

ENV-525

**Physics and hydrology of snow**

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<b>Cursus</b>	<b>Sem.</b>	<b>Type</b>
Environmental Sciences and Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Lecture	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

This course covers principles of snow physics, snow hydrology, snow-atmosphere interaction and snow modeling. It transmits sound understanding of physical processes within the snow and at its interfaces with the atmosphere and the ground, including 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 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, avalanches, hydrology, atmospheric boundary layer, environmental physics

**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)

50% Written exam (exam session)

### Supervision

Office hours	Yes
Assistants	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 other text books.

#### Ressources en bibliothèque

- [Principles of Snow Hydrology / DeWalle](#)
- [Snow and climate / Armstrong](#)
- [The global cryosphere / Barry](#)
- [The avalanche handbook](#)

#### Moodle Link

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