



3<sup>rd</sup> International Symposium on  
**E**nergy **C**hallenges & **M**echanics  
- towards a big picture

7-9 July 2015  
Aberdeen, Scotland, UK

## **If anthropogenic CO<sub>2</sub> emissions cease, will atmospheric CO<sub>2</sub> concentration continue to increase?**

Andrew H MacDougall

*Institute for Atmospheric and Climate Science, ETH Zurich, Zurich Switzerland*

Accepted for publication on the 22nd of January 2015

After the cessation of industrial fossil fuel emissions the evolution of atmospheric CO<sub>2</sub> concentration will depend on the relative strength of natural carbon cycle feedbacks. Under present conditions these feedbacks act to remove about half of the carbon emitted to the atmosphere, greatly mitigating the severity of climate change. Under simulated conditions where fossil fuel emissions are no longer being added to the atmosphere the carbon cycle feedbacks are altered such that the terrestrial biosphere transitions from a net carbon sink to a net carbon source. Whether atmospheric CO<sub>2</sub> concentration continues to increase, or decreases, following cessation of emissions therefore depends on the strength of the uptake of carbon by the ocean.

Here results from a set of climate model experiments investigating the post cessation carbon cycle are presented. The model simulations suggest that above a critical threshold of radiative forcing from non- CO<sub>2</sub> greenhouse gases that atmospheric CO<sub>2</sub> concentration will continue to increase following the complete cessation of industrial CO<sub>2</sub> emissions. The magnitude of this threshold is critically depended on equilibrium climate sensitivity. For a climate sensitivity of 3°C per doubling of CO<sub>2</sub> the threshold is 0.6 Wm<sup>-2</sup>. These model results suggest that if industrial CO<sub>2</sub> emissions were to cease tomorrow, atmospheric CO<sub>2</sub> concentration would continue to slowly increase for centuries.

**Keywords:** Climate change, climate model, carbon cycle feedbacks