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Raison d etre of simple climate models

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Now that GCM simulations using high-performance supercomputers are at the height of prosperity, is there any 'raison d'etre' in simple climate models that can be simulated by reasonable-priced PCs? The heat transfer model devised by Kleidon for explaining the Maximum Entropy Production (MEP) principle seems to be one of the proper examples to answer this philosophical question[1]. Generally speaking, the simplification of mathematical models has a merit to ease capturing the essence of phenomena. For example, it has been well known that dissipative structures characterized by low entropy can emerge spontaneously in open systems maintained in the state of far from equilibrium. Then, the Kleidon's heat transfer model is thought to contain all the elements indispensible for the formation of dissipative structures. To be concrete, these elements include heat or energy sources, space to dump degraded heat and materials, temperature gradient for heat flow, and so on. These are also necessities for dissipative structures other than atmospheric convection. There exist uncountable dissipative structures with low entropy on the Earth such as various types of lives and human societies. Energy sources that drive human societies are mineral resources and fossil fuel such as coal, oil and natural gas as well as the sun. Space to abandon disused goods is natural environment on the Earth or outer space. Moreover, freshness (the reciprocal of degradation) of the product would correspond to the temperature in the Kleidon's model. That is, new products have high temperature (freshness), while the temperature of exhausted products is low. Then, entropy in human societies could be defined as the division of the quantity of resources and energy used in production by freshness. In this session, we survey the application of the MEP theory to ecology, sociology and economics, redefining variables or parameters used in the Kleidon's model. Another theory well known in this field is the Bejan's constractal theory[2]. Last year, the MEP vs. constructal dispute has occurred as for which theory is more fundamental[3],[4],[5], which will be discussed also in this session.

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[3] Kleidon, A. (2010). Life, hierarchy, and the thermodynamic machinery of planet Earth. Physics of Life Reviews 7:424-460.

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[5] Kleidon, A. (2010). Life as the major driver of planetary geochemical disequilibrium. Reply to comments on "Life, hierarchy, and the thermodynamic machinery of planet Earth". Physics of Life Reviews 7:473-476.

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