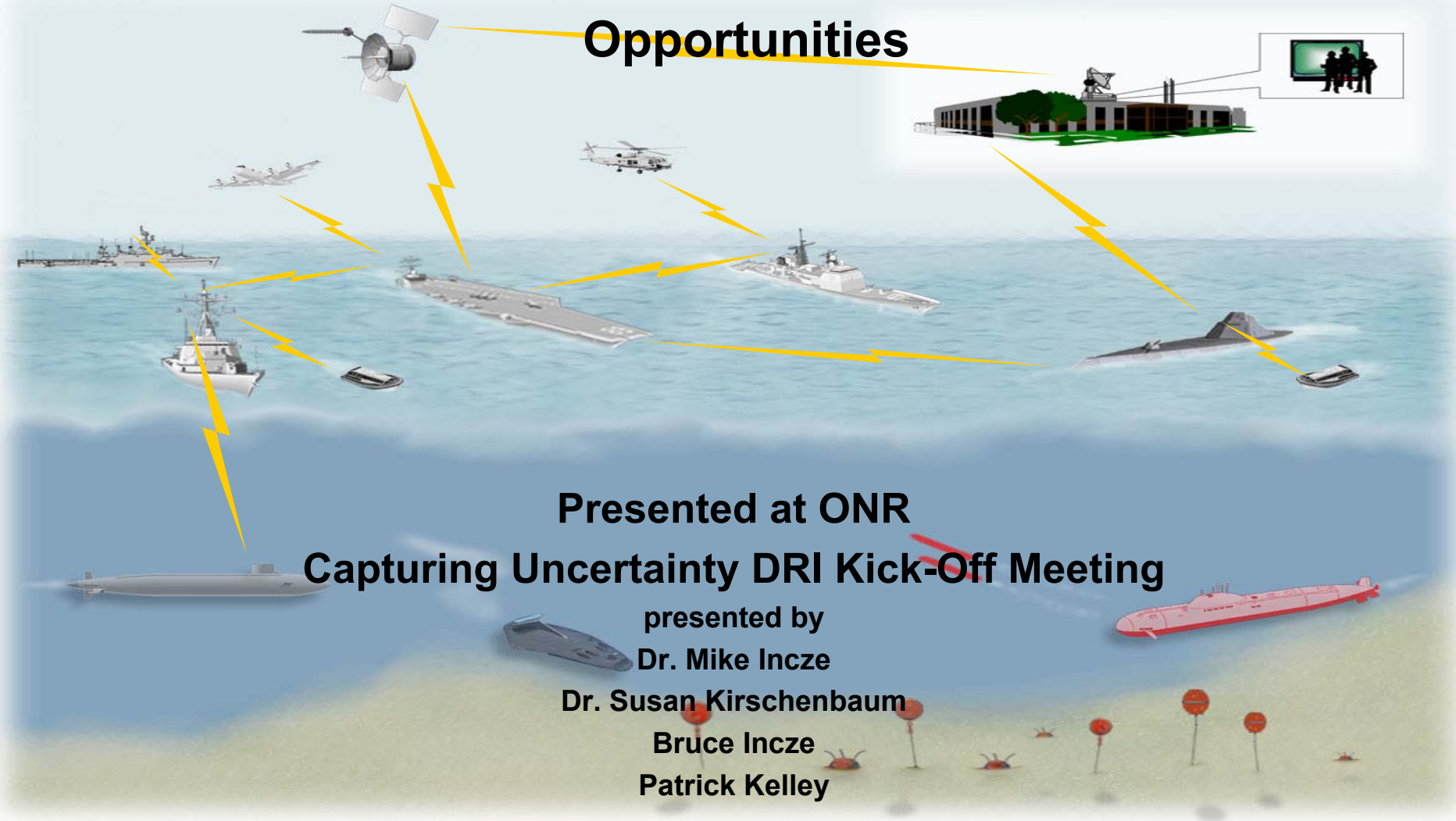
USW Environmental Uncertainty Characterization, Organization and Representation - Fleet Interaction and Demonstration Opportunities



Presented at ONR

Capturing Uncertainty DRI Kick-Off Meeting

presented by

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Common Undersea Picture 0-6 Fleet Requirements

- Compute and display optimized surveillance search plan and asset lay down recommendation; intelligent computer assisted plan generation and quantitative plan assessment; **computer assisted guidance of plan sensitivities to assumptions and parameters.**
- Assess own-force vulnerability to threat (detection/counter detection, weapons, etc.) **in operating environment** and provide recommended prioritization of asset/target set.
- Dynamically update plan **due to changes in environment**, threat, time line, assets readiness, etc.
- Determine **key environmental features (including information holes)** impacting sensors and weapons and provide heads up display of features overlaying the geographic display of battlespace
- Display **plan aging consistent with** search and **environmental** inputs
- **Recommend environmental data collection**
- **Clear indication of what is known vice what is extrapolated**

Fleet Exercise Demonstrations Supported

- **Previous Experience**
  - **COMSECONDFLT NCASW EXPERIMENTATION**
    - **ASWEX-99 (CDS-14)**
    - **ASWEX-00 (C2F/CDS-14)**
    - **ASWEX-01 (C2F)**
    - **JTFEX 01-3 (C2F/CDS-28/TRBATGRU)**
  - **Surface Warfare Development Group**
    - **SHAREM 137 (SWDG/CTF-84/CDS-2)**
    - **SHAREM 138 (SWDG/CTF-12/CDS-15)**
  - **Fleet Battle Experiments**
    - **FBE-E**
- **Future Opportunities**
  - **CUP Fielding FY02-FY07 (Planning for All BATGRU After FY04)**
  - **SHAREM Program (2-4 per year)**
  - **NCASW Experimentation (1-2 per year)**
  - **FBE (yearly)**

Fleet System Transition Opportunities

In Development Acoustic Prediction Systems

Common Undersea Picture Program	**IOC FY04**	**All USW Locations**
NITES 2000 JAVA Redesign	**IOC FY04**	**Ashore/Afloat OA Div**
		Ashore TSC
SPPFS/STDA-SPPFS (SQQ-89)	**IOC FY03**	**SQQ-89 Surface Ships**
STDA (SSN)	**IOC FY02**	**ARCI Submarines**
		IUSS Ships

System Engineering and Transition Support

- **The Problem**
  - There are several/many transition targets
  - There are many Fleet demonstration opportunities
  - Successful demonstration and transition will require tools implemented in the appropriate form factor
- **The Solution**
  - Evaluate evolving designs of Fleet systems
  - Specify framework to support data and models of uncertainty from ONR Teams compatible with transition opportunities
  - Identify Fleet exercises for data collection and demonstrations

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Process Tracing and Cognitive Modeling

- **The Problem**
  - **The Human Decision Maker**
    - **Responsible for taking actions and so:**
      - **Must understand the recommendations**
      - **Must understand the associated uncertainties**
    - **But humans are poor at interpreting some representations of uncertainty**
    - **Distrust system recommendations that appear to be overly "certain"**
  - **The Display**
    - **Provides information**
    - **Therefore, it must communicate to the decision maker**
      - **What the decision needs to know to act**
      - **What he/she needs to know to trust the answer**

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Process Tracing and Cognitive Modeling

- **The Solution**
  - ✉ **Understand How the Decision Maker Interprets Information from the Displays**
    - **Capture Expertise and Likely Cognitive Pitfalls by:**
      - **Process Tracing in controlled settings**
      - **Performance-based evaluation**
      - **Cognitive modeling**
  - → **Use Models to Guide User-Centered Design**
    - **Supports task-congruent reasoning by:**
      - **Reducing information overload while providing required information (including ability to assess uncertainty)**
      - **Building speed, accuracy, and user confidence**
      - **Facilitating decision making, even under uncertainty**

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Tactical/Operational Impact Assessment

Problem Statement

- **Understanding the tactical/operational impact of uncertainty requires:**
  - **Militarily relevant measures of effectiveness (MOE), which are**
  - **Modeled correctly.**
- **Even with enviro/psycho-acoustic data certainty,**
  - **ASW is a *N-P* hard problem,**
  - ***Optimal* solutions can only be approximated, and**
  - **Distributions of outcomes must be considered.**
- **With input data uncertainty**
  - **Only Pareto optimality is possible, and**
  - **Distributions of outcomes for families of problem conditions must be considered.**

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Tactical/Operational Impact Assessment

Solution

- **Collaborate with teams to understand how their projects treat uncertainty**
  - **Identify families of problem conditions to be evaluated, and**
  - **Identify appropriate tactical/operational MOEs (e.g., mean time to classify or probability the high value unit remains free from effective ASW attack).**
- **Apply MOE evaluation tools which**
  - **Account for kinematic effects,**
  - **Tactical/operational behaviors,**
  - **Families of uncertain input data (in 4-D), and**
  - **Random fluctuations within the families of input data.**
- **Provide feedback to the teams as to the**
  - **Military significance of the uncertainty being investigated, and**
  - **Analytical "knees in the curve" relating to those uncertainties.**

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