# ARMY GEOSPATIAL CENTER
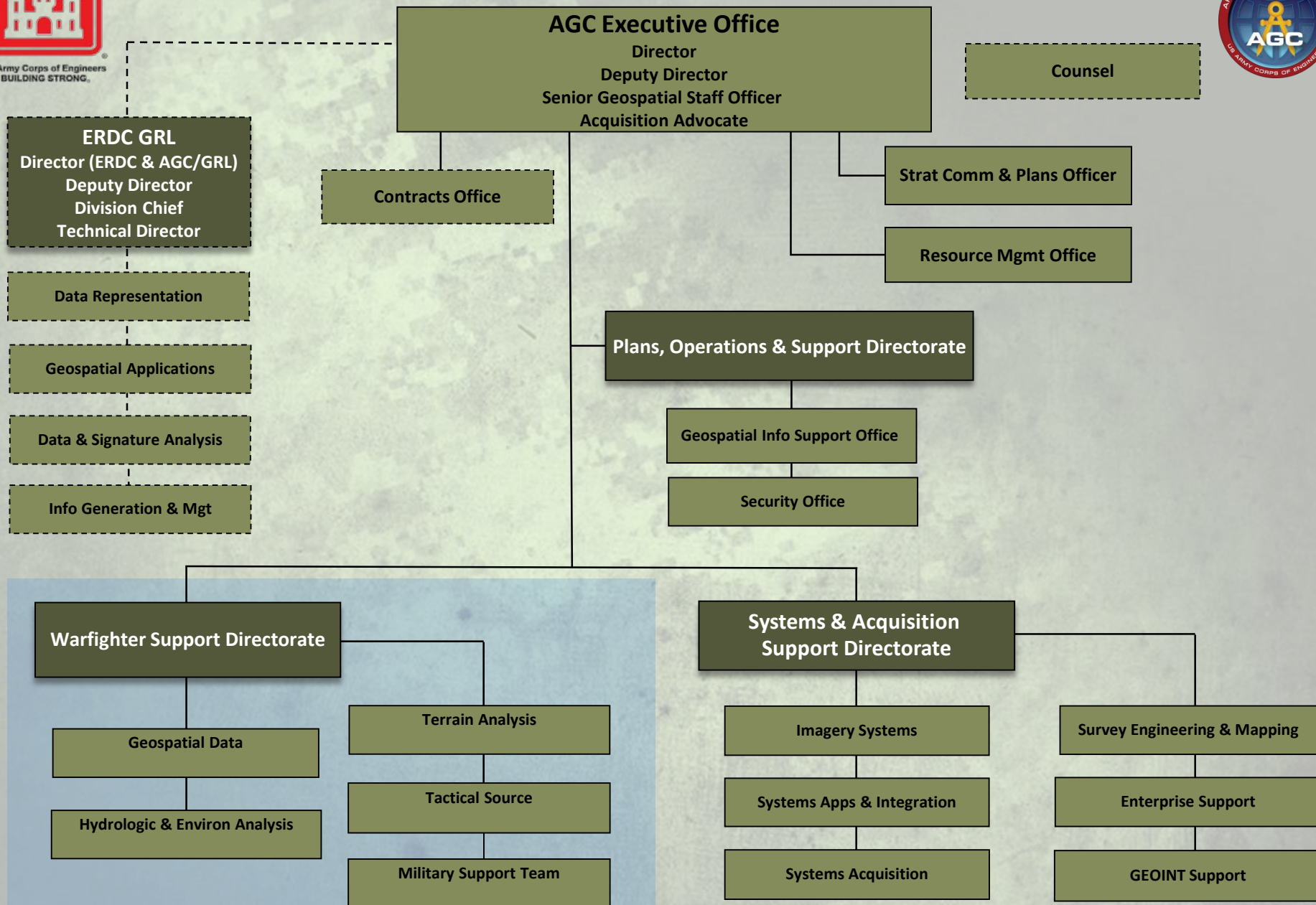*ENABLING GEOSPATIAL INFORMATION DOMINANCE*

**Mr. Andrew R. McHugh**
**Branch Chief, Tactical Source**
**1 DEC 2016**

**US Army Corps of Engineers**
**BUILDING STRONG®**

# AGC Executive Office
## Director
## Deputy Director
## Senior Geospatial Staff Officer
## Acquisition Advocate

**Counsel**

**ERDC GRL**
**Director (ERDC & AGC/GRL)**
**Deputy Director**
**Division Chief**
**Technical Director**

**Contracts Office**

**Strat Comm & Plans Officer**

**Resource Mgmt Office**

**Data Representation**

**Geospatial Applications**

**Data & Signature Analysis**

**Info Generation & Mgt**

**Plans, Operations & Support Directorate**

**Geospatial Info Support Office**

**Security Office**

**Warfighter Support Directorate**

**Systems & Acquisition Support Directorate**

**Geospatial Data**

**Terrain Analysis**

**Imagery Systems**

**Survey Engineering & Mapping**

**Hydrologic & Environ Analysis**

**Tactical Source**

**Systems Apps & Integration**

**Enterprise Support**

**Military Support Team**

**Systems Acquisition**

**GEOINT Support**

# WARFIGHTER SUPPORT DIRECTORATE

Provides geospatial engineering support to the Army's generating and operating forces focused on fulfilling critical geospatial production gaps; provides technical reach-back, data collection, production, exploitation and dissemination of geospatial information tailored to the Army's unique mission requirements and mission command systems.

## TACTICAL SOURCE BRANCH

- High Resolution 3D Data Collection (HR3D)
- BuckEye
- HALOE
- 3D Ground (Terrestrial Lidar)

## TERRAIN ANALYSIS BRANCH

- Engineering Route Studies
- Urban Feature Data
- Common Map Background
- Terrain Analysis
- 3D Visualization

## HYDROLOGIC & ENVIRONMENTAL ANALYSIS BRANCH

- World-Wide Water Resources Database
- Water Detection Response Team
- Water Security Appraisals
- Historical Photo Analysis

## GEOSPATIAL DATA BRANCH

- Army Commercial Imagery Office
- Data Preparation
- Data Dissemination
- Data Library Services

## MILITARY SUPPORT TEAM

- Provides Geospatial Engineering Expertise
- Training
- Reach-Back Support and Production
- Deployed Support

# WARFIGHTER SUPPORT MISSION AREAS

## EMAP: Army Geospatial Support



- Provides geospatial engineering support to both operating and generating forces

- Provides reach-back support, training, technical and domain expertise to maneuver commanders, geoint teams, and generating forces to extend organic capabilities

- Provides efficient and cost-effective solutions to make National and Service-level geospatial information mission and application ready

- Fills critical geospatial support and production gaps

## Water Resources
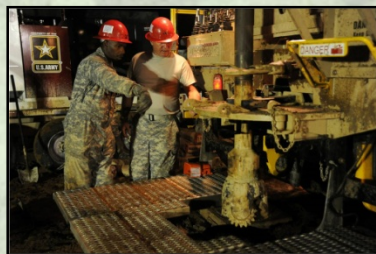


- **DoD's primary agent for military water resource analysis and water detection**

- **Water Resource Data Base (WRDB):** An enterprise geodatabase containing information on the location, quantity, quality, of land-based Surface, Ground, and Existing Water Facility features to support DoD water resource logistics decisions.

- **Water Detection Response Team (WDRT):** Provides site selection analysis and water detection support to assist DoD military well drilling operations.

## Historical Photo Analysis
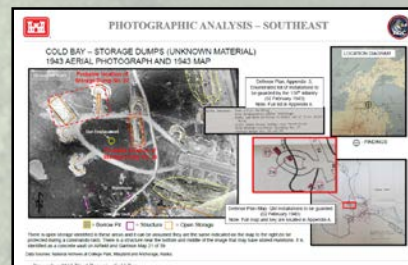


- GIS-based historical photo analysis (HPA) focuses restoration and remediation efforts, leading to overall cost savings

- Identifies potential areas of environmental concern on U.S. Military installations:

- Hazardous, Toxic and Radioactive Waste (HTRW)

- Unexploded Ordnance (UXO) under the Military Munitions Response Program (MMRP)

- Landfill Locations, Groundwater Contaminate Pathways, and Shoreline Changes

## HR3D Data Collection



- High Resolution, Color, unclassified Imagery and Elevation Data that can be shared among interagency and international partners for both military and civilian applications

- Provides Situational Awareness / Understanding Terrain

- Enables Accuracy and Precision

- Reduces Casualties / Collateral Damage

- Provides Required Foundation Data

# EMAP PRODUCTS AND SUPPORT

**Urban Tactical Planner**

**Terrain Analysis for Mobility Modeling**

**Generating Force Training Support**

**Engineering Route Study (ERS)**

**AGE GeoGlobe**

**Common Map Background (CMB) and CMB OnLine**

**Emergency Response & Humanitarian Mission Support**

**GeoPDF**

AGC Imagery Office

Geospatial Information Library GIL
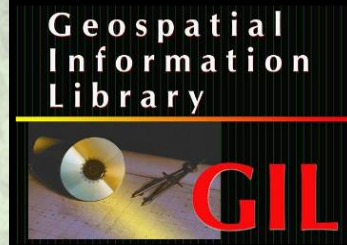
**Reach-Back Support**

**DOD Water Resources Operational Support**

**Garmin GPS**

**DAGR**

**BuckEye**
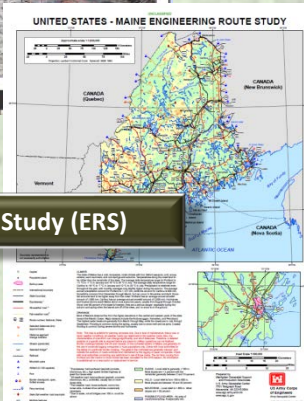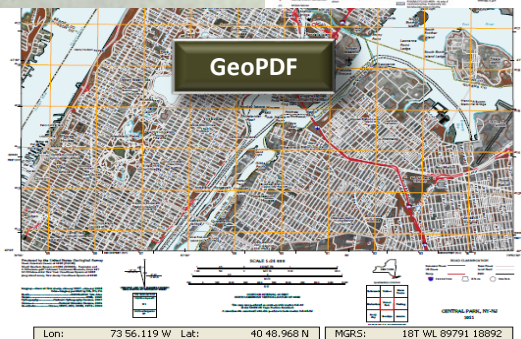
*Direct & OCO Funded:  Reachback RFIs, ASCC GI&S Requirements validated through G2*

# FEATURE DATA CONTENT AND SCALE

**Bridge Ref. No. = 2342656**
**Use = Road Bridge**
**No. of Spans = 2**
**Width = 20M**
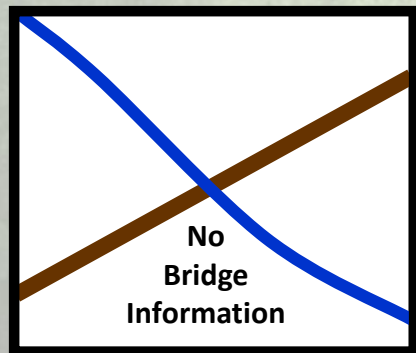**Length = 300M**
**Overhead Clearance = 10M**
**Under Bridge Clearance = 40M**
**Military Load Class = 70**

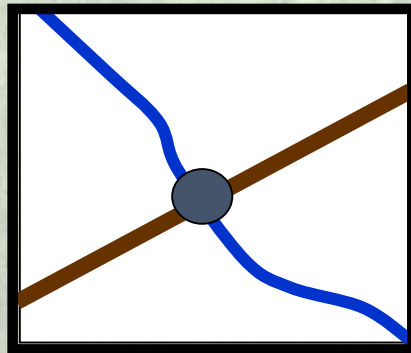**Bulk of Ground Force / SOF Requirements**
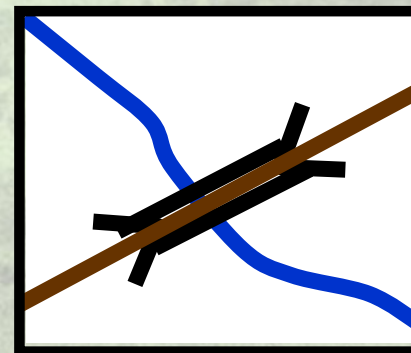
## FEATURE DETAIL AND ACCURACY

| Strategic | Operational | Tactical | Urban |
|---|---|---|---|
| No Bridge Information | | | |

## COST AND PRODUCTION CYCLE

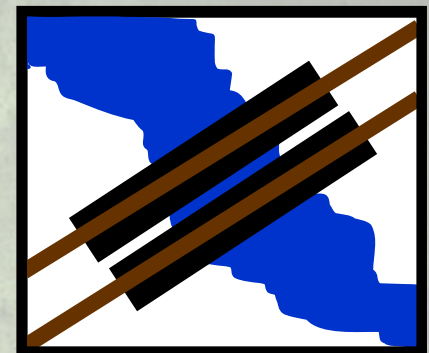| LOW FIDELITY | | HIGH FIDELITY |
|---|---|---|
| 1:1M TPC | 1:250K JOG | 1:50K TLM | 1:10K Urban |

**Programmatic and Production Gaps**

# AGC Geospatial Information Library



- **Mission:**

- The Geospatial Information Library (GIL)'s extensive collection is focused on OCONUS physical geography, terrain analysis, and military hydrology.

- Tech Info Specialists provide RFI mission support. Data holdings directly support engineering, planning, and response requirements of USACE, Army, and DOD activities.

- Geospatial Intelligence holdings are both digital and textual/on-line and static :
  - Actively converting unique map holdings to **GeoPDF** and posting to AGC websites for easier discovery/sharing.

# AGC Imagery Services

- **Army's Executor for Commercial Imagery Acquisitions, AR 115-11:**
- *"…functions as the U.S. Army's C2I acquisition monitor…designed to prevent Army agencies and organizations from duplicating C2I data purchases…designated as the repository of selected C2I data pertaining to terrain analysis and water resources operations…Any Army organization that has a command validated C2I requirement must forward its requirements to [AGC] for research, acquisition, and distribution of the data."*

- **Prevents Duplication of Commercial Imagery Data Purchases & Acquires imagery at no cost through NGA:**
- Total Army Cost Avoidance since FY06 over $100M
- Corps Civil FY10-11 Cost Avoidance: $7.1M
- Gain efficiencies through the sharing of data purchased just once, shared by all.
  - DISDI-AIO  Partnership for Installations

- **AGC Reach-back Collection Management Strategies/Options**
- Customers have direct access to CI products via NIPRNet
- SMEs advise, research, acquire, process, & disseminate CI:  Imagery stored in various places – Army Imagery Library,  NGA Libraries, USGS
- Submit requirements for new collects to NGA via Intelink-TS (JWICS)
- Executes USACE PUM (Proper Use Memorandum) Capability for NTM

# URBAN TACTICAL PLANNER

The Urban Tactical Planner (UTP) is an operational planning tool intended to support Military Operations on Urban Terrain (MOUT)

The UTP allows visualization and analysis of key aspects of the urban environment, including built-up terrain zones, buildings of interest, roads, railroads, streams, forests, marshes, water bodies, and vertical obstructions.

The UTP product provides an overview of the urban terrain in the form of maps, imagery, elevation data, and photographs. City Information, Airport Information, and Port Information textual sources are included.
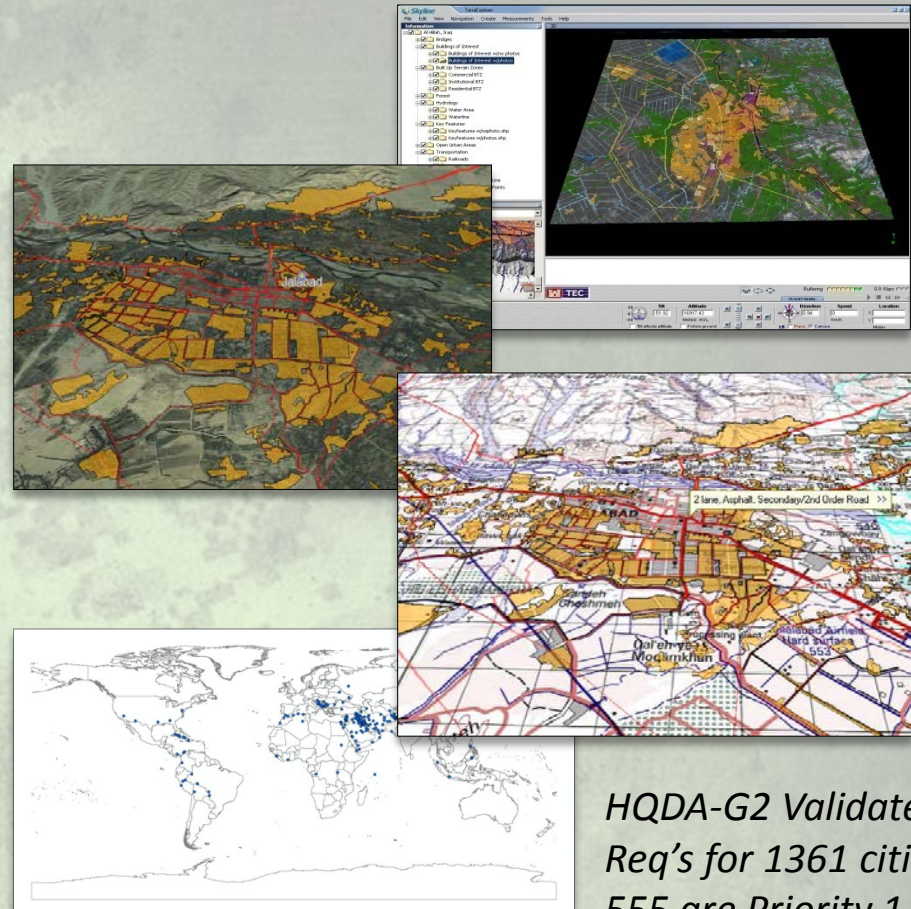
*HQDA-G2 Validated Req's for 1361 cities; 555 are Priority 1*

**ALL UTP PRODUCTS ARE DATA BUNDLED IN GEOPDF, SHAPEFILE AND KML FORMAT ON AGC WEB SITES**
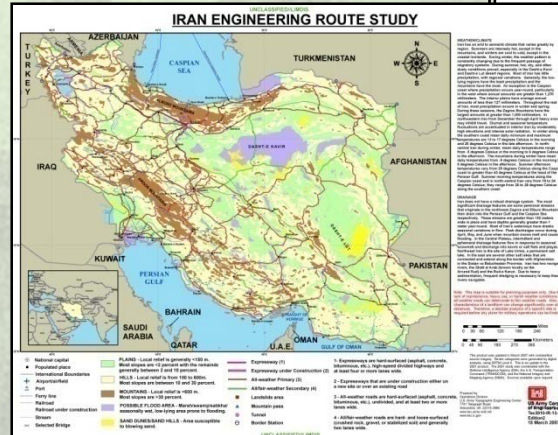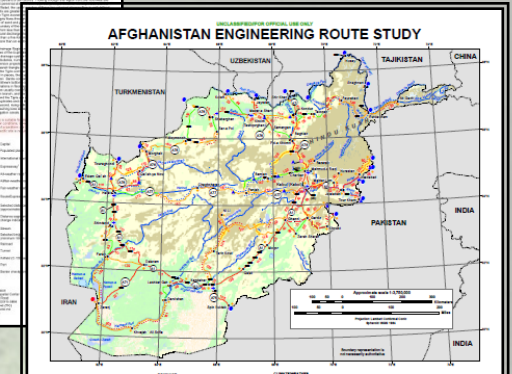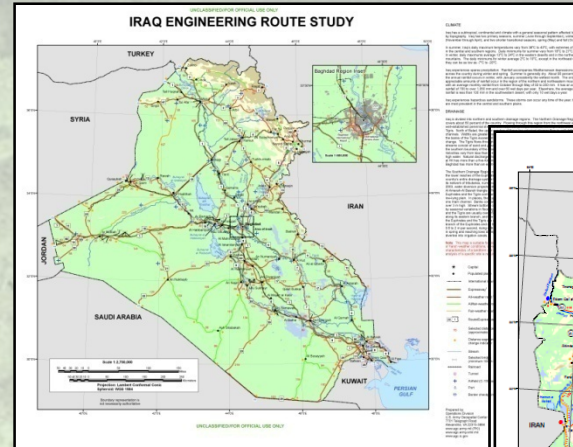
# ENGINEERING ROUTE STUDY (ERS)

**A Strategic / Operational Level Army Planning Product**

The Engineering Route Study provides current information on transportation systems, terrain, and environmental data, at the country or regional level.

The ERS can include man-made or environmental hazards affecting the major transportation routes.

Highway system information includes road classification, surface type, and distance in kilometers.

Other transportation systems delineated include C-130 capable airfields, strategic sealift capable ports, and major railroad lines. Terrain and environmental data includes key rivers, streams, surface con-figuration, areas of potential flooding and landslides, and descriptions of drainage and climate data.
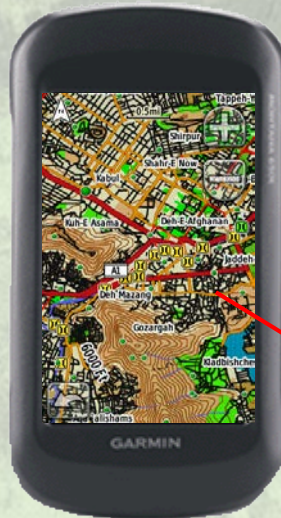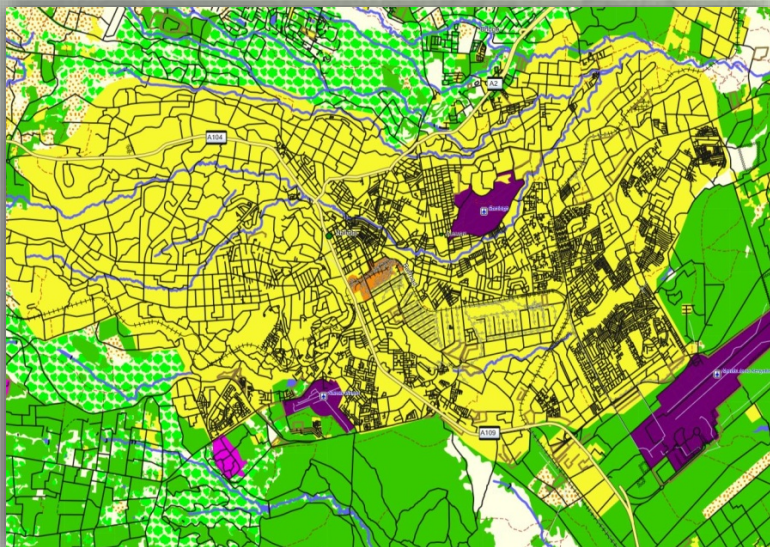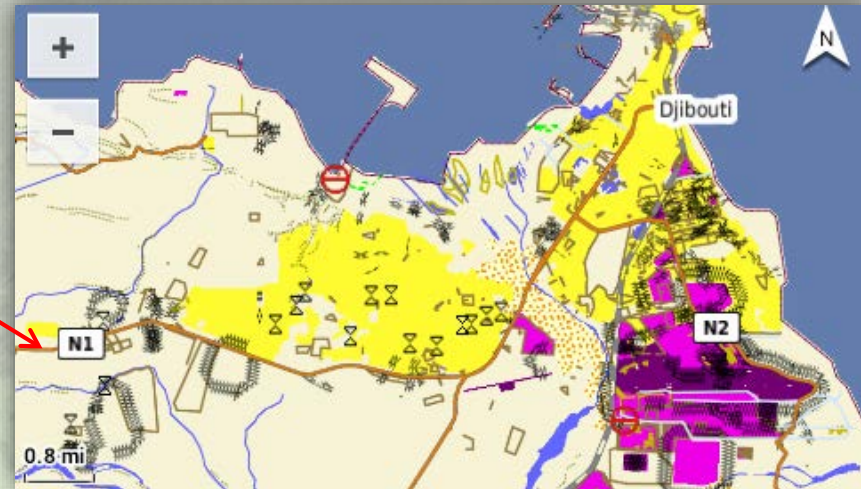
# GARMIN MAP SUPPORT



***Data available***

**Roads**
**Railways**
**Bridges**
**Hydrology**
**Vegetation**
**Airfields**
**International Borders**
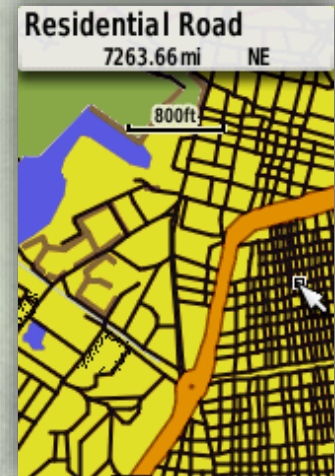**Cities, Towns**

Garmin GPS
with stock data

Garmin loaded
with AGC GPS data

## Garmin Map Support

This data was produced in response to user requests for custom map data compatible with Garmin GPS receivers. It is provided to enhance efficiency of ground navigation using Garmin GPS receivers.
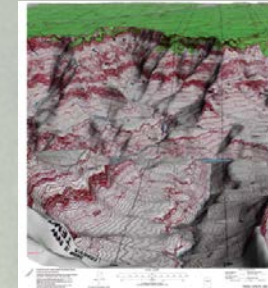
# GeoPDF

## Geospatial Representation, Access and Viewing

**GeoPDF products use Adobe PDF as a container for maps, imagery, and other geospatial data delivered to the end user via Adobe Reader**

- **Viewed on "ANY" computer with Adobe Reader**

- **Intended for Non-GIS user**

- **Allows for basic distance measurement and location**

- **Small file size (1.5-10MB) supports low bandwidth dissemination**

- **Ability to draw overlays**

- **Print Maps "On Demand"**
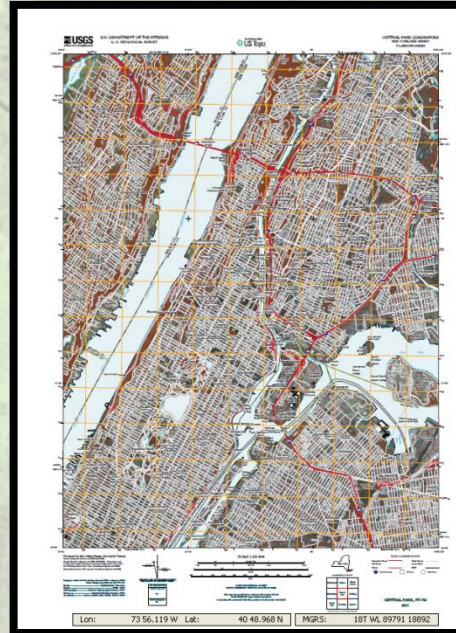
3D
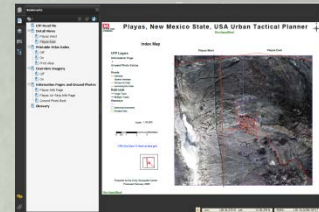
BuckEye 2D / 3D

ERS

UTP

CONUS and OCONUS

DataDoors

*GeoPDF is an NGA – AGC and a USGS - AGC success story and capability*

**Customer: 5th Ranger Training Battalion**
- ✓ Requirement: Update training area map
  - ❑ USGS map data over 25 years old
  - ❑ Compile & conflate updated multi-source data
  - ❑ Edit/create multiple features
    - ❑ Training area overlay
    - ❑ Lines of communication overlay
  - ❑ Standardize features using TLM specs
    - ❑ UTM/WGS 84/MGRS
    - ❑ Symbology, contour interval, etc.
  - ❑ Hard copy & digital reproduction
    - ❑ Blue Force Tracker compatible format

**Customer: United States Army Africa**
- ✓ Requirement: Remote Ebola Treatment Unit (ETU) site selection
  - ❑ Using remote sensing to determine:
    - ❑ Terrain suitability
    - ❑ Water resources
    - ❑ Infrastructure
  - ❑ Leveraged
    - ❑ Enhanced View site
    - ❑ AGC's Water Resource Database
    - ❑ Open source (ArcGIS online)

# AGE GEOGLOBE

**AGE GeoGlobe** - 3D based visualization tool, with some advanced analysis capabilities, designed to make the discovery and exploitation of geospatial information more intuitive

- ✓ Laptops first deployed to Afghanistan in 2010 with 101st Airborne and 4th Infantry Division
- ✓ 1st Cavalry Division implemented "7 Layers Concept" (2011)
- ✓ Main support program in RC-East with 1st Infantry Division (2012)
- ✓ Increases unit continuity during Division RIP/TOAs
- ✓ Currently host servers in 14 international locations
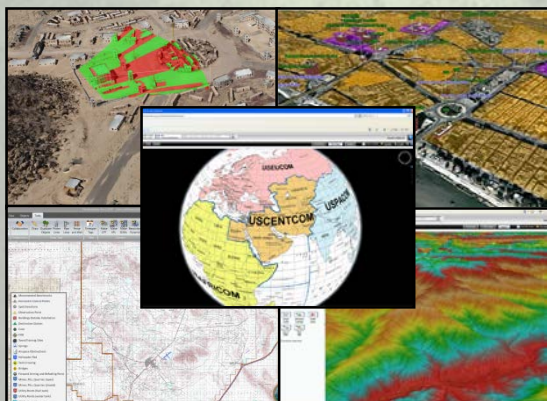
**GeoGlobe Data Services:**

- ✓ Leverages software investment made by DCGS-A
- ✓ Uses NGA DTED as the base elevation models, and Buckeye LiDAR and other high resolution elevation data where available
- ✓ NTM, Commercial and Buckeye Imagery coverage
- ✓ Photorealistic 3D Models (3DMLs) included for multiple sites
- ✓ Web Services (Web Feature Services, Web Mapping Services)
- ✓ Data is OGC compliant, and can be used in other GIS software

*Making NSG and Army data holdings discoverable and mission/application ready*

# AGE GEOGLOBE IN AFGHANISTAN

**Currently used by:**
- Geospatial Analysts
- All Source Analysts
- Intelligence Analysts
- Civil Affairs Teams
- Special Operations Forces
- Special Investigators
- Aviation
- Military Police
- Counterintelligence Officer
- Pre-deployment Trainers



**3DML Photogrammetric Models**



**Detailed Terrain Datasets**

**Operational uses:**
- Mission Planning
- Common Operating Picture (COP)
- HLZ Selection
- HUMINT Analysis
- Pattern Analysis
- Route Analysis and Route Clearing
- Battle Tracking
- Force Protection
- IED/Counter IED Operations
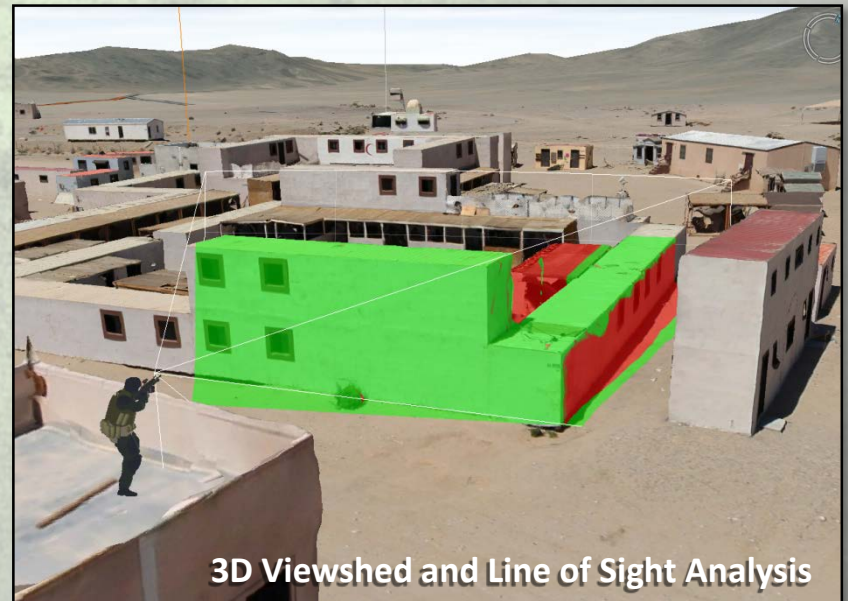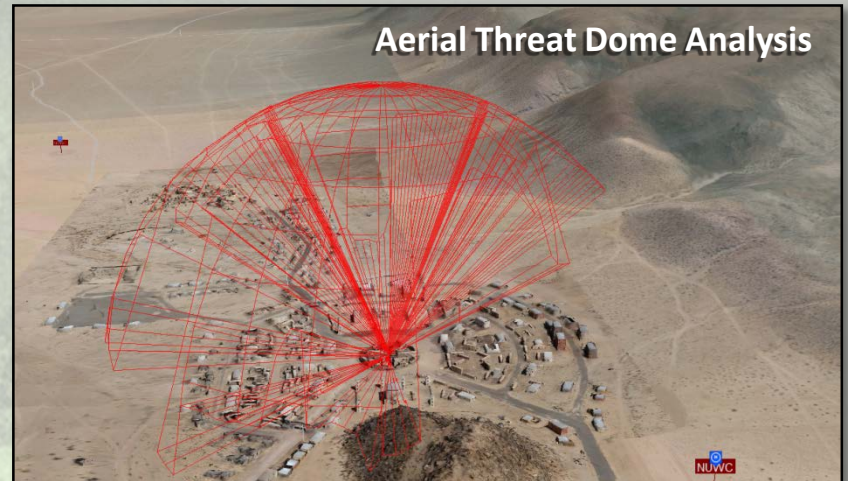- IDF – POO/POI Temporal Analysis
- Airspace Deconfliction
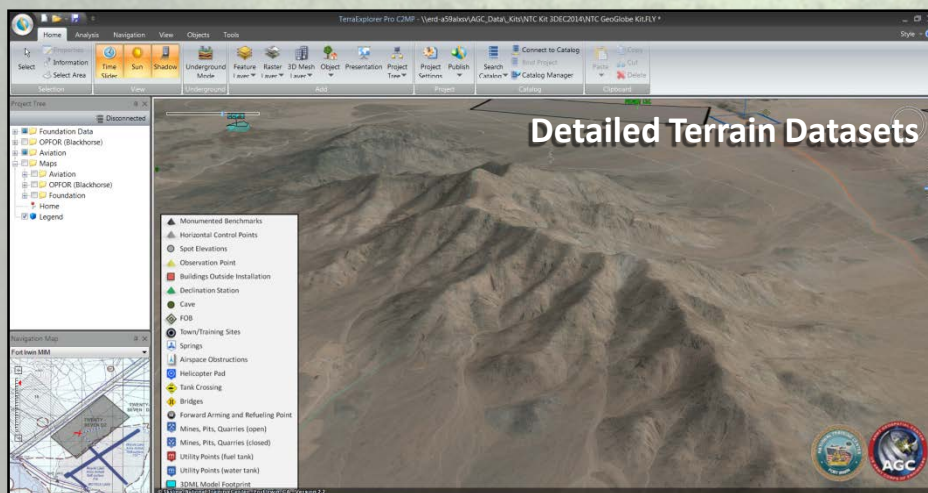
# TerraExplorer ANALYSIS TOOLS



Slope and Contour Analysis
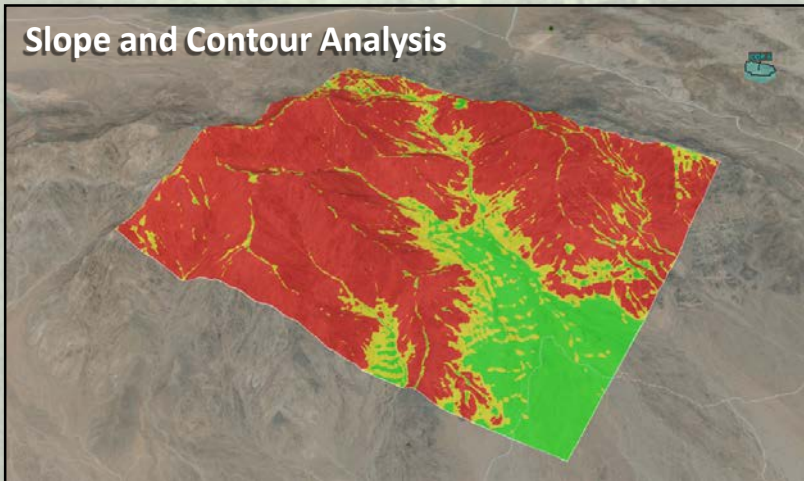
Aerial Threat Dome Analysis

Horizontal, Vertical and Area Measurements

3D Viewshed and Line of Sight Analysis

# 3D PHOTOGRAMMETRIC MODELING

## MODELING PROCESS


Collection


Photographs


Processing


Finished Model

### *What is 3D Photogrammetric Modeling?*

- *High Resolution 3D Mesh Layer (3DML)*
- *Created from high resolution photographs*
- *Finished models have photographic resolution with high spatial accuracy*
- *Models are completely interactive with GeoGlobe suite of software, and other 3D visualization tools*
- *Exportable to other standard formats, to include point cloud (.las) formats*
- *Can be reformatted into high resolution Digital Elevation Models (DEMs) and used as elevation layers*

### *Current Projects – National Training Center Models:*

- *AGC Collected 50 MOUT and Training Sites at Fort Irwin, CA*
- *30 NTC Models have been completed to date*
- *Models will allow soldiers to interact with urban environments for analysis, planning and decision making*

### *Equipment/Software Used for NTC modeling:*

- *Kiowa Helicopter (OH-58)*
- *18 MP DSLR Cameras (GPS Enabled)*
- *3D PhotoMesh Software*
- *TerraExplorer Pro*

# COMPLETED 3D MESH LAYER MODELS
# (3DML FORMAT)



Tiefort City MOUT Site
National Training Center
Fort Irwin, CA

© Skyline

Mining Quarry
Switzerland

# WHAT IS HR3D?

High Resolution, Color, **Unclassified** Imagery and Elevation Data that can be **shared** among interagency and international partners for both military and civilian applications



**Digital Elevation Model**

**Imagery**

**Point Cloud**

GPS SATELLITE

Z
Y
X
GPS

Pitch
IMU
Roll
Heading
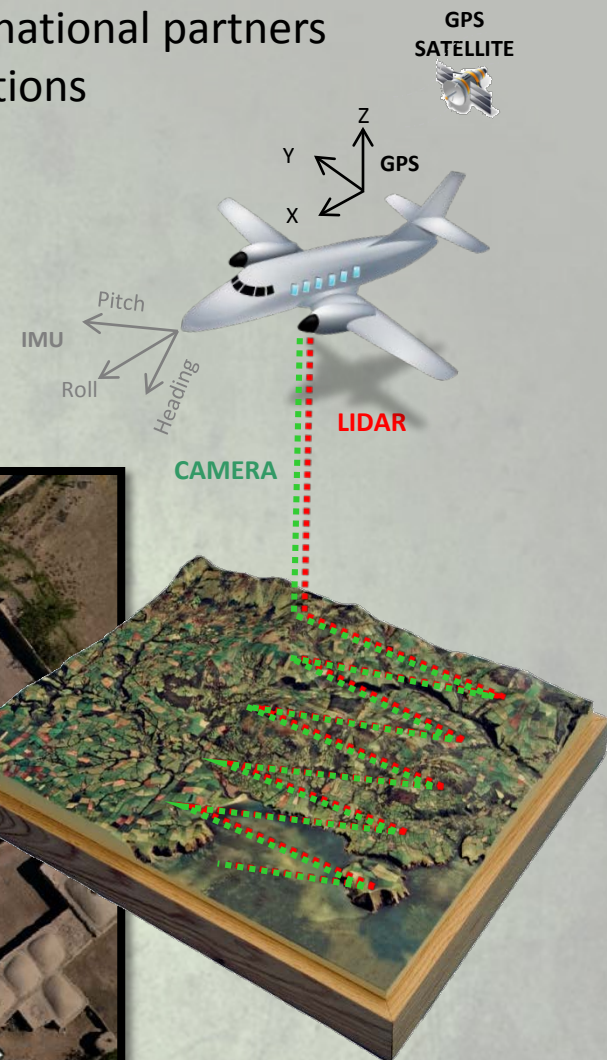
LIDAR

CAMERA

# HIGH RESOLUTION 3D DATA COLLECTION BUCKEYE

## Platforms / Sensors


Arrow UAS


King Air B100


Optech Orion LIDAR


Optech Gemini LIDAR


Aeroptic EO Mapping Camera

## Program Description

- Provides 2-10cm geo-registered, ortho-rectified, color imagery and 1m resolution elevation data, all unclassified
- Rapidly collects, processes and disseminates high-resolution, high-accuracy geospatial data in support of operations and intelligence
- Co-collection of imagery and elevation data improves situational awareness and provides precision data for mission planning, operations and a foundation data layer for other sensors and systems
- Current sensors: 60mp color EO camera and OPTECH LIDAR sensors
- BuckEye data is used extensively by Soldiers at all levels, all services and the IC

## Buckeye Data



Color Imagery 2-10cm
Processed to individual image frames with web-based index, and then to ortho-rectified mosaics – used for mission planning/rehearsal and feature identification



LIDAR Elevation Data-1m
Processed to point cloud data and then to gridded raster data – used for 3D visualization, LOS, feature extraction and control of imagery mosaics

## Status

- Operated in OIF from 2004-2010; collected over 86,000 km2 of data primarily over urban areas and MSRs / ASRs
- Operated in OEF form 2006-2010; collected over 464,000 km2
- UAS capability supported from 2010-Present
- Ongoing CONUS collects include military bases and training areas
- Collected over 678,195 km2 of data ISO CCMD requirements
- VCSA Approved Army Acquisition Program Candidate (MSCoE Lead)
- Conducting T&E of next generation LIDAR / EO sensor to increase collection efficiency
- Currently deployed in multiple AORs

# HIGH ALTITUDE LIDAR OPERATIONS EXPERIMENT (HALOE)

## Platform/ Sensor



**NASA WB-57**



**BD 700**

**On-board Processing**

**Ground Processing**

## Program Description

- DARPA developed sensor on loan to AGC
- HALOE program collects, processes, exploits, and disseminates high-resolution geospatial terrain data to the warfighter
- Unique side-looking operations
- HALOE data is used at various operational and tactical levels
- Capable of 0.5m wide-area mapping (WAM) and 0.2m datasets to time-dominant users
- Phase 1 – sensor development and integration on WB57/initial deployment to CENTCOM/AFG
- Phase 2 – transition deployed operations to AGC/continue CENTCOM/AFG deployment on WB57
- Phase 3 - refit sensor to BD700
- Phase 4 - redeploy to CENTCOM AOR
- Phase 5/6 - redeploy to AFRICOM AOR

## HALOE Data
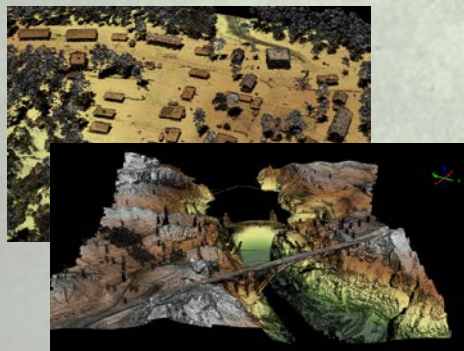


0.5m Resolution WAM
- Provides a high-resolution foundational dataset
- Data is processed CONUS and is discoverable on NIPR, SIPR, JWICS, both CONUS and OCONUS

0.2m Resolution Point-Target/ Mini-Map
- Provides very high-res data for time-dominant users
- Data is processed, exploited, and disseminated OCONUS
- Provides users information in support of mission planning, situational awareness, change detection, HLZ identification/ verification, LOS/ viewshed analysis, etc.

## Status

- **Operations**
  - Supported ISAF/CENTCOM Mar-Aug11
  - Collected 57,000 sqkm while deployed
  - Transitioned sensor pod to BD 700 platform
  - Deployed to AFRICOM AOR for 30 days; collected approx. 13,500 km2
  - In CENTCOM from Sep-Dec13; collected 74,175km2 of data
  - Deployed to AFRICOM AOR Nov14 – Present; collected ~46,000km2 thru 3Jun15
  - Redeployed to AFRICOM in SEP15
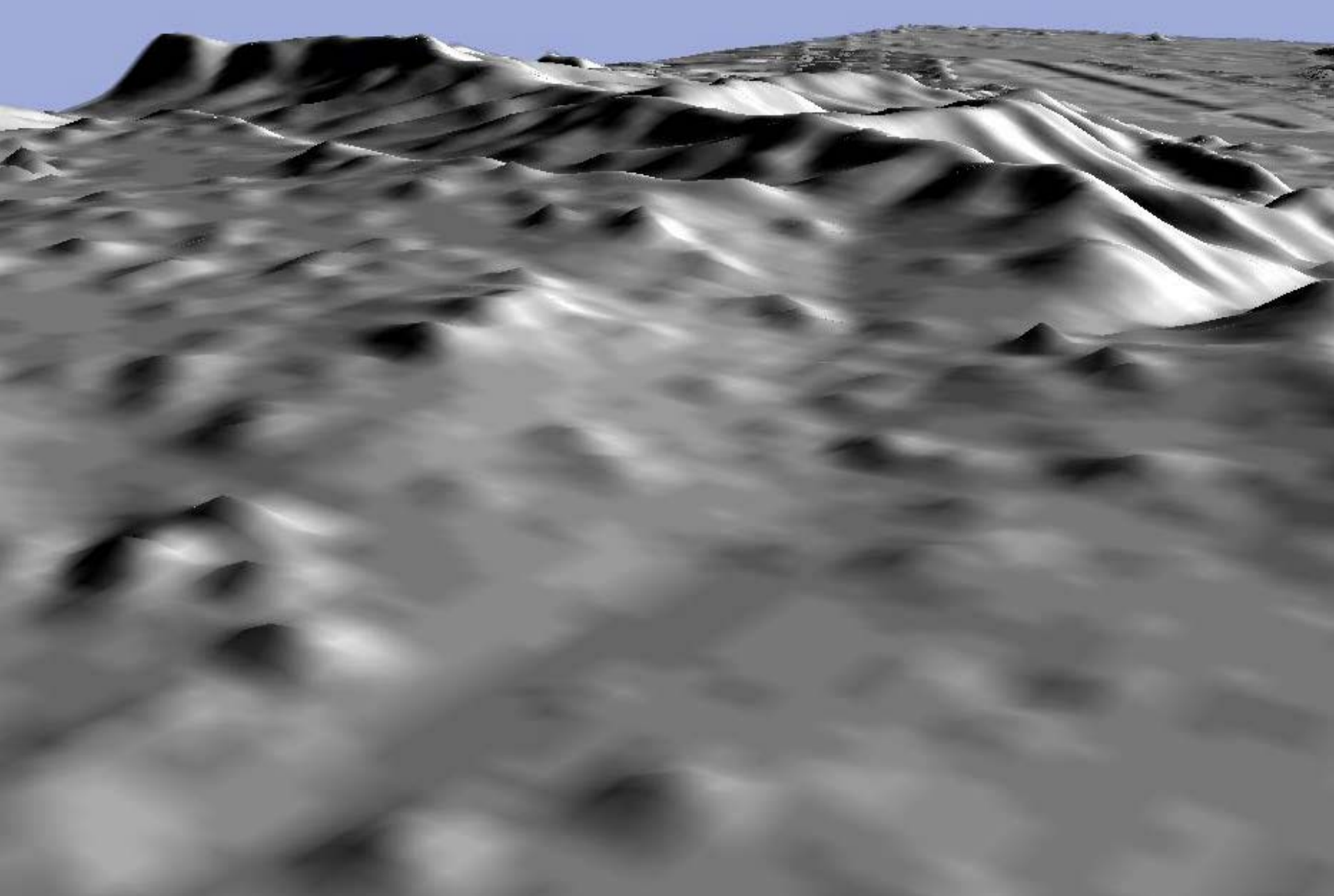
**Camp Pendleton, CA – Shaded Relief**
**1 m LIDAR Resampled to 30 m**
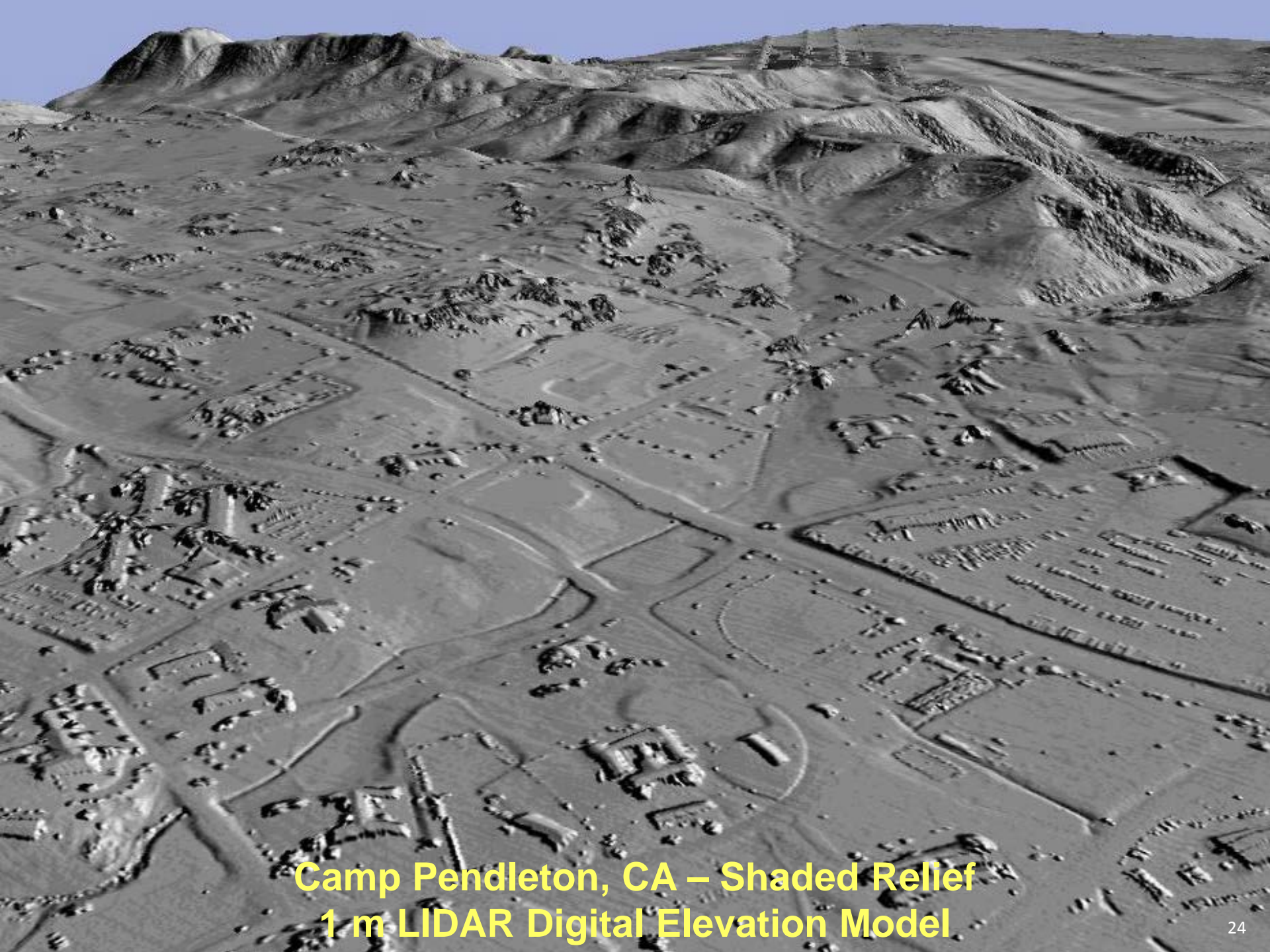
Camp Pendleton, CA – Shaded Relief
1 m LIDAR Digital Elevation Model

# WHY IS IT IMPORTANT?

- **Situational Awareness / Understanding Terrain**

- **Enables Accuracy and Precision**

- **Reduces Casualties / Collateral Damage**

- **Provides Required Foundation Data**
  - Mission Command Systems
  - Infrastructure Development / Real Estate

- **Unique Partnering Opportunity thru Mapping**
  - Enables Access / Sharing
  - Connects to Government and Institutions
  - Aids in Stability and Establishment of Governance
  - Has Value to Partner Nations

**Benefits of HR3D for Global Engagement**

- Supports host nation security / strengthens defense
- Supports development
- Promotes regional stability
- Advances U.S. strategic objectives
- Improves crisis response and theater security cooperation

- Helps close a Tier 1 DoD Geospatial Data gap

*HR3D is the basis for developing a multi-purpose spatial data infrastructure that can aid countries in their development, internal security, and preparedness for humanitarian assistance and disaster response scenarios*

# HR3D TERRAIN DATA ENABLES
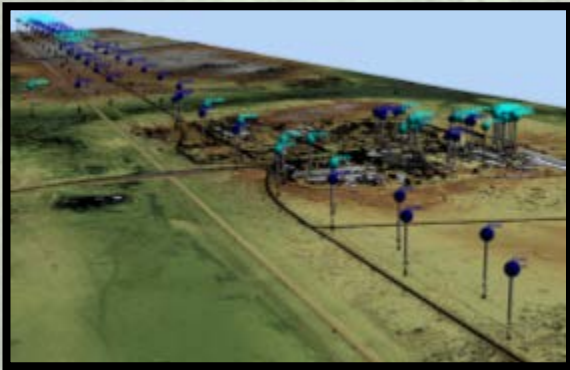


Accurate Vertical Obstruction Data


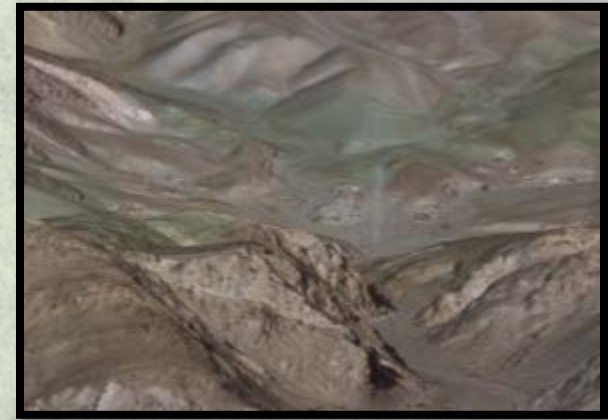
3D Extracted Features



Detailed LOS based on real terrain

**_Soldiers to Visualize and Understand the Terrain_**



Detailed Situational Awareness



Detailed Mission Analysis



3D Visualization

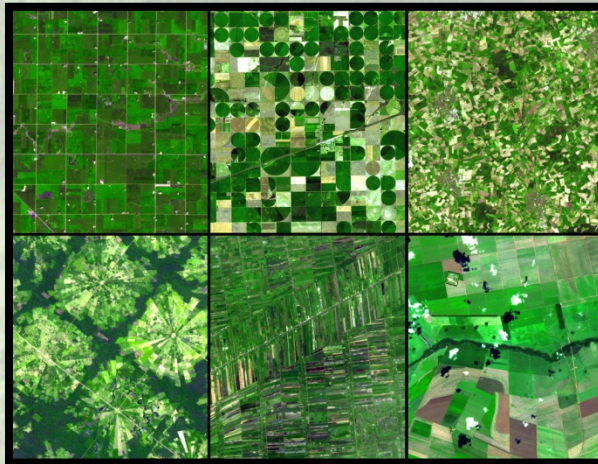**_An accurate and precise foundation for all sensor and operations data_**
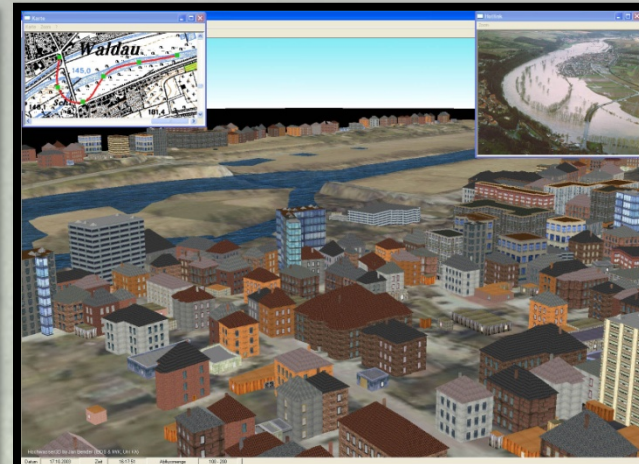
# HR3D TERRAIN DATA ENABLES



Cadastral Mapping / Land parcels / Governance
Addressing / Services / Taxation

Agricultural Mapping

Flood Modeling / Disaster Preparedness
Hazard Mitigation

Transportation / Construction Planning

Environmental Mapping , Spills, Dredging

Forestry / Natural Resource Mapping

*Access - Partnerships - Stability*

# Current Projects Displayed

- Project 1- High Resolution 3D Data Collection - GSA

- Project 2- Water Resources Data Base (WRDB) Production - OHASIS

- Project 3- Skyline

- Project 4- GeoNorth/i-Cubed – Army Data Library - GSA (small business)

- Project 5- Progressive Technology Federal Systems (PTFS) (small business) (Library) - GSA
  - provide software maintenance and renewal with periodic onsite support of a digital library system (DLS) also referred to as Bibliovation™ software.

# Questions ???