Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07577, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07577
EGU General Assembly 2008

Atmospheric control on the thermohaline circulation

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In an attempt to elucidate the role of atmospheric and oceanic processes in setting a vigorous ocean overturning circulation in the North Atlantic but not in the North Pacific, a comparison of the observed atmospheric circulation and net surface freshwater fluxes over the North Atlantic and Pacific basins is conducted. It is proposed that the more erratic meridional displacements of the atmospheric Jet stream over the North Atlantic sector is instrumental in maintaining high surface salinities in its subpolar gyre. In addition, it is suggested that the spatial pattern of the net freshwater flux at the sea surface favours higher subpolar Atlantic salinity because the geographical line separating net precipitation from net evaporation is found south of the time mean gyre separation in the North Pacific whereas the two lines coincide in the North Atlantic. Numerical experiments with an idealized two-gyre system confirm that these differences in 'atmospheric forcing' are significant in the salinity budget of the subpolar gyre.

Since the more erratic jet fluctuations in the Atlantic and the shift of the zero (E-P) line are likely explained by features independent of the state of the thermohaline circulation (eddy driven jet dynamics vs subtropical jet dynamics; relative strength of summer monsoon circulations over the North Atlantic and Pacific basins), it is proposed that the atmospheric circulation helps 'locking' high surface salinities and an active coupling between upper and deep ocean layers in the North Atlantic basin.