Friedrich-Alexander-Universität Erlangen-Nürnberg

Institut für Geographie

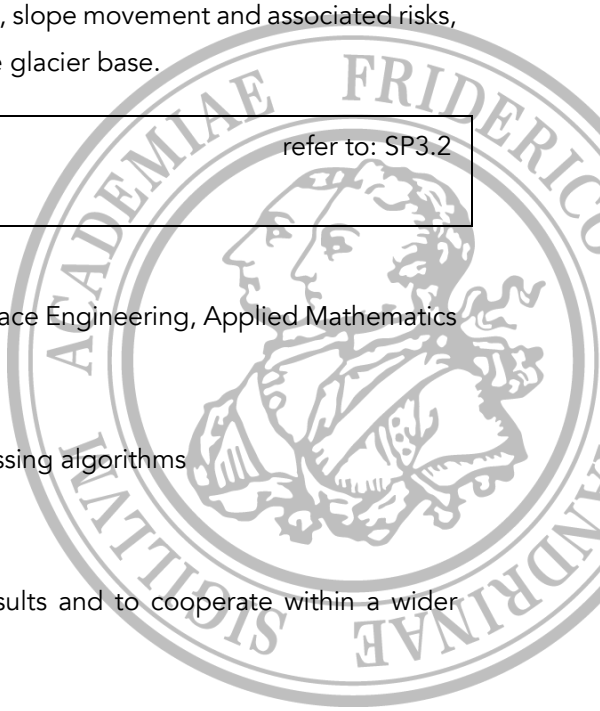
Detailed Information and Requirements on the vacant **PhD position** in sub-project 3.2 (SP3.2) on 'Reconciling machine learning and glacier system modelling' within the International Doctorate Program (IDP) 'Measuring and Modelling Mountain glaciers and ice caps in a Changing ClimAte' (M³OCCA).

Detailed sub-project description: A comprehensive description of the glacier system evolution considers near-surface energy transfer, snowpack processes, internal temperature changes as well as ice-dynamic adjustment. Associated computational expenses limit model applications to individual study cases. Regional to global glacier modelling efforts therefore rely on important simplifications, certainly with regard to the ice-dynamic description. Recently, machine learning techniques have successfully been employed to infer the regional glacier surface conditions. Yet the challenge relies in the coupled description of the ice dynamic (classical Navier Stokes) and the temperature evolution (advection-diffusion). Here, we intend to solve this coupled system of equations with the open-source 3D finite-element Elmer/Ice model. Within this PhD project, we envisage combining these model-driven simulation techniques with data-driven machine learning techniques. We plan to start from the existing simulation codes that will be first used to produce observation-informed training and test data. For generating realistic training data, we will employ transient data assimilation techniques for the last few decades to produce a best representation of short-term glacier evolution. The primary target quantity is the ice velocity, as its calculation is computationally expensive. The model output data will inform machine learning components that replace the classical methods. This specializes the underlying physical models to the data and reduces the computational effort. For training, development and validation, the project will focus on individual benchmark glaciers (e.g., Hintereisferner, Vernagtferner). With regard to mountain permafrost, slope movement and associated risks, this sub-project will also focus on the temperature conditions at the glacier base.

PhD	refer to: SP3.2
4 years, 75%/100%, Entgelt-/Bes.Gr. E13.	

Required skills specific to this sub-project:

- MSc in Earth Sciences, Physics, Computer Sciences, Aerospace Engineering, Applied Mathematics or a related field with an excellent grade
- Programming skills (Fortran, Python, C, C++, CUDA, …)
- Affinity for scientific computing and development of processing algorithms
- Good reporting and presentation skills
- Excellent level of written and spoken English
- Ability to work independently, to critically assess own results and to cooperate within a wider research team



Desired and advantageous are :

- Interest for understanding Earth System processes and their complex interactions
- Affinity for geophysical modelling and remote sensing with regard to glaciological topics
- Experience or interest in big data handling, high-performance computing or cloud computing
- Demonstrated capacity for independent thinking and diligence

For general information on the working environment, starting date, application procedure and submission deadline, please consult the IDP-wide advertisement (https://www.geography.nat.fau.eu/idp-mocca-measuring-and-modelling-mountain-glaciers-and-ice-caps-in-a-changing-climate/).

Further information for this SP:

Dr. Johannes Fürst, Institute of Geographie, FAU, phone +49-(0)9131-85-26680,
johannes.fuerst@fau.de
Prof. Dr. Harald Koestler, Department of Computer Science, phone +49 9131 85 28359,
harald.koestler@fau.de