EMS7/ECAM8 Abstracts,
Vol. 4, EMS2007-A-00022, 2007
7th EMS Annual Meeting / 8th ECAM

Thermohaline circulation as an example of nonlinear-processes in the climate system

M.N. Lorenzo (1), J.J. Taboada (2) and I. Iglesias (1)

(1) Grupo de Física de la Atmósfera y del Océano. Facultad de Ciencias. Universidad de Vigo, 32004 Ourense, Spain. (2) MeteoGalicia - Consellería de Medio Ambiente Santiago de Compostela, Spain

Thermohaline circulation (THC) is a classical example of non-linear processes in the climate system. If we describe this system with a stability diagram showing strength of the THC as a function of the freshwater input into the North Atlantic we can appreciate a bistable regime and a bifurcation point where the circulation breaks down. Thus, there exists the possibility that minor changes in parameters can cause a sudden change in climate conditions. This hypothesis has been also sustained by the growing evidence from paleoclimatic archives of past abrupt climate changes.

Many modelling studies have been done in the last decades in order to study the behaviour of THC under a changing climate, with different results. This is due to the uncertainties in the initial conditions that are amplified because of the non-linear characteristic of the climate system. In an attempt to mimic the impacts of the unresolved processes, it has been suggested that random noise should be added to climate models. The idea behind this work is partly motivated by recent improvements in mid-term weather-forecast methodology (Buizza et al, 1999). There, it was argued for the convenience of including a spatiotemporally correlated stochastic source in the hydrodynamic equations of the forecast model.

In previous work by the authors (Taboada and Lorenzo, 2005) it was obtained that the addition of noise in a simple climate model, representing synoptic-scale variations, can induce a collapse of the THC. The aim of this work is to prove the ability of an EMIC (Earth-model of Intermediate Complexity) to provoke a collapse of the THC under some hypothesis such as a massive sudden freshwater input, an increment of

the atmospheric greenhouse gases concentration or adding the synoptic atmospheric variability as noise in the equations.

[1] Buizza, R., Miller, M. and Palmer, T.N. (1999) Stochastic representation of model uncertainties in the ECMWF Ensemble Prediction System. The Quarterly Journal of the Royal Meteorological Society, 125, 2887-2908

[2] Taboada, J.J. and Lorenzo, M.N. (2005) Effects of the synoptic scale variability on the thermohaline circulation. Nonlinear Processes in Geophysics, 12, 435-439.