2017

The Value of Dispersant Use for Offshore Oil Spill Response

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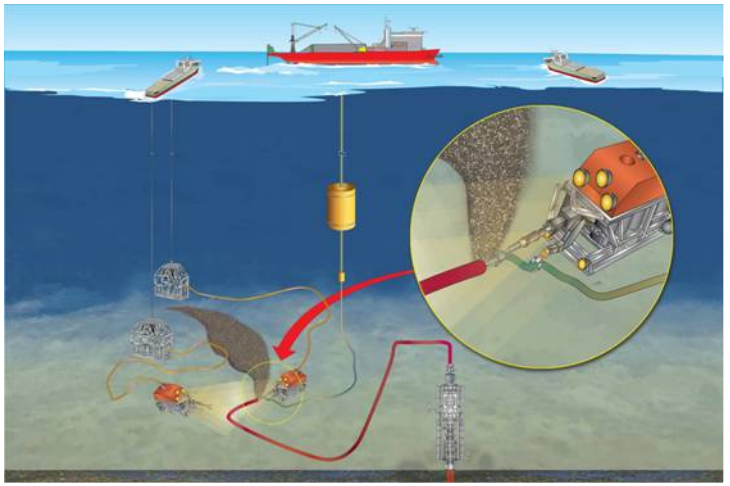
Topics of Discussion

- Oil spill response options
- Background on dispersants
- Subsea dispersants
- Observations on their use
- Other research activities



Spill Response Options: The Toolbox

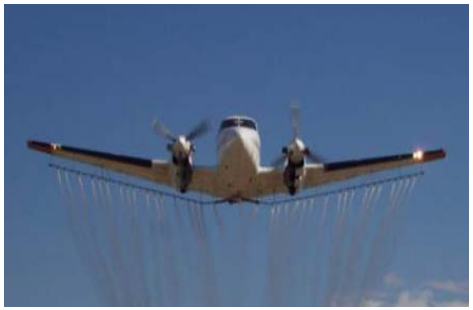
Monitor & Evaluate

Mechanical Recovery

In-Situ Burning

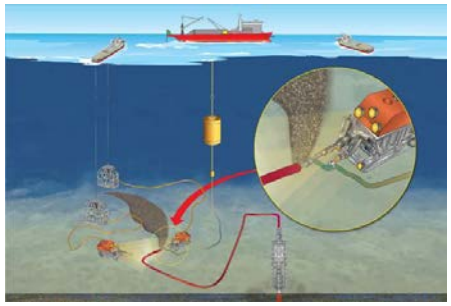
Dispersants

Aerial



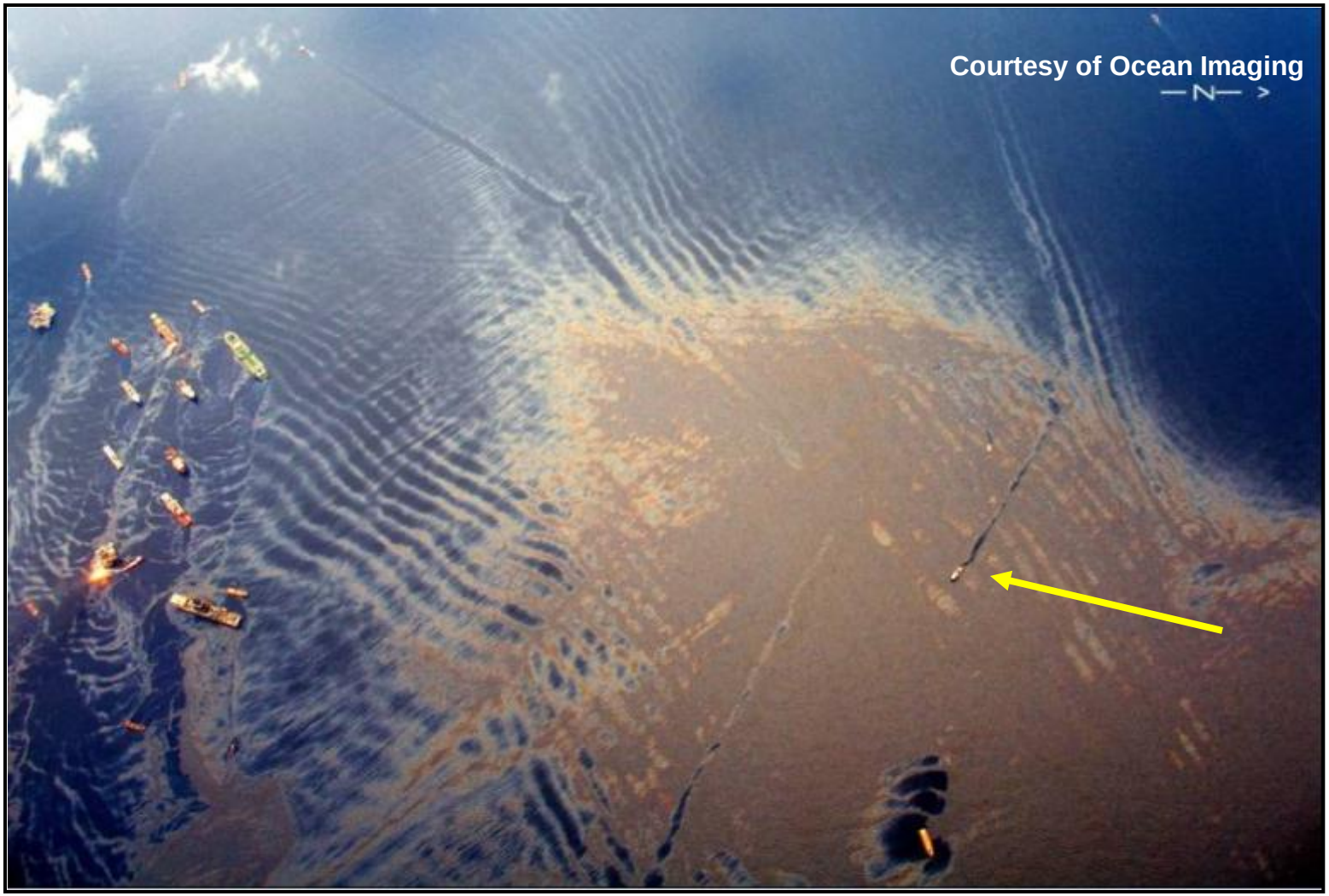
Vessel

Subsea



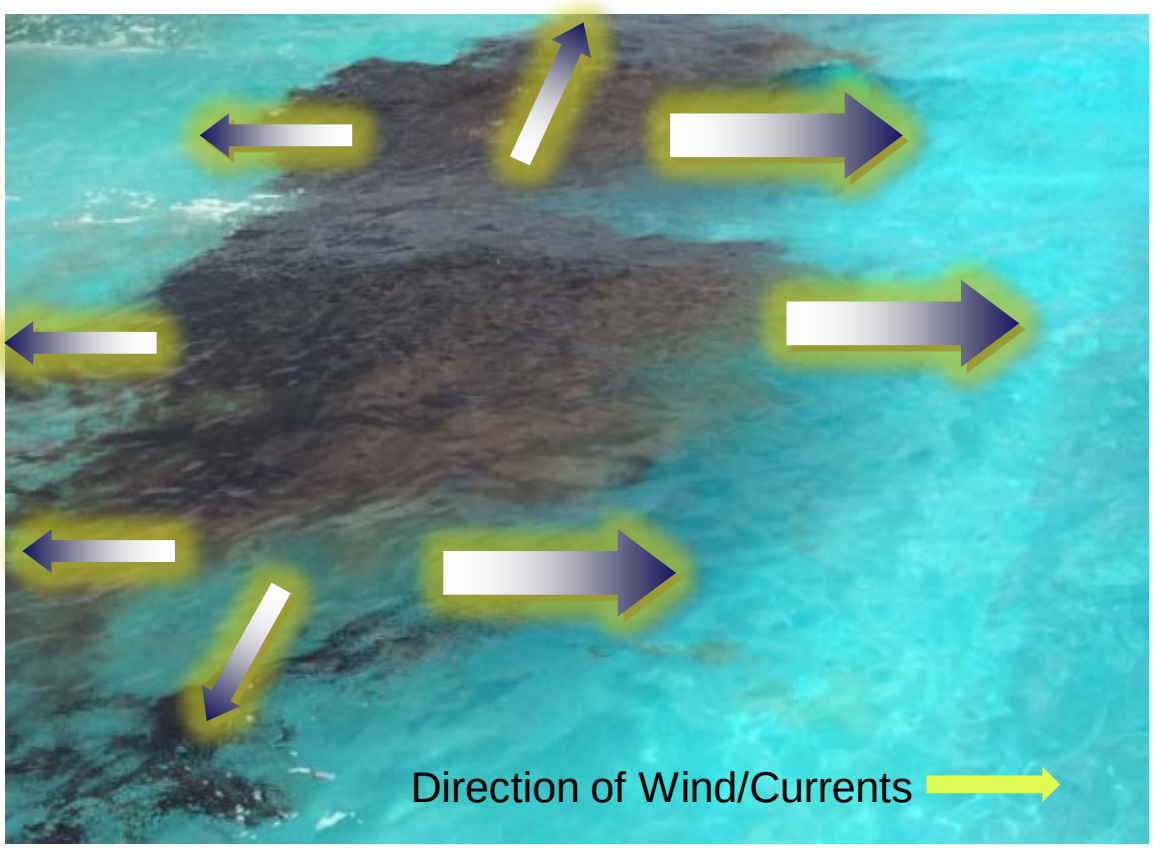
The goal is to design a response strategy based on Net Environmental Benefit Analysis (NEBA)

Encounter Rate is Key to Offshore Response



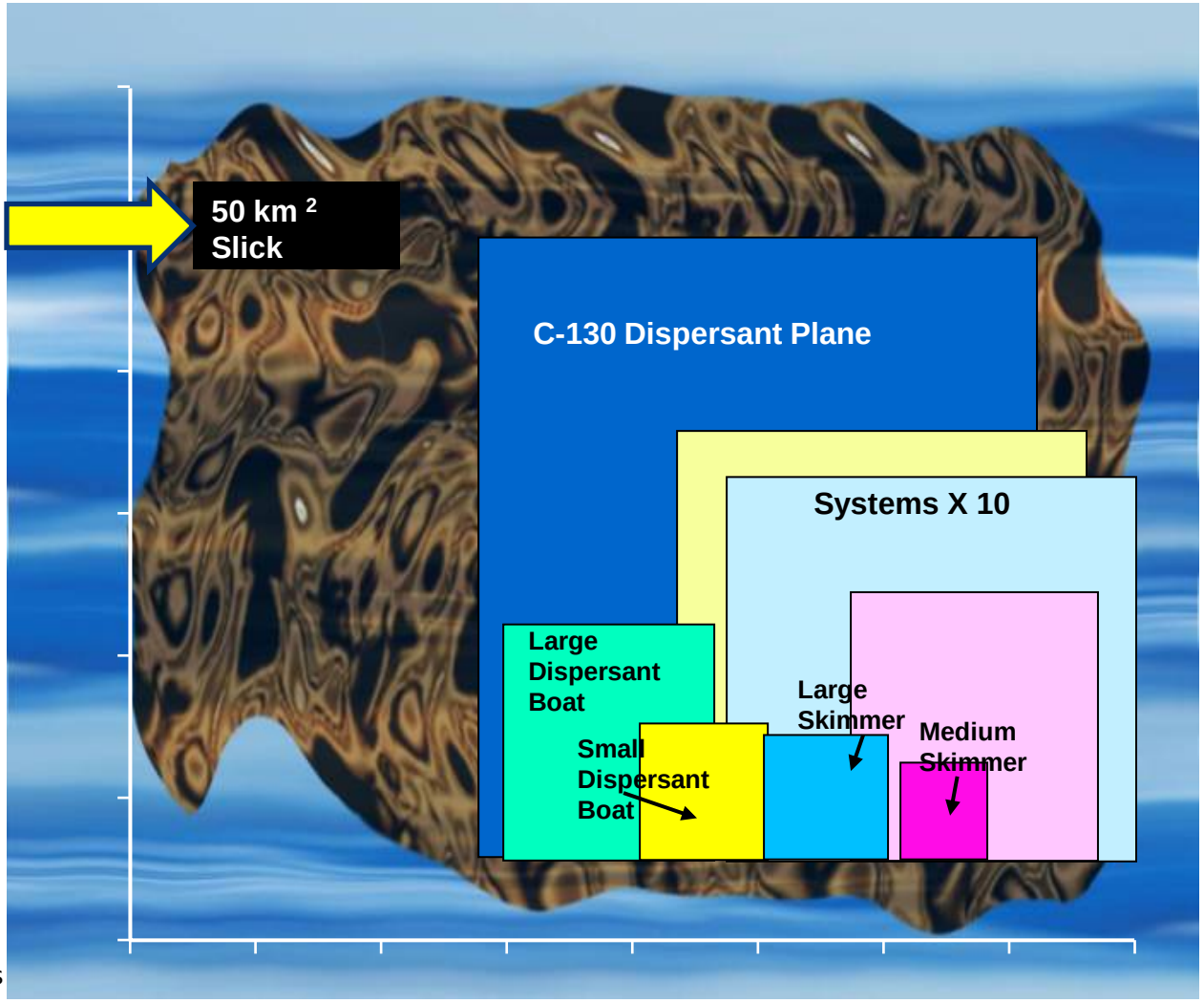
Oil Slicks Spread Quickly

- 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^2
- 8 hrs of operation
- Continuous encounter with slick



For reference:

9300 American Football fields

6500 Football (soccer) fields

2900 Australian rules Football fields

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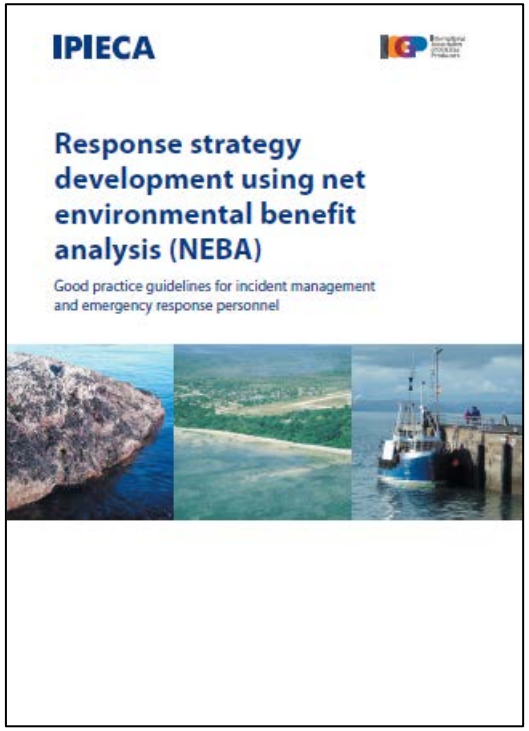
Optimum Response Strategy

- 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

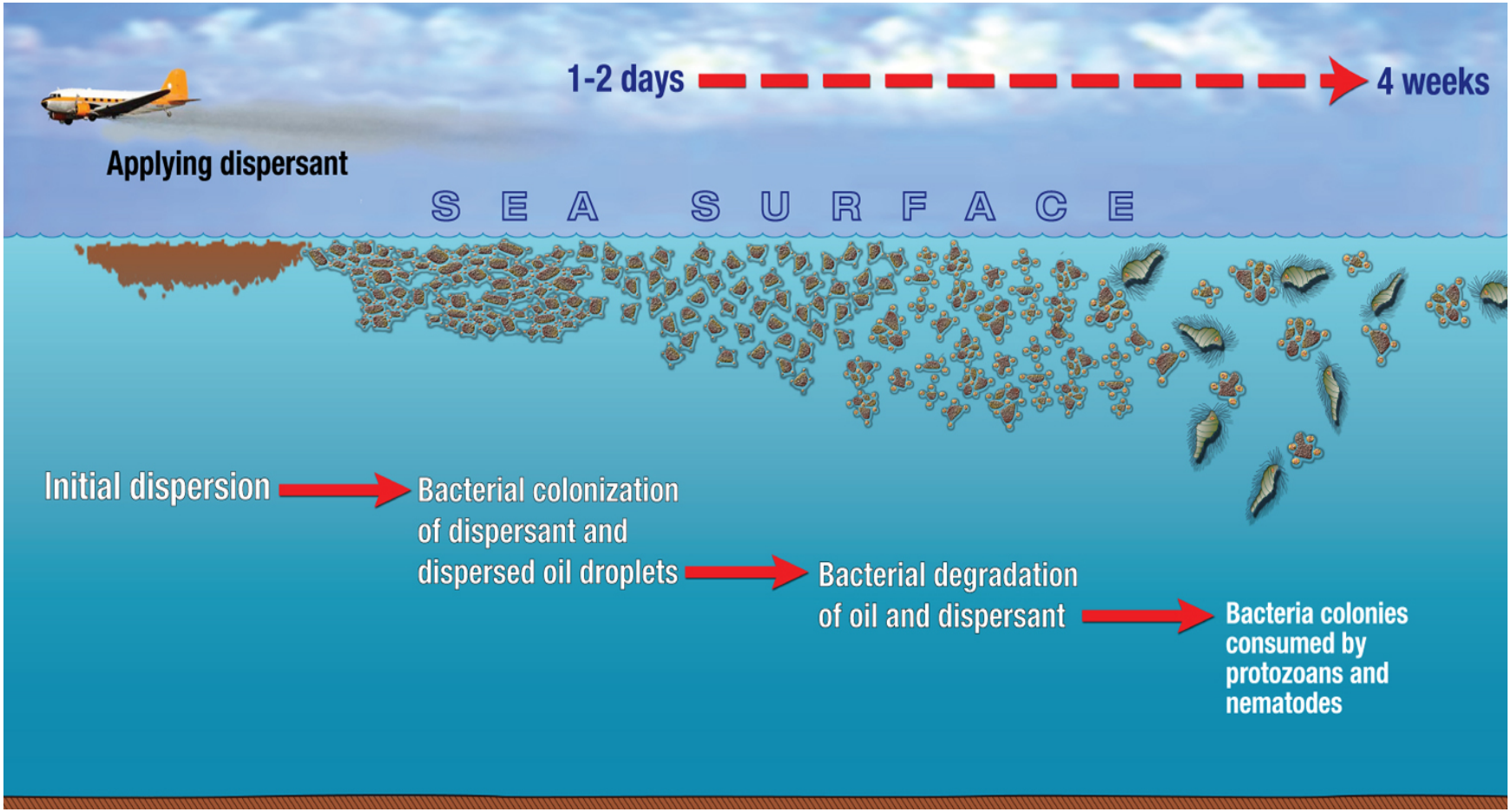
Net Environmental Benefit Analysis (NEBA) / Spill Impact Mitigation Assessment (SIMA)

- 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 discussions in advance of a spill



Dispersants Enhance Removal of Oil

Through Biodegradation



NEBA/SIMA Considerations Regarding Dispersants

- Oil on the Surface May Affect Birds and Habitats
- Oil in Water May Affect Marine Life

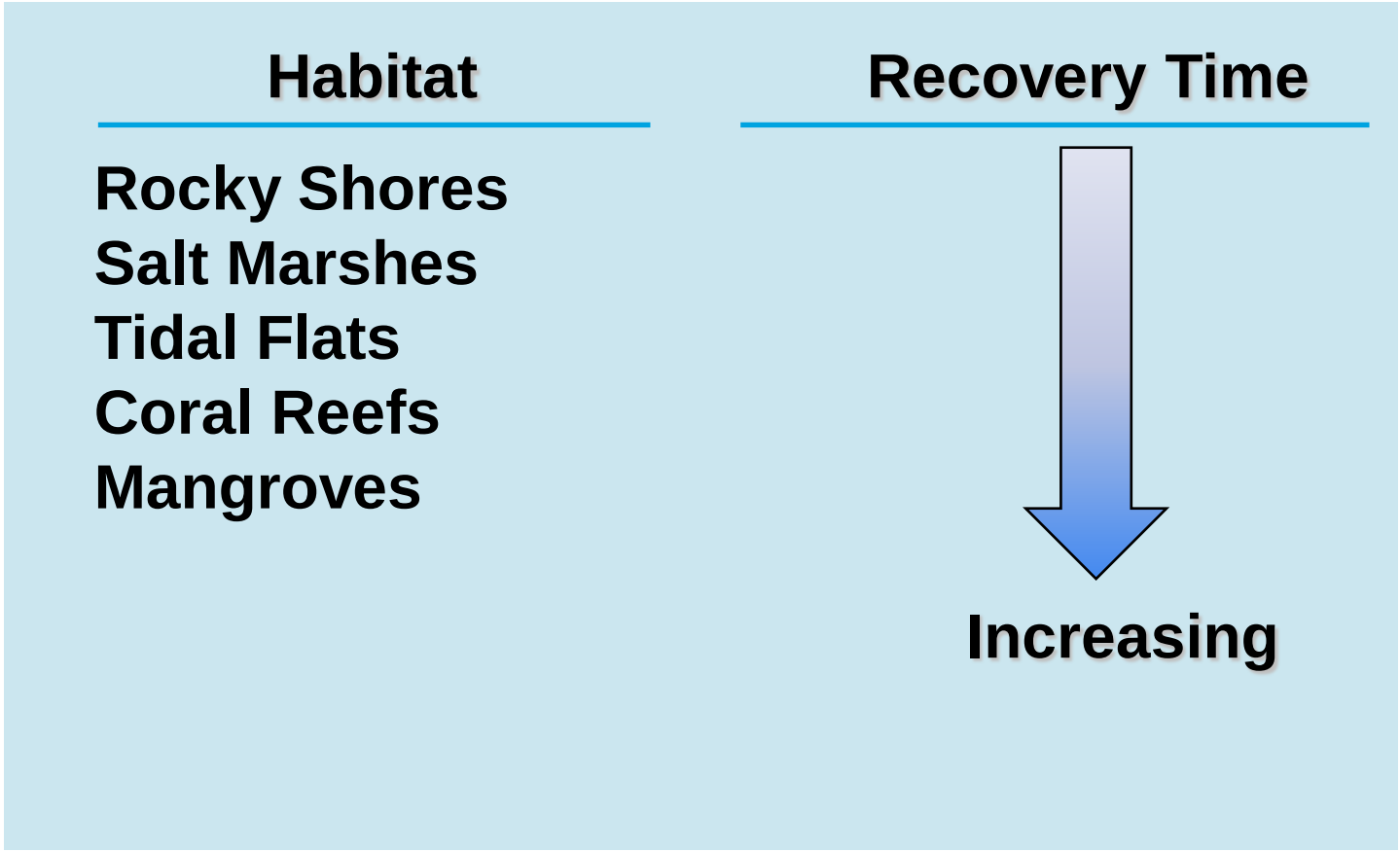
- Oil in Marshes May Affect Marsh Grass
- Oil in Water May Affect Sea Grass

- 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

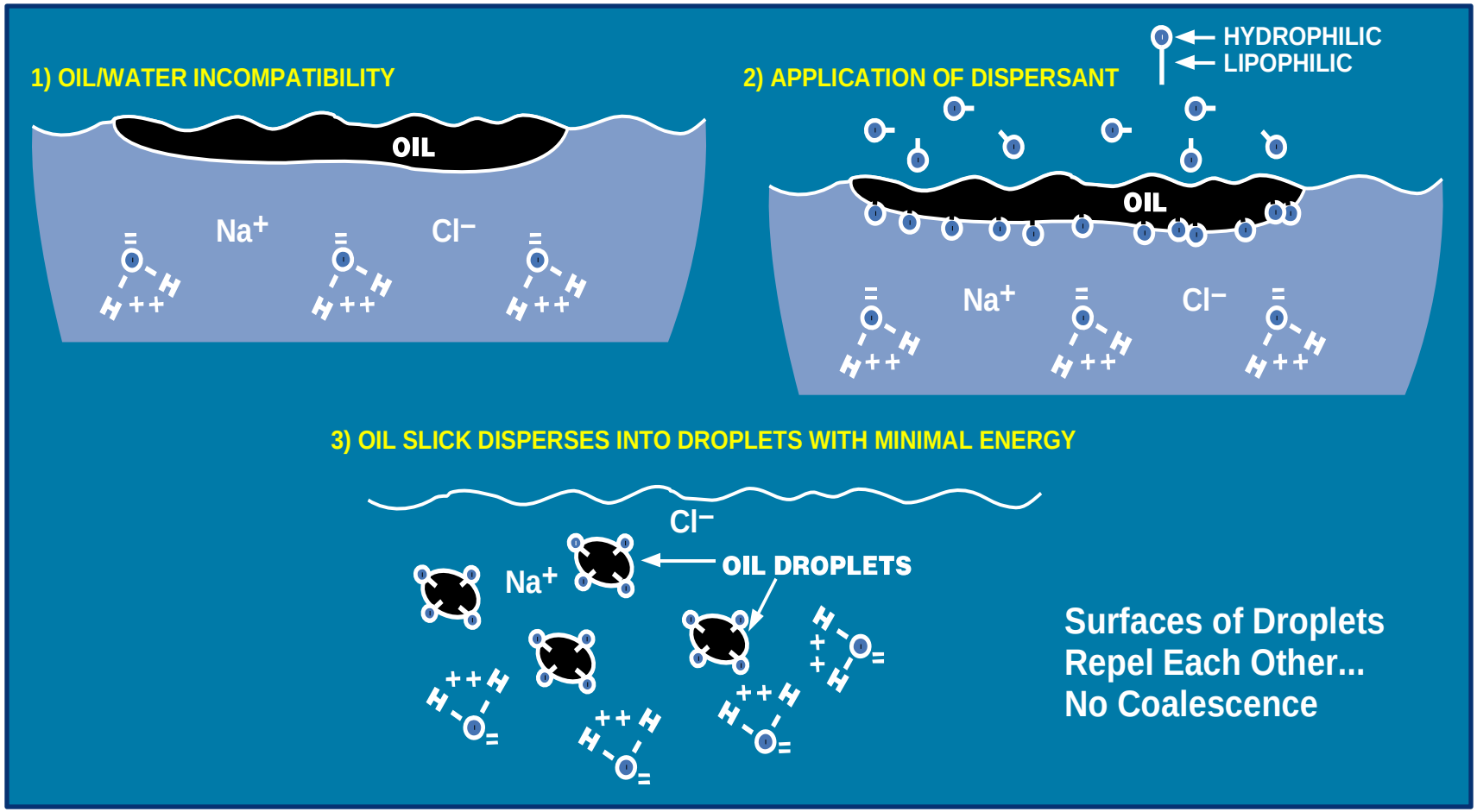
Water-Compatible (Hydrophilic)

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

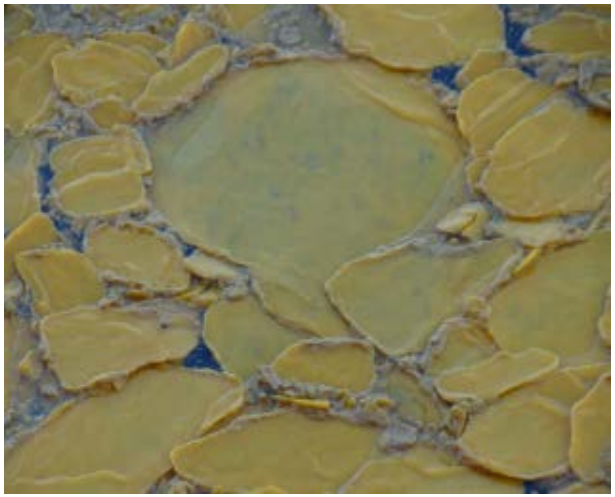
How Dispersants Work

The Goal: Reduce Oil Concentration to Below Impact Levels Rapidly



Factors Influencing Effectiveness

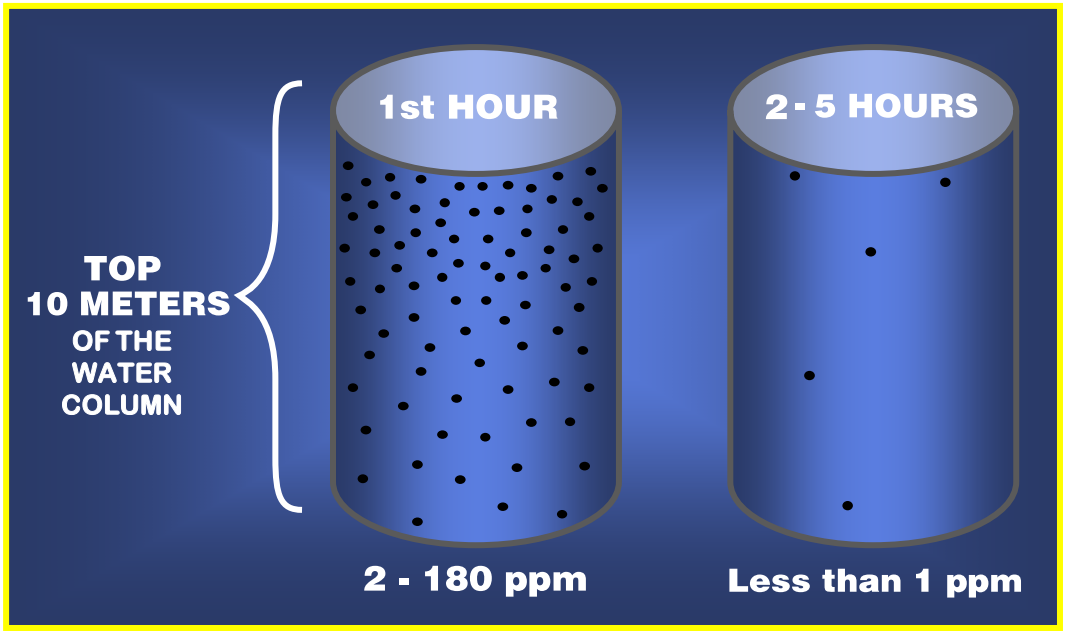
- Oil Type/Properties
  - Viscosity
  - API Gravity
  - Wax Content/Pour Point
  - Emulsifiers



- 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)*

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

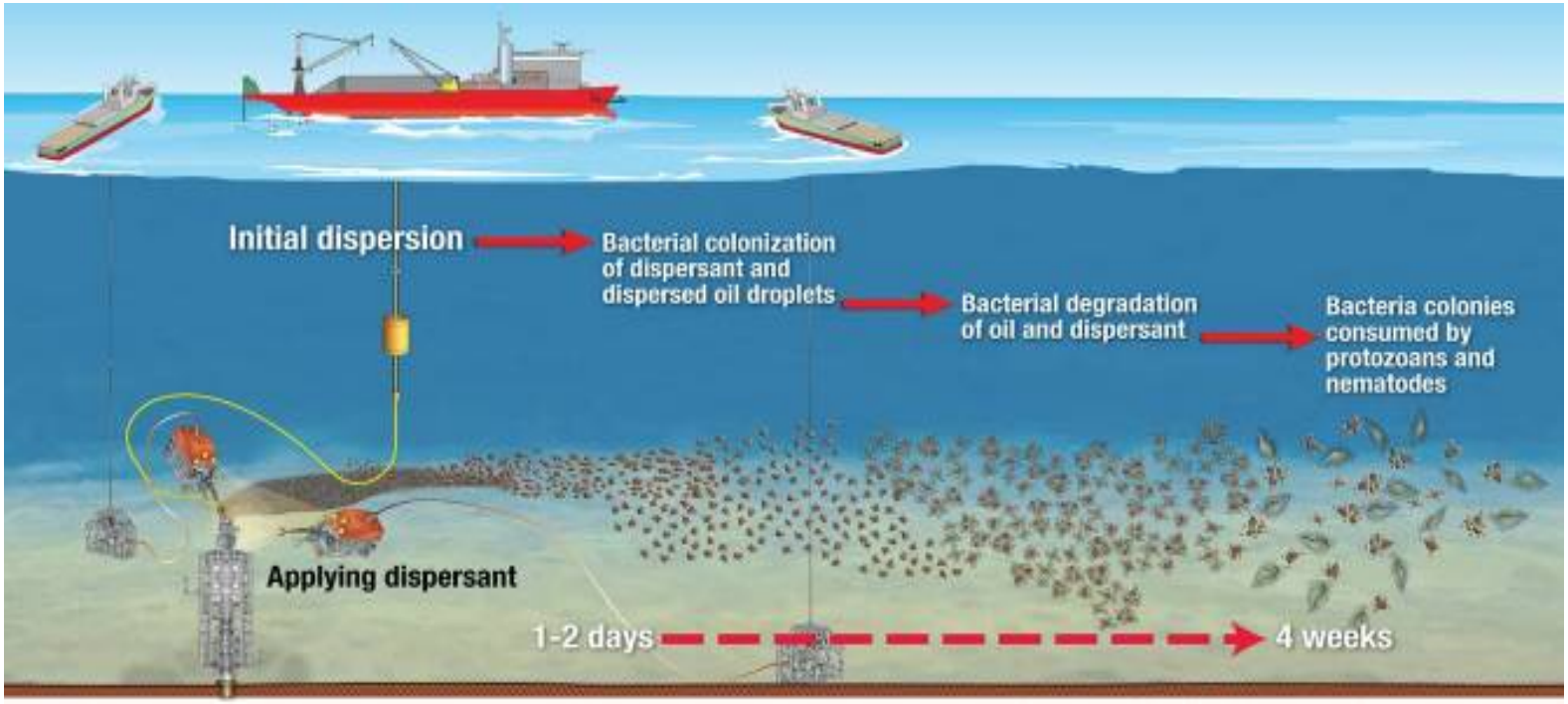
Product	Toxicity (ppm)
Palmolive® Dish Soap	13
Sunlight ® Dish Soap	13
Mr. Clean®	30
Corexit® 9527	108
Corexit® 9500	350

(96 HR Rainbow Trout LC50)

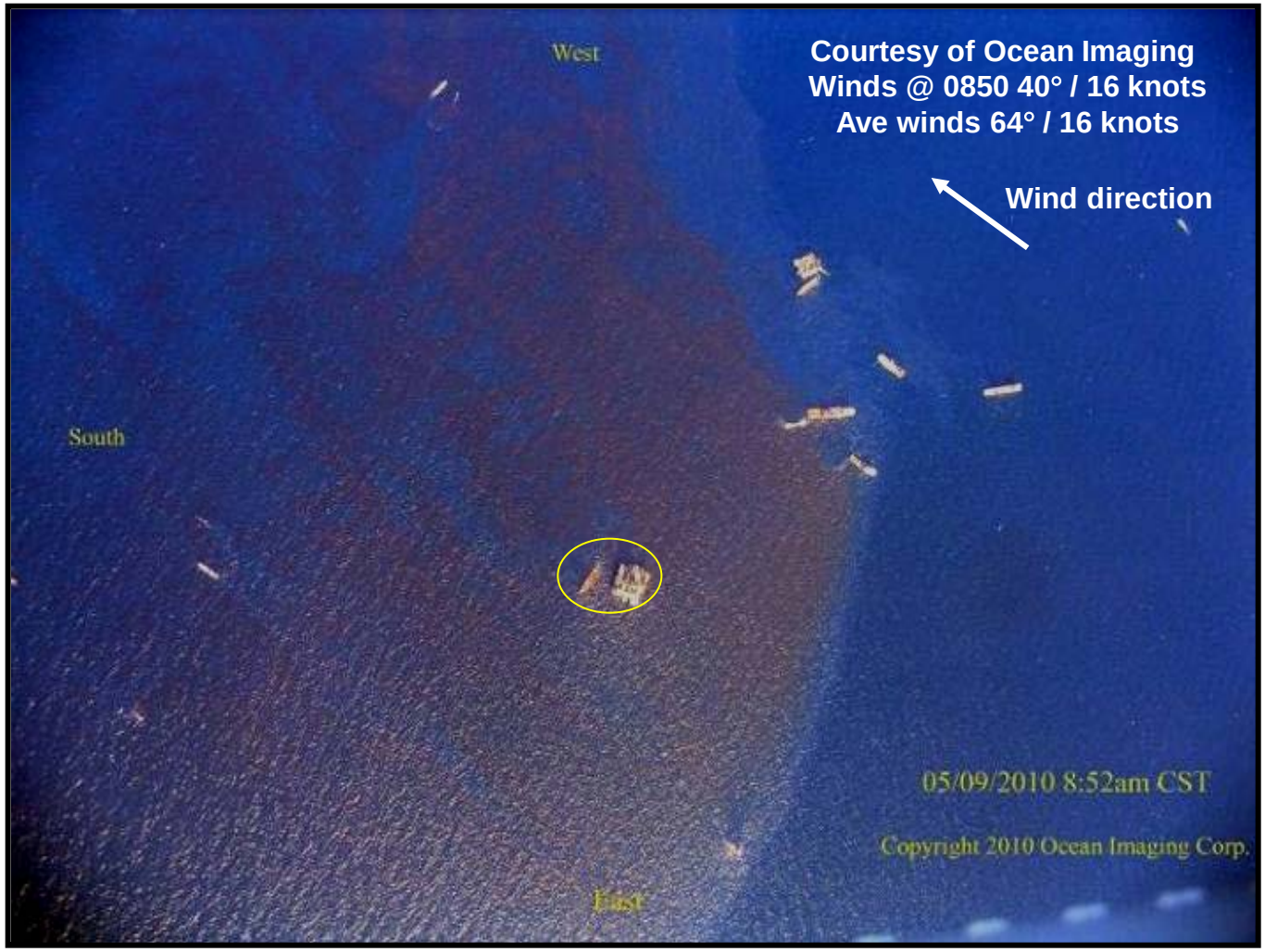
Less toxic

Subsea Injection of Dispersants

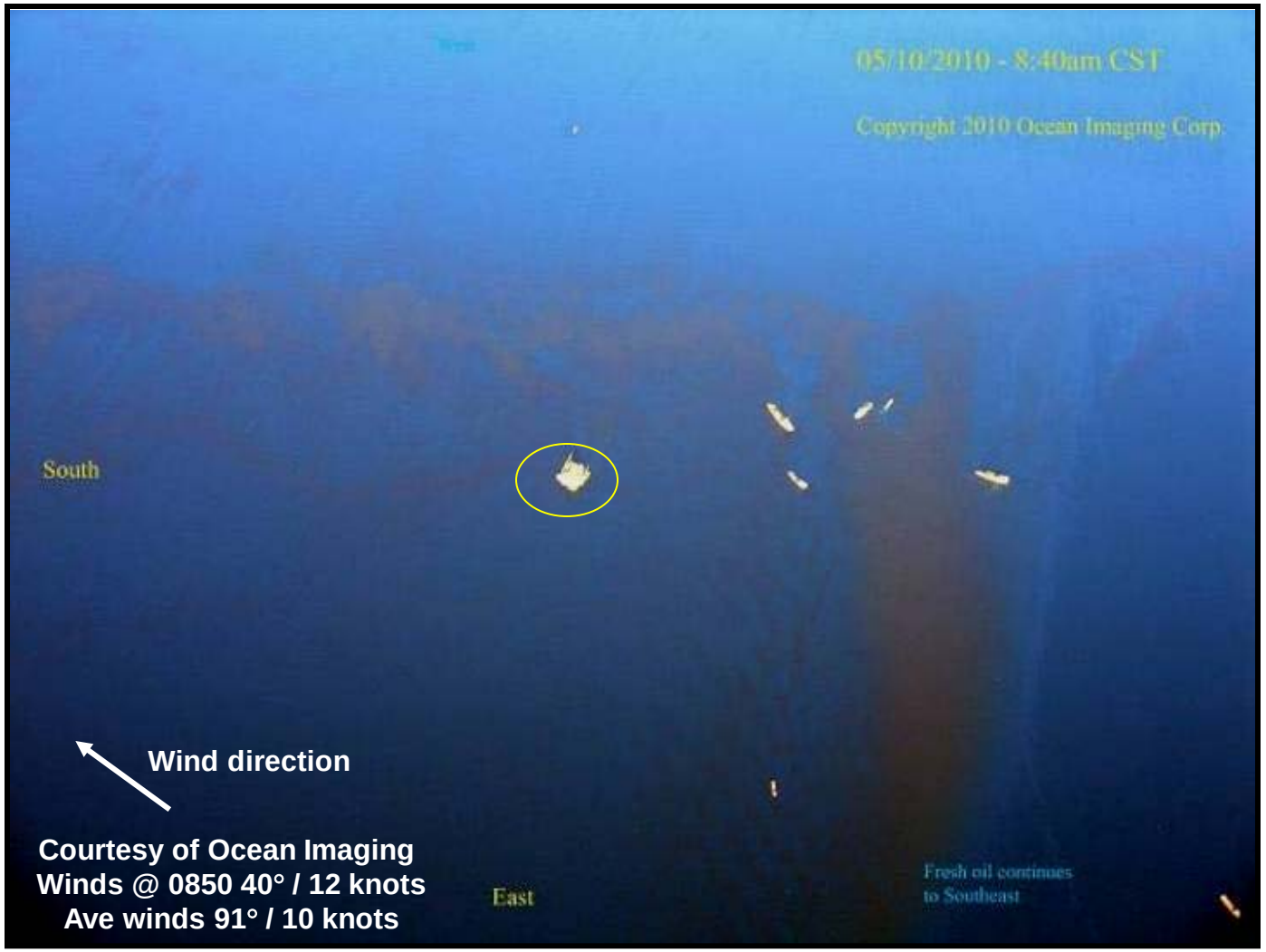
- Preliminary observations of Macondo Well experience
- Benefits of subsea injection
- Long-term fate and effects



Release Site May 9, 2010
Prior to Injection

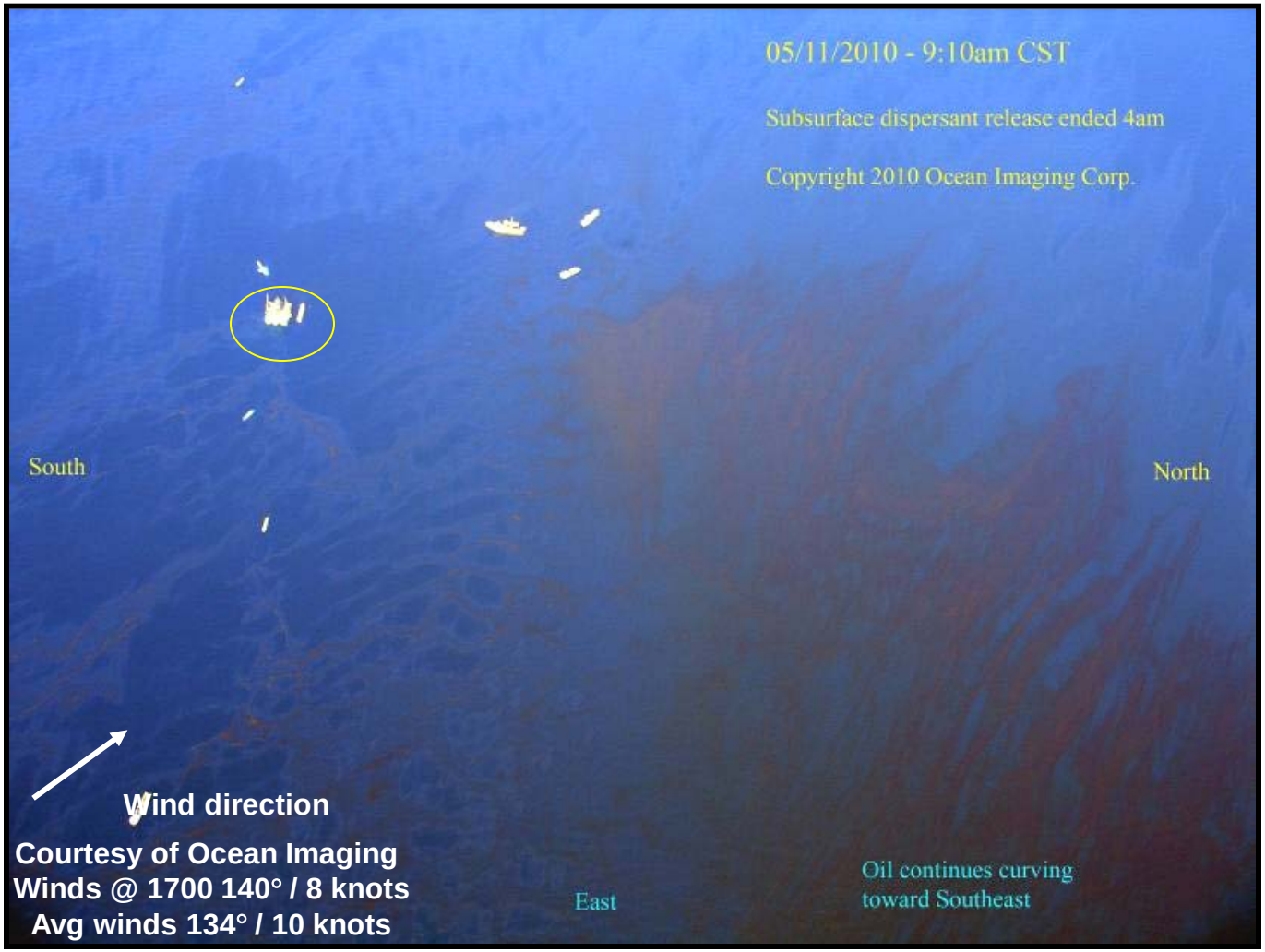


Release Site May 10, 2010
3 hours of Injection

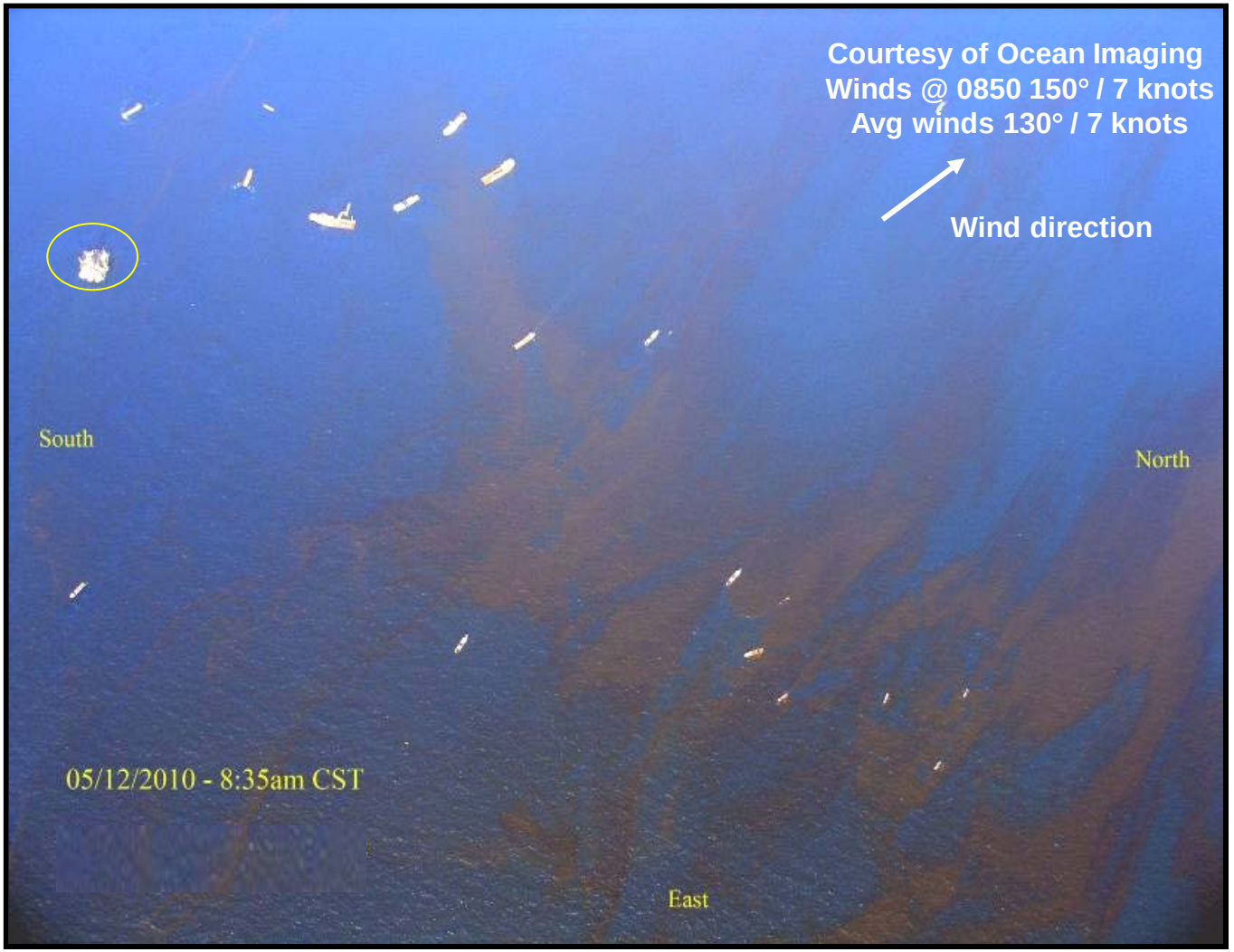


Release Site May 10, 2010
11 hours of Injection

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

- New Aerial Dispersant Delivery Platform
- Joint Industry Projects via IPIECA/IOGP and API

New Delivery Platform

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

The Oil Spill Response Joint Industry Project

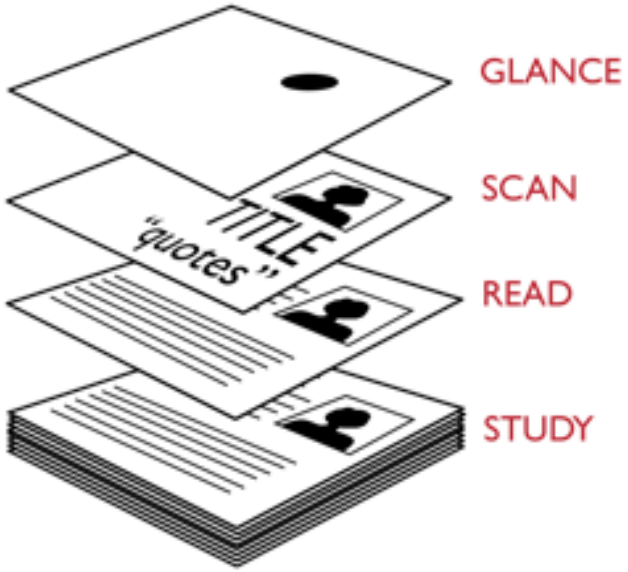
- Initially a three – year project (2012 – 2014) addressing recommendations for spill response developed following the Montara and Macondo incidents – Phase II complete 2016
- Nineteen members, twenty-two projects
- Improving co-ordination between the many groups that are also working global oil spill response issues
- Dispersant issues were addressed in about 20% of the JIP work streams

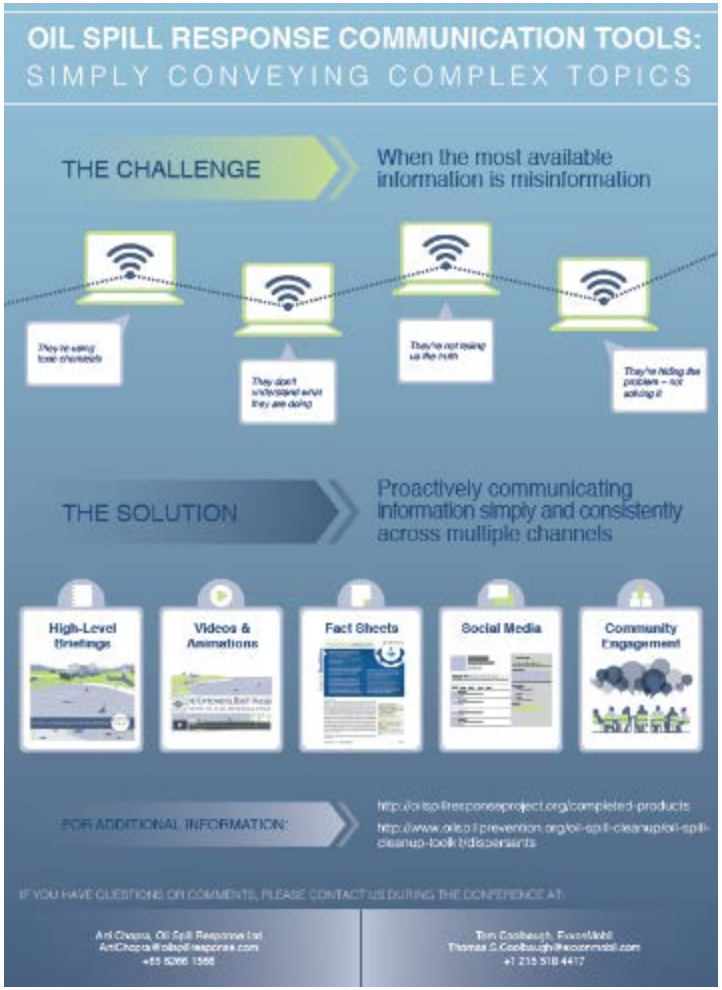
Dispersant Education

- Joined with API to co-fund NEBA communication project: Completed with “scan / glance” products
- Joined with API to co-fund SL Ross dispersant paper review panel: Summary of reviews complete
- Joined with API to develop materials on dispersants – added material on toxicity and human health; core basis is the API dispersant fact sheets – posted on website
- Make the most of communication opportunities, e.g., IOSC, InterSpill, Spillcon, SPE conferences and others as they arise

The Communications Challenge

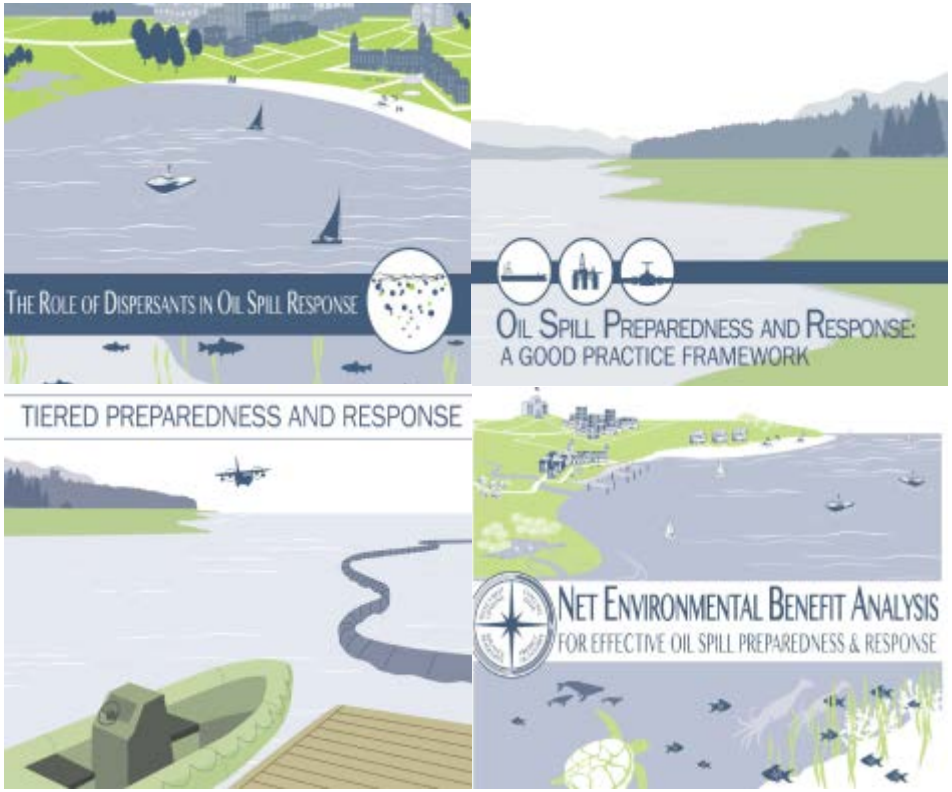
- All avenues for sharing information need to be considered





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

- GPGs fit into several themes

STRATEGY

- Oil Spill Preparedness & Response - Framework
- Incident Management Strategies
- SIMA/NEBA

RESPONSE

- Aerial Surveillance
- Dispersants: Sea surface
- Dispersants: Subsurface
- At Sea Containment and Recovery
- In-Situ Controlled Burning
- Shoreline Response Planning and SCAT
- Shoreline Cleanup Techniques
- Inland Responses
- Waste Management
- Oiled Wildlife Management
- Economic Assessment and Compensation
- Responder Health and Safety

PREPAREDNESS

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

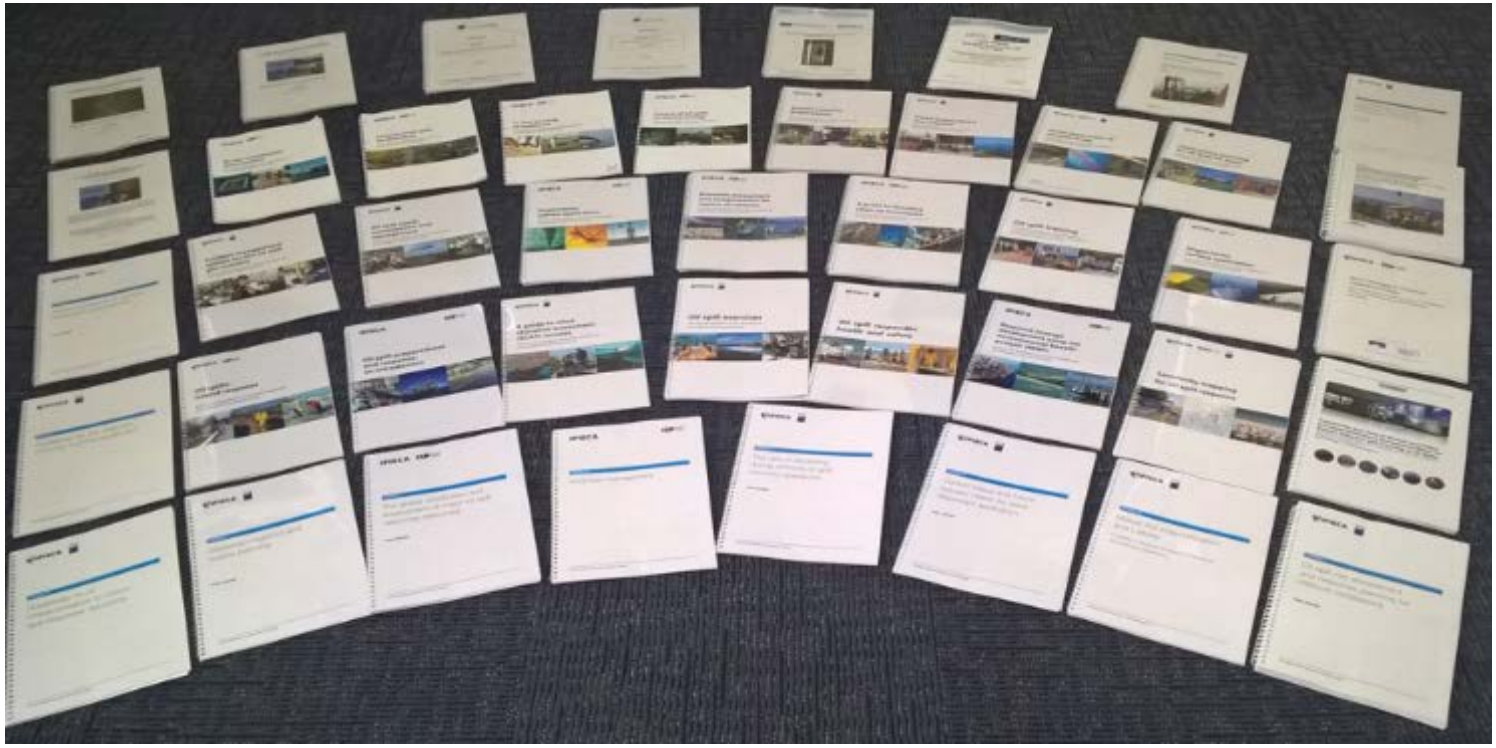
IMPACTS

- Impacts on Marine Ecology
- Impacts on Shorelines

The Good Practice Guides

How many have you seen/read?

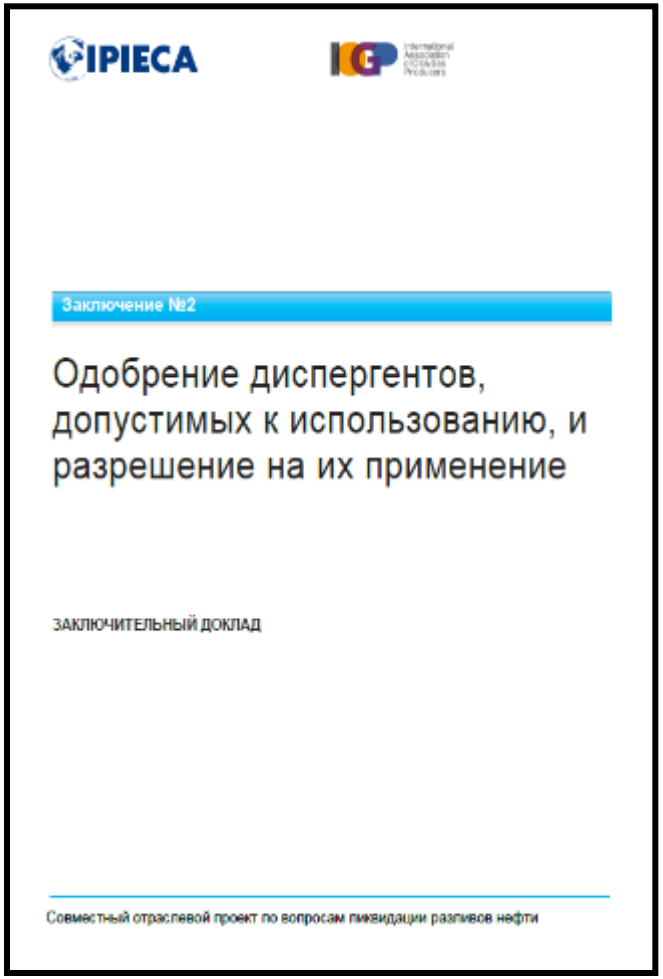
- Hard copy, tablet, computer memory



Future Work

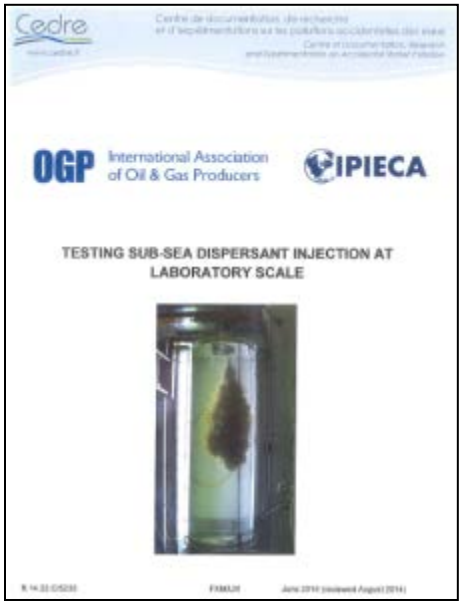
- Completion of the last few
- Translations – 22 documents
  - French, Portuguese, Russian and Spanish
  - 8 additionally in German and Italian
  - Phased delivery thru 2016 into Spring 2017
- Posted on JIP website as soon as each one is completed

http://oilspillresponseproject.org



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



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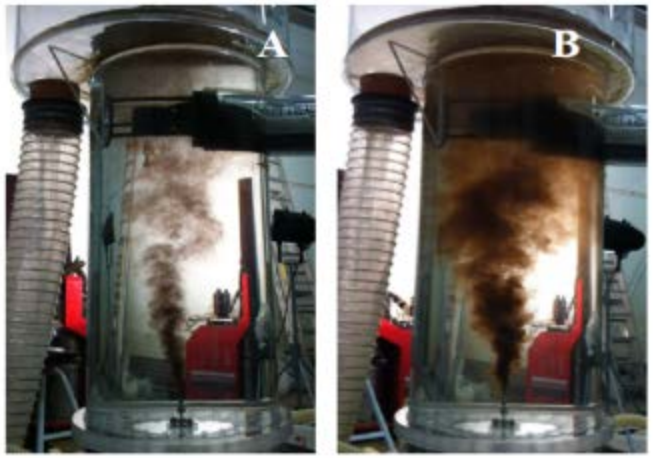
Development of Bench Scale Subsea Dispersant Effectiveness Test (IPIECA/IOGP)

- Four crude oils
- Three dispersants
- Two mixing regimes (high and low energy)
- Similar (but different) experimental set-up and analysis
- Studies completed and presented at AMOP

Cedre (France)

SINTEF (Norway)



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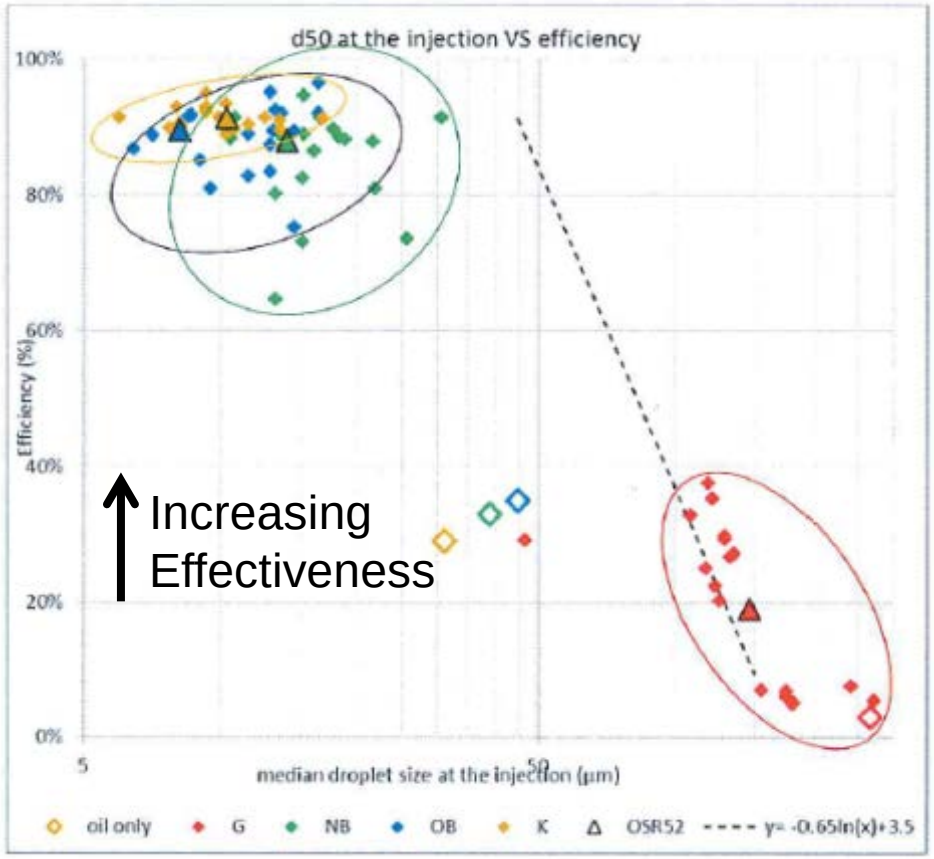
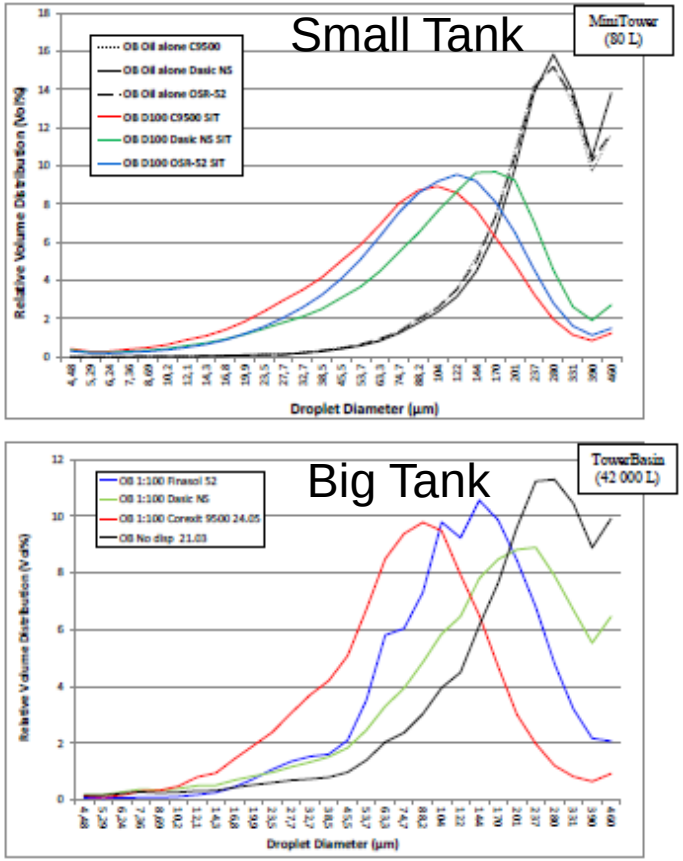
Example of Results: Droplet Size Effects

Cedre: Different Oils

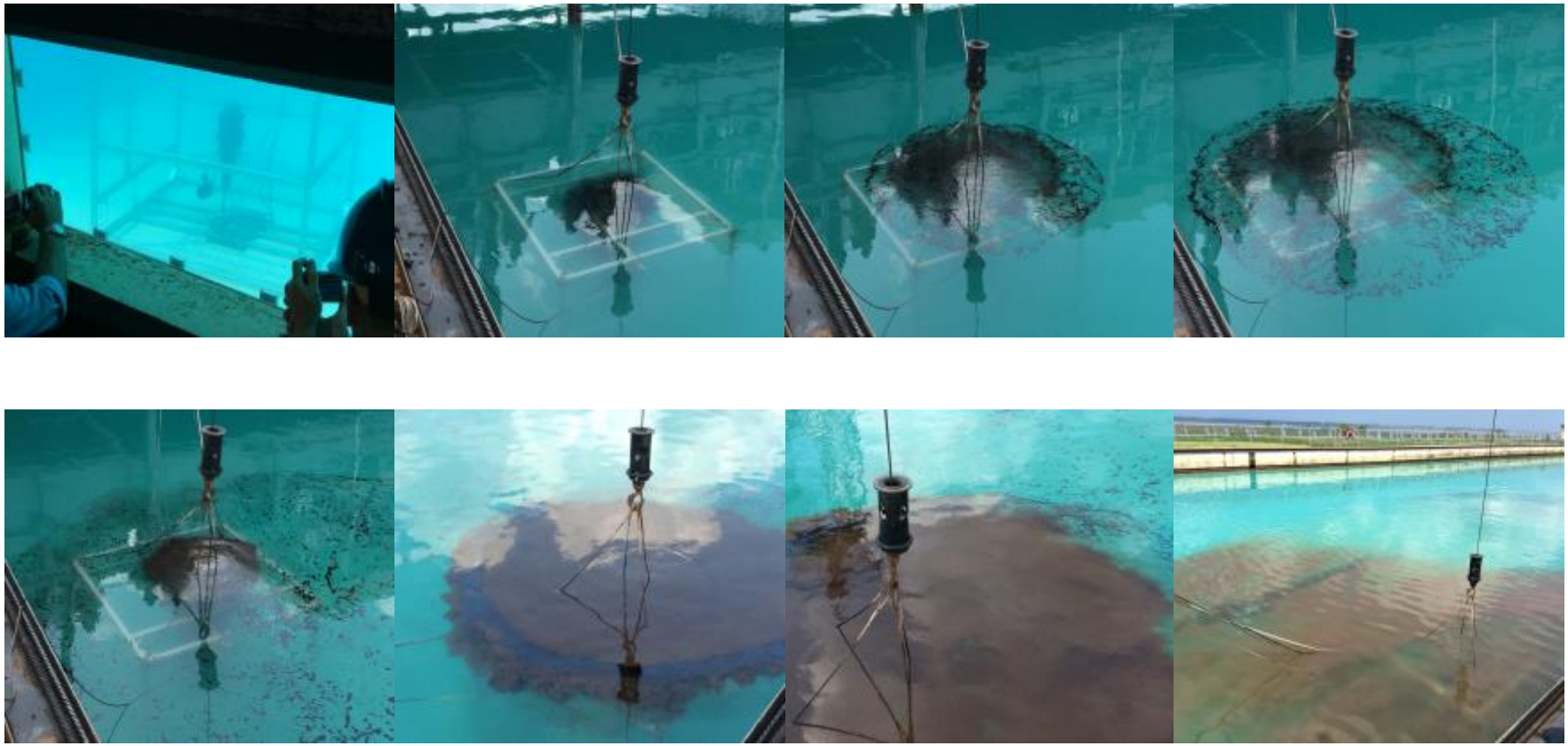


SINTEF: Different Dispersants



Increasing droplet size →

Demonstration of Subsea Dispersant Effectiveness (API)



OHMSETT Facility, New Jersey, July, 2014

Funded by API Joint Industry Task Force

OIL SPILL PREVENTION + RESPONSE

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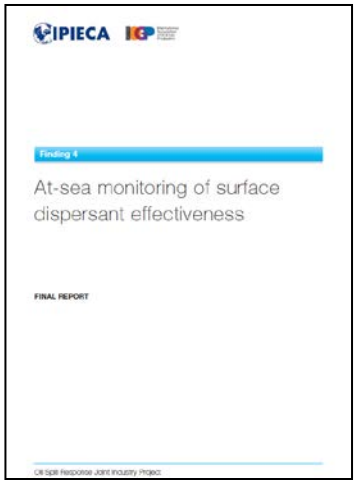
Other Dispersant Efforts

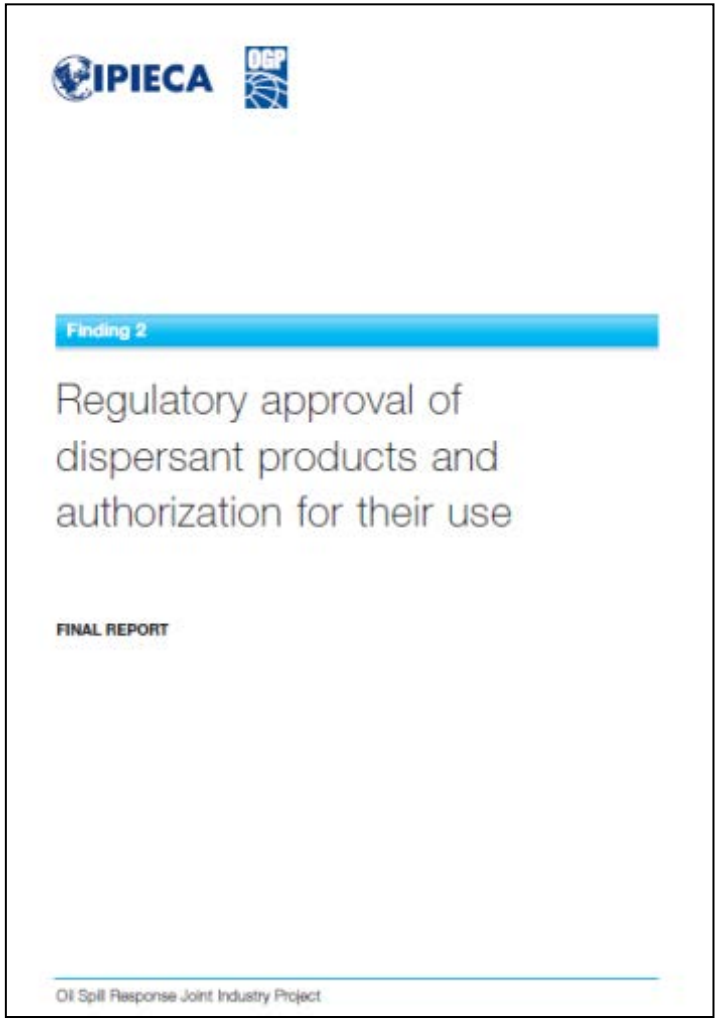
- Dispersant logistics & preplanning
- SMART/post-spill monitoring protocols
  - ✓ Can SMART be used to judge post-spill monitoring following dispersant spraying from an aircraft, as well as during more conventional use from a surface vessel?
  - ✓ Consultant R Goodman / Author OSRL



Dispersant Approval and Authorization Focus

The role of dispersant regulations

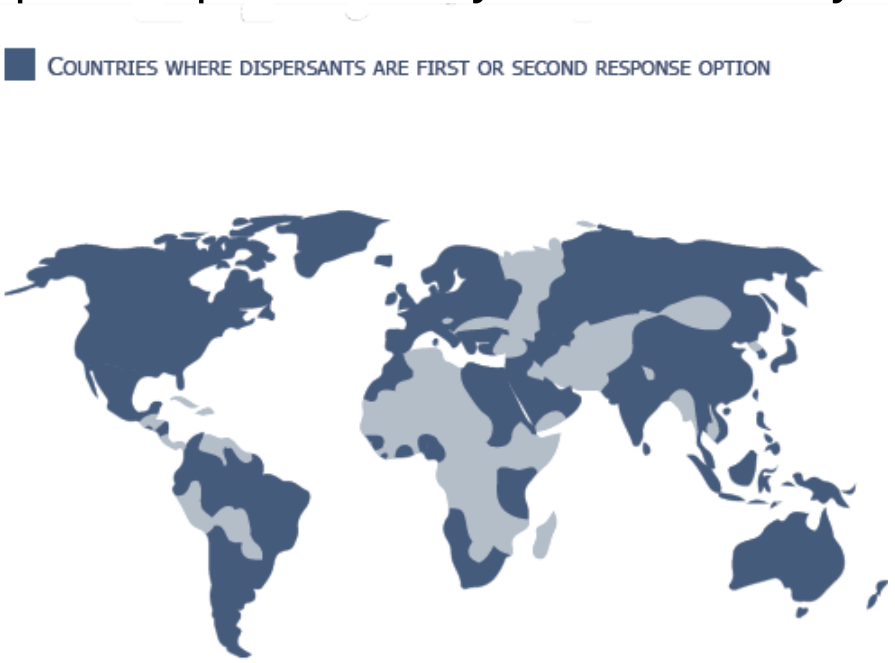
- Part 1: Dispersant product approval
  - ✓ Overview of the approval process
  - ✓ Effectiveness testing for product approval
  - ✓ Toxicity testing for product approval
  - ✓ Suggested additional information required for product approval
- Part 2: Dispersant use authorization
  - ✓ Use of NEBA/SIMA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



Dispersant Use Across the Globe

- Dispersants are a 1st or 2nd response option in many countries today

- Angola
- Argentina
- Australia
- Belgium
- Brazil
- Brunei
- Cameroon
- Canada
- Chile
- China
- Columbia
- Côte d'Ivoire
- Croatia
- Cyprus
- Denmark
- Djibouti
- Ecuador
- Egypt
- El Salvador
- Eritrea
- France
- French Guiana
- Gabon
- Georgia
- Germany
- Ghana
- Greece
- Greenland
- Iceland
- India
- Indonesia
- Ireland
- Israel
- Italy
- Japan
- Kenya
- Kuwait
- Lebanon
- Libya
- Malaysia
- Malta
- Mexico
- Montenegro
- Morocco
- Namibia
- Nicaragua
- Netherlands
- New Zealand
- Nigeria
- Norway
- Oman
- Pakistan
- Papua New Guinea
- Philippines
- Poland
- Portugal
- Qatar
- Russia
- Saudi Arabia
- Senegal
- Sierra Leone
- Singapore
- South Africa
- South Korea
- Spain
- Sri Lanka
- Sudan
- Syria
- Tanzania
- Thailand
- UAE
- UK
- Uruguay
- US
- Vietnam



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)

energy API

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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