

Curriculum Georisk and Climate Change



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This Master of Science (Laurea Magistrale) in “**Georisk and Climate Change**” tries to give answers to questions related to **Natural Hazards and their possible evolution in a Climate Change scenario** from the from the point of view of scientists that study and understand the Earth System and its phenomena and processes.

The Master of Science in “Georisk and Climate Change” is offered mostly in English, and provide the acquisition of 120 CFU, including a two-month traineeship (8 CFU), and a final thesis (30 CFU).

A tight collaboration with the **University of Vienna** allows the student to follow 1 or 2 semesters in Austria within the Erasmus Programme.



Curriculum di Georisk and Climate Change – I anno

PRIMO ANNO - 56 CFU - 9 esami

Insegnamenti obbligatori:

- | | | |
|--|--------------|--------------|
| - Tettonica e geologia strutturale | | 8 CFU |
| - <i>Tettonica attiva e Vulcanotettonica</i> | <i>(ENG)</i> | <i>6 CFU</i> |
| - <i>Applied Seismology</i> | <i>(ENG)</i> | <i>6 CFU</i> |
| - <i>Quantitative Georisk Analysis</i> | <i>(ENG)</i> | <i>6 CFU</i> |
| - <i>Earth System Models in Climate Change Science</i> | <i>(ENG)</i> | <i>6 CFU</i> |
| - <i>Slope Instability</i> | <i>(ENG)</i> | <i>6 CFU</i> |
| - Statistica | | 6 CFU |

Due insegnamenti (12 CFU) a scelta tra:

- | | | |
|---|--------------|--------------|
| - <i>Environmental Geochemistry</i> | <i>(ENG)</i> | <i>6 CFU</i> |
| - Mineralogia Industriale e Ambientale | | 6 CFU |
| - <i>Geo-hydrological Risk</i> | <i>(ENG)</i> | <i>6 CFU</i> |
| - Metodi di indagine Geologico-tecnica | | 6 CFU |
| - <i>Coastal Risk and Dynamics</i> | <i>(ENG)</i> | <i>6CFU</i> |

Curriculum di Georisk and Climate Change – Il anno

SECONDO ANNO - 60 CFU - 3 esami

Insegnamento obbligatorio:

- Climate Change Impacts on Geohazards (ENG) 6 CFU

Un insegnamento (4 CFU) a scelta tra:

- Telerilevamento per le Scienze della Terra (ENG) 4 CFU

- Scavo e Consolidamento Terre e Rocce 4 CFU

- Laboratory of Microzonation (ENG) 4 CFU

- Laboratory of Advanced Numerical Modelling (ENG) 4 CFU

- Laboratory of Mitigation-work Design (ENG) 4 CFU

Insegnamenti a scelta dello studente 16 CFU

Tirocinio 8 CFU

Prova finale 30 CFU

Courses offered in Vienna

	ECTS	
Third Semester	<i>Current research topics in Geomorphology</i>	3
	<i>Statistics in Physical Geography</i>	4
	<i>Risk in Contemporary Society</i>	5
	<i>Contested resources, Rural Livelihoods and Globalisation</i>	4
	<i>Intercultural Negotiation Patterns</i>	4
	<i>Terrestrial Systems</i>	5
	<i>Master Seminar Environmental Sciences</i>	2
	<i>Atmospheric Systems</i>	4
Fourth Semester	<i>Current research topics in Hazard and Risk Research</i>	3
	<i>Remote sensing in Physical Geography</i>	4
	<i>Modelling in Physical Geography</i>	4
	<i>Basics in Geophysics</i>	5
	<i>Seminar in Physical Geography</i>	5
	<i>Dealing with natural hazards: Scenario development and analysis</i>	4
	<i>Climate change and climate crisis. Interdisciplinary perspectives</i>	5

Job opportunities

1) **Professionals and consultants working in the choice and design of mitigation strategies for natural risks.** These professionals will be able to assess the actual and future risks, to evaluate the level of acceptability, to provide alternative solutions, to evaluate these solutions in terms of costs and benefit in order to choose the optimal solution, and to design the mitigation measures.

Job position: professional, consultant, or employee within a company working on mitigation design and installation.

2) **Professional and consultant working on urban planning for what concern the natural risks, including earthquakes (e.g., seismic microzonation), ground movements, floods and meteo-climatic risk.**

These professionals will be able to quantitatively assess and spatially analyse the hazard and risk level at local to regional scale.

Job position: professional, consultant.

Job opportunities

3) **Professionals and consultants working in the insurance market for the assessment of risk related to natural hazards in a changing world.** These professionals will be able to interpret existing risk data and to quantify with a probabilistic approach the hazard and risk potentially impacting the human structures and infrastructures.

Job position: employee of insurance and reinsurance companies, consultant.

4) **Professionals working in the public administration and civil protection.** These professionals will be able to evaluate the risk acceptability for the society and the different mitigation strategies to be adopted for risk reduction. They will be also able to work for civil protection and emergency response.

Job position: within public administrations

5) **Professionals working in the field of environmental geology and risks.** These professionals will be able to assess the risk related to soil, subsoil and groundwater contamination, and to design remediation strategies.

Job: professional, consultant, or employee in an environmental geology and risks company.

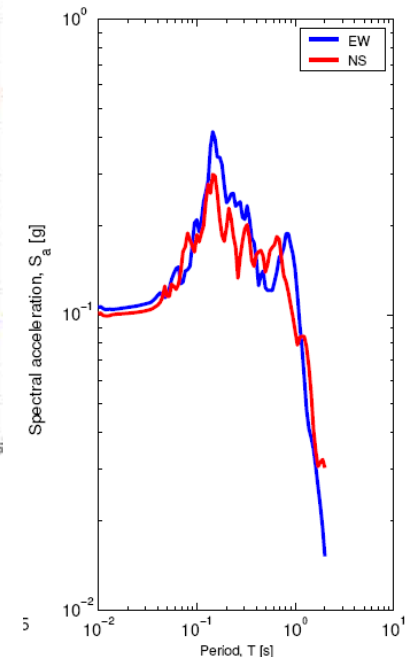
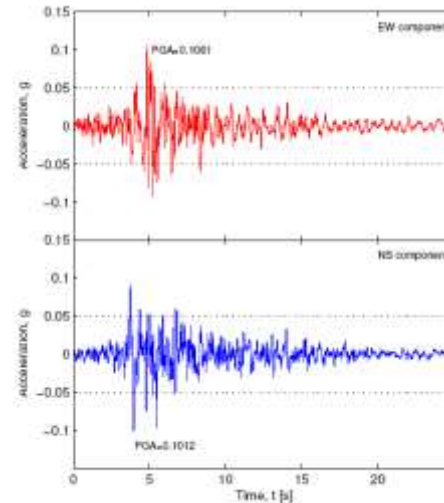
Il corso affronterà i seguenti argomenti

In ENGLISH

1) **Localizzazione e stima dei parametri di un evento sismico (earthquake location and estimation of the earthquake metadata)** - introduzione al concetto di terremoto, localizzazione, stima di magnitudo e momento sismico, meccanismo focale, cataloghi strumentali

2) **Reti sismiche e registrazione del moto del suolo (Seismic networks and ground motion recordings)** - introduzione alla strumentazione e al concetto di registrazione e principali reti di monitoraggio

3) **Sismologia storica e macrosismica (historical seismology and macroseismic data)** - introduzione al concetto di sismologia storica e macrosismica



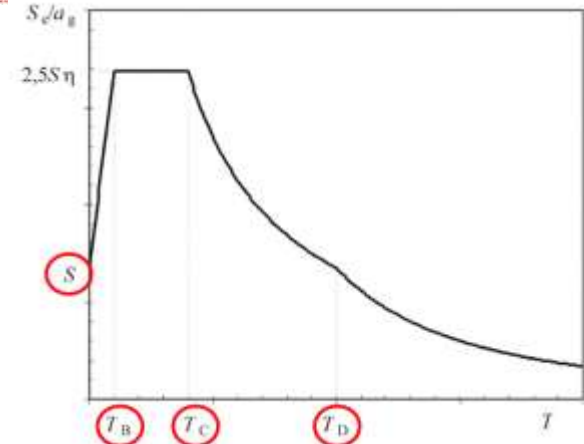
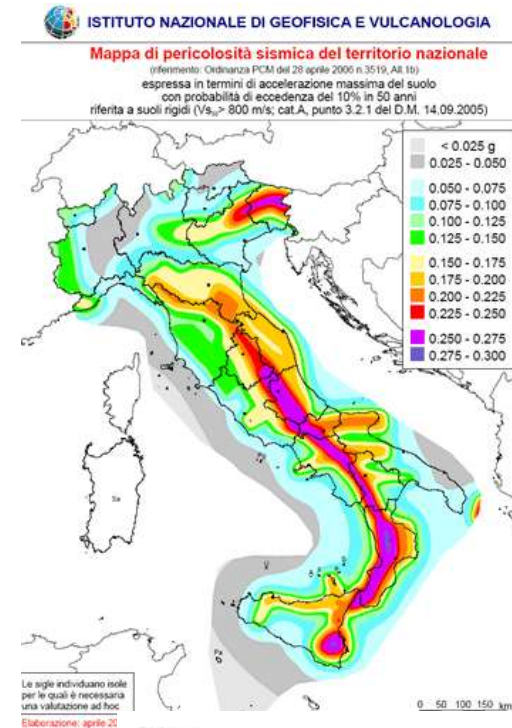
In ENGLISH

4) **Parametri di scuotimento del terreno e principi di analisi spettrale in sismologia (Ground motion parameters and introduction to spectral analysis in seismology)** - introduzione ai principali parametri di scuotimento, spettri di Fourier e spettri di risposta

5) **Pericolosità sismica probabilistica (probabilistic seismic hazard)** - principali concetti di pericolosità sismica e mappa di pericolosità sismica nazionale

6) **effetti di sito e microzonazione sismica (site effects and seismic macrozonation)** - concetti di base su effetti di sito e microzonazione e introduzione alle linee guida nazionali per la microzonazione

7) **Norme tecniche per le costruzioni:** focus sulle forme spettrali e sugli effetti di sito (Italian seismic code: focus on spectral shapes and site effects)



Oggetto:

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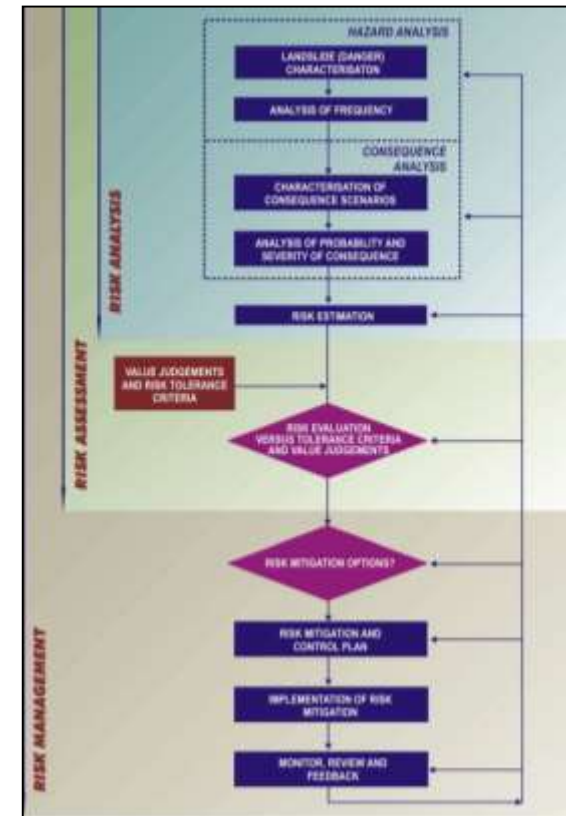
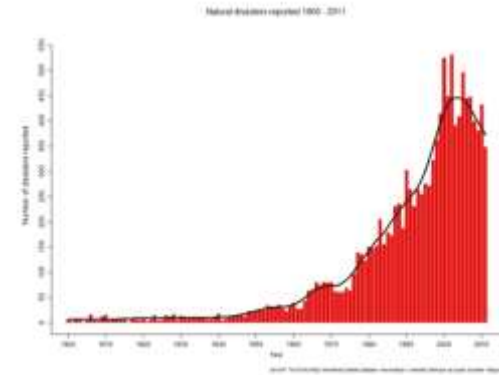
Principi di base e principali metodologie per l'analisi, la valutazione e la mitigazione dei rischi geologici.

Organizzazione:

→ Lezioni (6 CFU)

Contenuti:

- 1) Definizione di rischio, valutazione del rischio e gestione del rischio. Accettabilità del rischio.
- 2) **Rischio idraulico:** idrogramma di piena e cenni di idraulica fluviale. Relazione portata - tempo di ritorno. Curve di vulnerabilità. Mitigazione e monitoraggio.
- 3) **Rischio da frana:** fattori che controllano l'instabilità, tipologie di frana e condizioni di pericolosità. Valutazione della suscettibilità e pericolosità. Vulnerabilità. Tecniche di mitigazione e monitoraggio.



Quantitative Georisk Analysis (6 CFU)

Contenuti:

In ENGLISH

- 4) **Rischio sismico:** analisi della pericolosità sismica regionale con tecniche probabilistiche (PSHA). Effetti di sito e fenomeni co-sismici. Valutazione dell'azione sismica sugli edifici. Curve di fragilità. Tecniche di mitigazione e monitoraggio.
- 5) **Rischio valanga:** nivologia delle valanghe. Distacco, trasporto, accumulo delle valanghe. Linee Guida AINEVA per la perimetrazione delle aree a rischio valanghivo in ambiente alpino. Tecniche di mitigazione e monitoraggio.
- 6) **Rischio vulcanico.** Processi vulcanici pericolosi, Volcanic Explosive Index, alberi bayesiani. Tecniche di mitigazione e monitoraggio.
- 7) **Introduzione ad altri rischi geologici:** erosione del suolo e delle coste, tsunami, alluvioni costiere.



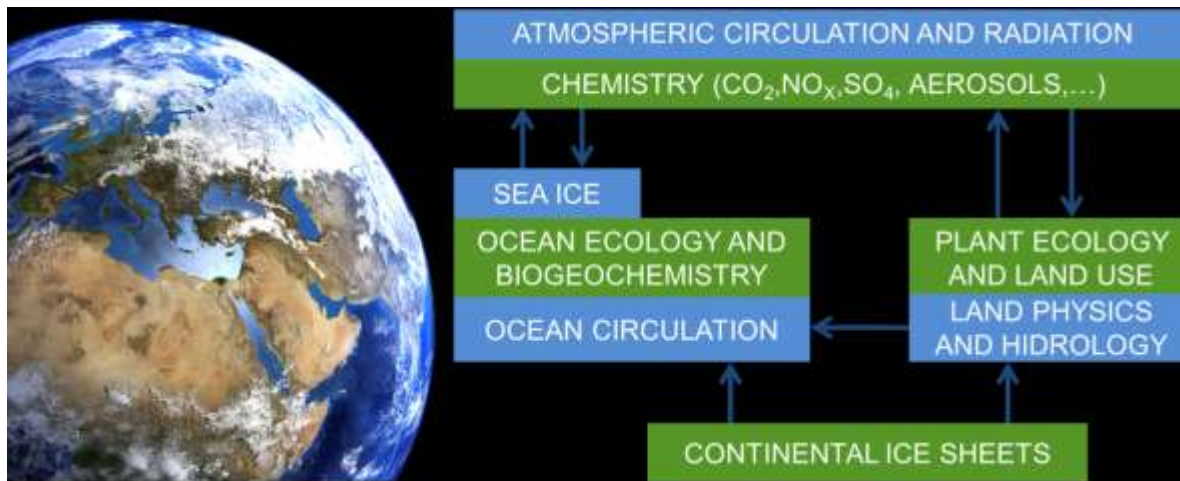
Earth System Models in Climate Change Science (6 CFU)

Aim:

In ENGLISH

To help us understand how the Earth system works and to improve predictions of future environmental change, through a variety of state-of-the-art computer models in areas including:

- **Atmosphere:** dynamics and chemistry
- **Ocean:** dynamics, chemistry and biological activity
- **Land-surface:** forests, vegetation and soils
- **Sea ice:** understanding the complex processes at the atmosphere-ocean interface
- **Glaciers and ice shelves:** their role in global sea level rise



Oggetto:

In ENGLISH

Teoria e tecniche di base ed avanzate per il riconoscimento, la caratterizzazione e la modellazione dei fenomeni di instabilità dei versanti in terre e rocce

Organizzazione:

- lezioni (4 CFU), laboratorio (1 CFU), campo (1 CFU)
- field trip nelle Prealpi e Alpi Centrali (2 giorni)

Contenuti:

- 1) **sistema versante:** aspetti geologici, topografici e idrologici; classificazione, controlli e cause delle frane
- 2) **indagini per aree in frana:** fotointerpretazione e rilevamento, monitoraggio, indagini in sito
- 3) **processi di instabilità dei versanti:** aspetti geotecnici, Fattore di Sicurezza, breve vs. lungo termine



Slope Instability (6 CFU)

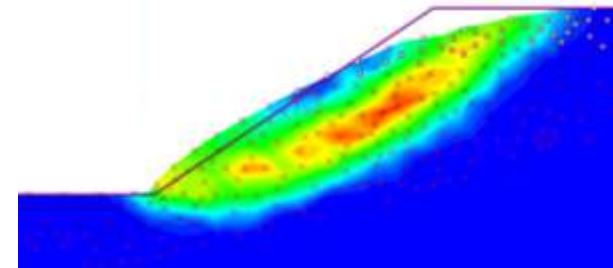
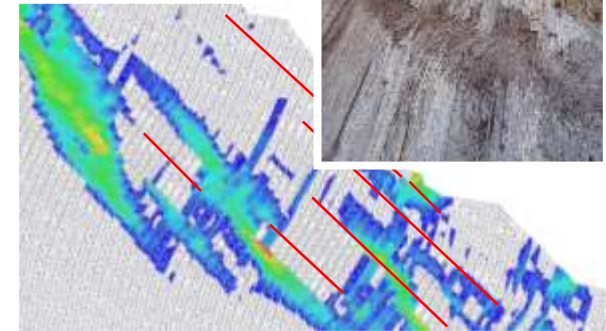
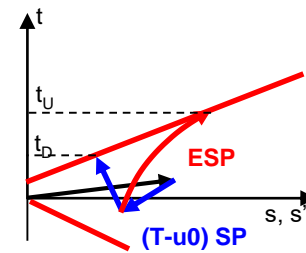
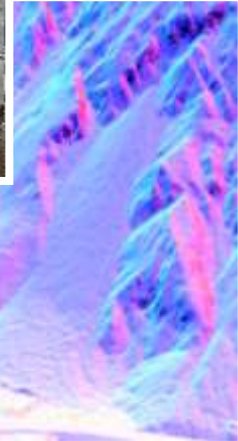
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Contenuti:

- 4) **frane**: frane profonde in roccia lente e catastrofiche, frane di crollo, frane superficiali, flussi e colate
- 5) **analisi di stabilità**: analisi cinematica, metodi dell'Equilibrio Limite, analisi probabilistica, metodi numerici.
- 6) **monitoraggio**: finalità e tecnologie; misura degli spostamenti e delle variabili idro-meteorologiche
- 7) **mitigazione del rischio da frana**: tecniche di stabilizzazione, opere di protezione, Early Warning

Laboratorio: ricostruzione del modello geologico di una frana, soluzione pratica al PC di problemi di stabilità dei versanti

Attività di campo: mappatura, field trip con visita a importanti siti di frane storiche o attive



Environmental Geochemistry (6 CFU)

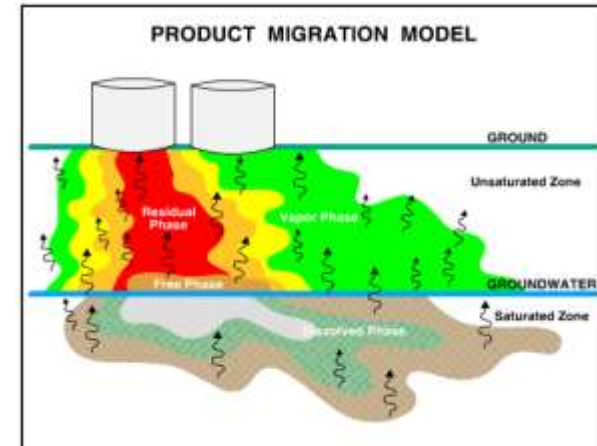
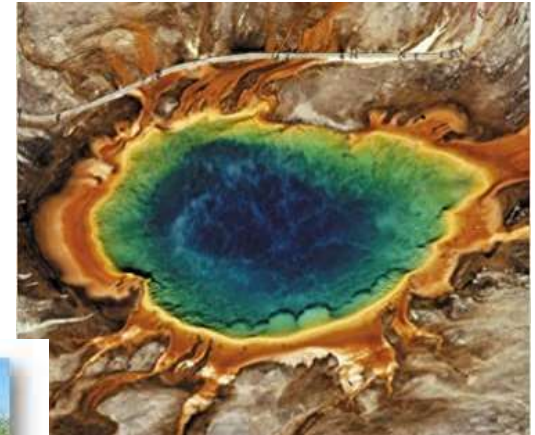
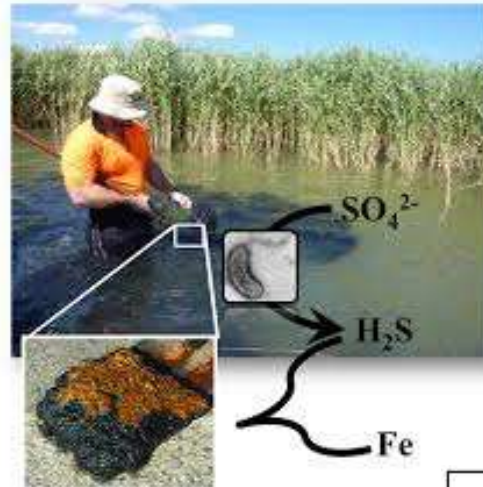
Aim:

This course focuses on geochemical processes that occur at or near the surface which are of particular importance to environmental quality and therefore to humans.

During the first few weeks of the course students explore some important principles that serve as the foundations of geochemistry.

The next weeks of the course explore the application of geochemical tools in sediments, soils, and waters. In the final part of the course students work on applying these tools to answer a question of interest as part of a course research project.

In ENGLISH



Geo-hydrological Risk (6 CFU)

Aim:

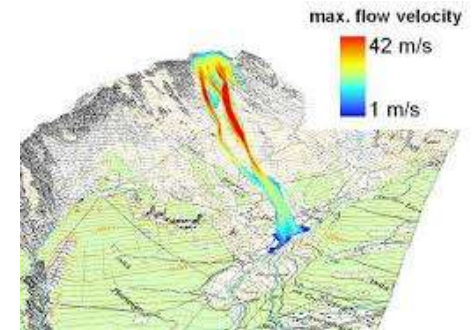
The objective of the course is to introduce students to the main hydrological hazards (fluvial flood, flash flood, excess of rainfall and drought, debris flow, snow avalanche) and the consequent risks. The course aims at providing to the students an overview of the main approaches to assess the hydrological risk and of the main modelling techniques to quantify it.

In ENGLISH



Description:

- Introduction to hydrology and flood risk
- The main processes of the hydrological cycle,
- Definition of flood,
- Statistical methods to describe the extreme events
- The Intense-Duration-Frequency curve,
- The Flood Frequency Curve,
- 1D and 2D hydraulic models,
- Simplified geomorphological models,
- Flood risk analysis,
- Main modelling approach to assess the drought risk.
- Debris flow modelling
- Snow avalanche modelling



Climate Change Impacts on Geohazards (6 CFU)

Aim:

Global warming can enhance local extreme weather conditions, which in turn can affect the frequency of geohazards such as landslides, avalanches and flooding. This course provides you with a broad understanding of the interaction between atmospheric and Earth's surface processes that control the occurrence of potentially catastrophic geohazardous events.

Content:

- learn about basic meteorological processes and their interplay during past, present and future climate change.
- gain a broad understanding of processes that create tsunamis, earthquakes, floods, landslides and avalanches, and how these can affect infrastructure and people.
- achieve knowledge about hydrological systems in urban and rural areas including measures, strategies and plans for run-off management.

In ENGLISH

