Aerial Visual Intelligence for GIS

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Just a few definitions

(Pop quiz at the end of presentation...)

- Unmanned Aerial Vehicle (UAV) – A fixed wing or rotor craft without a pilot on board. Fully-autonomous in some cases.
- Remotely Piloted Aircraft (RPA) – A fixed wing or rotor craft having a pilot that controls the vehicle from a remote location.
- Full Motion Video (FMV) – True color or infrared video source with accompanying aircraft metadata. Contains spatial information and aircraft attitude information allowing the video to be geo-referenced.
- Motion Industry Standards Board (MISB) – *THE* standard for FMV.
- Certificate of Authorization (COA) - Permit to operate a UAV in a defined airspace for a project of fixed duration.
- Common Operational Picture (COP) - A single identical display of relevant information shared by more than one command. A COP facilitates collaborative planning and assists all echelons to achieve situational awareness (NIMS).

Content is key

Aerial Platforms

- Manned aircraft
- UAVs

Progression of Data Types

- High Definition Digital Orthos
- Oblique Imagery
- 3D Point Cloud
- Full Motion Video (FMV)

Multi-capture capability for many types in a single flight!

Example Applications

- Emergency Management
- Utilities & Pipeline HCA reports
- Agriculture is a growing market

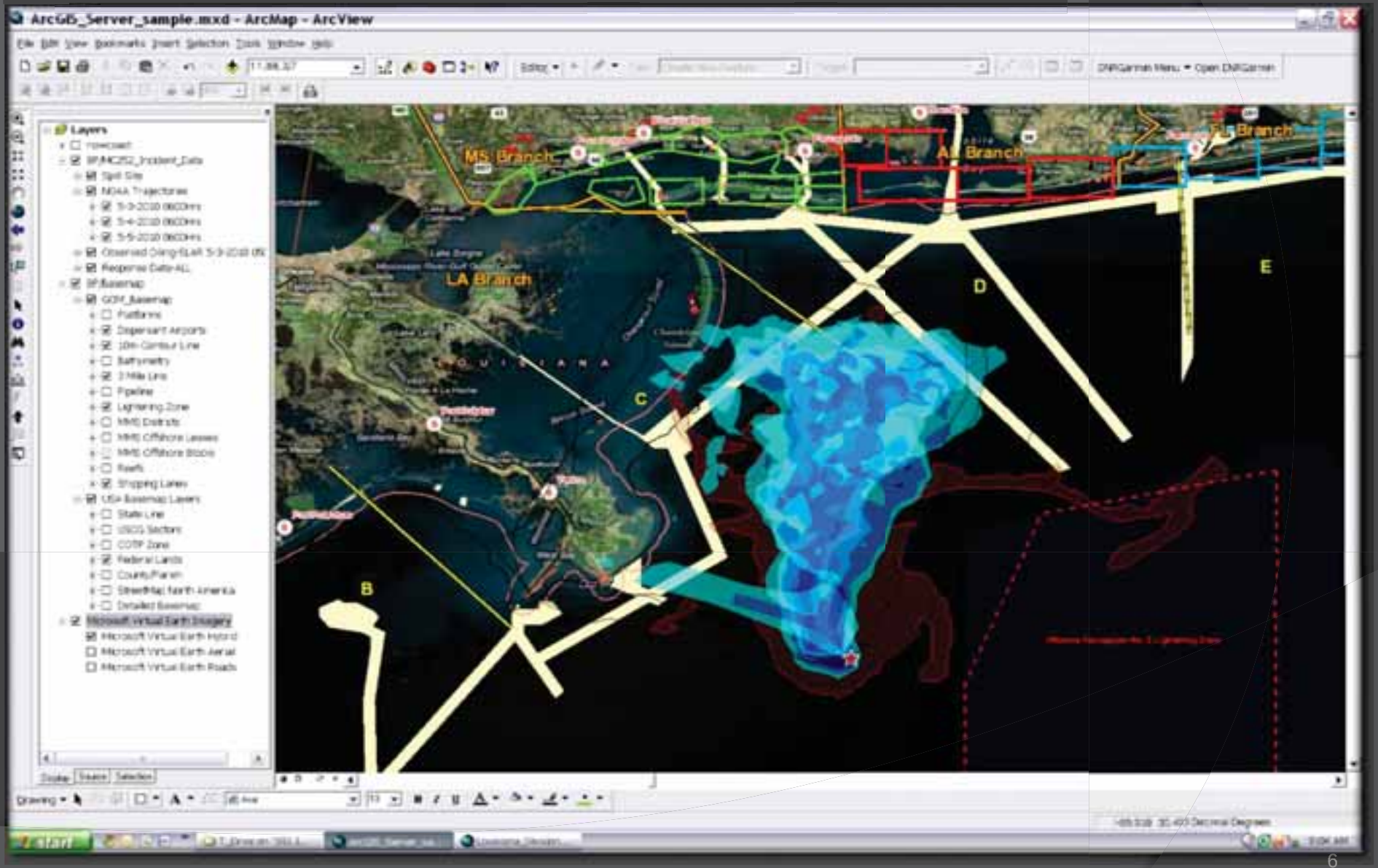
How is visual intelligence used in Emergency Management?

Situation Status Displays in the Incident Command Post

ACTIONABLE INTELLIGENCE

How can GIS contribute to Emergency Management?

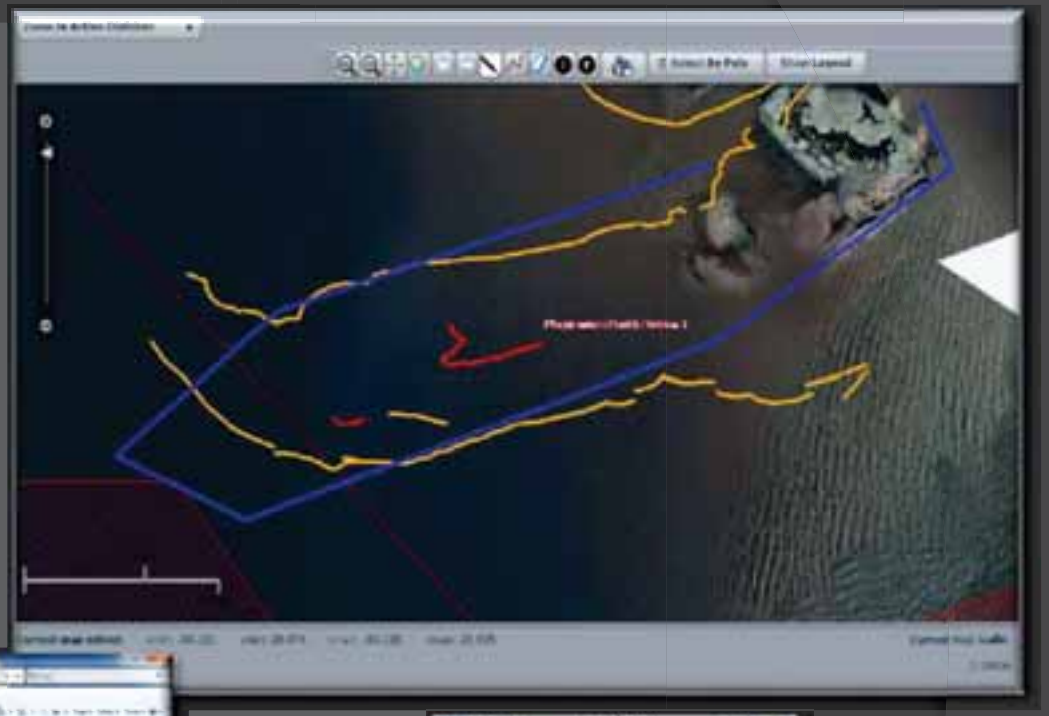
- **Example: ArcGIS COP at the Deepwater Horizon ICP**



Deepwater Horizon: How Visual Intelligence was used

ArcGIS COP FLEX Viewer
Used in ICP for Planning by: USCG, LA Nat. Guard, LA DNR, USFWS & others.

Early use of ArcGIS 10 FLEX Viewer & iOS a month prior to release!



Incident Command Post:

Comparing the trade-off between data timeliness & spatial accuracy.

(NGA provided imagery and data capture team via IRSCC.)

Timeliness is the OTHER type of accuracy…

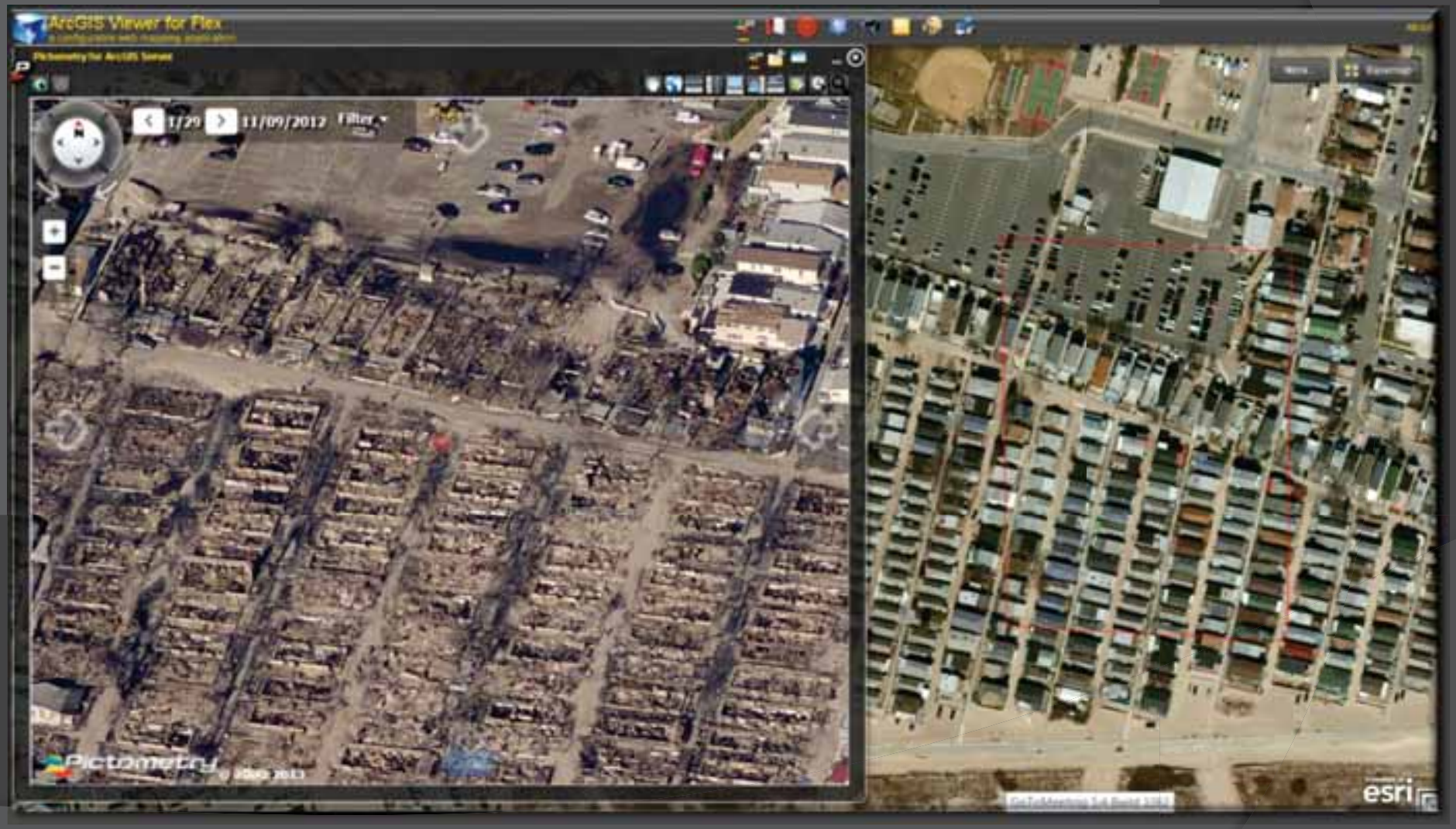
Photo by USCG

Oblique Aerial Imagery

- Georeferenced oblique image libraries now common
- Fully metric: can measure heights, areas and distances
- Directly integrates to ArcGIS
- Easy FLEX viewer for non-GIS users

Aerial Visual Intelligence for Emergency Management

- Fall 2012 - “Superstorm” Sandy

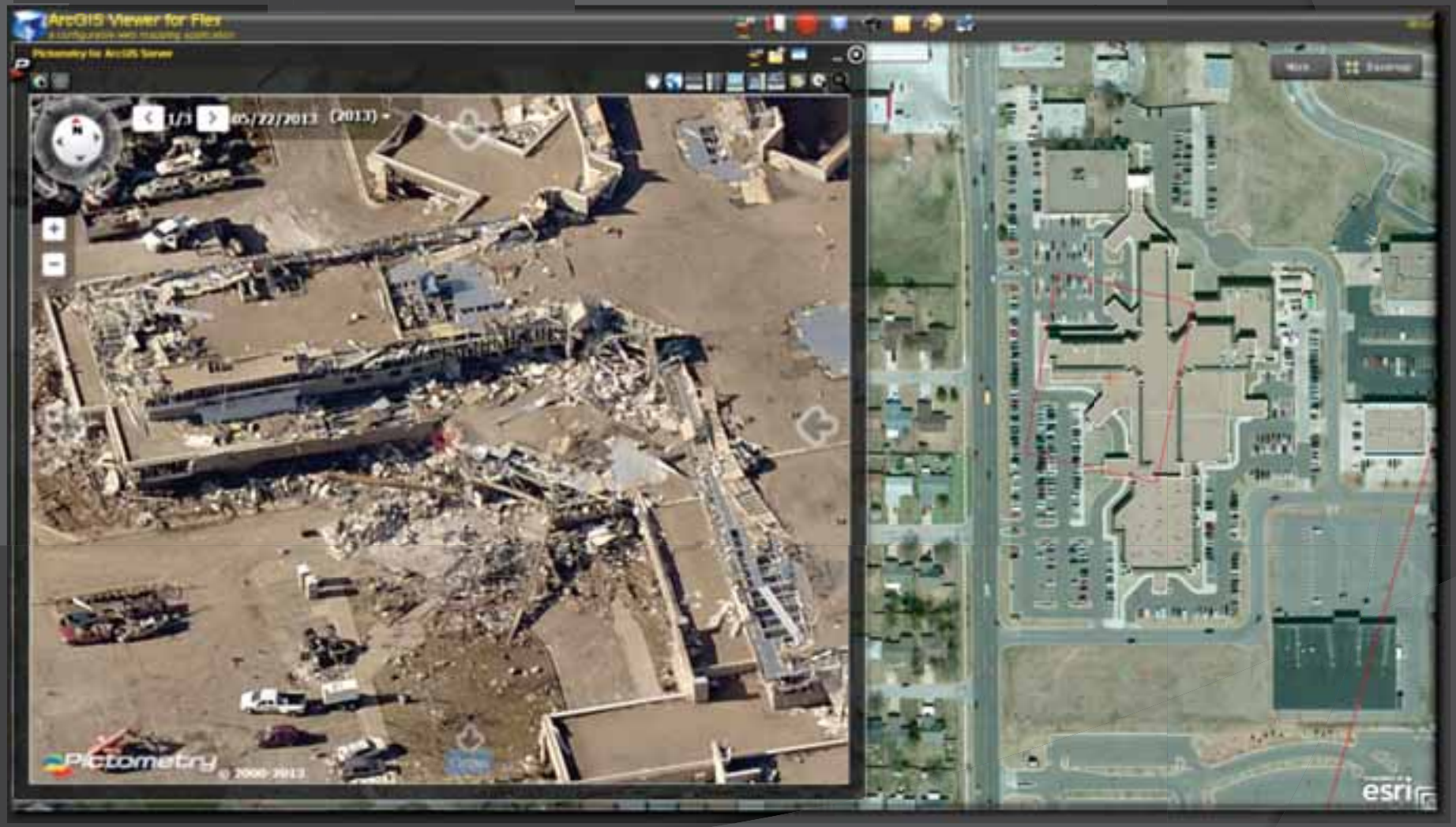


Aerial Visual Intelligence for Emergency Management

- **Rapid turn-around time for disaster response**

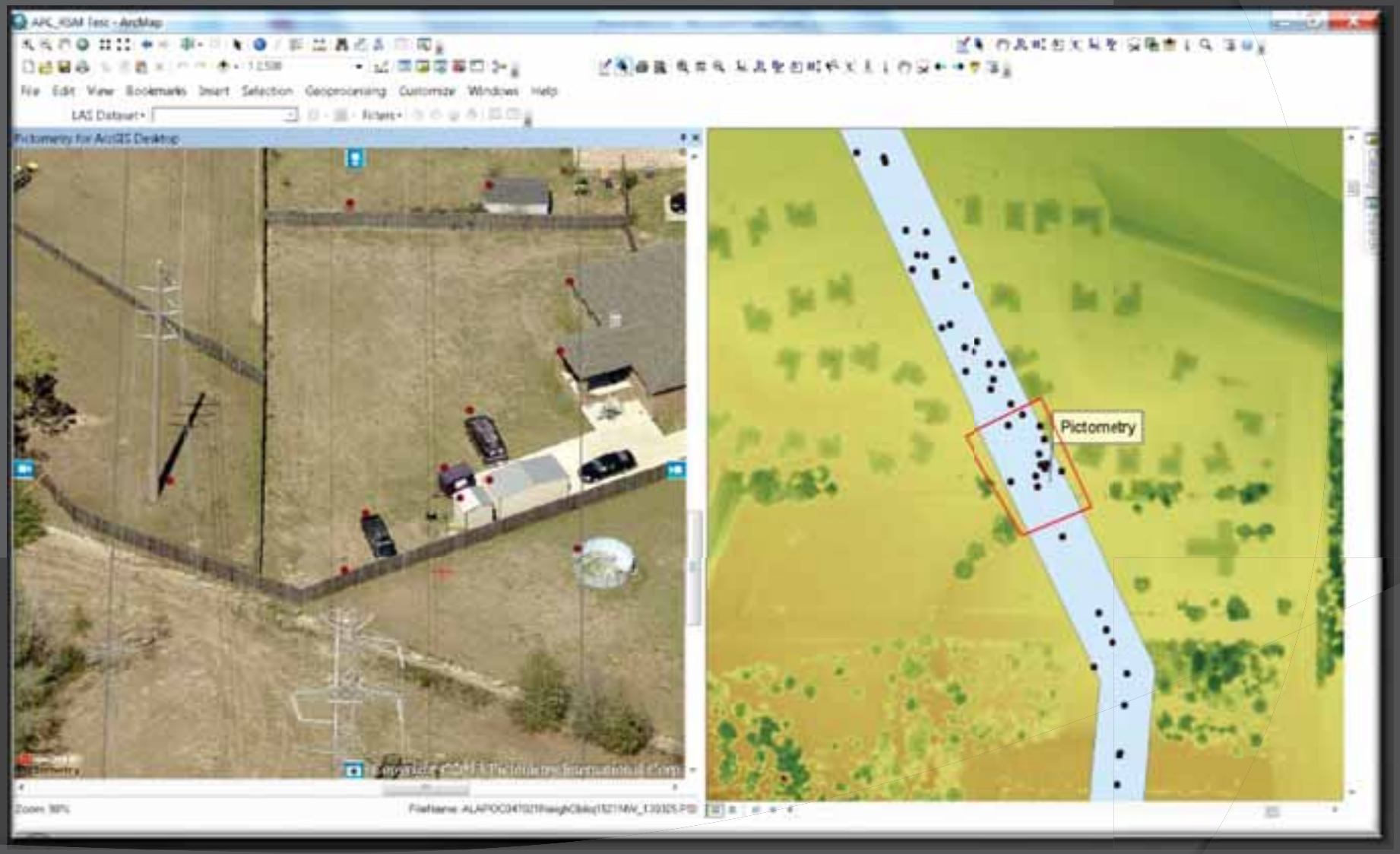
Aerial Visual Intelligence for Emergency Management

- Rapid turn-around time for disaster response
- May 2013 - Moore, OK



Aerial Visual Intelligence in Utilities

- **Spotting encroachment near Electric Transmission ROWs**

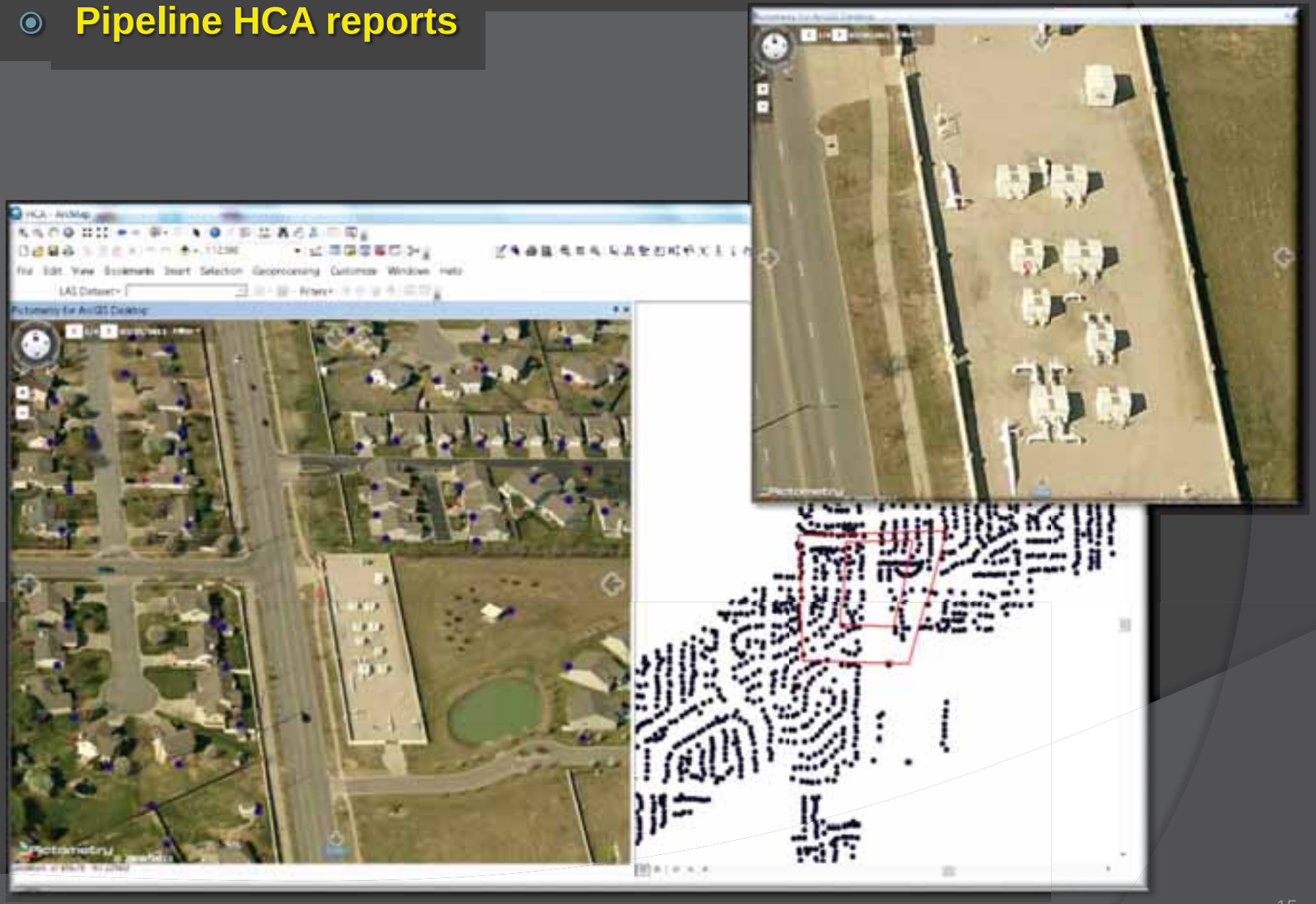


Aerial Visual Intelligence for Emergency Management

- **Wildfire damage assessments**

Aerial Visual Intelligence for Pipeline

- **Pipeline HCA reports**



Timeliness is becoming much more important.
UAVs & other aircraft can provide *Realtime Visual Intelligence*

- **High Definition orthophotos (up to 2cm resolution)**
- **3D terrain and structure mapping**
- **Full Motion Video**
- ***Update the Base Map***
- ***Use as Operational Layer***

UAVs come in all shapes and sizes

- Rotor-craft and fixed-wing configurations
- Various flight profiles and durations
- Easily launched and landed almost anywhere

UAVs for Photogrammetry

- Small to medium-sized project areas
- U.S. FAA restrictions (What is a COA and why do I need one?)

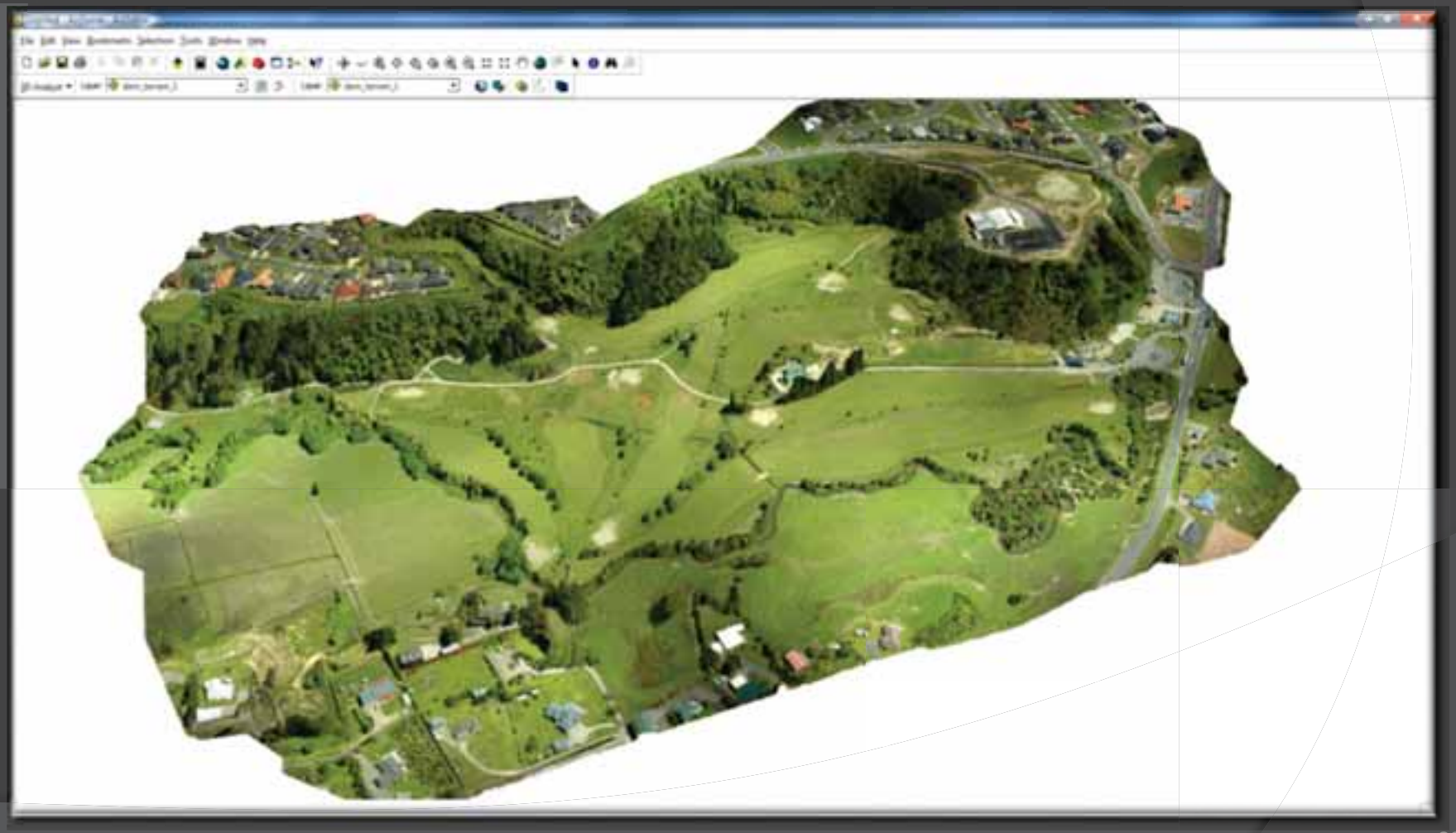
Click to watch UAV Launch

UAV-collected imagery

- Ground control station is GIS-based
- Results viewed in real-time
- *Training & Processing are very important*

UAV-collected imagery

- 3D imagery in ArcGIS
- Cost-effective for small to medium-sized projects
- Repeatability is possible due to low cost & fast turn-around time



UAV-collected imagery

- Fully rendered in true 3D
- Takes advantage of the lense & flight characteristics of UAVs

Play 3D UAV Video1

Play 3D UAV Video2

Full Motion Video: *A New Data Type for GIS*

December 2012

- Wimberley, TX
- Gas-powered UAV with 10 hour duration
- Large enough to carry EO/IR sensor pod for FMV
- Live streaming of data to Ground Station GIS

UAV Imagery in Google Earth

- Cabo San Lucas, MX
- 250 sq miles
- 2500 linear miles, 16,000 images
- 3” resolution

Real-time Aerial Video Exploitation (RAVE)

- **Full-Motion Video Processing**
  - Developed for USAF Predator & Reaper to enhance quality of UAV video
  - Ingests and processes “raw” incoming video feed in near real-time (1-2 seconds)
  - Geo-referenced video output in GIS-ready format

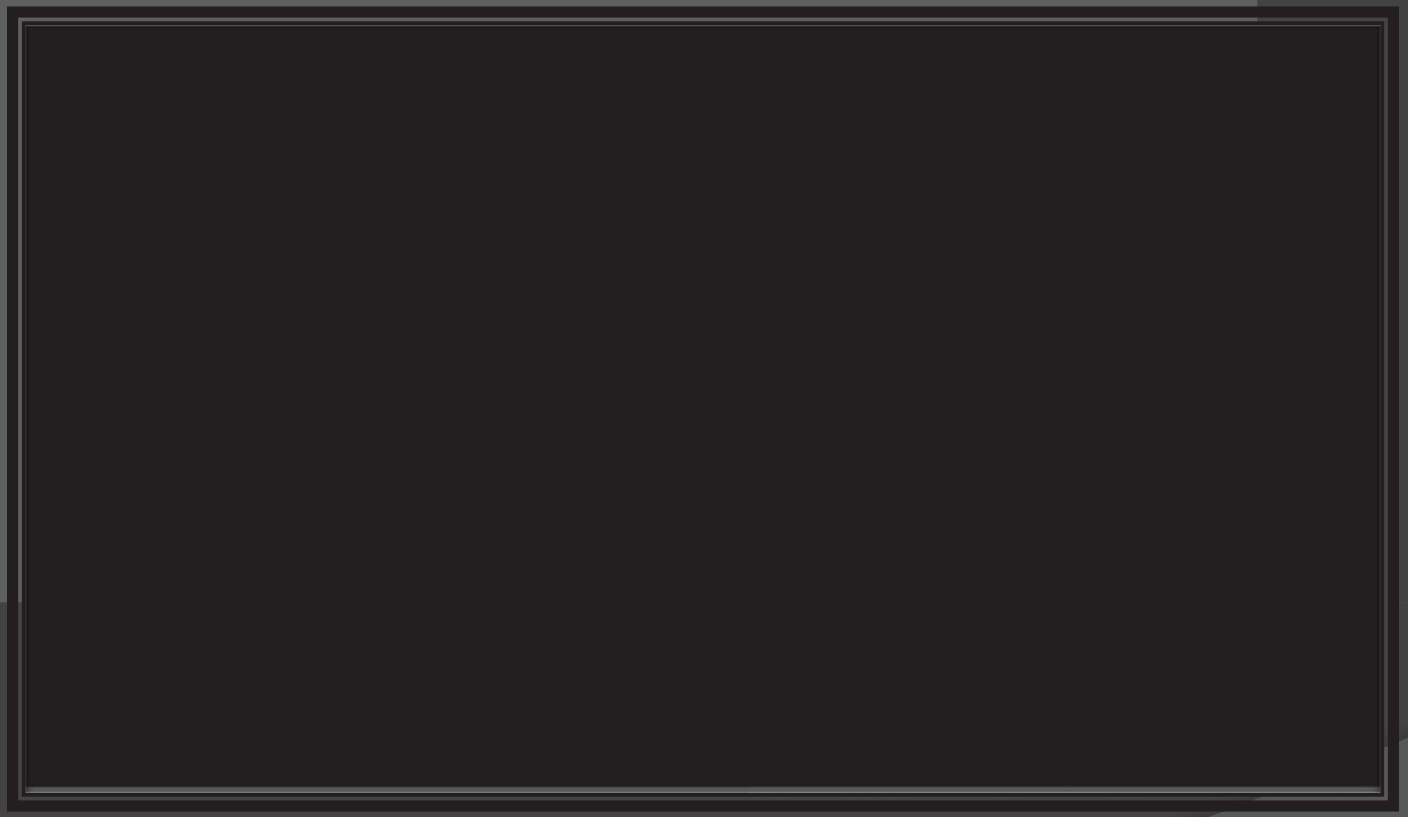
FMV Video Processing Tools

Video Stabilization

FMV Mosaicing

Geo-registration

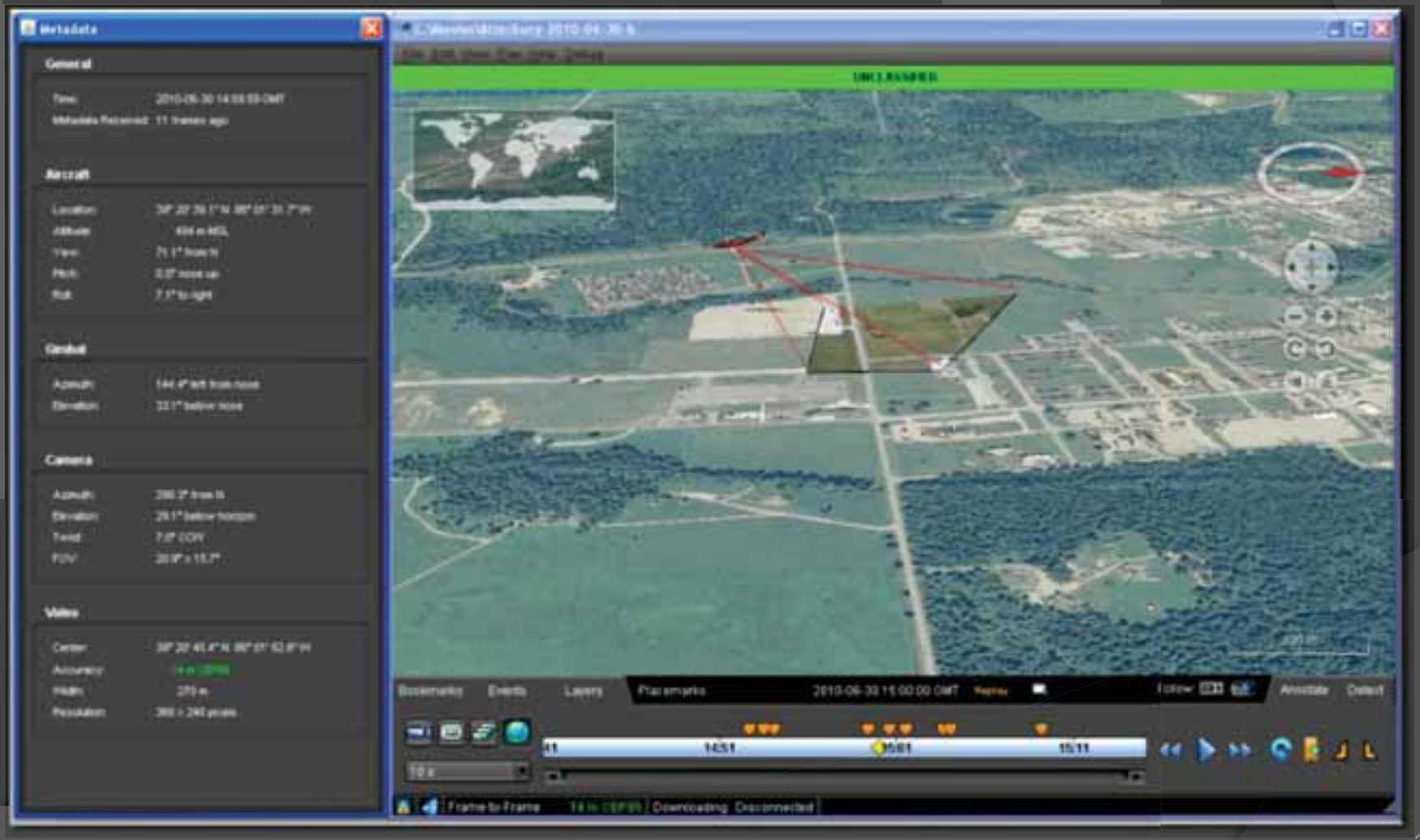
Example of Full Motion Video Processing for GIS



Click to watch FMV Processing

FMV Requirements

- Platform/Sensor/Hardware agnostic
- Can be used with all UAVs and/or FMV sensors (IR/EO)
- KEY: Standard video and meta-data feeds are required



Results of Full Motion Video Processing for GIS

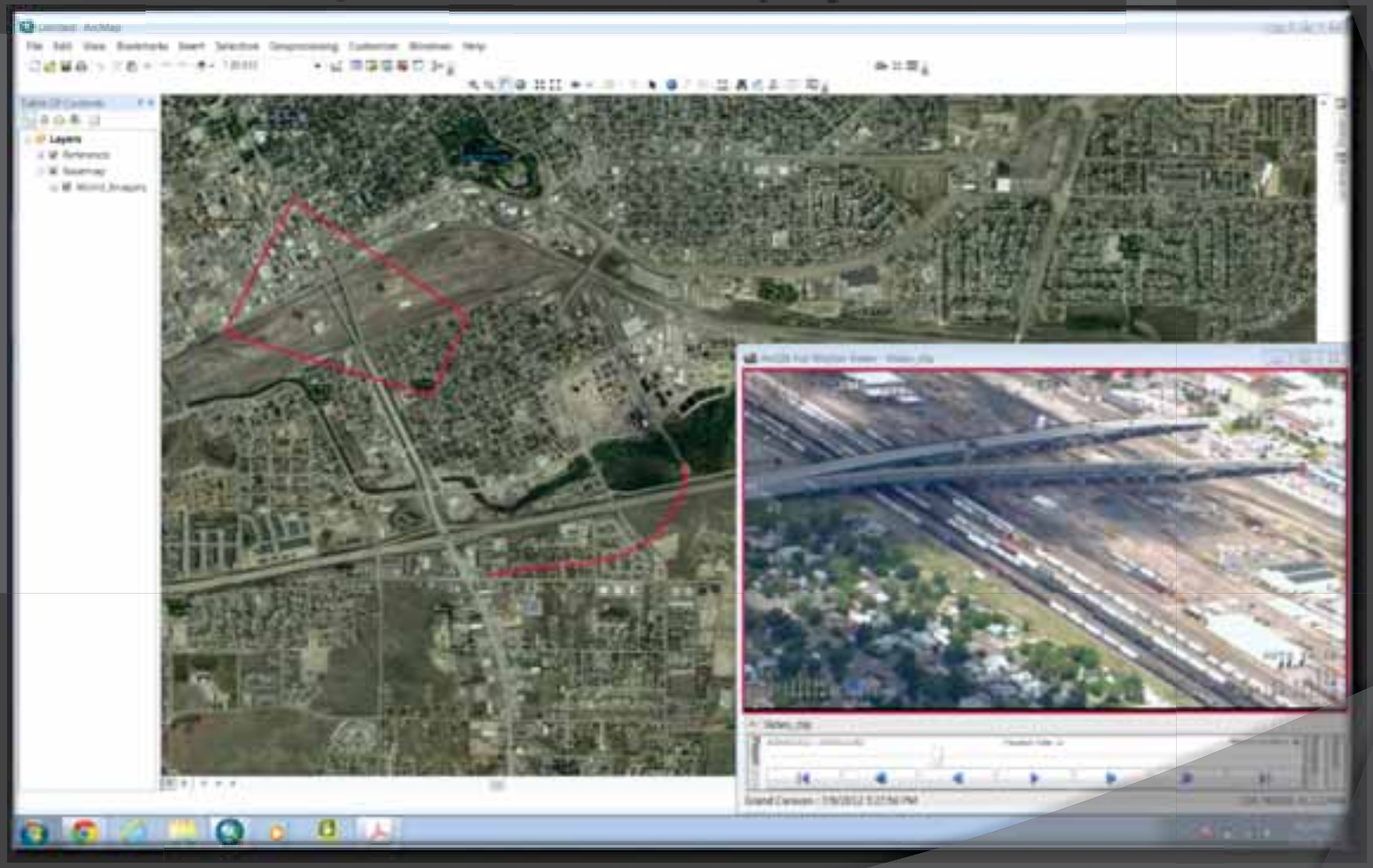
HD FMV Waterfall Mosaic (strip)

UAV Multi-Capture: HD Orthos + 3D Point Cloud + FMV

- Pipeline observation
- Rugged terrain
- 1 day mission
- Rapid turn-around time

How do GIS users make use of FMV?

- ESRI released is first generation FMV toolbar last Fall
- MISB-compliant FMV - *Must have accompanying metadata from the aircraft to work.*
- Allows *feature capture* in the video player window.



The ESRI FMV toolbar is our target platform for GIS users for feature capture and integration.

Benefits for GIS

- On-demand aerial visual intelligence
- Streaming data without the need to land & process
- Quickly update existing base maps
- Realtime Operational Layer for mission-critical applications
- *GIS data capture* directly from georeferenced video
- The time factor… *imagery now*.

While USA UAV regulations are changing,
piloted systems still provide value for many applications.
Especially where mission flexibility & platform stability are important.

Why can't I do this myself?

- You can. Just follow the rules.
- FAA COAs are required inside USA
- Recreational/hobby vs. professional
- MISB data format
- Public relations concerns
- Ask us about our experiences

See *"GIS Unmanned"*

April 2013 Point of Beginning Magazine

Emerging technologies are making data capture for GIS more timely and affordable for projects of all sizes.

GIS UNMANNED

by Devon Humphrey & Darron Pustam

State-of-the-industry summary of image data and full motion video capture from both manned and unmanned platforms for GIS.

Thank you for attending!

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