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Is the observed NAO variability during the instrumental record unusual?

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It is shown that the long-term NAO changes observed during the instrumental record including the recent strongest positive trends may be reproduced in control (without external forcing) simulations with coupled atmosphere-ocean GCMs. The simulated NAO exhibits significant changes on multi-decadal and even multi-centennial time scales. This strongly suggests that longer millennium time scale control simulations (at least of several thousand years) are needed in order to infer the range of natural NAO variability. These conclusions are crucially dependent on the models' ability to realistically simulate the real climate variability. Here, we base our confidence in the model results on a reasonable agreement of the simulated DJFM SLP variability in comparison to the NCEP reanalysis. The largest observed trend exceeds the 99% percentile of the simulated trend distribution for both control simulations considered here, confirming a very low probability of such a trend. In this respect, our results do not contradict other studies. We choose, however, a different perspective to interpret the unusualness of the long-term observed NAO changes. Based on a goodness-of-fit test applied to the observed and simulated trend distributions, we argue that the null hypothesis that the observed sample of climatic NAO trends and simulated trends (by the Kiel Climate Model and MPI Climate Model) are drawn from the same distribution may not be rejected. The result, however, does not disprove the hypothesis of external forcing, which is not considered here. The long term variations of the NAO properties simulated by the coupled models indicate that the instrumental NAO record is not long enough to estimate the level of natural variability. Thus longer and reliable NAO

reconstructions from paleo archives are very important.