


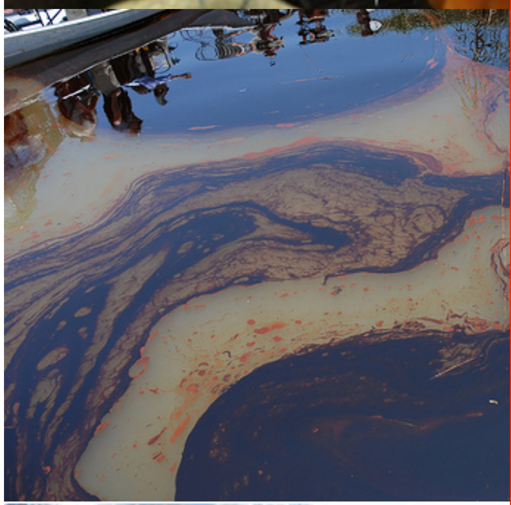

R&D ISSUES FOR MANAGEMENT OF OIL SPILLS AND IMPLICATIONS TO COASTAL ECOSYSTEMS

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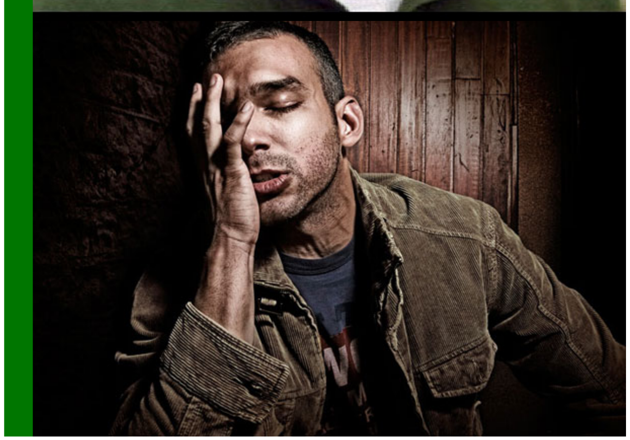
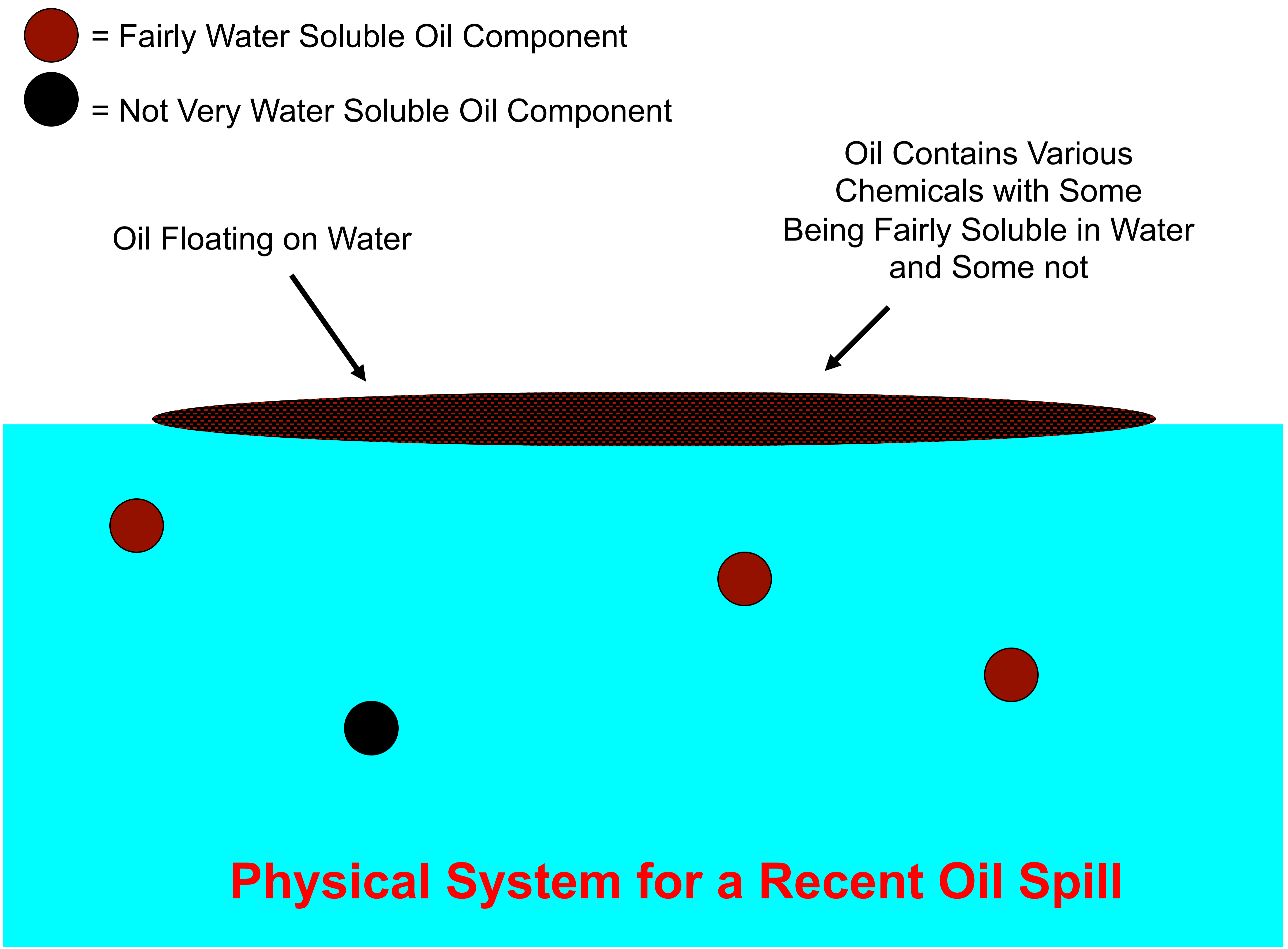
PRESENTATION OBJECTIVE

To Prime the Scientific Discussion Pump with Hopes of Initiating Scientific Dialog Leading to Much-Needed Scientific and Engineering R&D Efforts Among this Group

Science Disappointments

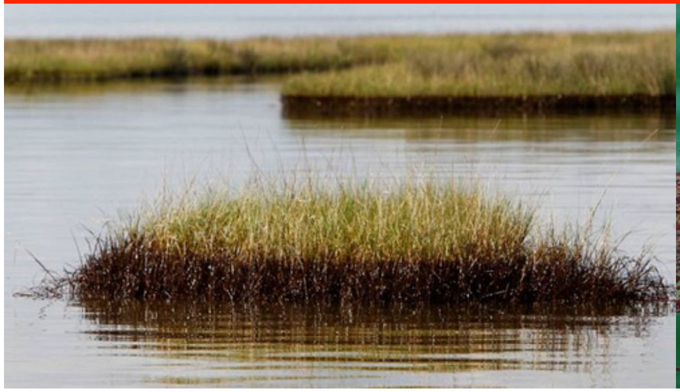
- Little advancement in oil cleanup technology over the past 20 years
- Lack of methods to rapidly assess remediation options and potential ecological impacts
- Lack of understanding of fundamental controlling factors related to an optimized bioremediation implementation scheme (micro-scale)
- Lack of a solid assessment of the various GOM Coastal Ecosystems ability to handle proposed Remediation & Abatement Strategies PRIOR to a Spill
- EPA's allowed use of products based on the commercial formulations listed on the NCP Product Schedule and not based on composition components (increases snake oil salesmen potential)
- Lack of a widely accepted analytical method for tracking oil fate
- Minimal reliance on Coastal States Scientific Community during and potentially after the spill
- Limited technical assistance & transfer to impacted parishes (counties)

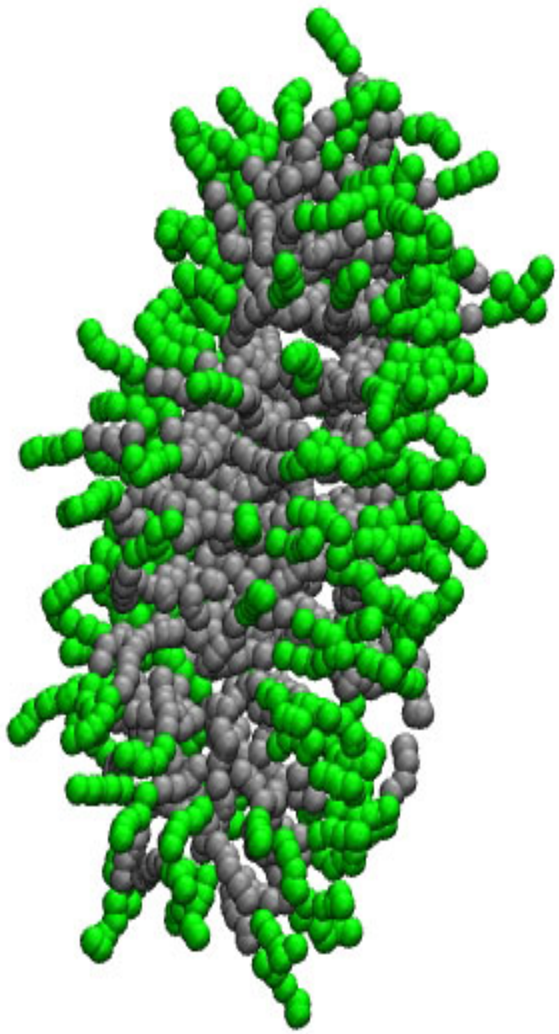



= Fairly Water Soluble Oil Component
= Not Very Water Soluble Oil Component
Oil Floating on Water
Oil Contains Various Chemicals with Some Being Fairly Soluble in Water and Some not
Physical System for a Recent Oil Spill

KEY OIL NATURAL FATE MECHANISMS WITHIN THE OPEN ENVIRONMENT AFTER RELEASE

- ✓Volatilization (evaporation into the atmosphere)
- ✓Solubilization (dissolves into water phase)
- ✓Dispersion (dilution via mixing eddies)
- ✓Photolysis (sunlight degradation)
- ✓Biodegradation (natural microorganisms at work)
- ✓Hydrolysis (natural chemical degradation)
- ✓Deposition onto coastal ecosystems
- ✓Picks up sediments and dust thus sinking to the bottom



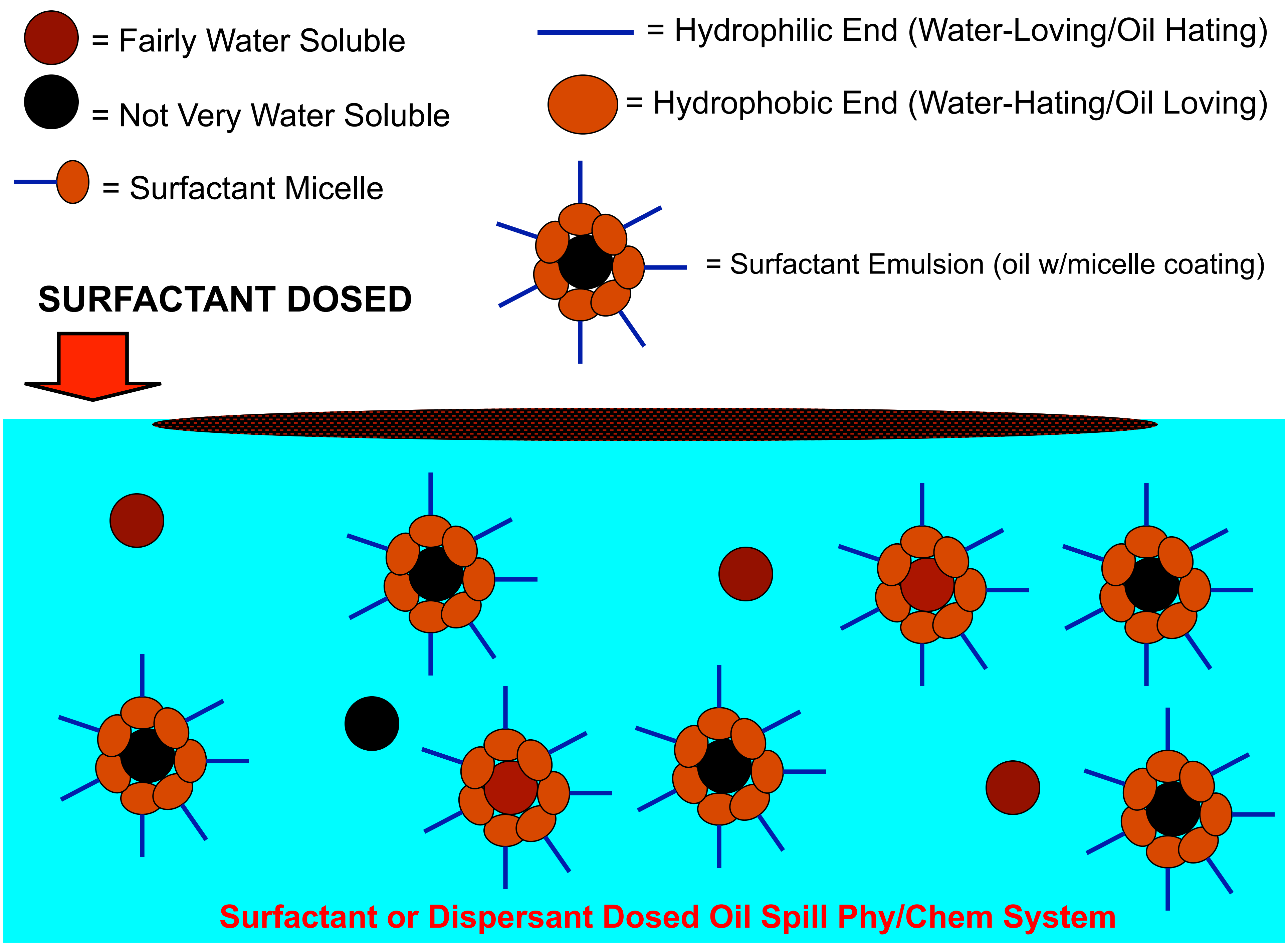


Source: STFC Daresbury Laboratory

SURFACTANT DOSING
(key component of dispersants)

- **Surfactants = Surface Active Agents that reduce interfacial tension between immiscible phases (oil and water)**
- **Four Main Types:**
  - ***Cationic (SDS)***
  - ***Anionic (most soaps)***
  - ***Nonionic (Tweens, Triton, etc.)***
  - ***Bioemulsifier (biosurfactants)***

  Eco-Concern Decreases In Descending Order of list
- **Common Dispersant Composition (Corexit):**
  - ***50% nonionic***
  - ***30% anionic***
  - ***20% solvents*** ← **Often Constituent of most Eco-Concern**
- **Critical Micelle Concentration (CMC) = minimal Dose to achieve sufficient amounts to result in widespread micelle coverage**
- **Typical Nonionic Doses:**
  - ***Nonionic CMC = ~100mg/l***
  - ***Doses used are in the 0.1% to 2% range***



= Fairly Water Soluble
= Not Very Water Soluble
= Surfactant Micelle
= Hydrophilic End (Water-Loving/Oil Hating)
= Hydrophobic End (Water-Hating/Oil Loving)
= Surfactant Emulsion (oil w/micelle coating)
SURFACTANT DOSED
Surfactant or Dispersant Dosed Oil Spill Phy/Chem System

KEY OIL NATURAL FATE MECHANISMS WITHIN THE OPEN ENVIRONMENT AFTER RELEASE

How do/did the Massive Infusion of Dispersant(s) Impact These Fate Mechanisms?

- ✓ **Volatilization (evaporation into the atmosphere)**
- ✓ **Solubilization (dissolves into water phase)**
- ✓ **Dispersion (dilution via mixing eddies)**
- ✓ **Photolysis (sunlight degradation)**
- ✓ **Biodegradation (natural microorganisms at work)**
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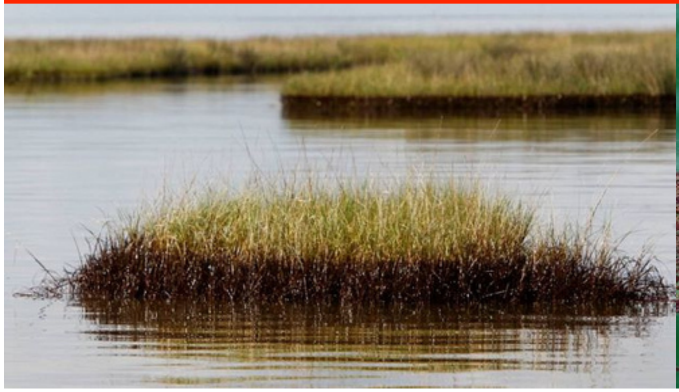


R&D Topical Areas

- Ecological Impacts
- Remediation Methods
- Environmental Fate and Transport of Oil Spill-Derived Chemicals
- Improved Response Technologies
- Scientifically Sound Post-Oil Spill, Long-Term Coastal Restoration Methods
- Impacts of Dispersant Use
- Effectiveness of Natural Attenuation

Ecological Impacts

- Oil, Dispersant, & Emulsion Fate
- Longevity and Degradation of Oil & Dispersants in Water Column
- Effects of Natural Salinity & Water Quality Gradients
- Impacts of Remediation Efforts
- Redefine and Accelerate Coastal Protection and Rehabilitation Efforts


Impacts of Dispersant Use

Ecological Implications of Dispersant

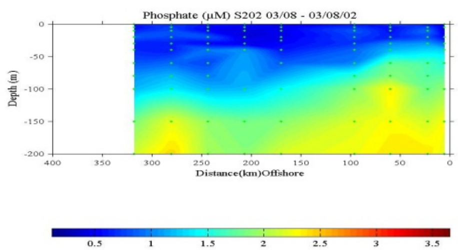
Fate of Dispersant
Toxicity Implications
Other Potential Biochemical Eco-Impacts
Oxygen Depletion caused by Biodegradation

Physical/Chemical Change to Oil Product

Fate of Modified Oil Product
Changes to Biodegradation Potential
Impact on Oil Weathering
Potential Changes to MutaTox of Oil Product
Potential Increased Bio-Vector Availability

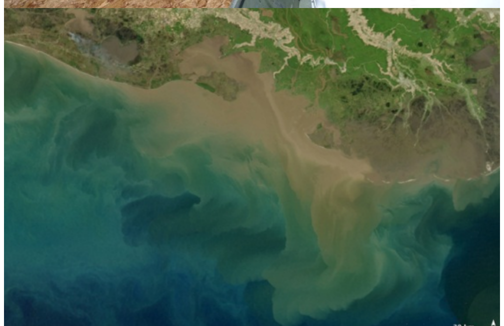
REMEDIATION METHODS

- Ecological Impact of Remediation Efforts
- Increased Knowledge of Performance of Specific Methods within GOM Ecosystems
- Pre-existing knowledge of GOM Ecosystem Characteristics for Handling Various Proposed Remediation Strategies
- Improved Remediation System Performance and Acceptance



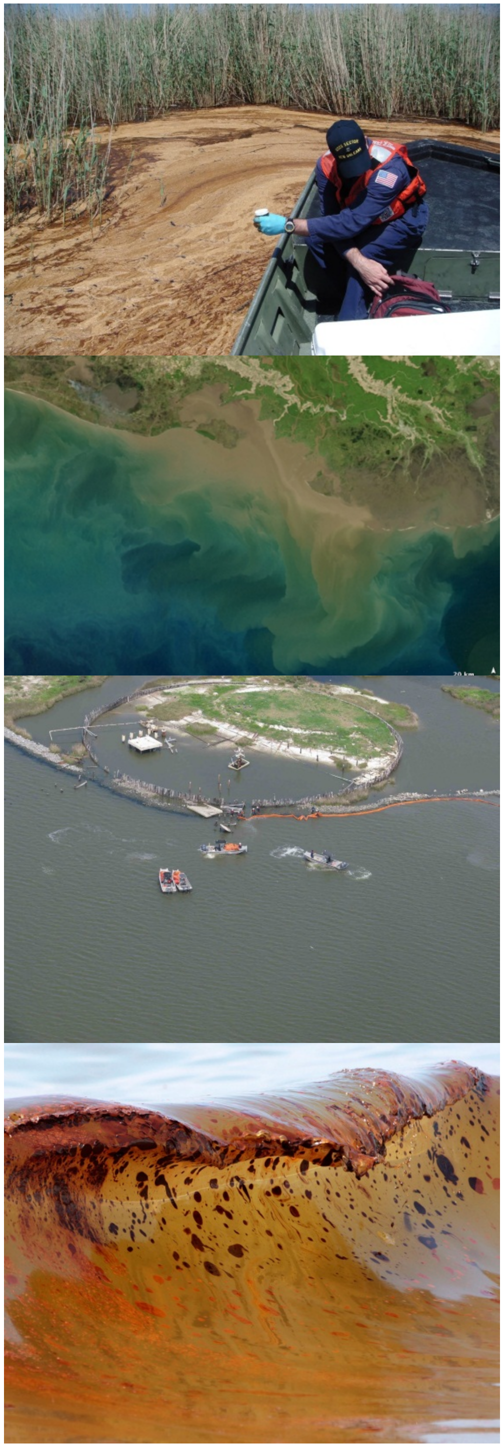
NATURAL ATTENUATION

- Established remediation technique that Capitalizes on the natural ability of site microbes to effectively degrade targeted contaminants
- Provides passive, proactive remediation
- Involves comprehensive assessment of site conditions (regard to oil degradation)
- Involves developing a process monitoring plan to monitor both the rate and extent of pollutant degradation
- Often used for treating petroleum hydrocarbon impacted sites

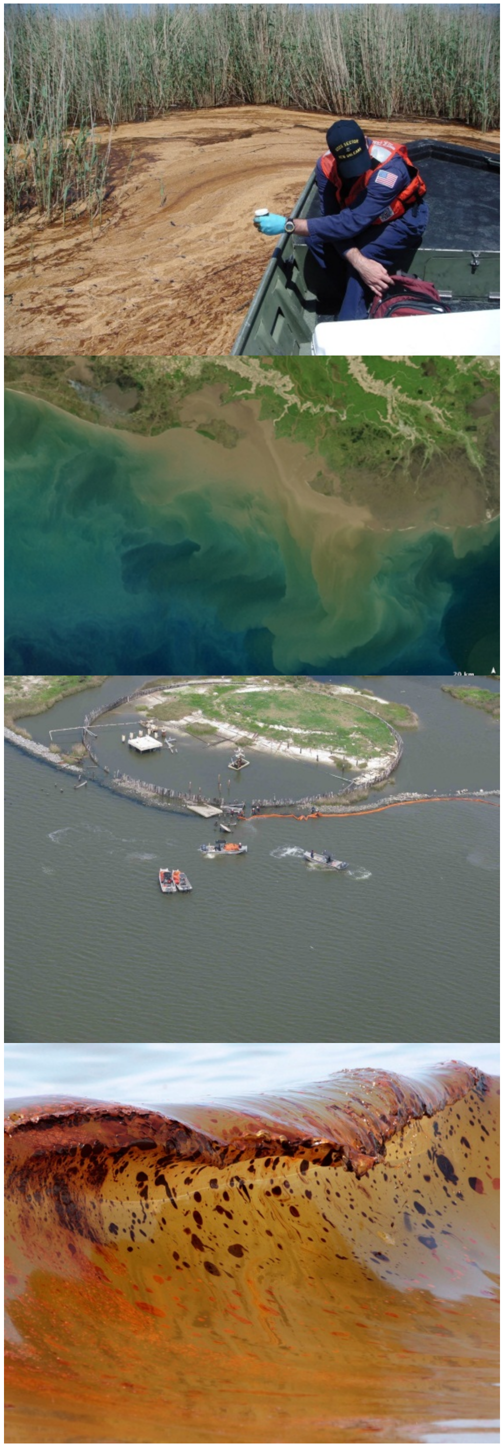
Environmental Fate and Transport of Oil Spill-Derived Chemicals

- Better Define Fate Mechanisms
- Include both At-Sea and On-Shore Systems
- Deepwater Environment Impacts on Chemicals
- Short and Long-Term Fate Modeling
- Improve Predictive Transport Models



Improved Response Technologies

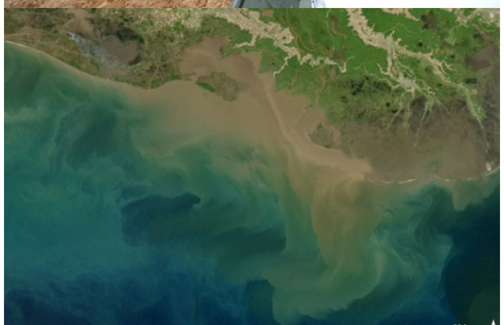
- Improve Barrier Designs and Effectiveness of Implementation
- Integrate Ecological Impacts within Implementation
- Optimize Remote Monitoring of Spill
- Improve Technical Information Access to Local Officials
- Rethink EPA's Product Schedule Methodology



Oil Spills and Coastal Restoration

- Factor Oil Presence in Restoration Plans
- Identify Potentially Synergistic Strategies
    - Freshwater Discharges
    - Sediment Reintroduction
- Focus on Sustainability

Sediment Capping of Oil-Contaminated Marshes

- Combine two established technologies to remediate oil-contaminated marshes
- Sediment nourishment of marshes
- Capping of contaminated soils and sediments
- Convenient synergy between restoration and remediation