Internship offer :
Calibrating a Hydrological Green Roof Model

Context

Managing rainwater is a major challenge in cities, especially with climate change and the increase in impermeable surfaces such as roads and buildings. Green roofs (GRs) have become an important part of sustainable urban development [1]. They can help reduce stormwater runoff by slowing it down and decreasing the total volume of water flowing into drainage systems.
To understand and predict how much water a green roof can retain, researchers use models based on water flow in porous materials like soil [2]. These models include soil parameters (related to the physical properties of the substrate) and vegetation parameters (related to plant characteristics). However, these parameters are often uncertain because they are difficult to measure accurately or vary naturally.
These uncertainties can affect the model's predictions of water content. Therefore, the model must be calibrated — that is, adjusted so that its outputs match real measurements. Calibration involves changing the model parameters step by step and comparing the simulated results to observed data until the model performs well according to a chosen objective function.

What You Will Do

The first goal of this work is to review the different calibration methods found in the literature, with a particular focus on the Bayesian Generalized Likelihood Uncertainty Estimation (GLUE) approach [3]. Unlike traditional methods that provide a single "optimal" parameter set, GLUE yields a range of parameter sets that all produce acceptable model simulations. In addition, a global sensitivity analysis [4] helps identify the parameters that most strongly influence the model's ability to reproduce the experimental data, as well as those with negligible impact, which can be excluded from the calibration process and fixed at a nominal value. The aim of the work is to explore this type of approach.
The second goal is to apply the selected method to the calibration of a hydrological green-roof model. Real monitoring data collected between 2020 and 2024 will be used for this application.

References

[1] D. Perivoliotis, I. Arvanitis, A. Tzavali, V. Papakostas, S. Kappou, G. Andreakos, A. Fotiadi, J.A. Paravantis, M. Souliotis, G. Mihalakakou. Sustainable Urban Environment through Green Roofs: A Literature Review with Case Studies. *Sustainability*, 2023, 15(15976). https://doi.org/10.3390/su152215976.
[2] Y. Li and Jr. RW Babcock. Green roof hydrologic performance and modeling: a review. *Water Science and Technology*, 2014, 69(4):727-38. doi:10.2166/wst.2013.770.
[3] M. Mirzaei, Y. F. Huang, A. El-Shafie and A. Shatirah. Application of the generalized likelihood uncertainty estimation (GLUE) approach for assessing uncertainty in hydrological models: A review. *Stochastic Environmental Research and Risk Assessment*, 2015, DOI: 10.1007/s00477-014-1000-6.
[4] E. Borgonovo and E. Plischke. Sensitivity analysis: A review of recent advances. *European Journal of Operational Research* 248 (2016)869–887, 2016, http://dx.doi.org/10.1016/j.ejor.2015.06.032

Keywords : calibration, uncertainty, sensitivity analysis, green roof model

What Skills & Experience You Should Bring

You are in the final year of an engineering school or enrolled in a Master's degree (M2) in Control Engineering or Applied Mathematics, and you have a background in statistics. You have strong analytical and synthesis skills, and you are curious, motivated, and interested in research.
You have good written and oral communication skills in English, and optionally in French.

Informations

Founding
Standard statutory internship allowance (600 euros per month)

Laboratory
CRAN Laboratory of University of Lorraine (CNRS UMR 7039)
`http://www.cran.univ-lorraine.fr/`

The internship will hold in CID (Control Identification Diagnosis) department, team DATA. The CID department brings together all the research activities of the CRAN focusing on Automatic Control of Continuous and Cyber-Physical Systems. A wide range of topics is covered, including: modeling, identification, analysis, control, observation, diagnosis, and fault tolerance.

Location
Polytech Nancy - 2 Rue Jean Lamour
54519 Vandoeuvre Lès Nancy Cedex
FRANCE

Period
Internship of 6 month from march to august 2026

Contact
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To apply

If you are interested in this internship offer, please contact Floriane COLLIN (floriane.collin@univ-lorraine.fr) and include your CV, a cover letter, and copies of your diplomas and transcripts.