Geophysical Research Abstracts
Vol. 16, EGU2014-15544, 2014
EGU General Assembly 2014

Temperature response to an emission of carbon dioxide today

Katharine Ricke and Ken Caldeira
Carnegie Institution for Science, Stanford, United States (kricke@carnegiescience.edu)

It is well known that carbon dioxide (CO_2) emissions cause the Earth to warm, but there is substantial uncertainty in just how much warming will be caused by any particular CO_2 emission. Here, by combining the results of a carbon-cycle model intercomparison project (Joos et al, 2013) and CMIP5 physical-climate model intercomparison project (Taylor et al, 2012), we estimate the amount and timing of warming caused by an individual CO_2 emission occurring today. We quantify the uncertainty in these estimates, portioning it into three different contributing factors: the carbon cycle response, climate sensitivity and ocean thermal inertia. We find that uncertainty in equilibrium climate sensitivity is the largest contributor to aggregate uncertainty in the temperature change resulting from a CO_2 emission, but carbon-cycle uncertainties and uncertainty in the thermal inertia of the climate system also play important roles. The time interval between an emission and maximum warming is estimated to have a median value of 10 years, with a likely (66% probability) range of 8 to 18 years. The amount of maximum warming is estimated to have a maximum value of 2.2 mK GtC-1, with a likely range of 1.8 to 2.6 mK GtC-1. Thus, the greatest warming from a typical emission today is likely to occur during the lifetime of the person doing the emitting. Our analysis provides an approximation of the time series for incremental warming caused by CO_2 emitted today that spans the uncertainty range of model results, yet is simple enough to be employed in a broad range of climate change assessment applications.