Geophysical Research Abstracts, Vol. 8, 04680, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04680

Non-normal amplification of the thermohaline circulation

L. Zanna (1), E. Tziperman (1) and P. Heimbach (2)

(1) Harvard University (zanna@fas.harvard.edu), (2) Massachusetts Institute of Technology

A simple zonally averaged coupled ocean-atmosphere model, with a relatively high-resolution in the meridional direction, is used to examine physical mechanisms leading to transient amplification of thermohaline circulation (THC) anomalies. It is found that in a stable regime, in which small perturbations eventually decay, there are optimal initial conditions leading to a dramatic amplification of initial temperature and salinity anomalies in addition to the THC amplification. The maximum amplification is reached after about forty years, and the eventual decay is on a centennial time scale. The initial temperature and salinity anomalies are considerably amplified by factors of a few hundreds and twenty, respectively. The initial conditions leading to this amplification are characterized by mutually canceling initial temperature and salinity anomalies contributions to the THC anomaly, such that the initial THC anomaly vanishes. The mechanism of amplification is analyzed and found to be the result of an interaction between a few damped (oscillatory and non-oscillatory) modes with decay time scales lying in a range of twenty to eight hundred years. The amplification mechanism is also found to be distinct from the advective feedback leading to THC instabilities for large fresh water forcing. Optimal initial conditions leading to a transient amplification of the THC anomalies are also investigated using a 3D General Circulation Model of the ocean.