The FiRe CTO Design Challenge: Wildfire Technology

May 23, 2008

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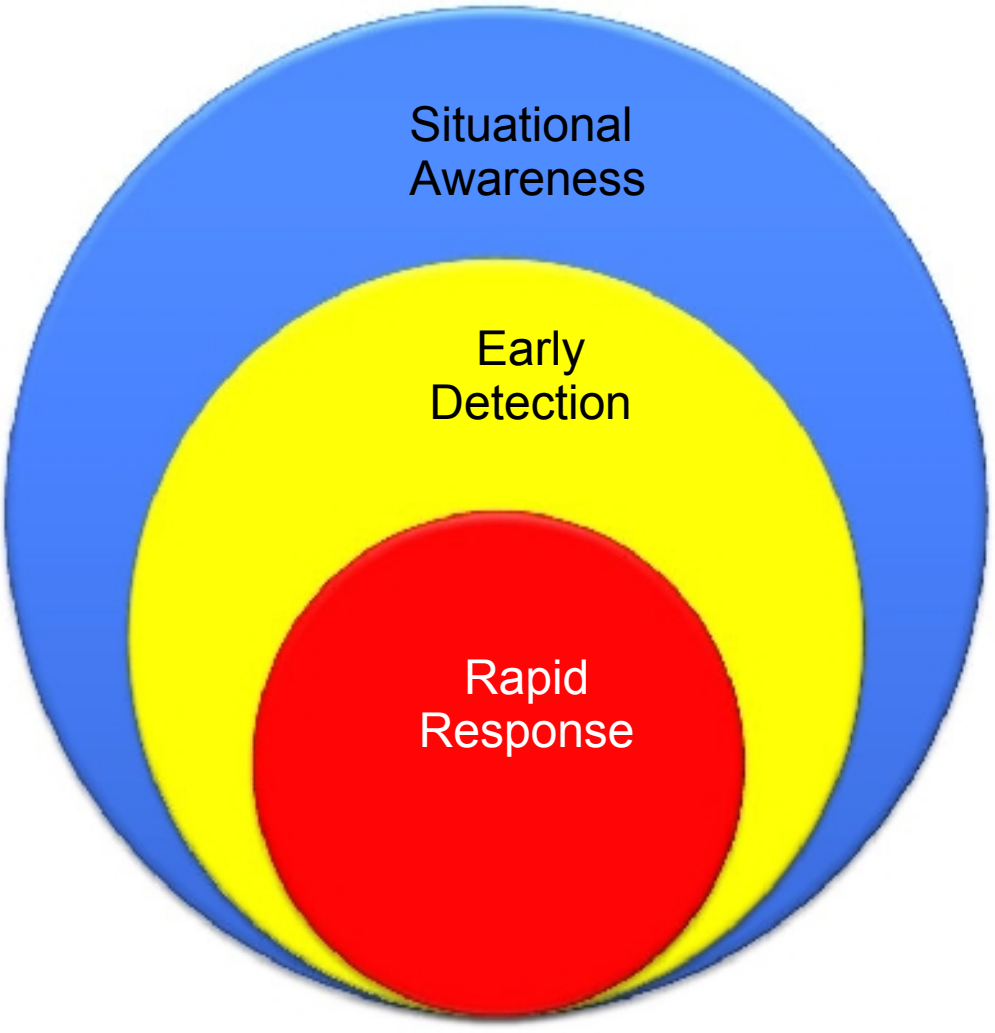
Ron Lane, SD OES

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Problem Statement

- **Focus on Fire Storms--Wildfires Driven by Santa Anna Winds**
  - **Questions Posed by Fire F**
    - **Where is the Fire Now?**
    - **Where is it Going?**
    - **When Will it Get there?**
- **Objectives:**
  - **Situational Awareness**
  - **Early Detection**
  - **Rapid Response**
- **Benefits**
  - **Save Lives**
  - **Save Property**
    - **Reduce Insurance Cost**
    - **Improve Building Codes**
  - **Slow Climate Change (Pre**

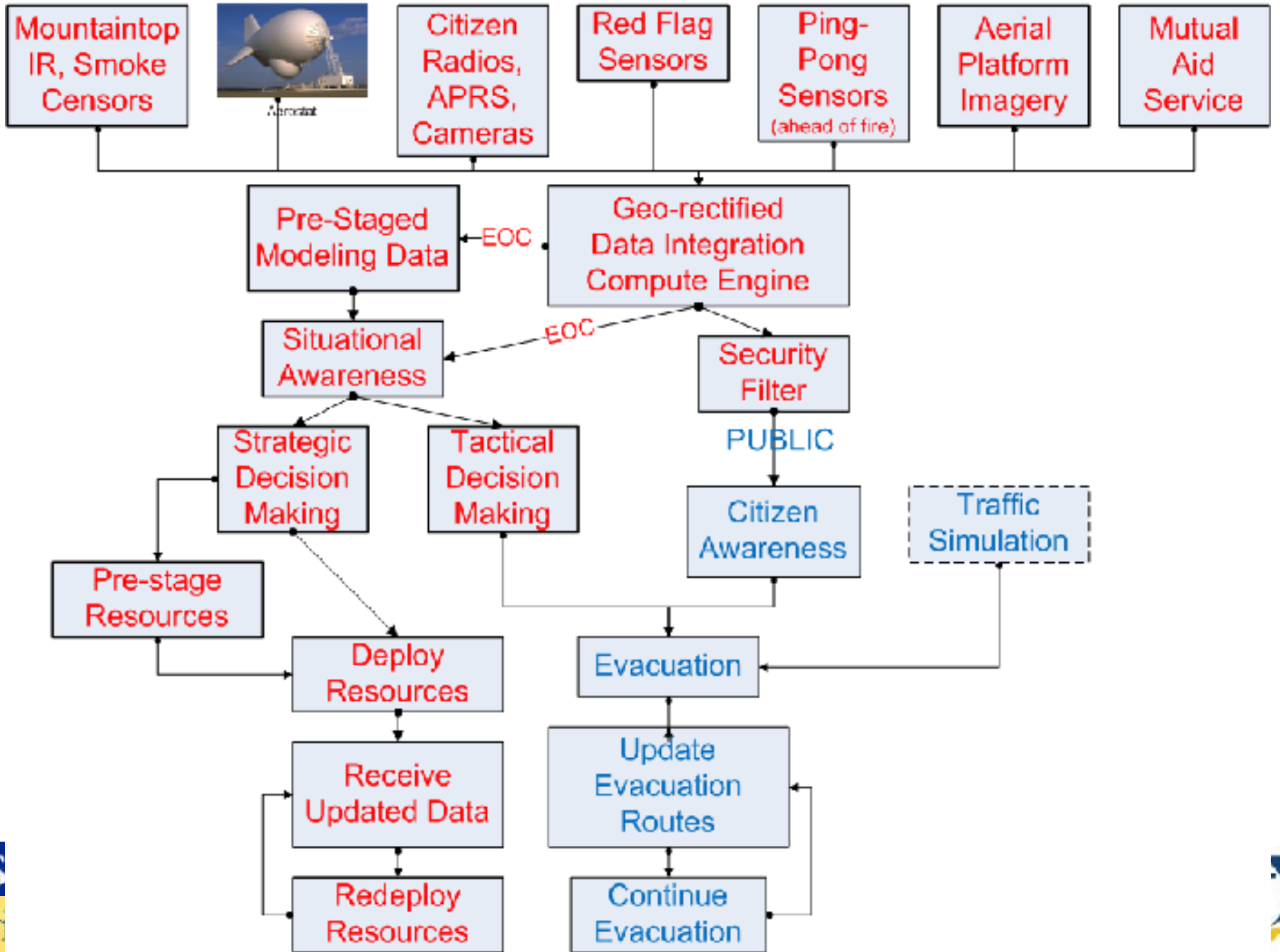


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Recommendation Overview

System Architecture



Early Detection

- **Goal**
  - Ignition To Detection In Less Than 5 Minutes
  - Today Detection ~30 Minutes Day, 1-2 Hours Night
    - Phone Call
    - Email
    - Ham operator
- **Fire Detection Grid Integrated Into Control Center**
  - Leverage/Integrate HPWREN Mountain-Top Weather Stations (Wind, Temp, RH)
    - Environmentally Harden Detection Components
  - Aerostat Balloons, NASA Helios as County-Wide Multi-Spectral Platform
    - Infrared, Smoke, Radar, Etc.
    - Automated Event Recognition & Location
  - Real-time Data Feeds To Control Center
  - #FIRE Mobile GSM Tagged Notification
  - Channel 0 on Family Band Radio (FRS)
  - Monitor Electric, Fiber Optic, And Phone Lines For Vibration

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FIRESNet: Fire Informatics and Realtime Environmental Sensor Network

- **Wireless System**
  - Local (30 Mb/s)
  - Back to UC Riverside
  - Over CENIC to others
- **Sensors Include:**
  - High-Res Cameras
    - All Visible
    - Some IR
  - Met-Stations
  - Particulate Sensors
  - Seismometers



Angora Ridge fire
June 25, 2007







Proposal Under review:
UCSD, VCR, UCD

Source: Graham Kent, SIO, UCSD

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MODIS Images Provide Targeting Information to NASA's EO-1 Satellite Which Cuts Through Smoke

Composite of the
Red, Blue, and Green Channels



Three of the
Shortwave Infrared Channels



October 23, 2007 Witch Wildfire south of Escondido, California

EO-1's Hyperion Spectrometer Observes 220 Contiguous Wavelengths
From Visible Light To Shortwave Infrared

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NASA/EO-1 Team
www.nasa.gov/vision/earth/lookingatearth/socal_wildfires_oct07.html

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Rapid Response

- **Challenge**
  - **Rice Fire of 2007**
    - **Instant Detection**
    - **5 Minute Response Time**
      - When Responders Arrived, Fire Was ~ 50 Acres In Size
    - **Fire Grew to 10,000 Acres Before Containment**
- **Recommendations**
  - **Tankers, Predators on Standby**
    - **Attempt to Retard Fire**
      - GPS Coordinates from Early Detection
  - **Simulation Models to Predict Path/Behavior of Fire**
    - **Pre-Position Resources**
      - Scatter Ping Pong Sensors Ahead of Projected Path
  - **Early Grounding of Shorts During Peak Risk Periods**
  - **SMS Message Emergency Push Capability**

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Result: Accurate & Coordinated Real Time Resource Management

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Situational Awareness

- **Modeling of firestorm scenarios for training in advance of event**
  - Repurpose and customize LANL models for San Diego
  - Simulation “war games” for training
  - Real time prediction
  - Triage
  - Resource re-deployment
  - Update policies based on modeling output

- **Current state integrated in a GEO-referenced framework**
  - Data Inputs: GIS, GPS, wind flow field, temperature, humidity, fuel load (hyperspectral & IFSAR imaging) , topology, event (fire) location, Fire Fighting personnel & resources, power lines, roads, water supplies, homes/property, CERT and civilian sources, News Media, aerial platform imagery
  - Output: GIS layers integrated into the EOC, data federation based on role (emergency personnel, public, etc.)
  - Mutual Aid Service: GIS/GSM integration into situational awareness

- **Early Detection**
  - Monitor electric, fiber optic, and phone lines for vibration

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NASA's Aqua Satellite's MODIS Instrument Provided "Situational Awareness" of the 14 SoCal Fires

Calit2, SDSU, and NASA Goddard Used NASA Prioritization and OptIPuter Links to Cut time to Receive Images from 24 to 3 Hours



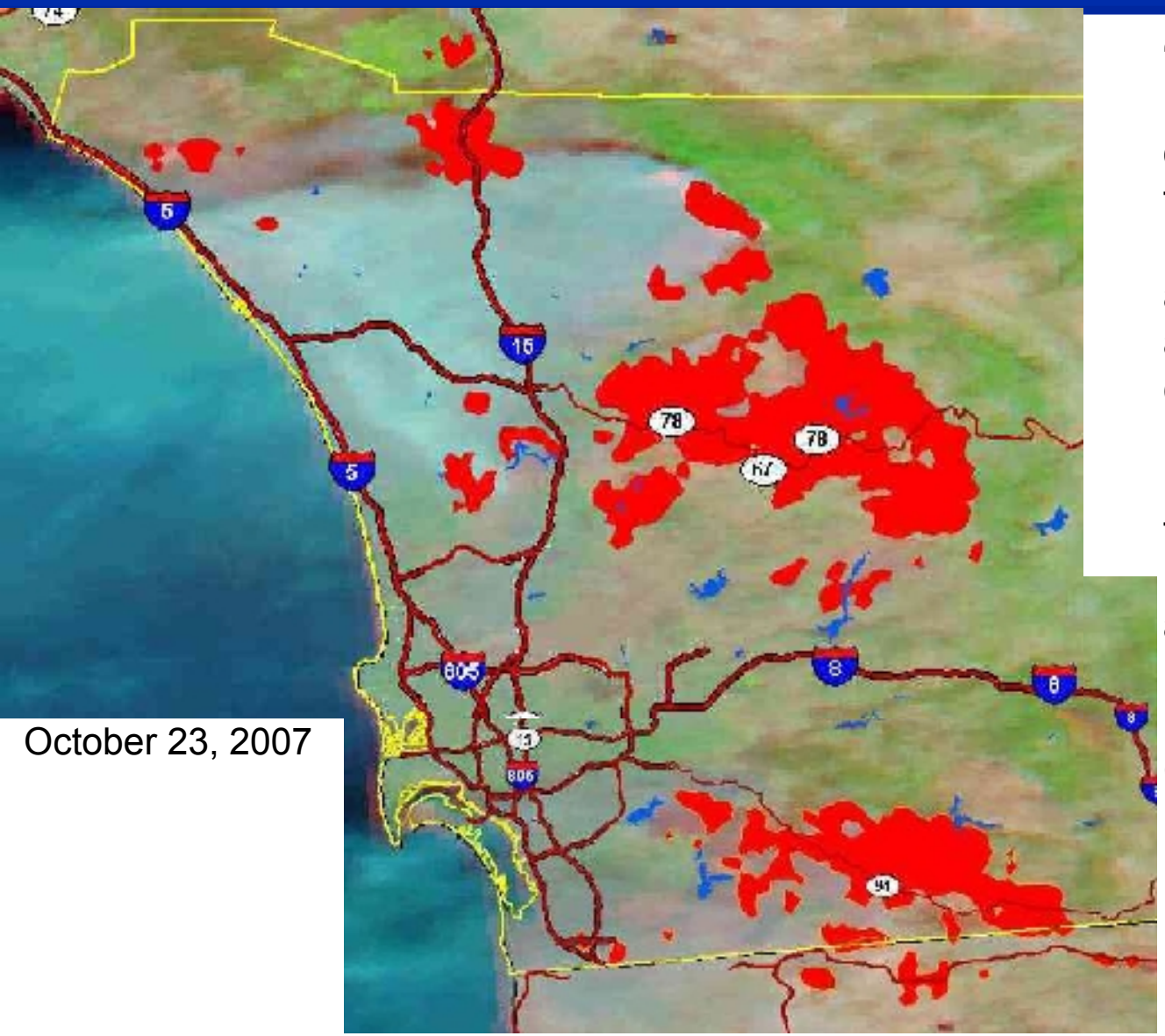
Moderate Resolution Imaging Spectroradiometer (MODIS)

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NASA/MODIS Rapid Response
www.nasa.gov/vision/earth/lookingatearth/socal_wildfires_oct07.html

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SDSU's San Diego GIS Force Group of Volunteers Geo-Referenced MODIS Data and Distributed Over Web



October 23, 2007

"We apologize for the slow server performance in the first two days of the wildfires (Oct. 21 & 22) due to overloaded requests from Web users. Tuesday we were given access to major Intel computers at Calit2 at UCSD and special connectivity between SDSU and UCSD (OptIPuter) from which this page is now being served (special thanks to John Graham, Eric Frost, Larry Smarr, John DeNune, and Cristiano). It is super fast now."

-- SDSU Department of Geography, Oct. 25, 11:00am.

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Site organized by Dr. Ming-Hsiang Tsou, SDSU

http://map.sdsu.edu/

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Communications

- Fire & Emergency Personnel
  - Enhanced Data Capabilities
    - Extend to Individual Actors
  - Current State Data on Fire: Location, Predicted Path & Timing
  - GIS Integrated View of Resource Locations
- Public
  - Current State Data on Fire
  - Evacuation Planning and Execution
  - News and Media Feeds
  - SDSU Fire Web Site (map.SDSU.edu & KPBS.org)
  - CERT Integration of Data & Procedures (# Fire, Amber Alert feeds, etc.)
- Communications Robustness
  - Scalable Replica Web Servers
  - Mobile Cellular Transmitter
    - Resilient to Local Cellular Tower Loss
    - Capacity Prioritized for Emergency Responders

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Calit2 Added Live Feeds From HPWREN Cameras to KPBS Google Map



www.calit2.net/newsroom/release.php?id=1194

Recommendation Summary

- System Architecture
  - Current state and predictive data integration
    - Where is fire now
    - Where is it going
    - When will it get there
  - Objectives
    - Situational Awareness
    - Communications Effectiveness
    - Early detection
    - Rapid Response
  - Benefits
    - Reduce insurance costs
    - Improve building codes
    - Save lives
    - Save property
    - Save the earth (prevent liberation of sequestered carbon
- Policy Dependencies

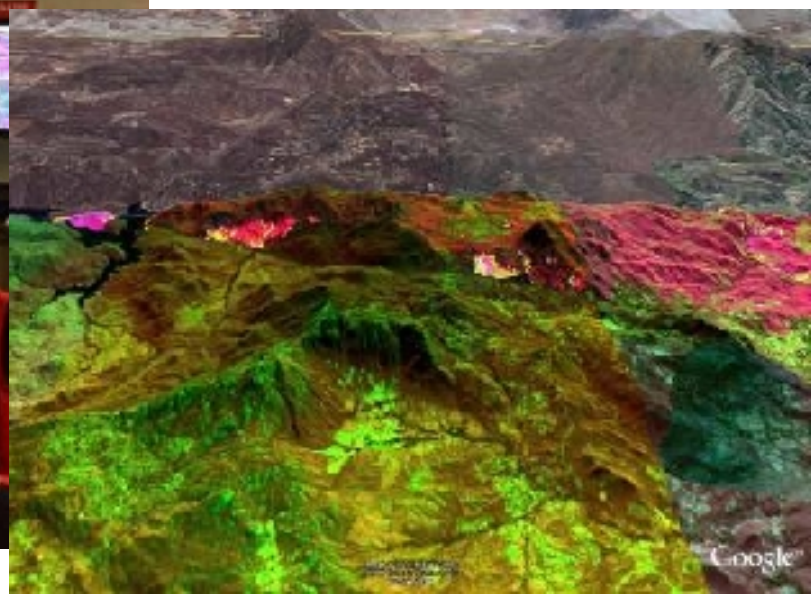
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Upgraded Command Center Integrating Early Detection, Rapid Response, Situational Awareness

www.nasa.gov/centers/dryden/news/Features/2007/wildfire_socal_10_07.html



Flight Plan and Ikhana Data Displayed in San Diego Emergency Operations Center's Situation Room



Pilot Flies Predator B from NASA Dryden in Edwards AF Base





NASA Ikhana Carrying Autonomous Modular Scanner on 8 Hour Flight, Coordinated with the FAA, Downlinks to NASA Ames

NASA Ames Overlaid Thermal-Infrared Images on Google Earth Maps, Transmitted in Near-Real Time to the Interagency Fire Center in Boise, Idaho