Manuel Álvarez Chaves

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Employment History

2022 – · · · **Doctoral researcher** at the University of Stuttgart.

2018 – · · · **Independent consultant** in hydrology and hydraulic engineering.

2018 – 2019 **Researcher** at the Center for Research in Sustainable Development (CIEDES) of the University of Costa Rica.

2017 – 2018 **Civil design assistant** at DEHC Consulting Engineers, San José, Costa Rica.

2015 – 2017 **Teaching assistant** at the School of Civil Engineering of the University of Costa Rica.

Education

2022 – 2025 **Dr. Ing. from the University of Stuttgart**
Thesis title: *Bridging Information Theory and Hydrological Modeling: The Role of Non-Parametric Methods* [in writing]

2019 – 2021 **M. Sc. in Flood risk management from IHE Delft**
Thesis title: *Comparing physically-based with data-driven models for landslide susceptibility: A case study in the Catalan Pyrenees*.

2011 – 2018 **License in Civil Engineering from the University of Costa Rica**
Thesis title: *Analysis of floods in the lower part of the Parrita river basin using a two-dimensional hydraulic model* (in Spanish).

Research Publications

Journal Articles

1. **M. Álvarez Chaves**, E. Acuña Espinoza, H. V. Gupta, D. Klotz, U. Ehret, and A. Guthke, "A variational approach for uncertainty estimation with deep learning rainfall-runoff models," *Hydrology and Earth System Sciences*, [in preparation].

2. **M. Álvarez Chaves**, E. Acuña Espinoza, U. Ehret, and A. Guthke, "When physics gets in the way: An entropy-based evaluation of conceptual constraints in hybrid hydrological models," English, *EGUsphere*, pp. 1–44, May 2025. DOI: 10.5194/egusphere-2025-1699.

3. **M. Álvarez Chaves**, H. V. Gupta, U. Ehret, and A. Guthke, "On the accurate estimation of information-theoretic quantities from multi-dimensional sample data," *Entropy*, May 2024. DOI: 10.3390/e26050387.

Research Software

Note: the number between [brackets] refers to the publication in which it was used.

- UNITE toolbox: a set of tools for non-parametric estimation for information theory. Collects different non-parametric methods (kNN, KDE, binning) to estimate fundamental quantities in information theory [1, 2, 3].
- hybrid-models: scripts to training hybrid hydrological models. Extension of Hy2DL [2].
- information_hydrology: scripts to train and post-process probabilistic deep-learning rainfall-runoff models [1].

Consulting Experience

Consulting Projects

Since 2018, I have provided consulting services for development projects in Costa Rica, working both locally and remotely for a total of six years. My expertise focuses on hydrological and hydraulic engineering, with specialized projects centered on:

- Flood event estimation for critical infrastructure, including precise design analyses for culverts and bridges
- Hydrodynamic modeling of water flow and potential flood scenarios
- Scour evaluation using engineering guidelines from the Hydrologic Engineering Center of the United States Army Corps of Engineers, and Federal Highway Administration (FHWA).

Consulting Software

- frequency-analysis: a collection of routines to fit hydrological data to extreme value statistical distributions using SciPy.

Skills

Languages	Spanish (native) - English (professional working proficiency)
Coding	Python, VBA, LaTeX
DevOps	Docker
Misc.	AutoCAD Civil3D, QGIS

Miscellaneous

Awards and Achievements

2023 **Outstanding Student Presentation Award (OSPA)** at the AGU Fall meeting of 2023.

Certification

Introduction to Computational Fluid Dynamics in High Performance Computing from the High-Performance Computing Center Stuttgart (HLRS).

From Machine Learning to Deep Learning: a concise introduction from the High-Performance Computing Center Stuttgart (HLRS).

2022 **Software Carpentry Workshop** from The Carpentries.

References

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