

Steffen Mehl

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EDUCATION

PhD 2003, University of Colorado, Boulder, Department of Civil, Environmental, and Architectural Engineering, Water Resources Engineering Program – Dissertation topic: Development and Evaluation of Local Grid Refinement Methods for Forward and Inverse Groundwater Models

M.S., 1998, University of Colorado, Boulder, Department of Civil, Environmental, and Architectural Engineering, Water Resources Engineering Program

B.S., 1996, Humboldt State University, Environmental Resources Engineering, Emphasis in Hazardous Waste

RESEARCH INTERESTS

Flow and transport modeling in hydrologic systems
Simulation of surface water-groundwater interactions
Parameter estimation and uncertainty analysis in hydrologic systems
Computational methods for solving engineering problems

HONORS AND AWARDS

2014 – ASCE Sacramento Section Faculty Advisor of the Year.
2003 University of Colorado Fellowship
1999 – 2000 NSF Graduate Research Traineeship in Hydrology
1991 Academic Performance Award, College of Natural Sciences, California State University, Chico

POSITIONS HELD

2014 – present, Professor, Department of Civil Engineering, CSU Chico, CA
2010 – 2014, Associate Professor, Department of Civil Engineering, CSU Chico, CA
2007 – 2010, Assistant Professor, Department of Civil Engineering, CSU Chico, CA
2007 – 2014, Hydrologist, WAE appointment, U.S. Geological Survey, Boulder, CO
2003 – 2006, Hydrologist, term appointment, U.S. Geological Survey, Boulder, CO
1997 – 2003, Hydrologist, student appointment, U.S. Geological Survey, Boulder, CO
1997 – 2003, Research Assistant, University of Colorado, Boulder, Department of Civil, Environmental and Architectural Engineering
1998 – 1999 Teaching Assistant, Department of Civil, Environmental and Architectural Engineering: Groundwater Engineering/Hydrology; Probability, Statistics and Decision for Civil Engineers; Water Resources Engineering Design

PROFESSIONAL ACTIVITIES

2004 – present, Member of the board of associate editors for Ground Water
2016, Co-convener, CWEMF Meeting – Sustainable Groundwater Management.
2015, Co-convener, CWEMF Meeting – Sustainable Groundwater Management.
2001, Co-convener, AGU Fall Meeting – Formulation, construction, and application of local-scale models of saturated groundwater flow and transport: Difficulties and solutions
2000 – 2003, Coordinator for the department Hydrologic Sciences and Water Resources Engineering Seminar Series
EIT License XE099100

PEER REVIEWED PUBLICATIONS

- De Filippis, G., Foglia, L., Giudici, M., **Mehl, S.**, Margiotta, S. and Negri, S. (Accepted) Seawater intrusion in karst, coastal aquifers: current challenges and future scenarios in the Taranto area (southern Italy), *Science of the Total Environment*.
- Morel-Seytoux, H., Miracapillo, C., **Mehl, S.**, 2016. Impact of aquifer desaturation on steady-state river seepage, *Advances in Water Resources*, 88:21-31, DOI:10.1016/j.advwatres.2015.09.012.
- Hill, Mary C., Kavetski D., Clark M., Ye M., Arabi M., Lu D., Foglia L., **Mehl S.**, 2016, Practical Use of Computationally Frugal Model Analysis Methods, *Groundwater*, 54(2):159-170, DOI: 10.1111/gwat.12330.
- Davids, J. and **Mehl, S.**, 2015, Sustainable Capture: Concepts for Managing Stream-Aquifer Systems, *Groundwater*, 53(6):851-858, DOI: 10.1111/gwat.12297.
- Foglia, L., and **S.W., Mehl**, 2015, The role of regression performance on multimodel analysis, *Groundwater*, 52(1): 130-139, doi: 10.1111/gwat.12144.
- Poeter, Eileen P., Mary C. Hill, Dan Lu, Claire R. Tiedeman, and Steffen **Mehl**, 2014, UCODE_2014, with new capabilities to define parameters unique to predictions, calculate weights using simulated values, estimate parameters with SVD, evaluate uncertainty with MCMC, and More: Integrated Groundwater Modeling Center Report Number GWMI 2014-02.
- Hanson, R.T., Boyce, S.E., Schmid, Wolfgang, Hughes, J.D., **Mehl, S.**, Leake, S.A., Maddock, Thomas, III, and Niswonger, R.G., 2014, One-Water Hydrologic Flow Model (MODFLOW-OVHM): U.S. Geological Survey Techniques and Methods 6–A51, 120 p., <http://dx.doi.org/10.3133/tm6A51>
- Morel-Seytoux, H., **Mehl, S.**, and Morgado, K., 2013, Factors Influencing the Stream-Aquifer Flow Exchange Coefficient, *Groundwater*, 49(5): 775-781. doi: 10.1111/gwat.12112.
- Mehl, S.W., and Mary C. Hill, 2013, MODFLOW–LGR— Documentation of Ghost Node Local Grid Refinement (LGR2) for Multiple Areas and the Boundary Flow and Head (BFH2) Package: U.S. Geological Survey Techniques and Methods 6-A44, 43 p.
- Foglia, L., **S. W. Mehl**, M. C. Hill, and P. Burlando (2013), Evaluating model structure adequacy: The case of the Maggia Valley groundwater system, southern Switzerland, *Water Resour. Res.*, 49, doi:10.1029/2011WR011779.
- Hanson, R.T., Kauffman, L.K., Hill, M.C., Dickinson, J.E., and **Mehl, S.W.**, 2013, Advective transport observations with MODPATH-OBS—Documentation of the MODPATH observation process, using four types of observations and Predictions: U.S. Geological Survey Techniques and Methods book 6–chap. A42, 94 p.
- Dickinson, J.E., Hanson, R.T., **Mehl, S.W.**, and Hill, M.C., 2011, MODPATH-LGR— Documentation of a computer program for particle tracking in shared-node locally refined grids by using MODFLOW-LGR: U.S. Geological Survey Techniques and Methods 6-A38, 42 p.
- Vilhelmsen, T.N., Christensen, C., and **Mehl, S.** (2011), Evaluation of two versions of MODFLOW-LGR to simulate regional-scale groundwater flow in a synthetic buried valley aquifer system, *Ground Water*, 50(1): 118-132, doi: 10.1111/j.1745-6584.2011.00826.x
- Mehl, S.W. and Hill, M.C. 2011, MODFLOW-LGR, Modifications to the Streamflow-Routing Package (SFR2) to route streamflow through locally refined grids: U.S. Geological Survey Techniques and Methods 6-A34.
- Mehl, S. and Hill, M.C. 2010, Grid-size dependence of Cauchy boundary conditions used to simulate stream-aquifer interactions, *Advances in Water Resources*, 33(4):430-442, doi:10.1016/j.advwatres.2010.01.008.

- Foglia, L., Hill, M.C., **Mehl, S.**, and Burlando, P., 2009, Sensitivity analysis, calibration, and testing of a distributed hydrological model using error-based weighting and one objective function, *Water Resources Research*, 45, W06427, doi:10.1029/2008WR007255.
- Mehl, S., 2007, Forward model nonlinearity versus inverse model nonlinearity, *Ground Water*, 45(6): 791-794.
- Mehl, S., and Hill, M.C., 2007, MODFLOW-2005, The U.S. Geological Survey Modular Ground-Water Model – Documentation of the multiple-refined-areas capability of local grid refinement (LGR) and the boundary flow and head package (BFH): U.S. Geological Survey Techniques and Methods 6-A21.
- Dickinson, J.E., James, S.C., **Mehl, S.**, Hill, M.C., Leake, S.A., Zyvoloski, G.A., Faunt, C.C., and Eddebbarh, A., 2007, A new ghost-node method for linking different models and initial investigations of heterogeneity and nonmatching grids, *Advances in Water Resources*, 30:1722-1736.
- Foglia, L., **Mehl, S.**, Hill, M.C., Perona, P. and Burlando, P. 2007, Testing Alternative Ground Water Models Using Cross-Validation and Other Methods, *Ground Water*, 45(5):627-641.
- Mehl, S., Hill, M.C., and Leake, S.A., 2006, Local Grid Refinement Methods for Modflow. *Ground Water*, 44(6):792-796.
- Mehl, S. 2006, Use of Picard and Newton Iteration for Solving Nonlinear Ground-Water Flow Equations, *Ground Water*, 44(4): 583-594.
- Mehl, S., and Hill, M.C., 2005, MODFLOW-2005, The U.S. Geological Survey Modular Ground-Water Model – Documentation of shared node Local Grid Refinement (LGR) and the Boundary Flow and Head (BFH) Package, U.S. Geological Survey Techniques and Methods 6-A12.
- Poeter, E., Hill, M.C., Banta, E. R., **Mehl, S.**, and Christensen, 2005, UCODE_2005 and six other computer codes for universal sensitivity analysis, calibration, and uncertainty evaluation: U.S. Geological Survey Techniques and Methods 6-A11.
- Mehl, S. and Hill, M.C. 2004, Three-Dimensional Local Grid Refinement for Block-Centered Finite-Difference Groundwater Models Using Iteratively Coupled Shared Nodes: A new method of interpolation and analysis of errors, *Advances in Water Resources*, .27(9): 899-912.
- Mehl, S. and Hill, M.C., 2002, Development and evaluation of a local grid refinement method for block-centered finite-difference groundwater models using shared nodes, *Advances in Water Resources*, 25(5): 497-511.
- Detwiler, R.L., **Mehl, S.**, Rajaram, H., and Cheung, W.W., 2002, Comparison of an algebraic multigrid algorithm to two iterative solvers used for modeling groundwater flow and transport, *Ground Water*, 40(3): 267-272.
- Mehl, S.W., and Hill, M.C., 2001, MODFLOW-2000, The U.S. Geological Survey Modular Ground-Water Model - User Guide to the Link-AMG (LMG) Package for Solving Matrix Equations Using an Algebraic Multigrid Solver: U.S. Geological Survey Open-File Report 01-177, 33 p.
- Mehl, S. and Hill, M.C., 2001, A Comparison of Solute-Transport Solution Techniques and Their Effect on Sensitivity Analysis and Inverse Modeling Results, *Ground Water*, 39(2): 300-307.

Publications Under Review

- Morel-Seytoux, H., Miller, C., Miracapillo, C., and **Mehl, S.** River seepage conductance in large-scale regional studies. Submitted to *Groundwater*.

Conference Publications

- Foglia, L., **Mehl, S.W.**, Hill, M.C., Perona, P., Burlando, P. (2010), Identifying important observations using crossvalidation and computationally frugal sensitivity analysis methods, *Procedia – Social and Behavioral Sciences*, Vol. 2, no.6, p.7650-7651, Sixth International Conference on Sensitivity Analysis of Model Output, Milan.

- Hill, M.C., L. Foglia, G. Barth. **S. Mehl**, P. Burlando (2006), Exploring models and data using sensitivity analysis: in Kovar, K, Hrkal, Z., and Bruthans, J., Proceedings of the HydreEco2006 international conference on hydrology and ecology, the groundwater/ecology connection, p. 207-212.
- Mehl, S. and Hill, M.C. 2003, Locally refined block-centered finite-difference groundwater models: evaluation of parameter sensitivity and the consequences for inverse modeling: in K. Kovar and Z. Hrkal, eds, Calibration and Reliability in Groundwater Modelling: A few steps closer to reality, IAHS Publication no. 277, p. 227-232. (This is a refereed publication).
- Mehl, S. and Hill, M.C., 2002, Evaluation of a local grid refinement method for steady-state block-centered finite-difference groundwater models, Computational Methods in Water Resources XIV, June, 23-28, 2002, Delft, Netherlands, Volume 1, 367-374.

PRESENTATIONS and POSTERS

- Mehl, S;** E. Houk; K. Morgado; K. Anderson; N. Reid. Can California Groundwater be Sustainably Managed with Agricultural Water Transfers? Effects on Aquifer Declines, Energy, and Food Production. Toward Sustainable Groundwater in Agriculture - An International Conference Linking Science and Policy, June 28-30, 2016.
- Eric Houk and **S. Mehl**. Water Transfers from Agriculture: Estimating the Impact of Foregone Production and Aquifer Decline in Northern California. International Society for Ecological Economics (ISEE) Annual Meeting. June 26-29, 2016.
- Eric Houk and **S. Mehl**. Impact of Land Fallowing on Agricultural Production and Aquifer Levels in Northern California. Western Economic Association International (WEAI) Annual Meeting. June 29-July 3, 2016.
- De Filippis, G., Foglia, L., Giudici, M., **Mehl, S.**, Margiotta, S. and Negri, S. 2016, Joining direct and indirect inverse calibration methods to characterize karst, coastal aquifers. European Geophysical Union General Assembly.
- Davids, J., Rutten, M., van de Giesen, N., **Mehl, S.**, and Norris, J. 2016, Citizen Hydrology - Tradeoffs between Traditional Continuous Approaches and Temporally Discrete Hydrologic Monitoring, European Geophysical Union General Assembly.
- Mehl, S;** E. Houk; K. Morgado; K. Anderson; N. Reid. "Effects of Agricultural Water Transfers in Northern California on Aquifer Declines, Energy, and Food Production." California Water and Environmental Modeling Forum (CWEMF) 2016 Annual Meeting. Published abstract in conference proceedings. April 11-13, 2016.
- Morel-Seytoux, H., Miracapillo, C., **Mehl, S.**, and Miller, C. A simple, rigorous, and accurate estimation for MODFLOW'S CRIV. California Water and Environmental Modeling Forum (CWEMF) 2016 Annual Meeting. Published abstract in conference proceedings. April 11-13, 2016.
- Anderson, K; E. Houk, and **S. Mehl**. "Modeled effects of rice field fallowing on groundwater systems in the Sacramento Valley". California State University (CSU) Council on Ocean Affairs, Science and Technology (COAST) and Water Resources and Policy Initiatives (WRPI) Student Research Poster Reception. Long Beach, CA. March 8, 2016.
- Foglia, L., Borsi, I., Cannata, M., Velasco, V., **Mehl, S.**, Rossetto, R. 2016, FREEWAT, a HORIZON 2020 Project to Build Open Source Tools for Water Management: A European Perspective., Groundwater Resources Association – Role of Models and Data in Implementing SGMA, UC Davis, February, 2016, Poster.
- Mehl, S. and Davids, J. 2015 Groundwater Storage vs. Surface Water Storage – Why Sustainability Requires a Different Management Framework, Fall AGU Meeting.
- Foglia, L., Borsi, I., Cannata, M., Velasco, V., **Mehl, S.**, Rossetto, R. 2015 FREEWAT: an HORIZON 2020 project to build open source tools for water management, Poster Fall AGU Meeting.

- Mehl, S., Houk, E., Morgado, K., Reid, N., and Anderson, K., 2015 Agricultural Water Transfers in Northern California: Effects on Aquifer Declines, Energy, and Food Production, Modflow and More 2015 conference.
- Davids, J. and Mehl, S., 2015. Sustainable Capture. Pop-up talk at CWEMF conference, Natomas, CA, March 9, 2015
- Houk, E. and Mehl, S., 2015. Water Transfers From Agriculture: Estimating the Impact of Foregone Production and Aquifer Decline in Northern California. WRPI Conference, Fresno, CA, April 9, 2015.
- Houk, E. and **Mehl, S.**, 2014. Making every drop count. Display at the Gateway Science Museum.
- Houk, E., Mehl, S., and Morgado, K. 2014. Groundwater Substitution Transfers: Modeling the Spatial and Temporal Distribution of Groundwater Pumping Cost Externalities. Western Agricultural Economics Association Meeting. Colorado Springs, CO. June 22-24, 2014.
- Davids, J. and Mehl, S., Davids, G., 2014. Sustainable Capture Fractions, Sustainable Capture Thresholds, Capture Efficiency, and Sustainable Groundwater Storage: Concepts for Managing Stream-Aquifer Systems, USCID Conference, March, 2014.
- Morgado, K.; **S. Mehl**; and E. Houk. "Effects of Large Scale Groundwater Pumping on Groundwater Elevations in the Sacramento Valley." Poster at the Groundwater Resources Association (GRA) 29th Biennial Groundwater Conference and 22nd Annual Meeting. Sacramento, CA. October 8-9, 2013
- Davids, J. and **Mehl, S.**, 2013, Defining Capture Thresholds for Sustainable Groundwater Management of Interconnected Stream-Aquifer Systems, MODFLOW and More 2013 conference.
- Mehl, S.**; K. Morgado; and E. Houk. "Effects of Groundwater Pumping for Water Transfers on Groundwater Elevations in the Sacramento Valley." Center for Water and the Environment Showcase, Gateway Science Museum. April 19, 2013.
- Foglia, L., **Mehl, S.W.**, Hill, M.C., Burlando, P. 2013. Processes, observations and parameters in a coupled surface water-groundwater model, European Geosciences Union, Geophysical Research Abstracts Vol. 15, EGU2013-12842.
- Mehl, S. 2012, Solving Coupled Groundwater Flow Systems using a Jacobian Free Newton Krylov Method, Fall AGU Meeting.
- Mehl, S. and Davids, J, 2011, Analysis of stream restoration efforts in depleted aquifer systems, MODFLOW and More 2011 conference.
- Hanson, R.T., Schmid, W, Leake, S.A., **Mehl, S.W.**, Niswonger, R.G., Hughes, J.D., and Maddock III, T., 2011, Enhancements in MODFLOW with the Farm Process (MF-FMP) for Conjunctive-Use Analysis, MODFLOW and More 2011 conference.
- Langevin, C, Panday, S, Niswonger, R.G., Hughes, J.D., Ibaraki, M., and **Mehl, S.**, 2011, Local Grid Refinement with an Unstructured Grid Version of MODFLOW, MODFLOW and More 2011 conference.
- Davids, J. and **Mehl, S.**, 2011, Spatial and Temporal Analysis of Stream Restoration Efforts in Depleted Aquifer Systems, Groundwater Resources Association of California, 7th Symposium in the Groundwater Resource Series, Sacramento, CA, Poster.
- Davids, J. and **Mehl, S.**, 2010, The Timing, Spatial Extent and Magnitude of Fishery Benefits Obtained From Re-watering Interconnected Stream-Aquifer Systems Depleted by Historical Diversions and Pumping, AGU Fall Meeting.
- Mehl, S., 2010, New Capabilities for Local Grid Refinement. USGS National Training Center Course on Advanced Ground-Water Modeling, November 17, 2010, Denver, CO.
- Foglia, L., Hill, M.C., **Mehl, S.** Burlando, P., (2010) Using Multiple Alternative Models and Local Sensitivity Analysis to Evaluate and Understand Uncertainty (invited), Proceedings of the 2010 Computational Methods in Water Resources conference, Barcelona, June 21-24 2010.

- Mehl, S., Foglia, L., Hill, M.C., (2010), Analysis of linear and nonlinear methods for investigating inverse modeling results, Proceedings of the 2010 Computational Methods in Water Resources conference, Barcelona, June 21-24 2010.
- Mehl, S. (2010), Effects of the Forward Model Nonlinearity on the Inverse Model Solution, USGS Modeling Conference, June 8-11, Broomfield, CO, Poster.
- Foglia, L., **Mehl, S.W.**, Hill, M.C., Perona, P., Burlando, P. (2010), Identifying important observations using crossvalidation and computationally frugal sensitivity analysis methods, Sixth International Conference on Sensitivity Analysis of Model Output, Milan, 19-22 July.
- Mehl, S., L. Foglia, and M.C. Hill, 2009, Comparison of Computationally Frugal (linear) to Expensive (nonlinear) Methods for Analyzing Inverse Modeling Results, AGU Fall Meeting.
- L. Foglia, M.C. Hill, and **S.W. Mehl**, 2009, Multi-model analysis to evaluate the importance of different recharge representations in a coupled hydrological/groundwater model, AGU Fall Meeting.
- Hill, M.C., Foglia, L., **Mehl, S.W.** (2009) Issues of model accuracy and uncertainty evaluation in the context of multi-model analysis, AGU Fall Meeting.
- L. Foglia, **S.W. Mehl**, M.C. Hill, and P. Burlando, 2009, Use of model discrimination techniques to improve hydrologic models under ecological constraints: the case of the Maggia Valley, Southern Switzerland. European Geosciences Union, General Assembly, Vienna.
- Mehl, S., 2008, Coupling MODFLOW-LGR with SFR to represent stream-aquifer interactions, MODFLOW and More 2008, MODFLOW and More 2006 conference.
- Dickenson, J.E., **Mehl, S.**, Hanson, R.T., and Hill, M.C., 2008, A method to simulate advective transport in embedded models, MODFLOW and More 2008 conference.
- Mehl, S., and Foglia, L., 2008, Do more with sensitivity and uncertainty analysis with less effort: Introduction to automated inverse modeling tools with practical examples, CWEMF Conference, Invited talk.
- Mehl, S., Dickinson, J.E., Hanson, R.T., and Hill, M.C., 2007, Simulating advective transport using locally refined grids, AGU Fall Meeting, Poster.
- Mehl, S., Faunt, C., Laczniaik, R., Li, Z., and Hill, M.C., 2006, Examination of ground-water pumping effects using regional-scale and locally refined grids, MODFLOW and More 2006 conference.
- Foglia, L., **Mehl, S.W.**, Hill, M.C., Burlando, P. (2006): Use of cross validation to analyze predictive capabilities of alternative groundwater models, MODFLOW and More 2006 conference.
- Mehl, S., Faunt, C., Laczniaik, R., Li, Z., and Hill, M.C., 2006, Evaluation of ground water pumping effects in the Death Valley regional model using regional and locally refined grids, Devil's Hole Workshop.
- Foglia, L., Hill, M.C., **Mehl, S.W.**, Burlando, P. (2005): Calibration, sensitivity and uncertainty analysis of a groundwater model with variable recharge estimated by a distributed rainfall-runoff model, ModelCARE 2005, The Hague, The Netherlands, 6-9 June 2005.
- Foglia, L., Hill, M.C., **Mehl, S.W.**, Birsan, M.V., Burlando, P. (2004): A Modelling Framework to Simulate the Dynamics of the Groundwater, Hydrologic, and Ecologic System in an Alpine floodplain; American Geophysical Union, San Francisco, 13-17 December 2004, Poster.
- Mehl, S. and Hill, M.C., 2004, Simulating Stream-Aquifer Interactions. AGU Fall Meeting.
- Foglia, L., Hill, M.C., **Mehl, S.W.**, Burlando, P. (2004): Evaluation of simulated river-aquifer interactions using sensitivity and cross-validation methods; 32nd International Geological Congress (32IGC), Florence, Italy, August 20 to 28, 2004
- Mehl, S. and Hill, M.C., 2003, Comparison of Three-dimensional Local Grid Refinement Methods for Simulating Stream-Aquifer Interactions. AGU Fall Meeting, Poster.
- Mehl, S. and Hill, M.C., 2003, Local Grid Refinement Methods For MODFLOW: The Good, the Bad, and the Ugly. MODFLOW and More 2003 Conference.

- Mehl, S. and Hill, M.C., 2001, Evaluation of Local Grid Refinement Methods for Block-Centered Finite-Difference Groundwater Models. AGU Fall Meeting, poster.
- Mehl, S. and Hill, M.C., 2000, Link-AMG (LMG): Solving Matrix Equations with an Algebraic Multigrid Solver. USGS National Training Center Course on Advanced Ground-Water Modeling, November 1, 2000, Denver, CO.

PROFESSIONAL SOCIETIES

American Geophysical Union
International Association of Hydrologic Sciences
American Society of Civil Engineers
Groundwater Resources Association of California