

## PHENOALP: a new project on phenology in the Western Alps

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### Abstract

PHENOALP is a new EU co-funded Interreg Project "Italy-France (Alps-ALCOTRA)", aiming to get a better understanding of phenological changes in the Alps. Two major goals of the project concerning research are the implementation of an observation network in the involved territories and the definition of a common observation strategy. Project activities are:

1. Pheno-plantes: definition of common observation protocols of different alpine flora species, analysis of the relations between climate and phenological events, application and evaluation of phenological models.
2. Pheno-detection: remote sensing of European larch and high elevation pastures with MODIS data; multitemporal analysis (2000-2011) of phenological variations in the Western Alps.
3. Pheno-flux: analysis of the relation between the seasonal and interannual variability of plant phenology and productivity, assessed measuring CO<sub>2</sub> fluxes (eddy-covariance technique), radiometric indexes and phenological events at specific (European larch stand and alpine pastures) monitoring site.
4. Pheno-zoo: definition of common observation protocols for the phenology of animal taxa (birds, mammals, amphibians and insects) along altitudinal gradients.
5. Inter-pheno: integrated analysis of the relationships between plants and animals phenology and their relation with climatic and other environmental conditions.
6. Meteo-reseau: implementation of a monitoring network of temperature data in the sites where phenological observations are done.
7. Pheno-form: involvement of community members (e.g. schools, naturalistic guides, ...) in the observations and diffusion of results.

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### Aims and study area

PHENOALP is a new EU co-funded Interreg Project, under the operational programme Italy-France ALCOTRA 2007-2013, aiming to get a better understanding of phenological changes in the Alps. The major goals of the project are:

1. The implementation of an observation network in the Aosta Valley and the Savoies (Western Alps);
2. The definition of a common observation strategy and protocols;
3. The involvement of local community members (e.g. through schools) in the observation activities as a way to increase the awareness on the issue of the effects of climate change.

Project leader is the Environmental Protection Agency of Aosta Valley (IT) and the partners are the CREA-Alpine Ecosystems Research Center (FR), "Mont Avic" Regional Park (IT), "Massif des Bauges" Natural Regional Park (FR) and the Protected Area Service of the Autonomous Region of Aosta Valley (IT).

## **Planned activities**

### PHENOPLANTES

The aim of the action is to develop climate change indicators from plants phenology. Regarding ten forest species the knowledge and the experience arising from the Phénoclim Project ([www.crea.hautesavoie.net/eng/phenoclim/](http://www.crea.hautesavoie.net/eng/phenoclim/)) will be transferred to the Italian partners territories (Aosta Valley). Observation protocols lead to the estimation of both the beginning and the end of the growth season; observations will be done either by specialist and volunteers.

A new protocol for alpine grasslands is under development; seven groups are considered: cyperaceae, graminoids (palatable and non palatable), evergreen and deciduous shrubs, asteraceae and leguminous. For each group, quantitative variables (e.g. leaves length, bud number, fruits number, ...) will be monitored along the growth season. Observation sites are located along an elevation gradient; observations will be carried out on marked individuals located in permanent plots. Phenological data will be processed to analyse the relationships between vegetation, climate and topography. This data set will allow the application and evaluation of phenological models aiming to estimate the onset and the duration of the growth season. (MIGLIAVACCA et al., 2008)

### PHENODETECT

The aim of PHENODETECT action is to use remotely sensed data for monitoring European larch forests and alpine grasslands phenology. MODIS NDVI time series regarding the territories involved in the project (Aosta Valley and the Savoies) will be collected and analysed according to a method developed in the framework of the REPHEX Project ([www.arpa.vda.it](http://www.arpa.vda.it) ; Busetto et al, 2009) in order to retrieve phenological events. Data collected in the PHENOPLANTES action will be used for the validation of the algorithms. A multi-temporal analysis (2000-2012) of phenological variations in relation with climate will be done. In some of the observation sites (a grassland and a larch forest) continuous phenological observations will be done using webcams. The elaboration of the images, based on recently proposed algorithms (Richardson et al., 2007) will lead to the automatic detection of the onset and the end of the growth season. The data will be included in the PhenoCam network (<http://klima.sr.unh.edu/>).

### PHENOFLUX

The aim of PHENOFLUX action is to analyse the relationship between inter-annual variability of plant phenology and productivity, assessed measuring CO<sub>2</sub> fluxes by using the eddy-covariance technique. The rationale behind this activity is related to the open question regarding the effect that longer growing seasons could have on the seasonal net ecosystem productivity (BALDOCCHI, 2008).

The data coming from two eddy towers will be linked to phenological observations (field observations and webcam). The sites are located in an alpine grassland (2160 m asl) and an European larch forest (2150 m asl). Data elaboration (pre-processing, post-processing, gap-filling and partitioning) is done following the EUROFLUX methodology (AUBINET et al., 2000). Flux data will be delivered to the CARBOEUROPE, CARBOITALY, IMMEC and FLUXNET database

In the two eddy tower sites, along with CO<sub>2</sub> flux measurements continuous spectroradiometric measurements will be done with the aim of monitoring traditional vegetation indexes (e.g., NDVI, MTCI etc) and radiative quantities related to photosynthetic efficiency (Fluorescence, PRI). A robotic system (HyperSpectral Irradiometer, his) was developed and tested and is going to be installed at the experimental sites.

### PHENOZOO

The aim of PHENOZOO action is to develop climate change indicators from animal phenology. A wide range of animal taxa is considered in order to detect which are the most suited for phenological monitoring and which are the most sensitive to climate change.

The effect of changing climatic conditions on the reproductive behaviour of some passerines will be studied using artificial nests installed along altitudinal gradients in 4 monitoring sites; deposition dates, clutch and brood size are the observed variables. Chamois and Mountain Sheep will be considered for: (i) a retrospective analysis of previously collected data in order to understand the influences of climatic conditions on demographic parameters and (ii) the definition of a protocol for the observation of breeding dates. Black Grouse will be considered to: (i) test the effects of snow cover changes on the behaviour during the winter season and (ii) set up an observation protocol of early reproductive phases. The phenology of some insects and amphibian species will be considered as well and specific observation protocol will be defined.

## METEORESEAU

The aim of METEORESEAU action is to create a network of temperature measurement stations in the involved territories. The network will be composed by almost a hundred of stations. The stations will be located close to the sites where plant and animal observations will be carried out in order to tightly link phenological shifts with temperature trends. The stations record soil temperature at a depth of 5 cm, surface temperature, and air temperature at 30 cm and 2m height.

## INTERPHENO

The aim of INTERPHENO action is to conduct an integrated analysis of the relationships between plants and animals phenology and their relation with changing climatic conditions.

## PHENOFORM

The aim of PHENOFORM action is to (i) create a network of partners in education that can diffuse and promote phenological observation as a way to increase the public awareness on the effect of climate change impact in the Alps and to (ii) involve community members in the observations and diffusion of the PhenoAlp project results.

## **References**

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