ENV-525

Physics and hydrology of snow

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Cursus	Sem.	Type
Environmental Sciences and Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course covers principles of snow physics, snow hydrology, snow-atmosphere interaction, and snow modeling. It transmits detailed understanding of physical processes within the snow and at its interfaces with the atmosphere and the ground, and presents field, laboratory, and modeling techniques.

Content

- Processes of snow formation in the atmosphere
- Physical (thermal, optical, mechanical) properties of snow
- Snow accumulation, transport, redistribution
- Heat and mass transfer in snow, metamorphism
- Energy balance within snow and at its boundaries
- Processes of snow pack ablation and melt
- Snow cover variability and interaction with vegetation
- Snow cover-climate interactions at various spatio-temporal scales
- Measurement methods and field techniques
- Snow avalanche mechanics and release processes
- Approaches of snow cover modeling
- Snow modeling using the SNOWPACK model

Keywords

Snow, glaciology, cryosphere, hydrology, atmospheric boundary layer, environmental physics, climate, avalanches

Learning Prerequisites

Recommended courses

ENV-167, ENV-221, ENG-272, ENV-320

Learning Outcomes

By the end of the course, the student must be able to:

- Analyze a snow cover and acting physical processes
- Compute heat and mass fluxes related to snow

- Apply a numerical snow cover model (SNOWPACK)
- Formulate snow-air-ground exchange processes
- Explain the temporal evolution of a snow cover
- Interpret a snow cover as a result of its genesis
- Perform practical field work and measurements
- Assess / Evaluate the role of snow in local and global climate
- Characterize a snow cover in terms of avalanche risk

Teaching methods

Lectures, exercises (incl. computer labs), autonomous learning, videos

Expected student activities

Active participation, individual work on exercises, group work where indicated, guided and autonomous learning

Assessment methods

50% Exercises (graded, including model simulations; individual and dyad assessment)
50% Written exam (exam session; individual assessment)

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Bibliography

Armstrong, R.L., and E. Brun, (Eds.), 2008. Snow and climate, Cambridge University Press.
Barry, R.G., and T.Y. Gan, 2011. The global cryosphere, Cambridge University Press.
DeWalle, D.R., and A. Rango, 2008. Principles of snow hydrology, Cambridge University Press.
McClung, D., and P.A. Schaerer. The avalanche handbook. The Mountaineers Books, 2006.
Selected journal articles and/or book chapters.

Ressources en bibliothèque

- Principles of Snow Hydrology / DeWalle
- The avalanche handbook / McClung
- The global cryosphere / Barry
- Snow and climate / Armstrong

Moodle Link

- https://go.epfl.ch/ENV-525