



Environmental Simulator in Support of Engineered Resilient Systems

**NDIA Systems Engineering Conference
October 29, 2014**

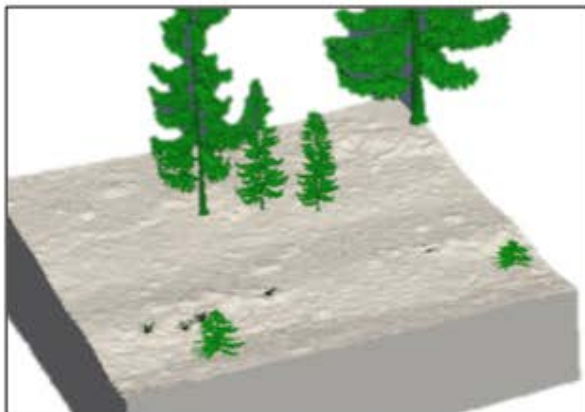
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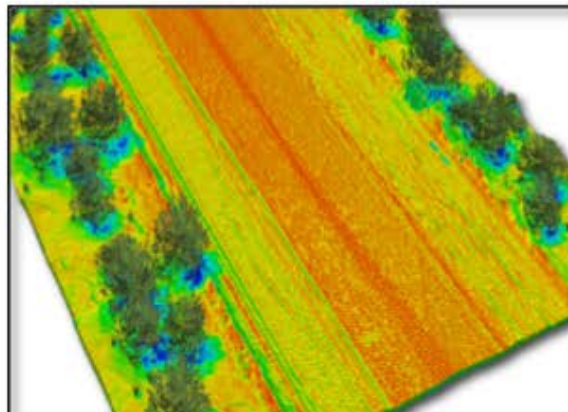
Need for Environmental Simulation



- *Military planning, operations, and acquisition decisions are strongly influenced by environmental considerations*
- *Resilient system design requires virtual prototyping and simulation under a variety of environmental conditions early in the acquisition process*
- *Lacking: A comprehensive environmental simulation environment that can predict system performance in a variety of geographic settings under a variety of environmental conditions*



Synthetic



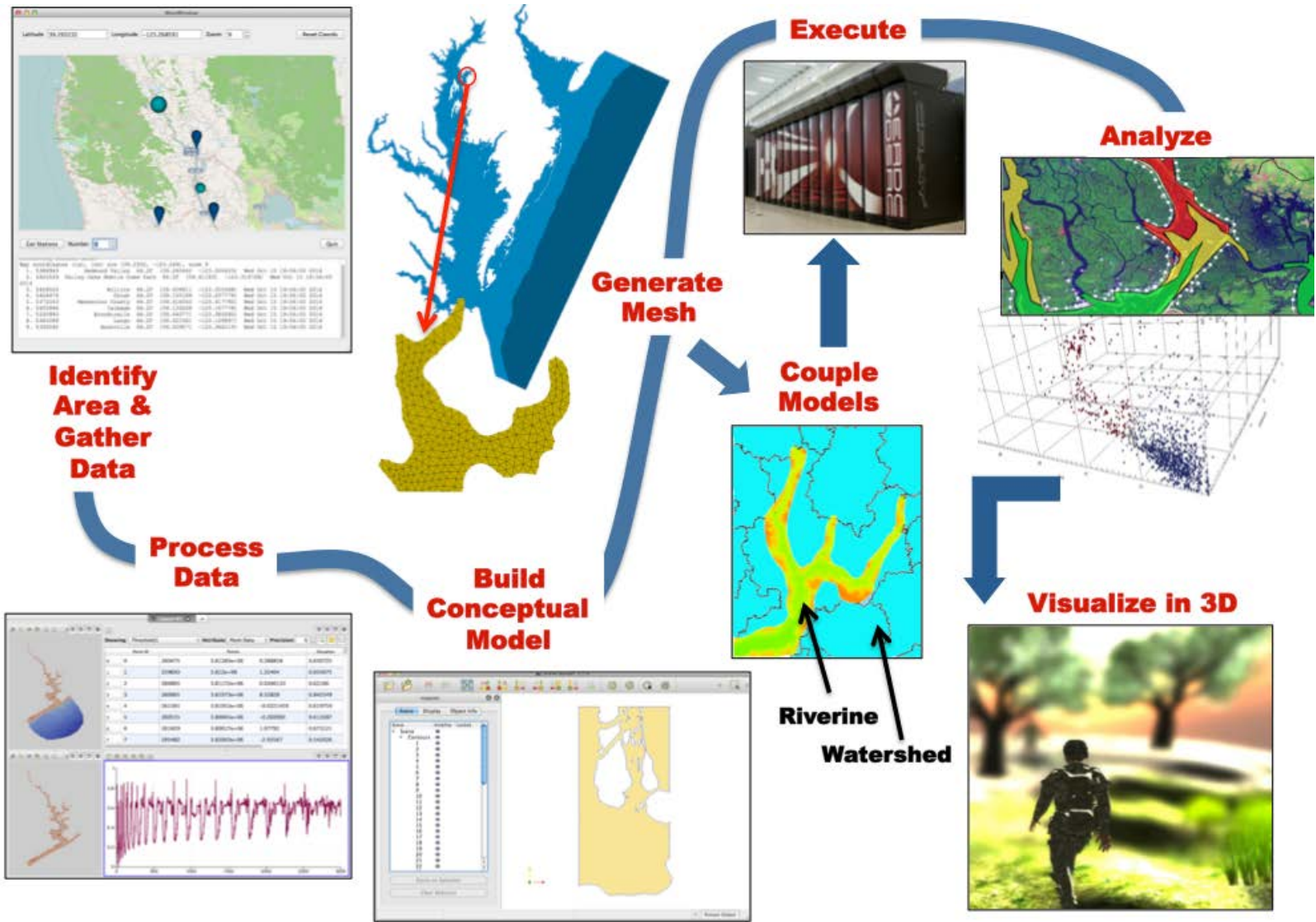
Geo-typical



Geo-specific



Environmental Simulation Process

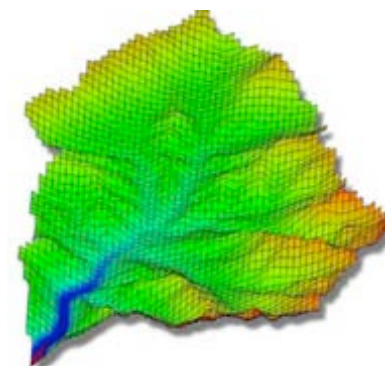
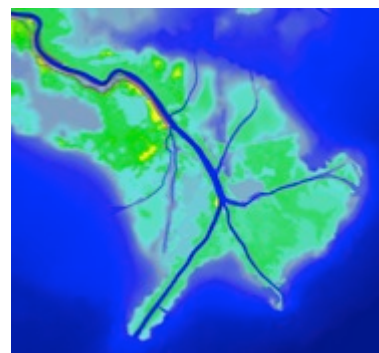
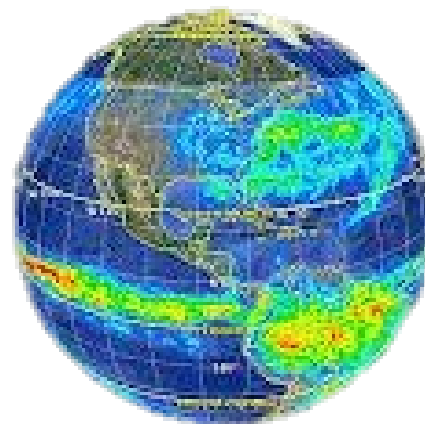




Environmental Data Types



- Land, Air, Sea
- Data Types
 - Terrain elevation
 - Vegetation distribution
 - Water depths and velocities
 - Moisture content
 - Soils
 - Temperature
 - Weather
 - Anthropomorphic (urban, etc.)





Computational Models

- **Watersheds**

- Rainfall, Runoff, Infiltration, SW/GW
- GSSHA and others

- **Rivers and Estuaries**

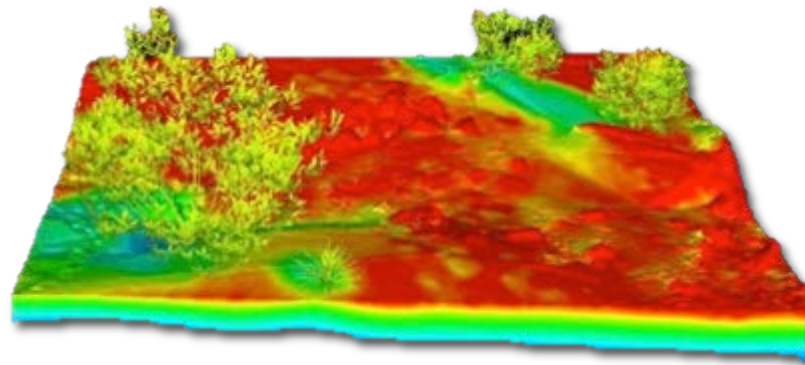
- Shallow water wave, density driven flows
- AdH, GSSHA, ADCIRC, others

- **Ocean & Wave**

- Deep water, wind waves
- STWAVE, others

- **Meteorological**

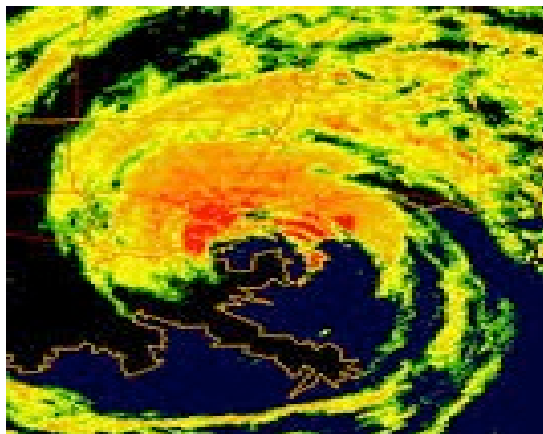
- Weather, local effects



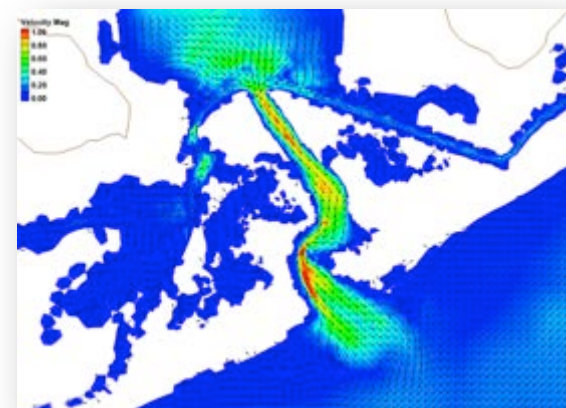
Terrain



Vegetation



Weather



Estuarine



Environmental Simulator Products



- **Data Services Library**

- Acquisition; transformation; cataloguing

- **Model Development Environment**

- Conceptual model development; grid and mesh generation; boundary condition assignment

- **Model Coupling Interface**

- Run time coupling of applications via data transfer
- Layer on top of Data Services Library

- **Simulation Workflow Manager / Scenario Generation Tool**

- Link models; create specific scenarios; manage execution

- **3D Virtual Explorer**

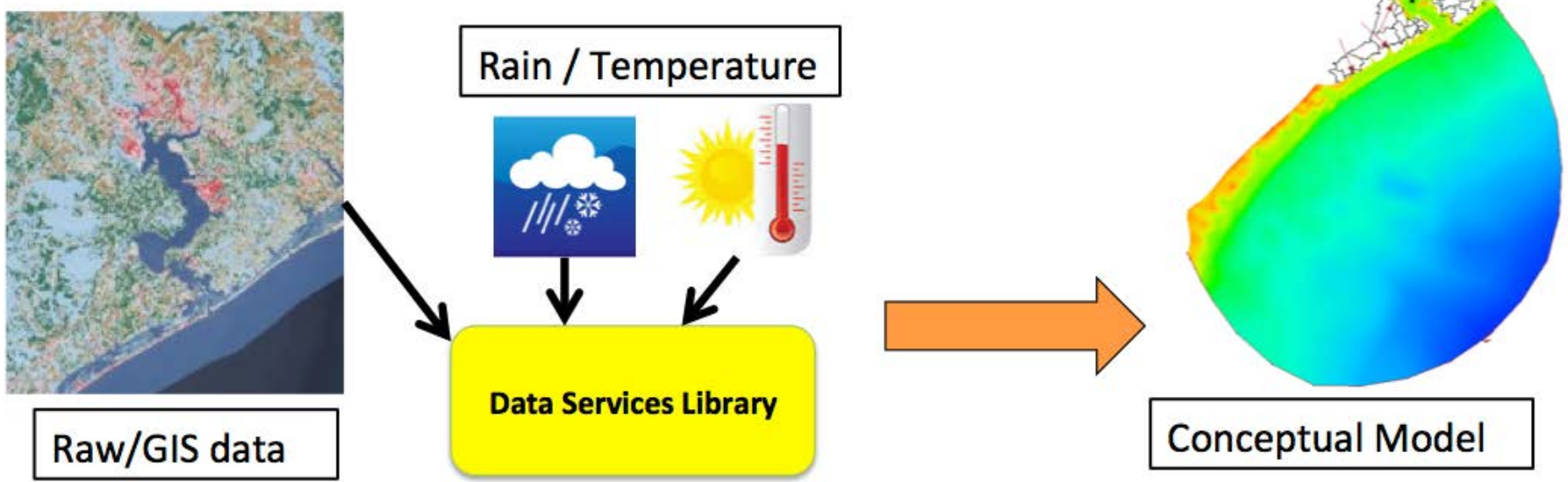
- Support Tradespace Environment





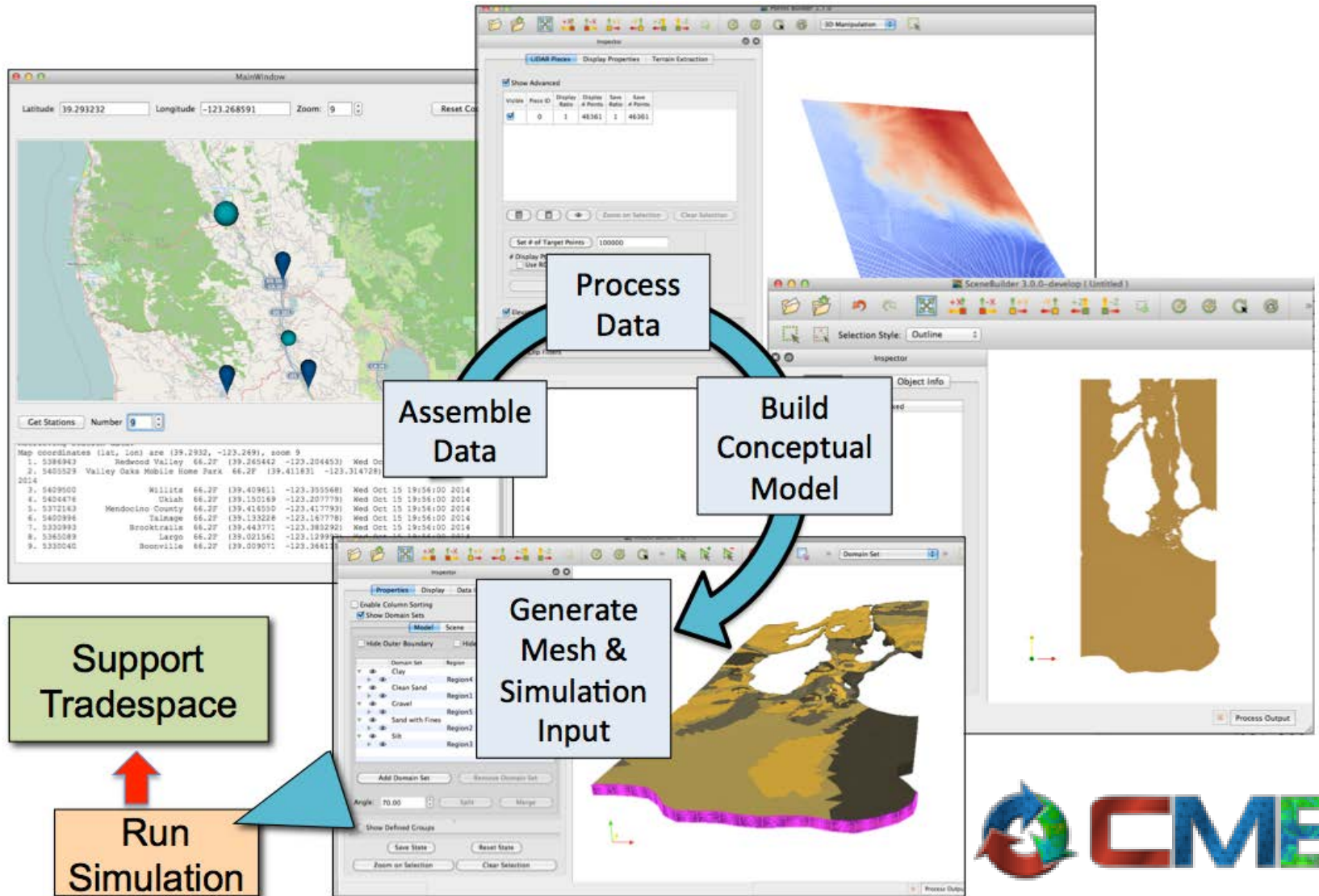
Data Services Library

- Locate and “ingest” data from standard sources (web services, databases, local files)
- API to ingest atypical sources/data types
- Manipulate data (interpolation, filters, etc.) to support computational models
- Translate data between application formats
- Support 3D visualization



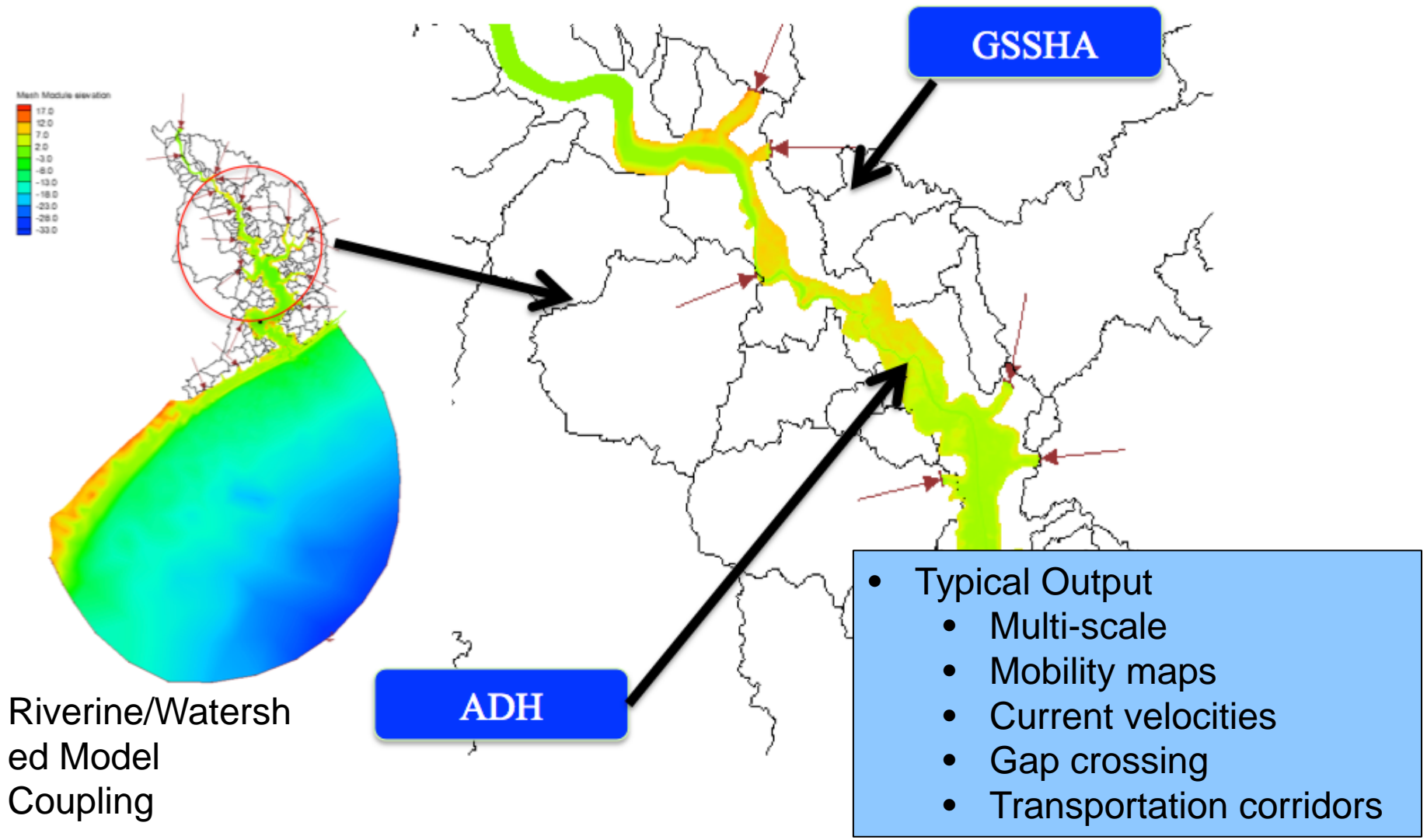


Model Development Environment





Typical Application of Environmental Simulator





Simulation Workflow Manager and Scenario Generation Tool



- Workflow Manager**

- Generate inputs and scripts for execution
- Link models via data transfer
- Prepare a scenario
- Create acquisition and operation scenarios

- Scenario Generation Tool**

- Create interface for a specific scenario
- User can tweak parameters & input data
- Execute and monitor runs
- Execute acquisition and operation analyses





3D Virtual Explorer



- Explore simulation results in a 3D immersive environment
- Land, Air, Sea

