

HOLLY A. MICHAEL

Department of Geological Sciences • College of Earth, Ocean, and Environment • University of Delaware
101A Penny Hall • 255 Academy Street • Newark, DE 19716 • (302) 831-4197 • hmichael@udel.edu

EDUCATION

- Massachusetts Institute of Technology** Cambridge, MA
Ph.D., Hydrology, February 2005
Department of Civil and Environmental Engineering
- University of Notre Dame** Notre Dame, IN
B.S., Civil Engineering, Summa Cum Laude, June 1998
Department of Civil Engineering and Geological Sciences
-

EXPERIENCE

- University of Delaware** Newark, DE
Associate Professor, Department of Geological Sciences (May 2014-present)
Unidel Fraser Russell Chair for the Environment (September 2013-present)
Assistant Professor, Department of Geological Sciences (September 2008 – present)
Joint Faculty, Department of Civil and Environmental Engineering
Joint Faculty, Department of Geography
Joint Faculty, School of Marine Science and Policy
- Flinders University** Adelaide, Australia
Visiting Professor, School of Earth Sciences (October 2014-present)
- Stanford University** Stanford, CA
Postdoctoral Researcher, Departments of Geological and Environmental Sciences and Energy Resources Engineering (January 2007-August 2008)
- United States Geological Survey** Reston, VA
National Academy of Sciences Postdoctoral Research Associate (December 2004 –December 2006)
-

RESEARCH INTERESTS

- Coastal groundwater dynamics
 - Submarine groundwater discharge and associated chemical fluxes
 - Groundwater-surface water interaction
 - Groundwater flow and solute transport modeling
 - Water supply sustainability
 - Water resources in developing countries
 - Geostatistical modeling of subsurface heterogeneity
 - Hydro-economics
-

HONORS and AWARDS

- National Academy of Engineering Kavli Fellow (2014)
- Unidel Fraser Russell Chair for the Environment, University of Delaware (2013)
- National Science Foundation CAREER Award (2012)

- National Academy of Sciences Kavli Fellow (2012)
- Distinguished Oliver Lecturer, Jackson School of Geosciences, University of Texas (2011)
- Oak Ridge Associated Universities Ralph E. Powe Junior Faculty Award (2010)
- National Research Council RAP Postdoctoral Research Fellowship (2004-2006)
- National Science Foundation Graduate Research Fellowship (1998-2002)
- Massachusetts Institute of Technology Hydrology Fellowship (2001)
- Thomas A. Steiner Prize for excellence in the Notre Dame College of Engineering (1998)
- Walter L. Shilts Award for undergraduate achievement in Civil Engineering (1998)

Italics denote University of Delaware student or postdoctoral researcher

PUBLICATIONS

*corresponding author

Submitted

Knappett, PSK*, BJ Mailloux, I Choudhury, *MR Khan*, **HA Michael**, S Barua, DR Mondal, MS Steckler, H Akhter, KM Ahmed, B Bostick, CF Harvey, M Shamsudduha, I Mihajlov, MR Mozumder, and A van Geen, Vulnerability of intermediate and deep low-arsenic aquifers to municipal pumping in Bangladesh, *Environmental Science and Technology*, revised manuscript submitted.

Published or In Press

*McAllister, SM, JM Barnett, JW Heiss, AJ Findlay, DJ MacDonald, CL Dow, GW Luther III, HA Michael, and CS Chan**, Dynamic hydrologic and biogeochemical processes drive microbially enhanced iron and sulfur cycling within the intertidal mixing zone of a beach aquifer, *Limnology & Oceanography*, in press.

*Russoniello, CJ and HA Michael** (2014) Investigation of seepage meter measurements in steady flow and wave conditions, *Groundwater*, doi: 10.1111/gwat.12302.

*Heiss, JW and HA Michael** (2014) Saltwater-freshwater mixing dynamics in a sandy beach aquifer on tidal, spring-neap, and seasonal cycles, *Water Resources Research*, doi: 10.1002/2014WR015574. (Selected for EOS Research Spotlight, forthcoming)

Liu, Z, KD Messer, JM Duke, HA Michael, and JF Suter* (2014) Strategic entry and externalities in groundwater resources: Evidence from the lab, *Resource and Energy Economics*, 10.1016/j.reseneeco.2014.07.002.

*Li, J, HA Michael**, JM Duke, KD Messer, and JF Suter (2014) Impact of risk information in a spatially explicit groundwater environment with contamination risk: Experimental evidence, *Water Resources Research*, doi: 10.1002/2013WR015230.

Sawyer, AH, LA Kaplan, O Lazareva, and HA Michael* (2014) Hydrologic dynamics and geochemical responses within a floodplain aquifer and hyporheic zone during Hurricane Sandy, *Water Resources Research*, doi: 10.1002/2013WR015101.

Sawyer, AH, O Lazareva, KD Kroeger, K Crespo, CS Chan, T Stieglitz, and HA Michael* (2014) Stratigraphic controls on fluid and solute fluxes across the sediment-water interface of an estuary, *Limnology & Oceanography*, 59(3) 997–1010, doi: 10.4319/lo.2014.59.3.0997.

*Heiss, JW, WJ Ullman, and HA Michael** (2014) Swash zone moisture dynamics and unsaturated infiltration in two sandy beach aquifers, *Estuarine, Coastal and Shelf Science*, doi: 10.1016/j.ecss.2014.03.015.

*Khan, MR, CI Voss, W Yu, and HA Michael** (2014) Water resources management in the Ganges Basin: A comparison of three strategies for conjunctive use of groundwater and surface water, Water Resources Management, doi: 10.1007/s11269-014-0537-y.

Michael, HA* (2013) An arsenic forecast for China, Science, 341, 852-853, doi: 10.1126/science.1242212.

*Russoniello, CJ, C Fernandez, JF Bratton, DE Krantz, JF Banaszak, AS Andres, LF Konikow, and HA Michael** (2013) Geologic effects on groundwater salinity and discharge into an estuary, Journal of Hydrology, 10.1016/j.jhydrol.2013.05.049.

Michael, HA*, *CJ Russoniello*, and *LA Byron* (2013) Global assessment of vulnerability to sea-level rise in topography-limited and recharge-limited coastal groundwater systems, Water Resources Research, doi: 10.1002/wrcr.20213.

Sahu, P, HA Michael, CI Voss, and PK Sikdar* (2013) Impacts on groundwater recharge areas of megacity pumping: Analysis of potential contamination of Kolkata, India, water supply, Hydrological Sciences, doi: 10.1080/02626667.2013.813946.

Sawyer, AH, F Shi, J Kirby, and HA Michael* (2013) Dynamic response of surface water-groundwater exchange to currents, tides, and waves in a shallow estuary, Journal of Geophysical Research – Oceans, 118, 1-10, doi: 10.1002/jgrc.20154.

Konikow, LF, M Akhavan, CD Langevin, HA Michael, and AH Sawyer* (2013) Seawater circulation in sediments driven by interactions between seabed topography and fluid density, Water Resources Research, 49, 1-14, doi 10.1002/wrcr.20121.

Suter, J, K Messer, J Duke, and HA Michael* (2012) Behavior in a spatially-explicit groundwater resource: Evidence from the lab, American Journal of Agricultural Economics, 94, 1094-1112, doi: 10.1093/ajae/aas058.

Radloff, KA, Y Zheng, HA Michael, M Stute, BC Bostick, I Mihajlov, M Bounds, MR Huq, I Choudhury, MW Rahman, P Schlosser, KM Ahmed, and A van Geen* (2011) Arsenic migration to deep groundwater in Bangladesh influenced by adsorption and water demand, Nature Geoscience, 4, 793-798, doi: 10.1038/NGEO1283.

Michael, HA*, *MA Charette*, and *CF Harvey* (2011) Patterns and variability of groundwater flow and radium activity at the coast: a case study from Waquoit Bay, Massachusetts, Marine Chemistry, 127, 100-114, doi: 10.1016/j.marchem.2011.08.001.

Fendorf, SF, HA Michael, and A van Geen* (2010) Factors controlling the spatial and temporal variations of arsenic in groundwater of South and Southeast Asia, Science, 328, 1123-1127, doi: 10.1126/science.1172974.

Michael, HA*, *H Li, A Boucher, T Sun, J Caers, and SM Gorelick* (2010) Combining geologic-process models and geostatistics for conditional simulation of 3-D subsurface heterogeneity, Water Resources Research, 46, W05527, doi: 10.1029/2009WR008414. (Selected for EOS Research Spotlight, *EOS* 9, 13 July 2010)

Burgess WG, MA Hoque, HA Michael, CI Voss, GN Breit, and KM Ahmed* (2010) Vulnerability of deep groundwater in the Bengal Aquifer System to contamination by arsenic, Nature Geoscience, 3, 83-97, doi: 10.1038/ngeo750.

Michael, HA* and CI Voss (2009) Controls on groundwater flow in the Bengal Basin of India and Bangladesh: regional modeling analysis, Hydrogeology Journal, 17, 1561-1577, doi:10.1007/s10040-008-0429-4.

Michael, HA* and CI Voss (2009) Estimation of regional-scale groundwater flow properties in the Bengal Basin of India and Bangladesh, Hydrogeology Journal, 17, 1329-1346, doi:10.1007/s10040-009-0443-1.

Michael, HA* and CI Voss (2008) Evaluation of the sustainability of deep groundwater as an arsenic-safe resource in the Bengal Basin, Proceedings of the National Academy of Sciences, 105, 8531-8536, doi: 10.1073/pnas.0710477105. (Selected for PNAS 'In This Issue' and Nature Research Highlight, *Nature*, 453, 19 June, 2008)

Harvey, CF*, AN Khandaker, W Yu, ABM Badruzzaman, MA Ali, PM Oates, **HA Michael**, RB Neumann, R Beckie, S Islam, and MF Ahmed (2006) Groundwater dynamics and arsenic contamination in Bangladesh, Chemical Geology, 228, 112-136, doi: 10.1016/j.chemgeo.2005.11.025.

Michael, HA, AE Mulligan, and CF Harvey* (2005) Seasonal oscillations in water exchange between aquifers and the coastal ocean, Nature, 436, 1145-1148, doi: 10.1038/nature03935.

Michael, HA, JS Lubetsky, and CF Harvey* (2003) Characterizing submarine groundwater discharge: a seepage meter study in Waquoit Bay, Massachusetts, Geophysical Research Letters, 30, 1297, doi: 10.1029/2002GL016000.

REFEREED CONFERENCE PROCEEDINGS AND REPORTS

Submitted

Andres, AS, **HA Michael**, *CJ Russoniello*, and *C Fernandez*, Investigation of submarine groundwater discharge at Holts Landing State Park, Delaware: Hydrogeologic framework, groundwater level and salinity observations, Delaware Geological Survey Report of Investigations, in review.

Published or In Press

Cross, VA, JF Bratton, **HA Michael**, KD Kroeger, A Green, and E Bergeron (2013) Continuous resistivity profiling and seismic-reflection data collected in April 2010 from Indian River Bay, Delaware, US Geological Survey Open-File Report 2011-1039, 23 p., <http://dx.doi.org/10.3133/ofr20111039>.

Yu, W, CI Voss, **HA Michael**, KM Ahmed, L Feinson, *MMR. Khan*, and A Tuinhof (2010), Implications of climate change on fresh groundwater resources in coastal aquifers in Bangladesh, Report of the World Bank, South Asia Reg., 2010, 105 pp.

Michael, HA, H Li, T Li, A Boucher, SM Gorelick, and J Caers (2008) Combining methods for geologically-realistic reservoir simulation, In: Proceedings of the Eighth International Geostatistics Congress, JM Ortiz and X Emery (eds.), Gecamin Ltd., Santiago, 1167-1172.

SPONSORED RESEARCH

CNH: Competing demands and future vulnerability of groundwater: Drinking water quality and food security in arsenic-impacted South and Southeast Asia, **National Science Foundation Coupled Natural Human Systems** (6/1/14-5/31/19), PI A van Geen (Columbia University), co-PIs B Bostick, W Schlenker, P Schlosser (Columbia University), C Harvey (MIT), H Michael (UD), J Duxbury (Cornell University).

Delaware EPSCoR: Meeting Delaware's 21st Century Water and Energy Challenges through Research, Education, and Innovation, **National Science Foundation EPSCoR RII** (EAR 1301765, 6/1/2013-5/31/2018), Lead PI D Sparks, H Michael funded collaborator (co-lead Theme 1).

Hydrological control of particle entrainment and nitrogen cycling in beach aquifer mixing and reaction zones, **National Science Foundation Hydrologic Sciences** (EAR1246554, 1/1/2013-12/31/15). Lead PI H Michael, PI W Ullman.

CAREER: Quantitative education and analysis toward integrating scales of water exchange between land and sea, **National Science Foundation Hydrologic Sciences** (EAR1151733, 9/1/2012 – 8/31/2017). PI H Michael.

WSC Category 1 Water Sustainability in Coastal Environments: Exploratory Research for an Integrated Study of the Effect of Anticipated Sea Level Rise on Contaminated Site Risk, **National Science Foundation Water Sustainability and Climate** (SES1204672, 8/1/2012-7/31/2013). Lead PI J Duke, PIs D Sparks, H Michael, K Messer (U Delaware).

Health Effects and Geochemistry of Arsenic and Manganese, **NIEHS Superfund Research Program** (4/1/2012-3/31/2017), Lead PIs J Graziano and L van Geen (Columbia University), H Michael co-PI on Hydrogeology Core D.

Microbial Fe oxidation and carbon cycling in aquifers of the Christina River Critical Zone Observatory, **Delaware EPSCoR Seed Grant** (2/1/12 – 1/31/13), Lead PI C Chan (U. Delaware), PI H Michael.

An experimental economics investigation of groundwater resource dynamics, **National Science Foundation Decision, Risk, and Management Science**, co-supported by **Hydrologic Sciences**, Environment, Society, and the Economy (ESE) (SES1024889, 9/1/2010 – 8/31/2013), Lead PI J Suter (Oberlin College) PIs K Messer, J Duke, and H Michael (U Delaware).

Quantifying Temporal and Geologic Controls on Water and Chemical Exchange between Groundwater and Surface Water in Coastal Estuarine Systems, **National Science Foundation Hydrologic Sciences** (EAR0910756, 10/1/2009-9/30/2013), Lead PI H Michael, PIs J Bratton and L Konikow (USGS), AS Andres (Delaware Geological Survey), D Krantz (University of Toledo).

CZO: Spatial and temporal integration of carbon and mineral fluxes: a whole watershed approach to quantifying anthropogenic modification of critical zone carbon sequestration, **National Science Foundation** (NSF0724971, 10/1/2009-9/30/2014), funded Collaborator with Lead PI Donald Sparks and PIs K Yoo, J Pizzuto (U Delaware), L Kaplan, A Aufdenkampe (Stroud Water Research Center).

Improving groundwater modeling in the Bengal Basin aquifer to support local and Transboundary water-resources management in the lower Ganges River, **The World Bank** (8/1/2010-4/30/2012), PIs H Michael and C Voss (USGS).

Investigation of tidal effects on nitrogen chemistry in subsurface mixing zones of coastal estuaries, **Oak Ridge Associated Universities Ralph E. Powe Junior Faculty Award** (6/1/2010-5/31/2011), PI H Michael.

Recovering uncompromised samples of aquifer sands with in-situ groundwater from up to 300-m depth in South and Southeast Asia, **International Continental Scientific Drilling Program**, one of 10 lead proponents on a workshop proposal with lead PI A Van Geen (Columbia University).

Fluid and fine-grained particle dynamics in the variably-saturated zone of sandy estuarine beachfaces, **Delaware EPSCoR Seed Grant** (2/1/2009 – 1/31/2011), Lead PI H Michael, PI W Ullman (U. Delaware)

Modeling dynamic effects of climate change on coastal groundwater systems, **University of Delaware Research Foundation** (6/1/2008 – 12/31/2009), PI H Michael.

Climate change implications on salt-water intrusion and groundwater resources in coastal aquifer systems in Bangladesh, **The World Bank** (4/1/2008 – 12/31/2009), PIs H Michael and C Voss (USGS).

Support for collaboration on groundwater modeling in Bangladesh and India and a MODFLOW workshop, **UNICEF** (2005-2006), PIs H Michael and C Voss (USGS).

Support for collaboration on groundwater modeling in Bangladesh and India and a MODFLOW workshop, **Department for International Development, UK** (2005), PIs H Michael and C Voss (USGS).

National Science Foundation Graduate Research Fellowship, 1998-2003.

CONFERENCE SESSIONS ORGANIZED

Custodio, E, A Jeuken, SA Khan, **HA Michael**, G Oude Essink, Fresh Water Management, Deltas in Times of Climate Change II, Rotterdam, The Netherlands, September 24-26, 2014 (invited).

Michael, HA, KB Moffett, AH Sawyer, and T Bianchi, Hydrologic controls on biogeochemical and ecosystem processes at the land-sea interface, American Geophysical Union Fall Meeting, San Francisco, CA, December 9-13, 2013, December 9-13, 2013.

Bhattacharya, P, A Mukherjee, DK Nordstrom, **HA Michael** and J Bundschuh, Recent Advances in Studies of Dissolved Arsenic and Other Metals in Global Hydrologic Systems, Geological Society of America Annual Meeting, Minneapolis, MN, October 9 - 12, 2011.

Andres, AS and **HA Michael**, Submarine Discharge of Groundwater and Nutrients into Estuaries and the Ocean, National Ground Water Association Ground Water Summit, Baltimore, MD, May 1-5, 2011.

Zheng, Y, and **HA Michael**, Sustainable Management of Safe Aquifers in Areas Affected by High Arsenic, Goldschmidt Conference on Earth, Energy, and the Environment, Knoxville, TN, June 13-18, 2010.

*presenting author

INVITED ABSTRACTS

*presenting author

Vargas, R*, **HA Michael**, Z Sanchez, A Seyfferth, Ecohydrology of greenhouse gas fluxes in a temperate estuary, American Geophysical Union Fall Meeting, San Francisco, CA, December 15-19, 2014.

*AH Sawyer**, *O Lazareva*, CS Chan, *K Crespo*, TC Stieglitz, **HA Michael**, Shallow stratigraphic controls on fluid and solute fluxes across the sediment-water interface of an estuary, American Geophysical Union Fall Meeting, San Francisco, CA, December 9-13, 2013

Michael, HA*, *LA Byron*, LS Feinson, CI Voss, *CJ Russoniello*, Vulnerability of topography-limited and recharge-limited groundwater systems to sea-level rise-induced salinization, American Geophysical Union Fall Meeting, San Francisco, CA, December 7, 2012.

*Sawyer, AH**, F Shi, JT Kirby, **HA Michael**, Dynamic response of surface water-groundwater exchange to currents, tides, and waves in a shallow estuary, American Geophysical Union Fall Meeting, San Francisco, CA, December 7, 2012.

Michael, HA*, Impacts of small-scale geologic heterogeneity on large-scale groundwater flow: Implications for sustainable arsenic-safe water supply in the Bengal Basin, The Geological Society of London, Water Futures Conference, London, England, March 6-7, 2012.

Michael, HA*, Transport of Solutes through Hydraulically and Chemically Heterogeneous Sediments of the Bengal Basin, Goldschmidt Conference, Prague, Czech Republic, August 14-19, 2011, Keynote.

Michael, HA*, CI Voss, KA Radloff, and Y Zheng, Assessment of the physical and chemical sustainability of deep, low-arsenic groundwater in the Bengal Basin: Regional- and local-scale considerations, American Geophysical Union Fall Meeting, San Francisco, CA, December 13-17, 2010.

Michael, HA*, CI Voss, KA Radloff, and Y Zheng, Evaluation of water supply sustainability in the Bengal Basin through regional modeling of flow patterns and arsenic sorption, Geological Society of America Annual Meeting, Denver, CO, October 31 - November 3, 2010.

Michael, HA* and CI Voss, Regional modeling of groundwater flow and arsenic transport in the Bengal Basin: challenges of scale and complexity, American Geophysical Union Fall Meeting, San Francisco, CA, December 14, 2009.

Michael, HA* and CI Voss, Is deep groundwater a sustainable source of arsenic-safe water in the Bengal Basin? Management insights from a regional modeling analysis, AGU Chapman Conference on arsenic in groundwater of southern Asia, Siem Reap, Cambodia, March 24-27, 2009.

Michael, HA*, Driving Mechanisms of Submarine Groundwater Discharge: Review of Recent Advancements and Observations in a Cape Cod Estuary, Geological Society of America Annual Meeting, Houston, TX, October 5-9, 2008.

CONTRIBUTED ABSTRACTS

*presenting author

2014 Tan, F*, *E Lunn*, B Fisher, K Yoo, PT Imhoff, **HA Michael**, The evolution of soil hydrological and physical properties under the impact of mineral weathering and organic matter sequestration, American Geophysical Union Fall Meeting, San Francisco, CA, December 15-19, 2014.

*Calhoun, KC**, *M Koneshloo*, **HA Michael**, Effects of the geometry of heterogeneous hydraulic conductivity fields on aquifer-ocean exchange processes, Geological Society of America Annual Meeting, Vancouver, BC, Canada, October 19-22, 2014.

*Khan, MR**, *M Koneshloo*, PK Knappett, MRH Mozumder, B Mailloux, KM Ahmed, BC Bostick, CF Harvey, A van Geen, **HA Michael**, Effect of aquifer heterogeneity on the sustainability of deep groundwater resources in the Bengal Delta near a mega-city pumping center, Geological Society of America Annual Meeting, Vancouver, BC, Canada, October 19-22, 2014.

*Kim, KHK**, **HA Michael**, WJ Ullman, Relationship between the physical and biogeochemical dynamics in the shallow freshwater-saltwater mixing zone of an intertidal beach aquifer (Cape Henlopen, Delaware), Geological Society of America Annual Meeting, Vancouver, BC, Canada, October 19-22, 2014.

Knappett, PSK*, SH Akhter, I Choudhury, M Steckler, **HA Michael**, CF Harvey, KM Ahmed, BC Bostick, M Shamsudduha, A van Geen, Impact of over-pumping from deep aquifer in Dhaka City on the safe water supply for surrounding rural population, Geological Society of America Annual Meeting, Vancouver, BC, Canada, October 19-22, 2014.

Michael, HA*, L Feinson, CI Voss, *CJ Russoniello, L Byron, MR Khan, K Calhoun, M Koneshloo*, Vulnerability of groundwater to salinization and the case of the Bengal Delta, Deltas in Times of Climate Change II, Rotterdam, The Netherlands, September 24-26, 2014.

*Sawyer, AH, K Kroeger, O Lazareva, K Crespo, CS Chan, T Stieglitz, HA Michael**, Geologic and hydrodynamic effects on shallow groundwater-surface water exchange and chemical fluxes to an estuary, CUAHSI Biennial Meeting, Shepherdstown, WV, July 28-30, 2014.

*Sawyer, AH**, LA Kaplan, *O Lazareva, HA Michael*, Insights into hydrogeochemical dynamics in a floodplain aquifer during Hurricane Sandy from multiple sensor technologies, CUAHSI Biennial Meeting, Shepherdstown, WV, July 28-30, 2014.

*Lunn, E**, *F Tan, P Imhoff, HA Michael*, Impact of mineral weathering and organic matter on soil water retention, CUAHSI Biennial Meeting, Shepherdstown, WV, July 28-30, 2014.

*Suter, J**, S Collie, J Duke, K Messer, **HA Michael**, Experiments on groundwater policy at the extensive and intensive margins, WAEA Annual Meeting, Colorado Springs, CO, June 23, 2014.

*Sawyer, AH, HA Michael**, K Kroeger, *O Lazareva, K Crespo, C Russoniello, F Shi, J Kirby, CS Chan, T Stieglitz*, Geologic and hydrodynamic effects on shallow groundwater-surface water exchange and chemical fluxes to an estuary, 23rd Salt Water Intrusion Meeting, Husum, Germany, June 16-20, 2014.

*Heiss, JW**, **HA Michael**, Tidal, spring-neap, and seasonal dynamics of a saltwater-freshwater mixing zone in a beach aquifer, 23rd Salt Water Intrusion Meeting, Husum, Germany, June 16-20, 2014.

Michael, HA*, *AH Sawyer, KD Kroeger, CJ Russoniello, LF Konikow*, Stratigraphic controls on submarine groundwater discharge, groundwater-surface water mixing, and associated chemical fluxes to an estuary, Ocean Sciences Meeting, Honolulu, HI, February 25, 2014.

*McAllister, SM**, JM Barnett, GW Luther III, **HA Michael**, CS Chan, Interplay between iron- and sulfur- cycling microbial communities and geochemistry along ecosystem gradients in the intertidal mixing zone of a beach aquifer Ocean Sciences Meeting, Honolulu, HI, February 25, 2014.

2013 Michael, HA*, KD Kroeger, C Fernandez, LF Konikow, AH Sawyer, CJ Russoniello, JF Bratton, Impact of Groundwater Flowpaths on Subsurface Denitrification and Nutrient Loading to an Estuary, American Geophysical Union Fall Meeting, San Francisco, CA, December 9-13, 2013.

AH Sawyer*, LA Kaplan, O Lazareva, **HA Michael**, Storm-associated hydrodynamics drive transient solute and redox chemistry within the floodplain aquifer and hyporheic zone of a piedmont stream, American Geophysical Union Fall Meeting, San Francisco, CA, December 9-13, 2013.

Li, J., J Duke, **HA Michael**, K Messer, D Sparks, The Joint Risks of Anticipated Sea Level Rise and Coastal Contaminated Sites: Economic and Scientific Evidence, The Northeast Agricultural and Resource Economics Association (NAREA) Annual Meeting, Ithaca, NY, June 23-25, 2013.

Li, J., **HA Michael**, J Duke, K Messer, J Suter, Impact of Risk Information in a Spatially Explicit Groundwater Environment with Contamination Risk: Experimental Evidence, The Northeast Agricultural and Resource Economics Association (NAREA) Annual Meeting, Ithaca, NY, June 23-25, 2013.

Knappett, PS*, BJ Mailloux, I Choudhury, S Barua, DR Mondal, M Steckler, H Akter, KM Ahmed, B Bostick, **HA Michael**, C Harvey, A van Geen, Investigating sources and sinks for water in deep

aquifers in Bangladesh, , National Ground Water Association Ground Water Summit, San Antonio, Texas, April 28-May 2, 2013.

Andres, AS*, **HA Michael**, J Madsen, *C Russoniello*, *C Fernandez*, J Bratton, V Cross, Integration of multiple geophysical techniques to image a submarine groundwater discharge zone, National Ground Water Association Ground Water Summit, San Antonio, Texas, April 28-May 2, 2013.

2012 Konikow, LF*, *M Akhavan*, *AH Sawyer*, **HA Michael**, CD Langevin, Bathymetry-density interaction as a driver for seawater recirculation in submarine groundwater discharge, American Geophysical Union Fall Meeting, San Francisco, CA, December 7, 2012.

Russoniello, *CJ**, *M Kereszi*, **HA Michael**, Exploring wave-induced artifacts and asymmetry in seepage meter measurements, Geological Society of America Annual Meeting, Charlotte, NC, November 4-7, 2012.

Khan, *Md MR**, **HA Michael**, CI Voss, Water resources management in the Ganges Basin: A comparison of three strategies for conjunctive use of groundwater and surface water, Geological Society of America Annual Meeting, Charlotte, NC, November 4-7, 2012.

Heiss, *JW**, *AH Sawyer*, WJ Ullman, **HA Michael**, Seasonal water table effects on tide-induced saltwater-freshwater mixing in sandy beaches, Geological Society of America Annual Meeting, Charlotte, NC, November 4-7, 2012.

Sawyer, *AH**, *O Lazareva*, *K Crespo*, **HA Michael**, Shallow stratigraphic controls on surface water-groundwater mixing and geochemical fate in the benthic zone of an estuary, Geological Society of America Annual Meeting, Charlotte, NC, November 4-7, 2012.

JF Bratton*, KD Kroeger, SA Ruberg, **HA Michael**, DE Krantz, Comparison of methods and results in recent studies of direct groundwater discharge to the Atlantic coast and Great Lakes, Goldschmidt Conference, Montreal, Canada, June 24-29, 2012.

Michael, **HA***, *CJ Russoniello*, *C Fernandez*, LF Konikow, AS Andres, JF Bratton, JF Banaszak, DE Krantz, Geologic effects on subsurface salinity distributions, groundwater flowpaths, and aquifer-estuary exchange in Indian River Bay, Delaware, USA, 22nd Salt Water Intrusion Meeting, Buzios, Brazil, June 17-22, 2012.

Liu, *Z**, J Suter, K Messer, J Duke, **HA Michael**, Spatial Externalities and Strategic Behavior in Accessing Groundwater Resource: Evidence from the Lab, Northeastern Agricultural and Resource Economics Association meeting, Lowell, MA, June 10-12, 2012.

Kroeger, KD*, *C Fernandez*, *CJ Russoniello*, AS Andres, JF Bratton, JK Bohlke, L Konikow, **HA Michael**, Denitrification and nitrogen loading at the aquifer/estuary interface: The role of coastal hydrology and implications for management of nitrogen loads, American Society of Limnology and Oceanography Annual Meeting, Salt Lake City, UT, February 20-24, 2012.

2011 *Heiss*, *J**, WJ Ullman, and **HA Michael**, Swash-Induced Infiltration in a Sandy Beach Aquifer, Cape Henlopen, Delaware, American Geophysical Union Fall Meeting, San Francisco, CA, December 4-9, 2011.

Russoniello, *CJ**, *C Fernandez*, JF Bratton, D Krantz, J Banaszak, AS Andres, LF Konikow, and **HA Michael**, Control of submarine groundwater discharge patterns and salinity by a low-permeability paleochannel cap at Indian River Bay, Delaware, American Geophysical Union Fall Meeting, San Francisco, CA, December 4-9, 2011.

Michael, HA*, CI Voss, KA Radloff, and Y Zheng, Multi-scale modeling of physical and chemical effects on arsenic transport to deep wells in the Bengal Basin, Conference on Arsenic in Groundwater in Southern Asia, Hanoi, Vietnam, November 14-17, 2011.

Radloff, KA*, Y Zheng, **HA Michael**, M Stute, KM Ahmed, A van Geen, Arsenic adsorption influences safe drinking water options in Bangladesh, Society of Environmental Toxicology and Chemistry Annual Meeting, Boston, MA, November 13-17, 2011.

Konikow, LF*, *M Akhavan*, **HA Michael**, and C Langevin, Coastal recirculation of saltwater due to coupled effect of variable bathymetry and density, Geological Society of America Annual Meeting, Minneapolis, MN, 9-12 October, 2011.

Michael, HA*, *C Fernandez*, *CJ Russoniello*, AS Andres, KD Kroeger, DE Krantz, JF Banaszak, A Musetto, K Myers, LF Konikow, and JF Bratton, Geologic and Hydrologic Control of Porewater Chemistry and Submarine Groundwater Discharge into Indian River Bay, Delaware, Goldschmidt Conference, August 14-19, 2011, Prague, Czech Republic.

Suter, J*, **HA Michael**, K Messer, and J Duke, An Experimental Investigation of Groundwater Resource Dynamics, Agricultural & Applied Economics Association & Northeastern Agricultural and Resource Economics Association Joint Annual Meeting, Pittsburgh, PA, July 24-26, 2011.

Suter, J*, **HA Michael**, KD Messer, JM Duke, An Experimental Investigation of Groundwater Resource Dynamics, International Water Resource Economics Consortium Conference, Banff, Canada, June 2011.

Michael, HA*, *CJ Russoniello*, *C Fernandez*, *A Musetto*, *K Myers*, JF Bratton, AS Andres, DE Krantz, JF Banaszak, KD Kroeger, and LF Konikow, Spatial patterns in subsurface salinity and submarine groundwater discharge into Indian River Bay, Delaware, National Ground Water Association Ground Water Summit, Baltimore, MD, May 1-5, 2011.

*Fernandez, C**, KD Kroeger, JF Bratton, *CJ Russoniello*, *A Musetto*, AS Andres, and **HA Michael**, Porewater Salinity Distribution and Geochemical Characterization of the Subsurface of Indian River Bay, Delaware, National Ground Water Association Ground Water Summit, Baltimore, MD, May 1-5, 2011.

*Russoniello, CJ**, **HA Michael**, AS Andres, and LF Konikow, Construction of a watershed-scale model towards an understanding large-scale influences on submarine groundwater discharge to the Inland Bays Watershed, Sussex Co., Delaware, National Ground Water Association Ground Water Summit, Baltimore, MD, May 1-5, 2011.

Andres, AS*, PS McCreary, CJ Russoniello, C Fernandez, K Myers, A Musetto, and **HA Michael**, Case study of use of offshore wells for monitoring submarine groundwater discharge, Indian River Bay, Delaware, National Ground Water Association Ground Water Summit, Baltimore, MD, May 1-5, 2011.

*Heiss, JW**, **HA Michael**, and WJ Ullman, Characterization of Fluid Flow and Seawater Infiltration through the Beachface Saltwater/Freshwater Mixing Zone, National Ground Water Association Ground Water Summit, Baltimore, MD, May 1-5, 2011.

2010 Voss, CI*, **HA Michael**, and P Aggarwal, Simply-structured groundwater model analysis for informing management of Transboundary aquifers: Examples from Bengal Aquifer System (Bangladesh, India) and Nubian Sandstone Aquifer System (Chad, Egypt, Libya, Sudan), International

Conference “Transboundary Aquifers: Challenges and New Directions” (ISARM 2010), December 6-8, 2010.

Michael, HA*, LS Feinson, *L Byron*, and CI Voss, Climate and human impacts on the vulnerability of coastal groundwater resources to salinization by seawater, Sixth International Conference on Sustainable Water Environment, “Water Infrastructures in Time of Climate Change”, Newark, DE, July 29-31, 2010.

Michael, HA*, LS Feinson, and CI Voss, Mechanisms of seawater intrusion in Bangladesh and the potential impacts of sea-level rise on coastal groundwater resources, 21st Salt Water Intrusion Meeting, Azores, Portugal, June 21-26, 2010.

Michael HA*, CI Voss, KA Radloff, and Y Zheng, Regional modeling of groundwater flow and arsenic transport in the Bengal Basin: Effects of sorption on safe groundwater use, Goldschmidt Conference on Earth, Energy, and the Environment, June 13-18, 2010, Knoxville, TN.

Radloff, KA*, Y Zheng, **HA Michael**, M Stute, I Mihajlov, and KM Ahmed, Evaluating arsenic adsorption in a low arsenic aquifer in Bangladesh using *in situ* and laboratory methods, Goldschmidt Conference on Earth, Energy, and the Environment, June 13-18, 2010, Knoxville, TN.

Michael, HA*, MA Charette, and CF Harvey, Mechanisms Driving Submarine Groundwater Discharge and Associated Radium Flux, 3rd Radium-Radon Meeting, March 15-18, 2010, Jerusalem, Israel.

2009 Michael, HA*, Investigating Fluxes between Aquifers and the Sea on Multiple Spatial and Temporal Scales through Modeling, International Conference on Aquatic Resources, Nov 20, 2009, Alexandria, Egypt.

Bratton, J*, J Crusius, K Kroeger, JK Bohlke, D Krantz, **H Michael**, S Baldwin, and A Green, Coastal groundwater discharge from both sides of the Delmarva Peninsula, Atlantic Estuarine Research Society Meeting, 5-7 March 2009, Ocean City, MD.

2008 Michael, HA*, H Li, T Li, A Boucher, SM Gorelick, and J Caers, Combining methods for geologically-realistic reservoir simulation, Eighth International Geostatistics Congress, December 2008, Santiago, Chile.

Michael, HA*, MA Charette, and CF Harvey, Mechanisms Driving Submarine Groundwater Discharge and Associated Radium Flux: Implications for Use of Radium as a Tracer, 20th Salt Water Intrusion Meeting, Naples, FL June 23-27, 2008.

Michael, HA and CI Voss*, Hydrogeologic Analysis and Evaluation of Sustainable Management Alternatives in the Bengal Basin Aquifer System in the Face of Data Sparsity, National Ground Water Association Ground Water Summit, Memphis, TN, April 2, 2008.

2007 Michael, HA and CI Voss*, Modelling evaluation of sustainable management alternatives in the high-Arsenic region of the Bengal Delta Aquifer (India and Bangladesh), MODEL CARE 2007, Copenhagen, Denmark, September 9-13, 2007.

2006 Michael, HA and CI Voss*, Transboundary hydrogeologic analysis of the Bengal Delta aquifer of India and Bangladesh, International Association of Hydrogeologists (IAH) 34th Congress, Beijing, China, October 2006.

Michael, HA*, AE Mulligan, and CF Harvey, Saline water exchange between aquifers and the coastal ocean driven by the seasonal hydrologic cycle, First International Joint Salt Water Intrusion Conference, Cagliari, Italy, September 24-29, 2006.

Michael, HA and CI Voss*, Hydrogeologic analysis of the Bengal Delta aquifer of India and Bangladesh, IAH Symposium, “Aquifer Systems Management”, Dijon, France, May 30 – June 1, 2006

2005 Michael, HA*, AE Mulligan, and CF Harvey, The seasonal hydrologic cycle: A driver of saline water exchange between aquifers and the coastal ocean, Geological Society of America Annual Meeting, Salt Lake City, UT, October 16-19, 2005.

Michael, HA* and CI Voss*, Hydrogeologic analysis of the Bengal Delta: Numerical modeling of groundwater flow, Symposium on Behavior of Arsenic in Aquifers, Soils and Plants: Implications for Management, Dhaka, Bangladesh, January 16-18, 2005.

2001 Michael, HA*, MA Charette, JS Lubetsky, and CF Harvey, Assessing rates and mechanisms of submarine groundwater discharge: A combined approach using seepage meters and radium isotopes, American Geophysical Union Spring Meeting, Boston, MA, May 29, 2001.

2000 Michael, HA*, JS Lubetsky, and CF Harvey, Groundwater discharge into Waquoit Bay on Cape Cod, American Geophysical Union Fall Meeting, San Francisco, CA, December 19, 2000.

INVITED PRESENTATIONS (Last 5 years)

2014 Michael, HA*, Land-sea water exchange: Implications for groundwater management and chemical inputs to the coastal ocean, *Simon Fraser University*, Vancouver, Canada, October 28, 2014.

Michael, HA*, *JW Heiss**, Impacts of sea-level rise on groundwater salinity and beach aquifer mixing dynamics, Institute of Fluid Mechanics and Environmental Physics in Civil Engineering, *Leibniz University*, Hannover, Germany, June 24, 2014.

Michael, HA*, DL Sparks, K Messer, V Perez, T Powers, The effect of sea-level rise on contaminant mobility and cycling, *Delaware National Estuarine Research Reserve Research Symposium*, Dover, DE, March 21, 2014.

2013 Michael, HA*, Salty water and rising seas: Groundwater salinization mechanisms and vulnerability, *University of Delaware Physical Ocean Sciences and Engineering Seminar*, Newark, DE, March 1, 2013.

2012 Michael, HA*, In search of a mitigation strategy for groundwater arsenic in the Bengal Basin: Are deep aquifers the solution?, *West Chester University*, West Chester, PA, October 31, 2012.

Michael, HA*, *CJ Russoniello, C Fernandez, A Musetto, K Myers, D Knights*, AS Andres, K Kroeger, LF Konikow, DE Krantz, J Banaszak, J Bratton, Hydrologic, geologic, and geochemical effects on nutrient fluxes to Indian River Bay: Evidence from measurements at Holts Landing State Park, *Delaware Center for the Inland Bays Scientific and Technical Advisory Committee Meeting*, Lewes, DE, September 2012.

*Khan, MMR, HA Michael**, and CI Voss, The Ganges Water Machine: How using groundwater can reduce monsoon flood risks, *The World Bank*, Washington, DC, April 24, 2012.

Michael, HA*, What controls groundwater nutrient fluxes to bays? A hydrogeological and geophysical study in Indian River Bay, Delaware, *University of Maryland Horn Point Laboratory*, February 1, 2012.

2011 Michael, HA*, Irrigation effects on hydrogeology and groundwater sustainability in the Bengal Basin, Columbia University Earth Institute series on Sustainable Development, seminar and panelist for discussion on Water Management in Agriculture, *Columbia University*, New York, NY, November 30, 2011.

Michael, HA*, Impacts of hydrologic, geologic, and geochemical interactions on fluxes to Indian River Bay, DE, Hydrology Brown Bag Lecture, *University of Texas at Austin*, Austin, TX, October 28, 2011.

Michael, HA*, In search of a mitigation strategy for groundwater arsenic in the Bengal Basin: Are deep aquifers the solution?, *University of Texas at Austin*, Austin, TX, Distinguished Oliver Lecture, October 27, 2011.

Michael, HA*, Hydrologic, geologic, and geochemical interactions at the coast: implications for fluxes into Indian River Bay, Delaware, *Tulane University Department of Earth and Environmental Sciences*, New Orleans, LA, October 11, 2011.

Michael, HA*, Is deep groundwater the solution to the arsenic crisis in the Bengal Basin? Insights from a regional hydrogeologic analysis, *Millersville University Department of Earth Sciences*, Millersville, PA, September 15, 2011.

Michael, HA*, In search of a mitigation strategy for the arsenic crisis in the Bengal Basin: Is deep groundwater the solution?, *Rutgers University Newark*, Department of Earth and Environmental Sciences, Newark, NJ, March 23, 2011.

Michael, HA*, In search of a mitigation strategy for Groundwater Arsenic in the Bengal Basin: Is deep groundwater the solution?, *Pennsylvania State University Department of Geosciences*, State College, PA, March 1, 2011.

2010 Michael, HA*, Is deep groundwater a viable arsenic mitigation option in the Bengal Basin? Management insights from a regional modeling analysis, *Temple University Department of Civil and Environmental Engineering*, Philadelphia, PA, November 12, 2010.

Michael, HA*, Quantifying Fluid and Chemical Exchange between Aquifers and the Ocean, *Delaware Environmental Institute (DENIN) Inaugural Research Symposium*, Newark, DE, April 9, 2010.

2009 Michael, HA* and CI Voss*, Managing Coastal Groundwater Resources of Bangladesh: Impacts of Climate Change and Sea-Level Rise, *World Bank*, Washington, DC, November 24, 2009.

Michael, HA*, Drivers and Implications of Water Exchange between Aquifers and the Ocean, *Temple University Department of Earth and Environmental Science*, Philadelphia, PA, September 18, 2009.

Michael, HA*, Water exchange between aquifers and the coastal ocean: Mechanisms, flowpaths, and implications for chemical fluxes, *University of Delaware Environmental Engineering Seminar*, May 2009.

2008 Michael, HA*, Investigating groundwater discharge into coastal bays: Overview, past research, and potential applications in the Delaware Inland Bays, *Delaware Center for the Inland Bays Scientific and Technical Advisory Committee Meeting*, Lewes, DE, December 2008.

Michael, HA* and CI Voss, In search of clean water: The sustainability of deep groundwater as an arsenic-safe resource in the Bengal Basin, *University of Delaware*, Geography Department Seminar, Newark, DE, September 2008.

TEACHING

University of Delaware

Newark, DE

GEOL 667: Classic Papers in Hydrogeology Seminar, Fall 2013
GEOL 428/628: Hydrogeology, Fall 2012; Fall 2011; Fall 2010; Fall 2009; Spring 2009
GEOL 467/667: Mathematical Modeling for Geoscientists (with J Pizzuto), Spring 2011
GEOL 467/667: Coastal Hydrogeology, Spring 2011
GEOL 467/667: Groundwater Modeling, Spring 2012; Spring 2010
GEOL/GEOG/STAT 667: Spatial Statistics (with D Legates), Spring 2013
GEOL 203: Earth Surface Processes (with J Pizzuto), Spring 2013, Spring 2014

University of Cagliari

Cagliari, Italy

Practical Modeling of Seawater Intrusion Course, Sept 20-23, 2006

University of Dhaka, Department of Geology

Dhaka, Bangladesh

MODFLOW Groundwater Modeling Workshop, September 11-15, 2005

MIT, Department of Civil and Environmental Engineering

Cambridge, MA

Teaching Assistant, Computing and Data Analysis for Environmental Applications, 2001-2003

MIT, Department of Athletics

Cambridge, MA

Assistant Varsity Women's Lacrosse Coach, 1999-2004

PROFESSIONAL ACTIVITIES (Selected)

- Board of Directors, NorthSouth Group for Poverty Reduction (2006-present)
- Board of Directors (elected), Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) (2013-present)
- Associate Editor: Water Resources Research (2014-present)
- Associate Editor: Hydrogeology Journal (2009-2013)
- American Geophysical Union Groundwater Technical Committee member (2013-present)
- CUAHSI representative to the Geological Society of America Hydrogeology Division (2014-present)
- Participated, by invitation, in National Academy of Engineering Kavli Frontiers Brazil Symposium (2014)
- Participated in National Academy of Sciences Kavli Frontiers of Science U.S. Symposium (2012)
- Participated in NSF EarthCube Early Career Strategic Visioning Workshop (2012)
- Salt Water Intrusion Meeting (SWIM) Scientific Committee (2010, 2008)
- Participated in NSF-sponsored workshop on *Marine Constituent Dynamics in Coastal Egypt* as part of the 3rd International Conference on Aquatic Resources (ICAR) conference in Alexandria, Egypt
- Review Panel member: NSF, DOE
- Manuscript Reviewer: Biogeochemistry, Environmental Monitoring and Remediation, Environmental Science and Technology, Geophysical Research Letters, Geology, Ground Water, Hydrogeology Journal, Journal of Geophysical Research, Journal of Hydrology, Limnology and Oceanography, Marine Chemistry, Nature, Nature Geoscience, Science, Proceedings of the National Academy of Sciences, Water Resources Research
- Proposal Reviewer: NSF and other funding agencies

- Professional Memberships: American Geophysical Union, Geological Society of America, International Association of Hydrogeologists, International Association of Mathematical Geosciences, The Geochemical Society