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MAXIMUM ENTROPY PRODUCTION PRINCIPLE AND GLOBAL SOCIETY

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ABSTRACT

Work in recent years has focused on application of the Maximum Entropy Production (MEP) principle to chemical reaction engineering in systems that operate very far from local equilibrium in the nonlinear regime of irreversible thermodynamics [1-2]. Results to date are consistent with the MEP principle providing probabilistic expectations about the direction of evolution in nonlinear irreversible systems, and experimental efforts are being planned to more robustly test the theoretical hypothesis. For this presentation, I will posit that (1) the MEP principle can be used to describe the probability of selecting stationary states in the nonlinear regime of irreversible thermodynamics; and (2) that the earth and human societies operate in the nonlinear regime and thus their evolution is subject to the MEP principle.

The earth, and life contained therein, comprises a complex dissipative system that receives heat from the sun as an input and sends thermal radiation to space as an output. Two expectations from the MEP principle can be made of the earth. With some constraints, the hypothesis is that evolutionary paths for human society, which decrease albedo and decrease the greenhouse effect, will ultimately be selected with higher probability than those that do not. Sunlight is the largest energy input to the surface of the earth [3]. The heat coming from the sun has an average temperature of approximately 5800 K, and thermal radiation from earth into space has an average temperature of approximately 287 K. Therefore, energy in sunlight absorbed by the earth and radiated into space generates entropy. The blackbody temperature of the earth, in the absence of albedo and greenhouse effect, would be approximately 250 K. The albedo of the earth, which describes the fraction of sunlight power diffusely reflected into space, without being absorbed, is approximately 30%. Sunlight diffusely reflected into space without absorption generates less entropy than absorbing the sunlight and radiating at the global average temperature. Therefore, the earth could generate more entropy if it either absorbed more sunlight (lower albedo), and/or had a lower temperature (less greenhouse effect). The conclusion presents an optimistic vision for increased solar energy harvesting in deserts comprised of high albedo minerals, and combating the rising CO_2 concentration in the atmosphere to lower the average global temperature and therefore increase the flow of entropy from earth into space. Some concrete examples and limitations of the analysis will be discussed.

References

1. Thimsen, E., Entropy production and chemical reactions in nonequilibrium plasma. *AICHE J.* **2021,** *67* (9), e17291.
2. Uner, N. B.; Thimsen, E., Superlocal chemical reaction equilibrium in low temperature plasma. *AICHE J.* **2020,** *66* (6), e16948.
3. Lewis, N. S.; Nocera, D. G., Powering the planet: Chemical challenges in solar energy utilization. *Proc Natl Acad Sci U S A* **2006,** *103* (43), 15729-15735.

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