

# NOAA's Increased Preparedness for Arctic Response

Amy A. Merten, Ph.D.

NOAA's Office of Response and Restoration/Coastal Response  
Research Center

Jun 11, 2009

National Ice Center Symposium  
Annapolis, MD



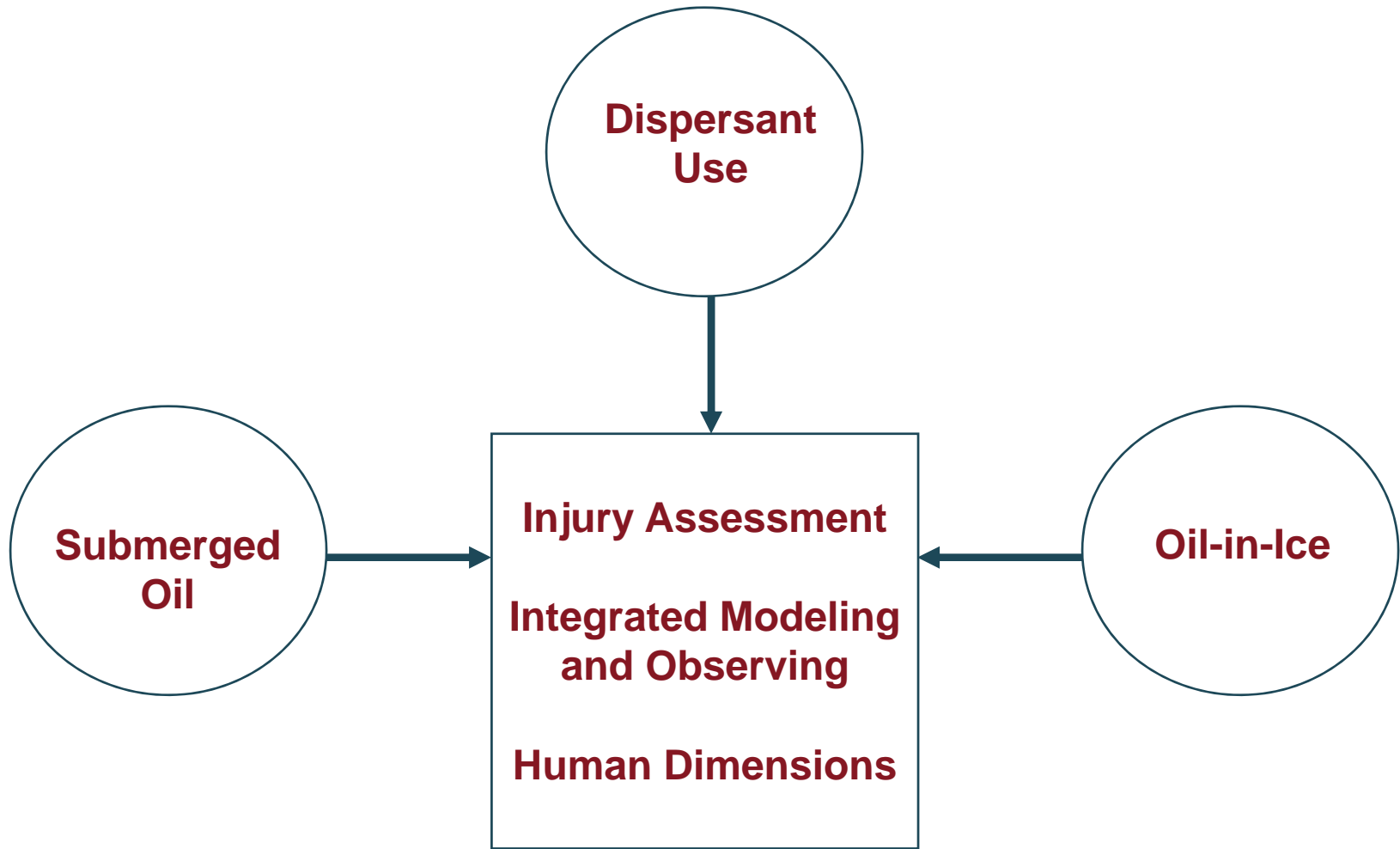
Coastal Response Research Center

# NOAA's Role in Spills

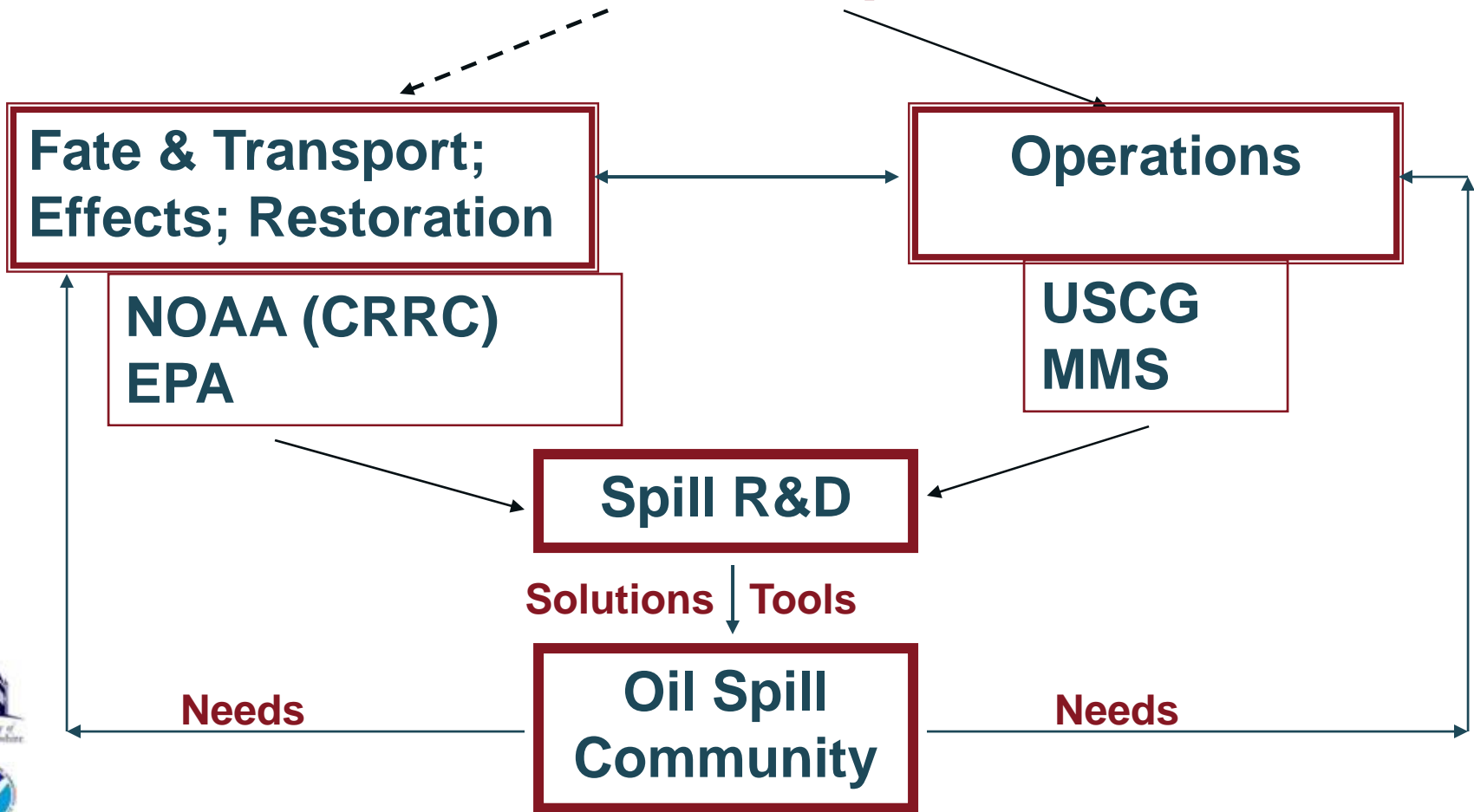
- Provide Scientific Support and Services to USCG
- Natural Resource Trustee
- Coastal Response Research Center -
  - Partnership between NOAA and the University of New Hampshire
- NOAA's Goals in Arctic Preparedness:
  - Arctic Disasters Workshop - Mar 2008
  - Joint Industry Project Oil-in-ice R&D Project
  - Environmental Response Management Application (ERMA)



# Focus Topics



# Federal Oil Spill R&D

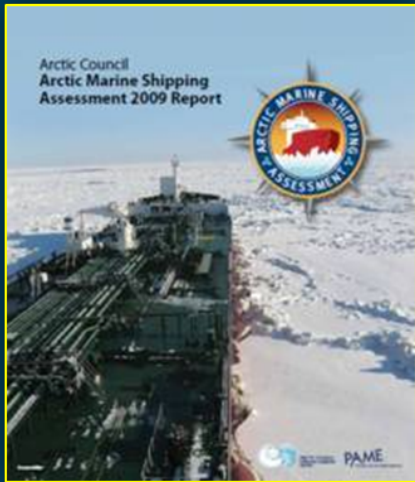
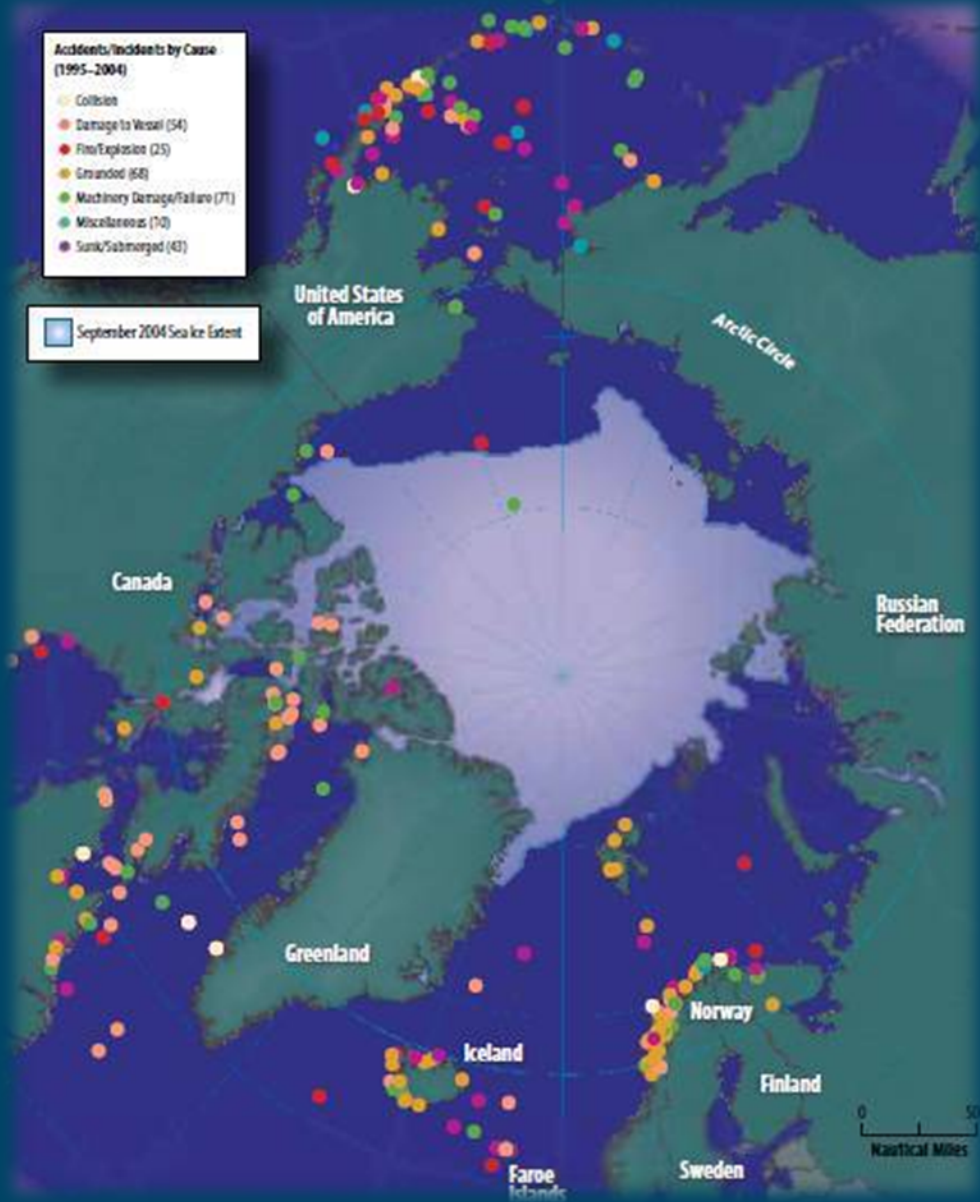
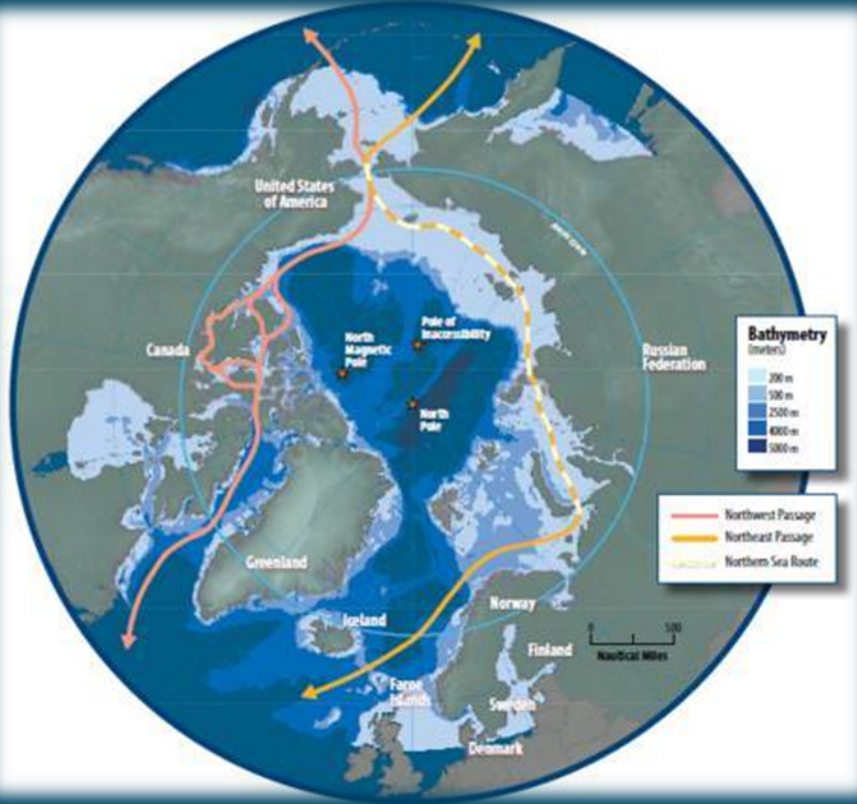




# Pressures & Issues

- Increased Shipping
- Increased Oil Exploration and Production
- Governance
- Harsh Environmental Conditions
- **Increased potential for environmental disasters**
- **Need for STRATEGIC PLANNING**

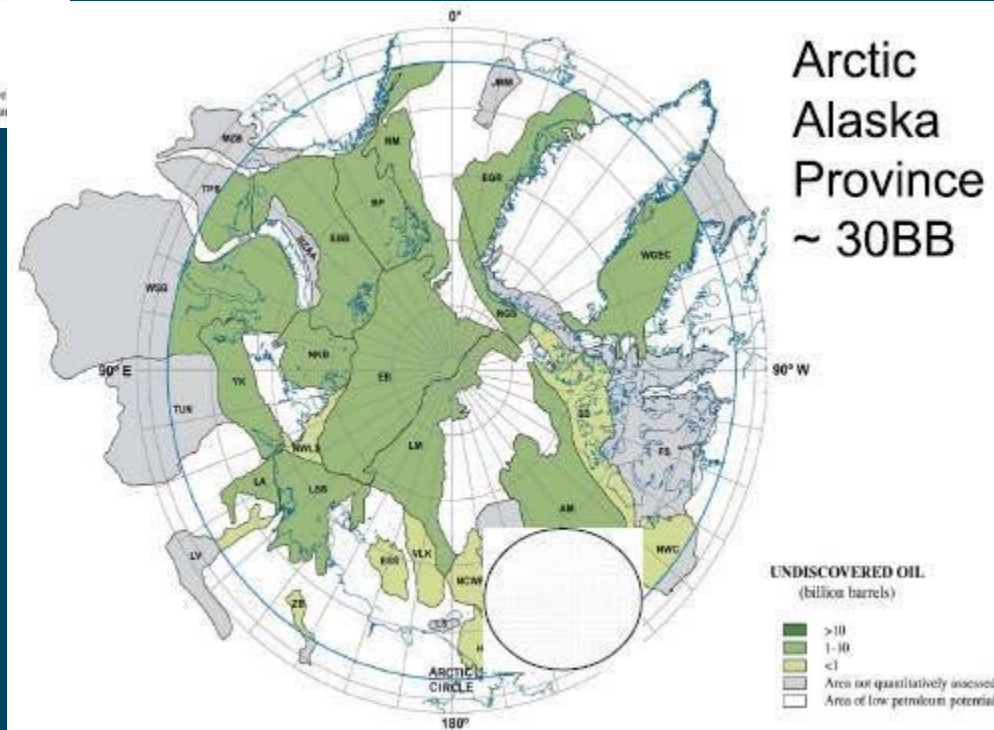
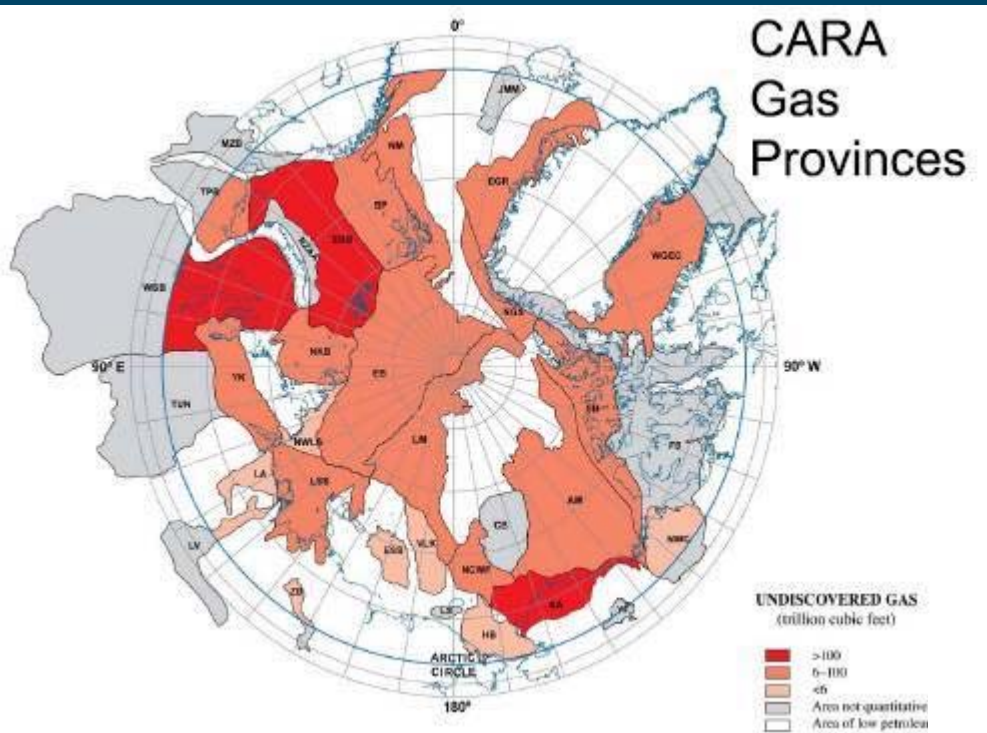




1995-2004 Accidents & Incidents

# USGS 2008 Circum-Arctic Resource Appraisal

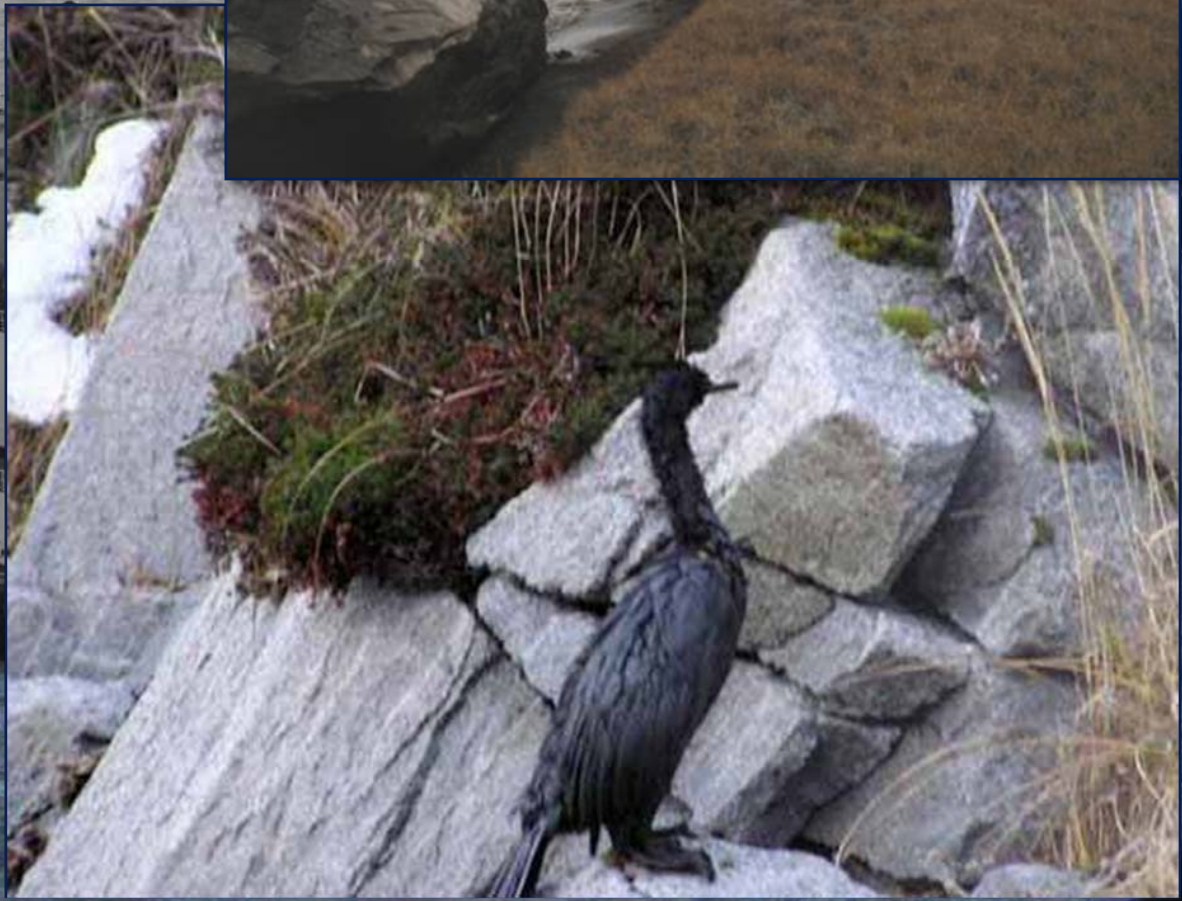
<http://pubs.usgs.gov/fs/2008/3049/fs2008-3049.pdf>



- 90 BBO – Undiscovered
- 1,669 TCF Gas – Undiscovered
- 44 BB Natural Gas Liquids



What's a



# Arctic Initiatives

- Opening the Arctic Seas: Envisioning Disasters and Framing Solutions Workshop-March 2008
  - Goal: identify key strategies, action items and research needs so Arctic Nations and communities can prepare for and respond to marine disasters incidents
  - Participants: 7 Arctic states/3 indigenous nations, governments, NGOs, private sector
  - U.S. and Canadian Coast Guard, Danish Navy
  - Scenarios: oil tanker collision, cruise ship grounding, oil rig fire, tug/barge accident, fishing vessels trapped in ice
  - Agreement on overarching conclusions used directly by:
    - Arctic Maritime Shipping Assessment: Infrastructure Chapter
    - Arctic Council



# CRRC Workshop Key Findings

- Designate ports of refuge
- Control and track vessel movement
- Strengthen multinational plans or create one Arctic agreement for all responses
- Increase training & logistical support for all stakeholders
- Increase emergency response assets
- Establish an international Arctic response fund
- Expand communications throughout the Arctic
- Update weather and navigational charts
- Improve ecological baseline information for Arctic resources at risk
- Better understanding of oil behavior in cold water and new spill response technologies





# Opening the Arctic Seas

ENVISIONING DISASTERS AND FRAMING SOLUTIONS

Durham, New Hampshire  
March 18-20, 2008

Report Issued: January 2009



## What We Need

- More **baseline information**
- More **resources** (NOAA currently has 1 SSC and 0 Damage Assessment/Restoration Personnel in the Arctic)
- More **research** on better response approaches and better restoration

Photos courtesy of NOAA/Department of Commerce and UNH Center for Coastal and Ocean Mapping/science party of HENRY 07-03 (Steve Roberts, Tom Palmer).



Coastal Response Research Center  
at the University of New Hampshire



# Summer Fish at Risk



**BIOLOGICAL RESOURCES AT RISK FROM OIL SPILLS IN THE ARCTIC**

MAP Number 11

Biological Resources (East Russia - Alaska - Canada)

Fish Summer Season

- Arctic Charr
- Capelin
- Polar Cod
- Greenland Halibut
- Herring

View or download this map or others in this series: [www.eppr.akvaplan.niva.no/](http://www.eppr.akvaplan.niva.no/)

Data compiled and maps produced for EPPR by Akvaplan-niva (Trondheim, Norway) under contract to the Norwegian Pollution Control Authority.

Copyright 2002 EPPR

**EPPR** Environmental Protection Programme

**sift** Strategic Information and Forecasting

**Akvaplan niva**

# What We Know

- Fragile and changing environment
- Ecosystems have strong temporal and spatial components
- Pristine resources
- Oil persistence in the environment
- Logistical nightmares



**BIOLOGICAL RESOURCES AT RISK FROM OIL SPILLS IN THE ARCTIC**

MAP Number 19

Biological Resources (East Russia - Alaska - Canada)

Mammals Summer Season

- Killer Whale
- Polar Bear
- Ringed Seal
- Walrus
- Bearded Seal
- Beluga (White Whale)
- Bowhead Whale
- Harbour Seal
- Grey Whale

View or download this map or others in this series: [www.eppr.akvaplan.niva.no/](http://www.eppr.akvaplan.niva.no/)

Data compiled and maps produced for EPPR by Akvaplan-niva (Trondheim, Norway) under contract to the Norwegian Pollution Control Authority.

Copyright 2002 EPPR

**EPPR** Environmental Protection Programme

**sift** Strategic Information and Forecasting

**Akvaplan niva**

# Marine Mammals at Risk



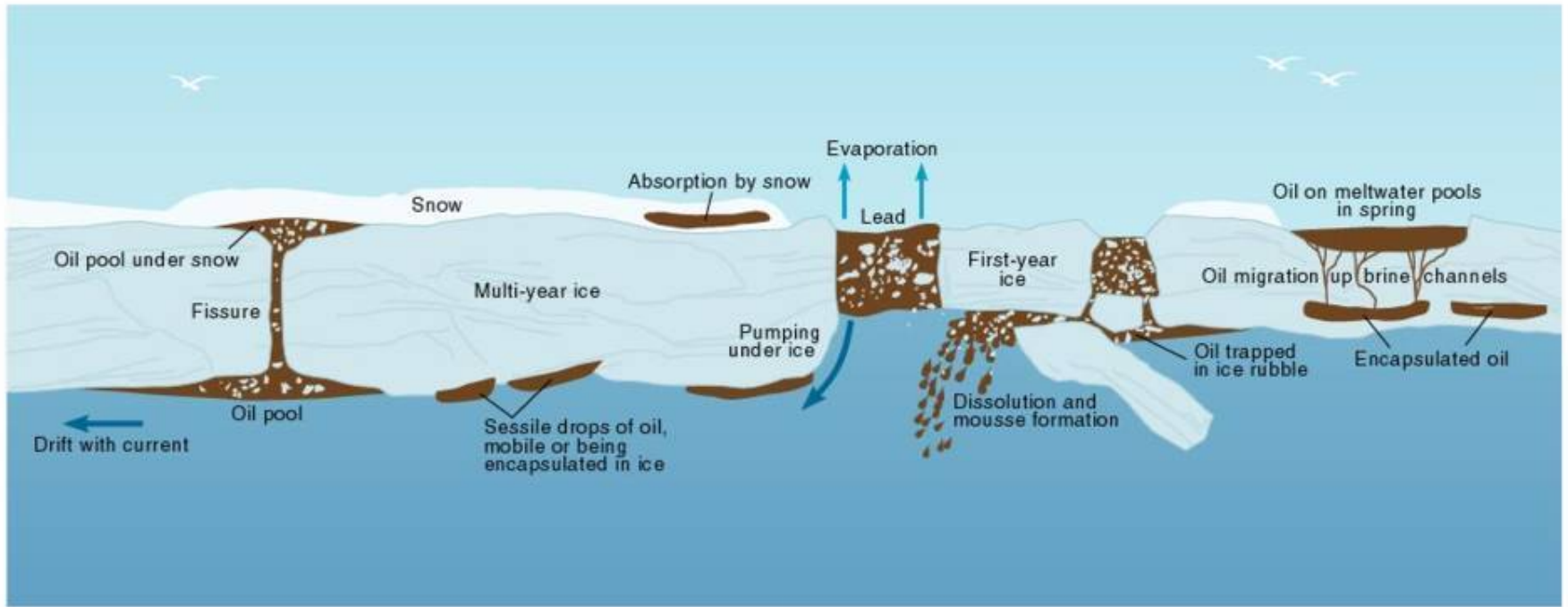
# What we don't know

- Ecological impacts associated with oil in ice releases
  - Impacts of spill to fish spawning under the ice
  - Even small spills at ecologically sensitive times or locations can be significant
- Baseline information on ecosystems at risk
- Effective ways to overcome logistic challenges
- Effective ways and better technologies to recover oil in ice
- Long-term impacts of oil in ice
- How to effectively restore impacted ecosystems



Arctic Monitoring and Assessment Programme

AMAP Assessment Report: Arctic Pollution Issues, Figure 10-5



# Overall objective of Joint Industry Project Oil in Ice

**Develop tools and technologies for environmental  
beneficial oil spill response strategies  
for ice-covered waters**

**The program will utilize existing Arctic and oil spill  
technology and the deliverables can directly be used in oil  
spill contingency plans for Arctic and ice covered areas.**





# Program

9 projects, 25 tasks,  
approximately US\$ 7 (8) mill, 3,5 years from September 2006

## ■ P1 Fate and behaviour

- Compile existing data
- Upgrade oil weathering model
- Meso scale experiments
- Field experiments on Svalbard
- Full scale experiment

## ■ P2 In situ burning

- Mapping of burnability as a result of weathering
- Field test of herding agents
- Test fire resistant booms
- Weathering and window of opportunity.

## ■ P3 Mechanical recovery

- Test existing concepts – winterisation
- Develop new concepts

## ■ P4 Chemical dispersants

- Effectiveness by use of dispersants
- Improve application technology

## ■ P5 Monitoring and remote sensing

- Dev and test remote sensing systems
- Test Shell methane detection system
- Develop detection and tracking concept
- Field verification of Laser Fluorosensor system

## ■ P6 Generic Guide

- Describe a set of relevant (typical) ice regimes (scenarios)
- Generic plan (scenarios and a set of recipes?)

## ■ P7 Field experiments

- Field experiments at Svalbard
- Offshore field experiments

## ■ P8 JIP Coordination

- Coordination and management
- Workshops and steering committee meetings
- Communication and publishing

## ■ P9 Biological effects

- Oil-ice interaction vs biological effects
- Biological survey during field experiments
  - Birds, mammals

# Organisation

## ■ Steering Committee

### Oil Companies

- **Agip KCO** Mark Shepherd
- **Chevron Norge AS**, Gunnar H Lille
- **Norske ConocoPhillips AS**, Eimund Garpestad
- **Shell Technology Norway A/S**, Gina Ytteborg
- **Statoil ASA**, Hanne Greiff Johnsen
- **Total E&P Norge**, Ulf Einar Moltu
  
- **Program coordinator**; Stein E Sørstrøm, SINTEF

### Cooperating Organisations

- NOFO, Hans V Jensen
- Alaska Clean Seas, Lee Majors
- Norw. Coastal Admin., Johan M. Ly
- MMS, Joe Mullins/Sharon Buffington
- OSRI, Scott Pegau
- CRRC/NOAA, Amy Merten

## ■ R&D Organisations

- SINTEF
- Dave Dickins Associates
- S L Ross
- ++++

## ■ Projects

- **1 Fate and behaviour**, Per J Brandvik
- **2 In-situ burning**, Ian Buist, USA
- **3 Mechanical recovery**, Ivar Singaas
- **4 Chemical dispersants**, Per Daling
- **5 Remote sensing**, Dave Dickens, USA
- **9 Biological Effects**, Amy Merten, NOAA
  
- **8 Field experiments**, Stein E Sørstrøm
- **6 Generic guideline**, Gina Ytteborg
- **7 Coordination**, Stein E Sørstrøm

# Oil-in-Ice: Behavior, Biodegradation and Potential Exposure Research

## Participation in Joint Industry Project (JIP):

- \$7+M
- Norwegian, Canadian, French, U.S., Russian participants
- Industry and Government partnership
- CRRC, OSRI, UAF, URI, SINTEF
- Oil Encapsulated in Ice Project = \$500K

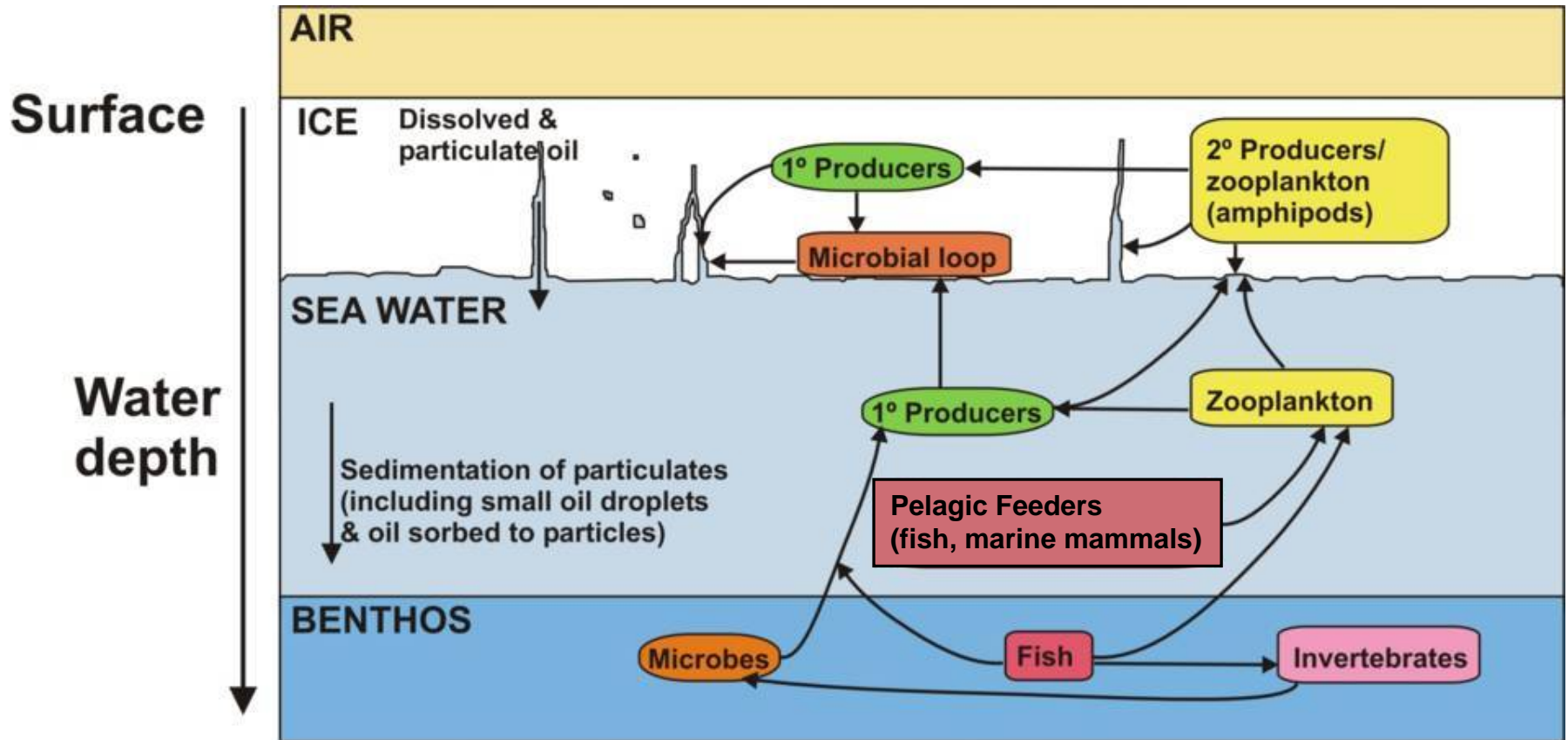


# Oil-in-Ice: Behavior, Biodegradation and Potential Exposure

- Questions We Want to Answer?
  - What is behavior of oil in ice?
  - What are transport & degradation processes and rates that control fate of oil frozen in ice?
  - What are exposures and effects for ice-related organisms?
  - How will response options affect exposure?
  - First Year Ice Scenario

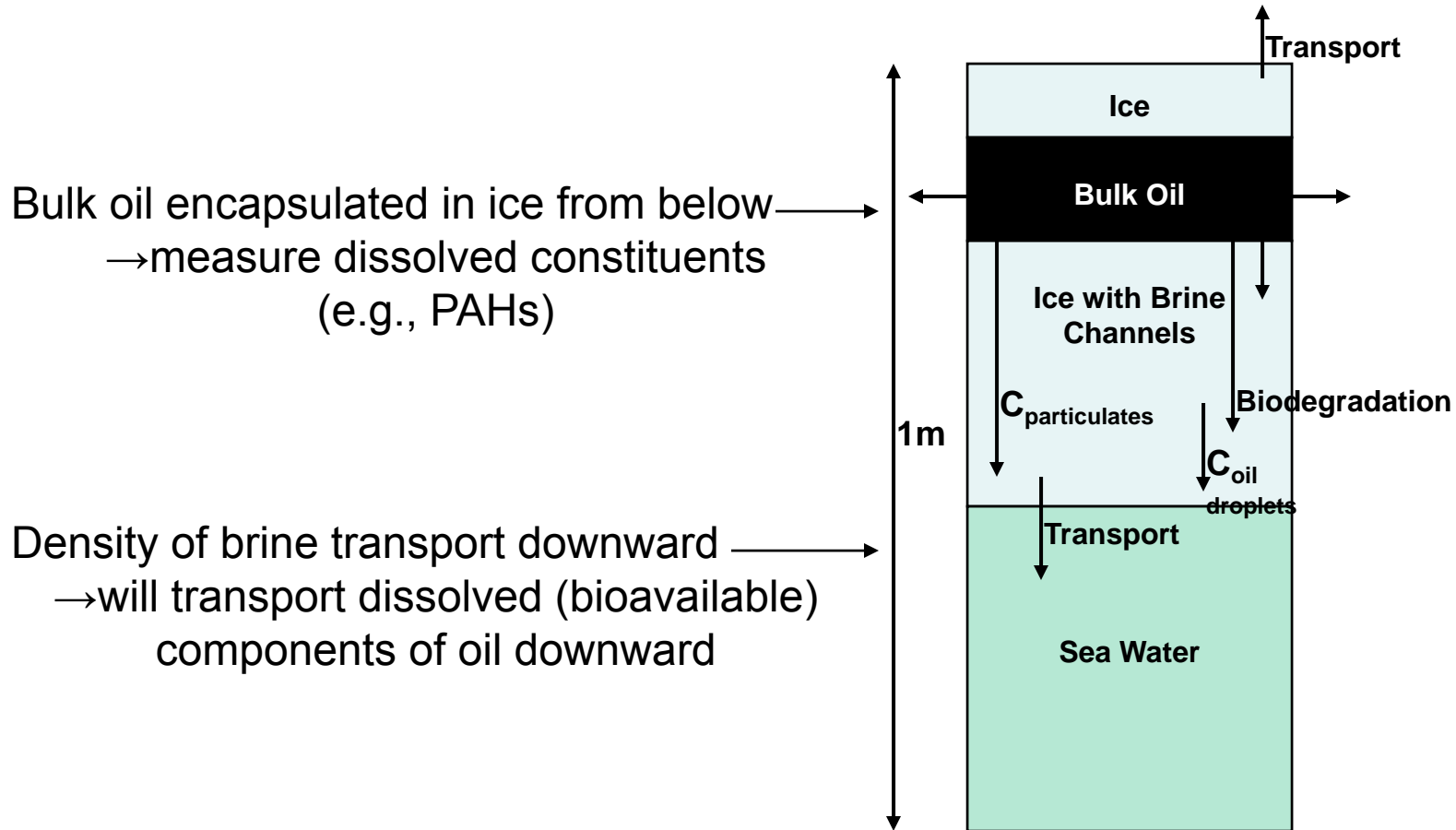


# Conceptual Model Food Web Cycle





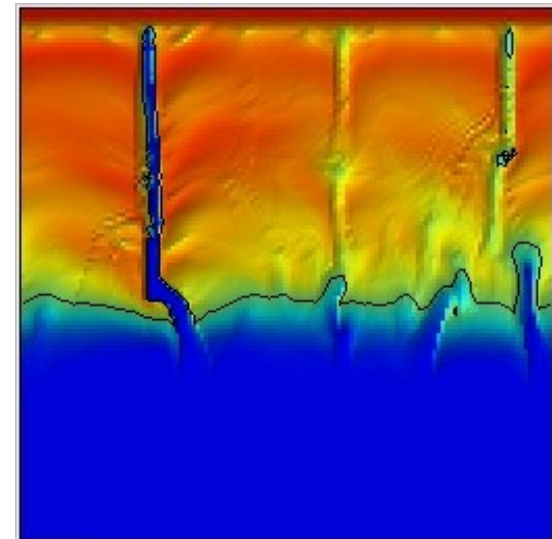
# Transport/Exposure Mechanisms



# Oil & WSC entrainment & movement in ice - University of Alaska Fairbanks (UAF)

## Project team:

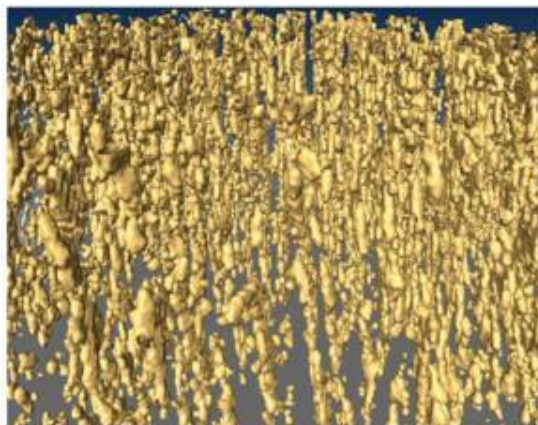
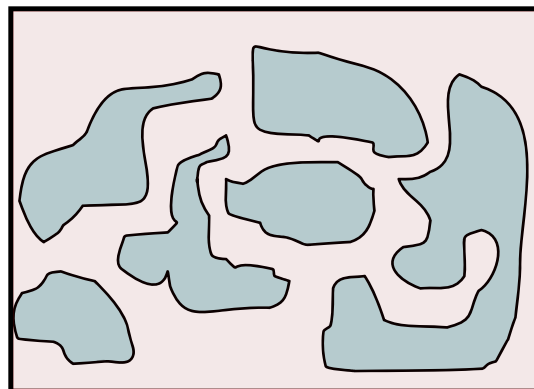
- Chris Petrich (Post-Doc, co-I) - fluid dynamics simulations
- Jonas Karlsson (Grad. Student) - oil-in-ice experiments
- Mette Kaufman (Research tech.) - oil-in-ice experiments
- Hajo Eicken (PI) - ice permeability & microstructure
- Financial support of this component of JIP through Oil Spill Recovery Institute (OSRI), Cordova, AK (Contract 08-10-13)



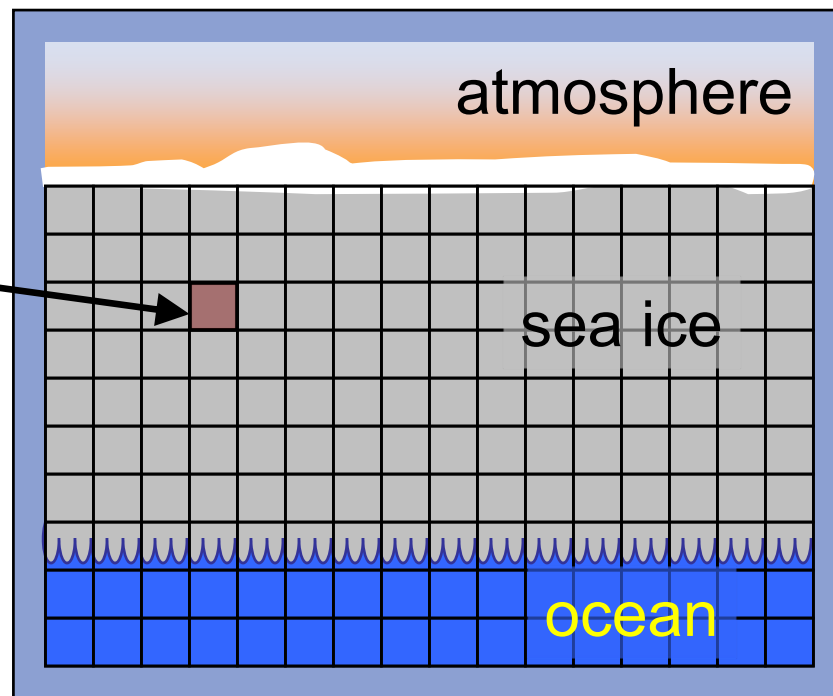
# Scale in fluid dynamics model:

microscopic scale  $\xrightarrow{\text{local average}}$  effective medium/  
continuum scale

microscopic structure described by  
one parameter: effective permeability  $\Pi$

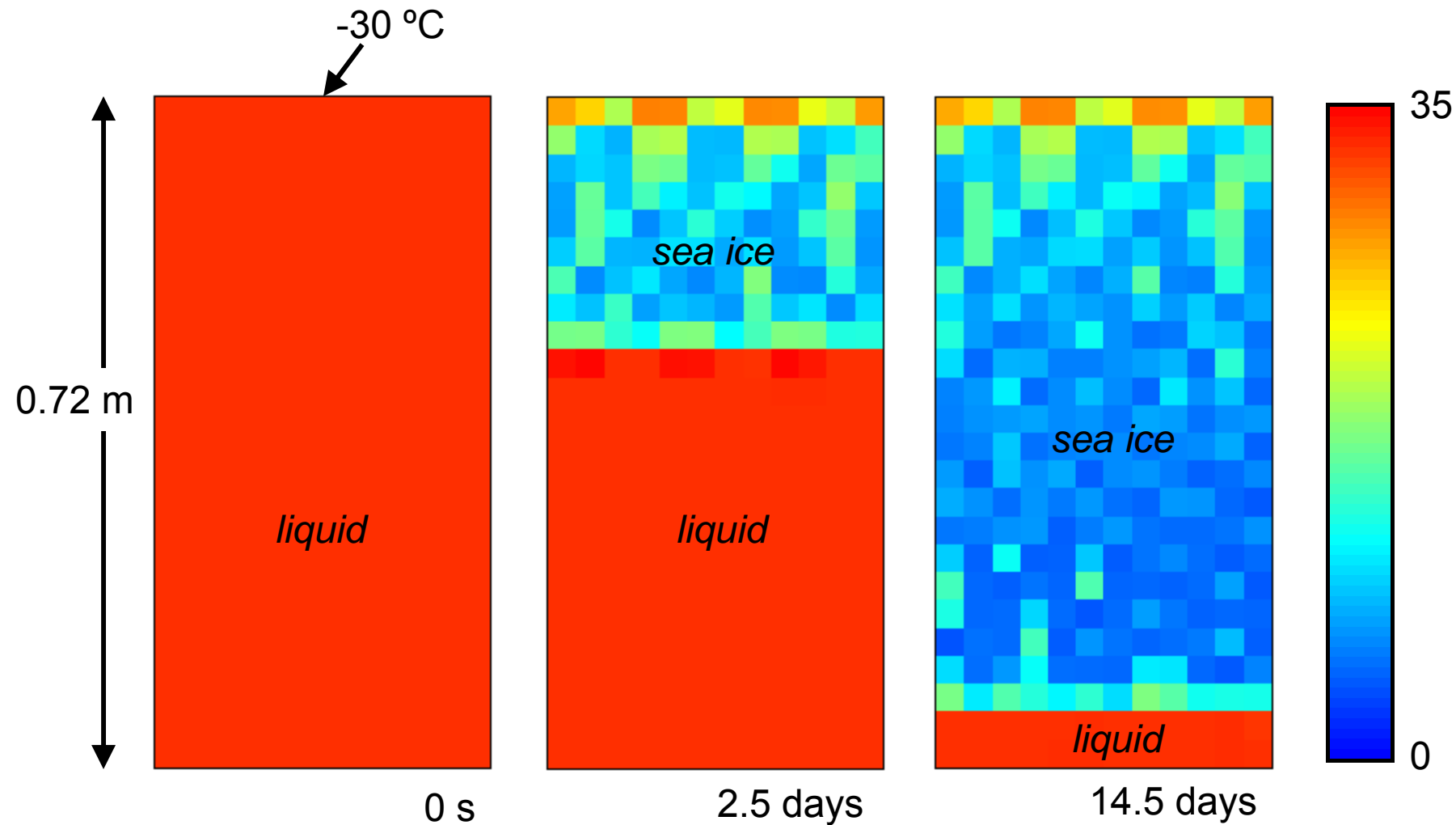


Golden et al. (2007)



Example:

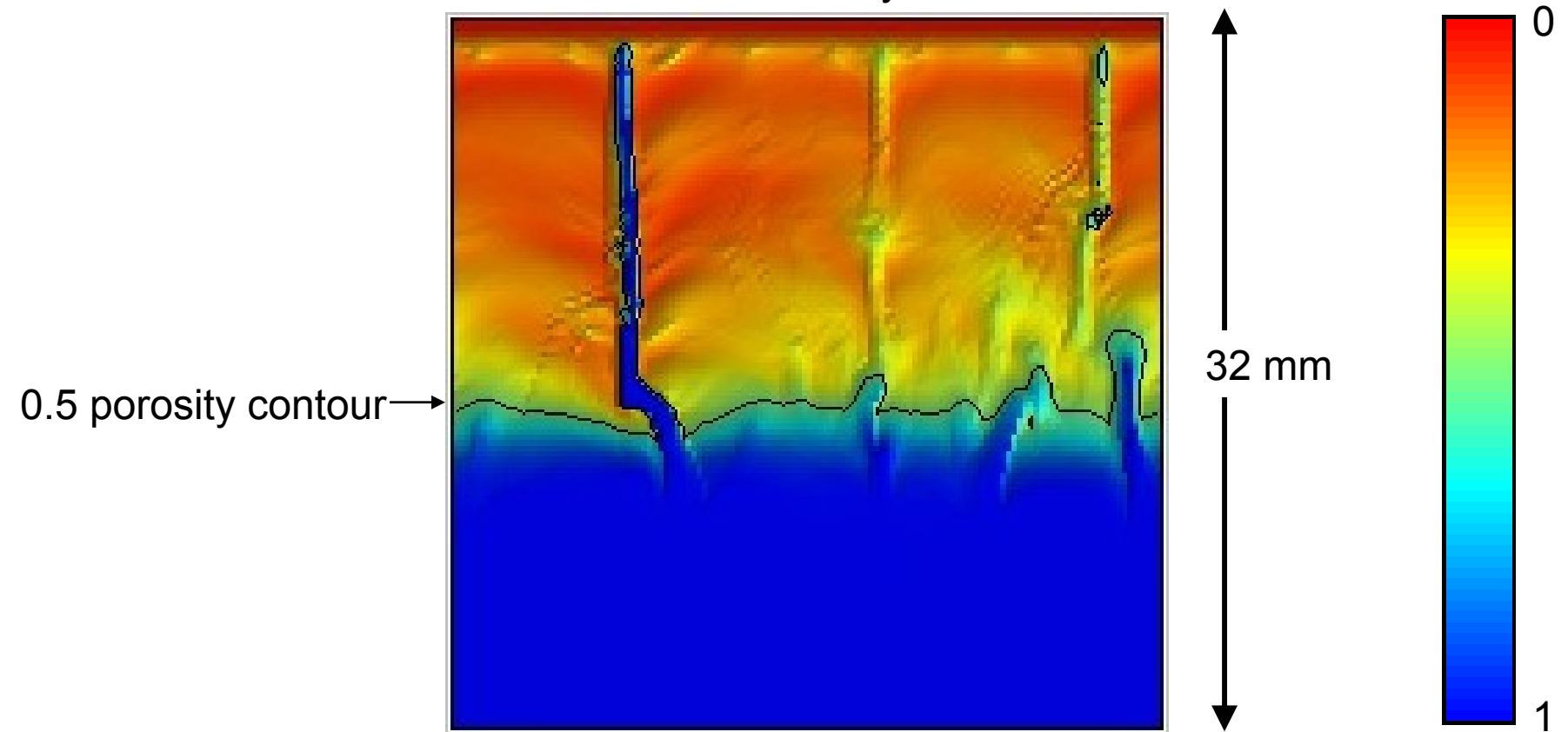
Development of the bulk salinity (salinity of the melt)



Temperature of brine entering domain: 10 mK above freezing point

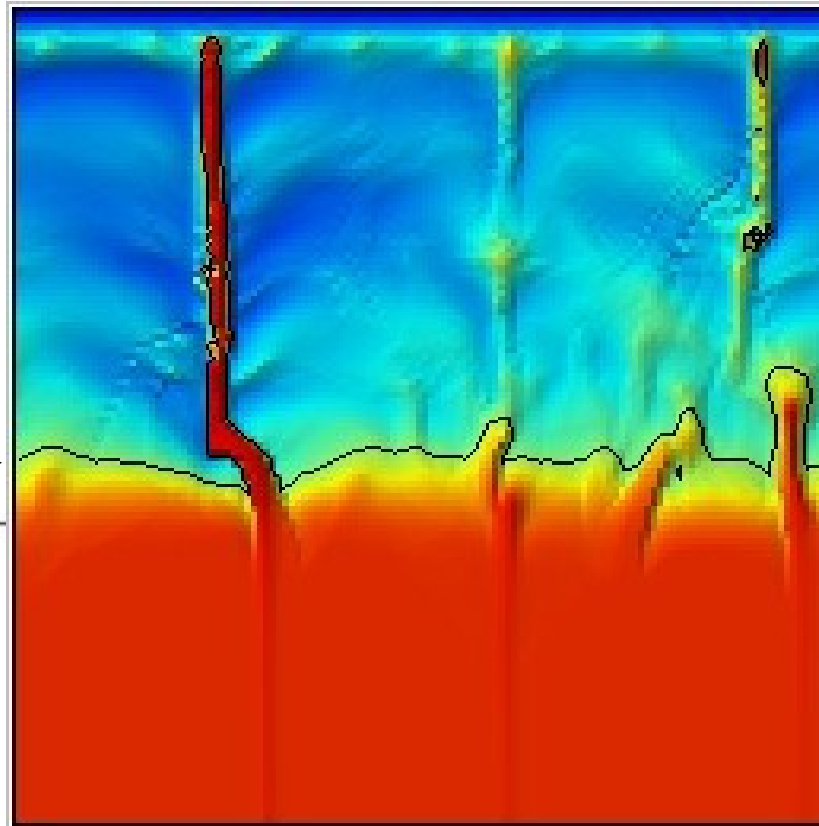
# High-resolution simulations of ice growth (250 $\mu\text{m}$ grid size)

Porosity

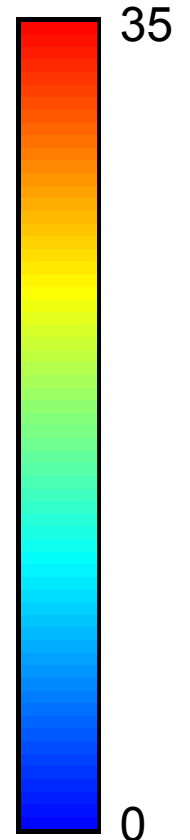


# High-resolution simulations of ice growth (250 $\mu\text{m}$ grid size)

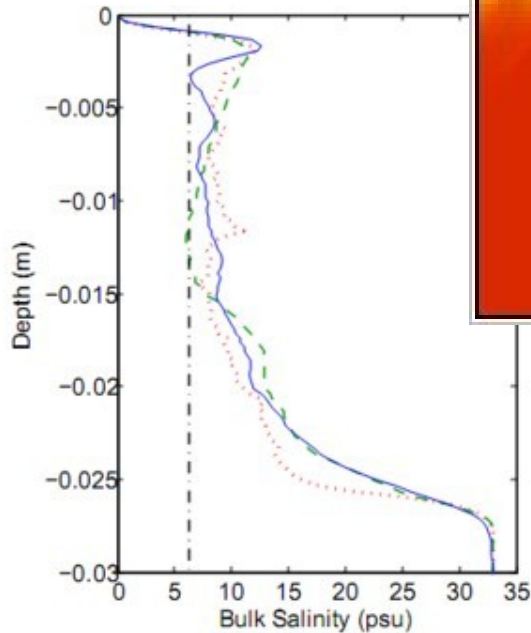
Bulk salinity



32 mm



0.5 porosity contour





# Environmental Response Management Application

Bobby Braswell, Stanley Glidden  
(UNH/EOS)

Steven Knight, Phil Collins, and  
Bob St. Lawrence (UNH/RCC)  
Kurt Schwehr (UNH/JHC-CCOM)  
Michele Jacobi (NOAA/ORR)



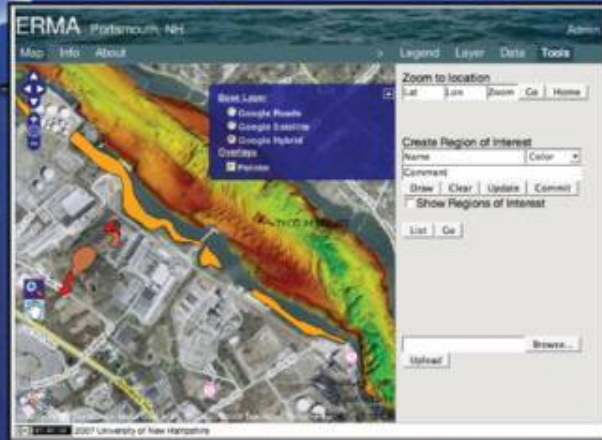
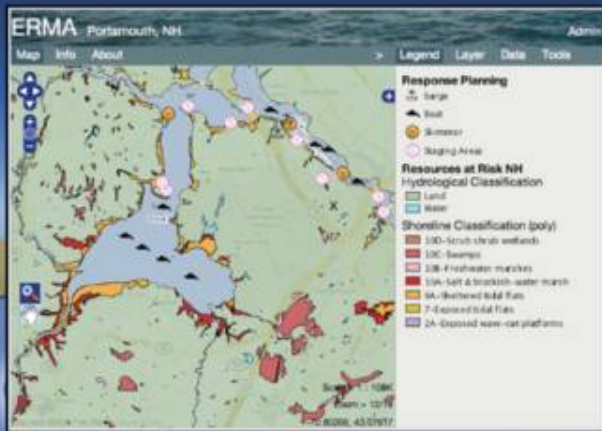
# Concept for ERMA

- Take advantage of open-source, web-based mapping tools
- Integrate and synthesize various types of information
  - Include both static and real-time
  - leverage what already exists
- Provide fast visualization of current information
- Improve communication and coordination among responders and stakeholders
- Provide integrated and timely information to improve decision-making



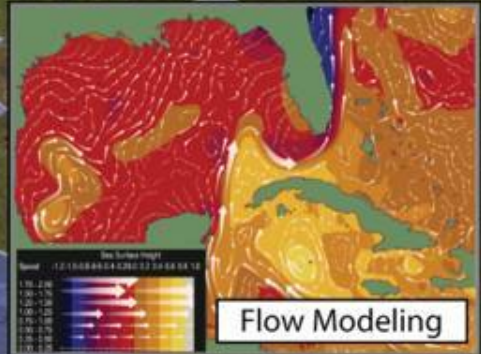


# Environmental Response Management Application (ERMA)

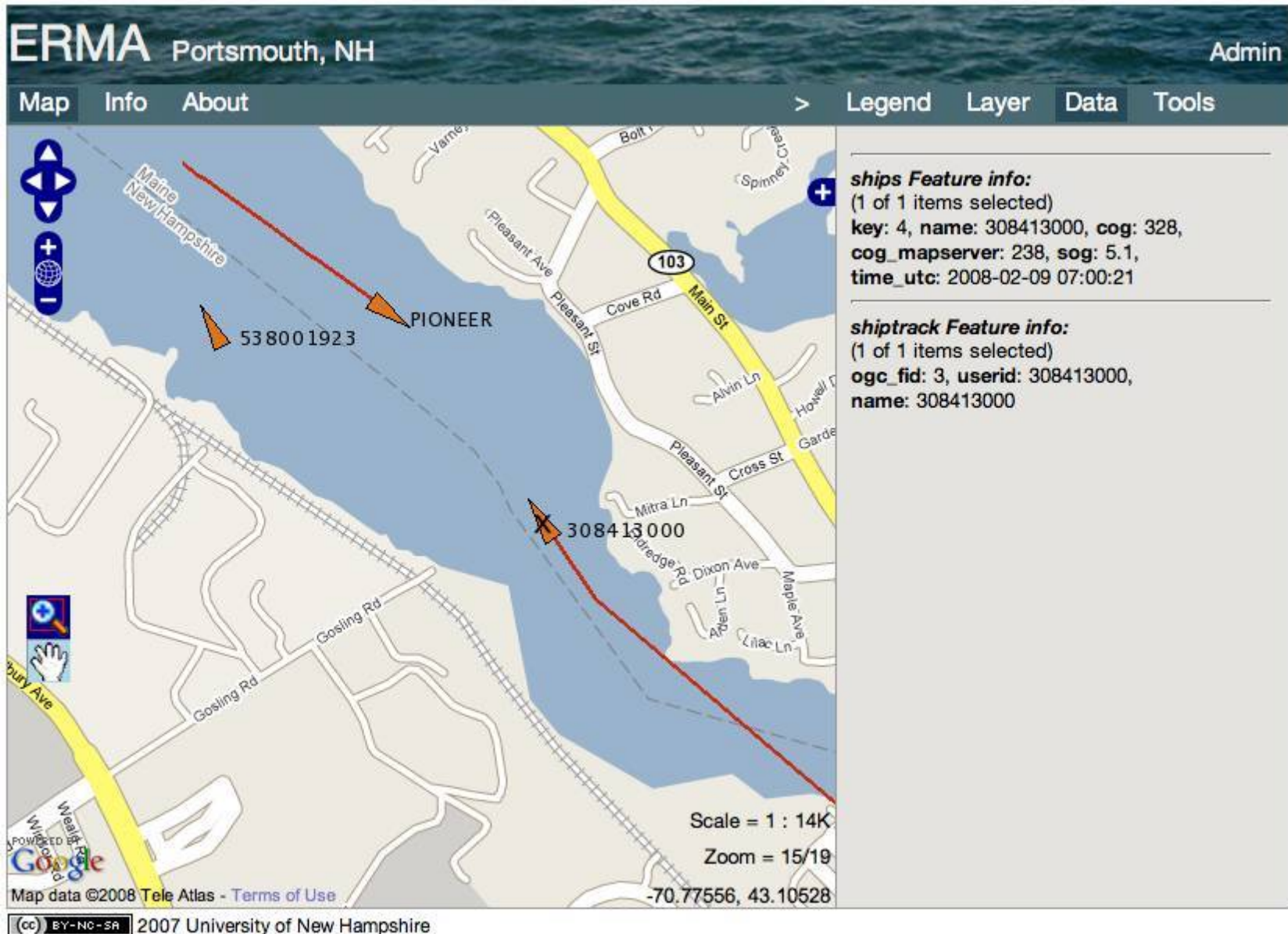


Kurt Schwab  
CCOM/IHC

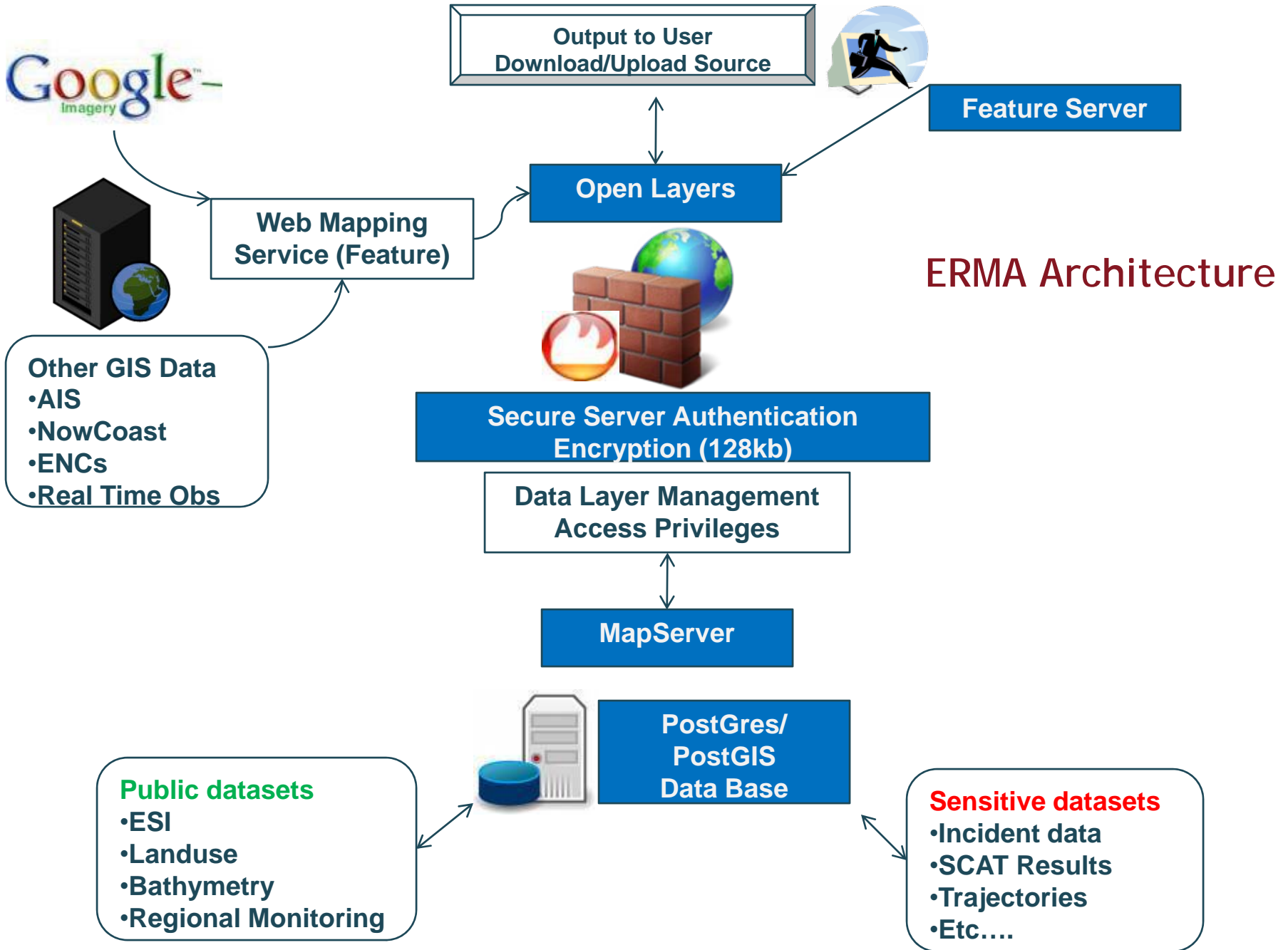
Moored Sensors



# Real-time vessel traffic from AIS







# ERMA Architecture



# Digitized GRPs with data links

## Coral Reef Lines

gid	shape leng
187	0.00941651714294

## Sector San Juan Oil Spill Sensitive Areas

gid	objectid	ID	name	map num	nasa chart	chart nam	esi map	esi nam	quad nam	physical d	contact	wildlife	habitat	threatened	other reso	summer pri	spring pri	fall pri	winter pri	area acces	staging ar
113	1132.00000000	A53	HULL, PALM, DOROTHEA, NELTJEBERG AND PEN	VI-5	25641	VIRGIN ISLANDS- VIRGIN GORDA TO ST THOMAS AND ST CROIX	VI-5	CENTRAL ST THOMAS, V.I. (1982)	CENTRAL ST THOMAS, V.I. (1982)	D	V.I. DPNR - (809) 774-3320, V.I. State Historic - Elisabeth Righter - (809) 774-3320, Preservation Office (SHP/O) - FAX 775-5706	Sea turtle nesting and foraging habitat, feeding seabirds and coral reefs.	Fine to medium grain sandy beaches, rocky shoreline, fringing reefs in front of most beaches, coral growth on subtidal be	Hawksbill Leatherback and Green sea turtles, Brown Pelicans and Ros	N	A	A	A	A	boat/vehicle	Vehicle: To Hull and Palms Bays take Route 35 from Charlotte Amalie to Route 37. To Dorothea Bay take Route 40 to 33 to 333. No vehicular access is available to Neltjeberg Bay. To Pern and Mail Bays take Route 3

# San Juan PREP Scenario

ERMA

Environmental Response Management Application  
Caribbean

Map Information Help Admin

Logout



Layers Legend AOI Labels Zoom Download Print

## San Juan PREP Drill 2009

- barge\_2009\_0527
- oiling\_2009\_0527\_1315
- boom\_2009\_0527

## Bioresources

- Turtle Nesting Shoreline (NAD83)
- Mangrove Shoreline

## Response Planning

### Oil Spill Sensitive Areas May 2009

- A - Highest Priority
- B - Protect After A Sites
- C - Protect After B Sites

POWERED BY  
Google

Map data ©2009 Tele Atlas - [Terms of Use](#)

Scale: 1: 14K

Zoom Level: 15

Location: -65.83733°, 18.06435°



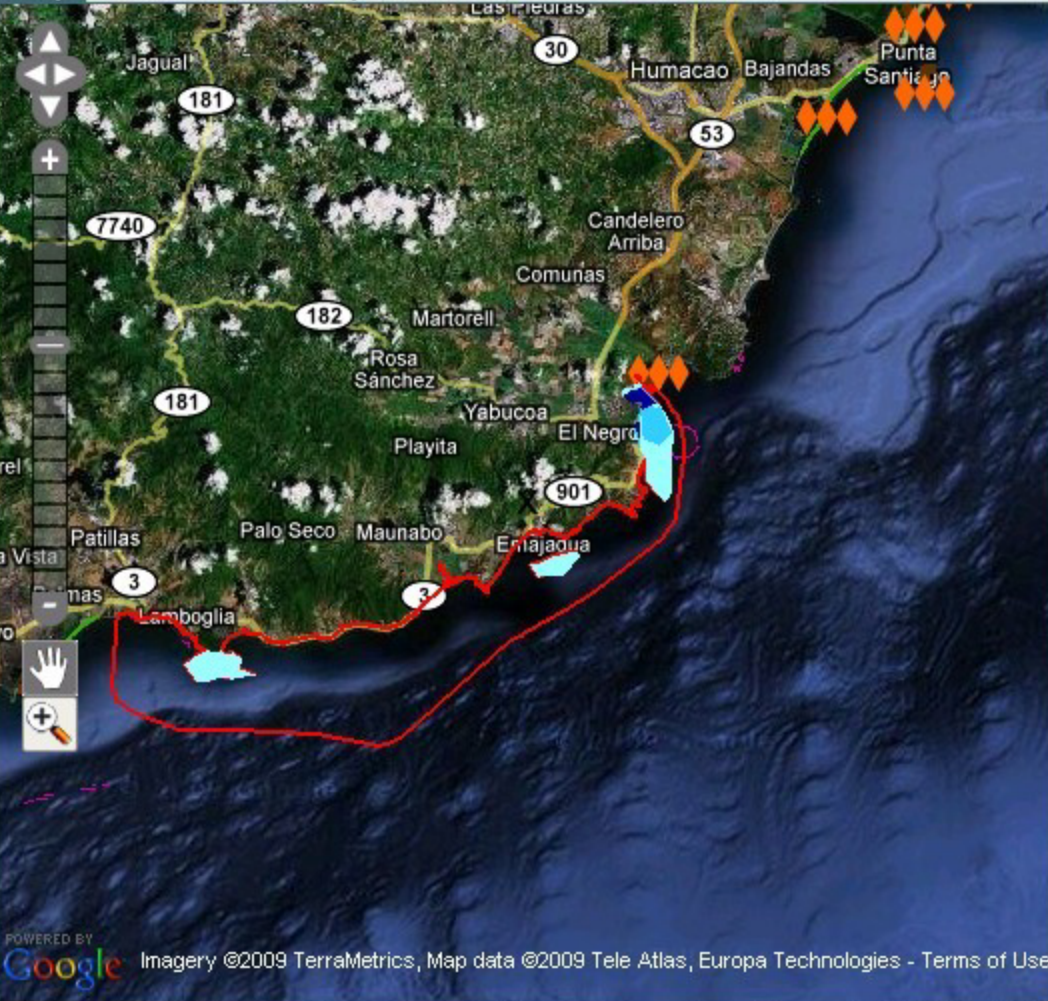
# Drill Trajectory and Resources at Risk

ERMA | Environmental Response Management Application  
Caribbean



Map Information Help Admin

Logout



Layers Legend AOI Labels Zoom Download Print

## San Juan PREP Drill 2009

trajectory\_2009\_0529\_1830

- FORECASTHEAVY
- FORECASTLIGHT
- FORECASTMEDIUM
- FORECASTUNCERTAINTY

## Bioresources

- Mangrove Shoreline
- Coral Reef Lines (NAD 83)
- Turtle Nesting Shoreline (NAD83)

## Response Planning

Oil Spill Sensitive Areas May 2009

- A - Highest Priority
- B - Protect After A Sites
- C - Protect After B Sites

POWERED BY Google Imagery ©2009 TerraMetrics, Map data ©2009 Tele Atlas, Europa Technologies - Terms of Use

Scale: 1: 217K Zoom Level: 11 Location: -65.69893°, 18.15172°

# Field photographs taken and posted

ERMA | Environmental Response Management Application  
Caribbean


Map Information Help Admin

Logout

Layers Legend AOI Labels Zoom Download Print

## San Juan PREP Drill 2009

 Features of Interest




 boom\_2009\_0527

## Bioresources

 Mangrove Shoreline

## Response Planning

### Oil Spill Sensitive Areas May 2009

-  A - Highest Priority
-  B - Protect After A Sites
-  C - Protect After B Sites

Yabucoa Harbor entrance to be boomed at  
18.051400 -65.830000 [X]



Yabucoa Harbor entrance to be boomed



Imagery ©2009 DigitalGlobe, GeoEye, U.S. Geological Survey - Terms of Use

Scale: 1: 6771

Zoom Level: 16

Location: -65.82725°, 18.05660°



# Imagery near drill site

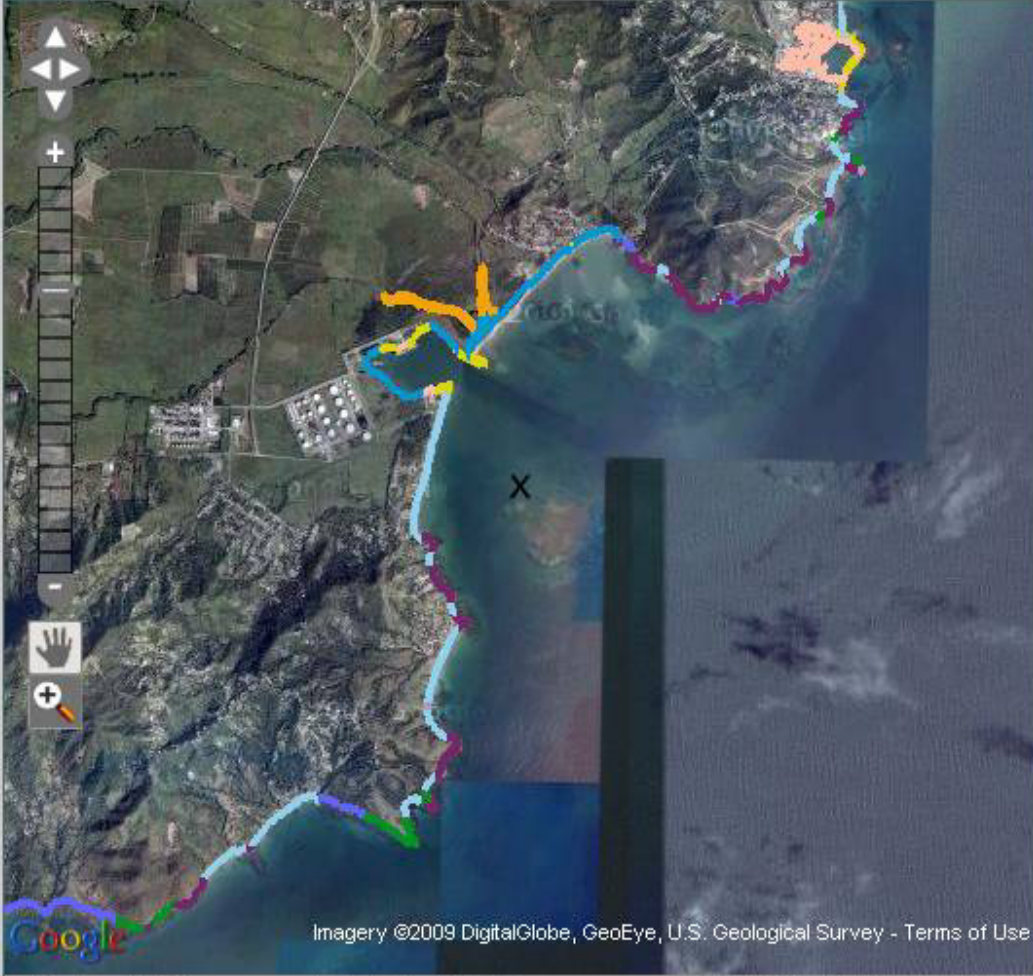
**ERMA** | Environmental Response Management Application  
Caribbean

Map Information Help Login

Layers Legend Zoom Print

**Layers** reload

- Base Layer
  - Open Street Map
  - Google Roads
  - Google Satellite
  - Google Hybrid
  - Google Terrain
- ESI clear | all
  - Puerto Rico clear | all
    - Management Areas
    - Hydrological Classification
    - Benthic
    - Shoreline Classification (line)
    - Bird Habitat
    - ESI Polygons
    - Fish Lines
    - Fish Habitat
    - Habitats
    - ESI Index Grid
    - Invertebrate Lines
    - Invertebrate Habitat
    - Karst
    - Marine Mammal Habitat
    - Reptile Habitat
    - RSI Lines
    - Shelf Boundaries



Imagery ©2009 DigitalGlobe, GeoEye, U.S. Geological Survey - Terms of Use

**Scale:** 1: 54K    **Zoom Level:** 13    **Location:** -65.78939°, 18.00241°

**Environmental Sensitivity Index layer turned on to display shoreline classifications**

# Example Data: Forecasted Weather

**ERMA** | Environmental Response Management Application  
Caribbean

Map Information Help Admin Logout

Layers Legend AOI Labels Zoom Download Print

**Layers** manage  reload

- Base Layer
- Incident
- Response Planning
- ESI
- Bioresources
- GeorSS
- Public Safety
- Charts, Surveys, Ships
- Environmental Quality
- BASE
- ERMA Tools
- Weather Observation
  - Weather Radar Mosaic (NWS)
  - Surface Wind Velocity- 12hr forecast
  - Surface Wind Velocity- 24hr forecast
  - Sig Wave Height 12-hr Forecast
  - Sig Wave Height 24-hr Forecast
- Trajectories

Scale: 1: 217K    Zoom Level: 11    Location: -65.61172°, 18.30368°

Imagery ©2009 TerraMetrics, Map data ©2009 Tele Atlas - Terms of Use



# Example Data: Real Time GeoRSS feed from Observation Buoys

**ERMA** | Environmental Response Management Application  
Caribbean

Map Information Help Login

Layers Legend Zoom Print reload

**Layers**

- Base Layer
  - Open Street Map
  - Google Roads
  - Google Satellite
  - Google Hybrid
  - Google Terrain
- ESI clear | all
- + Puerto Rico clear | all
- + Virgin Islands clear | all
- + ERMA Tools clear | all
- GeoRSS clear | all
  - NDBC NOAA Feed
  - internal georss
  - USGS Recent Earthquakes
  - Carribean Tsunami Warning Center
  - World News (not working)
  - test internal georss
- + Public Safety clear | all
- + Charts, Surveys, Ships clear | all
- + BASE clear | all
- + Bioresources clear | all
- + Environmental Quality clear | all

Station YABP4: Wind direction from 360.0 deg at 2.9 kt, gusting to 4.1 kt.  
Conditions at Yabucoa Harbor, PR (Station YABP4)  
**Last Update:** 2154 UTC on 05/01/2009

**Wind Direction:** 360.0 deg  
**Wind Speed:** 2.9 kt  
**Wind Gust:** 4.1 kt

Imagery ©2009 DigitalGlobe, GeoEye, U.S. Geological Survey - Terms of Use

**Scale:** 1: 6771    **Zoom Level:** 16    **Location:** -65.82718°, 18.06105°

# ERMA Functionality

- Complementary to Digital ACP project, and other systems; integrates 'one-plan' concept
- Non-GIS expert can use it and interact with ERMA
- Multi-tailored password protection:
  - Public interface
  - Responder interface
  - Super-user interface
- Real-time data delivery
- Data upload/download capability - improves data sharing
- Tools:
  - On the fly map labeling
  - On the fly regions of interests
  - On the fly layers management



# Pressures & Issues

The background of the slide is a photograph of an offshore oil rig, likely a jack-up rig, situated in the middle of a vast, blue ocean. The rig's complex structure, including its derrick and various platforms, is visible against the horizon. The overall tone of the image is somewhat muted, with a blue and grey color palette.

- Increased Shipping
- Increased Exploration and Production
- Governance
- Environmental Conditions
- **Critical and Strategic need for planning, resources, research, and preparedness**

Coastal Response Research Center  
[www.crrc.unh.edu/workshops/arctic\\_spill\\_summit/](http://www.crrc.unh.edu/workshops/arctic_spill_summit/)

