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Exploring the surface forced variability of the North Atlantic circulation

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Variability in the air-sea heat and freshwater fluxes over the North Atlantic and their impact on its circulation will be reviewed using a range of observational dataset and coupled model analyses. Particular attention will be given to extremes of heat loss at high latitudes and their influence on transports through key straits, particularly the Denmark Strait. In addition, results from a new high latitude temperature dataset, developed from a combination of marine mammal sensor and Argo profiling floats measurements will be presented and discussed in the context of earlier climatological analyses. We will also review progress with the use of water mass transformation theory to estimate surface forced variability in the strength of the Atlantic Meridional Overturning Circulation (AMOC) at various latitudes in the North Atlantic. The method has been used to determine the surface buoyancy forced overturning circulation (SFOC) of the Atlantic from various coupled ocean-atmosphere models and the latest version of the $\frac{1}{4}$ degree NEMO ocean model. We find that the method can be employed to provide useful estimates of the MOC variability in the range 35 – 65 oN. The method relies on averaging of the SFOC over an interval prior to that at which the AMOC estimate is required. The length of this interval increases as the latitude decreases from about 6 years at 65 oN to 15 years at 36 oN. The ability of this approach to provide valuable complementary information about AMOC variability in the mid-high latitude North Atlantic to that determined from the Rapid array at 26 oN will be discussed. Finally, we will discuss estimates of surface forced AMOC variability for the past 50 years obtained by applying this method to a range of observation based datasets.