Geophysical Research Abstracts, Vol. 9, 02632, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02632

Reconstruction of surface turbulent fluxes in the North Atlantic*:* 1880-2004

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Using 125 years (1880-2004) of Voluntary Observing Ship (VOS) observations from ICOADS we reconstruct surface ocean-atmosphere heat fluxes over the North Atlantic with monthly resolution in time and variable (2-degree to 5-degree) resolution in space. Methodology of reconstruction is based on the homogenization of sampling density, application of the double-exponential distributions of turbulent fluxes for minimizing sampling errors and the use of specially adopted for incomplete data coverage bulk-algorithms. In particular, a multi-regressive approach is used to reconstruct atmospheric humidity, playing important role in estimation surface fresh water fluxes. The methodology was first validated using the time series from VOS and reanalyses for the well sampled last several decades. Produced air-sea flux fields show reasonable minimization of sampling errors and allow for the analysis of regional heat balances and estimation of long-term changes in surface fluxes. Further analysis included computation of monthly anomalies of surface fluxes as well as estimation of the subpolar gyre heat and freshwater budgets. These were computed using two-demensional distributions of surface fluxes in the coordinates of sea-air temperature difference and wind speed. Reconstructed fluxes reveal long-term trends, implying, for example, about 4 W/m^2 per decade growing sensible heat fluxes in the Labrador Sea and about 2 W/m^2 per decade secular increase in the Central subpolar gyre. Non-secular signals are represented by the decadal-scale and multidecadal (about 40-50 years variability). Decadal scale signal has a clear association with the NAO-like atmospheric circulation variability during 1880-1915 and after 1955, but has a little association with NAO between 1915 and 1955.