Evaluation results: Thermodynamics of Earth system processes (March 1-2 and 16, 2018)

Course details

Instructors: Axel Kleidon (MPI for Biogeochemistry) and Erwin Zehe (KIT)

Water flows downhill, mountains erode, and wood decomposes. In the absence of other processes, 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, biogeochemical cycling and 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 a "dead" state.

This course provides the basics to understand how dynamics are maintained in Earth systems from a perspective of non-equilibrium thermodynamics. 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 fractal networks), and how these shape the interactions within the system and the boundary conditions. These descriptions are illustrated using examples from atmospheric science, hydrology, and human activity to provide a general appreciation of the general nature of the Earth as a thermodynamic system and its implications.

More information is provided on the webpage:
www.imprs-gbgc.de/index.php/Courses/Thermodynamics2018

9 out of 20 participants filled in the survey by March 20, 2018.

Survey results

Please assess the course in general.

The course stimulated my interest in this topic.

0%	Strongly disagree
0%	Disagree
0%	Neither agree nor disagree
67%	Agree
33%	Strongly agree

I think that the level of difficulty of this course is appropriate.

0%	Strongly disagree
0%	Disagree
11%	Neither agree nor disagree
56%	Agree
33%	Strongly agree

IMPRS-gBGC,
MPI Biogeochemie,
P.O. Box 10 01 64,
07701 Jena, Germany

Phone +49-(0)3641-576260
Fax +49-(0)3641-577260
E-Mail: imprs-gbgc@bgc-jena.mpg.de
Web www.imprs-gbgc.de

Spokesperson:
▷ apl. Prof. Dr. Gerd Gleixner
Coordinator:
▷ Dr. Steffi Rothhardt

I think the lectures were organized in a logical way.

0% Strongly disagree

22% Disagree

22% Neither agree nor disagree

33% Agree

22% Strongly agree

Overall, I am satisfied with this course.

0% Strongly disagree

0% Disagree

0% Neither agree nor disagree

67% Agree

33% Strongly agree

Which parts of the workshop were especially good (and why)?

- Work done by the atmosphere
- overall, explanations were very well Axel had a very nice and easy to follow structure Erwin's lecture was very vivid and thus it was easy not to thrift away with one's thoughts
- Discussing the earth system using Thermodynamics approach. It was interesting to me because I did not have any study on that.
- The explanation of concepts such as entropy and the exercises.
- The hydrology perspective by the guest lecturer was very nice
- I really liked the lectures by Axel, they were well organized and gave a good overview of the thermodynamic processes without getting stuck in to much detail. Erwins enthusiasm and way of presenting was great.
- I like that we also extensively discuss the history of thermodynamics, because it gives perspective to whence it came.
- Radiation, entropy explained by Axel. Hydrology basics by Ervin
- Applying basic concepts of Thermodynamics to approach complex problems in the Earth System.

Which parts of the workshop were not so good / not so fitting / not well enough presented?

- the standard soil science part was too long and had too little/no thermodynamics
- Especially the hydrology part was very much into basic knowledge and methods. That could have been shortened a lot and so the point about Thermodynamic principles in hydrology could have made earlier and more emphasized.
- All the parts were good fitting and well enough presented.
- The hydrology part made me a little bit confused. Although the concepts were properly explained, I missed more Thermodynamic concepts in this part, which I found more focused on hydrological fundaments and models.
- The radiation part was a bit overlapped with Julia's lecture but I guess is necessary for introduction
- The introduction on Thursday morning was to long for a two day course (and probably still for a 3 day course). The introduction to why normal hydrological models are not

sufficient and why its frustrating to work in an engineering dominated field was to long. Hydrologists already (should) know and non hydrologist wont care to much, I think the point can be made in 15 minutes or so instead of several hours.This way we can get back to the thermodynamics quickly (the reason why we are there). Also the hydrological thermodynamics part can in my opinion focus a bit more on the thermodynamic processes in hydrology and a bit less on the step by step implementation in a hydrological model.

- I liked the explanation of the hydrological HBV model, but it took somewhat too much time.
- Everything was good but may be it is okay to not include much equations in hydrology
- In the hydrology part, the connection to Thermodynamics in the ES was not always clear to me. Nevertheless it was very interesting.

Do you have other suggestions for a future course?

- Respect time constraints
- plan in more time - minimum of 3 days is needed better plan who is talking about what (in detail) and when
- Maybe the topics related to statistical physics could be little further mentioned.
- I would suggest to spread the course in shorter time slots, but more days.. So 4 afternoons, or 4 mornings, something like this. Just to avoid saturation at the end of the day, which can hamper participation and even understanding.
- Well its a first time so its to be expected there is some room for improvements. Obviously spend some time together to discuss who is going to spend how much time on what, and stick to this schedule. And add a warning that people in the front row should bring a raincoat.
- Rethink how much time is spent on each topic (the hydrology was nice, but it focused really long on non-thermodynamics related topics (HBV model); -Rethink the structure. In my opinion it would be better to really split the meteorological and hydrological part, because now the hydrological part was kind of in the middle of the meteorological part.
- Material was well structured, but two days are not long enough to cover everything - as already noted by the lecturer. One-Week Block Course would be ideal.