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Oceanic dominance of interannual subtropical North Atlantic heat content variability

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Ocean heat content varies on a range of timescales, with significant impact on the local climate through interactions with the atmosphere. This variability can be driven either by oceanic or atmospheric heat transport for a local body of water. To diagnose the relative contributions and respective timescales, this study uses a box model forced with GCM output to investigate the heat content variability of the upper 800m of the subtropical North Atlantic from 26°N to 36°N. The ocean and air-sea heat flux data needed to force the box model is taken from a 19 year (1985 to 2006) simulation performed with the $1/12°$ version of OCCAM. The box model heat content is compared to the corresponding heat content in OCCAM for verification. The main goal of the study is to identify to what extent the interannual to subannual ocean heat content variability is of atmospheric or oceanic origin. To this end, the box model was subject to a range of scenarios forced either with the full (detrended) ocean and air-sea fluxes, or their deseasoned counterparts. This revealed that in all cases, the seasonal variability was dominated by the subannual component of the air-sea flux, which produced a seasonal range of $\sim$0.41°C. However, on longer timescales the interannual oceanic heat transport dominates, with changes of up to $\sim$0.16°C.

The technique is subsequently appplied to observational data. For the ocean heat fluxes, we use data from the RAPID programme at 26°N, and at 36°N heat transport is inferred using a linear regression model from the oceanic low-frequency transport in OCCAM. The air-sea flux from OCCAM is used for the period 2004 to 2006 when the RAPID timeseries and the OCCAM simulation overlap, and a climatology is used for the air-sea flux from 2006 onwards. The results confirm that on longer (>2 years) timescales the ocean dominates the ocean heat content variability. This work illustrates that oceanic divergence significantly impacts the ocean heat content variability on timescales relevant for applications such as hurricane forecasts, and thus that understanding the underlying mechanisms is of great socioeconomic importance.