Geophysical Research Abstracts
Vol. 21, EGU2019-12207, 2019
EGU General Assembly 2019

Two-timescale carbon cycle response to an AMOC collapse

Søren Borg Nielsen (1), Markus Jochum (1), Joel B Pedro (2,3), Carsten Eden (4), and Roman Nuterman (1)

(1) University of Copenhagen, Niels Bohr Institute, Physics of Ice, Climate and Earth, Copenhagen, Denmark (soeren.nielsen@nbi.ku.dk), (2) Antarctic Climate and Ecosystems CRC, University of Tasmania, Hobart, Australia, (3) UNI Research AS, Bergen, Norway, (4) Institut für Meereskunde, University of Hamburg, Hamburg, Germany

Atmospheric CO_2 concentrations (pCO_2) varied on millennial timescales in phase with Antarctic temperature during the last glacial period. A prevailing view has been that carbon release and uptake by the Southern Ocean dominated this millennial-scale variability in pCO_2. Here, using Earth System Model experiments with an improved parameterization of ocean vertical mixing, we find a major role for terrestrial and oceanic carbon releases in driving the pCO_2 trend. In our simulations, a change in northern hemisphere insolation weakens the Atlantic Meridional Overturning Circulation leading to increasing pCO_2 and Antarctic temperatures. The simulated rise in pCO_2 is caused in equal parts by increased CO_2 outgassing from the global ocean due to a reduced biological activity and changed ventilation rates, and terrestrial carbon release as a response to southward migration of the Intertropical Convergence Zone. The simulated terrestrial release of carbon could explain stadial declines in organic carbon reservoirs observed in recent ice core δ^{13}C measurements. Our results show that parallel variations in Antarctic temperature and pCO_2 do not necessitate that the Southern Ocean dominates carbon exchange; instead changes in carbon flux from the global ocean and land carbon reservoirs can explain the observed pCO_2 (and δ^{13}C) changes.