Academic Modules

What can CREA Mont-Blanc offer?

The academic modules outlined by CREA Mont-Blanc in this catalog are meant to provide guidance in terms of our experience and what we are able to offer. While the majority of the modules listed fall within our areas of expertise, some may depend on external partners and collaborators. Please note that we are open to adapting these modules and helping you build and develop different modules that suit your needs and the needs of your students.

As described, most modules consist of a basic progression beginning with a theorhetical introduction, field data collection, data analysis and finally, scientific communication or visualization. Some modules will focus more on field data collection, while others put more emphasis on theory or data analysis. Module descriptions provide a legend indicating the importance of each of the elements (on a scale of 1 to 3). While some modules require a significant amount of time dedicated to field practicals, all modules could be shorted to half a day by reducing the time spent doing field work.

Proposed modules

Introduction to Alpine Ecology
Phenology
Remote Sensing
Climate
High Elevation Adaptation
Birds
Fauna Abundance and Distribution
Vegetation Dynamics (post glacier retreat)
Landscape Evolution
Scientific History and Storytelling

Academic Module: Introduction to Alpine Ecology

This adaptable unit is intended to situate your students in the Mont-Blanc massif and to serve as an introduction both to alpine ecology and to the work of CREA Mont-Blanc. Depending on the background of your students and your goal for the trip, this could last as little as a half day before launching into other, more in-depth scientific modules, or multiple days in order to give a general overview incorporating a variety of field visits and protocols. Although the focus is alpine ecology, this unit could be diversified with visitng specialists in a variety of subjects including glaciology, geomorphology, botany or history.

Research Questions

- What is alpine ecology and how is it different from 'regular' ecology?
- What is CREA-Mont Blanc, and what do they do?
- What are the main drivers of alpine ecosystems?
- What processes and issues (especially related to climate change) are unique to alpine and mountain environments?
- What challenges do researchers have to take into account in study design for alpine environments?

Length, Locations and Dates

1-4 days
Chamonix Valley; various fieldwork sites
Year round

Elements (with corresponding importance from 1 to 3)

- Theoretical Introduction (3)
- Field data and collection (2)
- Data analysis (2)
- Scientificy communication (1)

Data available for analysis

- All Mont-Blanc Atlas data (climate, phenology, species distrubtion)
- Historical photographs
- Topographic maps

Field Protocols

- All CREA Mont-Blanc protocols, according to season

Academic Module: Introduction to Alpine Ecology

Key Words Alpine ecology, elevation gradient, climate change, CREA Mont-Blanc

Above: Larch trees change color on north-facing slopes above Chamonix

Right: Flowering Gentiana acaulis, or stemless gentian

Far Right: In spring, CREA Mont-Blanc monitors 10 different tree species, including the Norway Spruce

Academic Module: Phenology

In 2004, CREA Mont-Blanc began Phénoclim, a citizen science phenology project, encouraging interested citizens to record observations of seasonal phenomena. In spring and fall, ten common tree and plant species and eleven bird and frog species are monitored by researchers and volunteers across the Alps. All data collected are compiled on CREA Mont-Blanc's open-source websites. Students will help collect data at CREA Mont-Blanc's field sites and analyze our 13 years of data from across the Alps.

Research Questions

- Are there significant changes in phenological events linked to climate change (primarily changes in temperature and snow patterns)?
- What are the individual and species capacities for adaptation?
- Does elevation have an impact on phenological events?
- Do phenological changes destablize trophic networks by modifying species interactions and synchronization?

Length, Locations and Dates

2-3 days

Vallorcine and Loriaz

April-June for all species, and limited data collection in the fall.

Please note that the timing of phenological events is, by nature, unpredictable. Nonetheless, analysis of phenological data can be done all year round.

Elements (with corresponding importance from 1 to 3)

- Theoretical Introduction (1)
- Field data and collection (3)
- Data analysis (3)
- Science communication (3)

Data available for analysis

- Tree phenology across the Alps (13 years)
- Coal tit and common frog phenology (8 years)
- Snow/temperature
- Green index
- Remote sensing data (webcams, sensors, satellite imagery)

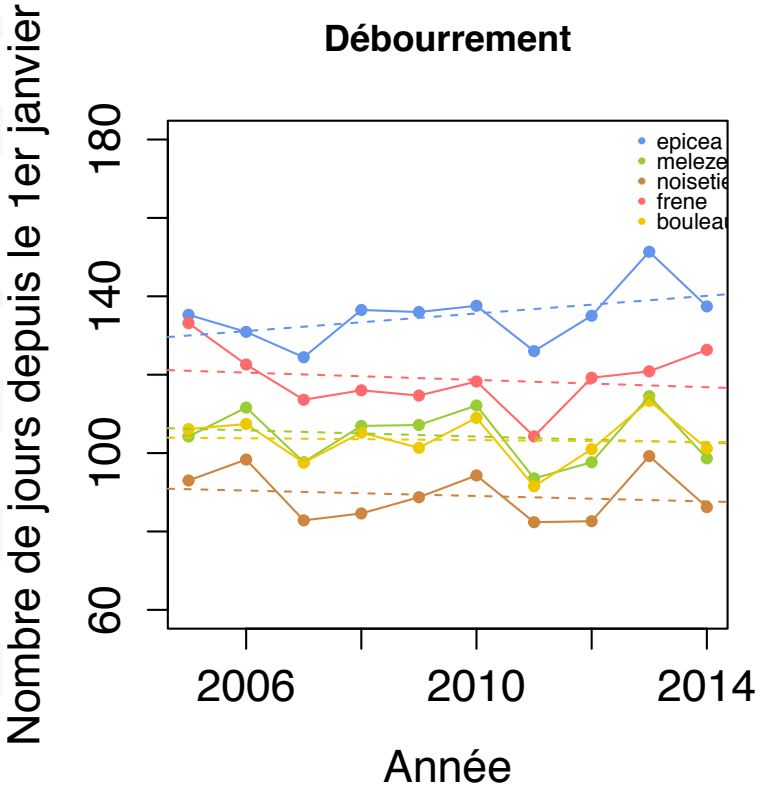
Field Protocols

- Tree monitoring in permanent sites
- Coal tit nestbox observation
- Frog observation in specific wetlands

Academic Module: Phenology

Key Words

Seasons, greenup, spring index, adaptations, trophic interaction, long-term monitoring, lag, trend analysis



The graph above displays budburst dates from 2005 through 2104 for pine, larch, hazelnut, ash and birch

Academic Module: Remote Sensing

In recent years, the research team at CREA Mont-Blanc has begun working with remote sensing data to try to increase our understanding of changes at the landscape level. Through the use of satellite data or other aerial imagery, we are working to examine greening and vegetation dynamics. Depending on the focus of your class and the experience of your students, this unit could include, in addition to a theoretical introduction, data and image analysis and modeling, and/or field protocols for ground-truthing CREA Mont-Blanc's analyses.
While CREA Mont-Blanc can provide data and instruction, students will be responsible for bringing laptop computers with them.

Research Questions

- How are ecotones changing in the massif and what are the main drivers?
- How is alpine plant productivity responding to climate change in terms of greening vs. browning?
- What are the spatial and temporal dynamics of spruce dieback in the massif?
- Could we provide decision-making tools for local authorities or stakeholders?

Length, Locations and Dates

2-3 days
Computer work and ground truthing at all field study sites
Time period is focus dependent (snow-free mid-summer for Alpine plant communities, earlier or later for forests and treeline)

Elements (with corresponding importance from 1 to 3)

- Theoretical Introduction (3, introductory GIS recommended)
- Field data and collection (2)
- Data analysis (3)
- Data divulgation (2)

Data available for analysis

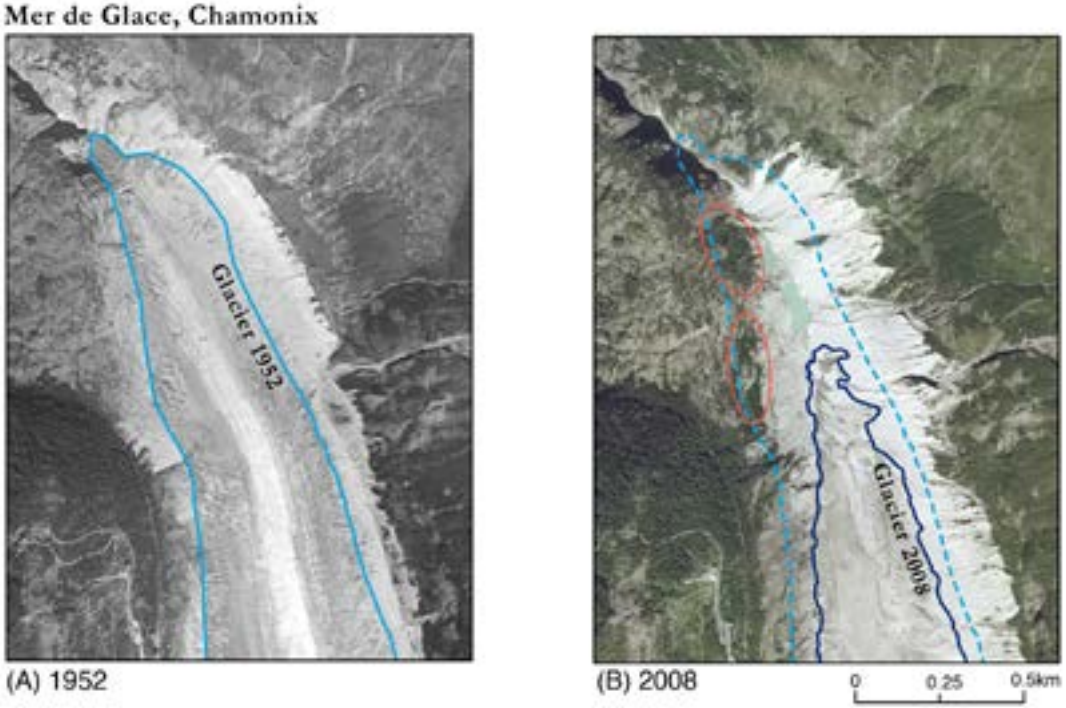
- Snow cover
- Vegetation indices (NDVI, etc)
- Topographic data (LIDAR in some sites, 25 meter data everywhere)
- Hyperspectral imagery

Field Protocols

- Data analysis
- Ecotone monitoring
- Hyperspectral habitat mapping

Academic Module: Remote Sensing

Key Words Imagery, time series, analysis, ecotone, habitat mapping, biomass, spatial dynamics



Above: Using remote sensing imagery, researchers at CREA Mont-Blanc are able to track glacial retreat and vegetation colonization at the Mer de Glace

Lower left: An integral part of verfying our models, volunteers use GPS to locate identified ecotone monitoring plots and estimate percentages of different vegetation communities

Upper left: A team discusses modeling at the Mont-Blanc Observatory

Academic Module: Climate

Thanks to a collaboration with the telecommunications company, Orange, and a local technical high school, CREA Mont-Blanc has been able to install around 60 temperature monitoring stations across the Alps. Through the study of trends in data collected by these stations, and complemented by data from a variety of partners, we can start to get an idea of the ways in which the climate is changing in our area. Understanding changes in climate also helps us to interpret phenomena observed among the flora and fauna populations in the Mont-Blanc massif.

Research Questions

- How are key bioclimatic parameters changing in the Mont-Blanc massif (snow cover duration, frost, growing degree days, soil moisture, precipitation)?
- Which parameters have the strongest effects on biodiversity?
- What are the limitations of downscaling general climatic models to a mountain range?

Length, Locations and Dates

2 days
Variable
Possible to carry out year-round

Elements (with corresponding importance from 1 to 3)

- Theoretical Introduction (2)
- Field data and collection (1)
- Data analysis (3)
- Science communication (2)

Data available for analysis

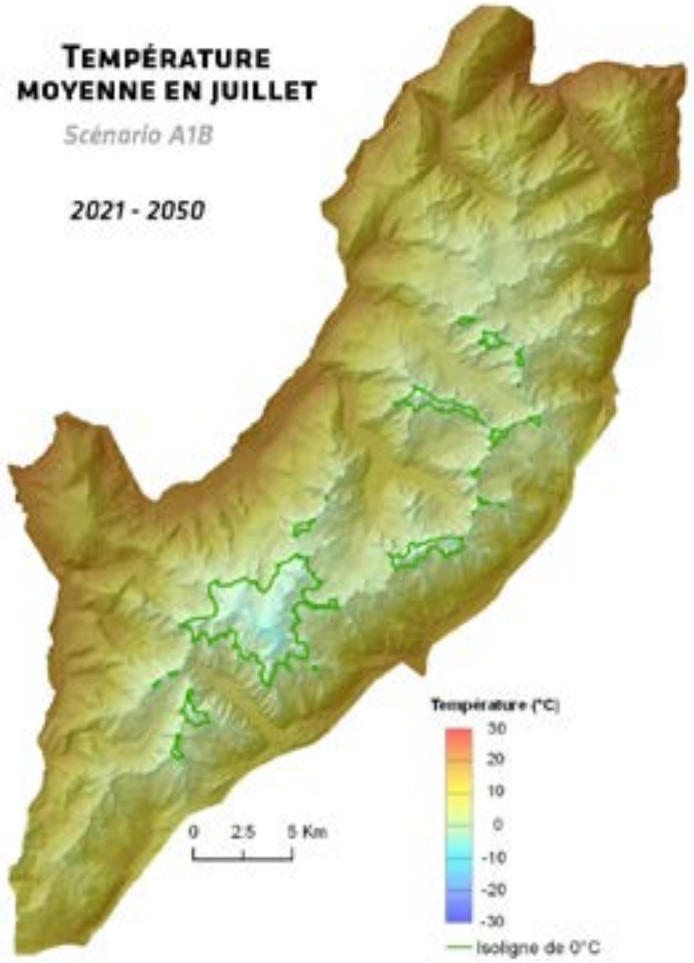
- 10 years of data from temperature stations (stations recorded at 4 heights, including soil temperature; 6 stations in Mont-Blanc range, 60 across the Alps)
- Snow depth data in two sites
- Meteorological data
- Metéo France physical climate and snowpack models
- Regional climate scenarios through 2100
- Snow patterns from satellite imagery

Field Protocols

- Installation or maintenance of equipment
- Collection of temperature loggers
- Design of new protocols (snow measure, etc.)

Academic Module: Climate

Key Words Temperature, climate, snow cover, analysis, inter-annual variability, precipitation



Left: A Mont Blanc climate scenario projects average temperatures for the month of July, including the 0° isotherm line

Below: Volunteers help install a new temperature monitoring station

Academic Module: High-elevation Adaptation

When Dr. Anne Delestrade founded CREA Mont-Blanc 20 years ago, she made it her mission to open people's eyes to the amazing things that she observed in mountain ecosystems. The Couvercle mountain hut and the surrounding environment has been her favorite field site ever since because it provides a unique setting for studying species living at high elevations. The most challenging site to access, the Couvercle Hut and Jardin de Talèfre require glacier travel and a high mountain guide, and puts students in the heart of the massif where they'll be called upon to look at the details - from plant morphology to animal adaptations.

Research Questions

- How are species that live at high elevations specifically adapted to do so?
- What are possible implications of climate change for these species?
- How do high elevation species interact to create facilitation or competition?

Length, Locations and Dates

4 days minimum
Couvercle/Jardin de Talèfre
July and August

Elements (with corresponding importance from 1 to 3)

- Theoretical Introduction (3; could take place at the hut)
- Travel to and from high elevation mounatin hut (3)
- Field data and collection (3)
- Data analysis (3)
- Science communication (2)

Data available for analysis

- Lont-term temperature and snow-cover data
- Plant surveys

Field Protocols

- Species distribution modeling
- Plant functional trait measurement
- Fauna observation
- Temperature and micro-topography experiments

Academic Module: High-elevation Adaptation

Key Words Elevation, extreme conditions, structural and functional adaptation, niche, specialization, species interaction

Above: An alpine plant community at 9,000 feet

Lower left: Dr. Anne Delestrade observes Alpine chough outside the Couvercle hut

Upper left: The Alpine ibex is specifically adapted to live in mountain environments

Academic Module: Birds

For over 30 years, CREA Mont-Blanc's founder, Anne Delestrade, has been studying the Alpine chough, an emblematic species of the Alps. In addition to the remarkable long term data she has collected, she has expanded her research to include other alpine bird species. Student work could include both analyzing the existing datasets as well as contributing to data collection and helping CREA Mont-Blanc to innovate field protocols.

Research Questions

- Do changes in climate affect bird abundance and distribution?
- Are changes in snow patterns affecting land use among birds in alpine meadows?
- How are the phenological events related to birds affected by climate change (return from migration, breeding dates, etc.)?

Length, Locations and Dates

1-3 days
Vallorcine and Loriaz for phenology protocols
Plan de l'Aiguille, Couvercle and other sites for additional protocols
Early to mid May for phenology
July-August for Alpine chough monitoring

Elements (with corresponding importance from 1 to 3)

- Theoretical Introduction (1)
- Field data and collection (2, limited by student capacity for bird identification)
- Data analysis (2)
- Science communication (2)

Data available for analysis

- Monitoring data for banded alpine chough (30 years)
- Migration data (10 years)
- Coal tit phenology data (8 years)
- Bird abundance in selected transects (3 years)

Field Protocols

- Coal tit phenology monitoring in nestboxes
- Bird listening transects
- Alpine chough observation

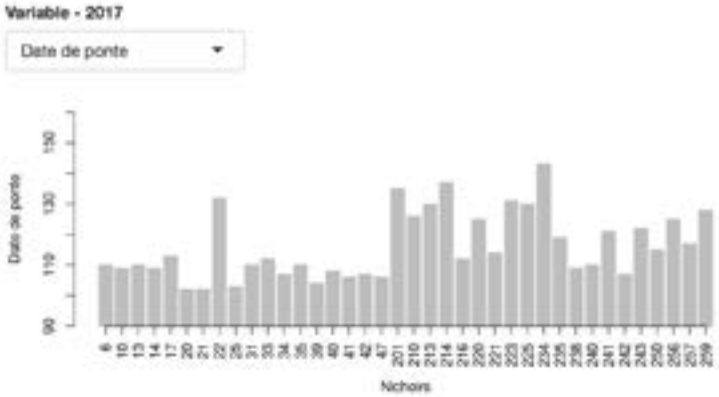
Academic Module: Birds

Key Words Birds, phenology, abundance, adaptation, snow cover

Left: Checking a coal tit nest box in Vallorcine

Right: Alpine chough monitoring in the Aiguilles Rouges, above Chamonix

Below: Analysis of coal tit laying data in 2017



Academic Module: Fauna Abundance & Distribution

Fauna is an integral part of the mountain ecosystem and we are currently in the process of developing CREA Mont-Blanc's field protocols and analyses of fauna distribution. In addition to long-term data on bird populations, our current monitoring includes ten motion-activated camera traps around the massif which automatically take photos of animals with minimal human disturbance. The camera traps are located in recently established ORCHAMP long-term monitoring plots put in place across elevation gradients as a part of a collaboration between the CNRS and CREA Mont-Blanc.

Research Questions

- What species are present in the massif and how are they distributed?
- How can we understand the evolution of abundance and distrubtion of fauna in different elevation gradients and habitat types?

Length, Locations and Dates

1-2 days
Loriaz and Peclerey
Year round for data and image analysis
Spring for bird monitoring
Camera trap access limited by snow cover

Elements (with corresponding importance from 1 to 3)

- Theoretical Introduction (3)
- Field data and collection (2)
- Data analysis (2)
- Science communication (1)

Data available for analysis

- Mont-Blanc Atlas fauna observations
- Camera trap images
- Coal tit phenology data (8 years)
- Bird abundance in selected transects (3 years)

Field Protocols

- Collection and maintenance of camera traps
- Analysis of camera trap images
- Morning fauna obseravation and monitoring walks
- Various bird protocols (see module dedicated to birds)

Academic Module: Fauna Abundance & Distribution

Key Words Fauna, habitats, distribution, abundance, alpine and subalpine

Top left: Chionomys nivals, the Alpine snow vole, is one of the focuses of CREA Mont-Blanc President, Nigel Gilles Yoccoz' research

Below: The Mont-Blanc Atlas is a tool that can be used by anyone to report and explore observations of flora and fauna in the Mont-Blanc massif.

Bottom left: A snowshoe hare captured by one of our camera traps

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Academic Module: Vegetation Dynamics

When most people think about how modern landscapes are responding to climate change, they focus on one of the most obvious and easily measurable aspects of the mountain ecosystem: glaciers. Nonetheless, as our climate changes, there is another important element of ecosystem services that is also actively changing: vegetation. Through the use of remote sensing and modeling, as well as on-the-ground fieldwork, CREA Mont-Blanc's scientists are seeking to understand how alpine plant communities, treeline and the distribution of other pionneer species are evolving with time.

Research Questions

- How quickly does plant colonization occur in the wake of glacier retreat?
- What is the sequence of species from a succession standpoint?
- How does plant colonization affect ecosystem services including landscape aesthetics and slope stability?

Length, Locations and Dates

3-4 days

Glacier du Tour moraine; Plan de l'Aiguille

Early summer through early fall

Elements (with corresponding importance from 1 to 3)

- Theoretical Introduction (3)
- Analysis of existing data and historical imagery (2)
- Fieldwork and data collection (2)
- Data analysis (3)
- Science communication (1)

Data available for analysis

- Repeat photography
- Aerial photos, satellite imagery, drone imagery
- Plant surveys

Field Protocols

- Ecotone monitoring
- Vegetation analyses
- Drone experiments

Academic Module: Vegetation Dynamics

Key Words Vegetation, plant succession, colonization, imagery, glacier retreat, ecotone, greening

Above: Volunteers, seen here in an aerial photo taken by drone, monitor ecotones by estimating the percentages of different vegetation communities

Upper left: Just above treeline, volunteers make measurements of Juniperus siberica and Vaccinium myrtillus

Bottom left: The Loriaz basin, one of CREA Mont-Blanc's fieldwork sites

Academic Module: Landscape Evolution

This unit calls on students to take a critical view of the landscape around Chamonix and to consider the different factors (glaciers, vegetation, human factors) that shape what we see today. Melding sciences and the humanities, and using a framework suggested by CREA Mont-Blanc, professors would be called upon to guide their students through an exploration of how the landscape has evolved over time and may evolve in the future. A possible direction for this unit could include a study of land use and the local economy. Highlights could include visiting local museums and using historical photographs and images to create repeat photography.

Research Questions

- How has the landscape of the Chamonix Valley changed over time (especially from the 19th century on), and for what reasons?
- How is the local economy structured, and to what extent is the economy dependent on the landscape?
- What are possible future landscape and land use trajectories?

Length, Locations and Dates

2-3 days

Chamonix Valley; Montenvers

Year round

Elements (with corresponding importance from 1 to 3)

- Theoretical Introduction (2)
- Individual or group work (bibliographic research, reflection) (3)
- Fieldwork and data collection (1)
- Communication of findings (2)

Data available for analysis

- Historical photography and paintings
- Repeat photography
- Written accounts and oral history
- Topographic maps
- Local economic data

Field Protocols

- Ecotone monitoring
- Repeat photography

Academic Module: Landscape Evolution

Key Words

Landscape change, aesthetics, glacial retreat, vegetation succession, economy, tourism, agriculture, ecosystem services, climate change

Upper right: Montenvers and the Mer de Glace is a prime location for studying landscape change in terms of glacier retreat and vegetation succession, as well as the development of infrastructure for tourism

Left: The cog railway to Montenvers is an example of infrastructure put in place to allow access to the mountains

Right: As the grazing of herds in the mountains becomes less common, the abandonment of alpine pastures (seen here at Loriaz) is shaping the landscape

Academic Module: Scientific History & Storytelling

Our least developed unit, Scientific History and Storytelling falls outside of CREA Mont-Blanc's area of expertise and is intended to be built in collaboration with university trip leaders. Nonetheless, CREA Mont-Blanc is housed in the historic Mont Blanc Observatory and follows a long legacy of scientific discovery in the Chamonix Valley. A variety of focuses are possible for this unit, including the history of science and citizen science in the area (early pioneers and alpinists through today) and the collection of historic data to compare with modern data and phenomena.

Research Questions

- How can different primary and secondary sources help us gain an understanding of what the Mont-Blanc massif was like years ago?
- What is the relationship between scientific disovery and alpinism in the Mont-Blanc massif?
- How can we use historical data to shed light on modern processes?

Length, Locations and Dates

1-2 days

Chamonix Valley; Montenvers; possible trips to the Couvercle Hut, Italy or Geneva would extend unit length

Year round

Elements (with corresponding importance from 1 to 3)

- Introduction (museum and heritage tour) (3)
- Individual or group work (bibliographic reasearch, reflection) (3)
- Communication of findings (3)

Data available for analysis

- Historical photographs
- Scientific articles
- Biographies (Vallot, Sassure, Payot, Agassi, etc.)
- Oral histories
- Mont-Blanc Atlas for comparative data

Academic Module: Scientific History & Storytelling

Key Words History, heritage, oral history, discovery, comparative science

Far left: Joseph Vallot, founder of the Mont Blanc Observatory, takes measurements at his cabin on the shoulder of Mont Blanc

Above: The Argentière glacier and town below, pictured in 1890 and 2015.

Left: A historical artist's rendering of Montenvers and the Mer de Glace

All photos courtesy of Amis de Vieux Chamonix