



An Application of Environmental Data to Modeling and Simulation

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Sensor Simulation Panel
TRACK 2, Thursday, January 8, 2004
4:00 - 6:00 PM



An Application of Environmental Data to Modeling and Simulation

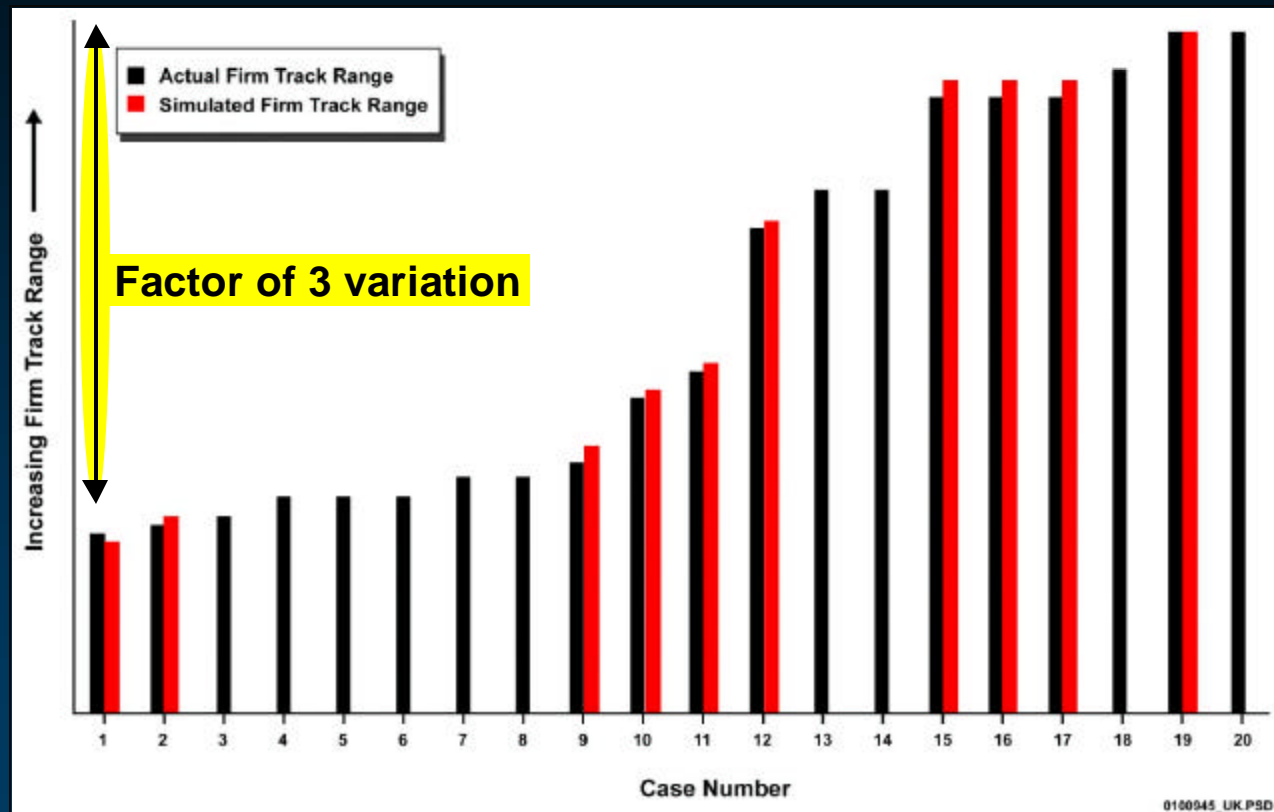
JHU/APL's Air Defense Systems Department, Theater Systems Development Group

- **Support development, testing, and analysis of naval air defense systems**
- **Focus on shipboard radar, communication, weapon systems**
- **Expertise in environmental measurement and characterization, and RF propagation analysis:**
 - **Atmospheric (Refractivity)**
 - **Sea and Land (Roughness & Scatter)**
- **Sensor M&S applications:**
 - **System-level performance studies**
 - **Engineering analyses**
 - **Navy Test and Evaluation (T&E)**
 - **Operational decision aids**



Comparison of Actual and Simulated Radar Tracking Performance

- Variation in actual firm track range for same target
- Comparison to simulated firm track range based on environmental measurements
- Significant differences from standard atmosphere performance
- **No red bar:** environmental data not available



- *Performance can vary significantly with the environment*
- *With adequate environmental data, performance is predictable*



State of System/Sensor Performance Simulation

- The impacts on naval Air Defense performance of realistically varying atmospheres, rough seas, and DTED-described terrains are generally well-modeled for engineering and analytical studies
 - Some open issues wrt land clutter modeling
- Limitations in reconstructing at-sea tests are generally due to imprecise knowledge of the environment and test targets, as opposed to the models themselves



Issues in System/Sensor Performance Simulation

- Environmental characterization **MUST** be appropriate/sufficient for the application
 - Sensitivity of performance to details in the environment can drive conclusions
 - High-level (force-on-force, trade study) analysis
 - Engineering design evaluation
 - Reconstruction of live-missile firing event
- Characterization of *in situ* atmospheres over large areas with sufficient fidelity to characterize propagation conditions is a current limitation
- No high-quality statistical data base of atmospheric refractivity conditions; important for constructing realistic environmental scenarios for some applications



A Perspective on System/Sensor Modeling Requirements

- **Requirements need to fit the application**
 - Ex. Force-on-Force vs. Engineering Design: Questions are different, Answers can be different, Requirements are different – Consistent?
- **Requirements on M&S to support system development generally track the system development process**
 - Concept development stage – General model – (trade studies and concept analyses guide high-level capability requirement and technology investment decisions)
 - Development of system requirements – More detailed engineering tools for designing the system to meet capability requirements; not system-level model
 - TECHEVAL/OPEVAL – System-level simulation for test scenario development and simulation-based certification as “operationally effective and suitable.”
 - Operational –Simulation to support variety of applications: tactics development, design refinement, system-level performance studies



The End

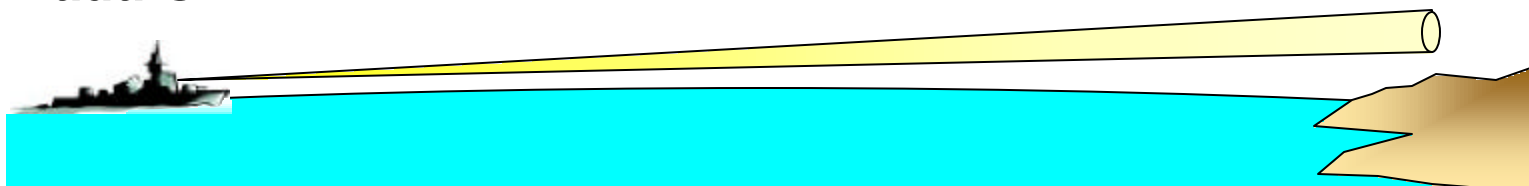


Backups

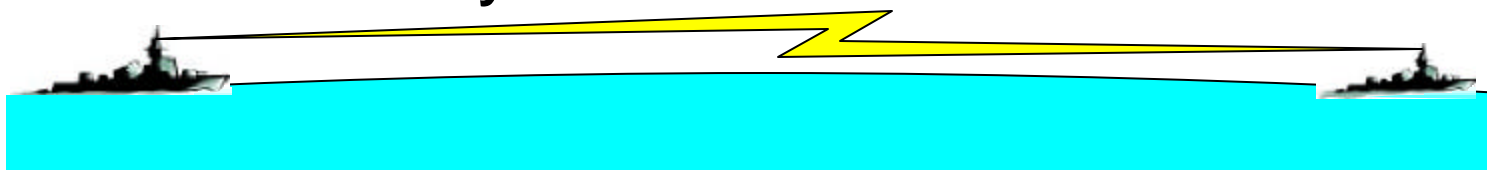


Types of Sensors / Systems

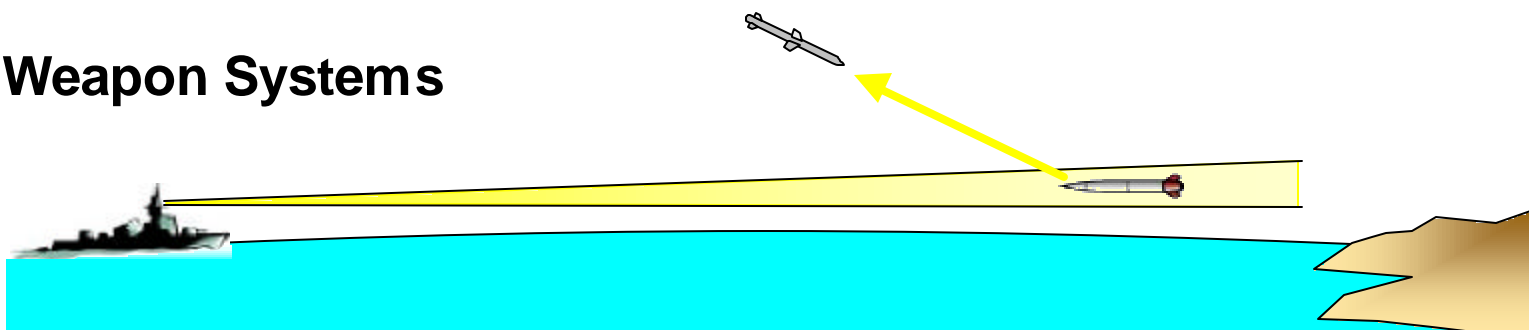
Radars



Communication Systems



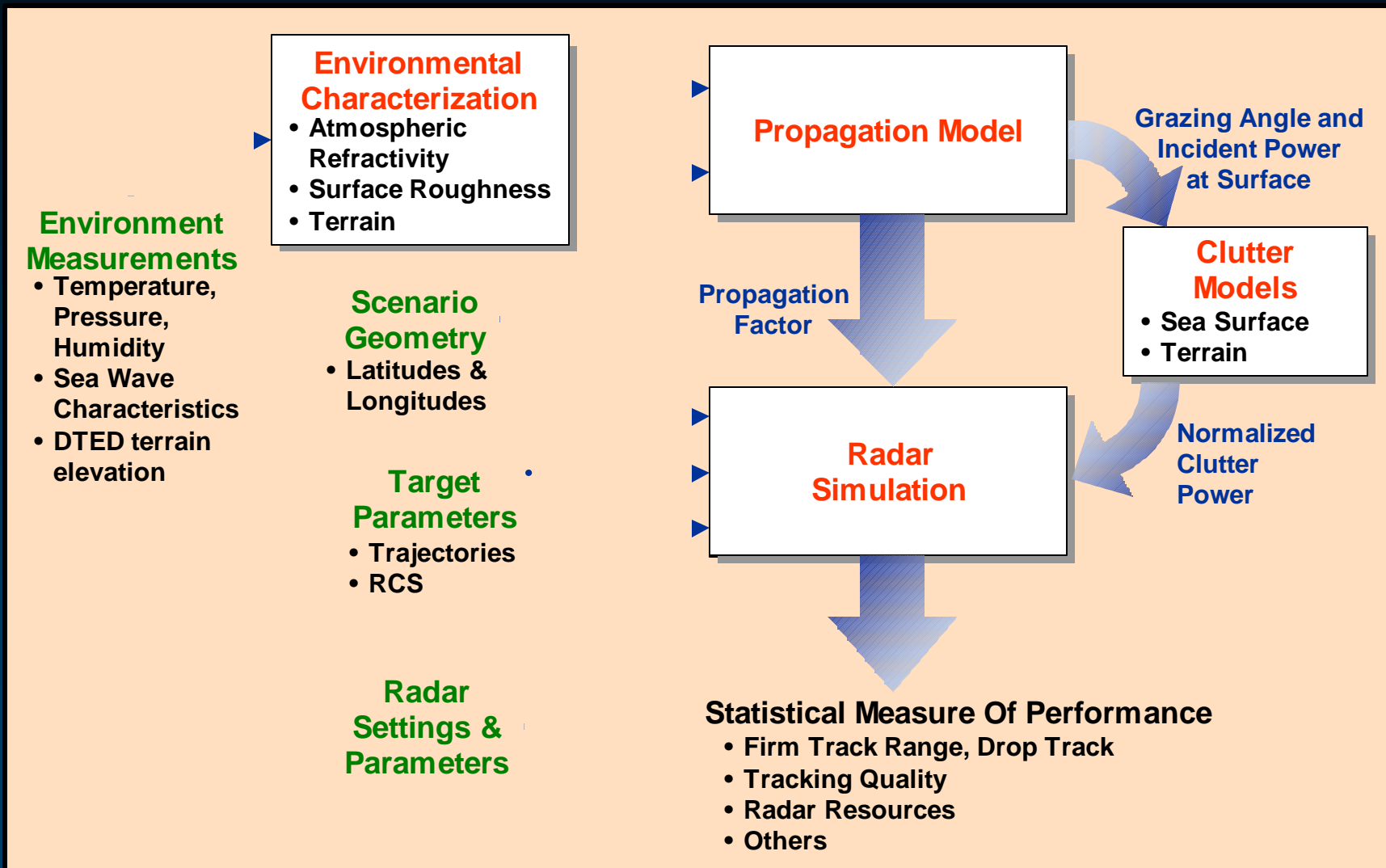
Weapon Systems



Surface-based, low-elevation RF systems with significant propagation paths, in the littorals



Radar Analysis Methodology





Environmental Data Collection

(Examples)

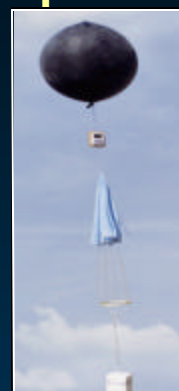
Helicopter Sensors



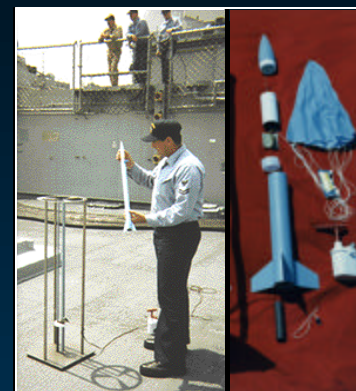
Catamaran Sensors



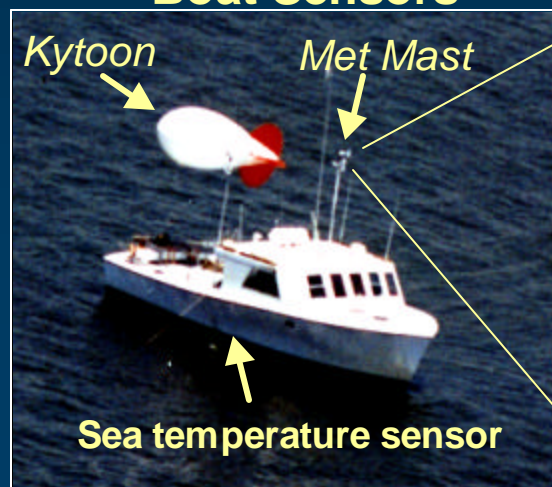
Balloon Dropsondes



Rocketsonde



Boat Sensors



Met Mast Sensors



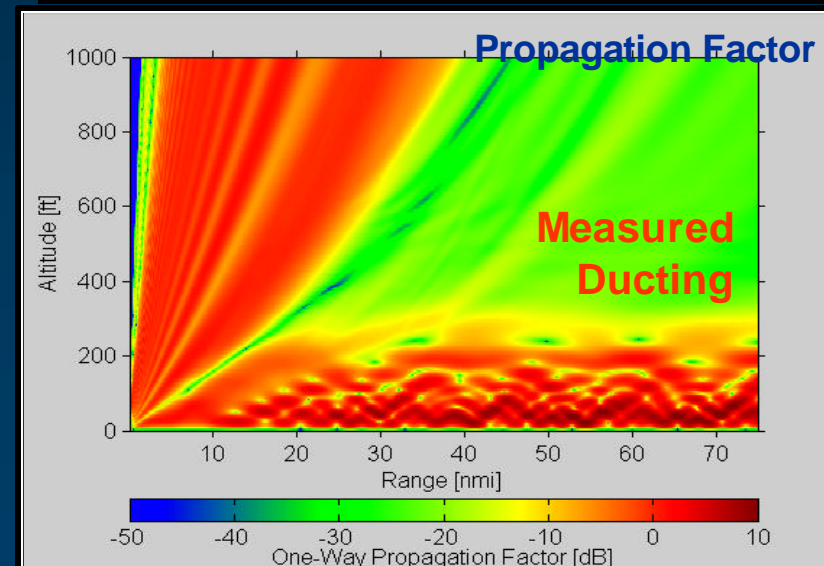
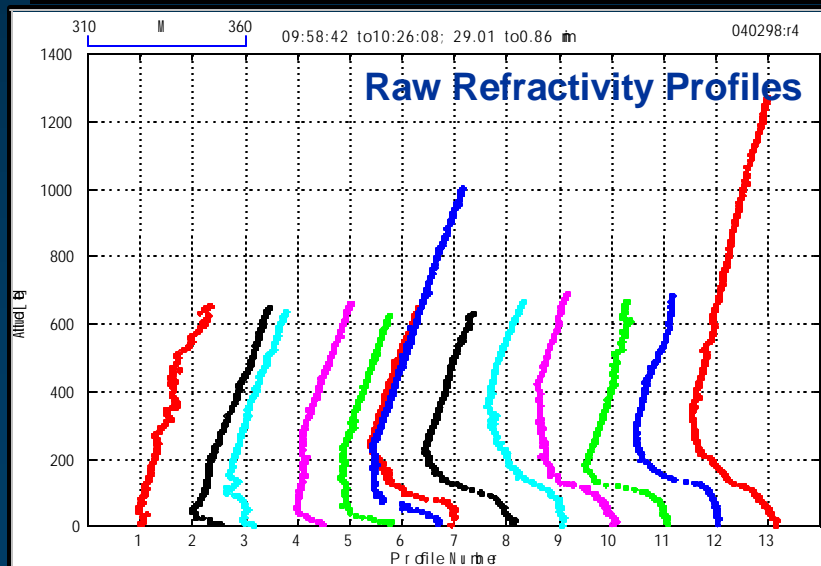
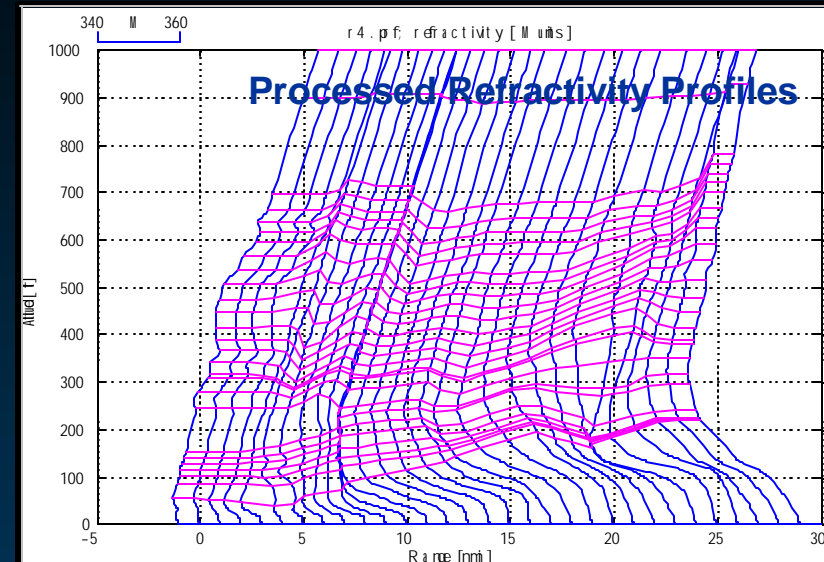
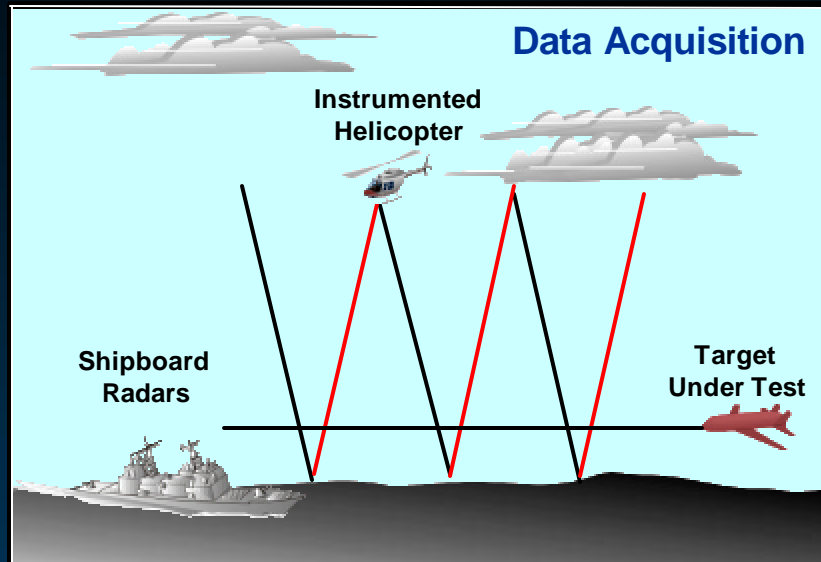
Handheld Sensors





Environmental Characterization

Helicopter Data Acquisition, Processing, and Propagation Assessment





Environmental Characterization

Helicopter Data Acquisition, Processing, and Propagation Assessment

