Geophysical Research Abstracts
Vol. 18, EGU2016-284-1, 2016
EGU General Assembly 2016


# How much would five trillion tonnes of carbon warm the climate?

Katarzyna (Kasia) Tokarska (1), Nathan P. Gillett (2), Andrew J. Weaver (1), and Vivek K. Arora (2)

(1) School of Earth and Ocean Sciences, University of Victoria, Victoria, British Columbia, Canada (tokarska@uvic.ca), (2) Canadian Centre for Climate Modelling and Analysis, Environment Canada, Victoria, British Columbia, Canada

While estimates of fossil fuel reserves and resources are very uncertain, and the amount which could ultimately be burnt under a business as usual scenario would depend on prevailing economic and technological conditions, an amount of five trillion tonnes of carbon (5 EgC), corresponding to the lower end of the range of estimates of the total fossil fuel resource, is often cited as an estimate of total cumulative emissions in the absence of mitigation actions. The IPCC Fifth Assessment Report indicates that an approximately linear relationship between warming and cumulative carbon emissions holds only up to around 2 EgC emissions. It is typically assumed that at higher cumulative emissions the warming would tend to be less than that predicted by such a linear relationship, with the radiative saturation effect dominating the effects of positive carbon-climate feedbacks at high emissions, as predicted by simple carbon-climate models.

We analyze simulations from four state-of-the-art Earth System Models (ESMs) from the Coupled Model Intercomparison Project Phase 5 (CMIP5) and seven Earth System Models of Intermediate Complexity (EMICs), driven by the Representative Concentration Pathway 8.5 Extension scenario (RCP 8.5 Ext), which represents a very high emission scenario of increasing greenhouse gas concentrations in absence of climate mitigation policies. Our results demonstrate that while terrestrial and ocean carbon storage varies between the models, the $CO_2$-induced warming continues to increase approximately linearly with cumulative carbon emissions even for higher levels of cumulative emissions, in all four ESMs. Five of the seven EMICs considered simulate a similarly linear response, while two exhibit less warming at higher cumulative emissions for reasons we discuss. The ESMs simulate global mean warming of 6.6-11.0°C, mean Arctic warming of 15.3-19.7°C, and mean regional precipitation increases and decreases by more than a factor of four, in response to 5EgC, with smaller forcing contributions from other greenhouse gases. These results indicate that the unregulated exploitation of the fossil fuel resource would ultimately result in considerably more profound climate changes than previously suggested.