FULL STEAM AHEAD, PROBABLY

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Abstract

Could the Earth's climate state be selected by thermodynamics [1] and information theory? In particular, there is no a priori reason that the equator to pole temperature gradient, which drives and is determined by the poleward heat transport in the oceans and atmosphere, should be the value we observe. However, it appears to be at a value where the production of thermodynamic entropy by that heat flow is maximized (more or less equivalent to maximizing its potential work output.) This Maximum Entropy Production (MEP) state appears to hold on Titan and, to some extent, Mars, even though their climates are very different in character[2,3].

One rationale is that the greatest number of possible combinations of modes of heat transport (Hadley circulation, eddies, ocean currents, etc.) at steady state will exist where that dissipation is maximized. In other words, that the MEP state is most probable, subject to the constraints that are applied to the system. Chief among these constraints are the pressure (or column mass) of the atmosphere, and the planetary rotation rate. It is recognition of these constraints on MEP that may allow the reconciliation of MEP approaches with a more conventional dynamical meteorological perspective. One obvious application of the principle may be to exoplanets, for which there are generally very little data to constrain more elaborate models.

This talk will review the MEP idea and related topics in planetary science, including the size spectrum of dust devils observed on Mars and Earth. This size distribution may be described by an exponential (suggested on MaxEnt grounds [4]), or perhaps a power law[5], which may arise from self-organized criticality which may in turn be associated with MEP[6].

References:

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