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COUPLED MODELS, CLIMATE VARIABILITY AND FLUX ADJUSTMENTS

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Coupled climate system models play a vital role in the study of anthropogenic climate change. As well as being used to predict future changes, they are also used to simulate the natural variability that occurs within the climate system. Understanding of this variability is fundamental to the detection of anthropogenic change.

In order to properly study natural climate variability using a coupled model, millennial-scale simulations are required. However, flux adjustments are generally required in order to obtain a control climate that is both realistic and stable on such timescales. These artificial adjustments to the fluxes of heat, freshwater and momentum between the atmosphere and the ocean can be larger in magnitude than the underlying physical processes. Their effect on the simulated natural variability, and on the simulated response to external forcing, requires careful consideration.

This study uses a coarse-resolution coupled atmosphere-sea ice-ocean general circulation model. Control simulations are carried out both with and without the use of traditional flux adjustments. An alternative approach is also tested, whereby the flux adjustments are zonally averaged across each of the ocean basins. This enables any errors in the simulated meridional transport to be corrected, while reducing the magnitude of the adjustments such that they become small relative to the underlying physical processes. The same model configurations are also used to simulate the changes that would occur if the atmospheric CO_2 concentration were ultimately to be stabilised at three times its pre-industrial value. The simulated natural variability is examined, as is

the effect of the flux adjustments on both the simulated variability and the simulated changes arising from increased atmospheric CO_2.