

February 24, 2015

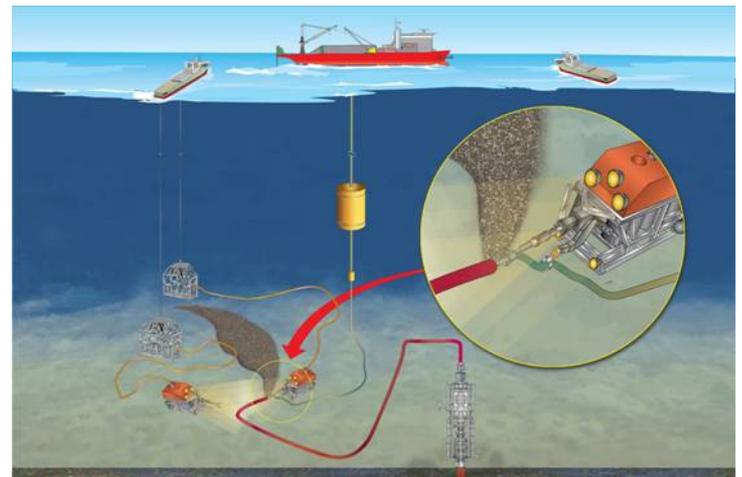
# The Value of Dispersant Use for Offshore Oil Spill Response

Energy lives here™

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Fairfax, Virginia

# Topics of Discussion

- Oil spill response options
- Background on dispersants
- Subsea dispersants
- Observations on their use
- Summary



# Spill Response Options: The Toolbox



**Monitor & Evaluate**



**Mechanical Recovery**



**In-Situ Burning**

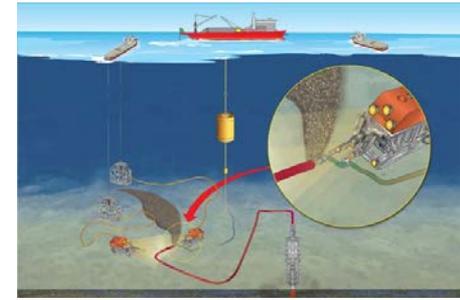
**Aerial**



**Dispersants  
Vessel**

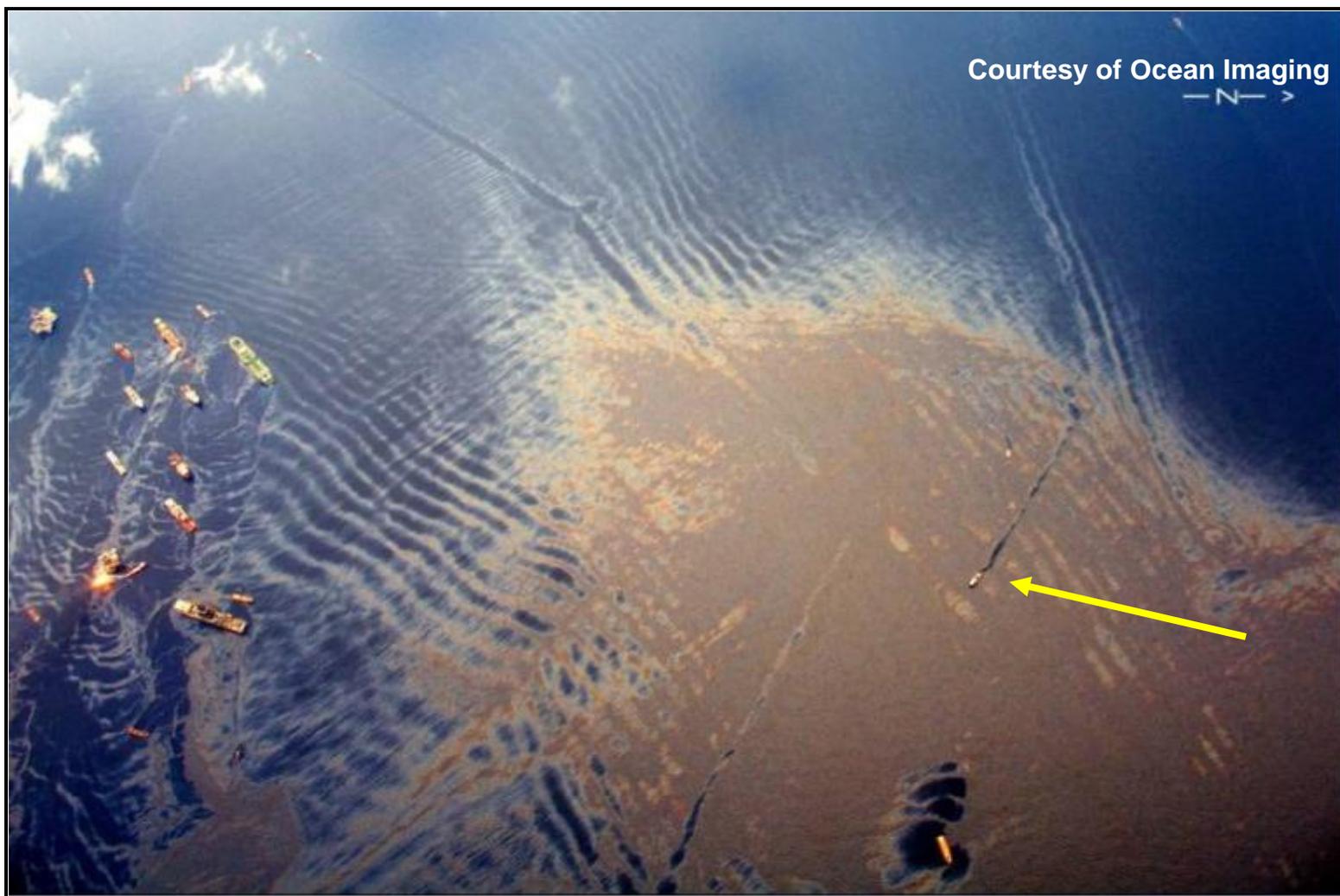


**Subsea**



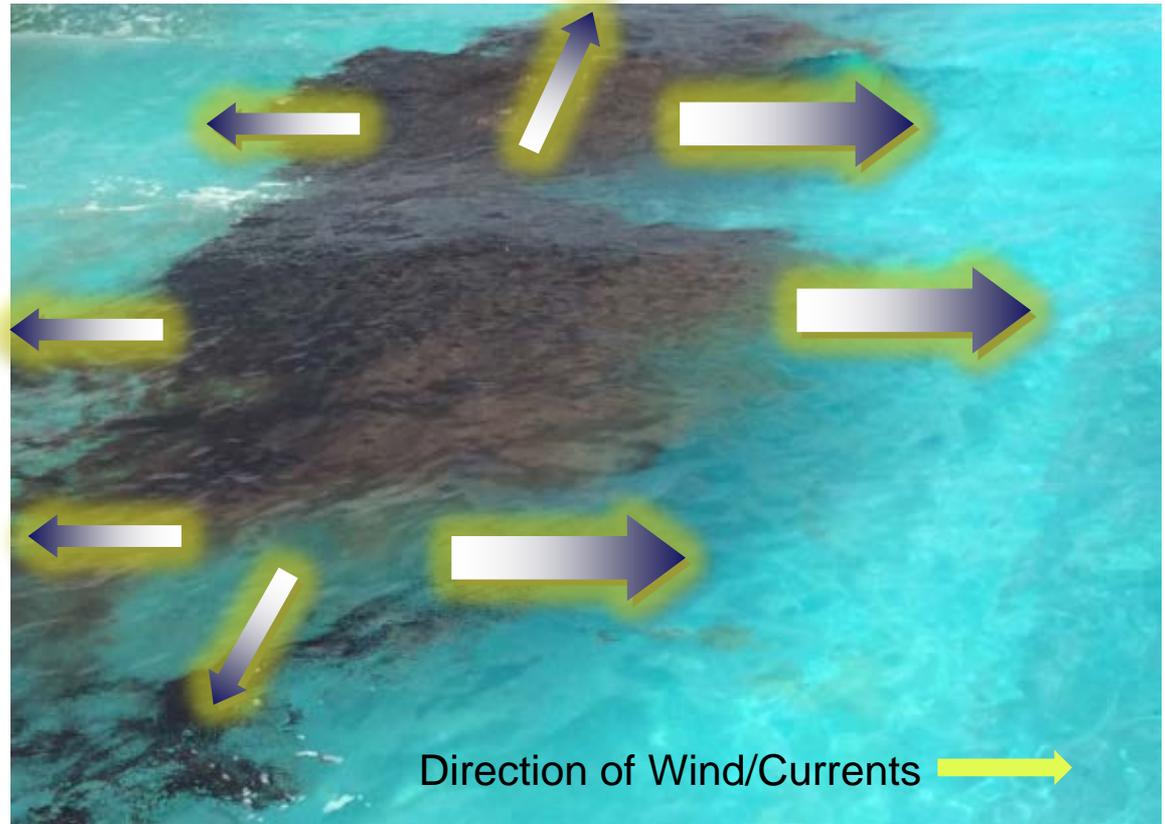
*The goal is to design a response strategy based on  
Net Environmental Benefit Analysis (NEBA)*

# Encounter Rate is Key to Offshore Response



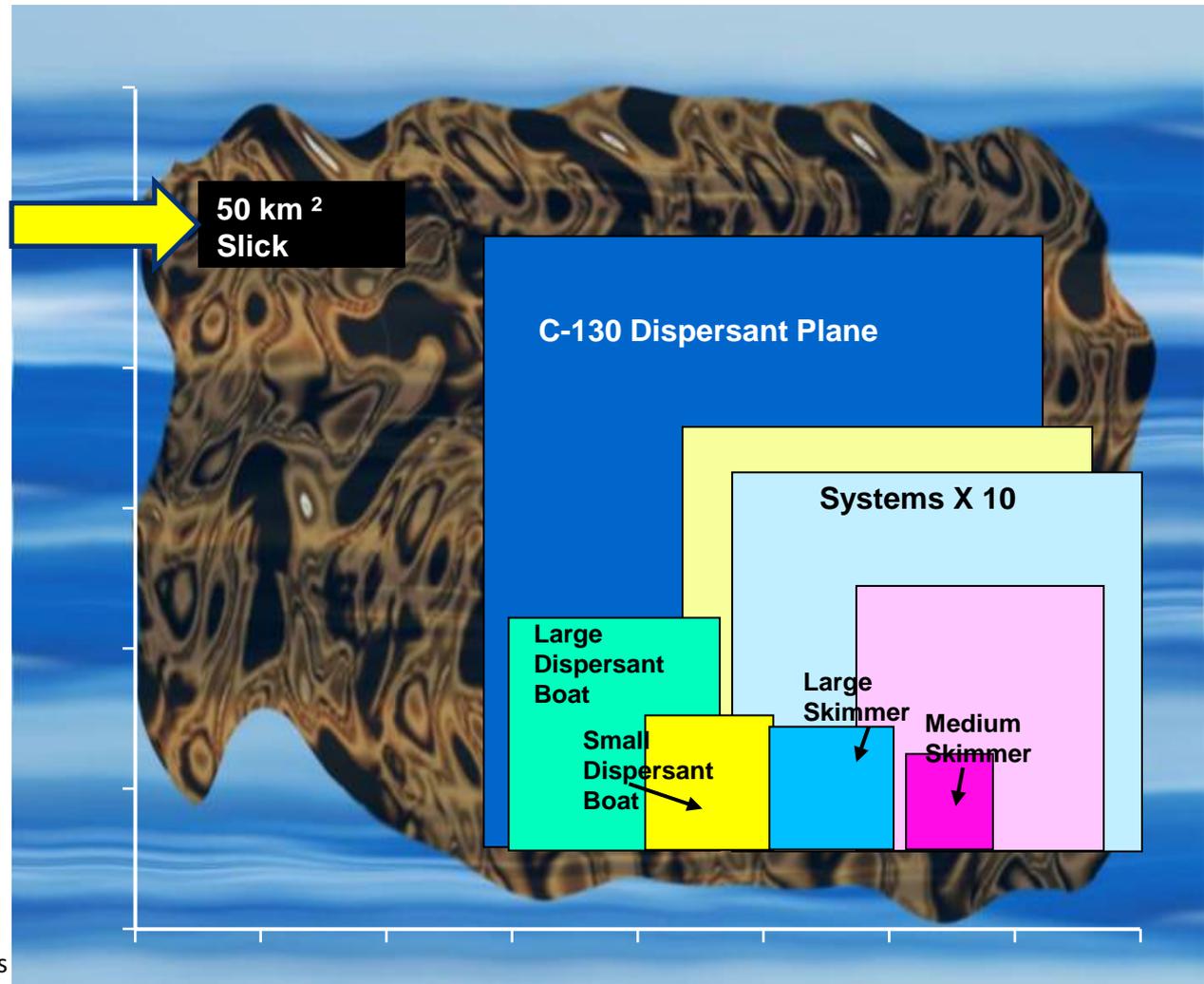
# Oil Slicks Spread Quickly

- A slick continuously expands and oil thins
  - The size of the problem will increase with time
- Response options get less efficient with time
  - The goal is to respond as quickly and as close to the source as possible



# Relative Area Coverage

- 5,000 MT spill (37K bbl)
- Slick 0.1 mm thick
- 100 MT/km<sup>2</sup>
- 8 hrs of operation
- Continuous encounter with slick



For reference:

9300 American Football fields

6500 Football (soccer) fields

2900 Australian rules Football fields

# Optimum Response Strategy

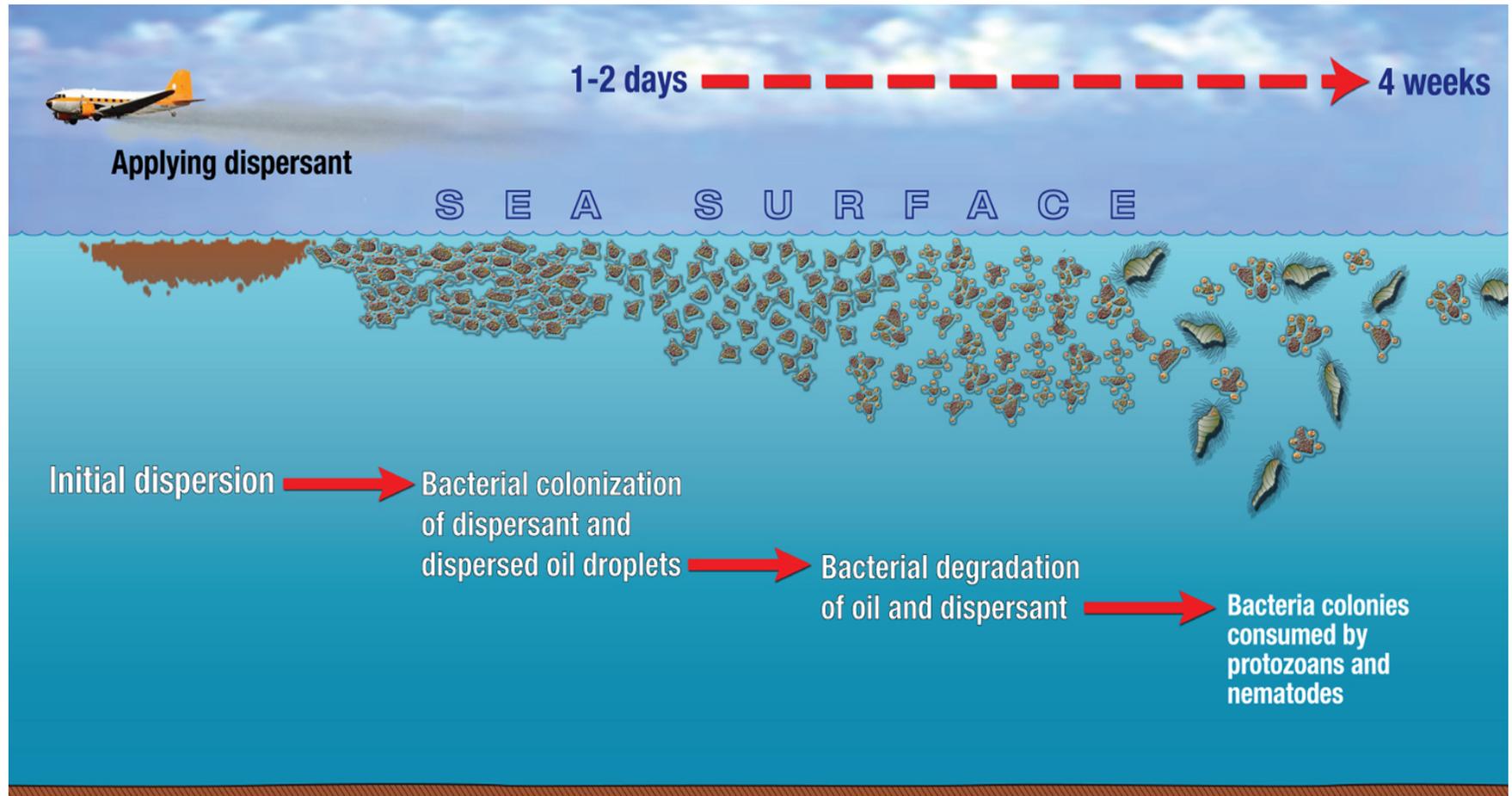
- Use appropriate combination of response tools to minimize impacts
  - If possible, deploy mechanical in thick oil to maximize recovery
  - Consider dispersant use early in a response
  - Responder and public safety is critical
- Environmental protection priorities
  - Minimize wildlife exposure
  - Minimize habitat contamination
  - Minimize oil stranding on sensitive shorelines
- Human resource protection priorities
  - Tourist beaches
  - Marinas, commercial activities
  - Shoreline property values

## Net Environmental Benefit Analysis (NEBA)

- A risk comparison process to improve decision-making
- A planning and response tool
  - Rank response options by least negative environmental consequences and effectiveness in treating/removing spilled oil
  - Speed the selection of response options for various locations, weather conditions and spill circumstances
- Can be an intensive and detailed process to arrive at a consensus with respect to the response decision
  - Have the necessary discussions in advance of a spill

# Dispersants Enhance Removal of Oil

## Through Biodegradation

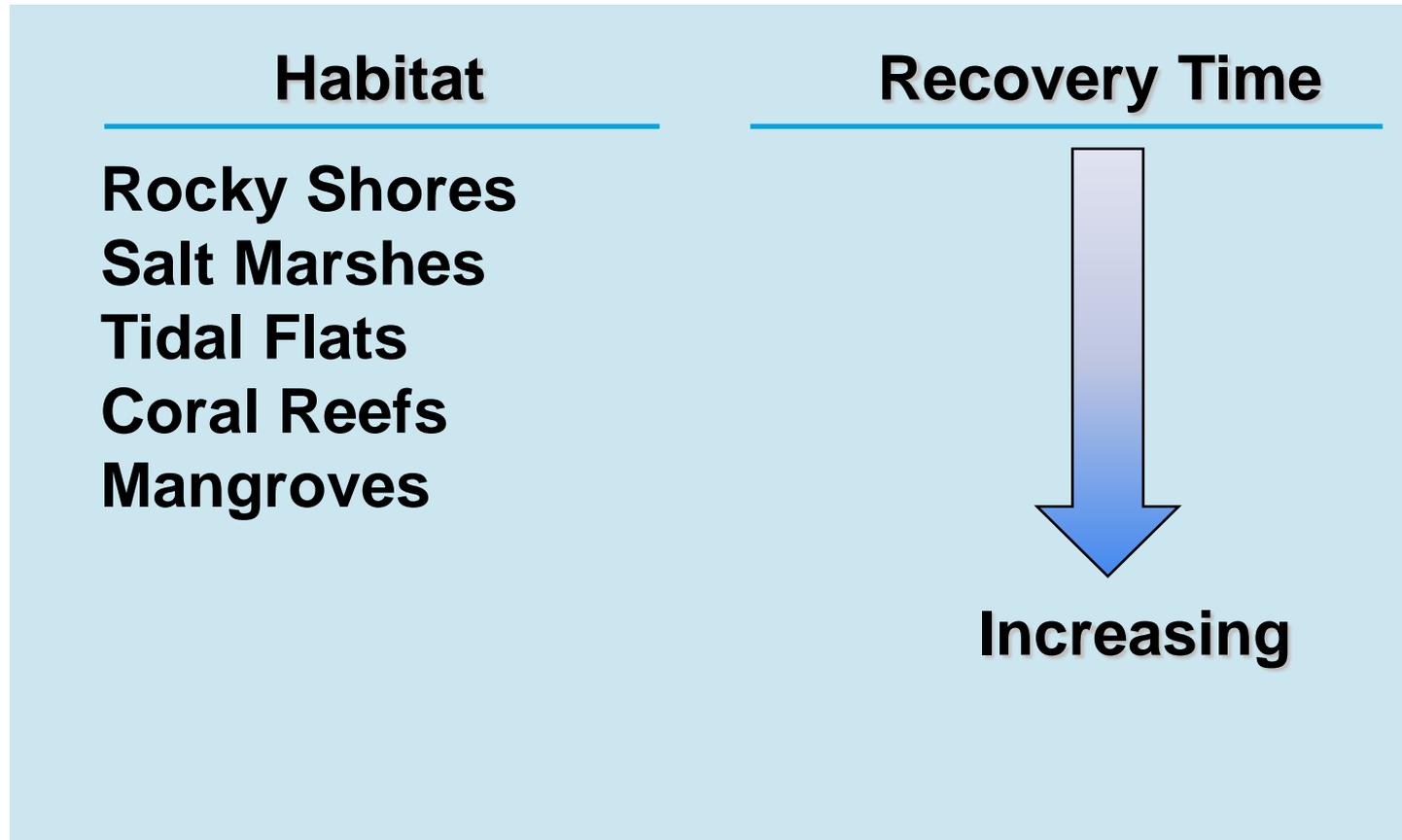


## NEBA Considerations Regarding Dispersants

- Oil on the Surface May Affect Birds and Habitats
- Oil in Water May Affect Marine Life
  
- Oil in Marshes May Affect Marsh Grass
- Oil in Water May Affect Sea Grass
  
- Oil on Beaches May Affect Turtle Eggs
- Oil in Water May Affect the Turtles
  
- Oil on the Surface May Affect Mangroves
- Oil in Water May Affect Coral

*Dispersant use may provide the most acceptable result*

## Shoreline Recovery Time May Differ by Type



# Dispersant Use Strategy

- Dispersants Are One Component of an Overall Response
- Environmental Protection Priorities
  - Minimize wildlife exposure
  - Minimize habitat contamination
  - Minimize oil stranding on sensitive shorelines

## Dispersants – What are they?

- Dispersants are solutions of surfactants dissolved in a solvent
- Surfactants reduce oil-water interfacial tension – allows slicks to disperse into very small droplets with minimal wave energy



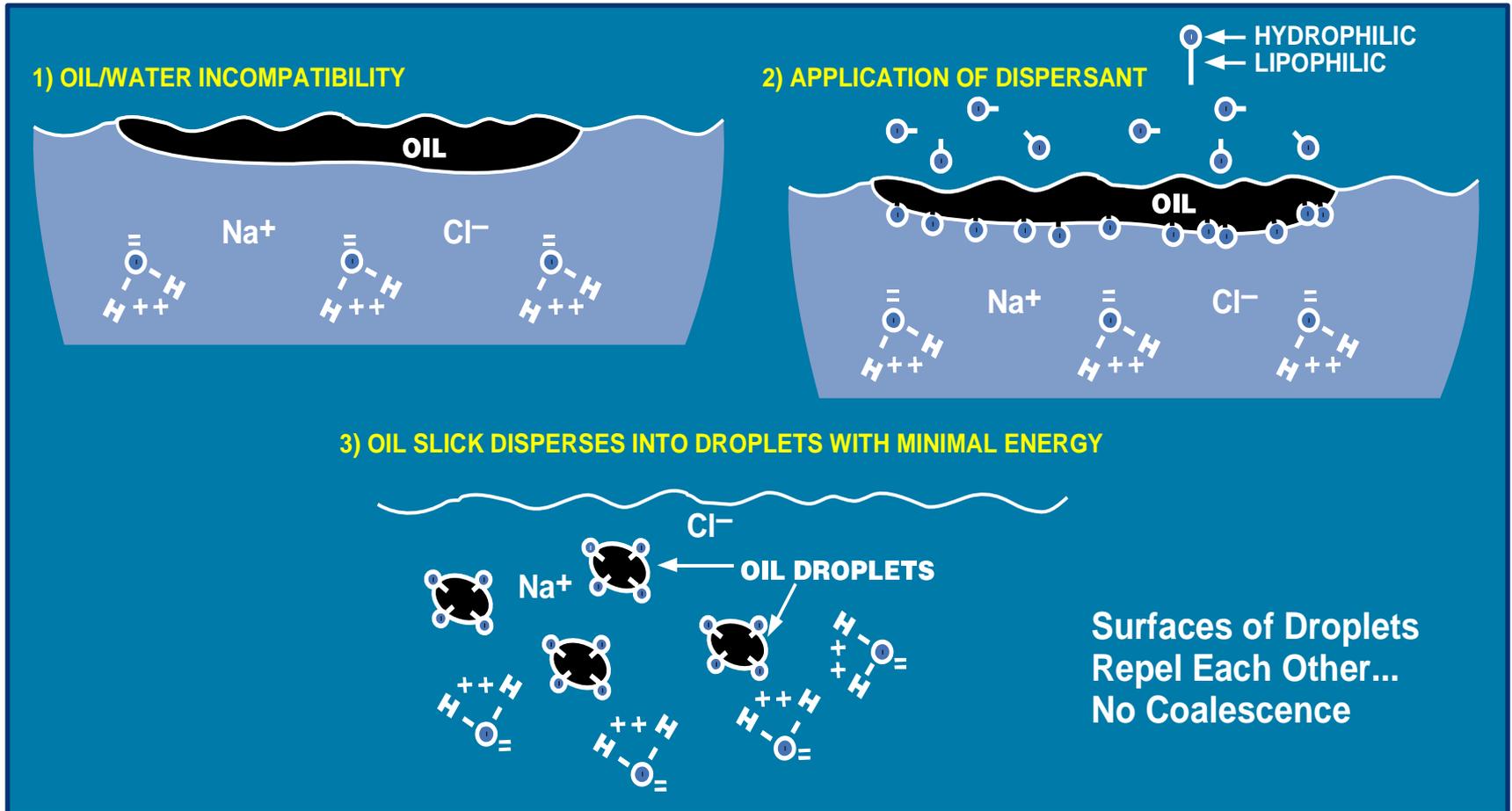
**Water-Compatible (Hydrophilic)**

**Oil-Compatible (Lipophilic)**

- Dispersed oil rapidly dilutes to concentrations <10 ppm within minutes, <1 ppm within hours, ppb range within a day
- Each dispersed oil droplet is a concentrated food source that is rapidly colonized and degraded by marine bacteria
- Dilution allows biodegradation to occur without nutrient or oxygen limits

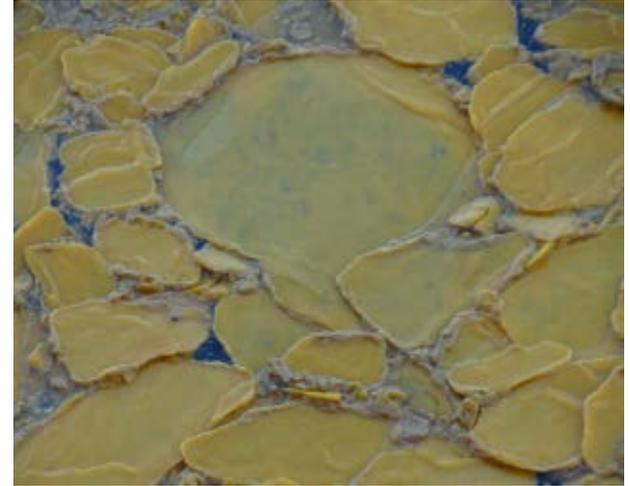
# How Dispersants Work

The Goal: Reduce Oil Concentration to Below Impact Levels Rapidly



# Factors Influencing Effectiveness

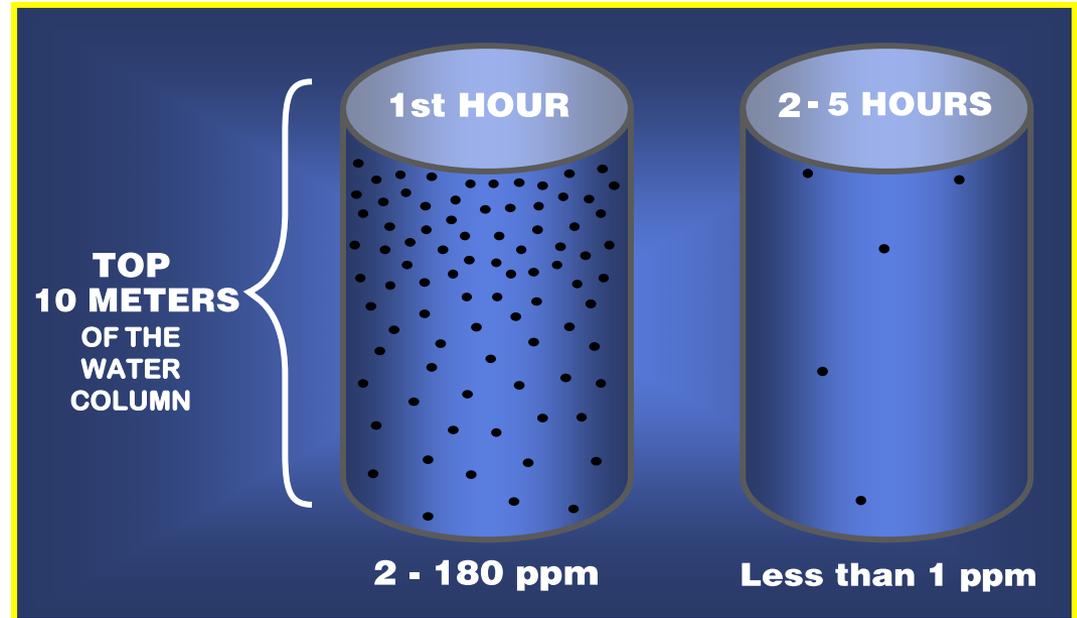
- Oil Type/Properties
  - Viscosity
  - API Gravity
  - Wax Content/Pour Point
  - Emulsifiers
- Environmental Conditions
  - Water Temperature
  - Sea State (Mixing Energy)
  - Extent of Weathering (How Long on the Sea)
  - Water Salinity



# Environmental Impacts

- Toxicity

- Rapid dilution limits ecosystem impacts of both dispersant and dispersed oil
- Concentrations start low and rapidly dilute (National Academy of Sciences, 1989)



Lessard, R.R. and DeMarco, G. (2000) The significance of oil spill dispersants. *Spill Science & Technology Bulletin*, 6, 59-68

- Lab tests expose organisms to constant concentrations for days
- Organisms only see elevated concentrations for hours during a spill
- Dispersants are only applied in areas with high potential for dilution

## Human Health

- Modern dispersants use ingredients found in household products
  - NALCO website\*
  - Centers for Disease Control assessment supports low health risk
- Following proper application procedures and wearing appropriate equipment is important
- NOAA & FDA test results for dispersants in Gulf seafood, "There is no question Gulf seafood coming to market is safe from oil or dispersant residue."

*([http://www.noaanews.noaa.gov/stories2010/20101029\\_seafood.html](http://www.noaanews.noaa.gov/stories2010/20101029_seafood.html))*

| Corexit® 9500 Ingredients    | Common Day-to-Day Use Examples                         |
|------------------------------|--|
| Span™ 80 (surfactant)        | Skin cream, body shampoo, emulsifier in juice          |
| Tween® 80 (surfactant)       | Baby bath, mouth wash, face lotion, emulsifier in food |
| Tween® 85 (surfactant)       | Body/Face lotion, tanning lotions                      |
| Aerosol® OT (surfactant)     | Wetting agent in cosmetic products, gelatin, beverages |
| Glycol butyl ether (solvent) | Household cleaning products                            |
| Isopar™ M (solvent)          | Air freshener, cleaner                                 |

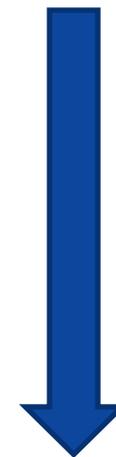
\*<http://www.nalco.com/applications/corexit-technology.htm>

## Relative Toxicity

### Environment Canada Study

| <u>Product</u>                   | <u>Toxicity (ppm)</u> |
|----------------------------------|-----------------------|
| Palmolive <sup>®</sup> Dish Soap | 13                    |
| Sunlight <sup>®</sup> Dish Soap  | 13                    |
| Mr. Clean <sup>®</sup>           | 30                    |
| Corexit <sup>®</sup> 9527        | 108                   |
| Corexit <sup>®</sup> 9500        | 350                   |

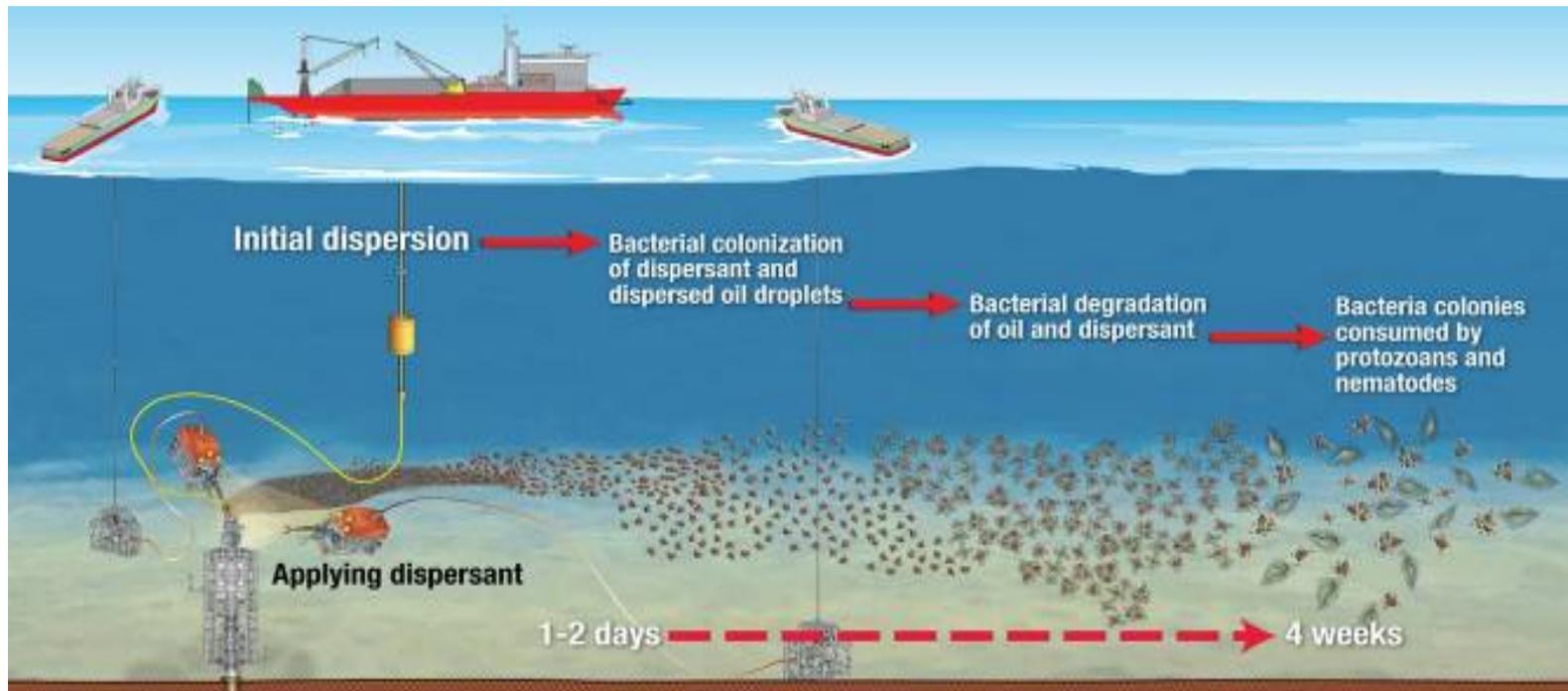
*(96 HR Rainbow Trout LC50)*



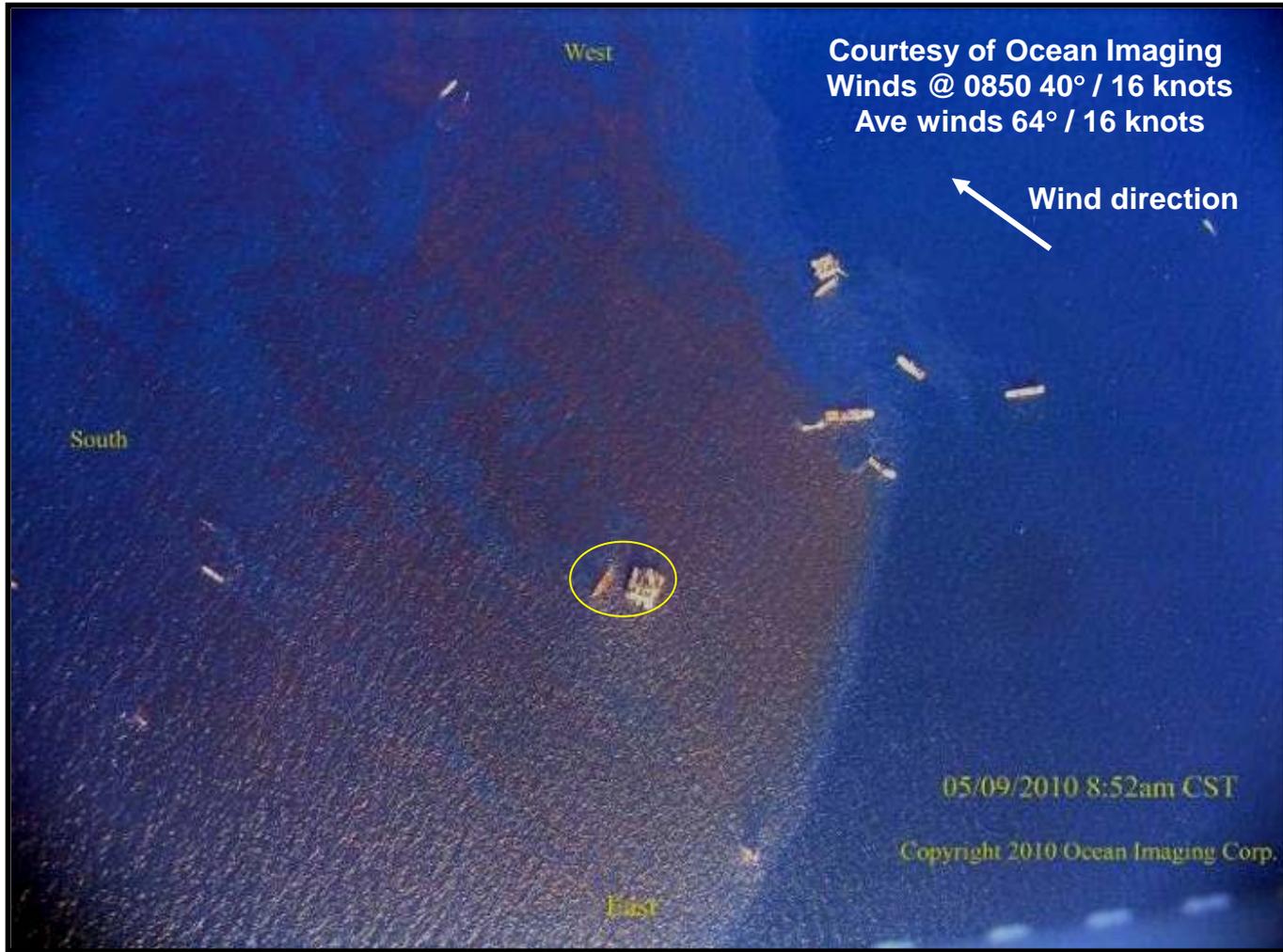
Less toxic

## Subsea Injection of Dispersants

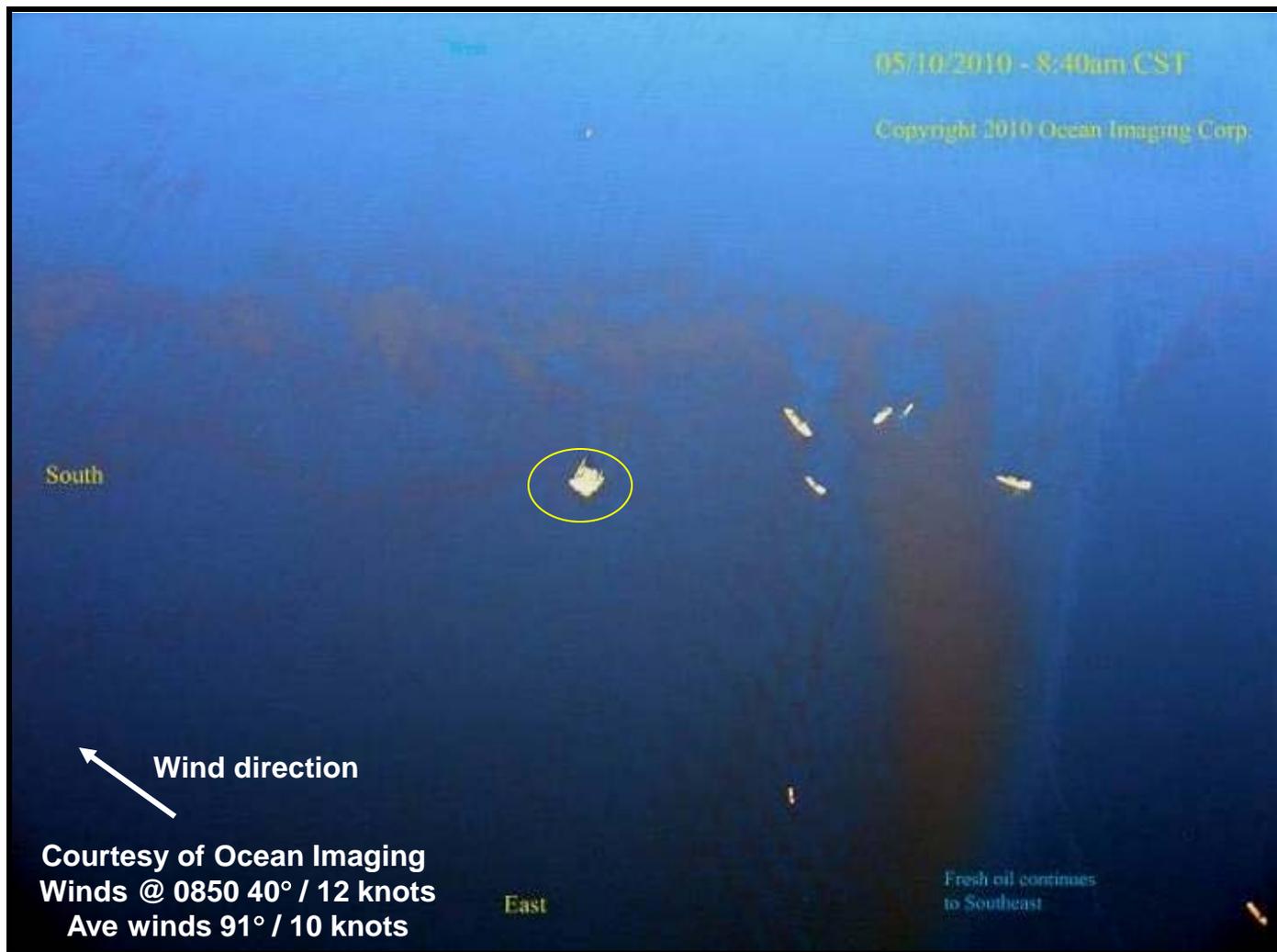
- Preliminary observations of Macondo Well experience
- Benefits of subsea injection
- Long-term fate and effects



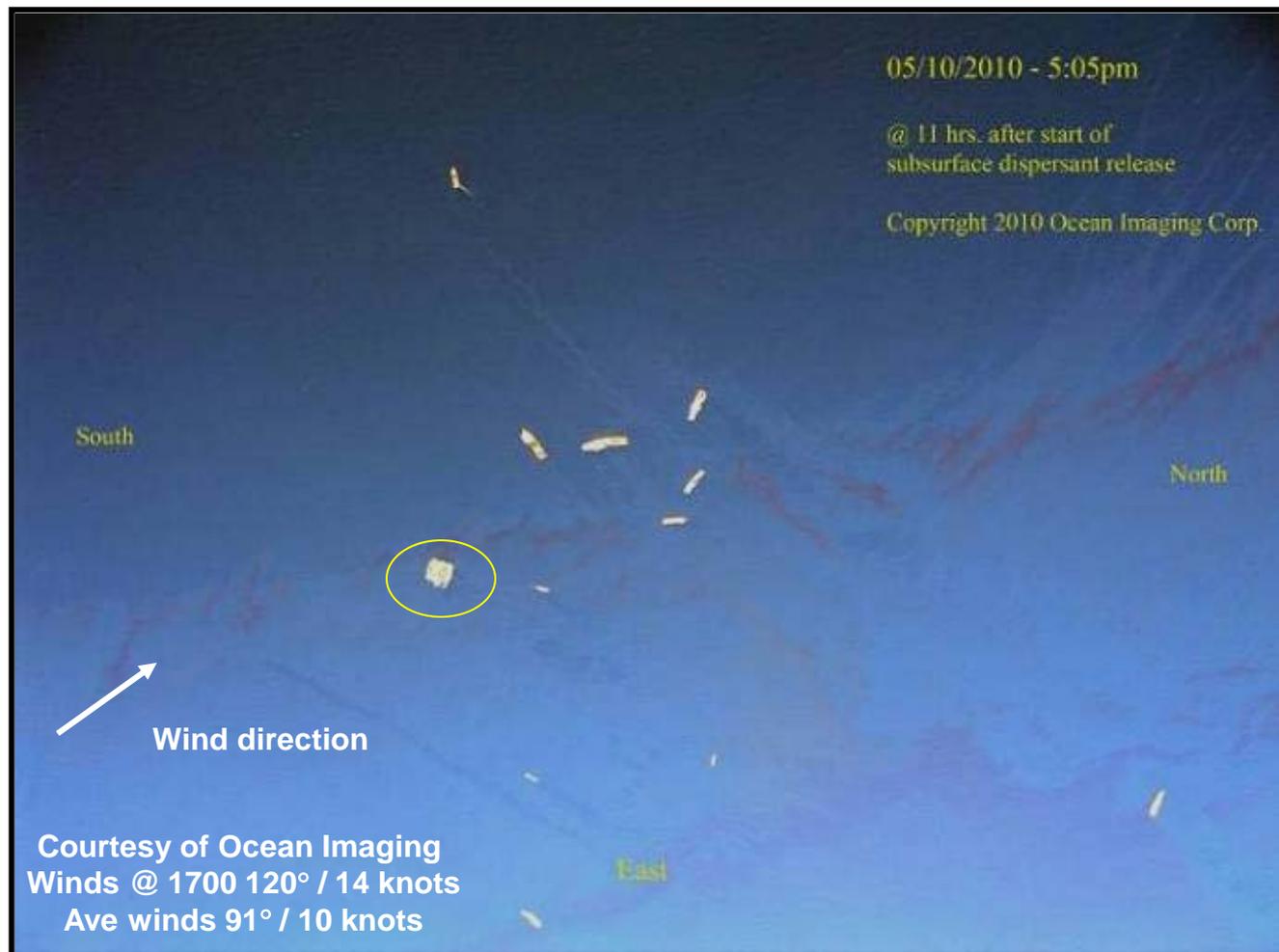
# Release Site May 9, 2010 Prior to Injection



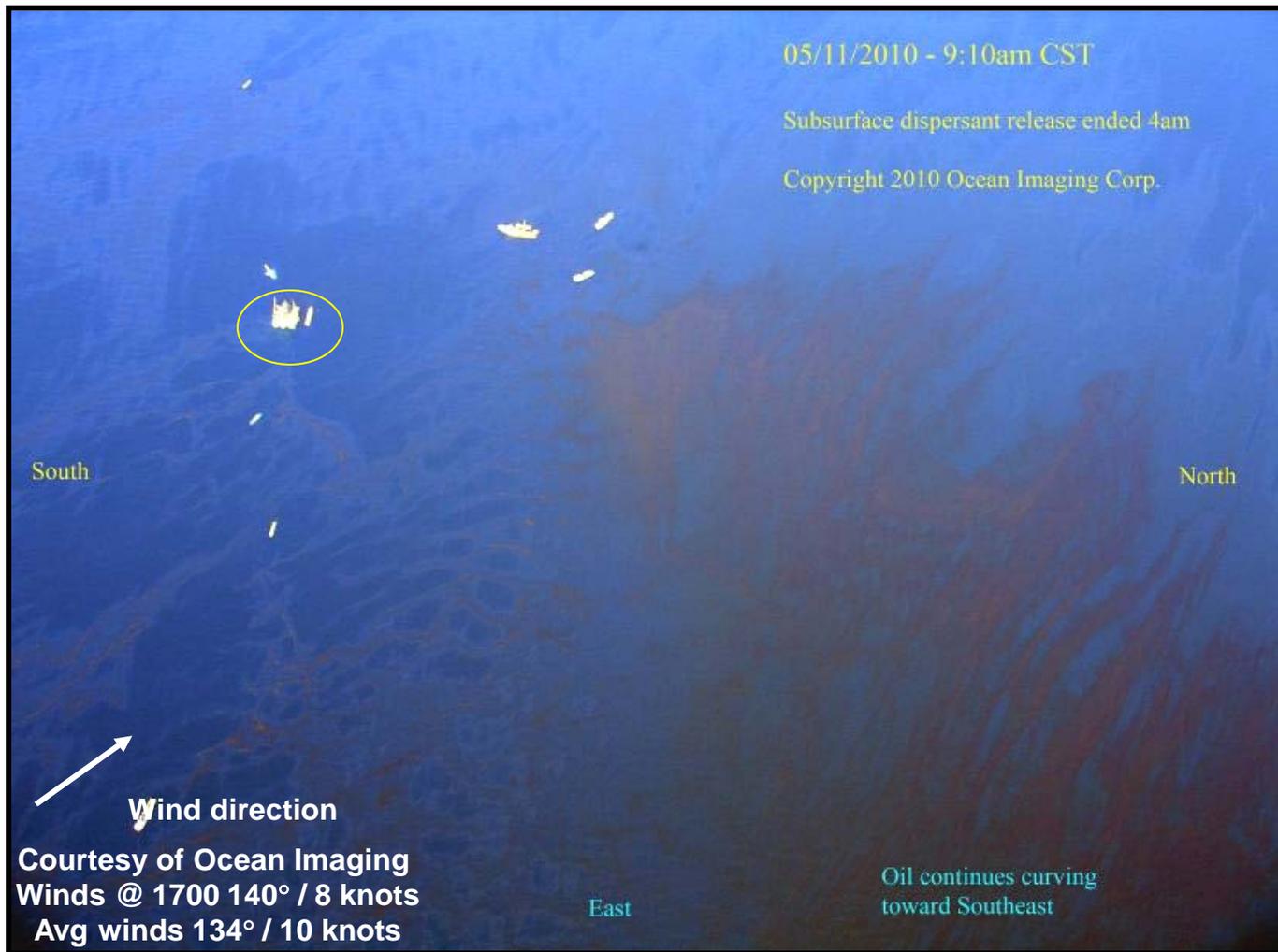
# Release Site May 10, 2010 3 hours of Injection



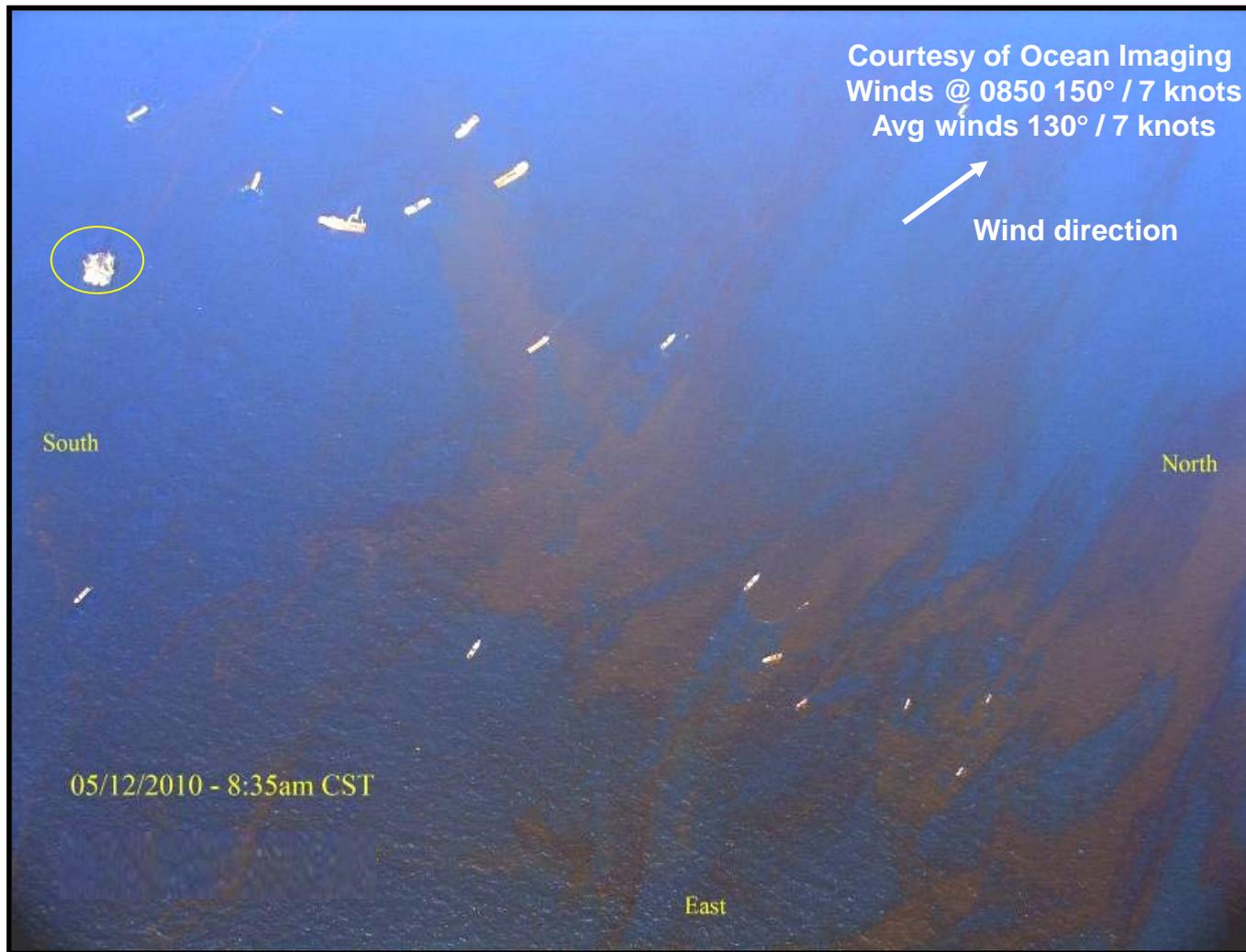
# Release Site May 10, 2010 11 hours of Injection



# Release Site May 11, 2010 5 hours after Injection Ended



# Release Site May 12 28 hours After Injection Ended



## Summary

- Oil spill response must be robust and should use all available tools
- Highest priority is human health and safety
- Basic strategy for addressing a spill
  - Respond as close to the source as possible
  - Use all appropriate tools to keep oil from reaching shorelines
- Dispersant use presents significant advantages over the limitations of mechanical recovery and should be considered as a primary response option
- Work is ongoing to enhance response capabilities

## Areas of Recent Activities and Ongoing Interest

- Joint Industry Projects via IPIECA/IOGP and API
- New Dispersant Formulation
- Remote Detection / Aerial Surveillance
- New Aerial Dispersant Delivery Platform
- ExxonMobil Oil Spill Response Field Manual

# The Oil Spill Response Joint Industry Project



- Three – year project (2012 – 2014) addressing recommendations for spill response developed following the Montara and Macondo incidents
- Nineteen members, twenty-two projects
- Improving co-ordination between the many groups that are also working global oil spill response issues
- Dispersant issues are being addressed in about 20% of the JIP work streams





## Other Communications Products

- In addition to dispersants, other complementary topics are being addressed
  - ✓ The goal is to have a suite of materials available as broadly as possible
  - ✓ Consistent presentation formats
  - ✓ Short narrated videos based on the presentations have been developed
  - ✓ Integral components of OSRL  
Confident Ambassador material



# The Good Practice Guides

## STRATEGY

- Framework Document
- Incident Management Strategies
- Net Environmental Benefit Analysis

## RESPONSE

- 
- Surveillance
  - Dispersants: Sea Surface
  - Dispersants: Subsurface
  - Mechanical Recovery
  - In-situ Controlled Burning
  - Shoreline Response Planning and SCAT
  - Shoreline Cleanup Techniques
  - Inland Responses
  - Waste Management
  - Oiled Wildlife Management
  - Environmental Assessment and Restoration
  - Economic Assessment and Compensation
  - Responder Health and Safety

## PREPAREDNESS

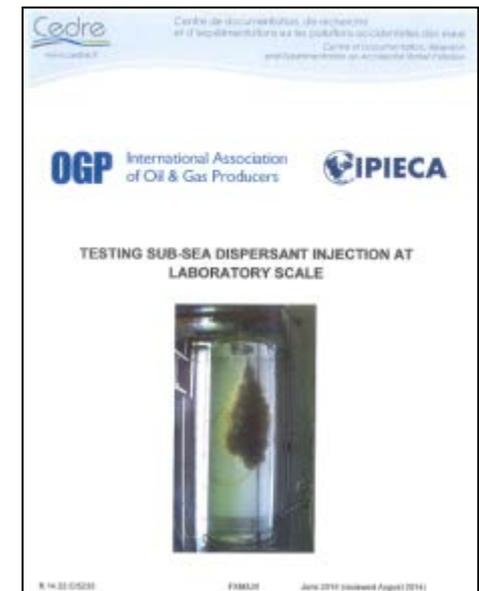
- Contingency Planning
- Sensitivity Mapping
- Tiered Preparedness and Response
- Training
- Exercise Planning

## IMPACTS

- Impacts on Marine Ecology
- Impacts on Shorelines
- Impacts on Freshwater Ecology

# Dispersant Focus - Subsea Bench Scale Testing Protocol

- Focus on testing and scaling to applicable to API's subsea dispersant program ("D3") using the same crude oils and dispersants
- SINTEF (Norway) & Cedre (France) running parallel testing programs
  - ✓ Kickoff June 2013 in Trondheim, Norway
  - ✓ Complete and comparative assessment has been received



# Development of Bench Scale Subsea Dispersant Effectiveness Test (IPIECA/IOGP)

- Four crude oils
- Three dispersants
- Two mixing regimes (high and low energy)
- Similar (but different) experimental set-up and analysis
- Studies complete December, 2014
- To be presented at AMOP, 2015

Cedre (France)



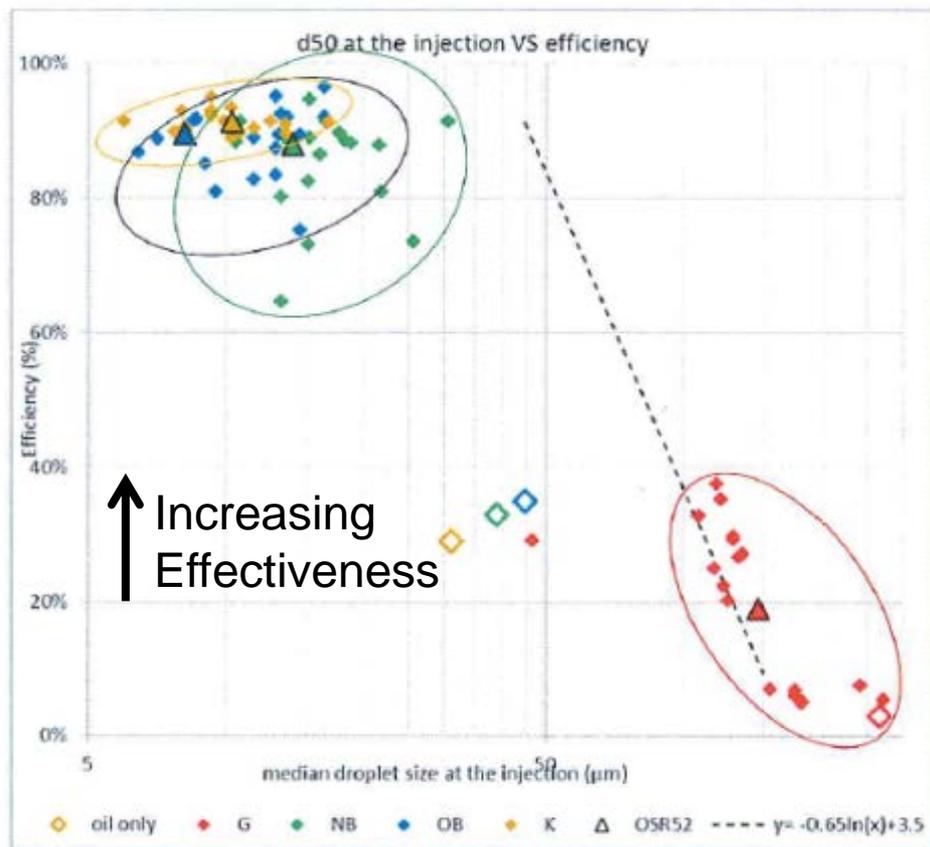
April 8, 2014 Cedre

SINTEF (Norway)



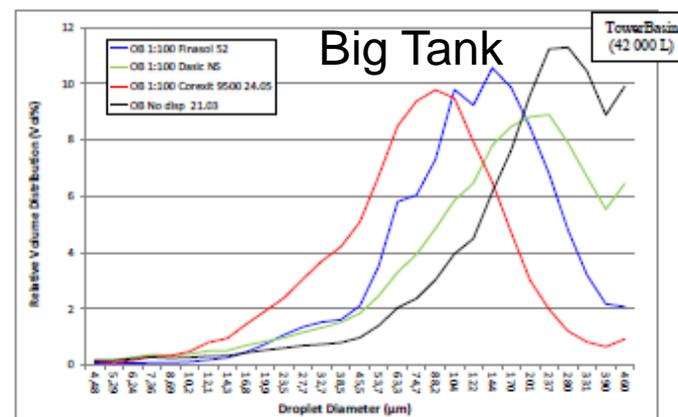
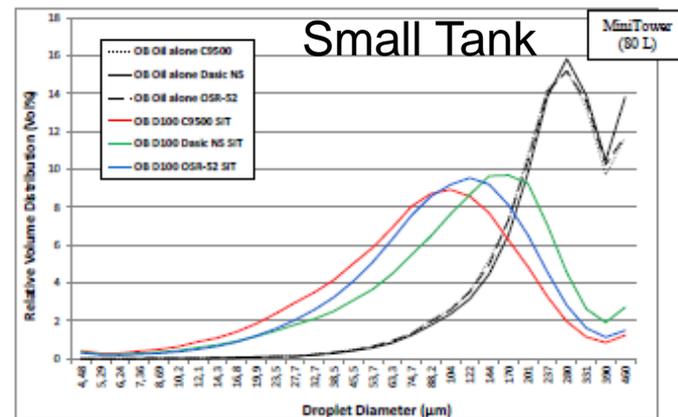
# Example of Results: Droplet Size Effects

Cedre: Different Oils

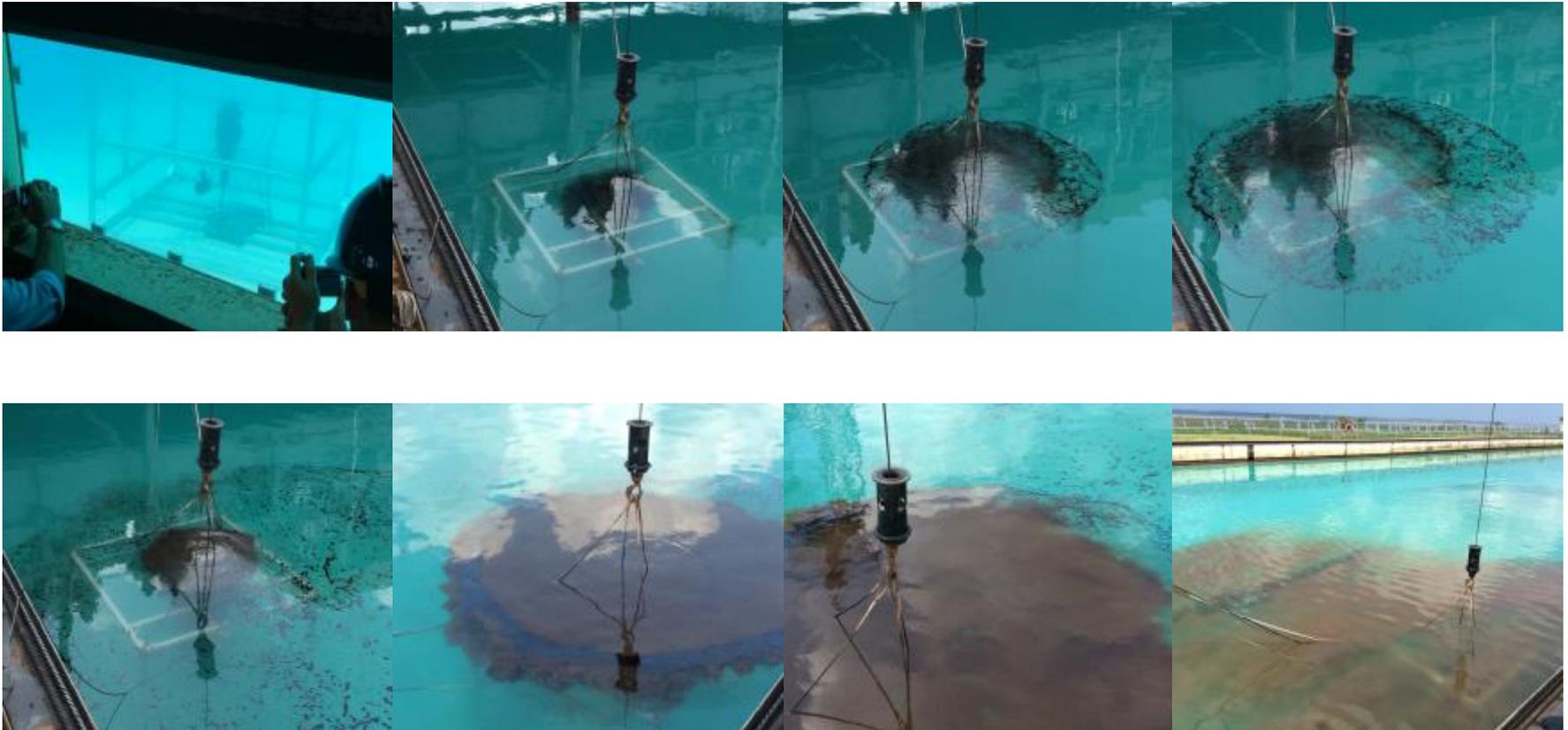


Increasing droplet size  $\longrightarrow$

SINTEF: Different Dispersants



# Demonstration of Subsea Dispersant Effectiveness (API)

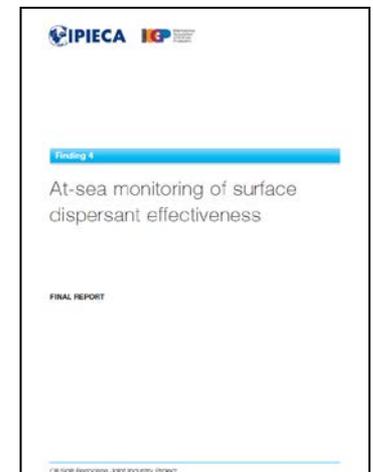
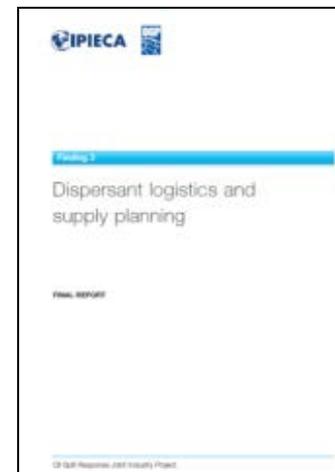


OHMSETT Facility, New Jersey, July, 2014

Funded by API Joint Industry Task Force

## Other Dispersant Efforts

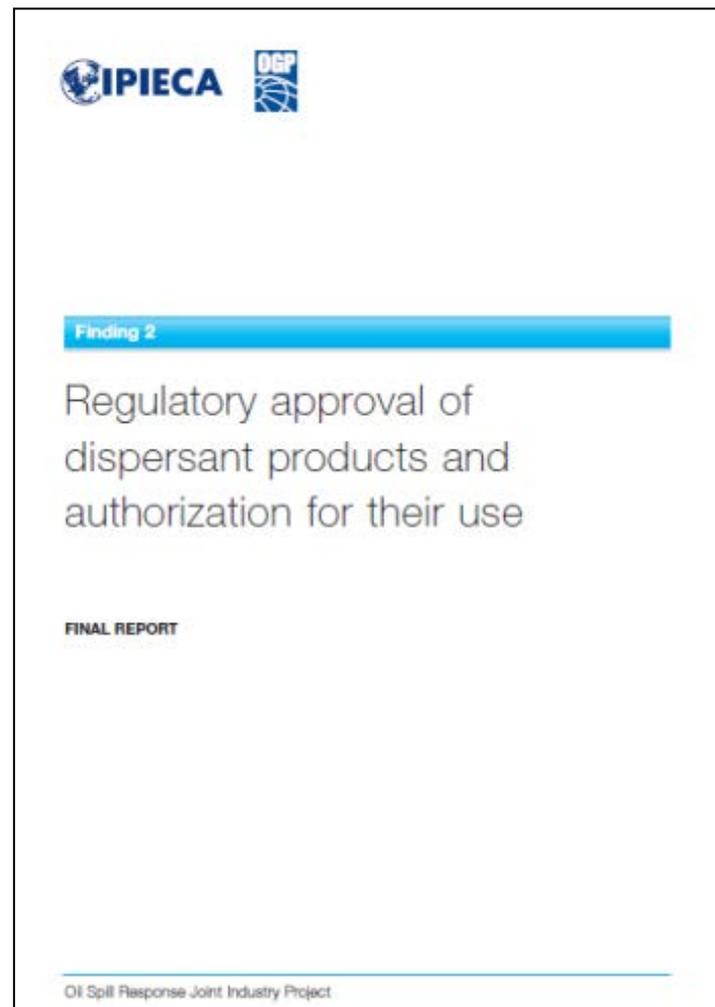
- Dispersant logistics & preplanning (Completed)
- SMART/post-spill monitoring protocols
  - ✓ Can SMART be used to judge post-spill monitoring following dispersant spraying from an aircraft, as well as during more conventional use from a surface vessel?
  - ✓ Consultant R Goodman / Author OSRL
  - ✓ Final draft circulated for comment



# Dispersant Approval and Authorization Focus

## The role of dispersant regulations

- Part 1: Dispersant product approval
  - ✓ Overview of the approval process
  - ✓ Effectiveness testing for product approval
  - ✓ Toxicity testing for product approval
  - ✓ Suggested additional information required for product approval
- Part 2: Dispersant use authorization
  - ✓ Use of NEBA
  - ✓ Oil spill risk and dispersant use authorization



## Dispersant Use Approval

- Regulations often require that permission be obtained before dispersants are used in certain locations, especially when close to shore and/or in shallow water
  - A pre-approval process may be used, especially for offshore and/or in deep water
- Documentation to support their use is often based on an environmental risk-analysis of relevant scenarios and is part of an approved contingency plan
  - Scenario-based contingency plans should demonstrate that dispersant use will give the best overall response for the environment
- Potential for significant differences from country to country
- Lots of current focus on US EPA proposal to amend the Subpart J regulatory requirements for the NCP Product Schedule
  - Comment period until April 22, 2015

# Dispersant Use Across the Globe

- Dispersants are a 1<sup>st</sup> or 2<sup>nd</sup> response option in many countries today

|                 |                    |
|-----------------|--------------------|
| • ANGOLA        | • LEBANON          |
| • ARGENTINA     | • LIBYA            |
| • AUSTRALIA     | • MALAYSIA         |
| • BELGIUM       | • MALTA            |
| • BRAZIL        | • MEXICO           |
| • BRUNEI        | • MONTENEGRO       |
| • CAMEROON      | • MOROCCO          |
| • CANADA        | • NAMIBIA          |
| • CHILE         | • NICARAGUA        |
| • CHINA         | • NETHERLANDS      |
| • COLUMBIA      | • NEW ZEALAND      |
| • CÔTE D'IVOIRE | • NIGERIA          |
| • CROATIA       | • NORWAY           |
| • CYPRUS        | • OMAN             |
| • DENMARK       | • PAKISTAN         |
| • DJIBOUTI      | • PAPUA NEW GUINEA |
| • ECUADOR       | • PHILIPPINES      |
| • EGYPT         | • POLAND           |
| • EL SALVADOR   | • PORTUGAL         |
| • ERITREA       | • QATAR            |
| • FRANCE        | • RUSSIA           |
| • FRENCH GUIANA | • SAUDI ARABIA     |
| • GABON         | • SENEGAL          |
| • GEORGIA       | • SIERRA LEONE     |
| • GERMANY       | • SINGAPORE        |
| • GHANA         | • SOUTH AFRICA     |
| • GREECE        | • SOUTH KOREA      |
| • GREENLAND     | • SPAIN            |
| • ICELAND       | • SRI LANKA        |
| • INDIA         | • SUDAN            |
| • INDONESIA     | • SYRIA            |
| • IRELAND       | • TANZANIA         |
| • ISRAEL        | • THAILAND         |
| • ITALY         | • UAE              |
| • JAPAN         | • UK               |
| • KENYA         | • URUGUAY          |
| • KUWAIT        | • US               |
|                 | • VIETNAM          |

■ COUNTRIES WHERE DISPERSANTS ARE FIRST OR SECOND RESPONSE OPTION



Many countries consider dispersants an important tool in oil spill response. However, there is global inconsistency in the types of approved dispersants and how and when to use them.

Source: International Tanker Owners Pollution Federation (ITOPF)

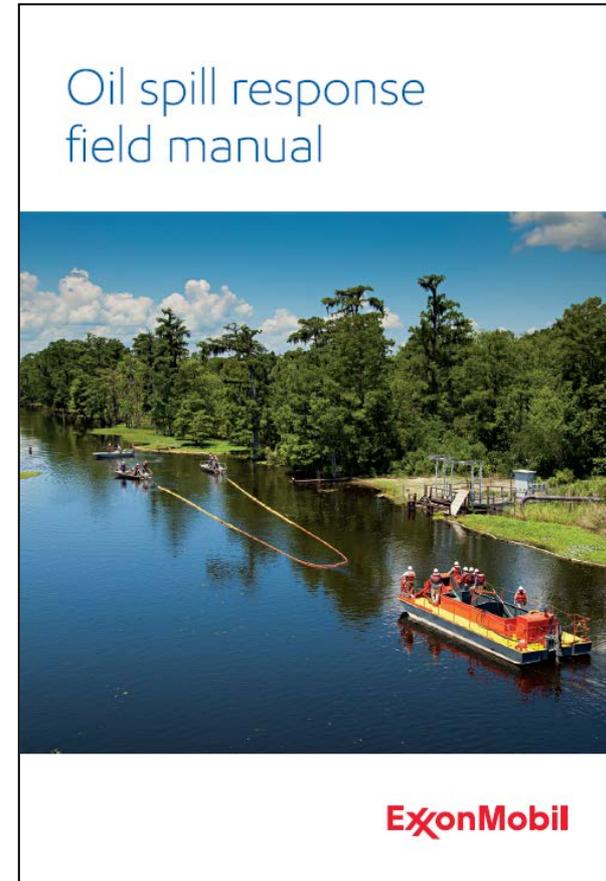
# New Delivery Platform

- 727 in development by Oil Spill Response Limited (OSRL)
  - Shorter transit times
  - Large payload
  - Demonstrated capability for dispersant application



# ExxonMobil OSR Field Manual

- Update to 2008 Edition
- Printing in 1Q, 2015
  - Updates to several topics, including Dispersants, Aviation, Communications, Safety, In-Situ Burn, Wildlife



# Reference Sites

For more information, please visit:

- American Petroleum Institute (API) / Joint Industry Task Force (JITF) website (factsheets and reports):

<http://www.oilspillprevention.org/oil-spill-research-and-development-cente>

- OGP / IPIECA JIP Website:

<http://oilspillresponseproject.org>

## Completed Products

### Oil Spill Preparedness and Response: A Good Practice Framework

**Oil Spill Preparedness and Response Framework**

This document outlines the basics of Oil Spill Preparedness and Response used by industry in responding to an oil spill. It explains how the industry has developed a framework of options for responding to oil spills and shows:

- Why effective Oil Spill Preparedness and Response is so critical
- What makes an Oil Spill Preparedness and Response framework effective
- The components of our Oil Spill Preparedness and Response framework
- How to support Oil Spill Preparedness and Response effort



The infographic is titled "SUBSEA AND POINT SOURCE DISPERSANT OPERATIONS". It features a circular logo with a gear and a globe. The text explains that dispersants may only be applied with the appropriate dispersant system. It details the process of dispersant application, including the use of dispersant systems and the importance of dispersant effectiveness. The infographic also mentions that dispersants are used to break down oil into smaller droplets, which are then dispersed throughout the water column. This process is essential for reducing the impact of oil spills on the environment and wildlife.

The infographic is titled "Fact Sheet Series" and lists several resources related to oil spill response. The resources include:

- Introduction to Dispersants
- Dispersants - General Health and Safety
- Initial Oil Spill Response
- Search and Dispersants
- Dispersant for Dispersants in the Arctic
- Assessing Dispersant for Trade-offs
- Arctic and Great Lakes Dispersant Operations
- Subsea and Point Source Dispersant Operations
- Dispersant Use and Response Goals
- Dispersant Use in the Arctic