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UNCLASSIFIED AND APPROVED FOR PUBLIC RELEASE
# The Integrated Natural Environment Authoritative Representation Process

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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 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
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.

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-

Simulation/User Request

ESG Web interface with SME

- ESG Archives (Off-the-Shelf)
- Data Mining & Just-In-Time Production (On-demand)

Data returned in native format or SEDRIS

Data Producer/Provider 1
Data Producer/Provider 2
Data Producer/Provider 3

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

Red Contour = Fog; Yellow Contour = Blowing Sand
Global War Games
Circa 2000-2001

Naval War College, Newport RI
Issues:  (1) Scripted Environmental Scenarios
(2) Game Floor Computer Decision Aids
1. NWC specifies environment requirements

2. Historic data does not meet NWC needs

3. NCAR-NCEP data mined for custom-ordered conditions.

4. Hi-res. COAMPS data produced - provides foundation of integrated environment

5. COAMPS fed to WAM and MODAS to provide integrated ocean surface and ocean water column data

6. CD of integrated natural environment including COAMPS, WAM & MODAS Data

7. Integrated (air, ocean surface and water column) environmental data in TEDS serves NITES applications

8. A specially formatted integrated environmental data set was provided for HPAC

9. Hazard Prediction & Assessment Capability

SAIC Monterey

NRLStennis

ESG

MEL

NWC METOC OFFICE

NWC WARGAMING CENTER

GameNet

SIIP

AREPS

JTS

TAWS

EMPIRE

VLSTRACK

Hazard Prediction & Assessment Capability

Game Players
Faster Than Real Time Simulations
Circa 2002-2005

Joint Warfare Simulation (JWARS)
Issues:  (1) Prescripted 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

Isobaric Fields
  Geopotential Height
  Relative Humidity
  Temperature
  Wind U Component
  Wind V Component

Cloud Fields
  Cloud Amount
  Cloud Base
  Cloud Top
  Cloud Type

Surface Fields
  Blowing Sand
  Blowing Snow
  Cloud Ceiling
  Density Altitude
  Dewpoint Temperature
  Elevation
  Evaporation Duct Height
  Fog
  Icing Intensity
  Illumination
  Pasquill 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
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.
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
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.
TEDServices
The Operational METOC Data Server

M&S Facility
Centers of Expertise
Domain Authorities
Regional Centers
Production Centers
TEDServices GateWay
Linking Operations and Simulation

**OPERATIONS**

Tactical Environmental Data Services (TEDServices)

Naval Integrated Tactical Environmental System (NITES)

**SIMULATION**

Environmental Data Server (OASES) HLA Compatible

Simulation (Such as JSAF)

**Tactical Decision Aids Aboard ships at sea**

METOC Data from NAVO, FNMOC, etc

METOC Data from the ESG

**Operaciones**

JSAF = Joint Semi-Automated Forces
Theater-level Campaign Analyses Using Legacy Models
Circa 2004-05

OPNAV N81
Issue: Providing representative environments to several disconnected legacy simulations
Building environmental data that can be used in models, used in scenario planning, and used for environmental impacts.
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.
# Environmental Impacts

For a Specific Area and Time

<table>
<thead>
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<th>Operation</th>
<th>Probability</th>
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- Environmental Impacts

- For a Specific Area and Time

### Environmental Conditions

- **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

### Legend

- No environmental impact
- Some impact
- Significant impact
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.
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
• Wave-current interaction
• Significant wave height
• Significant breaker height
• Peak period
• Tides
• Breaker period
• Breaker Type:
  • Spilling, Plunging, Surging
• Breaker angle
• Surf zone width
• Longshore current
• 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