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Did the Great Salinity Anomaly really prevent deep convection in the Labrador Sea from 1968 to 1971?

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In the late 1960's an anomalously fresh water mass, known as the Great Salinity Anomaly (GSA), reached the Labrador Sea. Coincident with this arrival, between 1968 and 1971 no intermediate to deep convection took place in this area. As a result, the Labrador Sea became increasingly more stratified, due to the accumulation of cold and fresh water at the surface and warm and salty Irminger Water beneath. Then, in the winter of 1972, deep convection resumed accompanied by the largest surface heat flux on record.

This sequence of events has led to the widespread notion that convection stopped as a result of the increase in stratification due to the GSA and later resumed simply as a result of the extreme atmospheric fluxes in 1972. Here we examine both these assertions to investigate their actual causal relationships. In particular, we explore to what extent the shutdown of convection was due to oceanic processes alone, as there seems to be an important contribution from the sizable decrease in the atmospheric fluxes during this 1968-1971 period as well. Similarly, we investigate to what extent the large air-sea fluxes in 1972 were associated with the resumption of deep convection and the exposure of the stored warm, salty subsurface waters to the cold atmosphere. In other words, what really stopped deep convection and what made it come back?

To address these questions we use a combination of oceanic hydrographic data collected by Ocean Weather Ship Bravo from 1964 to 1974 and of atmospheric data from reanalysis data products, in conjunction with a one-dimensional mixed-layer model to simulate the evolution of a water column in the central Labrador Sea over winter. Our results are relevant to our general understanding of which factors control the interannual variability of convection in the Labrador Sea (an important contributor to the Atlantic Meridional Overturning Circulation). Especially at a time when changes in both the subtropical and Arctic regions are contributing to large changes in stratification within the subpolar regions, the Great Salinity Anomaly is no longer just of historical interest.