

Web-based Geo-Referenced Image Manager (WebGRIM):

Automated correction, processing and
management of aerial data

October 17, 2007

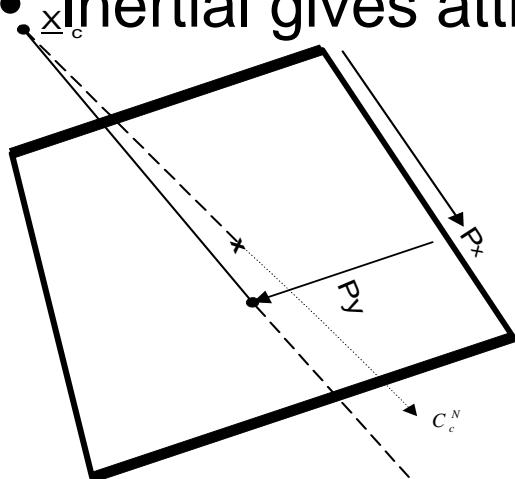
Alison Brown, President/CEO
NAVSYS Corporation
14960 Woodcarver Road
Colorado Springs, CO 80921
(719) 481-4877 www.navsys.com

Need for Timely Georeferenced Imagery Products

- Popularity of web-based Location Based Services is increasing
- Answer posted for FAQ at Google Earth:
“How old is your data”
“Google Earth acquires the best imagery available, most of which is approximately one to three years old
- Access to near real-time imagery products opens up new markets and applications for Location Based Services

GI-Eye Sensor Registration

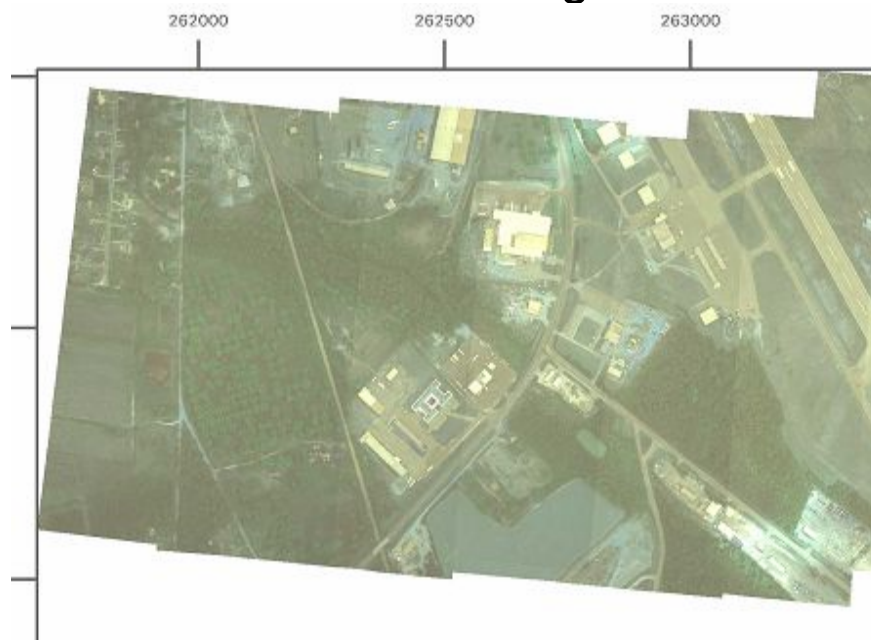
- GI-Eye Product
 - GPS gives position
 - Inertial gives attitude



$$l_{os}^{(N)} = C_c^N \left[P_x \quad P_y \quad f \right]^T / \sqrt{P_x^2 + P_y^2 + f^2}$$



- GRIM Enterprise Server
 - Manages registered sensor imagery
 - Auto-mosaic generation



GI-Eye Systems



NGA Tactical Surveying and Targeting System (TS2)

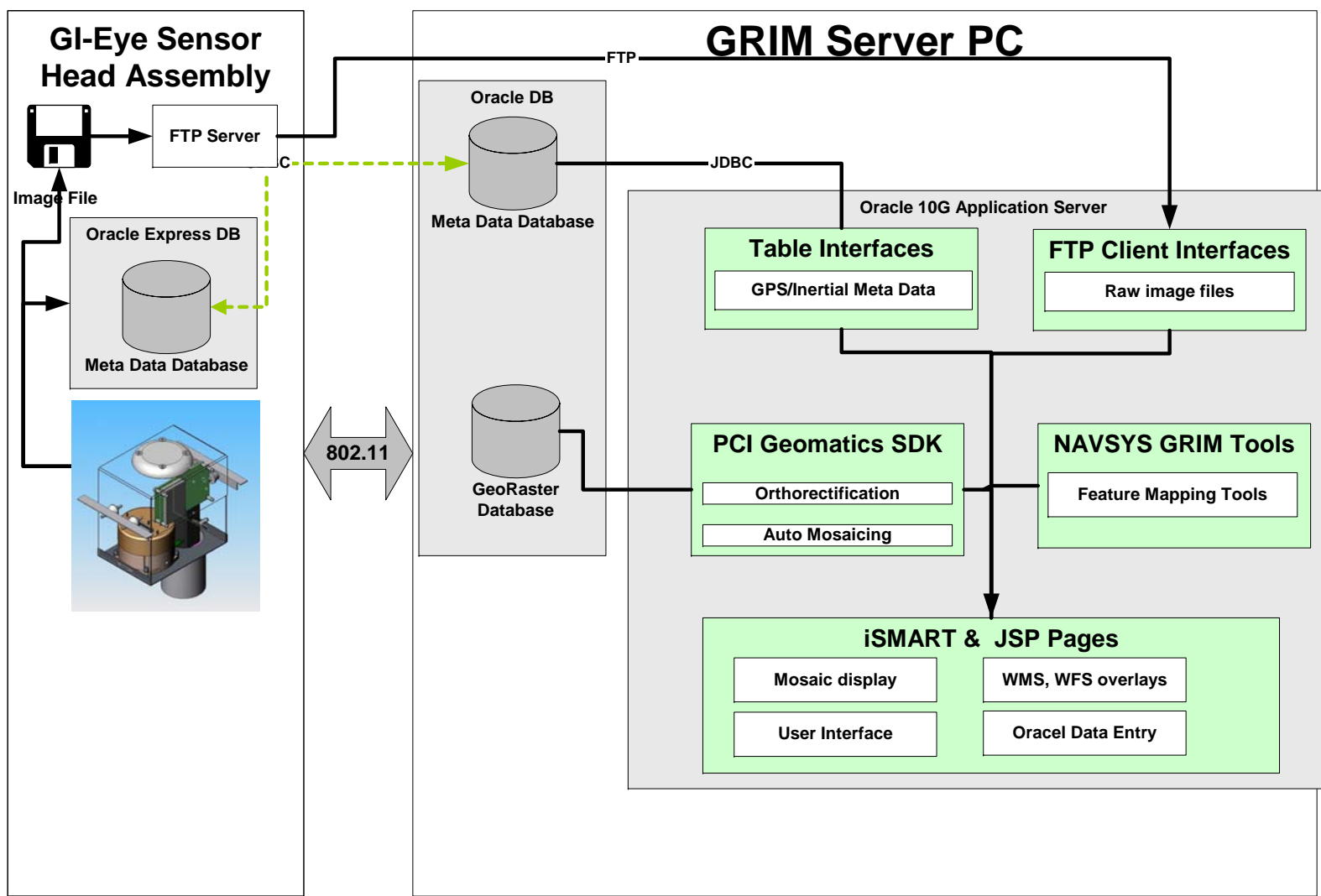


FLIR StarSAFIRE III

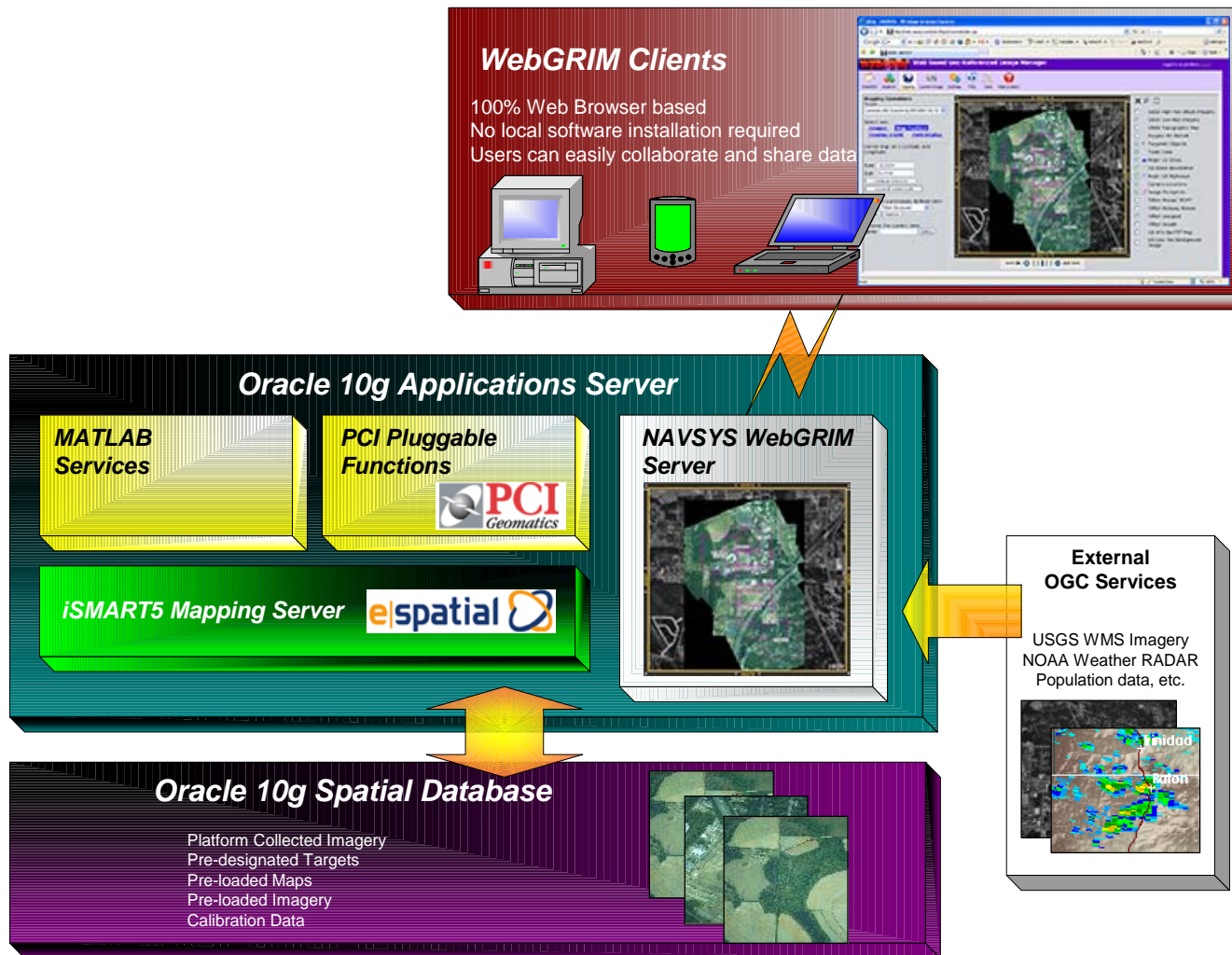


***Dual GI-Eye System
Flown at USAFA***

GI-Eye and GRIM Architecture



WebGRIM Architecture



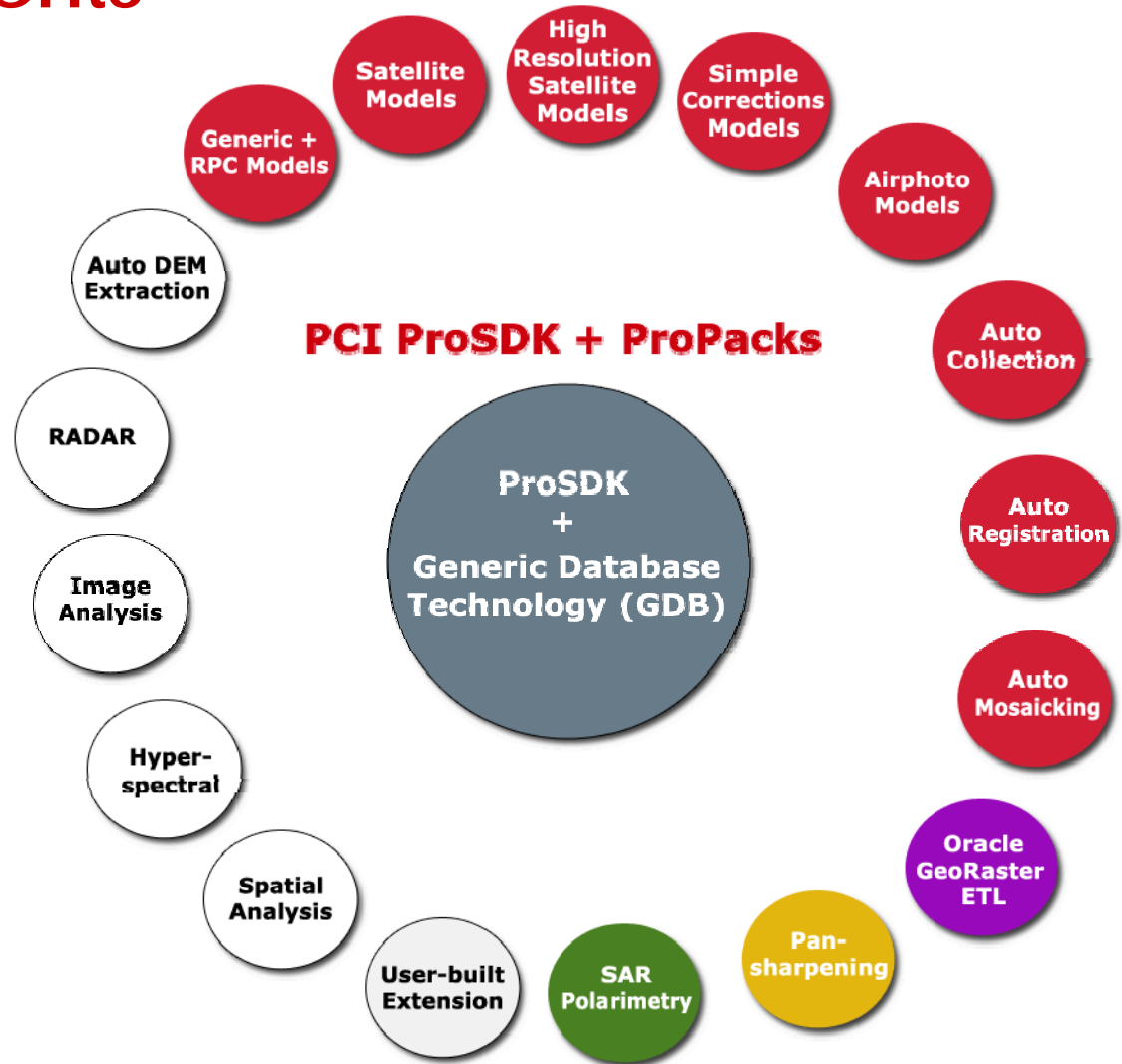
ProSDK Components

ProSDK and GDB Technology

- Base framework and file format interchange

ProPacks

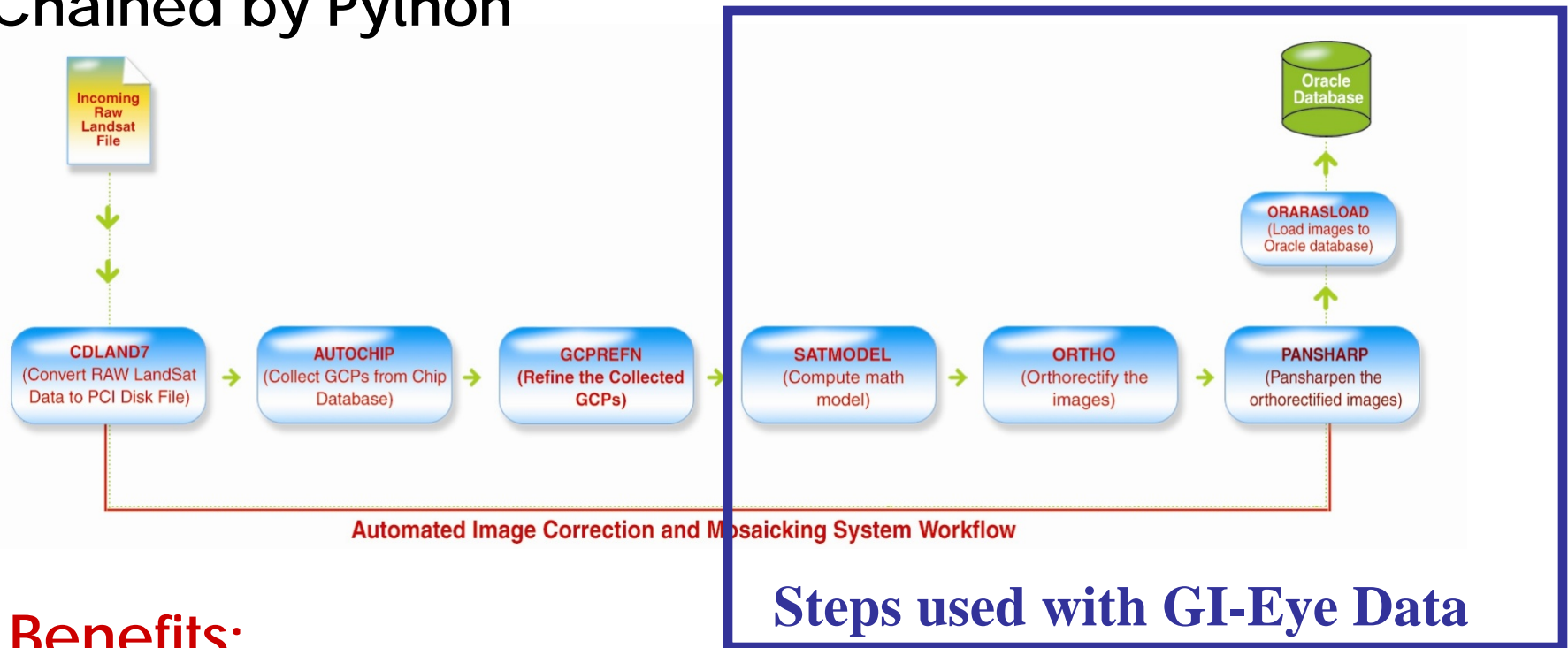
- Groups of PCI Pluggable Functions (PPFs)
- Grouped according to function
- Build Workflows using Python, C++ or Java



Automated Workflows using PPFs

Example:

- Seven PPFs used in this flowline
- Chained by Python

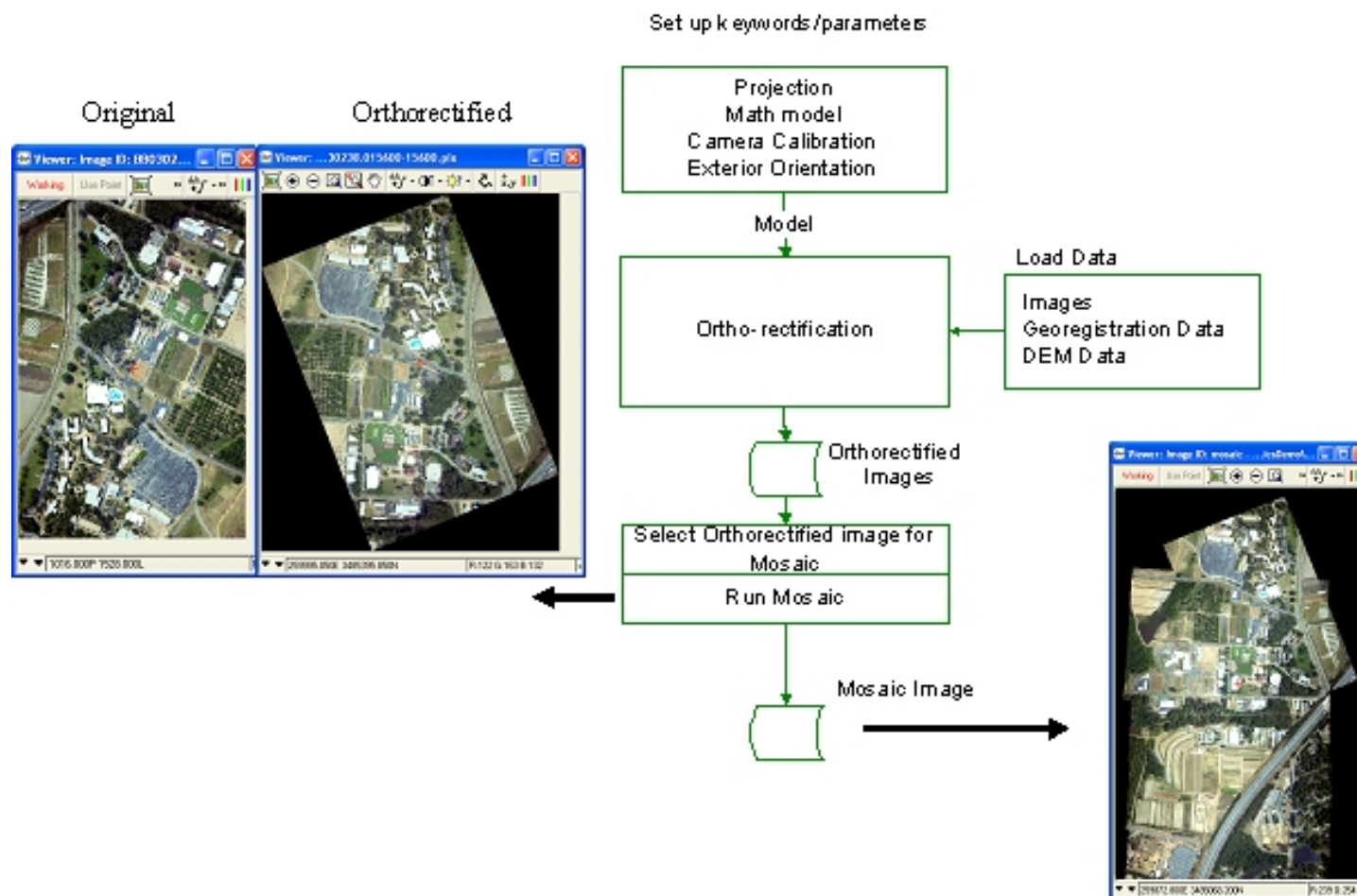


Benefits:

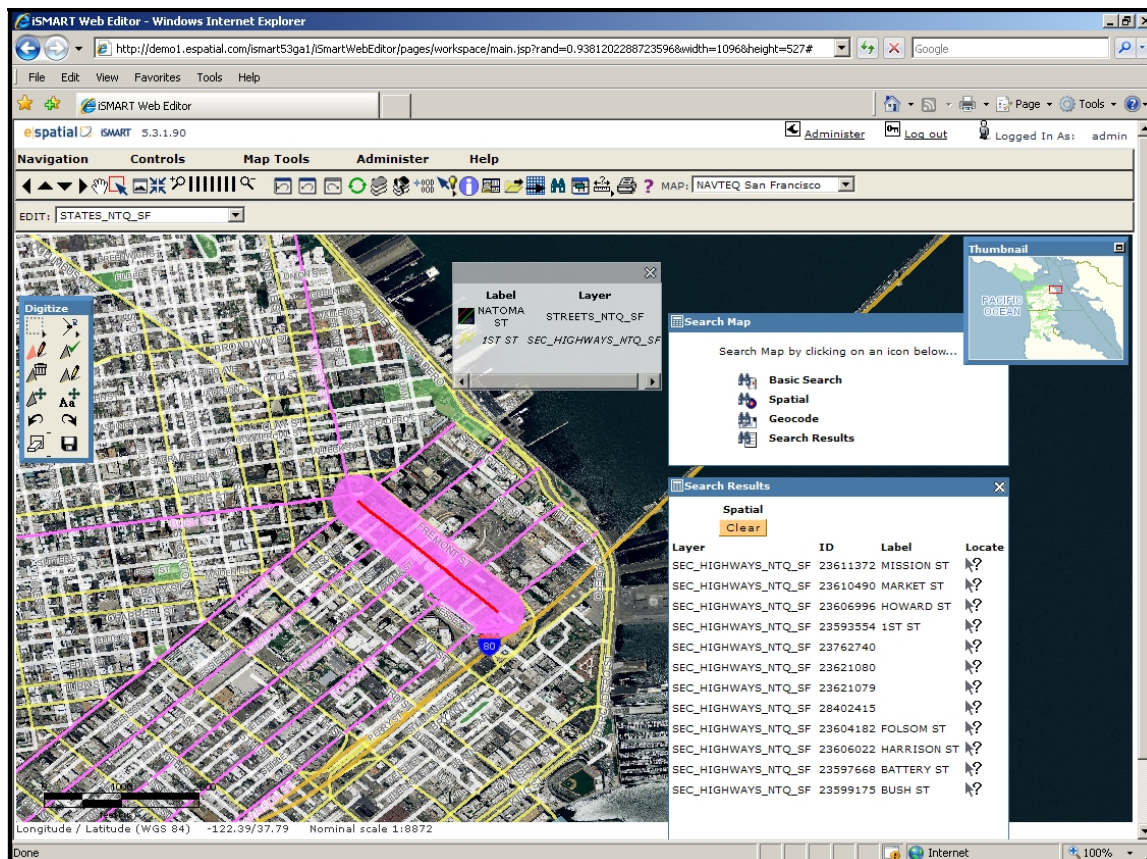
- ☒ completely automatic
- ☒ easy to chain
- ☒ parallel processing



Auto-Mosaic Generation Process with GI-Eye Meta-Data



iSMART Web Server



- Allows viewing of GRIM imagery products
- Compatible with Open Geospatial Consortium (OGC) Standards
- Needs only Web Browser to view (Thin Client)

GRIM Data Overview

GRIM - NAVSYS - Windows Internet Explorer

http://odm.navsys.com/GRIM/grim/source/index.jsp

GRIM Web-based Geo-Referenced Image Manager

Logged in as grimdemo Logout

WebGRIM Explorer Mapping Current Image Settings FAQ Tools Help & About

WebGRIM Operations

Tours:
Cessna 206 Academy AM 2007-05-10

Select one:
[Image Info](#) [Map Position](#)
[Overlay a Grid](#) [Path Display](#)

Center map on a Latitude and Longitude.

Lon -83.5284
 Lat 31.4732
 Locate @ scale 0.01
 Locate @ current scale

Or select a previously defined view:
 USAFA
 Delete Replace

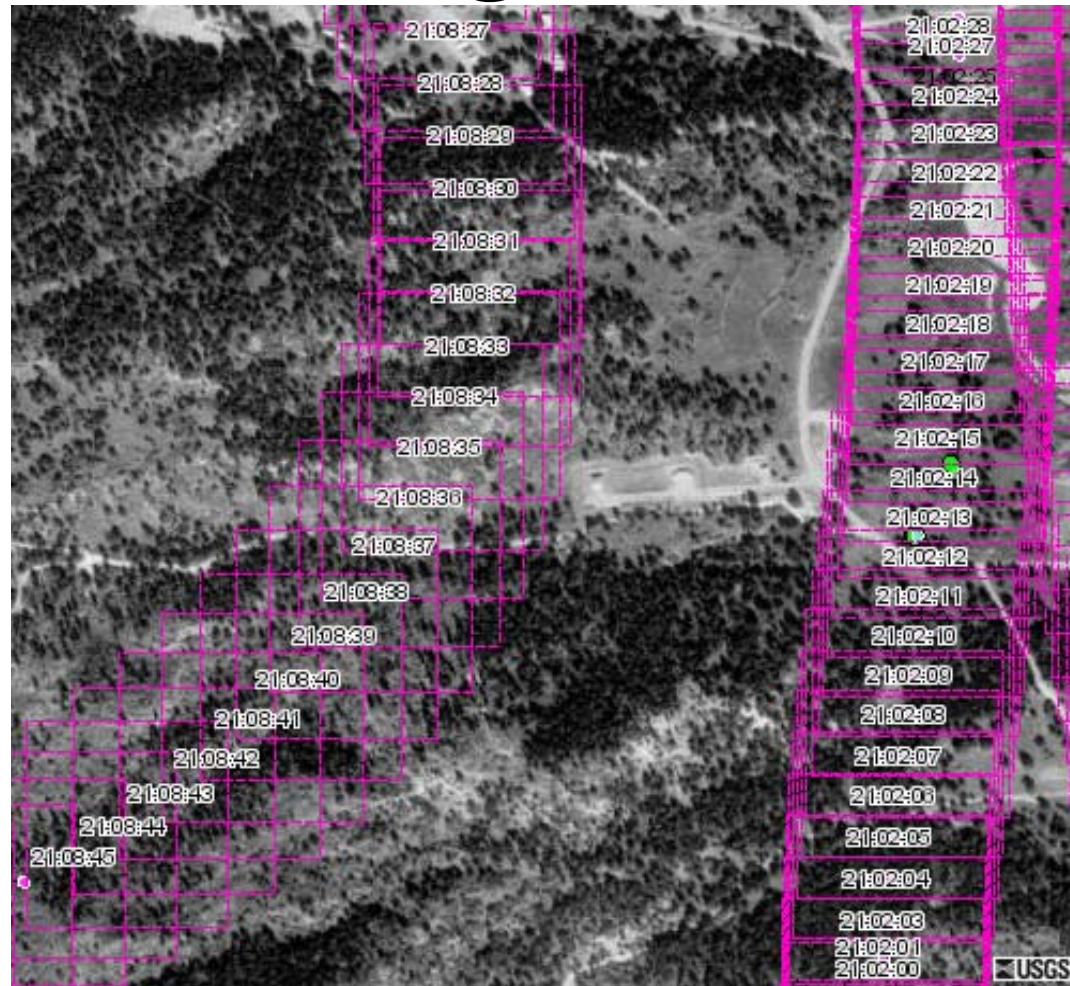
Or save the current view:
 Name: Define

- USGS High-Res Urban Imagery
- USGS Low-Res Imagery
- USGS Topographic Map
- Targeted Objects
- Truth Data
- ab Major US Cities
- US State Boundaries
- Major US Highways
- Camera Locations
- Image Footprints
- Bigger Tifton Mosaic2
- US Low-Res Background Image

zoom IN + | | | | - OUT zoom

Done Trusted sites 100%

Zooming in to AOI




Targeting/Reviewing

WebGRIM Image

2007-05-10 20:42:23 1426_420157

Previous Image Next Image Refresh

Silhouettes for Project: Object

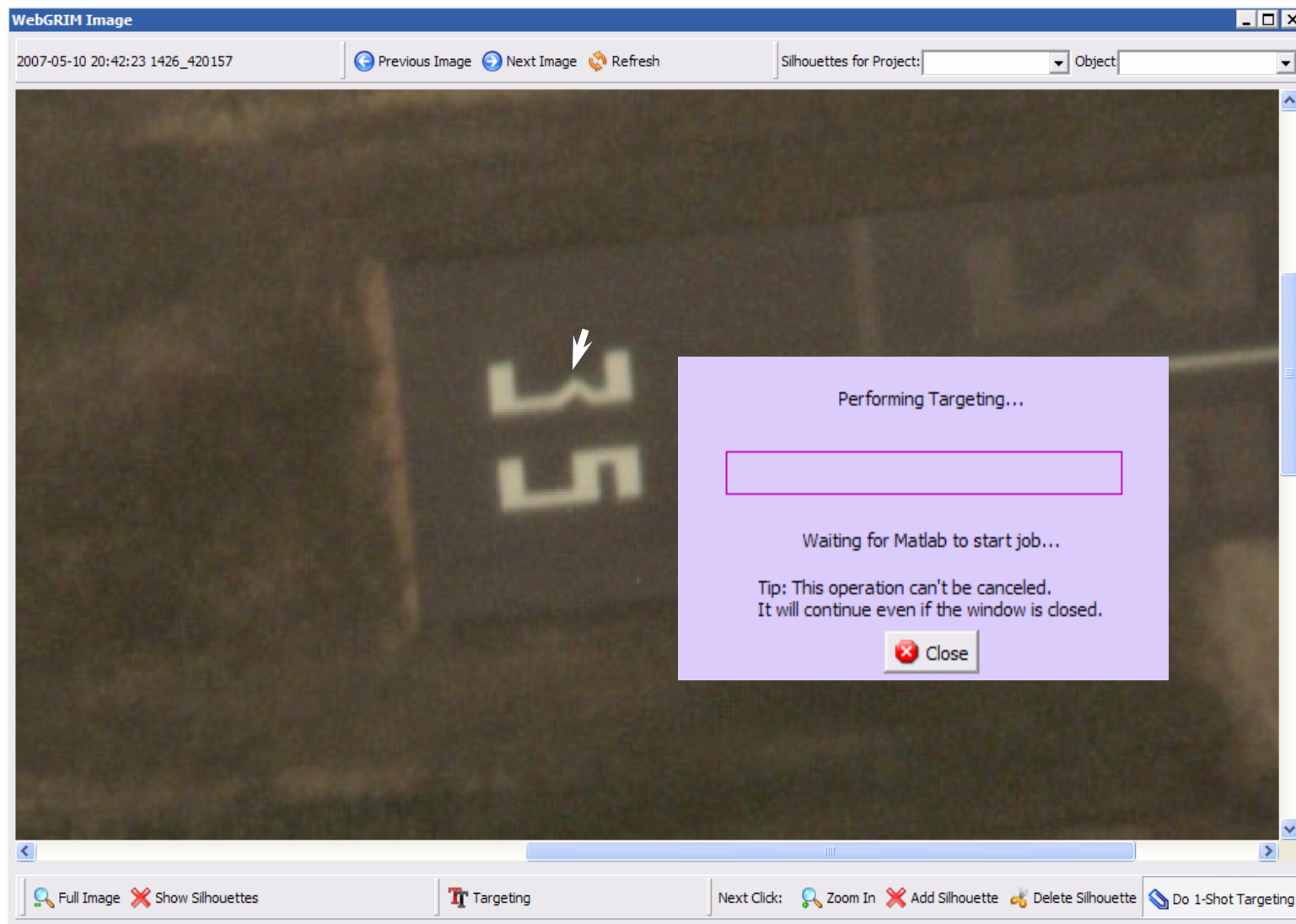


Full Image Show Silhouettes Targeting

Next Click: Zoom In Add Silhouette Delete Silhouette Do 1-Shot Targeting

The image shows a satellite view of a terrain with a dark rectangular object in the center. The object has the number '35' written on it. The interface includes navigation and targeting controls.

Single-Shot Targeting



Single-Shot Targeting Results

The screenshot shows the WebGRIM Image application interface. The main window displays a dark image with the number '35' in white. A dialog box titled 'Windows Internet Explorer' is overlaid on the image, displaying the following information:

Completed. Final status: Coordinates:
 Lat=39.032205° (N 39°01'55.937")
 Lon=-104.844676° (W 104°50'40.834")
 Alt= 6632.9 ft (2022.2 m) MSL
 Used DTED level 2 for calculations
 Copy results to clipboard?

The dialog box has 'OK' and 'Cancel' buttons. The WebGRIM Image interface includes a toolbar at the top with 'Previous Image', 'Next Image', and 'Refresh' buttons, and a status bar at the bottom with 'Full Image', 'Show Silhouettes', 'Targeting', 'Zoom In', 'Add Silhouette', 'Delete Silhouette', and 'Do 1-Shot Targeting' options.

Multi-Shot Targeting



Multi-Shot Targeting

The screenshot displays a software interface for Multi-Shot Targeting. The main window shows a target image with a red crosshair and the text "Aardvark 35 MST". The interface includes a toolbar with buttons for "Show Silhouettes", "Targeting", "Next Click:", "Zoom In", "Add Silhouette", "Delete Silhouette", and "Do 1-Shot Targeting".

The "Targeting" dialog box is open, titled "Targeting", and contains the following information:

- Calculate coordinates for an object
- Single-Shot Targeting
- Multi-Shot Targeting
- Project: USAFA
- Object: Aardvark 35 MST
- Tour: Cessna 206 Academy PM 2007-05-10
- Platform: TS2-C206
- Sensor: IMPERX
- (only images from this sensor will be used)
- Buttons: Go (with a green checkmark icon), Cancel (with a red X icon)

Selecting Images of Interest

WebGRIM Operations

Tours:

Select one:

[Image Info](#) [Map Position](#)
[Overlay a Grid](#) [Path Display](#)

To get more info on a WebGRIM image, use the **Select Tool**:

To select a region of WebGRIM images, or to define an area for mosaic creation, use the **Polygon Select Tool**:

zoom IN |||| OUT zoom

Spatially Filtered Data

WebGRIM Operations

Tours:
Cessna 206 Academy AM 2007-05-10

Select one:
[Images](#) [Map Position](#)
[Overlay a Grid](#) [Path Display](#)

To get more info on a WebGRIM image, use the **Select Tool**:

To select a region of WebGRIM images, or to define an area for mosaic creation, use the **Polygon Select Tool**:

When the polygon is complete press "Confirm Drawing". Any WebGRIM images in your polygon are displayed at the bottom of the page.

- USGS High-Res Urban Imagery
- USGS Low-Res Imagery
- USGS Topographic Map
- Targeted Objects
- Truth Data
- Major US Cities
- US State Boundaries
- Major US Highways
- Camera Locations
- Image Footprints
- Bigger Tifton Mosaic2
- US Low-Res Background Image

zoom IN OUT zoom

Web GRIM images found within your polygon: Aardvark

ID	Lat	Lon	Image Name	Down	Solution	Date/Time	Operations
<input checked="" type="checkbox"/> 110535	-104.8444	39.0309	IMAGES\Tour526\Sensor1\1426_420152.jpg	Y	Good	2007-05-10 20:42:18	Details Target/Review Mosaic
<input checked="" type="checkbox"/> 110536	-104.8443	39.0313	IMAGES\Tour526\Sensor1\1426_420153.jpg	Y	Good	2007-05-10 20:42:19	Details Target/Review Mosaic
<input checked="" type="checkbox"/> 110537	-104.8443	39.0317	IMAGES\Tour526\Sensor1\1426_420154.jpg	Y	Good	2007-05-10 20:42:20	Details Target/Review Mosaic
<input checked="" type="checkbox"/> 110538	-104.8443	39.0321	IMAGES\Tour526\Sensor1\1426_420155.jpg	Y	Good	2007-05-10 20:42:21	Details Target/Review Mosaic
<input checked="" type="checkbox"/> 110539	-104.8443	39.0324	IMAGES\Tour526\Sensor1\1426_420156.jpg	Y	Good	2007-05-10 20:42:22	Details Target/Review Mosaic

AutoMosaicing



Web Mosaic View

The screenshot displays the GRIM (Web-based Geo-Referenced Image Manager) interface within a Windows Internet Explorer browser window. The browser's address bar shows the URL: `http://odm.navsys.com/GRIM/grim/source/index.jsp`. The page title is "GRIM - NAVSYS - Windows Internet Explorer".

The main interface features a navigation bar with the following items: WebGRIM, Explorer, Mapping, Current Image, Settings, FAQ, Tools, and Help & About. The user is logged in as "bruce" with a "Logout" link.

The central map area displays a mosaic of satellite imagery. A green overlay is visible on the map, indicating a selected region. The map is framed by a yellow border with directional arrows (NORTH, SOUTH, WEST, EAST) and a "zoom IN" / "OUT zoom" control at the bottom.

On the left side, the "WebGRIM Operations" panel includes a "Tours:" dropdown menu (currently set to "Cessna 206 Academy AM 2007-05-10") and a "Select one:" section with links for "Images", "Map Position", "Overlay a Grid", and "Path Display". Below this, there are instructions on how to use the "Select Tool" for selecting a region of images.

On the right side, a list of layers is displayed with checkboxes:

- USGS High-Res Urban Imagery
- USGS Low-Res Imagery
- USGS Topographic Map
- Targeted Objects
- Truth Data
- ab Major US Cities
- US State Boundaries
- Major US Highways
- Camera Locations
- Image Footprints
- Bigger Tifton Mosaic2
- US Low-Res Background Image

The bottom status bar shows "Done", "Trusted sites", and a zoom level of "100%".

Targeting Results

GRIM - NAVSYS - Windows Internet Explorer

http://odm.navsys.com/GRIM/grim/source/index.jsp

GRIM Web-based Geo-Referenced Image Manager

Logged in as bruce Logout

WebGRIM Explorer Mapping Current Image Settings FAQ Tools Help & About

WebGRIM Operations

Tours:
Cessna 206 Academy AM 2007-05-10

Select one:
[Images](#) [Map Position](#)
[Overlay a Grid](#) [Path Display](#)

Center map on a Latitude and Longitude.

Lon: -83.5284
 Lat: 31.4732
 Locate @ scale 0.01
 Locate @ current scale

Or select a previously defined view:
 Aardvark35
 Delete Replace

Or save the current view:
 Name: Define

- USGS High-Res Urban Imagery
- USGS Low-Res Imagery
- USGS Topographic Map
- Targeted Objects
- Truth Data
- Major US Cities
- US State Boundaries
- Major US Highways
- Camera Locations
- Image Footprints
- Bigger Tifton Mosaic2
- US Low-Res Background Image

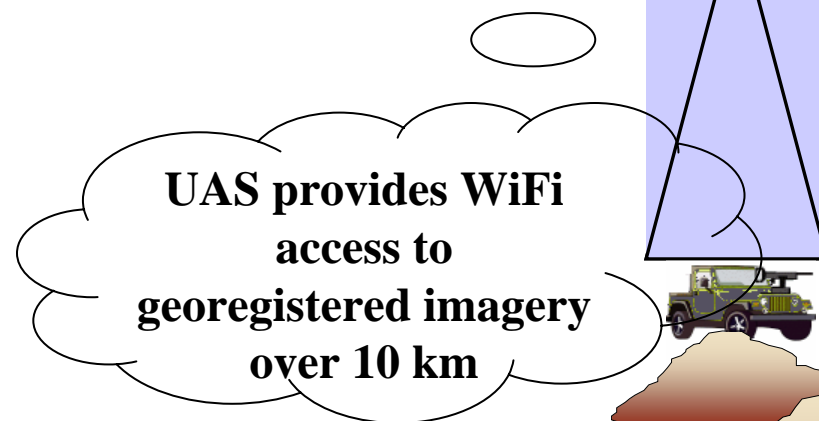
zoom IN + ||||| - OUT zoom

Done Trusted sites 100%

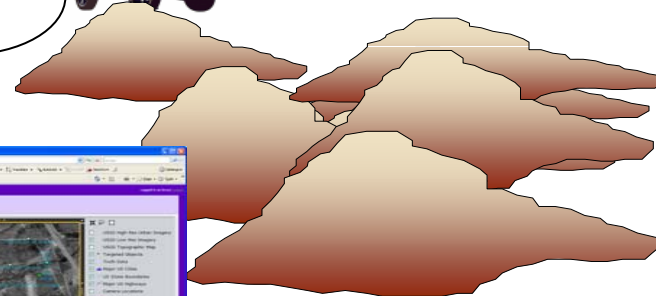
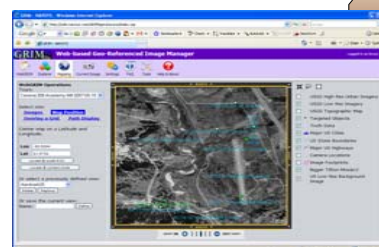
single shot target
accuracy at 2.7m
(2DRMS)

UAV GRIM Application

UAV carries GI-Eye and GRIM in payload



First Responders or Ground Forces get real-time access to Web maps



Conclusion

- GPS/inertial video provides precisely referenced imagery in real time
- Flight test data showed single shot feature location accuracy at 2.7m (2DRMS)
- Use of PPFs within WebGRIM allows automated mosaicking of images
- Use of iSMART in Web GRIM provides near real-time web access to mosaicked imagery
- Applications include situational awareness for military, first responders and commercial users

Back-Up