Changing spatial patterns of deep convection in the subpolar North Atlantic

Siren Rühs¹, Eric Oliver², Arne Biastoch¹,³, Claus W. Böning¹, Michael Dowd⁴, Klaus Getzlaff⁵, and Paul G. Myers⁵

¹GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany (sruehs@geomar.de)
²Department of Oceanography, Dalhousie University, Halifax, Canada
³Christian-Albrechts-Universität zu Kiel, Kiel, Germany
⁴Department of Mathematics & Statistics, Dalhousie University, Halifax, Canada
⁵Department of Earth and Atmospheric Sciences, University of Alberta, Alberta, Canada

Deep convection and associated deep water formation are key processes for climate variability, since they impact the oceanic uptake of heat and trace gases and alter the structure and strength of the global overturning circulation. For long, deep convection in the subpolar North Atlantic was thought to be confined to the central Labrador Sea in the western subpolar gyre (SPG). However, there is increasing evidence that deep convection also occurs in the eastern SPG south of Cape Farewell and in the Irminger Sea. In particular, observations indicate gyre-scale intensified convection in 2015-2018. Here we assess this recent event in the context of the temporal evolution of the spatial deep convection pattern in the SPG since the mid-twentieth century, using realistic eddy-rich ocean model simulations. These reveal large interannual variability, including several periods with intensified deep convection in the eastern SPG. Notably, this happened in 2015-2018, but to a lesser degree in the late 1980s to early 1990s, the period with highest deep convection intensity in the Labrador Sea related to a persistent positive phase of the North Atlantic Oscillation. Our analyses further suggest that deep convection in 2015-2018 occurred with an unprecedented high (low) relative contribution of the eastern (western) SPG to the total deep convection volume. This is partly linked to a considerable smaller north-westward extent of deep convection in the Labrador Sea compared to previous periods of intensified deep convection, and may be a first fingerprint of strong near-surface freshening in the Labrador Sea associated with Greenland melting.