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Observed and simulated temperature and salinity variability and their relation to MOC changes at 24N in the Atlantic

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The observed variability of water mass properties along the transatlantic section at 24N is compared to simulations of a coupled global climate model (ECHAM5/MPIOM). The observations are based on five hydrographic sections between 1957 and 2004. The model simulations are part of a suite of experiments performed for the IPCC AR4, using prescribed aerosol and greenhouse gas concentrations for 20th and 21rd century. A regression analysis of the strength of models meridional overturning circulation (MOC) vs. the temperature and salinity fields reveals similar anomaly patterns as found in the observations when comparing the 1957 section with the 2004 section. Most notably, the intermediate waters warm and become more salty, while the North Atlantic Deep Water (NADW) cools and freshens. These changes are - in both the observations and model model simulations - predominately confined to the western boundary of the section. At the eastern boundary of the section, the observations show a weak warming at intermediate depths, while the model results indicate a cooling. The results suggest that the observed changes in temperature and salinity can be associated with changes in the strength of the Atlantic MOC. The structure of the observed changes in temperature and salinity, when directly comparing the 1957 and 2004 section, are consistent with a MOC change of several Sverdrups in the employed model, in accordance with the results of Bryden et al (2005). In the model, these MOC changes are associated with the natural variability on interannual to decadal timescales, as the simulation does not show a significant trend in the MOC strength on the considered time period (i.e., the 20th century). In the 21st century temperature and salinity patterns associated with a global warming induced weakening of the model MOC are zonally uniform and dominated by the global warming signal. It remains to

be seen whether the ocean temperature and salinity structure evolves consistently with the structure of the simulated changes.