

EGU2020-10091

<https://doi.org/10.5194/egusphere-egu2020-10091>

EGU General Assembly 2020

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## Changes of decadal SST Variations in the subpolar North Atlantic under strong CO<sub>2</sub> forcing as an indicator for the ocean circulation's contribution to Atlantic Multidecadal Variability

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The question, whether ocean dynamics are relevant for basin-scale North Atlantic decadal temperature variability is subject of ongoing discussions. Here, we analyze a set of simulations with a single climate model, consisting of a 2000-year pre-industrial control experiment, a 100-member historical ensemble, and a 100-member ensemble forced with an incremental CO<sub>2</sub> increase by 1%/year. Compared to previous approaches, our setup offers the following advantages: First, the large ensemble size allows to robustly separate internally and externally forced variability and to robustly detect statistical links between different quantities. Second, the availability of different scenarios allows to investigate the role of the background state for drivers of the

variability. We find strong evidence that ocean dynamics, particularly ocean heat transport variations, form an important contribution to generate the Atlantic Multidecadal Variability (AMV) in the Max Planck Institute Earth System Model (MPI-ESM). Particularly the Northwest North Atlantic is substantially affected by ocean circulation for the historical and pre-industrial simulations. Anomalies of the Labrador Sea deep ocean density precede a change of the Atlantic Meridional Overturning Circulation (AMOC) and heat advection to the region south of Greenland. Under strong CO<sub>2</sub> forcing the AMV-SST regression pattern shows crucial changes: SST variability in the north western part of the North Atlantic is strongly reduced, so that the AMV pattern in this scenario is dominated by the low-latitude branch. We found a connection to changes in the deep water formation, that cause a strong reduction of the mean AMOC and its variability. Consequently, ocean heat transport convergence becomes less important for the SST variability south of Greenland.