Thermodynamic Efficiency and Entropy Production in the Climate System

V. Lucarini (1,2,3)

(1) University of Bologna, Department of Physics, Bologna, Italy (lucarini@adgb.df.unibo.it), (2) Istituto Nazionale di Fisica Nucleare - Sezione di Bologna, Via Irnerio 46, 40127 Bologna (Italy), (3) CINFAI, Via Venanzi 15, 62032 Camerino (Italy)

We present a succinct analysis of the thermodynamics of the climate system, studying some of its macroscopic properties in terms of the 1st law and the 2nd law of thermodynamics. We first review and clarify the notion of efficiency of the climate system treated formally as a thermal machine, and show how the Lorenz energy cycle can be framed in a macro-scale thermodynamic context. We then exploit a thermodynamic inequality to relate the Carnot efficiency of the climate system to the lower bound to the amount of entropy production. Since entropy production due to heat transport from hot to cold regions is basically the difference between the actual and the minimal entropy production, the controversial principle of maximum entropy production is given a rigorous interpretation.