Research Explorations at Michigan State University
Part of the NOAA Center of Excellence for Great Lakes and Human Health

MICHIGAN STATE UNIVERSITY

Overview

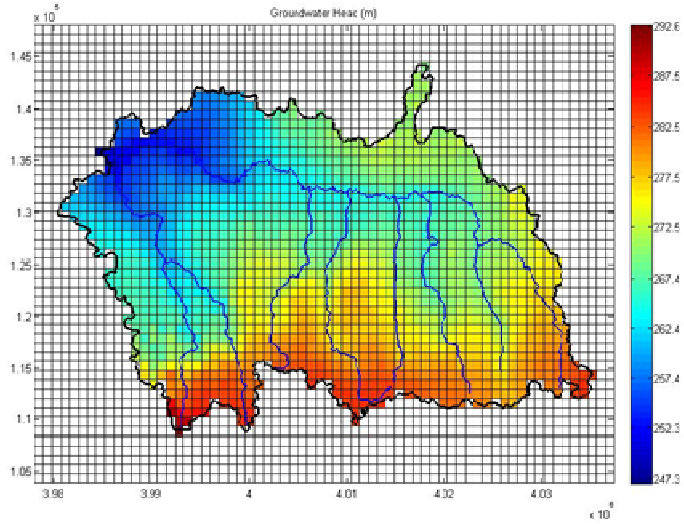
In 2004, competitive funding was received from the National Oceanic and Atmospheric Administration (NOAA) Office of Global Programs to establish the Center of Excellence for Great Lakes and Human Health (CEGLHH) at the Great Lakes Environmental Research Laboratory (GLERL) in Ann Arbor, Michigan. Michigan State University's research team, as one of the key partners in this consortium, has been addressing the goals of GLERL over the last five years, and presents its major research discoveries towards assessing, improving and restoring the quality of recreational beaches, drinking water and ecosystems in the Great Lakes.

Accomplishments

The broad science goals and key activities for the period from 2004 to 2009 included:

- to estimate the distribution of pollution within the Lower Grand River and its tributaries
- to quantify the effects of sediments and temporary detention in the surface features of the river on the microbial water quality of the river by developing watershed models
- to investigate the upstream fecal pollution and their potential effect on beaches at Lake Michigan
- to understand near-shore processes that contribute to inactivation of pathogenic microorganisms.

The accompanying list of journal publications gives an overview of how the research team at MSU has satisfied these goals, and forms the basis of future research. Work to date has focused on water pollution studies and a chemical-biological tracer study at the Lower Grand River, watershed models for describing in-channel processes in the Grand River watershed, and near-shore processes and inactivation in the surf zone of Lake Michigan.




Algal mats containing fecal pollution at Saginaw Bay

Photograph credit: Marc Verhougstraete, MSU

Future goals

The work already completed has required the development of a toolbox of molecular techniques, and transport and fate models. The goals of the MSU research team are now concerned with integrating the monitoring and modeling fundamental knowledge from the previous efforts into a Quantitative Microbial Risk Assessment (QMRA) framework to help determine associated risks to the Great Lakes and human health. An additional component of the future goals is the influence of climate change on the health of the Great Lakes, and the implications of resulting direct and indirect effects on water resources and human health. The QMRA component will combine data generated from completed, ongoing and future research using the novel molecular tools, transport and fate models, water quality assessment information and climate change data. This framework will be designed to reduce risk and improve decision making for local and national government agencies, industry, and communities. The importance of the Great Lakes ecosystem on the economy of the nation, and the health and well-being of people far beyond the limits of the watershed requires the continuation of sound scientific risk-based approach for predicting and preventing waterborne disease occurrences.

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Journal Publications

M. Wong, L. Kumar, T.M. Jenkins, I. Xagoraraki, M.S. Phanikumar, and J. B. Rose, Evaluation of Public Health Risks at Recreational Beaches in Lake Michigan via Detection of Enteric Viruses and a Human-Specific Bacteriological Marker, ***Water Research***, 43: 1137 -1149 (2009).

C. Shen and M.S. Phanikumar, An Efficient Space-Fractional Dispersion Approximation for Stream Solute Transport Modeling, ***Advances in Water Resources***, 32(10): 1482-1494 (2009).

C. Shen, J. Niu and M.S. Phanikumar, Estimating Longitudinal Dispersion in Rivers Using Acoustic Doppler Current Profilers, ***Advances in Water Resources*** (2009, in review).

T. Fong, M.S. Phanikumar, I. Xagoraraki, J.B. Rose, Quantitative Detection of Human Adenoviruses in Waste Water and Combined Sewer Overflows Influencing a Michigan River, ***Applied & Environmental Microbiology*** (2009, in review).

C. Shen, M.S. Phanikumar, T.T. Fong, I. Aslam, S.L. Molloy and J.B. Rose, Evaluating Bacteriophage P22 as a Tracer in a Complex Surface Water System: The Grand River, Michigan, ***Environmental Science & Technology*** , 42 (7): 2426 - 2431 (2008) .

J. B. Rose and E. A. Dreelin. (Eds) Effective Cross-Borer Monitoring Systems for Waterborne Microbial Pathogens, A Plan for Action, IWA Publishing, London, UK (2008).

I. Xagoraraki, D. H-W. Kuo, K. Wong, M. Wong, and J. B. Rose. Occurrence of Human Adenoviruses in Two Great Lake Recreational Beaches. ***Applied & Environmental Microbiology*** 73 (24):7874-7881. (2007).

M.S. Phanikumar, I. Aslam, C. Shen, D.T. Long and T.C. Voice, Separating surface storage from Hyporheic Retention in Natural Streams Using Wavelet Decomposition of Acoustic Doppler Current Profiles, ***Water Resources Research***, 43(5): W05406 (2007).

T.T. Fong, L.S. Mansfield, D.L. Wilson, D.J. Schwab, S.L. Molloy, J.B. Rose. Massive Microbiological Groundwater Contamination Associated with a Waterborne Outbreak in Lake Erie, South Bass Island, OH. ***Environmental Health Perspectives***, 115(6): 856-864 (2007).

L. Liu, M.S. Phanikumar, S.L. Molloy, R.L. Whitman, M.B. Nevers, D.A. Shively, D.J. Schwab, J.B. Rose, The Transport and Inactivation of *E. coli* and Enterococci in the Nearshore Region of Lake Michigan, ***Environmental Science & Technology***, 40(16): 5022-5028 (2006).

L. Liu, P. Manthas, S. L. Molloy, R. L. Whitman, D. A. Shiverly, M. Nevers, D. J. Schwab and J. B. Rose. Modeling the Transport and Inactivation of *E. coli* and Enterococci in the Near-Shore Region of Lake Michigan. ***Environmental Science & Technology***. 40 (16):5022-5028. (2006).

T. M. Jenkins, T. M. Scott, M. R. Morgan, and J. B. Rose. Occurrence of Alternative Fecal Indicators and Enteric Viruses in Michigan Rivers, ***Journal of Great Lakes Research*** 31: 22-31. (2005).

T. M. Scott, T.M. Jenkins, J. Lukasik, and J. B. Rose. Potential Use of a Host Associated Molecular Marker in *Enterococcus faecium* as an Index of Human Fecal Pollution; ***Environmental Science & Technology.*** 39(1): 283 – 287. (2005).

T. M. Scott, J. B. Rose, T. M. Jenkins, S. R. Farrah, and J. Lukasik. Microbial Source Tracking: Current Methodology and Future Directions. ***Applied & Environmental Microbiology***. 68 (12):5796-5803. (2002)

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