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Investigating the Feedbacks between Land Surface Cover and North Atlantic Climate Variability in the HadCM3 Climate Model

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The North Atlantic displays a number of major modes of decadal variability, namely the North Atlantic Oscillation (NAO) and the Atlantic Meridional Overturning Circulation (AMOC). A number of studies have investigated the role of oceanic and atmospheric forcing in modulating variability, however the feedbacks between the land surface and Atlantic variability have not been examined to the same degree. The land surface influences climate via biogeophysical and biogeochemical processes which interact and vary across a wide range of spatial and temporal scales. Increasing concentrations of CO_2 are expected to drive a change in the distribution and physiology (i.e. stomatal conductance and leaf area index) of vegetation, which can alter land surface structure and influence biogeophysical processes. It is important to more accurately constrain if/how land surface cover influences North Atlantic modes of variability and the associated feedback mechanisms and how these may change in a warming climate.

This sensitivity study will use the HadCM3 climate model to investigate the impact of a range of vegetation distributions, including the role of fixed and dynamic vegetation and the possible impact of crops, on the strength and variability of the AMOC/NAO at increasing CO_2 concentrations. Each simulation will be run for 2000 years in order to provide a clear statistical signal. We aim to elucidate feedbacks between the land surface, ocean and atmosphere in a coupled climate model and potential implications for decadal modelling studies.