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Does the climate change signal project onto the NAO / NAM?

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Many studies have analysed the response of climate models to greenhouse gas forcing and concluded that the circulation response projects onto the positive phase of the North Atlantic Oscillation (NAO) or Northern Annular Mode (NAM). However, most studies focus exclusively on the sea level pressure field. Here we use data from the CMIP3 multi-model ensemble and compare the vertical structure of the model responses to that associated with the NAM. While NAM variations are equivalent barotropic, the response to greenhouse forcing is shown to be strongly baroclinic. While the models in general predict stronger mid-latitude westerlies at the surface, many of them actually predict weaker westerlies in the mid-troposphere. This strongly baroclinic response is shown to be the simple hydrostatic signature of the uneven distribution of atmospheric warming, which is enhanced at low-levels over the Arctic and at upper levels in the tropics. The models are not, in general, predicting circulation responses which are large enough to re-distribute the heat and so dominate over the baroclinic signature.