



## Research Engineer position at CNRM-CEN, Grenoble, France

### Monitoring the evolution of an alpine snowpack over a winter based on X-ray tomography and field instruments

#### General information:

- Workplace: Centre d'Etudes de la Neige, CNRM-CEN, Grenoble, France
- Contract from ERC Starting Grant project IVORI
- Duration: 6months
- Expected date of employment: 9 December 2022
- Deadline for application: 30 July 2022
- Work proportion: 100%
- Salary will be provided according to Météo-France salary rates and depends on the background of the retained candidate. For example, the gross monthly salary is about 2552€ for an engineer with 1-2 years experience.
- Desired level of education: master or equivalent, PhD is not mandatory but considered as a plus
- Contact: pascal.hagenmuller@meteo.fr ; neige.calonne@meteo.fr

**Interested in this position? please send CV and motivation letter to the contact persons.**

#### Context:

The position is part of the ERC starting grant project IVORI, starting in February 2021 (5 years project). IVORI's goal is to build a microstructure-based snow-firn model encompassing all the relevant snow and firn physical variables to improve the modeling of seasonal and perennial snow.

More info regarding the ERC project : <https://ivori.osug.fr/>

#### Activities

The engineer will be in charge of conducting an innovative field measurement campaign to characterize the evolution of the snowpack internal structure at Col de Porte (1300 m elevation, 15km from Grenoble) over the winter season 2022-2023. The motivation is the need of highly resolved data on the snowpack properties to guide the current development of the new IVORI snowpack model. Besides, such data will allow further understanding on natural snowpack processes such as fresh snow settlement or vapor transport. A variety of instruments will be used to access different spatial resolutions, including the X-ray tomography (micron scale), snow micro-

penetrometer (mm scale), and snow pit measurements (cm scale). Measurements frequency will vary depending on the instruments from weekly to daily, and up to hourly over some specific time period. Tomography will be performed in the Col de Porte cold laboratory, located in the immediate vicinity of the field site from where the studied snow sample will be carefully extracted from the snowpack.

In addition to the field work, the engineer will be in charge of building a clean and ready-to-use dataset, which includes the post-processing of the measurements. A preliminary analysis of the measurements, such as providing the snow density and specific surface area evolution over the winter from the different instruments, will also be performed. This work involves image processing and numerical computations.

Pascal Hagenmuller (CNRM-CEN) and Neige Calonne (CNRM-CEN) will supervise the work. The position will benefit from a motivating scientific environment in the context of the research project ERC IVORI. Collaborations are expected with the team "Snowpack observation", which is in charge of the weekly measurement program at Col de Porte.

### **About the CNRM-CEN**

The CNRM is the research center of Météo-France, it is a joint unit of the CNRS. With about 230 permanent staff, its mission is to develop the knowledge and tools that Météo-France needs to produce its forecasts of weather, air quality or climate. One of the six units forming the CNRM, the CEN, focuses on the study of snow. With about 25 permanent staff, CEN has been involved for many years in the snow modelling.

### **Skills**

This job requires strong skills in cold environment practical work, field measurements, and/or cold-laboratory measurements. Experience with x-ray tomography and tomography image processing is an asset. Skill in programming language is required (Python). Skills in work organization and work autonomy are also required. A driving licence, to go to the measurement site, is also required.

### **Related scientific paper**

Calonne, N., Richter, B., Löwe, H., Cetti, C., ter Schure, J., Van Herwijnen, A., Fierz, C., Jaggi, M., and Schneebeli, M.: The RHOSSA campaign: multi-resolution monitoring of the seasonal evolution of the structure and mechanical stability of an alpine snowpack, *The Cryosphere*, 14, 1829–1848, <https://doi.org/10.5194/tc-14-1829-2020>, 2020.