PROPOSAL

Syllabus

1) Name and surname of Prof./Dr: Prof. Axel Kleidon

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- For details see CV https://www.bgc-jena.mpg.de/index.php/BTM/AxelKleidon

2) Title of the course: Thermodynamics and Optimality of the Earth system

3) Course content detailed per lesson of 2 h (room real: Sala Strozzi, DST UNIFI and virtual):

	Monday, 19.09.	Tuesday, 20.09.	Wednesday, 21.09.
Morning	**Short Course - Day 1** Introduction and Basics	**Short Course - Day 2** Hydrologic Cycling	**Short Course - Day 3** Humans, Sustainability, and Renewable Energy
Afternoon	**Short Course - continued** Climate and Climate Change	**Short Course - continued** Life and Habitability	**Short Course - continued** Discussion, Closing
	Short course dinner		

4) Course program (150-200 words):

Water flows downhill, mountains erode, and wood burns into ashes. If nothing else happened, sooner or later, water would collect in the world's oceans, mountains would be eroded down to the seafloor, and wood would decompose to its raw ingredients. The outcome would constitute a "dead" state of the Earth system, without atmospheric dynamics, hydrologic and biogeochemical cycling, and it would be unable to sustain life. The present Earth is nowhere near such a "dead" state, and thermodynamics provides the key answer to understand why the Earth is not in such a "dead" state and how processes perform work to keep the Earth in an active state.

This short course provides the basics to understand how dynamics are maintained in Earth systems from a thermodynamic perspective. It provides the basics for a comparatively non-technical description of the thermodynamic foundations, illustrate quantitatively how these apply to the various processes of the Earth

system, describe how thermodynamics links with organization of flows in space and time (such as turbulent structures and fractal networks), and how these shape the interactions with other processes and their boundary conditions within the system. These descriptions are illustrated with examples that apply these concepts to climate and global warming, hydrology, and limits of renewable energy. The course consists of a mix of lectures, exercises, and discussions.

5) Suggested reading: research articles provided by the teacher

6) Learning Objectives: The course has the primary objective to introduce to thermodynamic foundations of the Earth System.

7) Knowledge and skills to be acquired: How thermodynamics applies to the Earth system. It is less about thermodynamics itself, but rather about how it applies to Earth system processes, their interactions, and the operation of the Earth system as a whole.

8) Prerequisites: Master's degree in scientific disciplines

9) Teaching Methods: frontal lessons using slides

10) Further information: discussion welcome

11) Type of Assessment: written test (multiple choice)

Total hours must be: 12h frontal lessons **(3 ECTS)**

Period: September 19th-September 21st 2022

The lessons will be delivered both online and in presence. The lessons will be recorded and available to all the students that cannot take part to the lessons in streaming.

The Webex platform will be used.