

Multispectral Scanners for Wildland Fire Assessment

NASA Ames Research Center – Earth Science Division

Bruce Coffland
U.C. Santa Cruz



Slide Fire Burn Area (MASTER/B200)

R 2.2um G 0.87um B 0.65um



Airborne Science & Technology Lab
Ames Research Center



NASA Airborne Science Program

MISSION

Enable Earth science research and applications by providing airborne observational capability to augment space-based systems, and to provide targeted characterizations of regional or localized phenomena at high spatial and temporal resolutions.

Support is provided to these six science focus areas:

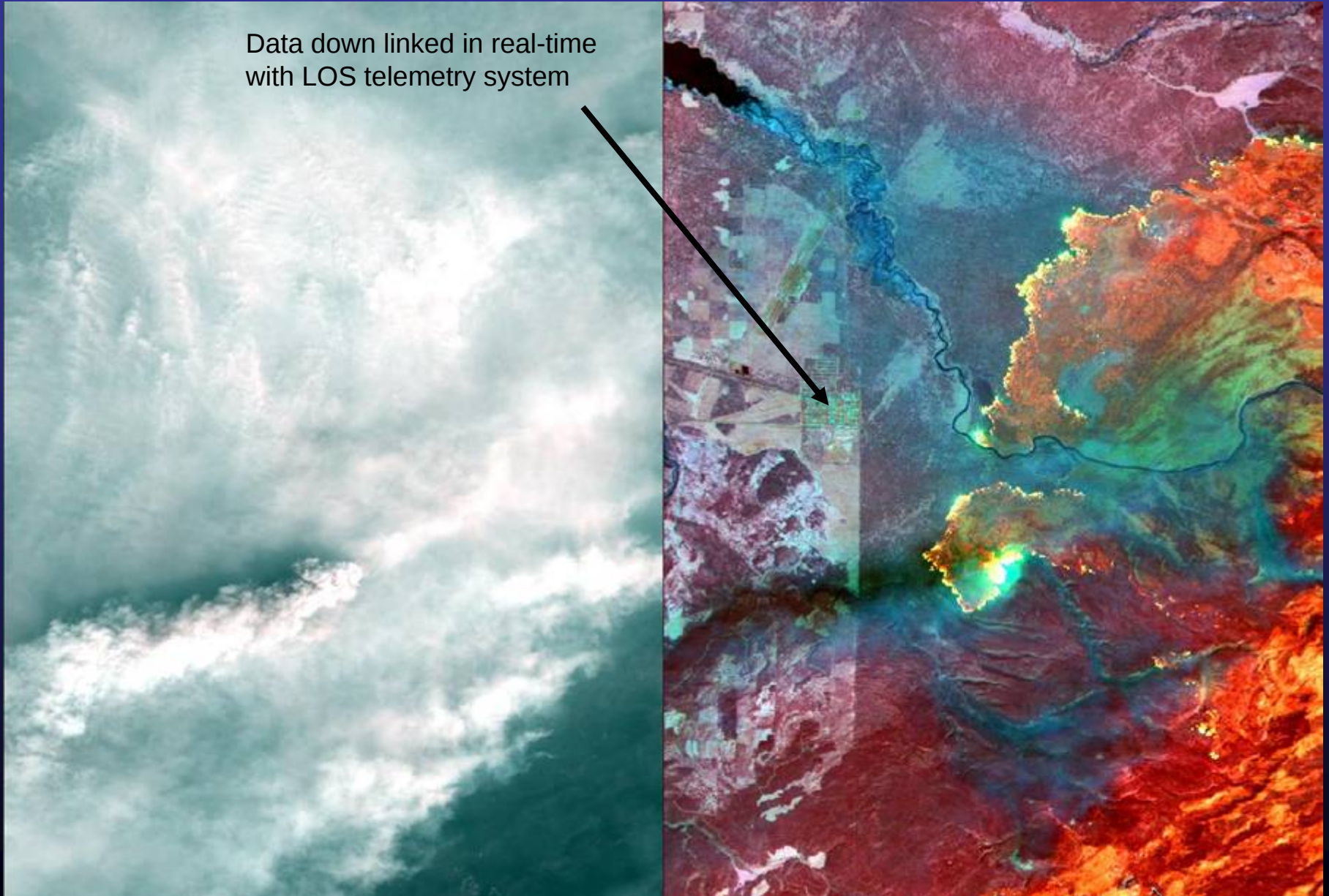
- Carbon cycle and Ecosystems
- Atmospheric Composition
- Climate Variability and Change
- Weather
- Earth Surface and Interior (Includes Natural Hazards)
- Water and Energy cycle



Yellowstone Fire, 1988

ER-2 TMS (TM 6,7,5 = RGB)

Data down linked in real-time
with LOS telemetry system





Oakland Hills Fire, 1989 NS001



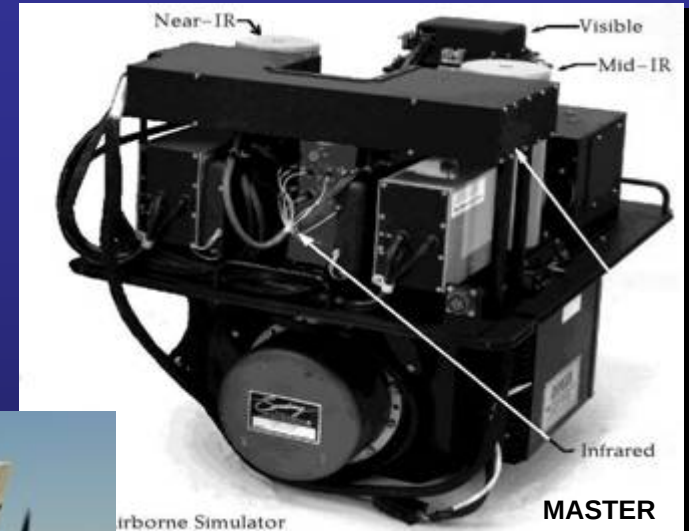
Marple Fire, 1996 TMS



Data broadcast in
real-time via
STARLink Ku-band
Sat-Com system



NASA Airborne Platforms & IR Imaging Systems



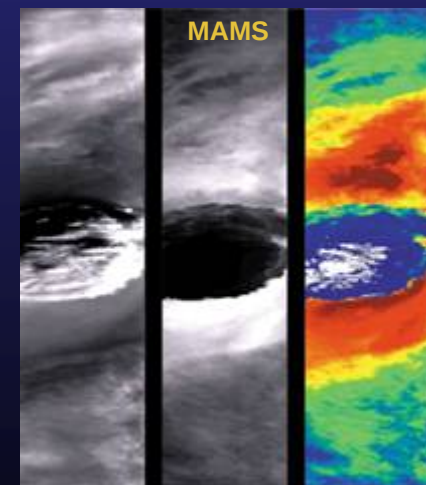
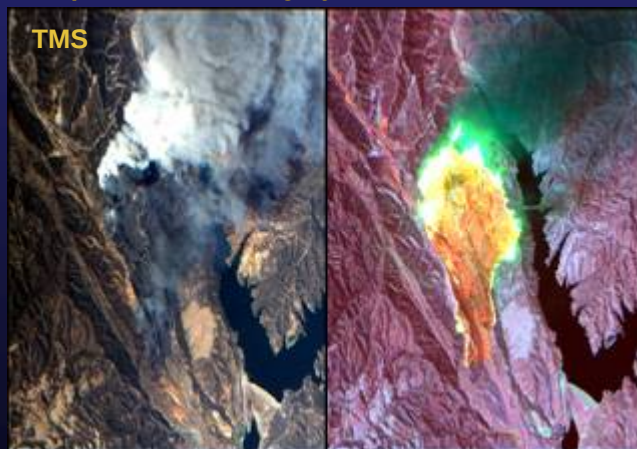
AMS

Autonomous Modular Sensor System (AMS)

- 3 Interchangeable Spectrometers for Land/Wildfire; Ocean Color, Atmospheric Dynamics
- On-board Processors for Real-time Geo-Rectification & PI Algorithms
- Packaged for Un-Pressurized Operation
Compatible with Crewed or UAS aircraft



Representative Imagery:



UAS – AMS WildFire

<u>Band</u>	<u>Wavelength μm</u>
1	0.42- 0.45
2	0.45- 0.52 (TM1)
3	0.52- 0.60 (TM2)
4	0.60- 0.62
5	0.63- 0.69 (TM3)
6	0.69- 0.75
7	0.76- 0.90 (TM4)
8	0.91- 1.05
9	1.55- 1.75 (TM5)
10	2.08- 2.35 (TM7)
11	3.60- 3.79 (VIIRS M12)
12	10.26-11.26 (VIIRS M15)

Total Field of View: 85.9 degrees (or 42.5 degrees)
IFOV: 2.5mrad (1.25mrad)
Altitude: 25000'
Spatial Resolution: 20m (10m) at sea level

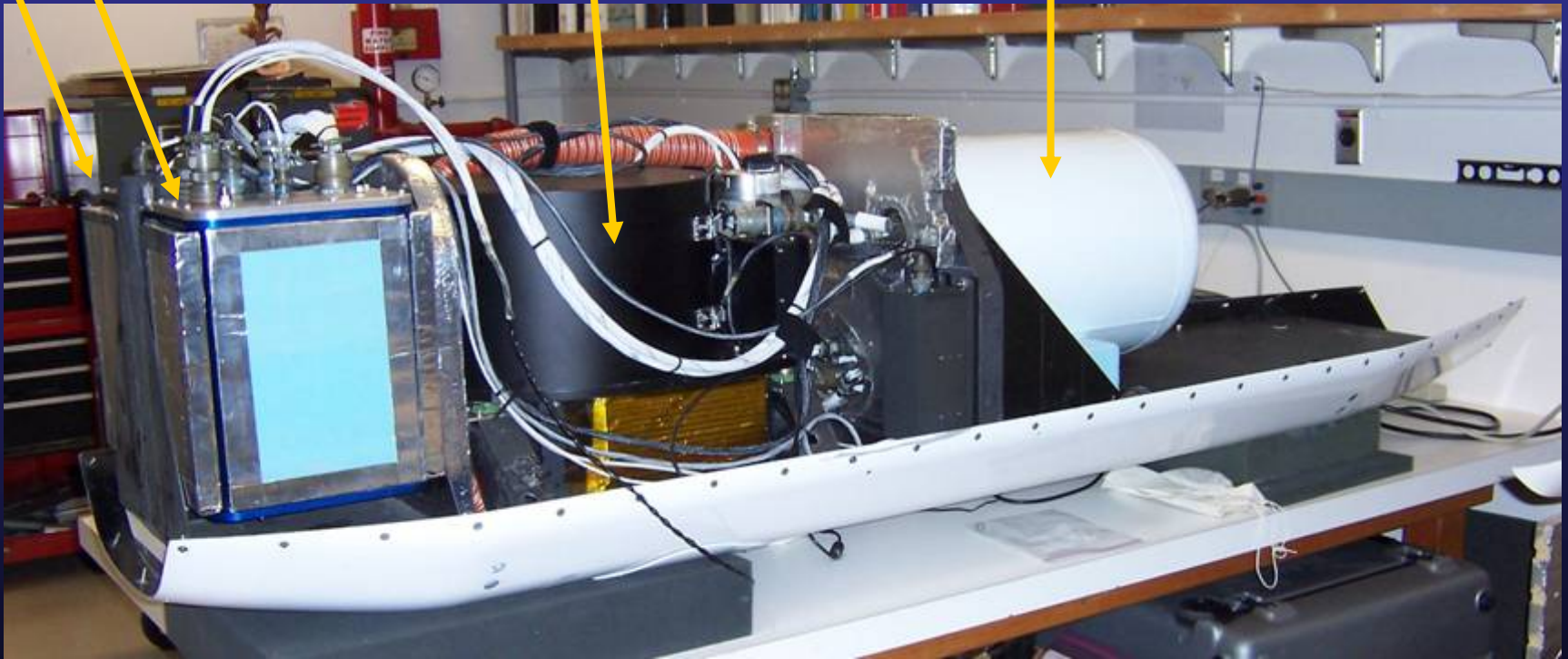


AMS System Components on Pod Tray

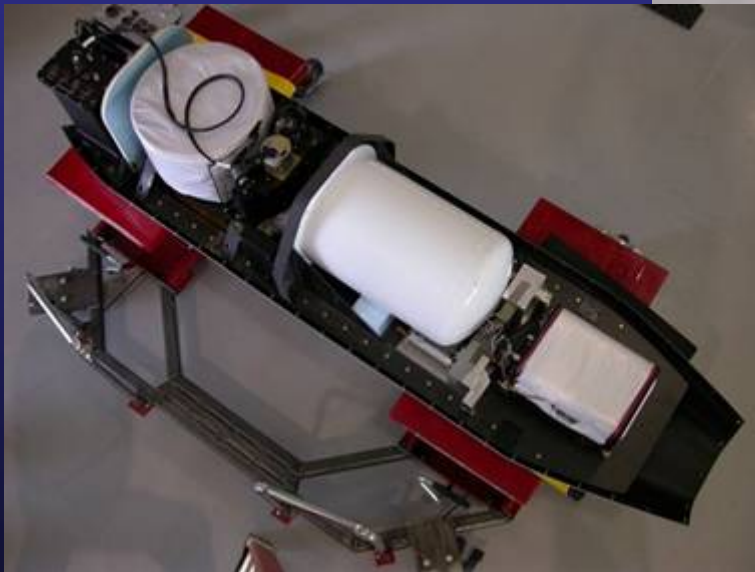
Two environmental enclosures
(data disks & GPS; and power
supplies & controllers)

Scan Head

Data System
Enclosure

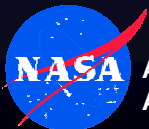
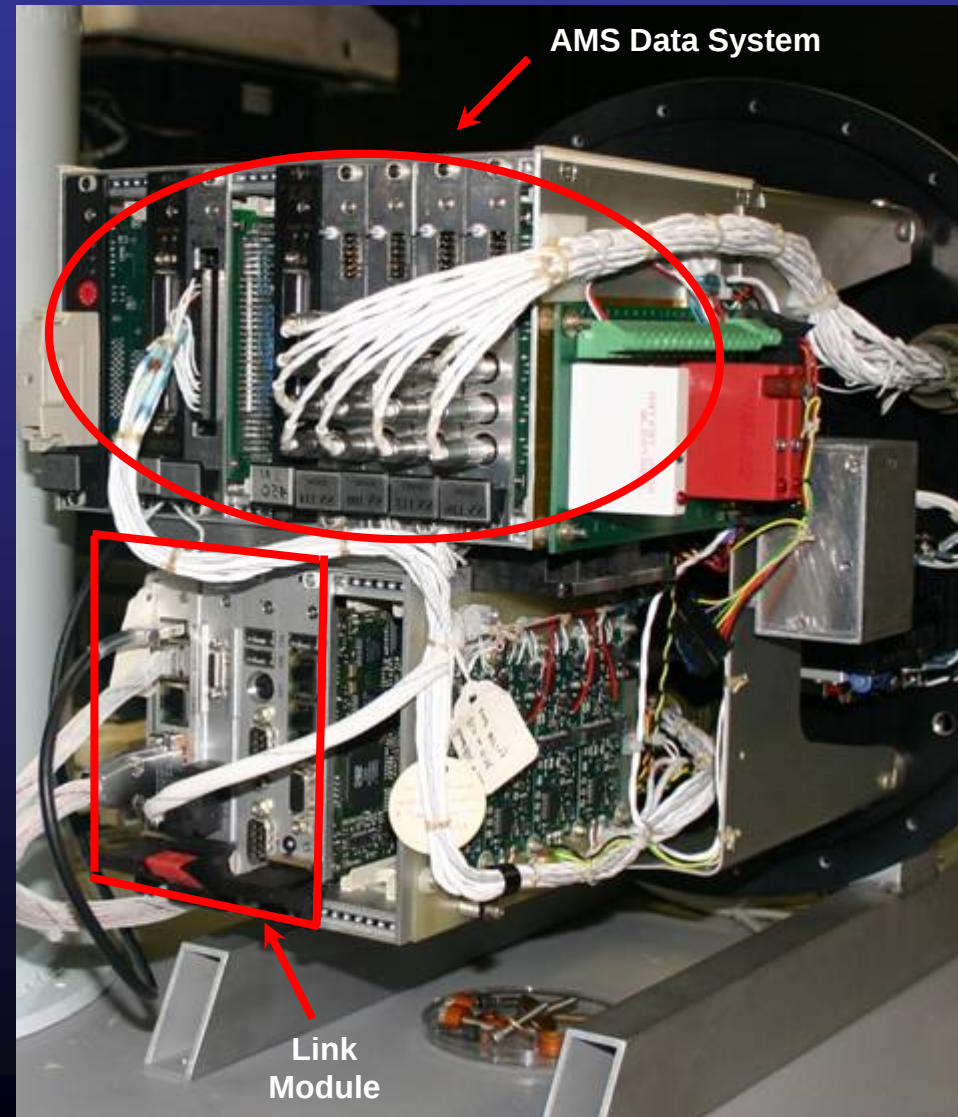


AMS Components on Pod Tray



UAS Telemetry Link Module

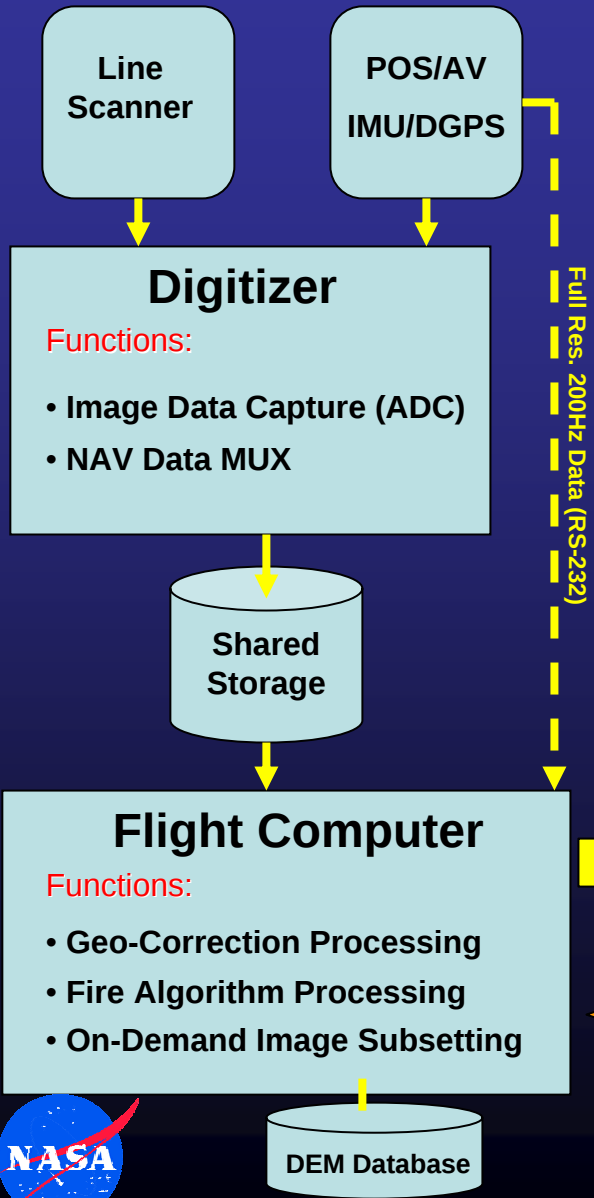
- A universal Interface for science payloads to broad band telemetry systems (Ku, S, C, L)
- Inputs for >20 instruments using standard protocols
- 40 Mbs max. throughput (link speed limited)
- Experimenter CPU & mass storage for science data reduction & recording
- Real-time on-board generation of Level-1 & 2 geophysical products (Fire mission config.)
- Interfaces to ground-based IMM & Collaborative Decision Sensor Web Environment
- Currently mounted in AMS data system enclosure



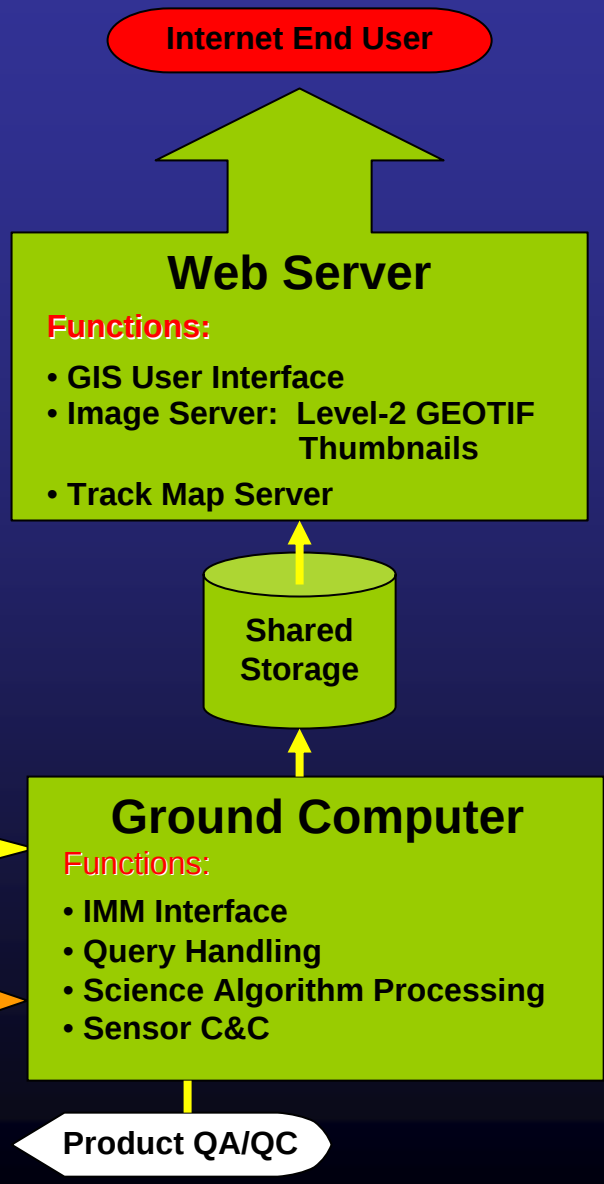


UAS Image Data Flow Diagram

Airborne Element

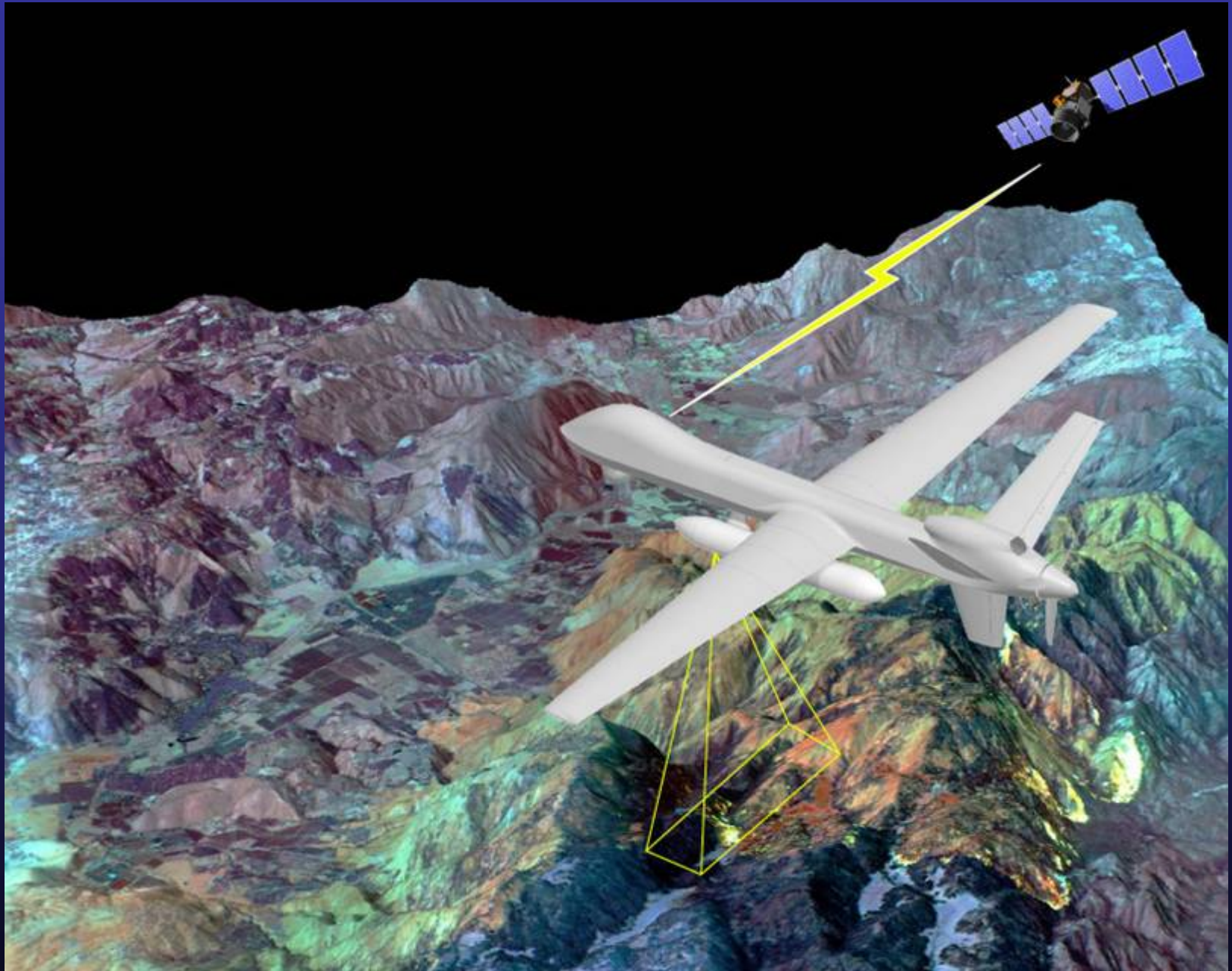


Ground Element



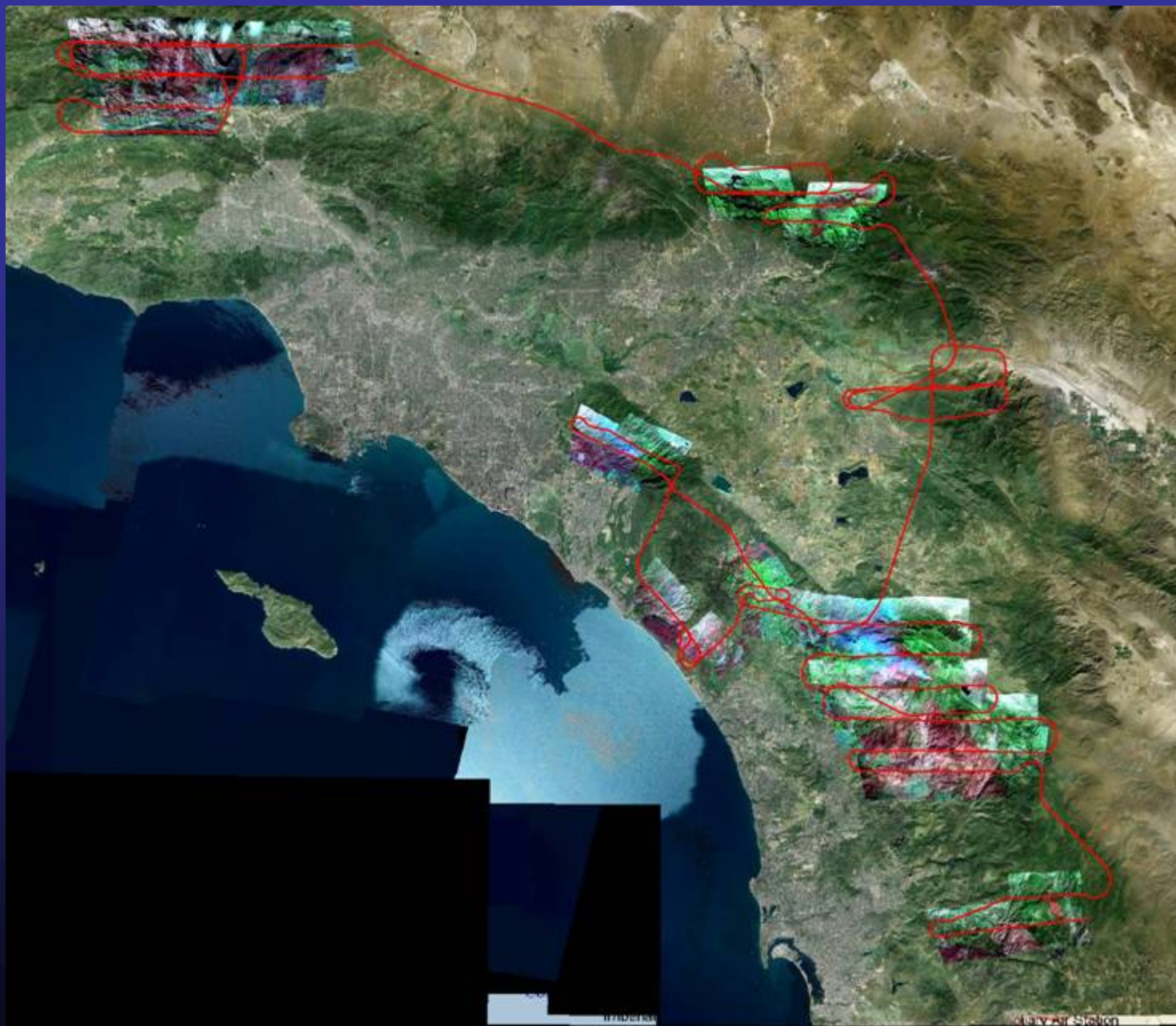
Sat Com Link





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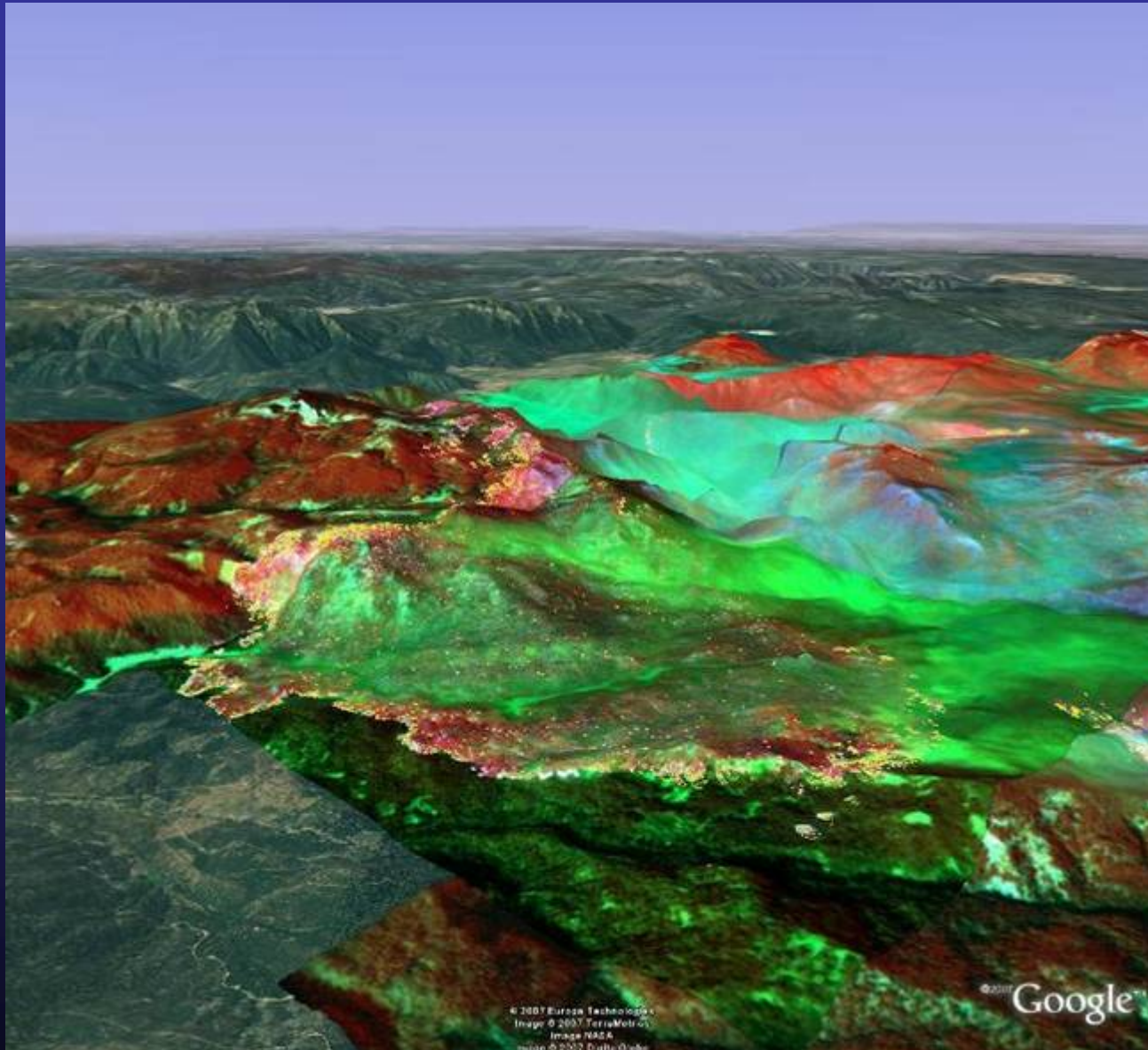
Poomacha Fire, 2007 AMS



AMS Coverage

Acquired October 28, 2007 (Ikhana)

AMS: Moonlight Fire 9/5/07 (Daytime Perspective View)



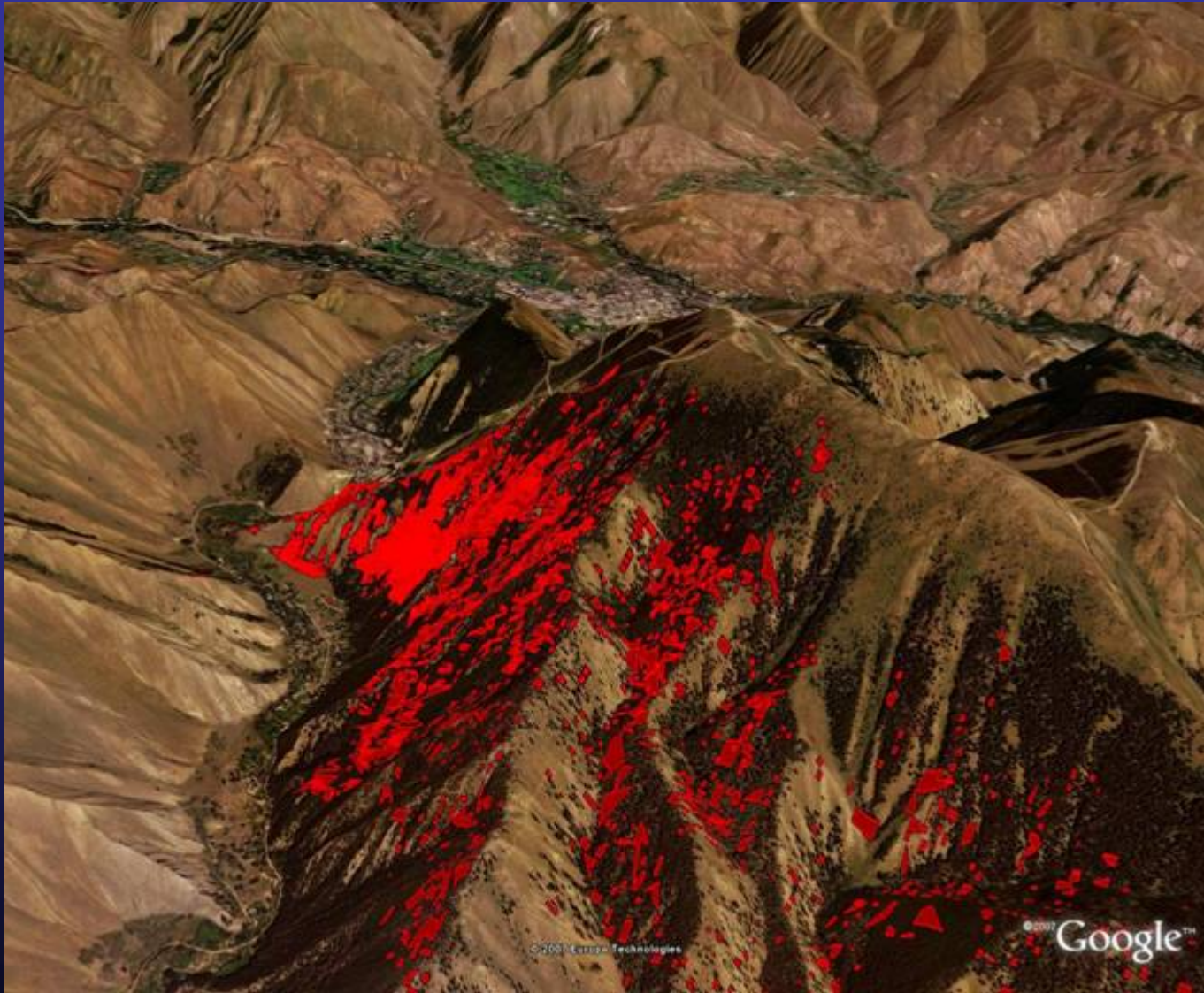
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Castle Rock Fire AMS



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Ketchum, Idaho

AMS – Next Steps

- Lower gain in 1.6 μ m bands to avoid saturation
- Add additional low gain band at 3.7 μ m, to avoid saturation and retain radiometric calibration
- Refine IR calibration with high-temperature laboratory blackbody
- System to be configured for UAS ocean color and hurricane observations in 2009-10
- System to remain available for fire mapping on a best-effort basis
- AMS data website: <http://asapdata.arc.nasa.gov/ams>

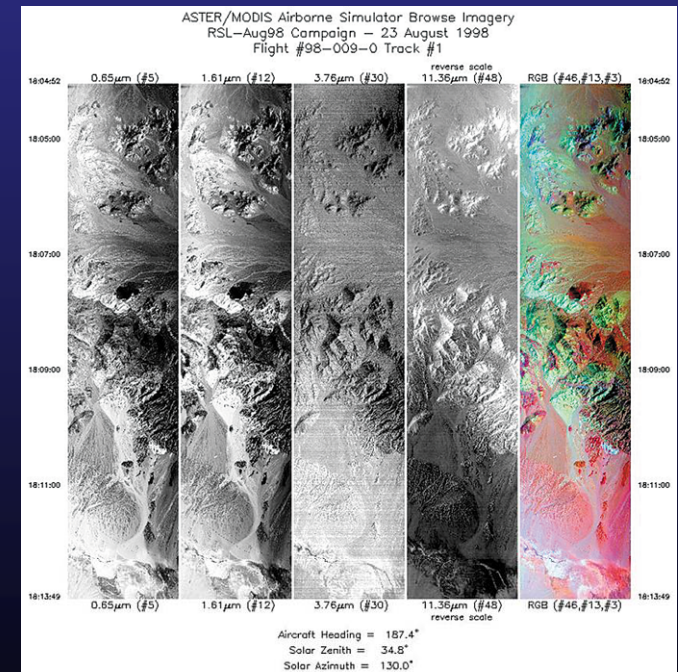


MASTER: the MODIS/ASTER Airborne Simulator

- Simulates the Terra Advanced Spaceborne Thermal Emission Reflection Radiometer (ASTER) and MODIS Sensors
- Supports NASA Earth Science and Natural Hazards Research
- 50 Spectral bands in four spectral regions (visible through thermal infrared)
- Automated Geo-Referencing

Spectral Range (μm)	Number of Bands	Bandwidth (μm)
0.440 - 0.965	11	0.040
1.600 - 2.427	14	0.050
3.075 - 5.325	15	0.150
7.700 - 13.000	10	0.500

<http://masterweb.jpl.nasa.gov>



MASTER: So Cal Fire Assessment

Acquisition Dates
November 5 – 15, 2007

- 5m Resolution
- 79 Flight lines
- 950 Nautical miles
- 54 Gbytes data

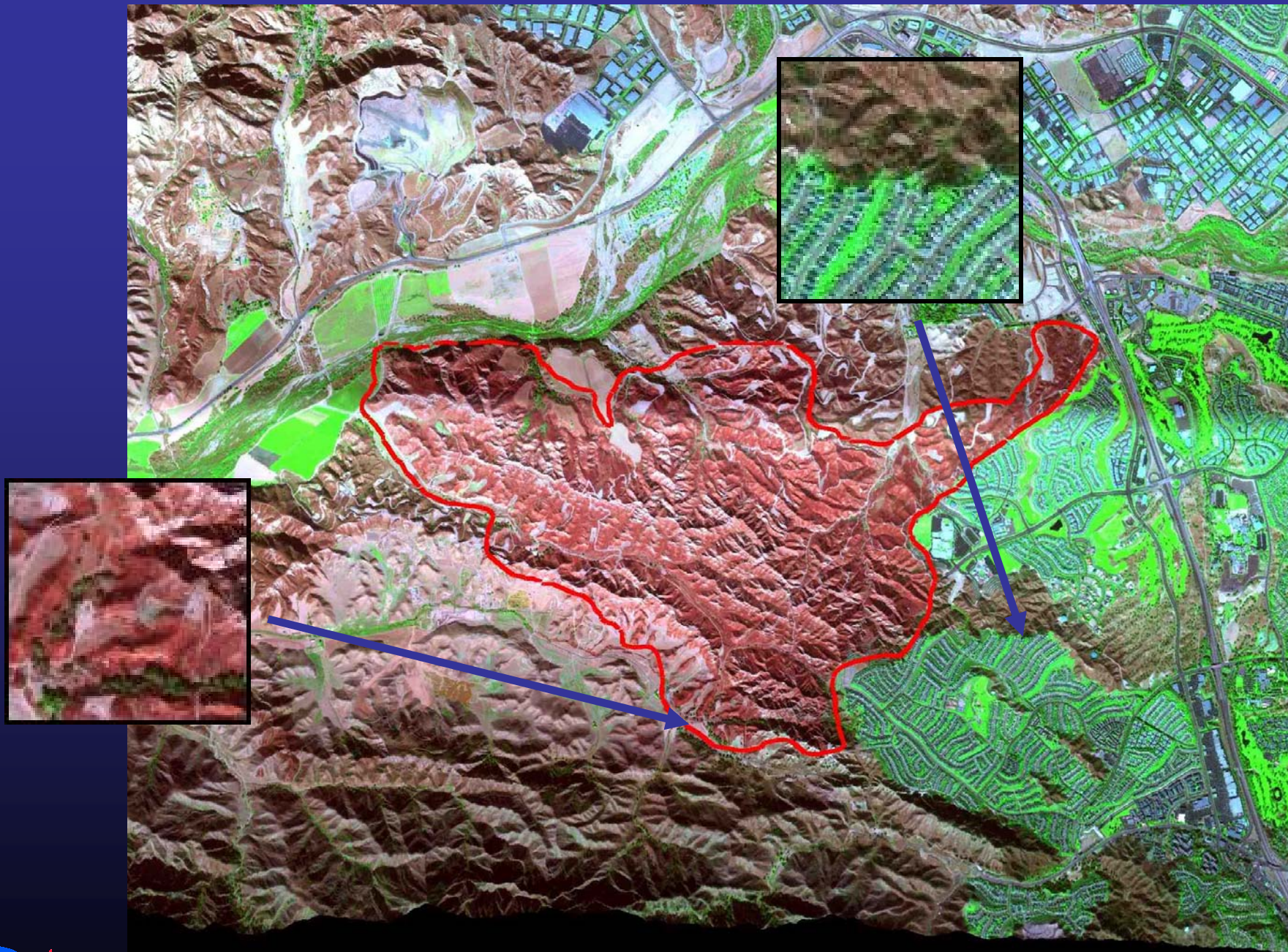


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Mission Parameters

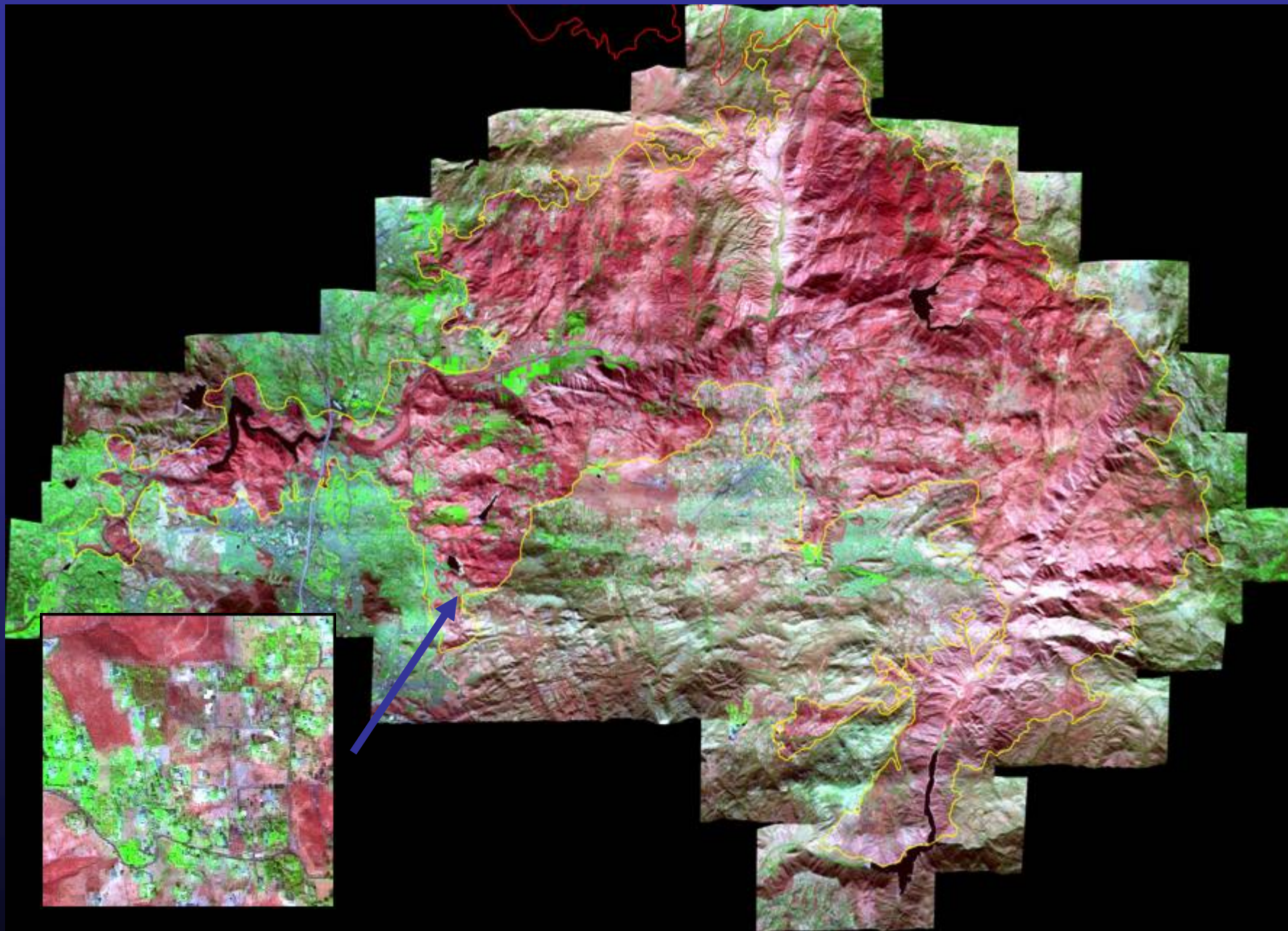
- **B200 Aircraft at 6500' AGL, 190kts**
- **79 flight lines; 950 nm (1,759 km) total**
- **6 Data flights (Nov. 5 – 15, 2007)**
- **5 meter ground resolution**
- **2 nm (3.7 km) swath width**
- **10:00 – 14:00L daily flight window
(solar elevation > 35 deg)**
- **53.8 Gbytes of data acquired.**



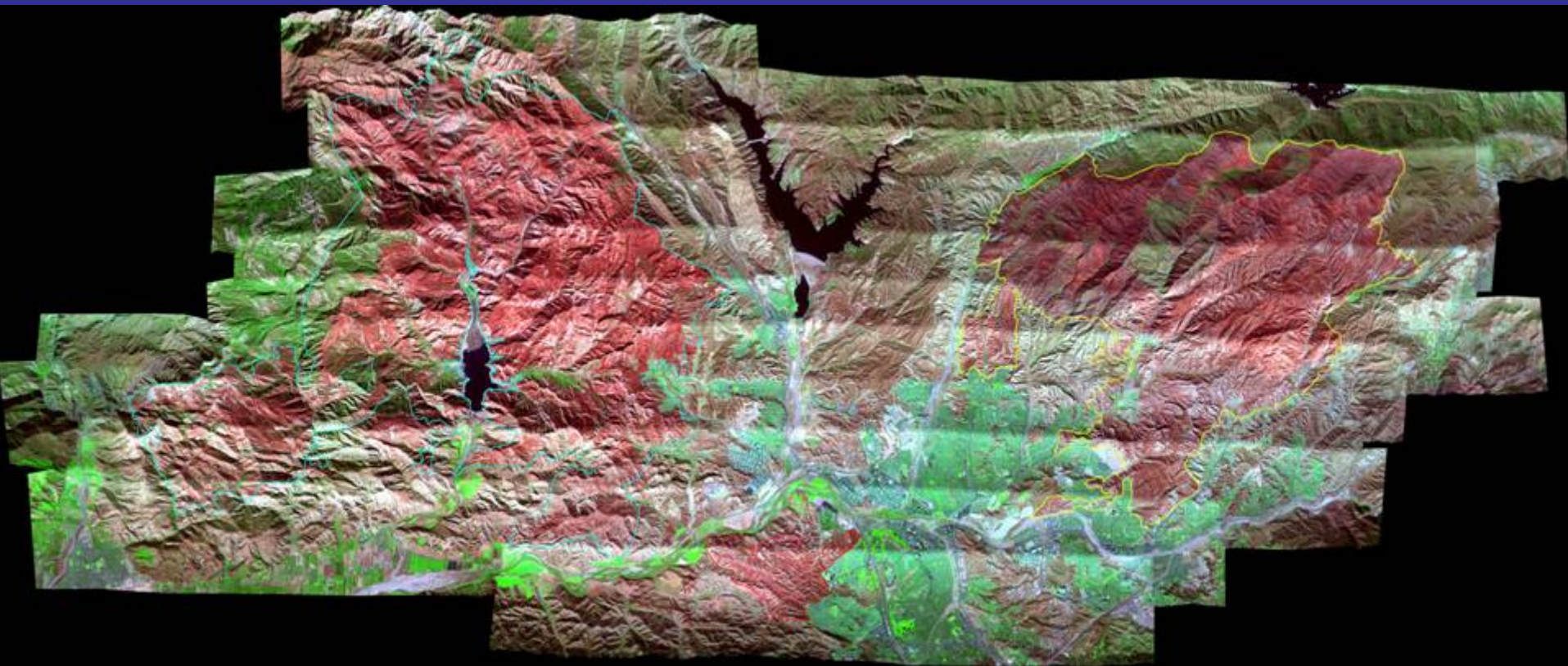


Magic Burn Area

Acquired November 7,12, 2007



Witch Burn Area Acquired November 13-14, 2007



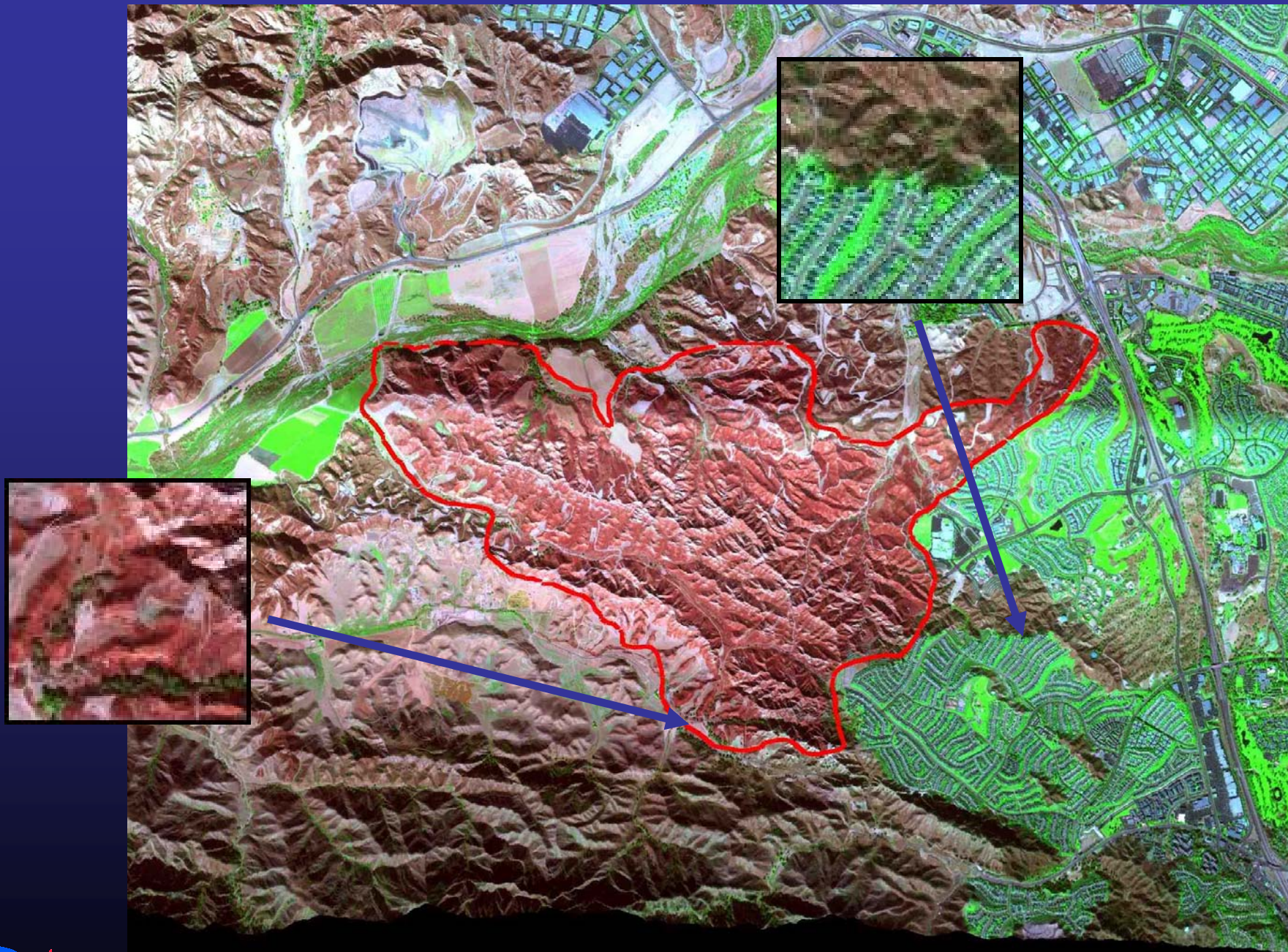
Ranch / Magic / Buckweed Burn Areas
Acquired November 5, 7, 12, 2007



Ranch Burn Area

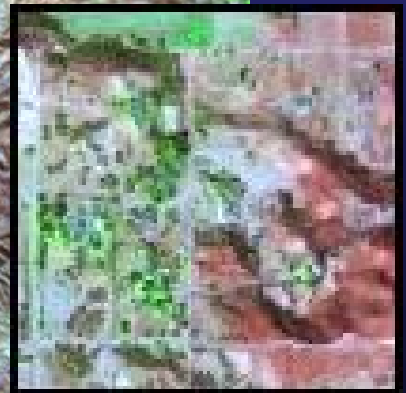
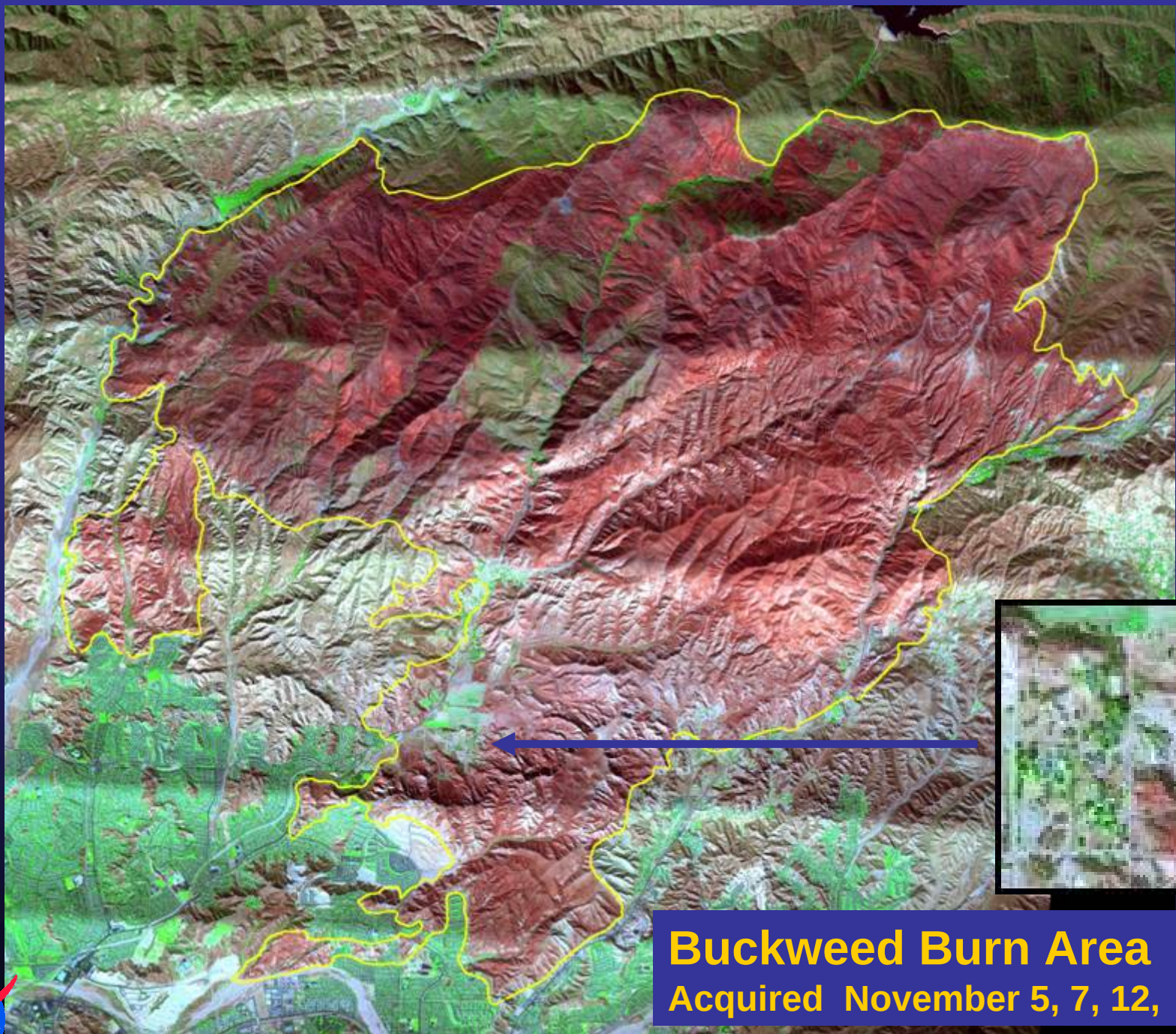
Acquired
November 5, 7, 12, 2007



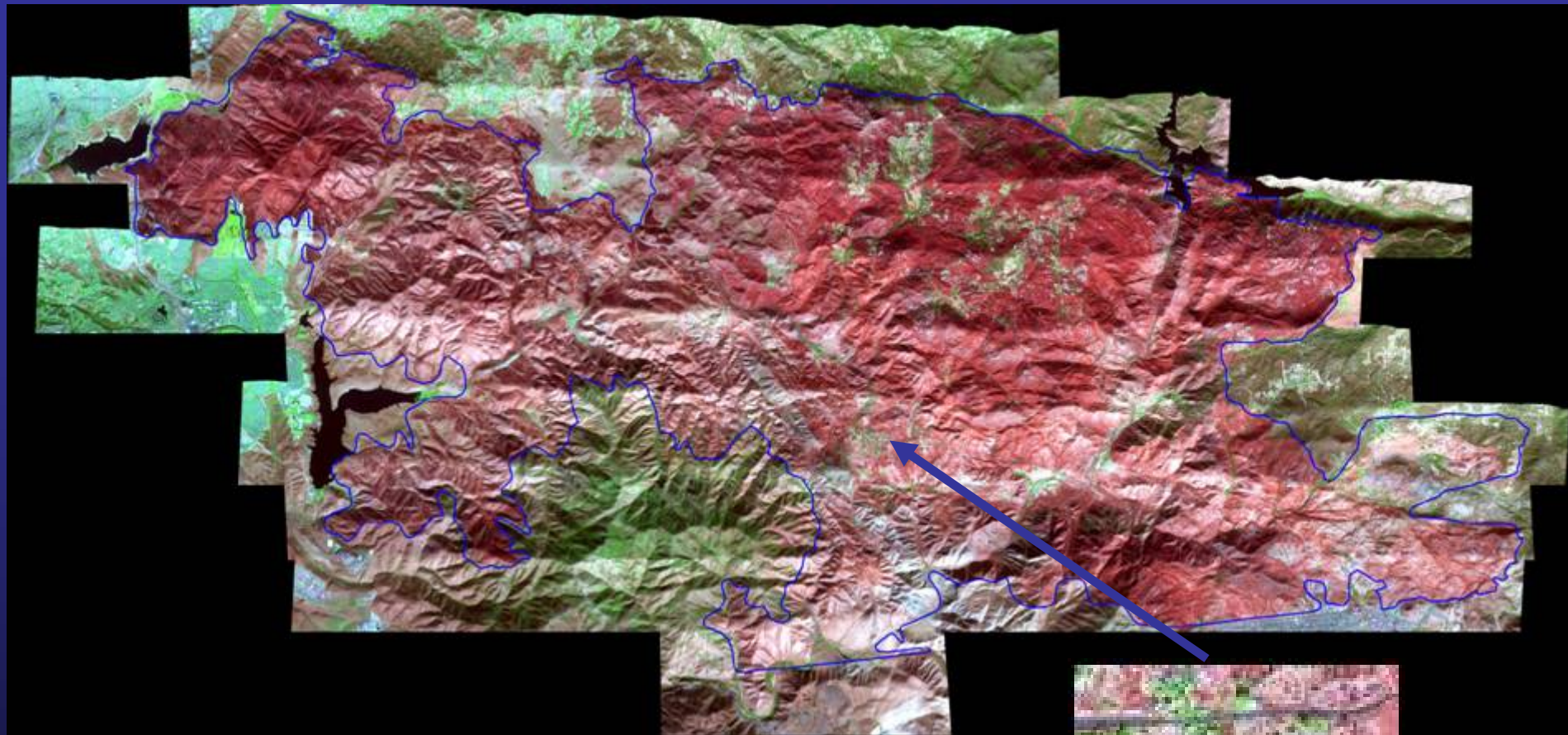


Magic Burn Area

Acquired November 7,12, 2007



Buckweed Burn Area
Acquired November 5, 7, 12, 2007

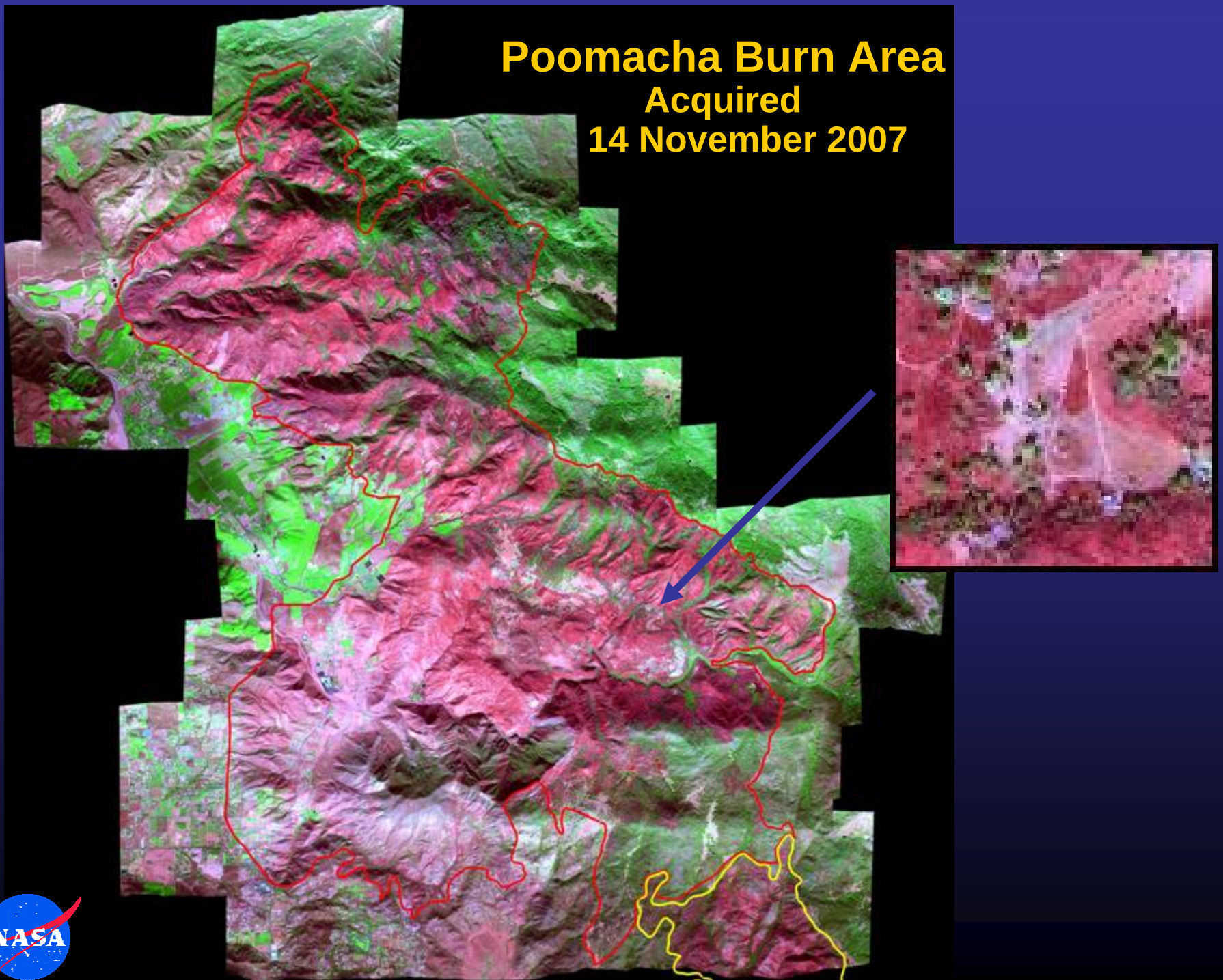


Harris Burn Area
Acquired
13 November 2007



Poomacha Burn Area

Acquired
14 November 2007



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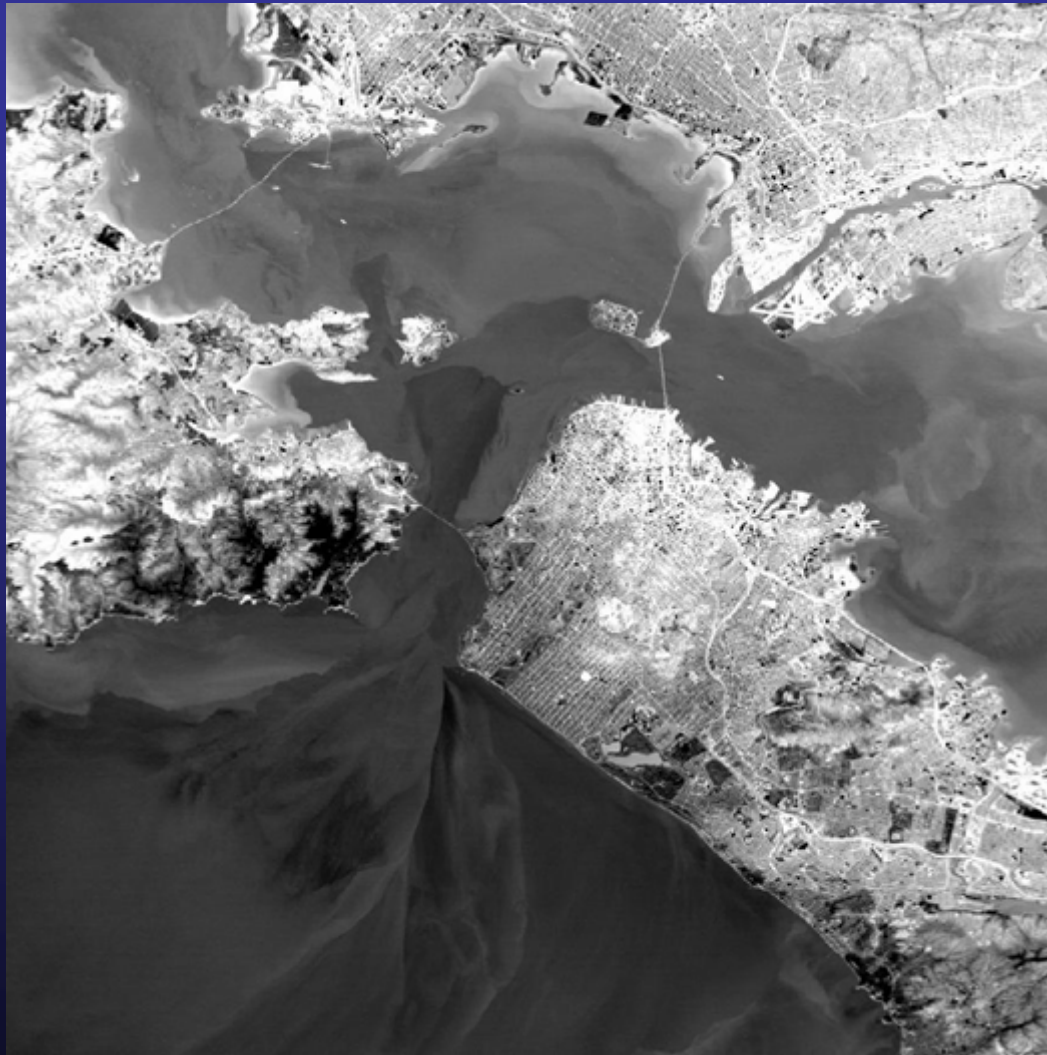
Slide Fire Burn Area (MASTER/B200)

R 2.2um G 0.87um B 0.65um



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San Francisco Bay Surface Temperature



ER-2 MAS 3-27-04 (50m)



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