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# Investigating the Impact of $CO_2$ on the Strength and Variability of the AMOC

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The strength and variability of the AMOC has important implications for North Atlantic climate, including sea surface temperature (SST), surface air temperature (SAT), and precipitation. It is crucial to understand how the AMOC may respond to anthropogenic climate change. A number of modelling studies have shown that increasing $CO_2$ will weaken the AMOC, however the impact on the characteristics (i.e. frequency/ amplitude) of variability remains uncertain and highly dependant on the model used.

This study uses the HadCM3 coupled climate model, run for 2000 years at a range of equilibrium $CO_2$ concentrations. At 350ppm, the AMOC shows basin-wide variability with a dominant timescale between 100-125 years. We show that higher concentrations of $CO_2$ reduce not only the overall strength of the AMOC, but also weaken its variability on centennial timescales. This has consequent impacts on SSTs, SATs and precipitation during periods of maximum AMOC. The reduction in AMOC strength is primarily linked to temperature driven density changes in downwelling regions (i.e. the GIN seas). In contrast, variability is dictated by salinity-driven density changes, which reduce stratification and increase convection initiating a strong phase of the AMOC. Lagged correlation analysis indicates that salinity anomalies are advected into the GIN seas prior to an AMOC maximum, primarily from the Arctic. Higher concentrations of $CO_2$ are linked to a weaker build-up and advection of these anomalies, reducing the extent to which the AMOC varies. This may reflect the reduction in overall strength of AMOC, increased stratification and so reduced convection.