pathway once emissions cease. By contrast, variables with longer response timescales, such ocean heat content and thermosteric sea level rise, exhibit stronger path-dependence. As expected, prior to the cessation of emissions, climate variables are path-dependent, and in particular peak responses of variables such as CO2 concentration, surface ocean pH and sea ice cover are found to be dependent on the emissions pathway. We conclude that a policy framework based on cumulative emissions is well suited for global mean temperature and precipitation, but is less effective in limiting changes in other climate variables whose peak response is less well correlated with cumulative emissions.