

Internship offer

Satellite reconstruction of lake ice phenology in the Pyrenees

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Background

Lakes constitute one of the main habitats for freshwater biodiversity in mountainous regions and play a key role in regulating the physico-chemical properties of surface waters. They also hold a significant importance for mountain societies, serving as natural heritage, recreational hubs, and water resources for livestock and hydropower production. At mid-latitude, high-mountains lakes are often frozen for part of the year. However, their freezing is highly sensitive to climate change, making them true sentinels of mountain environments. Satellite remote sensing is a powerful tool to monitor the phenology of lake ice (freeze-up and melt-out date) over large and remote mountain ranges. However, reconstructing a long-term time series of mountain lake observation require combining a high spatial resolution due to their small size and a high frequency of acquisition to monitor their rapid evolution.

Work plan

This project aims to produce a times series of the ice phenology of the pyrenean lakes by combining several satellite products. It will enable to map the spatial and temporal variability of the lake ice at a mountain range scale with distinct climatic and topographical contexts. In a first step, the MODIS-derived ice cover (500 m) and Sentinel-1 and -2 -derived ice cover (20 m, Copernicus product Water and Ice Cover) will be compared to in situ water temperature collected since 2010 by the hosting team over several pyrenean lakes. For each monitored lake, a set of thermometers provide hourly observations at one location in the middle of the lake but at several depths. Due to the reduction of diurnal variability of the water temperature when the surface is frozen, this data can be used to derive freeze-up and melt-out date. This will be the first evaluation of the Water and Ice Cover Copernicus product with precise in situ measurements. This will also enable to evaluate the spatial representativity of these point in situ measurement. The opportunity to downscale the MODIS product at the 20 m resolution will be considered. Depending on the different satellite products performances, the longest time series of ice phenology will be calculated over the Pyrenees. The internship may include fieldwork in the Pyrenees to contribute to the maintenance of the in situ sensor network.

Location

The place of employment and work is the research unit “Géode, Géographie de l’Environnement” (<https://geode.univ-tlse2.fr/>), at Toulouse Jean Jaurès University (<https://www.univ-tlse2.fr/home/>), France. Over 30,000 students are enlisted at the Jean Jaurès University in social sciences curriculum (history, arts, archeology, geography...). The intership will be co-advised by Simon Gascoin (CESBIO).

Requirements

The intern will be in master with geosciences and/or remote sensing processing background.

Basic knowledge are expected in :

- Python, R, or an equivalent programmation langage
- GIS program (QGIS)

Conditions

Duration : 6 months paid internship | Start : February-March 2027

Location : Laboratoire GEODE, Maison de la Recherche, allées Antonio Machado, Toulouse

Supervision : César Deschamps-Berger (GEODE), Florence Mazier (GEODE), Simon Gascoin (CESBIO)