Developing Science-Based Testing:
Characterizing the physical environment with enough detail to support test procedures

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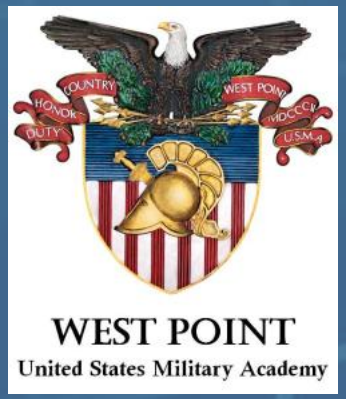

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Presentation Outline

Generate awareness of science-based methods and strategies to identify and characterize critical natural environmental parameters that may impact development and testing of military equipment

- Natural environment impacts to military equipment
- What we know about the environment – then and now
- How do we use what we know
- How can we make better use of what we know – Global Military Operating Environments – Terrain Analysis and Mapping

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Natural Environment Impacts to Military Operations - "Re-learning" Old Lessons?

- WWII – North Africa
- Iraq and Afghanistan
- Soil and dust affect military operations
- Weapon system now more complex

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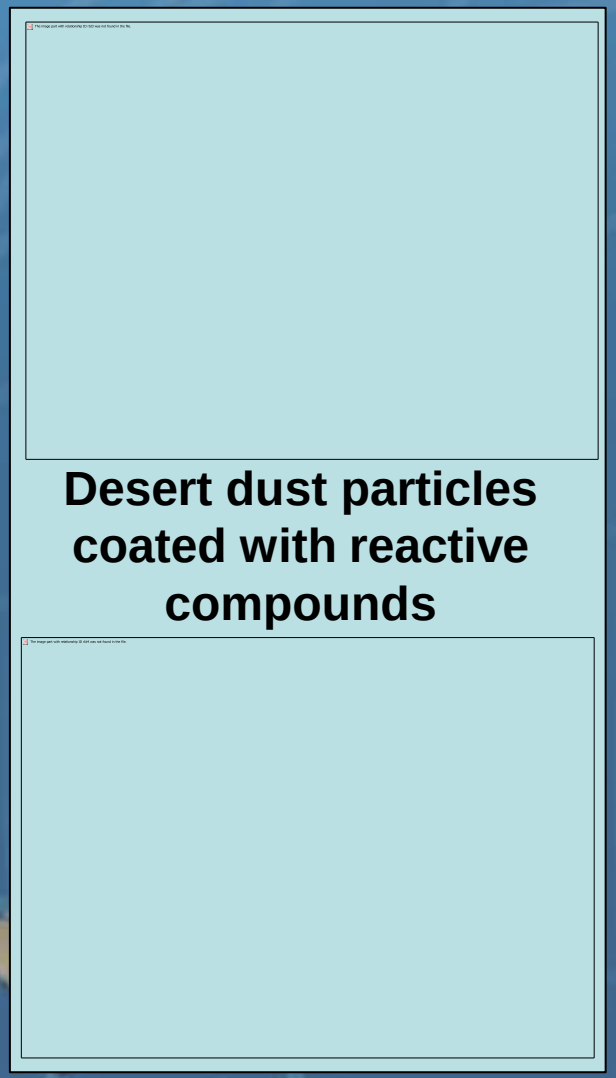
Testing for the Effect of Dust?

- Standard chamber testing uses ground silica sand (silica flour)
  - Ground silica is abrasive, “clean”, and not reactive



Desert dust particles coated with reactive compounds

Desert dust is “dirty” - abrasive and corrosive
- Includes reactive compounds: salts, carbonates, iron oxides, clays

Lessons Learned
- The properties of dust –
  - are well known in the scientific community
  - are critical to military operations

  But
  - limited use in the RDT&E community

Need:
- Identify & characterize the factors of the environment critical to operations
- Use the scientific knowledge of the natural environment during RDT&E

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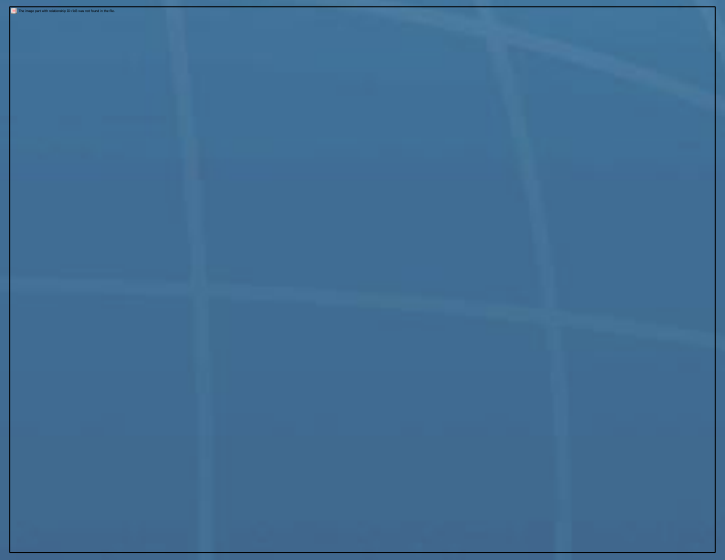
Natural Environment Impacts on Individual Weapons

- Troops report multiple malfunctions of the M16 and M4
- Exposure to dust appears to be part of the problem
- DRI and USMA analysis shows jamming due to chemical reaction between dust and gun lubricants



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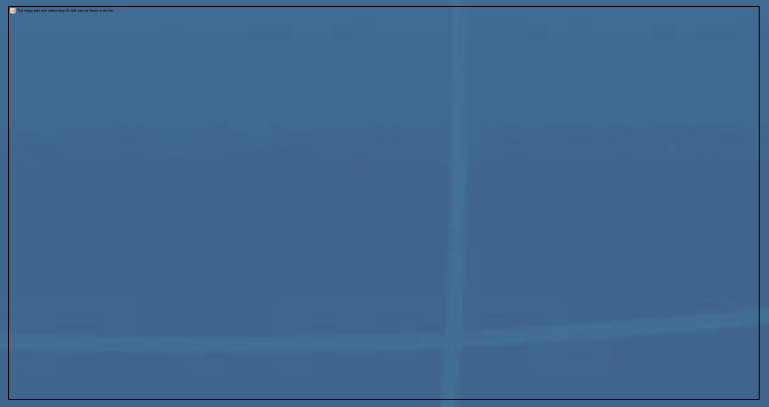
Natural Environment Impacts on Aircraft and Vehicles

Desert dust impacts to

- Rotorcraft blades
- Avionics
- Visibility
- Engine life
- Weapon system malfunctions
- Electronic and physical functionality



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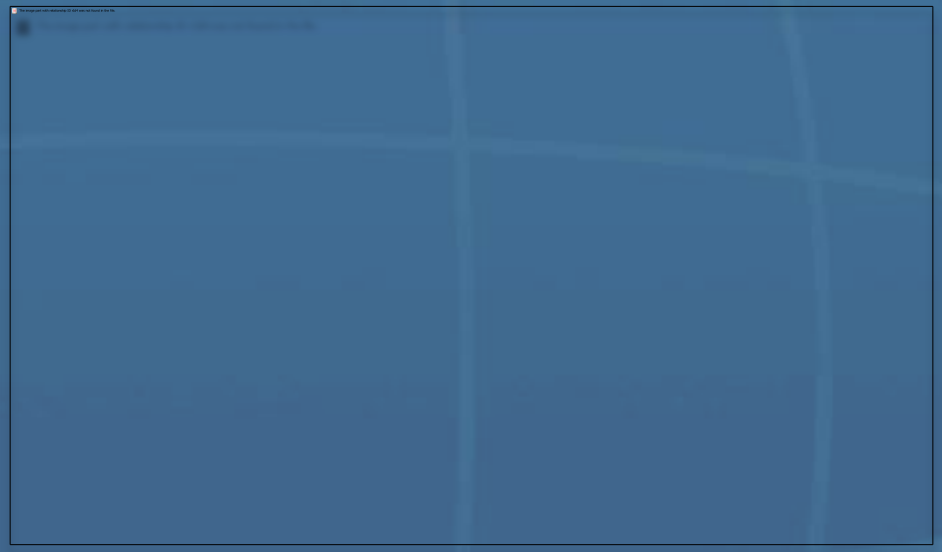
What we know about the environment – then

DoD References and Regulations about the Natural Environment

- **Commonly predate 1990, often 1970**
- **Have limited environmental data**
- **Have little digital data**
- **Lacks geospatial reference**
- **Do not address impact on modern equipment**
- **Do not apply or adapt to high-tempo warfare**



Simple, black and white, clean, and on paper

What we know about the environment – now

Global Military Operating Environments and Combatant Commander's Areas of Responsibility

Complex, colorful, dirty, described digitally, and geospatial

How do we use what we know

A complex world - determining what and where to test - camouflage study*

*Science Terrain and Assessment, COE Cold Regions Research and Engineering Lab, USA Natick Soldier RD&E Center, USA ATC, USA, RDECOM, presented at Camouflage Industry Days.

How do we use what we know

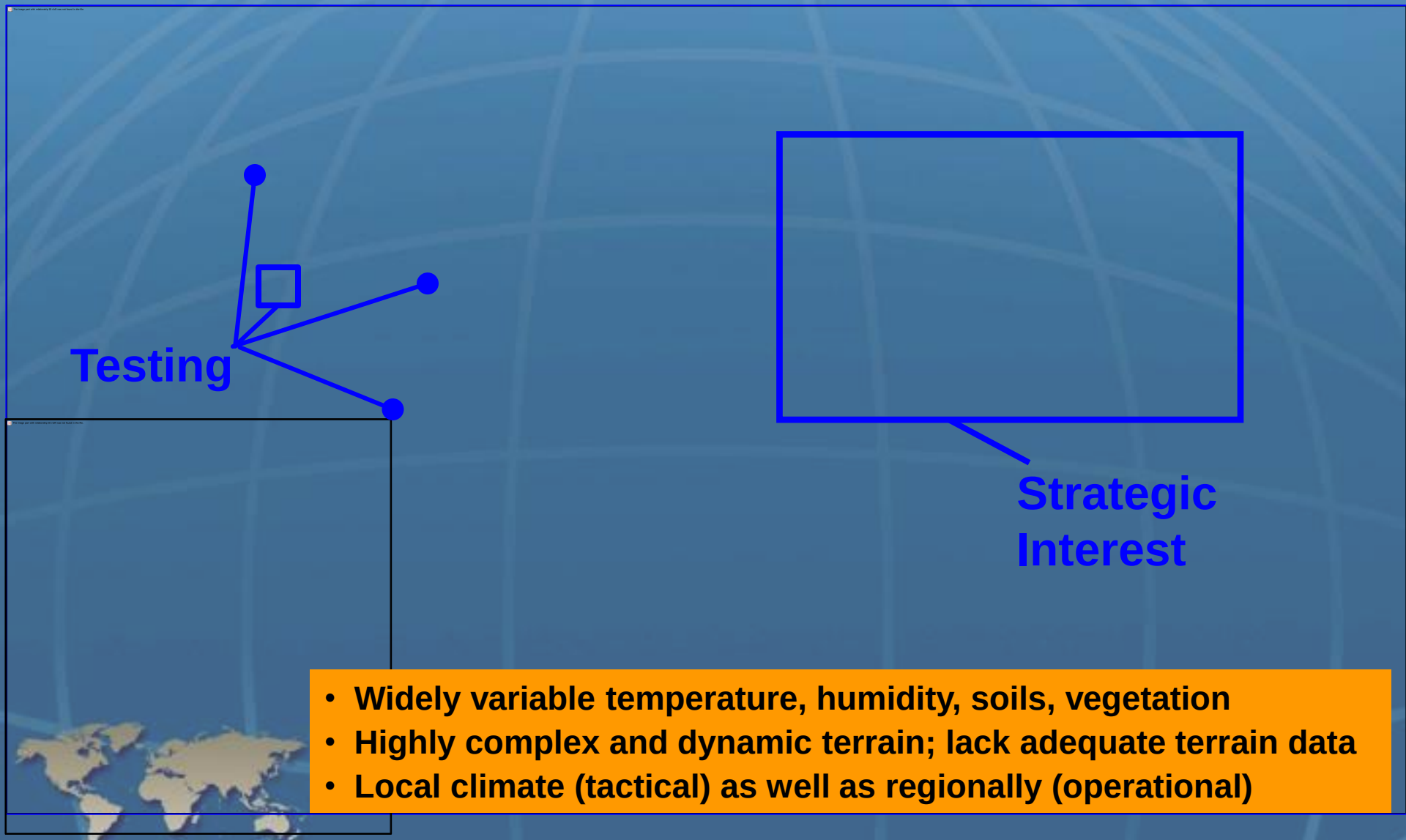
A complex world - determining what and where to test

Hierarchy of Environmental Elements for Locating Analogs - Camouflage study*

*Science Terrain and Assessment, COE Cold Regions Research and Engineering Lab, USA Natick Soldier RD&E Center, USA ATC, USA, RDECOM, presented at Camouflage Industry Days.

How do we design test for diverse geographic areas?

Do our test facilities provide realistic analogs?



- Widely variable temperature, humidity, soils, vegetation
- Highly complex and dynamic terrain; lack adequate terrain data
- Local climate (tactical) as well as regionally (operational)

How we can make better use of what we know

Army Research Office Project
Global Military Operating Environments (GMOE):

Project Objectives:

- Catalog key global terrain parameters likely to impact military equipment and operations
- Compare terrain of strategic areas of interest with test centers
- Analyze how the soil environment impacts military sensor technology, RF propagation, C-IED/C-mine
- Develop methods to rapidly characterize major global terrain settings
- Develop accessible global database of terrain and soil data

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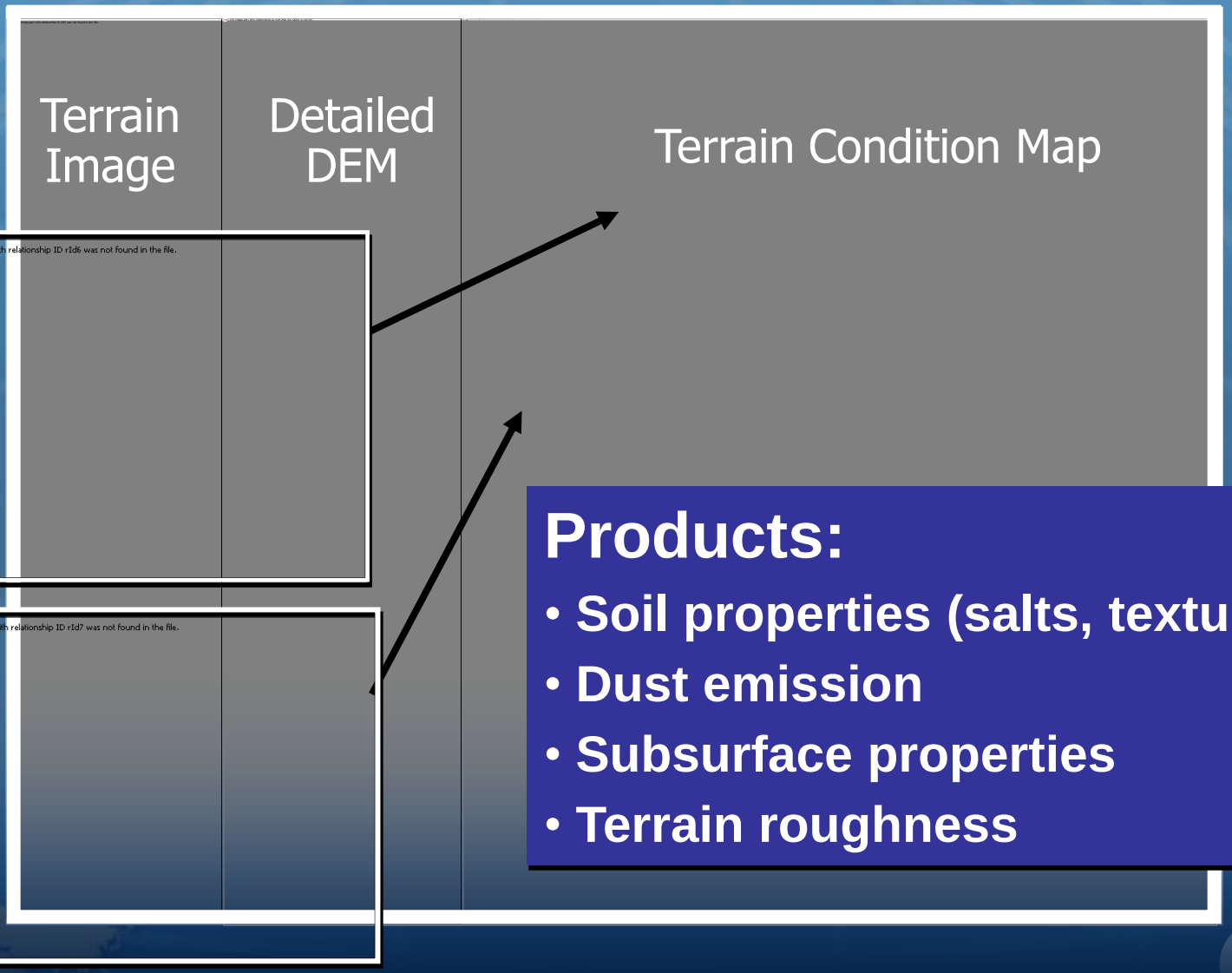
How we can make better use of what we know

GIS Based Rapid Terrain Mapping



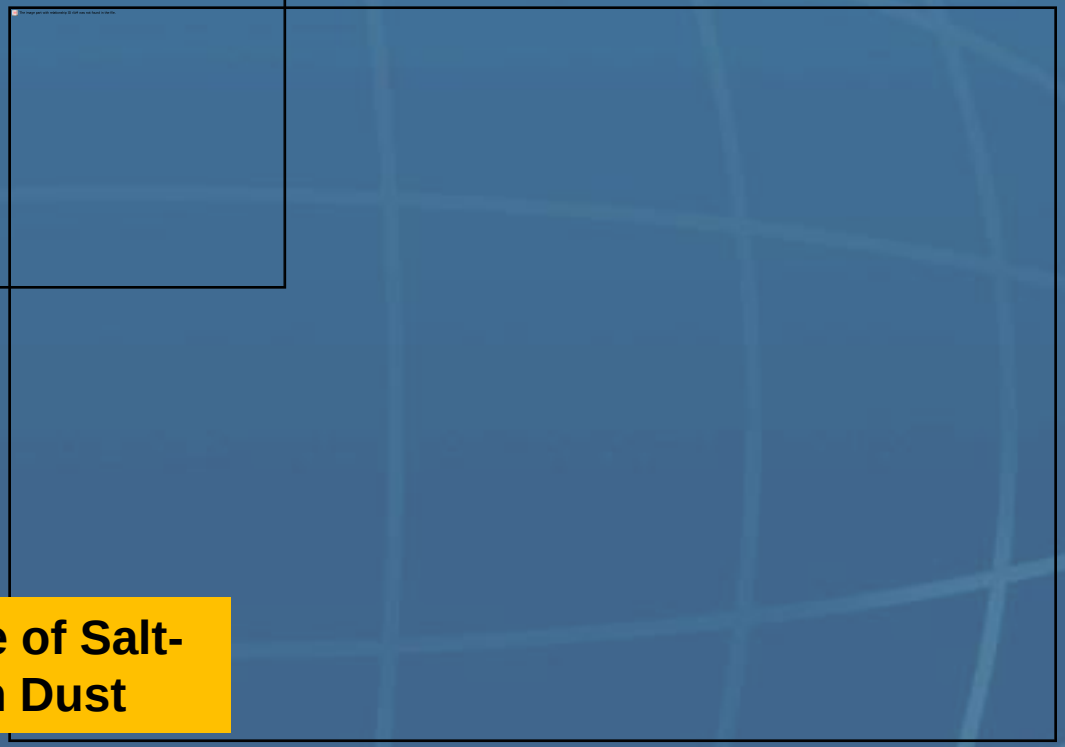
Products:

- Soil properties (salts, texture, etc)
- Dust emission
- Subsurface properties
- Terrain roughness

How we can make better use of what we know

Digital Products: Catalog of Major Terrain Properties

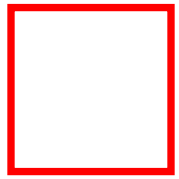
Geographic Landforms



Source of Salt-Rich Dust

Catalog of Analogs: Landforms – SW Asia to YPG

Common question: What terrain in the US is the best natural analog for SW Asia?

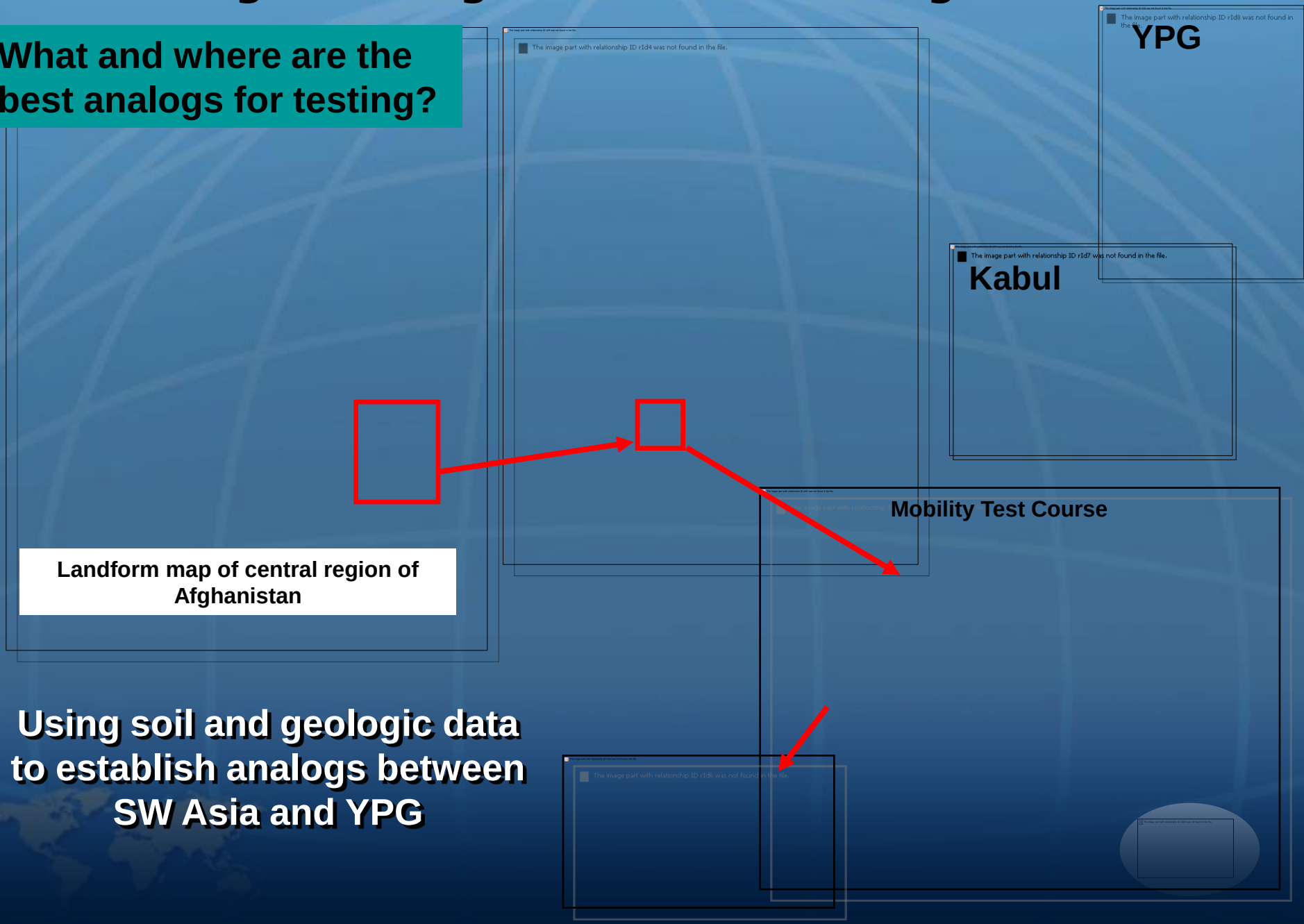


U.S. Army Photos

DRI Product: Terrain map of SW Asia

Catalog of Analogs: Global Desert Regions to YPG

What and where are the best analogs for testing?



Landform map of central region of Afghanistan

Using soil and geologic data to establish analogs between SW Asia and YPG

How we can make better use of what we know

Natural Environments Information on Military Operating and Test Areas:

- Multiple Reports : Accessible through: DTIC (Distribution D)
- Tropics
- Temperate
- Cold region
- Deserts

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Proposed Master Environmental Reference Sites (MERS)

Other sites:
Ft AP Hill (VA)
Ft Greely (AK)
Schofield Barracks (HI)

- Comprehensive soil characterization
- Energy/mass balance monitoring
- On-line (in future)
- Location to test, validate sensor technology

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How we can make better use of what we know

Climate Analysis for Test & Evaluation

Average Relative Humidity

Minimum Test Level

Panama

FL

APG

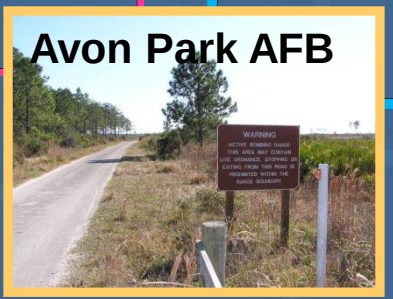
Average Air Temp

- Comparison among potential test areas
- Parameters for chamber testing
- Seasonal variations

APG

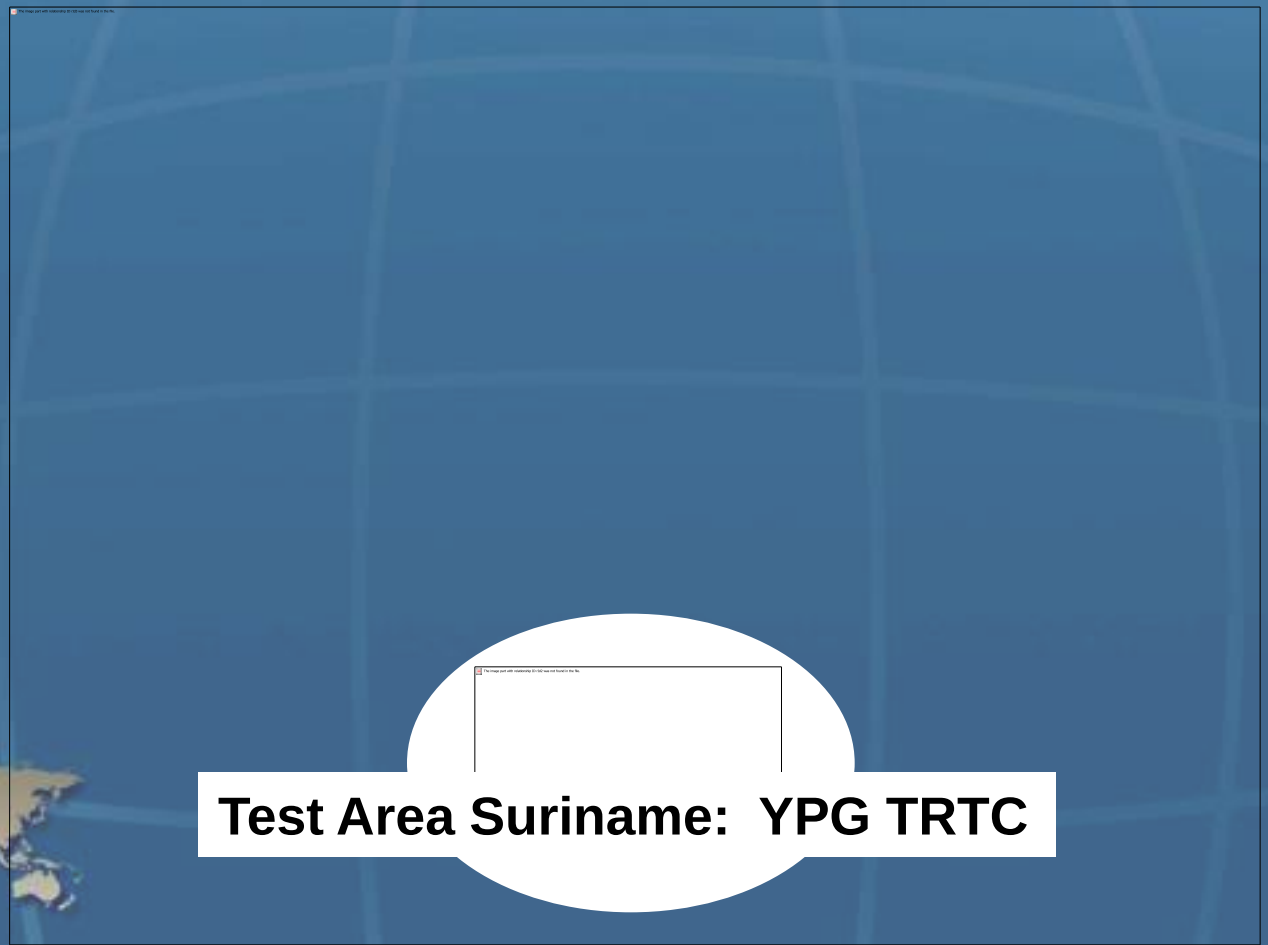
TRTC Panama

Avon Park AFB



Decision Support Model:

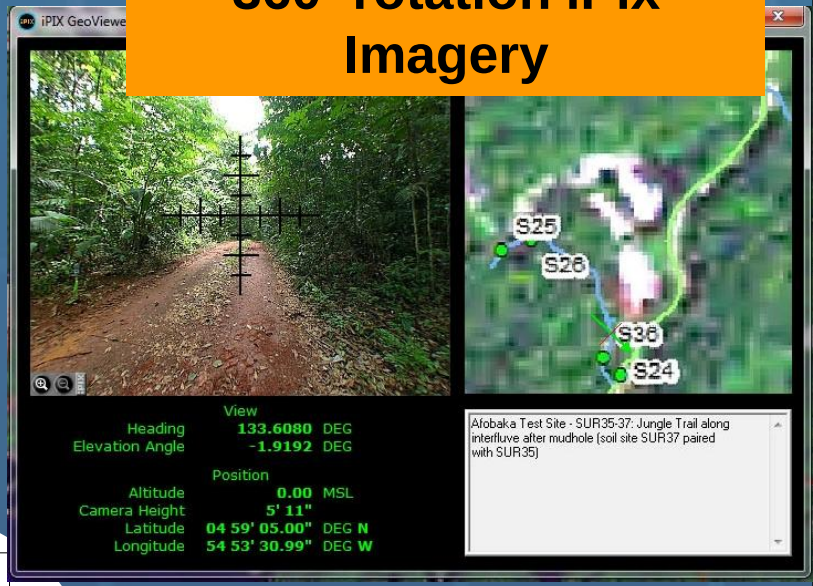
- Interactive map, image, and data format
- Developing on-line support network for PM and test community



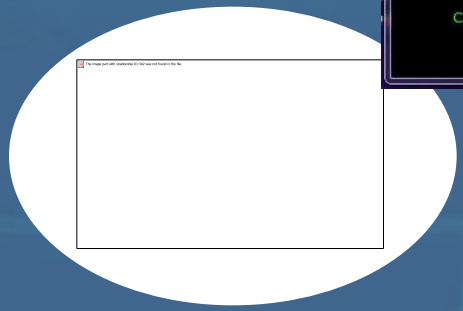
Test Area Suriname: YPG TRTC

Example of data output: Interactive, dynamic, updated

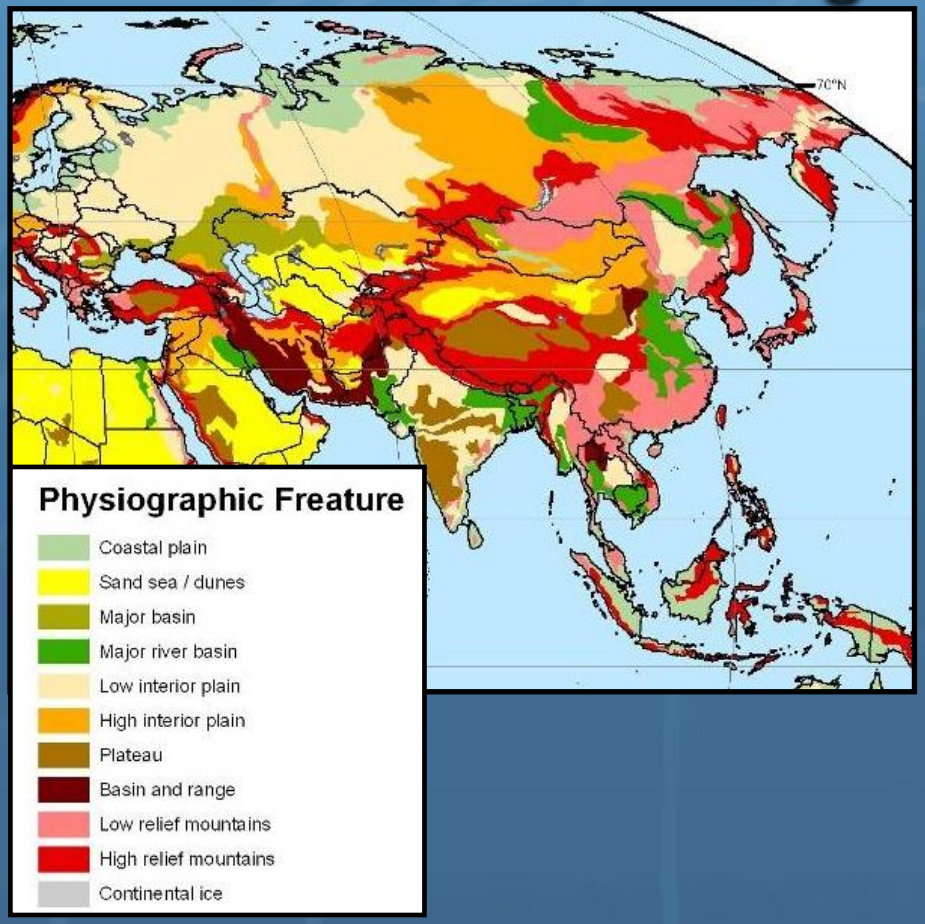
360º rotation iPix Imagery



Geotechnical data



Concluding Remarks: Future Areas of Strategic Interest.....



- What are the effects of environmental and terrain conditions on current or future military equipment.
- Need to ID and incorporate military operating environment data into Test & Evaluation strategies
- Tools exist to link science-based knowledge of global terrain with developing of effective Test and Evaluation procedures

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