Module Description, available in: EN

Advanced Alpine Risk Management

General Information

Number of ECTS Credits

3

Module code

TSM_AdvAlpRsk

Valid for academic year

2026-27 DRAFT

Last modification

2026-06-18

Coordinator of the module

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Explanations regarding the language definitions for each location:

- Instruction is given in the language specified for each location and module execution.
- Documentation is available in the language(s) listed for each location and module execution. If the documentation is in multiple languages, the percentage distributed is indicated (100% = all documentation provided).
- The examination, including both questions and answers, is provided entirely (100%) in the language(s) specified for each location and module execution. The exams are on-site.

	Lausanne			Lugano	Zurich		
Instruction				**X** E 100%			
Documentation				**X** E 100%			
Examination				**X** E 100%			

Module Category

TSM Technical scientific module

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competences

Prerequisites, previous knowledge

- Knowledge of applied geology, hydrology and natural hazard assessment.
- Basic knowledge of slope stability analysis, geotechnical engineering, hydraulic processes and Geographic Information Systems (GIS) is recommended.
- Students should also be able to interpret topographic, geological and hazard maps.

Brief course description of module objectives and content

Contents:

The module provides advanced knowledge and practical skills for assessing and managing natural hazards in Alpine environments. It focuses on slope instability, high-altitude cryosphere hazards, floods and debris flows, including their evolution under climate change.

The course combines process analysis, field and remote-sensing data, numerical modelling, hazard and risk mapping, vulnerability assessment and the evaluation of mitigation measures. Swiss standards and guidelines, particularly SIA 261/1, are applied through lectures, practical exercises, real case studies and a site-specific field investigation.

Objectives:

After completing the module, students should be able to analyse complex Alpine hazard processes, select and apply suitable investigation and modelling methods, interpret model and field data, and translate the results into hazard and risk assessments. Students should also be able to evaluate protective measures and develop technically appropriate, cost-effective and risk-informed solutions, taking into account uncertainty and the effects of climate change.

Aims, content, methods

Learning objectives and competencies to be acquired

- After completing this module, students should be able to:
- Understand and interpret slope failure mechanisms in soil and rock slopes;
- Delineate hazard-prone areas using advanced digital surveying and geospatial mapping techniques;
- Apply numerical modelling approaches to evaluate slope stability and landslide dynamics;
- Assess the performance of stabilization and mitigation measures under varying environmental and loading conditions;
- Carrying out complex case studies based on real examples and field data.
- Conducting a study and complying with specifications according to the client's instructions.
- Proposing technical solutions that are appropriate to the context and cost-effective.
- Interpreting and apply federal directives and norms for the dimensioning and construction of protective measures and structures.

Module content with weighting of different components

PART 1: Slope stability from modelling to hazard assessment, 12h (4 lectures)

This part of the course provides a detailed and integrated framework for the **analysis and management of slope-related natural hazards in alpine environments**, forming the methodological foundation for the subsequent modules on avalanches, debris flows, floods, permafrost and high-altitude hazards.

The module combines **mechanical principles, advanced numerical modelling, hazard dynamics**, and **territorial protection strategies**, with a strong focus on **decision-oriented risk management** under climate-change-driven conditions.

PART 2: Complex high-altitude cryosphere hazards, 12h (4 lectures)

In the context of climate change, the Alpine cryosphere is particularly affected by the temperature increase and the modification in rain/snow regimes, leading to **enhanced debris production** by rapid glacier retreat, **increasing permafrost degradation**, and **more intense precipitation** (by rain and snow).

By adopting an **integrative view** of the three components of the Alpine cryosphere (snow, ice, and permafrost), this second part of the course has the **objective to develop competences in the assessment of complex high-altitude hazards and risks**.

PART 3: Floods and debris flows hazards, 12h (4 lectures)

The third part of the course focuses on flood and debris flow hazards and risk management, integrating advanced concepts of hydrology and flood discharge estimation in order to develop competences in the hazard and risk mapping technique for floods and debris flows. Focus will be given to the hydrological extremes and debris flow generation in the context of climate change.

PART 4: SITE-SPECIFIC ANALYSIS ON THE FIELD (1 day)

Teaching and learning methods

- Lectures
- Independent exercises
- a site-specific field investigation based on a real case study in the Southern Swiss Alps

Literature

Teaching materials and selected scientific and technical references provided during the lectures.

Assessment

Additional performance assessment during the semester

The module does not contain an additional performance assessment during the semester

Basic principle for exams

As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

Duration of exam

120 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

No electronic aids are permitted, except for a non-programmable pocket calculator.

Other permissible aids

Permitted aids as agreed upon with the instructor.

Exception: In case of an electronic Moodle exam, adjustments to the permissible aids may occur. Lecturers will announce the final permissible aids prior to the exam session.

Special case: Resit exam as oral exam

Kind of exam

Oral exam

Duration of exam

30 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

No electronic aids are permitted, except for a non-programmable pocket calculator.

Other permissible aids

Permitted aids as agreed upon with the instructor.