Post-Doctoral position at IPSL/LSCE: Modeling of permafrost evolution within a river-valley system in Yakutia (Siberia) under climate change

Location: IPSL/Laboratoire des Sciences du climat et de l'environnement, unité mixte CEA-CNRS-UVSQ, Université Paris-Saclay, Orme des Merisiers, 91191 Gif sur Yvette Cedex.

Position: 18 months Post-Doctoral position in charge of the study of the impacts of climate change on a river-valley system in continuous permafrost in Yakutia (Siberia), considering centennial measurements of air and ground temperatures, results from climate simulations and thermal and hydrological monitoring at an instrumented site, to assess time of emergence and controlling factors of climate change on permafrost and river talik properties and their future evolution.

Subject: High latitude regions have experienced important climate warming in a recent past. Future simulations from the IPCC models predict that the largest temperature increase should be recorded there. These regions, characterized by the presence of permafrost are especially sensitive to climate warming through ground thaw with consequences on carbon release, erosion, mechanical stability, groundwater resources and landscape evolution. However the important thermal momentum of the frozen ground buffers the climate warming trends at depth, while a very large annual and significant inter-annual variabilities of the system introduce complexity in the understanding and modeling of permafrost thaw. In addition, heat propagation depends on land cover properties and the presence of a water bodies with possible lateral influences. The region of focus is Central Yakutia (CY – in Siberia). Permafrost is continuous and includes ground ice leading to intense ground subsidence and the creation of lakes through thermokarst processes when thaw propagates at depth. The local system studied consists of an alas valley with a northerly and southerly aspect containing a river and typical vegetation gradients (pine forest on top and meadows in lower elevations). While lake units have been the focus of numerous studies, river systems raising specific issues have been poorly studied. River-associated complementary studies were carried out recently through experiments in the cold room at GEOPS laboratory. The main societal issues associated are groundwater quality (river talik evolution) and landscape evolution (thermokarst processes related with the melting of ground ice). The Syrdakh site in CY and its ground (some meters) have been monitored thermally and hydraulically since 2012 in close collaboration with the Melnikov Permafrost Institute (Yakutsk) providing detailed access to the full complexity of the annual and inter-annual variability as well as spatial heterogeneities. The evolution of the ground thermal state (active layer, permafrost and river talik) within this system in the context of climate change will be studied in regard of short term high annual variability superimposed onto long term climate trends. The latter are issued from a compilation of local meteorological and soil temperature monitoring as well as from climate model simulation reanalyzes for past and future (IPCC & Arctic CORDEX). Special focus will be put on the time of emergence of climate change for Central Yakutian land cover and permafrost distributions, the main controlling parameters and the associated uncertainties. A view onto future evolution will be included.

Tasks: The candidate will work within the second phase of LABEX-IPSL Climate Impacts (2017-2019).

- The applicant will first perform a literature survey of the key factors that affect permafrost evolution in the region of interest, compile its meteorological facts (1830-present), soil temperature histories (1930-present) and review existing climate model simulations to regionalize them accordingly (CMIP & Arctic CORDEX + reanalyzes).
- The second major task will be the modeling of the inter-annual variability of the Thermo-Hydrologically (TH) monitored system at the Syrdakh site with the Cast3M spatially distributed and physically based code (www-cast3m.cea.fr). The monitoring data will be compiled into a database made available to the IPA Action Group InterFrost TH code inter-comparison project (wiki.lsce.ipsl.fr/interfrost) hosted at LSCE. In a near future, the contribution of InterFrost

participants could be to provide and test various modeling strategy to approach and capture the high complexity of the system.

- In a third task, relying on previous modeling efforts, the applicant will develop a strategy to identify controlling factors, time of emergence and uncertainties of through-talik and vanishing of ground ice shielding layer. Long term past and future simulations will be provided considering the full river-valley case and/or distinct sub-units of special interest.

Qualifications/Profile: The candidate should preferably have a PhD in cold regions hydro(geo)logy or dealing with heat transfers in the environment, and at least a good knowledge in physical/process-oriented modelling. Experience in statistical analyses and climate simulation re-analyses or downscaling will be appreciated as well as an interest for field survey. A good motivation, autonomy, the ability to interact and link within the IPSL and with MPI partners in a multi-disciplinary consortium will be important criteria in the candidate selection.

Collaborators: Christophe Grenier (IPSL/LSCE), Antoine Séjourné (IPSL/GEOPS), Catherine Ottlé (IPSL/LSCE), François Costard (IPSL/GEOPS), Mathieu Vrac (IPSL/LSCE), Masa Kageyama (IPSL/LSCE). International collaborations with Alexander Fedorov and Pasha Konstantinov at Melnikov Permafrost Institute (Yakutsk).

Application: CV and motivation letter should be sent to Christophe Grenier, no later than February 5, 2017 (christophe.grenier@lsce.ipsl.fr).