

## SYLLABUS

### ----- WEEK 1: 17-21 JUNE -----

#### MONDAY 17 JUNE - GRENOBLE

Welcome & General introduction by Dr. Sophie-Adélaïde MAGNIER, Dir. International projects, UGA International Office

#### The Anthropocene

> Dr. Pierre-Olivier GARCIA ([Laboratoire PACTE, "Environments" research team \(UGA\)](#))

The Anthropocene defines Earth's most recent geologic time period as being human-influenced, or anthropogenic, based on overwhelming global evidence that atmospheric, geologic, hydrologic, biospheric and other earth system processes are now altered by humans.

The Anthropocene is distinguished as a new period either after or within the Holocene, the current epoch, which began approximately 10,000 years ago (about 8000 BC) with the end of the last glacial period. (*The Encyclopedia of Earth*)

**Film viewing: “The mysterious volcano from the Middle Ages” (Awardee, 2019 Grenoble Science & Mountains short-film festival - Pascal GUERIN, Director).**

> Guest researcher

The origin of a volcanic eruption in the Middle Ages, one of the biggest in the last ten thousand years, had long remained a mystery. It was only in 2013 that a group of scientists would solve the puzzle, in an investigation unlike any other... (*CNRS News*).

#### Mountain culture and History in the Alps

> Name to be confirmed

**TUESDAY 18 JUNE – GRENOBLE**

**Between product and resource. Understanding the alpine tourist landscape through the study of history**

> **Caterina FRANCO** ([Lab MHAevt, ENSAG, Université Grenoble Alpes](#) and [DABC, Politecnico di Milano](#))

In the last two centuries, an acceleration in the evolution of mountain activities brought to a rapid transformation of the territory. The rise of productive activities first, and of tourism later used different resources, located at different altitudes. As a last step in the trajectory, the construction of ski resorts after WW2 highly impacted the high-altitude lands.

Concentrating specifically on the transformations brought by tourism, we propose to understand landscape as the result of a conjoint work between Man and Nature. In fact, the construction of a tourist settlement implied not only the implantation of new buildings but also, the realization of: transportation infrastructure networks to connect city and mountain; water and energetic supply systems; the transformation of forest surfaces; the modification of the topography for the creation of ski slopes, etc.

The tools and the methodology are those of a historical research in architecture: through the manipulation of archival documents and cartography we try to discern both the effective steps in the transformation of land (topographic maps of one territory drawn on different years, pictures, etc.) and the ideas that lie behind the actors of the processes (projects produced by architects and urbanists, the regulation plans...).

**WEDNESDAY 19 JUNE & THURSDAY 20 JUNE**

**VERCORS FIELD TRIP: ADAPTATION TO CHANGE IN MID-ALTITUDE MOUNTAIN RANGES RESORTS**

This course will guide you to observe a series of complementary social, economic and cultural configurations that illustrate varied trajectories of mountain territories evolving towards the diversification of their activities.

Against the background of social innovation and climatic, cultural and economic change, you will be shown the ability of people but also organizations to rethink their activity.

■ **WEDNESDAY**

**Touristic Reconversion - New trends**

> **Pr. Philippe BOURDEAU** ([Laboratoire PACTE](#))

■ **THURSDAY – VILLARD DE LANS - RESEARCH AND TOURISM ECONOMIES**

**The Viability of snow conditions and its Challenges for mid-altitude Ski resorts**

> **Dr. Hugues FRANCOIS** and PhD student **Lucas BERARD** ([Laboratoire EcoSystèmes et Sociétés En Montagne \(LESSEM\), Irstea Grenoble](#))

Since the late 80's, snow reliability has been a real concern for ski resorts. Over years, natural variability of snowfalls has become an issue addressed by the use of snowmaking. The snow production slowly became an ordinary tool to manage ski areas and it is compulsory to take its effect into account to assess snow reliability. In the context of climate change, the growing need for machine-made snow goes along with the decrease of cold windows required for snow production. Thus, it is important to have a better understanding of its actual impacts compared to its costs before this snowmaking becomes an economical issue.

**Public Policies in support of the Tourism Diversification**

> **Dr. Coralie ACHIN** ([Laboratoire EcoSystèmes et Sociétés En Montagne \(LESSEM\), Irstea Grenoble](#))

With the snow-free winters of the late 1980s and the publication of the IPCC report in 2007, the future of the so-called “mid-elevation ski resorts” is highly questionable. The winter season may no longer be the only alternative for these resorts. Thus, various public policies adopted since the 2000s have aimed to support the tourism diversification. This can result in a diversification of the tourist offer offered in winter or during the other seasons, or even to initiate a diversification of the economy to no longer rely only on tourism. In addition, it raises the question of the territorial scale to be favored for this new tourism project, as well as the actors involved. Finally, it is the renewal of tourism governance that is particularly questioned with the diversification process.

**FRIDAY 21 JUNE - GRENOBLE**

**Geographic information for Mountains: Environmental engineering**

> **Dr. Raffaella BALZARINI** ([INRIA \(French National Institute for computer science and applied mathematics\) Grenoble](#))

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**GROUP PROJECTS**

----- WEEK 2: 24-28 JUNE -----

**MONDAY 24 JUNE - GRENoble**

**Climate change in Mountains of the world**

> Dr. Samuel MORIN (Director, [Centre d'Etudes de la Neige \(CEN\)](#), Centre National de Recherches Météorologiques)

This presentation will provide evidence and key information on changing climate conditions in mountain regions, with direct impacts on snow, glaciers and permafrost, and indirect impacts on virtually all components of the mountainous environment. Emphasis will be placed on the European Alps, with examples also taken from other mountainous regions of the world.

**From Crystal growth to Avalanche: Why and How avalanche hazard is impacted by climate change**

> Dr. Anne DUFOUR ([Centre d'Etudes de la Neige \(CEN\)](#), Centre National de Recherches Météorologiques)

In this presentation, we will explore how seasonal snowpacks grow and evolve from the micro to the macro scale : beginning with crystal growth in the cloud, their fall on the ground and the subsequent metamorphism once in the snowpack, conditioning its stability or instability.

A special focus will be put on avalanche risk forecasting at the regional scale and numerical tools associated.

As a conclusion, we'll discuss why and how avalanche hazard is impacted by climate change.

**State and Fate of glaciers: What do we know? How do we measure and model it?**

> Dr. Antoine RABATEL ([Institut des Géosciences de l'Environnement \(UMR 5001-IGE\)](#), UGA)

This lecture will first present an overview of glaciers evolution through time from the glacial/interglacial cycles during the Pleistocene to the current glacier shrinkage. In a second time, a focus will be made on the methods (in situ and remote sensing) used to monitor the glaciers and the modeling approaches developed to simulate the evolution of glaciers. Finally, the up-to-date simulations of glaciers future changes will be discussed (including their limits) as well as the related impacts in terms of sea level rise and water resources.

### **Black carbon deposition to Ice and Snow: Climate and environmental impacts**

> Dr. Jennie THOMAS ([Institut des Géosciences de l'Environnement \(UMR 5001-IGE\)](#), UGA)

Black carbon particles (often referred to as soot) are formed by combustion, such as fossil fuel and wood burning. Black carbon impacts climate by absorbing solar radiation (warming) when it is present in both in the atmosphere and on snow/ice surfaces. It has a relatively short lifetime in the atmosphere (~1 week), but still has significant impacts on the climate. Snow and ice covered regions are impacted by black carbon because the particles are darker than snow and therefore reduce snow reflectivity and increase the rate of melting. This is important in the Arctic region, including the Greenland ice sheet, and can also impact snow present in mountain regions such as the Alps and the Himalayas. Here, the sources, processes, and environmental impacts of black carbon are presented.

### **The International [Ice Memory](#) Research project**

> Anne-Catherine OHLMANN (Executive Director, [Fondation Université Grenoble Alpes](#))

The project's goal is to create a global ice archive sanctuary in Antarctica, a continent devoted to science and peace, in an effort to preserve ice cores from the world's key endangered glaciers. That way, scientists in the decades and centuries to come will still have enough high-quality raw material to investigate and make future discoveries.

## **TUESDAY 25 JUNE - GRENoble**

### **Landslides in Nuclear waste areas of Central Asia**

> Pr. Frédéric-Victor DONZE ([Institut des Sciences de la Terre \(ISTerre\)](#), UGA)

There is high level of environmental disaster risk of regional and transboundary characters in warehousing areas of radioactive and toxic mining wastes of Central Asia (Mailuu-Suu, Min-Kush, for examples). These waste storehouses are located in hazardous zones of geological processes (earthquakes, landslides, avalanches, mudflows), which are typical for geodynamic active mountain areas of Tien-Shan. In a worst-case scenario, the fertile land of the Ferghana Valley and the 6 million people who live in and around it could face severe pollution with radioactive elements and heavy metals, lasting hundreds of years. We will discuss the existing options for remediation.

### **Deciphering and mitigating the effects of climate change on high mountain permafrost**

> Dr. Xavier BODIN ([Environnements, Dynamiques, Territoires, Montagnes \(Edytem\)](#), Université Savoie Mont-Blanc)

A few decades ago we discovered that high mountains are affected by permafrost, and, at the same time, that 'ground ice' may constitute a natural concrete of many rock walls or debris accumulations covering the slopes. In the Alps, the warming of mountain permafrost is clearly documented in several boreholes, and related geomorphological processes, such as the increase of rock falls activity or the speed-up of rock glaciers flow, are thought to be a regional consequence of global warming. Though numerous anthropic activities are developing on permafrost itself (for instance, touristic facilities...) or downvalley, it is not yet well known where, when and how the 'emerging' risks related to the degradation of permafrost may hit mountain territories. In this lecture, we will see how remote sensing techniques, as well as in situ measurements, long-term monitoring or modelling approaches help us to explore and better understand the state and evolution of mountain permafrost and the impacts on socio-environmental systems.

### **The many facets of a volcanic eruption: Managing a volcanic crisis**

> Dr. Alain BÜRGISSER ([Institut des Sciences de la Terre \(ISTerre\)](#), UGA)

Volcanic eruptions are highly disruptive events for humans. Volcanologists have a panel of modern tools at their disposal to follow the mood of the volcano prior to an eruption. Mitigation of the volcanic risks, however, does not stop at the work of a handful of scientists riveted to their instruments. Populations at risk need to be warned and displaced to safer grounds. Managing a volcanic crisis involves many disciplines, and this course will explore some of them in a hands-on manner.

### **Introduction to the Geodynamics of the Alps - Preparation to the Oisans, Lautaret & Chenaillet field-trip**

1. Observation of extensional and shortening geological features
2. Observation of witnesses of the Tethys Ocean incorporated in the mountain range

> Dr. Pascale HUYGHE & Dr. Thierry DUMONT ([Institut des Sciences de la Terre \(ISTerre\)](#), UGA)

The Alpine range results from the closure of a part of the Tethyan ocean opened during Jurassic times between Eurasia and Gondwana, and Tertiary collision from 55 Ma onwards due to the northward drift of the African plate relative to Europe. The Western termination of the Alps is arc shaped due to lateral extrusion of the Adria microplate, a northern extension of Africa, since 30 Ma. This kinematics caused recent exhumation of the Alpine roots, allowing their observation along a short E-W transect near Grenoble.

**WEDNESDAY 26 & THURSDAY 27 JUNE –**

**FIELD TRIP TO COL D'ORNON - LAUTARET PASS & BOTANICAL GARDEN – LES OPHIOLITES DU CHENAILLET**

■ **WEDNESDAY**

**Alpine Geological Transect *on the way* (Col d'Ornon & Villar Reymond)**

> Dr. Pascale HUYGHE & Dr. Thierry DUMONT ([Institut des Sciences de la Terre \(ISTerre\)](#), UGA)

Our fieldtrip will cover famous remnants of the Jurassic passive margin and ocean from the Alpine front to the Internal zones, more or less preserved from compressional deformation: a kilometric-scale normal fault scarp with slided blocks (Ornon "Olistoliths"), syn-rift sedimentary sequences with huge variations across tilted blocks, and a quite unique witness of the Tethyan oceanic floor showing spectacular pillow basalts and serpentized peridotites exposed. Parallel to this, the orogenic processes will be illustrated, through tectonic inversion of marginal structures, polyphase thrusting and subduction/exhumation record. Particular attention will be paid to geological and geomorphological landscape interpretation along natural cross-sections carved by quaternary glaciers.

**The [Lautaret Alpine Botanical garden](#) and hosted Research projects: A geological panorama of its own creating exceptional biodiversity in a region of major Alpine passes**

> Dr. Jean-Gabriel VALAY, Dir

The Lautaret Alpine Station is located at the very heart of the French Alps right next to Lautaret pass, between the urban centres of Grenoble and Briançon in the Hautes-Alpes area.

The Lautaret pass is located close to the driest spot in the French Alps, and enjoys an exceptional climate which combines dry summers, lots of sunshine and significant temperature variations.

The natural diversity of species growing in the Lautaret region is due to its extraordinary geographic, geological and climatic configuration. There are over 1,500 species (out of the 5,000 recorded species in France) growing in the wild in the three nearest municipal areas.

The Lautaret pass is renowned for its geological panorama, where the large Alpine structural units that overlap from east to west with very complex tectonics can be observed.

**Entering the [Trajectories Project](#) Annual Conference**

> Dr. Sandra LAVOREL

■ THURSDAY

The [Ophiolites du Chenaillet](#) geological phenomenon

> Dr. Pascale HUYGHE & Dr. Thierry DUMONT ([Institut des Sciences de la Terre \(ISTerre\)](#), UGA)

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FRIDAY 28 JUNE - GRENOBLE

Where do We go from here?

> Member of the [Intergovernmental Panel on Climate Change](#) (IPCC) - Name to be confirmed

GROUP PROJECTS



## ASSESSMENT

Based on the topics, knowledge and methods encountered during the course of this program, the participants will provide, over 3-5 slides (or on a format agreed on with the academic supervisor):

- a research question or a problem statement,
- an abstract,
- an outline of discussion, and
- a bibliography

## CREDIT ATTRIBUTION

The course does not directly deliver credits, however the program is built so as to be potentially recognized a certain amount of credits by your institution on the basis of:

**75 hours total** estimated duration of which:

- **60 hours** classes and field trips
- **15 hours** individual and group work, as well as assessment

N.B.: We will deliver all necessary supporting documents (detailed descriptions, transcript and certification) for your Higher Education Institution to receive the right elements to proceed to a recognition into their own credit system. However it will eventually remain all up to the HEI to decide on the final equivalence. We advise that the student speaks with their study advisor before they apply.