



Recent and long-term changes in the Arctic/North Atlantic oceans

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High-latitude regions play a crucial role in global climate change and variability, and the Arctic Ocean is a major source region for the surface waters of the sub-polar seas, in which weak stratification leads to deep convection, a key part of the global thermohaline circulation. Thus, interactions between the North Atlantic Ocean and Arctic Ocean are predicted to have profound effects on climate on regional-to-global scales. Our analysis demonstrates that during the last several decades the upper 300m Atlantic Ocean was warming steadily providing increased oceanic heat influx to the Arctic Ocean. This transport of heat northward is abrupt, or pulse-like, with each new pulse of anomalously warm water making the polar basin warmer. However, spatially averaged North Atlantic temperature and salinity from the 0-300m and 1000-3000m layers vary in opposition: prolonged periods of cooling and freshening (warming and salinification) in one layer are generally associated with opposite tendencies in the other layer, which is consistent with the notion of thermohaline overturning circulation. These changes may be partially attributed to multi-decadal fluctuations with time scales of 50-80 years which are known to be exceptionally strong in the Arctic and North Atlantic. Associated with this variability, the Arctic and upper North Atlantic water temperature records show two warmer periods in the 1930-40s and in recent decades, and two colder periods early in the 20th century and in the 1960-70s. Finally, since the Arctic/North Atlantic oceans play a crucial role in establishing and regulating global thermohaline circulation, the multi-decadal fluctuations of the heat and fresh water balance should be considered when assessing long-term climate change and variability, both in the Arctic/North Atlantic and at global scales.