Ecole Nationale de la Météorologie

Direction des Etudes

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***PROJET DE FIN D’ETUDES

INGENIEURS DE L'ECOLE NATIONALE DE LA METEOROLOGIE***

***FICHE DE PROPOSITION DE SUJET***

**Titre du sujet proposé :**Estimation des blooms d’algues des neiges à partie d’imagerie satellitaire.

**Organisme ou service proposant le sujet : Centre d’Etudes de la Neige (Grenoble)**

**Responsable principal du stage :**

Responsable principal (le responsable principal est l'interlocuteur direct de l'Ecole. C'est à lui, en particulier, que seront adressés les courriers ultérieurs) :

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**Le stage présente-t-il un caractère de confidentialité ? : Non**

Le stage peut-il être effectué à distance ?: Non

**1) Description du sujet – livrables attendus**

Sometimes in summer, the alpine snow cover takes on a bright red color. This phenomenon, also known as the "blood of the glaciers" or “watermelon snow”, is the result of the multiplication (or blooming) of micro-algae in the snowpack (Stewart et al., 2021). This change in snow color can increase the rate of snow melt. This acceleration of melt may matter for alpine glaciers and locally for seasonal snow in the Alps.

 The location, frequency, extent and conditions under which these blooms occur are still poorly understood. The evolution of theses blooms in a changing climate is thus currently unknown. Satellite imagery, in particular multispectral data from Sentinel-2, provides the opportunity to detect these blooms in the world’s mountains for the last few years.

 A snow algae detection algorithm has been implemented at the Centre d'Etudes de la Neige based on a methodology used for the detection of snow algae in Antarctica (Gray et al., 2020). This algorithm needs to be evaluated and potentially adapted to the case of algae species found in the Alps. Then, it will be applied to the entire French Alps from 2016 on to establish a "climatology" of snow algal blooms.

The objectives of the internship are thus two folds:

- to evaluate and adapt if necessary the processing chain using field data from “Jardins du Lautaret” over a limited area

- to run the processing chain since 2016 over the French Alps to establish where, when and with what extent the blooms occur.

All developments will be done in Python using git as a versioning tool. The large scale analysis involves the processing of terabytes of Sentinel-2 data and will be done in collaboration with CESBIO.

This work will take place within the collaborative research project ALPALGA, which includes several laboratories (https://alpalga.fr/?lang=en).

Potential candidates have a strong interest in cryospheric science and/or remote sensing, are proficient in Python. They have a Master's degree.

*References:*

*Gray, A., Krolikowski, M., Fretwell, P. et al. Remote sensing reveals Antarctic green snow algae as important terrestrial carbon sink. Nat Commun 11, 2527 (2020). https://doi.org/10.1038/s41467-020-16018-w*

*Stewart, Adeline, Delphine Rioux, Fréderic Boyer, Ludovic Gielly, François Pompanon, Amélie Saillard, Wilfried Thuiller, Jean-Gabriel Valay, Eric Marechal, and Eric Coissac. "Altitudinal zonation of green algae biodiversity in the French Alps." Frontiers in plant science 12 (2021): 679428.*

**2) lieu du stage, durée ou période**

Le stage se déroule au Centre d’Etudes de la Neige à Grenoble sur une durée de 6 mois environ (janvier - juillet) à discuter en fonction des contraintes de l’Ecole Nationale de la Météorologie.