Paul Muñoz

paulmunoz@udec.cl
WEB: https://paulmunoz.com
ORCID: https://orcid.org/0000-0002-8000-8840
Departament of Water Resources, Faculty of Agricultural Engineering
University of Concepción, Chile

EDUCATION

December 2019 – June 2023

Ph.D. in Water Resources.
University of Cuenca, Cuenca, Ecuador.
Thesis: Towards the improvement of machine learning peak runoff forecasting by exploiting ground- and satellite-based precipitation data: A feature engineering approach.

September 2016 – September 2018

MSc. in Water Resources Engineering.
KU Leuven, Leuven, Belgium.
Thesis: Flash-flood forecasting in an Andean mountain catchment—development of a step-wise methodology based on the random forest algorithm.

September 2009 – November 2015

Bachelor's in civil engineering.
University of Cuenca. Cuenca, Ecuador.
Thesis: Effect of the resolution of tipping-bucket rain gauge and calculation method on rainfall intensities in an Andean mountain gradient.

HONORS, GRANTS, AND AWARDS

- Award for outstanding researchers at the Universidad de Cuenca, 2021. Vicerectorate of Research, Universidad de Cuenca. 2022.
- DAAD scholarship to complement doctoral studies at the Philipps-University at Marburg, Germany. Research Grants-Binationally Supervised Doctoral Degrees/Cotutelle, 2020/21, www.daad.de. 2020.
- Selected member of the young scientist program. International Research on Disaster Risk (IRDR), China, 2018. www.irdrinternational.org.

TEACHING EXPERIENCE

October 2025 – present

Associate Professor, Faculty of Agricultural Engineering, University of Concepción, Chile.
Undergraduate courses: Hydrology; Introduction to Data Science.
Graduate courses: Computational mathematics for AI.

April 2022 – March 2025

Master program in Hydrology mention Ecohydrology, Universidad de Cuenca, Ecuador.

Graduate courses: Advanced Hydrometry; Statistical methods; Data-driven modelling for runoff and climate; Hydrology; Hydrological modeling.

March 2023 - present

Master in Highway and transportation engineering, Universidad de Cuenca, Ecuador.
Graduate course: Fundamentals of Research Methodology.

October 2022 - present

Universidad de Cuenca, Ecuador. Undergraduate course: Introduction to Data Analytics.

October 2023

Hydrological Forecasting Techniques focused on ENSO events. Institute of Meteorology and Hydrology of Ecuador. 30 hours.

July 2019 – August 2019

International course on "Hydrology of Andean ecosystems: Introduction to ecohydrology and environmental tracers". https://www.ucuenca.edu.ec/idrhica/index.php/es/educacion/formacion-continua/.

RESEARCH AND CONSULTANCY EXPERIENCE

May 2024 – September 2025

Postdoctoral researcher at the Department of Water and Climate. Vrije Universiteit Brussel, Belgium. Artificial Intelligence applications in Water and Climate.

July 2023 – present

Postdoctoral researcher at the Department of Water Resources and Environmental Sciences at Universidad de Cuenca, Ecuador. Project: Data fusion of near-real-time satellite products for improving runoff forecasting.

August 2023 - present

Specialist in impact assessments on water scarcity and agricultural droughts. Food and Agriculture Organization of the United Nations (FAO). External consultant. Project: FAO TCP RLA 3909 "Reducing the impact of droughts and water scarcity on livelihoods and food security without leaving anyone behind". https://www.fao.org/

January 2020 - January 2022

Consultancy for the Minas-San Francisco hydropower plant operated by the Corporación Eléctrica del Ecuador CELEC-EP. Project: Development of a real-time runoff forecasting system for the Minas-San Francisco hydropower dam.

October 2018 – July 2023

- Development of runoff and flash flood forecasting models for Andean basins
- Development of hydrological forecasting models using weather radar data in Andean basins.
- Comparison of methods for actual evapotranspiration estimation in a paramo ecosystem microcatchment.
- High-resolution radar analysis of precipitation extremes in Ecuador and north Peru and implications of the ENSO-dynamics.
- A research network for the resilience of headwater systems and water availability for downstream communities across the Americas.

July 2013 - August 2016

Junior Researcher at the Department of Water Resources and Environmental Sciences at Universidad de Cuenca, Ecuador. Duties included the installation, operation and maintenance of hydrometeorological stations. Analysis of hydrometeorological databases.

SUPPORTING STUDENTS AND MENTORING

2023 – present

Co-supervision PhDs. Doctoral program in Natural Resources, Universidad de Cuenca, Ecuador.

May 2024 – present

Supervision of master thesis. Master program in Water Resources Engineering, Vrije Universiteit Brussel, Belgium.

November 2019

Mentor obtaining funding from the German Academic Exchange Service. Trip to Germany (15 days) to seek for doctoral opportunities for an entire master class (15 people).

October 2018 – present

Supervision of master thesis. Master program in Hydrology, mention ecohydrology, Universidad de Cuenca, Ecuador.

September 2022 – March 2023

Mentoring in the Club of Statistical methods for Hydrometeorology. Universidad Agraria La Molina, Perú.

PEER-REVIEWED PUBLICATIONS

21. Wikimpacts 1.0: a new global climate impact database based on automated information extraction from Wikipedia. Li, N., Thiery, W., Zahra, S., Madruga de Brito, M., Worou, K., Kurfalı, M., Lampe, S., **Muñoz, P.**, Flynn, C., Trigoso, C., Nivre, J., Zscheischler, J., & Messori, G. Natural Hazards and Earth Systems Sciences, 26, 2609–2636

20. Variable renewables fortify Ecuador's power system against recurrences of drought-driven energy crises. Sterl, S., Pineda, L.E., Mast, T., Rodríguez, Y., **Muñoz, P.** & Thiery, W. Nature Water, 2026

19. Luna Abril, P., **Muñoz, P.**, Samaniego, E., Muñoz, D.F., Merizalde, M., Lillo-Saavedra, M. & Célleri, R. (2026). Evaluating the three-cornered hat method for hourly satellite precipitation fusion in hydrological forecasting: A case study in a Tropical Andean Basin. *Journal of Hydrology: Regional Studies, 64(4), 103163*.

18. Muñoz, J., **Muñoz, P.**, Muñoz, D. F., & Célleri, R. (2025). Reducing Latency in Satellite-Based Precipitation Estimates Using GOES-16 and Machine Learning. *Journal of Hydrologic Engineering, 30(6), 04025036*.

17. Vélez-Hernández, M., **Muñoz, P.**, Samaniego, E., Merizalde, M. J., & Célleri, R. (2025). Advancing timely satellite precipitation for IMERG-ER using GOES-16 data and a U-Net convolutional neural network modelling approach. . *Environmental Modelling & Software, 106457*.

16. Daramola, S., Muñoz, D. F., **Muñoz, P.**, Saksena, S., & Irish, J. L. (2025). Predicting the Evolution of Extreme Water Levels With Long Short-Term Memory Station-Based Approximated Models and Transfer Learning Techniques . *Water Resources Research, 61,e2024WR039054*.

15. Yao, Y., Ducharne, A., Cook, B. I., De Hertog, S. J., Aas, K. S., Arboleda-Obando, P. F., … **Muñoz, P**... & Thiery, W. (2025). Impacts of irrigation expansion on moist-heat stress based on IRRMIP results. Nature Communications, 16(1), 1-11.

14. Montenegro, M., Célleri, R., Orellana-Alvear, J., **Muñoz, P.**, & Córdova, M. (2025). Precipitation forecasting using random forest over an ecuadorian andes basin . Meteorology and Atmospheric Physics, 137(1), 1-12.

13. **Muñoz, P.**, Muñoz, D. F., Orellana-Alvear, J., & Célleri, R. (2024). Enhancing runoff forecasting through the integration of satellite precipitation data and hydrological knowledge into machine learning models. Natural Hazards, 1-23.

12. Álvarez-Estrella, J., **Muñoz, P.**, Bendix, J., Contreras, P., & Célleri, R. (2024). Enhancing Peak Runoff Forecasting through Feature Engineering Applied to X-Band Radar Data. Water, 16(7), 968.

11. **Muñoz, P.**, Corzo, G., Solomatine, D., Feyen, J., Celleri, R. (2023). Near-real-time satellite precipitation data ingestion into peak runoff forecasting models. Environmental Modelling & Software, 160, 105582.

10. **Muñoz, P.**, Corzo, G., Solomatine, D., Feyen, J., Celleri, R. (2023). Use of Near-Real-Time Satellite Precipitation Data and Machine Learning to Improve Extreme Runoff Modeling. AGU books: Hydroinformatics. Accepted.

9. Merizalde M.J., P., **Muñoz P.**, Muñoz D.F., Corzo, G., Samaniego, E., Célleri, R. (2023). Integrating geographic data and the SCS-CN method with LSTM networks for enhanced runoff forecasting in a complex mountain basin. Frontiers in Water.

8. **Muñoz, P**., Orellana-Alvear, J., Bendix, J., Feyen, J., Celleri, R. (2021). Flood Early Warning Systems Using Machine Learning Techniques: The Case of the Tomebamba Catchment in the Southern Andes of Ecuador. Hydrology, 8(4), 183.

7. **Muñoz, P.**, Orellana-Alvear, J., Celleri, R. (2021). Application of a Machine Learning Technique for Developing Short-Term Flood and Drought Forecasting Models in Tropical Mountainous Catchments. In Integrated Research on Disaster Risks (pp. 11-35). Springer, Cham.

6. Muñoz, D. F., **Muñoz, P**., Alipour, A., Moftakhari, H., Moradkhani, H., Mortazavi, B. (2021). Fusing multi-source data to estimate the effects of urbanization, sea level rise, and hurricane impacts on long-term wetland change dynamics. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing.

5. Contreras P, Orellana-Alvear J, **Muñoz P.**, Bendix J, Celleri R. Influence of Random Forest Hyperparameterization on Short-Term Runoff Forecasting in an Andean Mountain Catchment. Atmosphere. 2021; 12(2):238.

4. Muñoz, D. F., **Muñoz, P.**, Moftakhari, H., Moradkhani, H. (2021). From local to regional compound flood mapping with deep learning and data fusion techniques. Science of the Total Environment, 782, 146927.

3. Orellana-Alvear, J., Celleri, R., Rollenbeck, R., **Muñoz, P.**, Contreras, P., Bendix, J. (2020). Assessment of Native Radar Reflectivity and Radar Rainfall Estimates for Discharge Forecasting in Mountain Catchments with a Random Forest Model. Remote Sensing, 12(12), 1986.

2. **Muñoz, P.**; Orellana-Alvear, J.; Willems, P.; Celleri, R. Flash-Flood Forecasting in an Andean Mountain Catchment—Development of a Step-Wise Methodology Based on the Random Forest Algorithm. Water 2018, 10, 1519.

1. **Muñoz, P.**; Celleri, R.; Feyen, J. Effect of the Resolution of Tipping-Bucket Rain Gauge and Calculation Method on Rainfall Intensities in an Andean Mountain Gradient. Water 2016, 8, 534.

CONFERENCES

- **EGU general assembly** co-convener 2023-2025, Austria. Hydroinformatics, Hydrological Sciences Division
- Oral presentation: **Water Security and Climate Change conference**. Germany, October 2024. Leveraging data-driven techniques for hydrological understanding and water management.
- Oral presentation: **Communications and dissemination of climate impacts**. PROCLIAS. Austria, September 2024. Facing hydrological extremes in South America: The energy crisis.
- Oral presentation: **HydroML Symposium on big data machine learning in hydrology and water resources**. The Pennsylvania State University. May 2022. Use of near-real-time satellite precipitation data and machine learning to improve extreme runoff modeling.
- Oral presentation: **EGU general assembly**, Austria. 2021. Long short-term memory networks for real-time runoff forecasting using remotely sensed data.
- Oral presentation: **Water Security and Climate Change conference**, Vietnam. 2021. Remote Sensing and Machine Learning for Real-Time Runoff Forecasting in Large Complex Mountainous Basins – Application to Hydropower Optimization.
- Oral presentation: **EGU general assembly**, Austria. 2020. Comparison of Machine Learning Techniques Powering Flood Early Warning Systems. Application to a catchment located in the Tropical Andes of Ecuador.
- Poster presentation: **EGU general assembly**, Austria. 2019. Short-term extreme flow forecasting in a tropical Andean Mountain catchment.

LANGUAGES

- English, advanced. TOEFL test score: 112.
- Dutch, A1.
- Spanish, native.