Geophysical Research Abstracts
Vol. 18, EGU2016-11644, 2016
EGU General Assembly 2016

Impact of the seasonal cycle on the decadal predictability of the North Atlantic volume and heat transport under global warming

Matthias Fischer (1), Wolfgang A. Müller (2), Daniela I.V. Domeisen (3), and Johanna Baehr (1)

(1) Institute of Oceanography, Center for Earth System Research and Sustainability, Uni Hamburg, Hamburg, Germany (matthias.fischer@uni-hamburg.de), (2) Max Planck Institute for Meteorology, Hamburg, Germany, (3) GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany

The North Atlantic ocean circulation is projected to change considerably with future climate change. Here, we investigate whether changes in the North Atlantic meridional overturning circulation (AMOC) and the meridional heat transport (OHT) result in changes in their decadal predictability. In MPI-ESM-LR, we generate two hindcast ensembles with 20 start dates and 10 ensemble members per start date for (i) the present climate state in the CMIP5 historical simulation extended with RCP4.5 starting in 1995 and (ii) a future climate state in RCP4.5 starting in 2045. These two hindcast ensembles are compared against the historical simulation and RCP4.5 as control simulation, respectively, using the anomaly correlation coefficient (ACC) and the Brier skill score (BSS) decomposition in combination with reliability diagrams. The analysis is performed for yearly means and multiyear seasonal means of the AMOC and the OHT.

Our results show a decrease in predictability of the AMOC and the OHT from the present climate state to the future climate state in RCP4.5. Both, changes in the AMOC and the OHT decadal predictability are largest at latitudes where the mean seasonal cycle of both AMOC and OHT is projected to change. For example around 25°N, the AMOC shows a reduction in the seasonal amplitude of about 0.5 Sv and a shift of up to 5 months in concert with a reduction in predictable lead times from up to 10 years to 2 years in the ACC. For the OHT, we find a reduction in the seasonal amplitude of about 0.1 PW and a shift of up to 5 months in concert with a reduction in predictable lead time from up to 4 years to 2 years in the ACC around 25°N. Similarly, the BSS and reliability diagrams show a reduction in skill from the present climate state to the future climate state. For multiyear seasonal means, summer months dominate the predictability in the present and future climate.

Even though the changes in the decadal predictability of AMOC and OHT are small in general, their latitude dependence is similar to changes in the seasonal cycle that shows continuous and more robust changes until the 23rd century in RCP8.5. Longterm changes in the seasonal cycle can be related to changes in the surface wind stress and the associated Ekman transport, that is the main driver of the AMOC's and OHT's seasonal variability. Overall, the results show an impact of changes in the seasonal cycle on the decadal predictability of the AMOC and the OHT under global warming.