Dynamical Systems in Geosciences

Overview

Overview: Structure of lecture

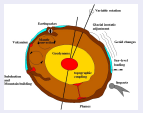
Structure of lecture

This lecture introduces **dynamical systems** as a physical model to discuss problems in geosciences.
We will use mathematical methods to **describe** processes acting on and within the Earth, which often have a dynamical character. We will discuss concepts such as

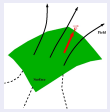
- **Flux**, representing the **movement** of a quantity in space and time (examples: heat flux, groundwater flux, mass flux, ...).
- **Continuity** as a concept describing the **transport** of the quantity (e.g. continuity of mass, energy, momentum, charge, ...).
- **Differential equations** for **motion** and **material**.

Overview: Lectures

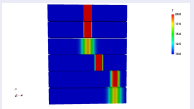
1. Introduction



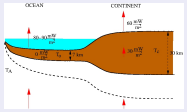
2. Flux



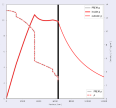
3. Continuity



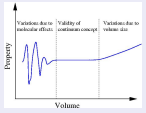
4. Heat



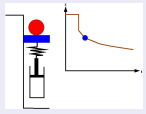
5. Gravity



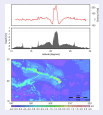
6. Motion



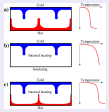
7. Material



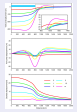
8. Elastic



9. Viscous



10. Viscoelastic



11. Reactions

11. Shallow water

(empty)

Overview: Tentative schedule

Week

1. Overview
2. Introduction
3. Flux
4. Continuity
5. Heat
6. Gravity
7. Motion
9. Material
10. Elastic
11. Viscous
12. Viscoelastic
13. Reactions
14. (spare time)
15. Exam

Overview: Exercises and Seminar

Exercises

- We will have practical exercises, which follow some of the (mathematical) concepts introduced in the lectures.
- We introduce PYTHON as simple programming language.
- For some of the lectures a link is given to a running JUPYTER NOTEBOOK.
- Explore and play with it!

Seminar

- We discuss and run the concepts developed in the lectures with practical exercises in PYTHON.
- For advanced problems, we use OPENFOAM as software.
- We need the open-source software DOCKER ...
- The coded geophysical exercises should be **handed in** as jupyter notebook to: dropdown

Overview: Suggested reading

Suggested reading

- Turcotte, D.L. & Schubert, G. (1982).
  Geodynamics
  J. Wiley, UK.
- Fowler, C.M.R. (1990).
  The Solid Earth
  Cambridge Univ. Press, UK.
- Press, F. & Siever, R. (2001).
  Understanding Earth
  Freeman, UK.
- Ranalli, G. (1987).
  Rheology of the Earth
  Allen & Unwin, UK.
- Strobach, K. (1991).
  Unser Planet Erde
  Bornträger, Germany.