

Gabriel Perez

Research Hydrologist

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Research Hydrologist with expertise in numerical modeling, processing of radar and satellite remote sensing data, and stochastic hydrological analysis. My research is focused on developing and using physically-based hydrological models to dissect the roles of rainfall and land surface process interactions in producing surface and subsurface flow at a wide range of temporal and spatial scales.

Research Interests

Hydrologic modeling; Hydraulic modeling; High performance computing, Hydroclimate impact assessment, Flood Frequency Analysis; Statistics of extremes; Flood risk estimation; Stochastic modeling; River network structures; Remote sensing; machine learning; Groundwater modeling; Hyporheic exchange.

Education

2019

Ph.D. Hydraulics and Water Resources

The University of Iowa - Iowa City, IA, U.S.

Thesis: "Advancing Multiple Aspects of a Nonlinear Geophysical Theory of Floods"

2015

M.Sc. Water Resources

Universidad Nacional de Colombia - Medellin, Colombia

Thesis: "Proposed Methodology for Estimating Flood Areas with Scarce Information Through Geomorphometric Descriptors Derived from Digital Elevation Models"

2012

B.S. Civil Engineering

Universidad Nacional de Colombia - Medellin, Colombia

Thesis: "Analysis of the Confluence Dona Maria – Medellin River based on a Hydraulic Simulation and Monte Carlo Simulation."

Professional Experience

2023 - Current

Postdoctoral Research Associate

Oak Ridge National Laboratory, Oak Ridge, U.S.

Development of integrated surface/subsurface simulation tools for watershed hydrology and reactive transport.

2019 - 2022

Postdoctoral Scholar

Vanderbilt University, Nashville, U.S.

Development of hydrological models; Modeling of groundwater systems; Spatial and temporal variability of flood events; Rainfall dynamics.

2015 - 2019

Research Assistant

Iowa Flood Center, University of Iowa, Iowa City, U.S.

Data analysis of flood events; Hydrological modeling; Radar Rainfall data processing; Stochastic transposition of rainfall events.

2012 - 2014

Civil Engineer

Perez Mesa Ingenieros SAS, Medellin, Colombia

Design of water supply systems; Sewage networks; Hydrologic and hydraulic studies; Water quality analysis; Integrated watershed management plans.

2011

Assistant Civil Engineer

W&W Ingeniería Ltda, Medellin, Colombia

Design of storm drains and sanitary sewers

2010 - 2011

Research Assistant

Universidad de Antioquia, Medellin, Colombia

Hydrologic and Hydraulic studies

Teaching Experience

2022 Spring

Instructor, Water Resources Engineering

Vanderbilt University, Nashville, U.S.

**2018 Spring and
Fall**

Teaching Assistant, Fluid Mechanics

The University of Iowa, Iowa City, U.S.

**2017 Spring and
Fall 2018**

Teaching Assistant, Groundwater

The University of Iowa, Iowa City, U.S.

2017 Spring

Teaching Assistant, Water Resources Design

The University of Iowa, Iowa City, U.S.

2012 - 2014

Instructor, Introduction to Geographic Information Systems

The Universidad Nacional de Colombia, Medellin, Colombia.

Papers Published in Refereed Journals

1. Krajewski, W.F., Otto, L., Vishwakarma, S., and **Perez, G.**, (2023) Revisiting Turcotte's approach: Flood frequency analysis. *Journal of Stochastic Environmental Research and Risk Assessment*. (In press)
2. Grant, S.B; Rippey, M; Birkland, T; Schenk, T; Rowles, K; Aminpour, P; Kaushal, S; Vikesland, P; Berglund, E; Gomez-Velez, J; Hotchkiss, E; **Perez, G**; Zhang, H; Armstrong, K; Bhide, S; Krauss, L; Maas, C; Mendoza, K; Shipman, C; Zhang, Y; Zhong, Y. (2022) "Can Common Pool Resource theory catalyze stakeholder-driven solutions to the freshwater salinization syndrome?" *Environmental Science & Technology*, <https://doi.org/10.1021/acs.est.2c01555>
3. **Perez, G.**, Gomez-Velez, J.D., Chen, X., Scheibe, T., Chen, Y., Bao, J. (2021) Identification of Characteristic Spatial Scales to Improve the Performance of Analytical Spectral Solutions to the Groundwater Flow Equation. *Water Resources Research*, 57(12) <https://doi.org/10.1029/2021WR031044>
4. **Perez, G.**, Gomez-Velez, J.D., Mantilla, R., Wright, D., Li, Z. (2021) The Effect of Storm Direction on Flood Frequency Analysis. *Geophysical Research Letters*, 48(9):1–10. <https://doi.org/10.1029/2020GL091918>
5. Quintero, F., Krajewski, W. F., Muste, M., Rojas, M., **Perez, G.**, Johnson, S. J., Anderson, A., Hunemuller, T., Cappuccino, B., & Zogg, J. (2021). Development of synthetic rating curves: A case study in Iowa. *Journal of Hydrologic Engineering*, 1–12. [https://doi.org/10.1061/\(ASCE\)HE.1943-5584.0002022](https://doi.org/10.1061/(ASCE)HE.1943-5584.0002022)
6. **Perez, G.**, Mantilla, R., Krajewski, W. F., & Quintero, F. (2019). Examining Observed Rainfall, Soil Moisture, and River Network Variabilities on Peak Flow Scaling of Rainfall-Runoff Events with Implications on Regionalization of Peak Flow Quantiles. *Water Resources Research*, 2019WR026028. <https://doi.org/10.1029/2019WR026028> .
7. **Perez, G.**, Mantilla, R., Krajewski, W. F., & Wright, D. B. (2019). Using Physically Based Synthetic Peak Flows to Assess Local and Regional Flood Frequency Analysis Methods. *Water Resources Research*, 2019WR024827. <https://doi.org/10.1029/2019WR024827> .
8. **Perez, G.**, Mantilla, R., & Krajewski, W. F. (2018). Estimation of Historical-Annual and Historical-Monthly Scale-Invariant Flow Duration Curves with Implementation for Iowa. *Journal of Hydrologic Engineering*, 23(12), 05018021. [https://doi.org/10.1061/\(ASCE\)HE.1943-5584.0001707](https://doi.org/10.1061/(ASCE)HE.1943-5584.0001707) .
9. **Perez, G.**, Mantilla, R., & Krajewski, W. F. (2018). The Influence of Spatial Variability of Width Functions on Regional Peak Flow Regressions. *Water Resources Research*, 54(10), 7651–7669 <https://doi.org/10.1029/2018WR023509>.

Book Chapters

1. **Perez, G.**, Mantilla, R., & Krajewski, W. F. (2018). Spatial patterns of peak flow quantiles based on power-law scaling in the Mississippi River basin. In A. A. Tsonis (Ed.), *Thirty Years of Nonlinear Dynamics in Geosciences*. Springer. https://doi.org/10.1007/978-3-319-58895-7_23

Data Release

1. Ikard, S.J., Rucker, D.F., Carroll K.C., Adams, R.F., and **Perez, G.**, (2022), Waterborne Self-potential Data, Surface-water Temperature and Conductivity Logging data, and Electric Resistivity Tomography Data Measured at East Fork Poplar Creek, Oak Ridge, Tennessee, January-March 2022, U.S. Geological Survey data release, <https://doi.org/10.5066/P9BAW75G>

Papers in Preparation

- Mantilla, R., **Perez, G.**, Velasquez, N., Wright, DB., Yu, G., Regional Flood Frequency Analysis Using Physics-based Hydrologic Modeling. In preparation for Water Resource Research.
- **Perez, G.**, Gomez-Velez, J. D., Chen, X., Scheibe, T. The Directional Unit Hydrograph Method: Connecting Streamflow Response to Storm Direction. In preparation for Journal of Hydrology.
- **Perez, G.**, Gomez-Velez, J. D., S. B. Grant. A Parsimonious Model for Flow in Sanitary Sewer Networks: Revisiting the Width Function Instantaneous Unit Hydrograph. In preparation for Water Research.
- **Perez, G.**, Gomez-Velez. JD., Chen, X., Scheibe, T., Chen, Y., Bao, J. Spectral solutions of the groundwater flow equation for the characterization of hyporheic exchange: How accurate is the pumping model? In preparation for Water Resources Research.
- **Perez, G.**, Gomez-Velez. JD., Chen, X., Scheibe, T., Chen, Y., Bao, J. Multiscale characterization of hyporheic exchange along the Columbia River. In preparation for Water Resources Research.
- Gomez-Velez, J. D., **Perez, G.**, Y. Zhang, S. B. Grant. Water Mixing in Sanitary Sewer Systems: Implications for the Interpretation of Water Quality Observations. In preparation for Environmental Science & Technology.
- Zhang, Y., **Perez, G.**, Gomez-Velez, J. D. Using Deep Learning to Characterize Rainfall-derived Inflow and Infiltration in Sanitary Sewer Systems. In preparation for Water Resources Research.
- Gonzalez-Duque, D., Gomez-Velez, J.D, **Perez, G.**, Harvey, J., Chen, X., and Scheibe, T. Networks with Exchange and Subsurface Storage (NEXSS) In preparation for Journal for Advances in Modeling Earth Systems (JAMES).
- Gomez-Velez, J.D, Wang, C., Gonzalez-Duque, D., **Perez, G.**, Harvey, J., Schwarz, G., Konrad, C., Scott, D., Chen, X., and Scheibe, T. Estimating Grain Size for Streambeds Across the Conterminous US. In preparation for Water Resources Research.

Honors and Awards

- Nomination to STAHY Best Paper Award (2021).
- Best Case Study Award – Journal of Hydrologic Engineering (2020).
- Graduate College Post-Comprehensive Research Award (Spring 2018 semester).
- CEE Outstanding TA for Water Resources Engineering (Fall 2017 semester).
- Outstanding Student Scholarship – Universidad Nacional de Colombia – M.Sc. Hydraulic resources (2012-2014).

Conference and Seminar Presentations

- **Perez, G.**, Gomez-Velez, J., Chen, X., Scheibe, T., Chen, Y., & Bao, J. A Systematic Assessment of the Pumping Model as a Tool to Understand and Upscale Hyporheic Exchange Processes - AGU Fall Meeting 2022.
- **Perez, G.**, Mantilla, R., Krajewski, W., & Gomez-Velez, J. Insights on Physical Controls and Statistical Effects on the Interpretation of Peak Flow Scaling from a Mesoscale Basin to the Mississippi River Basin - AGU Fall Meeting 2022.
- Gomez-Velez J., **Perez G.**, Grant S., Mendoza, K., Rippy, M., & Vikesland, P. A novel modeling framework to understand the fate and transport of salts in sanitary sewer systems - AGU Fall Meeting 2022.
- Shipman, C., Grant, S., Mendoza, K., Vikesland, P., **Perez, G.**, Gomez-Velez, J., Rippy, M., Schenk T., & Birkland, T. The Potential Contribution of Household Detergents to Inland Freshwater Salinization - AGU Fall Meeting 2022.
- Ayers, J., Jing, W., Chen, M., Daugherty, E., **Perez, G.**, & Gomez-Velez, J., Effects of Nutrient Pollution and Urbanization on Diel Cycles and CO₂ Emissions in Two Middle TN Streams - AGU Fall Meeting 2022.
- **Perez, G.**, & Gomez-Velez, J., Development of a Parsimonious Hydrological Model to Evaluate the Effect of Changes in Storm Tracks in Flood Events Under Future Climates. - AGU Fall Meeting 2021.
- **Perez, G.**, Gomez-Velez, J., Chen, Y., Chen, X., Scheibe, T., & Bao, Ji., Analysis of Nested Hyporheic Flow Paths Using Analytical Spectral Solutions. GSA 2021.
- Mantilla, R., Velasquez, N., **Perez, G.**, & Wright, D., Quantifying Sources of Uncertainty in Regional Flood Frequency Analysis Using Physics-based Hydrologic Modeling - AGU Fall Meeting 2021.
- Velasquez, N., Mantilla, R., **Perez, G.**, Wright, D., & Yu, G., A performance index based on hydrograph moments: A descriptor to identify strengths and shortcomings hydrological simulations - AGU Fall Meeting 2021.
- **Perez, G.**, Resonance in hydrologic systems: Detecting critical conditions that can exacerbate extreme floods during current and future climate. Emerging Scholar Seminar, Vanderbilt University, March 2021.
- **Perez, G.**, Gomez-Velez, J., Mantilla, R., Wright, D., & Li, Z., The Effect of Storm Direction on Flood Frequency Analysis Using Physically-Based Streamflow Simulations - AGU Fall Meeting 2020.
- Mantilla, R., **Perez, G.**, Velasquez, N., Wright, D., & Yu, G., Insights from Physics-based Hydrologic Models and Stochastic Storm Transposition into the Underlying Assumptions of Flood Quantile Regionalization Techniques - EGU General Assembly Conference, 2020.
- Mantilla, R., **Perez, G.**, Quintero, F., & Krajewski, W. F., A Physical Interpretation for Peak Flow Scaling of Rainfall-Runoff Events in Nested River Networks with Implications on Peak Flow Regionalization. EGU General Assembly 2019.
- **Perez, G.**, Mantilla, R., & Krajewski, W. F., The influence of spatial variability of width functions on regional peak flow regressions. AGU Fall Meeting Abstracts, Washington D.C. 2018.

- Mantilla, R., **Perez, G.**, & Krajewski, W. F., Comparison of local and regional methods to estimate peak flow quantiles based on synthetic records. AGU Fall Meeting Abstracts, Washington D.C. 2018.
- Krajewski, W. F., Mantilla, R., **Perez, G.**, Comparison of local and regional methods to estimate peak flow quantiles based on synthetic records. STAHY, Australia-Adelaide 2018.
- Krajewski, W. F., Mantilla, R., **Perez, G.**, Temporal and spatial power laws of river peak flows and flood frequency estimation. AGU Fall Meeting Abstracts, New Orleans, 2017.
- Rodriguez-Gaviria, E. M., **Perez, G.**, & Botero-Fernández, V. Methodological design for flood risk assessment at a local level using scare information. 6th International Conference on Flood Management, 1–12. 2011.

Affiliations

- American Geophysical Union
- American Society of Civil Engineers
- Geological Society of America

Participation in Courses and Seminars

- Certificate in College Teaching, Vanderbilt University, Fall 2021 – Spring 2022
- SMAPVEX16 Research campaign, soil moisture and vegetation sampling, NASA, University of Iowa, August 2016.
- CUAHSI Watershed Science Master Class, University of Arizona's Biosphere 2 facility in Oracle, Arizona. January 2016.
- Course in water quality modeling in rivers and streams and its application to sanitation plans and managing spills. ACODAL, July 2012.
- XIX National seminar of hydraulics and hydrology and the first national forum on safety of dams. Bogota DC Colombia, March 2011.

Community Services

Reviewer service: Journal of Hydrology; Water Resources Research; Hydrology and Earth System Sciences; Advances in Water Resources; Hydrogeology Journal; Water; Journal of the American Water Resources Association.

Conference: Session chair of Groundwater-Surface Water Interactions: Integrating Physical, Biological, and Chemical Patterns and Processes Across Systems and Scales - AGU Fall Meeting 2022

Technical Skills

- Programming Skills: MATLAB, Python, R, PostgreSQL
- Modeling experience: WRF-Hydro, HEC-HMS, EPA-SWMM, Hillslope-Link-Model (HLM), EPANET, HEC-RAS, HEC-GeoRAS, COMSOL Multiphysics, MODFLOW.
- Research Tools: Linux, GitHub, ArcGIS pro, QGIS, SAGA GIS, GRASS GIS, gv-SIG, AutoCAD.

Contact Information

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Associate Professor, Civil Engineering
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Associate Professor, Civil & Environmental Engineering
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