Measurement & Monitoring:
27th Quarterly Literature Update

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Accumulation of Dechlorination Daughter Products: a Valid Metric of Chloroethene Biodegradation
Bradley, P.M. and F.H. Chapelle.
Remediation Journal, Vol 17 No 4, p 7-22, 2007

In situ reductive dechlorination of perchloroethene (PCE) and trichloroethene (TCE) generates characteristic chlorinated (cis-dichloroethene [cis-DCE] and vinyl chloride [VC]) and nonchlorinated (ethene and ethane) products. The accumulation of these daughter products is commonly used as a metric for ongoing biodegradation at field sites, but this interpretation assumes that reductive dechlorination is the only chloroethene degradation process of any significance in situ and that the characteristic daughter products of chloroethene reductive dechlorination persist in the environment. Laboratory microcosms, prepared with aquifer and surface-water sediments from hydrologically diverse sites throughout the United States and amended with radiolabeled chlorinated hydrocarbons, demonstrated widely variable patterns of intermediate and final product accumulation. Accumulation of radiolabeled DCE, VC, ethene, and ethane predominated in methanogenic sediment treatments, whereas treatments characterized by significant Fe(III) and/or Mn(IV) reduction demonstrated substantial, and in some cases exclusive, accumulation of radiolabeled carbon dioxide and methane. These results suggest that relying on the accumulation of cis-DCE, VC, ethene, and ethane may underestimate overall chloroethene biodegradation substantially at many sites.

Accurate Quantification of Freely Dissolved Organochlorine Pesticides in Water in the Presence of Dissolved Organic Matter Using Triolein-Embedded Cellulose Acetate Membrane
Ke, R., Z. Wang, S. Huang, and S. Khan.
Analytical and Bioanalytical Chemistry, Vol 387 No 8, p 2871-2879, Apr 2007

A novel method is described using triolein-embedded cellulose acetate membrane (TECAM) for accurate determination of the freely dissolved fraction of organochlorine pesticides (OCPs) in waters rich in dissolved organic matter (DOM). Method performance was tested with an air-bridge system for extracting OCPs from aqueous solutions with and without humic acid. In addition, the partition coefficients between humic acid and water for 20 OCPs were determined by TECAM with negligible depletion extraction. TECAM predominantly extracts the freely dissolved compounds, and its extraction efficiency decreases significantly with an increase in concentration of humic acid in water. The kinetic uptake rate constants and TECAM/water partition coefficients for the 20 OCPs were obtained using the controlled laboratory continuous-flow and static exposure system, respectively. These calibration parameters were used in the field experiment to estimate the freely dissolved concentrations of OCPs in lake water. The results showed that TECAM can be used successfully to determine the freely dissolved OCPs in aquatic environments containing DOM. The method is particularly suited for long-term water sampling.

Advances in Remote Sensing for Oil Spill Disaster Management: State-of-the-Art Sensors Technology for Oil Spill Surveillance
Jha, M.N. (Univ. of Calgary, Calgary, AB, Canada); J. Levy (Western Washington Univ., Bellingham); Y. Gao (Univ. of Calgary).
Sensors, Vol 8 No 1, p 236-255, 2008

This paper examines the characteristics and applications of the different sensors currently available for oil spill surveillance. A better understanding of the strengths and weaknesses of these sensors will improve their operational use for oil spill response and contingency planning. Laser fluorosensors were found to offer the most flexibility for oil spill detection because they detect and classify oil on all surfaces and also operate in daylight or darkness. For example, the scanning laser environmental airborne fluorosensor (SLEAF) sensor was identified to be a valuable tool for oil spill surveillance. No single sensor was able to provide all information required for oil spill contingency planning; therefore, combinations of sensors currently are used for oil spill surveillance. Specifically, satellite sensors are used for preliminary oil spill assessment, while airborne sensors are used for detailed oil spill analysis. While satellite remote sensing is not suitable for tactical oil spill planning, it can provide a synoptic coverage of the affected area.

http://www.mdpi.org/sensors/list08.htm

AGLITE: a Multi-Wavelength Lidar for Measuring Emitted Aerosol Concentrations and Fluxes and Air Motion from Agricultural Facilities
Wilkerson, T.D., G.E. Bingham, V.V. Zavyalov, J.A. Swasey, J.J. Hancock, B.G. Crowther, S.S. Cornelsen, C. Marchant, J.N. Cutts, D.C. Huish, C.L. Earl, J.M. Andersen, and M.L. Cox, Space Dynamics Lab.
Lidar Remote Sensing for Environmental Monitoring VII, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6409, 10 pp, 2006

AGLITE is a multi-wavelength lidar developed for the Agricultural Research Service, U.S. Department of Agriculture and its program on particle emissions from animal production facilities. The lidar transmitter is a 10 kHz pulsed NdYAG laser at 355, 532, and 1064 nm. Lidar backscatter and extinction are analyzed to extract aerosol physical properties. All-reflective optics and dichroic and interferometric filters permit all wavelengths to be measured simultaneously, day or night, using photon counting by MTs, an APD, and fast data acquisition. The lidar housing is a transportable trailer suitable for all-weather operation at any accessible site. The laser and telescope FOVs are directed to targets of interest in both azimuth and elevation. The lidar has been applied in atmospheric studies at a swine production farm in Iowa and a dairy in Utah. Prominent aerosol plumes emitted from the swine facility were measured as functions of temperature, turbulence, stability, and the animal feed cycle. Particle samplers and turbulence detectors were used by colleagues specializing in those fields. Lidar measurements also focused on air motion as seen by scans of the farm volume. The value of multi-wavelength, eye-safe lidars for agricultural aerosol measurements has been confirmed by the successful operation of AGLITE.

Air Monitoring of a Coal Tar Cleanup Using a Mobile TAGA LPCI-MS/MS
Chen, Qing-Feng, R.K. Milburn, G.B. DeBrou, and N.S. Karellas, Mobile Air Monitoring, Ontario Ministry of the Environment, Toronto, ON, Canada.
Journal of Hazardous Materials, Vol 91 Nos 1-3, p 271-284, 26 Apr 2002

Real-time detection of air contaminants at low levels, which is important to understanding contamination sources and constituents, requires reliable sampling and calibration techniques, and sophisticated analytical instrumentation. A new low-pressure chemical ionization (LPCI) source was developed recently for ambient real-time air monitoring of benzene, toluene, xylene (BTX), and gas-phase polycyclic aromatic hydrocarbons (PAH). When used in conjunction with a triple quadrupole (Q1, Q2, Q3) mass spectrometer (trace atmospheric gas analyzer (TAGA IIe)), the ion source has proven highly useful. Under LPCI conditions, the ion chemistry involves charge transfer reactions, yielding parent ions that are selected in the first quadrupole, Q1, and dissociated in the second quadrupole, Q2. The resultant daughter ions are identified in the third quadrupole, Q3. Monitoring specific parent/daughter (P/D) ion pairs is used to measure concentrations of BTX and selected PAH. The response of the TAGA IIe is characterized through multi-point calibration curves. Detection limits (DL) as low as 0.5 ug/m3 for BTX and PAH were accomplished by optimizing various TAGA IIe operating parameters. In November 1999, this unique method was used to monitor emissions released during the cleanup of a historical coal tar site in Kingston, Ontario. Local officials used the results to enhance abatement activities or in some cases temporarily halt excavation when levels of air toxics exceeded those allowed by provincial guidelines.

Amperometric Enzyme-based Gas Sensor for Formaldehyde: Impact of Possible Interferences
Achmann, S., M. Hammerle, and R. Moos, Univ. of Bayreuth, Bayreuth, Germany.
Sensors, Vol 8 No 2, p 1351-1365, Feb 2008

Cross-sensitivities and environmental influences on the sensitivity and the functionality of an enzyme-based amperometric sensor system for the direct detection of formaldehyde from the gas phase were studied. The sensor shows a linear response curve for formaldehyde in the tested range (0 to 15 vppm) with a sensitivity of 1.9 uA/ppm and a detection limit of about 130 ppb. Cross-sensitivities by environmental gases, such as vapors of organic solvents like methanol and ethanol, were evaluated along with the influence of temperature and humidity on the sensor system. The sensor showed no significant reaction to methanol or ethanol or to variations in the humidity of the test gas. Temperature variations had the biggest influence on the sensor sensitivity, with variations in the sensor signal of up to 10% for 5 vppm CH_2O at a temperature range of 25 to 30 degrees C.
http://www.mdpi.org/sensors/list08.htm

Application of Solid Phase Microextraction with Gas Chromatography-Mass Spectrometry as a Rapid, Reliable, and Safe Method for Field Sampling and Analysis of Chemical Warfare Agent Precursors
Parrish, Douglas K., Ph.D. dissertation, Uniformed Services University of the Health Sciences.
NTIS: ADA435624, 136 pp, Mar 2005

Solid-phase microextraction was combined with gas chromatography-mass spectrometry (SPME-GC-MS) for detection of hydrogen cyanide (HCN) in the headspace above deionized

water samples, with linear results that were sensitive to below DoD short-term drinking water standards. HCN and several common volatile organic contaminants also were detected in 3 water types in lab and field settings. The method provides an advantage over the standard drinking water detection methods for HCN as it also can detect common low molecular-weight hydrocarbons simultaneously.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=A435624&Location=U2&doc=GetTRDoc.pdf

Applications of Open-Path Fourier Transform Infrared for Identification of Volatile Organic Compound Pollution Sources and Characterization of Source Emission Behaviors
Lin, Chitsan, Naiwei Liou, and Endy Sun.
Journal of the Air & Waste Management Association, Vol 58 No 6, June 2008

An open-path Fourier transform infrared spectroscopy (OP- FTIR) system was set up for 3-day continuous line-averaged monitoring of VOCs in a paint manufacturing plant. Seven VOCs (toluene, m-xylene, p-xylene, styrene, methanol, acetone, and 2-butanone) were identified in the ambient environment. Major sources of methanol, m-xylene, acetone, and 2-butanone were identified in the direction where paint solvent manufacturing processes are located. An attempt to uncover sources of styrene was not successful because the method detection limit of the OP-FTIR system was not sensitive enough to produce conclusive data. The OP- FTIR system also was set up in an industrial complex, where 8 major VOCs were identified in the ambient environment. The pollutant detected wind-rose percentage plots that clearly showed the main origination of ethylene, propylene, 2-butanone, and toluene from the tank storage area, whereas n-butane came mainly from the butadiene manufacturing processes of the refinery plant, and ammonia was identified as an accompanying reduction product in the gasoline desulfuration process. Advantages of OP-FTIR include its ability to analyze many compounds simultaneously and continuously, and monitoring over the length of its long path can obtain more comprehensive data than the traditional multiple, single-point monitoring methods.
http://www.redorbit.com/news/science/1440253/applications_of_openpath_fourier_transform_infrared_for_identification_of_volatile/index.html?source=r_science

Applications of Polarimetric and Interferometric SAR to Environmental Remote Sensing and its Activities: Recent Advances in Extrawideband Polarimetry, Interferometry and Polarimetric Interferometry in Synthetic Aperture Remote Sensing and its Applications
Boerner, Wolfgang-Martin, University of Illinois at Chicago.
RTO-EN-SET-081bis, NTIS: ADA470880, 35 pp, Feb 2007

The development of radar polarimetry and radar interferometry is advancing rapidly, and these novel radar technologies are revamping synthetic aperture radar (SAR) imaging decisively. With radar polarimetry, the textural fine structure, target orientation and shape, symmetries, and material constituents can be recovered with considerable improvements above that of standard amplitude-only polarization radar, whereas with radar interferometry, the spatial (in depth) structure can be explored. With polarimetric-interferometric synthetic aperture radar (POL-IN-SAR) imaging, it is possible to recover such co-registered textural plus spatial properties simultaneously. This includes the extraction of digital elevation maps (DEM) from either fully polarimetric (scattering matrix) or interferometric (dual antenna) SAR image-data takes, with the additional benefit of obtaining co-registered 3-D POL-IN-DEM information. Extra-wide-band POL-IN-SAR imaging (when applied to repeat-pass image overlay interferometry) provides

differential background validation and measurement, stress assessment, and environmental stress-change monitoring capabilities with hitherto unattained accuracy. These are essential tools for improved global biomass estimation. More recently, application of multiple parallel repeat-pass EWB-POL-D(RP)-IN-SAR imaging along stacked (altitudinal) or displaced (horizontal) flight-lines is expected to result in tomographic (multi-interferometric) polarimetric SAR stereo imaging, including foliage and ground-penetrating capabilities. The accelerated advancement of these modern EWB-POL-D(RP)-IN-SAR imaging techniques is of direct relevance and of paramount priority to wide-area dynamic homeland security surveillance and local-to-global environmental ground-truth measurement and validation, stress assessment, and stress-change monitoring of the terrestrial and planetary covers. In addition, the author appraises closely related topics of (i) acquiring additional and protecting existing spectral windows of the natural electromagnetic spectrum (NES) pertinent to remote sensing, and (ii) mitigating against common radio frequency interference (RFI) and intentional directive jamming of airborne and space-borne POL-IN-SAR imaging platforms.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA470880&Location=U2&doc=GetTRDoc.pdf

Assessing and Managing Contaminated Sediments, Part I: Developing an Effective Investigation and Risk Evaluation Strategy
Apitz, S.E., J.W. Davis, K. Finkelstein, D.W. Hohreiter, R. Hoke, R.H. Jensen, J. Jersak, V.J. Kirtay, E.E. Mack, V. Magar, D.W. Moore, D. Reible, and R.G. Stahl Jr.
Integrated Environmental Assessment and Management, Vol 1 No 1, p 2-8, 2005

This review (part 1 of 2) introduces some of the major technical and policy issues stemming from the assessment and management of contaminated sediments, highlights aspects of successful contaminated sediment assessment and management, and when appropriate, addresses the barriers that still exist for improving contaminated sediment management. The many key elements of an effective investigation and risk evaluation strategy are reviewed, beginning with the development of a conceptual site model and including a discussion of some of the key factors influencing the design of sediment investigations and ecological risk assessment of sediment-bound chemicals on aquatic biota.

Assessing and Managing Contaminated Sediments, Part II: Evaluating Risk and Monitoring Sediment Remedy Effectiveness
Apitz, S.E., J.W. Davis, K. Finkelstein, D.W. Hohreiter, R. Hoke, R.H. Jensen, J. Jersak, V.J. Kirtay, E.E. Mack, V. Magar, D.W. Moore, D. Reible, and R.G. Stahl Jr.
Integrated Environmental Assessment and Management, Vol 1 No 1, (online only): p e1-e14, 2005

This review (part 2 of 2) assesses various approaches for evaluating sediment risk and monitoring sediment remedy effectiveness. While many of the technical and policy issues described are relevant to dredged material management, the focus of the paper is on sediment assessment for environmental management.

Assessing Steady-State Fluorescence and PRI from Hyperspectral Proximal Sensing as Early Indicators of Plant Stress: The Case of Ozone Exposure
Meroni, M., M. Rossini, V. Picchi, C. Panigada, S. Cogliati, C. Nali, and R. Colombo.
Sensors, Vol 8 No 3, p 1740-1754, Mar 2008

High spectral resolution spectrometers were used to detect optical signals of ongoing plant stress in potted white clover canopies subjected to ozone fumigation, which was used as a paradigm of oxidative stress. Steady-state fluorescence (Fs) and the photochemical reflectance index (PRI) were investigated as advanced hyperspectral remote sensing techniques able to sense variations in the excess energy dissipation pathways occurring when photosynthesis declines in plants exposed to a stress agent. Fs and PRI were monitored in control and ozone-fumigated canopies during a 21-day experiment alongside traditional normalized difference vegetation index (NDVI) and physiological measurements commonly employed to describe stress development (i.e., net CO2 assimilation, active fluorimetry, chlorophyll concentration, and visible injuries). The investigators found that remote detection of ongoing stress through Fs and PRI can be achieved in an early phase, which is characterized by the decline of photosynthesis, whereas NDVI was able to detect stress only after actual damage had occurred. These results open up new possibilities for assessment of plant stress by means of hyperspectral remote sensing.
http://www.mdpi.org/sensors/list08.htm

Assessment of Organophosphate and Carbamate Pesticide Residues in Cigarette Tobacco with a Novel Cell Biosensor
Mavrikou, S., K. Flampouri, G. Moschopoulou, O. Mangana, A. Michaelides, and S. Kintzios.
Sensors, Vol 8 No 4, p 2818-2832, Apr 2008

A novel cell biosensor has been developed for detecting organophosphate and carbamate pesticide residues in tobacco. The sensor is based on neuroblastoma N2a cells and the measurement of changes of the cell membrane potential, based on the working principle of the bioelectric recognition assay. The presence of pesticide residues is detected by the degree of inhibition of acetylcholine esterase (AChE). The sensor instantly responded to both the organophoshate pesticide chlorpyriphos and the carbamate carbaryl in a concentration-dependent pattern at a detection level of 1 ppb. Tobacco leaf samples (in blended dry form) were analyzed with both the novel biosensor and conventional methods, according to a double-blind protocol. Pesticide residues in tobacco samples caused a considerable cell membrane hyperpolarization to neuroblastoma cells immobilized in the sensor, as indicated by the increase of the negative sensor potential, which was clearly distinguishable from the sensor's response against pesticide-free control samples. The observed response was quite reproducible, with an average variation of +/-5 to 6%. Fluorescence microscopy observations showed that treatment of the cells with either chlorpyrifos or carbaryl was associated with increased cytoplasmic calcium ion concentration. The novel biosensor offers fresh perspectives for ultra-rapid, sensitive and low-cost monitoring of pesticide residues in tobacco as well as other food and agricultural commodities.
http://www.mdpi.org/sensors/list08.htm

Assessment of Vegetation Stress Using Reflectance or Fluorescence Measurements
Campbell, P.K.E. (Univ. of Maryland, Greenbelt), E.M. Middleton (NASA/Goddard Space Flight Center, Greenbelt, MD), J.E. McMurtrey (USDA-ARS, Beltsville, MD), L.A. Corp (Science Systems and Applications Inc., Lanham, MD), and E.W. Chappelle (NASA).
Journal of Environmental Quality, Vol 36, p 832-845, 2007

Current methods for large-scale vegetation monitoring rely on multispectral remote sensing, which has serious limitations for the detection of vegetation stress. To contribute to the establishment of a generalized spectral approach for vegetation stress detection, this study compares the ability of high-spectral-resolution reflectance (R) and fluorescence (F) foliar measurements to detect vegetation changes associated with common environmental factors affecting plant growth and productivity. To obtain a spectral dataset from a broad range of species and stress conditions, plant material from three experiments was examined, including (i) corn, nitrogen (N) deficiency/excess; (ii) soybean, elevated carbon dioxide, and ozone levels; and (iii) red maple, augmented ultraviolet irradiation. Fluorescence and R spectra (400 to 800 nm) were measured on the same foliar samples in conjunction with photosynthetic pigments, carbon, and N content. For separation of a wide range of treatment levels, hyperspectral (5 to 10 nm) R indices were superior compared with F or broadband R indices, with the derivative parameters providing optimal results. For the detection of changes in vegetation physiology, hyperspectral indices can provide a significant improvement over broadband indices. The relationship of treatment levels to R was linear, whereas that to F was curvilinear. Using reflectance measurements, it was not possible to identify the unstressed vegetation condition, which was accomplished in all three experiments using F indices. Large-scale monitoring of vegetation condition and the detection of vegetation stress could be improved by using hyperspectral R and F information, a possible strategy for future remote sensing missions.

Autonomous Field-Deployable Device for the Measurement of Phosphate in Natural Water
Slater, C. (Dublin City Univ., Ireland), J. Cleary, C.M. McGraw, W.S. Yerazunis, K.T. Lau, and D. Diamond.
Advanced Environmental, Chemical, and Biological Sensing Technologies V, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6755, 8 pp, 2007

An autonomous platform for the measurement of phosphate levels in river water is designed to take a measurement every hour, relay the result to a laptop computer, and operate unassisted for one year. A first-generation prototype has already been developed and successfully field tested. The system contains the sampling, chemical storage, fluid handling, colorimetric data acquisition, and waste storage capabilities necessary to perform the phosphate measurement. The device has an embedded control, a GSM communications system, and a power supply to allow independent operation. The entire system is placed inside a compact and rugged enclosure. Although a new second-generation system is identical in operation to the prototype, its design has a greater emphasis on power efficient components and power management to allow for a longer lifetime. Other improvements include an automated 2-point calibration to compensate for drift and a more rugged design to increase device lifetime.

Biomonitoring: Guide for the Use of Biological Endpoints in Monitoring Species, Habitats, and Projects
NAVFAC Risk Assessment Workgroup and Argonne National Laboratory.
TR-2284-ENV, 146 pp, Nov 2007

This document presents a six-step framework for using biological endpoints in monitoring species, habitats, and projects associated with Navy Environmental Restoration Program (NERP) sites undergoing remediation in compliance with CERCLA. The framework, which is fully consistent with U.S. EPA guidance on monitoring plan development, includes identification of biomonitoring objectives and the development of biomonitoring hypotheses to focus the monitoring plan; the development of decision criteria such as action levels and alternative actions for terminating or continuing the biomonitoring program; and the design of data collection and analysis methods, including identification of appropriate biological endpoints and biota. The guidance is not intended to specify the scale, complexity, protocols, data needs, or investigation methods for meeting the needs of site-specific biomonitoring. Instead, it addresses the development of the logic and rationale needed to support a decision to design and implement a monitoring program using biological endpoints at NERP sites. This text identifies general categories of biomonitoring endpoints and the use of captive and naturally occurring biota, as well as factors (e.g., ease of collection, exposure potential) to be considered when selecting biological endpoints and biota for use in a biomonitoring program.
http://web.ead.anl.gov/ecorisk/related/documents/FinalBiomonitoringGuideNov2007.pdf

Brownfields Technology Primer: Vapor Intrusion Considerations for Redevelopment
U.S. EPA, Office of Solid Waste and Emergency Response.
EPA 542-R-08-001, 48 pp, Mar 2008

Along with the normal financial and business risks associated with developing properties, brownfields redevelopers must manage environmental risk, including risks from vapor intrusion, which is the migration of chemical vapors from contaminated soil and groundwater into buildings. This primer is designed for land revitalization stakeholders concerned about vapor intrusion, including property owners, municipalities, and real estate developers. It provides an overview of the vapor intrusion issue and how it can affect redevelopment. It also summarizes techniques for quickly and cost effectively assessing the potential for vapor intrusion, as well as techniques for mitigating it. The core message of the primer is that early consideration of vapor intrusion beginning during the Phase I environmental site assessment will help ensure that redevelopment protects the health of current and future building occupants. In addition, incorporating relatively inexpensive mitigation (prevention) techniques into the construction of new buildings, rather than retrofitting them later, will result in significant cost savings and help avoid the occurrence of vapor intrusion in the future. Because there are many available, cost-effective approaches to mitigation, vapor intrusion concerns need not stand in the way of brownfields redevelopment.
http://brownfieldstsc.org/newpublications.cfm?tabS=2

Cadmium Arachidate Single-Walled Carbon Nanotubes Composites as Sensitive Coatings for High Sensitivity Fiber Optic Chemo-Sensors
Consales, M., A. Crescitelli, A. Cutolo, M. Penza. P. Aversa, M. Giordano, and A. Cusano.
Third European Workshop on Optical Fibre Sensors, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6619, 4 pp, 2007

The authors have investigated the feasibility of exploiting optoelectronic chemo-sensors based on cadmium arachidate/single-walled carbon nanotube composites for detection of chemical pollutants in air and water. The nanocomposite sensing layers have been transferred upon the distal end of standard optical fibers by the Langmuir-Blodgett technique. Single-wavelength reflectance measurements have been carried out to monitor chemicals concentration through changes in the optical length of the Fabry-Perot cavity induced by the interaction of the sensitive layer with the analyte molecules. The preliminary experimental results show good potential for using these fiber-optic nanosensors to detect toluene and xylene at ppm levels in both air and water at room temperature.

Characterization and Quantification of Pneumatic Fracturing Effects at a Clay Till Site
Christiansen, C.M., C. Riis, S.B. Christensen, M.M. Broholm, A.G. Christensen, K.E. Klint, J.S. Wood, P. Bauer-Gottwein, and P.L. Bjerg, Technical Univ. of Denmark, Kgs. Lyngby, Denmark.
Environmental Science & Technology, Vol 42 No 2, p 570-576, 15 Jan 2008

Pneumatic fracturing in low-permeability matrices (e.g., clays) provides pathways in the subsurface to aid remediation efforts. A pilot study of pneumatic fracturing was performed at a typical basal clay till site, with a focus on direct documentation of fracture propagation patterns and spacing. A novel package of documentation methods was applied: injection of five tracers with different characteristics (bromide, uvitex, fluorescein, rhodamine WT, and brilliant blue), subsequent tracer-filled fracture documentation via direct and indirect methods, and geological characterization of the fractured site. The direct documentation methods consisted of Geoprobe(r) coring, augering, and excavation. A mass balance and a conceptual model have been established for the distribution of the injected tracers in the subsurface. They reveal that tracer was distributed within 2 m of the fracturing well, mainly in existing fractures above the redox boundary. Spacing of observed tracer-filled fractures was large (>1 m) at greater depths. The pilot study results indicated the potential for increasing the number of fractures induced/activated via adjustments to the fracturing equipment design.

Characterization of Preferential Ground-Water Seepage from a Chlorinated Hydrocarbon-Contaminated Aquifer to West Branch Canal Creek, Aberdeen Proving Ground, Maryland, 2002-04
Majcher, Emily H., Daniel J. Phelan, Michelle M. Lorah, and Angela L. McGinty
U.S. Geological Survey Scientific Investigations Report 2006-5233, 193 pp, 2007

Although field and laboratory demonstrations have shown efficient natural attenuation processes in the non-seep wetland areas and stream bottom sediments of West Branch Canal Creek, chlorinated volatile organic compounds (VOCs) are present in a freshwater tidal creek at Aberdeen Proving Ground, Maryland. In some areas of the wetland, preferential flow paths or seeps allow transport of organic compounds from the contaminated sand aquifer to the overlying surface water without undergoing natural attenuation. From 2002 through 2004, the U.S.

Geological Survey, in cooperation with the Environmental Conservation and Restoration Division of the U.S. Army Garrison, Aberdeen Proving Ground, characterized preferential groundwater seepage as part of an ongoing investigation of contaminant distribution and natural attenuation processes in wetlands at this site. Qualitative thermal infrared surveys coupled with quantitative verification of temperature differences, and screening for VOC and methane concentrations proved to be effective tools in determining the overall extent of preferential seepage. Seep locations characterized as focused seeps contained the highest concentrations of chlorinated parent compounds, relatively low concentrations of chlorinated daughter compounds, and insignificant concentrations of methane in shallow pore water samples. These seeps were primarily along the creek edge or formed a dendritic-like pattern between the wetland and creek channel. In contrast, seep locations characterized as diffuse seeps contained relatively high concentrations of chlorinated daughter compounds (or a mixture of daughter and parent compounds) and detectable methane concentrations in shallow pore water samples. These seeps were primarily along the wetland boundary. When the hydrologic properties were extrapolated to focused and diffuse seep locations within the creek, seep areas were estimated to account for about 1 percent of the total discharge area of the wetland. However, this 1 percent of wetland discharge area is estimated to contribute more than 20 percent of the total groundwater discharge to the creek, indicating that the seeps play an important role in the transport of groundwater and dissolved VOCs to surface water. Some limited, passive remediation in seep areas coupled with natural attenuation could preserve the wetland ecosystem and reduce the loading of VOCs to West Branch Canal Creek.
http://pubs.usgs.gov/sir/2006/5233/

Chemical and Bioassay Monitoring of PCB-Contaminated Soil Remediation Using Solvent Extraction Technology
Takigami, H., T. Etoh, T. Nishio, and S.-I. Sakai.
Journal of Environmental Monitoring, Vol 10, p 198-205, 2008

In Kobe, Japan, investigators found in 2001 that 68 cubic meters of soil had been contaminated with ~6.6 kg of polychlorinated biphenyl (PCB) as a result of the illegal dumping of PCB capacitors. During a full-scale remediation carried out in 2002 and 2003, solvent extraction using isopropyl alcohol was conducted in 47 batch treatments. Achievement of the Japanese environmental quality standard for PCBs in soil needed, on average, 8.4 extraction cycles per batch. Analytical results showed that the average PCB concentration (88 ug/g dry soil) in untreated soil samples of all the batches fell to 1.2 ug/g dry soil in treated soil samples, indicating a removal efficiency of 98.6%. Dioxin responsive-chemical activated luciferase gene expression assay (DR-CALUX) and enzyme-linked immunosorbent assay (ELISA) adopting a monoclonal antibody against 2,3,4,4,5-pentachlorobiphenyl (PCB #118) were used to screen soil samples rapidly before and after solvent extraction. The DR-CALUX and ELISA results were in good agreement with World Health Organization toxicity equivalent values and analytically determined PCB concentrations, respectively. After the full-scale treatment, the amount of PCBs recovered from the solvent purification system approximated the estimated amount of PCBs spilled.

Chemical Sensing Sensitivity of Long-Period Grating Sensor Enhanced by Colloidal Gold Nanoparticles
Tang, J.L. (National Chung Cheng Univ., Taiwan); J.-N. Wang (National Yunlin Univ. of Science and Technology, Taiwan).
Sensors, Vol 8 No 1, p 171-184, 2008

A simple and effective method is proposed to improve spectral sensitivity and detection limit of long period gratings for refractive index or chemical sensing, where the grating surface is modified by a monolayer of colloidal gold nanoparticles. The transmission spectra and optical properties of gold nanospheres vary with the different refractive index of the environment near the surface of gold nanospheres. The sensor response of gold colloids increases linearly with solvents of increasing refractive index. The results for the measurement of sucrose and sodium chloride solutions are reported, which show that this type of sensor can provide a limiting resolution of ~10(-3) to ~10(-4) for refractive indices in the range of 1.34 to 1.39 and a noticeable increase in detection limit of refractive index to external medium.
http://www.mdpi.org/sensors/list08.htm

A Compact, Low-Power Cantilever-Based Sensor Array for Chemical Detection
Loui, A., T.V. Ratto, T.S. Wilson, E.V. Mukerjee, Z.-Y. Hu, T.A. Sulchek, and B.R. Hart, Lawrence Livermore National Lab.
Nanotech 2007: Technical Proceedings of the 2007 NSTI Nanotechnology Conference and Trade Show. NSTI: Nano Science & Technology Institute, ISBN: 1-4200-6184-4, Vol 3, p 37-40, 2007

A compact, low-power, cantilever-based sensor array has been developed and used to detect various vapor analytes. This device employs sorptive polymers that are deposited onto piezoresistive cantilevers. Several organic vapors have been detected successfully, representing a breadth of chemical properties over a range of concentrations. Comparisons of the polymer/vapor partition coefficient to the cantilever deflection responses show that a simple linear relationship does not exist, emphasizing the need to develop an appropriate functional model to describe the chemical-to-mechanical transduction that is unique to this sensing modality.

Comparative Distributions of Size Fractionated Metals in Pore Waters Sampled by In-Situ Dialysis and Whole-Core Sediment Squeezing: Implications for Diffusive Flux Calculations
Huerta-Diaz, M.A., I. Rivera-Duarte, S.A. Sanudo-Wilhelmy, and A.R. Flegal.
Applied Geochemistry, Vol 22 No 11, p 2509-2525, 2007

Trace elements (Ag, Cd, Co, Cr, Cu, Fe, Mn, Pb, V, Zn) and ammonia were measured in pore waters extracted from sediments collected in Green Sands Beach (Mare Island, San Francisco, CA) using peepers and whole-core squeezers. Samples were size-fractionated, either by using 0.45 and 0.1 um polycarbonate filters (whole-core squeezers), or by passive filtration using peepers with 0.45 um and 3,000 MWCO membranes. Results indicate that the distribution profiles of pore water constituents in the traditionally defined total dissolved fraction reflect different diagenetic processes, as well as anthropogenic inputs from the former Mare Island Naval Shipyard.

Comparison of Bioluminescent Dinoflagellate (QwikLite) and Bacterial (Microtox) Rapid Bioassays for the Detection of Metal and Ammonia Toxicity

Rosen, G., A. Osorio-Robayo, I. Rivera-Duarte, and D. Lapota.
Archives of Environmental Contamination and Toxicology, Vol 54 No 4, p 606-611, May 2008

Both QwikLite and Microtox tests measure a reduction in light production from bioluminescent microorganisms (dinoflagellates and marine bacteria, respectively) as a means of toxicity detection and are simple and inexpensive to conduct compared to many standardized acute toxicity tests. For QwikLite tests of exposure to 7 metals and ammonia, three marine dinoflagellate species were evaluated separately following a 24-h exposure period. A marine bacterium was used in the Microtox tests, in 15-min exposures to the same metal preparations as those used for the QwikLite tests. The QwikLite tests generally were one to two orders of magnitude more sensitive than the Microtox tests, as indicated by lower median effects concentrations. Both QwikLite and Microtox resulted in similar toxicity rankings for the 7 metals tested. QwikLite also was more comparable in sensitivity to several commonly used standardized toxicity tests. As with all toxicity tests, species selection for QwikLite should take into account study-specific factors, including the potential for sensitivity to confounding factors, such as ammonia.

Comparison of Hollow Fiber Liquid Phase Microextraction and Dispersive Liquid-Liquid Microextraction for the Determination of Organosulfur Pesticides in Environmental and Beverage Samples by Gas Chromatography with Flame Photometric Detection

Xiong, J. and B. Hu, Wuhan Univ., Wuhan, China.
Journal of Chromatography A, Vol 1193 Nos 1-2, p 7-18, June 2008

Two methods based on hollow-fiber liquid-phase microextraction (HF-LPME) and dispersive liquid-liquid microextraction (DLLME) were compared for the analysis of organosulfur pesticides (OSPs) in environmental and beverage samples by gas chromatography-flame photometric detection (GC-FPD). Under optimal conditions, the limits of detection for the six target OSPs (malathion, chlorpyrifos, buprofezin, triazophos, carbosulfan, and pyridaben) obtained by HF-LPME-GC-FPD and DLLME-GC-FPD ranged from 1.16 ug/L to 48.48 ug/L and 0.21 ug/L to 3.05 ug/L, respectively. The relative standard deviations were in the range of 3.4 to 8.0% and 8.5 to 13.7%, respectively. Both methods were found to be simple, fast, efficient, and inexpensive. Compared with HF-LPME, the DLLME technique required less extraction time, was suitable for batches of samples pretreatment simultaneously, and had a higher extraction capacity when analyzing simple samples, such as water samples; however, HF-LPME was found to be more robust and more suitable for analysis of complicated matrices, such as soil and beverage samples.

Conductometric Microbiosensors for Environmental Monitoring

Jaffrezic-Renault, N. (Univ. de Lyon, UMR CNRS, Villeurbanne, France); S.V. Dzyadevych (National Academy of Sciences of Ukraine, Kiev, Ukraine)
Sensors, Vol 8 No 4, p 2569-2588, Apr 2008

This review first describes the principles of conductometric measurements in ionic media and the equivalent electrical circuits of different designs for conductometric measurements. These types of measurements were first applied for monitoring biocatalytic reactions. The use of

conductometric microtransducers is then presented and detailed for pollutant detection for environmental monitoring. Conductometric biosensors have advantages over other types of transducers: they can be produced through inexpensive thinfilm standard technology; no reference electrode is needed; and differential mode measurements allow cancellation of a lot of interferences. The specifications obtained for the detection of different pesticides, herbicides, and heavy metal ions, based on enzyme inhibition, are presented as well as those obtained for the detection of formaldehyde, 4-chlorophenol, nitrate, and proteins as markers of dissolved organic carbon based on enzymatic microbiosensors.
http://www.mdpi.org/sensors/list08.htm

Contaminant Detection, Identification, and Quantification Using a Microchip Laser Fluorescence Sensor
Sinfield, J.V. (Purdue Univ., West Lafayette, IN); H.F. Hemond and J.T. Germaine (Massachusetts Inst. of Technology, Cambridge); B. Johnson (Lincoln Laboratory, Lexington, MA); J. Bloch (Haft, Harrison, and Wolfson, Inc., Boston, MA).
Journal of Environmental Engineering, Vol 133 No 3, p 346-351, Mar 2007

A novel fluorescence-based in situ sensor for environmental contaminants can be deployed downhole in a monitoring well or incorporated into the shaft of a cone penetrometer. The sensor is less than 4 cm in diameter and uses a miniature microchip laser that produces ~200 ps pulses of ultraviolet radiation at a high repetition rate (~10 kHz) to excite fluorescence in a wide range of compounds. Results from laser-induced fluorescence tests in the laboratory on single compound aqueous solutions of benzene, toluene, and o-xylene (BTX) demonstrate the sensor's ability to perform contaminant analyses on compounds with fluorescence lifetimes on the order of 1 ns. A linear relationship between contaminant concentration and fluorescence intensity was observed for concentrations over several orders of magnitude from the sensor's detection limit (<1 ppm for o-xylene) to solutions of pure BTX compounds at aqueous solubility. Owing to the microchip laser's short pulse length, fluorescence lifetimes were obtained directly from measurements without the need for spectral deconvolution.

Continuous Monitoring of Polychlorinated Biphenyls in Air Using Direct Sampling APCI/ITMS
Yamada, M., M. Suga, and I. Waki (Hitachi Ltd., Tokyo, Japan); M. Sakamoto (Hitachi High-Technologies Corp., Tokyo); M. Morita (National Inst. for Environmental Studies, Ibaraki, Japan).
International Journal of Mass Spectrometry, Vol 244 No 1, p 65-71, 15 June 2005

A continuous monitoring system of polychlorinated biphenyls (PCBs) in air using direct sampling atmospheric pressure chemical ionization/ion trap mass spectrometry (APCI/ITMS) was applied to measure Di- to Hp-CB in ventilation air from a PCB decomposition plant. In dry air (0.5% humidity), the detection limits of Di- to Hp-chlorinated biphenyls (CB) are 0.01 to 0.44 ug/Nm3 (ug/m3 at normal condition) with a time resolution of 1 min, whereas the sensitivity decreases to less than 1/10 when water vapor concentration is 10 vol%. An internal standard, trichlorophenol, was used in real time to calibrate the sensitivity decrease. The monitored PCB concentration levels agreed well with those measured using high-resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS).

Demonstration and Validation of a Regenerated Cellulose Dialysis Membrane Diffusion Sampler for Monitoring Groundwater Quality and Remediation Progress at DoD Sites (0313)
Imbrigiotta, T.E. (U.S. Geological Survey, Trenton, NJ); J.S. Trotsky (NFESC, Port Hueneme, CA); M.C. Place (Battelle, Columbus, OH).
TR-2281-ENV, 141 pp, Aug 2007

This report documents the demonstration and validation of regenerated cellulose dialysis membrane diffusion samplers for use in collecting groundwater samples for a range of inorganic and organic water-quality parameters, which was funded by the Environmental Security Technology Certification Program under project ER-0313. The primary objectives of the project were to (1) determine the usefulness of dialysis samplers in collecting a range of organic and inorganic water quality constituents from ground water, (2) determine the optimum equilibration times for these constituents to diffuse into the dialysis sampler, (3) compare water quality results and sampling costs from samples collected with dialysis samplers to samples collected with a low-flow purging technique and polyethylene diffusion bag (PDB) samplers, and (4) transfer the technology while gaining regulatory acceptance. Field comparisons were conducted at three DoD sites: (1) Naval Air Engineering Station Lakehurst, NJ; (2) Naval Base Ventura County, Port Hueneme and Point Mugu, CA; and (3) Naval Air Warfare Center West Trenton, NJ. Dialysis samplers were found to cost significantly less than samples collected with a low-flow purging procedure. Field sampling time was reduced by a factor of more than six times compared to low-flow purging. The total cost per sample was estimated to be three times lower than the cost for a sample taken using low-flow purging.
http://www.estcp.org/viewfile.cfm?Doc=ER%2D0313%2DFR%2Epdf

Demonstration/Validation of Long-Term Monitoring Using Wells Installed by Direct Push Technologies: Cost and Performance Report
Environmental Security Technology and Certification Program, ESTCP Project ER-0011, 43 pp, Mar 2008

Project ER-0011 was to compare the results of laboratory analyses conducted on samples obtained from direct-push (DP) wells to those obtained from wells installed utilizing conventional techniques (e.g., hollow-stem auger [HSA] wells). The demonstration consisted of side-by-side comparisons followed by comprehensive statistical analyses over several years of quarterly monitoring. Five sites comprising various geologic regimes and contaminants of concern were selected for the demonstration. The ultimate goal of the demonstration was to determine whether DP wells can yield representative data for long-term monitoring applications. Comparisons between conventional drilled wells and DP wells consisted of evaluation of requirements for mobilization, installation, maintenance, removal, labor requirements for each step, performance metrics based on chemical and hydrogeologic representativeness, training requirements, ease of use considerations, appropriateness of innovative approach (e.g., lithologic restrictions where applicable), pertinent health and safety issues (e.g., less exposure for DP well installations), and overall costs. Hydraulic comparisons comprised of pneumatic slug and conventional aquifer tests were also performed in selected wells. According to conservative estimates, cost savings for DP well installations range from ~32 to 68%. Highest percentage installation savings can be derived when using smaller diameter wells at deeper total depths.
http://www.estcp.org/viewfile.cfm?Doc=ER%2D0011%2DC%26P%2Epdf

Detailed Hydraulic Assessment Using a High-Resolution Piezocone Coupled to the GeoVIS
Environmental Security Technology Certification Program, ESTCP PROJECT CU-0421, 360 pp, Apr 2008

Detailed 3-D groundwater and contaminant flow pathways typically cannot be delineated using monitoring well data; however, understanding 3-D flow pathways, gradients, and contaminant flux is essential for developing a remedial design, for risk determination, and to evaluate remediation effectiveness. Methods capable of providing the required level of resolution to evaluate site conditions in three dimensions include non-conventional multi-level well installation networks, comprehensive soil sampling and laboratory analyses, or the use of tracer tests. These options can be cost prohibitive, especially at sites where contamination may be aerially extensive or the site has complex hydrogeologic conditions. The key to determining direction and rate of flow (or "seepage velocity") is to understand the distribution of groundwater head, gradient (i.e., change in head divided by the distance between measurement points along the direction of flow), soil effective porosity, and soil hydraulic conductivity. When coupled to the distribution of contaminant concentration, a contaminant flux estimate can be derived. This report describes a full-scale demonstration of the use of two innovative direct-push sensor probes (the high-resolution piezocone and GeoVIS) deployed with a standard cone penetrometer system for the purpose of determining direction and rate of groundwater flow in three dimensions. A piezocone is a direct-push sensor probe consisting of a porous element connected to a customized transducer that converts pore pressure to water level. A high-resolution piezocone is a direct push sensor probe capable of generating highly resolved hydraulic head values (plus or minus 1 inch of water level) while simultaneously collecting critical soil type information. The GeoVIS is a Navy/SERDP-developed video microscope sensor probe capable of yielding real-time soil and contaminant images that can render effective porosity estimates in aquifers.
http://www.clu-in.org/s.focus/c/pub/i/1558/

Detection of Nitrite by Flow Injection Analysis Using a Novel Paired Emitter-Detector Diode (PEDD) as a Photometric Detector
O'Toole, M., R. Shepherd, K.-T. Lau, and D. Diamond, Dublin City Univ., Ireland.
Advanced Environmental, Chemical, and Biological Sensing Technologies V, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6755, 10 pp, 2007

This paper describes an inexpensive flow-injection analysis system employing the Griess reagent spectrophotometric method for determining low concentration levels of nitrite. The novel photometric detector applied within this manifold is a highly sensitive, low-cost, miniaturized light-emitting diode (LED)-based flow detector. The colorimetric detector employs two LEDs, operating one as a light source and the other as a light detector. The emitter LED is forward biased and the detector reverse biased. A simple timer circuit measures the time taken for the photocurrent generated by the emitter LED to discharge the detector LED from 5 V (logic 1) to 1.7 V (logic 0). The Griess reagent method employed for nitrite determination is based on the formation of an azo dye, the intensity of which is directly related to nitrite concentration. Detection limits in the nanomolar range were achieved using the paired emitter-detector diode (PEDD) flow-analysis device. For comparison, the linear range and limit of detection also were investigated using a plate-well reader. The PEDD exhibited greater sensitivity and precision compared to the commercially available plate-well reader.

Determination of Carbaryl Pesticide Using Amperometric Acetylcholinesterase Sensor Formed by Electrochemically Deposited Chitosan
Du, D., J. Ding, J. Cai, and A. Zhang.
Colloids and Surfaces B: Biointerfaces, Vol 58 No 2, p 145-150, 1 Aug 2007

This paper describes a sensitive, fast, and inexpensive sensor for quantitative determination of a pesticide (carbaryl) using amperometric acetylcholinesterase (AChE) on electrochemically deposited chitosan. From a mildly acidic chitosan solution, a chitosan film is electrochemically deposited on Au electrode surface via a negative voltage bias, leading to a stable AChE sensor. The characteristics of the deposited layer are dependent upon deposition time, pH, and chitosan concentration. Fourier-transform infrared spectra proved that the immobilized enzyme could preserve their native structure due to the biocompatibility and non-toxicity of chitosan. Under optimal conditions, the carbaryl inhibition on AChE-CHIT/Au was proportional to its concentration in two ranges, from 0.005 to 0.1 ug/mL and 0.5 to 5 ug/mL, with correlation coefficients of 0.9966 and 0.9982, respectively. The detection limit was 0.003 ug/mL taken as the concentration equivalent to a 10% decrease in signal. The developed sensor exhibited good fabrication reproducibility and acceptable stability, which provides a promising tool for pesticide analysis.

Determination of Chloride, Chlorate and Perchlorate by PDMS Microchip Electrophoresis with Indirect Amperometric Detection
Li, X.A., D.M. Zhou, J.J. Xu, and H.Y. Chen, Nanjing Univ., Nanjing, China.
Talanta, Vol 75 No 1, p 157-162, 15 Mar 2008

Chloride, chlorate, and perchlorate can be separated quickly on a PDMS microchip and detected via in-channel indirect amperometric detection mode. With a PDMS/PDMS microchip treated by oxygen plasma, chloride, chlorate, and perchlorate anions can be separated within 35 seconds. Optimized separation conditions use 15 mM (pH 6.12) of 2-(N-morpholino)ethanesulfonic acid (MES)+L-histidine (L-His) as running buffer, -2000 V as separation voltage, and 0.7 V as detection potential. Under these conditions, the detection limits of chloride, chlorate, and perchlorate are 1.9, 3.6, and 2.8 uM, respectively.

Determination of Chlorine Containing Species in Explosive Residues Using Chip-Based Isotachophoresis
Prest, J.E. (Univ. of Manchester, Manchester, UK), M.S. Beardah, S.J. Baldock, S.P. Doyle, P.R. Fielden, N.J. Goddard, and B.J. Brown.
Journal of Chromatography A, Vol 1195 Nos 1-2, p 157-163, June 2008

A new method has been developed to allow the determination of the chlorate, chloride, and perchlorate anions in inorganic explosive residues to be made using isotachophoresis (ITP). For good separation of species, the method involves the use of two complexing agents--indium(III) to allow the determination of chloride whilst using nitrate as the leading ion, and alpha-cyclodextrin to allow the separation of chlorate and perchlorate. Separations were carried out using a miniaturized poly(methyl methacrylate) separation device. The method was applied to analyzing both model samples and actual residue samples. Successful determinations were achieved with no interference from other anions typically found in inorganic explosive residues. Limits of detection for the species of interest were calculated to be 0.80mg/L chloride, 1.75mg/L chlorate, and 1.40 mg/L perchlorate.

Determination of Organochlorine Pesticides in Marine Sediments Samples Using Ultrasonic Solvent Extraction Followed by GC/ECD
Vagi, M.C., A.S. Petsas, M.N. Kostopoulou, M.K. Karamanoli, and T.D. Lekkas, Mytilene, Greece.
Desalination, Vol 210, p 146-156, 2007

A rapid multiresidue method, based on the ultrasonic solvent extraction (USE) of sediment samples, has been developed for the analysis of 17 organochlorine pesticides (OCPs): alpha-, beta-, gamma-, and delta-HCH, aldrin, heptachlor epoxide, endosulfan I, 4,4-DDE, dieldrin, endrin, 4,4-DDD, endosulfan II, 4,4-DDT, endrin aldehyde, endosulfan sulfate, methoxychlor, and endrin ketone in marine sediments. The extraction procedure was optimized with regard to the solvent type, amount of solvent, and duration of sonication steps. Gas chromatography using electron capture detector (GC/ECD) was used for the analytical determinations of the 17 OCPs. When samples were extracted twice by ultrasonication for 20 min with 5 mL of dichloromethane, the highest recoveries from sediment samples spiked at trace concentrations of 50 ng/g. Correlation coefficients (ranging from 0.9652 to 0.9993) from the recovery studies that were performed at 1, 2, 5, 10, and 50 ng/g fortification levels showed that the method is linear over the range assayed. The detection limits varied from 0.1 to 1 ng/g dry weight for the organochlorine compounds tested in marine sediments. Use of OCPs from marine sediments using dichloromethane showed satisfactory extraction efficiencies combined with simplicity of use and low solvent consumption.
http://www.desline.com/articoli/8534.pdf

Determination of Pesticide Residues in Soil by Modified Matrix Solid-Phase Dispersion and Gas Chromatography
Shen, X., Q. Su, X. Zhu, and Y. Gao.
Annali di Chimica, Vol 97 No 8, p 647-653, Aug 2007

Modified matrix solid-phase dispersion (MMSPD) and gas chromatography have been developed for quantitative analysis of various classes of pesticides (pirimicarb, metalaxyl, metolachlor, isopropalin, and pendimethalin) in soil. MMSPD pesticide analysis was performed using Florisil as a dispersant and acetone as a solvent. Determination was carried out by gas chromatography (GC) with nitrogen-phosphorus detection. MMSPD had good extraction and cleanup efficiency, and the extract obtained could be subjected directly to GC analysis without further purification. Recoveries ranged from 93 to 100%, with relative standard deviations lower than 10%. The limits of detection ranged from 0.2 to 2.0 ng/g.

Determination of Polar Organophosphorus Pesticides in Water Samples by Hydrophilic Interaction Liquid Chromatography with Tandem Mass Spectrometry
Hayama, T., H. Yoshida, K. Todoroki, H. Nohta, and M. Yamaguchi.
Rapid Communications in Mass Spectrometry, Vol 22 No 14, p 2203-2210, 10 June 2008

A method combining hydrophilic interaction liquid chromatography (HILIC) with tandem mass spectrometry (MS/MS) was developed for the determination of polar organophosphorus pesticides (acephate, methamidophos, monocrotophos, omethoate, oxydemeton-methyl, and vamidothion) in water samples. An activated carbon cartridge was used for pretreatment to extract the pesticides and minimize matrix effects from the water sample. After pretreatment of the water sample, the eluate from the activated carbon cartridge was injected directly into the HILIC/MS/MS system. The pesticides were separated on an Atlantis HILIC silica column by isocratic elution with a mixture of acetonitrile, isopropanol, and ammonium formate buffer as a mobile phase, and they were detected by positive electrospray ionization MS/MS in the selected reaction monitoring mode. The method was validated at 0.05, 0.5, and 5 ug/L levels in water samples with recoveries between 76.4 and 98.6%. The limits of detection were between 0.13 and 1.0 pg on-column, and the limits of quantification were between 0.43 and 3.4 pg on-column.

Determination of Premining Geochemical Background and Delineation of Extent of Sediment Contamination in Blue Creek Downstream from Midnite Mine, Stevens County, Washington
Church, S.E., F.E. Kirschner, L.M. Choate, P.J. Lamothe, J.R. Budahn, and Z.A. Brown.
U.S. Geological Survey Scientific Investigations Report 2007-5262, 177 pp, 2007

Geochemical and radionuclide studies of sediment recovered from eight core sites in the Blue Creek flood plain and Blue Creek delta downstream in Lake Roosevelt have provided a stratigraphic geochemical record of contamination from uranium mining at the Midnite Mine. Cores provided sufficient data to determine the premining geochemical background, contamination by uranium during the mining period, and postmining metal concentrations that are lower than during the mining period, but elevated relative to premining geochemical background. These data have been used to delineate the extent of contaminated sediment in Blue Creek cove along the thalweg (i.e., the line connecting the lowest points along the bed of a stream) of Blue Creek into Lake Roosevelt.
http://pubs.usgs.gov/sir/2007/5262/

Determining the Extent of Biodegradation of Fuels Using the Diastereomers of Acyclic Isoprenoids
Mcintyre, C.P. (CSIRO Petroleum, North Ryde, NSW, Australia), P.M. Harvey, S.H. Ferguson, A.M. Wressnig, H. Volk, S.C. George, and I. Snape.
Environmental Science and Technology, Vol 41 No 7, p 2452-2458, 2007

Isoprenoid/n-alkane ratios are commonly used to determine the extent of petroleum product biodegradation at low levels but are not useful once the n-alkanes have been removed. In a bioremediation trial conducted at Casey Station, Antarctica, researchers found that the diastereomers of the acyclic isoprenoids can be used to determine the extent of biodegradation in moderately biodegraded fuel in soil. The biological diastereomers of pristane were depleted more rapidly during moderate biodegradation than the geological or mature diastereomers, and thus the ratio of pristane diastereomers could be used to determine the level of biodegradation. The statistical difference among mean diastereomer ratios for samples grouped according to the biodegradation scale and pristane/phytane ratios was highly significant. The ratios of norpristane and phytane diastereomers changed with biodegradation in a similar fashion, and different levels of sensitivity exist for each. The method can be performed on conventional gas chromatographs by non-specialist chemists; the ratios are independent of evaporation and do not necessarily require a non-biodegraded reference sample. This paper describes a simple alternative method for determining the extent of biodegradation of fuels at moderate levels that can be applied to a wide range of petroleum products.

Development of a Cytochrome c Oxidase Based Sensor for Monitoring Respiration and Metabolism
Hawkridge, Fred M., Virginia Commonwealth Univ.
DTIC: ADA470608, June 2007

Electrodes modified with bilayers that incorporate cytochrome c oxidase (CCO), the terminal enzyme in mammalian respiration, will be studied as biosensors for cyanide. This CCO modified electrode has an architecture that exhibits robust response behavior and stability that mimics the in vivo behavior of this enzyme. These CCO modified electrodes remain active on storage in buffer, can withstand exposure to temperatures as extreme as 80 degrees C (176 degrees F) and have a functional lifetime exceeding two months. The structure of the CCO modified electrode proposed for study here is uniquely similar to its in vivo environment in the inner mitochondrial membrane. No other enzyme-modified electrodes reported thus far in the literature have this structure. Experiments have shown that the electrochemical response of these CO-modified electrodes to the oxidation of reduced cytochrome c (its reductive reaction partner) is sensitive to cyanide, and the response is reversible. Work proposed here will characterize the affect of cyanide on the direct electron transfer reaction of these CCO modified electrodes with ambient dioxygen concentrations (its oxidative reaction partner). Initial experiments testing this hypothesis have been positive. This is a simpler biosensor configuration compared with the cytochrome c system described above (no added component) and it has potential for providing practical sensors for toxins that inhibit the electron transfer reactions of CCO with lethal consequences.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA470608&Location=U2&doc=GetTRDoc.pdf

Development of a Screening Tool to Facilitate Technology Transfer of an Innovative Technology to Treat Perchlorate-Contaminated Water
Craig, Daniel A., Master's thesis, Air Force Inst. of Technology, Wright-Patterson AFB, OH.
AFIT/GEM/ENV/08-M06, NTIS: ADA480654, 145 pp, Mar 2008

The purpose of this study was to develop a tool to predict the cost and performance of tailored granular activated carbon (T-GAC), an innovative technology that is being evaluated as a cost-effective treatment for perchlorate-contaminated water. The ability to predict performance and cost accurately can facilitate the transfer and commercialization of innovative technologies. A model was developed to predict T-GAC performance and life-cycle costs for removing perchlorate under varying influent water quality and technology operating conditions. The model's design parameters were obtained from lab-based rapid, small-scale column tests

(RSSCTs) using inverse modeling. Cost data used in the model were based on conventional GAC installations, modified to account for tailoring. The parameterized model was used to predict the observed performance from a pilot-scale field demonstration at a water treatment plant in Southern California. The model over-predicted field performance; however, it predicted reasonably well the results of laboratory RSSCTs for two waters that were not used to calibrate the model. The screening model indicates that annual operation and maintenance (O&M) costs are more significant than capital costs, and costs associated with media regeneration or replacement dominate the O&M costs.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA480654&Location=U2&doc=GetTRDoc.pdf

Development of Spatially-Based Emission Factors from Real-Time Measurements of Gaseous Pollutants Using Cermet Sensors
Skubal, L., M. Vogt, and N. Meshkov, Argonne National Lab.
Strategic Environmental Research and Development Program, SERDP Project CP-1243, 65 pp, 2005

The research presented in this report was intended to support the need to identify and characterize emissions of trace air toxic compounds, especially persistent organic pollutants, from operations and activities at DoD facilities. The compounds acetaldehyde, acrolein, benzene, and 1,3-butadiene were targeted for this study. An self-contained, person-portable instrument was developed that could be operated from a notebook computer, providing near real-time emissions analyses. The instrument employed inexpensive, nearly disposable, miniature sensor arrays capable of rapidly detecting and characterizing air toxics in real time. Sensing elements in the array were composed of various ceramics, metals, and metal oxides tailored to be sensitive to specific compounds. The arrays were self-heated to an ideal operating temperature, and then were exposed to the four primary compounds of interest at different concentrations and in different combinations in air and mixed into actual diesel exhaust. Chemical "signatures" were gathered and recorded, and a library of signatures was constructed. The sensing array used voltammetric and photocatalytic sensing elements and two different chemical measurement techniques to improve chemical detection and discrimination. Results from this work demonstrated that the instrument could be used to detect and discriminate the four gases of interest at varying low (ppm) concentrations. The microsensors created in this research could readily be tailored for detection of other toxic industrial chemicals at ppm levels. Additional effort is needed to improve sensor detection at low ppb levels, possibly including the use of a gas pre-concentrator (increasing sensitivity by increasing the effective surface area of the sensors) and/or introducing nanoparticle films to increase sensor reactivity to target gases.
http://www.estcp.org/viewfile.cfm?Doc=CP%2D1243%2DFR%2D01%2Epdf

DGT Use in Contaminated Site Characterization: The Importance of Heavy Metal Site Specific Behaviour
Ruello, M.L., M. Sileno, D. Sani, and G. Fava, Univ. Politecnica delle Marche, Ancona, Italy.
Chemosphere, Vol 70 No 6, p 1135-1140, Jan 2008

The diffusive gradients in thin films (DGT) technique and a sequential extraction procedure were used to quantify the labile pools of Cu, Fe, Mn, and Ni in solid-phase pools of soil. The results were compared to metal concentrations in groundwater measured directly using in situ piezometers, as well as to the total concentration of metal in the soils. High concentrations of metal in the directly analyzed soil solution compared to DGT measurement were attributed to the presence of colloidal metal. The use of DGT allowed only calculation of the leaching parameters of the free ions and labile metal fractions. The investigators concluded that efficient use of the DGT technique requires a preliminary investigation of metal speciation in soil solution prior to its application as a tool for characterizing contaminated sites.

Domestic Preparedness Program Evaluation of the NEXTTEQ Civil Defense Kit(tm) against Chemical Warfare Agents: Summary Report
Longworth, T.L., R.L. Matthews, and J.M. Baranoski.
ECBC-TR-394, NTIS: ADA430798, 31 pp, Oct 2004

This report characterizes the chemical warfare (CW) agent detection characteristics of the commercially available NEXTTEQ Civil Defense Kit(tm). The kit uses colorimetric detection tubes to detect the presence or absence of chemical warfare agents. The system was tested against HD, GB, and GA vapor under various conditions. This report provides the emergency responders concerned with CW agent detection and verification an overview of the capabilities of the Civil Defense Kit(tm).
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA430798&Location=U2&doc=GetTRDoc.pdf

Downhole Sensor for Long-Term Monitoring of Groundwater for Contamination by Explosives
Strategic Environmental Research and Development Program, SERDP Project CU-1298, 12 pp, Aug 2005

A prototype sensor capable of deployment in a two-inch groundwater monitoring well was constructed and tested extensively in the lab. The integration effort involved miniaturizing the flow cell, optics stack, PC board, and supporting hardware. A miniaturized prototype sensor was constructed, assembled, tested, and debugged. This prototype sensor was engineered using technology from two other Nomadics sensors, an underwater TNT sensor (SeaDog) and the Fido(r) TNT vapor sensor. Both sensors employ patented amplifying fluorescing polymer technology. The vapor sensor is capable of detecting TNT at the parts-per-quadrillion level, and the aqueous-phase sensor can detect TNT in water at low parts-per-billion levels. Its performance is comparable to the previous laboratory prototype constructed under SERDP CU-1298 Phase I.
http://www.estcp.org/viewfile.cfm?Doc=ER%2D1298%2DFR%2Epdf

Dredged Material Analysis Tools: Performance of Acute and Chronic Sediment Toxicity Methods
Steevens, J., A. Kennedy, D. Farrar, C. McNemar, M.R. Reiss, R.K. Kropp, J. Doi, and T. Bridges.
ERDC/EL-TR-08-16, NTIS: ADA480947, 73 pp, Apr 2008

This report and research were supported by the U.S. Army Corps of Engineers New York District and U.S. EPA Region 2 to provide insight into the potential advantages and disadvantages of using chrome semi-toxicity tests with relevant benthic micro invertebrates as part of dredged material evaluations, as described in the Inland and Ocean Testing Manuals (USEPA/USACE 1991, 1998). Nine sediments collected from the New York Harbor (NYM) were needed to assess test methods in a preliminary evaluation at one test facility and an

interlaboratory evaluation at three test facilities. The two test methods (10-day Ampelisca abdita and Americamysis bahia) currently used in evaluations of NYM material were compared to available chronic protocols to gauge relative performance of the toxicity tests. Acute tests are typically short term (e.g., 10-day) lethality assessments conducted over a small portion of the test organism's life cycle, while chronic tests are longer term and assess sublethal measurement endpoints (e.g., growth and reproduction) in addition to lethality. The available chronic test methods used in this study were the 28-day test using the estuarine amphipod, Leptocheinis plumulosus, and 20-day and 28-day tests using the marine polychaete, Neanthes arenaceodentata. Use of chronic tests is recommended or required by dredged material evaluation guidance and regulations, respectively. The sublethal endpoints measured in chronic tests may be more sensitive measures of toxicity and more predictive of longer-term population effects. Of the tests compared, the currently used acute (10-day) A. abdita test and the available chronic (28-day) L. plumulosus test were the most responsive (i.e., sensitive) to the tested NYM sediments. Response is defined as the amount an endpoint (e.g., survival) was reduced for test organisms in site sediments relative to that same endpoint in the control sediment. Of these two test methods, neither clearly demonstrated better capability to identify contaminated sediments. Specific conclusions and recommendations are provided on the application of the test methods.
http://el.erdc.usace.army.mil/elpubs/pdf/trel08-16.pdf

Electrochemical Sensors Based on Organic Conjugated Polymers
Rahman, M.A., P. Kumar, D.-S. Park, and Y.-B. Shim, Pusan National Univ., Busan, South Korea.
Sensors, Vol 8 No 1, p 118-141, Jan 2008

This review summarizes recent advances in conducting polymer-based electrochemical sensors, which covers chemical sensors (potentiometric, voltammetric, amperometric) and biosensors (enzyme based biosensors, immunosensors, DNA sensors). Due to their straightforward preparation methods, unique properties, and stability in air, organic conjugated polymers (conducting polymers) have emerged as potential candidates for electrochemical sensors. They have been applied to energy storage, electrochemical devices, memory devices, chemical sensors, and electrocatalysts. Because they are known to be compatible with biological molecules in a neutral aqueous solution, they are used extensively in the fabrication of accurate, fast, and inexpensive devices, such as biosensors and chemical sensors in medical diagnostic laboratories. Conducting polymer-based electrochemical sensors and biosensors can achieve rapid detection, high sensitivity, small size, and specificity for environmental monitoring and clinical diagnostics.
http://www.mdpi.org/sensors/list08.htm

Estimating Ammonia and Methane Emissions from CAFOs Using an Open-Path Optical Remote Sensing Technology
Ro, K.S., P.G. Hunt, M.H. Johnson, A.A. Szogi, and M.B. Vanotti.
2007 ASAE Annual Meeting. American Society of Agricultural and Biological Engineers, St. Joseph, Michigan. Abstract 074004, 2007

The U.S. EPA recently demonstrated the open-path optical remote sensing technology to identify hot spots and estimate mass flux of fugitive gases from a closed landfill. The objective of this research was to validate this technology for estimating ammonia and methane emission from concentrated animal feeding operations (CAFOs). The technology utilizes the vertical radial plume mapping (VRPM) method, which reconstructs a vertical plume map based on several path-integrated concentrations of fugitive gases measured with open-path optical instruments. The mass flux of fugitive gas is then estimated by multiplying the vertical plane-integrated concentration by the averaged wind speed components normal to the vertical plane. The experimental system consists of an open-path tunable diode laser CH4 detector (Boreal Laser) mounted on an automatic positioning device, a 10-m weather mast, wind sensors, and integrated VRPM software (Arcadis Inc., NC). This method measured the methane emission rate from a distribution source with good accuracies.

Estimating Cleanup Times for Groundwater Contamination Remediation Strategies
Widdowson, M, E. Mendez III, and F. Chapelle.
Journal AWWA, Vol 99 No 3, p 40-42, 44, & 46, 2007

The Natural Attenuation Software (NAS) can help remedial project managers and their contractors estimate the time of ground-water remediation through consideration of natural attenuation processes, such as advection, dispersion, sorption, source zone depletion, and biodegradation. NAS consists of a combination of computational tools implemented in three main interactive modules to provide the following estimates: the target source concentration and the time required for a plume extent to contract to regulatory limits; the maximum distance at which a plume with a given source area concentration will stabilize; and the time that would be required for contaminants in the source area to attenuate to a predetermined target source concentration. This paper discusses testing and evaluation of NAS along with expected benefits of the software tool. The software is available as a free download from Virginia Polytechnic University at www.nas.cee.vt.edu/index.php.

Evaluation of a Dialysis Sampler's Integrity in a Cold Climate
Iwakun, O., K. Biggar, J. Armstrong, R. Donahue, and D. Sego.
Ground Water Monitoring & Remediation, Vol 28 No 1, p 50-56, 2008

In an evaluation of the integrity of a diffusion sampler made from a regenerated cellulose dialysis membrane, the dialysis samplers were deployed in monitoring wells at two upstream oil- and gas-contaminated sites. The average ambient temperature in the monitoring wells was 4 +/- 1 degree C over the 6 months of the test. Test results showed no adverse impacts on the samplers' integrity after 6 months, thus indicating potential for long-term monitoring associated with natural attenuation assessment under the conditions tested.

Evaluation of Ahura's FirstDefender Handheld Chemical Identifier
Matthews, R.L., K.Y. Ong, and C.D. Brown.
ECBC-TR-461, 58 pp, June 2006

The handheld Raman spectrometer for point detection of chemicals developed by Ahura Corporation was tested using chemical warfare agents (CWAs). The device was assessed for its capacity to detect and identify liquid through sealed glass containers in a completely non-contact, non-destructive manner. Mustard, nitrogen mustard, VX, tabun, sarin, and lewisite were the CWAs tested. Detection characteristics were examined for neat agents, as well as detection in the

presence of interferents (JP8 jet fuel, aqueous film forming foam, Windex, and floor wax) at various concentrations.
http://www.edgewood.army.mil/hld/ip/ahura_handheld_summary_report_download.htm

Evaluation of ToxTrak(tm) for Analysis of Protein Toxin Toxicity
Schenning, A.M. (SAIC); V.L.H. Bevilacqua (ECBC); K.M. Morrissey (SAIC); J.S. Rice (ECBC).
ECBC-TR-578, NTIS: ADA475390, 18 pp, Oct 2007

Ascertaining the toxicity of samples containing proteins such as ricin and SEB requires an activity assay that yields accurate and reproducible results. The ToxTrak(tm) system was investigated as a possible quantitative assay. ToxTrak(tm) is a commercially available kit supplied by the Hach Company (Loveland, CO). The ToxTrak(tm) system correlates the toxicity of a sample with its effect on the respiration of bacteria, as measured by percent inhibition. Initially, the intent was to develop a modified version of the ToxTrak(tm) test that would be amenable for use with a microplate reader. Development of a plate reader version of the test, however, first required the successful demonstration of the unmodified ToxTrak(tm) method to indicate toxicity due to protein toxins. Toxtrak(tm) proved to be useful for identifying the toxicity of various levels of cyanide; however, when the kit was evaluated for the ability to indicate toxicity due to a protein known to be toxic to E. coli, reproducible results were not achieved. A modified method for use with a microplate reader was not pursued due to the inconsistencies obtained for percent inhibition while utilizing the standard protocol with protein toxins.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA475390&Location=U2&doc=GetTRDoc.pdf

Eye-Safe Aerosol Lidar at 1.5 Microns: Progress toward a Scanning Lidar Network
Spuler, S.M. and S.D. Mayor, National Ctr. for Atmospheric Research.
Lidar Remote Sensing for Environmental Monitoring VIII, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6681, 11 pp, 2007

A multi-dimensional scanning lidar has been developed for tracking and monitoring aerosol plumes in urban settings. The reliability of the system has been demonstrated and plans for additional units are in place to create a unique scanning lidar network. The paper discusses the current capabilities of the instrument and research underway to extract more information, such as quantitative aerosol properties, from the network.

Fiber Optic Biosensors for Contaminant Monitoring
Environmental Security Technology Certification Program, ESTCP Project CU-0115, 79 pp, Dec 2005

Colorado State University has developed fiber-optic biosensors that are ideally suited for field monitoring of groundwater contaminants. Generally, a biosensor is a device that utilizes a biological recognition element (typically enzymes or antibodies) to sense the presence of an analyte and create a response that is converted by a transducer to an electrical or optical signal. The primary issue regarding the use of biosensors is reliability (i.e., are biosensor results comparable to laboratory analyses?). The end user also needs to know whether there are

conditions that affect the reliability of biosensor performance. Biosensors need to be easy to use and calibrate so that reproducible results can be obtained by different users. The demonstration described in this document was designed to address these issues. Biosensors were used to analyze groundwater sampled from several monitoring wells at Operable Unit 8 of the Naval Submarine Base in Kipsap County, WA (SUBASE Bangor) to evaluate biosensor performance under a range of conditions. The target analyte was 1,2-dichloroethane (1,2-DCA). Groundwater samples were collected from monitoring wells spaced throughout the plume to analyze a wide range of 1,2-DCA and co-contaminant concentrations. Groundwater samples were analyzed by biosensors and gas chromatography/mass spectroscopy. A flow-through cell was also set up to allow biosensor readings in flowing water similar to the setup typically used to collect pH, conductivity and turbidity readings prior to monitoring well sampling. Lastly, biosensors were lowered into monitoring wells to record down-hole in situ readings. ESTCP has posted 3 appendices to this report on the Site Characterization page at
http://www.estcp.org/technology/ER-Site-Characterization.cfm
http://www.estcp.org/Technology/upload/ER_0115_FR.pdf

Field Demonstration and Validation of a New Device for Measuring Water and Solute Fluxes: ESTCP Cost and Performance Report
Environmental Security Technology Certification Program (ESTCP), Project ER-0114, 47 pp, Apr 2007

The passive flux meter (PFM) is a new technology that measures subsurface water and contaminant flux directly. This technology addresses the DoD need for cost-effective, long-term monitoring because flux measurements can be used for process control, remedial action performance assessments, and compliance monitoring. Under ESTCP Project ER-0114, the PFM was demonstrated and validated as an innovative flux monitoring technology at several locations: the National Air and Space Administration's (NASA) Launch Complex 34 in Cape Canaveral, Florida; the Canadian Forces Base in Ontario, Canada; the Naval Construction Base in Port Hueneme, California; and the Naval Surface Warfare Center at Indian Head, Maryland. Projects at NASA, Borden, and Port Hueneme included objectives of evaluating the flux meter as a technology for direct in situ measurement of cumulative water discharge and contaminant flux under controlled flow and under natural gradient conditions. Tetrachloroethene, trichloroethene, dichloroethene, vinyl chloride, ethylene, and methyl tertiary butyl ether were the contaminants studied. At the Naval Surface Warfare Center at Indian Head, Maryland, the PFM was demonstrated and validated as a technology for measuring water and perchlorate fluxes. Data and results from all sites were compiled and interpreted to expedite regulatory and end-user acceptance and to stimulate commercialization.
Report at http://www.estcp.org/viewfile.cfm?Doc=ER%2D0114%2DC%26P%2Epdf

Field Monitoring of a Permeable Reactive Barrier for Removal of Chlorinated Organics
Lai, K.C.K. and I.M.C. Lo (Hong Kong Univ. of Science and Technology, Kowloon); V. Birkelund (Ramboll Consultants, Odense NV); P. Kjeldsen (Technical Univ. of Denmark).
Journal of Environmental Engineering, Vol 132 No 2, p 199-210, 2006

In 1999, a funnel-and-gate permeable reactive barrier (PRB) was installed at the Vapokon site in Denmark to remediate chlorinated aliphatic hydrocarbon (CAH) contamination in the groundwater. Over a four-year period, the reactive zero-valent iron (ZVI) in the barrier achieved

92.4 to 97.5% CAH removal. Although approximately 0.88% porosity loss was recorded per year, no noticeable deterioration of barrier performance was observed between March 2000 and August 2003. When the PRB's dechlorination performance was tracked against climatic variation, the dechlorination rates in cold weather were generally smaller than those in warm weather. The monitoring data indicated that 1,2-dichloroethane and dichloromethane, which are not amenable to ZVI treatment, were nonetheless being removed within the PRB, perhaps by enhancement from ZVI adsorption or microbial degradation.

Field Test of Infrared Thermography Applied to Biogas Controlling in Landfill Sites
Madruga, F.J., J.M. Munoz, D.A. Gonzalez, J.I. Tejero, A. Cobo, J.L. Gil, O.M. Conde, and J.M. Lopez-Higuera, Univ. of Cantabria, Spain.
Thermosense XXIX, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6541, 6 pp, 2007

Gases accumulate inside a landfill as result of waste fermentation, creating biogas. Any system for collecting, regulating, and controlling the biogas must include safety features, such as infrared thermography, which can be use to detect gas leakages via the differences in temperature between the gas and the immediate surroundings. This method is able to monitor a wide landfill area quickly, although the technology will not be effective if the differences in temperature are not greater than five degrees. This paper describes a field test conducted to study the limitations of the infrared thermography caused by weather conditions and the moment of day or/and season when the thermal images were captured. Pipelines, borders, cells, covers, slopes, and leakage (hot spots) are studied and optimum conditions are defined.

Fluorescence Remote Sensing and Plant Stress
Young, Donald R., Virginia Commonwealth Univ., Richmond
NTIS: ADA406798, 19 pp, 2001

The project objective was to determine the degree of plant stress detectable with remote fluorescence measurements in response to the application of stressors: salinity, drought, herbicide, organophosphate-based pesticide, and trampling. All experiments were conducted with Phragmites australis (common reed), a weedy wetland grass common throughout the mid-Atlantic region. The degree of stress was quantified through measured changes in photosynthetic rate, leaf pigment concentrations, stomatal conductance and leaf xylem pressure potential. The pesticide and trampling experiments were inconclusive, there was no evident change in fluorescence. For salinity and herbicide treatment, induced stress was detectable with measurements of fluorescence emission spectra. Stress was evident at 10 ppt salinity and higher, and within 24 hours of herbicide application. Relative to control plants there were significant decreases in fluorescence emission intensity across wavelengths from 678 to 765 nm. Additional preliminary experiments with drought stress revealed significant changes in fluorescence within four days and corresponded to reductions in water relations parameters. For these experiments, fluorescence decreases corresponded to significant decreases in all physiological parameters, except pigment concentrations. For most experiments, decreases in fluorescence were measured before the plants appeared to be visibly stressed. These preliminary results indicate that analysis of fluorescence emission spectra may accurately indicate the onset of stress in plants.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA406798&Location=U2&doc=GetTRDoc.pdf

A Framework for Assessing the Sustainability of Monitored Natural Attenuation
Chapelle, F.H., J. Novak, J. Parker, B.G. Campbell, and M.A. Widdowson.
U.S. Geological Survey Circular 1303, 48 pp, 2007

The sustainability of monitored natural attenuation (MNA) over time depends upon both the presence of chemical/biochemical processes that transform wastes to innocuous byproducts and the availability of energy to drive these processes to completion. The presence or absence of contaminant-transforming chemical/biochemical processes can be determined by observing contaminant mass loss over time and space (mass balance). The energy available to drive these processes to completion can be assessed by measuring the pool of metabolizable organic carbon available in a system, and by tracing the flow of this energy to available electron acceptors (energy balance). For the special case of chlorinated ethenes in groundwater systems, for which a variety of contaminant-transforming biochemical processes exist, natural attenuation is sustainable when the pool of bioavailable organic carbon is large relative to the carbon flux needed to drive biodegradation to completion. To illustrate the principles for assessing the short- and long-term sustainability of MNA, the authors provide an assessment of the sustainability of MNA for perchloroethene constituents at a contaminated site in Kings Bay, GA. The principles for assessing MNA sustainability can be described briefly as follows: (1) estimate the time required for contaminants to dissolve/disperse/degrade under ambient hydrologic conditions (time of remediation); (2) quantify the organic carbon flux to the system needed to consume competing electron acceptors (oxygen) and direct electron flow toward chloroethene degradation (short-term sustainability); and (3) compare the required flux of organic carbon to the pool of renewable and non-renewable organic carbon given the estimated time of remediation (long-term sustainability). These are general principles that can be used to assess the sustainability of MNA in any hydrologic system. http://pubs.usgs.gov/circ/circ1303/

Gas Fingerprinting Using Carbon Nanotubes Transistors Arrays
Bondavalli, P., P. Legagneux, and D. Pribat, Thales, France.
Nanotech 2007: Technical Proceedings of the 2007 NSTI Nanotechnology Conference and Trade Show. NSTI: Nano Science & Technology Institute, ISBN: 1-4200-6184-4, Vol 3, p 29-32, 2007

The first paper describing the great potential of carbon nanotubes field-effect transistors (CNTFET) for gas sensing applications was published in 2000. These devices exploit the extremely sensitive change of the Schottky junction built up between carbon nanotubes (CNT) and drain/source metal electrodes: the gas changes the metal work function and so the bending and the height of the Schottky barrier. This paper deals with a new approach for the quick and selective detection of different gases. The authors propose to realize an array of CNFET transistors where each device is obtained using different contact metals (drain/source). Each gas will change the work function of metal electrodes in a very specific way and will thus modify the CNTFET electrical characteristics. With this approach, a highly detailed electronic fingerprinting of the gas can be obtained. Gas molecules desorption could be achieved easily using UV light exposition or via thermal anneal. Results concerning exposition of a matrix of CNTFET with different metals contacts to dimethyl-methyl-phosphonate (a simulant for sarin gas) in environmental conditions are presented for proof-of-concept demonstration of the device.

Geomorphology and Hydrogeology of Hartshorne Coal Basin in Oklahoma and the Impact on Remediation of Acid Mine Drainage
Behum, Paul, Office of Surface Mining, Alton, IL.
Mid-Continent Region Technology Transfer Acid Mine Drainage Workshop, Collinsville, Illinois, 11-13 September 2007

Underground mine features, such as workings, portals, and shafts, as well as geological information, were mapped using the TIPS geologic mapping software, earthVision. This information and hydrologic analysis via TIPS software will be used to evaluate the long-term impacts of mine pool discharges in the Hartshorne Basin. Two sites within the basin currently treat acid mine drainage (AMD) discharges from artesian seeps. Additional treatment facilities are planned using TIPS-supplied LIDAR (light detection and ranging) topographic data. The use of LIDAR technology is necessary because most mine pool discharges occur near or in the center of the basin in an area of low topographic relief (and forest cover). As a consequence, limited hydrologic head is available to maintain flow through the cascading passive treatment cells necessary to remediate the AMD. The readily available digital topographic data are too coarse (20-foot contour interval) for use in treatment design. LIDAR data were used to generate 2-ft contour intervals on the northern limb of the basin floor. This will provide data for design activity for the treatment of two of these discharges from one large mine pool using earthVision and TIPS computer-aided design CAD software. A second pool exists along the southern limb where there are three additional discharges. Visualization of proposed treatment systems using color-keyed perspective views developed with earthVision will aid decision making.
http://www.mcrcc.osmre.gov/PDF/in%20house%20forums/2007%20AMD%20Workshop/B4%20Hydrogeology%20of%20Hartshorne%20Coal%20Basin%20in%20Oklahoma%20Paul%20Behum%202007.pdf

Geospatial Metadata Technical Specification, Version 1.0
U.S. EPA, Office of Environmental Information, 48 pp, Nov 2007

The primary purpose of this document is to establish guidelines for publishing geospatial metadata for data sets, applications, and services developed by U.S. EPA. The intent of establishing publishing guidelines for Agency geospatial metadata is two-fold: (1) to ensure that consistent implementation practices are followed for geospatial metadata implementation across the Agency, and (2) to ensure that sufficient information is provided within geospatial metadata published by different Agency authors that will serve multiple Agency needs. Consistency in geospatial metadata publishing and management practices leads to improved discovery and reuse of geospatial data for internal purposes while also improving Agency support for the National Geospatial Data Infrastructure. The guidelines set forth in this document should be applied to the creation of all new geospatial metadata records at EPA. Existing metadata records should be updated to meet EPA requirements in accordance with each organization’s records management schedule.
http://www.epa.gov/geospatial/docs/EPA_Geospatial_Metadata_Technical_Specification_v1_11_2_2007.pdf

Groundwater Contamination Plume Monitoring in Sealed Waste Dumps
Lopes, M., G. Avillez, C.N. Costa, and J.A. Almeida.
Engineering Geology, Vol 85 Nos 1-2, p 62-66, 26 May 2006

After a waste dump has been closed, a monitoring plan should be implemented, and characterization studies should be undertaken when necessary to avoid unforeseen problems. To design monitoring plans for these areas, it is essential to have knowledge of local geology and hydrogeology because potential contamination of soils and groundwater depends essentially on the physical characteristics of the area (e.g., porosity and permeability) and local fluid dynamics (e.g., groundwater level, flow direction). This paper presents a methodology for monitoring the area surrounding sealed waste dumps and for determining the presence of contamination in groundwater, based on Portuguese experience.

A Guide to Vegetation Sampling for Screening of Subsurface Pollution
Trapp, S., M. Larsen, C.N. Legind, J. Burken, J. Machackova, and U.G. Karlson.
BIOTOOL project GOCE 003998, 5 pp, Dec 2007

Measurement of vegetation samples is an alternative, cheap method to drilling for exploring sub-surface pollution. The objective of this manual is to transfer the experience gained within the EU project BIOTOOL into a concise guide for practical work. Vegetation samples are analyzed, and the occurrence of compounds like chlorinated solvents in vegetation is mapped. A relationship, but not necessarily a linear correlation, has been observed between concentrations of chemicals in vegetation samples and subsurface concentrations. Elevated concentrations of chemicals in vegetation usually indicate elevated soil or groundwater concentration. The method can be used as an exploratory method and may also serve for monitoring plume movement and natural attenuation. This method has been field-tested with good results for chlorinated solvents, copper, and cadmium.
http://www.gbf.de/biotools/Biotool/GuidetoVegetationSampling.pdf

Hadamard Spectrometer for Passive LWIR Standoff Surveillance
Kruzelecky, R.V., B. Wong, J. Zou, N. Mohammad, W. Jamroz, M. Soltani, M. Chaker, E. Haddad, P. Laou, and S. Paradis.
Photonics North 2007, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6796, 10 pp, 2007

Based on the principle of the integrated optical spectrometer, a waveguide-based, long-wave infrared dispersive spectrometer with multiple input slits for Hadamard spectroscopy has been designed and built for passive standoff chemical agent detection in the 8 to 12 um spectral range. This prototype unit comes with a 3-inch input telescope providing a field of view of 1.2 degrees, a 16-microslit array (each slit 60 um by 1.8 mm) module for Hadamard binary coding, a 2-mm core ZnS/ZnSe/ZnS slab waveguide with a 2 x 2 sq mm optical input and micro-machined integrated optical output condensor, a Si micro-machined blazing grating, a customized 128-pixel LWIR mercury-cadmium-telluride (MCT) LN2 cooled detector array, proprietary signal processing technique, software, and electronics. In the current configuration, the total system weight is estimated to be ~4 kg, spectral resolution <4/cm and noise equivalent spectral radiance <10(-8) W/sq cm/sr/cm in 8 to 12 um. System design and preliminary test results of some components are presented.

Heavy Metal Contamination from Mining Sites in South Morocco: Monitoring Metal Content and Toxicity of Soil Runoff and Groundwater
El Khalil, H., O. El Hamiani, G. Bitton, N. Ouazzani, and A. Boularbah, Univ. Cadi Ayyad, Marrakech, Morocco.
Environmental Monitoring and Assessment, Vol 136 Nos 1-3, p 147-160, Jan 2008

Metals toxicity was assessed in runoff, contaminated soil, and groundwater sampled from two mining areas using MetPLATE(tm), a microbial bioassay. This bioassay is based on the specific inhibition by the metallic pollutants of the beta-galactosidase enzyme of a mutant strain of Escherichia coli. The stream waters from all but two sampling stations in the two mines were very toxic and displayed percent enzyme inhibition exceeding 87%. Their high concentrations of copper (Cu) and zinc (Zn) confirmed the acute toxicity shown by MetPLATE(tm). The pH of stream waters from mines B and C varied between 2.1 and 6.2 and was probably responsible for metal mobilization, suggesting a problem of acid mine drainage in these areas. MetPLATE(tm) was also applied to mine tailings and soils contaminated by the acidic waters. The high toxicity of the soil and tailings was due mainly to the relatively high concentrations of soluble Zn and Cu. Most of the samples exhibited low metal toxicity (2.7 to 45.5% inhibition) except for one station in mine B, which had 95.3% inhibition during the wet season and 82.9% inhibition during the dry season. These results show the potential risk of the contamination to different ecosystems situated in the vicinity of the two sites. The investigators found the MetPLATE(tm) bioassay to be a fast, reliable method to estimate metals toxicity in aquatic and solid samples.

Highly Selective Cyanide Coated-Wire Electrode Based on a Recently Synthesized Co(II) Complex with the N,N'-bis(2-Quinolinecarboxamido)-1,2-Benzene Applying Batch and Flow Injection Analysis Techniques
Alizadeh, N., H. Teymourian, M. Aghamohammadi, S. Meghdadi, and M. Amirnasr.
Sensors Journal, IEEE, Vol 7 No 12, p 1727-1734, Dec 2007

The article reports on the development of a novel sensing material for determining trace amounts of cyanide ions using a PVC-based coated wire electrode based on [Co(II)bqb] (bqb= N,N'-bis(2-quinolinecarboxamido)-1,2-benzene). As opposed to most other cyanide-sensitive electrodes, this one demonstrates high selectivity and a short response time among the entire range of concentrations. The flow cell shows no memory effect problems over time, and is easy to build. No significant differences were found by a comparative study between this method and the ASTM method.

Hyperspectral Imaging Based Procedures Applied to Bottom Ash Characterization
Bonifazi, G. and S. Serranti, La Sapienza, Univ. di Roma, Italy.
Advanced Environmental, Chemical, and Biological Sensing Technologies V, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6755, 8 pp, 2007

Bottom ash from municipal solid waste incinerators can be used as material for the foundation of roads in European countries. Bottom ash usually is first crushed to below 40 mm and separated magnetically to recover the steel scrap. The presence of residual organic matter in the ash poses a problem in that the large surface area presented by the fine fraction creates leaching values for elements, such as copper, above the accepted levels for standard building materials. The authors assessed the potential of hyperspectral imaging to identify organic matter inside the residues. Reflectance spectra of selected bottom ash samples acquired in the VIS-NIR field (400 to 1,000 nm) indicated that the organic content of the different samples influences the spectral signatures, particularly an inverse correlation between reflectance level and organic matter content.

Hollow Waveguide Gas Sensor for Mid-Infrared Trace Gas Analysis
Kim, S., C. Young, J. Chan, C. Carter, and B. Mizaikoff.
IEEE Sensors 2007, 28-31 Oct 2007, Atlanta, GA. 6 pp, 2007

A hollow waveguide mid-infrared gas sensor operating from 1,000/cm to 4,000/cm has been developed, optimized, and its performance characterized by combining a FT-IR spectrometer with Ag/Ag-halide hollow core optical fibers. The hollow core waveguide simultaneously serves as a light guide and miniature gas cell. CH4 was used as test analyte during exponential dilution experiments for accurate determination of the achievable limit of detection. It is shown that the optimized integration of an optical gas sensor module with FT-IR spectroscopy provides trace sensitivity at the few hundreds ppb, v/v for CH4.
https://e-reports-ext.llnl.gov/pdf/349944.pdf

Homogeneous Liquid-Liquid Extraction Combined with Gas Chromatography-Electron Capture Detector for the Determination of Three Pesticide Residues in Soils
Wang, X., X. Zhao, X. Liu, Y. Li, L. Fu, J. Hu, and C. Huang, Wenzhou Medical College, Wenzhou, China.
Analitica Chimica Acta, Vol 620 Nos 1-2, p 162-169, 14 July 2008

A new method was developed for analyzing pesticides (malathion, cypermethrin, and lambda-cyhalothrin) in soil samples by homogeneous liquid-liquid extraction (HLLE) and gas chromatography with electron capture detector. Acetone was used as extraction solvent for the extraction of target pesticides from soil samples. When the extraction process was finished, the target analytes in the extraction solvent were transferred rapidly from the acetone extract to carbon tetrachloride using HLLE. Under optimum conditions, linearity was obtained in the range of 0.05 to 40 ug/kg for malathion, 0.04 to 10 ug/kg for lambda-cyhalothrin, and 0.05 to 50 ug/kg for cypermethrin. The proposed method was applied successfully for the determination of target pesticide residues in real soil samples.

Hyperspectral Signal Processing Applications in Environmental Monitoring Identification and Mapping of the Invasive Plant Species Purple Loosestrife
Liu, G. and J. Allen (Clemson Univ., SC); L. Kang (Towson Univ., MD); G. Kleppel (State Univ. of New York); J. Parkey (North Wind Inc., ID).
Proceedings of the 8th International Conference on Signal Processing, 16-20 November 2006, Guilin, China. Institute of Electrical and Electronics Engineers, Inc.
ISBN: 0-7803-9736-3, p 3063-3066, 2006

The invasive Purple Loosestrife plant is considered a threat to numerous ecosystems across the United States. Introduced from Europe to North America in the 1800s, it now is

known as the "purple plague" and has spread across 48 of 50 states in the U.S. and all provinces of Canada. The U.S. Fish and Wildlife Service declared Purple Loosestrife "Public Enemy #1 on Federal Lands," and The Nature Conservancy listed it as the second most troublesome weed in wetlands. Monitoring and mapping the plant is a challenge due to the difficulty of access to the vast, remote, and often privately owned marsh lands of New York State. This paper presents the results of a recent study of hyperspectral signal processing for identification, classification, and mapping of Purple Loosestrife. The following signal processing methods were combined: geographic calibration, atmospheric correction, minimum noise fraction, pixel purity index, regions of interesting locating, hyperspectral library creation, and spectral angle mapper classification. The classification accuracy is significantly increased (91.7%) due to the application of the self-built hyperspectral library STIHL.
ftp://stately.clemson.edu/pub/lgreg/SPHypPaper06CN1.doc

Identification of Compounds in Water Above a Pollutant Plume by High Resolution Mass Spectrometry
Grange, A.H. and G.W. Sovocool, U.S. EPA, ORD, NERL, Las Vegas, NV.
Environmental Forensics, Vol 8, p 391-404, 2007

The identification of compounds in contaminated media is essential for determining sources of pollution and for assessing risks posed by the chemicals to ecosystems or human health. Eighty-five compounds were identified or tentatively identified in a 1-L extract of water sampled above a pollutant plume containing wastes from a chemical plant. Gas chromatography/high resolution mass spectrometry determined exact masses of apparent molecular ions and the exact masses and relative isotopic abundances of their +1 and +2 isotopic mass peaks, which provided their elemental compositions. Ion compositions, mass spectral libraries, the presence of related compounds, and knowledge of organic chemistry provided tentative identifications, half of which were confirmed by comparison of analyte retention times and mass spectra with those of standards.
http://www.epa.gov/nerlesd1/pdf-ecb/EnvirnForen81307.pdf

Identification of Contaminant Sources in Enclosed Spaces by a Single Sensor
Zhang, T. and Q. Chen, Purdue Univ., West Lafayette, IN.
Indoor Air, Vol 17 No 6, p 439-449, Dec 2007

This paper presents an analytical method that can be used to find a gaseous contaminant source location and determine its strength in enclosed spaces with the data of contaminant concentration measured by one sensor. The method can be a very useful tool to find where, what, and how the contamination has happened. The method is also enables optimal placement sensors in enclosed spaces. The results can be applied to develop appropriate measures to protect occupants in enclosed environments from infectious diseases or chemical/biological warfare agents released by a terrorist.

Imaging of Methane Gas Using a Scanning, Open-Path Laser System
Gibson, G. and B. van Well (Univ. of Glasgow, UK); J. Hodgkinson and R. Pride (Advantica Ltd.); R. Strzoda (Siemens AG); S. Murray (AOS Technology Ltd.); S. Bishton (Semelab Plc.)'; M. Padgett (Univ. of Glasgow).
New Journal of Physics, Vol 8, 2006

An imaging system developed for the detection and visualization of methane gas leaks is based on a distributed feedback InGaAs laser diode emitting at 1.65 um, the beam from which is directed at neighbouring objects. The backscattered light is collected by a Fresnel lens, and the gas concentration is deduced from the reduction in collected intensity as measured using a second derivative wavelength modulation technique. The incident laser and the collected beam are both scanned over an area to form an image of the gas emission. To ease the task of locating the source of the emission, the resulting low-resolution image of the gas emission is combined with a high-resolution color image of the scene. Results show that the system can image a gas cloud of 1 mm effective thickness at a range of several meters, sufficient to detect a gas leak of 1 L/min in light to moderate winds.
http://www.iop.org/EJ/article/1367-2630/8/2/026/njp6_2_026.html

An In Situ Device to Measure Oxygen in the Vadose Zone and in Groundwater: Laboratory Testing and Field Evaluation
Patterson, B.M. and G.B. Davis, CSIRO Land and Water, Australia.
Ground Water Monitoring & Remediation, Vol 28 No 2, p 68-74, 2008

During long-term field evaluation trials at contaminated sites, oxygen probes developed to measure in situ oxygen concentrations in gaseous and aqueous environments were shown to have a linear calibration and to be accurate compared to conventional dissolved oxygen electrodes and gas chromatography, both of which require labor-intensive sample collection and processing. Once calibrated, the probes required no maintenance or recalibration for as much as seven years in low-oxygen environments, demonstrating long-term stability. Times to achieve 90% of the stabilized concentration after a step change in aqueous oxygen concentration were 100 to 120 min in lab experiments and up to 180 min in field experiments, which is sufficient for monitoring subsurface changes. Field application data demonstrated that the oxygen probes could monitor oxygen concentrations in hydrocarbon-contaminated groundwater to a depth of 20 m below the water table or in pyritic vadose zones over extended periods. During bioremediation field trials, oxygen monitoring enabled estimation of oxygen utilization rates by microorganisms and hydrocarbon biodegradation rates. The probes also were able to monitor the development of groundwater desaturation during air sparging trials, enabling the automated assessment of the distribution of injected air.

An In Situ Laser-Induced Fluorescence System for Polycylic Aromatic Hydrocarbon-Contaminated Sediments
Aldstadt, J. (Univ. of Wisconsin, Milwaukee); R. St. Germain (Dakota Technologies, Inc.); T. Grundl; R. Schweitzer (Schweitzer Consulting).
U.S. EPA, Great Lakes National Program Office, Chicago, IL. 54 pp, 2002

This report describes the development of an adaptation of the proven terrestrial DPT-LIF technique used for the in situ characterization of PAHs in freshwater sediments. This technique

provides for the rapid, vertically discrete quantitation of PAH compounds with the following specific objectives: (1) to adapt LIF-DPT techniques for the in situ detection of PAH contamination in submerged harbor sediments, (2) to develop an in situ sediment sampling system for the collection of submerged harbor sediments that directly correspond to the LIF depth profile, and (3) to demonstrate the ability of this system to detect PAHs in sediment samples and its applicability as a tool to delineate the extent of sediment contamination in Milwaukee Harbor. Once the physical development of the delivery platform and sampler was in place, development shifted to the acquisition and interpretation of LIF-DPT measurements taken in the field. The first task was to identify the individual species contributing to the overall fluorescence signal. A second task was to remove background signals. A third task was to provide relative concentrations of the species detected and to relate these relative concentrations to true concentrations in a quantitative manner.
http://www.epa.gov/glnpo/sediment/pah/finalrpt.pdf

In-Tube Solid-Phase Microextraction-Capillary Liquid Chromatography as a Solution for the Screening Analysis of Organophosphorus Pesticides in Untreated Environmental Water Samples
Chafer-Pericas, C., R. Herraez-Hernandez, and P. Campins-Falco, Univ. de Valencia, Spain.
Journal of Chromatography A, Vol 1141 No 1, p 10-21, Feb 2007

In-tube solid-phase microextraction (SPME) in an open capillary column coupled to capillary liquid chromatography (LC) with UV detection has been used for preconcentration, separation, and detection of the analytes in the same assembly. For in-tube SPME, two capillary columns of the same length (30 cm) and different internal diameters (0.25 mm vs 0.1 mm) and coating thicknesses (0.25 um vs 0.1 um) have been tested and compared. In both columns, the coating was 95% dimethylpolysiloxane (PDMS)-5% diphenylpolysiloxane. The proposed methodology provided limits of detections (LODs) for the tested organophosphorus pesticides in the 0.1 to 10 ug/L range, whereas the direct injection of the samples onto the capillary LC system provided LODs in the 50 to 1,000 ug/L range. The sensitivity of the proposed in-tube SPME-capillary LC method is adequate for monitoring the analyte levels in drinking water. Several triazines, PAHs, nonylphenol, organochloride pesticides, or PBDEs have been evaluated as possible interferents. The reliability of the described method was demonstrated by analyzing real water samples.

Integrated Field Screening for Rapid Sediment Characterization: Cost and Performance Report
Environmental Security Technology Certification Program, ESTCP Project CU-9717, 39 pp, Aug 2004

The primary objectives of this demonstration were to evaluate three field-screening technologies--field-portable x-ray fluorescence spectrometry for metals; UV fluorescence for PAHs; and a bioluminescent-based bioassay, QwikSed, for bioavailability--in the following areas: (1) their performance compared to conventional sampling and analytical methods; (2) data quality; (3) the logistical and economic resources necessary to operate the technologies; and (4) the range of usefulness in which the technologies can be operated and integrated into a screening procedure that allows more efficient assessment of sediment sites. Secondary objectives for this demonstration were to evaluate the technologies for their reliability, ruggedness, and ease of operation. The fourth primary objective is important because current regulatory projects often

rely on "blind" sampling, with little or no knowledge of how much volume of sediment each laboratory measurement represents. Cheaper screening techniques will allow more knowledgeable sample selection for laboratory analysis and better insight into how representative the samples are. As additional screening techniques are developed, they may be incorporated into existing screening procedures.
http://www.estcp.org/documents/techdocs/CU_9717.pdf

Integrated Methodology to Evaluate Bioremediation Potential of Creosote-Contaminated Soils
Molnar, M., K. Gruiz, and M. Halasz.
Periodica Polytechnica Chemical Engineering, Vol 51 No 1, 23-32, 2007

Short-term laboratory bioreactor feasibility studies using contaminated field soils from two separate locations indicated that bioventing and slurry-phase bioremediation with inoculation were suitable approaches to remediating creosote-contaminated soil. In the experiments, slurry-phase biodegradation was more efficient for loamy soil (Site I) than bioventing. Both technologies were suitable for remediation of loose, humic soil (Site II) with aged contamination in which the soil microbes had adapted their genetics and biochemistry to the contaminants. An applied integrated evaluation methodology provided detailed results for the quality and quantity of the contaminant and soil characteristics, the biological and toxicological status, and complex interactions between the soil compartments. The results underline the need to take ecotoxicological effects into account to assess remediation efficiency, using test batteries that can measure responses and interactions to characterize contaminated soil as a dynamic system. Based on the study results, the authors propose a toxicity test battery that includes the Vibrio fisheri bioluminescence test, Sinapis alba shoot elongation test, and Folsomia candida mortality test. The test battery results provided complementary and essential information to chemical characterization.
Paper at http://www.pp.bme.hu/ch/2007_1/pdf/ch2007_1_05.pdf

Interim Guidance for Developing GPS Data Collection: Standard Operating Procedures and Quality Assurance Project Plans
U.S. EPA, National Exposure Research Laboratory, Geospatial Quality Council, Las Vegas, NV.
EPA 600-R-80-020, 66 pp, Feb 2008

A Geospatial Quality Council (GQC) survey in 2002 found that most EPA Regions and Program Offices do not have a standard operating procedure (SOP) for global positioning systems (GPS) data collection activities. The impact of this finding suggests low confidence in interoperability and shared information. Modern GPS units contain many settings that can serve as quality checks during data acquisition. For data collected using GPS, accuracy information can be collected to document the limitations of the unit itself, the accuracy for a given collection, and other steps involved in data processing. This guidance is designed to improve the administrative efficiency and the interoperability of GPS data collected by stakeholders by harmonizing the approaches used to develop GPS data collection SOPs and Quality Assurance Project Plans (QAPPs) in the following areas: (1) reduces the time scientists spend on writing GPS SOPs and QAPPs, (2) decreases the time necessary to gather locational data for responding to emergency situations, (3) provides consistency in implementing the Graded Approach and provides information for extramural stakeholders when Regions require use of the GQC

guidance documents. Additional information is available in Geospatial Metadata Technical Specification v. 1.0 (U.S. EPA 2007).
http://www.epa.gov/nerlesd1/gqc/pdf/InterimGuidance_for_GPS-SOP-QAPP.pdf

Laboratory Calibration and Field Deployment of a Passive Sampling Device for Time-Weighted Average Concentrations of Pharmaceuticals and Personal Care Products in Wastewater and Surface Water
Sudhir, P., C. Wong, and S. MacLeod, Univ. of Alberta.
Book of Abstracts: 34th Annual Aquatic Toxicity Workshop, Halifax, Nova Scotia, 30th September - 3rd October 2007

Aqueous sampling rates for 25 common pharmaceuticals and personal care products (PPCPs) were determined on the commercially available passive POCIS (polar organic chemical integrative sampler). To date, POCIS calibration has only been carried out for a few other compounds. Uptake rates were 0.040 to 2.462 L/d under flowing water conditions while quiescent conditions resulted in uptake rates between 0.016 and 0.223 L/d. The uptake of many PPCPs appears to be boundary-layer controlled, as indicated by higher sampling rates under flowing conditions. Sampling rates were corrected for analyte dissipation rates, and some correlations with octanol/water partition coefficients were noted. Field deployments of POCIS in wastewater effluent and surface waters provided time-weighted average concentrations derived from laboratory calibrations that were consistent with regular grab samples. This work indicates that POCIS can be used as a quantitative tool for measuring time-weighted average concentrations of PPCPs in the aquatic environment.

Laboratory Evaluation of Acoustic Backscatter and LISST Methods for Measurements of Suspended Sediments
Meral, Ramazan, Kahramanmaras Sutcu Imam Univ., Kahramanmaras, Turkey.
Sensors, Vol 8 No 2, p 979-993, Feb 2008

Acoustic backscatter and LISST (laser in situ scattering transmissometry) devices and methodologies were used in a laboratory study conducted to compare pumping methods for different sediment radiuses at the same concentration. Glass spheres (ballotini) of three different radiuses of 115, 137, and 163 um were used to obtain suspension in a sediment tower in the laboratory. Good agreement was obtained between these methods and the pumping results, with a range of 60.6 to 94.2% for sediment concentration and 91.3 to 100% for radius measurements. The results of this and other studies show that these methods have potential for research tools for sediment studies. Additional studies are needed to assess the performance of these methods for sediment measurement under different water and sediment material conditions.
http://www.mdpi.org/sensors/list08.htm

Landfills in Jiangsu Province, China, and Potential Threats for Public Health: Leachate Appraisal and Spatial Analysis Using Geographic Information System and Remote Sensing
Yang, K., X.N. Zhou, W.A. Yan, D.R. Hang, P. Steinmann.
Waste Management, [in press] 2008

A study using a geographical information system (GIS) and remote sensing was conducted to determine the performance (i.e., leachate and gas emissions) and suitability of location of 5 existing landfills used for domestic waste disposal in a metropolitan area of Jiangsu province, China. The authors also investigated remotely-sensed environmental features in close proximity to landfills and evaluated the compliance of the location and leachate quality with the relevant regulations. The leachates of the sampled landfills contained heavy metals (Pb, As, Cr(6+), and Hg) and organic compounds in concentrations considered harmful to human health, although measured methane concentrations on landfill surfaces were low. Spatial analysis of the location of landfills with regard to distance from major water bodies, sensible infrastructure, and environmental conditions resulted in the rejection of four of the five sites as inappropriate for landfill use. The results call for rigorous evaluation of the spatial location of landfills in China that must take into consideration environmental and public health criteria.

Leaf Optical Properties in Higher Plants: Linking Spectral Characteristics to Stress and Chlorophyll Concentration
Carter, Gregory A. and Alan K. Knapp, Stennis Space Center, MS, and Kansas State Univ.
American Journal of Botany, Vol 88, p 677-684, 2001

Study results have linked responses in leaf spectral reflectance, transmittance, or absorptance to physiological stressors, such as dehydration, flooding, freezing, ozone, herbicides, competition, disease, insects, and deficiencies in ectomycorrhizal development and N fertilization. In species ranging from grasses to conifers and deciduous trees, the maximum difference in reflectance within the 400 to 850 nm wavelength range between control and stressed states occurred as a reflectance increase at wavelengths near 700 nm. In studies that included transmittance and absorptance as well as reflectance, maximum differences occurred as increases and decreases, respectively, near 700 nm. This common optical response to stress could be simulated closely by varying the chlorophyll concentration of model leaves (fiberglass filter pads) and by the natural variability in leaf chlorophyll concentrations in senescent leaves of five species. The optical response to stress near 700 nm, as well as corresponding changes in reflectance that occur in the green/yellow spectrum, can be explained by the general tendency of stress to reduce leaf chlorophyll concentration.
http://www.amjbot.org/cgi/content/full/88/4/677

Long Term Remote Monitoring of TCE Contaminated Groundwater at Savannah River Site
Duran, C., R. Gudavalli, L. Lagos, B. Tansel, J. Varona, and M. Allen.
ANES 2004: Americas Nuclear Energy Symposium, 3-6 October 2004, Miami, Florida. 8 pp, 2004

The purpose of this study was to develop a mobile, self-powered, remote monitoring system enhanced for field deployment at the Savannah River Site (SRS). The system used a localized power source with solar recharging and has wireless data collection, analysis, transmission, and data management capabilities. The prototype was equipped with a Hydrolab's DataSonde 4a multi-sensor array package managed by a Supervisory Control and Data Acquisition (SCADA) system, with an adequate pumping capacity of water samples for sampling and analysis of TCE in contaminated groundwater wells at SRS. This paper focuses on a study and technology development efforts conducted at the Hemispheric Center for Environmental Technology at Florida International University to automate the sampling of contaminated wells with a multi-sensor array package developed using COTS (commercial off the shelf) parts. Bladder pumps pump water from different wells to the sensors array, and water

quality TCE indicator parameters (pH, redox, ORP, DO, NO3 -, Cl-) are measured. To increase user access and data management, the system is designed to be accessible over the Internet. Remote users can take sample readings and collect data remotely over the Web. Results obtained at Florida International University in-house testing and at a field deployment at the Savannah River Site indicate that this long-term monitoring technique can be a feasible solution for the sampling of TCE indicator parameters at remote contaminated sites.
http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=841449

A Long-Term Resistivity Experiment along Vertical Probes: Implications for Time-Lapse Monitoring
Sherrod, Laura, Grand Valley State Univ.
Abstracts: 2008 Ground Water Summit, Memphis, TN. National Ground Water Association, 2008

Four vertical geophysical probes were constructed mainly to measure subsurface resistivity through the vadose zone and into the aquifer. The probes were installed at increasing distances from a pond in Van Buren County, MI, in an inhomogeneous soil. Over nearly two years of uninterrupted data collection (Dec 2005-Sep 2007), pole-pole resistivity measurements with an a-spacing of 5 centimeters were recorded every four hours during normal conditions and at 3-minute intervals during and for two hours after infiltration events. Long-term results illustrate the importance of temperature, saturation state, and seasonal effects (related to the changing ionic load of infiltrating water) on resistivity in the shallow subsurface. These factors can create a change in subsurface resistivity of over 100% in the vadose zone and nearly 40% within the upper saturated zone. The measurements and analysis suggest caution for the use and interpretation of time-lapse, shallow-subsurface resistivity measurements to monitor site changes.

Low-Cost Gas Correlation Detection of Methane
Chapman, O.M. and M. Hilton, Univ. of Reading, UK.
Optical Sensing II, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6189, 10 pp, 2006

Two instruments have been designed for airborne remote sensing of landfill methane emissions using the infrared absorption of reflected sunlight. A gas correlation filter wheel and a length modulated cell have been produced to discriminate between methane and other interfering species. The performance of the two systems is discussed. When the two systems were interfaced with an indium gallium arsenide (InGaAs) 2-D detector array and an indium antimonide (InSb) point detector, respectively, the InGaAs array detector response rate was slow compared to the InSb detector. The gas correlation filter wheel has been shown to detect levels of methane equivalent to 200 ppmv with a 30-m pathlength at the 3.3 um methane band with the InSb point detector. It should be possible to detect levels equivalent to 20 ppmv over a 30-m pathlength at the 1.65 um band with the gas correlation filter wheel and a fast-response InGaAs detector. The length-modulated device was found to have far less sensitivity in comparison to the filter wheel system but performance could be enhanced with improved design.

Magnetic Resonance Imaging Methods to Reveal the Real-Time Distribution of Nickel in Porous Media

Moradia, A.B., S.E. Oswald, J.A. Massner, K.P. Pruessmann, B.H. Robinson, and R. Schulin.

European Journal of Soil Science, Vol 59 No 3, p 476-485, June 2008

Magnetic resonance imaging (MRI) was used to visualize the dynamic distribution of paramagnetic nickel (Ni+2) ions in porous media. Various MRI sequences were tested to image Ni2+ at small concentrations. Noisy gradient echo images had poor contrast between samples containing various Ni2+ concentrations. Turbo spin echo and spoiled gradient echo images showed a linear relation between Ni2+ concentrations and signal intensity over a wide range of concentrations. Spoiled gradient echo images resolved Ni2+ concentrations (down to 30 mg/L) better than turbo spin echo images, although for smaller concentrations, uncertainty in intensity values increased. A T1 measurement, obtained using an inversion recovery sequence, showed a linear correlation between T1 and Ni2+ concentration down to 1.5 mg/L. In a glass bead medium with an ion exchange resin as a Ni sink, the real-time development of the Ni2+ depletion zone around the resin, as Ni was sorbed into the resin, was imaged by T1 mapping. A spatial resolution of 0.58 mm and a temporal resolution of less than a minute were achieved. The 2-D Ni2+ gradient determined from MRI agreed well with geochemical modeling results. The results of this study showed that MRI, in particular T1 mapping, can quantify microscale behavior of paramagnetic species in porous media; however, ferromagnetic components that occur naturally in most soils can easily disturb the MRI signal.

Magnitude and Directional Measures of Water and Cr(VI) Fluxes by Passive Flux Meter

Campbell, T.J., K. Hatfield, H. Klammler, and M.D. Annable (Univ. of Florida, Gainesville); P.S.C. Rao (Purdue Univ., West Lafayette, IN).

Environmental Science & Technology, Vol 40 No 20, p 6392-6397, 2006

A new configuration of the passive fluxmeter (PFM) provides for simultaneous measurements of both the magnitude and the direction of ambient groundwater-specific discharge and Cr(VI) mass flux. The PFM is configured as a cylindrical unit with an interior divided into a center section and three outer sectors, each packed with a granular anion exchange resin having high sorption capacity for the Cr(VI) oxyanions CrO(4)(2-) and HCrO(4-). The sorbent in the center section is preloaded with benzoate as the resident tracer. In column experiments with synthetic groundwater containing Cr(VI), some of the resident tracer was depleted during the deployment period while the Cr(VI) was sorbed. The resin was then removed from the four sectors separately and extracted to determine the mass of Cr(VI) captured and the residual mass of the resident tracer in each. Cumulative specific discharge values were assessed using the residual mass of benzoate retained in the center section. The direction of this discharge was ascertained from the mass distribution of benzoate intercepted and retained in the outer three sections of the PFM. Cumulative chromium fluxes were quantified using the total Cr(VI) mass intercepted and retained on the PFM. Results demonstrate the potential utility of the new PFM configuration for characterizing groundwater and contaminant fluxes.

Making Sense of Contaminant Mass Flux as a Remediation Performance Metric: Demonstration of the EnviroFlux Passive Flux Meter(tm)

RPM News, p 15-22, fall 2007

Passive flux meters (PFM), like the EnviroFlux Passive Flux Meter(tm) developed at the University of Florida and field-validated under DoD's Environmental Security Technology

Certification Program, are a valuable alternative to discrete or point concentration measurements for direct quantification of contaminant mass flux. They are inserted into groundwater monitoring wells to passively intercept groundwater flow. The PFM is a nylon mesh tube filled with a sorbent/tracer mixture. This permeable sorbent retains dissolved contaminants present in the groundwater as it flows through the flux meter under natural-gradient flow conditions. With appropriate sorbents, the PFM can intercept a broad range of contaminants (hydrophobic organic compounds, organic or inorganic ions). The sorbent mixture is preloaded with specified amounts of resident tracers that leach from the sorbent as groundwater flows through the PFM. For common organic contaminants, such as trichloroethene (TCE) and tetrachloroethene (PCE), activated carbon is used as the sorbent with a suite of different alcohols as tracers. The PFM containing the sorbent and resident tracers is inserted into the well screen interval using a rod attached to the bottom end of the nylon mesh tube and left for a specified time. Multiple tracers provide flexible installation durations, as in zones with a much higher flow than others. Optimum installation duration is achieved when the mass of the tracer (e.g., ethanol) removed is about one-half of the initial mass for that particular tracer compound. Deployment times of one to two weeks are typical during field investigations, although deployments may last as long as four months. After the specified period of exposure to groundwater flow, the PFM is removed from the well, and the sorbent is extracted to quantify the mass of all contaminants intercepted by the PFM and the residual masses of all resident tracers. The contaminant masses are used to calculate cumulative and time-averaged contaminant mass flux, while residual resident tracer masses are used to calculate cumulative or time-average groundwater flux. PFM deployment and data evaluation currently cost about $150 to $200 per linear foot of saturated thickness investigated. Some regulatory agencies are not versed in these types of non-conventional measurements. Full story in the Fall 2007 issue of RPM News.
https://portal.navfac.navy.mil/portal/page?_pageid=181,5390323&_dad=portal&_schema=PORTAL

Manufacturable, Highly Responsive Nanowire Mercury Sensors
Keebaugh, S., W.J. Nam, and S.J. Fonash, Pennsylvania State Univ.
Nanotech 2007: Technical Proceedings of the 2007 NSTI Nanotechnology Conference and Trade Show. NSTI: Nano Science & Technology Institute. ISBN: 1-4200-6184-4, Vol 3, p 33-36, 2007

Researchers have developed a manufacturable and highly responsive gold nanowire sensor capable of detecting ppb concentrations of mercury in air and water. The nanowire sensor exhibits a superior response compared to thin film sensors; this response is closely related to the morphology of the nanowire. By carefully controlling the sensor fabrication and post-processing steps, smooth, continuous nanowire morphologies can be reproduced to obtain highly responsive and manufacturable sensors. These nanowire sensors are very robust and capable of withstanding regeneration temperatures without significant changes in the nanowire morphology or baseline electrical properties.

Measurement of Gas-Accessible NAPL Saturation in Soil Using Gaseous Tracers
Kim, H. and K.-M. Choi (Hallym Univ., Chuncheon, Gangwon-do, Korea); P.S.C. Rao (Purdue Univ., West Lafayette, IN)
Environmental Science & Technology, Vol 41 No 1, p 235-241, 2007

A method involving the use of a set of four gaseous tracers was developed in the lab for measuring the NAPL saturation directly accessible to the mobile gas as well as the total NAPL saturation in unsaturated sand. One tracer with low water solubility (n-pentane) was used as the tracer that partitions into NAPL directly accessible to the mobile gas, and another (chloroform) tracer with moderate water solubility and NAPL-partitioning, was selected for detecting total NAPL saturation. Helium and difluoromethane were used as the nonreactive and water-partitioning tracers, respectively. A saturated hydrocarbon, n-decane, was used as NAPL. Column experiments were conducted at two water saturations (Sw = 0.68 and 0.16). At Sw = 0.68, only 28% of the total NAPL was detected by n-pentane, whereas 87% of the total NAPL was accessible to n-pentane at Sw = 0.16, suggesting that more NAPL was accessible to the mobile gas phase at lower water saturation.

Metal Ion Sensor with Catalytic DNA in a Nanofluidic Intelligent Processor
Cropek, D.M., et al.
Strategic Environmental Research and Development Program, SERDP Project CS-1265, 96 pp, 2005

Project CS-1265 assessed the potential of combining Pb2+-specific catalytic DNA enzymes with microfluidic devices. The catalytic DNAzyme is incorporated into a detection channel on the microfluidic device. A Pb-containing solution is placed in a source channel. By appropriate application of voltages across channels, the Pb solution can be injected through nanocapillary array interconnects (NAI) that separate the channels. These gateable microfluidic devices build upon research developed by Bohn and Sweedler et al. Methods for adapting Pb-specific biosensors to the NAI microfluidic device are presented. Performances of the developed method were evaluated by studying quantifiable concentration range, method accuracy, and precision. Successful application to real sample analysis using an electroplating sludge certified reference material is also presented. The sensor architecture developed here is not analyte dependent; other molecular beacons can be incorporated on this microfluidic device.
http://www.estcp.org/viewfile.cfm?Doc=CS%5F1265%5FFR%2Epdf

Microbial Fuel Cell-Based Biosensor for Fast Analysis of Biodegradable Organic Matter
Kumlanghan, A., J. Liu, P. Thavarungkul, P. Kanatharana, and B. Mattiasson.
Biosensors and Bioelectronics, Vol 22 No 12, p 2939-2944, 2007

A novel biosensor is based on a single-chamber microbial fuel cell in which anaerobes are retained in the anode compartment separated from the cathode compartment by a proton exchange membrane. A replaceable anaerobic consortium was used in the sensor for analyzing biodegradable organic matter. The anaerobes act as biocatalysts in oxidizing organic matter and transferring electrons to the anode. The biocatalysts are renewed for each sample analysis by replacing the old anaerobic consortium with an equal amount of a fresh one. A glucose standard solution is used as the target substrate. To obtain the maximum sensor output, the MFC-based sensor system is optimized using an 800-ohm resistor as the load to the external electric circuit and 25 mM phosphate buffer with 50 mM NaCl as catholyte in the aerobic compartment. The temperature of the anaerobic compartment was maintained at an optimal 37 degrees C. The cell potential across the electrodes increased with increasing loading of glucose. The sensor response was linear against concentrations of glucose up to 25 g/L. The detection limit was 0.025 g/L. The microbial fuel cell with replaceable anaerobic consortium could be used as a biosensor for online monitoring of organic matter.

Microradiography as a Tool to Detect Heavy Metal Uptake in Plants for Phytoremediation Applications
Reale, L., A. Lai, I. Bellucci, A. Faenov, T. Pikuz, F. Flora, L. Spano, A. Poma, T. Limongi, L. Palladino, A. Ritucci, G. Tomassetti, G. Petrocelli, and S. Martellucci.
Microscopy Research and Technique, Vol 69 No 8, p 666-674, 2006

Contact microradiography with soft X-rays for detecting the uptake site of heavy metal in whole plant leaves was investigated. A laser-plasma based on an Nd:glass laser provided the X-ray source. The radiation from the plasma laser can be strongly absorbed in regions of the leaves rich in iron, magnesium, and copper, thereby pointing to the structures where these heavy elements are found. Leaves treated with copper sulfate diluted in water at 1, 2, and 5% were imaged by using a copper target to evaluate differences with untreated control leaves. The test highlighted the presence of copper in the treated leaves. This new methodology should detect heavy element pollutants inside plants and become a useful analytic tool in phytoremediation studies.

Miniature and Low-Cost Wireless Sensor Platform for Environmental Monitoring
Kostov, Y., G. Rao, and U. Ghosh, Univ. of Maryland.
Strategic Environmental Research and Development Program, SERDP Project SI-1466, 87 pp, Sep 2007

A sensor platform developed with DO, pH, and turbidity sensors was equipped with pH- and oxygen-sensitive fluorescent foils. The foils were attached outside the waterproof case and read through optical window. The foils had also antibiofouling protection, which allowed them to operate for extended period of time. A microcontroller switched the channels and collected the reading of O2, pH, and turbidity every 15 minutes, then transmitted it through wires interfaced to a base station. The platform operates from 4 AA-size alkaline batteries. The transmitter has a range of approximately 1 kilometer, depending on the terrain, with transmission rate of 10 kbps. The sensor platform is miniature in size (3"x3"x3" sensing head, electronics, and battery pack) and low in cost (~$450/unit).
http://www.estcp.org/viewfile.cfm?Doc=SI%2D1466%2DFR%2Epdf

Monitoring and Modeling of Emissions from Concentrated Animal Feeding Operations: Overview of Methods
Bunton, B., P. O'Shaughnessy, S. Fitzsimmons, J. Gering, S. Hoff, M. Lyngbye, P.S. Thorne, J. Wasson, and M. Werner.
Environmental Health Perspectives, Vol 115 No 2, 303-307, Feb 2007

Accurate monitors are required to determine ambient concentration levels of contaminants emanating from concentrated animal feeding operations (CAFOs), and accurate models are required to indicate the spatial variability of concentrations over regions affected by CAFOs. This workgroup report describes instrumentation currently available for assessing contaminant concentration levels in the vicinity of CAFOs and reviews plume dispersion models that might be used to estimate concentration levels spatially. Recommendations for further research with respect to ambient air monitoring include accurately determining long-term average concentrations for a region under the influence of CAFO emissions using a combination

of instruments based on accuracy, cost, and sampling duration. Development of instruments capable of accurately quantifying adsorbed gases and VOCs also is needed. Further research with respect to plume dispersion models includes identifying and validating the most applicable model for use in predicting downwind concentrations from CAFOs. Additional data are needed to obtain reliable emission rates from CAFOs.
http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1817704

Monitoring Near Surface and Sub-Surface Nitrogen Contamination Using Trees and Stable Nitrogen Isotope (delta15N) Analyses
Nichols, Elizabeth Guthrie, North Carolina State Univ.
Fourth International Phytotechnologies Conference, 24-26 September 2007, Denver, Colorado: Abstracts, p 52, 2007

Stable nitrogen isotopic analyses (delta15N) of tree foliage and tree cores were used to map the extent of groundwater nitrogen attenuation in riparian buffers adjacent to various waste-application fields. The author discussed the development of this technique, sample collection, sample analysis costs, supporting data for its use, and potential applications as a phytotechnology to monitor surface and subsurface nitrogen wastes in the environment.

Monitoring of the Heavy-Metal Hyperaccumulation in Vegetal Tissues by X-Ray Radiography and by Femto-Second Laser Induced Breakdown Spectroscopy
Kaiser, J., O. Samek, L. Reale, M. Liska, R. Malina, A. Ritucci, A. Poma, A. Tucci, F. Flora, A. Lai, L. Mancini, G. Tromba, F. Zanini, A. Faenov, T. Pikuz, and G. Cinque.
Microscopy Research and Technique, Vol 70 No 2, p 147-153, 2007

X-ray microradiography and laser induced breakdown spectroscopy (LIBS) techniques were used to investigate metal accumulation in different parts of leaf samples. The potential of the LIBS-analysis to find the proper plant species for phytoremediation is compared with the results of microradiography measurements at the HERCULES source at ENEA, Rome (Italy) and X-ray microradiography experiments at the ELETTRA Synchrotron, Trieste (Italy).

Monitoring of Water and Contaminant Migration at the Groundwater-Surface Water Interface (ER200422): Final Cost and Performance Report
Chadwick, B. and A. Hawkins.
SPAWAR Systems Center, San Diego. Technical Report 1966, 75 pp, 2008

The overall objective of this project was to demonstrate and evaluate the field effectiveness of two technologies for characterizing coastal contaminant migration. The specific objectives of the demonstration were to achieve the following: (1) demonstrate that the Trident probe can be used to help delineate areas where groundwater seepage is occurring and contaminants of concern concentrations in those areas; (2) demonstrate that the UltraSeep system can be used to quantify the flow of groundwater and concentration of contaminants that may impinge on the surface water system; (3) demonstrate the technology to end users to determine the utility of these tools for making decisions at DoD coastal landfills and hazardous waste sites; and (4) quantify costs associated with the operation of each technology. At the NSA Panama City site, the Trident probe was used successfully to identify areas of groundwater discharge

from the site to the surface waters of St. Andrews Bay. Thirty offshore stations were sampled with the probe sensors and water sampler and the results were validated with shallow piezometers. The UltraSeep was used successfully at the NSA Panama City site to quantify groundwater discharge rates and VOC discharge concentrations in two discharge zones identified with the Trident probe. Although groundwater discharge was detected, all target VOC analytes (including DCE) in all UltraSeep samples were below the practical quantitation limit. Results from three shallow piezometers installed adjacent to each UltraSeep station validated the results obtained from the UltraSeep. The utility of the Trident probe and UltraSeep in assessing coastal contaminant migration was successfully demonstrate at the NSA Panama City. No DCE discharge into St. Andrews Bay at levels above the surface water cleanup target level (3.2 ug/L) was detected. The results from the study support the selection of monitored natural attenuation as a corrective action alternative for the site. A second demonstration was performed at the former NTC Orlando in Florida.
http://www.spawar.navy.mil/sti/publications/pubs/tr/1966/tr1966cond.pdf

MRI Studies of Flow and Dislocation of Model NAPL in Saturated and Unsaturated Sediments
Nestle, N. (TU Darmstadt, Germany); A. Wunderlich (Univ. of Ulm); T. Baumann (TU Munchen, Germany).
European Journal of Soil Science, Vol 59 No 3, p 559-571, June 2008

The authors explored the possibilities of studying transport phenomena that involve non-aqueous phase liquids (NAPL) by means of magnetic resonance imaging (MRI) with a paramagnetic contrast agent. A model NAPL, n-octanol, was studied in alcohol flooding in a water-saturated sediment and in flood-drainage-cycles in a temporally unsaturated sediment column. While the natural relaxation time contrast between water and n-octanol often allows a distinction of the two liquids in quartz-sand sediment, the use of Mn2+ ions dissolved in the water phase as a biphasic contrast agent allows much better discrimination between the different liquid phases and faster imaging. Using a 3-D FLASH sequence, a NAPL-saturated region can be visualized against a background of water-saturated sediment in 11 seconds with a resolution of 1.9 by 1.9 by 3.2 cubic mm.

Multi-Scale Monitoring and Prediction of System Responses to Biostimulation
Hubbard, S., J. Banfield, J. Chen, M. Conrad, J. Druhan, A. Englert, A. Kemna, L. Li, P. Long, M. O'Brien, D. Ntarlagiannis, Y. Personna, S. Pride, L. Slater, C. Steefel, and K. Williams.
Annual Environmental Remediation Science Program (ERSP) Principal Investigator Meeting, 16-19 April 2007, Lansdowne, VA. Poster presentation, 2007

Previous lab experiments conducted under controlled and homogeneous conditions suggest that geophysical methods have the potential for elucidating system transformations that often occur during remediation. Examples include tracking the onset and aggregation of precipitates associated with sulfate reduction using seismic and complex resistivity methods, as well as estimating the volume of evolved gas associated with denitrification using radar velocity. These studies illustrated that geophysical responses correlated with biogeochemical changes, but also that multiple factors could affect the geophysical signature. The current research consists of theoretical, numerical, and experimental investigations performed at lab and the field scales to determine if geophysical methods can be used uniquely to monitor system transformations. The

work is geared toward the uranium mill tailings site at the site in Rifle, CO, where ERSP-sponsored investigations are exploring the efficacy of electron-donor amendments for facilitating sustainable microbial reduction of U(VI) to U(IV) through a series of local-scale field experiments conducted in 2002-2005. Early experiments at the site showed that U(VI) loss from groundwater occurred synchronously with growth of Geobacter after acetate amendment, and illustrated the importance of maintaining iron-reducing conditions for optimal U(VI) removal. Since the interplay between iron and sulfate reduction is believed to be of critical importance to the sustainable reduction of U(VI) at this site, quantitative interpretation of geophysical data in terms of redox state, exhaustion of bioavailable iron mineral phases, or onset of sulfate reduction is expected to greatly benefit the understanding and sustained remediation of uranium at the site. This presentation describes the key components of the work, including lab and field characterization and monitoring during biostimulation experiments conducted in 2006, reactive transport modeling, and biogeochemical property estimation using geophysical datasets.
http://www.osti.gov/energycitations/servlets/purl/926539-grNM8u/926539.PDF

Multi-Incremental Sampling: An Innovative Approach for Site Characterization at the Portland Harbor Superfund Site
Koch, Kristine, U.S. EPA Region 10.
NARPM 2007: National Association of Remedial Project Managers 17th Annual Training Conference, 21-25 May 2007

This paper discusses the methodology and findings of multi-incremental sampling in contrast with previous sampling methodologies and findings at a property located within the Portland Harbor Superfund site in Oregon. Based on historical soil sampling conducted at the site, the following soil constituents of concern (COCs) have been identified: antimony, arsenic, cadmium, chromium, copper, lead, nickel, zinc, PAHs, PCBs, diesel and heavy oil petroleum hydrocarbons, pentachlorophenol, tributyltin, and dioxins/furans. As part of a Bona Fide Prospective Purchaser (BFPP) agreement for this property, EPA Region 10 has applied the concept of multi-incremental sampling for the property. The multi-incremental sampling concept is partially based on EPA's guidance document, Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples (U.S. EPA 2003). Multi-incremental sampling is an innovative approach to evaluate whether soils at a site can be considered "clean" of COCs. This approach, which is being disseminated to EPA technical staff throughout the U.S., involves collecting multi-incremental samples composed of 30 or more sub-samples within each designated sampling area, which results in a high sampling density. The multi-incremental sampling approach is considered more representative of areas with no known source of hazardous constituents. This approach has been developed using a statistical analysis to assess the representativeness of sampling; its effectiveness has been confirmed by empirical testing. The number of samples required for characterization of a surface using the multi-incremental sampling approach is based on statistical analysis and is independent of the area of the surface; the number of samples collected from any one area may not differ appreciably from the number of samples collected from an area half the size of the first area. More samples may be necessary, however, to delineate the contamination in that area for a removal action.

Multi-Instrumental Analysis of Tissues of Sunflower Plants Treated with Silver(I) Ions: Plants as Bioindicators of Environmental Pollution
Krizkova, S., P. Ryant, O. Krystofova, V. Adam, M. Galiova, M. Beklova, P. Babula, J. Kaiser, K. Novotny, J. Novotny, M. Liska, R. Malina, J. Zehnalek, J. Hubalek, L. Havel, and R. Kizek.
Sensors, Vol 8 No 1, p 445-463, Jan 2008

The basic physiological response of sunflower plants to stress induced by 0, 0.1, 0.5, and 1 mM silver(I) ions for 96 h was investigated. Treated plants embodied depressed growth, color changes, and a lack of root hairs. Autofluorescence of anatomical structures, such as lignified cell walls, showed important changes to shoot and root structures, mainly vascular bungles and development of secondary thickening. With increasing silver(I) ions concentration, the vitality of rhizodermal cells declined and rhizodermal cells early necrosed and were replaced by the cells of exodermis. Laser-induced breakdown spectroscopy to determine the spatial distribution of silver(I) ions in plant tissues showed that silver accumulated mainly in the near-root part of the sample. The total content of proteins expressively decreased with increasing silver(I) ion dose and treatment time, indicating a connection with photosynthesis. A comparison of urease activity in treated and control plants showed that the presence of silver(I) ions markedly enhanced the activity of urease at all applied doses. They also studied the effect of silver(I) ions on urease activity under in vitro conditions.
http://www.mdpi.org/sensors/papers/s8010445.pdf

Multi-Residue Determination of Pesticides in Water Using Multi-Walled Carbon Nanotubes Solid-Phase Extraction and Gas Chromatography-Mass Spectrometry
Wang, S., P. Zhao, G. Min, and G. Fang, Tianjin Univ. of Science and Technology, Tianjin, China.
Journal of Chromatography A, Vol 1165 Nos 1-2, p 166-171, 21 Sep 2007

A reliable multi-residue method based on solid-phase extraction (SPE) with multi-walled carbon nanotubes (MWCNTs) as adsorbent was developed for the determination and quantitation of 12 pesticides (carbofuran, iprobenfos, parathion-methyl, prometryn, fenitrothion, parathion-ethyl, isocarbofos, phenthoate, methidathion, endrin, ethion, methoxychlor) in surface water by gas chromatography/mass spectrometry (GC-MS). Results showed excellent linearity of 12 pesticides (R2 > 0.99) over a range of 0.04 to 4 ug/L. Precision was 3.1 to 15.1% under optimal conditions. The detection limits of the proposed method could reach 0.01 to 0.03 ug/L based on the ratio of chromatographic signal to baseline noise (S/N = 3). Recoveries with spiked water samples ranged from 82.0 to 103.7%. The results indicated that MWCNTs have good adsorbability to the 12 pesticides tested in this study. The developed multi-residue method can be used to determine multi-class pesticides in water simultaneously faster, at lower cost, and with less consumption of solvents than conventional analytical methods.

Nature's Sensors: Monitoring Short-Term Temporal Fluctuations in Phytoremediation Systems Using Tree Branches
Gopalakrishnan, G. (Univ. of Illinois at Urbana-Champaign); M.C. Negri (Argonne National Lab., Argonne, IL). Fourth International Phytotechnologies Conference, 24-26 September 2007, Denver, Colorado: Abstracts, p 31, 2007

This paper presents the results of a study conducted to assess the impact of short-term fluctuations in PCE concentrations in plant tissue and to elucidate the mechanisms governing these fluctuations. Short-term fluctuations in PCE concentrations present in tree branches collected on a weekly basis over the summer were observed in field studies conducted at the phytoremediation site at Argonne National Lab. This result was confirmed in smaller-scale greenhouse growth experiments. No correlation between weather and PCE concentrations was observed for the short-term effects in either field observations or lab experiments. In other experiments performed with willows in hydroponic conditions, the authors determined that these effects are due primarily to contaminant availability and trees, indicating that trees can function as dynamic indicators of subsurface conditions. The relative importance of diffusion and transpiration in contaminant release from plants in the phytoremediation system also was studied. In hydroponic experiments in which contaminated willow trees were exposed to clean water, residual contamination present in the tree samples after a 2-week period was negligible.

A New Framework for Adaptive Sampling and Analysis during Long-Term Monitoring and Remedial Action Management: Final Report
Minsker, Barbara, Albert Valocchi, and Barbara Bailey.
DOE Contract Number: EMSP 87023 Acct. 37-6000.511, 2008

DOE and other federal agencies are making a significant investment in the development of field analytical techniques, nonintrusive technologies, and sensor technologies that will have a profound impact on the way environmental monitoring is conducted. Monitoring and performance evaluation networks will likely be based on suites of in situ sensors, with physical sampling playing a much more limited role. Designing and using these types of networks effectively will require development of a new paradigm for sampling and analysis of remedial actions, which is the overall goal of this project. Specifically, the objectives of this project are to create an adaptive framework that will (1) enable effective interpretation of non-intrusive monitoring data, (2) improve predictions and assessment of remediation performance, (3) develop decision rules for onsite adaptive sampling and analysis, and (4) enable more informed decision making and risk analysis of long-term monitoring systems. These objectives were accomplished through development of a new framework for adaptive sampling and analysis, decision making, and risk assessment. The framework assumes that existing data have been used to develop some type of conceptual model for the site, be it an analytical, numerical, or statistical model. This project tested the effectiveness of new models that integrate multiple sources of process knowledge at the site, including geological data collected during site characterization, measurements of parameters collected during routine groundwater monitoring (including surrogate data and data at different spatial and temporal resolutions), and scientific understanding of biochemical transformation processes. An interactive model and parameter identification system was developed for creating the new models efficiently. The models were used to identify future sampling plans, using novel interactive and multi-objective optimization approaches. The approaches were tested using data from the 317/319 area at Argonne National Laboratory, the Waste Isolation Pilot Plant site, and a British Petroleum site.
http://www.osti.gov/bridge/purl.cover.jsp?purl=/859257-wSLJOq/

New Tools for Monitoring Coastal Contaminant Migration
Chadwick, D.B., A. Gordon, J. Groves, C. Smith, R. Paulsen, and B. Harre. 2003.
Sea Technology, Vol 44 No 6, p 17-22, June 2003

Coastal landfills and hazardous waste sites pose a potential environmental threat to surface water bodies through the exchange of groundwater-borne contaminants. Many of these sites are located adjacent to harbors, bays, estuaries, wetlands and other sensitive coastal environments. The Navy has entered into a collaborative program with researchers from Cornell

University to develop new techniques for identifying potential areas of groundwater impingement into surface waters and for quantifying the flow rates and contaminant levels of groundwater at the surface water interface.

Nucleic Acid Sensor for Insecticide Detection
Solanki, P.R., N. Prabhakar, M.K. Pandey, and B.D. Malhotra, National Physical Laboratory, New Delhi, India.
Journal of Molecular Recognition, Vol 21 No 4, p 217-223, Apr 2008

A disposable nucleic acid sensor based on polyaniline (PANI) has been fabricated by covalently immobilizing double-stranded calf thymus (dsCT) DNA onto perchlorate-doped PANI film deposited onto indium-tin-oxide (ITO) glass plate using 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride (EDC)/N-hydroxysuccinimide (NHS) chemistry. The dsCT-DNA-PANI-ClO(4)/ITO bioelectrode, stable for about 4 months, can be used to detect cypermethrin (0.005 ppm) and trichlorfon (0.01 ppm) in 30 and 60 seconds, respectively.

Obtaining Qualitative Information on Trace Species in Continuous Open-Path Fourier Transform Spectroscopic Measurements Using Target Factor Analysis and Related Techniques
Shao, L. and P.R. Griffiths, Univ. of Idaho, Moscow.
Analytical Chemistry, Vol 79 No 5, p 2118-2124, Mar 2007

Target factor analysis (TFA) was applied to the identification of trace analytes in open-path Fourier transform infrared (OP/FT-IR) spectra. Where the path-integrated concentration was greater than ~100 ppm.m for components such as methane and ammonia, TFA yielded results that closely match corresponding reference spectra. The rotation of certain eigenvectors allowed the presence of trace analytes to be recognized when the SNR of these molecules in individual spectra was below 1.0, even though no prior knowledge that a particular molecule was present in the atmosphere being monitored was available. The presence of the analyte was confirmed by conventional TFA. The presence of ethanol and ozone was observed in OP/FT-IR spectra measured near dairy and hog farms in this way. The application of TFA to OP/FT-IR spectra needs no preprocessing.

Optimizing TPH Analysis with Gravity Settling and Silica Gel Cleanup Methods for Groundwater Samples: NFD Point Molate
RPM News, p 4-5, winter 2007

Sampling and analysis of total petroleum hydrocarbons (TPH) in groundwater was optimized at Naval Fuel Depot Point Molate, Installation Restoration Site 3. Filtering and settling of the groundwater samples was performed in the field, and the silica gel cleanup method (EPA Method 3630C) was used on the sample extract in the laboratory. These steps were performed to minimize potential sample interferences that were identified during a project review as being the likely cause of false positive TPH concentrations in groundwater. The silica gel cleanup method removes polar organic acids and alcohols that can cause false positives without affecting the analysis of petroleum hydrocarbons. Further investigation using the optimized sampling and analysis approach provided a better understanding of the conceptual site model for the Corrective Action Plan. Full story in the winter 2007 issue.
https://portal.navfac.navy.mil/portal/page?_pageid=181,5390323&_dad=portal&_schema=PORTAL

Optimum Sampling Density for the Prediction of Acid Mine Drainage in an Underground Sulphide Mine
Modis, Kostas and Kostas Komnitsas.
Mine Water and the Environment, Vol 26 No 4, p 237-242, 2007

Information theory allows one to define an optimal sampling density. Sampling above this critical frequency adds very little accuracy to the mapping results. This study involved a critical sampling grid for the Stratonion-mixed, sulphide mining area in Chalkidiki peninsula, Greece, for the extraction of maximum information. The data used was derived from a previous sampling campaign carried out to estimate ore reserves and to predict the net neutralization potential (NNP) of the rock formations. A structural analysis of NNP values generated a variogram model that can be used to define the optimum sampling grid.

ORS-Based Air Monitoring during an MGP Site Cleanup (Fourier Transform Infra Red) (Optical Remote Sensing, Manufactured Gas Plant)
Schulz, Stuart P., Jr., Timothy R. Minnich, Robert L. Scotto, and Stephen H. Perry, ATMOS Energy Corp.
Pipeline & Gas Journal, Nov 2005

During a removal action at a former manufactured gas plant (MGP) site in Tennessee, Dallas-based Atmos Energy Corporation removed about 1,200 tons of coal tar and impacted soil from two tar wells and a spray pond area. Due to the location of the site in downtown Bristol, an effective ambient air monitoring program was necessary to ensure safe air quality downwind during the cleanup. Optical remote sensing (ORS) fulfilled the requirement for improved data quality and real-time data capabilities. ORS uses the ultraviolet (UV) and mid-infrared portions of the electromagnetic spectrum to detect and measure contaminants in situ. ORS technologies include open-path Fourier-transform infrared (FTIR), UV, and tunable diode laser spectroscopy. ORS has been dubbed "the eye that never sleeps" because, in theory, once positioned along the downwind site perimeter, any gaseous compound that passes through the beam of light can be detected and measured even when the monitoring equipment is unattended. EPA-approved open-path FTIR was selected based on the technology's ability to measure the contaminants of concern. The system was simple, unobtrusive, and able to acquire real-time data, and it had the capability to analyze many compounds simultaneously.

Perchlorate-Selective Polymeric Membrane Electrode Based on bis(Dibenzoylmethanato)Cobalt(II) Complex as a Neutral Carrier
Rezaei, B., S. Meghdadi, and S. Bagherpour, Isfahan Univ. of Technology, Isfahan, Iran.
Journal of Hazardous Materials [in press], 2008

A synthesized bis(dibenzoylmethanato)Co(II) complex (Co(DBM)(2)), has been used as a ionophore for the preparation of a new perchlorate ion-selective electrode. The limit of detection as determined from the intersection of the extrapolated linear segments of the calibration plot is 5.6x10(-7)M. The electrode shows good selectivity toward perchlorate with respect to many common anions. The response time of the sensor is very fast (</=5s), and it can be used for at least 2 months in the pH range of 2.0 to 9.0. The electrode has been used to

determine perchlorate in water and human urine. The interaction of the ionophore with perchlorate ions was demonstrated by UV-Vis spectroscopy.

Performance Assessment and Monitoring of a Permeable Reactive Barrier for the Remediation of a Contaminated Site
Zolla, V., R. Sethi, and A. Di Molfetta, DITAG, Torino, Italy.
American Journal of Environmental Sciences, Vol 3 No 3, p 158-165, 2007

The cleanup of chlorinated solvents contamination at an industrial landfill located near the City of Turin (Italy) involved the installation in 2004 of a zero-valent iron (ZVI) permeable reactive barrier (PRB), the first full-scale application of this technology in Italy. Site characterization revealed the presence of two contaminant plumes resulting from perchloroethene (maximum concentration of 40 ug/L), trichloroethene (130 ug/L), and 1,2-dichloroethene (135 ug/L). A long-term monitoring program began in November 2005 to verify attainment of the cleanup goals and evaluate the efficiency of the PRB. This effort focuses not only on the monitoring of contaminant concentrations but also on the hydraulic and chemical conditions created by the barrier with the aim of evaluating potential long-term effects of secondary biogeochemical processes (e.g., mineral precipitation, microbially mediated redox transformation, gas accumulation) on PRB performance. The monitoring plan provides controls on groundwater chemistry (target contaminants and geochemical indicators) and core sampling for mineralogical analysis of ZVI by X-ray diffraction and scanning electron microscopy. The initial monitoring results indicate that the plume is being captured and treated, largely attaining the remediation goals; however, mineral precipitation and gas-phase accumulation could result eventually in a decrease in hydraulic conductivity and porosity of the barrier, thus modifying the flow field through the treatment zone. Further investigations will be performed to assess microbial processes that could lead to the production and accumulation of gases inside the PRB and to evaluate the impact on system performance.
http://www.scipub.org/fulltext/ajes/ajes33158-165.pdf

Performance Monitoring of Remediation Technologies for Soil and Groundwater Contamination: Review
Lai, Keith C. K., R.Y. Surampalli, R.D. Tyagi, Irene M.C. Lo, and S. Yan, Univ. of Nebraska-Lincoln, U.S. Environmental Protection Agency, Kansas City, KS.
Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, Vol 11 No 3, p 132-157, 2007

Performance monitoring of applied remediation technologies involves periodic measurement of site parameters used to determine performance and the termination date of the remediation. Site parameters are selected based on the chosen remediation technologies and objectives. This paper covers mainly the general criteria for establishing site-specific remediation objectives and the key monitoring parameters for various remediation technologies. It is intended to help avoid wasted efforts to collect unnecessary site parameters during performance monitoring. As examples, if the reduction of the mass or volume of a contaminant zone is the prime remediation objective, contaminant concentrations in soil, soil vapor, and groundwater within the contaminant zone should be monitored. If the objective is to mitigate contaminant migration, contaminant concentrations in groundwater just outside the contaminant zone should be the main monitoring parameter. To ensure proper operation of in situ thermal remediation, subsurface temperature is a unique monitoring parameter. Groundwater oxidant concentration is the monitoring parameter for in situ chemical oxidation technologies.

Plant Sampling for Groundwater Investigations: Plume Delineation, Contaminant Degradation and Improved Detection Limits
Burken, J.G. and E. Sheehan (Univ. of Missouri-Rolla); P. Mayer, U. Karlson, and C. Legind (Danish National Environmental Research Inst.). Fourth International Phytotechnologies Conference, 24-26 September 2007, Denver, Colorado: Abstracts, p 7, 2007

Tree-core analysis recently has provided a rapid, semi-quantitative delineation of VOC-contaminated soil and groundwater with minimal cost and impact to property. Case studies illustrate benefits and concerns attendant upon the use of tree-coring methods for sampling chlorinated solvents. Methods described in this presentation have led to detection of degradation products, showing the potential for monitoring natural attenuation using plant-sampling methods. Sampling plant matrices can be complicated by variable volatility of compounds and the difficulty in quantifying low levels in plant tissues, as headspace sampling can be mass limited. Using newly developed methods presented here, in-plant sampling can be accomplished with much lower detection levels; mass limitations are essentially nonexistent as the entire tree is the sample size. Overall method detection limits are reduced by several fold and metabolic products detected give evidence of natural attenuation or remedial efficacy.

Plume Stability Analysis: An Innovative Method for Assessing Contaminant Plume Stability
Ricker, J.A. and B.C. Laine, Premier Environmental Services. Abstracts: 2008 Ground Water Summit, Memphis, TN. National Ground Water Association, 2008

Evaluating plume stability is important for most remediation sites and particularly so when evaluating natural attenuation sites. Plume stability analysis (PSA) is a method for evaluating plume stability using innovative techniques to calculate and assess historical trends in various plume characteristics, such as area, average concentration, contaminant mass, and center of mass. Contaminant distribution isopleths were developed for several sampling events and the plume characteristics were calculated for each event using numerical methods and engineering principles. A statistical trend analysis was performed on the calculated values to assess temporal trends and ultimately demonstrate plume stability. This presentation demonstrates the importance of using grid files generated from contouring and spreadsheet software to eliminate both spatial and temporal human bias. PSA has been used at wood treating and chemical manufacturing sites to demonstrate the stability of contaminant plumes, including pentachlorophenol, creosote, carbon tetrachloride, naphthalene, benzene, and chlordane. Although other methods for assessing contaminant plumes exist, PSA is cost-effective, efficient, reliable, and applicable to any site with historical analytical data and a base map.

Polymer Waveguide Sensor Arrays for Enhanced Multichemical Detection
Cordero, S.R., A. Low, D. Ruiz, and R.A. Lieberman, Intelligent Optical Systems. Advanced Environmental, Chemical, and Biological Sensing Technologies V, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6755, 11 pp, 2007

Absorption-based waveguide sensors have been developed for the toxic industrial chemicals hydrogen cyanide, hydrogen sulfide, and chlorine using polymeric materials formulated as colorimetric sensors and engineered into miniature waveguide channels. The channels have dimensions of 30x0.6x0.05 mm (LxWxH) and are patterned on glass substrates using a photolithography process. Subsequent light coupling was achieved using optical fibers. Enhanced sensitivity is observed owing to the increased path length as described by the Beer-Lambert law. When the individual sensors are challenged with the IDLH concentrations of their target gases, they react instantaneously, with response times <20 seconds. When tested simultaneously as an array, a predictable level of cross interference was observed. The cross interference indicates that the inclusion of a signal-processing algorithm is required to resolve the analytes selectively and reduce or eliminate false alarms.

Portable SERS Instrument for Explosives Monitoring
Environmental Security Technology Certification Program, ESTCP Project CU-9917, 97 pp, 2006

A new method based on surface-enhanced Raman spectroscopy (SERS) has been developed, fielded, and validated for field analysis of explosives in water samples. The SERS technique offers enhanced performance over colorimetry and other field screening techniques for groundwater well, direct push, and process water monitoring. When compared to the reference laboratory HPLC Method 8330 and field screening methods, the SERS method has the potential to reduce the time, cost, and waste generated per analysis while providing discriminate quantification of multiple analytes, even those within a chemical class, in a single measurement. This project entailed three demonstrations at two Army facilities. The first demonstration aimed at establishing that a SERS instrument could be brought from the laboratory to the field and used to perform explosives analysis on samples collected from groundwater wells. The purpose of the other two demonstrations was to extend the applicability of the SERS method from conventional groundwater well monitoring to include expedited site characterization from a cone penetrometer, direct push platform and at-line remediation process monitoring. Comparative statistical analyses of the data obtained by SERS for five prevalent explosive contaminants in split water samples were in good agreement with Method 8330 results for the splits, validating the performance of SERS as an alternative to HPLC and colorimetric methods.
http://www.estcp.org/viewfile.cfm?Doc=ER%2D9917%2DFR%2Epdf

Potential for Sample Bias Due to NAPL Partitioning
Soutter, D. and E. McBean.
Ground Water Monitoring & Remediation, Vol 27 No 3, p 129-132, summer 2007

If areas of free-phase petroleum are present within the boundaries of a chlorinated ethene plume, consideration must be given to the interpretation of groundwater samples due to interactions between chlorinated ethenes and the petroleum. Chlorinated ethene concentrations in groundwater samples can be significantly greater than concentrations immediately upgradient of the free-phase petroleum zone if any of the free-phase petroleum is entrained in the sample due to turbidity or a sheen/layer of product. This occurs because a significant mass of chlorinated ethenes can partition into the petroleum. The bias due to the entrainment of petroleum in a groundwater sample becomes significant if a visible thickness of petroleum or oily sediment occurs in the sample.

Preconcentrating Minicolumn Sensors for Trace Environmental Monitoring

Grate, J.W., R.M. Ozanich, J.S. Hartman, M.J. O'Hara, and O. Egorov.

IEEE Sensors 2007: 6th IEEE Conference on Sensors, p 1357-1360, 2007

A selectively sorbent phase collects and concentrates analyte molecules as sample liquid is pumped through the column, ultimately equilibrating the entire sorbent phase with the analyte concentration in the sample. At equilibration, the amount on the column will be proportional to the analyte concentration when working at trace concentrations. Radiometric detection has been demonstrated for the detection of radionuclides with this sensor, incorporating scintillating material in the column with the sorbent phase. The pertechnetate form of 99-technetium can be sensed using a mixed column bed containing anion exchange resin and scintillating plastic beads, collecting scintillation light with a pair of photomultiplier tubes external to the transparent column body. For hexavalent chromium (chromate), anions can be collected with anion exchange resin; optical fibers are coupled to the column body to measure the optical absorbance as a function of the amount of chromate captured by the column. Both sensors can detect their respective analytes to levels below water standards.

Preliminary Investigation of Submerged Aquatic Vegetation Mapping using Hyperspectral Remote Sensing

Williams, David J. (U.S. EPA); Nancy B. Rybicki and Alfonso V. Lombana (U.S. Geological Survey); Tim M. O'Brien (Environmental Concern, Inc.); and Richard B. Gomez (Center for Earth Observing and Space Research, George Mason Univ.-Fairfax, VA).

Environmental Monitoring and Assessment, Vol 81 Nos 1-3, 2003

Airborne hyperspectral remote sensing imagery for automated mapping of submerged aquatic vegetation (SAV) in the tidal Potomac River was investigated for near to real-time resource assessment and monitoring purposes. A spectral library database containing selected ground-based and airborne sensor spectra obtained from airborne hyperspectral imagery and field spectrometer measurements in October 2000 was developed. The spectral library is used to automate the processing of hyperspectral imagery for potential real-time material identification and mapping. Field-based spectra were compared to the airborne imagery using the database to identify and map two species of SAV (Myriophyllum spicatum and Vallisneria americana). The vegetation maps derived from hyperspectral imagery were compared to a product that combined aerial photography and field-based sampling at the end of the SAV growing season to determine overall accuracy. The algorithms and databases developed in this study will be useful with the current and forthcoming space-based hyperspectral remote sensing systems.

Production of Plants to Serve as Highly Specific Detectors

Medford, J., H. Hellinga, K. Morey, M. Antunes, and J.J. Smith. Fourth International Phytotechnologies Conference, 24-26 September 2007, Denver, Colorado: Abstracts, p 48, 2007

A plant detector requires development of multiple traits: the ability to sense specific substances of interest, the ability to transmit the sensing information, and the ability to respond in way that is detectable by humans. The authors used computer-designed receptors so plants could sense specific ligands of interest, such as explosives and environmental pollutants. Ligand reception activates a synthetic signal transduction system based on well-characterized histidine kinase pathways. The signal is transmitted to the nucleus and triggers a degreening gene circuit that causes plants to turn white, and provides a simple readout system that is easily recognized. In laboratory conditions, plants sensed 23 parts per trillion of an explosive and turned white within 24 to 48 hours. The changes are remotely detectable within a few hours by hand-held chlorophyll fluorescence detectors or with aircraft and satellites using hyper-spectral imaging. Plants regreen upon removal of the ligand, providing a biosensor with a reset capacity. Because the system is modular, substance detection can be altered by changing a computationally designed receptor. For example, detection of explosives currently is being changed to detection of MTBE. These data suggest plants can be produced that will serve as simple monitors for a variety of compounds of concern.

Pyridine Vapors Detection by an Optical Fibre Sensor
Elosua, C., C. Bariain, and I.R. Matias (Univ. Publica de Navarra, Pamplona, Spain); A. Rodriguez, E. Colacio, A. Salinas-Castillo, A. Segura-Carretero, and A. Fernandez-Gutierrez (Univ. de Granada, Granada, Spain).
Sensors, Vol 8 No 2, p 847-859, Feb 2008

An optical fiber sensor using a novel vapochromic cobalt complex has been developed for detection of pyridine vapors. Pyridine is widely used in the synthesis of compounds such as insecticides, herbicides, pharmaceuticals, dyes, adhesives, paints, and explosives. The sensor changes reversably in color from blue to pink-white in the presence of pyridine vapors. The vapochromic material is added to a solution of polyvinyl chloride, tributylphosphate, and tetrahydrofuran to form a plasticized matrix. The sensing material is fixed onto a cleaved-ended optical fiber by a dip-coating technique. The fabrication process was optimized in terms of number of dips and dipping speed. The final devices were evaluated by dynamic range. Employing a reflection setup, the absorbance spectra and changes in the reflected optical power of the sensors were registered to determine their response. A linear relation between optical power versus vapor concentration was obtained, with a detection limit of 1 ppm (v/v).
http://www.mdpi.org/sensors/list08.htm

Radon-222 as Natural Tracer for Monitoring the Remediation of NAPL Contamination in the Subsurface: Cost and Performance Report
Environmental Security Technology Certification Program, ESTCP Project ER-9916, 71 pp, Mar 2008

This report describes the use of naturally occurring radon-222 as a partitioning tracer for locating and quantifying residual or pooled nonaqueous-phase liquid (NAPL) contamination in the subsurface and for monitoring changes in NAPL quantities resulting from remediation activities. Radon is produced in the subsurface by the continuous decay of naturally occurring radium-226. In the absence of NAPL contamination, the aqueous radon concentration quickly reaches a site-specific equilibrium value determined by the mineralogy and porosity of the geologic formation. In the presence of NAPL, however, the radon concentration is reduced substantially due to partitioning of radon into the organic NAPL phase. The reduction in radon concentration of groundwater in contact with a NAPL phase is correlated quantitatively with the quantity of NAPL present, as described by simple equilibrium models. The method is based on measuring radon in groundwater samples from existing monitoring wells. Two methods of using radon were evaluated in the study: a static method that involves the monitoring of NAPL concentrations in groundwater samples collected spatially and temporally at a site, and a

dynamic method using single well push-pull tests. The two methods were used at the Dover National Test Site to detect changing NAPL saturations in a sand-filled test cell spiked with 100 L of perchloroethene (PCE) to create NAPL contamination in the saturated zone. Results of radon surveys and push-pull tests performed in four wells installed near the PCE spill indicate that a combination of static and dynamic push-pull tests might be used to monitor the progress of NAPL remediation, though static tests are much easier and less costly to employ than push-pull tests. The results indicate that the radon method is best employed when a NAPL residual saturation greater than 1% exists, and wells for sampling exist within a NAPL source zone. The method would be best combined with other methods, such as Flexible Liner Underground Technologies, LLC (FLUTe(tm)) ribbon samplers, that can identify the depth intervals where NAPL exists. Long-term monitoring using the static radon method, and possibly combined with dynamic push-pull tests, can be used to estimate NAPL saturation and monitor the progress of remediation. Cost estimates indicate that the radon method would be less costly to perform than partitioning tracer tests where tracers must be added; however, the method is useful only if samples can be obtained within the NAPL zone, so well installation and use of other methods will be needed to confirm the presence of NAPL. The most cost-effective use of the method is for monitoring the progress of NAPL contamination using the static method where groundwater samples are periodically collected and changes in radon concentration are monitored at a specific location over time.
http://www.estcp.org/Technology/upload/ER-9916-C&P.pdf

Rapid Spatial Mapping of Chemicals Dispersed Across Surfaces Using an Autosampler/DART/TOFMS
Grange, Andrew H. The 55th ASMS Conference on Mass Spectrometry and Allied Topics, 3-7 June 2007, Indianapolis, IN. 4 pp, 2007

Accidental, deliberate, or weather-related dispersive events can spread chemicals onto surfaces over a large area. First responders must determine rapidly the dispersal direction, distance, and the identities of the chemicals. A compass-based sampling scheme is illustrated. Direct Analysis in Real Time/Time-of-Flight Mass Spectrometry (DART/TOFMS) mass-analyzes absorbates on cotton-swab, wipe samples in 6 seconds per swab using a simple and inexpensive autosampler based on N-scale model railroad flat cars and track. Exact masses of precursor and product ions accurate to within 2 mmu yield tentative identifications, even when a compound is not found in an exact-mass library. Hundreds of samples must be analyzed rapidly to guide remediation efforts and to document meeting targeted levels. An example sampling scheme has 1,000 grid points, and these large sample sets also could be used to characterize Superfund sites, wherein small hot spots of contamination could be revealed.
http://www.epa.gov/nerlesd1/pdf-ecb/asms07PosterF1.pdf

Real Time Air Monitoring of Hydrogen Chloride and Chlorine Gas during a Chemical Fire
Karellas, N.S., Q.F. Chen, G.B. De Brou, and R.K. Milburn, Ontario Ministry of the Environment, Air Monitoring Section, Toronto, ON, Canada.
Journal of Hazardous Materials, Vol 102 No 1, p 105-120, 2003

On 9 August 2000, a fire started at a facility that manufactures pool chemicals in Guelph, Ontario. A mobile trace atmospheric gas analyzer (TAGA) unit was used to provide real-time onsite air monitoring of the airborne contaminants released through the combustion of pool chemicals. An atmospheric pressure chemical ionization (APCI) source was incorporated with the newest TAGA (model IIe), a triple quadrupole mass spectrometer that allows direct sampling and real-time analysis of air for a wide range of toxics at low ppb levels. The ionization mechanism under negative APCI conditions is dominated by charge transfer reactions, yielding parent ions, which are selected in Q1 and dissociated in Q2, and the resultant daughter ions are identified in Q3. By monitoring specific parent/daughter (P/D) ion pairs, the TAGA IIe was able to measure levels of hydrogen chloride (HCl) and chlorine (Cl2) present in the air simultaneously and in real time. The response of the TAGA IIe was characterized by multi-point calibration curves (which were linear) up to 250 ug/m3 for HCl and up to 600 ug/m3 for Cl2. The average detection limit for this application was 0.50 ug/m3 for both HCl and Cl2. Onsite measurements of HCl and Cl2 were made at several locations upwind and downwind of the fire site over a period of 3 days. Local officials used the TAGA data for real-time assessment of the airborne levels of HCl and Cl2.

Real-Time and Delayed Analysis of Tree and Shrub Cores as Indicators of Subsurface Volatile Organic Compound Contamination, Durham Meadows Superfund Site, Durham, Connecticut, August 29, 2006
Vroblesky, D.A., R.E. Willey, S. Clifford, and J.J. Murphy.
U.S. Geological Survey Scientific Investigations Report 2007-5212, 12 pp, Feb 2008

This study examined volatile organic compound (VOC) concentrations in cores from trees and shrubs for use as indicators of vadose-zone contamination or potential vapor intrusion by VOCs into buildings at the Durham Meadows Superfund Site, Durham, CT. The study used real-time tree- and shrub-core analysis, which involved field heating the core samples for 5 to 10 minutes prior to field analysis, as well as delayed analysis, which involved allowing the gases in the cores to equilibrate with the headspace gas in the sample vials unheated for one to two days prior to analysis. General correspondence was found between the two approaches, indicating that preheating and field analysis of vegetation cores is a viable approach to real-time monitoring of subsurface VOCs. In most cases, VOCs in cores from trees and shrubs at the Merriam Manufacturing Company property showed a general correspondence to the distribution of VOCs detected in a soil-gas survey, despite the fact that most of the soil-gas survey data in close proximity to the relevant trees were collected about three years prior to the tree-core collection. Most of the trees cored at the Durham Meadows Superfund site, outside the Merriam Manufacturing Company property, contained no VOCs and were in areas where indoor air sampling and soil-gas sampling showed little or no VOC concentrations. An exception was tree DM11, which contained barely detectable concentrations of trichloroethene (TCE) near a house where previous investigations found low concentrations of TCE (0.13 to 1.2 ppb by volume) in indoor air and 7.7 ug/L of TCE in the groundwater. The barely detectable concentration of TCE in tree DM11 and the lack of VOC detection in nearby tree DM10 (adjacent to the well having 7.7 ug TCE) may be attributable to the relatively large depth to water (17.6 feet), the relatively low soil-vapor TCE concentration, and the large amount of rainfall during, and preceding, the tree-coring event. The data indicate that real-time and delayed analyses of tree cores are viable approaches to examining subsurface VOC soil-gas or vadose-zone contamination at Durham Meadows and other similar sites. Thus, the methods may have application for determining the potential for vapor intrusion into buildings.
http://pubs.usgs.gov/sir/2007/5212/

Real Time Monitoring of Hazardous Airborne Chemicals: A Styrene Investigation
Chen, Q.F. (Ontario Ministry of the Environment, Air Monitoring Section, Toronto, ON); R.K. Milburn (Humber College, Toronto, ON); N.S. Karellas (Ontario Ministry of the Environment).
Journal of Hazardous Materials, Vol 132 Nos 2-3, p 261-268, 2006

Air emissions from two manufacturing facilities in close proximity to each other were monitored with a mobile unit for chemical characterization and differentiation of the emissions from each facility. Based upon the downwind fingerprinting and concentration levels, the mobile unit was able to isolate the source of the emissions to the responsible facility. A few chemicals detected by the trace atmospheric gas analyzer (TAGA) had never been reported by the companies. Real-time proximity monitoring was accomplished by using a TAGA IIe, which is a triple quadrupole mass spectrometer. The unit interfaces with a low-pressure chemical ionization source that operates at 3 Torr and 100 uA. By monitoring the response of specific parent/daughter ion pairs, the unit was able to determine the point-of-impingement concentrations of styrene and other ambient airborne chemicals. A method detection limit of 1.1 ug/m3 was achieved for styrene. The mobile capability of the unit was used to determine the ambient airborne concentration of styrene at various distances from the companies with the maximum levels measured at close proximity to the emission sources.

Rejection Criteria for Open-Path Fourier Transform Infrared Spectrometry during Continuous Atmospheric Monitoring
Shao, L., Pollard, M.J., Griffiths, P.R., Westermann, D.T., Bjorneberg, D.L.
Vibrational Spectroscopy, Vol 43, p 78-85, 2006

Over 32,000 interferograms measured during open-path Fourier transform infrared (OP/FT-IR) measurements at dairy and hog farms were evaluated for anomalies. Five types of anomalies could be distinguished: a reduction in the interferogram intensity because of weather-related optical misalignment; an increase in the amplitude of interferograms measured with too short a path-length that leads to a non-linear detector response; a periodic interference caused by wind-induced vibrations; the presence of spikes in the interferogram; and an increase in the noise level of the interferogram (and hence of the spectrum) because of the effect of electrical interference. Prior to testing for the presence of anomalous data, each interferogram is subjected to a high-pass filter. A noise level index is then calculated from the wings of the interferogram and interferograms are rejected if the value of this parameter is too high. When the criteria developed in this project are applied, OP/FT-IR spectra can be measured at 1-min intervals over a period of several days.

Remote Gas Sensing with Long Wavelength DFB Laser Diodes
Koeth, J., M. Fischer, M. Legge, J. Seufert, and R. Werner, Nanoplus Nanosystems and Technologies GmbH, Germany.
Advanced Environmental, Chemical, and Biological Sensing Technologies V, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6755, 5 pp, 2007

The authors report on novel distributed feedback laser diodes with emission wavelengths as long as 2.9 m. Single-mode laser emission is realized by use of metal Bragg gratings patterned laterally to the laser ridge. The laser diodes work at room temperature in cw mode and deliver output powers of a few mW. A high side mode suppression ratio of < 35 dB ensures high spectral selectivity within a broad wavelength tuning range of up to 10 nm. These devices promise to be key enablers for a new generation of laser-based gas-sensing systems featuring detection limits not previously reached.

Remote Sensing by Open-Path FTIR Spectroscopy: Comparison of Different Analysis Techniques Applied to Ozone and Carbon Monoxide Detection
Briz, S., A.J. de Castro, S. Diez, F. Lopez, and K. Schaefer.
Journal of Quantitative Spectroscopy and Radiative Transfer, Vol 103 No 2, p 314-330, Jan 2007

Methods based on classical least-squares (CLS) procedures normally are appropriate to analyze OP-FTIR spectra, but occasional discrepancies with standard extractive methods have been observed. The authors performed analyses with the addition of a line-by-line method (SFIT) to explain the sporadic discrepancies observed between CLS and standard extractive method results and to study the capability of both methods (CLS and SFIT) to analyze open-path measurements. The methods were applied to the analysis of ozone and carbon monoxide. In CLS-based methods, discrepancies are induced by the experimental background reference spectrum. In these cases, SFIT results agreement well with the standard extractive methods.

Remote Sensing of Sulfur Dioxide (SO2) Using the Lineate Imaging Near-Ultraviolet Spectrometer
Khoo, Sing S., Master's thesis, Naval Postgraduate School, Monterey, CA. NTIS: ADA432240, 71 pp, 2005

The Lineate Image Near Ultraviolet Spectrometer (LINUS) is a spectral imager developed to operate in the 0.3-0.4 micron spectral region. The 2-D imager operates with a scan mirror, forming image scenes over time intervals of 10-20 minutes. Sensor calibration was conducted in the laboratory, and the system response to sulfur dioxide (SO2) gas was determined. The absorption profile for SO2 was measured, and curves of growth were constructed as a function of gas concentration. Test measurements were performed at the Naval Postgraduate School from the roof of Spanagel Hall. Field observations were conducted at a coal-burning factory site at Concord, CA, with the purpose of quantifying the presence of SO2. The Concord field measurement showed traces of SO2, with further analysis still required.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA432240&Location=U2&doc=GetTRDoc.pdf

A Review on the Electrochemical Sensors and Biosensors Composed of Nanowires as Sensing Material
Yogeswaran, U. and S.-M. Chen, National Taipei Univ. of Technology, Taipei, Taiwan.
Sensor, Vol 8 No 1, p 290-313, 2008

This review of the development and application of nanowires for electrochemical sensors and biosensors discusses the preparation methods of nanowires and their properties along with their advantages for use in electrochemical sensors and biosensors. Key results from the reviewed papers are summarized, relating the concept and mechanism behind each sensor under experimental conditions as well as their behavior in varying conditions.
http://www.mdpi.org/sensors/list08.htm

Rhizoremediation of PCBs: New Insights from Stable Isotope Probing Techniques
Leigh, Mary Beth, University of Alaska Fairbanks. Fourth International Phytotechnologies Conference, 24-26 September 2007, Denver, Colorado: Abstracts, p 42, 2007

Stable isotope probing (SIP) enables the direct identification of microorganisms that degrade pollutants within the complex soil community by tracing C from a C-13-labeled compound into microbial DNA. SIP was applied to identify active biphenyl-utilizing bacteria and their aromatic degradative genes in the root zone of Austrian pine growing in a site contaminated with PCBs. Previous studies at the site indicating that larger populations of PCB-degrading bacteria were associated with pine in comparison to other tree species. SIP revealed 75 different genera that derived carbon from C-13 biphenyl, with Pseudonocardia, Kribella, Nocardiodes, and Sphingomonas predominating carbon acquisition. Rhodococcus spp. were not detected with SIP, despite being the most abundant biphenyl-utilizers isolated from agar plates. Functional gene contents of C-13 DNA derived from the biphenyl utilizing population were explored using the GeoChip, a functional gene microarray containing 6,465 probes that target microbial aromatic degradative genes. The GeoChip detected several genes associated with catabolism of biphenyl, benzoate, and various aromatic ring hydroxylating dioygenases subunits. Also detected were genes associated with the beta-ketoadipate pathway, a conserved pathway for degradation of plant-derived aromatic compounds, lending support to the hypothesis that plant aromatic compounds have the capacity to biostimulate PCB-degrading bacteria. SIP provided new insights into PCB degradation in soil and the rhizosphere and may benefit rhizoremediation research by facilitating the development of molecular tools to detect, quantify, and monitor important microbial populations.

Sediment Sampling and Analysis for Stream Restoration Projects
Fischenich, C. and C. Little, U.S. Army Engineer Research and Development Center, Vicksburg, MS.
EMRRP-SR-39, 23 pp, 2007

The studies used in sediment investigations can be generalized into those that support characterization of the sediments, those used to support system stability analyses, and those used to support local stability analyses. This technical note summarizes the most common sediment investigations, their use, and the frequency and circumstances under which they are applied.
http://el.erdc.usace.army.mil/elpubs/pdf/sr39.pdf

Sediment Toxicity Identification Evaluation (TIE): Phases I, II, and III. Guidance Document
Ho, K.T., R.M. Burgess, D.R. Mount, T.J. Norberg-King, and J.R. Hockett, U.S. EPA.
EPA 600-R-07-080, 145 pp, Sep 2007

This document provides guidance for both interstitial water and whole sediment Toxicity Identifications and Evaluations (TIEs) and combines current understanding of TIE methods for both marine and freshwater interstitial waters and whole sediments. This guidance does not include approaches for the implementation of sediment TIE in a regulatory context. Phase I TIE (characterization) methods for interstitial waters and whole sediments includes guidance on when to use whole sediment or interstitial water methods, the collection of interstitial waters for

testing, and test volume considerations. Interstitial water methods comprise the following manipulations: graduated pH, aeration, filtration, C18 reverse-phase chromatography extraction, EDTA addition, and cation exchange solid phase extraction. Whole sediment methods consist of general procedures and considerations for whole sediment testing and the following manipulations: Ulva lactuca, zeolite, cation exchange resin, anion exchange resin, acid volatile sulfide, Ambersorb, and powdered coconut charcoal additions and base metal substitution. Existing guidance for Phases II and III methods have been tailored for chemical classes normally found in sediments.
http://www.epa.gov/nheerl/publications/files/Sediment%20TIE%20Guidance%20Document.pdf

Selective Pressurized Liquid Extraction for Multi-Residue Analysis of Organochlorine Pesticides in Soil
Hussen, A., R. Westbom, N. Megersa, L. Mathiasson, E. Bjorklund, Lund Univ., Lund, Sweden.
Journal of Chromatography A, Vol 1152 Nos 1-2, p 247-253, 8 June 2007

A selective pressurized liquid extraction (SPLE) procedure capable of performing simultaneous extraction and cleanup has been demonstrated for multi-residue analysis of organochlorine pesticides (OCPs) in soil. The final method was performed at 100 degrees C for 3 x 10 min using acetone/n-heptane (1:1, v/v). Florisil was placed inside the extraction cell downstream of the sample to remove interfering compounds. Extraction of two soil samples by SPLE gave over 80% recovery for beta-endosulfan, endosulfan sulfate, p,p'-DDT, and p,p'-DDE compared to PLE with off-line cleanup. The SPLE method also yielded 80 to 90% recovery for a certified reference soil sample (CRM 811-050) containing 13 OCPs.

Selective, Specific, and Versatile Personal Biosensors to Organophosphate Chemical Toxins Composed of Polyurethane Immobilized Enzymes
Gordon, R.K., A.T. Gunduz, S.R. Feaster, and B.P. Doctor (Walter Reed Army Inst. of Research, Silver Spring, MD); T. Cronin (Chemical Biological Radiological and Nuclear Countermeasures, Ft. Washington, MD).
NTIS: ADA436273, 9 pp, 2002

Organophosphorus (OP) nerve agents are a serious threat to military and civilian personnel, so rapid detection of OP compounds in all of its forms is of paramount importance to prevent casualties. Enzymes immobilized in porous polyurethane foam formed in situ from water-miscible hydrophilic urethane prepolymers and enzymes, such as ChEs, are resistant to denaturing events. Because the enzyme will not leach from the polyurethane support, the ChE-badge can be used to sample for OPs in diverse environments, such as soil and large bodies of water, as well as in air. Immobilized enzyme badges are being designed with a unique attribute (not present in the current non-immobilized detectors): a rapid field system to identify which OP is present. For instance, organophosphorus hydrolase (OPH) hydrolyzes sarin more readily than soman, while laccase hydrolyzes the VX agent preferentially over the G agent OPs. Polyurethane-immobilized laccase is being evaluated for long-term stability and kinetic properties of VX hydrolysis. The immobilized sensor can provide new features and testing of more diverse environments than the M256A1 and M272 kits combined. The ability to identify OP toxins in real time using the immobilized differential detector would help to treat and secure

the contaminated area, in the identification of the use of OPs, and in permitting first responders to identify the OP present in a civilian terrorist act.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA436273&Location=U2&doc=GetTRDoc.pdf

Sequential Extraction of Lead from Grain Size Fractionated River Sediments Using the Optimized BCR Procedure
Sutherland, R.A. and F.M.G. Tack.
Water Air and Soil Pollution, Vol 184, p 269-284, 2007

Fluvial bed sediments are widely used for characterizing anthropogenic contaminant signals in urban watersheds. This study presents the first preliminary examination of sequentially extracted lead (Pb) from grain-size fractionated bed sediments using the optimized (standardized) Community Bureau of Reference (BCR) procedure. Baseline sediment samples and samples from the vicinity of three storm-sewer outlets were examined. The weighted average Pb liberated from four sequentially extracted phases was 144 +/- 26 mg/kg (+/- SD). Pb in the reducible phase exceeded that in oxidizable, residual, and acid extractable phases. Weighted reducible Pb concentrations for the three sewer outlet sites ranged from 69 to 92 mg/kg, and this phase typically accounted for 70 to 80% of all labile Pb. The < 63 um grain size class did not exhibit the highest Pb concentration, which was found in either the 125 to 250 um or 500 to 1,000 um fractions. Overall, all data point to a significant anthropogenic signal for Pb in bed sediments in the stream area studied.

Soil Metal Concentrations and Vegetative Assemblage Structure in an Urban Brownfield
Gallagher, F.J. (Rutgers, New Brunswick, NJ), I. Pechmann, J.D. Bogden, J. Grabosky, and P. Weis.
Environmental Pollution, Vol 153 No 2, p 351-61, May 2008

Analysis of the soil samples from a brownfield within Liberty State Park, Jersey City, NJ, showed that arsenic, chromium, lead, zinc, and vanadium exist above concentrations natural for the area. Accumulation and translocation features were characterized for the dominant plant species of four vegetative assemblages. A comparison of soil metal maps and vegetative assemblage maps indicates that areas of increasing total soil metal load were dominated by successional northern hardwoods, while semi-emergent marshes containing mostly endemic species were restricted to areas of low soil metal load.

Soil Sensor Technology: Life within a Pixel
Allen, M.F. (Univ. of California Riverside), R. Vargas, E.A. Graham, W. Swenson, M. Hamilton, M. Taggart, T.C. Harmon, A. Rat'ko, P. Rundel, B. Fulkerson, and D. Estrin.
Bioscience, Vol 57 No 10, p 859-867, 2007

New sensor technologies can measure and monitor soil organisms and processes at rapid and continuous temporal scales. The authors describe these technologies and how they can be arrayed for an integrated view of soil dynamics.

Spatio-Temporal Modelling of Dust Transport over Surface Mining Areas and Neighbouring Residential Zones

Matejicek, L., Z. Janour, L. Benes, T. Bodnar, and E. Gulikova.

Sensors, Vol 8 No 6, p 3830-3847, June 2008

A case study focused on the modeling of dust transport over a surface coal mining area was developed by exploring spatial data from 3-D laser scanners, GPS measurements, aerial images, time-series meteorological observations, inputs/outputs from numerical models, and existing geographic resources. Digital terrain models, layers including GPS thematic mapping, and scenes with simulation of wind flows were created to visualize and interpret coal dust transport over the mine area and a neighboring residential zone. A temporary coal storage and sorting site located near the residential zone was one of the dominant sources of emissions. Using numerical simulations, the potential effects of wind flows were observed over the surface, modified by natural objects and man-made obstacles. The coal dust drifted with the wind in the direction of the residential zone and was partially deposited in this area. The simultaneous display of the digital map layers together with the location of the dominant emission source, wind flows, and protected areas enabled the performance of a risk assessment of the dust deposition in the area. 3-D laser scanning and GPS thematic mapping were used to create a more detailed digital terrain model and thus to obtain a more accurate simulation of wind flows over the temporary storage and sorting site. Visualization of wind flows over the area of interest combined with 3-D map layers enabled exploration of the processes of coal dust deposition at a local scale. In general, this project could be used as a template for dust-transport modeling that couples spatial data focused on the construction of digital terrain models and thematic mapping with data generated by numerical simulations based on Reynolds averaged Navier-Stokes equations.

http://www.mdpi.org/sensors/list08.htm

Spectral Induced Polarization and Electrodic Potential Monitoring of Microbially Mediated Iron Sulfide Transformations

Robert, Y., D. Ntarlagiannis, L. Slater, N. Yee, and M. O'Brien (Rutgers Univ., Newark, NJ); S. Hubbard (Lawrence Berkeley National Lab, Berkeley, CA).

Journal of Geophysical Research, Vol 113, May 2008

Stimulated sulfate-reduction is a bioremediation technique utilized for the sequestration of heavy metals in the subsurface. Lab column experiments to investigate the geoelectrical response of iron sulfide transformations by Desulfo vibriovulgaris. Two geoelectrical methods--spectral induced polarization (SIP) and electrodic potential measurements--were investigated. Aqueous geochemistry (sulfate, lactate, sulfide, and acetate), observations of precipitates (identified from electron microscopy as iron sulfide), and electrodic potentials on bisulfideion (HS) sensitive silver-silver chloride (Ag-AgCl) electrodes (630 mV) were diagnostic of induced transitions between an aerobic iron sulfide forming conditions and aerobic conditions promoting iron sulfide dissolution. The SIP data showed 10m rad anomalies during iron sulfide mineralization accompanying microbial activity under an anaerobic transition. These anomalies disappeared during iron sulfide dissolution under the subsequent aerobic transition. SIP model parameters based on a Cole-Cole relaxation model of the polarization at the mineral/fluid interface were converted to estimated biomineral surface area to pore volume, and an equivalent polarizable sphere diameter (d) controlling the relaxation time. The temporal variation in these model parameters is consistent with filling and emptying of pores by iron sulfide biofilms, as the

system transitions between anaerobic (pore filling) and aerobic (pore emptying) conditions. The results suggest that combined SIP and electrodic potential measurements might be used to monitor spatiotemporal variability in microbial iron sulfide transformations in the field.
http://www.osti.gov/energycitations/servlets/purl/929708-BcoFSR/

Spectral Sensing for Plant Stress Assessment: a Review
Kim, Y. and J. Reid.
International Journal of Agricultural and Biosystems Engineering, Vol 7 No 1, p 27-41, 2007

Assessment of plant nitrogen (N) has been of interest worldwide to provide growers with site-specific N fertilizer and minimize environmental impact. Plant leaf interaction with radiation is a major influence on the remote sensing signals. It is important to understand the optical characteristics of plant leaves to apply the principle of remote sensing. Most spectral measurements of plant leaves previously reported were made in the 500 to 2500 nm portion of the electromagnetic spectrum. It was generally observed that N stressed plant leaves have a reflectance higher in visible and lower in near-infrared waveband than non-stressed leaves. Spectral signature of plant leaves have great potential to characterize the plant features, and the spectral reflectance of the plants in the visible region (400 to 750 nm) is primarily influenced by the leaf pigment chlorophyll and inversely correlated to leaf chlorophyll content. Several studies indicated a good estimation of leaf N content at 550 nm wavelength. This paper described remote sensing technologies, applications, and factors to be considered. With the progress of remote sensing technology and understanding plant optics, remote sensing is a promising tool to lead precision agriculture in the future.

Spectrophotometric Analysis of the Cyanide Metabolite 1-Aminothiazoline-6-Carboxylic Acid
Hawkridge, Fred M.
NTIS: ADA468614, 10 pp, June 2006

Electrodes modified with bilayers that incorporate cytochrome C oxidase (CCO), the terminal enzyme in mammalian respiration, will be studied as biosensors for cyanide. This CCO-modified electrode has an architecture that exhibits robust response behavior and stability that mimics the in vivo behavior of this enzyme. These CCO-modified electrodes remain active on storage in buffer and can withstand exposure to temperatures as extreme as 76 degrees F and have a functional lifetime exceeding two months. The structure of the CCO-modified electrode is uniquely similar to its in vivo environment in the inner mitochondrial membrane. No other enzyme-modified electrode reported thus far in the literature has this structure. Experiments have shown that the electrochemical response of these CCO-modified electrodes to the oxidation of reduced cytochrome c (its reductive react partner) is sensitive to cyanide, and the response is reversible. The proposed work will characterize the affect of cyanide on the direct electron transfer reaction of these CCO-modified electrodes with ambient dioxygen concentrations (its oxidative reaction partner). Initial experiments testing this hypothesis have been positive. This is a simpler biosensor configuration compared with the previously described cytochrome c system (no added component) and it has potential for providing a practical sensor with military applications for toxins that inhibit the electron transfer reactions of CCO with lethal consequences.
http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA462070&Location=U2&doc=GetTRDoc.pdf

Standard Practice for Open-Path Fourier Transform Infrared (OP/FT-IR) Monitoring of Gases and Vapors in Air

American Society for Testing and Materials, ASTM E1982-98, 2007

An OP/FT-IR monitor can, in principle, measure the concentrations of all IR-active gases and vapors in the atmosphere. Detailed descriptions of OP/FT-IR systems and the fundamental aspects of their operation are given in ASTM Guide E1865 and the FT-IR Open-Path Monitoring Guidance Document (EPA 600-R-96-040, 1996). A method for processing OP/FT-IR data to obtain the concentrations of gases over a long, open path is given in EPA's Compendium Method TO-16. Applications of OP/FT-IR systems include monitoring for gases and vapors in ambient air, along the perimeter of an industrial facility, at hazardous waste sites and landfills, in response to accidental chemical spills or releases, and in workplace environments. This practice covers procedures for using active OP/FT-IR monitors to measure the concentrations of gases and vapors in air. Procedures for choosing the instrumental parameters, initially operating the instrument, addressing logistical concerns, making ancillary measurements, selecting the monitoring path, acquiring data, analyzing the data, and performing quality control on the data are given. Because the logistics and data quality objectives of each OP/FT-IR monitoring program will be unique, standardized procedures for measuring the concentrations of specific gases are not explicitly set forth in this practice. Instead, general procedures that are applicable to all IR-active gases and vapors are described. These procedures can be used to develop standard operating procedures for specific OP/FT-IR monitoring applications.

Substrates with Discretely Immobilized Silver Nanoparticles for Ultrasensitive Detection of Anions in Water Using Surface-Enhanced Raman Scattering

Tan, S., M. Erol, S. Sukhishvili, and H. Du, Stevens Inst. of Technology, Hoboken, NJ.

Langmuir, Vol 24 No 9, p 4765-4771, May 2008

Positively charged silver nanoparticles, obtained by UV-assisted reduction of silver nitrate using branched poly(ethyleneimine) (BPEI) and 4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid (HEPES) solutions as reducing agents, were immobilized on glass surfaces to produce substrates active in surface-enhanced Raman scattering (SERS). Negatively charged silver nanoparticles, synthesized via a modified citrate-reduction method, were investigated for comparison. At a sparse surface coverage of 30 nanoparticles/um(2), substrates with immobilized Ag+ showed increasing SERS sensitivity to a variety of anions in water in the order sulfate < cyanide < thiocyante~perchlorate. Substrates with Ag+ allowed limit of detection values of 8 ppb and 7 ppb for environmentally relevant perchlorate and cyanide anions, respectively. In contrast, substrates with immobilized Ag-, even upon subsequent modification by a monolayer of BPEI for positive surface charge of the nanoparticles, showed a drastically lower sensitivity to these anions.

Testing of Ahura's FirstDefender Handheld Chemical Identifier Against Toxic Industrial Chemicals

NTIS: ADA461530, 28 pp, Dec 2006

The handheld Raman spectrometer for point detection of chemicals developed by Ahura Corporation was tested using toxic industrial chemicals (TICs). The device was assessed for its

capacity to detect and identify liquid and solid substances/mixtures through sealed glass containers in a completely non-contact, non-destructive manner.
http://www.edgewood.army.mil/hld/ip/ahura_handheld_toxic_report_download.htm

Three Dimensional Monitoring of Stack Plume Dynamics by a Scanning Mie Lidar System as a Plume Watchdog Station
Saito, Y., H. Kurata, Y. Hara, F. Kobayashi, T. Kawahara, and A. Nomura, Shinshu Univ., Nagano, Japan.
Optical Review, Vol 12 No 4, p 328-333, 2005

A scanning lidar system was developed to watch the nighttime diffusion process of a plume from a smokestack of a large incinerator located at 3 km distance. Observed data sets were visualized as 3-D images in which the diffusion pattern could be seen from any direction, which made it easy to investigate the exhaust dynamics. The original plume extended at least 1.6 km across a residential area, increasing in diameter from the smokestack to about 500 m. High density aerosols originating from the smokestack were measured in that area even at midnight. The lidar system performance as a plume watchdog station is discussed.

Trace Determination of Organophosphorus Pesticides in Environmental Samples by Temperature-Controlled Ionic Liquid Dispersive Liquid-Phase Microextraction
Zhou, Q., H. Bai, G. Xie, and J. Xiao, Henan Normal Univ., Xinxiang, China.
Journal of Chromatography A, Vol 1188 No 2, p 148-153, Apr 2008

A new approach for the determination of organophosphorus pesticides involves temperature-controlled ionic liquid dispersive liquid-phase microextraction prior to high-performance liquid chromatography with ultraviolet detection. Methylparathion and phoxim were used as model analytes for the investigation of the development and application of the new microextraction method. 1-Hexyl-3-methylimidazolium hexafluorophosphate [C6MIM][PF6] was used as the extraction solvent. Under optimal extraction conditions, methylparathion and phoxim exhibited good linear relationship in the concentration range of 1 to 100 ng/mL with detection limits of 0.17 ng/mL and 0.29 ng/mL, respectively. This method was applied successfully in the analysis of four environmental water samples and obtained good spike recoveries over a range of 88.2 to 103.6%, indicating that temperature-controlled ionic liquid dispersive liquid-phase microextraction has excellent prospects for application in the environmental field.

Transgenic Plants as Sensors of Environmental Pollution Genotoxicity
Kovalchuk, I. and O. Kovalchuk, Univ. of Lethbridge, Lethbridge, AB, Canada.
Sensors, Vol 8 No 2, p 1539-1558, Feb 2008

The authors discuss various transgenic plant-based models that have been used successfully for biomonitoring genotoxic pollutants, the benefits and potential drawbacks of these systems, and some novel ideas for the future generation of efficient transgenic phytosensors.
http://www.mdpi.org/sensors/list08.htm

Use of a Whole-Cell Biosensor to Assess the Bioavailability Enhancement of Aromatic Hydrocarbon Compounds by Nonionic Surfactants
Keane, A., P.C. Lau, and S. Ghoshal, McGill Univ., Montreal, Quebec, Canada.
Biotechnology and Bioengineering, Vol 99 No 1, p 86-98, 2008

The whole-cell bioluminescent biosensor Pseudomonas putida F1G4 (PpF1G4) contains a chromosomally-based sep-lux transcriptional fusion. The sensor was used as a tool for direct measurement of the bioavailability of hydrophobic organic compounds (HOCs) partitioned into surfactant micelles. The increased bioluminescent response of PpF1G4 in micellar solutions of Triton X-100 and Brij 35 indicated higher intracellular concentrations of toluene, naphthalene, and phenanthrene compared to control systems with no surfactants present. In contrast, Brij 30 caused a decrease in the bioluminescent response to the test compounds in single-solute systems, without adversely affecting cell growth. The decrease in bioluminescent response in the presence of Brij 30 did not occur in the presence of multiple HOCs extracted into the surfactant solutions from crude oil and creosote. The effect of the micellar solutions on the toluene biodegradation rate was consistent with the bioluminescent response in single-solute systems. None of the surfactants was toxic to PpF1G4 at the doses tested, and PpF1G4 neither produced a bioluminescent response to the surfactants nor utilized them as growth substrates. The results indicate that for the PpF1G4 biosensor, nonionic surfactants, such as Triton X-100 and Brij 35, at doses between 2 and 10 CMC, can increase the bioavailability and direct uptake of micellar-phase HOCs commonly found at contaminated sites.

Use of Chemical Analysis and Assays of Semipermeable Membrane Devices Extracts to Assess the Response of Bioavailable Organic Pollutants in Streams to Urbanization in Six Metropolitan Areas of the United States
Bryant, W.L., S.L. Goodbred, T.L. Leiker, L. Inouye, and B.T. Johnson.
U.S. Geological Survey Scientific Investigations Report 2007-5113, 46 pp, July 2007

As part of an integrated assessment, semi-permeable membrane devices (SPMDs) were deployed in streams along a gradient of urban land-use intensity in and around six metropolitan areas. Sites were selected to avoid point-source discharge and to minimize natural variability within each of the six metropolitan areas. In addition to standard chemical analysis for hydrophobic organic contaminants, three assays were used to address mixtures and potential toxicity: (1) fluoroscan provides an estimate of the total concentration of polycyclic aromatic hydrocarbons (PAHs), (2) the P450RGS assay indicates the presence and levels of aryl hydrocarbon receptor agonists, and (3) Microtox(r) measures toxicological effects on photo-luminescent bacteria.
http://pubs.usgs.gov/sir/2007/5113/

User's Guide for Assessing Sediment Transport at Navy Facilities
Blake, A.C. and D.B. Chadwick (SSC San Diego); P.J. White (CH2M HILL); C.A. Jones (Sea Engineering, Inc.).
SPAWAR Systems Center, San Diego. Technical Report 1960, 164 pp, Sep 2007

This document provides practical guidance on planning and conducting sediment transport evaluations. It identifies and reviews methods and tools that can be used to characterize

sediment transport and provides a framework that can be used to identify the types of measurements and data analysis methods that can be used at a contaminated sediment site. It also provides guidance on how the results of a well-designed sediment transport evaluation can be used to develop management decisions for contaminated sediment sites. Technologies and data analysis methods identified in this guide were applied at field sites, and the results were used to develop a detailed conceptual site model that could be used to support the development and selection of the most cost-effective and environmentally sound remediation scenarios for the sites. A case study report for each of the demonstration sites is provided in the appendices. Demonstration site results were used to refine the general approach for characterizing sediment transport presented in this guide.
http://www.spawar.navy.mil/sti/publications/pubs/tr/1960/tr1960cond.pdf

Using Dissolved Gas Analysis to Investigate the Performance of an Organic Carbon Permeable Reactive Barrier for the Treatment of Mine Drainage
Williams, R.L., K.U. Mayer, R.T. Amos, D.W. Blowes, C.J. Ptacek, and J.G. Bain.
Applied Geochemistry, Vol 22 No 1, p 90-108, 2007

The strongly reducing nature of organic materials emplaced in permeable reactive barriers (PRBs) can lead to gas production, potentially resulting in the formation of carbon dioxide or methane gas bubbles. Degassing in organic carbon-based PRB systems was investigated using the depletion of naturally occurring, non-reactive argon and molecular nitrogen gases to identify, confirm, and quantify chemical and physical processes. Sampling and analysis of dissolved gases was performed at the Nickel Rim Mine PRB, which was designed for the treatment of groundwater contaminated by low-quality mine drainage characterized by slightly acidic pH and elevated iron(II) and sulfate concentrations. Analysis of the dissolved gas data with a simple 4-gas degassing model indicated that sulfate reduction is by far the dominant process of organic carbon consumption within the barrier. The data provided additional information to delineate rates of microbially mediated sulfate reduction and confirm the presence of slow and fast flow zones within the barrier. Degassing was incorporated into multicomponent reactive transport simulations for the barrier and the simulations were successful in reproducing observed dissolved gas trends.

Using MIP Technology to Detect VOCs in Real-Time and HPT Data for Remedial Action
Dean, Sven, GroundTech Solutions.
Remtech 2007: Proceedings of Remediation Technologies Symposium, 24-26 October 2007, Banff, Alberta, Canada. 3 pp, 2007

Direct push (DP) tools include the membrane interface probe (MIP), hydraulic profiling tool (HPT), electrical conductivity (EC), DP slug testing with groundwater sampling, and dual tube soil coring. Each of these tools can be used to describe a certain aspect of the subsurface, related either to the nature of the soil materials at depth, or the location and concentration of contaminants. At the described case study site, the MIP probe was used to locate a known groundwater plume contaminated with chlorinated VOCs. The information gained allowed the comparison of relative concentrations across the site, identification of source areas, and selection of future groundwater sampling intervals. MIP logs were made to a depth of 20 m. VOC contaminants were found at depths of 10.8 to 18 m. Based on MIP logging, depths were selected

for discrete-interval groundwater sampling to determine concentrations of selected VOCs. The sampled intervals were also used for hydraulic conductivity measurements using pneumatic slug testing techniques through the DP groundwater sampler. HPT, which was also employed at this site, is a percussion driveable tool that uses fluid injection pressure to measure the relative permeability of a soil. This technique compared favorably to EC logs at the site. HPT logs clearly showed the position of permeable materials as well as fine grained units beneath the site. The results of lithologic profiling using the various DP logging tools were confirmed using core samples obtained with a Geoprobe Systems DT325 coring system. This dual-tube soil coring system allowed rapid recovery of 50-mm diameter soil cores over a 20-m depth. The cores allowed rapid visual confirmation of the lithology, the position of permeable materials, and potential flow paths as predicted by HPT and EC logging.
http://www.esaa-events.com/remtech/2007/pdf/Paper55.pdf

Using Monoclonal Antibody to Determine Lead Ions with a Localized Surface Plasmon Resonance Fiber-optic Biosensor
Lin, T.-J. and M.-F. Chung, National Chung-Cheng Univ., Chia-Yi, Taiwan.
Sensors, Vol 8 No 1, p 582-593, 2008

A novel reflection-based localized surface plasmon resonance (LSPR) fiber-optic probe has been developed to determine the concentration of heavy metal lead ions, using a monoclonal antibody as the detecting probe. The probe contains massive amino groups immobilized onto gold nanoparticle-modified optical fiber (NMAuOF) to capture Pb(II)-chelate complexes. The optimal conditions for immobilizing monoclonal antibody on the NMAuOF are 189 ug/mL at pH 7.4 PBS for 2 h at 25 degrees C. The absorbability of the functionalized NMAuOF sensor increases to 12.2% upon changing the Pb(II)-EDTA level from 10 to 100 ppb with a detection limit of 0.27 ppb. The sensor retains 92.7 % of its original activity and gives reproducible results after storage in 5% D-(+)-Trehalose dehydrate solution at 4 degrees C for 35 days. The monoclonal antibody/functionalized NMAuOF sensor shows promise for determining the concentration of Pb(II) with a high degree of sensitivity.
http://www.mdpi.org/sensors/list08.htm

Using Sequential Biodegradation Patterns to Improve PAH Phytoremediation Monitoring
Reynolds, C.M. and D.B. Ringelberg, ERDC-CRREL, Hanover, NH.
Fourth International Phytotechnologies Conference, 24-26 September 2007, Denver, Colorado: Abstracts, p 59, 2007

To study rhizosphere effects on PAH degradation at cold, remote locations, field demonstrations were conducted at sites in Alaska and Korea, in addition to a growth chamber study. At each field site, a factorial experiment was performed in a randomized complete block design. Factors included vegetation (seeded or fallow) and nutrient (fertilized or not) additions. Using a fraction-depletion approach to express changes in contaminant composition rather than concentration and normalizing these data with respect to both time and temperature allowed improved precision and specificity of the relative loss of specific hydrocarbon fractions. Analysis of microbial biomarkers--membrane lipids--revealed associations among microbial communities that could be related to experimental treatment and the degradation of hydrocarbon fraction.

These data suggest strategies for near real-time monitoring based on the dynamics of enzyme expression and microbial activity, rather than contaminant loss.

Using Tunable Diode Lasers to Measure Emissions from Animal Housing and Waste Lagoons
D.B. Harris, R.C. Shores, and E.D. Thoma, U.S. EPA, NRMRL, Research Triangle Park, NC.
16th Annual International Emission Inventory Conference--Emission Inventories: Integration, Analysis, and Communications, 14-17 May 2007, Raleigh, NC. 16 pp, 2007

Open-path optical spectroscopy has been applied to several fugitive sources by scientists at EPA's National Risk Management Research Laboratory for more than a decade. Open-path Fourier transform infrared (OP-FTIR) was used during the initial research phase because of the ability to detect multiple compounds simultaneously. Recent improvements in solid-state, near-infrared (NIR), tunable diode lasers (TDL) has led to their development as a spectroscopic measurement system when only a single pollutant is of interest. Emissions from animal husbandry facilities are being studied both as a particulate precursor (ammonia) and a greenhouse gas (methane) source. The OP-FTIR initially was used to monitor both ammonia and methane, and the TDL has been deployed recently to focus on ammonia. The TDL has been developed into a reliable instrument for collecting long-term data at animal husbandry facilities and is a major component of testing by the agricultural industry to develop sector-specific emission factors.
http://www.epa.gov/ttn/chief/conference/ei16/session12/harris.pdf

Visualization of Root Growth in Heterogeneously Contaminated Soil Using Neutron Radiography
Menon, M., B. Robinson, S. Oswald, A. Kaestner, K. Abbaspour, E. Lehmann, and R. Schulin.
European Journal of Soil Science, Vol 58 No 3, p 802-810, June 2007

Neutron radiography (NR), a non-invasive in situ technique, was used to study living plant roots in soil. Plant roots have greater water content than their unsaturated surrounding media. As water strongly attenuates a neutron-beam, NR can identify root structures in detail, as was demonstrated using NR to visualize the root growth of lupin in quartz sand and in a loamy sand field soil. Further experiments elucidated the root growth of lupin in the loamy sand heterogeneously contaminated with 10 and 20 mg/kg boron (B) and 100 mg/kg zinc (Zn). High-quality images of root growth dynamics were obtained in both media with a resolution range of 110 to 270 um. The images with quartz sand revealed fine structures, such as proteoid roots, that are difficult to locate in situ by other methods without destruction of the soil. Though quartz sand provided excellent visibility of roots, it proved to be a poor medium for growing plants. The images with field soil showed normal root growth with slightly less contrast than the quartz sand. The poorer contrast was due to the greater neutron interaction with soil water and soil organic matter. In the heterogeneously contaminated soil, root growth decreased significantly in the contaminated part of the soil in all B and Zn treatments. This study shows that NR has potential as a non-invasive method to investigate root growth over time, as well as the response of roots to abiotic stress factors.

A Wireless Sensor Network for Methane Monitoring
Hayes, J., C. Slater, B. Kiernan, C. Dunphy, W. Guo, K.T. Lau, and D. Diamond.
Advanced Environmental, Chemical, and Biological Sensing Technologies V, Proceedings of SPIE -- The International Society for Optical Engineering, Vol 6755, 8 pp, 2007

A system for monitoring methane via readings sent over the Internet is based on a simple wireless sensor network. The system was developed for use at a capped landfill site that contains municipal solid waste. The sensor nodes use commercially available metal oxide semiconductor gas sensors to monitor and allow for near real-time monitoring of gas emissions. This system is intended to complement the work of field personnel who take measurements using hand-held infrared instruments. Preliminary testing of this system is outlined.

SMALL BUSINESS INNOVATIVE RESEARCH (SBIR)
AND OTHER GRANT AWARDS

Department of Defense

Advanced Development for Defense Science and Technology (DoD DARPA 2007 SBIR Phase 1)
Contract Number: W31P4Q-08-C-0026
10/24/2007 to 6/26/2008
Award Amount: $99,000
David S. Bomse (PI), 505-984-1322, dbomse@swsciences.com
Southwest Sciences, Inc., Santa Fe, NM

Southwest Sciences proposes the development of an ultra-sensitive optical spectroscopy technique having applications in explosives and chemical agent detection, as well as rapid health screening/monitoring for warfighter field diagnostics and health care. The technique, called noise-immune, cavity-enhanced optical heterodyne spectroscopy (NICE-OHMS), was invented about 10 years ago, but has remained a research laboratory technique. It was considered too complex for commercial development. Southwest Sciences plans to take advantage of recent improvements in enabling technologies to make NICE-OHMS a reliable, field-rugged, and portable method. If successful, two- to four-orders of magnitude in sensitivity improvement over competing spectroscopic methods is anticipated at only modestly higher expense. The proposed technology has numerous military and commercial applications. The project approach starts with the detection of ultra-trace (ppb or lower concentrations) gases in exhaled breath that are markers for disease and injury. This application has both military and civilian uses. Obvious target compounds include nitric oxide, acetone (which is a marker for diabetes and ketosis), ethylene (an indicator for radiation exposure), ethane and higher alkanes (markers for lipid damage), and dimethyl sulfide (kidney function). In addition, numerous metabolic tests involve ingestion of 13C-labeled compounds followed by time-resolved, high precision measurements of 13CO2/12CO2 changes.

Advanced Environmental Monitoring Technology (Navy 2006 SBIR Phase 1)
Contract Number: N65538-07-M-0034
12/19/2006 to 6/29/2007
Award Amount: $69,817
Scott Lang (PI), 814-867-5122, slang@rlwinc.com
RLW, Inc., State College, PA

The team of RWL Inc., Mountain Research LLC, and AccuWeather proposes to develop and demonstrate a system that will detect various contaminants in storm water flows; process the data into useful information; transmit the information wirelessly; provide alerts, storage and trending; be capable of initiating actions such as gate-closings and treatment initiation; and collect weather information that will support proactive responses. The heart of the system will be RLW Inc.'s S2NAP(r), which was developed in earlier SBIR projects for machinery health monitoring. Mountain Research brings environmental monitoring and treatment expertise to the team; AccuWeather is known internationally.

Carbon Nanotube-Based Filters for Aerosol Sample Collection (DoD CBD 2007 SBIR Phase 1)
Contract Number: W9132V-07-C-0014
5/3/2007 to 11/3/2007
Award Amount: $70,000
Joel Tabb (PI), 607-272-0002, jtabb@agavebio.com
Agave Biosystems, Inc., Austin, TX

Aerosols represent one of the more efficient methods to distribute biological and chemical agents throughout the atmosphere. Small aerosol droplets can be readily inhaled and easily penetrate deep into the lungs where they lodge in bronchial alveoli. Within the alveoli, chemical and biological agents can breach epithelial and endothelial cell layers and enter the bloodstream, where they cause damage and disease. Rapid collection and analysis of aerosols containing potential biological and chemical threat agents will be essential in determining the nature of the threat agents as well as planning measures to combat and neutralize these threats. In this Phase I program, Agave BioSystems, in collaboration with Dr. Randy Vander Wal of the University Space Research Association, proposes to develop a novel aerosol collection system based on carbon nanotubes (CNTs) synthesized directly on stainless steel (SS) mesh. The high surface area, structural robustness and inert nature of CNTs grown on SS mesh make them ideal for use in such an aerosol collection system.

Chemical/Biological Agent Non-Intrusive Detection (DoD DTRA 2006 SBIR Phase 2)
Contract Number: HDTRA1-07-C-0007
12/20/2006 to 12/19/2008
Award Amount: $749,641
Robert K. Brandt (PI), 262-695-6900, kbrandt@brandtinnovativetech.com
Brandt Innovative Technologies, Inc., Pewaukee, WI

A prototype system is proposed that is capable of non-invasively probing the characteristics of material properties using acoustical waves through thermal conversion of a remote laser pulse. The advantages of a proposed system as an inspection and identification technique are: 1) Non-contact: Sensor does not require contact with container 2) Stand-off: Sensor could be located many meters away from container 3) Non-intrusive: Sensor measures properties inside a container 4) Real time: Sensor and processing system gives results in seconds or less 5) Robust Penetration: Sensor able to sense through a variety of container materials including glasses, polymers, ferrous and non-ferrous metals. 6) Robust Identification: Sensor able to identify a wide variety of materials, including solids, liquids, and gases.

Chemical/Biological Agent Standoff Detection (DoD DTRA 2006 SBIR Phase 2)
Contract Number: HDTRA1-07-C-0003
11/2/2006 to 11/1/2008
Award Amount: $746,509
Neil Goldstein (PI), 781-273-4770, neil@spectral.com
Spectral Sciences, Inc, Burlington, MA

Spectral Sciences, Inc. proposes an innovative standoff detection system for remote detection and mapping of chemicals agents and other hazardous materials. The adaptive multiplex spectrometer (AMS) is a general-purpose passive infrared sensor whose characteristics can be set on-the-fly in software. As a spectrograph, it would provide performance similar to the SORAD. It also can perform 1-D spectral imaging and implement target-specific detection algorithms in hardware for rapid-response, selective detection of weak spectral signatures against complex backgrounds. Furthermore, the AMS design is inherently rugged, with no macroscopic moving parts. These characteristics make it applicable in a variety of fieldable sensors for man-portable, vehicle-mounted, and UAV-based operations. In Phase I, we demonstrated the feasibility of the approach through laboratory experiments, simulations, and optical design. In Phase II, we will develop a prototype long-wave infrared sensor for use in field tests and demonstrate its operation in a variety of modes: as a spectrometer, spectral imager, and high-speed target-specific imager. This prototype will serve as a test bed to develop sensors for specific military and commercial applications.

Compact and Highly Sensitive MEMS Enhanced Fiber Gas Spectrometer (Army 2007 SBIR Phase 1)
Contract Number: W911SR-08-C-0006
11/15/2007 to 5/15/2008
Award Amount: $69,915
Vincent Lee (PI), 781-935-1200, Vlee@agiltron.com
Agiltron Corp., Woburn, MA

Leveraging extensive production experience on MEMS technology and fiber optic components, AGILTRON proposes to realize a new class of gas spectrometer with built-in MEMS-enhanced mid-IR tunable laser and gas-filled hollow fibers as gas cells, targeted for TIC and CWA detection. The proposed MEMS-enhanced QCL-based external cavity tuning laser has high output power (tens of mW) and very large wavelength tunable range (about 2 um), which can dramatically increase the sensitivity and selectivity. Besides, a long hollow fiber coiled in small diameter can further increase sensitivity due to its long optical absorption path. This kind of spectrometer not only has very high sensitivity but also is very lightweight, miniature in size, highly reliable, and durable. The design intrinsically eliminates the requirement for optical alignment, providing excellent temperature stability and longevity. The designs offer quick action, lower power consumption, and low cost, and can withstand severe environmental conditions. In Phase I, state-of-the-art MEMS-enhanced EC-QCL will be designed, and the sensitivity increase of long, hollow-fiber gas cells will be further developed and demonstrated. In addition, the proposed gas spectrometer theoretical receiver operational characteristics will be analyzed and simulated.

Detection of Explosive Materials Using an Encapsulated Fluorescent Bioprobe (Army 2007 STTR Phase 2)
Contract Number: W9132V-07-C-0017
9/11/2007 to 9/9/2008
Award Amount: $750,000
Joel Tabb (PI), 607-272-0002, jtabb@agavebio.com
Agave Biosystems, Inc., Austin, TX / Universities Space Research Association, Columbia, MD

Agave BioSystems is collaborating with Universities Space Research Agency (USRA) to develop an encapsulated fluorescent bioprobe for in situ detection of explosive materials. The bioprobe uses a displacement immunoassay and fluorescence quenching to detect the presence of specific explosives residues. In Phase I, a bioprobe was developed specifically for TNT (2,4,6-trinitrotoluene). This fluorescent bioprobe is encapsulated within novel nanoporous silica microspheres. Encapsulation within nanometer-sized pores in the microspheres provides a protective structure to stabilize the bioprobes and minimize environmental influences. Protecting the bioprobes from micron-sized clays and other materials present in soil will allow development of a robust and sensitive detection system. In Phase I, Agave BioSystems successfully demonstrated probe development, encapsulation, and detection of TNT. The Phase II effort will focus on scaling up materials, developing assays to detect multiple agents, and adapting the assay for stand-off detection of explosives residues under field conditions.

Development of Portable Sensor Array Systems for Monitoring Air Contaminants in Cockpit (Air Force 2006 SBIR Phase 1)
Contract Number: FA8650-06-M-6674
5/2/2006 to 3/2/2007
Award Amount: $99,710
Jin Luo (PI), 607-757-0281, jluo@NSCTek.com
NSC Technology, Vestal, NY

This Phase I proposal addresses the need specified in Air Force SBIR 06.1 under the Topic Index of AF06-023: Advanced Sensor to Identify and Quantify Contaminants in Cockpit Air. A highly sensitive and selective sensor array technology is needed to achieve effective detection and speciation in cockpit air. This proposed work focuses on the development of portable sensor array technology that couples with nanostructured sensing materials and pattern recognition engine that can detect multiple targeted vapors simultaneously. The phase I goal is to develop the feasibility of a portable, low-power driven, cost-effective sensor array prototype capable of detecting, identifying, and quantifying pollutants in cockpit air, such as fuel vapor, carbon monoxide, and smoke. The approach couples a new class of core-shell structured nanomaterials as array elements to chemiresistive devices in an integrated system. NSC will pursue the following specific objectives in the Phase I funding period: (1) design nanostructured sensing materials on chemiresistor devices; (2) test the array nanomaterials in detecting the targeted contaminants with the desired sensitivity, selectivity, detection limit, and response speed; and (3) build a prototype integrated system with sensing arrays, pattern recognition, and device miniaturization.

Development of Portable Sensor Array Systems for Monitoring Air Contaminants (Air Force 2006 SBIR Phase 2)
Contract Number: FA8650-07-C-6748
5/1/2007 to 6/2/2009
Award Amount: $749,990
Jin Luo (PI), 607-757-0281, jluo@NSCTek.com
NSC Technology, Vestal, NY

The development of sensor arrays is critical to the achievement of chemical fingerprinting in an environment with complex chemical species. The objective of this research project is to develop portable sensor array systems with integrated modules for targeting air contaminants in military and civilian applications. In Phase I, the feasibility of interfacing nanostructured sensing materials as chemiresistor array to a circuit board and data acquisition software was demonstrated for the detection of VOCs. The modules feature plug-and-play array, handheld hardware, and laptop-based data acquisition/analysis software. The Phase II work plans to pursue advanced development of these modules towards integration and prototyping for the targeted applications. The design parameters for the array, the hardware, and the software will be optimized for integration into a portable sensor array system. The sensor array system will be compact, low power, lightweight, and cost effective. The tasks to be accomplished by NSC Technology will lead to a final product in the form of a portable sensor array system for detecting VOCs and other air contaminants. The technology will also find applications by military and commercial entities for air monitoring, leak detection, and other applications involving environmental effects on human health.

Development of Protein-Based Taggants for Chemical and Biological Agent Detection (Air Force 2008 SBIR Phase 2)
Contract Number: FA8650-08-C-5018
3/26/2008 to 7/26/2010
Award Amount: $749,985
Melanie M. Tomczak (PI), 937-426-6900, mtomczak@ues.com
UES, Inc., Dayton, OH

Detection of chemical and biological warfare agents in a real-world setting is an increasingly urgent problem. Many of the current state-of-the-art sensors are aqueous based and require large biomolecules, such as antibodies, to achieve binding of the target molecule and subsequent reporting of the binding event. These technical hurdles are a drawback when considering deployment of these technologies to a battlefield situation. Here, we propose a sensor that is based on short peptide sequences that act as ligands for the target(s) of interest. Due to their small size, these ligands are not susceptible to conformational instability and the sensors should have a long lifetime even when deployed. Additionally, we propose a "dry" signal transduction mechanism that only requires the binding of the target of interest in order to relay that event. No washing or blocking steps are required. After deployment, the sensor on which the binding takes place can be interrogated, either locally or remotely, by a reader to determine if the target of interest has bound.

Dynamic Multicomponent Optical Analyzer for Chemical Weapon (CW) Exposure Studies (DoD CBD 2008 SBIR Phase 1)
Contract Number: W911SR-08-P-0029
4/28/2008 to 10/28/2008
Award Amount: $69,990
Pajo Vujkovic-Cvijin (PI), 781-273-4770, pajo@spectral.com
Spectral Sciences, Inc., Burlington, MA

Spectral Sciences Inc. proposes to develop a prototype sensor for real-time trace-level analysis of complex multicomponent gas mixtures, specifically those containing chemical weapon (CW) agents and interferents. The instrument is based on high power quantum cascade lasers and photocoustic spectroscopy detection. Advanced detection algorithms take advantage of wide spectral coverage to provide high sensitivity with low occurrence of false positives. The laser source features digitally controlled fast wavelength tuning and wavelength modulation. An integrated-optics acoustic transducer provides noise-canceling gas absorption signal acquisition. In Phase I and Phase I Option tasks, the digitally tunable and lockable laser source will be demonstrated, followed by the delivery of a laboratory prototype by the end of Phase II.

E-Tongue Sensor Array For Shipyard Water Monitoring (Navy SBIR 2006 Phase 1)
Contract Number: N65538-07-M-0033
12/19/2006 to 6/29/2007
Award Amount: $70,000
Senerath Palamakumbura (PI), 617-668-6801, SPalamakumbura@rmdinc.com
Radiation Monitoring Devices, Inc., Watertown, MA

The Navy program office needs to monitor known pollutants in shipyard waste water discharges to comply with local environmental discharge limits. The primary pollutants of concern are heavy metal ions, but petroleum hydrocarbons and SVOCs are also of interest. The monitoring system should be lightweight (handheld), low power, reliable, low maintenance, affordable, and very responsive. The sensor must detect, identify, and quantify heavy metals and should be operable by field personal. Configuration in wireless mode to alert monitors is also desirable. RMD in collaboration with Prof. Barry Lavine of Oklahoma State University proposes a chemiresister sensor array (e-tongue) to address this need. The analyte signatures from the cross-reactive array will be characterized by a trained pattern recognition algorithm, developed and trained by Prof. Lavine. The discrimination and orthogonality of the sensor elements in the array will be optimized by choosing different film compositions as well as ionophores for respective metal ions. Commercial ionophores as well as specialized ionophores being developed by Prof. Lavine will be employed. The sensor components are low cost and hand held. The sensor also can be configured for continuous monitoring with remote communication capability.

Field-Deployable, Small, Ultra-Sensitive, Battery-Powered Laser Spectrometer for Toxic Chemical Detection (Army 2007 SBIR Phase 1)
Contract Number: W911SR-08-C-0007
12/10/2007 to 6/10/2008
Award Amount: $69,030
Philippe Bado (PI), 734-528-6330, pbado@translume.com
Translume, Ann Arbor, MI

Using a proprietary and proven technique for machining fused silica, Translume proposes to manufacture robust and stable hybrid fiber-waveguide tunable lasers. These hybrid lasers will be integrated into field-deployable, high-sensitivity, miniature, infrared laser spectrometers capable of performing real-time measurements of a wide range of chemical toxics. Broad IR coverage will be obtained through non-linear mixing of two or more hybrid sources. Unlike present commercial systems, the tunable IR laser source will be fully waveguided. This design approach will provide exceptional robustness. Wavelength tuning, bandwidth control, synchronization, and wavelength monitoring functionalities will be implemented using waveguided elements and MEMS elements imbedded deep inside fused silica substrates. These energy-efficient spectrometers will run on standard batteries without outside power sources.

Field Portable Device for Monitoring Trihalomethanes in Water (Air Force 2007 SBIR Phase 1)
Contract Number: FA9302-08-M-0012
1/26/2008 to 10/22/2008
Award Amount: $100,000
Bikas Vaidya (PI), 979-693-0017, bikas.vaidya@lynntech.com
Lynntech, Inc., College Station, TX

The treatment of water with chlorine is an effective way to kill waterborne pathogens such as bacteria, parasites, and viruses; however, this process produces a toxic byproduct from the chemical reaction between chlorine and natural organic matter in the form of trihalomethanes (THMs). These THMs are considered a significant health hazard with studies showing a link to an increased risk of cancer. Currently, total trihalomethanes (TTHMs) are analyzed using the EPA Methods 502.2 and 551.1, both of which require the use of large, expensive, and non-portable laboratory equipment. Commercially available portable chemical monitors show insufficient levels of performance in terms of detection limits and sensitivity to interference or are entirely non-specific; hence, detection of trace levels of THMs in the field remains a challenge. Lynntech proposes to develop and deliver to the military a compact, lightweight and easy-to-operate handheld TTHM monitor capable of providing rapid test results and withstanding the harsh environmental conditions typical of field use.

Field Sensor for Measuring Total Trihalomethanes (TTHM) Concentrations in Drinking Water (Air Force 2007 SBIR Phase 1)
Contract Number: FA9302-08-M-0011
1/26/2008 to 10/22/2008
Award Amount: $100,000
Mehran Pazirandeh (PI), 607-272-0002, mehranp@agavebio.com
Agave Biosystems, Inc., Austin, TX

Rapid detection of the total trihalomethanes (TTHM) in treated drinking water is essential for compliance with EPA's Stage 2 Disinfectants and Disinfection Byproducts (DBP) rule, which limits the maximum contaminant level of TTHM in drinking water to 80 ppb. The current detection method for TTHM determination involves sending samples to EPA-certified laboratories for gas chromatography analysis, a method that is both expensive and time consuming. The ideal TTHM water monitoring system would be a hand-held, rapid-response device that would detect TTHM levels and aid in the identification of contamination before it develop into larger problems. In Phase I, Agave BioSystems proposes to develop a colorimetric/ fluorometric TTHM detection system based on a modified Fujiwara reaction, which will be subsequently integrated into a portable field sensor. This assay system will elute THMs, filtered from a water sample, into a reaction buffer and through a modified Fujiwara reaction, yielding a detectable color or fluorescent product that correlates directly to the TTHM levels of the water sample.

Field Sensor for Measuring Total Trihalomethanes (TTHM) Concentrations in Drinking Water (Air Force 2007 SBIR Phase 1)
Contract Number: FA9302-08-M-0013
1/25/2008 to 10/22/2008
Award Amount: $99,991
Won Tae Kim (PI), 505-524-3664, wkim@lasysinc.com
Nantal, Inc., Las Cruces, NM

Nantal Inc. is developing a proprietary nanoparticle/fractal-based sensor that will be integrated into two electronic devices, resulting in an ultra-sensitive optical detector based on the Raman effect. The devices will be capable of detecting chemical contaminants in water at concentrations in the low ppb range. In Phase I, the sensor will qualitatively detect total trihalomethanes (TTHM) both above and below EPA's Maximum Contaminant Level of 80 ppb. In Phase II, the sensor will be scaled up to production levels and integrated into two newly designed and developed electronic instrument devices that will quantitatively detect TTHM in water in the 20 to 200 ppb range. The devices will include a small, handheld, field-ready device and a bench-top unit for use in a laboratory. The ultra-sensitive instruments will provide accurate, precise, and quantitative measurements in real time via a digital readout, require no preparative steps, and be simple for non-technical individuals to use. TTHM results from the reaction of chlorine with organic materials in water. Two of the four organic TTHM agents are classified as possible carcinogens, and the group has been shown to affect development and reproduction in laboratory animals.

Hand-Held System for On-Site Trihalomethane Measurement (Air Force 2008 SBIR Phase 1)
Contract Number: FA9302-08-M-0014
1/25/2008 to 10/22/2008
Award Amount: $99,953
Kevin R. Cooper (PI), 910-695-8884, kevin@scribner.com
Scribner Associates, Inc., Southern Pines, NC

The aim of the proposed work is to develop an electrochemical-based sensor array system and measurement method procedure for rapid, accurate determination of the total trihalomethane content of drinking water. The proposed electrochemical approach is well-suited to accurate quantification of analytes at the ppb level; electrochemical-based sensor array systems are ideal for portable applications because they are easily miniaturized without sacrificing performance; are low power, which facilitates battery operation; and are inherently safe. High-density sensor arrays permit redundant analysis for enhanced measurement fidelity as well as targeted detection of multiple analytes without sacrificing cost or portability. Phase I will demonstrate the technical feasibility of the proposed electroanalytical approach and the efficacy of developing small, low-mass, and low-power analytical instrumentation for the sensor array. Using results from Phase I, the expected performance of the detection system will be critically evaluated against established performance criteria. In Phase II, the research team will develop a prototype handheld detection system.

Handheld FT-IR/Photoacoustic Chemical Agent Detector (DoD CBD 2005 SBIR Phase 2)
Contract Number: W911SR-06-C-0030
6/30/2006 to 6/30/2008
Award Amount: $750,000
Christopher Manning (PI), 208-835-5402, chris@appl-tech.com
Manning Applied Technology, Troy, ID

Manning Applied Technology proposes development of the MP-100 handheld FT-infrared photoacoustic chemical agent detector, following a highly successful Phase I effort. Chemical attacks and accidents can be mitigated partially by cost-effective sensors. The device is ideally suited to detection of airborne chemical agents and TICS, at 1 to 100 ppt, well below permissible exposure limits. The MP-100 is modular, rugged, compact, and inexpensive (~$1,500 each). A vapor preconcentrator is integrated with photoacoustic detection using high-sensitivity MEMS microphones. A novel field-widened interferometer provides high throughput of infrared energy. A computer-machined aluminum housing and COTS handheld computer complete the system. Dr. McClelland will manage integration of the photoacoustic cell and MEMS microphone. Dr. Manning, the Principal Investigator, is an internationally recognized spectrometer design expert. Military applications include a variety of sensing activities for personnel protection. Commercial applications include a wide range of process and quality control, medical, environmental monitoring, laboratory research, field measurements and remote sensing applications. Conservative estimates are a $10 million per year market, with the low cost insuring significant market share. Several partners will provide Phase II and III support.

Handheld Photoacoustic Chemical Agent and Toxic Industrial Material Detector (Army 2005 SBIR Phase 1)
Contract Number: W911SR-05-C-0043
5/12/2005 to 11/12/2005
Award Amount: $99,995
Christopher Manning (PI), 208-835-5402, chris@appl-tech.com
Manning Applied Technology, Troy, ID

Manning Applied Technology proposes to develop a handheld infrared spectrometer, ideally suited to detection of airborne chemical agents at and below permissible exposure limits. This approach offers unmatched sensitivity and specificity for detection of all types of chemical vapors. The instrument is modular, rugged, compact and highly sensitive. Volume pricing will be less than $1,000 each. The vision is to combine, for the first time, a preconcentrator with a photoacoustic detector that uses a high-sensitivity MEMS microphone. A novel field-widened interferometer will provide high throughput from a high-efficiency infrared source. A computer-machined aluminum housing and COTS handheld computer complete the system. The low cost insures that it will capture a significant market share. ATK/MRC will provide Phase I, II and III support.

Imaging Sensor Constellation for Tomographic Chemical Plume Mapping (Army 2006 SBIR Phase 2)
Contract Number: W911S6-06-C-0001
12/1/2006 to 12/1/2008
Award Amount: $729,974
Bogdan R. Cosofret (PI), 978-689-0003, cosofret@psicorp.com
Physical Sciences, Inc., Andover, MA

In this SBIR effort, Physical Sciences, Inc. has proposed to develop a sensor constellation that can be used to determine the size (length, width, and height), location, and detailed concentration distribution of chemical agent simulant clouds released on test ranges. The proposed system will be capable of imaging in the 8 to 11 micron region with a spectral resolution of 8 to 10/cm and an NESR of 1 to 2 uW/sq cm/sr/um. The system will be capable of detecting the chemical cloud from a standoff distance of 1.5 km and to beyond 300 m downwind of the plume release point with a spatial resolution of 6 meters per pixel. The sensor constellation is based on the use of standoff passive multispectral infrared imaging to make simulant column density measurements through the chemical cloud from two or more locations around its periphery. A computed tomography inversion method will be employed to produce a 3-D concentration profile of the cloud from the line density measurements. The system will also be able to determine the boundaries of the cloud (length, width, and height) from the concentration profile data. This information will be presented in real time to the end user.

In-Line Toxicity Monitoring System (Army 2006 SBIR Phase 1)
Contract Number: W56HZV-07-C-0090
11/20/2006 to 5/20/2007
Award Amount: $66,990
Naibing Ma (PI), 310-320-3088, sutama@poc.com
Physical Optics Corporation, Torrance, CA

To address the U.S. Army need for an in-line continuous water toxicity monitoring system to maintain the integrity of potable water supplies, Physical Optics Corporation (POC) proposes to develop a new in-line TOxicity MOnitoring (TOMO) system. This proposed system is based on an AChE reversible inhibitor immobilized on gold electrodes of a polymer micromembrane capacitive sensor array. The device will enable 92W tactical water purification system operators to continuously monitor and identify classes and concentrations of nerve agents, their hydrolysis products, industrial organophosphate compounds, and pesticides in water below military exposure guideline detection limits, ensuring safe drinking water for soldiers. In Phase I, POC will demonstrate the feasibility of TOMO by detecting one class of compounds with three independent chemicals and demonstrate system efficacy by receiver operational characteristic curve analysis. In Phase II, POC plans to develop a TOMO prototype capable of detecting other classes of compounds that represent toxic industrial chemicals described in Tech Guide 230. The Phase II prototype will be able to monitor the performance of the granular activated carbon column for breakthrough of contamination in a field environment, validated through third-party testing.

In Situ Near Real-time Detection of RDX in Soil (1000-908) (Army 2006 STTR Phase 1)
Contract Number: W9132V-06-C-0029
9/12/2006 to 3/11/2007
Award Amount: $99,977
Manoj Ram (PI), 978-250-4200, mram@tritonsystems.com
Triton Systems, Inc., Chelmsford, MA / Auburn University

Triton Systems, Inc., with Prof Aleksandr Simonian of Auburn University, proposes to develop an in situ, on-site, near real-time response detector of explosive particles in large areas of soil for the BRAC program. The explosive detector is designed to withstand environmental factors such as pH, temperature, soil moisture, and soil salinity changes. The device detects ultra-low concentrations of explosives in soil and distinguishes RDX from other explosive materials. Additionally, the device meets the user requirements for selectivity and reliability in the field.

Inexpensive TSP Based Reagentless Explosive Detector (DoD DARPA 2006 SBIR Phase 1)
Contract Number: W31P4Q-07-C-0020
12/14/2006 to 8/6/2007
Award Amount: $99,000
Anjal Sharma (PI), 979-693-0017, anjal.sharma@lynntech.com
Lynntech, Inc., College Station, TX

Bomb-making factories typically are located in apartment buildings or other large dwellings, where the level of out-gassed explosive marker vapors is so small and buried within numerous common chemicals that current detectors cannot aid in their location. Lynntech proposes to address this critical DoD need by fabricating three novel TSP-based colorimetric sensor elements, each selective for DNT, TNB, and picrate, and incorporate them into an automated bench-scale detector to demonstrate the capability to detect and quantify (without reagent) trace vapor-phase explosives markers in the presence of common household chemicals and matches. During Phase II, Lynntech will fabricate additional selective TSP sensor elements for other molecular explosives markers encompassing groups A through D and integrate these into a prototype compact, inexpensive explosives detection device that can be placed in the HVAC system of an apartment building. The device will be tested for reliable operation with low false positives, multiplex-ability, and wireless control during Phase II.

MEMS Enhanced Laser Spectrometer for Ultra-sensitive Toxic Chemical Detection (Army 2007 SBIR Phase 1)
Contract Number: W911SR-08-C-0004
11/15/2007 to 5/15/2008
Award Amount: $69,922
E. Robert Schildkraut (PI), 508-480-9643, erschild@aol.com
Block MEMS LLC, Marlborough, MA

Block MEMS, LLC proposes the development of an ultra-high sensitivity, MEMS-enhanced, tunable diode laser spectrometer. With the aid of micro-electromechanical (MEMS) components, this spectrometer should achieve a size of <1800 cm3 while exhibiting sensitivities greatly exceeding the current JCAD specification, but with a very low false alarm rate. It should exhibit extremely favorable Receiver Operating Characteristic curves compared to current IMS or SAW point detection devices. While primarily for chemical detection, the unit should also be capable of biological cueing/detection consistent with current spectral data. The unit could also be adapted to serve as a moderate range (from 10 to 50 meters) standoff detector at somewhat larger size, weight, and power The approach combines several variable frequency Quantum Cascade Lasers operating in the 2 to 14 um infrared (IR) fingerprint region. The unit can also measure some Mie scatter parameters, which would help detection of biological aerosols. The Block approach further seeks to optimize the cost/benefit parameter by first analyzing the optimal spectral discrimination regions that differentiate among toxic species and between toxic species and military or other interferents. Through more efficient use of the spectral discrimination information, Block expects further increase in the Signal-to-Noise Ratio (SNR).

Microbial Detectors of Explosives (Army 2006 STTR Phase 1)
Contract Number: W9132V-06-C-0028
9/12/2006 to 3/11/2007
Award Amount: $99,967
Vladimir Gilman (PI), 781-890-1338, vgilman@infoscitex.com
Infoscitex Corp., Waltham, MA / Texas A&M University / University of Rhode Island

Current methods of detecting explosives in soil require extensive soil and/or water sampling and analysis using portable laboratories, which can impose significant cost and time burdens during the site remediation process. In this Phase I program, Infoscitex Corporation (IST), Texas A&M University, and the University of Rhode Island propose the development of a new microbial detector for explosives. This detector will contain microorganisms that react specifically with targeted energetic materials and reveal their presence via intensive fluorescence. Experimental efforts will focus on development of microorganisms, production of microbial sensors, and validation on a selected energetic material.

Microfluidic Optical Biosensor for Detection of Biowarfare Agents (Army 2006 STTR Phase 1)
Contract Number: W9132T-06-C-0029
9/1/2006 to 2/28/2007
Award Amount: $100,000
Joel Tabb (PI), 607-272-0002, jtabb@agavebio.com
Agave Biosystems, Inc., Austin, TX / University of Rochester, Rochester, NY

This STTR Phase I project will develop a microfluidic optical biosensor based on whispering gallery mode resonator technology for the detection of bioterrorism agents. The proposed device will bridge biological sciences with optics and material sciences to develop a commercially useful tool for homeland security. This microfluidic optical biosensor proposed by Agave BioSystems, in collaboration with Dr. Robert Boyd of the Institute of Optics at the University of Rochester, has the potential to detect low levels of pathogens within minutes after air sampling has been completed and will not be prone to the ambiguous results associated with PCR-based detection technologies. The device relies on measuring the direct absorption of biological materials on the whispering gallery mode resonators by monitoring their effect on the light resonating within its microcavity. The proposed device will respond to the specific capture of Bacillus anthracis spores by antibodies on the resonator surface. By coupling the detection mechanism to a microfluidic delivery system, the device will have the potential to be automated and rely on small sample volumes. The microfluidics will be designed and fabricated at the wafer level using glass-wafer etching to embrace the current trend in the microsystems industry.

Nanotechnology-Enhanced Sensor for Toxic Industrial Chemicals (DoD DARPA 2007 SBIR Phase 1)
Contract Number: W31P4Q-08-C-0004
11/1/2007 to 7/2/2008
Award Amount: $99,000
Mark Wagner (PI), 781-864-9884, mark.wagner@sensorcon.com
Sensorcon, Inc., Reading, MA

Toxic industrial chemicals (TICS) include substances such as ammonia, chlorine, and hydrogen cyanide. To help DoD detect TICS in military operations, Sensorcon is proposing to integrate carbon nanotubes (CNT) into its micro electrochemical sensors (MECS) by means of a highly scalable process. MECS are smaller, less expensive, and more rugged than traditional electrochemical sensors. CNT-enhanced MECS will have enhanced sensitivities that are at least 1 to 2 orders of magnitude greater than the leading commercial sensors, thus enabling the detection of some TICS in the ppb/ppt range. In Phase I, the processing techniques will be developed to create & test CNT-enhanced MECS. Phase II will refine the process and incorporate additional nanomaterials for further enhanced performance. Testing will focus on TICS of DoD interest, with an initial focus on comparative tests with chlorine and nitrogen dioxide sensors.

Nanotechnology-Enhanced Sensor for Toxic Industrial Chemicals (DoD DARPA 2007 SBIR Phase 1)
Contract Number: W31P4Q-08-C-0007
1/31/2008 to 8/22/2008
Award Amount: $98,962
Michael Vogt (PI), 256-713-1220, Michael.Vogt@StreamlineAutomation.biz
Streamline Automation, LLC, Huntsville, AL

Chlorine gas was first used as a weapon during World War I and has reemerged as a threat in Iraq. One of the significant challenges with preventing attacks that involve toxic industrial chemicals (TICs) like chlorine and ammonia is that they have genuine civilian uses in water treatment and refrigeration systems, which makes it impossible to outlaw their sale and possession. Streamline Automation proposes to develop a thin-film voltammetric gas sensor that utilizes nanoscale features to enhance sensitivity to TICs. This will involve doping the sensor materials with catalysts that enhance reactions with specific chemicals of interest through techniques such as ion implantation. The use of thin-film fabrication techniques will enable an array of voltammetric sensing cells to be laid down in a very small area and tailored to the detection of a range of TICs. The Phase 1 effort will focus on demonstrating that a thin-film sensor behaves as expected with the addition of a dopant, as well as on identifying candidate dopants for several high-hazard TICs.

Portable Infrared Monitor for In-Field Identification of Chemical Unknowns (Navy 2005 SBIR Phase 1)
Contract Number: N00164-05-C-6081
8/15/2005 to 2/15/2006
Award Amount: $69,956
Jay Schwartz (PI), 978-694-9991, jschwartz@ssginc.com
SSG, Inc. Wilmington, MA

SSG Precision Optronics proposes the development of a compact handheld infrared (IR) hyperspectral instrument for detection of chemical and biological threat agents. The proposed system will combine SSGPO's recent developments in compact grating imaging spectrometers and miniature front-end optics for the mid- and long-wave infrared, a new programmable sensor technology developed by Nova Sensors, and long experience with hyperspectral operational hardware. This combination of technologies and experience will provide the ability to rapidly detect and identify threat agent spectral signatures by programming the sensor to selectively detect in the hyperspectral bands that match those of the threat agent. This can be accomplished at readout rates significantly above typical camera rates (>>60 Hz) with no moving parts. The overall dimensions of a fieldable, battery-powered instrument are anticipated to be on the order of 4" x 5" x 2". Phase 1 will develop system level design concepts for the compact, spectrally agile hyperspectral instrument with the base Phase 1 effort defining the system requirements and performing design trades. A Phase 1 option will experimentally confirm the viability of the system concept. Phase 2 will develop and demonstrate a prototype instrument for evaluation.

Rapid Detection Nano-Sensors for Biological Warfare Agents in Buildings and HVAC Systems (Army 2007 STTR Phase 2)
Contract Number: W9132T-07-C-0022
9/11/2007 to 9/9/2008
Award Amount: $749,941
Dinakar Ramadurai (PI), 630-771-0203, rdinakar@epir.com
EPIR Technologies, Inc., Bolingbrook, IL / University of Illinois, Chicago

In the Phase I program, EPIR Technologies successfully developed a technology for real-time, simultaneous detection of several types of biological agents using a novel FRET-based detection technique. The development of multiplexed detection capabilities with extremely low false positives in this Phase I program allowed EPIR to establish improved standards in biosensing. Innovative surface modification protocols for bioconjugation of quencher-labeled bioagents enabled the shelf life of these complexes to be extended greatly. In the proposed Phase II program, EPIR will develop the Phase I "proof of concept" to prototyping, while continuously working toward the advancement of the FRET-based detection to go beyond the current state-of-the-art biosensors for HVAC systems. To sustain a commercially viable biosensor program, EPIR has already initiated the development of on-site facilities to lower production costs and expand process quality control. EPIR also proposes to investigate innovative design and engineering processes to develop low-cost miniature biosensors. Finally, EPIR proposes several innovative "smart decontamination" techniques that will be integrated into the biosensors to not only detect but also provide large-scale rapid decontamination of the air inside buildings and HVAC systems.

Real Time Parallel Channel Spectrometer for 3D Cloud Profiling (Army 2006 STTR Phase 1)
Contract Number: W911SR-06-P-0046
8/28/2006 to 2/28/2007
Award Amount: $99,982
Julia Rentz Dupuis (PI), 978-887-6600, jrentz@optra.com
OPTRA Inc., Topsfield, MA / University of North Carolina, Chapel Hill

OPTRA is proposing the development of a 3D cloud profiling system that combines an innovative Imaging Open Path Fourier Transform Infrared Spectrometer (I-OPFTIR) with advanced computational tomography algorithms. The proposed technology expands the capability of OP-FTIR systems to 3D profiling applications by adding a spatially dispersed array of sensors at the focal plane of a single interferometer. This maintains the high performance of the OP-FTIR system without adding the bulk and expense of multiple systems. The active measurement allows for detection when there would otherwise be zero contrast between the plume and background (a likely scenario for indoor test applications). System cost and weight will be further reduced by the use of OPTRA's lightweight, low-cost retroreflector array. OPTRA will partner with Dr. Lori Todd of the University of North Carolina. Dr. Todd and her associates have been applying infrared tomographic techniques to environmental monitoring applications for over ten years now and are the ideal partners for this STTR development. The proposed system is an innovative and cost-effective means of profiling a chemical cloud in three dimensions.

Real Time Parallel Channel Spectrometer for 3D Cloud Profiling (Army 2007 STTR Phase 2)
Contract Number: W911SR-07-C-0089
9/4/2007 to 9/4/2008
Award Amount: $748,154
Julia Rentz Dupuis (PI), 978-887-6600, jrentz@optra.com
OPTRA Inc., Topsfield, MA / University of North Carolina, Chapel Hill

OPTRA proposes the development of an imaging open-path Fourier transform infrared (I-OP-FTIR) spectrometer for 3D cloud profiling. The system employs a single modulator and a novel optical configuration that projects an array of angularly dispersed IR beams, each of which exhibits comparable throughput to a single channel OP-FTIR, to an array of respective retroreflector arrays remotely located at the opposite side of the test grid. The return light from each retroreflector array is imaged onto respective detectors that record the spatially resolved interferograms, which subsequently are transformed and analyzed for molecular content via advanced multicomponent algorithms. The result is a capability to sensitively, quantitatively, and simultaneously measure the molecular absorbance and associated concentration-pathlength of an open release plume over an array of spatial regions. Use of two or more I-OP-FTIR sensors around the perimeter of the release allows for tomographic reconstruction of the concentration map of each molecular species contained in the plume. OPTRA has teamed with the University of North Carolina, Department of Public Health, who brings extensive experience in computed tomography for this type of measurement. Phase II activities include the building and testing of a prototype sensor and demonstration of the tomographic reconstruction capabilities on a simulant plume.

Remote Site Detection of Chemical Agents Using Functionalized Nanoparticles (Air Force 2007 SBIR Phase 1)
Contract Number: FA8650-08-M-5907
1/8/2008 to 1/8/2009
Award Amount: $99,998
Bryan Dickerson (PI), 540-769-8400, submissions301@lunainnovations.com
Luna Innovations, Inc., Roanoke, VA

Luna Innovations proposes to develop a of stand-off covert method of detecting chemical warfare agents and toxic industrial chemicals using functionalized nanocrystals. Alterations of the near infrared spectra from the distributed nanoparticles under laser illumination will be analyzed using a compact high-sensitivity spectrometer integrated with telescope collection optics. The chemistry of the functionalized nanoparticles will be tailored to identify a specific set of target chemicals according to their combination of functional groups. This system can be used from the air or from the ground to monitor local atmospheric or surface contamination.

Spectroscopic Imaging Technology for THz Biosensor Integrated with a Lab-on-Chip Platform (DoD CBD 2007 SBIR Phase 1)
Contract Number: W911NF-07-C-0055
5/22/2007 to 11/22/2007
Award Amount: $69,612
Tatyana Khromova (PI), 434-985-7459, tak@estart.com
VIBRATESS, Barboursville, VA

This Phase I SBIR project proposes a new imaging mechanism for sub-wavelength THz spectroscopy based on a very strong enhancement of electromagnetic field of the THz radiation at the edges of periodic semiconductor structure. Recent theoretical study showed THz radiation power enhancement ~1,100 with the half power width around the slot edges ~500 nm. Such strongly enhanced local electromagnetic fields can potentially be used for the development of novel biophotonic spectroscopic and imaging sensors (e.g., for water monitoring) with increased radiation coupling to biomaterial, leading to a substantial increase in detection sensitivity and spatial resolution and allowing THz spectroscopy and imaging at the micron/submicron scale. The major goal of the Phase I project will be to confirm experimentally the expected effect of increasing the electric field in nanosize regions and to demonstrate the feasibility of application of a proposed imaging mechanism integrated with a lab-on-a chip device for subwavelength THz spectroscopic microscope. The other goal of the proposed project is to improve controlled conditions for more uniform orientation of biological materials. The initial phase I SBIR project will include preliminary experimental investigations of fluidic-chip processing of biomaterials and/or bioagents. In the phase II SBIR project, the proposed imaging technology will be further optimized and will be integrated into a pre-existing or a newly developed fluidic platform to be used in THz spectroscopy and microscopy.

Ultrasonic Pollution Detector (Navy 2006 SBIR Phase 1)
Contract Number: N65538-07-M-0032
12/19/2006 to 6/29/2007
Award Amount: $69,986
Mark McKenna (PI), 757-224-0687, submissions@lunainnovations.com
Luna Innovations, Inc., Blacksburg, VA

Luna Innovations will develop a practical, compact, ultrasonic pollution detection instrument capable of detecting multiple pollutants and paths and of monitoring the levels of pollutants (e.g., copper, zinc) in storm water. Detecting the level of pollutants is an increasing problem as the EPA requires additional monitoring as part of the NPDES permitting process. The device will be based on surface acoustic waves probing affinity layers that can be fabricated for high sensitivity and selectivity to specific chemicals or pollutants. The basis of the device is the small change that occurs in sound velocity in a sensor as the pollutants bind to the polymer layer. This allows a rapid detection that can be sent back to a central monitoring facility. This technology is based on instruments used for the detection of biological and chemical hazards.

Use of Environmental Forensics for Trichloroethylene (TCE) Plume Delineation (Air Force 2006 SBIR Phase 1)
Contract Number: FA8103-06-C-0198
7/25/2006 to 4/25/2007
Award Amount: $97,069
Jason Shiflet (PI), 704-358-8240, jshiflet@zapeng.com
Zapata Engineering, Charlotte, NC

Under anaerobic conditions, TCE is sequentially reduced primarily through microbial reductive dechlorination, which involves the sequential reduction of TCE to DCE (primarily cis-1,2-dichloroethene, but trans-1,2-dichloroethene and 1,1-dichloroethene have also been observed), followed by conversion of DCE to vinyl chloride (VC), and finally VC to ethene. As chlorinated solvents biodegrade, the products of the degradation process may or may not be less harmful than the original contaminants. These toxic compounds can accumulate under certain conditions. Investigative experience, sound data collection, and a combination of traditional (physical, chemical, and biological) information along with isotope composition or contaminant fingerprinting are necessary for developing a thorough understanding of the nature and extent of TCE contamination in the subsurface.

Use of Environmental Forensics for Trichloroethylene (TCE) Plume Delineation (Air Force 2008 SBIR Phase 2)
Contract Number: FA8103-08-C-0005
10/3/2007 to 10/3/2009
Award Amount: $749,536
Jason Shiflet (PI), 704-358-8240, jshiflet@zapeng.com
Zapata, Inc., Charlotte, NC

Zapata Engineering will determine the sources and approximate percentage of contribution to the co-mingled TCE plume located at a government-designated site. This Phase II process specifically will allow the project team to refine and complete development of the

Comparative Isotope Fractionation Methodology (CIFM), a process by which stable isotopic signatures are combined with traditional hydrogeologic parameters and utilized within a three-dimensional fate-and-transport finite-element model to resolve and identify the source(s) of TCE. Initially, Zapata Engineering will offer the methodology as a service to be performed or supervised by Zapata Engineering personnel. This service dovetails nicely with the other current engineering and environmental services, thereby mitigating potential risks associated with bringing a new product to market.

Versatile Agent Detection/Decontamination System (Air Force 2006 SBIR Phase 1)
Contract Number: FA8651-06-M-0173
6/8/2006 to 3/8/2007
Award Amount: $99,990
Gregory Zeltser (PI), 310-320-3088, sutama@poc.com
Physical Optics Corporation, Torrance, CA

To address the U.S. Air Force need for a nano-enhanced technology to detect and neutralize chemical and biological agents remotely and autonomously, Physical Optics Corporation proposes to develop a new versatile agent detection/decontamination system (VAD/D). The VAD/D concept is based on the integration of dielectrophoretic aerosol particulate trapping, Raman spectrum reading, and photocatalytic deactivation of collected particles. The VAD/D will be a stand-alone instrument capable of continuous, fully autonomous monitoring and decontamination of multiple airborne biological and chemical threat agents. The system will be highly sensitive with >95% accuracy and a frequency of false alarms <5%, and will operate in real time, be power-efficient, and be deployable in high-threat environments. It will have information processing electronics and a communication capability easily accessible to operators. Phase I will demonstrate the feasibility of the VAD/D system by fabrication of a prototype and a demonstration of its capability to collect, identify, and destroy chem/bio agent simulants. Phase II will optimize the VAD/D design and performance parameters and develop a production-scalable process to implement the device. The device will be evaluated for its ease of production and long-term effectiveness.

Xenopus Melanophore-Based Toxicity Sensor for Water (Army 2007 STTR Phase 1)
Contract Number: W81XWH-07-C-0107
8/9/2007 to 2/8/2008
Award Amount: $99,999
Theresa Curtis (PI), 607-272-0002, tcurtis@agavebio.com
Agave Biosystems, Inc., Austin, TX / Northwestern Univ., Chicago, IL

Analysis of water supplies often requires complex instrumentation that is not practical for field use. An innovative alternative is the use of cell-based biosensors that can rapidly assess the general toxicity of the water sample and can be made field-portable. The use of living test organisms is a reliable way of measuring the biological impact or toxicity of unknown samples. Agave BioSystems has successfully demonstrated a broad-ranging water toxicity monitoring system using electrical impedance measurements across endothelial cell monolayers. While this system has proven sensitive to many chemicals of interest, the Army desires to extend detection capability to a broader class of toxicants, including neurotoxins. Therefore, in collaboration with

Dr. Vladimir Gelfand of Northwestern University and in consultation with Dr. Ethan Lerner of Harvard University, Agave BioSystems proposes to demonstrate that Xenopus melanophores can be used as a powerful field toxicity detection system for a wide variety of waterborne toxicants, including neurotoxins.

U.S. Environmental Protection Agency

Development of an Improved Detector for Use with a Gas Chromatograph to Measure NO2 and PAN in the Atmosphere (EPA 2008 SBIR Phase 1)
EPA Contract Number: EPD08034
March 1, 2008 to August 31, 2008
Project Amount: $66,885
Dennis R. Fitz, 951-676-0324
Fitz Aerometric Technologies, Temecula, CA

The objective of this proposed research is to develop a luminal-based chemiluminescent gas chromatographic detector that is a sealed system. The amount of luminal in a liter of reagent is enough for tens of thousands of parts per million (ppm)-hours of detection in a gas chromatograph. The primary problem is maintaining a consistent wetted surface for contact with the effluent of the chromatographic column. In the past, this was done by continuously pumping fresh luminal reagent to the top of the wick and allowing the excess reagent to flow out by gravity with the effluent carrier gas. An alternative method is proposed to maintain a wetted surface and eliminate the liquid pump.

Identifying and Monitoring Environmental Toxicity Using Ceriodaphnia Microarrays (EPA 2008 SBIR Phase 1)
EPA Contract Number: EPD08032
March 1, 2008 to August 31, 2008
Project Amount: $70,000
Owen Hughes, 530-758-5804
Eon Research Corporation, Davis, CA

The aim of this work is to show that Ceriodaphnia dubia microarrays can be a practical technology for identifying, characterizing, and monitoring environmental impact. Specifically, Eon Research hopes to show that microarrays can provide information on the degree of environmental impact and the identity and effects of multiple contaminants in complex mixtures. In Phase I, three reference chemicals (diazinon, chlorphyifos, and copper), whose toxic effects on C. dubia have been well-defined by conventional testing, will be used to generate expression signatures using a 10,000-element spotted cDNA array developed in previous work. Each of these chemicals will be tested individually over a range of concentrations. Eon Research hopes to identify different expression signatures at different levels of toxins corresponding to specific toxicity responses at low dose, and more general stress and cell death responses at higher doses where acute lethality becomes apparent. Additionally, the expression signatures of the binary mixtures of the three chemicals will be examined and compared to the signatures of the individual components. These experiments will help us gauge the difficulty of determining what chemicals are in a mixture based on the mixture’s expression signatures. In Phase II, Eon

Research will identify expression signatures for a wide range of important environmental contaminants using sequence-defined oligo microarrays. By the end of Phase II, Eon Research will have commercially available environmental contaminants in applications ranging from assessment characterization to monitoring of environmental contaminants and in applications ranging from Toxicity Identification Evaluation (TIE) studies to new chemical registration to Whole Effluent Toxicity (WET) testing.

Low Cost Imager for Pollutant Gas Leak Detection (EPA 2008 SBIR Phase 1)
EPA Contract Number: EPD08017
March 1, 2008 to August 31, 2008
Project Amount: $69,952
Lawrence H. Domash, 978-694-1006
Agiltron Inc., Woburn, MA

Infrared (IR) imaging is the best method for detecting leaks of pollutant gases, but current technology based on cooled IR imagers is far too expensive ($75,000 to $150,000) for everyday field use by those who need it to meet regulatory limits, such as electric and petrochemical utilities, manufacturing plants, and businesses like supermarkets. Agiltron will demonstrate a new class of IR imager instrument for the detection of leaks of pollutant gases. Variants of the camera will be demonstrated for the long-wave (8 to 12 um) and mid-wave (3 to 5 um) IR, which between them will be able to locate leaks for dozens of pollutant gases. The proposed technology combines Agiltron's LightLever(tm) photomechanical thermal imager technology with a tunable IR filter developed originally for the telecommunications industry. In Phase I, Agiltron will show the feasibility of the long-wave version using sulfur hexafluoride as a target gas. The mid-wave version will be able to visualize leaks for methane, benzene, and VOCs. The new technology will lead to a hand-held gas-leak viewer that can be sold to end users for less than $5,000.

LSPR Nano-Immunosensor for Simple and Sensitive Water Monitoring (EPA 2008 SBIR Phase 1)
EPA Contract Number: EPD08036
March 1, 2008 to August 31, 2008
Project Amount: $69,998
Glenn J. Bastiaans, 310-530-7130, gbastiaans@intopsys.com
Intelligent Optical Systems Inc., Torrance, CA

Intelligent Optical Systems intends to address the current limitations of available water monitoring technologies by applying emerging optical detection and nanotechnologies to develop on-line water monitoring instrumentation that will be capable of detecting a wide range of organic pollutants, toxins, and microorganisms in a multiplexed fashion. One innovative aspect of the proposed detection method is that immunoassays can be performed in a simplified manner where no additional reagents or labeled molecules are required. The assays can be performed using inexpensive, disposable flow cell cartridges that can be chosen for the assays of interest. Thus, it will be possible to obtain near real-time results in a portable field-use format. The objectives of the proposed study are to demonstrate the use of this innovative optical assay for both a toxin and a microorganism present in a flowing stream of water. As part of the proposed studies, a disposable flow cell will be designed and fabricated to implement the innovative optical immunoassays. These cells will be used to demonstrate the assay of a toxin, microcystin, and E. coli bacterial cells. The success of the proposed work will result in the capability to conduct water monitoring for organic chemicals, toxins, and microorganisms in near real time using economical instrumentation that can be operated in an unattended fashion. The anticipated commercial applications for this water monitoring system include monitoring surface water, monitoring source water at drinking water processing facilities, monitoring water in air conditioning systems, and monitoring drinking water in distribution systems.

A Sensitive and Affordable Compact Ammonia Monitor (EPA 2008 SBIR Phase 1)
EPA Contract Number: EPD08015
March 1, 2008 to August 31, 2008
Project Amount: $70,000
Joanne H. Shorter (PI), 978-663-9500x208, shorter@aerodyne.com
Aerodyne Research Inc., Billerica, MA

The goal of the proposed Phase I project is to develop an affordable, highly sensitive, rapid response, robust, and portable instrument for autonomous real-time monitoring of ammonia. The instrument will use mid-infrared quantum cascade laser (QCL) absorption to accurately quantify ammonia with a precision of 0.3 parts per billion by volume (ppbv) in a 1-second measurement without cryogens or calibration gases. The proposed compact ammonia monitor will be possible with the development of a novel astigmatic multipass absorption cell based on an in-line construction. The novel cell will allow the design of an instrument that is reduced to its optical essentials--little more than a laser, an absorption volume, and a detector. The objective of the Phase I research and development effort is to determine the feasibility of an extremely compact, low-cost noncryogenic QCL spectrometer to measure ammonia. Aerodyne Research will investigate the design of a novel in-line multipass absorption cell and explore approaches to simplify the cooling and temperature control of the QCL and infrared detector. These approaches will be studied to determine how they reduce the instrument complexity and, thus, the component and overall cost of a high sensitivity ammonia monitor. The anticipated result of our approach is a robust, portable, sensitive real-time monitor that will be characterized as user friendly and affordable. This instrument will meet the needs and demands of the environmental and atmospheric science communities. The development of a sensitive, affordable instrument for ammonia detection has wide benefits for atmospheric and environmental research. This novel compact QCL instrument will have extensive commercial applications in areas such as air pollution and air toxics monitoring, breath analysis for medical diagnostics, combustion exhaust research, and plasma diagnostics for semiconductor fabrication.

Sensitive, Quantitative, and Portable Anatoxin Assay Using Apatamers and Quantum Dot Nanoshell Reporting (EPA 2008 SBIR Phase 1)
EPA Contract Number: EPD08024
March 1, 2008 to August 31, 2008
Project Amount: $69,961
George W. Jackson
BioTex Inc., Houston, TX

The focus of this research project is to develop a rapid assay kit for cyanobacterial anatoxins using aptamers as the primary molecular recognition element. The developed sensor chemistries will result in a detectable signal in 20 minutes or less and will require a very inexpensive, portable solid state detector system for quantitative test interpretation (readout).

BioTex will first develop aptamers for highly sensitive and specific binding to anatoxins and then optimize the composition of a fluorescence resonance energy transfer (FRET)-based sensor employing quantum dot (QD) fluorescence reporters and aptamers labeled with quenching chromophores. Finally, BioTex will demonstrate the sensitivity and specificity of the novel sensing chemistry for field and laboratory use.

Using Flathead Minnow Microarrays to Test Toxicity of Nanoparticles (EPA 2008 SBIR Phase 1)
EPA Contract Number: EPD08026
March 1, 2008 to August 31, 2008
Project Amount: $69,500
Barbara J. Carter, 386-418-1400, bcarter@ecoarray.com
EcoArray Inc., Alachua, FL

Assessing the potential effects of nanoparticles on human health is not an easy task, as the properties of nanoparticles depend not only on the size of the particle, but also on the structure, microstructure, and surface properties (coating). The uptake of nanoparticles by aquatic biota is a major concern. Concerns about environmental contaminants that adversely affect health, development, and reproduction of exposed wildlife have lead to the development of specific in vitro and in vivo assays to test for these effects. Gene microarrays integrate in vivo exposures with mechanistic outcomes. Using this technology, thousands of genes can be tested at one time with mRNAs isolated from tissues of exposed animals. These tools show potential for providing more precise, quantifiable data than existing assays, and are now affordable. The overall goals of this Phase I grant are to employ microarrays to identify genes that fluctuate in fathead minnows after acute exposure to nanotubes. The data will be analyzed to determine what, if any, pathways are affected in the fathead minnow. This information should enable EcoArray to identify "genetic fingerprints" and to use the database as a tool for identifying contaminants in unknown situations (class prediction), which may lead to an interpretation of human health issues. The research undertaken in the Phase I study of nanotubes should help validate the expediency and affordability of the high density fathead minnow microarrays for compound screening and use in environmental toxicology.

Water Security Monitoring Using Surface-Enhanced Raman Spectroscopy (EPA 2008 SBIR Phase 1)
EPA Contract Number: EPD08028
March 1, 2008 through August 31, 2008
Project Amount: $70,000
Kevin M. Spencer, 781-769-9450, spencer@eiclabs.com
EIC Laboratories Inc., Norwood, MA

It is virtually impossible to protect every river, stream, or lake that contributes to the nation's drinking water supply; therefore, rapid detection of a chemical/biological attack followed by rapid remediation is paramount. Many toxins are deadly at very low dosages (low parts per billion [ppb] or less for chemical, 1 to 100 cts/mL for biologic), requiring sensitive and precise measurements. Immediate on-site identification and action precludes the transport of samples to a laboratory setting. This program will demonstrate the capabilities of a hand-held sensor that potentially could be used in-line. This sensor is based on the technique of surface-enhanced Raman spectroscopy (SERS); the ability of SERS to detect chemical warfare agents was demonstrated at EIC Laboratories during the Joint Services Agent Water Monitor program. In addition, bacteria, toxins, pesticides, cyanotoxins, and explosives have been effectively detected in water. The ability to mass produce reproducible sensors has recently enabled increased precision and sensitivity. In the Phase I program, the ability to precisely detect an agent degradation product, seven pesticides, and a toxin will be tested in water samples in the presence of various natural interferents. During the Phase II program, the SERS database will be extended to include additional pesticides, toxic industrial chemicals, toxins and bacteria, and a field portable unit, incorporating the SERS library, will be produced and tested at an EPA-defined site.

Wireless Electrochemical ClO2 Monitor for Decontamination Operations (EPA 2008 SBIR Phase 2)
EPA Contract Number: EPD08060
May 1, 2008 to April 30, 2010
Project Amount: $224,997
Mourad Manoukian, 781-529-0500
Giner Inc., Newton, MA

To address the EPA's concern and need for portable, accurate, and field-rugged chlorine dioxide (ClO2) monitors for use in monitoring building decontamination operations, this Phase II project will continue the developmental work started in Phase I to design, develop, and demonstrate a simple-to-operate electrochemical ClO2 microsensor (sensor cell with integrated potentiostatic control and signal-processing circuit) and demonstrate its successful operation with wireless data transmission. The proposed microsensor will be rapid (<30 seconds for 90% of full response, T90), accurate, selective, and capable of measuring 0 to 3,000 ppm ClO2 in real time with a detection limit of 2 ppb. The unique and advanced sensing technology is based on integrated solid polymer proton-conducting electrolytes and thick-film electrode (sputtered or screen printed on alumina substrates) technology. The proposed microsensor will be configured for continuous unattended or handheld operation and be fully integrated with wireless data transmission and configured into a compact and lightweight monitor.