Effect of the Atlantic Meridional Overturning Circulation on atmospheric pCO2

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The Atlantic Meridional Overturning Circulation (AMOC) plays an important role in regulating the climate of the Northern Hemisphere. Several studies have shown that the AMOC can be in two stable states under equal forcing. This bistability, and associated tipping behavior, has been suggested as a mechanism for climate transitions in the past such as the Dansgaard-Oescher events. The relationship between AMOC variability and that in atmospheric pCO2 concentration is still unclear since different studies provide contradictory results. Here, we investigate this relationship using the Simple Carbon Project Model v1.0 (SCP-M), which we extended to represent a suite of nonlinear carbon cycle feedbacks. By implementing SCP-M in the continuation and bifurcation software AUTO-07p, we can efficiently explore the multi-dimensional parameter space to address the AMOC - pCO2 relationship while varying the strengths of the carbon cycle feedbacks. We do not find multiple equilibria in the carbon-cycle dynamics, with fixed AMOC, but there are intrinsic oscillations due to Hopf bifurcations with multi-millennial periods. The mechanisms of this variability, related to biological production and to calcium carbonate compensation, will be presented and their relevance is addressed.