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Linking variable Nordic Seas inflow to upstream circulation anomalies

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The inflow across the Iceland-Scotland Ridge determines the amount of heat supplied to the Nordic Seas from the subpolar North Atlantic (SPNA). Variability in inflow properties and volume transport at the ridge influence marine ecosystems and sea ice extent further north. The predictability of such downstream impacts depends on how variability at the ridge relate to large-scale ocean circulation changes in the North Atlantic. Here, we identify the upstream pathways of the Nordic Seas inflow, and assess the mechanisms responsible for interannual inflow variability. Using an eddy-resolving ocean model hindcast and a Lagrangian analysis tool, numerical particles are released at the ridge during 1986-2015 and tracked backward in time. Overall, 64% of the mean inflow volume transport has a subtropical origin and 26% has a subpolar or Arctic origin. The local instantaneous response to the NAO is important for the overall transport of both subtropical and Arctic-origin waters at the ridge. In the years before reaching the ridge, the subtropical particles are influenced by atmospheric circulation anomalies in the gyre boundary region and over the SPNA, forcing shifts in the North Atlantic Current (NAC) and the subpolar front. An equatorward shifted NAC and westward shifted subpolar front correspond to a warmer, more saline inflow. Wind stress curl anomalies over the SPNA also affect the amount of Arctic-origin water re-routed from the Labrador Current toward the Nordic Seas. A high transport of Arctic-origin water is associated with a colder, fresher inflow across the Iceland-Scotland Ridge. The results thus demonstrate the importance of gyre dynamics and wind forcing in affecting the Nordic Seas inflow properties and volume transport.