*Sujet de thèse: Vers des modèles hydrologiques climatiquement robustes for l'évaluation de la ressource en eau et des impacts des changements climatiques*

**Position:** The Hydrology Group of the National Research Institute of Science and technology for Environment and Agriculture (IRSTEA, www.irstea.fr), based in Antony (France), develops applied research focusing on the development of hydrological models, the management of water resources and the assessment of hydrological risks of floods and droughts for a range of applications in operational hydrology. The Hydrology Group is offering a PhD scholarship for a suitable candidate in the field of hydrological modelling under climate and catchment changing conditions. The project will examine the challenges of model parameter estimation and model performance evaluation in a global change context, considering uncertainties of future evolution of climate and water resources availability. Particularly, the work will investigate the robustness of spatially distributed hydrological models applied in the context of climate change to assess impacts on the water sector. Attention will be paid to novel frameworks for the calibration/validation of models in historic climate periods and their applicability to ensembles of future scenarios of climate and hydrological changes. An important task will be the definition of metrics for quantifying the ability of climate and hydrological models, as well as their associated techniques of bias correction and downscaling, to perform under non-stationary / changing conditions.

The PhD work will contribute to the European project AQUACLEW and will be developed in close collaboration with a variety of stakeholders in the water sector. Applicants are encouraged to visit the group's website http://webgr.irstea.fr for more information on current research projects and recent publications of the research team.

**Background:** The impacts of climate change on the hydrological cycle raises a growing concern among water managers, policymakers and end-users with respect to the evolution of water resources and risks. To face a growing demand in estimating impacts and defining adaptation strategies in various sectors, climate services are blooming across Europe, especially under the umbrella of the Copernicus Climate Change Service (C3S, https://climate.copernicus.eu/) of the European commission. The AQUACLEW European project (2017-2020, www.jpi-climate.eu/nl/25223436-AQUACLEW.html) will contribute to improve these services, especially the Service for Water Indicators in Climate Change Adaptation (SWICCA, http://swicca.climate.copernicus.eu/) platform. The overall goal of AQUACLEW is to use innovative research techniques and integrated co-development with users to advance the quality and usability of several climate services for a number of water related sectors. The current work to develop these services indicates that the following crucial improvements are required to increase user adoption and satisfaction: (a) indicators and resolution of the indicators given by the service needs to address a wider range of user needs; (b) large-scale climate service data should be more reliable at the local decision scale and (c) guidance and visualisation tools in the services should better reflect the wider range of user needs.

**Role:** While there is flexibility to shape the role of the successful applicant to the skills and interests of the individual, it is envisioned that the PhD candidate's research will focus on the development, evaluation and sensitivity analysis of large-scale semi-distributed hydrological models at regional, national and continental scales. The candidate will start from state-of-the-art models and propose approaches to improve their robustness. Focus will be placed on the representation of fluxes at the interface between surface and groundwater, and between surface and the atmosphere, as well as on model parameter estimation and performance evaluation. The PhD candidate will particularly propose a framework for evaluating hydrological model suitability for simulating climate-based hydrological changes at different scales.

**Pre-requisites:** Applicants need to have a Master degree in a related field such as surface hydrology or environmental modelling. Candidates are expected to master a programming language (typically Fortran and/or R), to have excellent skills to write scientific reports/papers and to have strong interpersonal skills to successfully work within a multidisciplinary and multicultural team. Previous experience with semi-distributed hydrological modelling and/or climate change impacts assessment will be viewed favourably. An excellent knowledge of English, spoken and written, is essential, and knowledge of French is an asset.

**Salary and practical information:** The three-year PhD scholarship will provide an annual gross salary of circa €21,000. The PhD work is expected to start in Oct-Nov 2017. The PhD candidate will be based in the Hydrology Group in Antony, close to Paris, France, and the candidate will be enrolled at the GRNE doctoral school in Paris (www.ed398.upmc.fr). Travels for meetings, conferences and collaborative work are expected during the PhD, especially in link with the AQUACLEW project activities.

**Application procedure:** Interested applicants should send their CV, including the names and contact details of at least two referees, and a short letter highlighting their research background and interest in this area, to Dr Vazken Andréassian (recrute.hydro.antony@lists.irstea.fr). The application closing date is 15 September 2017and PhD is expected to start in December 2017.

**PhD Position**

**Improving the performance of water-energy systems by integrating large-scale climate services indicators into local impact models for the hydropower sector**

*Sujet de thèse: Amélioration des performances des systèmes eau-énergie en intégrant des indicateurs de services climatiques à large échelle dans des modèles locaux d'impact pour le secteur hydroélectrique*

**Position:** The Hydrology Group of the National Research Institute of Science and technology for Environment and Agriculture (IRSTEA, www.irstea.fr), based in Antony (France), develops applied research focusing on the development of hydrological models, the management of water resources and the assessment of hydrological risks of floods and droughts for many applications in operational hydrology. The Hydrology Group is offering a PhD scholarship for a suitable candidate to investigate the use of large-scale climate data at local decision scale in the hydropower sector. The project will examine the way climate and hydrologic projections of future changes, provided by different models, can be used, through flexible tailoring, in decision-making, with focus on usability for hydropower planning and adaptation. It will comprise the development of suitable climate indicators and their integration into impact-decision models for river basins and reservoir management. Special attention will be given to the way uncertainty and biases on ensembles of modelling scenarios are handled in the modelling-decision chain.

The PhD work will contribute to the European project AQUACLEW and will be developed in close collaboration with hydropower stakeholders. Applicants are encouraged to visit the group's website http://webgr.irstea.fr for more information on current research projects and recent publications of the research team.

**Background:** The impacts of climate change on the hydrological cycle raises a growing concern among the water manager community, especially in the hydropower sector which may face a strong evolution of water resources. To face the growing demand in estimating impacts and defining adaptation strategies in this sector (among others), climate services are blooming across Europe, especially under the umbrella of the Copernicus Climate Change Service (C3S, https://climate.copernicus.eu/) of the European commission. The AQUACLEW European project (2017-2020, www.jpi-climate.eu/nl/25223436-AQUACLEW.html) will contribute to improve these services, especially the Service for Water Indicators in Climate Change Adaptation (SWICCA, http://swicca.climate.copernicus.eu/) platform. The overall goal of AQUACLEW is to use innovative research techniques and integrated co-development with users to advance the quality and usability of several climate services for a number of water related sectors. The current work to develop these services indicates that the following crucial improvements are required to increase user adoption and satisfaction: (a) indicators and resolution of the indicators given by the service need to address a wider range of user needs; (b) large-scale climate service data should be more reliable at the local decision scale and (c) guidance and visualisation tools in the services should better reflect the wider range of user needs. The case study of hydropower will be the focus of the project.

**Role:** While there is flexibility to shape the role of the successful applicant to the skills and interests of the individual, it is envisioned that the PhD candidate's research will focus on the use of climate services in the hydropower sector. The candidate will work closely with climate service providers and end-users to co-develop indicators and test their suitability to make decisions related to planning and

setting up strategies for climate change adaptation. The work will be based on state-of-the-art climate services, hydrological models and tools to simulate decisions for hydropower systems (including under constraints of multiple water uses in a river basin).

**Pre-requisites:** Applicants need to have a Master degree in a related field, such as surface hydrology, environmental modelling or water management. Candidates are expected to master a programming language (typically Fortran or R), to be able to handle large amounts of hydro-climatic data, to have excellent skills to write scientific reports/papers and to have strong interpersonal skills to successfully work within a multidisciplinary and multicultural team. We search for candidates that are autonomous and appreciate close collaborations with end-users. Previous experience with hydrological modelling and/or water management tools will be viewed favourably. An excellent knowledge of English, spoken and written, is essential, and knowledge of French is an asset.

**Salary and practical information:** The three-year PhD scholarship will provide an annual gross salary of circa €21,600. The PhD work is expected to start in Oct-Nov 2017. The PhD candidate will be based in the Hydrology Group in Antony, close to Paris, France, and the candidate will be enrolled at the GRNE doctoral school in Paris (www.ed398.upmc.fr). Travel for meetings and conferences, as well as regular meetings with end-users are expected during the PhD in link with the AQUACLEW project activities.

**Application procedure** Interested applicants should send their CV, including the names and contact details of at least two referees, and a short letter highlighting their research background and interest in this area, to Dr Maria-Helena Ramos (recrute.hydro.antony@lists.irstea.fr). The application closing date is 15 September 2017 and PhD is expected to start in December 2017.