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Causes and Consequences of Exceptional North Atlantic Heat Loss in Recent Winters

Simon Josey (1), Jeremy Grist (1), Aurelie Duchez (1), Eleanor Frajka-Williams (2), Joel Hirschi (1), Robert Marsh (2), and Bablu Sinha (1)

(1) National Oceanography Centre, Southampton, United Kingdom, (2) Ocean and Earth Science, University of Southampton, United Kingdom

The mid-high latitude North Atlantic loses large amounts of heat to the atmosphere in winter leading to dense water formation. An examination of reanalysis datasets (ERA-Interim, NCEP/NCAR) reveals that heat loss in the recent winters 2013-14 and 2014-15 was exceptionally strong. The causes and consequences of this extraordinary ocean heat loss will be discussed. In 2013-2014, the net air-sea heat flux anomaly averaged over the whole winter exceeded 100 Wm-2 in the eastern subpolar gyre (the most extreme in the period since 1979 spanned by ERA-Interim). The causes of this extreme heat loss will be shown to be severe latent and sensible heat fluxes driven primarily by anomalously strong westerly airflows from North America and northerly airflows originating in the Nordic Seas. The associated sea level pressure anomaly field reflects the dominance of the second mode of atmospheric variability, the East Atlantic Pattern (EAP) over the North Atlantic Oscillation (NAO) in this winter. The extreme winter heat loss had a significant impact on the ocean extending from the sea surface into the deeper layers and a re-emergent cold Sea Surface Temperature (SST) anomaly is evident in November 2014. The following winter 2014-15 experienced further extreme heat loss that served to amplify the strength of the re-emergent SST anomaly. By summer 2015, an unprecedented cold mid-latitude North Atlantic Ocean surface temperature anomaly is evident in observations and has been widely referred to as the ‘big blue blob’. The role played by the extreme surface heat loss in the preceding winters in generating this feature and it subsequent evolution through winter 2015-16 will be explored.