

Exponent®
Engineering & Scientific Consulting

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Professional Profile

Dr. Hong is a computational hydrologist and water resources engineer addressing complex environmental challenges through advanced modeling and data analysis. He specializes in multi-scale hydraulic and hydrologic (H&H) modeling and chemical transport across surface water, groundwater, and variably saturated soils, integrating geospatial analytics and climate science. His work leverages high-resolution, water-energy-contaminant transport models to predict hydrologic and chemical dynamics in hydraulically connected watershed systems. Dr. Hong applies model-derived datasets to inform data-driven strategies in water resources management and environmental risk assessment, with a particular focus on localized assessment of climate change impacts on contaminant behavior and water system dynamics. His technical toolkit includes geospatial analysis of regional-scale datasets (e.g., remote sensing, in-situ observations, and climate model outputs) and the application of statistical learning methods for environmental inference and decision support.

Dr. Hong has 10 years of professional and academic experience in representing and interpreting hydrologic and ecologic processes through advanced computational methods. Prior to joining Exponent, Dr. Hong served as a research faculty member at Princeton University, where he developed and applied advanced modeling frameworks to quantify the role of groundwater in shaping regional-scale water and energy dynamics. His work integrated hydraulic theory, geospatial datasets, and statistical analysis to improve understanding of coupled hydrologic systems. As a consultant, Dr. Hong leverages this expertise to deliver data-driven insights using physics-based simulations for water-energy balance forecasting, hydrologic extremes analysis (e.g., flood and drought risk), and integrated water, nutrient, and contaminant management in agricultural and environmental systems. His modeling-driven approach supports decision-making in climate resilience, resource planning, and environmental risk assessment.

Dr. Hong has collaborated extensively with U.S. federal agencies including the USDA, USGS, and NOAA, contributing to applied research and decision-support initiatives in hydrology and climate science. He has employed a wide range of hydraulic and hydrologic models — such as HYDRUS, HEC-RAS, HEC-HMS, and MODFLOW-MT3D — to simulate surface and subsurface flow processes across diverse environmental settings. Additionally, he has applied advanced land surface and climate models, including Noah-MP, the NOAA National Water Model (WRF-Hydro), and GFDL's Land Model 4 (LM4), to investigate land–atmosphere interactions and climate-driven hydrologic and ecological responses. These modeling efforts have supported projects spanning watershed-scale water quantity and quality assessments to national-scale climate impact analyses, underscoring Dr. Hong's ability to translate complex simulation outputs into actionable insights.

Academic Credentials & Professional Honors

Ph.D., Water Resources Engineering, Texas A&M University, 2022

M.S., Water Resources Engineering, Seoul National University, Korea, 2016

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B.S., Rural System Engineering, Seoul National University, Korea, 2014

Bill and Rita Stout International Graduate Student Achievement Award (2020). Texas A&M University

USGS TWRI Graduate Fellowship (2020). United States Geological Survey (USGS) & Texas Water Resources Institute (TWRI)

Soil Science Society of America Presentation Award (2019). Soil Science Society of America (SSSA)

BAEN Graduate Student Competitive Scholarship (2019). Texas A&M University

Aggies Commit Fellowship (2019). Texas A&M University

National Water Center Summer Institute Fellowship (2018). National Oceanic and Atmospheric Administration (NOAA) & National Water Center (NWC)

Academic Appointments

Professional Specialist, Atmospheric and Oceanic Sciences, Princeton University, 2022-2025

Prior Experience

Professional Specialist, Princeton University, 2022-2025

Professional Affiliations

American Geophysical Union (AGU)

Soil Science Society of America (SSSA)

The Korean Society of Agricultural Engineers (KSAE)

Korea Water Resource Association (KWRA)

Publications

Hong M, Chaney N, Shevliakova E, Malyshev S, Zorzetto E, Preucil A. **LM4-SHARC v1.0: Resolving the Catchment-scale Soil-Hillslope Aquifer-River Continuum for the GFDL Earth System Modeling Framework.** Geoscientific Model Development 2025; 18(7):2275-2301. https://doi.org/10.5194/gmd-18-2275-2025.

Mohanty BP, .. Hong M .. **Texas Water Observatory: A Distributed Network for Monitoring Water, Energy, and Carbon Cycles Under Variable Climate and Land Use on Gulf Coast Plains.** Journal of Hydrometeorology 2024; 25(11). https://doi.org/10.1175/JHM-D-23-0201.1.

Hong M, Mohanty BP. **Representing Bidirectional Hydraulic Continuum Between the Stream and Hillslope in the National Water Model for Improved Streamflow Prediction.** Journal of Advances in Modeling Earth Systems 2023; 15(3):e2022MS003325.

Hong M, Mohanty BP. **A New Method for Effective Parameterization of Catchment-Scale Aquifer through Event-scale Recession Analysis.** Advances in Water Resources 2023; 174:104408.

Karki R, Krienert JM, Hong M, Steward DR. **Evaluating Baseflow Simulation in the National Water Model:**

A Case Study in the Northern High Plains Region, USA. JAWRA Journal of the American Water Resources Association 2021; 57(2):267-280.

Hong M, Lee SH, Lee SJ, Choi JY. **Application of high-resolution meteorological data from NCAM-WRF to characterize agricultural drought in small-scale farmlands based on soil moisture deficit.** Agricultural Water Management 2021; 243:106494.

Hong M, Mohanty BP, Sheng Z. **An Explicit Scheme to Represent the Bidirectional Hydrologic Exchanges Between the Vadose Zone, Phreatic Aquifer, and River.** Water Resources Research 2020; 56(9):e2020WR027571.

Hong M, Karki R, Krienert J, Memari SS. **Evaluating Alternative Groundwater Discharge Estimations for Improved National Water Model Forecasting.** NOAA-National Water Center Innovators Program Report 2018.

Hong M, Lee SH, Choi JY, Lee SH, Lee SJ. **Estimation of soil moisture and irrigation requirement of upland using soil moisture model applied WRF meteorological data.** Journal of the Korean Society of Agricultural Engineers 2015; 57(6):173-183.

Presentations

Hong M, Malyshev S, Chaney N, Shevliakova E. **On the use of pedotransfer function for global surface simulation.** Oral presentation, *American Geophysical Union Fall Meeting,* Washington DC, USA, 2024.

Taboada S, Hong M, Malyshev S, Preucil A, Shevliakova E. **The Role of the Stream-Hillslope Continuum on Extreme Hydrologic Events: Is Groundwater a Moderator or a Facilitator?** Poster presentation, *American Geophysical Union Fall Meeting,* Washington DC, USA.

Wang R, Zorzetto E, Hong M, Chaney N, Malyshev S, Shevliakova E.**Quantifying wildfire simulations' sensitivities to surface lightning and soil properties at sub-grid scales using orography-aware NOAA/GFDL land model LM4.2.** Oral presentation, *American Geophysical Union Fall Meeting,* Washington DC, USA, 2024.

Lee SJ, Kim S, Lee S, Kim K, Baek J, Hong M. **A Land-atmosphere Modeling Package (LAMP) Dedicated to Agricultural and Forest Management in South Korea: History So Far and Plans for the Near Future.** Oral presentation, *Asia Oceania Geosciences Society (AOGS)*, Pyeongchang, Gangwon-do, Republic of Korea, 2024.

Hong M, Lee SJ. **Understanding the Emergent Properties of Catchment-scale Hillslope Aquifers for the Improved Predictability of Soil Moisture and Evapotranspiration in LSM.** Oral presentation, *Asia Oceania Geosciences Society (AOGS)*, Pyeongchang, Gangwon-do, Republic of Korea, 2024.

Hong M, Chaney N, Malyshev S., Shevliakova E, Preucil A. **Implications of floodplain dynamics for terrestrial water-energy-carbon cycle.** Poster presentation, *WaterSciCon24, American Geophysical Union (AGU),* St. Paul, USA, 2024.

Hong M, Chaney N, Malyshev S, Shevliakova E. **Resolving the Catchment-Scale Soil-Groundwater-River Interactions for an Earth System Modeling Framework.** Poster presentation, *American Geophysical Union Fall Meeting (AGU),* San Francisco, USA, 2023.

Mohanty B, Hong M. **Representing the Stream-Hillslope Bidirectional Continuum in the National Water Model for Improved Predictability of Terrestrial Water and Energy Cycles.** Oral presentation, *Frontiers in Hydrology-Future of Water Meeting (AGU),* Puerto Rico, USA, 2022.

Hong M, Mohanty B. **Representing the Dupuit-Boussinesq Aquifer in the National Water Model: Catchment-scale Application of Hydraulic Groundwater Theory.** Oral presentation, *American Geophysical*

Union Fall Meeting (AGU), New Orleans, USA, 2021.

Hong M, Mohanty B. **A New Method for Effective Parameterization of Catchment-scale Aquifer.** Oral presentation, *American Geophysical Union Fall Meeting (AGU),* New Orleans, USA.

Hong M, Mohanty B, Sheng Z. **Enhanced Drainage and Altered Streamflow Sensitivity of Soil Water Storage through Topographically-Driven Connectivity between Stream and Aquifer.** Poster presentation, *American Geophysical Union Fall Meeting (AGU),* Virtual, 2020.

Hong M, Mohanty B, Sheng Z. **An explicit scheme to represent the bidirectional hydrologic exchange between vadose zone-phreatic aquifer-river.** Poster presentation, *American Geophysical Union Fall Meeting (AGU),* San Francisco, USA, 2019.

Hong M, Mohanty B. **An explicit scheme to represent the bidirectional hydrologic exchange between vadose zone-phreatic aquifer-river.** Oral presentation, *The Soil Science Society of America (SSSA),* San Antonio, USA, 2019.

Hong M, Mohanty B, Sheng Z. **A predictive modeling framework accounting for the interactions between unsaturated, phreatic zone, and stream.** Poster presentation, *American Geophysical Union Fall Meeting (AGU),* Washington, DC, USA, 2018.

Hong M, Karki R, Krienert JM, Memari SS. **Evaluating Alternative Groundwater Discharge Estimations for Improved National Water Model Forecasting.** Poster presentation, *American Geophysical Union Fall Meeting (AGU),* Washington, DC, USA, 2018.

Hong M, Lee SH, Lee SJ, Choi JY. **Evaluation of the application of WRF meteorological data on grid-based soil moisture model for upland soil moisture prediction.** Oral presentation, *International Council of Irrigation and Drainage (ICID),* Montpellier, France, 2015.

Hong M, Lee SH, Lee SJ, Choi JY. **Estimation of soil moisture and irrigation water requirement of upland using WRF meteorological data.** Oral presentation, *The 2015 KSAE Annual Conference,* Daejoen, Korea, 2015.

Hong M, Lee SH, Lee SJ, Choi JY. **Evaluating the applicability of WRF meteorological data on grid-based soil moisture model in upland areas.** Oral presentation, *KWRA annual meeting,* Gosung, Korea, 2015.

Hong M, Lee SH, Lee SJ, Choi JY. **A distributed soil moisture model for irrigation factors assessment using enhanced meteorological data.** Oral presentation, *PAWEES-INWEPF Joint International Conference,* Kaoshiung, Taiwan, 2014.

Project Experience

Flood and Inundation Mapping and Forecasting (2022–2025)

Enhanced the hydrologic prediction capabilities of the GFDL climate model to improve NOAA's operational flood forecasting and inundation mapping. Integrated land surface and hydrologic modeling to better capture flood dynamics under changing climate conditions. Supported national-scale decision-making for flood risk management.

Sustainable Water Resources for Irrigated Agriculture in a Desert Basin Facing Climate Change and Competing Demands (2017–2021)

Conducted groundwater flow modeling and geospatial data analysis to evaluate sustainable irrigation strategies in the Rio Grande River Basin. Assessed the impacts of climate variability and competing water

demands on aquifer sustainability. Informed adaptive water management practices for arid agricultural systems.

Harris County Drainage Reuse Initiative (2019–2020)
Performed feasibility analysis for stormwater reuse by integrating groundwater monitoring data and hydrologic modeling. Evaluated potential for non-potable reuse applications to support urban water sustainability. Contributed to regional planning for flood mitigation and water supply diversification.

Development of Water Use Information Forecasting System for Agricultural Ecosystem Management (2014–2016)
Developed a high-resolution soil moisture forecasting system using 250m WRF meteorological data. Evaluated the influence of weather and soil conditions on agricultural water use and crop productivity. Supported precision agriculture and ecosystem-based water management strategies.

Peer Reviews

Remote Sensing of Environment

Geoscientific Model Development

Hydrology and Earth System Sciences

Agricultural and Forest Meteorology