# Spring 2008 EWRE Seminar Series

**Thursday, May 1**
3:30 PM ECJ 1.204

**Robert Nerenberg, Ph.D., P.E.**
**Assistant Professor, Department of Civil Engineering and Geological Sciences**
**University of Notre Dame**

*Total Nitrogen Removal in the Hybrid Membrane-Biofilm Process*

The Hybrid Membrane-Biofilm Process (HMBP) is a novel means of achieving total nitrogen (TN) removal from wastewater. It incorporates oxygen-supplying, hollow-fiber membranes into an aeration tank, making it easily retrofittable into existing activated-sludge treatment facilities. A nitrifying biofilm develops on the outside of the membranes and, by suppressing bulk aeration, denitrification is carried out by suspended heterotrophs. Since oxygen is supplied from the biofilm attachment surface, while ammonium and BOD are supplied from the bulk liquid, a unique microbial community structure develops. We used FISH, microsensors, and modeling to explore the structure and function of the HMBP biofilm for a variety of operating conditions. We also conducted pilot-scale tests in New York City. In this presentation, I will provide an overview of this research, with an emphasis on the microbial ecology findings.

**Thursday, April 17**
3:30 PM ECJ 1.204

**Ram Kannappan**
**BS Chemical Engineering 2001, University of Texas at Austin**
**MS EWRE 2004, University of Texas at Austin**

*Combined Effect of Trihalomethanes and Monochloramine on Distribution System Nitrification*

The presence of disinfection byproducts (DBPs) from chlorination has led many utilities to switch to chloramination for the purpose of lowering DBP concentrations. A result of the switch to chloramination has been an increase in distribution system nitrification. In this process residual ammonia (NH3) from chloramine formation is converted to nitrite (NO2-) by ammonia oxidizing bacteria (AOB) and then nitrate (NO3-) by nitrite oxidizing bacteria (NOB). These bacteria and the products of their growth react with residual disinfectant, and the diminished residual allows heterotrophic bacterial growth in the distribution system. A variety of factors affect the onset of distribution system nitrification and not all are fully understood at this time. Recent work has shown that AOB can cometabolize certain DBPs, specifically trihalomethanes (THMs). The byproducts of THM cometabolism are toxic to the AOB and can limit their growth if the concentrations of THMs are high enough. Also,

monochloramine itself inhibits bacteria growth and can delay or prevent the onset of nitrification. This research examines the combined effect of THMs and monochloramine on distribution system nitrification.

**Elizabeth Ojeh**
**BS Civil Engineering from the University of Ibadan, Nigeria.**

*Fueling the Future: The Evolution of Liquefied Natural Gas (LNG) and the Issues and Challenges Ahead*

The report reviews global energy trends and needs, based on the Energy Information Administration (EIA) International Energy Outlook Reference Case data. It examines the potential for LNG to become a major primary energy source for meeting the growing global energy needs. Recent developments in technology in each section of the LNG value chain - Exploration and Production, Liquefaction, Shipping and Regasification and Storage, are reviewed and the finding is that these developments signal an expansionary move within the industry and contribute to the globalization of the LNG market.

The issues that challenge the LNG industry, such as safety and security, environmental impact considerations, interchangeability, and market factors such as demand and supply, trade and financing are analyzed. Although each of the issues presenting varying threats and the opportunities, the outlook for the industry still remains positive.

**Thursday, April 10**
3:30 PM ECJ 1.204

**Casey Forrest**
**B.S. Chemical Engineering (Lamar University)**

*The Effectiveness of Novel Biopolymer Materials for Capping Contaminated Sediments*

Capping technology is one of the few in-situ technologies available to environmental scientists and engineers to remediate polluted sediments. While capping technology has been applied successfully in some sites, conventional capping technology employs simply passive sand caps. Innovative capping technologies need to be explored to enhance the capabilities of a sand cap. Novel biopolymer materials composed of chitosan, xanthan gum, and guar gum were prepared and applied as a coating to clean sand. The experiments involved testing the ability of these materials to significantly reduce the migration of contaminants from sediment to above water body and to evaluate their suitability as capping materials based on their physical properties.

**Juan Morán-López**
**B.S. Biological Systems Engineering (Virginia Polytechnic Institute and State University)**

*The SWAT Team and Its Master Plan*

The City of Austin's Watershed Protection Department plans to create a hydrologic model for numerous creeks in Austin. Modeling efforts are centered on flood control, erosion control, and water quality. Using ArcSWAT, engineers will model 17 of the city's creeks and assess the level of degradation in the creeks to prioritize them accordingly. Modeling is done using ArcSWAT; since the program caters mainly to non-point source pollution and rural settings, the city is working to make adjustments that more readily represent an urban setting. When completed, the project will help the Watershed Protection Department with its long-term goal to provide cost-effective and sustainable solutions for water quality management.

**Thursday, April 3**
3:30 PM ECJ 1.204

**Carrie Stefanelli**
**BS, Illinois State University**

*Anaerobic Treatment of Ethanol Production Wastewater*

The "energy return on investment" of ethanol, or the ratio of energy output to non-renewable energy input, has been a topic of hot debate for over 25 years. The ethanol production process generates a significant amount of wastewater termed "stillage." Anaerobic treatment of stillage has the potential to generate a substantial amount of methane, which may be used as an in-plant fuel source. As a result, less non-renewable resources would be utilized, and the energy return on investment would increase. This report focuses on anaerobic treatment of stillage, and the potential to use methane to displace non-renewable fuels for the ethanol production process.

**Tyler McEwen**
**BS, North Carolina State University**

*Hydraulic Performance of Bridge Rails in Series: Rating Curves and Submergence Effects*

To ensure ongoing safety on our nations roads, in 1986 the Federal Highway Administration (FHWA) instituted all highway bridges on the National and Interstate Highway Systems must use successfully crash tested bridge rails. Current TxDOT policy not only states new construction must use successfully crash tested rails, but also bridges subject to rehabilitation. Rehabilitation includes replacing failed crash tested bridge rail systems with higher rails with less open space. Also, construction or modification projects within

communities participating in National Flood Insurance Program (NFIP) must not increase Federal Emergency Management Agency (FEMA) delineated 100-year floodplains more than 1 foot. In an effort to study the hydraulic performance of successfully crash tested bridge rails and the potential implications of rehabilitation projects, we used half-scale physical models to produce rating curves and test submergence effects for single bridge rails as well as bridge rails in series.

**Thursday, March 27**
3:30 PM ECJ 1.204

**Samuel Sandoval Solis, Ph.D. Candidate**
**BS Civil Engineering, National Polytechnic Institute, IPN, Mexico**
**MS Hydraulics, National Polytechnic Institute, IPN, Mexico**

*Water Management Scenarios for the Rio Grande/Bravo Basin*

Due to the scarcity of the water resources in the Rio Grande/Bravo basin, alternative water management policies or "Scenarios" have been evaluated to determine their hydrologic feasibility and the individual or joint benefits to water users in the basin. The policies evaluated are proposals of stakeholders, local water management agencies, technicians, and experts in Mexico and the United States. Scenarios include water rights buybacks, groundwater banking through *in lieu* recharge, allocation of non-treaty tributary flows toward treaty delivery obligations, and allocation of water savings from agricultural water conservation. For example, the *in lieu* groundwater banking method is defined by the surface water available in the basin. If there is enough surface water available, recharge is accomplished by curtailing groundwater pumping and providing surface water to water users. On the other hand, if there is not enough surface water, groundwater and surface water are used to meet the water demands. The evaluation model has been constructed in the Water Evaluation and Planning system (WEAP). Various hydrological conditions, such as normal, wet or dry, have been defined to compare the performance of the proposed policies with the current water management policies under different hydrological conditions. The scenarios and their evaluation are presented along with a comparison against the current water management policies.

**Yi-Hsiang Yu, PhD Candidate**
**B.S. Marine Environment and Engineering, National Sun Yet-sen University, Taiwan**
**M.S. Marine Environment and Engineering, National Sun Yet-sen University, Taiwan**

*Prediction of Flows around Ship-shaped Hull Sections in Roll Using an Unsteady Navier-Stokes Solver*

The objective of this research is to model the physics of the separated unsteady viscous flow over a ship-shaped hull section subject to roll motions. A cell center based Finite

Volume Method (FVM) scheme is implemented for solving the Navier-Stokes equations subject to the appropriate conditions on the hull and on the free surface. The results from the present scheme are compared with experimental data and results from other methods, FLUENT and a potential flow solver, for different hull geometries. In the case of prescribed roll motion, the highest amplitude of motion studied is 20 degrees. The effects of the hull geometries in damping the hull motions will be presented for three cases: (a) prescribed roll motion, (b) roll decay from an initial displacement, (c) roll motion due to incoming waves.

## Thursday, March 20

3:30 PM ECJ 1.204

### Y. Peter Sheng, Ph.D., Professor, University of Florida
### Ph.D. Engineering (Fluid and Thermal Sciences) at Case Western Reserve University
### M.S. Engineering (Fluid and Thermal Sciences) at Case Western Reserve University
### B.S. Mechanical Engineering at National Taiwan University

*Hurricane-Induced Coastal Inundation*

Seventy-five percent of the U.S. population lives within 100 miles of coastlines. Coastal population and infrastructure, particularly those in the Gulf of Mexico region, are subject to increasing risk of extreme wind, storm surge, and coastal inundation during hurricane seasons. Coastal states including Florida and Texas must develop robust plans to mitigate the risk and damage associated with hurricane-induced coastal inundation. To this end, this presentation provides a review of hurricane-induced coastal inundation. Following a review of the processes (wind, atmospheric pressure, wave, structure, bathymetry, and topography, etc.) affecting coastal inundation during hurricanes, recent progresses in simulation of wave effects and structure effects are presented using simulation results of an integrated storm surge modeling system for recent hurricanes including Isabel, Ivan, and Katrina. A review of several products of coastal inundation simulation – realtime inundation map, NOAA surge atlas, and FEMA Flood Insurance rate Maps is then given. Use of the integrated modeling system to assist Florida's hurricane response exercise is also described. Future efforts needed to improve these products are discussed.

## Thursday, March 13

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### SPRING BREAK

**Thursday, March 6**
3:30 PM ECJ 1.204

## Younggy Kim
**B.S. in Civil and Environmental Engineering, Korea University, Seoul, Korea**
**M.S in Civil and Environmental Engineering, Korea University, Seoul, Korea**

A one-dimensional model is suggested to analyze the ionic transport in the boundary layer of an electrodialysis (ED) or electrodialysis reversal (EDR) system. The model can simulate two different steady-state electrochemical systems: a potential drop across the boundary layer and a current density in the system. The model result has proven that the diffusivity of the selected ion plays a more important role than the ionic charge does in the ionic transport within the boundary layer located at a diluate cell and a relatively smaller diffusion coefficient of a cation explains why the separation process is usually rate-limited near an cation exchange membrane. A non-uniform distribution of current density is expected when salt concentation varies along a diluate cell. This implies a two-dimensional model is necessary to explain the ionic movement in a whole ED or EDR system. In operational aspects, a thin boundary layer is desirable in a diluate cell with a sufficient potential drop while a thick boundary layer is favorable in a concentrate cell. An ED or EDR system is recommended to operate under about 90 percent of the limiting current density for its efficiency based on a potential and current density curve. Application of 90 percent of the limiting current density can also significantly reduce the additionally required potential energy to maintain the separation rate with decreased perm-selectivity of a nearby ion exchange membrane. The degree of dependency of the separation rate on a non-ideal ion exchange membrane varies in a wide range among 16 binary systems under a limiting current density condition and NaCl is shown to be relatively sensitive.

## Wil Sarchet
**B.S. Civil Engineering, Texas A&M University**

*Effects of a Thin Layer Sand Cap on Bioavailability and Bioaccumulation in Sediments*

The use of a thin layer sand cap (under one foot thick) could prove to be an effective management tool for sediments with relatively low contamination levels, such as dredging residuals. Benefits of a thin layer cap when compared to a thick layer cap include reduced cost, monitoring needs, and environmental impact on waterways. This study examines the effectiveness of a thin layer sand cap in providing protection from bioaccumulation of contaminants in the benthic community, which could lead to risk in human health. Microcosm cells were used to simulate an aquatic environment, and different sand cap thicknesses were evaluated. Additionally, the hypothesis that porewater concentrations can be used to predict bioaccumulation was tested using porewater concentration profiles measured with Solid-Phase Microextraction fibers. Results show that a thin layer cap is effective in reducing bioaccumulation, and initial analysis indicates that porewater concentrations correlate with bioaccumulation.

**Thursday, February 28**
3:30 PM ECJ 1.20

## Li-Jung Chen
## B.S., M.S. Environmental Engineering, National Chung Hsing University, Taiwan

*Biological Treatment of Hazardous Air Pollutants (HAPs) Emitted from Corn-Based Ethanol Production Facilities*

Domestic production of ethanol has expanded dramatically in the past few years as the United States seeks to develop renewable energy sources and replace MTBE as an oxygenate in reformulated gasoline. Formaldehyde and acetaldehyde, generated during ethanol production, are major pollutants of concern since they are classified as hazardous air pollutants (HAPs) and probable human carcinogens. The objective of this research is to evaluate the feasibility of using biofiltration to treat the aldehyde mixtures emitted from ethanol facilities. Experiments were conducted using a biofilter packed with a compost based material. The results indicate that the biofilter can achieve high removal efficiencies of a single aldehyde over the loading ranges typical of ethanol plant emissions. Monod kinetic parameters have been determined from single substrate degradation experiments and will be used in conjunction with lab-scale biofiltration experiments employing aldehyde mixtures to describe the extent of competition in these systems.

## Vimal Vinayan
## B.Tech (Naval Architecture), Cochin University of Science and Technology, India
## M.S. (Ocean Engineering), Florida Atlantic University

*Numerical modeling of surface-piercing hydrofoils*

A surface piercing propeller is a type of supercavitating propeller that operates in a partially submerged configuration. These propellers tend to be more efficient than conventional submerged propellers at service speeds of 70-80 knots and are the primary choice of propulsion for high performance crafts. The increase in efficiency at high speeds is achieved as a result of the reduction in appendage drag, lesser restriction on propeller diameter from hull and draft limitations and reduction of blade surface friction and erosion as cavitation is replaced by ventilation. A two-dimensional potential-flow based Boundary Element Method scheme, with fully nonlinear boundary free-surface boundary conditions, is presented to analyze the ventilated flow past blade sections, which can also be seen as 2D hydrofoils, in the entry-phase. Importance is given to the formation of high speed jets along the wetted portion of the hydrofoil. A FLUENT® model based on multiphase Volume-of-Fluid and Mixture Model is also presented and is used to study the effects of viscosity and spray. Preliminary results are presented comparing the BEM and FLUENT models with existing experimental data for the case of a symmetrical surface-piercing wedge for different angles of attack.

## Thursday, February 21
3:30 PM ECJ 1.204

**Dr. Len Imas**
**Stevens Institute of Technology**

*Computational Aerodynamics for High Performance Yacht Sails*

Advances in hybrid approaches comprising commercially-available Navier-Stokes solver technology and structural dynamic modeling of membranes, coupled with the capability allowing for integration of user-defined physics and numerics into the core solvers, have enabled sail designers and research aerodynamicists to implement complex aerodynamic and fluid-structure interaction (FSI) models of sails and increase the fidelity of sail design in high performance yacht racing. As a consequence, recent research activity in this area has seen a decline in model-scale wind-tunnel testing and use of panel-BL (BoundaryLayer) methods for such applications while sail design has advanced and performance has increased in comparison to earlier generation flying shapes. This presentation will describe current trends in aerodynamic and fluid-structure interaction (FSI) analysis of racing sails through examples and will review relevant topics related to (i) mesh generation; (ii) fluid and structural solver algorithms;(iii) turbulence and transitional flow modeling technology; and (iv) fluid-structure interaction (FSI)and optimization.

## Thursday, February 14
3:30 PM ECJ 1.204

**Allison DenBleyker**
**BS, Texas A&M University**

*Air Pollutant Concentration near Texas Roadways*

Understanding the public health impact of roadway emissions necessitates knowledge of pollutant concentrations near roadways. Studies in Los Angeles and other cities around the world found elevated levels of pollutants near roadways which fell to background levels exponentially with increased distance from the roadway. Such data are not available for any roadways in Texas, where on-road fleets and roadway design differ from previously studied locations. The Texas Commission on Environmental Quality sponsored a team led by the University of Texas to examine CO, NOx, VOCs, PM, UFP and selected carbonyl concentrations near three roadways in the Austin area. This research focuses on maximum pollutant exposures at the edge of the roadways and the decay profile as one moves downwind of the road.

**Rémi Candaele**
**BS, Ecole Centrale de Lille**

*Characterizing flow through porous asphalt*

Porous Friction Course (PFC) or porous asphalt is a permeable asphalt layer placed over an impervious pavement. Air void spaces inside the pavement allow rainfall to flow to the base of the porous asphalt and runoff appears at the edges of the pavement. Numbers of benefits of PFC are acknowledged such as reduced hydroplaning and better visibility. Â This study focuses on the hydraulic properties of porous asphalt overlays installed by TxDOT at three locations around Austin: Loop 360, FM1431 and FM620. Air void content and hydraulic conductivity have been measured through different laboratory methods on extracted cores. Results have revealed a substantial clogging phenomenon of the PFC samples.

**Thursday, February 7**
3:30 PM ECJ 1.204

**Tina Stanard**
**BS, University of Texas at Austin**

*Porous Asphalt and all its glory*

Permeable Friction Course (PFC) is a porous asphalt overlay that is placed over an existing impervious base. The interconnected voids of the overlay allow rainwater to drain down into the pavement and then out to the edge of the pavement along the boundary with the impervious base. Benefits of PFC include noise reduction and improved driving safety in wet weather conditions due to less spray, reduced hydroplaning and increased skid resistance. PFC also improves stormwater quality due to possibly reducing the generation of pollutants and retaining a portion of the pollutants within pores of the pavement. This research investigates the stormwater quality improvements through monitoring at two sites located on Loop 360 in Austin, Texas. Concentrations of TSS and total lead, zinc, copper and phosphorous are found to be significantly lower in runoff from PFC than from conventional pavement. The benefits of PFC are lost when the pores in the pavement become clogged. Through ongoing monitoring, the functional life of the pavement will be established.

**Katie Alfredo**
**BS, Cooper Union University**

*How important is research ethics for engineers?*

The topic of research ethics may appear to be well researched and defined, but how these codes and guidelines specifically affect graduate engineering students still remains a grey area. The prevalence of plagiarism scandals and the internal debate about whether words or data as a product are an engineer's main concern give weight to the argument that a more structured method of teaching proper research ethics than mere observation is needed. To address this issue an NSF sponsored project is underway. Through a review of the literature, faculty and student focus groups, and a pilot

survey the place of UT students on the ethical scale is being studied. Using the information gathered, the research team is creating instructional modules tailored to the topics facing most graduate engineering students in an attempt to engage more of the research community in this ongoing conversation about proper research ethics.

**Thursday, January 31**
3:30 PM ECJ 1.204

### Rebecca Teasley, Ph.D. Candidate
### BS Environmental Resources Engineering, Humboldt State University
### MS Environmental and Water Resources Engineering, University of Texas at Austin

*Cooperative Game Theory for Transboundary River Basins: The Syr Darya Basin*

Water resources management is a complex and varied topic which is further complicated when a water source is shared by more than one countries. With over 200 transboundary river basins shared by two or more countries, it is important to develop tools to allow riparian countries to cooperatively manage these shared water resources. Cooperative game theory provides methods for quantifying the value of cooperation across jurisdictional boundaries through a suite of mathematical tools that measure the benefits of that cooperation among basin stakeholders. Cooperative game theory also provides methods to fairly and equitably allocate the gains of that cooperation to all participating stakeholders. Cooperative game theory has been applied to the Syr Darya basin as a three player cooperative game. Benefits are determined for varying levels of cooperation among the three major players in the basin.

### Heather Simon, PhD Candidate
### B.S. Earth Systems, Stanford University
### M.S.E Environmental and Water Resources Engineering, University of Texas at Austin

*Modeled Effects of Observed Nitryl Chloride Concentrations in the Houston Area*

The recent TexAQS II field study involved intensive air pollutant measurements over Texas during the summer and fall of 2006. During TEXAQS II, NOAA researchers measured concentrations of nitryl chloride of up to 1 ppb in the Houston urban area. Nitryl chloride is potentially important to atmospheric chemistry in urban environments because its photolysis products include both NO2 and chlorine radicals. Chlorine radicals have previously been shown to significantly increase ozone formation in urban Houston. If the values of nitryl chloride measured in Galveston Bay are widespread, this compound has the potential to significantly affect the local reactive chlorine budget and ultimately ozone mixing ratios. Photochemical modeling was performed using the comprehensive air quality model with extensions (CAMx) to investigate the possible effects of measured nitryl chloride concentrations on local chemistry. CAMx was modified to include nitryl chloride and its

photolysis reaction (the dominant loss mechanism of this compound). The photochemical modeling runs were performed for a series of days during the TEXAQS II study. After an initial 3 day ramp-up period, model runs were stopped at 7am every morning (the approximate time of sunrise). At that time, measured concentrations of nitryl chloride were inserted into the modeling domain in the nine by nine grid cell region around the measurement point (a 36 km2 region). The parcel of air which contained the initial nitryl chloride concentrations was followed throughout the day. Chlorine radical and ozone concentrations in this model run were compared to those predicted in a basecase model run which did not include any nitryl chloride.

## Thursday, January 24

3:30 PM ECJ 1.204

**Susan K. De Long**
**Ph.D. Candidate**

### *Development of Molecular Biology Tools for Biological Perchlorate Treatment*

Perchlorate is a widespread groundwater contaminant that is known to cause adverse health effects such as thyroid dysfunction in humans. Biological treatment is a promising treatment option because perchlorate-reducing bacteria (PRB) are common in the environment and are likely to be present at perchlorate-contaminated sites; the feasibility of biological perchlorate treatment using biologically active carbon (BAC) filters has been demonstrated at the pilot-scale. Many PRB have been isolated that reduce perchlorate to chlorate, and then to chlorite, using perchlorate reductase (pcr). Chlorite, a toxic by-product, is converted to oxygen and chloride using chlorite dismutase (cld). However, successful biological treatment requires not only that the PRB are present, but that they are also actively expressing perchlorate-reducing genes (e.g., pcr and cld) and degrading perchlorate. Changes in the microbial community can lead to process failures; however, few tools currently exist to diagnose these problems. Molecular biology tools, such as quantitative reverse transcription polymerase chain reaction (PCR), might be used to track the expression of perchlorate degradation genes as a function of water quality conditions and process operating parameters, and they even have the potential to detect upsets in the microbial community before process performance is adversely affected. Sequences for pcr and cld have been reported in the literature for a number of phylogenetic groups (e.g., Dechloromonas, Dechlorosoma), and PCR primers have been designed based on these; however, these primers might not detect all PRBs present. For example, while Azospirillum PRB have often been found at perchlorate-contaminated sites, they were not considered in the design of these primers since their perchlorate-reducing genes have not been sequenced. Therefore, we recently developed a tool called Prokaryotic cDNA Subtraction that can be used to obtain the sequences of biodegradation genes from bacteria. We are currently applying this tool to obtain perchlorate reducing genes from bacteria isolated from a perchlorate contaminated site. These sequences will be used to design PCR primers for monitoring bioreactors treating perchlorate contaminated water.

**Thursday, January 17**
3:30 PM ECJ 1.204

**Glenn Morrison**
**Associate Professor of Civil, Architectural and Environmental Engineering**
**Missouri University of Science & Technology**

## *Using chemical activity in materials to reconstruct pollution histories and improve exposure analysis*

"If the walls could talk, what stories they would tell." From the perspective of public health, this popular phrase expresses my contention that useful information about past chemical exposure is stored in the nearby materials that witness the event. If the walls could indeed surrender that information, a great deal would be learned about recent contaminant history. We all know that building materials store *some* information about chemical exposure in indoor environments. When you walk into a room where cigarette smoking has recently occurred, you know that someone in the recent past was smoking; all you needed was your nose. I believe that a more sophisticated analysis will reveal a treasure-trove of information about recent pollution episodes. In this presentation, I will show how we can derive the chemical exposure history of an environment by measuring chemical concentration profiles within nearby materials, such as vinyl flooring, concrete and even trees. The key to mastering the past is to mathematically reconstruct exposure events from the residual contaminant concentration gradients. Contaminants adsorb and absorb into nearby porous solids and immediately begin diffusing into them. Diffusion in uniform materials is well understood, and we can predict the resulting internal concentration gradient if we know the external concentration time-history. To learn about past events, it is necessary to solve an "inverse diffusion problem". Having shown that these systems have unique mathematical solutions, we are now working towards useful solution methods. I will show early results of this work and also discuss results to date measuring concentration gradients in vinyl flooring, wood and polyurethane foam. I will also discuss applying these techniques to identify asthma promoters in homes with children, monitor groundwater remediation progress, investigate vapor intrusion into buildings and develop passive badges for dynamic personal monitoring of pollutants.