Geophysical Research Abstracts
Vol. 12, EGU2010-1745, 2010
EGU General Assembly 2010

Dynamic Transition Theory for Thermohaline Circulation

Tian Ma (1) and Shouhong Wang (2)

(1) Sichuan University, Mathematics College, Chengdu, P. R. China, (2) Indiana University, Dept. Mathematics, Bloomington, IN 47405, United States (showang@indiana.edu, 001-812-85)

The main objective of this study is to derive a mathematical theory associated with the thermohaline circulations (THC). The results derived provides a general transition and stability theory for the Boussinesq system, governing the motion and states of the large-scale ocean circulation. First, it is shown that the first transition is either to multiple steady states or to oscillations (periodic solutions), determined by the sign of a nondimensional parameter K, depending on the geometry of the physical domain and the thermal and saline Rayleigh numbers. Second, for both the multiple equilibria and periodic solutions transitions, both Type-I (continuous) and Type-II (jump) transitions can occur, and precise criteria are derived in terms of two computable nondimensional parameters b1 and b2. Associated with Type-II transitions are the hysteresis phenomena, and the physical reality is represented by either metastable states or by a local attractor away from the basic solution, showing more complex dynamical behavior. Third, a convection scale law is introduced, leading to an introduction of proper friction terms in the model in order to derive the correct circulation length scale. In particular, the dynamic transitions of the model with the derived friction terms suggest that the THC favors the continuous transitions to stable multiple equilibria.