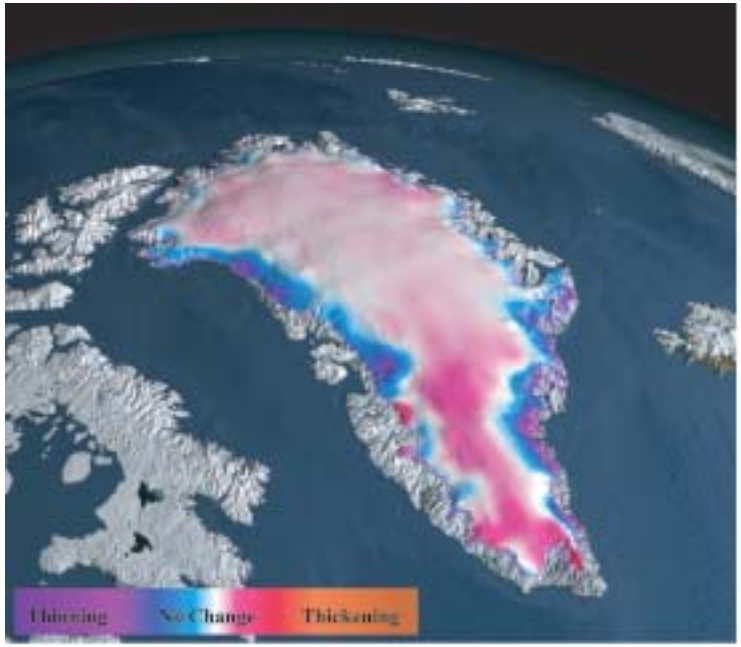
Airborne Science Program Support for International Polar Year (IPY) Missions

Climate Change / Cryosphere Science



- Sea ice roughness
- Ice thickness and topography
- Glacier changes
- Arctic cloud properties
- Polar atmospheric measurements

Other IPY supported activities include ARCTAS and AMISA

International Polar Year Missions

ASP Management of Instrument Development, Test Flights, and Missions for IPY

PI	Instrument	Platform	Mission location	Mission Schedule
Maslanik, CU	Ice profilometer	Aerosonde or Sierra	Barrow, AK; Svalbard	Spring 09
Moller, JPL	Ka-band SAR	G-III	Greenland	Spring 09
Zebker, Stanford	L-band SAR	G-III	Greenland	Spring 09
McGill, GSFC	Cloud Physics Lidar	Global Hawk	Alaska	Spring 09
Mahoney, JPL	Microwave Temperature Profiler	Global Hawk	Alaska	Spring 09

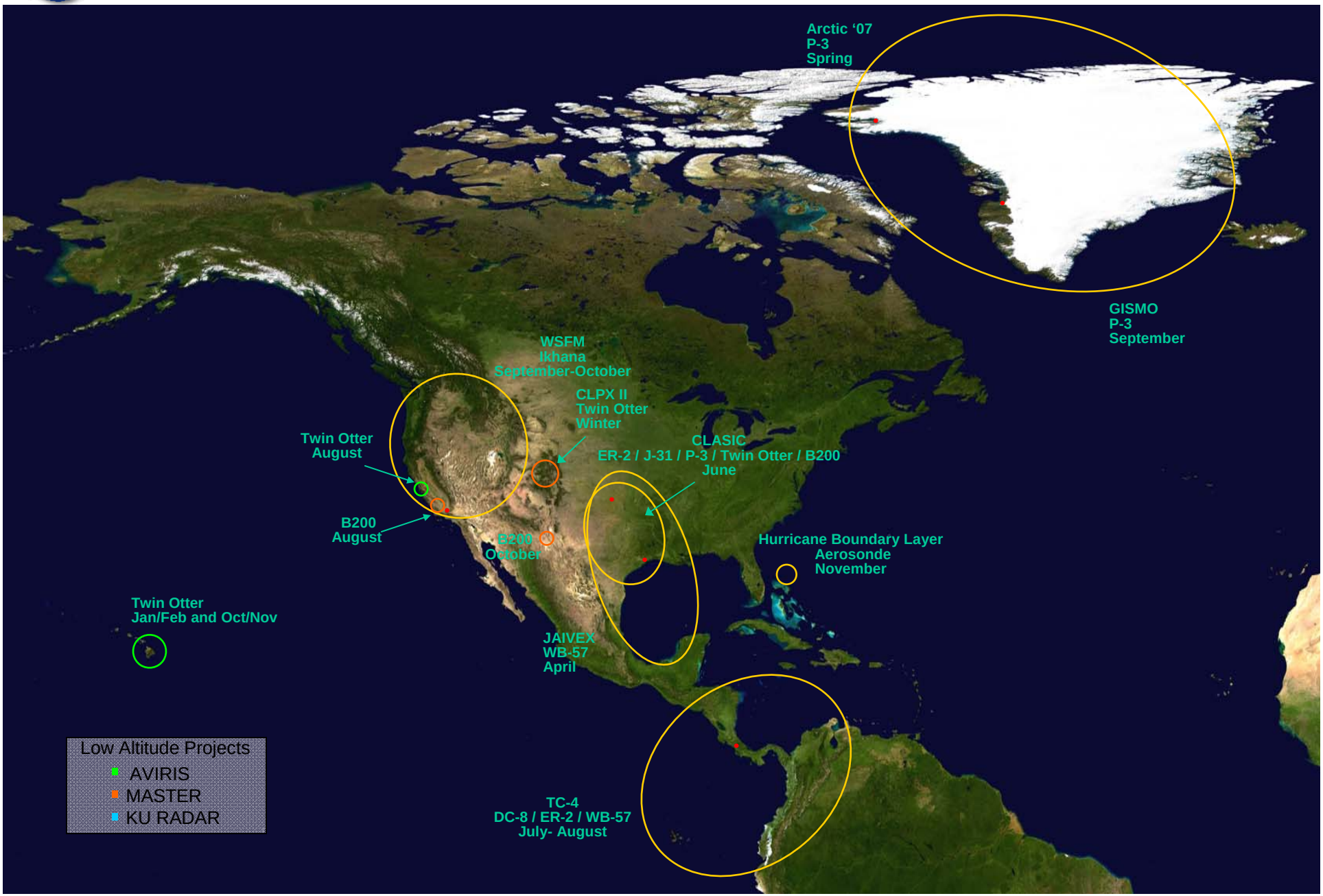
NASA Ames Research Center Program Elements

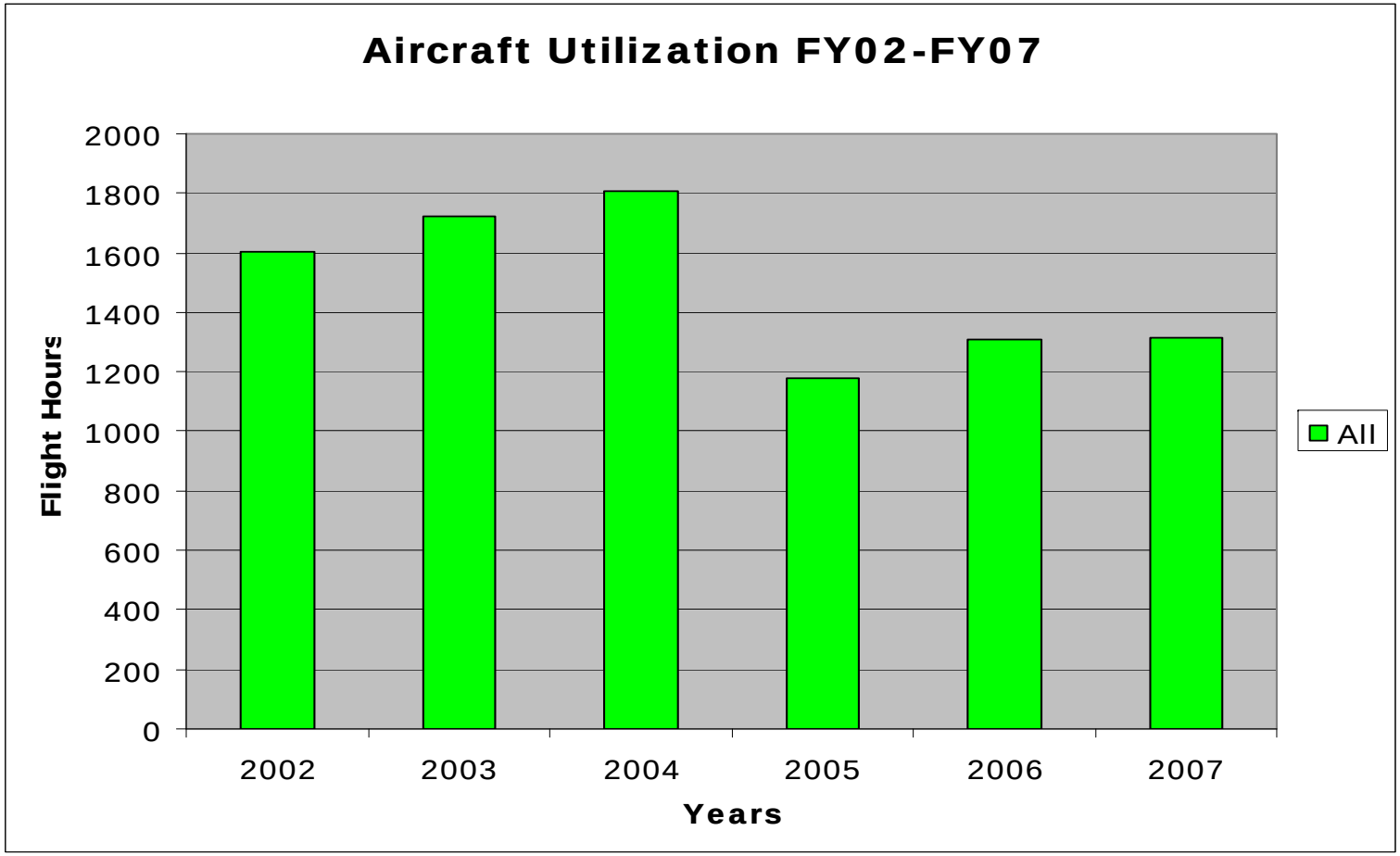
Matt Fladeland – Airborne Science Manager
Mike Craig – ESPO Director
Marilyn Vasques – Flight Request Manager
Jeff M[illegible] (UCSC) – ASTL Director

NASA Ames ASP Program Elements

- **Earth Science Projects Office**
  - Mission management
  - Flight request management
  - Lesson's learned
- **Airborne Science Office**
  - Requirements Analysis
  - Strategic Planning
  - Program Development
- **Payloads and Instrumentation element**
  - Upgrades and operations of MAS & MASTER
  - Calibration facility (NIST traceable)
  - Next generation Navigation data recorders
- **New Technology**
  - SIERRA UAS
  - CDE/RTMM mission tool development (ARC/MSFC/DFRC)
  - SBIR instrument development

2007 Airborne Campaigns




Aircraft Utilization FY02-FY07
Flight Hours
2000
1800
1600
1400
1200
1000
800
600
400
200
0
2002
2003
2004
2005
2006
2007
Years
All

Aircraft	Submitted	Total Approved	Total Completed	Total Science Flight Hours Flown
DC-8	5	1	1	104.8
ER-2	10	4	4	190.4
P-3	17	11	10	250.9
WB-57	6	2	2	83.8
Twin Otter	18	15	7	171.7
B-200	8	4	3	212.4
Caravan	2	1	1	7.3
G-3	1	1	1	101.9
J-31	8	1	1	22.8
Aerosonde	11	2	1	11
Altair	5	5	5	98.4
Ikhana	1	1	1	61
TOTAL	92	47	37	1316

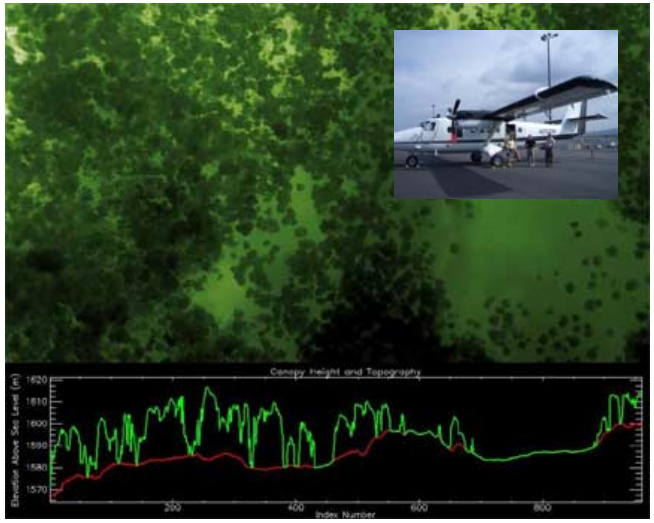
*The Langley B-200 flight hours we completed separate from the flight request system but the flight hours (117.4) are reflected in the B-200 total hours.

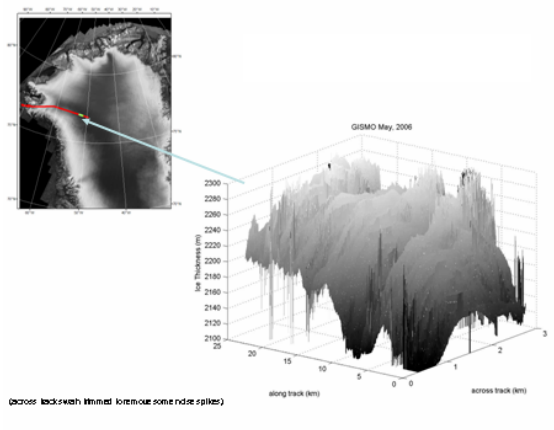
Major Mission Accomplishments in FY2007

- Arctic 2007
- Carbon Airborne Observatory testflights (CAO)
- Cloud and Land Surface Interaction Campaign (CLASIC)
- Cold Process Field Experiment (CLPX II)
- Cosmic Dust Collection
- Global Ice Sheet Mapping Orbiter (GISMO)
- Joint Airborne IASI Validation Experiment (JAIVEx)
- Raman Airborne Spectroscopic Lidar testflight (RASL)
- Radar Synthetic Aperture Thinned Array (RADSTAR) A/P
- Tropical Composition, Cloud, and Climate Coupling (TC-4)
- Western States Fire Mission (WSFM)

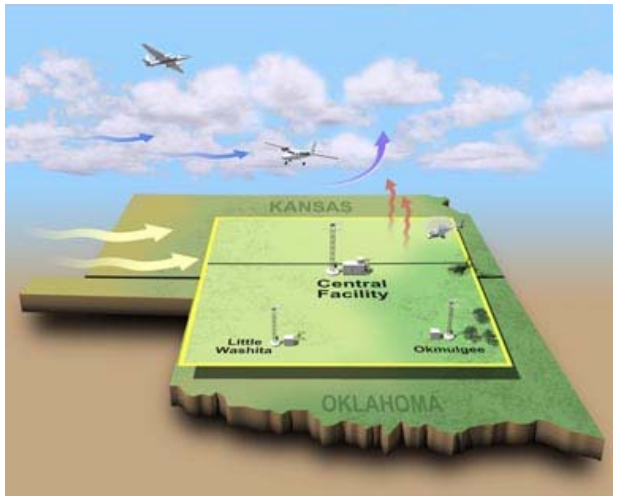
Instrument Test-flights in FY2007

- Pathfinder Advanced Radar Ice Sounder (PARIS) – P-3
- Carbon Airborne Observatory (CAO) – Twin Otter
- Global Ice Sheet Mapping Orbiter (GISMO) – P-3
- Raman Airborne Spectroscopic Lidar (RASL) – B-200
- Radar Synthetic Aperture Thinned Array, Active/Passive (RadSTAR A/P) – P-3

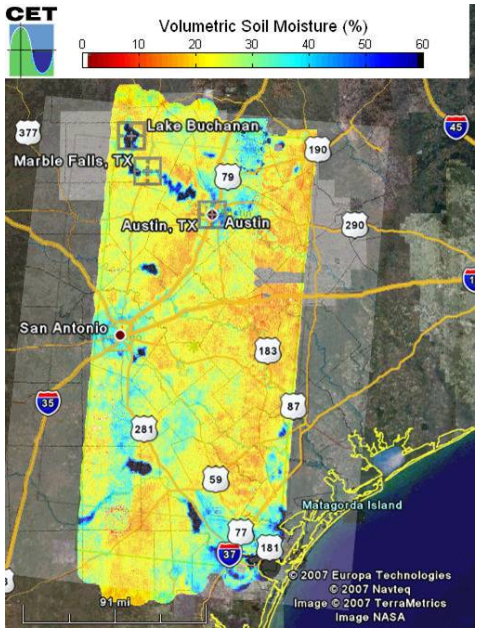




Cloud and Land Surface Interaction Experiment (CLASIC)



This DOE-sponsored CLASIC campaign focused on the influence of land surface processes on the evolution of cumulus convection, especially the stages leading from fair weather clouds to storm clouds.



- The P-3 flew the AATS-14 sunphotometer and the PSR

- The ER-2 carried the MAS instrument

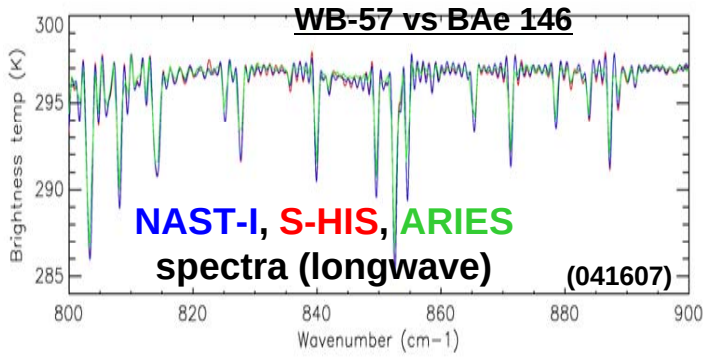
- The NASA contracted J-31 flew the CAR

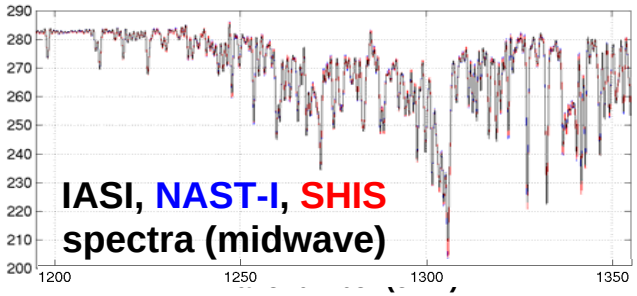
- NASA Argus sensor was flown on the CIRPAS Twin Otter

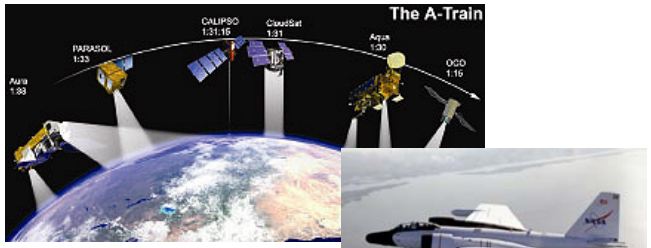
- NASA LARC B-200 supported the affiliated CHAPS study looking at aerosols above, within, and below fields of fair-weather clouds.

Joint Airborne IASI Validation Experiment (JAIVEx)

In-field radiance inter-comparison:







- Aqua AIRS validation using NAST-I flown on
- the WB-57 as part of an international
- experiment to compare A-Train and Metop-A
- measurements in preparation for NPP and
- NPOESS validation activities

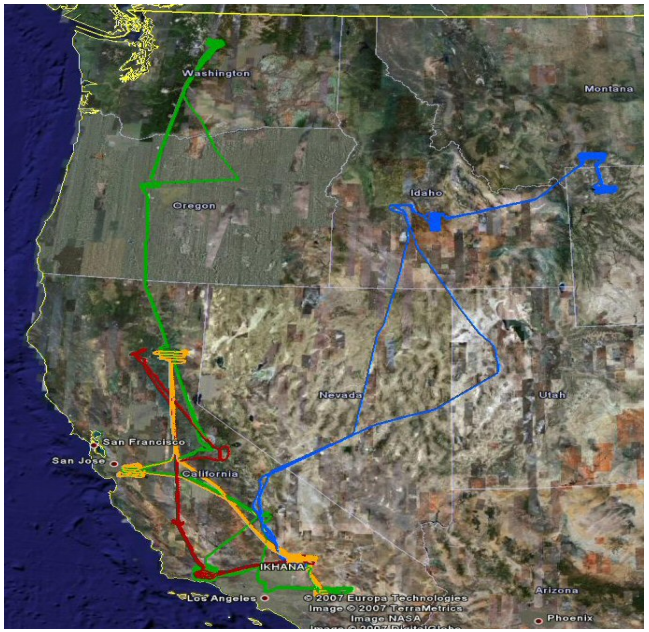
- **Location/dates**
  - **Ellington Field (EFD), Houston, TX, 14 Apr – 4 May, 2007**
- **Aircraft**
  - **NASA WB-57 (NAST-I, NAST-M, S-HIS)**
  - **UK FAAM BAe146-301 (ARIES, MARSS, SWS; dropsondes; in-situ cloud phys. & trace species)**
- **Satellites**
  - **Metop (IASI, AMSU, MHS, AVHRR, HIRS, ASCAT)**
  - **A-train (Aqua AIRS, AMSU, HSB, MODIS; Aura TES; CloudSat; and Calipso)**
- **Ground-sites**
  - **DOE ARM CART site (RAOBS, Raman Lidar, AERI, etc.) & GOM (scene uniformity—radiometric, spatial, & spectral)**
- **Participants**
  - **LaRC, UKMO, UW, MIT, MIT-LL, NASA, IPO, EUMETSAT, ECMWF, + …**

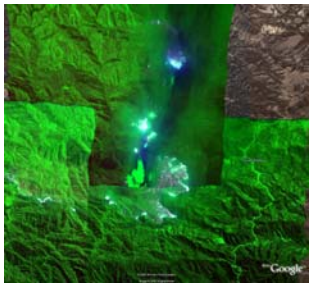
Tropical Composition, Cloud and Climate Coupling (TC-4)

- TC-4 was the largest ASP campaign of 2007 with over **60 payloads on the ER-2, DC-8 and WB-57** flying out of Costa Rica and Panama, in addition to 2 ground radars, a research trailer and scientific balloons
- This complex, multi-aircraft mission made some of the **first measurements of particle properties and water vapor in the subvisible cirrus clouds** and obtained data to clarify the amount of water in the upper atmopshere and the sizes of ice crystals in cirrus tops.
- Over **300 scientists, engineers, and mission support personnel** were based in Costa Rica and Panama from mid-July through mid-August, 2007.
- Total flight hours for DC-8, ER-2 and WB-57 = **221 flight hours**
- There were also 292 balloons launched from Costa Rica, Panama and the Galapagos Islands in support of TC4.
- An international experiment **united researchers from 8 NASA centers, over 14 U.S. and International universities, and more than 20 U.S. and international agencies.**
- An exhaustive **"lesson's learned" study** was conducted to ensure continuous improvement and to reduce risk for upcoming campaigns such as ARCTAS.

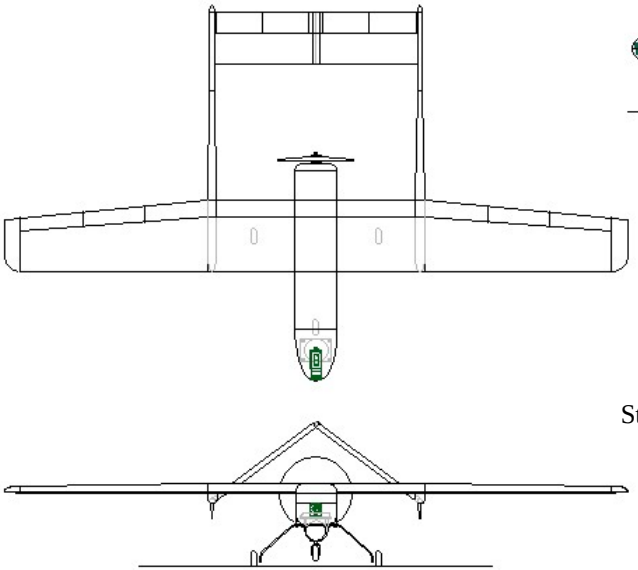
2007 Western States Fire Mission (WSFM)

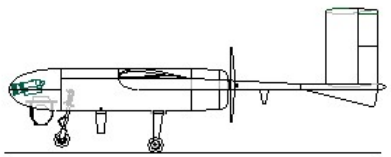
- The Wildfire Research and Applications Partnership was a joint NASA/USFS project funded through the Applied Science and Airborne Science Programs
- The goals of the effort were to develop improved imaging and communications processes for delivering near-realtime information to fire fighters.
- In FY2007 4 flights were flown across the Western US in the NAS
- The project also supported emergency responders during the San Diego fires with 4 flights in early FY2008





SIERRA UAS First Flight





Wing Span	20 ft.
Length	11.8 ft.
Height	4.6 ft.
Wing Area	42.4 sq. ft.
Empty Weight	215 lbs.
Gross Weight	345 lbs.
Max Speed	79 kts.
Cruise Speed	55 kts.
Stall Speed (clean)	30 kts.
L/D	11:5
Rate of Climb	545 ft./min.
CG Position	30% Chord

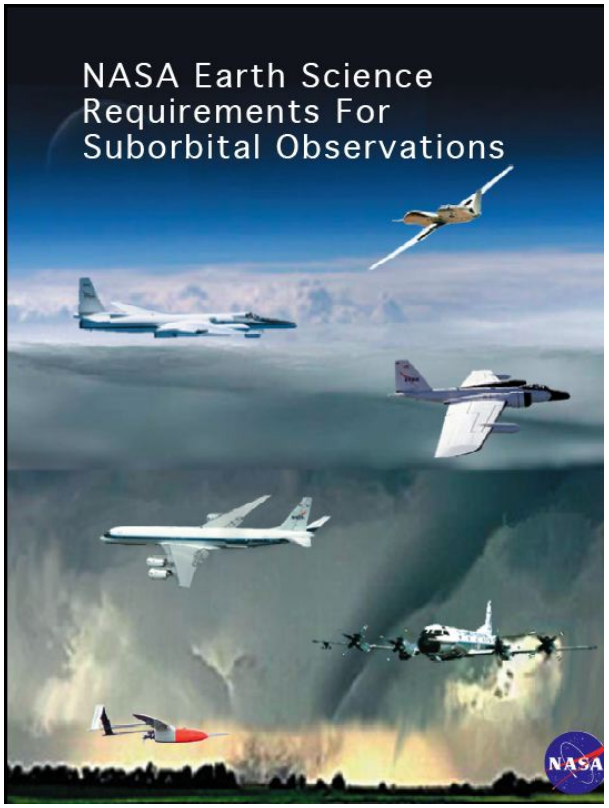
- 4 flights Oct 17-19 under LOS radio control - > 1hr total flight time
- Pilots reported that the aircraft handles exceptionally well with very stable flight characteristics
- Engine power was greater than expected leading to revision of max speed and increased range
- Envelope expansion flights to be conducted in December through February
- Autopilot installation and testing in Feb-Mar 08

ASP Requirements Analysis

1. **Elicit, catalog and analyze capabilities needed for airborne observing platforms - a critical element of an integrated observing system for Earth science**

2. **Provide reports on current and future requirements for:**
   a. **Satellite cal/val**
   b. **Research & Analysis (R&A) Program**
   c. **Technology development**

q **3. Demonstrate traceability of ASP investments to validated requirements & identify gaps in needed capabilities.**



Technology Working Group Roadmaps

Purpose: Assess the state of technologies required to provide airborne science capabilities based upon requirements analysis

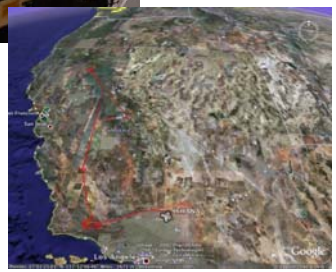
Approach: Technology working groups consisting of SMEs chartered to review capabilities, identify technology solutions and potential partners, and provide a development pathway to access the capability

Scope: No ASP resources expended; contributions from ARC, DFRC, GRC, WFF, and universities

Schedule: work began late 2006, roadmaps delivered Sept. 2007, proposals delivered Nov. 2007, review meeting Dec. 2007

Plans and Proposed Near-term Investments

Project
GH Vertical profiling implementation study
GH Wing pod implementation study
Ku-band satellite communications options
Sierra range and endurance enhancement modifications
UAS in the NAS Gap analysis and working group participation
Real-time Science: Collaborative decision environment (CDE) / Real-time mission management (RTMM) Ground portal harmonization



Payloads & Instrumentation Element

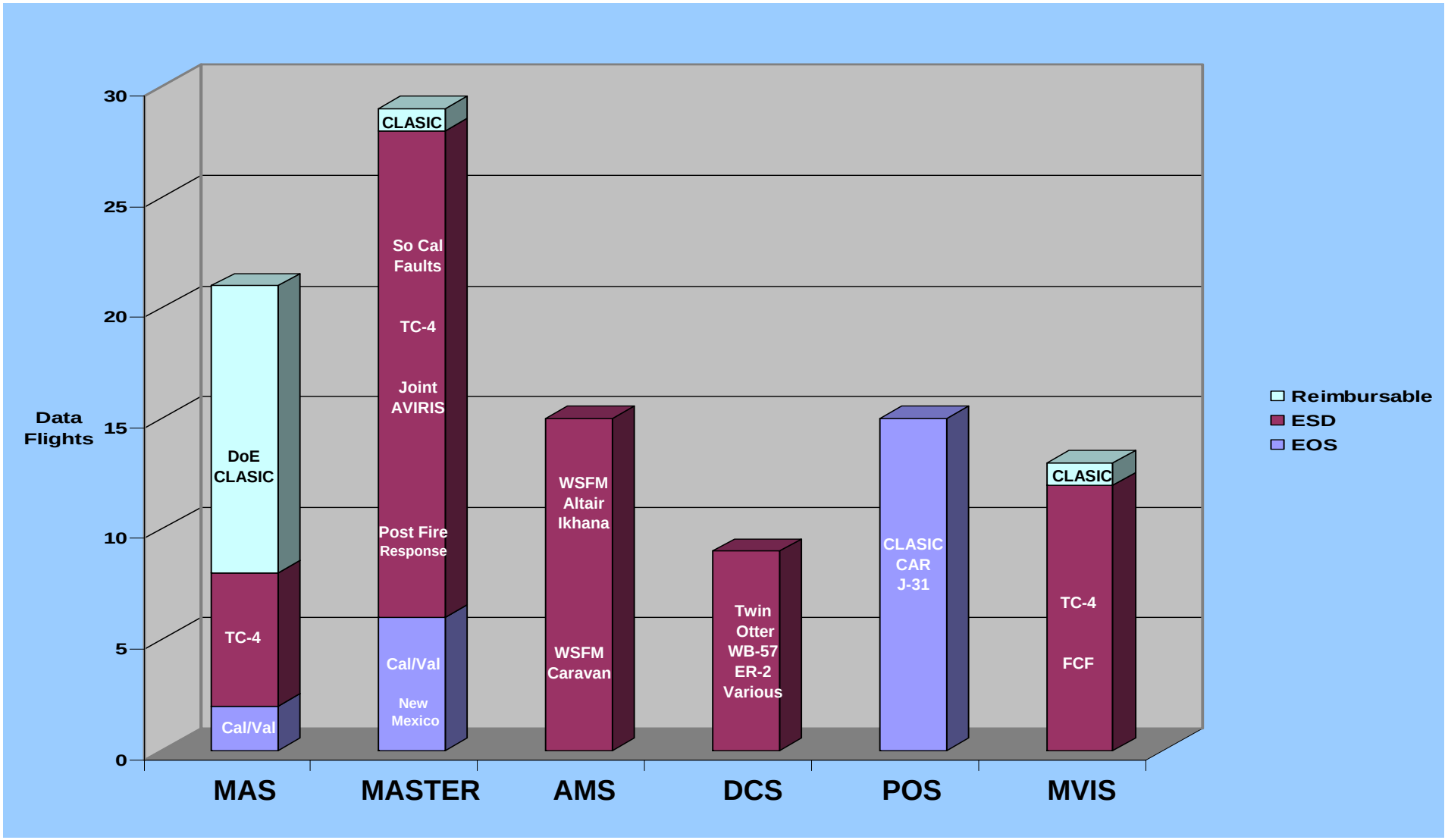
- **Roles & Responsibilities:**

- **<u>Engineering Support:</u>**
- **Assists with payload integrations and promotes the portability**
- **of systems by developing common platform interfaces and data**
- **communication infrastructures**

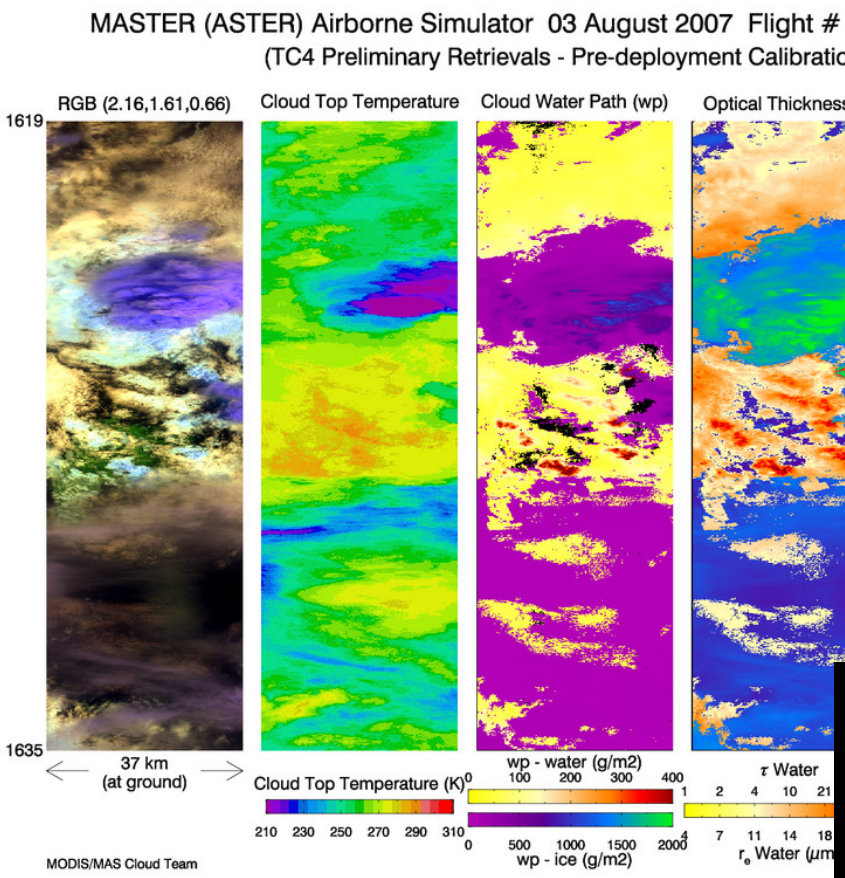
- **<u>Facility Sensors:</u>**
- **Maintains a small suite of facility sensors and equipment to**
- **support multi-disciplinary ESD research**

- **<u>Instrument Technology Development:</u>**
- **Supports hardware R&D to maximize science return from**
- **airborne platforms; as risk reduction for future satellite**
- **missions; and for on-orbit cal/val and process studies**

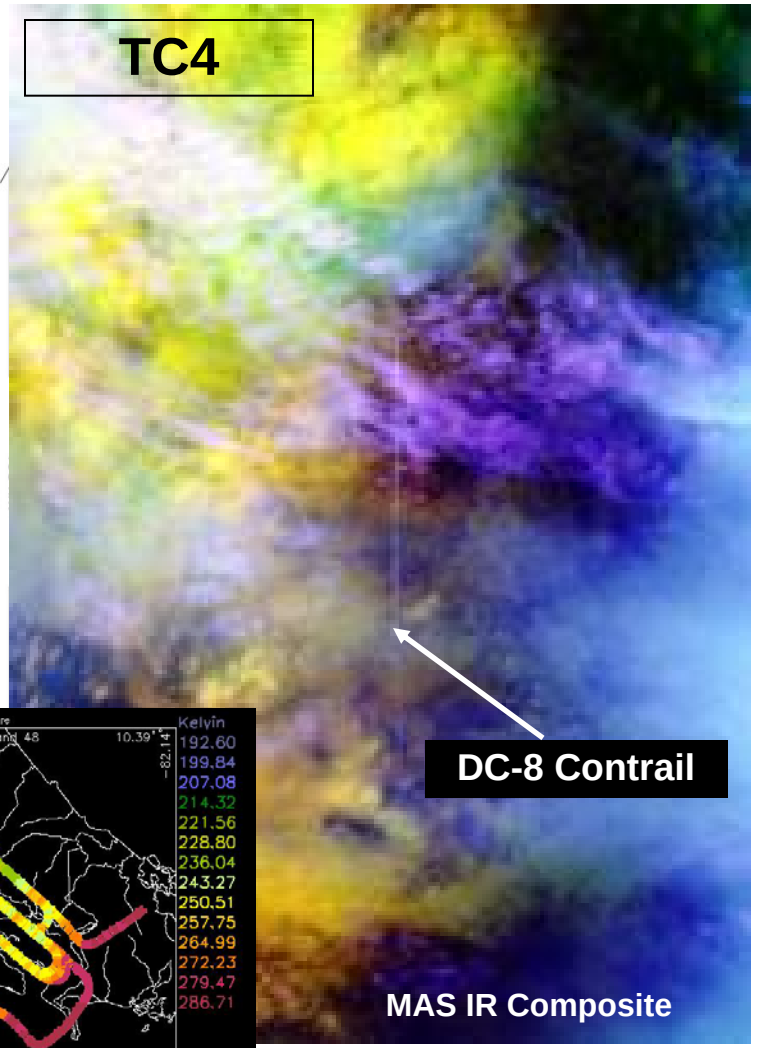
FY07/08 Facility Instrument Utilization

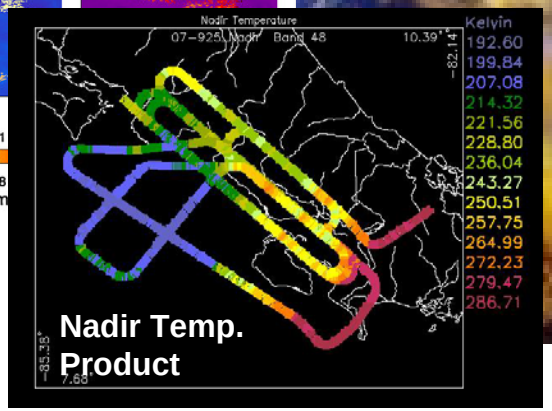


MAS & MASTER Data Collections: TC4

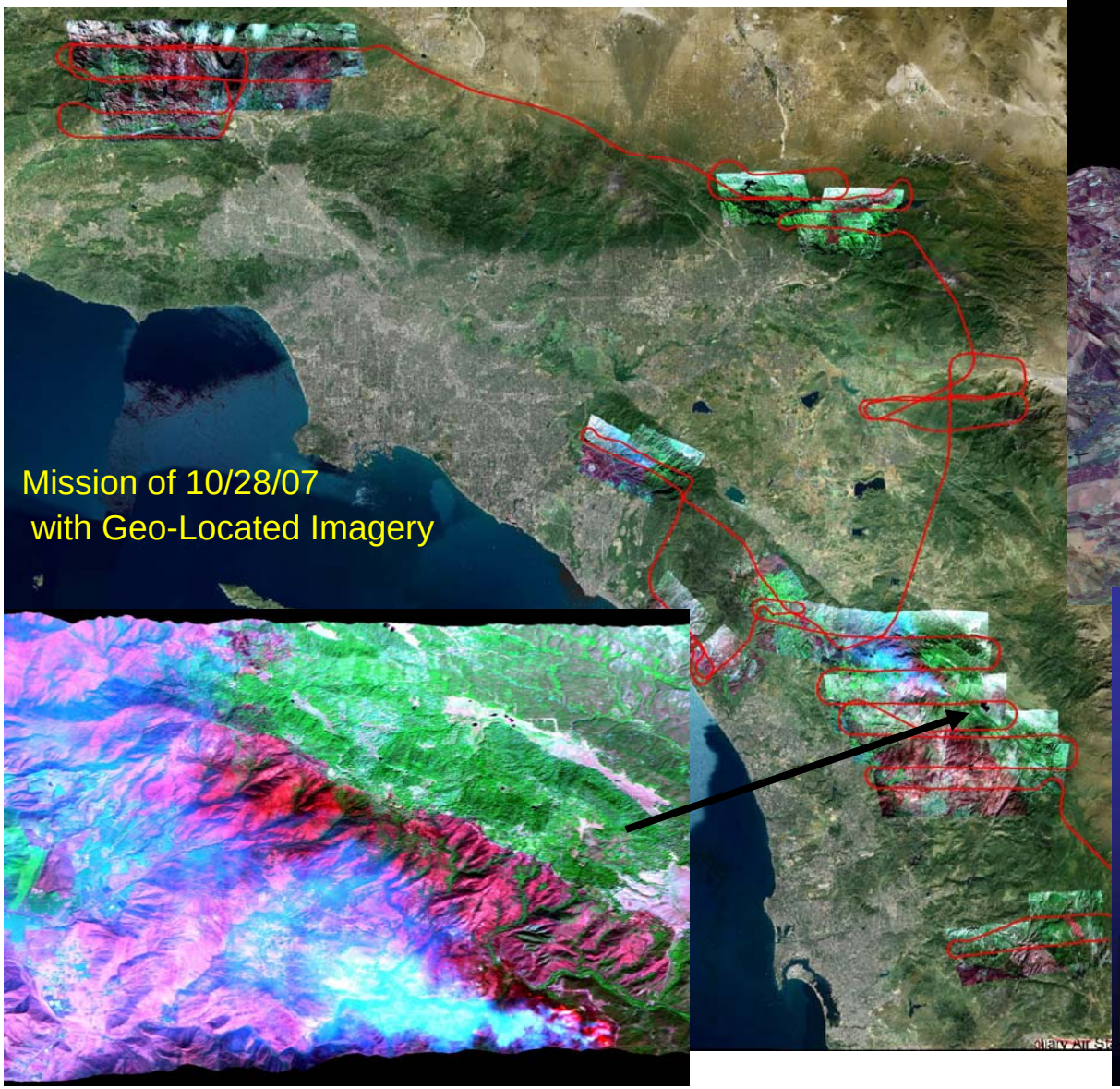


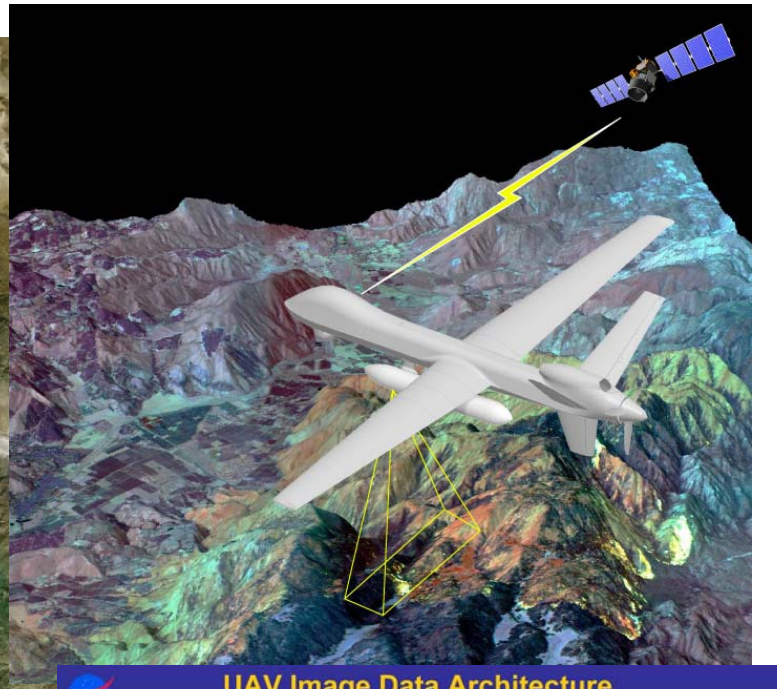
Field-Generated Level-2 Data Products (with GSFC MODIS Cloud Team)

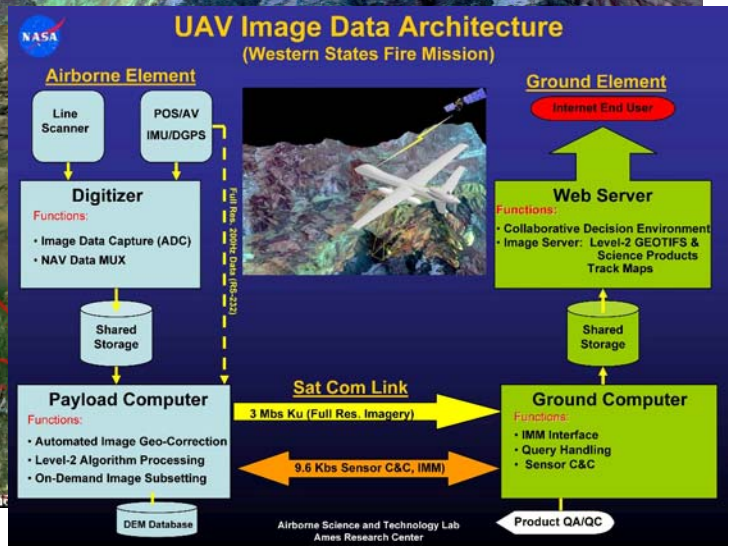




Western States Fire Mission
UAS-AMS (Ikhana)





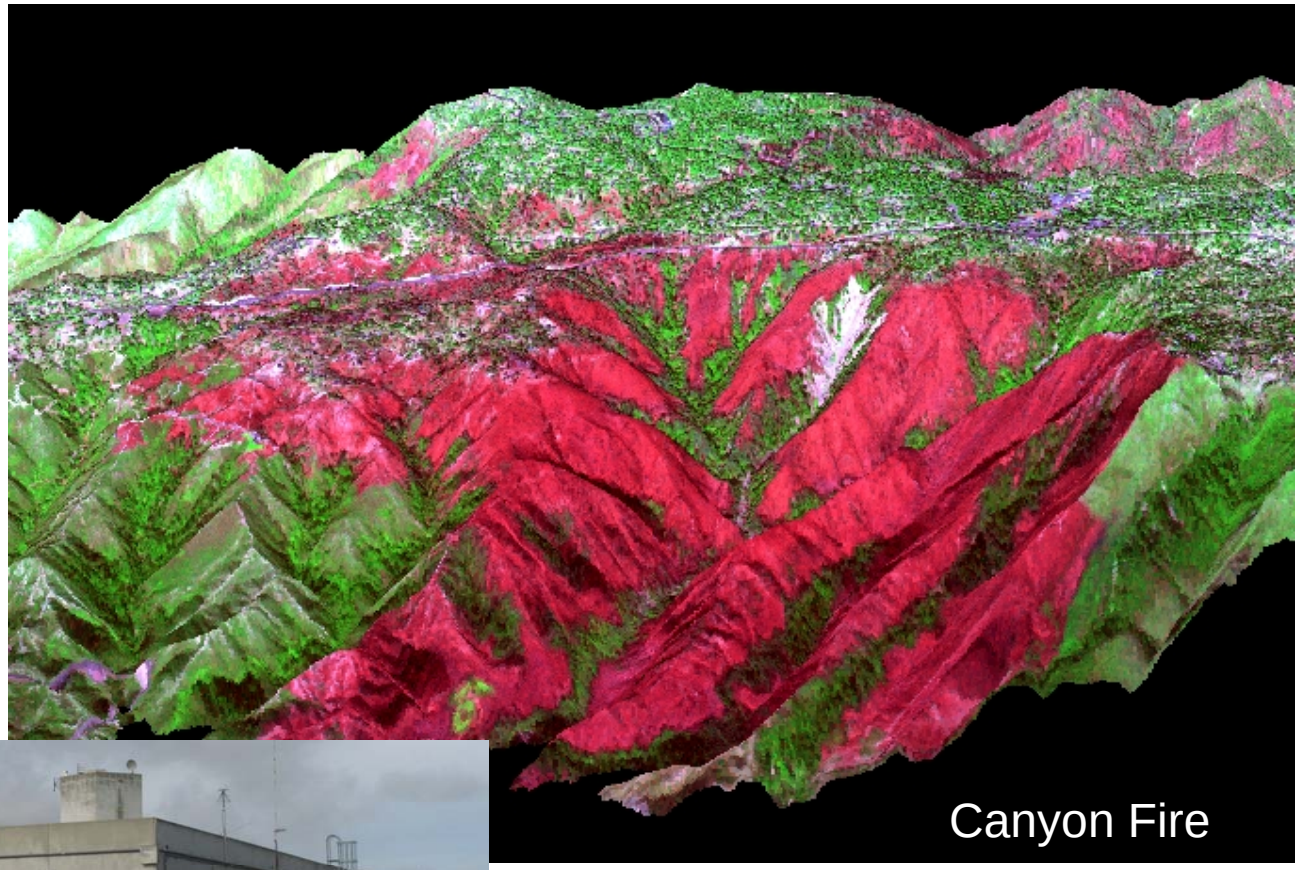


MASTER Data Collections:
Calif. Post- Fire Assessment

Baseline data over major fire areas for impact assessment & ecosystem studies

Flown 11/5-15/2007

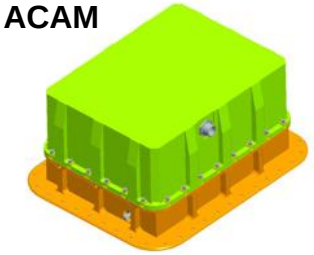
- **79 flight lines, 950nm**
- **5 meter resolution**
- **54 Gbytes of data**
- **All Data Precision Geo-Rectified**



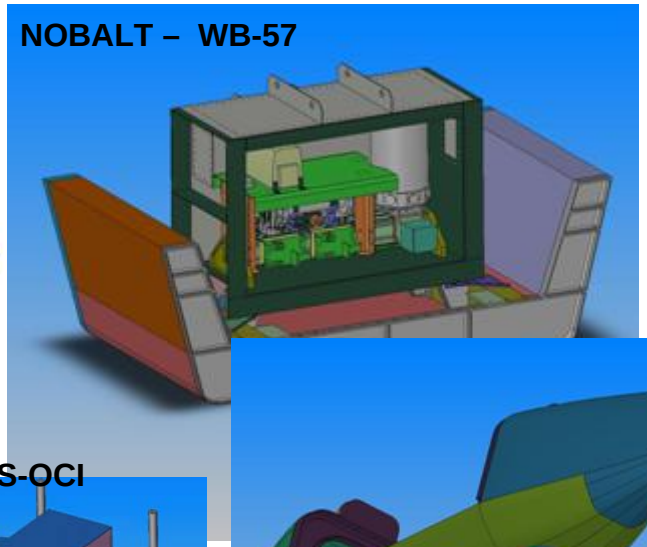
Ongoing Payload Engineering Projects

- Next-Generation Navigation Data Recorder project
- Airborne Sensor Web Infrastructure
- (Sat-Com and Web Portals)
- Ikhana and WB-57 payload integration support
- Twin Otter MASTER Integration
- DCS & MVIS Tracking Cameras
- Global Hawk payload
- infrastructure design

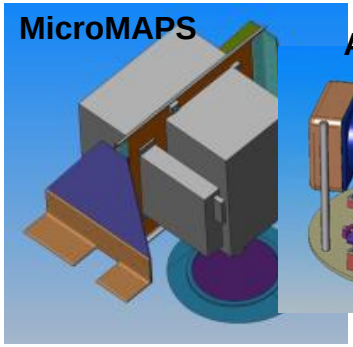
ACAM



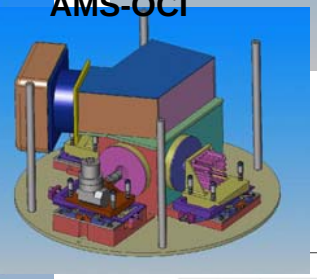
NOBALT – WB-57



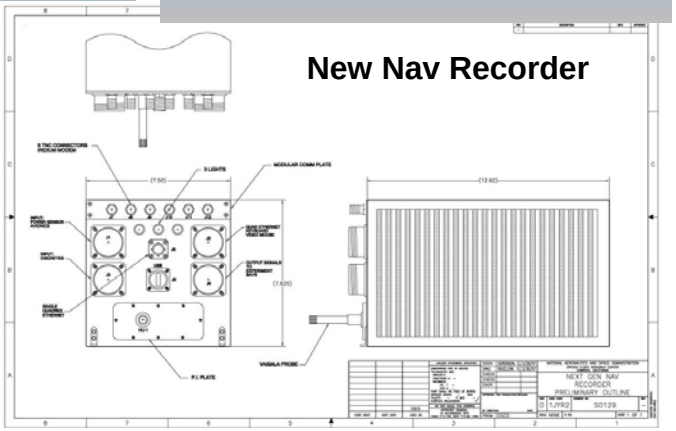
MicroMAPS



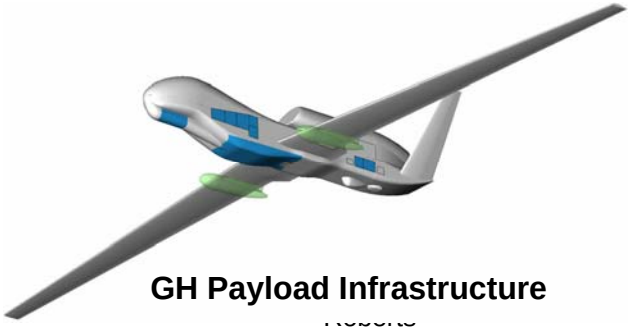
AMS-OCI



Ikhana Sensor Pod



New Nav Recorder



GH Payload Infrastructure

University Affiliated Research Center