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Decomposing barotropic transport variability in a high-resolution ocean model of the North Atlantic Ocean

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Temporal variability of the annual mean barotropic streamfunction in a high-resolution model configuration (VIKING20) for the northern North Atlantic is analyzed using a decomposition technique based on the vertically-averaged momentum equation. The method is illustrated by examining how the Gulf Stream transport in the recirculation region responds to the winter North Atlantic Oscillation (NAO). While no significant response is found in the year overlapping with the winter NAO index, a tendency is found for the Gulf Stream transport to increase as the NAO becomes more positive, starting in lead years 1 and 2 when the mean flow advection (MFA) and eddy momentum flux (EMF) terms associated with the nonlinear terms dominate in the momentum equations. Only after 2 years, the potential energy (PE) term, associated with the density field, starts to play a role and it is only after 5 years that the transport dependence on the NAO ceases to be significant. The PE contribution to the transport streamfunction has significant memory of up to 5 years in the Labrador and Irminger Seas. However, it is only around the northern rim of these seas that VIKING20 and the transport reconstruction exhibit similar memory. This is due to masking by the nonlinear MFA and EMF contributions.