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Multiple causes of the Younger Dryas cold period: new insights from coupled model experiments constrained by data assimilation

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The Younger Dryas cooling event disrupted the overall warming trend in the North Atlantic region during the last deglaciation. Climate change during the Younger Dryas was abrupt, and thus provides insights into the sensitivity of the climate system to perturbations. The sudden Younger Dryas cooling has traditionally been attributed to a shut-down of the Atlantic meridional overturning circulation by meltwater discharges. However, alternative explanations such as strong negative radiative forcing and a shift in atmospheric circulation have also been offered. In this study we investigate the importance of these different forcings in coupled climate model experiments constrained by data assimilation. We find that the Younger Dryas climate signal as registered in proxy evidence is best simulated using a combination of processes: a weakened Atlantic meridional overturning circulation, moderate negative radiative forcing and an altered atmospheric circulation. We conclude that none of the individual mechanisms alone provide a plausible explanation for the Younger Dryas cold period. We suggest that the triggers for abrupt climate changes like the Younger Dryas are more complex than suggested so far, and that studies on the response of the climate system to perturbations should account for this complexity.

Reference: Renssen, H. et al. (2015) Multiple causes of the Younger Dryas cold period. Nature Geoscience 8, 946-949.