Geophysical Research Abstracts
Vol. 13, EGU2011-4661, 2011
EGU General Assembly 2011

How Does Earth Maintain the Stability of its Rotation Motion?: An Irreversible Thermodynamics Approach

Florin Caldararu

Romania (florin@ecosen.ro), Ecological University from Bucharest, Department of Environmental Engineering, Bd. G-ral Vasile Milea, no. 1G, sector 6, Bucharest 061341, Romania, Phone: 0040212529653, E – mail: florin@ecosen.ro

The last decades have seen a major improvement in the quantity and quality of available data for earth systems at both regional and planetary scales. This data has improved our knowledge of individual aspects of this system (e.g. tectonics, climate, vegetation), but very few studies have as yet looked at the dynamics of the entire planet. What is missing is a global model of Earth as a complex system describing the planet's evolution as a whole, together with all the negative and positive feedbacks which determine the stability of the planet.

This paper proposes to provide a physical description of how the Earth achieves the stability of its rotation motion. We demonstrate that Earth is a self-organizing system due to its complexity levels, which are structured according to the ergodic theorem. As a self-organizing system the Earth generates all the negative feedbacks necessary to reach the near to equilibrium state. We focus on the Earth's rotation as this can be more easily perturbed than the revolution motion around the Sun, thus its stability determines the Earth to reach the near to equilibrium state.

We study the stability of the Earth rotation using the master equation given by the conservation of angular momentum. The perturbation of the rotation motion is determined by the fluctuations of the Earth's radius and those of the mass distribution. The radius fluctuations can appear due to crustal dilatation during heat transfer, this heat being generated by the continuous cooling of the Earth's core. The dilatation phenomena are controlled by plate motion as the excess heat is rapidly transferred to the planetary ocean and the atmosphere. The excess heat is also transferred to the atmosphere by volcanic eruptions, as the Earth radius fluctuation remains in the near to equilibrium zone. Another control process are earthquakes, as the mass distribution changes due to fault ruptures. This positive feedback determines changes in the Earth's rotation period according to the angular momentum conservation law. These changes have already been reported for the large earthquakes as those of Chile (1960), Alaska (1964), Sumatra (2004) and Chile (2010). In order for the Earth's rotation period to return to its initial value, a negative feedback is activated. This negative feedback is the mass redistribution on the Earth surface by changes in distribution of the polar ice sheets.

Thus, phenomena such as earthquakes, volcanic eruptions and changes of the polar ice sheets, viewed as planetary catastrophes, are the negative feedbacks which realize the control of the Earth rotation stability.