Decadal variability of CFC-11 east of Abaco and its relationship to North Atlantic ventilation and AMOC

Dongxiao Zhang (dzhang@uw.edu), Michael J. McPhaden, Wei Cheng
JISAO/University of Washington and NOAA/PMEL

Formation of the North Atlantic Deep Water (NADW), and the Deep Western Boundary Current (DWBC) transporting water masses into the subtropics, are responsible for the deep penetration and high inventory of anthropogenic CO_2 and CFCs in the North Atlantic. While anthropogenic CO_2 is not a variable that can be directly measured, the CFC-11 can be measured fairly accurately, and its uptake in the ocean is qualitatively similar to that of anthropogenic CO_2. It is well documented that the ventilation of Labrador Sea has undergone large decadal variations. In the subtropics, Molinari et al. (1998) have related the sudden increase of CFC-11 observed east of Abaco in late 1990s in the DWBC to the increase of Labrador Sea Water (LSW) formation 10 years before in the mid-1980s. Whether this observed CFC-11 variation can be traced back to the Labrador Sea has however been questioned by a number of studies because of the strong mixing in the DWBC. The purpose of this study is to investigate the decadal variations of CFC-11 along the DWBC from Labrador Sea to Abaco, and relate them to variations of ocean circulation (the AMOC) and Labrador Sea ventilation using a model simulation. The CFC-11 uptake model is introduced to the global HYCOM simulation after a 300-year spin up under the interannual CORE II forcing. Large decadal variability of AMOC transport is simulated, and is attributed to modeled decadal variations of the LSW ventilation, that compared well with the observation. Model results also suggest a strong connection between the decadal variation of CFC-11 east of Abaco and AMOC transport.