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THE INTEGRATED NATURAL ENVIRONMENT AUTHORITATIVE REPRESENTATION PROCESS

**A brief on some of the relevant aspects of providing an
authoritative natural environment to models and simulations.**

Presented by Ed Weitzner

**The Johns Hopkins University Applied Physics Laboratory
On-Site Support to the Oceanographer of the Navy**

73rd MORS Symposium

USMA West Point, NY

21-23 June 2005

The Integrated Natural Environment Authoritative Representation Process (INEARP)

The INEARP is a process developed by the environmental Modeling & Simulation Executive Agents (MSEAs) in collaboration with the Defense Modeling & Simulation Office (DMSO) to meet the environmental representation requirements of the DoD M&S community.

Outline

Background

Description

Four Diverse Examples

- Global Naval War Game
- Much-faster-than-real-time Campaign Simulation
- Fleet Battle Experiment
- Theater-wide Naval Campaign Analysis Study

Background

No realistic simulation can be conducted without an in-depth understanding of the environment and its effects on platforms, weapon systems, sensors and people.

The Washington Post
TUESDAY, APRIL 6, 1999
122ND YEAR No. 122

Weather
Today: Increasingly cloudy.
High 66, Low 48.
Wednesday: Partly sunny,
warmer. High 72, Low 48.
Details, Page B8.

Inside: Health
Today's Contents on Page A2
25¢
Prices may vary by publication
and location. Washington, D.C. for the Post 12

Lockerbie Suspects Delivered For Trial

Sanctions on Libya Suspended by U.N.

By ANNE SWARDSON
Washington Post Foreign Service

ROTTERDAM, April 5—After years of false hopes and agonizing negotiations, two Libyans accused in the 1988 bombing of a Pan Am jetliner over Lockerbie, Scotland, arrived here from Tripoli today and were turned over to Scottish authorities in preparation for trial. The arrival of the two men in the Netherlands triggered an automatic suspension of U.N. economic sanctions against Libya.

President Clinton welcomed the surrender of the two men—alleged former intelligence agents Abdel Basset Ali Megrahi and Lamen Khalifa Fhimah—calling it “a moment much awaited and long overdue.”

Relatives of those killed in the bombing, however, were less enthusiastic about this hoped-for end

Skies Clear, NATO Rains Bombs; Clinton Vows Relentless Attack



Yugoslav Troops Elude Aerial Scan, Allies Report

By BRADLEY GRAHAM
Washington Post Staff Writer

Aided by clearing skies over Yugoslavia, NATO warplanes yesterday launched what alliance officials said were the most extensive airstrikes since the bombing began 13 days ago. President Clinton vowed the campaign will be “unending and unrelenting” until President Slobodan Milosevic reverses course in Kosovo.

While alliance officials continued to provide few details about targets being struck, they said the heavy cloud cover that had forced cancellation of many previously planned bombing runs has lifted, enabling NATO aircraft to accelerate the pace of their attacks. The increased air operations drew more anti-aircraft fire from Yugoslav missile and artillery sites, whose inactivity up to now had surprised alliance commanders. But NATO spokesmen reported that no alliance planes were hit.

Even with the improved weather, however,

Lessons of Kosovo and the Limits of Air Power

In the first month of the air campaign, nearly half of NATO air combat missions were canceled due to *bad weather*.

DoD Modeling & Simulation Executive Agent Designations

Circa 1995-1996

DoD Directive 5000.59, "DoD Modeling and Simulation (M&S) Management," January 4, 1994, stated need for Modeling & Simulation Executive Agents (MSEAs).

Under Secretary of Defense for Acquisition, Technology & Logistics (USD (AT&L)) designated 3 environmental MSEAs:

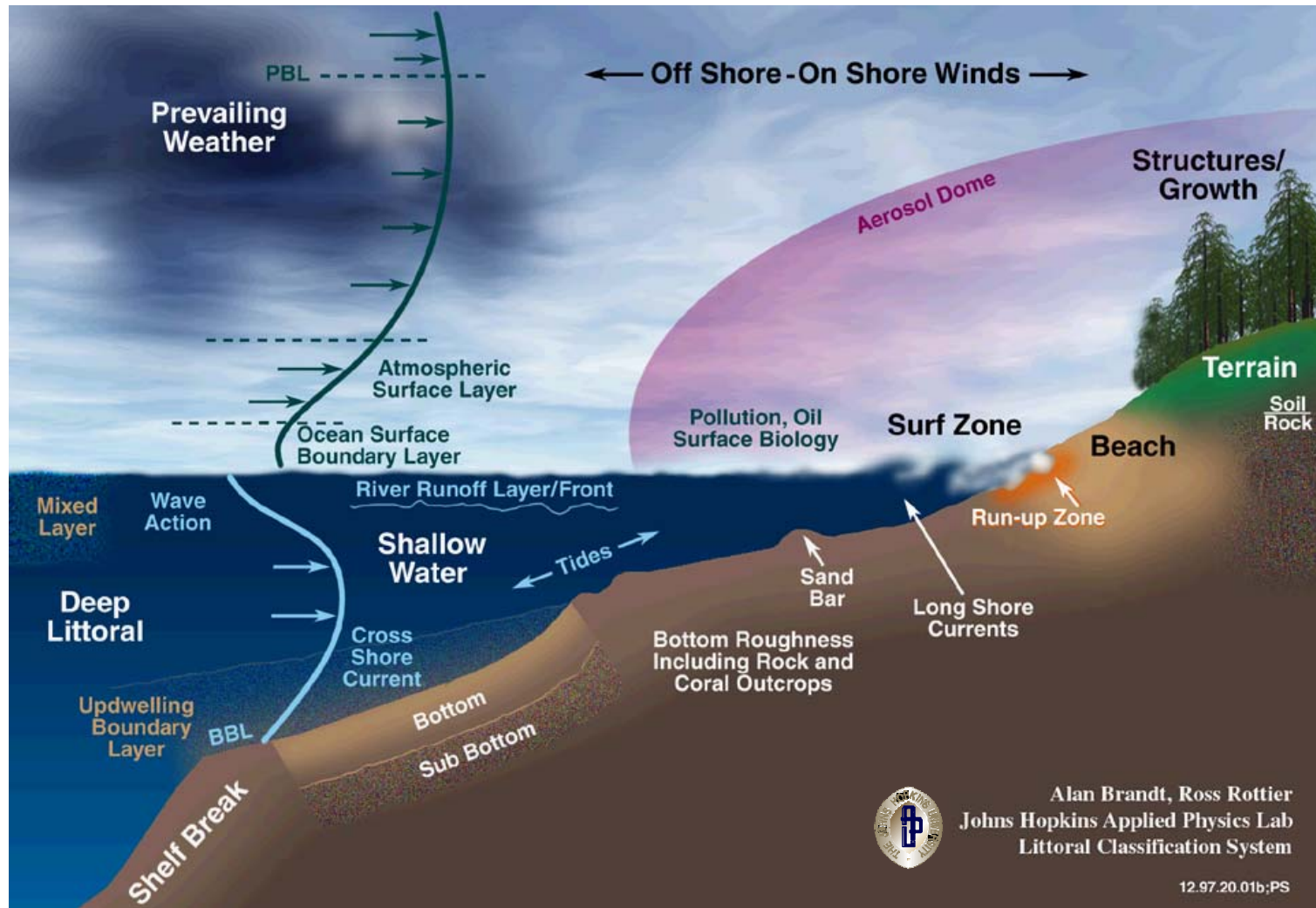
- Defense Mapping Agency (now National Geospatial-Intelligence Agency) as MSEA Terrain**
- Dept of Navy as MSEA Ocean**
- Dept of Air Force as MSEA Air & Space**

The Environmental MSEA Domain Responsibilities

Terrain – All land and into the ocean to 10 feet water depth at low low tide.

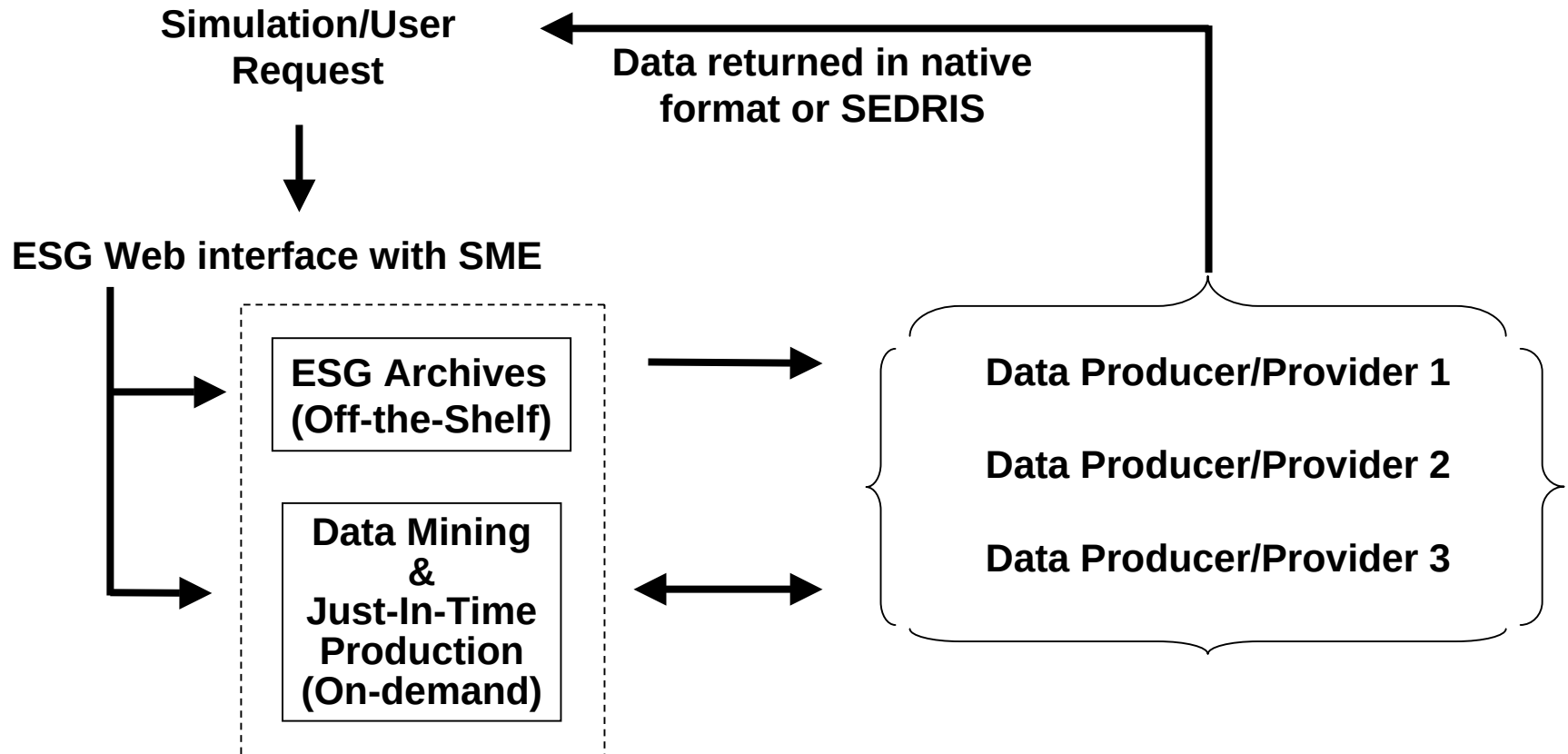
Air & Space – From the surface of the Earth to the Sun.

Ocean – From the ocean sub-bottom to the ocean surface.



Integrated Natural Environment Authoritative Representation Process (INEARP)

Circa 1997- ➡



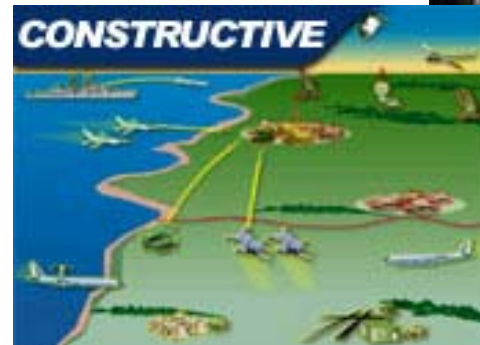
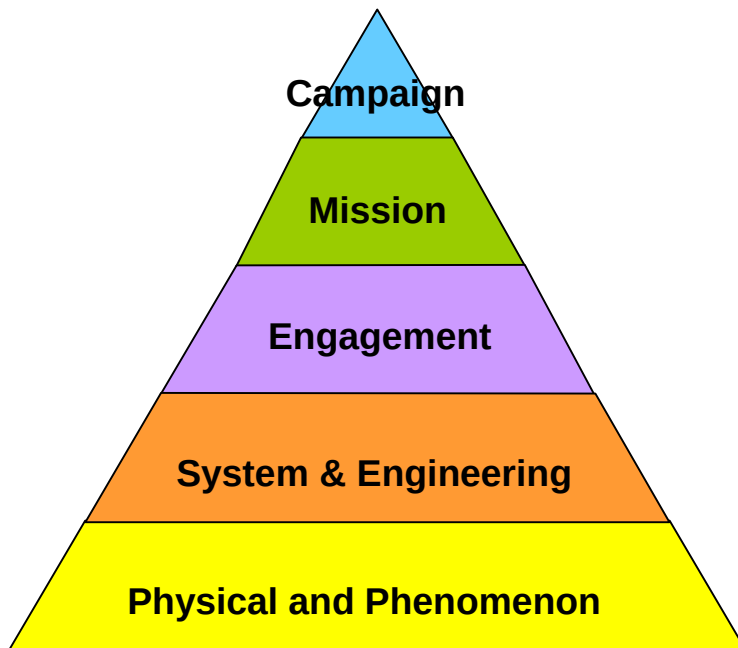
ESG = Environmental Scenario Generator

SEDRIS = Synthetic Environmental Data Representation & Interchange Specification

SME = Subject Matter Expertise

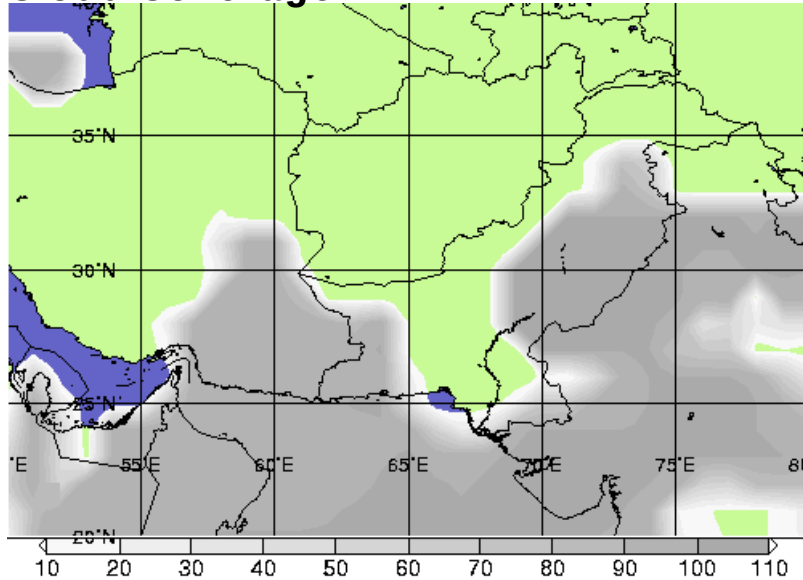
The Goal

One environmental support architecture
for all DoD models and simulations

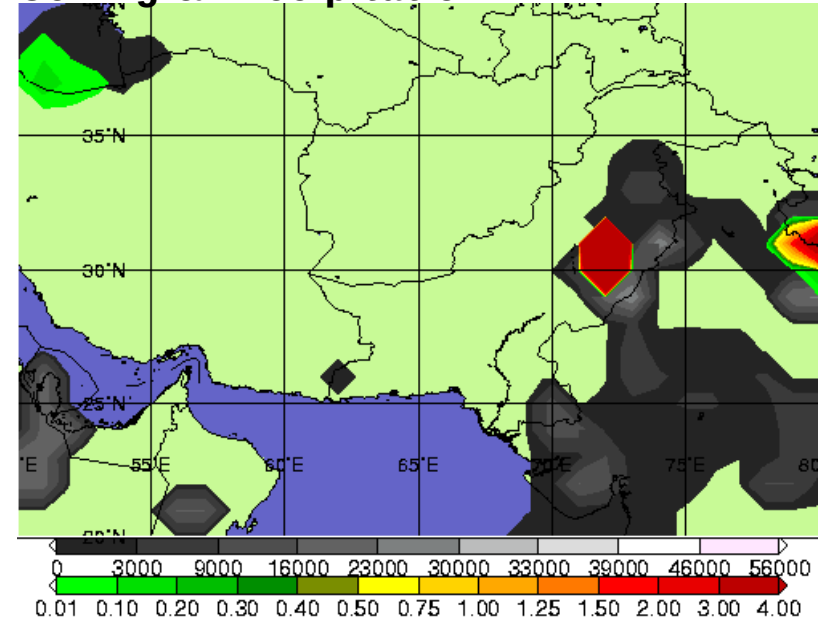


Sample Products from the ESG

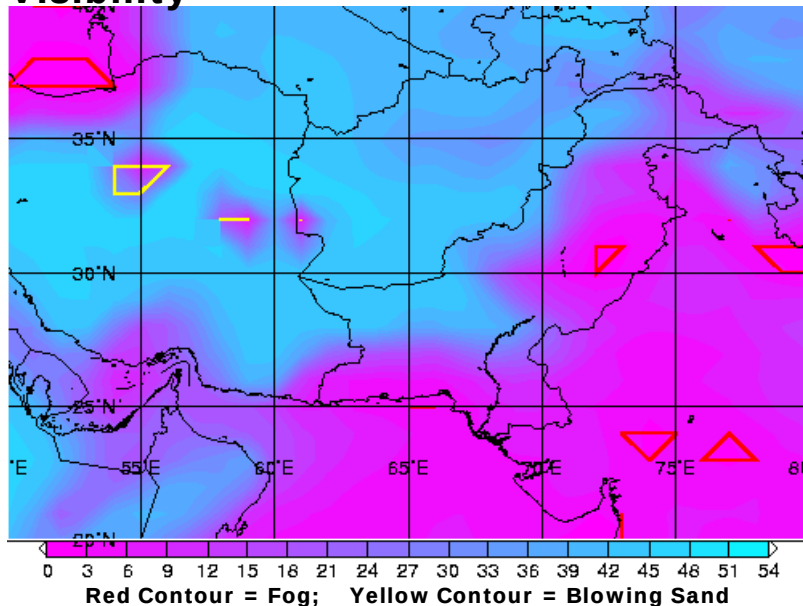
Cloud Coverage



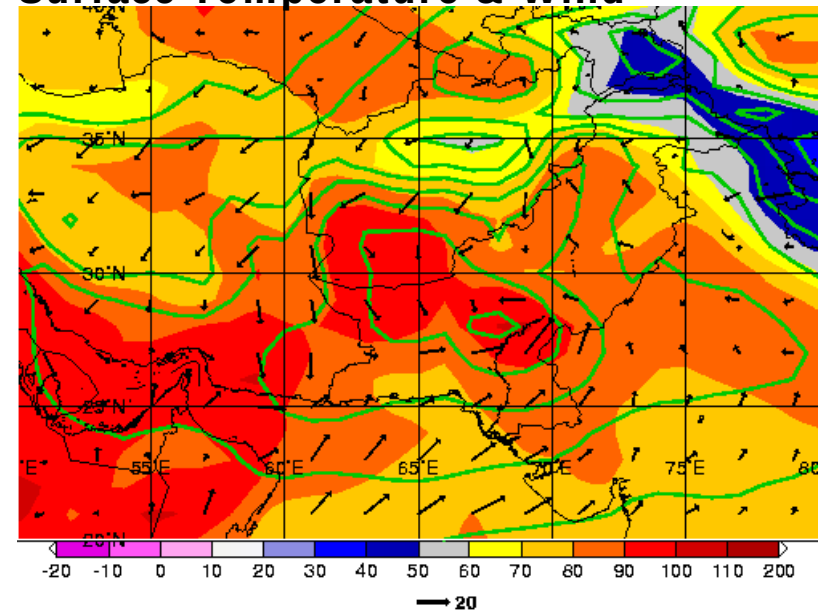
Ceiling & Precipitation



Visibility



Surface Temperature & Wind



Global War Games

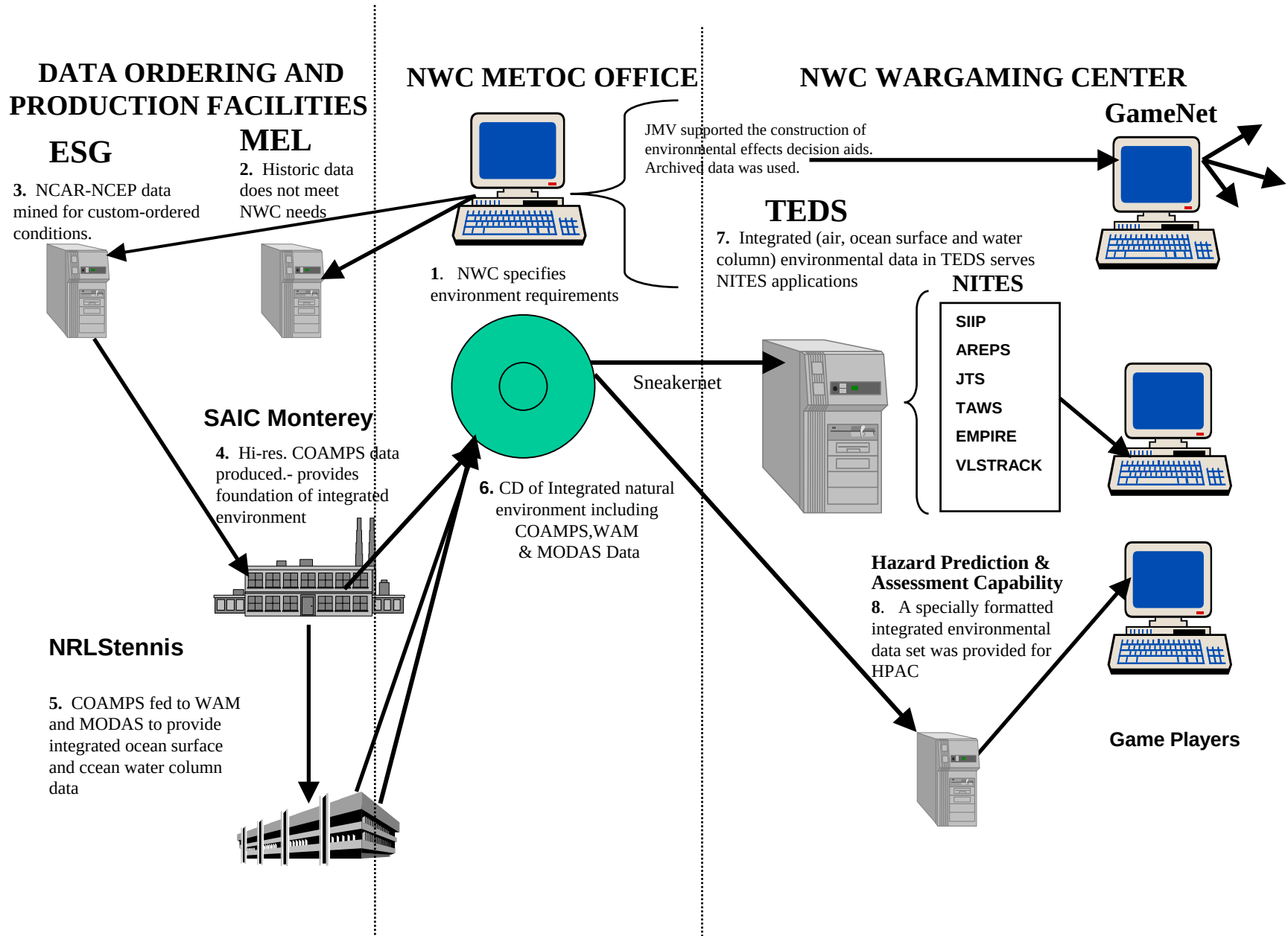
Circa 2000-2001

Naval War College, Newport RI

**Issues: (1) Scripted Environmental Scenarios
(2) Game Floor Computer Decision Aids**



GLOBAL 2000 METOC Information Flow

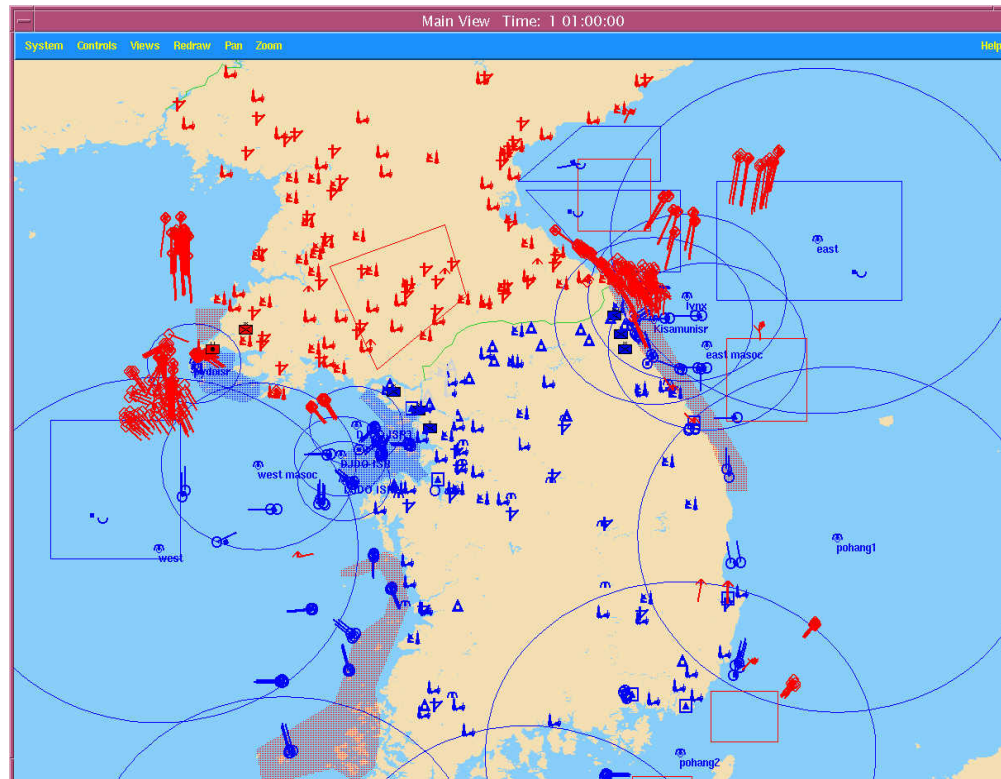


Faster Than Real Time Simulations

Circa 2002-2005

Joint Warfare Simulation (JWARS)

- Issues:
- (1) Prescribed campaign scenarios that run 1000x faster than real time
 - (2) No human intervention – objects can have free play within the simulation



JWARS Atmospheric Data Set

Spatial Resolution: 1.0 Deg

Temporal Resolution: 6 hr

Vertical Resolution:

Six Isobaric (mb) levels

Levels: 1000, 925, 850, 500, 250, 100

Three Cloud Layers

“Low”: Base < 2000 m

“Mid”: 2000 m < Base < 6000 m

“High”: Base > 6000 m

Surface

Surface Fields

Blowing Sand

Blowing Snow

Cloud Ceiling

Density Altitude

Dewpoint Temperature

Elevation

Evaporation Duct Height

Fog

Icing Intensity

Illumination

Pasquil Stability Index

Precipitation Intensity

Precipitation Type

Pressure Altitude

Pressure Reduced to MSL

Sea State

Snow Depth

Surface Duct Height

Temperature

Thunderstorm Probability

Total Cloud Cover

Total Precipitation

Turbulence Intensity

Visibility

Wind Chill

Wind Gust Speed

Wind U Component

Wind V Component

Isobaric Fields

Geopotential Height

Relative Humidity

Temperature

Wind U Component

Wind V Component

Cloud Fields

Cloud Amount

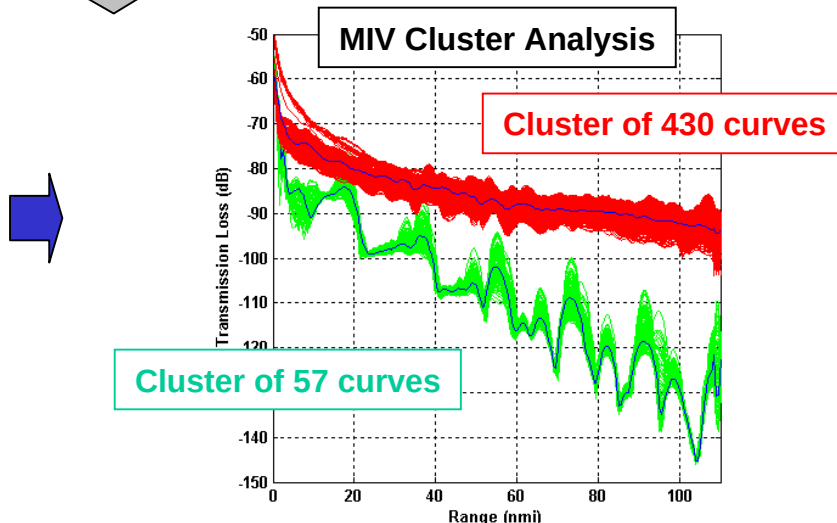
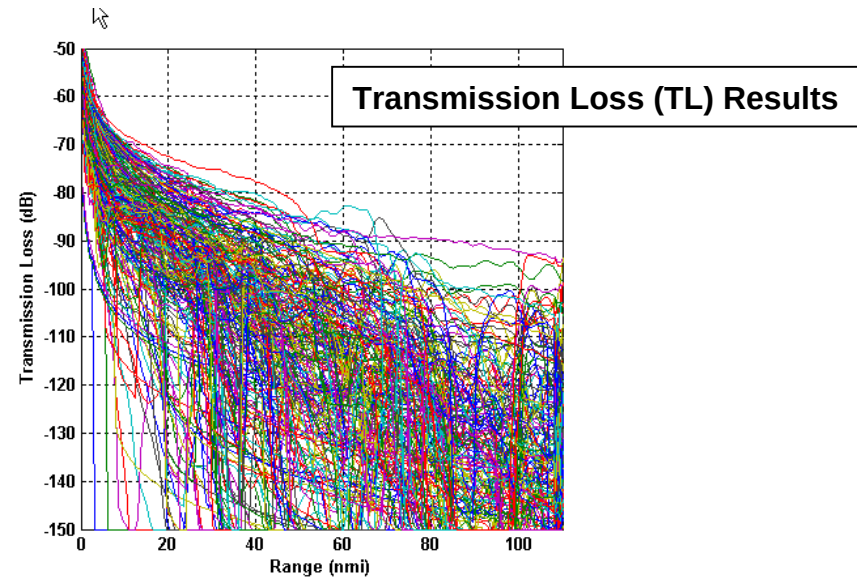
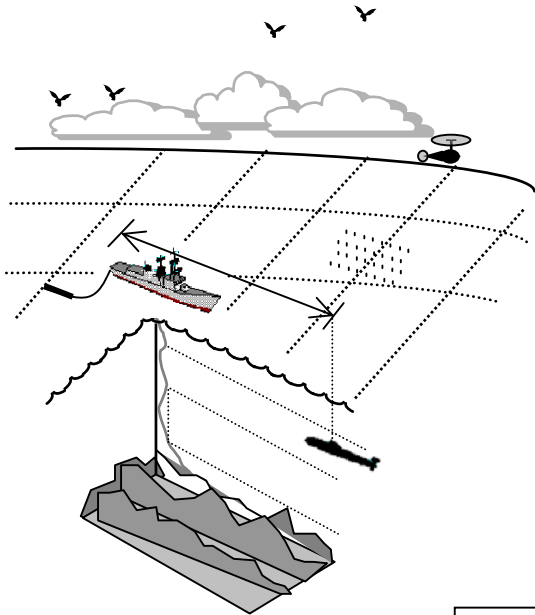
Cloud Base

Cloud Top

Cloud Type

MODEL-RESPONSE INVESTIGATION AND VISUALIZATION (MIV)

A methodology for using cluster analysis to characterize the way in which an environmental effects model (e.g. acoustic propagation) responds to a particular environment.



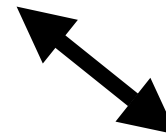
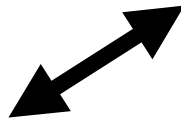
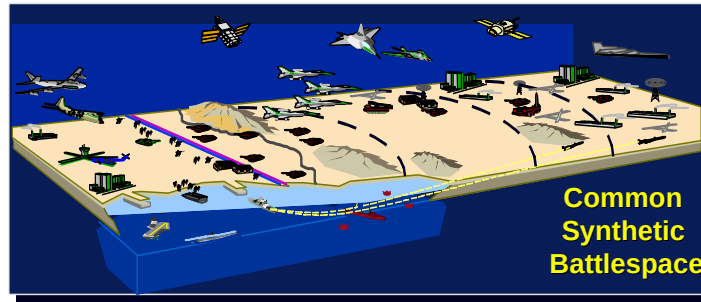
Compact TL Library (say, **250** TL curves) representing entire range of TL behaviors

Fleet Battle Experiments

Circa 2002-2004

Naval Warfare Development Command, Newport RI

- Issues:** (1) Live and simulated forces must operate in the same environment
(2) Operational METOC must be foundation for both live and simulated forces



Model Inputs

The Navy's Fleet Battle Experiment (FBE) program was designed to explore new weapons systems, technologies, and the necessary concepts, organization, and doctrine to employ them in joint operations.

**Joint Semi-Automated Forces (JSAF)
(Sonar Models)**

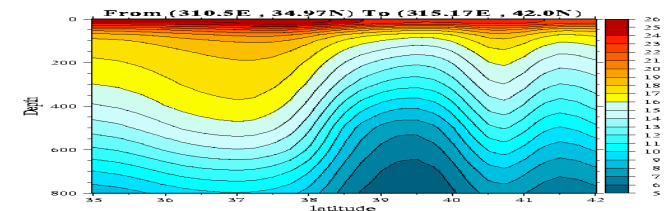
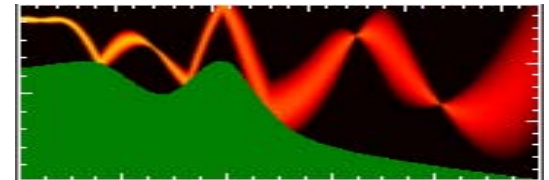
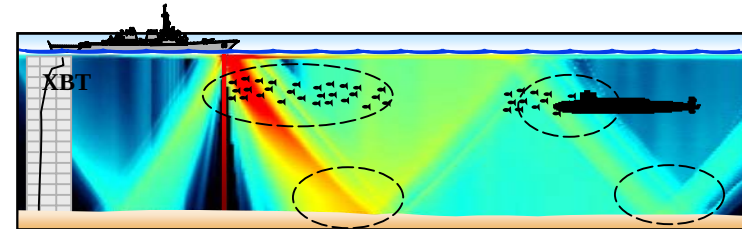
ATLOS
Requests

ATLOS
Responses

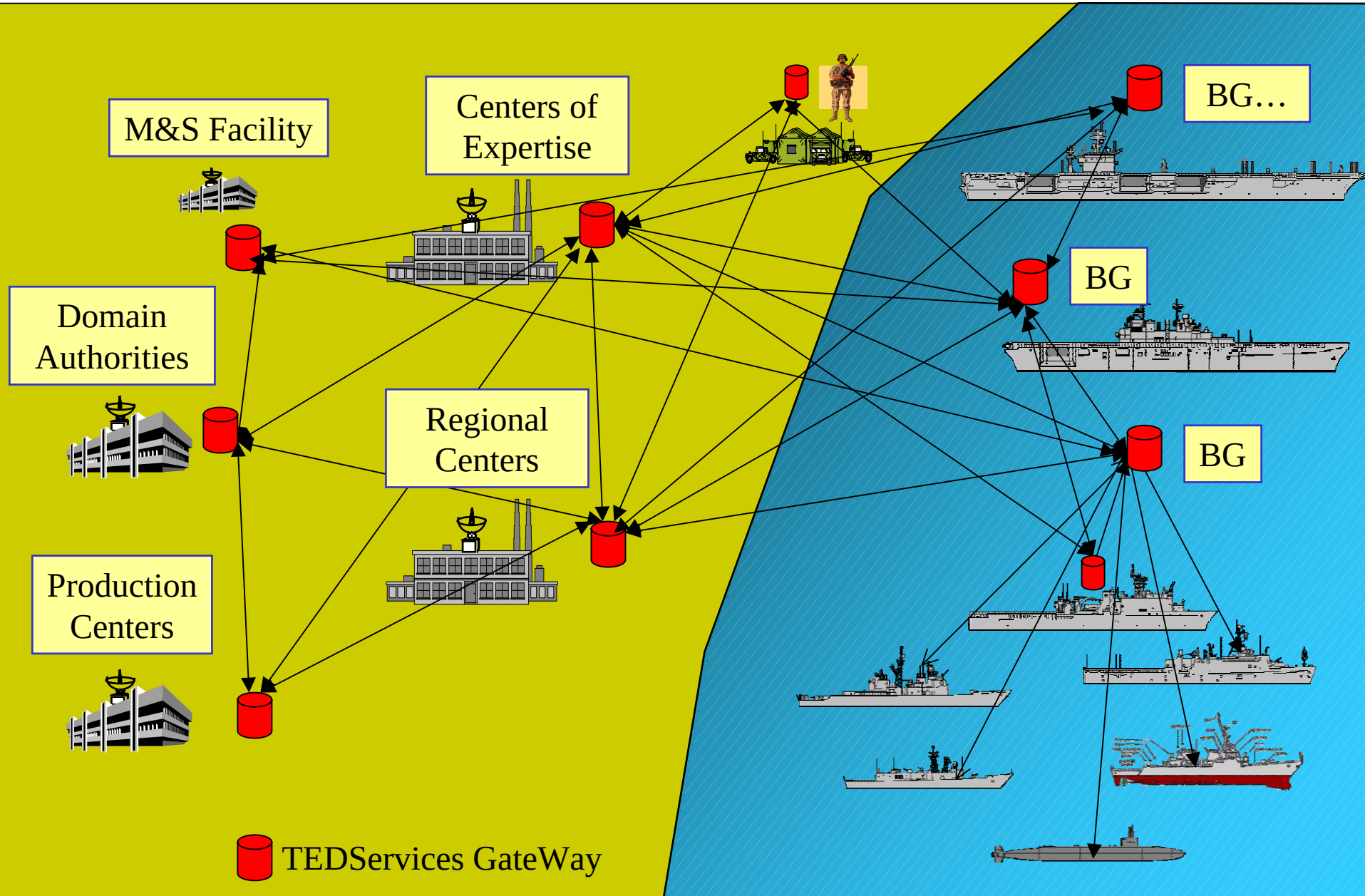
Acoustic TL Server (ATLOS)

Environmental Data Server (OASES)

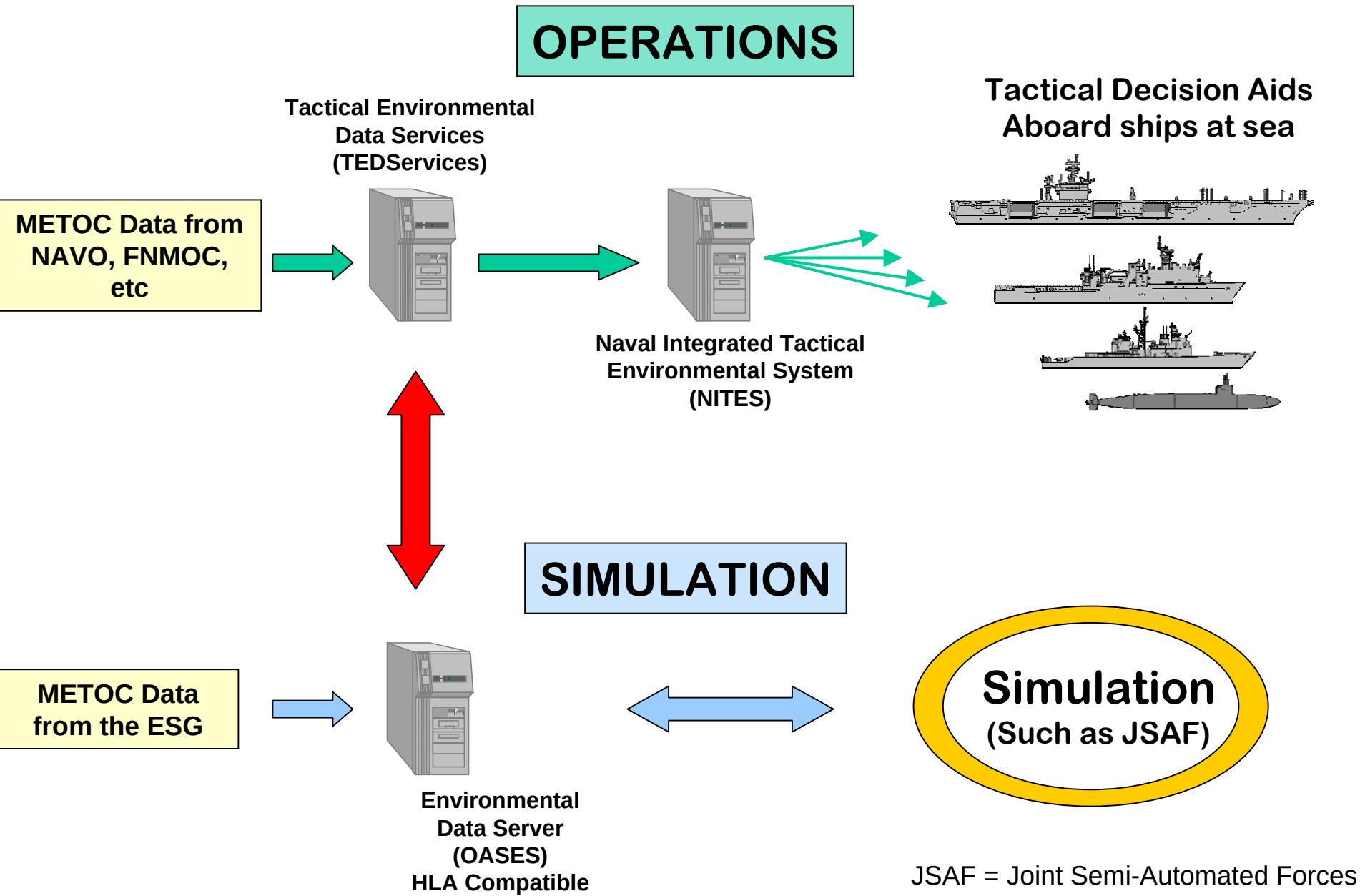
**Ocean
Environment**



The Operational METOC Data Server



Linking Operations and Simulation

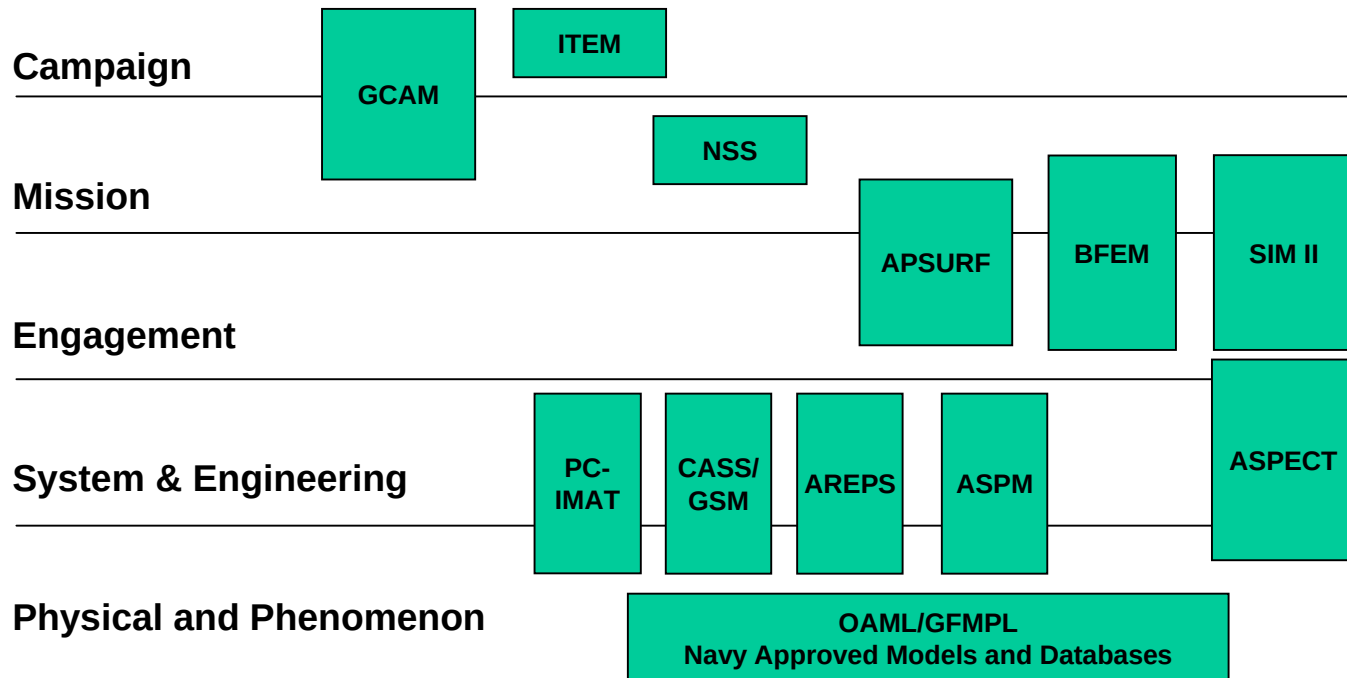


Theater-level Campaign Analyses Using Legacy Models

Circa 2004-05

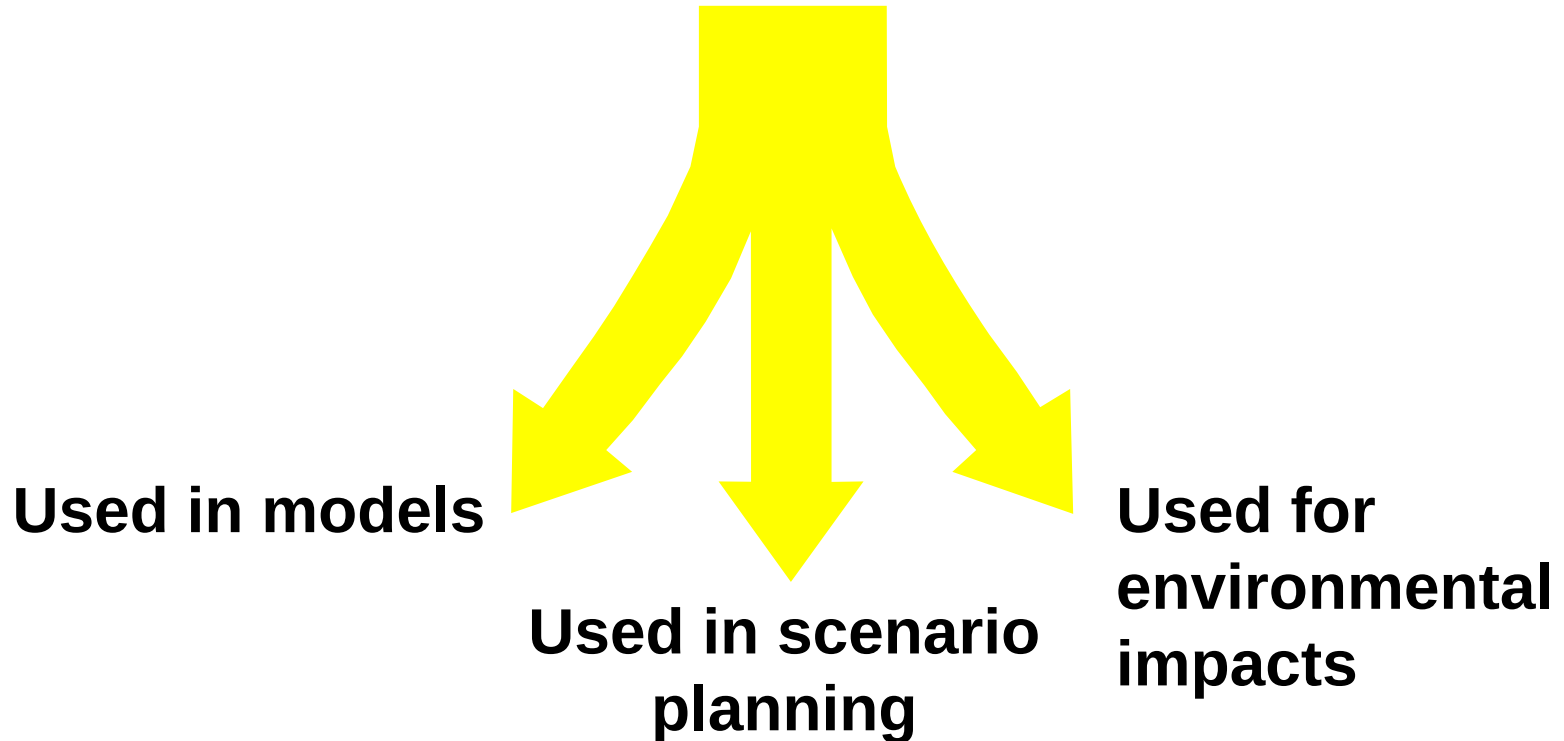
OPNAV N81

Issue: Providing representative environments to several disconnected legacy simulations



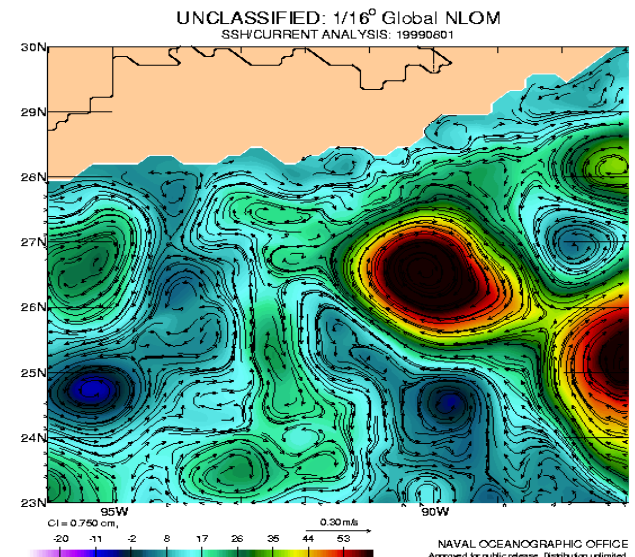
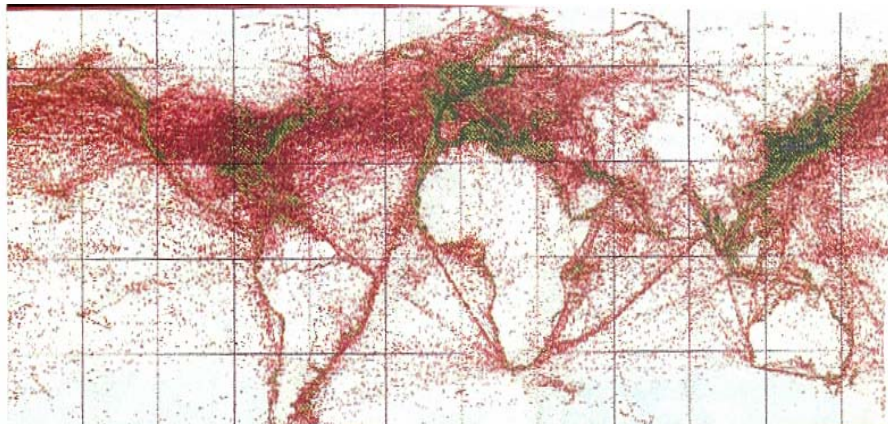
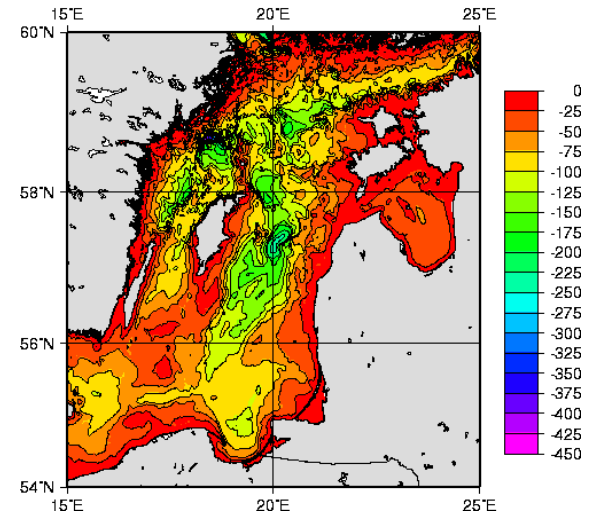
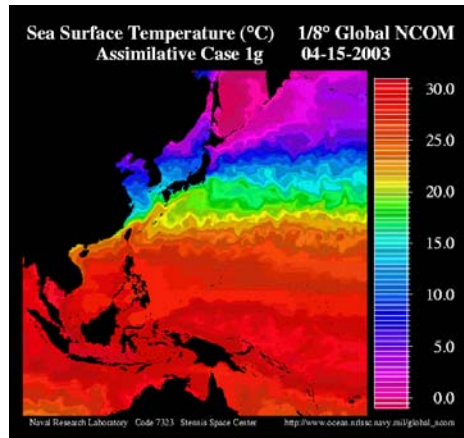
Approach

Building environmental data that can be



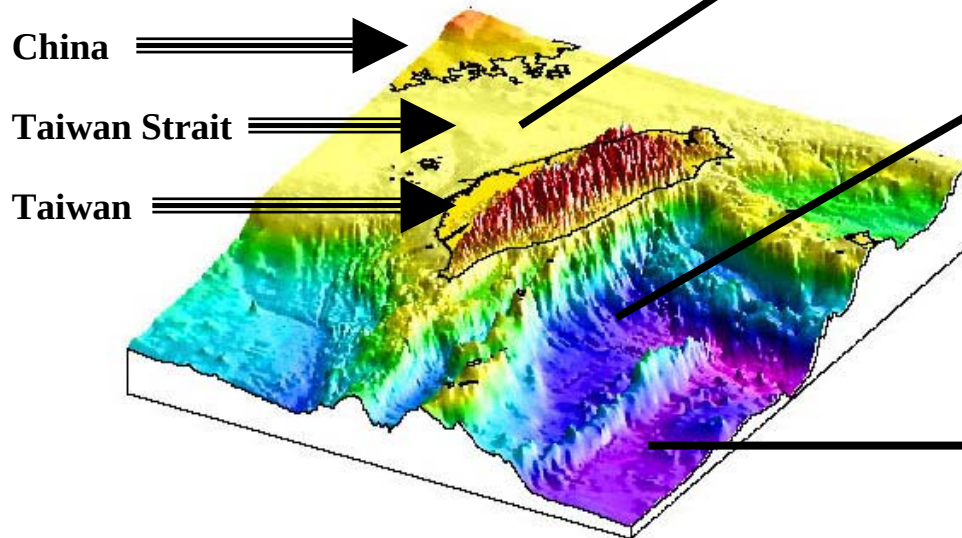
Ocean Models & Databases

Temperature/salinity/sound speed
Acoustic transmission loss
Digital bathymetric databases
Shipping density
Waves
Tides
Currents
Surf
Optics



Scenario Planning

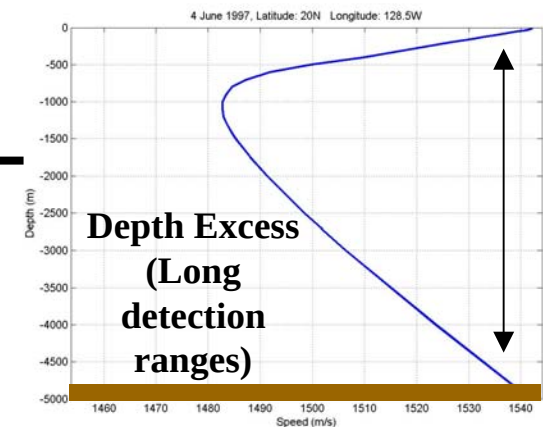
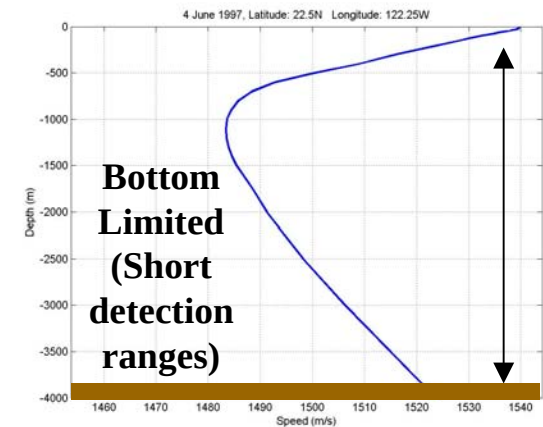
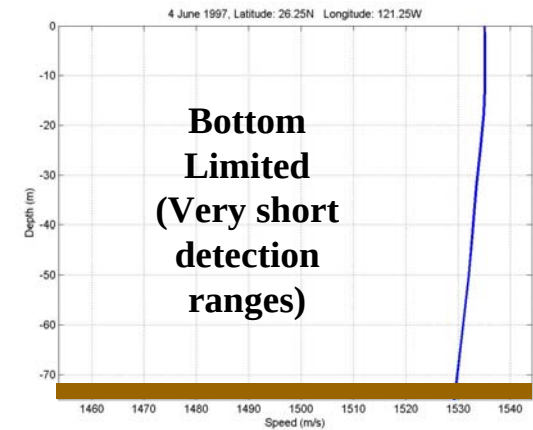
Simple plots of the environment can help determine how to set up your scenario.



Shallow

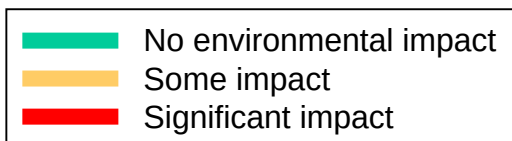
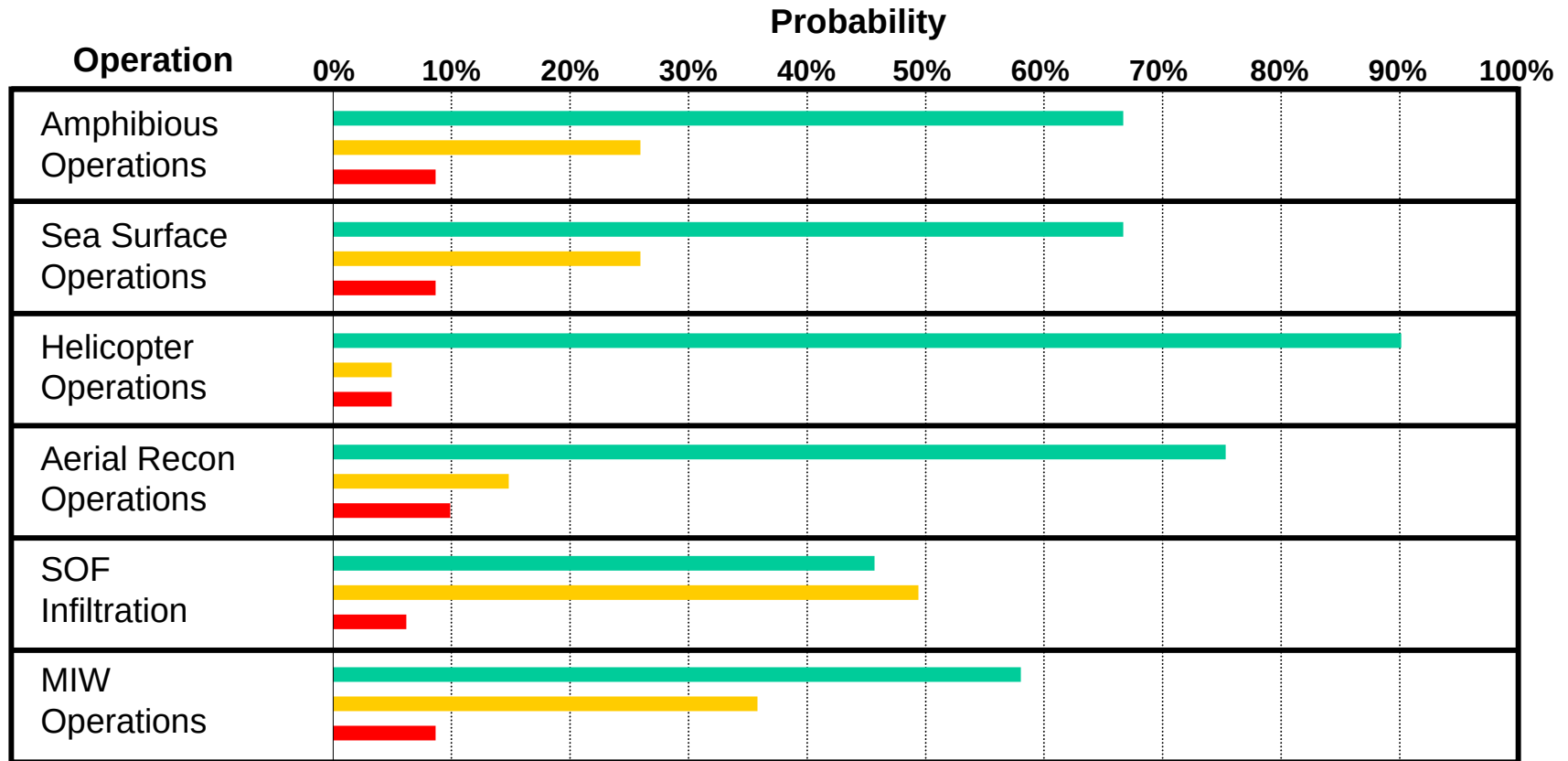
Mid-depth

Deep



Environmental Impacts

For a Specific Area and Time



Amphibious Ops	Wave Ht >8 ft	>6 ft	<6 ft
Sea Surface Ops	Wave Ht >12 ft	>7 ft	<7 ft
Helicopter Ops	Ceiling <300 ft	<500 ft	>500 ft
Aerial Recon Ops	Visibility <4800 m	<8000 m	>8000 m
SOF Infiltration	Wind Spd >25 kts	>13 kts	<13 kts
MIW Ops	Wave Ht >12 ft	>7 ft	<7 ft

Summary

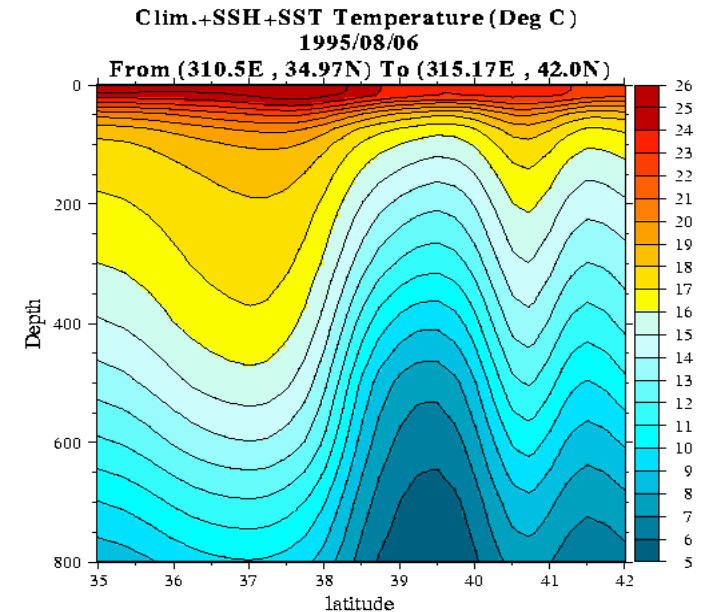
- The MSEAs have developed the Integrated Natural Environment Authoritative Representation Process to meet the environmental representation requirements of the DoD M&S community.
- The MSEAs have expanded METOC play in
 - Global War Games
 - JWARS
 - Fleet Battle Experiments
 - Navy Campaign Analyses
- But, we are not finished building the capability that's possible, desired and required to support all DoD M&S.
 - Technology is there, but resources are scarce.
 - Each year the capability grows.

Coming soon ...

10-Year Ocean Volume Archive

Products include:

- 3D volumes of
 - Temperature
 - Salinity
 - Sound speed
 - Currents
- 2D derived quantities of the above at
 - Arbitrary depths
 - Mixed layer depth
 - Sonic layer depth
 - Deep/shallow sound channel axes
 - Depth excess

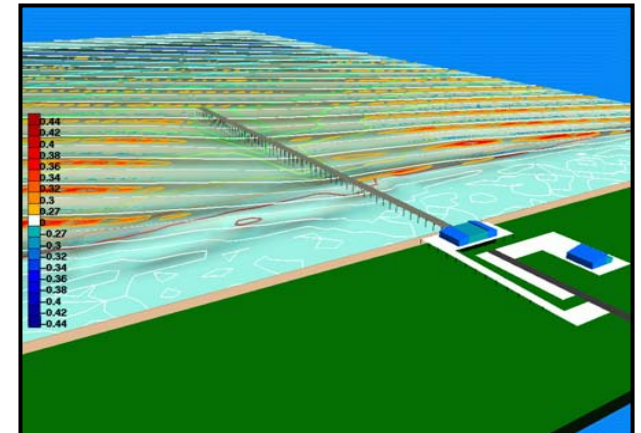


10-Year Ocean Surface Wave Archive

Provides a physically consistent representation of the ocean surface from the open ocean to the surf zone.

Products include:

- | | |
|------------------------------|---|
| • Wave Height and direction | • Breaker period |
| • Wave-current interaction | • Breaker Type: <ul style="list-style-type: none">• Spilling, Plunging, Surging |
| • Significant wave height | • Breaker angle |
| • Significant breaker height | • Surf zone width |
| • Peak period | • Longshore current |
| • Tides | • Modified Surf Index |



**So how do you get access to
these capabilities?**

Ed Weitzner
Chief of Naval Operations (N7C22A)
METOC Support for Modeling & Simulation

Edward.Weitzner@Navy.Mil

And by the way ...
All data is free to DoD and DoD contractors