Water Related Research Projects
at the
University of Massachusetts Amherst

Impacts of Climate Change on the New England Environment

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http://www.cns.umass.edu/neclimate/

We are using regional climate models to assess potential future changes in the climate of New England, to provide guidance on potential impacts on agriculture, ecosystems and various sectors of the economy. The project complements the new NOAA National Climate Services initiative.

Modeling DOC Dynamics from Landscapes to Coasts: Hydrological Connectivity and Estuary Processes

Qian Yu (UMass Amherst PI) 413-545-2095, Co-PIs: **Anna Liu**, UMass Amherst, Yong Tian and **Robert Chen** (UMass Boston)

We are using remote sensing, GIS and spatial modeling to study the dynamics of dissolved organic carbon (DOC) from landscapes to coastal water through hydrological connectivity and estuarine processes to improve understanding of the impact of upland ecosystems and landscapes to coastal marine ecosystems through the medium of water. At local and regional scale, DOC export from coastal watersheds has significant impacts on the ecology of aquatic systems. At a global scale, DOC fluxes to the coastal zone can cause associated continental shelves to be supersaturated in CO_2 and a net source of CO_2 to the atmosphere. Therefore, it has important implications for the global carbon cycle and climate change.

Measurement of Arsenic in Ground Water

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We are developing reliable, low-cost, portable chemical measurement technologies for the determination of arsenic in well water. One method is based on the analysis of the images, taken by a digital still camera, of a colored reaction product on a chemically modified polymer surface. A second method is based on the change in frequency of an oscillating piezoelectric quartz crystal whose surface is coated with an arsenic-binding ligand.

Environmental Fate, Transport, and Bioavailability of Nanomaterials

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Nanomaterials are present in an increasing number of commercial products, and their release into natural waters is inevitable. We are investigating the relationships between nanomaterial chemical/physical properties and their fate, transport, bioavailability and bio-accumulation to understand the full environmental impact of these materials which is important for producing sustainable materials and for protecting the citizens of Massachusetts.

Lidar (Light Detection and Ranging)

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LIDAR ("Light Detection and Ranging") is a high-tech eye-safe laser technology used from an airplane to produce detailed and accurate elevation maps, even through dense ground cover. Municipal public health agents need this information for a number of purposes: to make decisions about on-site septic systems; to update the State's floodplain maps; to delineate wetlands; to measure the thickness of ground cover and therefore calculate the amount of biomass for forest and ecological management; to map out historic landslides and assess areas of future landslide risk; and to produce detailed maps of bedrock aquifer systems for geothermal systems and water resource management. Municipal and State agencies need elevation data with detail to at least two feet. The majority of the Commonwealth does not have elevation maps approaching anywhere near this kind of accuracy or detail. Developing detailed statewide elevation data was recommendation #2 in the Strategic Plan for Massachusetts' Spatial Data Infrastructure. An investment of $1.5 to $2.0 million could provide LIDAR data for the entire Commonwealth.

Impacts of Decadal Climate Variability on Ground Water Quantity and Quality

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http://www.agu.org/pubs/crossref/2010/2010GL045561.shtml

Over 50 percent of the residents in the state of Massachusetts rely on ground water for drinking water. Our research group in the Department of Geosciences is utilizing long-term records of hydro-climatic variables to further our understanding of past behavior of ground water systems. Documentation and characterization of these systems and how they respond to climate variability is essential for understanding potential future changes. See for more information

Ecohydrology of Deep Crystalline Rocks at Homestake-DUSEL, South Dakota

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The deep subsurface has recently been recognized as an ecosystem that could profoundly influence the way we view the origin and early evolution of life on Earth, our search for novel life forms and enzymes, and our approaches to future energy production. Despite the fact that the deep subsurface comprises a significant fraction of the living carbon on our planet it is the most poorly understood ecosystem. We are studying subsurface water interactions that play an important role in sustaining these ecosystems. David Boutt is the lead PI of the ecohydrology experiment which would be part of the ~$800 million underground research facility in South Dakota. The project is poised to be a major US science investment in physics, earth science, and engineering.

Recharge Mechanisms of Fractured Crystalline Bedrock Aquifers

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Fractured crystalline rocks underlie a significant portion of Massachusetts (and the Northeast US) and are used heavily for private drinking water supplies. These aquifers systems are vulnerable to over-use and significant degradation in water quality. We are monitoring these systems throughout Massachusetts and providing conceptual models of how water is recharging these aquifers.

Robust Water Management under Climate Change for Ecohydrologic Sustainability

Casey Brown (PI) and **Rick Palmer**, Dept. of Civil and Environmental Engineering, **Jenna Marquard** and **Erin Baker**, Mechanical and Industrial Engineering, UMass Amherst
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We are focusing on the Connecticut River Basin as a laboratory for developing innovative approaches to water management that are robust under climate change. The impacts of climate change threaten society due to increases chances of floods, droughts and other impacts. We are developing new tools, including the use of seasonal climate forecasts, financial mechanisms and dynamic infrastructure operations to manage the impacts of climate change while preserving the vital ecosystem functions of the Connecticut River Basin. The results will have potential to change the way water is managed throughout the nation. *:* All of western Massachusetts and most of New England have vital interests in the Connecticut River, the largest river in New England and the home of recreation, hydroelectricity generation and several important ecosystems and species of interest, including the endangered Atlantic salmon. In addition, the water supply for metropolitan Boston is located within the basin.

Developing Tools for More Effective Assessment of Wetlands and Aquatic Ecosystems

Kevin McGarigal (PI) and **Scott Jackson** (Co-PI), Department of Environmental Conservation

The University of Massachusetts is working with the MA Department of Environmental Protection, MA Office of Coast Zone Management and U.S. EPA to develop cost-effective tools and techniques for assessment and monitoring of wetland and aquatic ecosystems. Extensive field research is used to develop and test sophisticated landscape-based assessment models as part of the Conservation Assessment and Prioritization System (CAPS). The result of this work will be a comprehensive wetlands monitoring and assessment program for Massachusetts that will guide policy decisions and restoration efforts. Benefits of this project include more cost-effective use of public and private resources to protect and enhance water, fish and wildlife resources and protect public health and safely through natural flood control and storm damage prevention.