

Understanding the Earth from a thermodynamic systems perspective

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Abstract

The Earth is a vastly complex system that converts the energy contained in sunlight into various forms, from the kinetic energy of motion to chemical energy of life and the electric energy that powers human societies. These conversions follow the laws of thermodynamics, which set the directions and fundamental limits, yet these also result in interactions and feedbacks that emphasise the need for an Earth system perspective. In this talk, I provide the background for this thermodynamic description of the Earth system and use examples to show how thermodynamic limits in combination with a formulation of the dominant interactions can be used to describe the emergent behaviour. I show how this approach can be used to provide simple, yet physically-based estimates of climate and climate change, as well as how it sets limits on different forms of renewable energy. I close with an outlook on potential future applications, highlighting the generality of the approach as energy, its conversions into other forms, and interactions are at the very core of literally every Earth system process.

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