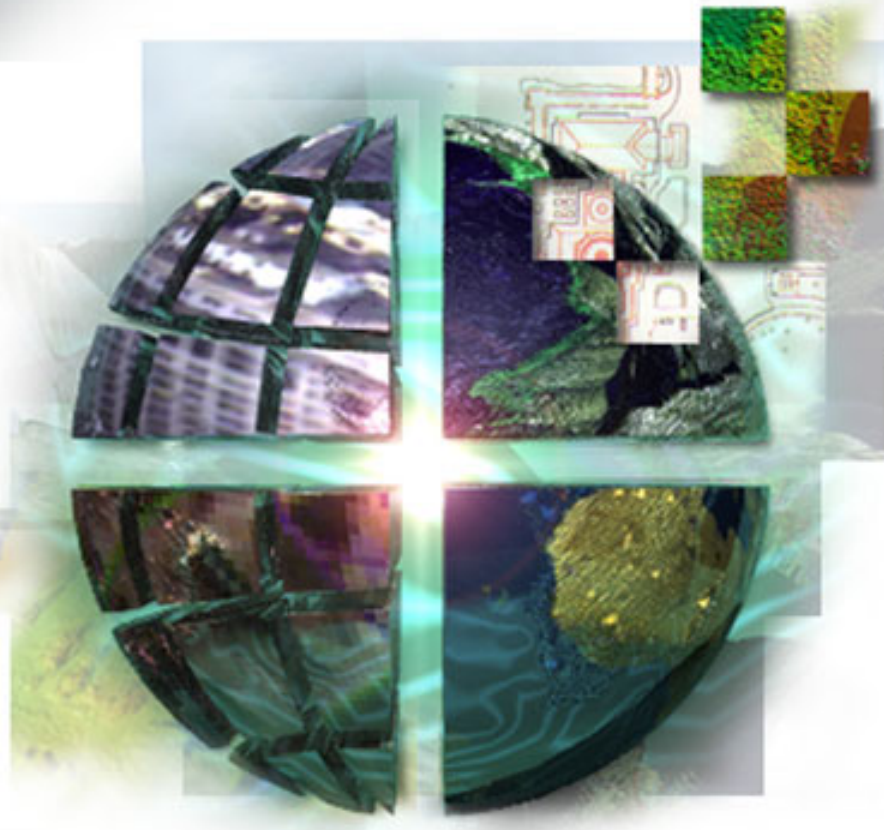


Airborne Rapid Imaging for Emergency Support EarthData

Abstract

Following the World Trade Center Crisis, a need existed to improve the response time for imagery collections to support GIS and emergency operations. With a grant from the U.S. Department of Homeland Security, Office of Domestic Preparedness, EarthData demonstrated that imagery can be collected, processed, ortho-rectified, and disseminated almost immediately following a crisis. ARIES (Airborne Rapid Imaging for Emergency Support) demonstrated this capability at the Picatinny Arsenal in November 2004. Using GIS and remote sensing tools, more than five gigabytes of data was collected and made available to users in a field setting.

Airborne Component

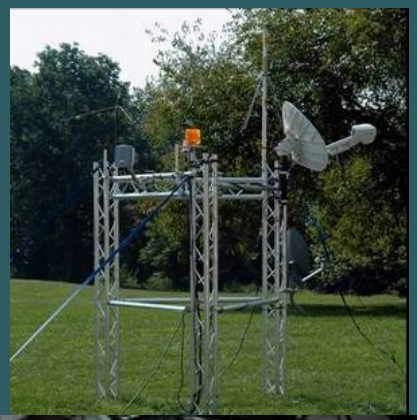
- Simultaneous collection by multiple imaging sensors
- Integrated with GPS/IMU systems for highly accurate, instantaneous georeferencing
- Sends data to ground component via high-speed broadband downlink

Ground Component

- Trailerable shipping container
- 30 minute set-up
- Self-contained power source and environmental controls

Ground Component

- VHF/UHF/satellite receivers
- Direct broadcast to wireless mobile devices
- 4 screen command display
- 8 GIS workstations
- Internet connectivity

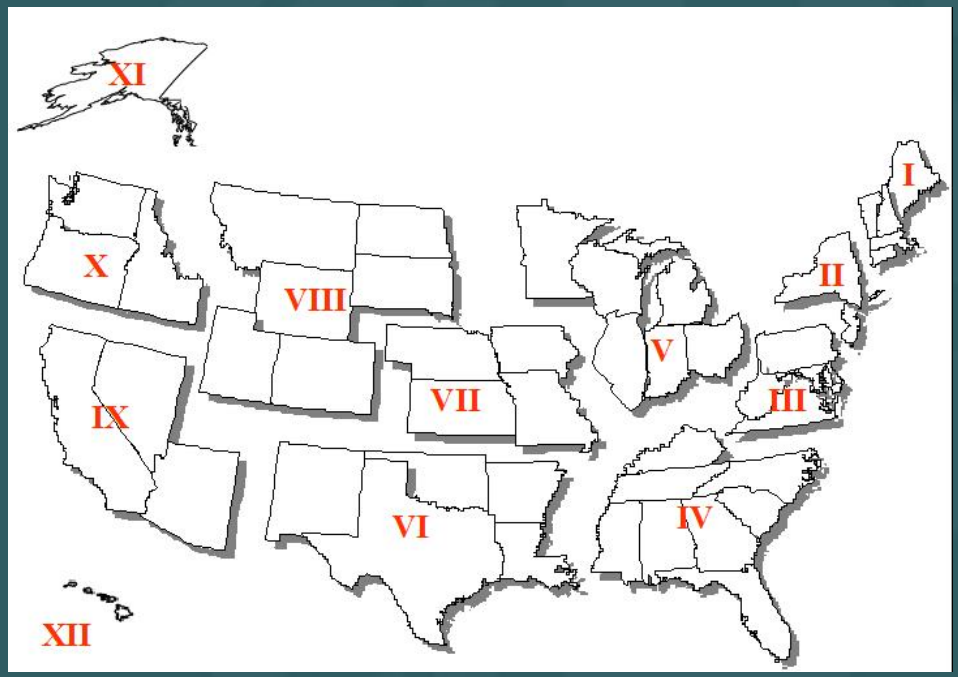


Operational Concept

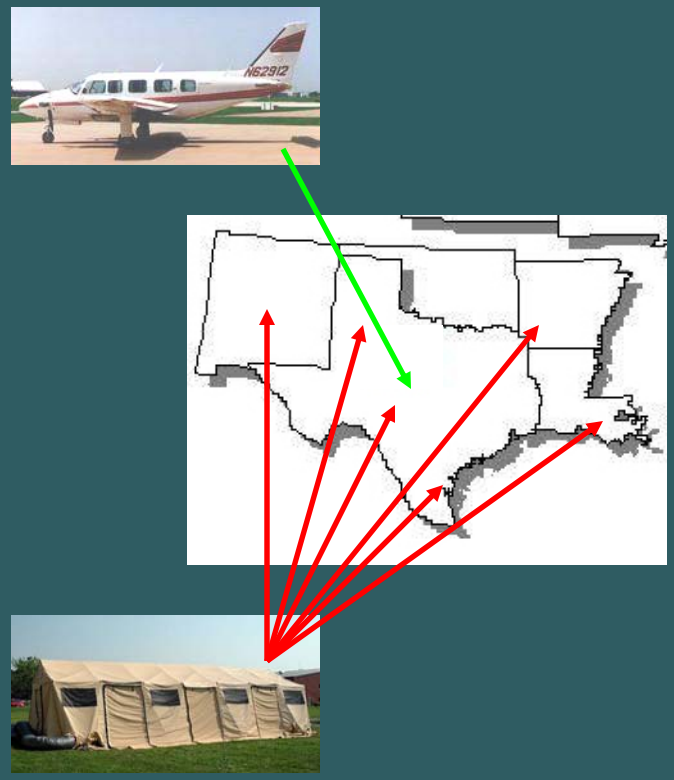
- Airborne Component
  - Commercially owned and operated
  - Pre-negotiated on-call contracts for rapid response support
  - In non-crisis mode, collecting imagery for commercial and public sector customers
- Ground Component
  - Under the control of regional/state agencies
  - Pre-positioned in high-risk regions
  - Jointly manned by private and public sector technicians
  - Interoperable with regional and national geospatial portals, such as TNRIS and GeoSpatial One-Stop

Regional Deployment

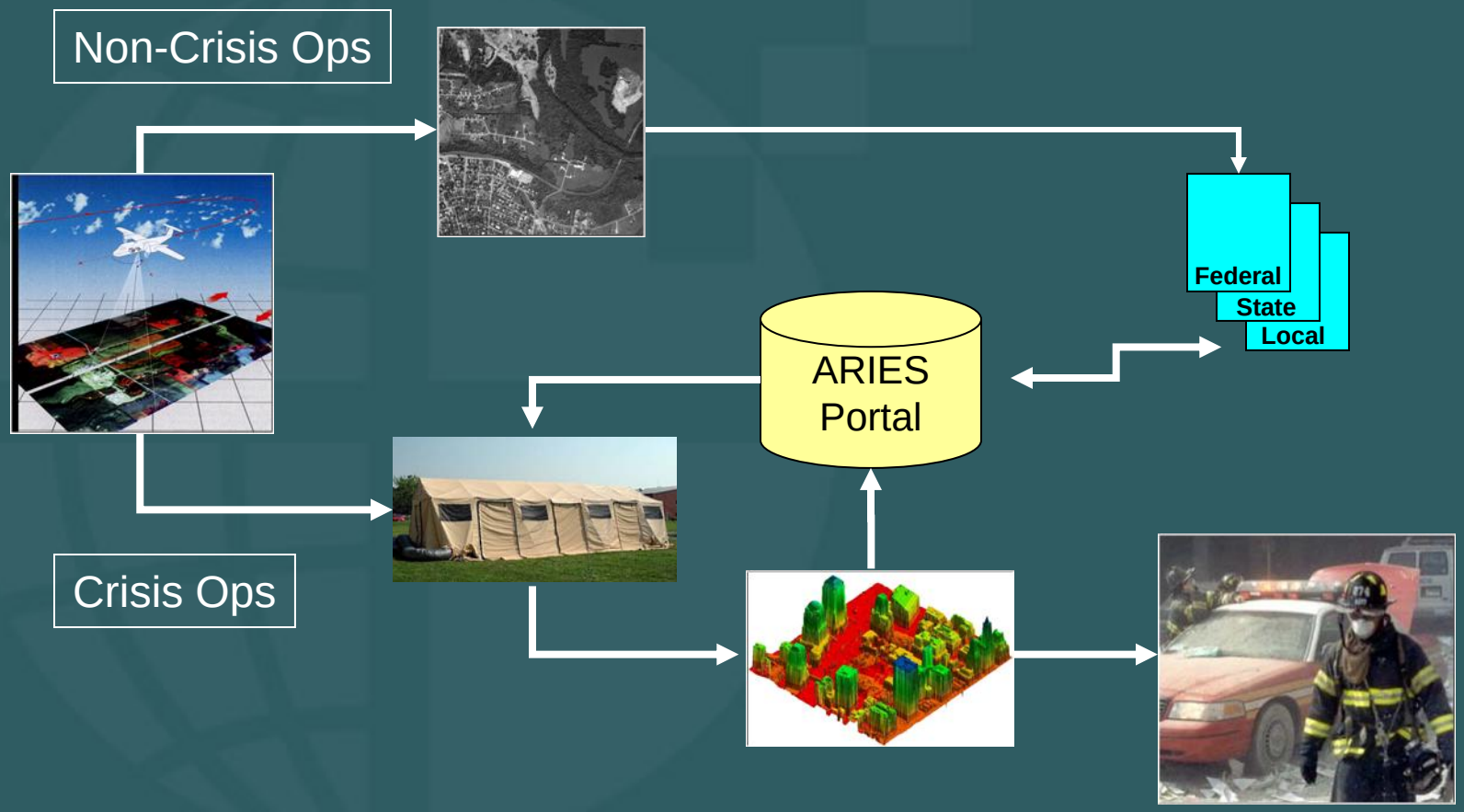
ARIES Regions Aligned with FEMA Regions



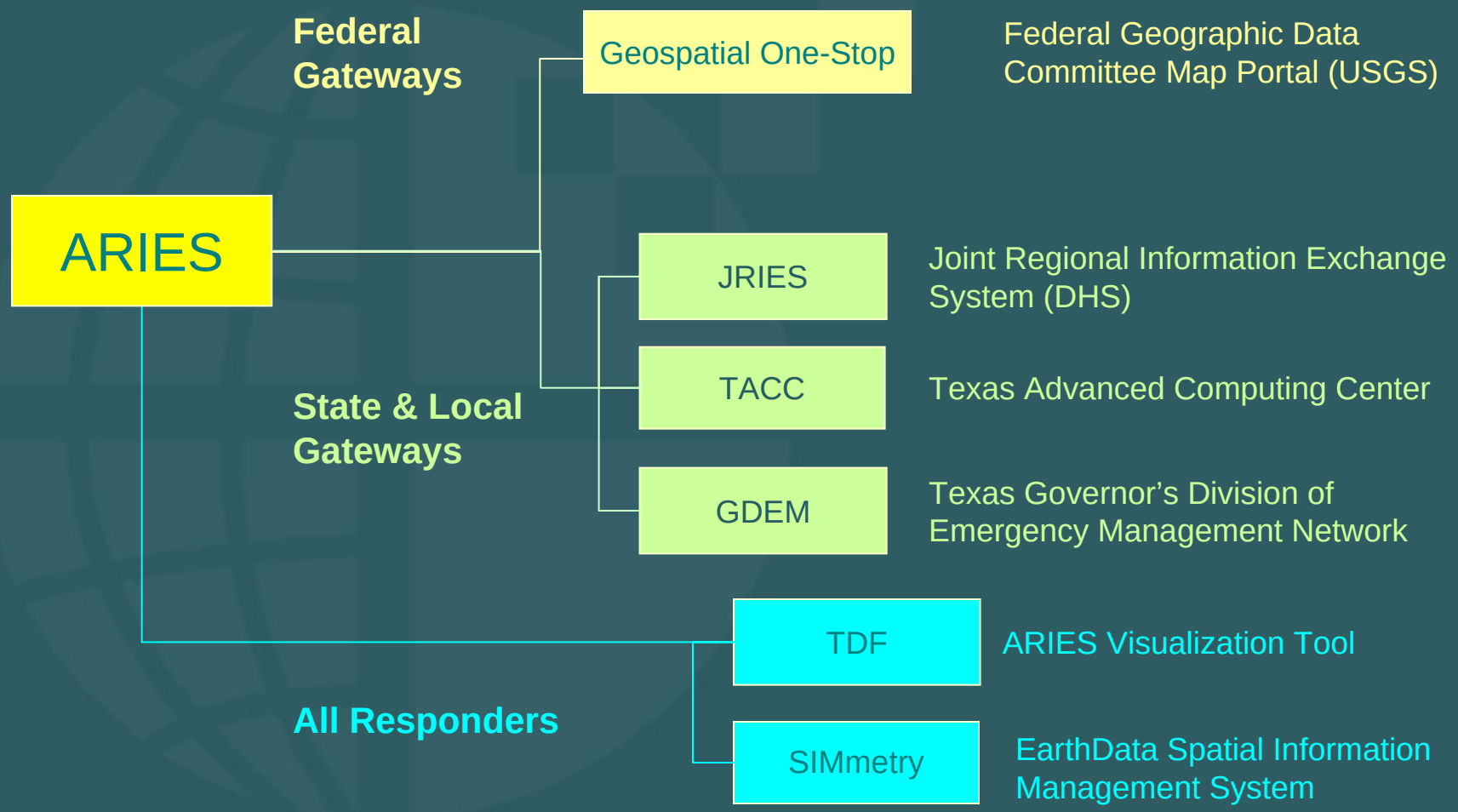
Asset Distribution



Geospatial Infrastructure Integration



Interoperability Concept



ARIES Program Plan

- Phase 1: Proof-of-Concept
  - Funded with DHS/Office of Domestic Preparedness grant
  - Successful demonstration in Nov 2004 at Picatinny Arsenal
- Phase 2: Prototype Development
  - Refinement of sensor package and downlink technology
  - Demonstrations with regional and state partners
  - Robust interoperability with geospatial portals
- Phase 3: System Implementation
  - National system with regional deployment
- Phase 4: Production Sustainment
  - Maintenance, training, exercise support, system upgrades

Picatinny Arsenal Demonstration

- Conducted 17 Nov 2004
- Imagery products
  - Digital orthophotos
  - Lidar terrain models
  - Thermal images
- Independent evaluation by Institute for Defense Analysis
- Final report by Texas A&M to be published in 2005

Picatinny Demonstration

Airborne Component

Preflight Calibration

Collecting Data

Success!

Picatinny Demonstration

Ground Component

Radio, Video & Satphone
Antenna Farm with Tent

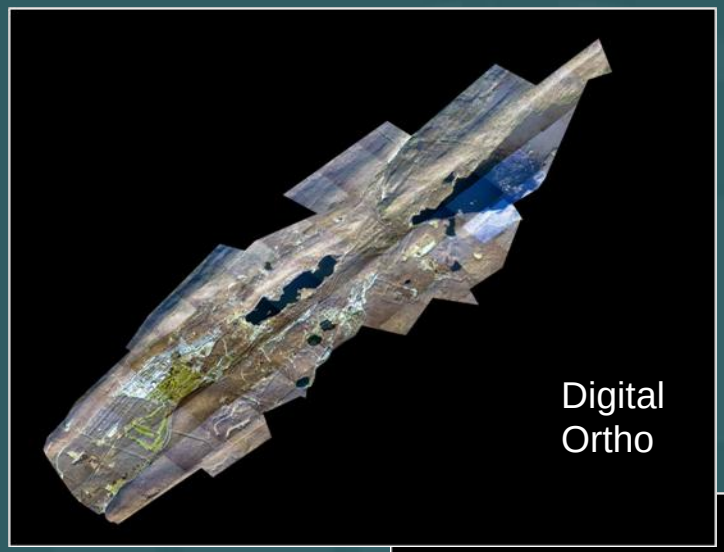
Downlink Antenna

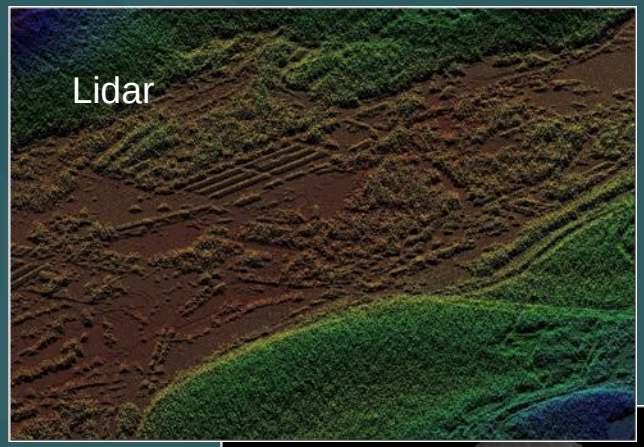
Mission Control & Data Processing

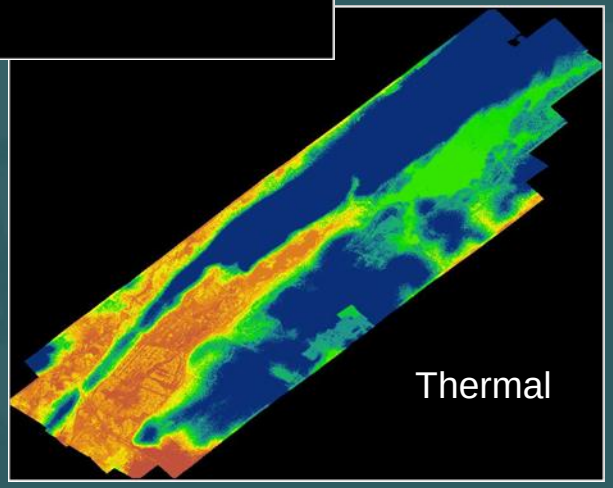
PDA Link

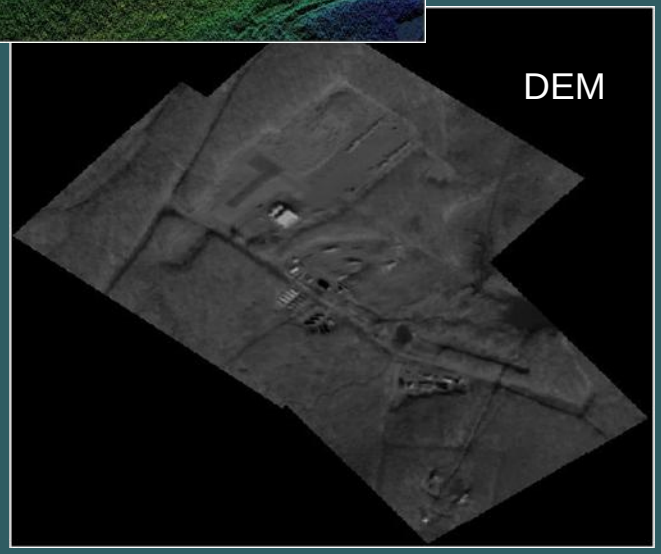
Picatinny Demonstration

Geospatial Products



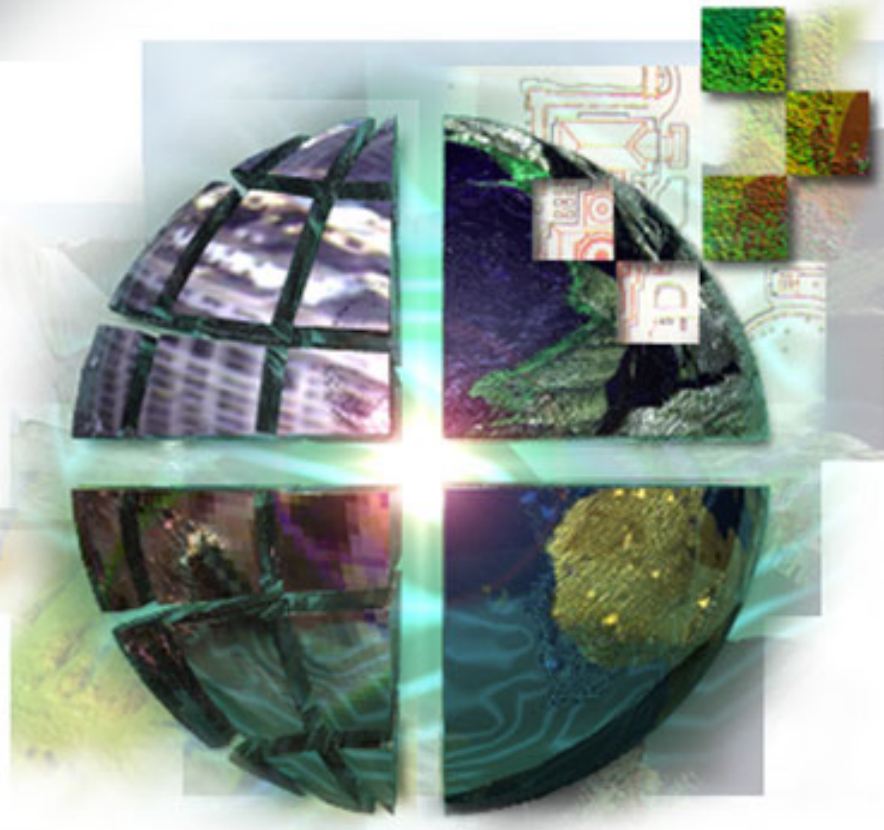






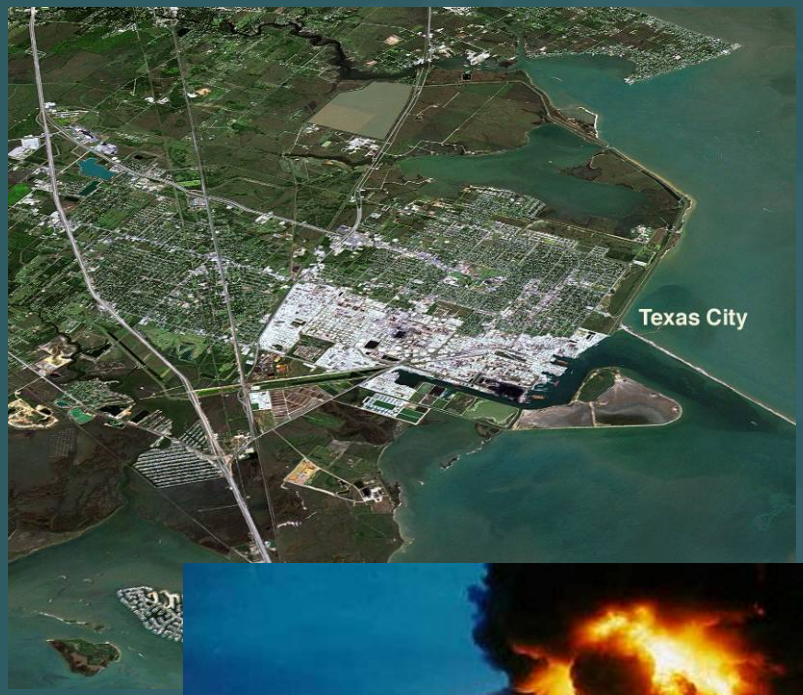
Next Steps

- Develop relationships with potential phase 2 partners
- Identify a spectrum of emergency preparation and response scenarios
- Explore interoperability requirements and specifications
- Assist partners with DHS grant applications



ARIES Exercise Scenarios

Petrochemical Refinery Explosion



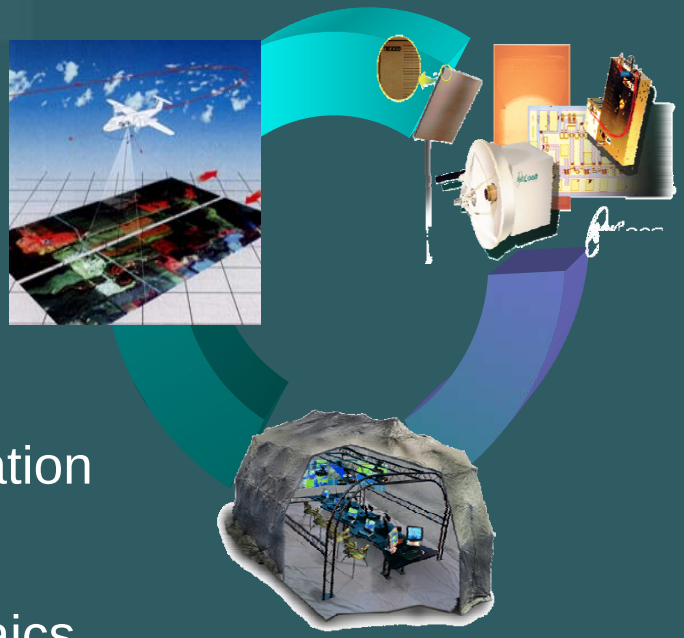
- Example of terrorist attack or industrial accident
- Dangerous chemicals stored near schools and residential neighborhoods
- Opportunity to exercise state, local and private response coordination
- Ground based observation hazardous and ineffective
- Command and control requires “God’s eye view”

ARIES Demonstration Objectives

- Demonstrate use of airborne remote sensing in disaster response
- Demonstrate reliability of downlink
- Deliver products within specified timeframe
- Integrate newly acquired imagery with existing GIS and CAD
- Disseminate information products over Internet and wireless LAN
- Demonstrate support to first responders with digital and hardcopy products
- Provide on-site analysis support to decision makers and news media

Sensors and Products

- Imaging Sensors
  - DSS Digital Camera
  - ALS50 LIDAR System
  - FLIR Thermal Imager or ITRES TABI
- First-look products
  - Available in real-time via downlink
  - Spatial accuracy based on GPS navigation
- Sub-meter accuracy products
  - High-resolution digital orthophoto mosaics
  - LIDAR-derived DEMs
  - Georeferenced, orthorectified thermal maps



Data Processing

- COTS hardware
  - Windows-based PCs
  - Windows-based servers
  - Gb Ethernet networking
- COTS software
  - MicroStation/AutoCad
  - ESRI GIS
  - ERDAS image processing
- ARIES customized components
  - LIDAR processing toolkit
  - Tactical Display Application
  - SIMmetry web info access

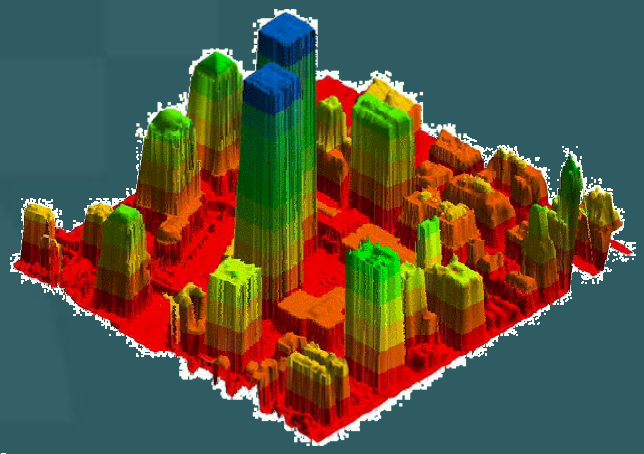
Product Applications

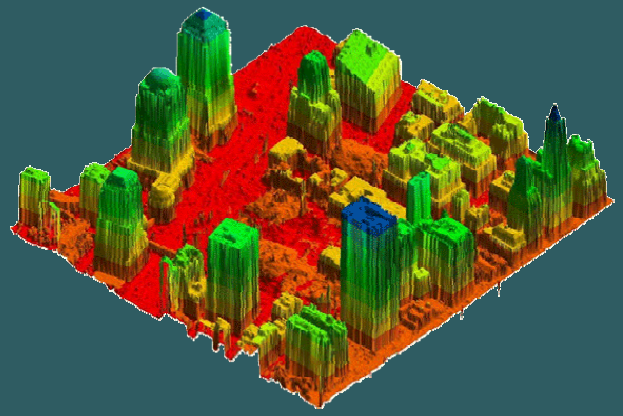
- Quick-look Image Collage
  - Real-time situation awareness
  - Accuracy determined by navigation
  - Commercial industry standards and data formats

- Digital Orthophoto Mosaic
  - Available within 3 hours
  - Detailed assessment and planning
  - Suitable for superimposition of existing CAD and GIS layers
  - Submeter accuracy from post-processed GPS/IMU
  - Commercial industry standards and data formats

Product Applications

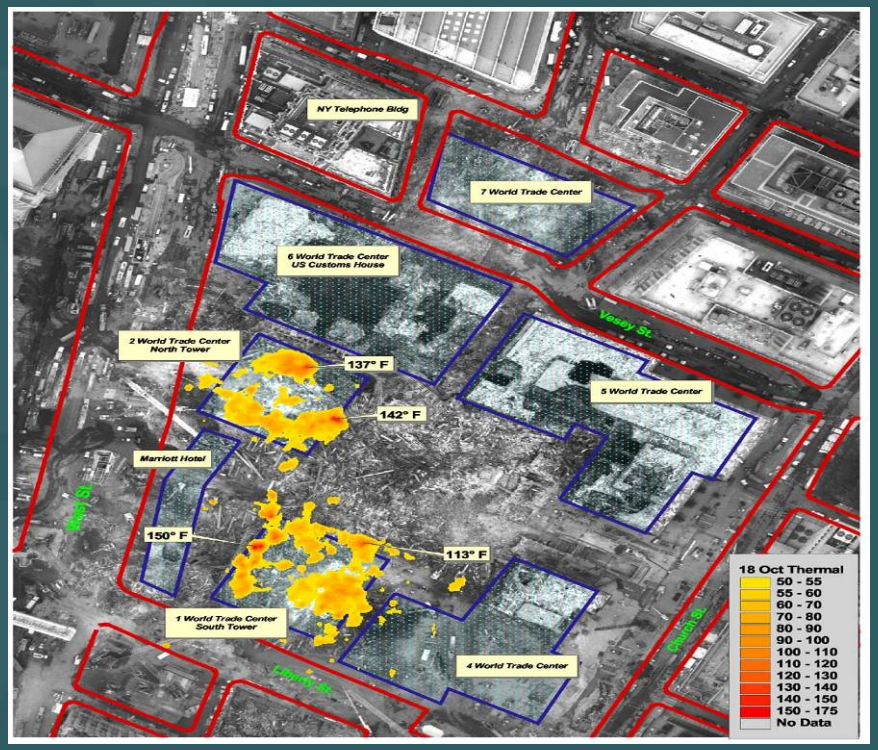
- LIDAR 3D Model
  - Detailed planning and assessment
  - Surface and bare earth
  - Supports image rectification
  - Suitable for assessing distribution and volume of rubble and debris
  - 15 cm vertical RMSE
  - Commercial industry standards and data formats





Product Applications

- Thermal Mapping
  - Identification of hot spots
  - Commercial industry standards and data formats
- Weather Data
  - 3rd party source
  - Assess extent and spread of toxic materials
  - Assess effects of wind and precipitation on events and operations



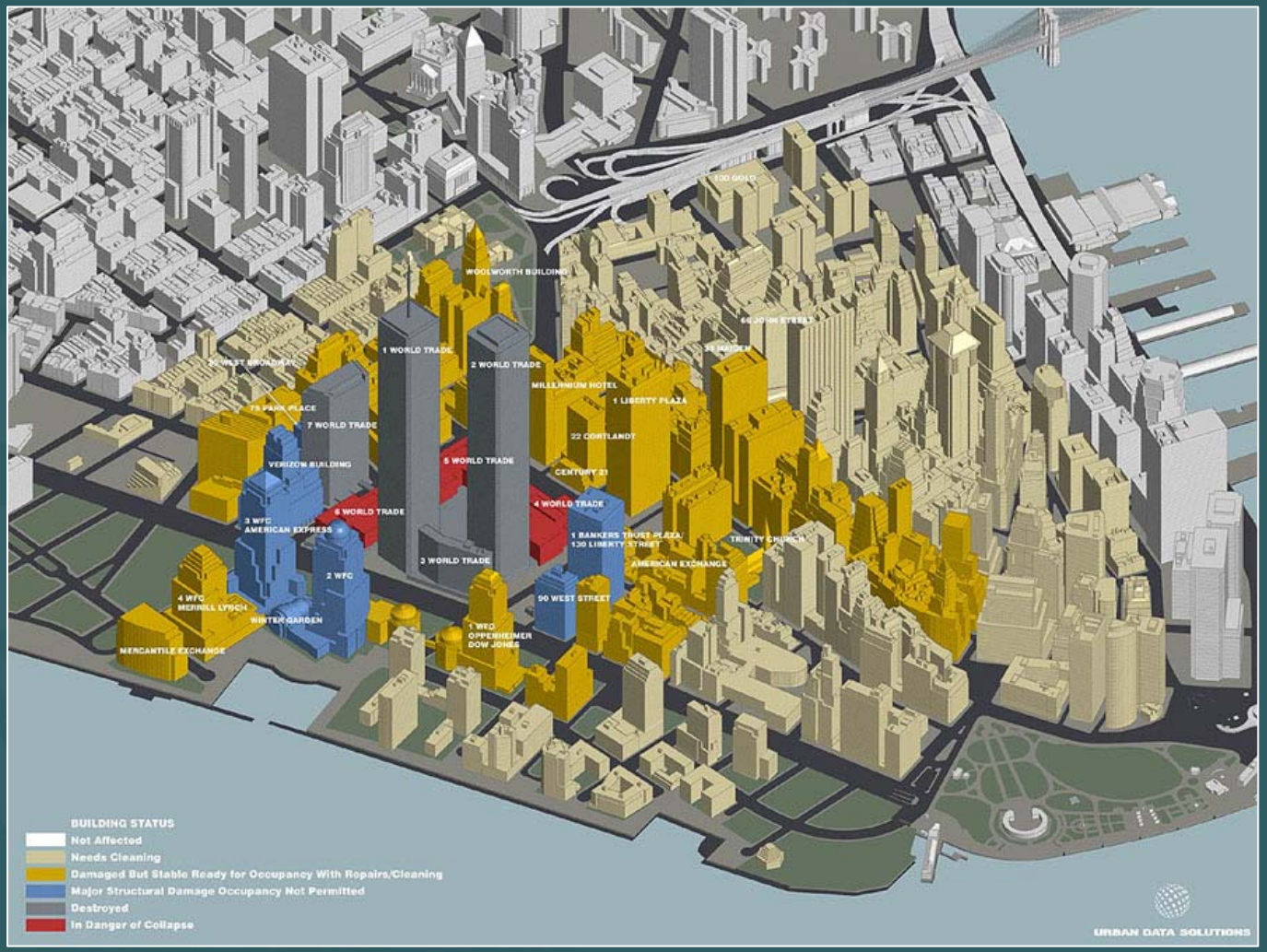
Decision Support

- Simple web browser interface
- Live Internet feed
- Wireless link to mobile devices
- Access to multiple data layers including ARIES imagery and existing GIS or CAD
- Designed to handle thousands of requests and multiple simultaneous users
- Security levels and information access can be controlled and customized
- Hardcopy, magnetic and optical media outputs also available.

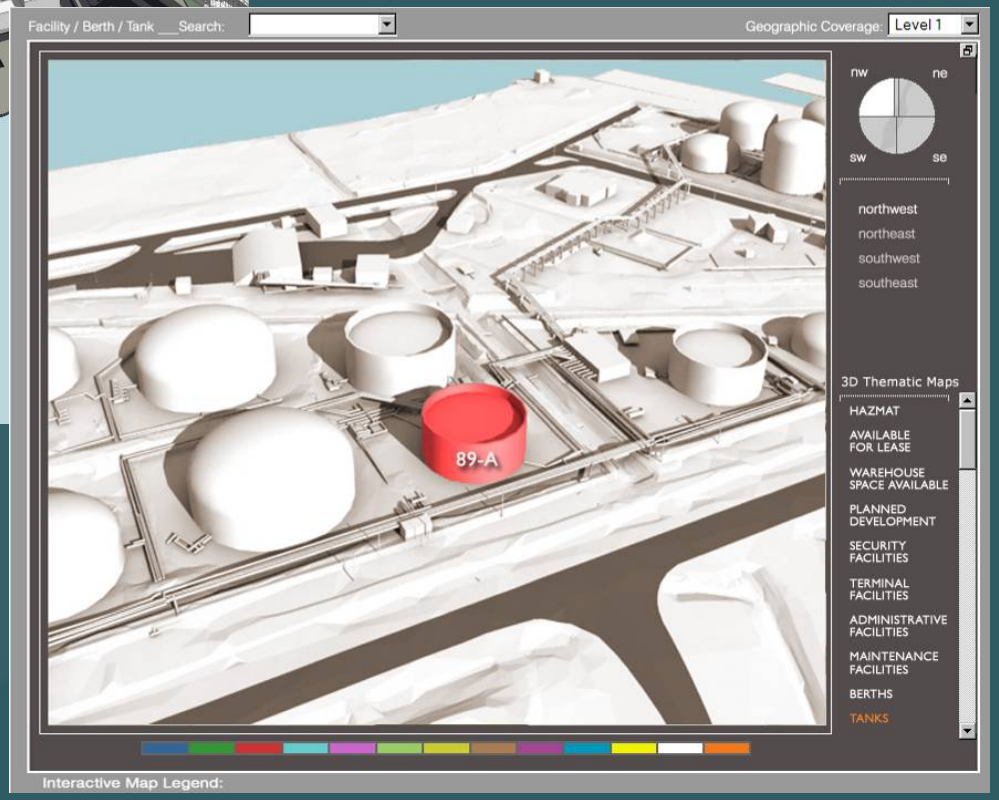
WEB BROWSER

PDA LINK

Decision Support



GIS Integration and Analysis



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