Geophysical Research Abstracts
Vol. 16, EGU2014-5402, 2014
EGU General Assembly 2014

Potential predictability of the Atlantic Meridional Overturning Circulation in depth and density space

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Previous estimates of potential predictability of the Atlantic Meridional Overturning Circulation (AMOC) have been limited to depth space, though AMOC variability has been shown to differ between depth space and density space. Here, we investigate the latitude dependence of the AMOC's potential predictability in both depth space and density space using experiments performed with the coupled climate model MPI-ESM.

Lag correlations between the maximum AMOC (40°N in depth space and 54°N in density space), and the AMOC at individual latitudes indicate southward propagation of AMOC variations in both spaces. In depth space, a signal emerging at 54°N takes about 4 years to reach 30°N. In density space, a signal emerging at 54°N takes about 7 years to reach 30°N. In both spaces, these lag correlations increase by 1 – 2 years when the Ekman variability is removed from the AMOC.

In the CMIP5 ensemble decadal prediction experiments, we also test whether this meridional propagation results in potential predictability of the AMOC. We find that the potential predictability of the AMOC shows longest predictable lead times around 40°N in both spaces. Potential predictability of the AMOC in density space is with ∼4-6 years about 1-3 years longer than in depth space, particularly around 40°N. Potential predictability of the AMOC increases when the Ekman variability is removed from the AMOC, especially in the region between the AMOC maxima and more significantly in density space than in depth space.