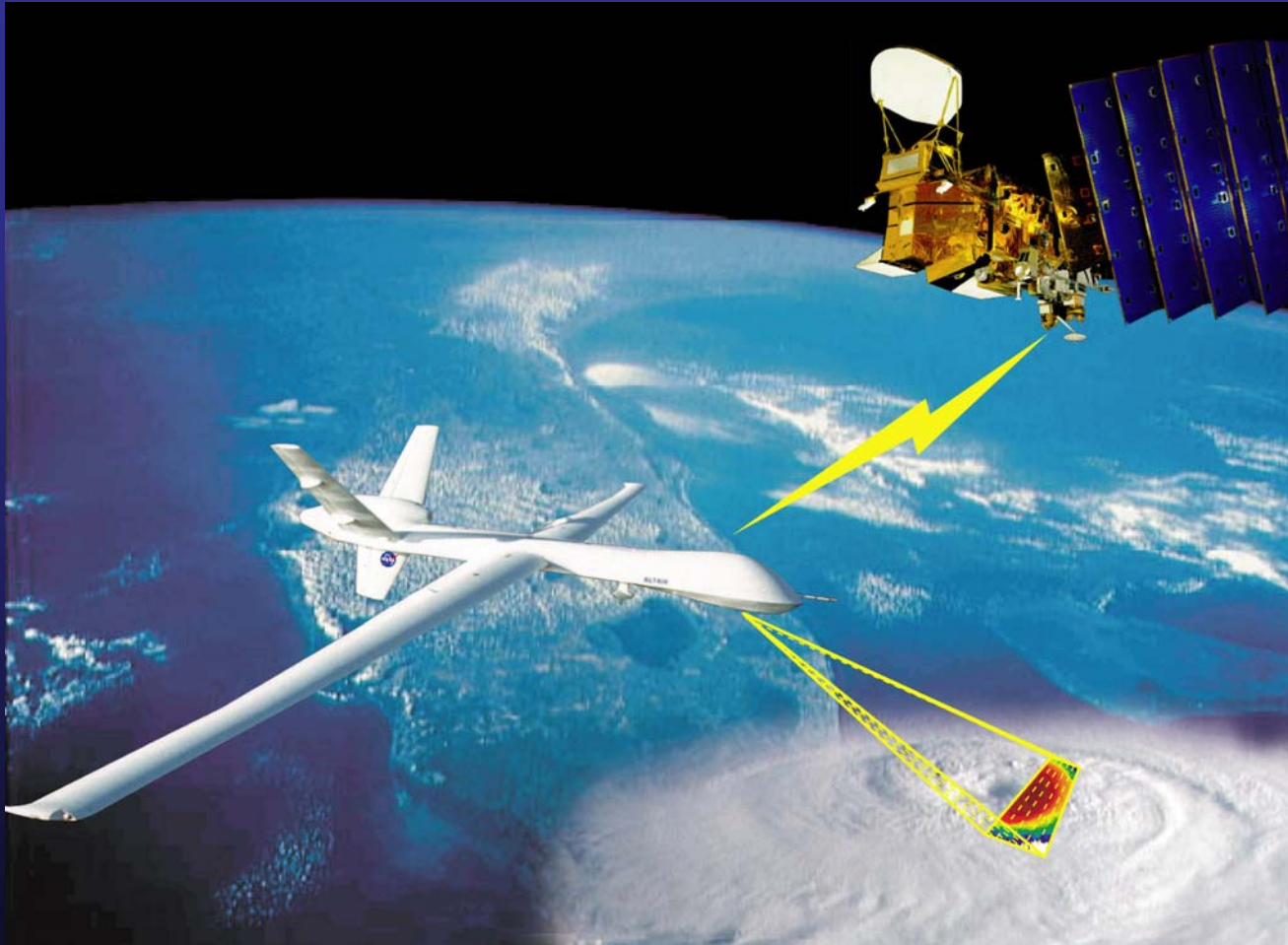


The NASA UAS AMS Ocean Color Imager

Jeff Myers, Edward Hildum

U.C. Santa Cruz

NASA Ames Research Center



Suborbital Science Program

Airborne Science &
Technology Lab



Outline

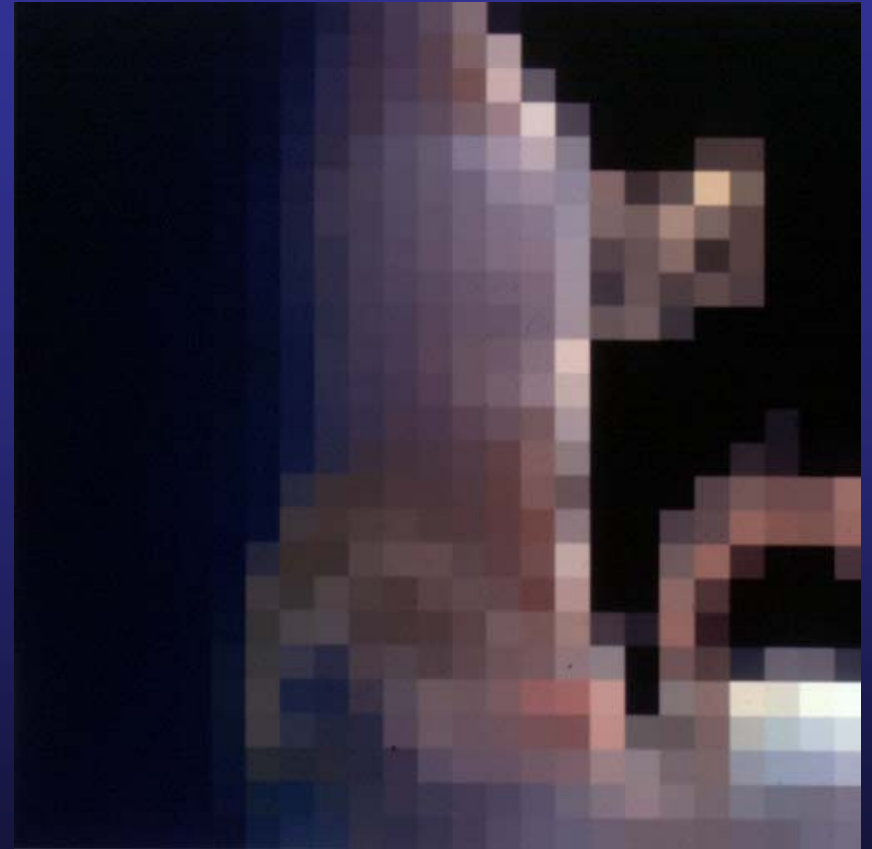
- The OCI Sensor
- The Mission Computer
- The UAV Common Sensor Pod
- Initial Test Flight Results
- Overview of the ASTL

Why Airborne Imagery?

Spatial Resolution Comparison



50m (AOCl from ER-2)



1Km (SeaWiFS Pixel Size)

[San Diego Sewage Plume]



UAS AMS: Autonomous Modular Sensor System

Spectral Configurations:

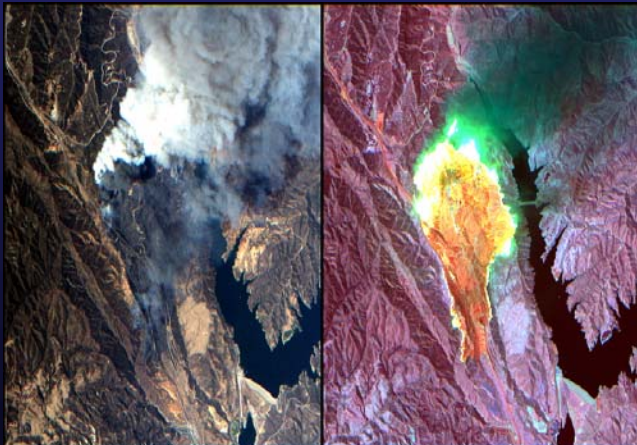
- Wild Fire/Earth Surface Mapping (TM)
- Ocean Color (SeaWiFS) Imager
- Atmospheric Mapping (VIIRS/AVHRR)

Features:

- Common Scanning Optics and Data Modules
- Compatible with Altair, Predator-B, Global Hawk, conventional aircraft



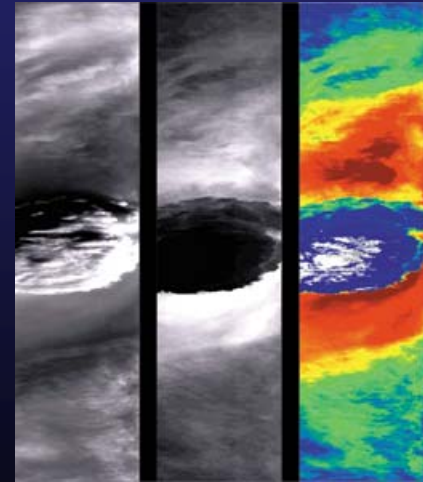
General Atomics Altair UAS



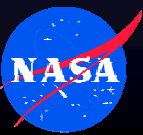
Wild Fire Research

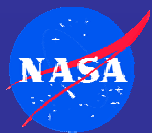


Ocean Color / Coral Reef Research



Hurricane and Atmospheric Studies





NASA UAS Ocean Color Imager



- A Configuration of the AMS Sensor System
- Includes SeaWiFS™ Bands + Thermal IR
- Resolution 2 – 50 meters
- Highly Calibrated

<u>Band</u>	<u>Center Wl, nm</u>
1	412*
2	443*
3	490*
4	510*
5	555*
6	620
7	670*
8	770*
9	860*
10	1024
11	11.5um

*SeaWiFS Bands

Aircraft Platforms:

Altair/Ikhana or Global Hawk UAS, ER-2,
WB-57, B200, Cessna Caravan

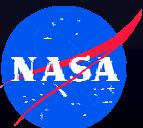


S.F. Bay Salt Ponds
AMS Image, 7.6m res. (4/06)

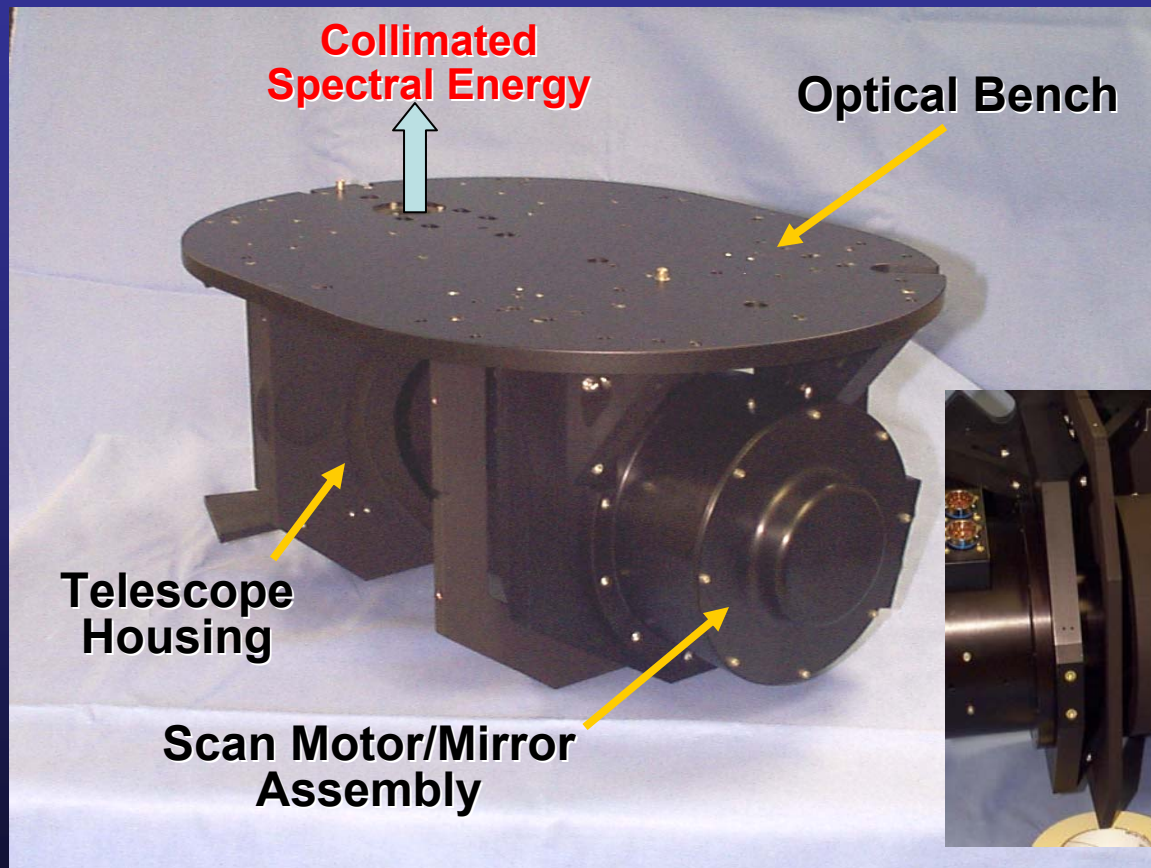
UAS AMS System Features

(Autonomous Modular Sensor)

- **Pressurized Electronics Packaging**
- **16-bit Digitizer, Up to 24 Channels**
- **Interchangeable Spectrometer Modules**
- **Sterling & TE-Cooled IR Detectors for Long-Duration Operation**
- **Solid State Storage Media**
- **Internal Ku-, L-, or C- Band Telemetry Link Module**
- **Embedded Applanix POS-AV/DGPS Precision Navigation System**
- **Mission Computer for Level-1, -2 Real-time Processing**
- **Sensor Web-Enabled with CDE/IMM, SensorML, SPS Software**
- **Multi-Platform Compatibility (UAS, Manned)**



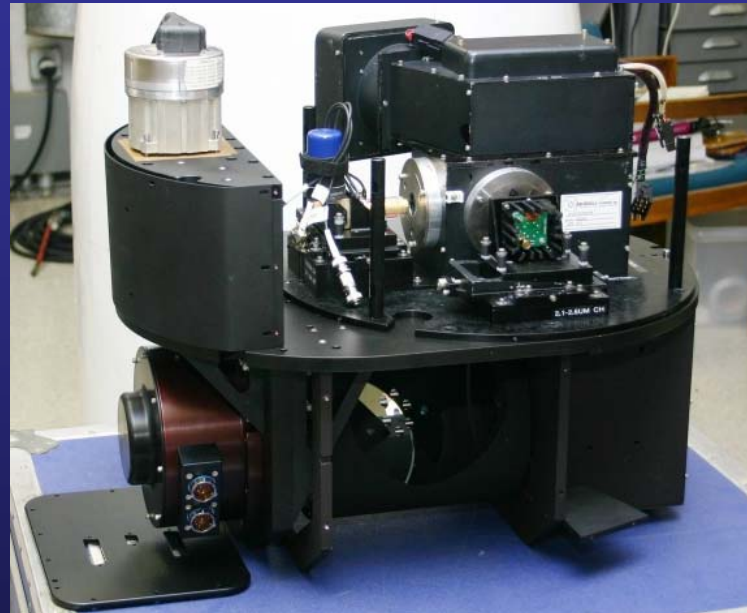
AMS Opto-Mechanical Module



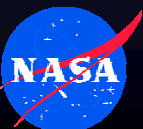
(Interfaces to the Wildfire, OCI, or
Wildfire Spectrometers)

AMS System Components

Data System

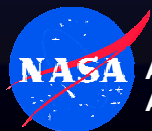
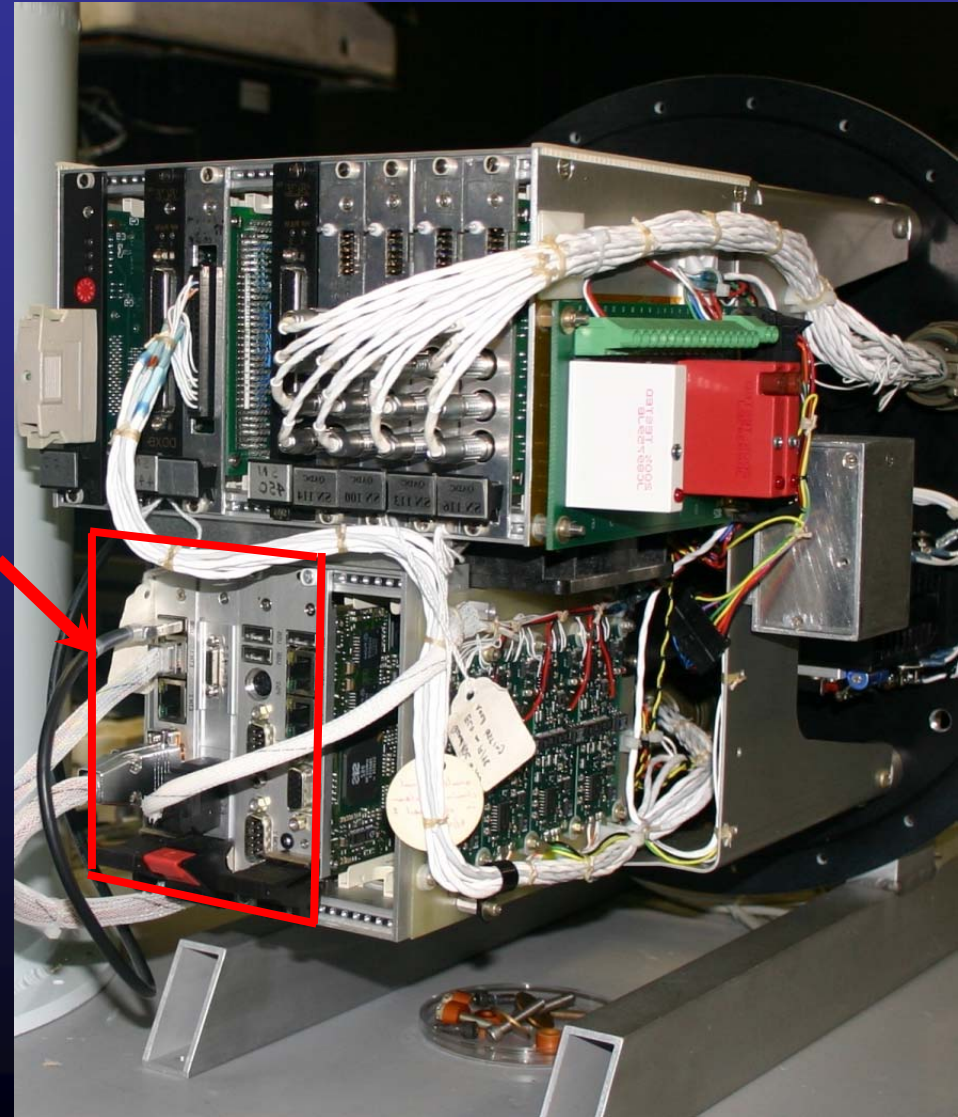


Scanhead - Wildfire Configuration
(covers removed)



UAS Science Mission Computer

- A Universal Payload Interface to High-Bandwidth Telemetry Systems
- Inputs for >20 instruments; Up To 40 Mbs Throughput
- Fast CPU & Solid State Storage For Experimenter Data & Algorithms
- Real-time on-board generation of Level-1 & 2 geophysical products, Geo-Tiffs and JPG-2000s
- Embedded SRTM Digital Elevation Model of the Western U.S.
- Interface to ground-based IMM/Collaborative Decision Sensor Web Environment
- Stand-alone packaging in FY07, for Ikhana/Altair



UAS Common Sensor Pod

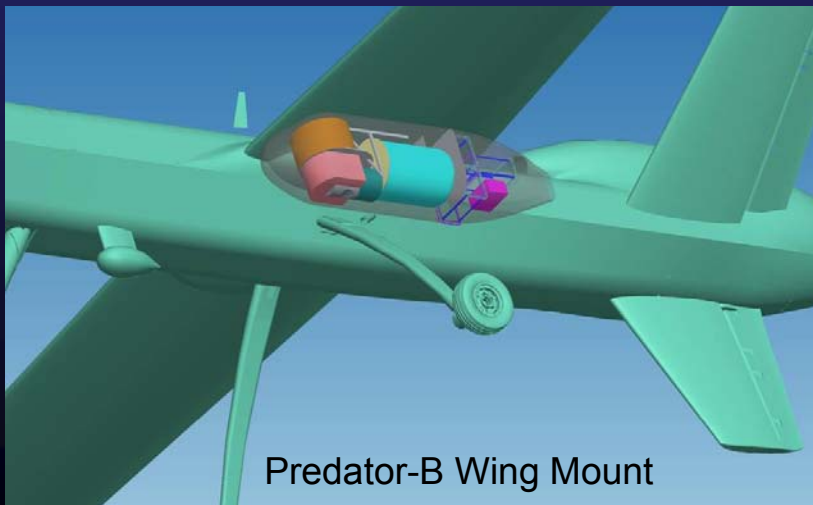
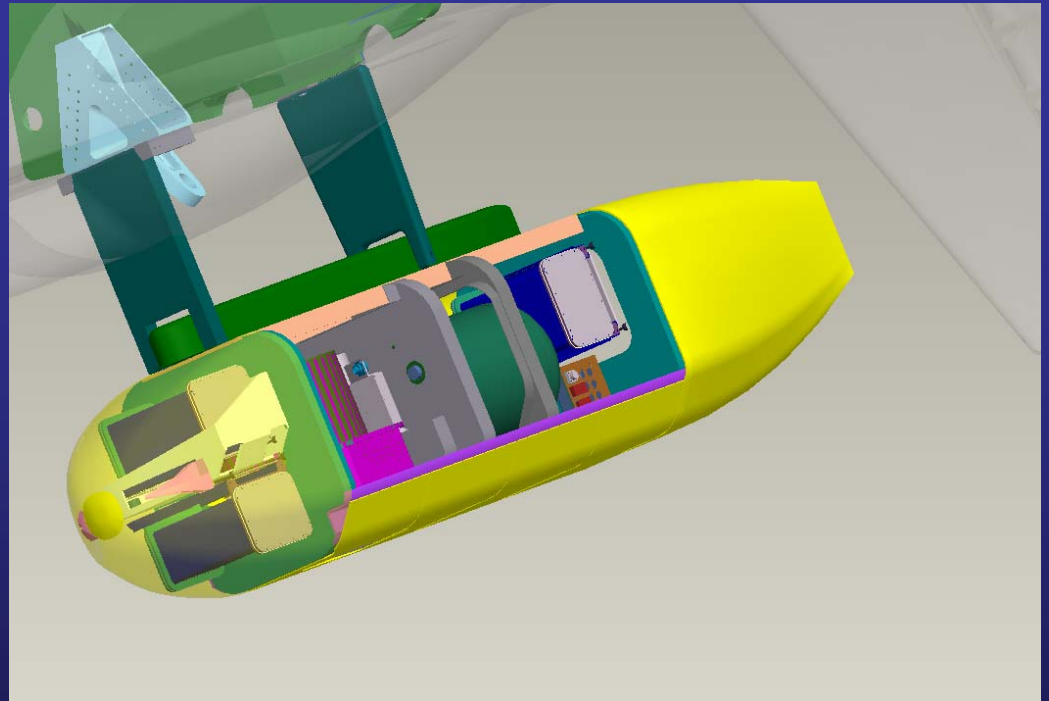
For Altair, Predator-B/Ikhana

**Internal Capacity: 1,500 lbs
(approx.)**

**Removable lower pallet for
carrying payload**

**Inter-changeable mission-
specific pallets**

**Common electrical & mechanical
interfaces**



Predator-B Wing Mount



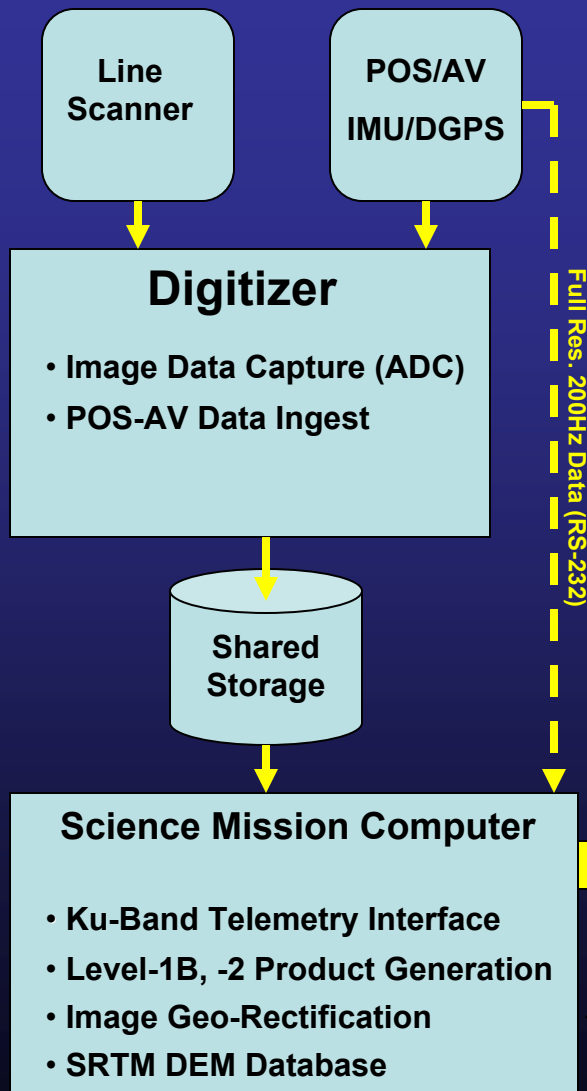
Altair
Centerline
Mount

(Renderings courtesy of General Atomics)

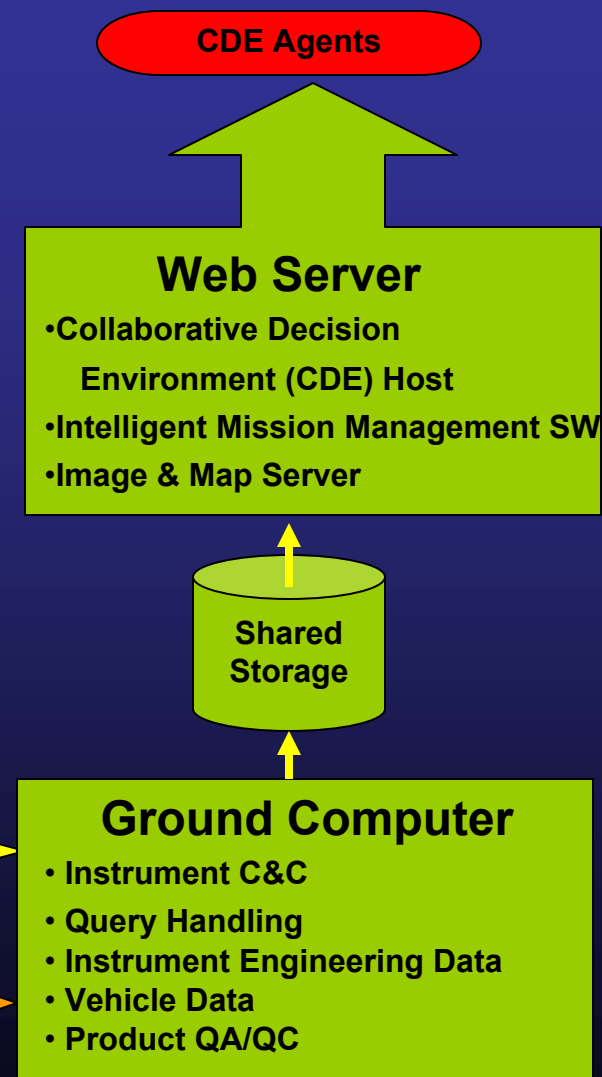
UAS-AMS Image Data Flow Diagram

(Western States Fire Mission, 8/06)

Airborne Element



Ground Element

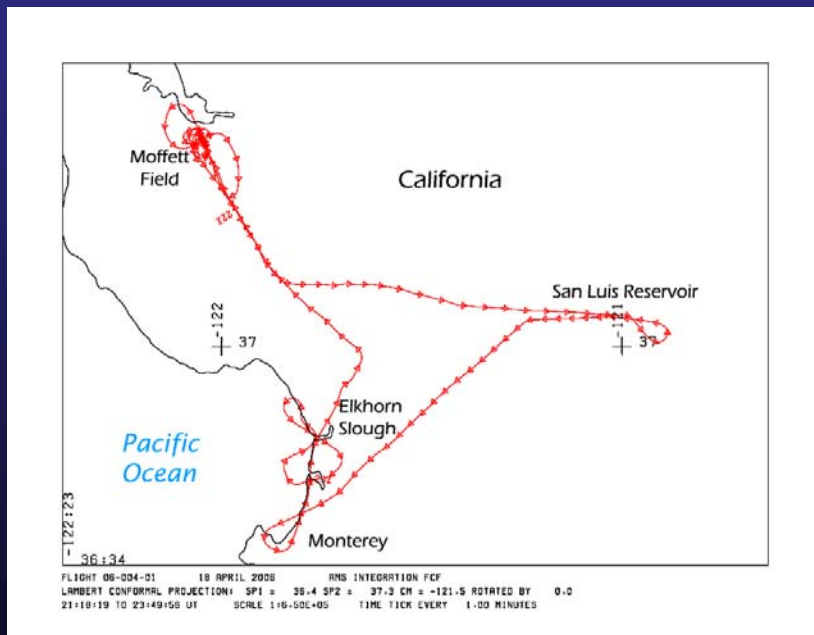


Ku Sat Com Link

3 Mbs Link (Forward Only)

9.6Kbs Duplex Channel

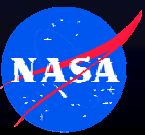
Recent Flight Test Data From the UAS-AMS (Autonomous Modular Sensor, Land Configuration) April 20-21, 2006



Flight Track



Sky Research Cessna 208 Caravan
(OK, *not* a UAV – but a *lot* cheaper!)



Elkhorn Slough (7.6m Res.)

Natural Color



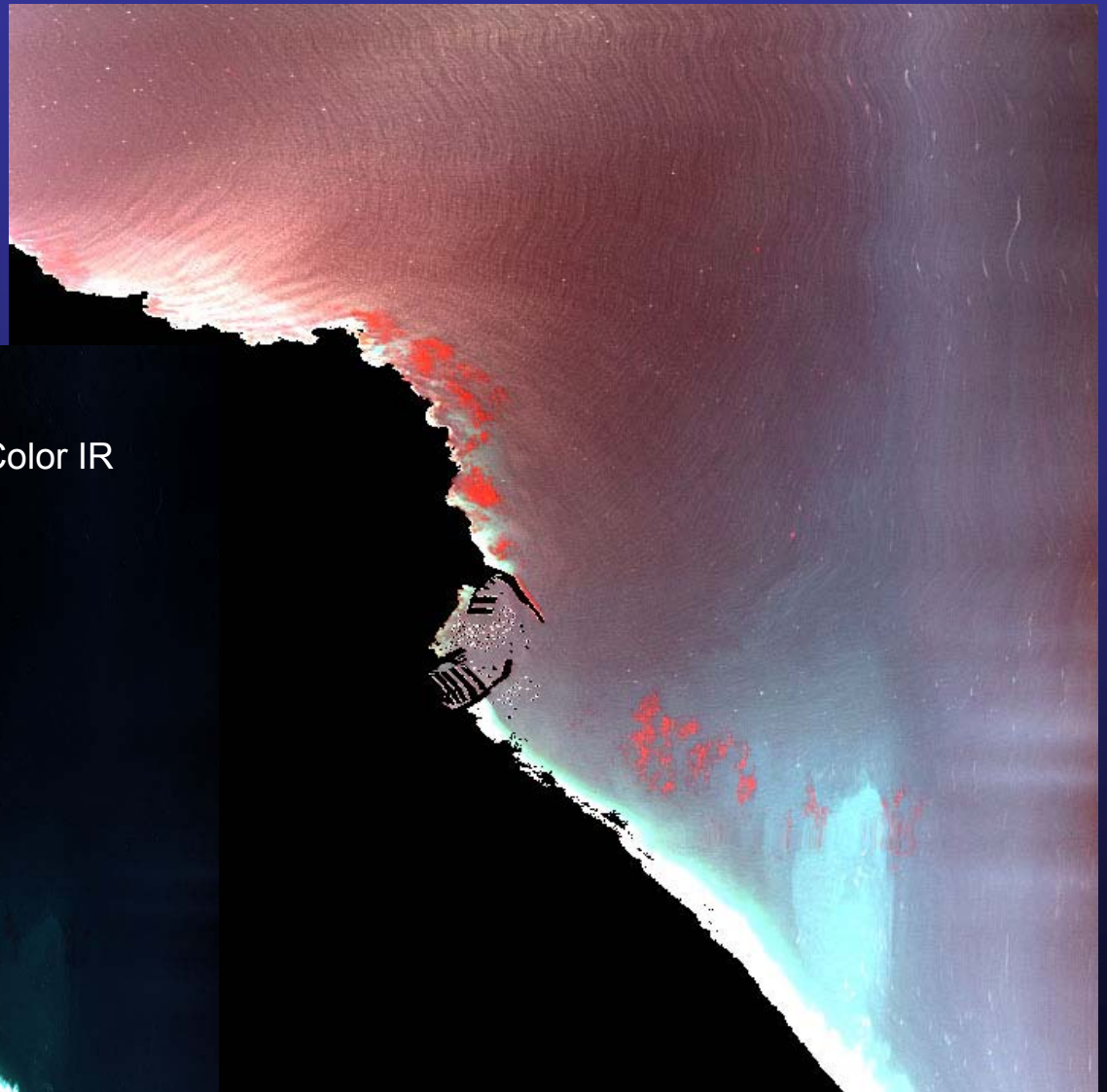
Thermal IR



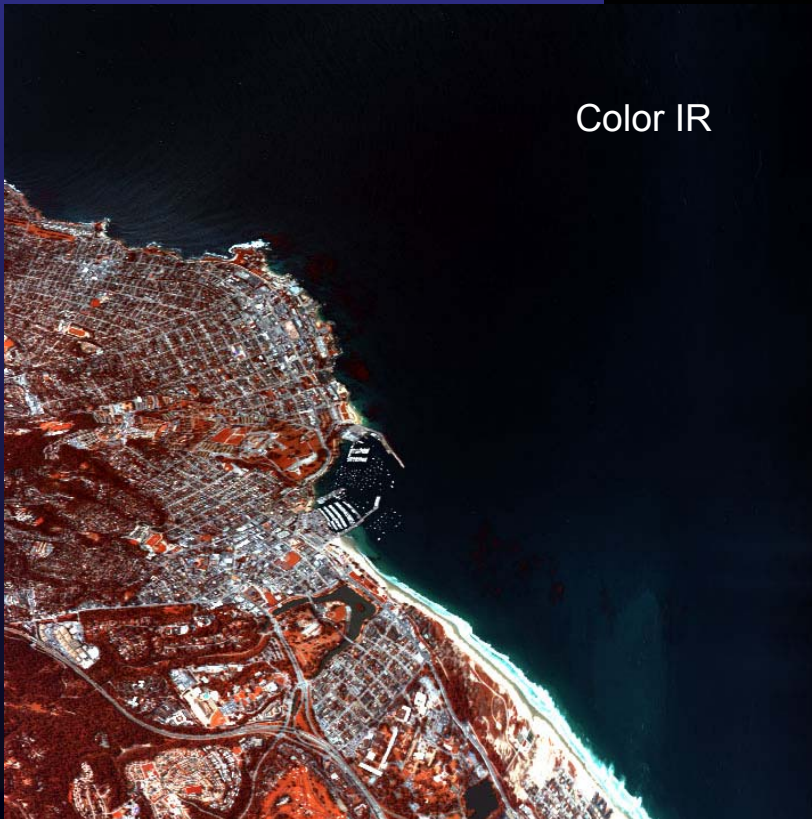
Elkhorn Slough (7.6m Res.) (enlarged)



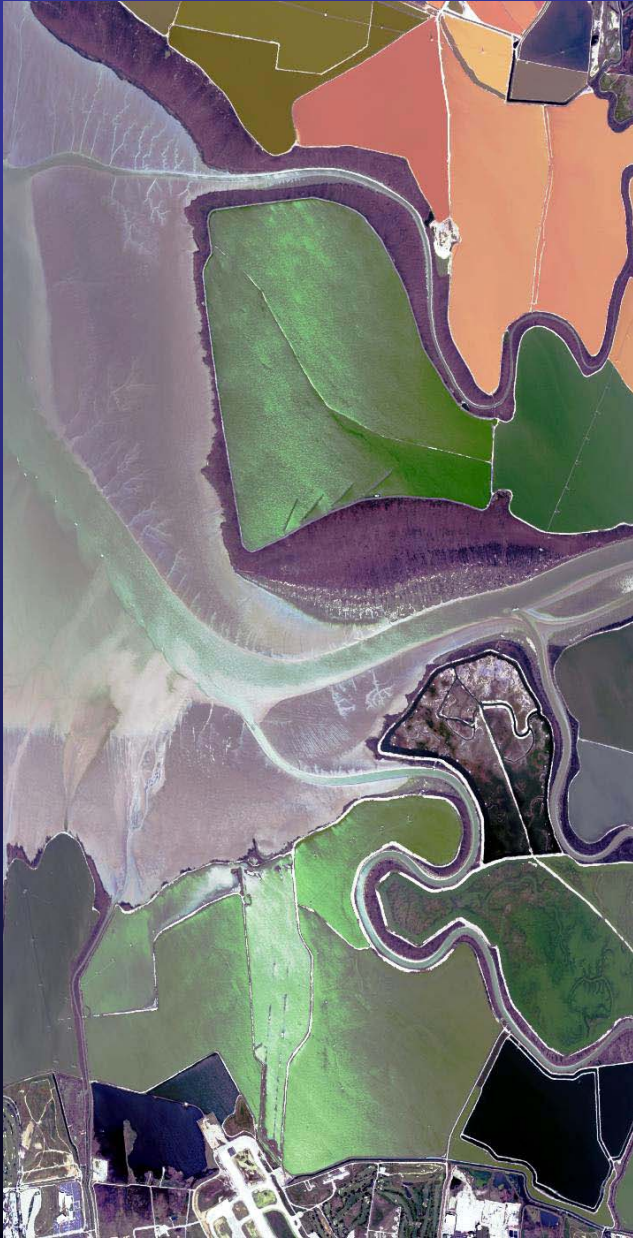
Monterey (7.6m Res.)



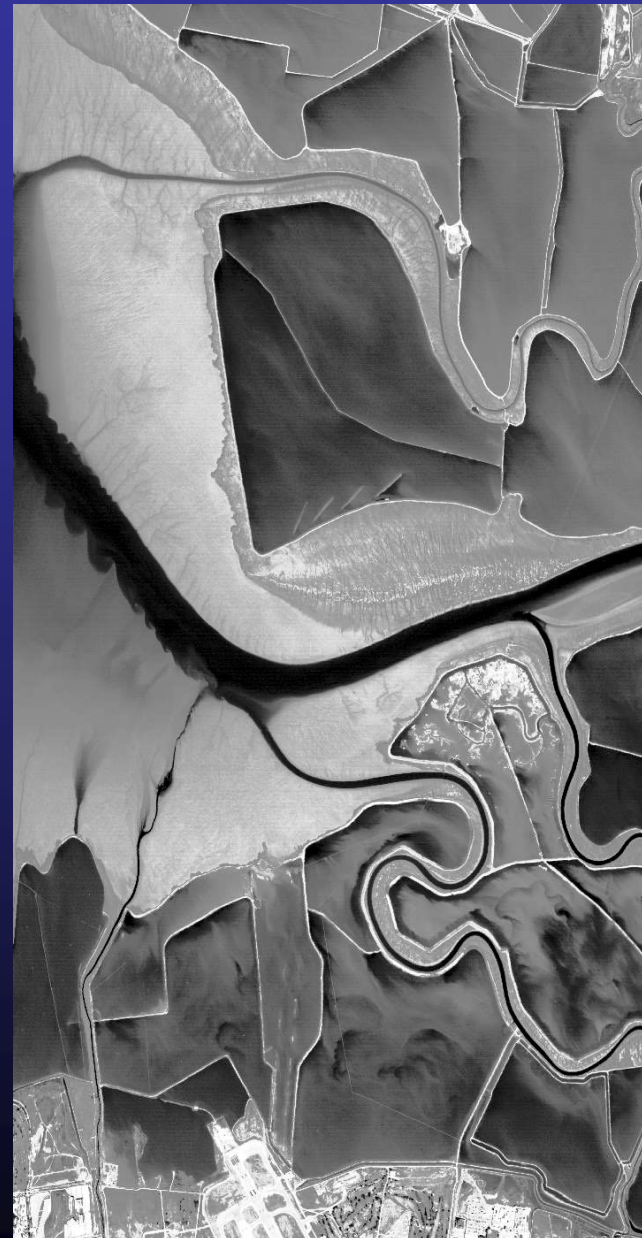
Color IR



S.F. Bay AMS (7.6m Res.)



Natural Color

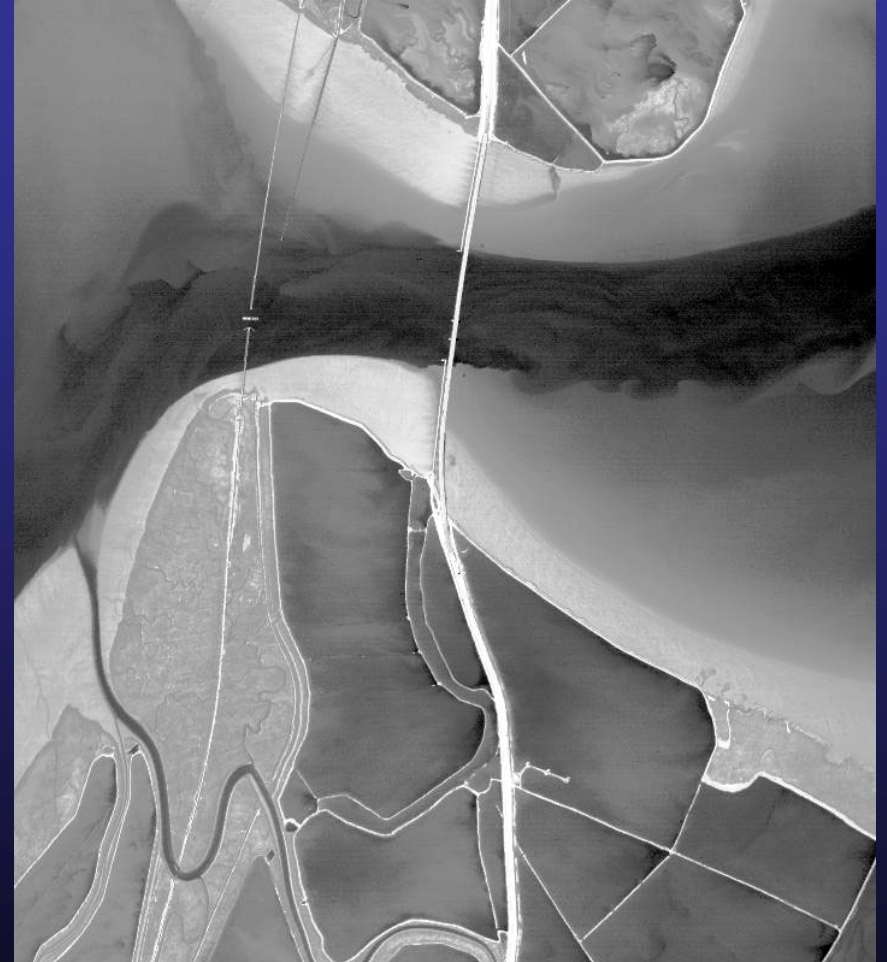


Thermal IR

Dumbarton Bridge Area (7.6m Res.)

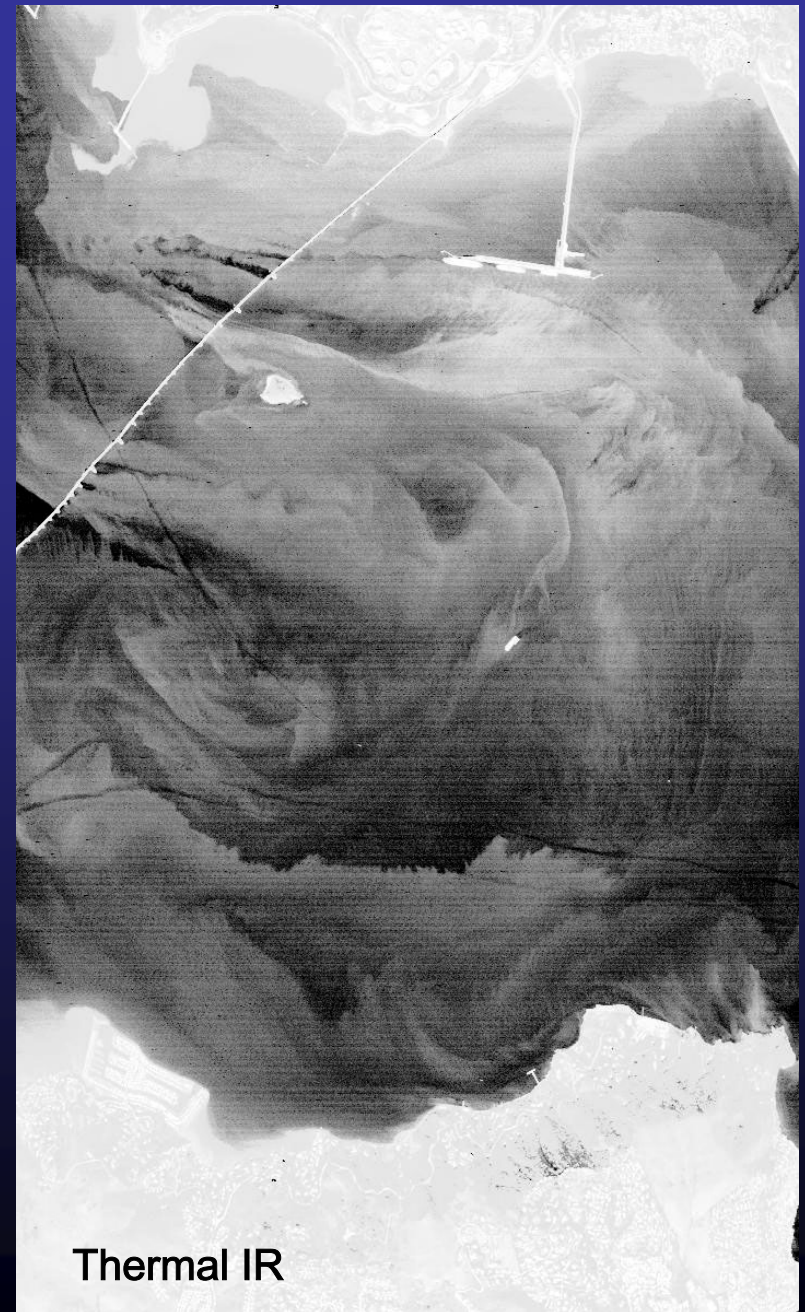


Natural Color



Thermal Infrared

Richmond-San Rafael Bridge (7.6 m Res.)

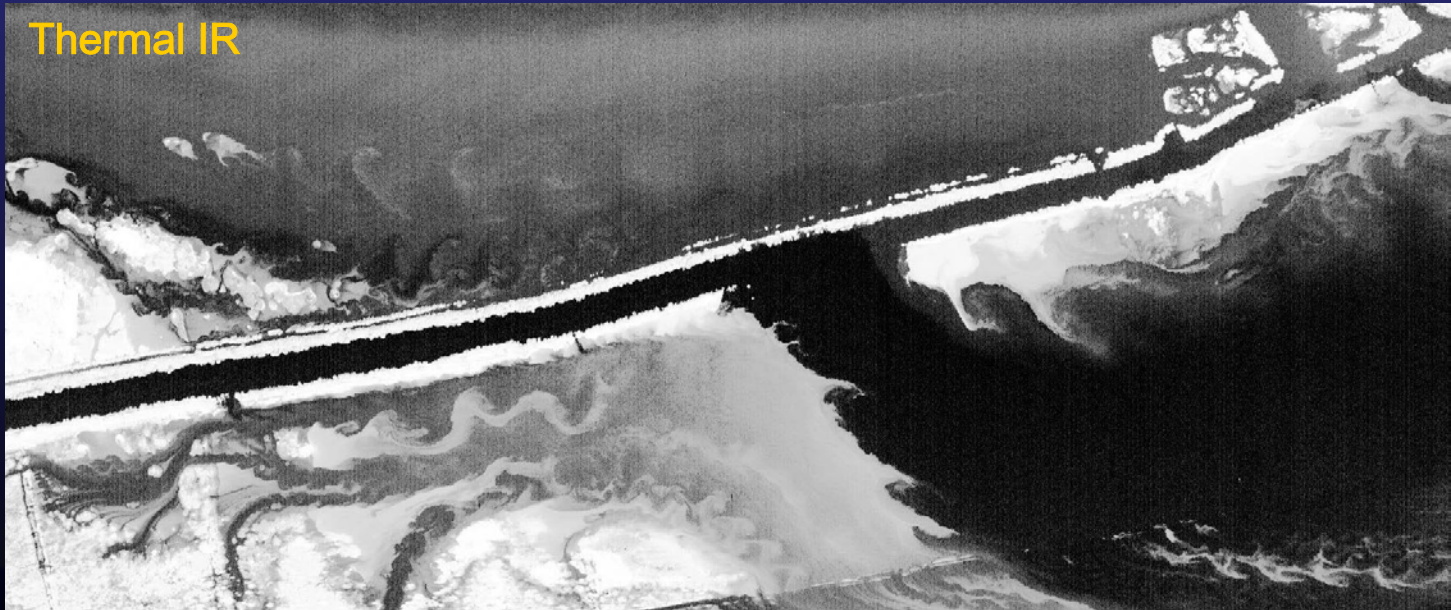


Sacramento River Delta Area Liberty Island (2 m Res.)

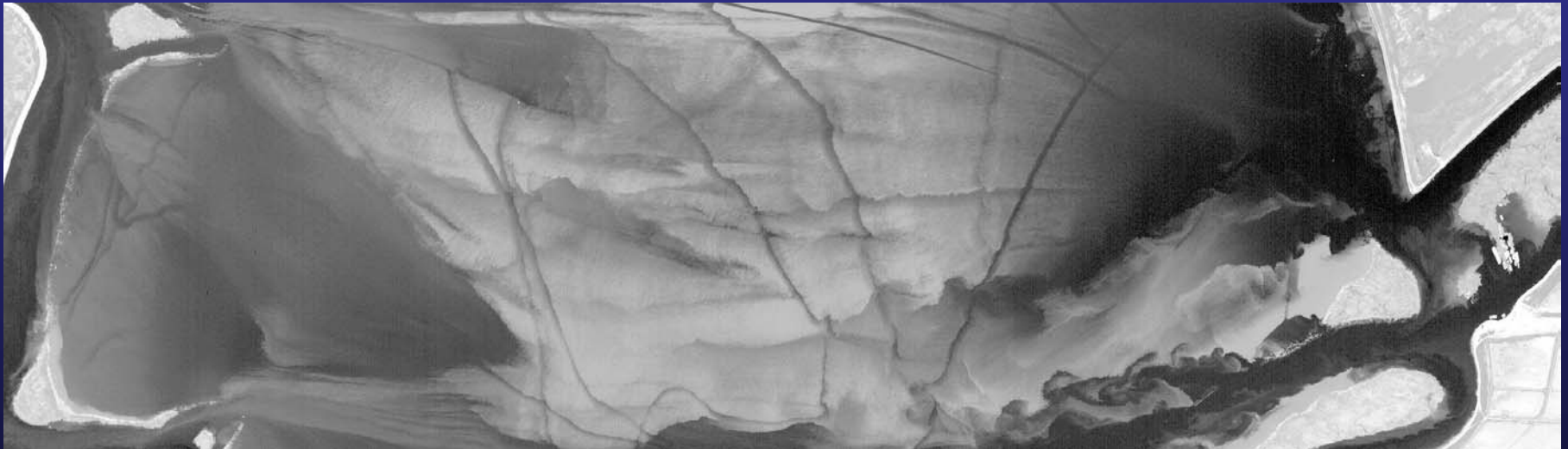
Natural Color



Thermal IR



Sacramento River Delta Area
Frank's Tract Thermal IR (2 m Res.)



ASTL Calibration Lab

**NIST-Traceable Spectral and Radiometric
Calibration Services for Airborne Sensors**

Currently supporting:

AMS

MAS and MASTER

SSFR (Solar Flux Radiometer)

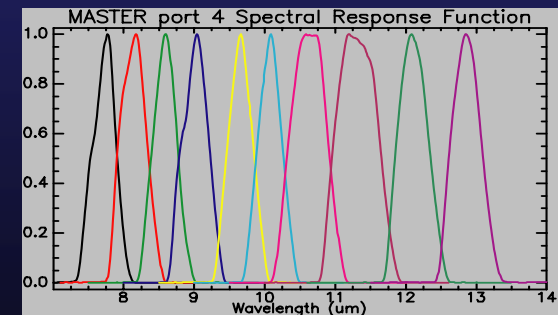
AATS-14 (Sun Photometer)

CAR (Cloud Radiometer)

Field Spectro-Radiometers

New Paper:

*Radiometric Validation of NASA
ARC Calibration Laboratory, S.
Brown, C. Johnson, et al. Applied
Optics/Vol.44, No. 30, Oct. 2005*

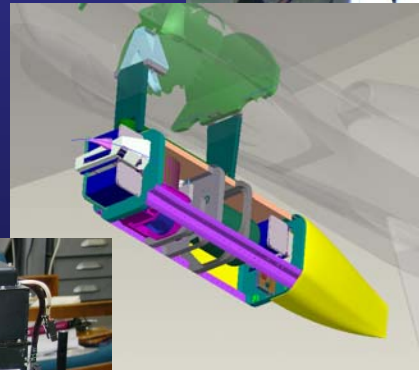




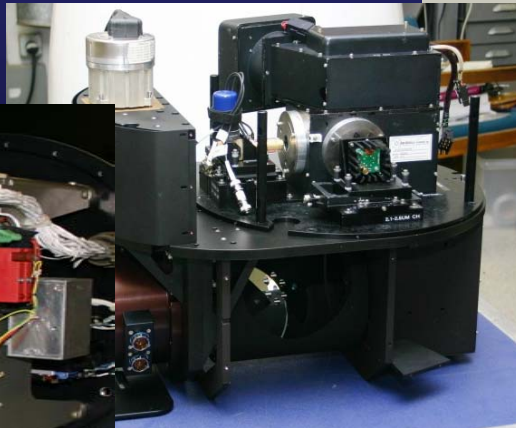
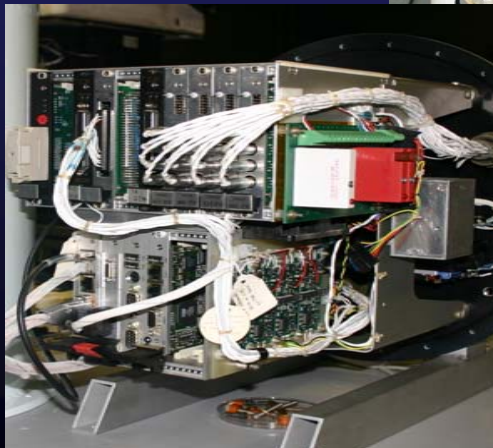
Ames Airborne Science & Technology Laboratory



- Sensor Engineering
- Systems Integration
- World-wide Data Collections
- Calibration Facility
- Large Earth Imagery Archive
- Staffed By U.C. Santa Cruz



Payload Integration



Flight Hardware Development



Sensor Calibration

This development effort supported by:

NASA Suborbital Science Program
(C. Yuhas)

NASA Earth Science Applications Program
Wildfire REASON-CAN
(S. Ambrose; V. Ambrosia, P.I.)

