

# *Air and Space Natural Environment Modeling and Simulation Executive Agent*

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## **INTEGRATED NATURAL ENVIRONMENT AUTHORITATIVE REPRESENTATION PROCESS (INEARP)**

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ESG Development Lead**

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# Report Documentation Page

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# Motivation



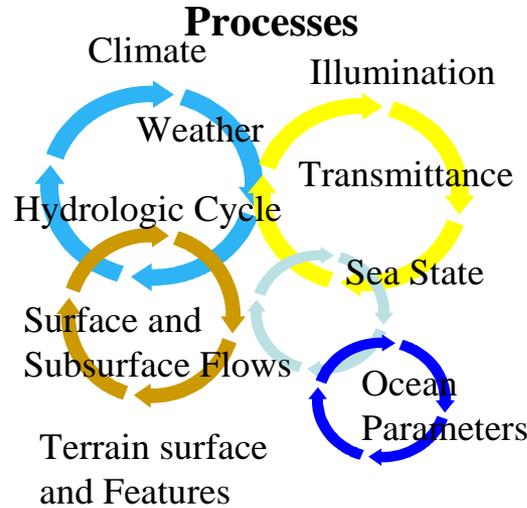
- In many cases, a simulation's fidelity depends on interaction with the environment
  - Aircraft tactics based on clouds and visibility
  - Naval tactics based on acoustic performance
  - Troop movement rate determined by ground wetness
- Environment must be realistic and consistent
  - Should see ground get wet if it rains
  - Should see ocean response to high winds



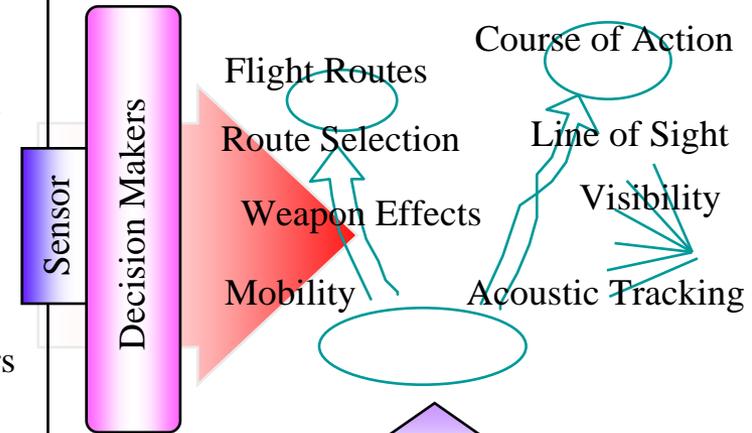


# Integrated Natural Environment

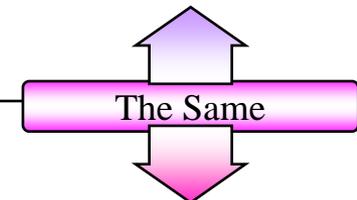
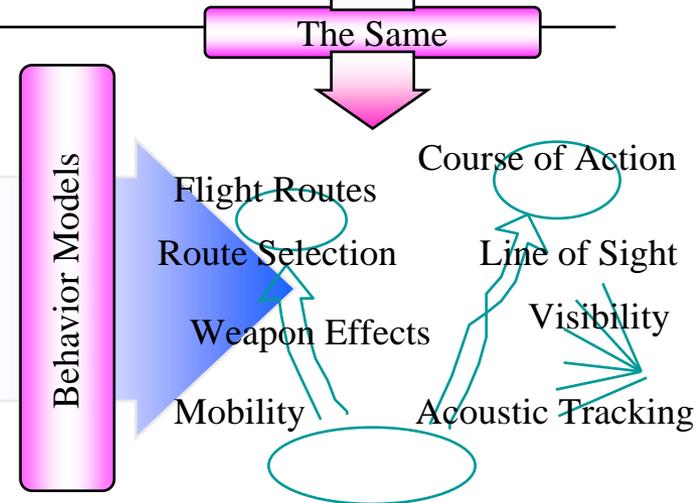
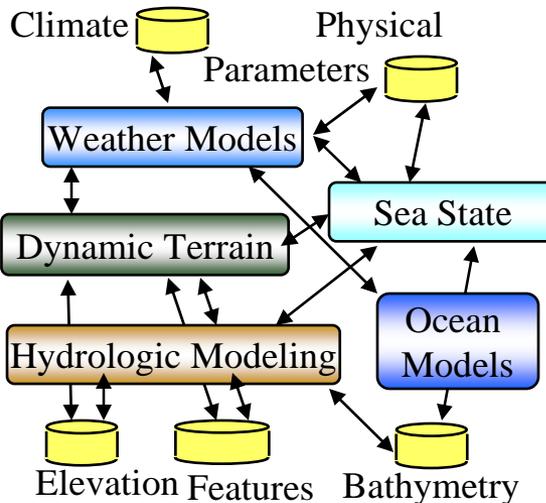
Natural



## System Performance



Synthetic



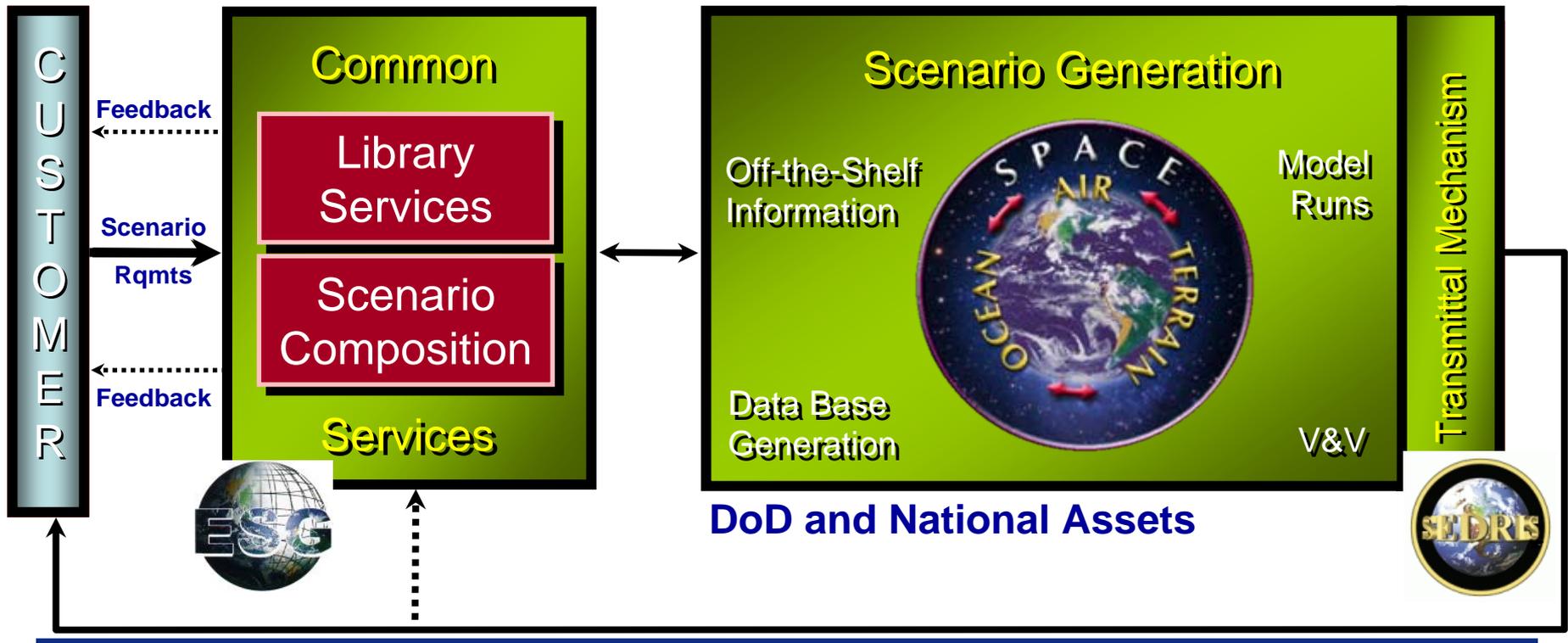


# INEARP: A Strategy and Process Model for Environment Support M&S

## Integrated Natural Environment Authoritative Representation Process (INEARP)

### The Challenge

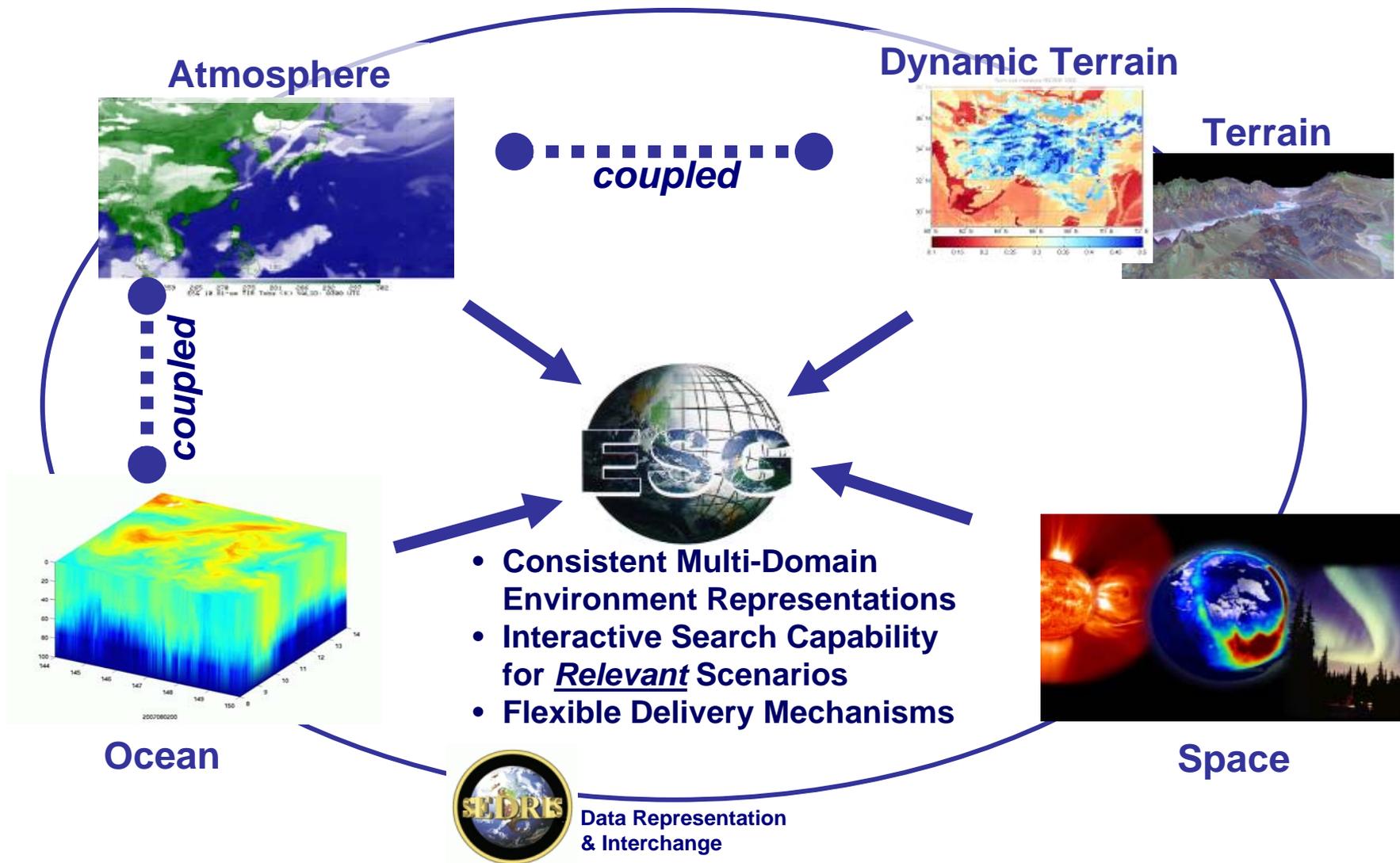
Create a physically consistent, cross-domain authoritative “ground truth” environment representation that meets user requirements.





# Environmental Scenario Generator

Key Enabling Technology for the INEARP

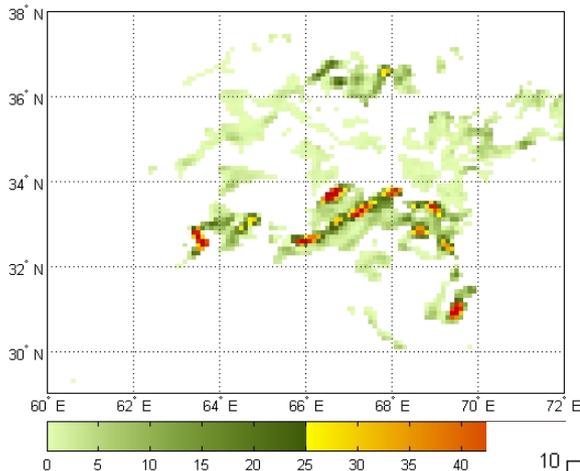




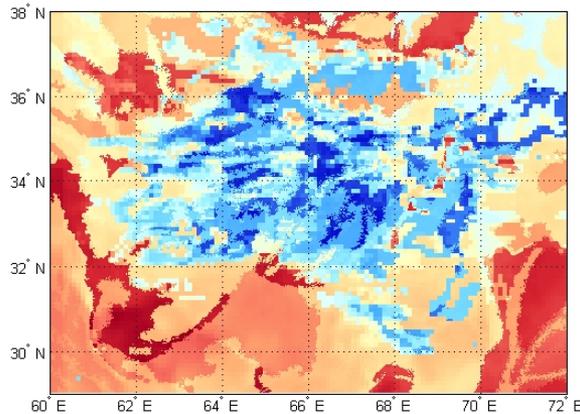
# Atmosphere - Terrain Coupling



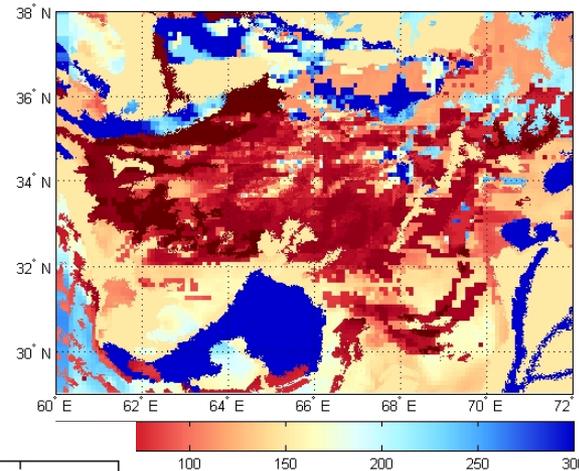
### Precipitation Field



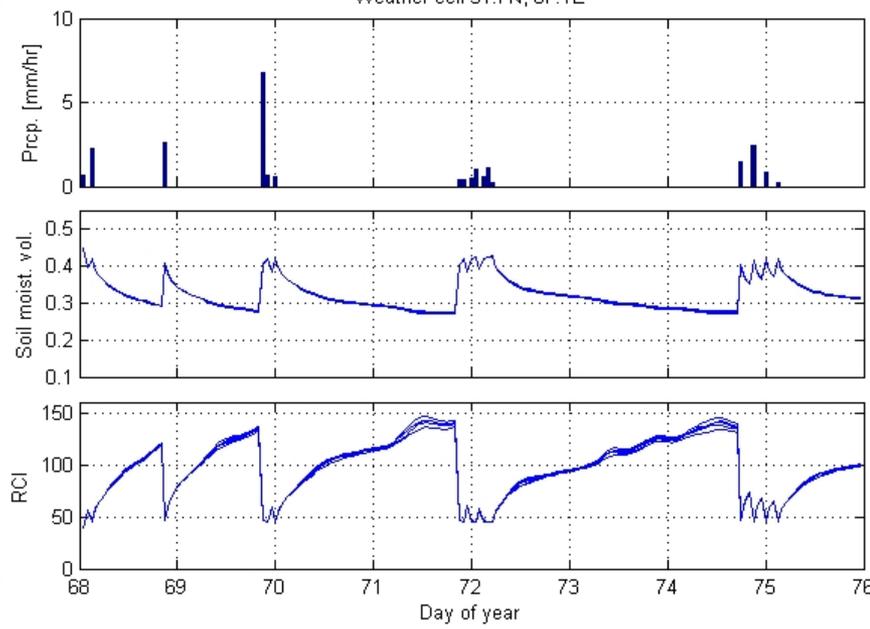
### Dynamic Soil Moisture



### Dynamic Soil Cone Index

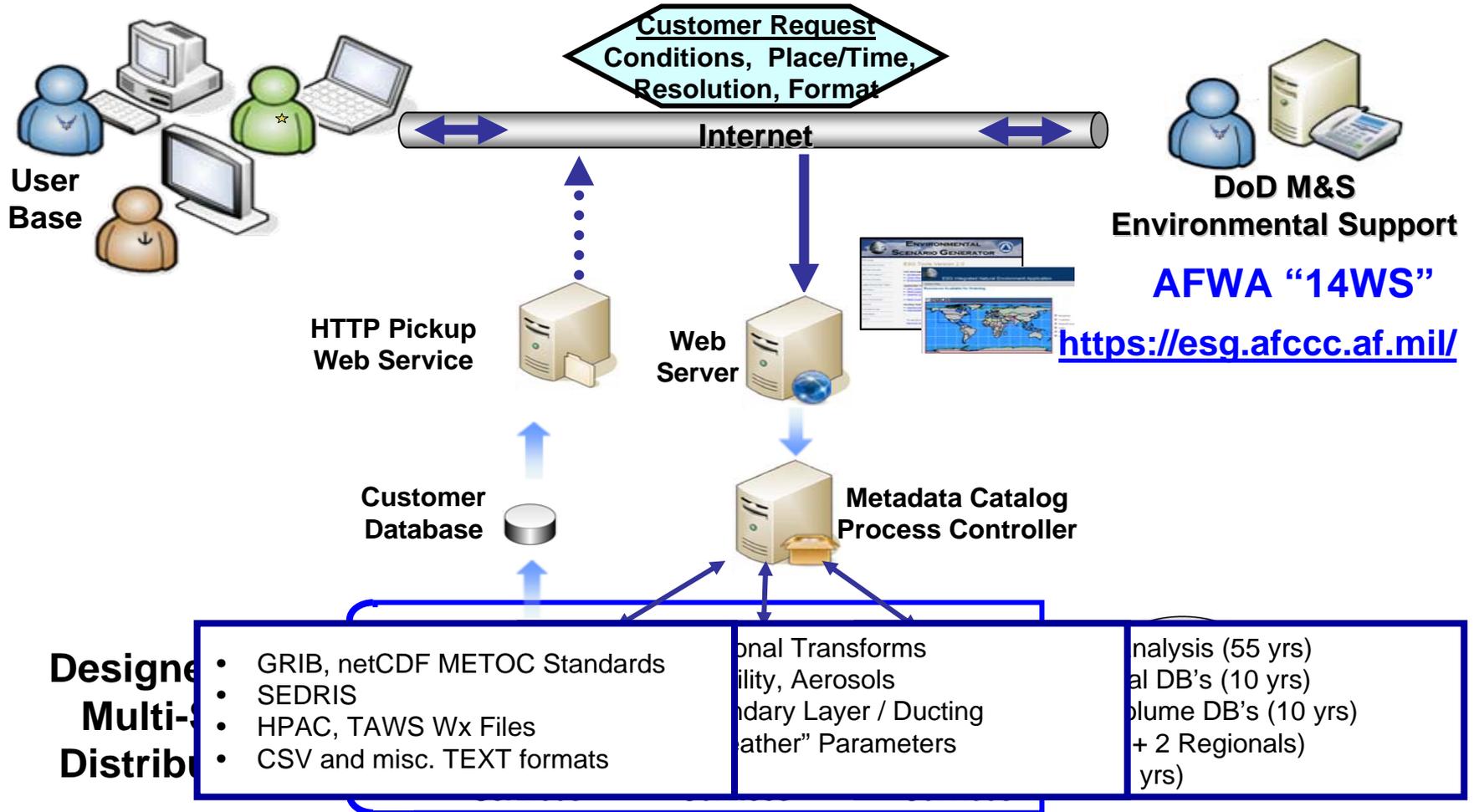


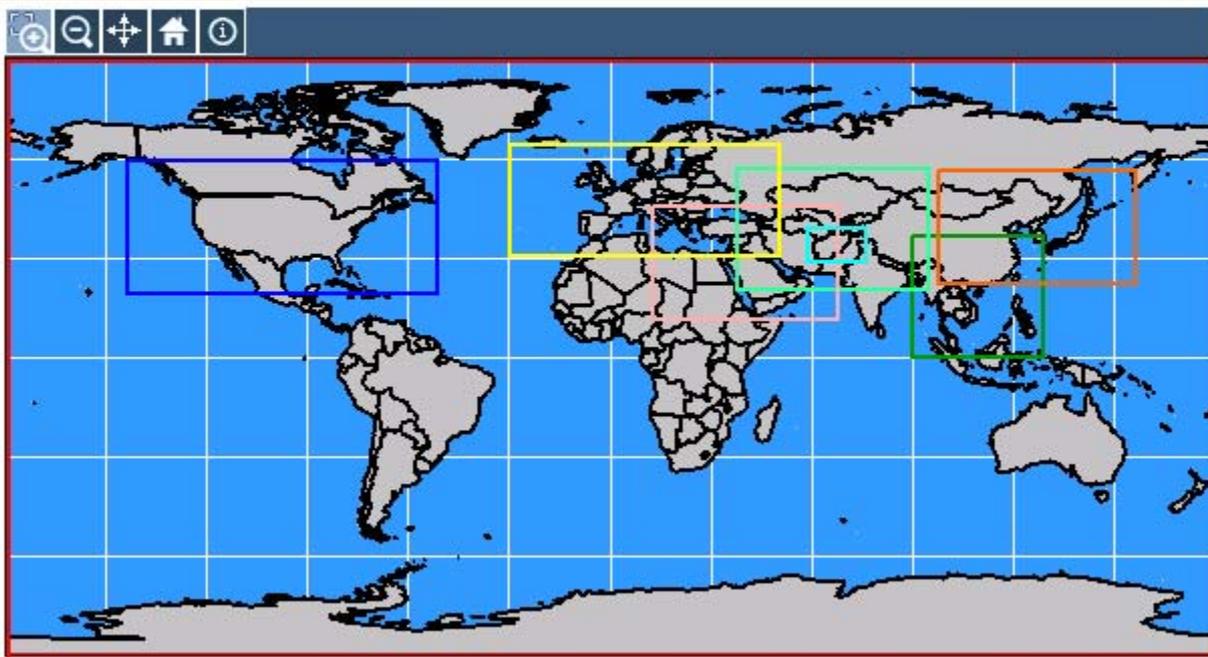
Weather cell 31.7N, 67.1E





# ESG Conceptual Architecture





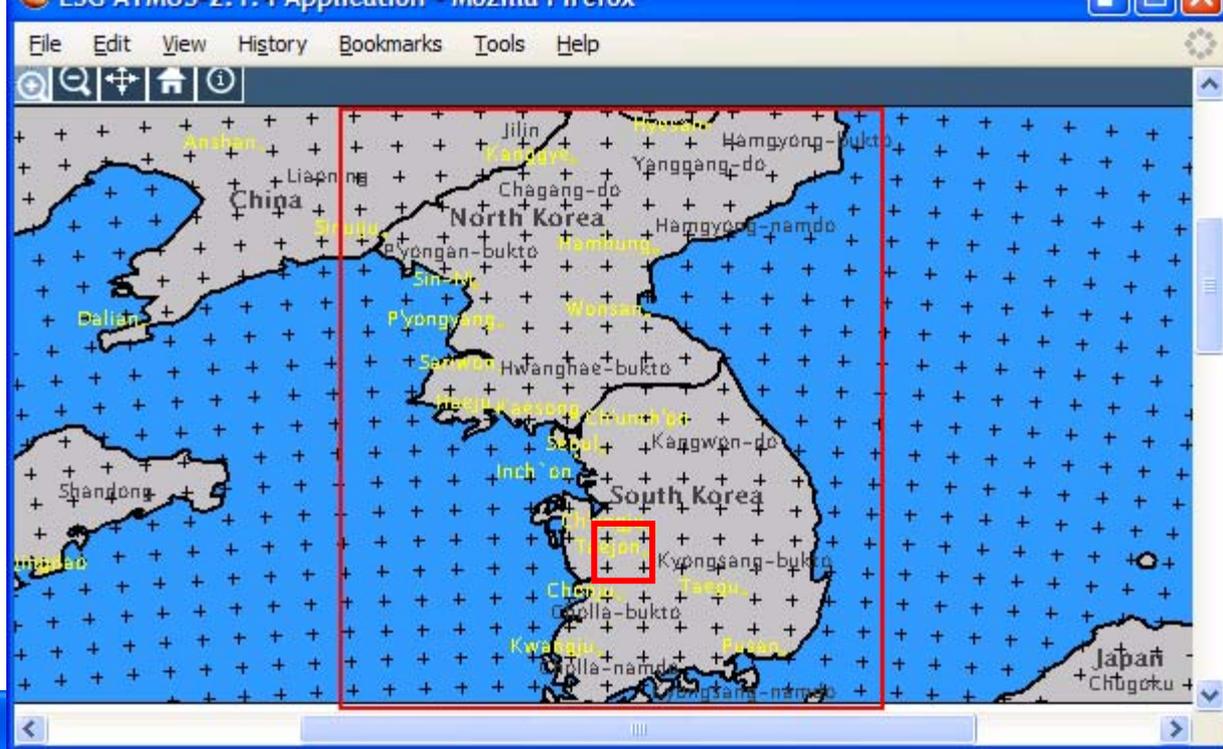
- WorldGrid
- Countries
- States/Provinces
- Cities
- Rivers
- Lakes

**Atmosphere Resources**

|                       |   |                                     |                         |         |         |
|-----------------------|---|-------------------------------------|-------------------------|---------|---------|
| <input type="radio"/> | <span style="color: red;">■</span> NCEP/NCAR Reanalysis | <input checked="" type="checkbox"/> | 01/01/1950 - 06/30/2006 | 6 hours | 2.5 deg |
| <input type="radio"/> | <span style="color: green;">■</span> ACMES CASIA        | <input checked="" type="checkbox"/> | 10/01/1986 - 09/30/1996 | 1 hour  | 40 km   |
| <input type="radio"/> | <span style="color: pink;">■</span> ACMES IRAQ          | <input checked="" type="checkbox"/> | 10/01/1986 - 09/30/1996 | 1 hour  | 40 km   |
| <input type="radio"/> | <span style="color: orange;">■</span> ACMES KOR4        | <input checked="" type="checkbox"/> | 10/01/1986 - 09/30/1996 | 1 hour  | 40 km   |
| <input type="radio"/> | <span style="color: green;">■</span> ACMES SEAS2        | <input checked="" type="checkbox"/> | 10/01/1986 - 09/30/1996 | 1 hour  | 40 km   |
| <input type="radio"/> | <span style="color: yellow;">■</span> ACMES EUROPE      | <input checked="" type="checkbox"/> | 10/01/1986 - 09/30/1996 | 1 hour  | 40 km   |
| <input type="radio"/> | <span style="color: blue;">■</span> ACMES Conus3        | <input checked="" type="checkbox"/> | 10/01/1986 - 09/30/1996 | 1 hour  | 40 km   |
| <input type="radio"/> | <span style="color: cyan;">■</span> ACMES CASIAB        | <input checked="" type="checkbox"/> | 10/01/1986 - 09/30/1996 | 1 hour  | 10 km   |

**Space Resources**

|                       |  |                                     |                         |        |         |
|-----------------------|--|-------------------------------------|-------------------------|--------|---------|
| <input type="radio"/> | <span style="color: red;">■</span> Space Weather Global Derived Indices  | <input checked="" type="checkbox"/> | 01/01/1991 - 12/31/2002 | 1 hour | 0.0 deg |
| <input type="radio"/> | <span style="color: red;">■</span> Space Weather Global Observed Indices | <input checked="" type="checkbox"/> | 01/01/1991 - 12/31/2002 | 1 hour | 0.0 deg |



- Mozilla Firefox

s Tools Help

|                                     | Add Segment       | Delete Segment >> |         | Delete Segment << |         |       |
|-------------------------------------|-------------------|-------------------|---------|-------------------|---------|-------|
|                                     | Segment Duration: | 12 Hour           | 12 Hour | Segment Duration: | 12 Hour |       |
| Criteria                            | Operator          | T1                | T2      | Operator          | T1      | T2    |
| Temperature( F ) @ Surface          | Very High         | 0.0               | 0.0     | Low               | 0.0     | 0.0   |
| Total Cloud Cover( % ) @ Surface    | Any Value         | 0.0               | 0.0     | Any Value         | 0.0     | 0.0   |
| Wind Direction( degTrue ) @ Surface | t1 < Parm < t2    | 180.0             | 270.0   | t1 < Parm < t2    | 270.0   | 360.0 |
| Wind Speed( m/s ) @ Surface         | Very High         | 0.0               | 0.0     | High              | 0.0     | 0.0   |

**Wind Speed@Surface of Ground**



**Temperature@Surface of Ground/S**



**Wind Direction@Surface of Ground**



**Total Cloud Cover@Surface of Ground**





# Programs Leveraging the INEARP



**DMO**



Working with ACC and AFRL to integrate realistic weather effects into Distributed Mission Operations (DMO).



**SHU**



Near-Space data helping Talon SHU program look at ways to perform missions in unexploited regime.

**JEFX**

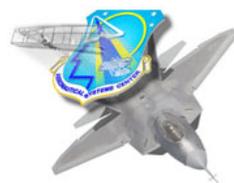


LPD-17 using authoritative atmospheric data to determine probability of raid annihilation. Ensured consistent environment for dislocated/ distributed simulations.

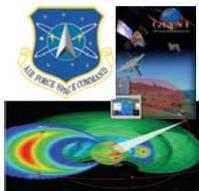
**FAA**



Virtual Airspace Simulation Technologies (VAST)



Aeronautical Systems Center (ASC) using data to determine how capable future systems are under various environmental scenarios.



Hi-resolution weather enables realistic SOF helicopter training using Army SOF Aviation Training and Rehearsal System (ASTARS).



**DTRA**

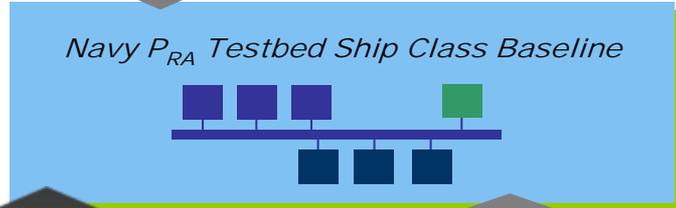
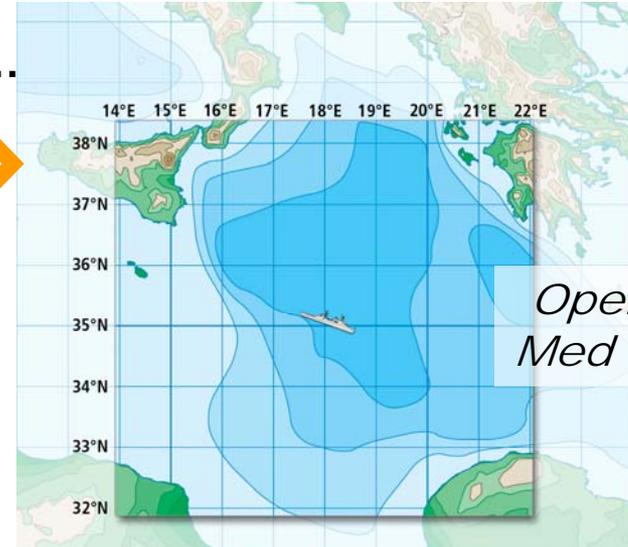
Unique interface developed to allow Defense Threat Reduction Agency (DTRA) to rapidly generate and ingest atmospheric data to help mitigate consequences of possible NBC event. Also being used to compare proposals for future dispersion models.



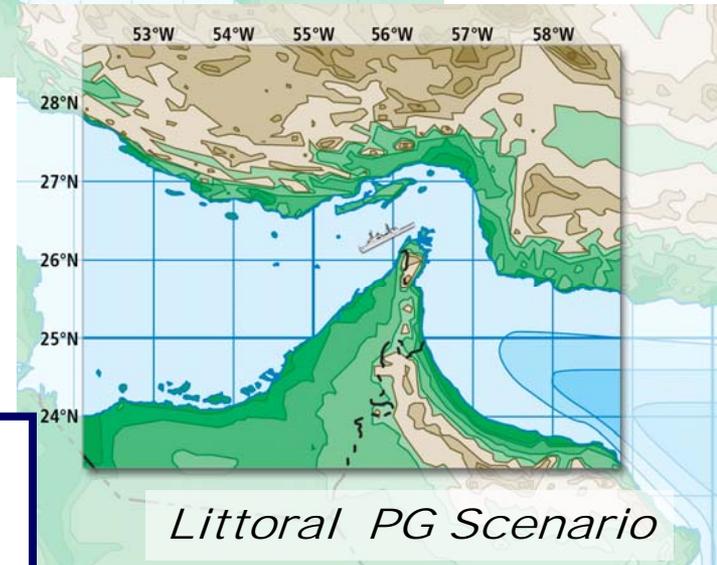
# PEO/IWS Enterprise P<sub>RA</sub> Testbed

“Virtual Range”

Obtained from ESG ..



“Virtual Test Ship”



**RDML Frick:** “Thanks to ESG technology... for datasets to meet specified conditions...(program) lifetime cost avoidance \$50M!”



# ***INEARP Program***

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- **Three-Year effort (FY-08 is year two) sponsored by the Acquisition community via the M&S Coordination Office**
    - **Sponsor: Mr. Dipetto**
    - **Oversight: Mr. Lewis, DoD ASNE MSEA**
    - **Performance: AER, Inc.**
  
  - **FY-08 Funded Development Initiatives**
    - **Working with NGDC on remote access to Space resources**
    - **Integration of higher-res atmospheric data archives (ERA-40) and modeling capabilities (WRF)**
    - **Standup of SIPRNET site**
    - **Upgrade of SEDRIS capabilities per FCS requirements**
    - **Expanded Web Service capabilities**
-

# JOINT END-TO-END PROGRAM

“A Factory to Foxhole Process”

#1

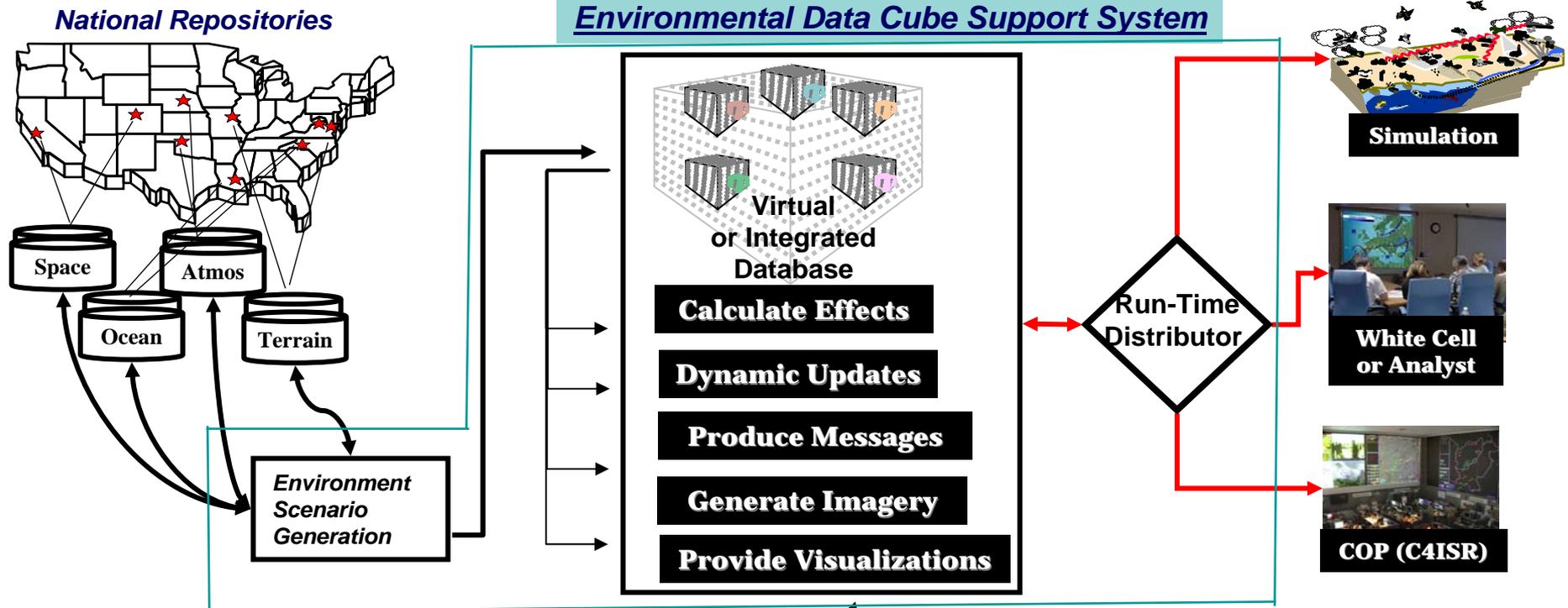
Build & Tailor  
Data

#2

Correlate  
Products, Effects

#3

Distribute  
Live, Virtual, Constructive



Users Set  
Objectives

## Environmental Data Cube Support System

- AF, Navy, NGA Led
- Over-arching Environment Effort
- Leverage Gov't Environment Data Centers



# Summary

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- **Realistic M&S requires high-fidelity, consistent, and relevant multi-domain environment representations**
  - **The INEARP provides the roadmap. The ESG and SEDRIS are two key enabling technologies**
    - **National data and modeling assets provide the content**
  - **The ASNE MSEA is working with the Ocean and Terrain MSEA's to realize the full INEARP vision**
-



# ***DoD ASNE MSEA Contact Info***

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