Position Profile for Chinese Applicants running for 2019 Helmholtz – OCPC – Program

PART A (Info about the Position)

Helmholtz Centre and institute: Helmholtz Centre Potsdam GFZ German Research centre for Geosciences; www.gfz-potsdam.de

Title of the project: Physics-informed machine learning (PIML) approaches for debris flow modeling

Project leader:

1. Prof. Dr. Jean Braun,
   Head of section "Earth Surface Process Modeling",
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2. Dr. Hui Tang,
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Description of the project (max. half page)**:**

Significant uncertainty remains regarding the fundamental mechanisms of hydrology and sediment transport during extreme debris flow events. This hinders studies related to the interpretation of the control factors with debris flow/landslide frequency, as well as the role of these extreme events in urban planning and landscape evolution. To fill this knowledge gap, we need to combine existing debris flow/landslide database, numerical deterministic simulations, and machine learning algorithms. The database from Illgraben (Switzerland), Chalk Cliffs (USA) and Dongchuan (China) used for this study as training and testing purpose were based on the previous debris flow research in the western US, the Swiss Alps and southwestern China. These sites, with at least ten years of record at debris basins, were selected for this study because they provide a wealth of geological and geophysical (such as geophone) data.

In this project, we focus on combining the debris flow database with machine learning algorithms. We propose to develop a machine learning approach for figuring out the physical processes during debris flow, the controlling factors and thresholds for debris flows. We will use this modeling framework to test the hypothesis that natural patterns exist such that geospatial and climate characteristics can be correlated with debris flow frequency utilizing a machine learning approach combined with a physically based numerical model. We will use this approach to study and predict

debris flow frequency in the western US, the Alps, and southwestern China under climate change conditions. By applying our techniques to the database, the study also has the broader impact of leading to improved hazard assessment of debris flows in critical regions of these study area.

Description of existing or sought Chinese collaboration partner institute (max. half page)**:**

We have existing collaborations with several institutions in China, including State Key Laboratory of Geohazard Prevention and Geoenvironmental Protection, Chengdu University of Technology, Jilin University and Chang'an University. With this application, we also seek to bring together groups with unique expertise in natural hazards research and computational scientists who have developed the database and machine learning models for natural hazard. Postdocs of these and other organizations with a strong background in natural hazard, surface processes modeling or machine learning are invited to apply.

Required qualification of the post-doc:

- PhD degree in geology, geophysics, data science, and mathematics or related areas;
- With a background in earth surface processes modelling and/or machine learning;
- Strong programming skills;
- Excellent communication skills in English in an international environment
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PART B (Materials and Procedures)

The applicants shall submit the following documents to a Chinese postdoc station affiliated to a research institution or a university, after passing through the internal selection, the qualified application shall be forwarded to OCPC, and then to Helmholtz for evaluation:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation
- Proof of command of English language

PART C (General Conditions)

Additional requirements on the postdoctoral fellows:

- Chinese citizenship from Mainland China (allows application while staying abroad)
- Max. age of 35 years, PhD degree not more than 5 years by submission of application
- Very good command of English language
- Strong ability to work independently and in a team