Geophysical Research Abstracts
Vol. 20, EGU2018-15215, 2018
EGU General Assembly 2018

What can we say about large scale ocean variability from local scale shelf-sea reconstructions

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The North Atlantic Ocean experiences multi-decadal variability that is not well understood due to the limited timespan of ocean observation. Given the importance of North Atlantic conditions to the regional climate of Europe and North America, ocean modellers seek improved understanding of this variability and the mechanisms that might cause it. We consider the capacity of networks of multi-centennial sclerochronological oxygen isotope datasets from marine bivalves located around the Atlantic basin to reveal multi-decadal variability over the last millennium. Multi-centennial sclerochronological datasets provide annually resolved and absolutely dated records of marine variability on the continental shelf. When these records are extended into the pre-industrial they provide a uniquely valuable insight into multi-decadal variability. Common variability between individual sites over a region can be used by sclerochronologists to infer broad scale regional oceanographic changes, but across the whole North Atlantic, ocean and atmosphere responses to climatic forcings may have complex fingerprints (different sites may exhibit different, potentially opposite, responses to the same forcing). Here we use high resolution models to consider what these coastal locations can tell us about broader Atlantic climate variability. We subsample sclerochronology site locations in the model output and look at the relationship between variability at the sites to the wider Atlantic basin in several different types of models. We examine multi-centennial control simulations from coupled climate models with approximately 1 degree ocean resolution (e.g. CMIP5 archive used in IPCC AR5), a state of the art high resolution ocean (0.25 degree) model, and a high resolution north west European shelf model. We compare variability at the model sites to that of the multi-centennial sclerochronological data that is currently available to reveal the capacity of models to accurately capture multi-decadal variability at sclerochronological sites. The difference between variability in the global and shelf model simulations reveals whether site variability is sensitive to shelf processes not included in global climate models, and thus whether we can realistically expect bivalve sites in global models to accurately reflect their true variability. Ultimately, we evaluate the relationship between variability at the model sclerochronlogical sites to the rest of the north Atlantic to identify where we can skilfully reconstruct wider variability from limited sclerochronological networks. This also reveals preferable locations for future bivalve collection.