

On the Long-term Mean AMOC across the Arctic-Atlantic Gateways and the Downstream Subpolar North Atlantic

Authors: Rong Zhang (NOAA/GFDL) and Matthew Thomas (NOAA/GFDL and UCAR)

The Greenland Sea is often viewed as the northern terminus of the AMOC. It has also been proposed that the shutdown of open-ocean deep convection in the Labrador or Greenland Seas would substantially weaken the AMOC. Unlike many other climate variables, there is no established long-term mean state of directly observed AMOC over the past several decades to serve as a reference for future AMOC changes, and it is challenging to determine whether model simulated AMOC mean state and future changes are reliable. To address these issues, in this study robust diagnostic calculations (RDC) are conducted using a high-resolution global coupled model constrained by observed hydrographic climatology to provide a holistic picture of the long-term mean AMOC across Arctic-Atlantic gateways and the subpolar North Atlantic. In contrast to the traditional view, the RDC results suggest that the Arctic Ocean, not the Greenland Sea, is the northern terminus of the mean AMOC; the deep AMOC branch across the Fram Strait/Barents Sea Opening section (i.e., Arctic outflow) provides the densest source water to the mean AMOC and downstream Greenland-Scotland Ridge overflows; horizontal circulation across sloping isopycnals contributes substantially (more than 40%) to the mean AMOC across OSNAP East; open ocean deep convection, in either Greenland or Labrador Seas, contributes minimally to the mean AMOC. Across the entire OSNAP section, the observed AMOC strength over the recent period (2014-2018) is similar to the RDC-estimated long-term mean AMOC strength over the past several decades. (Reference: Zhang and Thomas, 2021, Communications Earth & Environment, <https://www.nature.com/articles/s43247-021-00182-y>).