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NORTH ATLANTIC DECADAL VARIABILITY OF OCEAN SURFACE FLUXES

By

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The members of the Committee approve the thesis of Paul J. Hughes defended on 29 March 2006.

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Dedicated to my family for their endless love, support, and encouragement

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ABSTRACT

The spatial and temporal variability of the surface turbulent heat fluxes over the North Atlantic is examined using the new objectively produced FSU3 monthly mean 1°x1° gridded wind and surface flux product for 1978-2003. The FSU3 product is constructed from in situ ship and buoy observations via a variational technique. A cost function based on weighted constraints is minimized in the process of determining the surface fluxes.

The analysis focuses on a low frequency (basin wide) mode of variability where the latent and sensible heat flux anomalies transition from mainly positive to negative values around 1998. It is hypothesized that the longer time scale variability is linked to changes in the large scale circulation patterns possibly associated with the Atlantic Multidecadal Oscillation (AMO; Schlesinger and Ramankutty 1994, Kerr 2000). The changes in the surface heat fluxes are forced by fluctuations in the mean wind speed.

Zonal averages show a clear dissimilarity between the turbulent heat fluxes and wind speed for 1982-1997 and 1998-2003 over the region extending from the equator to roughly 40°N. Larger values are associated with the earlier time period, coinciding with a cool phase of the AMO. The separation between the two time periods is much less evident for the humidity and air/sea temperature differences. The largest differences in the latent heat fluxes, between the two time periods, occur over the tropical, Gulf Stream, and higher latitude regions of the North Atlantic, with magnitudes exceeding 15 Wm^{-2}. The largest sensible heat flux differences are limited to areas along the New England coast and poleward of 40°N.