



## **Probabilistic hindcasts and projections of the coupled climate, carbon cycle, and Atlantic meridional overturning circulation systems**

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How has the Atlantic Meridional Overturning Circulation (AMOC) varied over the past centuries and what is the risk of an anthropogenic AMOC collapse? Current AMOC projections have broken important new ground, but either use only a small subset of the relevant observational constraints or sample mostly in the region around the best parameter estimates.

Here we improve on previous studies by (i) greatly expanding the considered observations and (ii) carefully sampling the tail areas of the parameter probability distribution (pdf). We use a Bayesian inversion to fuse observations covering the last two centuries with a simple model of the coupled climate, carbon cycle, and AMOC systems to derive multi-century hindcasts and projections.

Our hindcasts show considerable skill in representing the observational constraints. We show that robust AMOC risk estimates can require carefully sampling the tails of the pdfs. The probability of experiencing an AMOC collapse within the 21st century is less than ten percent in our model for a business-as-usual emissions scenario. However, the probability of crossing a forcing threshold during the 21st century and committing to a future collapse is 40 percent in this scenario. The probability of an AMOC collapse within the next two centuries exceeds 50 percent.