Key Issues In Use of UAV’s For Disaster Management

- Match the sensor and airframe to the “event.”
- Provide autonomous or “remote operation” capabilities to sensor.
- Provide capabilities for data telemetry.
- Examine data compression if required to telemeter large data volumes.
- Capabilities for data handling on ground.
- Information distribution to community.
Improved Airborne Platforms (UAVs)

**Goals:** Provide technology development and demonstrations that prove and extend the use of UAVs to collect critical disaster information in real-time to affect decision processes.

**Driving the development of UAV technology for utility in disaster management**
UAVs Provide Unique Assets

Data Acquisition Capabilities

**UAVs Allow:**
- Extreme Altitude Flight
- Continuous flight for hours to days
- No pilot on board
- Real-time telemetry capabilities

**Digital Imaging Sensors:**
- AIRDAS, DASI, ARTIS, ALFI, Kodak, Bassler, DuncanTech, Microbolometer
UAV platform providing long-duration flights w/o pilot in hazardous conditions (24/7).

- Integrated remote-operated, adaptive, multi-spectral sensor (AIRDAS) payload.
- Integrated OTH satellite telemetry communications.
- Geo-rectify image data in real time.
- Global distribution to WWW.
ALTUS II PLATFORM

ALTUS Specifications:

- **Wing Span:** 55.3 ft.; **Length:** 23.6 ft.; **Height:** 9.8 ft.
- **Weights:** Max GTOW: 2150 lb; **Payload:** 330 lb
- **Navigation:** Litton LN-100G INS/P-Code GPS
- **Avionics:** C-Band Line-Of-Sight RF; adaptable for OTH Operations; Remote Operations or autonomous

Performance:

- **Max Altitude:** 65,000 Feet
- **Endurance:** 8 Hours @ 60K ft.
  - 18 Hours @ 30K ft.
  - 24 Hours @ 25K ft.
- **Max Speed:** 100 KIAS
- **Cruise / Loiter Speed:** 65 KIAS
- **Range:** ~1500 Mi. at 25K ft.
Sensor Development & Application

Develop a high-temperature calibrated airborne thermal imaging system suitable for fire imaging and measurement

The AIRDAS Optical Head in the ALTUS UAV payload compartment

Bands: 1 (0.61 - 0.68) 2 (1.57 - 1.70) 3 (3.60 - 5.50) 4 (5.50 - 13.0)

Calibration: IR bands to +600°C.
Spectral and Radiometric – twice a year

FOV: 108 degrees
IFOV: 2.62 milliradians
Scan Rate: 4-23 scans/sec.
Digitized Swath Width: 720 pixels
Ground Resolution: 8m at 10K feet

The ALTUS II UAV with the AIRDAS payload aboard during FiRE Mission
Real Time Data Telemetry Development

INMARSAT Global Area Network Service Coverage
- Pure Digital Interface
- Clean Upgrade Path
- Upgrade satcom network to 432 kbit/s in 2005
- Worldwide coverage

Driving the development of data telemetry technology for utility in disaster management

NERA WC M4
64KBS
Planned to 432 Kbs

GA-ASI 500Kbs
C&C / data telemetry
Disaster (Fire) Decision Support Systems

The ability to telemeter highly calibrated thermal instrument data in near-real-time is essential to supporting tactical fire operations within the fire fighting community.

Real-time data geo-rectification procedures allow the tactical fire product to be integrated into the fire manager’s decision support system for overlay with other critical data.

AIRDAS Data – Baker Fire, CA 1997, time-series analysis.

AIRDAS Data – Tire Fire, CA 1999, geo-rectified and overlain on 7.5' digital quad.

AIRDAS Data – Baker Fire, CA 1997, geo-rectified imagery.

AIRDAS Data – Tire Fire, CA 1999, geo-rectified and draped over SRTM terrain data.

Fire Incident Command Center (ICC) – Assimilation of Fire Remote Sensing Information and Data into the Fire Decision Support System.
Heritage of UAV Fire Imaging At NASA-Ames

**FiRE (2001)**
- AIRDAS system / ALTUS UAV
- NERA / INMARSAT data telemetry – 64 Kbs
- Three channel color data (thermal, IR and vis)
- Data available (geo-rectified) in 15 minutes

**FiRE II (2004)**
- ALTUS II performing in FAA NA
- High Altitude (20-55K ft)
- AIRDAS Payload / 500Kbs Telemetry
- Wildfire Condition
- Real-time scramble and data relay
- Geo-rectify and terrain fit using SRTM

**Western States Mission (2004-2005)**
- AIRDAS, Radar, and Skyball systems / ALTAIR UAV
- Ku Band Telemetry – 512 Kbs
- Multiple channel color data
- Data available for many fires over Western US in 10 minutes
Attainable Capabilities

- Operate payload and platform remotely.
- OTH data telemetry lock-on and transmission in 1-2 minutes!
- Disaster image data available at WWW within 2-3 minutes of collection!
- Geo-correction and re-distribution to WWW in 7 minutes!
- Total time (from collection to distribution): ~10-15 minutes!!!
ALTAIR Specifications:

- Wing Span: 84 ft.; Length: 36.2 ft.; Height: 11.8 ft.
- Weight: Max GTOW 7700 lbs.; Payload: 750 lbs.
- Max Altitude: 55K feet
- Endurance: 32 hrs w/ 700 lb payload
- Cruise / Loiter Speed: 144 KIAS; Range: 4500 nm
- C-Band LOS Range: 100 nm; 500 Kbs Ku-band OTH Operations; Autonomous flight capable
- Navigation: 3 integrated IMU’s & 3 D-GPS

Mission Plan with ALTAIR UAV:

- Fly +24 Hr Mission over Western US
- Collect AIRDAS data over multiple fires
- Telemeter via Ku-band to ground
- Real-time image rectification
- Distribute information to web and ICC’s

ALTAIR FiRE
Entertaining Ideas, Partnerships, and Collaboration Towards Improved Use of UAVs For Disaster Management

- Volcanic Event Monitoring
- Tsunami Monitoring
- Hurricane Tracking
- Flooding and Major Storm Events
- Earthquake-triggered events
Contact and Further Info

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FiRE Project Web Site:
  http://geo.arc.nasa.gov/sge/UAVFiRE

UAV Applications Center Web Site:
  http://www.uav-applications.org

NASA Ecosystems Branch Web Site:
  http://geo.arc.nasa.gov/sge