



Executive Forum on Modeling & Simulation 2001
31 May 2001

Modeling & Simulation

Executive Agent Panel

PRESENTER

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OCEAN EXECUTIVE AGENT

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) 30-05-2001		2. REPORT TYPE Briefing		3. DATES COVERED (FROM - TO) xx-xx-2001 to xx-xx-2001	
4. TITLE AND SUBTITLE Modeling & Simulation Executive Agent Panel Unclassified				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Spinrad, Richard W. ;				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME AND ADDRESS Office of the Oceanographer of the Navy xxxxxx, xxxxxxxx				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME AND ADDRESS United States Department of Defense Defense Modeling and Simulation Office 1901 N. Beauregard St., Suite 500 Alexandria, VA22311-1705				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT APUBLIC RELEASE ,					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Three Primary Mission Areas ? Safety of the Fleet and the Navy Shore Establishment ? Application of Meteorology and Oceanography (METOC) to optimizing performance of Navy Platforms, Weapon Systems, and Sensors ? Application of Geospatial Information and Services (GI&S) and Precise Time and Astrometry (PTA) Data to Navigation, Communications, and Targeting Systems					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:		17. LIMITATION OF ABSTRACT Public Release	18. NUMBER OF PAGES 29	19. NAME OF RESPONSIBLE PERSON Fenster, Lynn lfenster@dtic.mil	
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified		19b. TELEPHONE NUMBER International Area Code Area Code Telephone Number 703767-9007 DSN 427-9007	
				Standard Form 298 (Rev. 8-98) Prescribed by ANSI Std Z39.18	



Three Primary Mission Areas

- **Safety of the Fleet and the Navy Shore Establishment**
- **Application of Meteorology and Oceanography (METOC) to optimizing performance of Navy Platforms, Weapon Systems, and Sensors**
- **Application of Geospatial Information and Services (GI&S) and Precise Time and Astrometry (PTA) Data to Navigation, Communications, and Targeting Systems**





Community Size & Scope



$< 0.4\%$
Navy TOA

Assets:

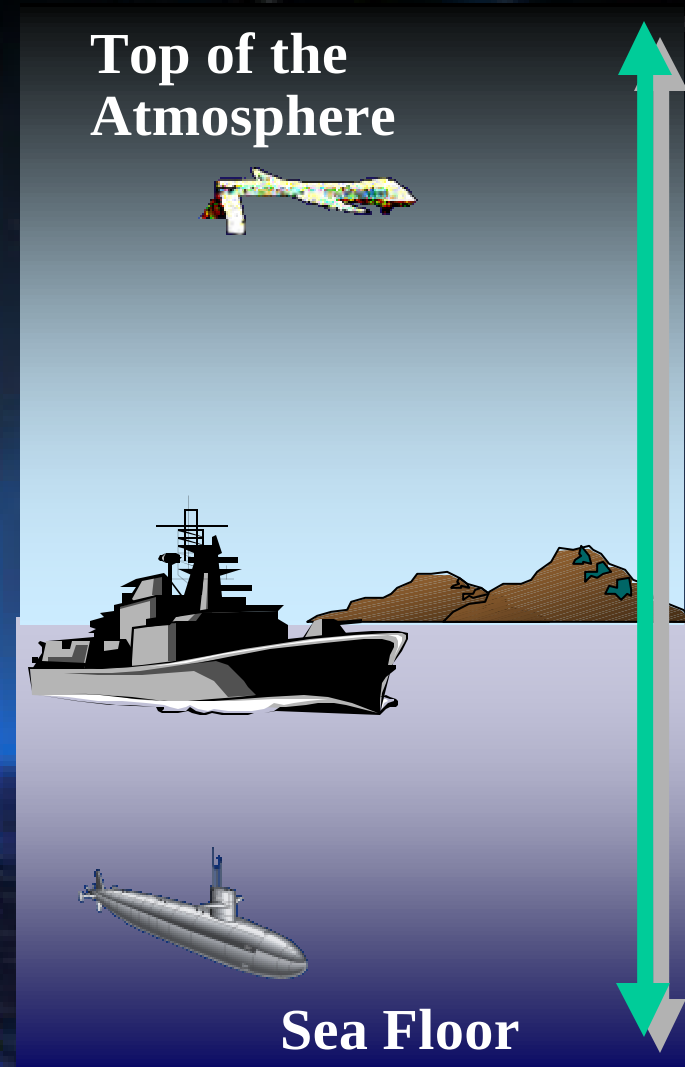
Almost 3300 Total End Strength

8 Military Survey Ships

9 Major Activities

Almost \$400M Total Resources

\$36M R&D (6.4 & 6.5)



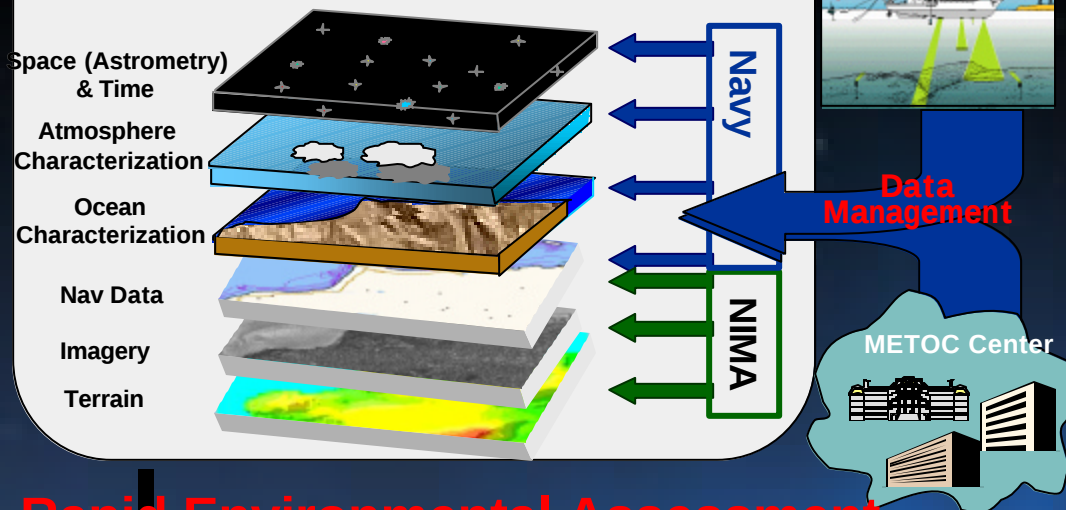


METOC Concepts

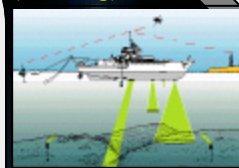
- **Overarching Theme:**
 - *Network-Centric METOC Operations*
- **Common METOC Picture**
 - 4-D Cube supporting COP/CTP
- **Collection of METOC Data in Denied Areas**
- **Rapid Environmental Assessment (REA)**
- **Through the Sensor Data Collection**

The 4-D "Cube"

Feature Foundation Data (Static Characterization)



Military
Survey Ships
(Existing)

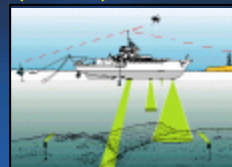


Common
Operational
Picture

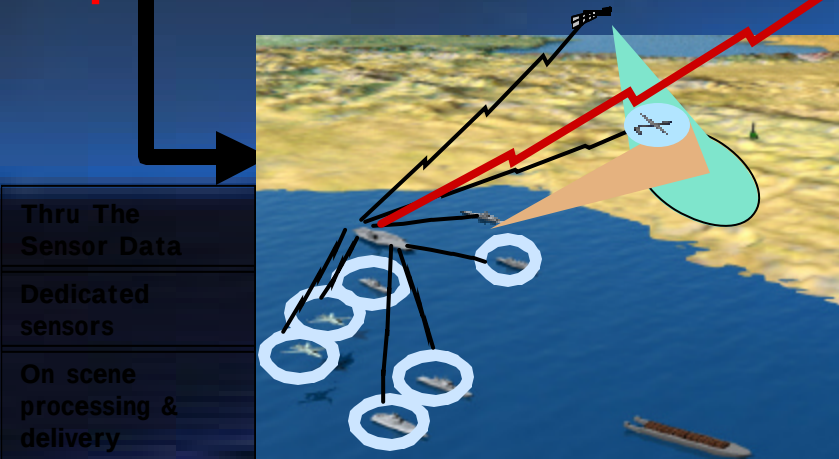
Mission
Planning
Systems

Weapon
Systems

Multi-Mission
Support Ship
(Future)

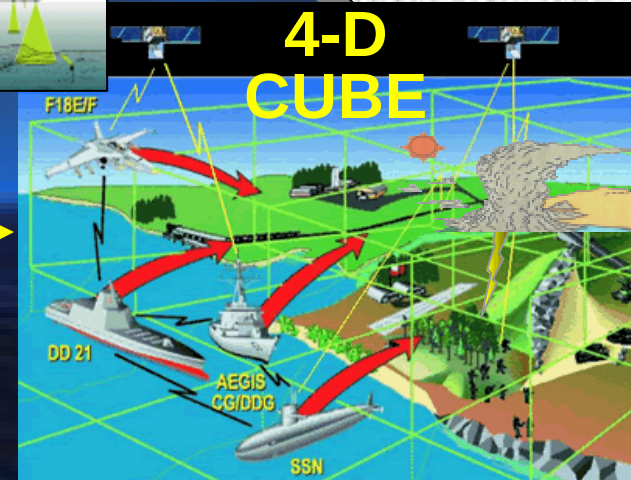


Rapid Environmental Assessment



Force and
Threat Data

4-D CUBE



Dynamic Nowcast/Forecast



Our Goal

As stated in the Navy's M&S Master Plan:

“Ensure that authoritative representations of the ocean environment are defined and accessible to the DoD M&S analysis, acquisition, and training communities.”

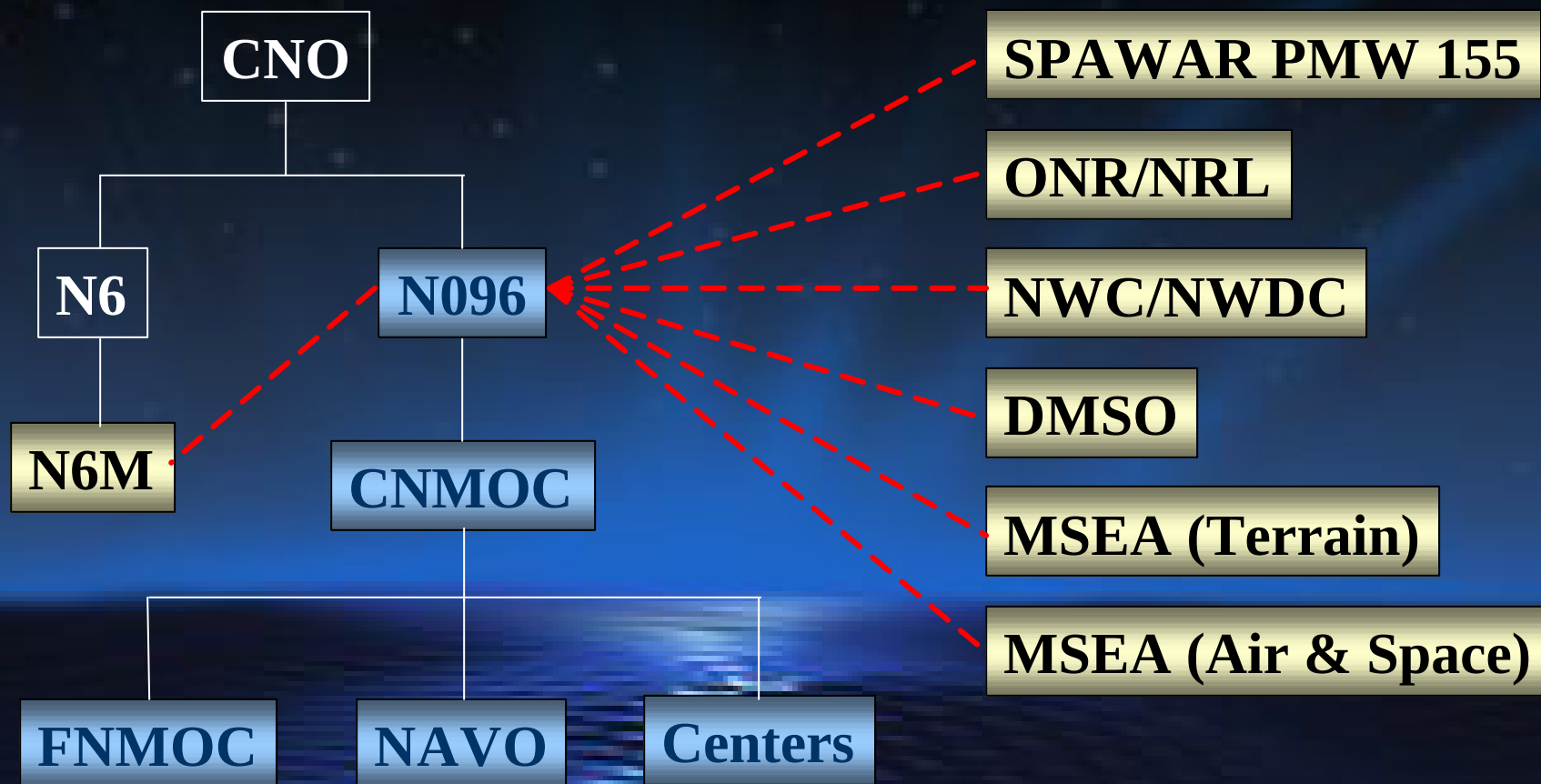


MSEA Role

- Facilitator in the project startup phase
- Catalyst during development
- Certifier in the capability delivery/migration phase of a simulation.

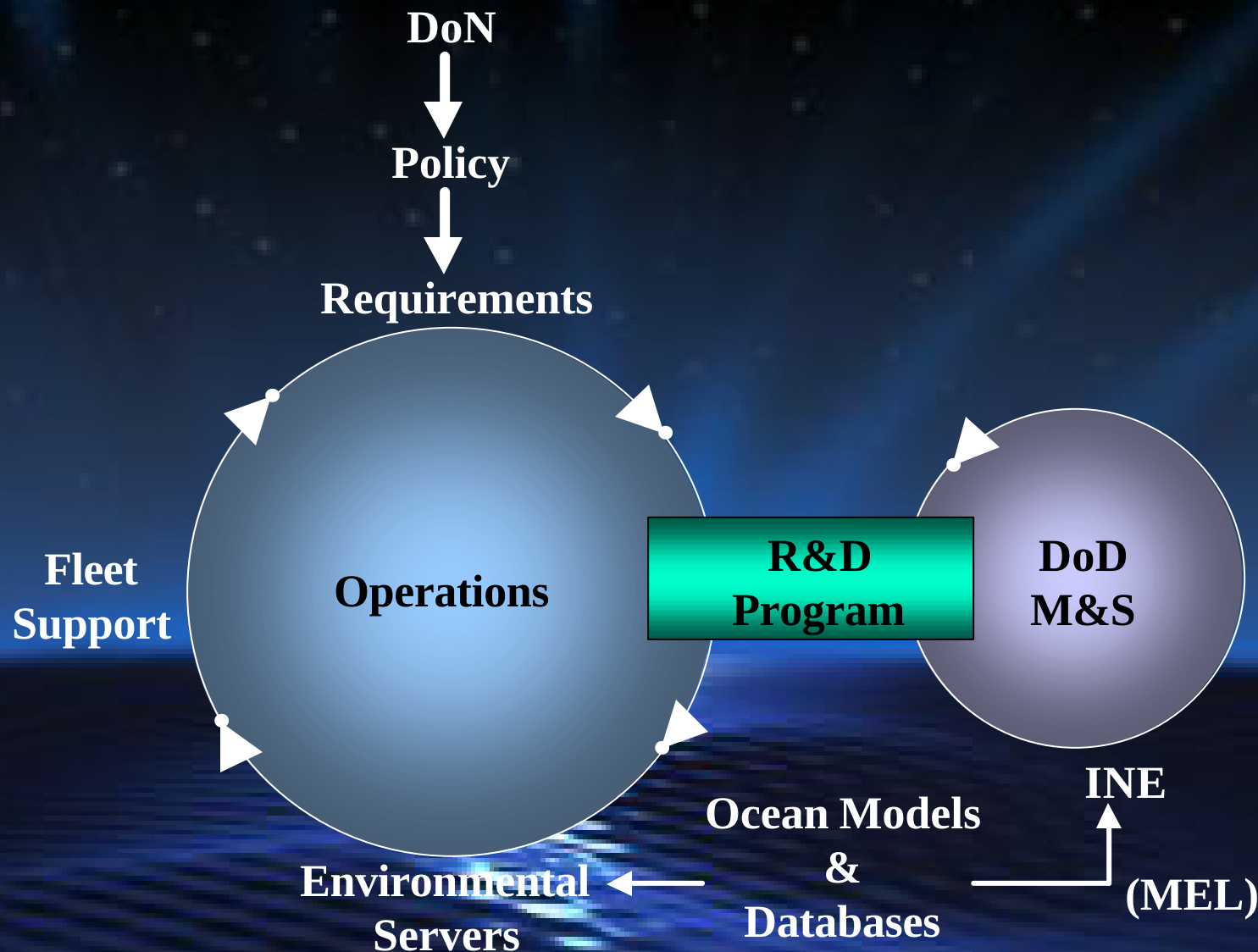


Our Extended M&S Organization





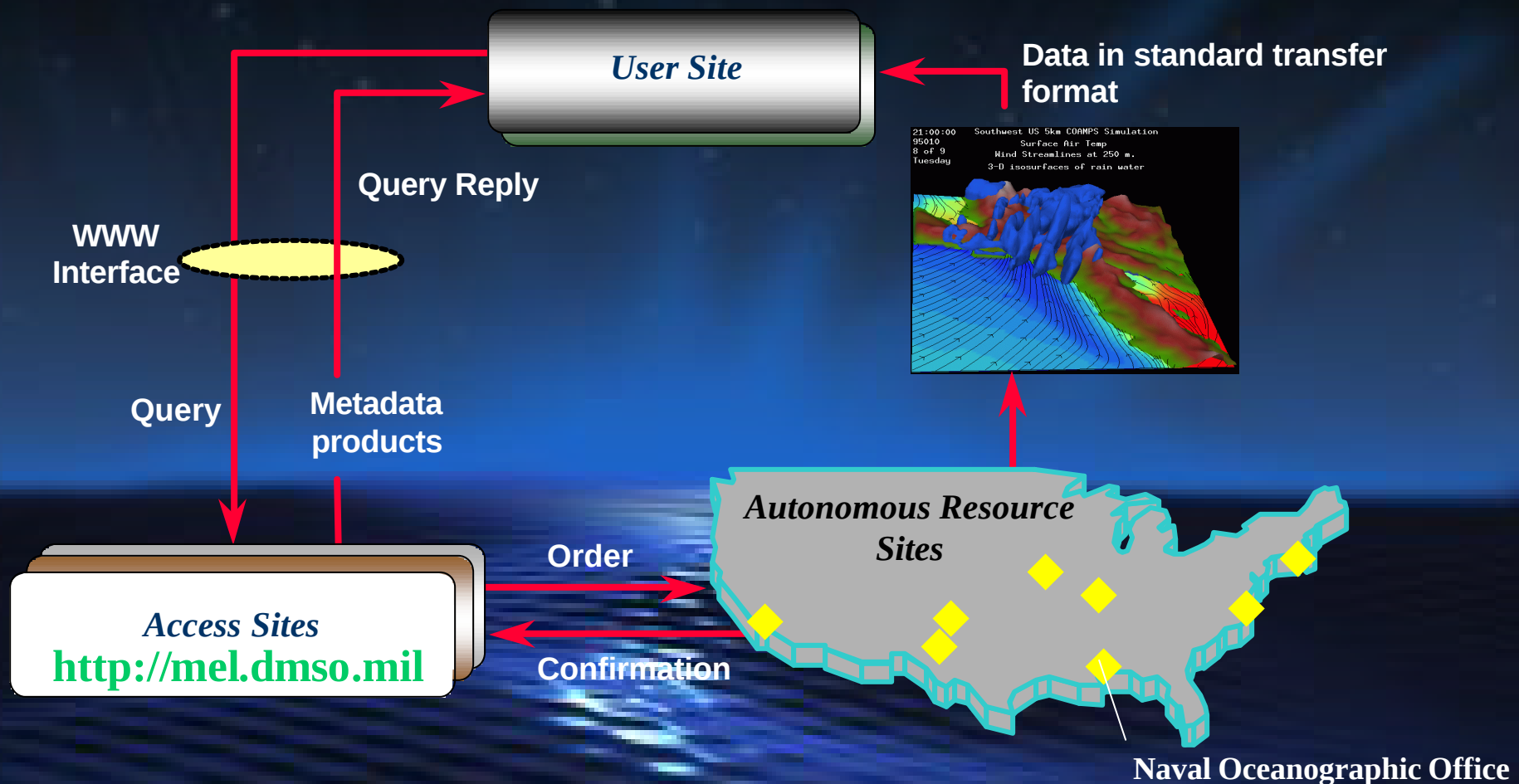
Operational Concept





Master Environmental Library (MEL)

Challenge: Facilitate discovery, access, subscription, and delivery of environmental information, products, and data wherever they are stored.





Ocean and Atmospheric Master Library

- **Navy Standard** library of models, algorithms and databases for use in operational METOC prediction systems.
- 59 configure-managed items are available:
 - 19 Data Bases
 - 33 Models
 - 7 Algorithms
- 34 more approved for development
- Independent model and database V&V panels



OAML Library Items

Representational Example: 2000

OCEAN MODELS

MODAS 1.0

Naval Search and Rescue 1.0

Surf Prediction 3.0

Shallow Water REF/DIF 1.0

OCEAN DATA BASES

GDEM PROV. 4.0

ICECAP 2.0

Historical Temporal Shipping-V 1.1

GDEM-V 2.5

GDEM-Province 4.0

SENSOR SPECIFIC DATA BASES

VLAD NOISE GAIN 2.0

GI&S PRODUCTS (Digital Bathy)

DBDB-V Ver 3.0

ACOUSTIC MODELS

Parabolic Equation 5.0

ASTRAL 5.0

ASPM 4.3

Gaussian Ray Bundle 1.0

High Freq Env Acoustic (HFEVA) 1.0

COLOSSUS II 1.0

Low Freq Bottom LOSS 2.4 (LFBLTAB)

Surface LOSS 2.0

System LOSS 1.0

Active LOSS 2.0

CASTAR 1.0

CASS 3.0

ACOUSTIC DATA BASES

High Freq BL 2.1

Low Freq BL 9.1

Consolidated BLUG 1.1

Vol Scattering Strength 6.2

Wind & Residual Noise 2.1

Shipping Noise 5.2



OAML Library Items

Representational Edition 1.0 2000

ATMOSPHERIC MODELS

MUF 1.1
LUF 1.1
EDH 1.0
RFSDR 1.0
CLUTTER 1.1
STD EM PROP. 1.0
SSR 1.0
RADFO 1.0
FLIR 2.0
CHAFF TRAJ. 1.0
CHAFF DISP. 1.0
METBAL 1.0
RPO 1.16
RIA 1.0
MVOI 1.0
VLSTRACK 2.0

ATMOSPHERIC DATABASES

HEPC 1.0
UAGC 1.1
GTCT 1.0
NHECT 1.0
SMGC 1.0

ALGORITHMS

SLAC 3.0
Wilson Sound Speed 1.0
TEMP/UTIL 1.0
D-Values 1.0
PADA 1.0
Surface Scattering Strength 1.0



M&S Issues

- Rapid Data Assimilation in M&S
- Surf models for shallow water special operations
- A nesting of ocean-related models and products
- Timely demonstrations to assess progress/effectiveness



Rapid Data Assimilation in M&S

(Same as for Operations)



Remote Sensors

- MCSST & Altimetry
- Air, Buoy, & Ship XBTs
- Through-the-Sensor

NAVOCEANO



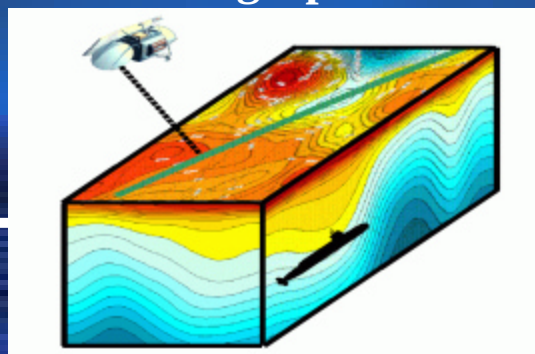
Global Data Fusion

METOC Centers



Regional Fusion & Tailored Operational Support

Compressed Oceanographic Data

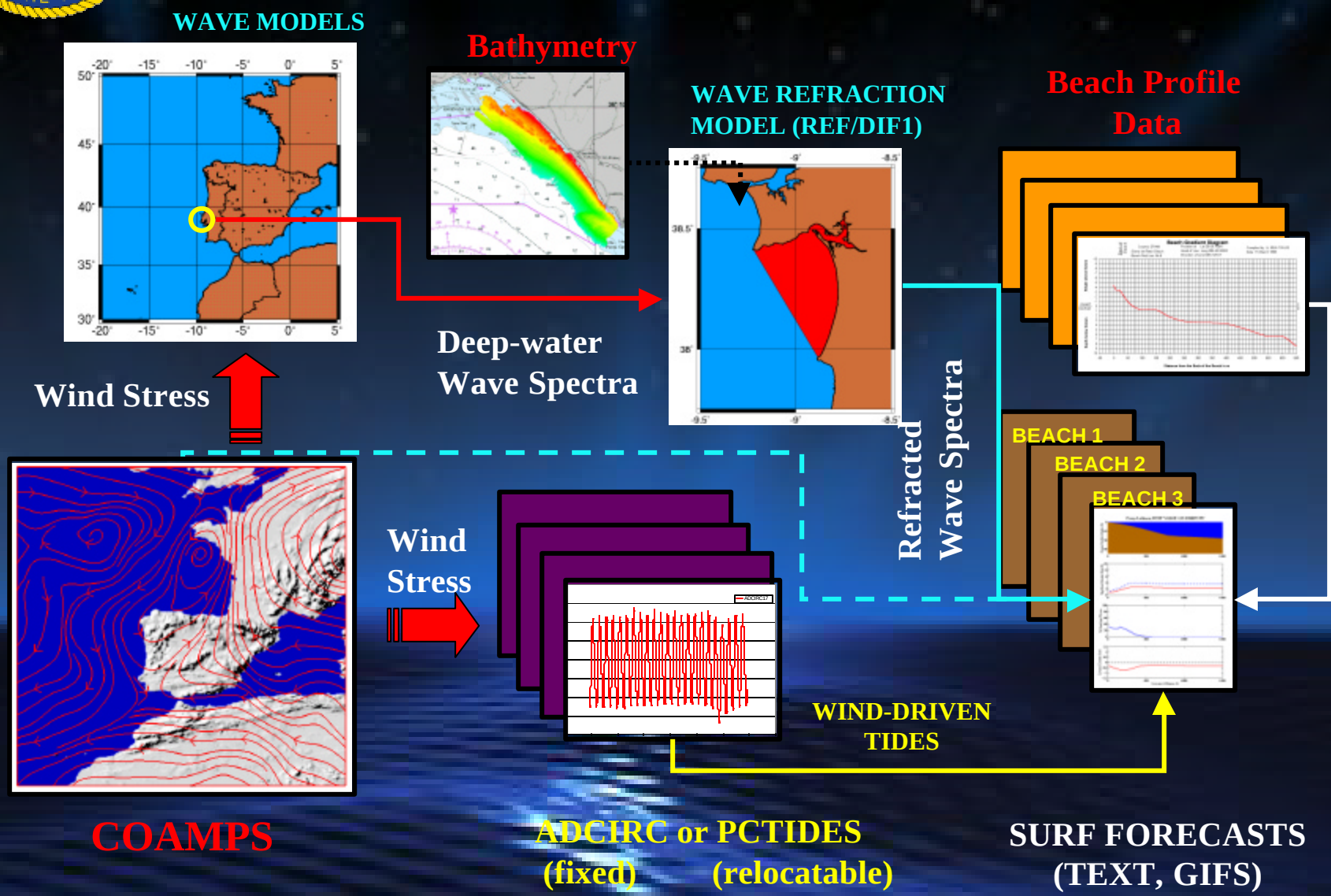


Local XBT Measurements





Integrated Wave to Surf Modeling





Distributed Integrated Ocean Prediction System (DIOPS 1.0)

Beach Profiles

- Navy SEAL Team Survey
- Constant slope
- Sediment-based
- REA (SHOALS etc.)
- Blended

Shallow-Water Directional Wave Spectra

- STWAVE
- REFDIF

Tides

- ADCIRC
- PC-TIDES
- Tide Tables

Winds

- COAMPS
- Other

SURF3.0

SURF 3.0 OUTPUT:

- Significant wave height
- Significant breaker height
- Peak period, Breaker period
- Breaker Type:
 - Spilling
 - Plunging
 - Surging
- Breaker Angle
- Surf Zone Width
- Longshore Current
- Modified Surf Index



Nesting of Ocean-related Models and Products

Telescoping Strategy

Global/Mesoscale/Tactical/Nowcast Scales

NOGAPS:

- FNMOC spectral model, T239/L36*
- Data assimilation; 0-10 day guidance
- Provides boundary conditions for COAMPS coarse mesh

* Scheduled for FY02

COAMPS:

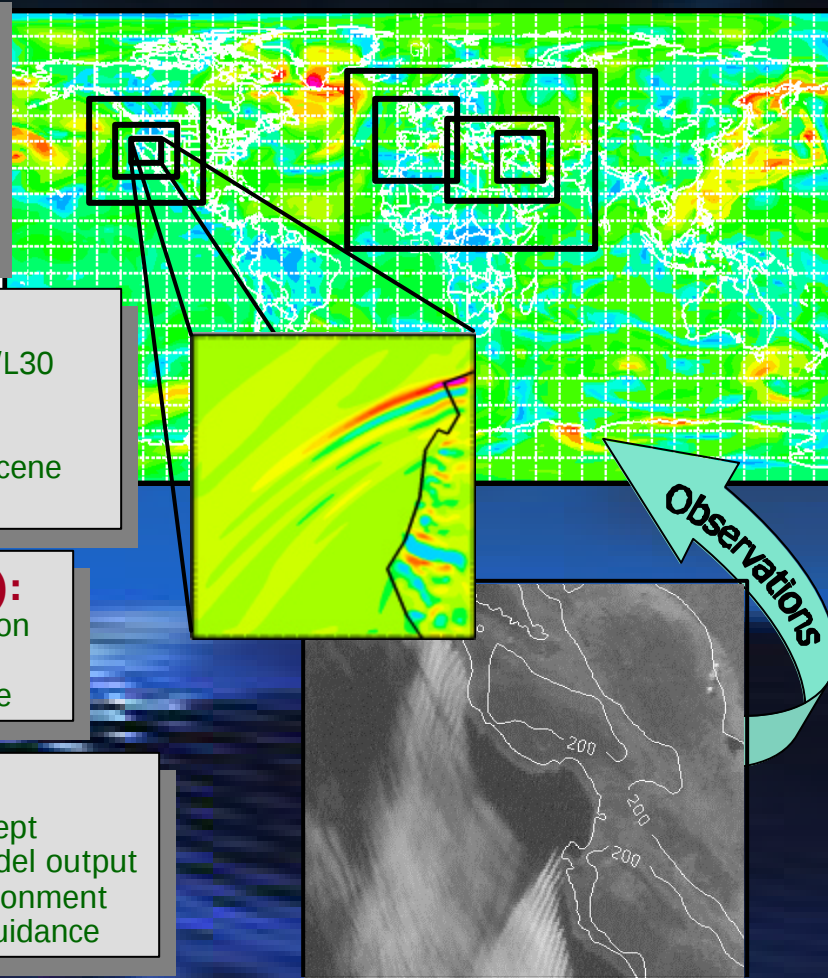
- FNMOC nonhydrostatic model, <9 km/L30
- Globally relocatable; Data assimilation
- Explicit moist physics; 0-72h guidance
- Provides boundary conditions for on-scene COAMPS coarse mesh

TAMS/RT (6.4) / (DAMPS):

- On-scene tactical data assimilation
- COAMPS, METOC database, GUI
- Tactical weather; 0-48h guidance

NOWCAST (6.2):

- Battlegroup mesonet concept
- Fuse observations and model output
- Common battlespace environment
- Tactical end users; 0-6h guidance





Timely Demonstrations to Test Progress

NWDC M&S Objective

To create a condition/state where novel concepts involving C2 architectures, organizations, and technologies can be end-to-end and repeatedly stimulated in a robust and scalable manner for FBEs and Laboratory Experiments.

Directly relates to the direction, management of information flow to critical nodes of war fighting decision makers

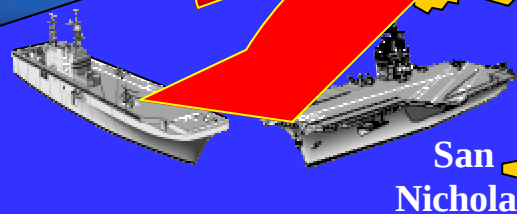


FBE Concept of Operations

- Set Conditions
- Establish Access
- Conduct Initial Strikes & Joint Tactical Actions
- Sustain
- Achieve Dimensional / Time-definite Superiority

Sea Ranges

Land Ranges



San Nicholas

Monterey

Vandenberg

Point Mugu

China Lake

Edwards

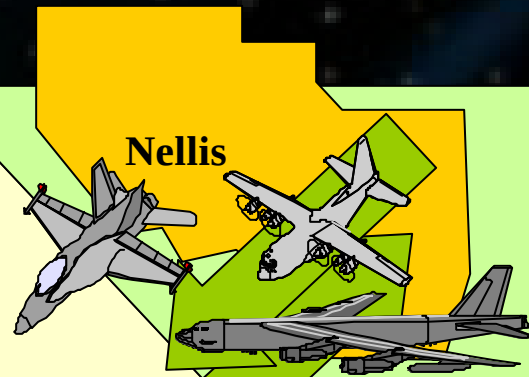
Los Angeles

Ft. Irwin

29 Palms

Nellis

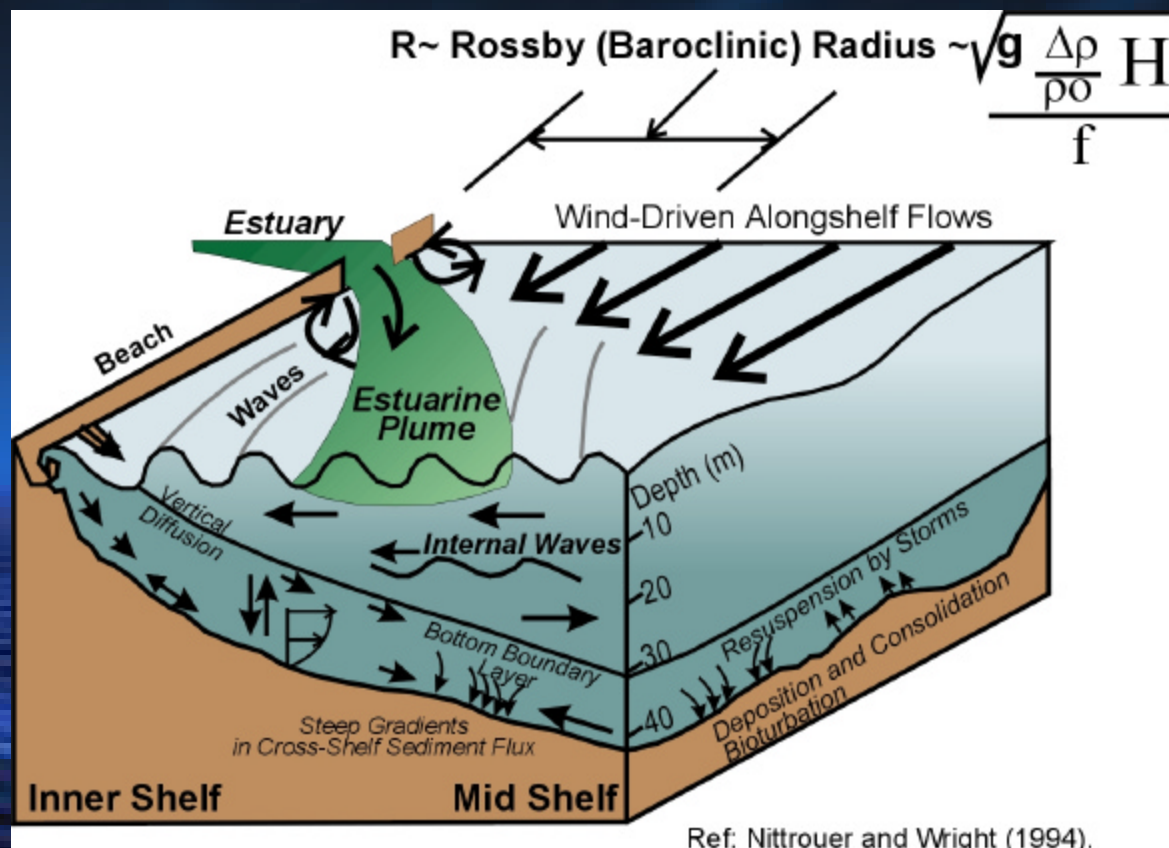
Las Vegas





Assessing Model Effectiveness

- A Problem of Time: Refresh rates.
 - Littoral Ocean Regions are characterized by long and short term factors, but unlike the deep water, short term effects are more significant
- A Problem of Space
 - Rapid changes in bottom slopes create the need for non-uniform grids



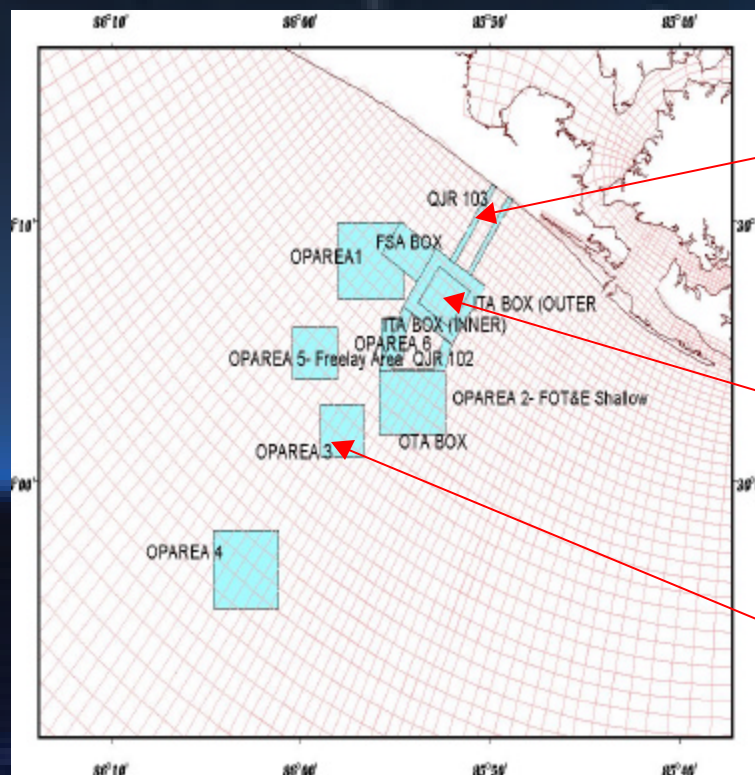


Ocean Sensitivity Study

Gulf of Mexico

Aug 29 to Sept 3, 1999

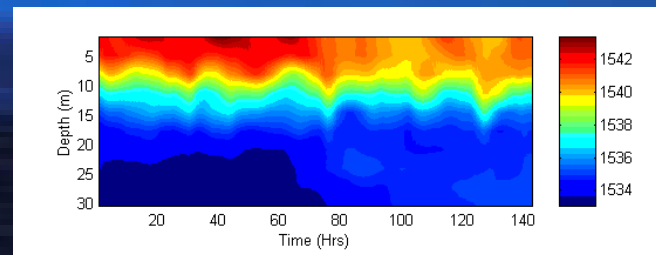
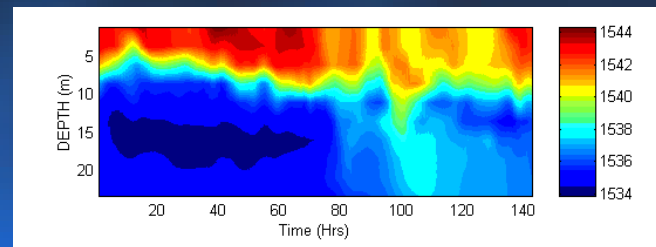
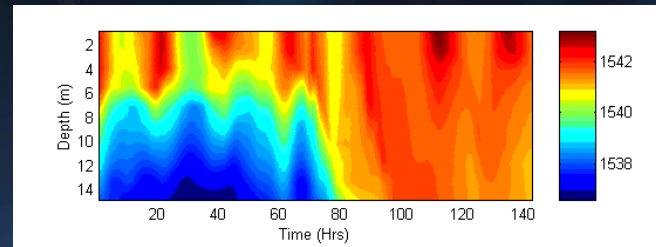
Sound Speed



QJR 103

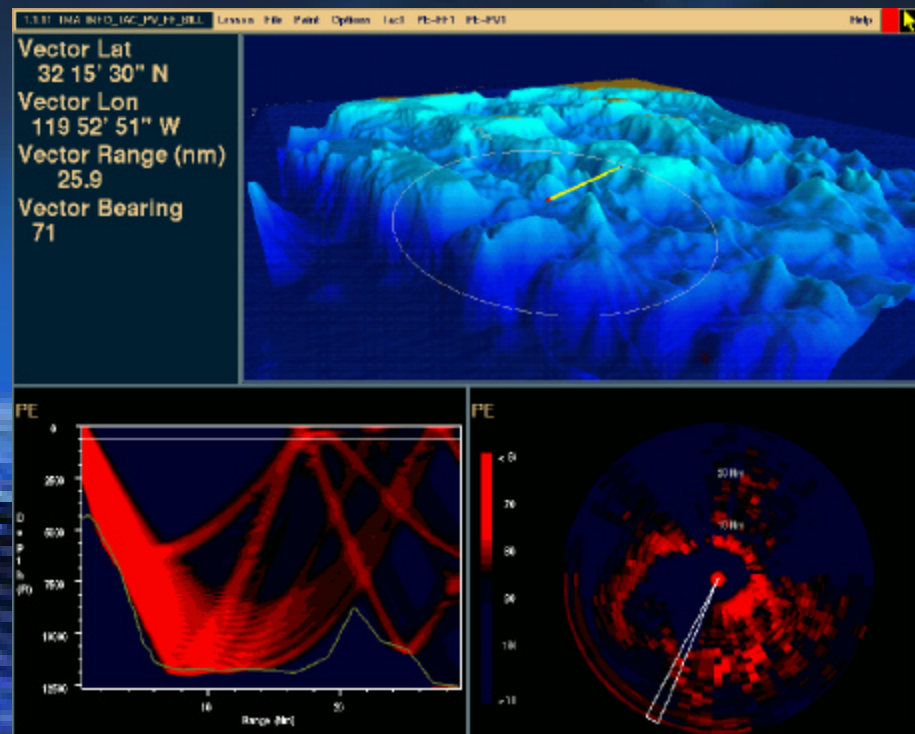
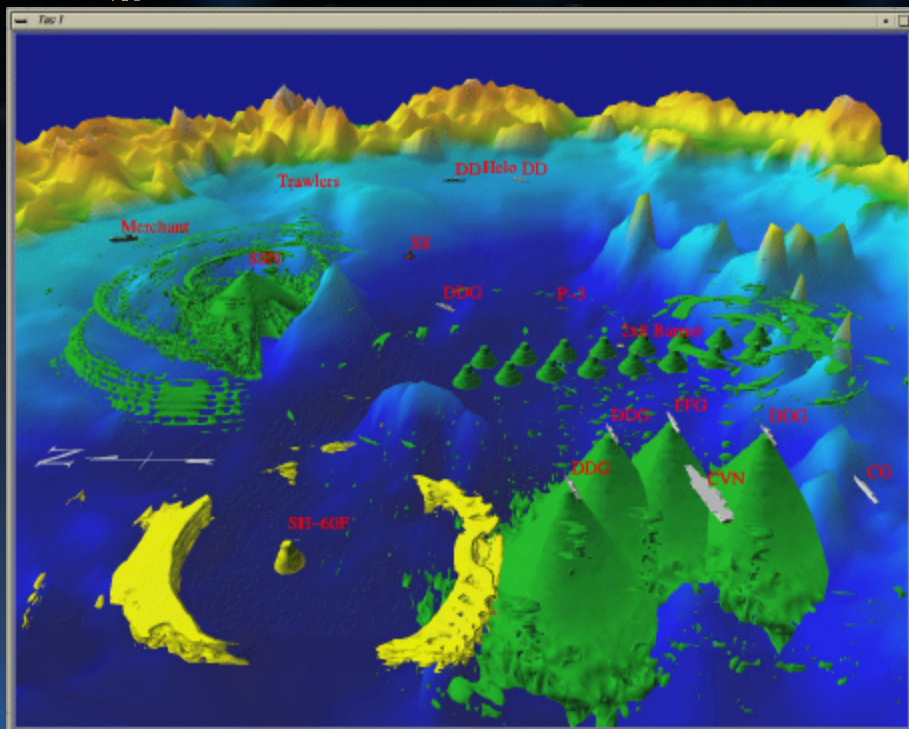
ITA Box Inner

OPAREA 3





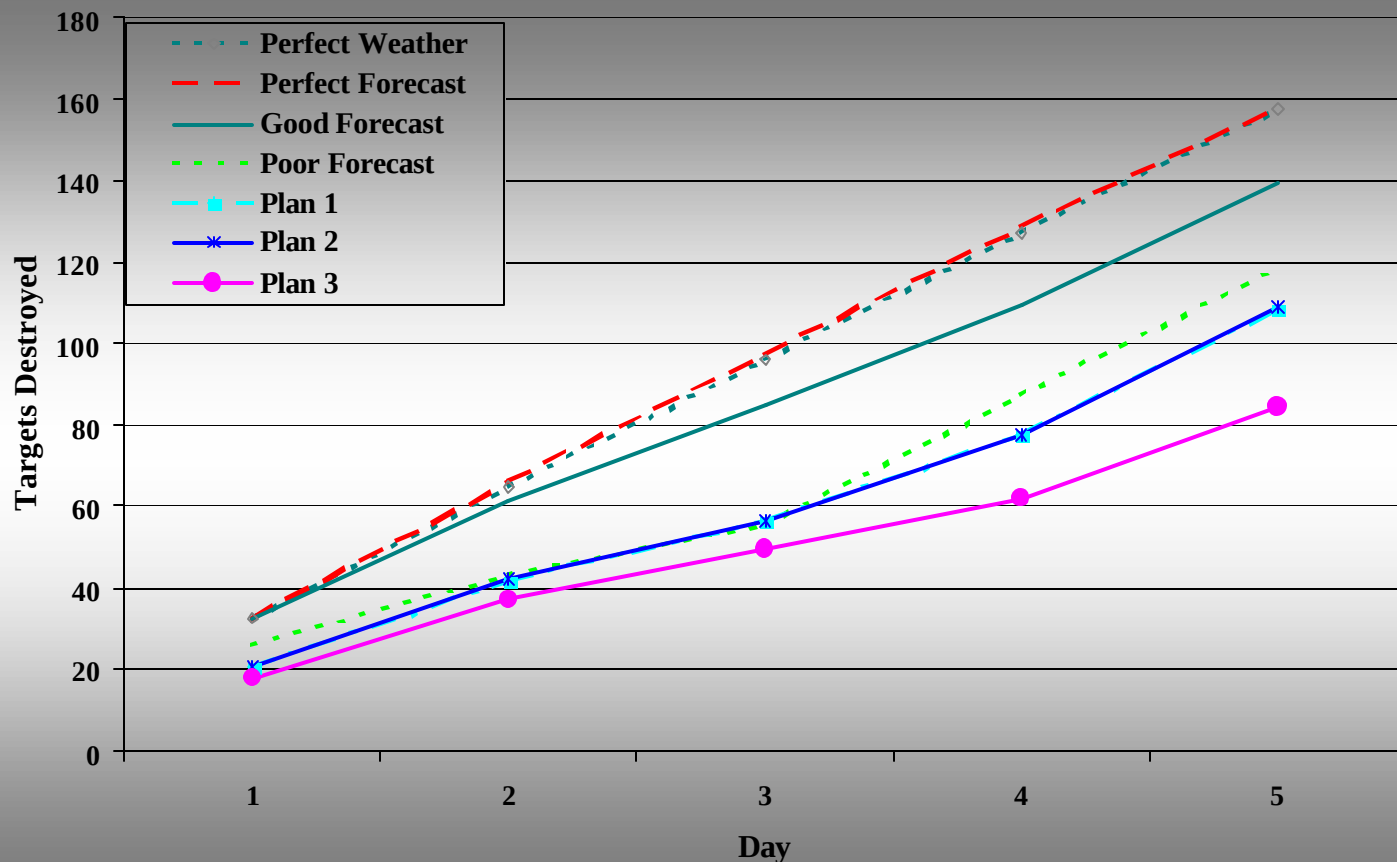
Effectiveness of M&S





Environmental Impact

Targets Destroyed



- Developed weather pattern – clouds, ceiling, visibility, precip, temp.
- Modeled weather, impact on flights & available targets.
- Results: targets destroyed and risk to aircraft.



The Way Ahead in Ocean M&S

- **Display technologies**
- **Sensitivity to the environment**
 - Sensitivity studies
 - Impact studies and products
- **Data acquisition**
- **Resolution**
 - Space and time



Industry's Role

- **Rapid Environmental Assessment**
- **Sensor Development / Integration**
- **Through the Sensor Technologies**
- **Information Fusion**



Contact Information

Policy

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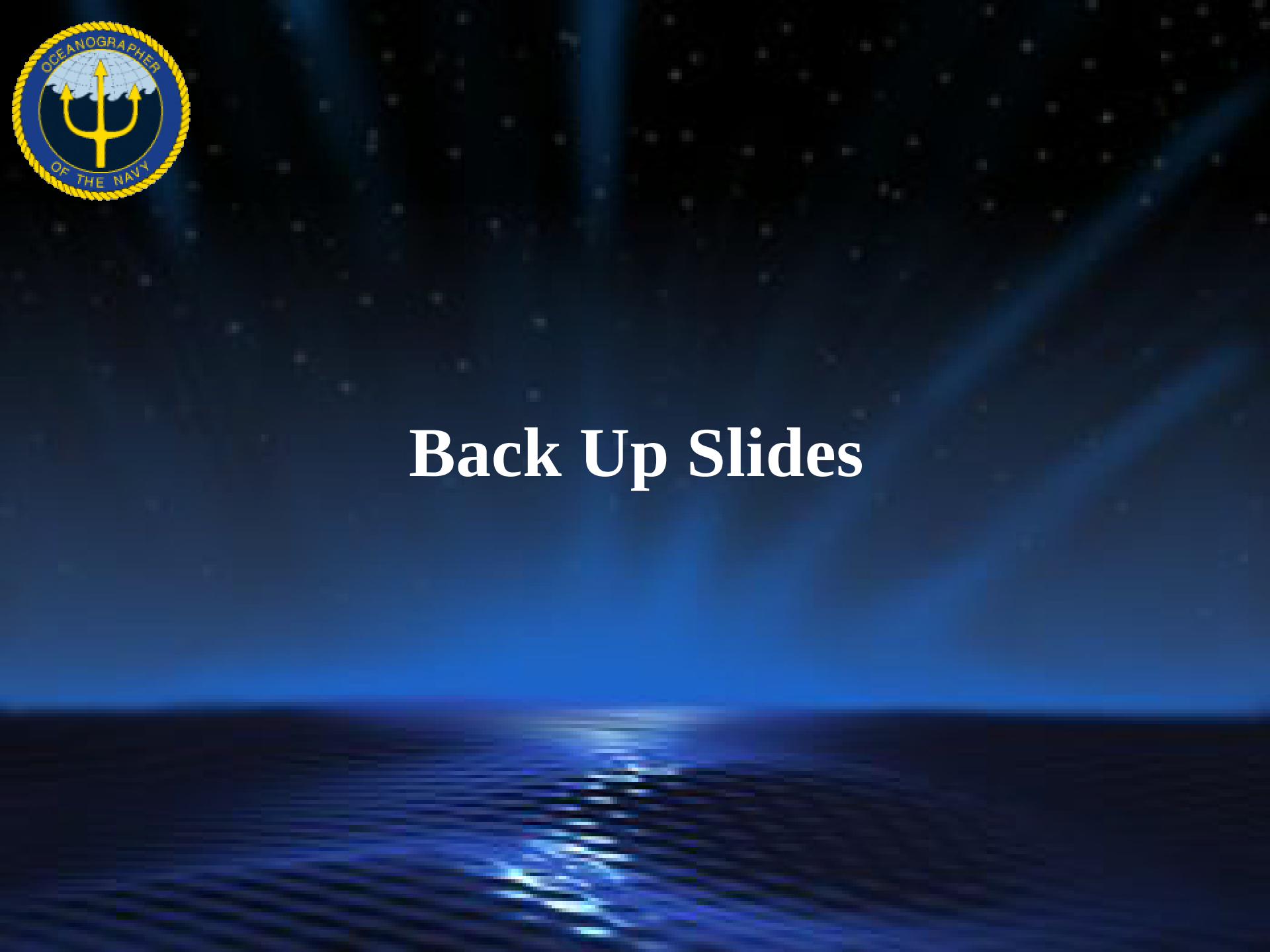
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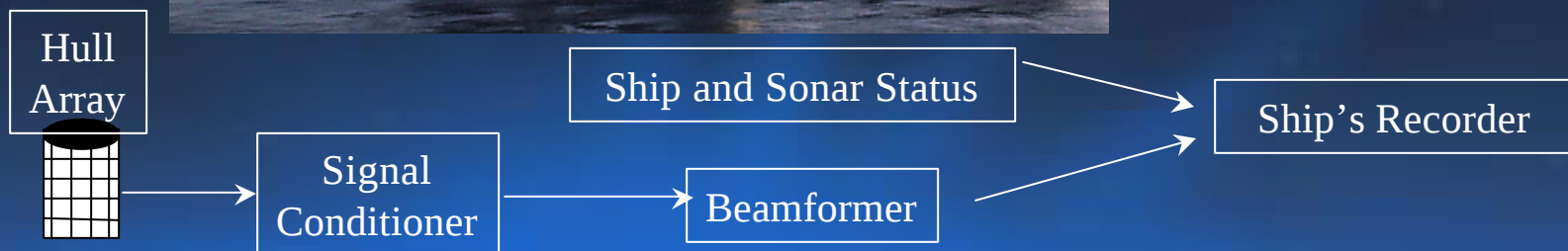


Back Up Slides

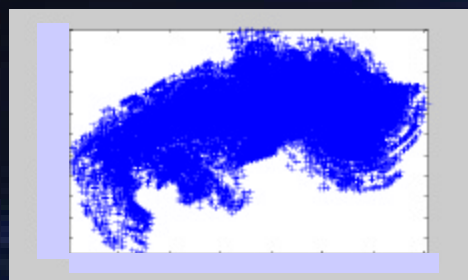


Through the Sensor Data Collection

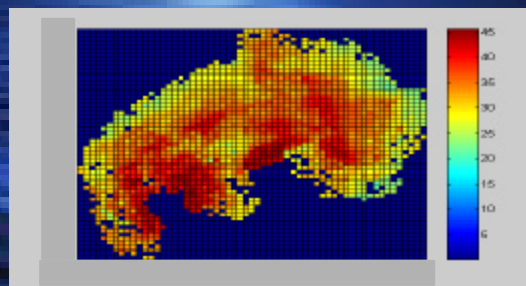
SABLE currently processes recorded active sonar returns from the AN/SQS-53C sonar.



Database Filtering



Reverberation



Scattering Strength

