Current and Future Directions of the Environmental Technologies R&D Program at SSC-SD

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SPAWAR Systems Center San Diego

Federal Remediation Technologies Roundtable meeting - May 17, 2006

Current Efforts

- Fleet Environmental Support
- Shoreside Environmental Program (Y0817) DemVal
- Regional Direct Environmental Support
- Environmental Security Compliance Conservation & Cleanup RDTE
- Sensor Development

Fleet Environmental Support (FES)

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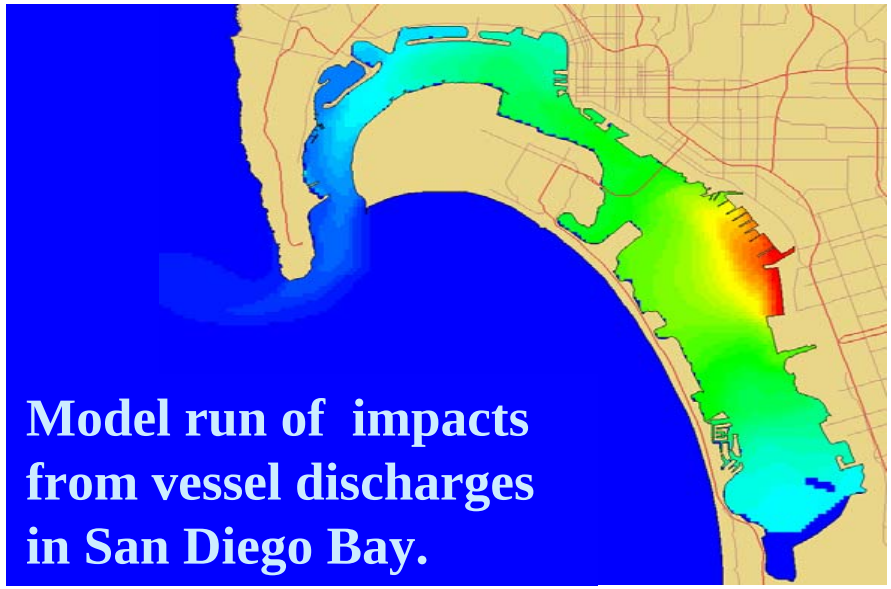
- OBJECTIVES:
  - **Improve fleet environmental quality profile without sacrifice to military capability**
  - **Support technical development of discharge standards for ships**
  - **Support risk assessment of fleet operations, coatings, materials, and pollution control devices**
- PROJECTS:
  - **UNDS: Uniform National Discharge Standards for Ships**
  - **REEFEX: Risk Assessment for using Navy vessels for shallow-water artificial reefs**
  - **SINKEX: Risk Assessment of the release of contaminants in the deep ocean from solid materials on sunken Navy ships**
  - **COATINGS/MATERIALS: Antifouling Coating & Shipboard Material Leach Rate and Environmental Fate Modeling**

Uniform National Discharge Standards Program (UNDS)

OBJECTIVE:

Provide modeling and technical analysis of Armed Forces ship discharges in the marine environment. Support NAVSEA in the development and promulgation of UNDS regulations

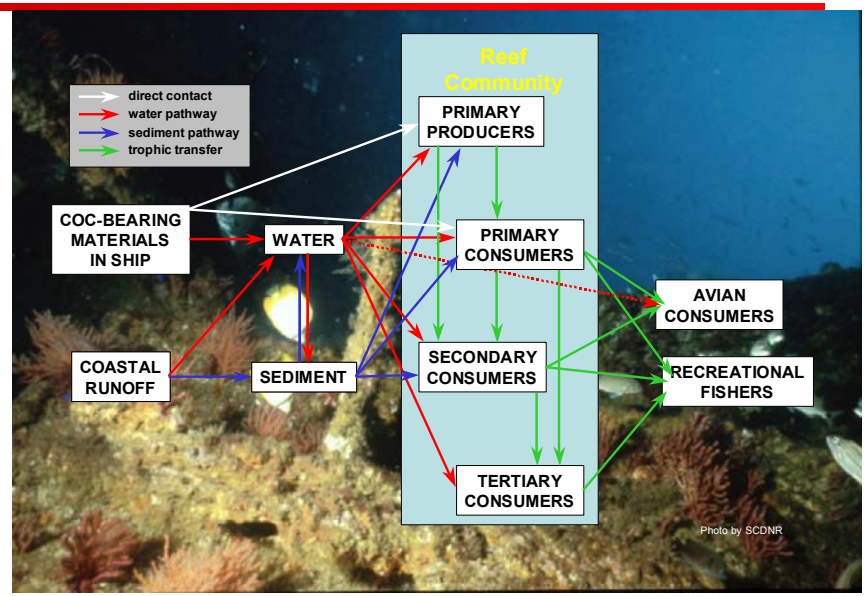


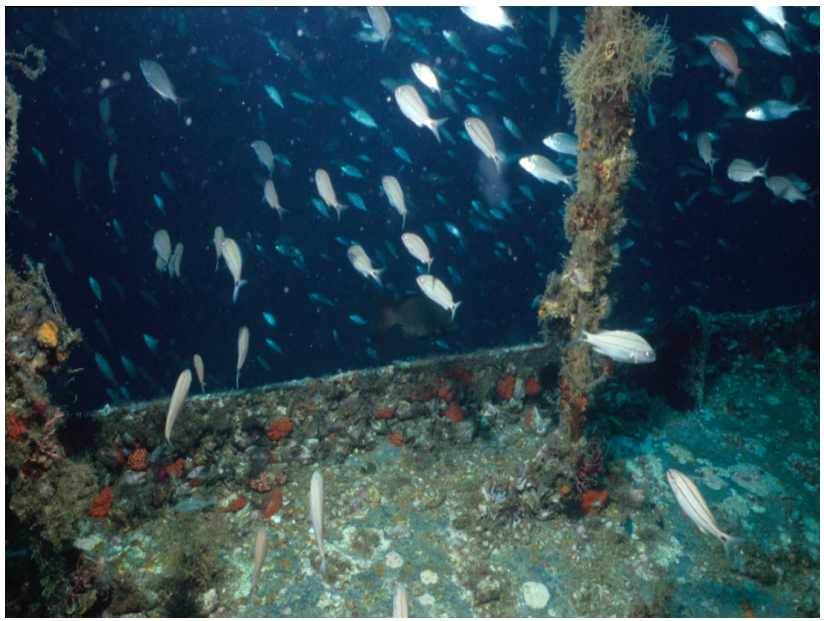
- **Support future discharge analysis for the next phases of the UNDS Program.**
- **Refine existing harbor models for better environmental impact analysis.**
- **Provide online access to modeling results and real-time discharge simulations.**
- **Continue to leverage modeling and research capabilities into other SPAWAR and NAVSEA programs**

REEFEX EcoRisk Assessment

Inactive Navy vessels would make excellent artificial reefs if preliminary data suggesting they pose no threat to human health or the environment can be verified.

Conduct ecological risk assessments to support PEO Ships' (PMS333) application for a risk-based disposal permit to create artificial reefs with decommissioned vessels





SINKEX: Risk Assessment of the Potential Release of PCBs from Solid Materials on Sunken Navy Ships in the Deep Ocean

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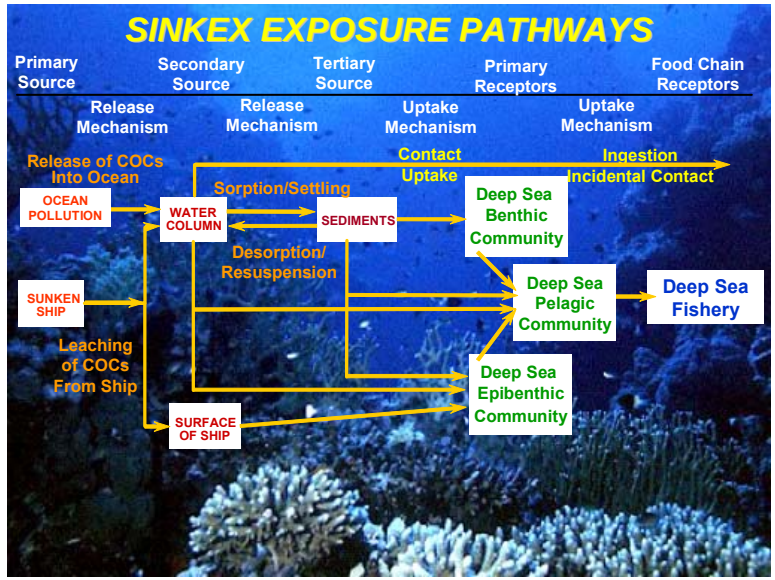
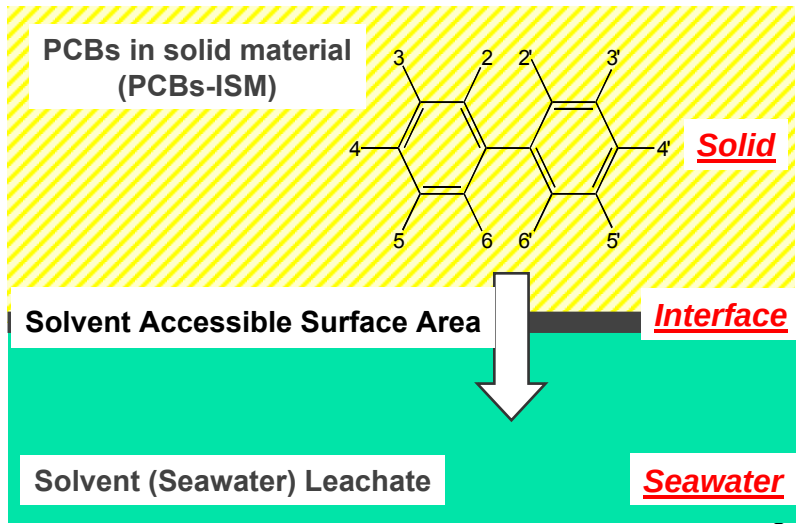
- **Determine if PCBs, metals, or PAHs (potential contaminants of concern) have been released from a representative sunken naval vessel**
  - **Release behaviors of polychlorinated biphenyls in solid materials (PCBs-ISM) have been investigated under laboratory-simulated shallow and deep ocean leaching conditions.**
- **If so, determine whether they have adversely impacted the adjacent marine environment.**
- **Data from this effort was used to support risk assessments for the sinking of ex-ORISKANY off the coast of Florida early in May 2006, an aircraft carrier and first vessel in the Navy's artificial reef inventory.**





Shoreside Environmental Program (Y0817) DemVal

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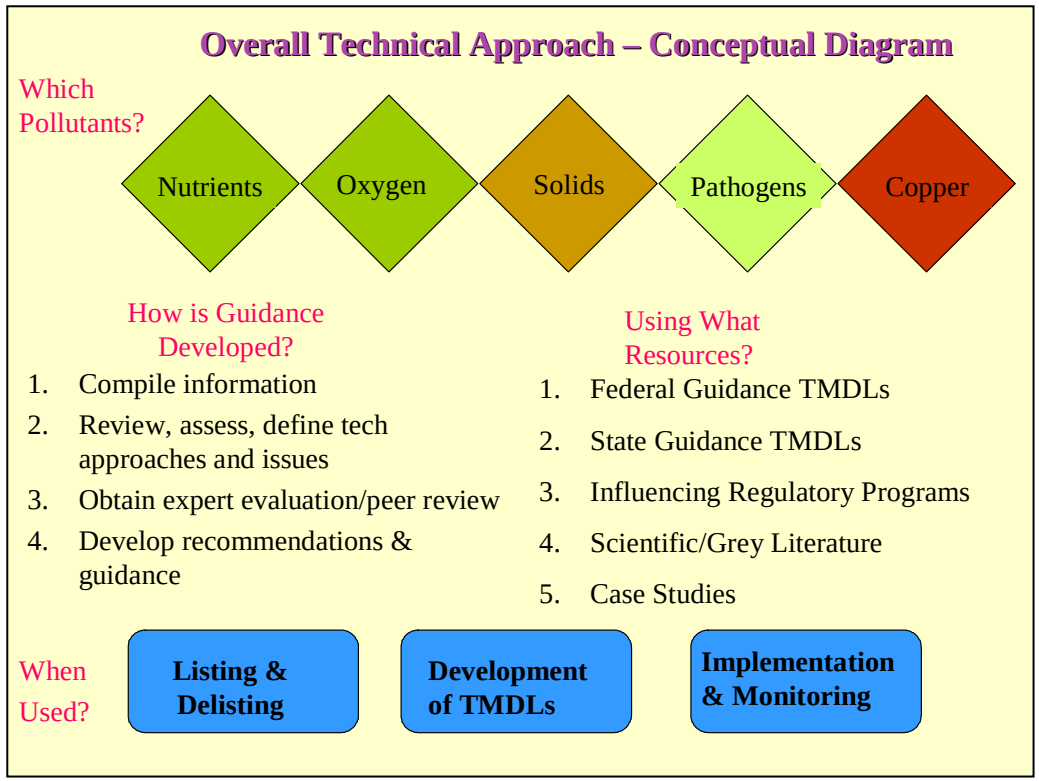
OBJECTIVES:

- **Support Fleet Readiness by minimizing operational risk, constraints, and costs while ensuring shore-based environmental stewardship and regulatory compliance**
- **Execute RDT&E for innovative and cost-effective technologies, processes, materials, and knowledge that enhance environmental readiness of Naval shore activities and weapons system acquisition programs**
- **Integrate solutions and products successfully into the Fleet and future weapons system acquisitions and verify anticipated benefits**

PROJECTS

- **Navy-wide TMDL Technical Guidance**
- **Sediment Transport Tools to Evaluate Physical Stability and Natural Recovery**
- **Containment and Monitoring Strategies for Contaminated Sediment Management**
- **Web-enable BirdRad Imaging**

NAVY TECHNICAL GUIDANCE FOR TOTAL MAXIMUM DAILY LOADS (TMDLS)

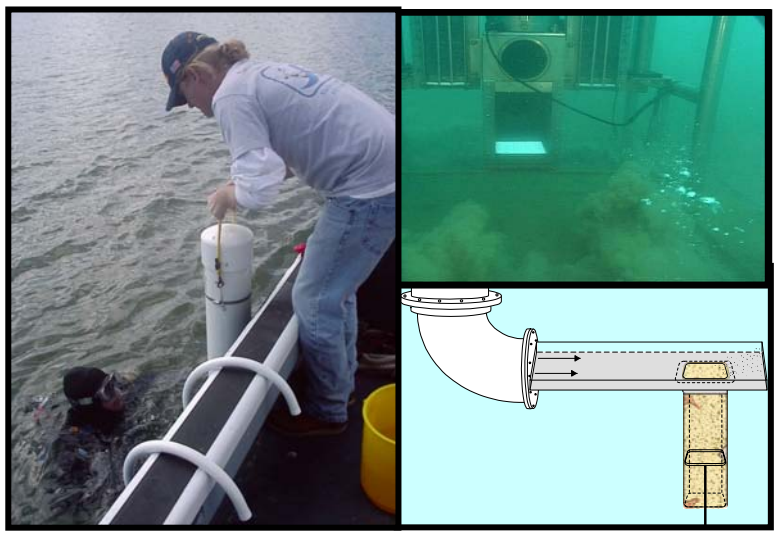


To provide credible, science-based guidance for the assessment of the most common TMDL constituents so that Navy environmental staffs can effectively collaborate with regulators and other stakeholders in the cost-effective development of appropriate TMDLs, which impact Navy operations.

Contaminated Sediment Management

Sediment Transport Tools

- To characterize the fate and transport of contaminated sediments using a reliable set of measurement technologies and analysis techniques
- To evaluate physical stability and natural recovery potential



Containment and Long-Term Monitoring Strategies

Hypothetical Integrated Remedy Assessment Package (IRAP)

- Remedy: Sand Cap
- Validation
  - Physical placement
- Monitoring
  - Physical stability
  - Chemical containment
  - Isolation of exposure pathway

Sand Cap IRAP

Precision Bathymetry
Side-scan Sonar
Sub-bottom Profiler
Sediment Profile Imaging

Fine-scale coring
Porewater profiling
Sediment chemistry
Flux assessment

Develop a suite of integrated remedy, validation and monitoring packages key for contaminated sediment management strategies.

BirdRad Data Systems (BRDS): a portable radar system developed at Clemson University

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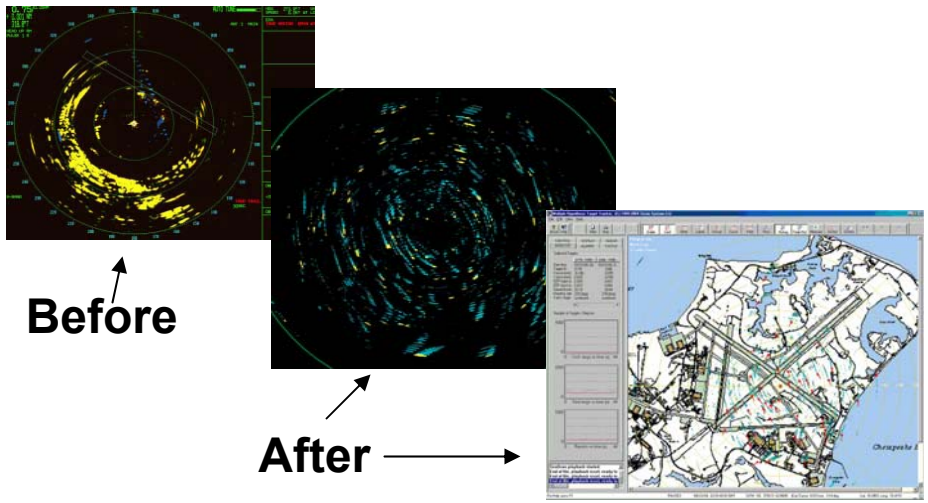
Furuno 2155BB Radar and Parabolic Antenna



BirdRad Was Designed:

- To Measure Diurnal & Seasonal Activity Of Birds In A 0-6 NM Radius Around Military Facilities
- For Natural Resource Managers and BASH Coordinators

Objectives:

- Remove Ground Clutter From Radar Images
- Automate Bird Tracks
- Display Bird Data In A GIS
- Develop A Software Program To Control The Collection Of Data

Regional Direct Environmental Support

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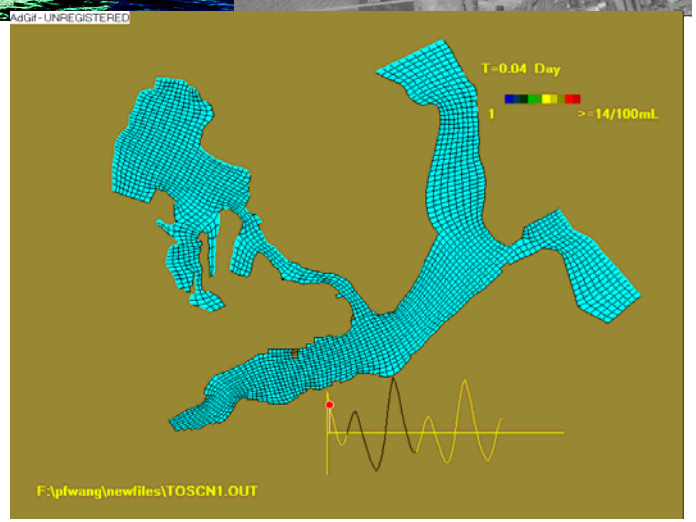
OBJECTIVES:

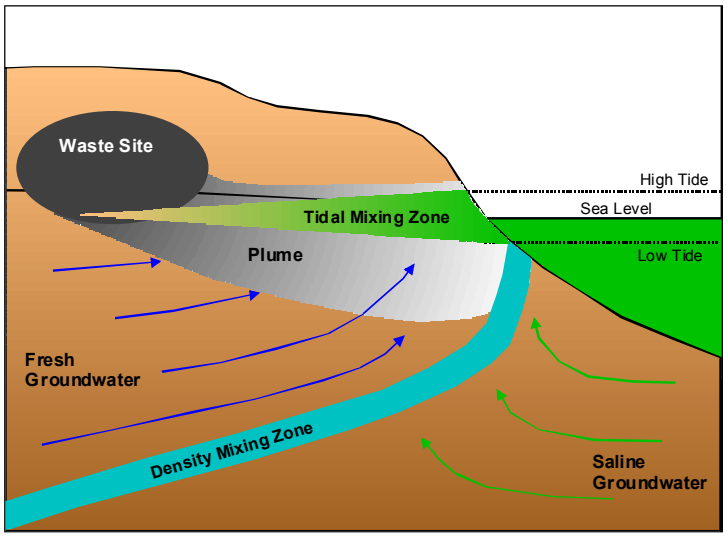
- Provide direct technical environmental support to Navy regions and facilities
- Evaluate environmental impacts to soils, waters, and sediments
- Provide technical guidance to meet compliance and clean up requirements

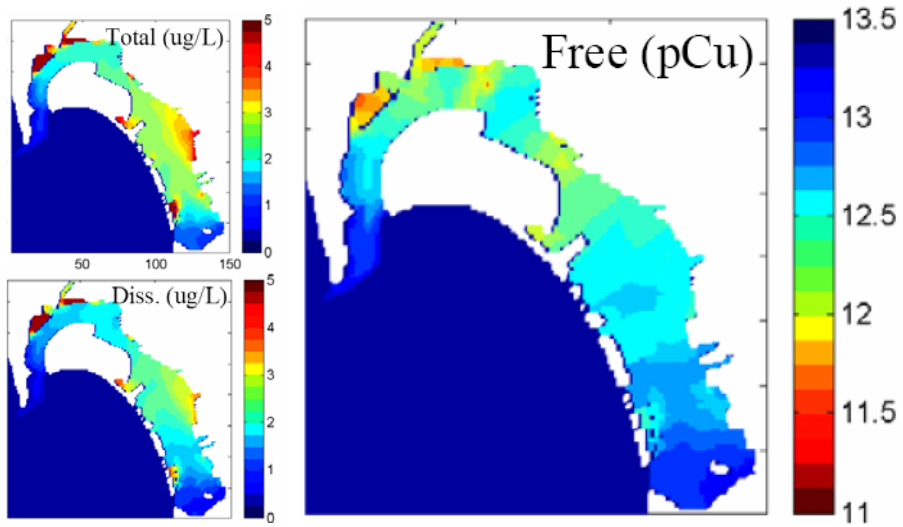
PROJECTS:

- TMDL: Total Maximum Daily Load
- ENVVEST: Environmental Investment
- ECORISK: Ecological Risk Assessment
- STORM: Storm Water Compliance
- IR: Installation Restoration



Environmental Security RDT&E





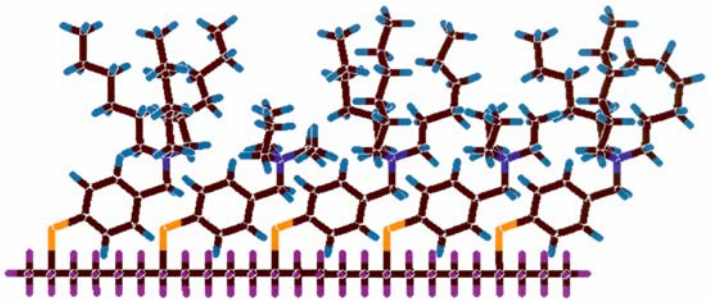
Demonstrate new technologies (trident probe and ultraseep system) for the assessment of coastal landfills and hazardous waste sites with groundwater discharge to surface

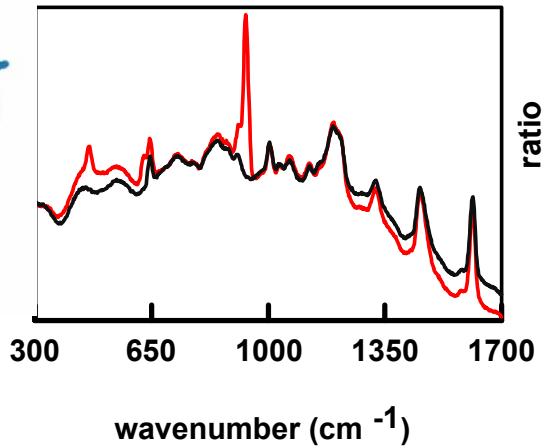
Demonstrate and validate an integrated, harbor-scale, fate and effects model for copper in DoD harbors to achieve more scientifically-based, cost-effective compliance and account for transport, flushing, sediment exchange, complexation & bioavailability

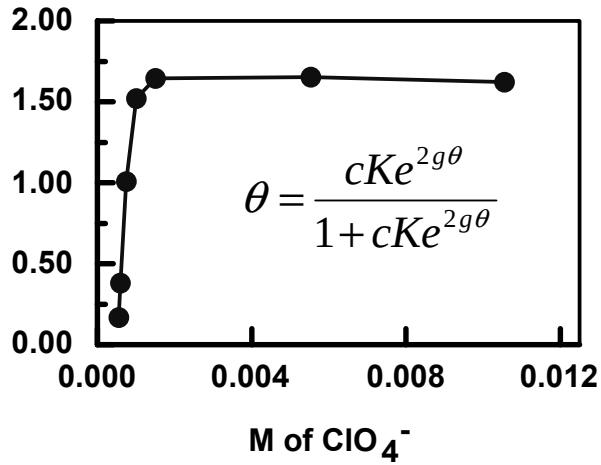
Sensor Development

- Perchlorate Sensor
- MEMS-Based Optical Sensor
- The Electronic ‘Tongue’
- Dual Camera GeoVis
- Commercialization of QwikLite

Perchlorate Sensor Based Upon Raman (SERS) and BiQuat

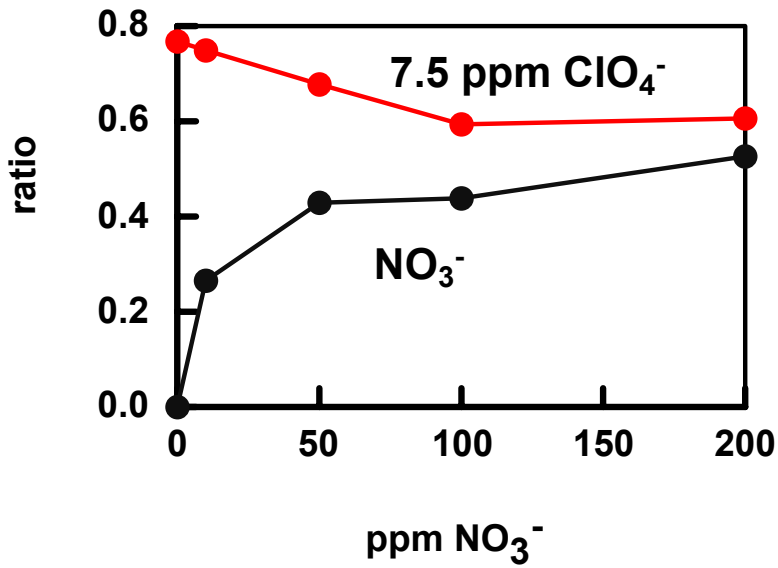




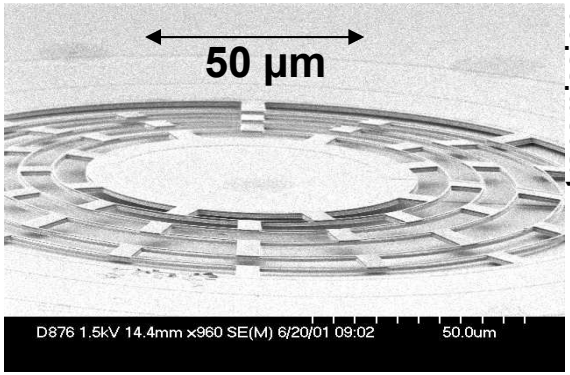


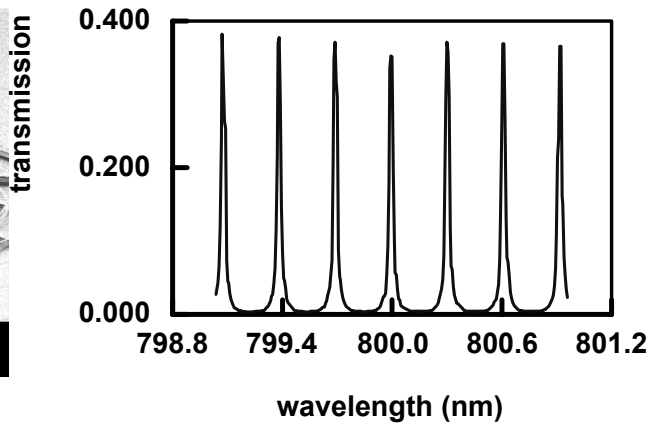
ANION	K	g
ClO_4^-	1960 ± 410	1.69 ± 0.16
NO_3^-	3360 ± 320	0.918 ± 0.090
$CrO_4^=$	2180 ± 270	1.48 ± 0.19
$SO_4^=$	53800 ± 5300	-0.440 ± 0.089
Cl^-	35 ± 10	0.918 ± 0.090

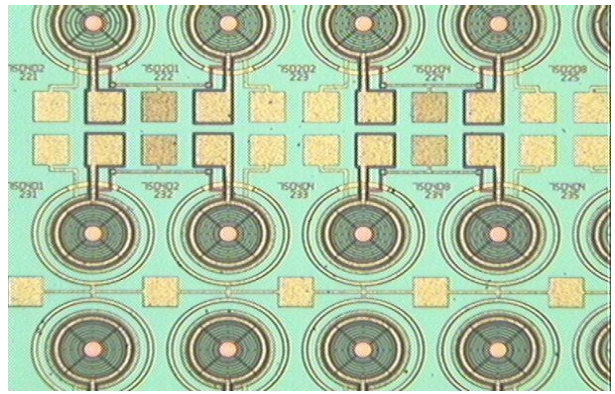
No interaction with $HPO_4^=$ or H_2PO4^-

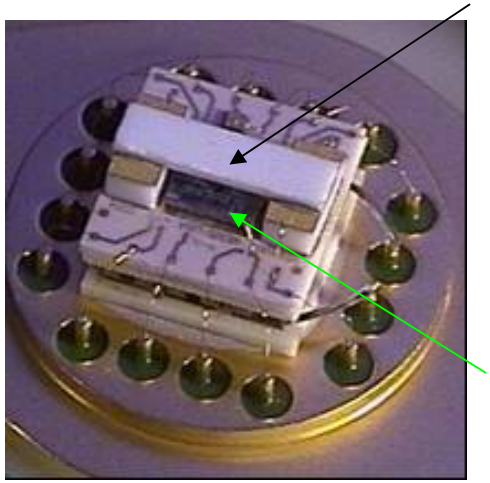


MEMS-Based Optical Sensor





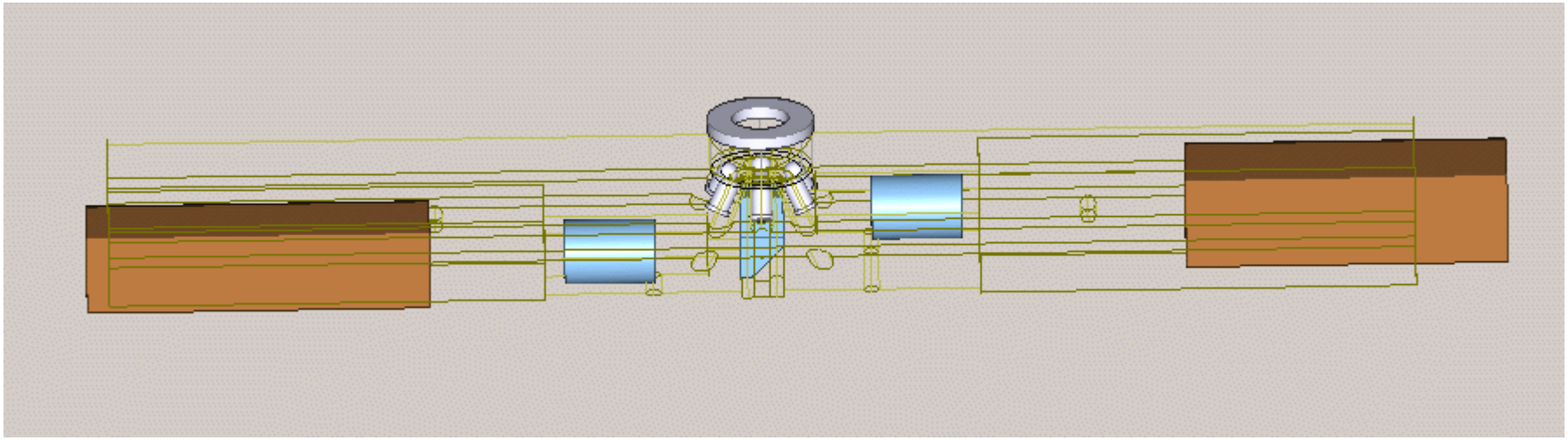




The Electronic Tongue

- **Uses Non-Specific Calcogenide Glass Sensors**
  - Respond to several chemical constituents
  - Easy to make
- **Sensor Array Pattern Recognition Systems (SAPRs)**
  - Multi-sensor system
    - ►Multiple and different selectivity, cross sensitivity between sensors
    - ►Stability and reproducibility paramount
    - ►Requires some data processing
  - Uses decision algorithms to examine fluctuation chemical patterns in complex chemical systems
  - Sensor are not required to directly respond to the analytes of interest
    - ►Analyzing chemical fluctuation patterns
    - ►Identifying patterns that are associated with the presence of the analyte of interest

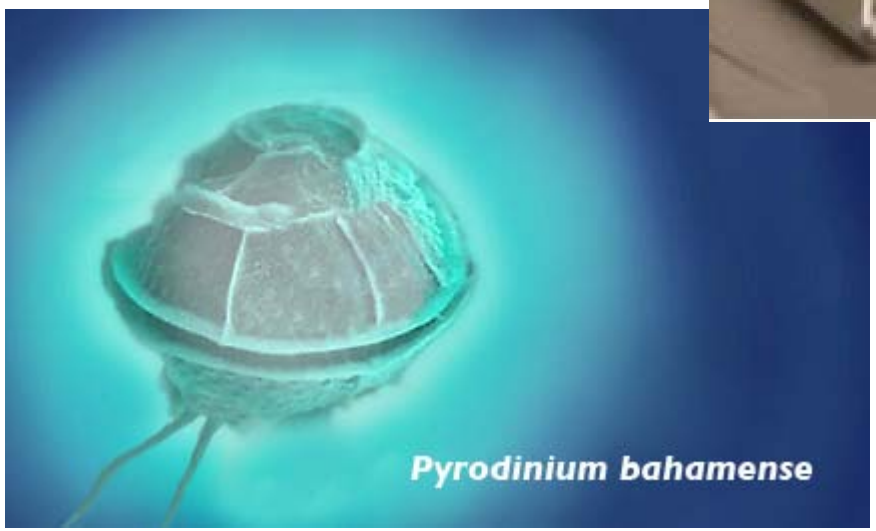
Dual Camera GeoVis (Being Developed for Pacific Northwest NL)

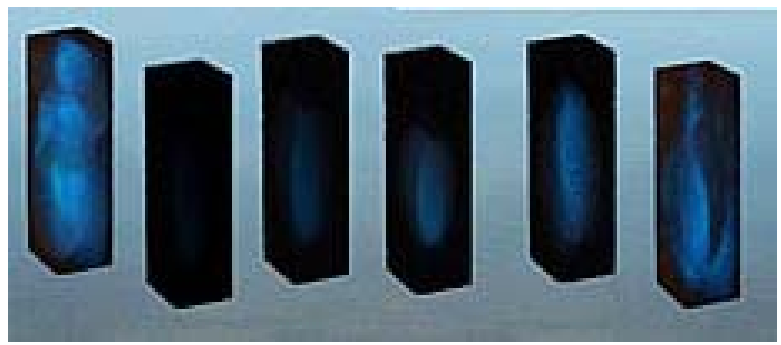


- **Both cameras look out the same window**
- **In the current configuration, the cameras will have different magnifications to cover the range of soil types (greater magnification is better to view finer soils, less magnification needed for sandy soils)**
- **Dual camera GeoVis is going to be used to characterize soil porosity**

Assure Bioassay Controls: QwikLite 200

Rapid, inexpensive bioluminescent field screening tool to detect the presence of toxic metals and organics in sediments and pore water samples

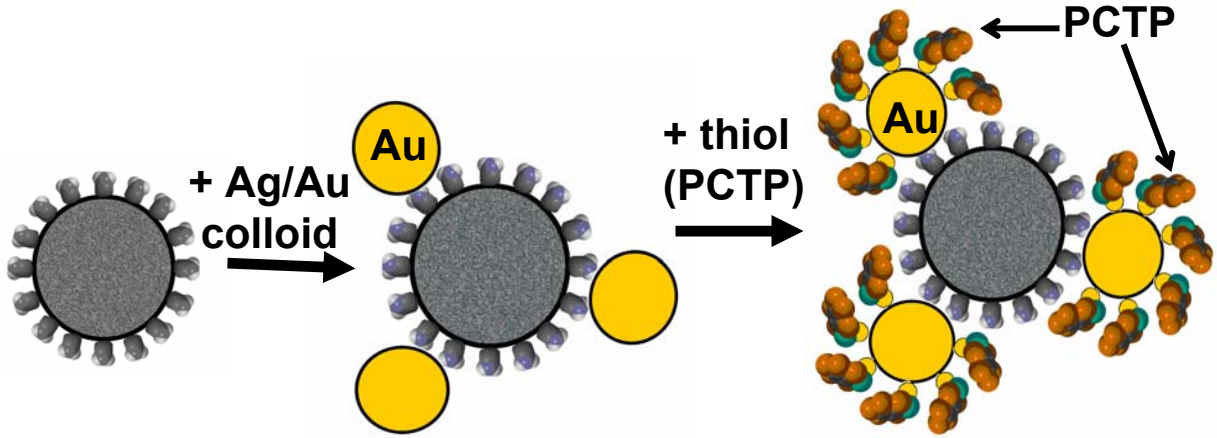


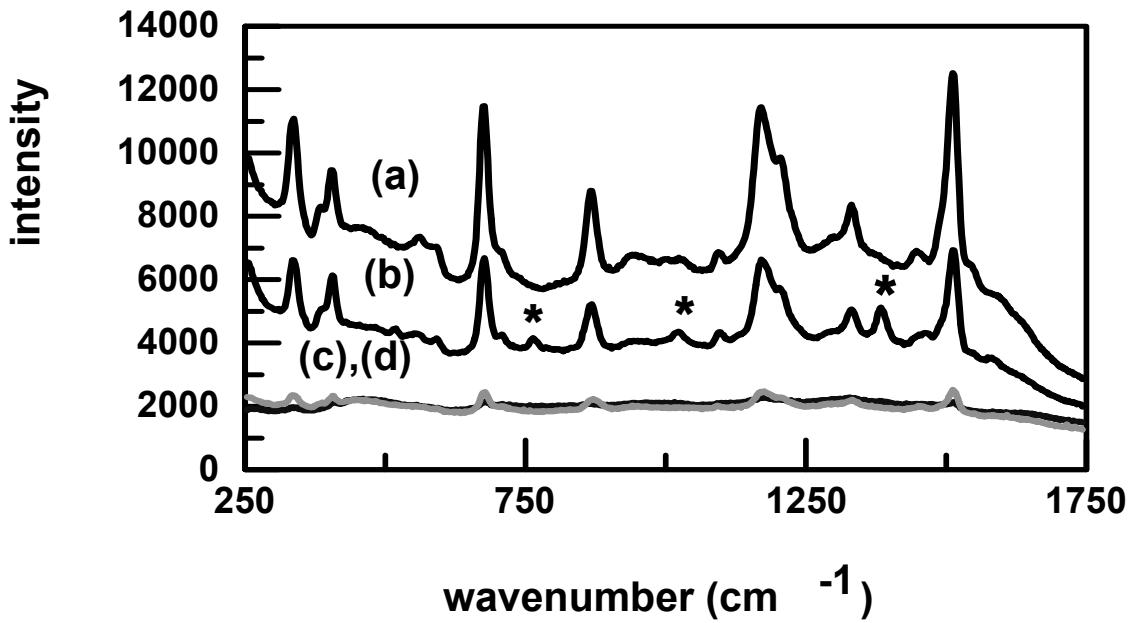


Future Directions

- **Fleet and Regional Environmental Support will be on-going**
- **Sensors**
  - **Capture Matrices**
  - **MEMS-based Sensors**
  - **Putting sensors on robots, underwater vehicles, and buoys**

Capture Matrices

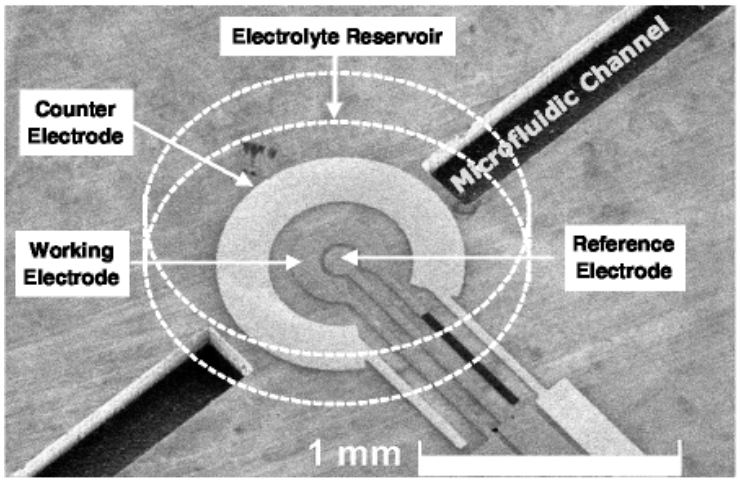




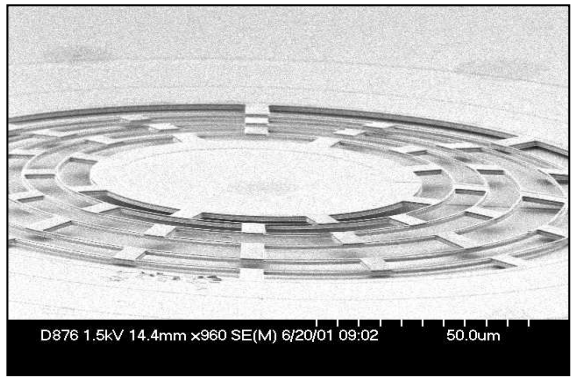
Advantages:

- Extraction/concentration of the target analyte from a complex sample matrix
- Ease of separation
- Suitability for automation

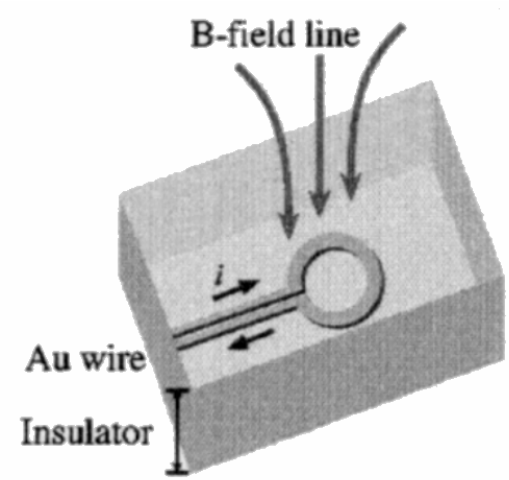
MEMS-Based Sensors

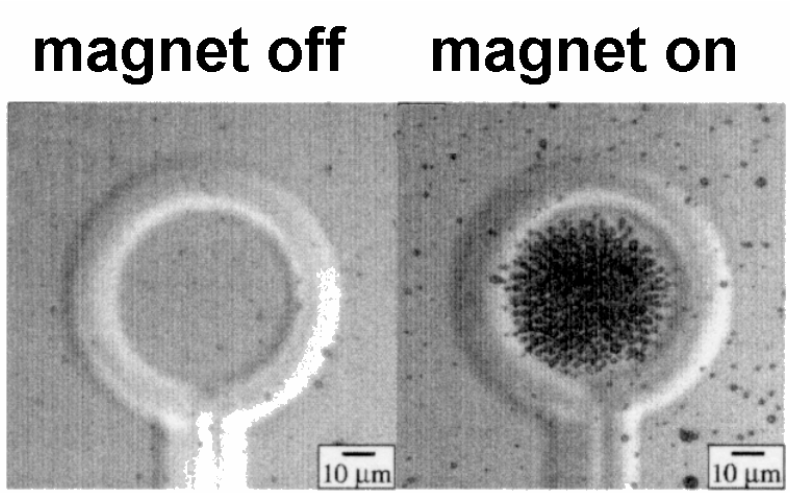


Potentiostat for voltammetry



FPI: Absorbance (VIS & IR), Fluorescence, Raman (normal & SERS)





Use capture matrices to manipulate transport of the analyte in the sensor

Putting Sensors on Buoys and Non-autonomous Vehicles