

# Meridional reorganizations of marine and terrestrial productivity during Heinrich events

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Short title: DYNAMIC CO<sub>2</sub> RESPONSE TO A FRESHWATER INPUT INTO THE  
NORTH ATLANTIC

**Abstract.** Freshwater perturbation experiments under pre-industrial and glacial conditions are conducted with an Earth system model of intermediate complexity (LOVECLIM) to study the response of the global carbon cycle to a weakening of the Atlantic Meridional Overturning Circulation (AMOC). A shutdown of the AMOC leads to substantial cooling of the North Atlantic, a weak warming of the southern hemisphere, intensification of the northeasterly trade winds and a southward shift of the Intertropical Convergence Zone (ITCZ). This in turn drives changes of tropical upwelling and hence of marine productivity and of terrestrial primary productivity, respectively. The freshwater perturbation experiments simulate a reduction of terrestrial carbon stocks mainly in northern Africa and northern Latin America, both under pre-industrial and glacial conditions. The ocean acts as a sink of CO<sub>2</sub>, primarily through increased solubility. The net atmospheric CO<sub>2</sub> anomaly due to the AMOC shutdown amounts to about +15 ppmv and -10 ppmv for pre-industrial and glacial conditions, respectively. This discrepancy can be explained by the fact that the glacial climate is drier and the terrestrial vegetation therefore releases a smaller amount of carbon to the atmosphere. The modeling results are compared in detail with available paleo-proxy data for ocean productivity, vegetation and atmospheric CO<sub>2</sub>.