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Subpolar Mode Water variability in the North Atlantic subpolar gyre

Eric DE BOISSESON (1), Virginie THIERRY (1), and Herlé MERCIER (2)

(1) IFREMER, LPO, BREST, France (virginie.thierry@ifremer.fr), (2) CNRS, LPO, BREST, France (herle.mercier@ifremer.fr)

Subpolar Mode Water (SPMW) of the North Atlantic are fed by the upper branch of the thermohaline circulation, which supplies subpolar and subtropical waters to the eastern subpolar gyre. SPMW provide much of the water that feeds the lower branch of the thermohaline circulation. An intense variability of the properties of these SPMW has been observed between the mid-1960's and the mid-1970's and between the early and the late 90's. These signals coincide with strong NAO events. Previous studies have suggested that this oceanic variability could be linked to a shift in the subarctic front in the eastern subpolar gyre which controls the amount of water supplied to the SPMW. This work aims to determine the oceanic mecanisms that drive the Subpolar Mode Water variability by using the DRAKKAR 1/4° global simulation ORCA025-G70 running from 1958 to 2004. This simulation reproduces fairly well the observed variability of the SPMW and its correlation with NAO events. In the ORCA025-G70 fields, the variability of the SPMW properties is not related to a shift of the subarctic front, but is driven rather by varying advective processes. We use the Lagrangian tool ARIANE to determine how advective processes drive the variability over the 1960's, the 1970's and the 1990's. We observe that, during positive NAO periods (the mid-1970's and the early-1990's), the subpolar and the subtropical contributions to the feeding of SPMW are similar. By contrast, during negative NAO periods (the mid-1960's and the late-1990's), the subtropical waters contribute two thirds of the water fed into the SPMW. These variable contributions explain the intense variability of the SPMW observed in ORCA025-G70. The consistency of ORCA025-G70 to the signals observed in the data suggests that the connection between the advective processes and the SPMW variability is realistic.