

Co-existence of Chaos and Order in Weather and Climate Dynamics

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Abstract: It is widely accepted to believe that the atmospheric dynamics is chaotic, and so unpredictable for more or less distant future. It is because all solutions of the hydrothermodynamical equations governing the dynamics are unstable to small disturbances of their initial data. The aim of this report is to demonstrate that it is not fatal as seen because some orderings always co-exist with the chaos induced by these instabilities. Taking different ordering elements into account it is possible to exclude from further consideration certain of the above-mentioned instabilities. In particular, the processes within the timescales of 10^4 – 10^5 years (like the glacial cycles of climate) are affected by many insolation oscillations with incommensurate periods. By this reason, the attractor of these processes modeling turns out to be similar to the so-called strange but nonchaotic attractors (SNA) well-known in the dynamical system theory. The history of these processes evolution seen in paleoclimatic records can be depicted as a sequence of the period multiplying bifurcations from a simple limit cycle attractor during the Pliocene to a SNA-like attractor during the late Pleistocene including the main period-doubling bifurcation at the moment of the famous mid-Pleistocene transition. The processes of the interannual atmospheric variations (like El-Nino – Southern Oscillation) are governed not only by the annual periodic heating of the climate system but also luni-solar nutations of the Earth's rotation axis and the Chandler wobble in the Earth's pole motion. By these reasons, these processes reveal another SNA-like climatic attractor. Consideration of the ENSO-processes with details will be given in a report of my young colleague I.V. Serykh.

These facts open the door for hyper- and super-long term climatic predictions.

Keywords: Weather chaos, Strange nonchaotic climatic variations.