Experimental Evaluation of Advanced Automated Geospatial Tools

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  - Ryan Johnson, Research Assistant
- NGA University
  - CW3 Martinez, Chief Instructor
  - Participants in pilot and main experiment

Thank You!

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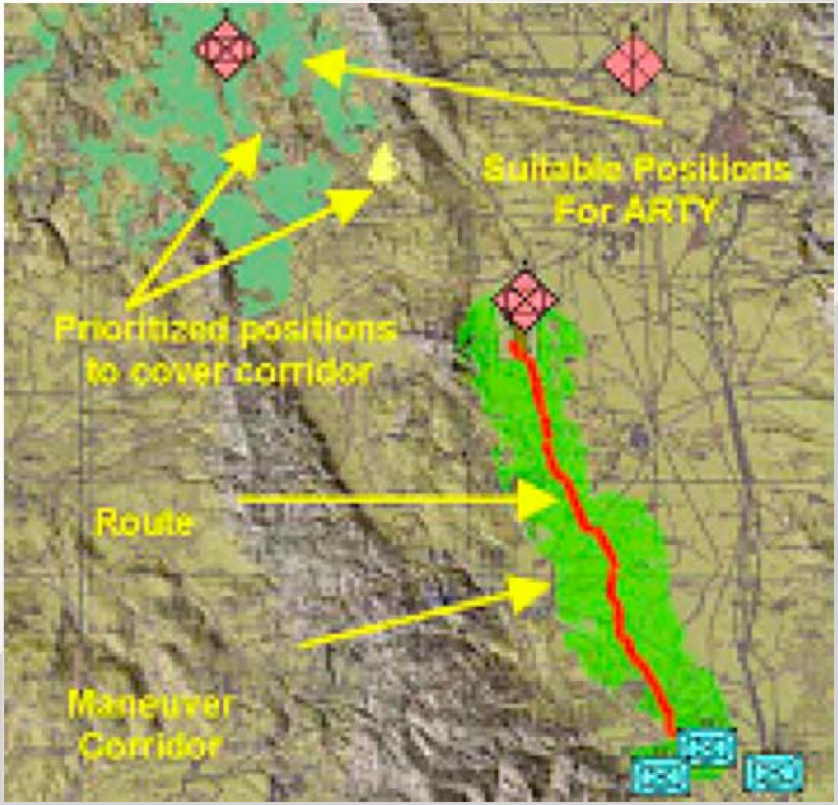
Background

- Map is focal point of command post
- Automated geospatial support tools are rapidly penetrating all command levels
- Empirical research is needed to:
  - Evaluate military value of emerging tools
  - Prioritize future tool development



Purpose of Research Program

- General Purpose:
  - Assess the value-added to Military Decision Making from use of Advanced Automated Geospatial Tools (AAGT)
- Specific Purpose:
  - Evaluate contribution of the Battlefield Terrain Reasoning and Awareness – Battle Command (BTRA-BC) suite of geospatial reasoning tools

BTRA-BC

- Research program sponsored by U.S. Army Engineer Research and Development Center (ERDC)
- Objective:
  - Empower commanders, soldiers, and systems with information that allows them to understand and incorporate the impacts of terrain and weather on their functional responsibilities and processes
- Products
  - Information and knowledge products that capture integrated terrain and weather effects
  - Predictive decision tools that exploit these products
- Some BTRA-BC products have been fielded in the U.S. Army’s Digital Topographic Support System (DTSS)
  - Used by U.S. Army for terrain analysis

Current Study

- Study Objective
  - Assess the benefit of BTRA-BC tools to terrain technicians in performing terrain analysis

- Study Method:
  - Perform experiment to compare performance with and without BTRA-BC
  - Participants were students in Advanced Topographic Analysis Course (ATAC) trained as terrain technicians
  - Participants performed two trials of a military planning task:

    (1) With BTRA-BC, and

    (2) DTSS without BTRA-BC

Primary Hypotheses

1. Subjects who use BTRA-BC will produce a military planning output *more quickly*
2. Subjects who use BTRA-BC will produce a *higher quality* partial MDMP output
3. Subjects who use BTRA-BC will display *as good an understanding* of the impact of the given terrain on military planning
4. The quality of the output generated with BTRA-BC will be *more uniform*
5. There will be *little or no learning effect* due to evaluation design
6. *Participants will consider BTRA superior* with respect to speed, quality, understanding, usability, and overall

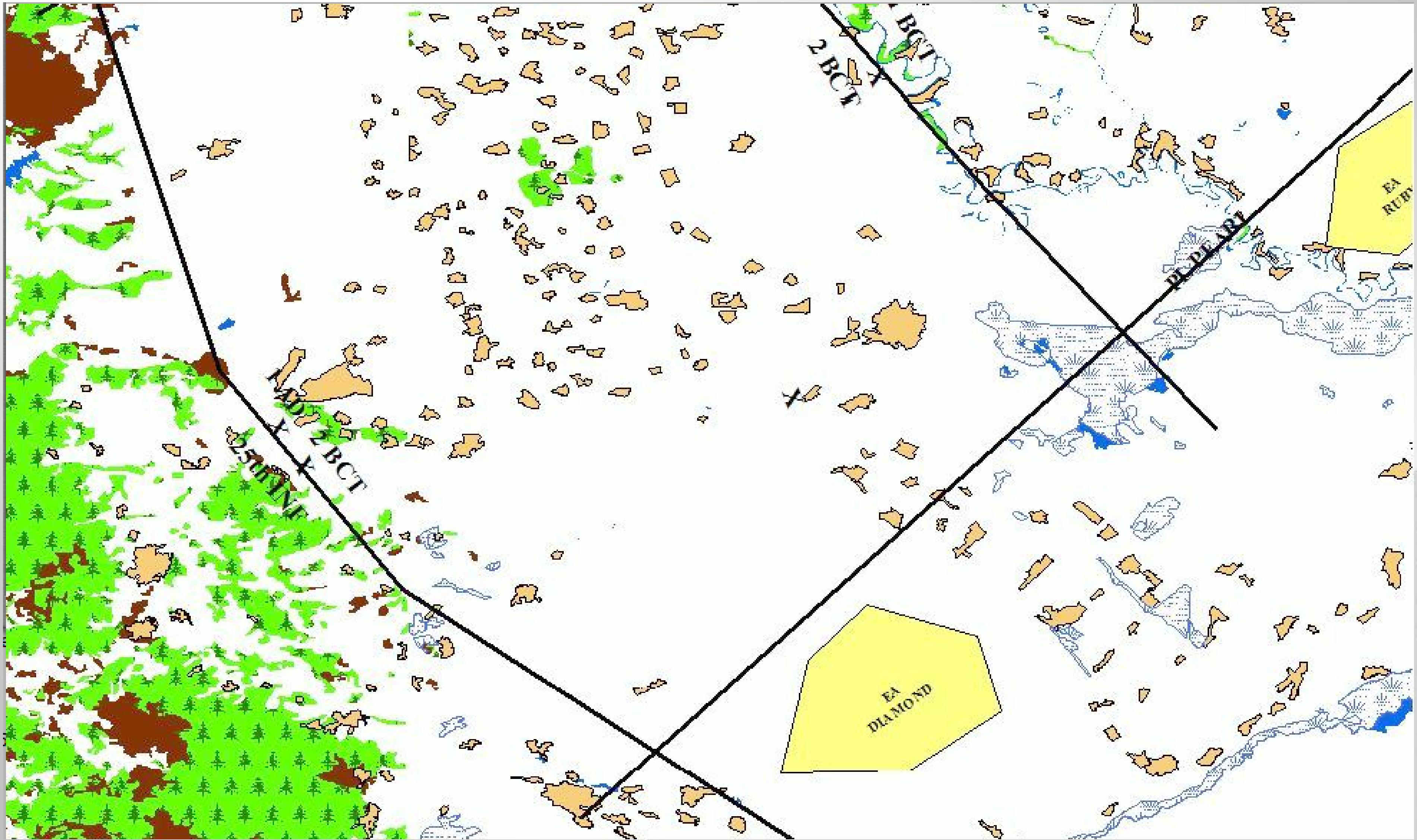
Study Design

- Environment: DTSS with and without added BTRA functionality
- Subjects: 18 ATAC students (mid-grade military terrain analysts)
- Within subjects design:
  - Each subject solved problem in both conditions (with and without BTRA)
    - Two near-identical scenarios with similar terrain
    - Design was counterbalanced on scenario order and system order
  - Training was conducted on BTRA-BC (1-2 hours) immediately prior to BTRA-BC trial

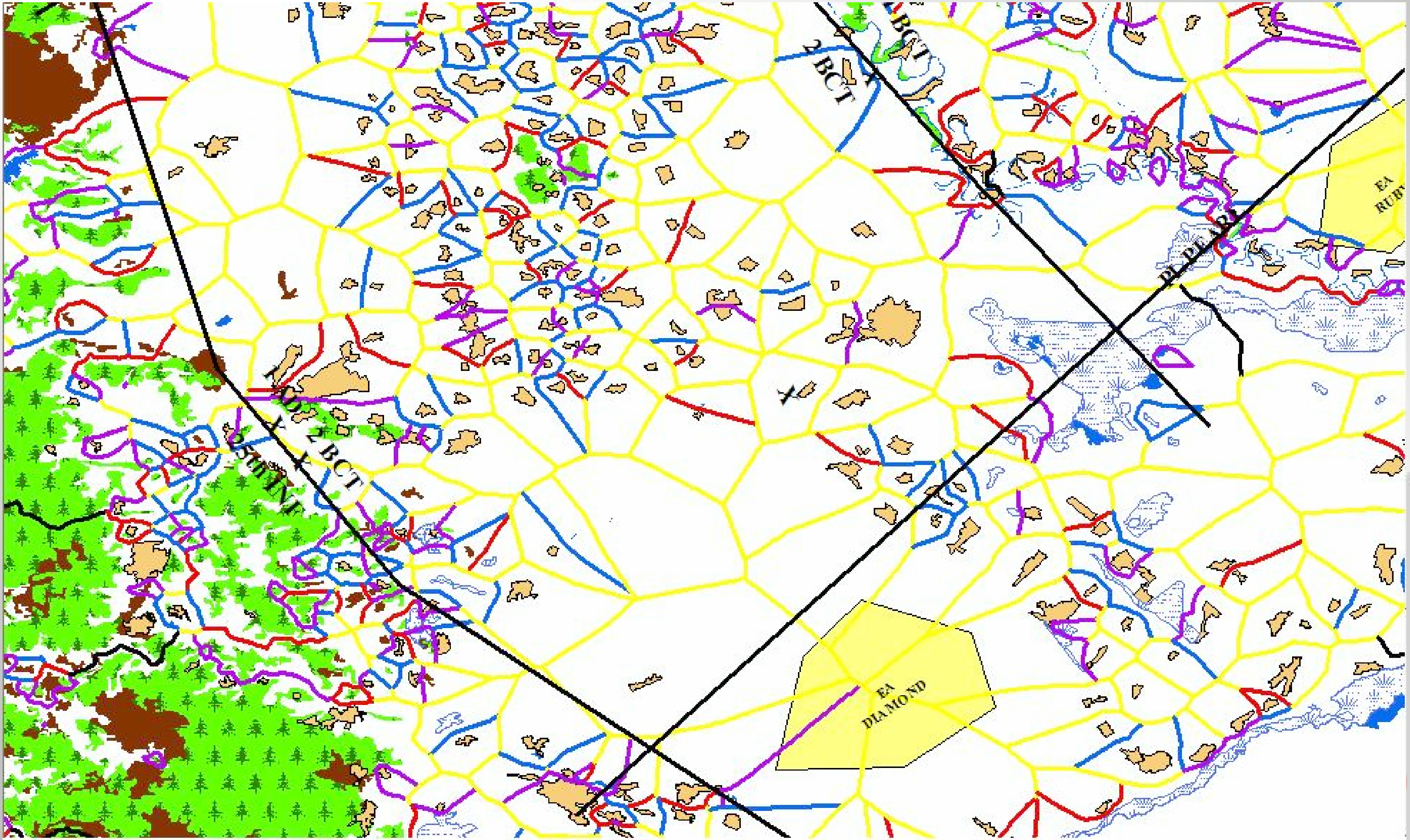
Experimental Tasks

- The evaluation scenario began with analysis of specific terrain and continued to the point of generating potential AAs.
- Specific tasks :
  - Generate Combined Obstacle Overlay (COO) (automated, but different process in the two conditions)
  - Identify Mobility Corridors (MC)
  - Categorize Mobility Corridors by size
  - Group Mobility Corridors to form potential Avenues of Approach
  - Plan routes for 3 types of vehicles
  - Identify Choke Points on Avenues of Approach
  - Calculate travel times
  - Recommend subordinate echelon Areas of Responsibility
  - Answer questions to assess terrain understanding
  - Answer questions to assess subjective experience with system

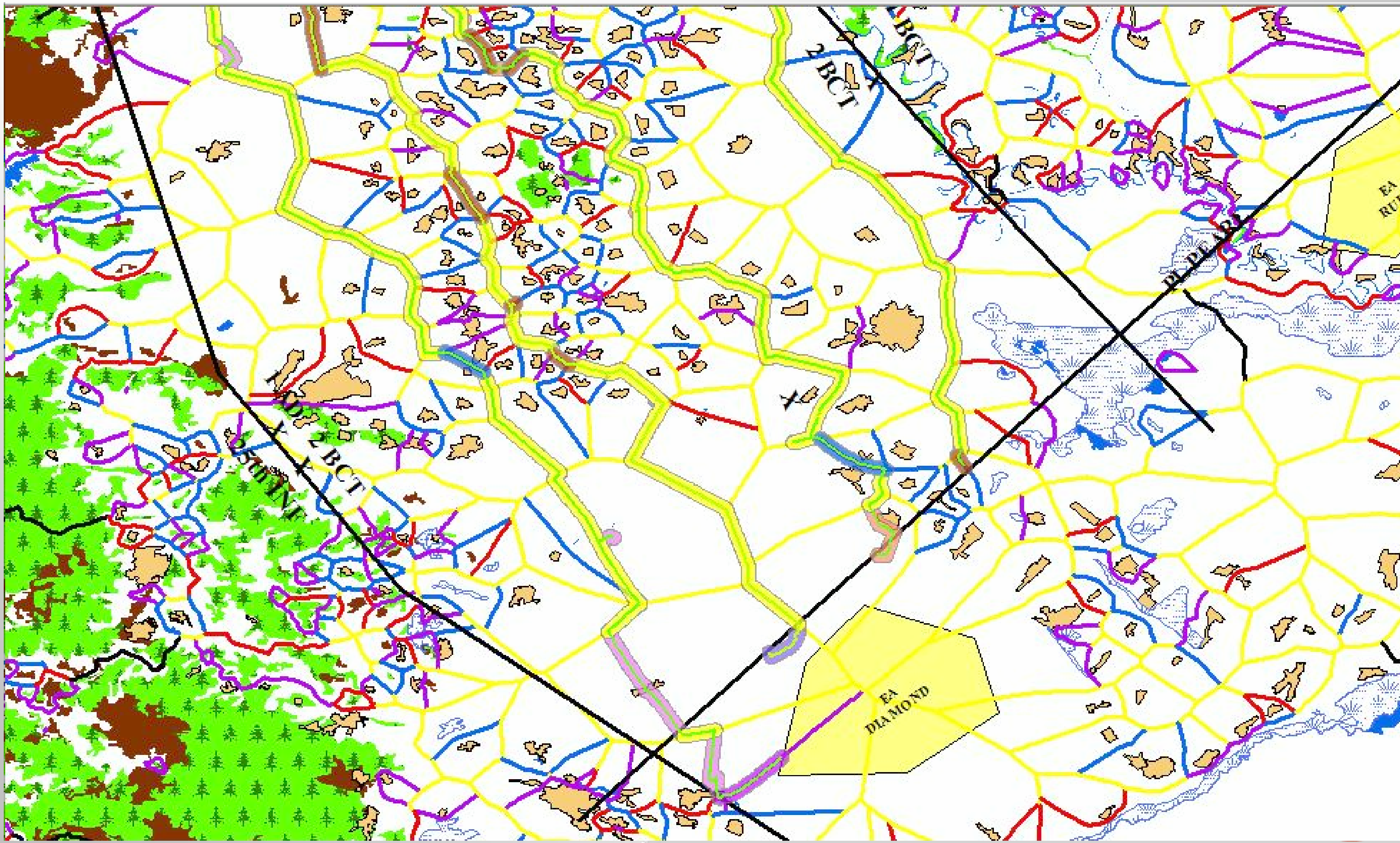
Combined Obstacle Overlay



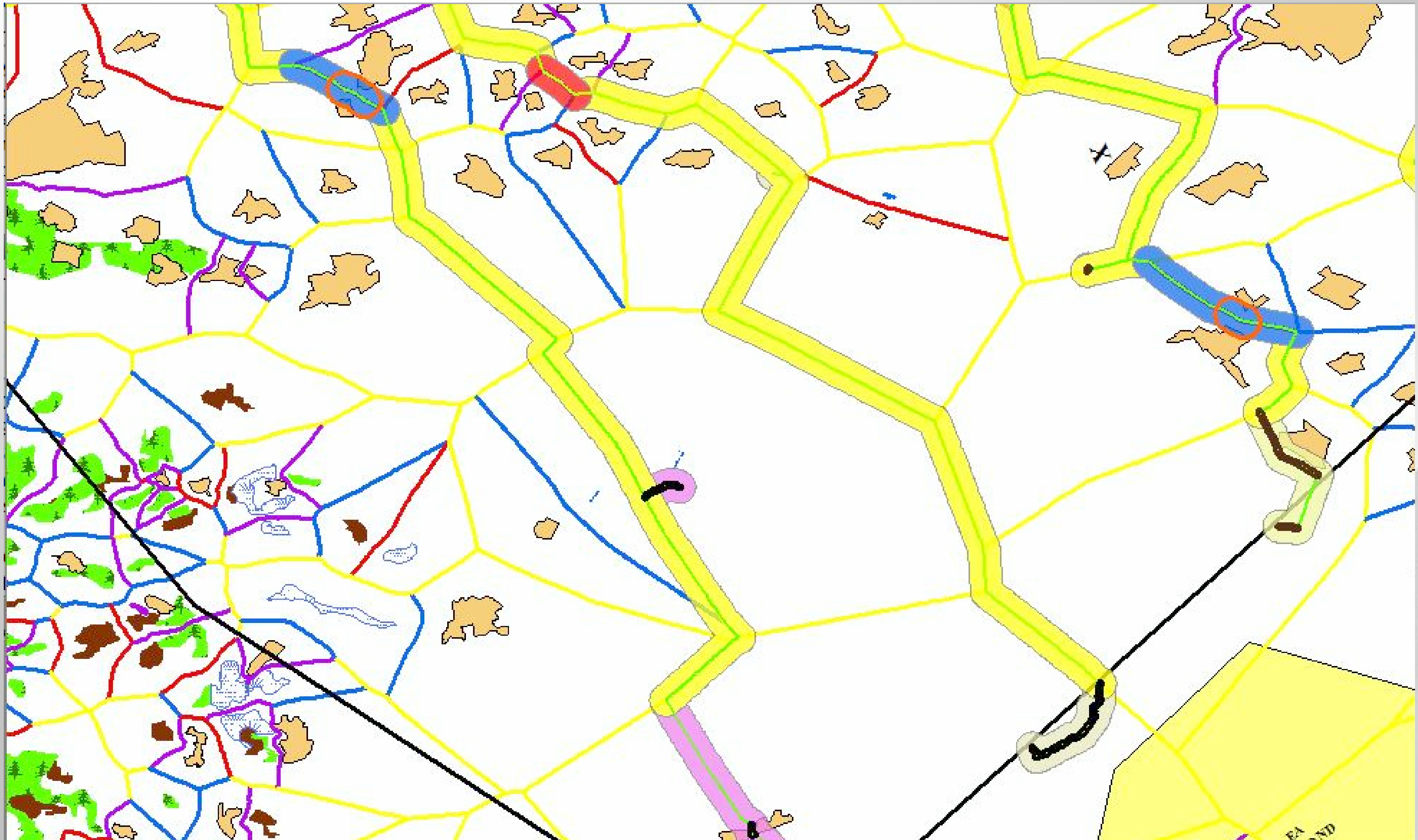
Mobility Corridors



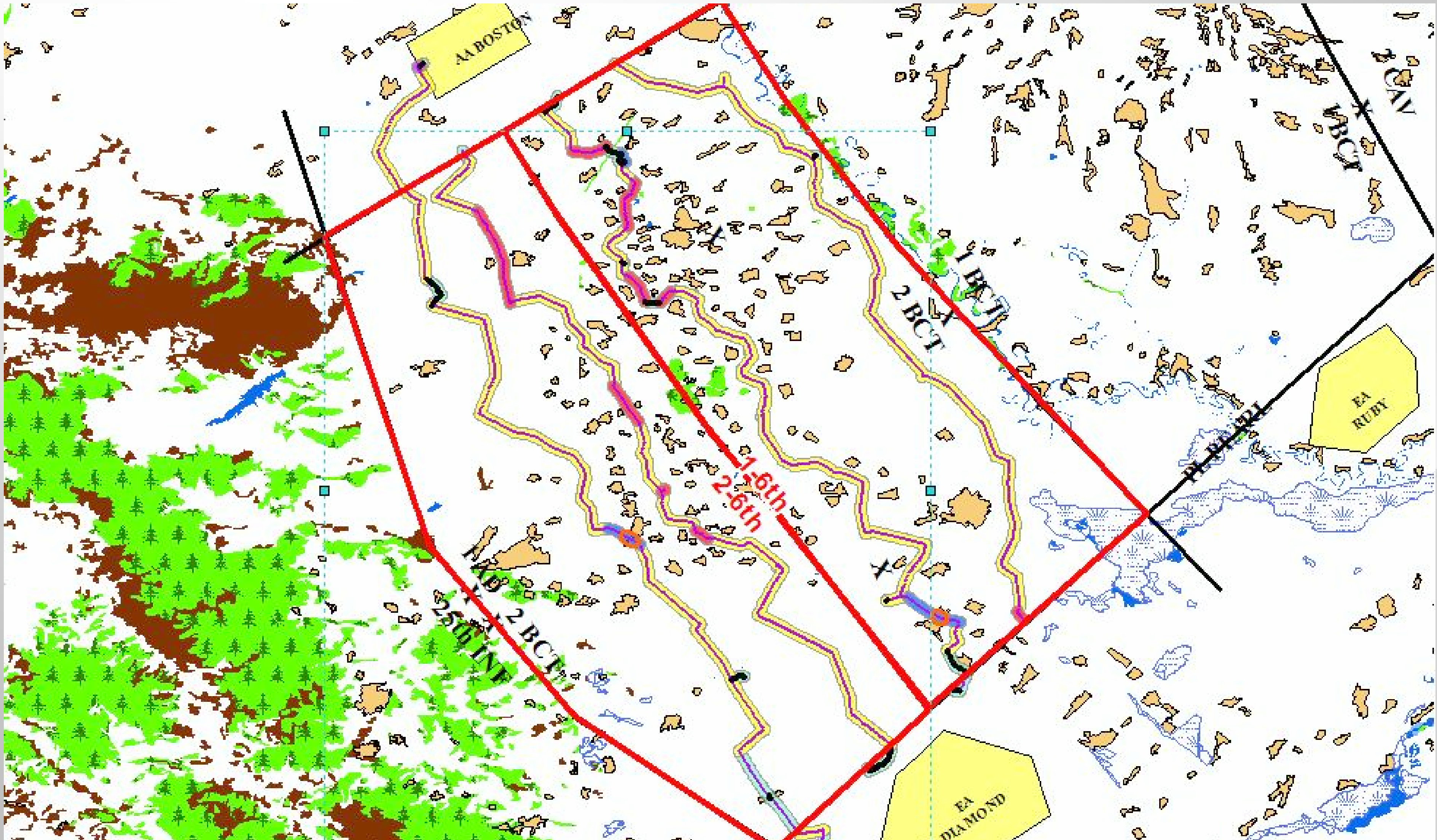
Potential Avenues of Approach



Choke Points



Battalion Boundaries

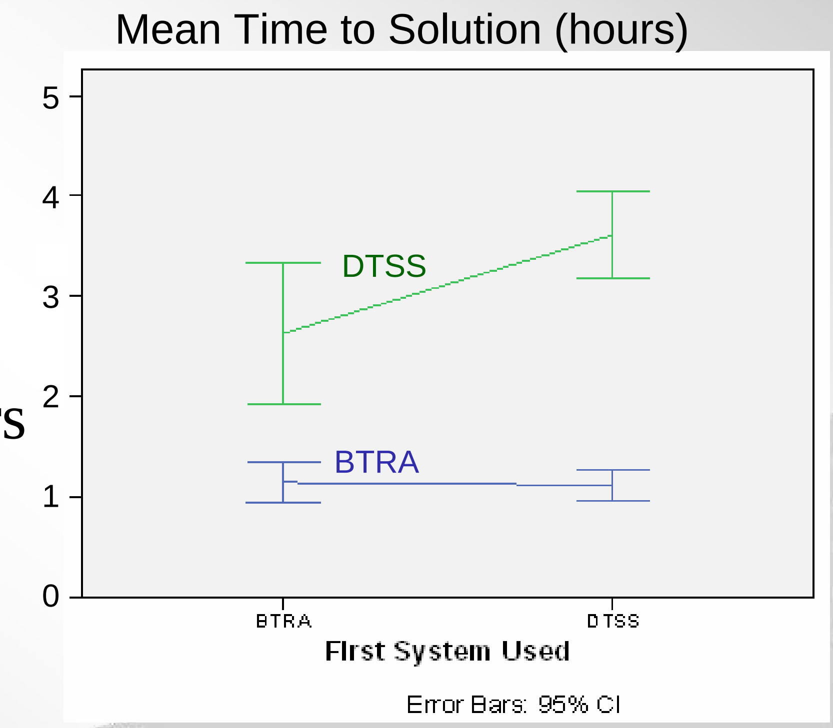


Measures

- Time to complete scenario (H1, H5)
- Quality of solutions as judged by expert evaluators (H2, H4, H5)
- Scores on a questionnaire evaluating subject understanding of the problem (H3, H5)
- Scores on a questionnaire evaluating subjective perception of BTRA (H6, H5)

Initial Results: Time to Solution

- Average time to scenario completion (H1)
  - BTRA: 1.1 hours
  - DTSS: 3.1 hours
  - >99.99% confidence that average times are different
- Learning effect (H5)
  - Average time to completion on DTSS was shorter for subjects who used BTRA first (3.6 hours vs 2.6 hours)
  - >99% confidence that average times are different



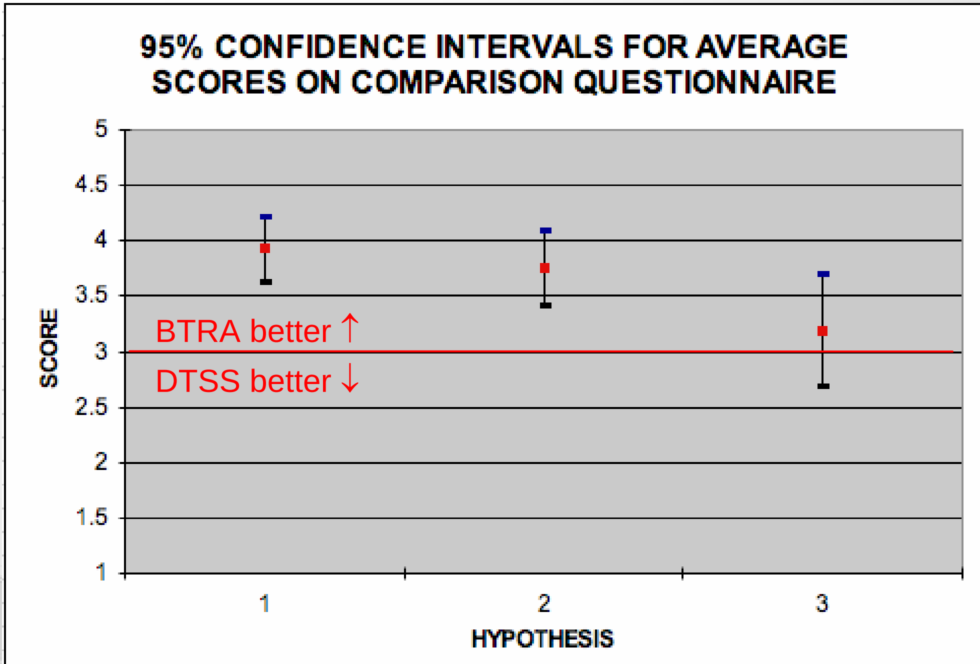
Hypothesis Tests: Subjective Perception

There is strong statistical evidence that:

1. Subjects believe they can produce the required output *more quickly* with BTRA-BC than with DTSS
2. Subjects believe they can produce an output of *higher quality* with BTRA-BC than with DTSS

The results provide no evidence against the hypothesis that:

3. Subjects believe they have *as good an understanding* of the impact of the given terrain on military planning when using BTRA as when using DTSS



Preliminary Conclusions

- BTRA-BC dramatically speeds performance on terrain reasoning tasks
- Experience with BTRA-BC may help speed terrain analysis using DTSS
- Terrain technicians believe BTRA-BC speeds performance and improves accuracy without degrading understanding of the terrain

Project Status

- Analysis of data from experiment continues
  - Results for solution quality
  - Results for other hypotheses
  - Additional analyses of questionnaire data
- Planning is underway for a follow-on experiment
  - Intelligence or operations officers perform a planning task using the Commander's Support Environment (CSE)
    - With access to BTRA-BC products
    - Without access to BTRA-BC products
  - Experiment will evaluate speed, performance, subjective perceptions
- Future experiments will assess effect of geospatial tools on collaborative planning

Questions?