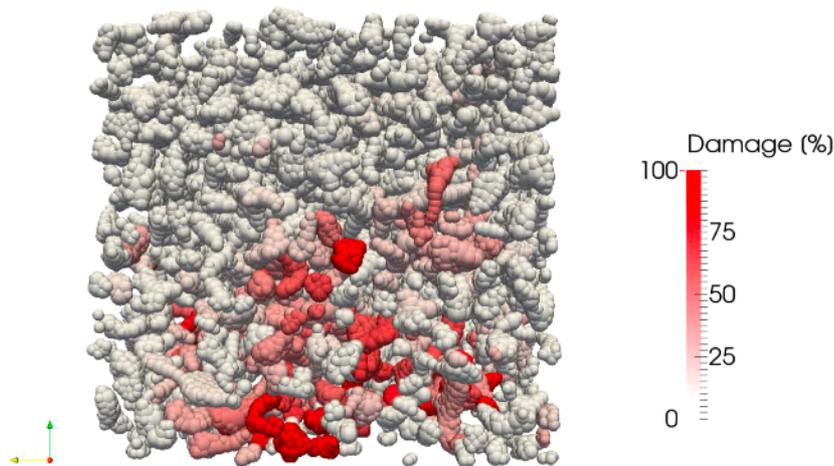


**Post-doc CNRS (ANR project Mimesis-3D)**  
Discrete element modeling of snow mechanical behavior



Simulation of damage occurring in a centimetric snow sample under compressive loading

**General information:**

- **Candidate through <https://emploi.cnrs.fr> via the offer PASHAG-002**
- Workplace: Centre d'Etudes de la Neige, Saint Martin d'Hères, France
- Contract from ANR Project Mimesis-3D
- Duration: 12 months
- Expected date of employment: 1 November 2020
- Deadline for application: 10 September 2020
- Work proportion: 100%
- Salary will be provided according to CNRS salary rates and depends on the background of the retained candidate. For example, the net monthly salary is about 2300€ for 2 years research experience after PhD.
- Desired level of education: PhD
- Contact: [pascal.hagenmuller@meteo.fr](mailto:pascal.hagenmuller@meteo.fr) and [guillaume.chambon@inrae.fr](mailto:guillaume.chambon@inrae.fr)

**Context:**

Knowledge of the mechanical properties of snow is required for many applications such as avalanche risk forecasting, analyzing ice cores as paleo-archives, optimizing vehicle traffic, quantifying loads on structures, etc. Snow is a porous material existing close to its melting point. While the effect of environmental conditions on snow metamorphism, which leads to numerous snow microstructural patterns, is fairly well-known, the relation between snow microstructure and its mechanical properties remains poorly understood. To decipher this link, an increasing number of studies have tried to reproduce the mechanical behavior snow with numerical simulations using solely the 3d snow microstructure and the mechanical properties of ice as inputs. These studies have provided new insights on the micro-mechanics of snow but lack of direct evaluation against experimental data. Furthermore, the considered ice mechanical behavior generally suffers from over-simplification and no coupling with metamorphism is considered, in contrast to modeling needs at the macroscopic scale.

**Activities:**

This post-doctoral project aims to improve the understanding and quantification of snow mechanical properties at moderate and high strain rates (brittle regime). In particular, the discrete element method will be used to recover the mechanical behavior of snow from ice contact mechanics and the microstructure captured by X-ray tomography. The main goals of the project will be to implement time-dependent features (e.g. ice sintering and snow metamorphism) in the model, to evaluate the results against in-situ mechanical experiments, and to provide homogenized mechanical laws for an extensive set of samples spanning a wide range of snow types.

The work will be supervised by Pascal Hagenmuller (CNRM / CEN) and Guillaume Chambon (INRAE / ETNA) and hosted by the CNRM / CEN in Grenoble, France. The candidate will benefit from new and

unique facilities of X-ray tomography at cold temperatures and a motivating scientific environment in the context of the research project Mimesis-3D about snow microstructure.

The CNRM is the research center of Météo-France, it is a mixed 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 twenty permanent staff, CEN has been involved for many years in the study of the microstructure of snow and processes taking place at this scale.

**Skills:**

This job requires recognized skills in material sciences, mechanics and numerical modeling. A general interest in the Cryosphere and experience in X-ray tomography are assets. Skills for writing scientific papers, work organization and work independently are also required.