



Centro Studi sugli Impatti dei
Cambiamenti Climatici
Università di Padova - Rovigo



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DIPARTIMENTO DI INGEGNERIA CIVILE, EDILE E AMBIENTALE - I C E A
DEPARTMENT OF CIVIL, ENVIRONMENTAL AND ARCHITECTURAL ENGINEERING

How thermodynamics shapes the dynamics of the hydrological cycle and its response to global climate change



Date: 30 September 2025



Time: 12:30-13:30



Location: Room T – Area di Ingegneria – via Marzolo 9 - Padova Rovigo



Speaker: **Axel Kleidon**, Max-Planck-Institute for Biogeochemistry in Jena, Germany

Abstract

The hydrological cycle is a thermodynamic Earth system that is maintained far from an equilibrium state of saturation. This may sound complicated. Yet, what I intend to show is that this approach results in quite a simple, intuitive, and physically-based description of hydrological cycling in the Earth system. I use such a systems description to show that thermodynamic constraints control the magnitude of evaporation rates as well as precipitation events. A central part of this description deals with the constraint on how much power can be generated to drive motion from heating - either from absorption of solar radiation or from condensational heating. This constraint can be used to derive relatively simple estimates for potential evaporation rates that agree very well with observations, the magnitude of extreme precipitation events, and it provides a basic perspective of how the hydrological cycle responds to global climate change.

Axel Kleidon studied physics and meteorology at the University of Hamburg and Purdue University. He received his Ph.D. in meteorology from the University of Hamburg. After his PostDoc at Stanford University he joined the faculty of the University of Maryland. Since 2006 he leads an independent research group at the Max-Planck-Institute for Biogeochemistry in Jena, Germany. In his research, he uses thermodynamics to quantify natural energy conversions within the Earth system and their limits, and applies this approach to understand atmosphere-biosphere interactions, Earth system responses to global change, and the natural limits of renewable energy.

All are welcome!

For more information, contact: marco.marani@unipd.it