

# Timothy M. Weigand, PhD

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## Education

- **PhD University of North Carolina at Chapel Hill (2012-2020)**
  - Thesis: On the Use of Entropy Production to Improve Mathematical Models and Numerical Methods for Non-Dilute Flow and Transport in Porous Medium
- **MS University of California, Los Angeles (2009-2010)**
  - Civil and Environmental Engineering
  - UCLA Civil and Environmental Engineering Department Fellowship Recipient
- **BS Humboldt State University (2005-2009)**
  - Major: Environmental Resource Engineering
  - Minor: Chemistry
  - Senior Capstone Project: Design of a Wastewater Treatment Plant for the Mad River Brewery

## Experience

- **Research Assistant Professor – University of North Carolina at Chapel Hill**
  - March 2023 - current
- **Postdoctoral Research Associate – University of North Carolina at Chapel Hill**
  - November 2022 - February 2023
  - Parallel morphological and topological toolkit
  - Symbolic regression for model closure
- **Postdoctoral Fellow – Oak Ridge Institute for Science and Education**
  - February 2020 - November 2022
  - Physics-informed machine learning approaches for fluid dynamics
  - Reduced order modeling methodologies for saltwater intrusion in coastal areas
  - Multiphysics partitioning approaches for 2D/3D shallow water applications and integrated hydrologic modeling
- **Research Fellow – University of North Carolina at Chapel Hill**
  - February 2020 - November 2022
  - Molecular scale simulations and morphological and topological analysis of polyamide membranes
  - Closure approximations for non-dilute flow and transport in porous media
- **Research Assistant – University of North Carolina at Chapel Hill**
  - August 2012 - February 2020
  - Thermodynamically Constrained Averaging Theory (TCAT) with applications to groundwater supply, environmental remediation, CO<sub>2</sub> sequestration, hydraulic fracturing and tumor growth
  - Advanced numerical methods (finite elements, entropy production, adaptive grid) for environmental models
- **Project Engineer – RMC Water and Environment**
  - September 2010 - January 2012
  - Maintained and further developed several integrated water resources models (IGSM, IWRM, and ArcIGSM).
  - Groundwater resources studies in the Central Valley of California with Integrated Groundwater and Surface Water Model (IGSM)
  - Three California Department of Water Resources Integrated Regional Water Management Grant Applications (Prop 1E, Prop 84 Planning and Prop 84 Implementation) successfully earning a combined total of \$26.6 million (fully funded)

- **Graduate Student Researcher – University of California, Los Angeles**

- September 2009 - June 2010
- Principal Investigator: Eric M.V. Hoek
  - Modeling of biofilms on reverse osmosis membranes
- Principal Investigators: Shaily Mahendra and Michael Stenstrom
  - Biodegradation of PFOS and PFOA in groundwater

- **Water Quality Research Assistant – Humboldt State University**

- May 2008 - June 2009
- Principal Investigators: Brad Finney and Robert Gearheart
- Feasibility of UV disinfection at the Arcata WWTP

**Teaching/Mentoring Experience**

- **Teaching Assistant – University of North Carolina at Chapel Hill**

- Courses: Environmental Physics I and II, Numerical Methods, Groundwater Hydrology
- Seminar: Introduction to Latex

- **Graduate Student Instructor – University of California, Los Angeles**

- Course: Introduction to Probability and Statistics for Engineers

- **Teaching Assistant – Humboldt State University**

- Courses: Computational Methods for Environmental Engineering I,II, & III, Systems Analysis, Groundwater Hydrology

- **Student Advising – University of North Carolina at Chapel Hill**

- Thomas M. Nelson (2020-current): PhD Committee, On the Macroscale Modeling of Two-Fluid Flow in Porous Medium Systems Using the Thermodynamically Constrained Averaging Theory
- Riley Vickers (2018-current): PhD Committee, Molecular Dynamics Simulation of Membrane Synthesis and Transport Phenomena
- Eliza Harrison (2017): Evaluation and Validation of a TCAT Model to Describe Non-Dilute Flow and Species Transport in Porous Media

- **Advising – Statistical and Applied Mathematical Sciences Institute**

- Industrial Mathematical and Statistical Modeling Workshop for Graduate Students
- Advised graduate students in week long workshop designed to expose students to real-world problems and collaborative work (2013-2016)

**Relevant Professional Service**

- Computer Applications in Engineering Education - Peer Reviewer (2015 - 2018)
- Consortium for Mathematics and Its Applications (COMAP) Mathematical Contest in Modeling - Reviewer/Judge (2020 - current)

**Publications**

- Weigand, T. M., Farthing, M. W., & Miller, C. T. (2022). Groundwater Models. In D. Whittington (Ed.), *Encyclopedia of water resources management and policy*. Oxford University Press.
- Weigand, T. M., Farthing, M. W., Kees, C. E., & Miller, C. T. (2021). A physically-based entropy production rate method to simulate sharp-front transport problems in porous medium systems. *Computational Geosciences*, 25(3), 1047–1061.
- Weigand, T. M., & Miller, C. T. (2020). Microscale modeling of nondilute flow and transport in porous medium systems. *Physical Review E*, 102, 033104.
- Weigand, T. M., Schultz, P. B., Giffen, D. H., Farthing, M. W., Crockett, A., Kelley, C. T., ... Miller, C. T. (2018). Modeling nondilute species transport using the thermodynamically constrained averaging theory. *Water Resources Research*, 54(9), 6656–6682.
- Hoek, E., Weigand, T. M., & Edalat, A. (2022). Reverse osmosis membrane biofouling: causes, consequences and countermeasures. *npj Clean Water*, 5(1), 1–16.
- Vickers, R., Weigand, T. M., Miller, C. T., & Coronell, O. (2022). Molecular methods for assessing the morphology, topology, and performance of polyamide membranes. *Journal of Membrane Science*, 644, 120110.

- Hauswirth, S. C., Bowers, C. A., Fowler, C. P., Schultz, P. B., Hauswirth, A. D., Weigand, T., & Miller, C. T. (2020). Modeling cross model non-newtonian fluid flow in porous media. *Journal of Contaminant Hydrology*, 235, 103708.
- Lin, L., Weigand, T. M., Farthing, M. W., Jutaporn, P., Miller, C. T., & Coronell, O. (2018). Relative importance of geometrical and intrinsic water transport properties of active layers in the water permeability of polyamide thin-film composite membranes. *Journal of Membrane Science*, 564, 935-944.
- Miller, C. T., Farthing, M. W., Kees, C. E., Dye, A. L., Weigand, T. M., Schultz, P. B., & Adalsteinsson, D. (2015). Groundwater modeling. In J. H. Cushman & D. M. Tartakovsky (Eds.), *Handbook of groundwater modeling*. CRC Press.

#### **Selected Conference Presentations**

- Weigand, T.M., Farthing, M.W., Kees, C., Miller, C.T. (2013) Evaluation of Proteus as a Tool for the Rapid Development of Models of Hydrologic Systems. American Geophysical Union 2013 Fall Meeting, San Francisco, CA
- Ramon, G.Z, Weigand, T.M, Hoek, E.M.V. (2013) Modeling the Effects of Biofouling On Full-Scale Reverse Osmosis Desalination: Spacer Clogging Or Membrane Fouling? North American Membrane Society Annual Meeting, Boise, Idaho
- Weigand, T.M., Dye, A., McClure, J., Gray, W.G., Miller, C.T. (2014) Simulation of Two-Phase Flow Based on a Thermodynamically Constrained Averaging Theory Flow Model. Computational Methods in Water Resources 2014 Meeting, Stuttgart, Germany
- Weigand, T.M., Dye, A., Farthing, M.W., McClure, J., Gray, W.G., Miller, C.T. (2014) Simulation of Two-Phase Flow Based on a Thermodynamically Constrained Averaging Theory Flow Model. American Geophysical Union 2014 Fall Meeting, San Francisco, CA
- Miller, C.T., A.L. Dye, T.M. Weigand, J.E. McClure, and W.G. Gray (2015) Multiscale Analysis of Two-Fluid-Phase Flow in Porous Medium Systems, 7th International Conference on Porous Media, Padova, Italy, 18-21 May 2015.
- Miller, C.T., W.G. Gray, J.E. McClure, A.L. Dye, T.M. Weigand, S.C. Hauswirth, and P.B. Schultz (2015) Development, Application, and Validation of Thermodynamically Constrained Averaging Theory Models of Porous Medium Systems, Abstract H11J-01. American Geophysical Union Fall Meeting, San Francisco, California, 14-18 December 2015.
- Weigand, T.M., C.T. Miller, A.L. Dye, W.G. Gray, J.E. McClure, and I. Rybak (2015) Themodynamically Constrained Averaging Theory (TCAT) Two-Phase Flow Model: Derivation, Closure, and Simulation Results, Abstract H41D-1347. American Geophysical Union Fall Meeting, San Francisco, California, 14-18 December 2015.
- Weigand, T.M., P.B. Schultz, D.H. Giffen, C.T. Kelley, and C.T. Miller (2016) Modeling of Density-Dependent Flow Based on the Thermodynamically Constrained Averaging Theory. XXI International Conference on Computational Methods in Water Resources, CMWR 2016, Toronto, Canada, 20-24 June 2016.
- Weigand, T.M., P.B. Schultz, C.T. Kelley, C.T. Miller, and W.G. Gray (2016) Modeling of Density-Dependent Flow Based on the Thermodynamically Constrained Averaging Theory, Abstract H13H-1501. American Geophysical Union Fall Meeting, San Francisco, California, 12-16 December 2016.
- Weigand, T.M., E. Harrison, and C.T. Miller (2017) Evaluation and Validation of a TCAT Model to Describe Non-Dilute Flow and Species Transport in Porous Media, Abstract H11F-1244. American Geophysical Union Fall Meeting, New Orleans, Louisiana, 11-15 December 2017.
- Weigand, T.M., M.Q. de Luna, M.W. Farthing, C.E. Kees, and C.T. Miller (2018) A Fully Second Order Entropy Viscosity Model for Species Transport in Porous Media, Society for Industrial and Applied Mathematics, 42nd Southeastern Atlantic SIAM Conference, Chapel Hill, North Carolina, 9-11 March 2018.
- Weigand, T.M., M.Q. de Luna, M.W. Farthing, C.E. Kees, and C.T. Miller (2018) Entropy Viscosity Methods and Thermodynamically Constrained Averaging Theory for Non-Dilute Transport, Abstract H22F-05. American Geophysical Union Fall Meeting, Washington D.C, 10-14 December 2018.
- Weigand, T.M. and C.T. Miller (2018) Microscale Simulations of Non-Dilute Flow and Transport in Porous Media, Abstract H33T-2329. American Geophysical Union Fall Meeting, Washington D.C, 10-14 December 2018.

- Weigand, T.M., M.W. Farthing, and C.T. Miller (2019) The use of Entropy Production for Non-dilute Flow and Transport Models, SIAM Conference on Mathematical & Computational Issues in the Geosciences (GS19), Houston, Texas, 11-14 March 2019.
- Vickers, R., Wang, J., Weigand, T.M., Miller, C.T., Coronell, O. (2019) 'Estimating salt diffusion coefficients in polyamide active layers of reverse osmosis membranes using microscale continuum modeling' Presented at the 2019 North American Membrane Society Annual Meeting, Pittsburgh, PA, May 11-15, 2019.
- Weigand, T.M., M.W. Farthing, and C.T. Miller (2020) Microscale Modeling of Non-Dilute Flow and Transport, Abstract H13R-2020. American Geophysical Union Fall Meeting, San Francisco, California, 9-13 December 2020.
- Vickers, R., Weigand, T. M., Miller, C. T., Coronell, O. (2020) Estimating Fluid Pressure Gradients within Crosslinked Aromatic Polyamide Using Molecular Dynamics. Presented at the 2020 North American Membrane Society Annual Meeting, Online, May 18-21, 2020.
- Vickers, R., Weigand, T. M., Miller, C. T., Coronell, O. (2020) Molecular Dynamics Simulations of Water Transport through Crosslinked Aromatic Polyamide Reverse Osmosis Membranes. Presented at the National Institute of Environmental Health Sciences Superfund Research Program Annual Meeting, Online, December 14-15, 2020.
- Vickers, R., Weigand, T. M., Miller, C. T., Coronell, O. (2020) Estimating Pressure Gradients within Crosslinked Aromatic Polyamide during Water and Solute Transport Using Molecular Dynamics. Presented at the International Congress on Membranes and Membrane Processes, Online, December 7-11, 2020.
- Vickers, R., Weigand, T.M.; Miller, C.T., Coronell, O. (2021) Molecular Dynamics Simulation Methods for Assessing Hydration and Performance of Polyamide Active Layers. Presented at the 2021 North American Membrane Society Annual Meeting, Estes Park, CO, August 28-September 2, 2021.