The UNOLS Scientific Committee for Oceanographic Aircraft Research (SCOAR) and The Interagency Coordinating Committee for Airborne Geoscience Research and Applications (ICCAGRA)

Joint meeting on May 23-24, 2006 at the

Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) Marina, CA

Executive Summary

A joint meeting of the Interagency Coordinating Committee for Airborne Geoscience Research and Applications (ICCAGRA) and the UNOLS Scientific Committee for Aircraft Resarch (SCOAR) was held at the Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) in Marina, California on May 23 and 24. Agenda items included reports from the Federal agencies, a report on the activities of the Interagency Working Group for Airborne Data and Telemetry Systems and a report on UNOLS activities. Topics of discussion include the Univeristy of North Dakota's proposal to acquire an A10 Falcon Jet as a replacement Storm Penetration aircraft, the Interagency Committee for Aviation Policy's study of the effects of fltght profiles on airframe lifecycle and a request by the Asscociated Scientists at Woods Hole for an exemption to the experimental aircraft certification from FAA for scientific research applications. The final topic of the SCOAR meeting session was to prepare for the Airborne Ocean Science Conference to be held starting later that day.

APPENDICES

V NSF Report (PDF 1.55MB)

VI NOAA Report (PDF 5.10MB)

VIIa Suborbital Science Program R & A Retreat March 2006 (PDF 1.83MB)

VIIb NASA Report (PDF 1.20MB)

VIII Interagency Working Group for Airborne Data and Telemetry Systems (IWGADTS) Update

IX UND Falcon Proposal (PDF 202KB)

X NSF/ICAP Report -The Effect of Flight Profiles on Airframe Lifecycle (PDF 108KB)

XI UNOLS Report (PDF 960KB)

XII FAA Exemptions to the Experimental Aircraft Certifications to Allow for Scientific Research Applications (24.7 KB)

Minutes for the Joint Meeting of the ICCAGRA and UNOLS SCOAR

ICCAGRA Meeting Minutes

1. Introductions

2. Agency Reports

CIRPAS – Bob Bluth

The primary mission is to support UAS conops development and exercise support using their suite of aircraft (NAT – 750, Pelican, Altus, Predator, UV 18-A Twin Otter, Ground control station). They also maintain a number of scientifically valuable ground stations (Winds LIDAR, MPQ-64 Mobile Storm Radar, 95GHz Cloud Radar) and they are working with NSF to develop software and algorithms. New sensors are developed through the ONR SBIR program, with 2-4 topics covered each year and a budget of approximately $750k/topic. A recently tested system based on the Meggitt towed target system will gather momentum, heat, and wind fluxes at low altitudes towed from a twin otter. Future plans: In June CIRPAS will be testing the 95GHz cloud radar for a planned deployment in Chile in 08. They are also ramping up for a multi-agency mission in August mission that will include 6 research ships and their Twin Otter. CIRPAS will also be support a NOAA/ONR pollution experiment in Texas (GMAC, TEX-

EX)

NRL – Pat Herring – scientific development squadron 1

The VXS-1 squadron, formerly NRL flight support detachment, is the only S&T squadron in Navy. They operate NP-3Ds, RC-12Fs and are currently investigating acquisition of mid-range support aircraft. They try to schedule their aircraft 3 years out, but the schedules usually don't solidify until 6 months out because of the budget cycle. Piggy-back opportunites are available but commitment to funding is critical and it must be on a non-interference basis. They are actively working to standardize aircraft interfaces and improve power distribution systems for mission flexibility and to improve bus structure toward a "flying bench laboratory". Future plans: The Rampant Lion mission in Afghanistan will consist of 5 geosynchronized sensors to collect geologic information; the NASA AVIRIS mission will follow this mission. He described the difficulty of doing research work in theatre.

NSF – Jim Huning

They are working to expand the mix of available facilities with a facilities assessment in progress (universities, national labs, private companies). Aircraft and operations are funded through an annual deployment pool that amounts to slightly less than $5M/yr for aircraft, ground based, sounding facilities (30-40% for aircraft). NSF has instituted a new review procedure for NSF-sponsored field campaigns starting in FY07. In general, larger, complex programs need longer lead times because facility managers have difficulty scheduling upgrades and maintenance to facilities. In addition, competition for facilities is growing and many campaigns involve facilities not reviewed with NSF facilities. The new process is a rigorous early review (2yrs prior to deployment) to avoid unnecessary expenditures, earlier planning and ROM costs for program managers. Formal proposals follow successful pre-review. The G-V "HIAPER" completed its first major science campaign (T-REX) in Owens valley, and was used to deploy dropsondes. The new instruments are starting to be delivered. They discussed the FAA certification process and weighed the relative merits of FAA certified vs. State aircraft designation (1931 Chicago convention) vs. research certification. They are planning for next generation of storm penetrators. As the T-28 retired and they transition to an A-10 (joint w/ NAVY, SD school of mines) A workshop will be held on Oct 23rd-24th

NOAA – Jim McFadden

The Aircraft Operations Center facilities at MacDill AFB Hanger #5 operate 3 P-3s, 3 Twin Otters, a G4MD500, Turbo commander, Citation, Bell 212, SeaWolf. They received an earmark for a new P-3 to allow the other 2 to be dedicated to hurricanes.

In FY05 NOAA conducted a 5-yr planning effort. Currently $15M is appropriated for flight programs operations; $3M for staff and maintenance, but in FY06 they received a $18M supplemental for Katrina related activities. He described a number of activities in FY05 including an Ocean Winds experiment that included cal/val for QuikSCAT and WindSat, the Atmospheric Rivers experiment to study the pineapple

express, and Ghostnet which studied driftnet tracking in the N. Pacific. The busy hurricane season saw 897 flight hours for P-3s and G-IV. Other activities included support for TCSP/IFEX, RAINEX/IFEX, Ocean Heat content studies, Synoptic flow studies w/ G-IV using dropsondes which improved tracking models by 40% for Katrina, SALEX, which focused on the role of Saharan air contributing to hurricane development.
The Citation conducted Katrina damage photography. In FY06 they will be conducting a Texas Air quality study and he discussed airspace issues (1500 AGL flight lines). Future plans include installation of GIV tail Doppler radar, introduction of N44RF into service, possible construction of new AOC facilities (75k sq. ft. hanger), introduction of 4th Twin Otter to service marine sanctuary, and replacement of citation w/ King Air. He also discussed FAA Certification; new installations require engineering studies and airworthiness certifications - taxes the workforce, creates delays. Public use is an option for civilian agencies if it serves an inherently governmental function

NASA – Cheryl Yuhas

There is a new organizational chart for the agency's Science Mission Directorate. The Suborbital Science Program objectives are to assist in the development of new space sensors, cal/val of satellite systems, process studies, in situ measurements and model evaluations. The program is restructuring toward an evolving catalogue of aircraft, to infuse new airborne technologies, provide an on-ramp to off-ramp, and a renewed emphasis on reliability. There are 4 elements to the program: Program management & science support, catalogue aircraft, new platform capability development, airborne sensors with a budget - $35M. Planned missions for 2006 include Costa Rica AVE, Stardust Re-entry, INTEX-B, Arctic 2006, Maldives AUAV Campaign (NSF, NOAA, NASA), low-altitude AVIRIS, Wildfire response, Cloudsat/Calipso Validation, NASA-African Monsoon Multidisciplinary Analysis, NOAA/NASA aerosonde low-level hurricane sampling.

The catalogue aircraft consists of:

- Core (base-funded) - ER-2, WB-57, DC-8, P-3
- Other NASA – G-3, S-3, Learjet, KingAir
- Commercial – Twin Otter, J-31, Caravan
- Other Gov't – DOE, NRL, NSF, NOAA

ER-2 update – PDM complete;
WB-57 upgrades – avionics upgrade, landing gear update, gross weight increase;
P-3 back in service, completed Arctic 2006, due for overhaul next year;
DC-8 transition to UND through an RFI is complete but needs fine-tuning.

She described the Earth Science Demonstration project and the new UAVSAR precision trajectories work. UAS mission demonstrations include Altair demo, Aerosonde Ophelia Demo, the WRAP small UAS demo and Altair western states fire mission, and a UAS Aura validation experiment in 2007. The Airborne Science & Technology Laboratory continues to support facility sensors, engineering support,

and sensor calibration, with recent work to support a Altair/Ikhana sensor pod.

3. IWGADTS – Interagency Working Group for Airborne data and telecommunications systems – Larry Freudinger, Chris Webster

This is a working group under ICCAGRA. They held 2 meetings in past year and are working to support 3 main themes: situational awareness, network computing, sensors and instruments. Their strategy involves interoperability over networks through software systems evolving towards sensor web. The charter focuses on identifing needs, improving interoperability, enhancing interagency sharing, and providing recommendations on best practices. Membership conists of ICCAGRA agencies, academia & platform reps. They described recent work on standards for data Exchange – ASCII packet standards for commonly used information, interface Descriptions – common language for describing data, machine-readable interfaces, portability, and multi-aircraft displays using Google earth.

4. UND Falcon Proposal – Michael Poellet

He described a proposal for transfer of DLR Falcon 20 to US Airborne research fleet
Citation II operated from ’81-’05 fro DOI, FAA, NOAA, DOE, NSF, NASA, DoD, EPA studying cloud microphysics, turbulence, air chemistry, water vapor, boundary layer, thunderstorms, icing. After aircraft loss in ‘05, analysis of replacement narrowed to Citation II and Falcon 20. A comparison of capabilities shows that the Falcon has greater range, endurance, payload weight, cabin volume, airspeed, and power and the Falcon has significant modification for research. The acquisition schedule would have 07-09 shared operational use, 09 transfer and operations from UND. Issues: Airworthiness certification (est. $10-15k under PART91), ownership strategies, shared cost transition, O&M costs

5. ICAP – Jim Huning

Interagency Committee for Aviation Policy (18 civilian agencies). GSA makes policy for managing acquisition, use and disposal of a/c that civilian agencies own or hire. GSA sponsors ICAP with a goal to ensure government operations are as safe or safer than commercial operations. Responsibilities include management overview and FAIRS reporting, safety of government aircraft, including ARMS and ASO, A/C regulations and guidance overview. He discussed the concept of utilization hours – includes time its taken out of service for integration and de-integration – issue of quantifying cost effectiveness
Update: A/C regulations and guidance overview, which includes 41 CFR 102-33 and 41 CFR 300-3; 301-10, and 301-70; A-126 (Improving the management and use of government aircraft); sponsoring FEDFLEET Fed Aviation workshops June19-22 in Los Angeles.

6. Discussion of issues

Flight profiles affect life cycle of airframe. Using statistics from Citation aircraft flying different profiles, they found that complex flight lines such as repeated vertical profiling are a large contributor to wear and tear. The point was made that old aircraft were designed for more general use with larger thresholds built-

in while newer aircraft are built for more specific roles, with less margins. Discussed an NRL analyses of P-3; NOAA analysis that atm. Chem. Missions did more damage than hurricanes. NAVAIR acquisitions group can provide useful statistics for characterizing life-cycle costs for civilian agencies.
Much discussion on UAS. The Congressional request to NASA and NOAA was filled with misconceptions so both agencies tried to clarify issues in their responses. Discussion of how best to compare UAS operations to manned operations: cost per flight hour/weight of payload. In general, the cost of manpower explodes budget compared to manned aircraft and so they should be used where you exploit their unique capabilities. Power requirements are an issue for most UAS. A DOE ARM study on use of Altus showed that it was too costly. Discussion of whether adding cost per variable to estimate costs might be more accurate. NAVAIR's 3 conditions for acquiring/using UAS: extend platform range, extend sensor range, protect crew. Recommendation to use AGU and AMS to help determine utility of UAS for science. Consensus was reached that they are still in experimental phase and the need was to establish key performance benchmarks for use in science missions, as well as defining criteria for operationalizing UAS. Car use analogy – need for critical infrastructure; airspace issues need to be resolved.

ICCAGRA Meeting Participants

Cheryl Yuhas (NASA) - Chair
Eric Berkowitz (NOAA)
Dick Zimmerman (ODU)
Jack Jones (NRL/ESI)
Mike Poellot (UND)
Carl Friehe (UC Irvine/UNOLS/SCOAR)
John Bane (UNC/UNOLS/SCOAR)
Cdr. Patrick Herring (VXS-1)
Capt. Walt Jackson (NRL)
Jim Huning (NSF)
Jim McFadden (NOAA/AOC)
Mike Prince (UNOLS)
Bob Bluth (CIRPAS)
Chris Webster (NSF/NCAR)
Larry Freudinger (NASA DFRC)
Matt Fladeland (NASA ARC)

Scientific Committee for Oceanographic Aircraft Research (SCOAR)
May 24, 2006

Introductions were made around the room, including acknowledging and thanking Kate Sawyers for organizing the logistics for the meeting and the upcoming Airborne Ocean Science Conference.

Participants: John Bane, Carl Friehe, Charlie Flagg, Dick Zimmerman, Dan Reimer, Steve Hartz, Jack Jones NRL, Pat Herring NRL Pax River, Jim Hunning, Bob Bluth, Cheryl Yuhas, Jim McFadden, Eric

Berkowitz, Matt Fladeland (NASA).

John Bane reviewed the membership status of the committee and discussed the need to recruit a new member in the coming months. This need will be advertised to the community in a number of ways and selection could take place before or at the Fall SCOAR meeting.

A motion was made, seconded and approved to accept the minutes of the November 2005 SCOAR meeting.
John reviewed the agenda for today's meeting.

Discussion about the methods that might be used for a coordinated scheduling and perhaps utilization included major issues:

- Aircraft operators are primarily federal agencies and for the most part are dedicated to agency missions or particular research programs.
- There is no uniform method for requesting, scheduling or for cost reimbursement of aircraft operations.
- There is still a need to better utilize some of the aircraft facilities and to improve access for users that need aircraft support.
- Making information about schedules, requesting procedures and costs centrally available will help facilitate access. The information should be more complete.
- Moving towards a “unols like” process might start with a aircraft schedule coordinating group made up of aircraft schedulers and funding agency representatives.

ICAGGRA action item to determine what the next steps might be for more coordinated scheduling and utilization of research aircraft with Matt Fladeland (NASA) taking the lead in consolidating information on research aircraft scheduling. Look at phone conferencing on some regular schedule.

UNOLS report see slides

Exemption from FAA for operation of an expermental aircraft

Jim Hains with the Associated Scientists at Woods Hole gave an overview of their application for an exemption from the FAA for operation of an experimental amateur built aircraft for scientific purposes. They filed for this exemption in November 2004 and to date they have not received a response. They asked their Congressman’s staff to enquire about the status of their application and now they expect some decision in the next few weeks. Jim was looking for comments or advice on the regulatory procedures. He also thought it would be useful to have an informational repository for how to handle development of aircraft facilities. The problem is that they want to fund the operation of this experimental aircraft with grant funding for study of whales and turtles and this makes it more than just personal use.
Jim proposed that SCOAR put on the list of topics the issue of dealing with the FAA on non-traditional aircraft uses and airframe certifications. The discussion also focused on the issue of whether or not

SCOAR should provide an opinion about the use of experimental aircraft and even write a letter to FAA about the need for these type of aircraft. The committee determined that SCOAR would not write any opinions unless it was necessary and only after thoroughly examining the issues. Also, we discussed whether SCOAR should provide information on dealing with regulatory issues and even act on behalf of aircraft operators in getting feedback from the FAA on certain issues. The consensus was that SCOAR might point to the appropriate regulatory bodies and processes, but not provide advice.

Airborne Ocean Science Conference

John led a discussion about the goals and objectives of the first Airborne Ocean Science Conference and in particular how to conduct the wrap-up discussion – "What does the future hold for airborne oceanography?"

The committee developed a set of bullets for this discussion:

- Problems and hurdles (and their solutions) experienced by present users
- How do students and newcomers learn?
- Seminars on aircraft use at institutions and science meetings
- Mentors for different aircraft or instruments.
- Where do you find $$ for flight time.
- How do you uniformly characterize the cost of ships
- Use of aircraft for satellite instrumentation development and proof of concept
- Ocean observing systems use of aircraft
- Routine monitoring
- Event response and adaptive sampling
- Use of interoperable sensors, hardware (connectors, etc.), procedures, …
- How to position platforms?

We will use the time to have a round table discussion where the audience will be encouraged to raise questions or issues. John would moderate and Dick can keep the white board, Mike will take notes.

Extensive discussion about the hurdles of having agency-directed funding mechanisms for specific facilities, Having to include facility costs in proposal budgets has a real negative effect on success. There is still a strong desire to find a way to treat aircraft more like UNOLS vessels in terms of facilities funding.

The need for the white paper and questionnaire was discussed.

To do items for SCOAR include:

- Announce and start looking for candidates for new members.
- Focus topics for next meeting: white paper, clearinghouse for aircraft facility information.

- The potential for too many different web pages with similar content was discussed. These should use hot links as much as possible. Action items might include a list of past projects and instruments and a table of available aircraft.

John Bane will draft a letter of appreciation for Ken Melville for his and Peter Wiebe's signature, cc Ken's boss.

SCOAR Meeting Participants

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Bob Bluth CIRPAS
Charles Flagg SUNY
Dan Reimer RSMAS
Jim Hain Assoc Sci. W. H.

Draft Agenda
ICCAGRA Meeting
CIRPAS Facility, Marina Airport, Hangar 507

Tuesday May 23

830am Welcome & meeting Objectives

845 Agency Reports (current facilites, future plans, schedules, science missions) - 30 minutes each

CIRPAS
ONR

945 BREAK

1000 Agency Reports (continued)

NRL
NSF
NOAA
NASA

1100 IWGADTS Report

1130 Lunch

1pm UND Falcon Proposal

130 ICAP Update

145 Issues & future strategies
OMB Exhibit 300
UAVs
UNOLS-type structure

245 Next Meeting

3pm Adjourn

Meeting Agenda
Scientific Committee for Oceanographic Aircraft Research (SCOAR)
May 24, 2006
CIRPAS Facility, Marina, CA

8:30 to 9:00 - Welcome and Introduction

* Welcome by SCOAR Chair and UNOLS Executive Secretary
* Introduction of participants, incl. "new" SCOAR member Carl Friehe
* Remarks by CIRPAS Director, Bob Bluth
* Accept minutes of the November 2005 meeting
<http://www.unols.org/meetings/2005/200511sco/200511scomi.html>
* Review Agenda for this meeting

9:00 to 10:30 - Discussion of Agency and CIRPAS Reports (Delivered at ICCAGRA Meeting on Tuesday)

* UNOLS report - Mike Prince
* CIRPAS report - Bob Bluth and/or Haf Jonsson

* Overviews from federal agency representatives
    * NSF - Jim Huning
    * ONR - John Freitag
    * NOAA - Beth White and/or Jim McFadden
    * NASA/ICCAGRA - Cheryl Yuhas

10:30 to 11:00 - Break

11:00 to 12:00 - Discussion of Upcoming Airborne Ocean Science Meeting

* Overview of the AOSC meeting -- What is our goal? - Bane
* How can we best get input from attendees about the effective operation of SCOAR for the ocean sciences community and for UNOLS? - Bane
* Letter to the community about the need for a long-range assessment of aircraft (and satellite?) requirements and development of instrumentation through the SBIR program -- this may be the way to get community input - Bane

12:00 to 1:30 – Lunch

1:30 to 2:00 - Guest Presentation and Discussion

* Jim Hain, Associated Scientists at Woods Hole - "FAA exemptions to the experimental aircraft certifications to allow for scientific research applications"

2:00 to 3:00 - Continued Discussion of AOSC Preparations

3:00 to 3:30 - Future Business

* Action item list and assignment - SCOAR
* Next meeting - SCOAR

3:30 to 4:00 - Adjourn and Head to MLML for AOSC

The Scientific Committee for Oceanographic Aircraft Research
and
The Interagency Coordinating Committee for Airborne Geoscience Research and Applications

Joint meeting May 23-24, 2006
Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS)
Marina, CA

MEETING PARTICIPANTS

(1) May 23 only (2) May 24 only

LAST	FIRST	AFFILIATION	Phone	Email
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CENTER FOR INTERDISCIPLINARY REMOTELY-PILOTED AIRCRAFT STUDIES (CIRPAS)

AIRCRAFT ASSETS

NAT – 750
(2)

Pelican (2)

Altus

Ground Control
Station (2)

Predator (3)

UV 18-A Twin Otter

CENTER FOR INTERDISCIPLINARY REMOTELY-PILOTED AIRCRAFT STUDIES (CIRPAS)

GROUND BASED ASSETS

MPQ-64 (2) Mobile Storm Radar

Winds LIDAR

95 GHz Cloud Radar

CIRPAS FACILITIES:

- **Marina Facility (Hager 507)**
  - 35,000 sq ft maintenance hangar
  - 3500 ft runway - manned operations only
  - Office space
  - Maintenance facility
  - Payload development and integration
  - Logistics planning and support to research and test projects

CIRPAS FACILITIES:

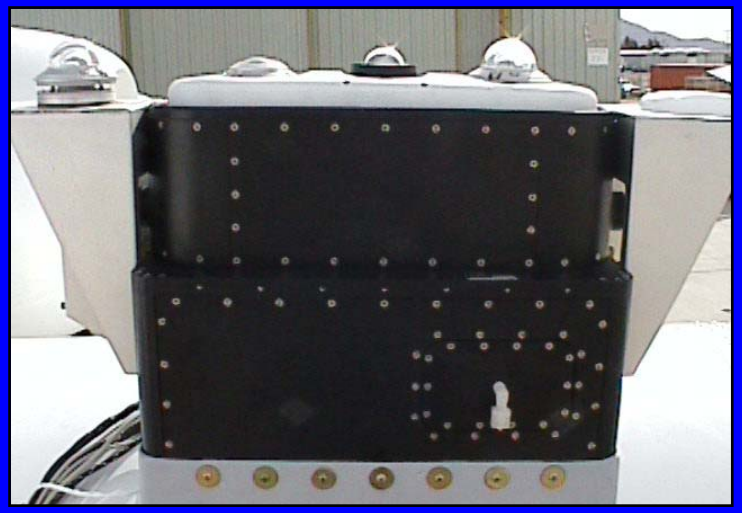
- **Camp Roberts Facility**
  - Friendly airspace for UAV testing and training (R2503).
  - Military ground maneuvers (equipment, personnel)
  - 3500 x 60 ft runway
  - 2000 sq ft hangar
  - Office Space

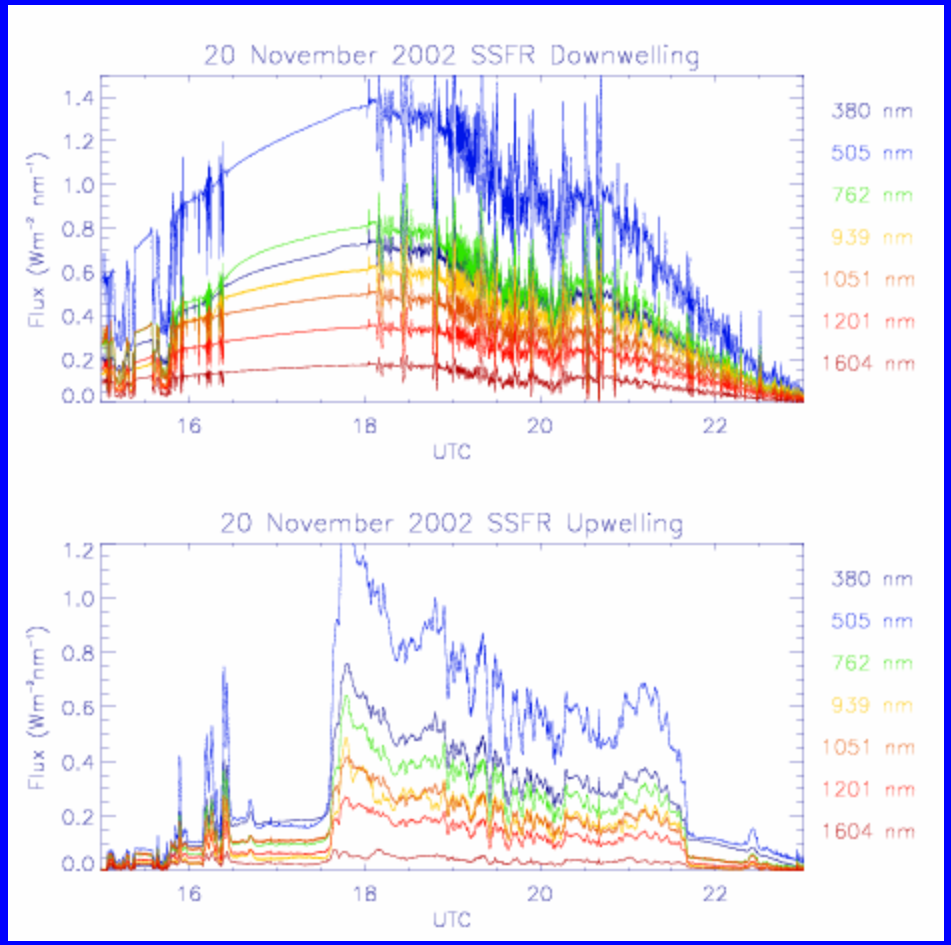
SUPPORT FOR THE FLEET

SUPPORT FOR NATIONAL SCIENCE INITIATIVES

CIRPAS SCIENTIFIC INSTRUMENTATION

Stabilized Radiometer Platform



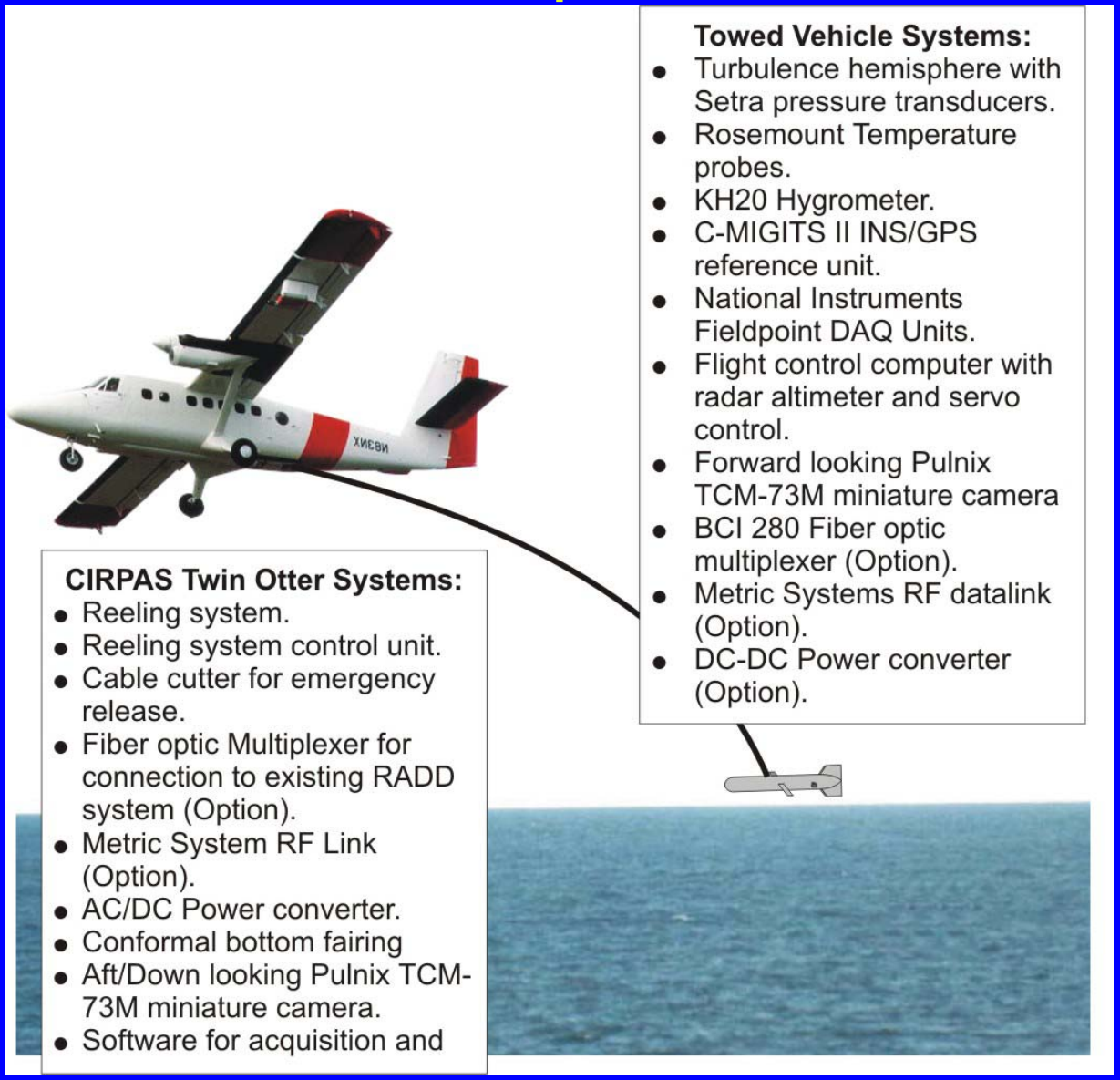


CIRPAS SCIENTIFIC INSTRUMENTATION

Theromodynamic Fluxes

CIRPAS SCIENTIFIC INSTRUMENTATION

Low Altitude Atmospheric Flux Platform



Towed Vehicle Systems:

- Turbulence hemisphere with Setra pressure transducers.
- Rosemount Temperature probes.
- KH20 Hygrometer.
- C-MIGITS II INS/GPS reference unit.
- National Instruments Fieldpoint DAQ Units.
- Flight control computer with radar altimeter and servo control.
- Forward looking Pulnix TCM-73M miniature camera
- BCI 280 Fiber optic multiplexer (Option).
- Metric Systems RF datalink (Option).
- DC-DC Power converter (Option).

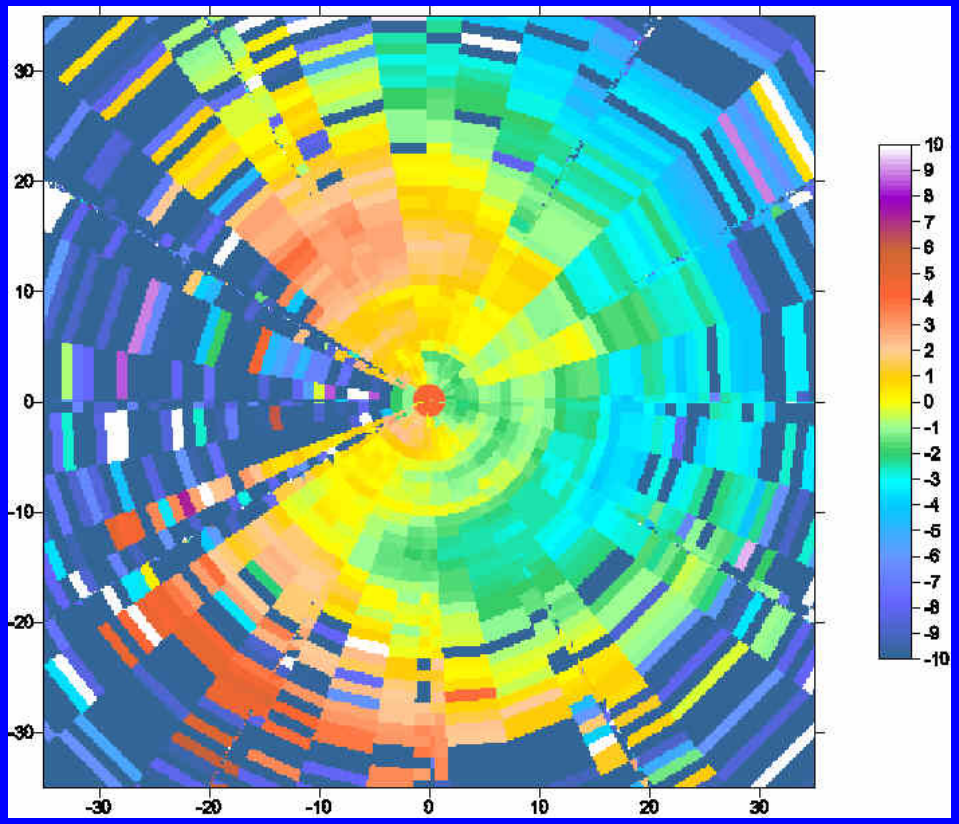
CIRPAS Twin Otter Systems:

- Reeling system.
- Reeling system control unit.
- Cable cutter for emergency release.
- Fiber optic Multiplexer for connection to existing RADD system (Option).
- Metric System RF Link (Option).
- AC/DC Power converter.
- Conformal bottom fairing
- Aft/Down looking Pulnix TCM-73M miniature camera.
- Software for acquisition and

CIRPAS SCIENTIFIC INSTRUMENTATION

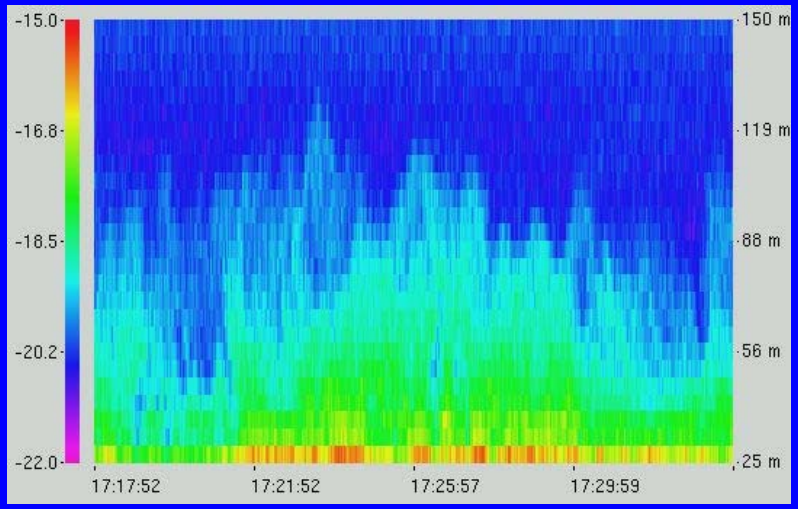
Winds LIDAR

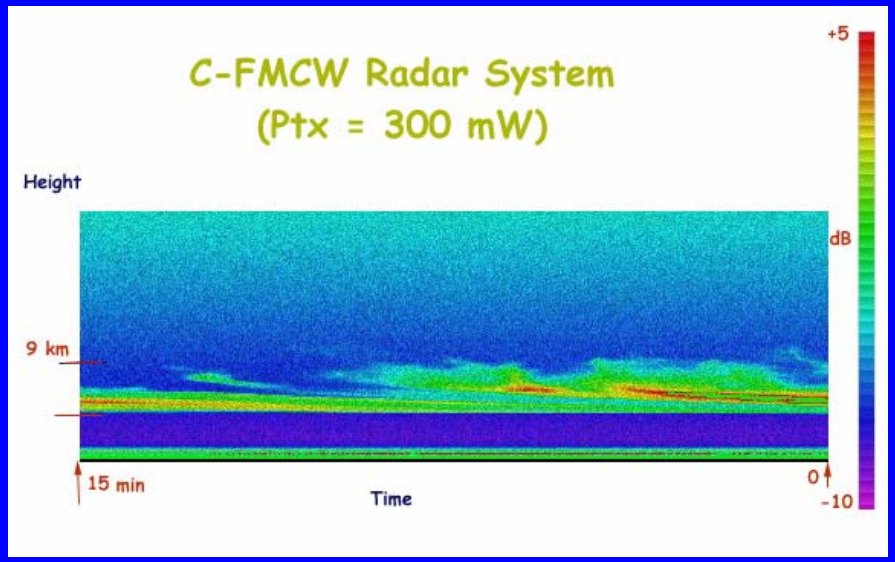
TODWL two axis scanner



CIRPAS SCIENTIFIC INSTRUMENTATION

95 GHz Cloud Radar





Scientific Development Squadron One (VXS-1)

VXS-1 Squadron Overview

- Formally Naval Research Laboratory Flight Support Detachment (NRLFSD)
- Commissioned by CNO Dec 2004
- Navy's "ONLY" S&T squadron
  - Provide airborne research laboratories to support Navy and other Government research projects
- 3 NP-3D and 2 RC-12F aircraft (New capability)
  - Currently investigating acquisition of Mid-range support aircraft
- POC's
  - Commanding Officer - CDR Patrick Herring - 301.342.3751 patrick.herring@navy.mil
  - Executive Officer – LCDR Garron Morris – 301.342.3751 garron.morris@navy.mil
  - Special Projects Coordinator – Mr. Sam Kogel – 301.342.3256 samuel.kogel@navy.mil

Airborne Laboratories

- **2 Research Configured NP-3D's**
  - National and Navy S&T projects
    - NRL / USGS / NGA
    - ONR
    - Johns Hopkins APL
    - NSF / NOAA

- **1 AEW NP-3D**
  - E-2C HE2K/CEC configured
    - MDA
    - NAVSEA

- **2 RC-12's**
  - Smaller scale S&T projects
    - NRL
    - NAVAIR

RC-12F

- Up to 4.5 hours on station
  - 1000 Nmi range
- Up to three equipment/operator stations
  - 22” high single 19” racks
  - 400 lbs project weight capability
- Research Load Center
  - 28Vdc, 115Vac 60/400 cycle 20 amp
- Belly mounted projects radome
- Aircraft systems tie in
  - GPS
  - Altitude/heading/speed

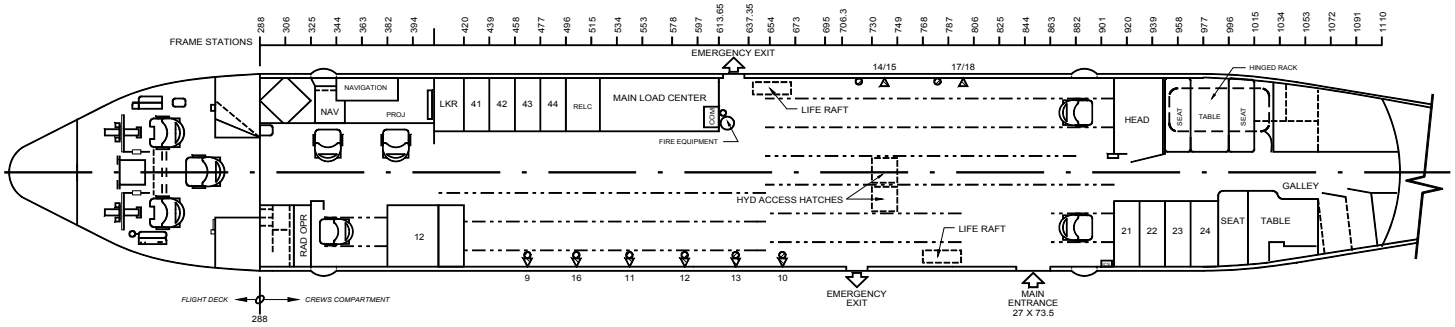
NP-3D Aircraft

- Two full research configured interiors
- One AEW configured aircraft w/HE2K equipment suite
- Support World-wide independent operations
  - Rampant Lion – Middle East
  - Antarctica Mapping
- Can dedicate up to 12 hours on station
- Operate at ranges up to 4,500 Nautical miles
- Operate at altitudes from 200 ft to 31,000 ft
- Equipped for extensive over water operations

Research Configured NP-3D

- Configurable Interiors
- Project/Research Electrical Load Centers
- Modified Bomb-Bay pallets
- 20” floor rails to accommodate up to 10 equipment/operator consoles totaling up to 4500 lbs total weight
- Support up to 11 project specialist on flights over 6 hours long
- Aircraft Navigational data access
- Wing wiring to support up to 10 external pod’s
- Research configured nose/tail
- Project dedicated static pressure port
- Project Communication
- Lower sono-door system

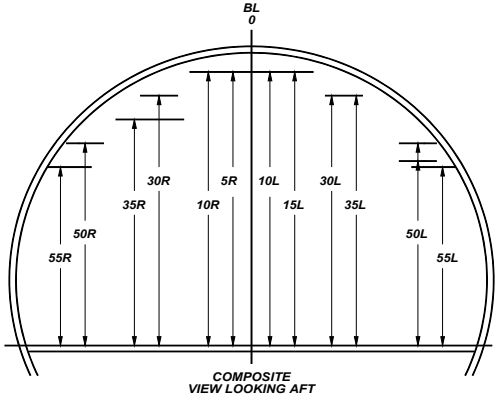
Research Configured NP-3D



WING STATION DISCONNECT

ICS / VIDEO DISCONNECT

REFERENCE INFORMATION		
4'7"	55L	400-647
4'11.8"	50L	647-787
5'4.5"	50L	862-920
6'6.5"	35L	400-647
6'6.5"	30L	647-787
6'6.5"	30L	862-920
7'1"	15L	400-647
7'1"	10L	647-920
7'1"	5R	400-647
7'1"	10R	647-920
6'6.5"	30R	647-920
6'1"	35R	343-405
5'4.5"	50R	647-920
4'9"	55R	343-405



GENERAL ARRANGEMENT
NRL P-3B MODIFICATION
(BUNO154589)

Project Coordination

- Technical
  - Assistance in assuring projects meet Navy safety requirements
  - Assistance in obtaining equipment flight certification and clearances
  - Maintenance scheduling for project installation/de-installation
  - Weight & Balance, Center of Gravity computations
  - Assistance in developing aircraft interface, i.e. GPS, INS, Communications
  - Operation of all Ground Support equipment

- Project Sponsors
  - Develop project equipment interfaces IAW Navy specifications
  - Provide drawings, wiring diagrams, stress analysis, etc to VXS-1 to obtain flight certification/safety clearances
  - Provide certified Project Specialists
  - Assure Project Technicians adhere to VXS-1/Navy safety procedures


WARLOCKS
VXS-1

Questions?


DEPARTMENT OF THE NAVY
USN
ONR
Science & Technology


NAVAL RESEARCH LABORATORY
WASHINGTON, D.C.

SCOAR Meeting
May 23-24, 2006

CIRPAS

Monterey, California

Jim Huning, NSF

Deployment Pool

- *NSF Deployment Pool provides funding to deploy NSF national facilities for NSF funded science proposals (aircraft, ground based, sounding facilities).*
- *Working to expand facilities mix*
- *In progress: facilities assessment (universities, national labs, private companies)*
- *DP amounts to slightly less than 5M/year*

New Review Procedures for NSF Sponsored Field Campaigns

- *Description of New Process*
- *Impact on:*
  - Facility Managers
  - OFAP
  - PIs
- *Objectives of Changes*

PROBLEMS

- *Many field programs are becoming too large and complex to execute on short time frames*
- *Facility Managers are finding it difficult to optimally schedule facility upgrades and maintenance*
- *Competition for facilities is growing*
- *Many field campaigns involve critical facilities that are not currently reviewed along with the NSF facilities*

OBJECTIVES

- *Develop a process that will allow:*
  - Increased lead time for planning of field campaigns
  - More rigorous early review process than afforded by the SOD
  - Avoidance of unnecessary expenditure of effort by PIs
  - Better coordination with international and national partners
  - Holistic review of entire experimental design

PROCESS

- *Procedures will be different for "large" and "small" programs.*
  - "Large" Programs:
    - Field Costs >$1 Mil {Under discussion}
    - Unusually Complex Programs
    - Programs with Int'l Partners
  - "Small" Programs – all the rest
  - NSF in consultation with PIs and FMs will determine category

PROCESS – Large Programs

- *Before submission of individual science proposals, PIs must submit two overarching documents:*
  - Scientific Program Overview (SPO; formal NSF Proposal)
  - Experimental Design Overview (EDO; submitted to FMs, OFAP, FAC)

Timeline – Large Programs

- *NOTE: For Large Programs there will be only one review cycle per fiscal year.*
- *Summer/Fall of FY-3: Initial contacts between PIs, NSF POs and FMs*
- *15 Jan FY-2 SPO and EDO submitted {Date Under discussion}*
- *May FY-2 Review Completed*

Timeline – Large Programs

- *Jun FY-2: Proposals encouraged or discouraged*
- *Jul FY-2 Facility requests submitted*
- *Aug FY-2 Individual science proposals submitted to NSF*
- *Nov FY-1 OFAP/FAC review of Facility requests*
- *Jan FY-1 Final NSF action on proposals*
- *FY (Oct-Sep) Field campaign conducted*

Timeline – Large Programs

- *Formal submission to NSF – copy to OFAP, FMs*
- *Section D, Project Description*
  - Brief description of experimental design (EDO will be made available to reviewers)
  - Relationship to prior similar efforts
  - List of all facilities and PIs (irrespective of source of support)
  - Scientific Rationale - Holistic

EDO

- *OFAP will have copy (or equiv. of SPO)*
- *Holistic*
- *Structure*
  - Exec Summary
  - Scientific Rationale/Objectives
  - Exp Design
  - Proj Mgt (before and during field campaign)
  - Data Mgt
  - List of Facilities and PIs

IMPACT ON FMs

- *Advice/Guidance earlier in planning process than before. Also perhaps a bit more in depth*
- *Early cost estimates must be provided by FMs (not intended to be a major burden)*

IMPACT ON PIs

- *Must have their act together much earlier in the process*
- *Formal proposal to NSF provides a mechanism to support program management*

IMPACT ON OFAP

- *OFAP will review the entire program not just the part associated with NSF facilities.*
- *Review, therefore, will be much more intense and thorough*
- *{Will be discussed later, but review process of "small" programs will be basically the same.}*

SUMMARY

- *New policy and procedures are in effect and will impact programs in FY 2007*
- *SDO and EDO are serious documents and serious decisions will be made based on their review*
- *Evolving process. Comments are welcome.*

SMALL PGMS -- Timeline

- *For Deploy. Oct-Mar of FY*
  - Jul FY-2 Fac Req Submitted
  - Aug FY-2 Prop to NSF
  - Nov FY-1 OFAP Eval Fac Req
  - Jan FY-1 Final NSF action on prop
  - Oct – Mar FY Field Campaign conducted

SMALL PGMS -- Timeline

- *For Deploy. Mar-Sep of FY*
  - 1 Dec FY-1 Fac Req Submitted
  - 15 Jan FY-1 Prop to NSF
  - May FY-1 OFAP Eval Fac Req
  - Jul FY-1 Final NSF action on prop
  - Apr – Sep FY Field Campaign conducted

NSF GV (HIAPER)

HIAPER on First Major Science Campaign:
T-REX


2005 12 08 19:10

NSF C-130Q

NRL P-3 with ELDORA Attached

University of Wyoming King Air

Planning for the next Generation Storm Penetration Aircraft

FAA Certification

The GV delivered with a Standard Airworthiness Certificate per contract with GAC.

Three STCs (Supplemental Type Certificate) were generated as part of the contract for the structural modifications (LMAC), the interior (Garrett/SAC) and the ICS (Garrett).

The GV was ferried to Jeffco in the Experimental category (March 2005).

The Satcom installation took place in July 2005 by subcontractor Atlas Telecom and this was approved with a FAA 337 Field Approval form.

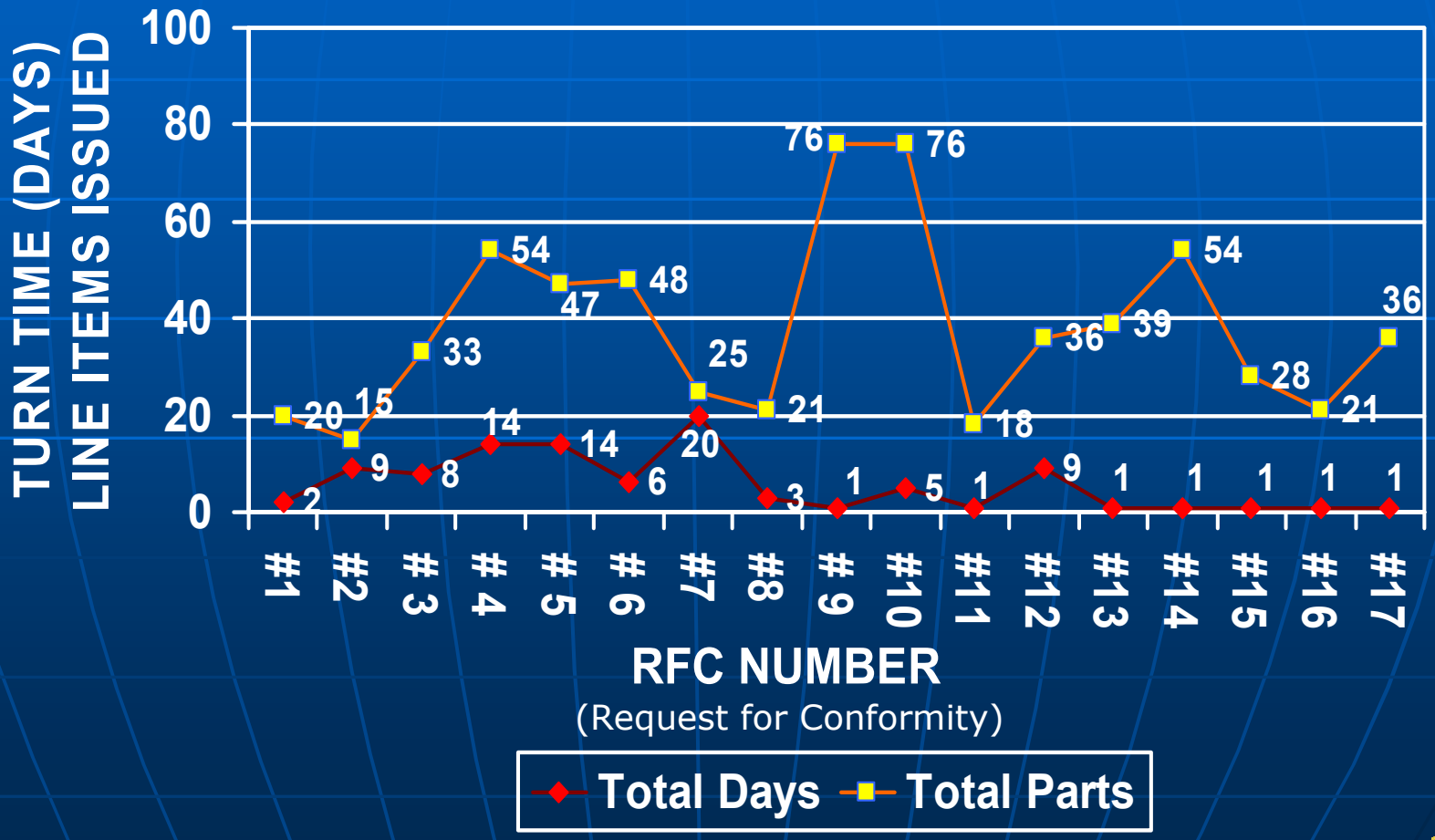
NCAR/EOL Structures DER (with support from consulting Electrical Systems DERs) obtained 2 STCs for the “Basic Research Systems Installation” and the “Quick Change Cabin Configuration w/ Equipment Racks”.

Final Standard Airworthiness Certificate issued in October 2005.

Atlanta ACO

- Over 1,000 separate approvals required for the primary structural and electrical modifications
- Preservation of schedule was paramount (due to NSF Major Research Equipment project requirements (levied by OMB and Congress))
- Time of approval changed dramatically as FAA and GAC/LMAC personnel gained confidence with one another (over 20 days to as short as same day)
- Lesson learned: Communication was key

Turnaround


TURN TIME (DAYS)
LINE ITEMS ISSUED
100
80
60
40
20
0
20
15
33
54
47
48
25
21
76
76
18
36
39
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28
21
36
2
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#7
#8
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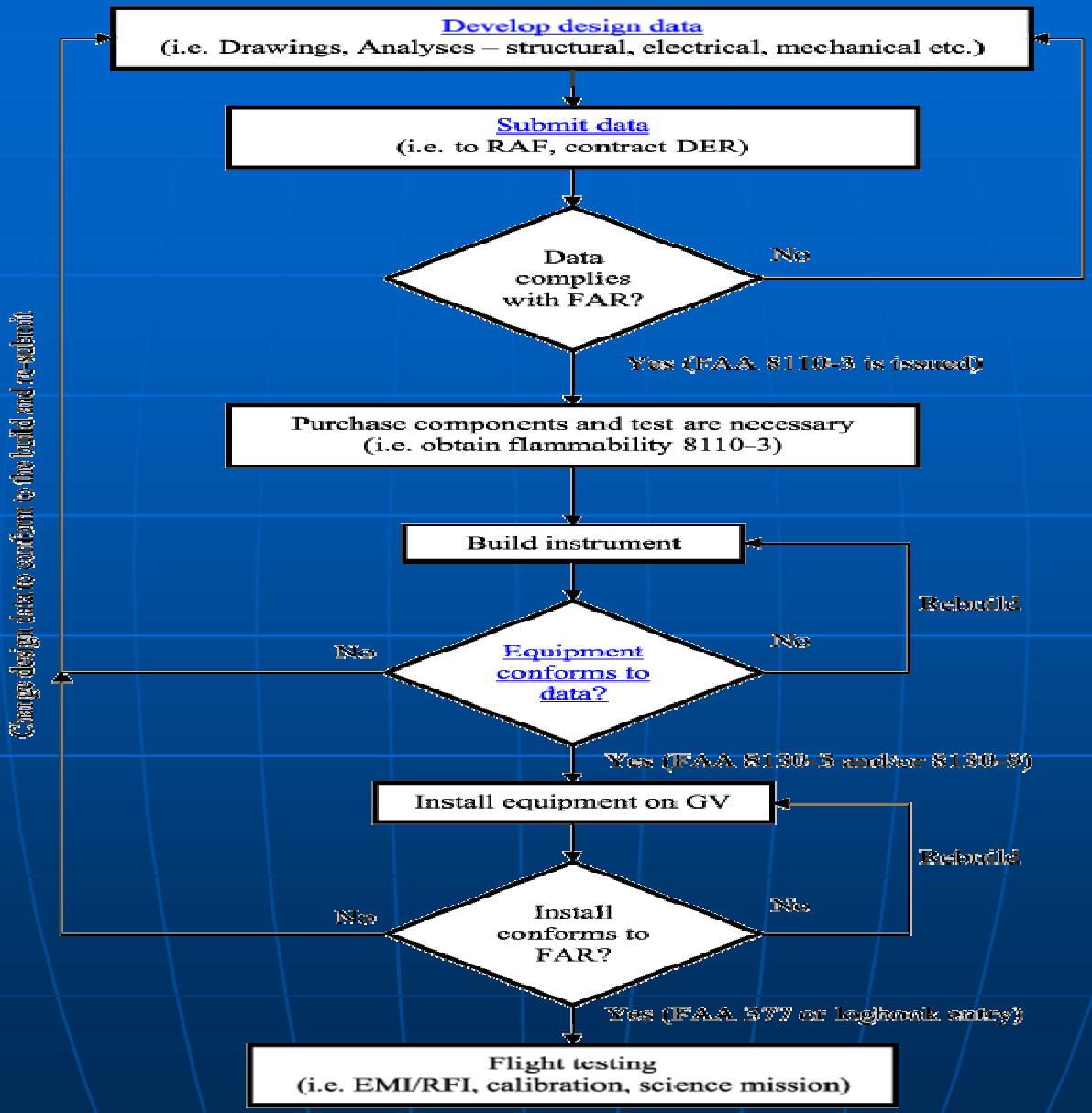
#10
#11
#12
#13
#14
#15
#16
#17
RFC NUMBER
(Request for Conformity)
Total Days
Total Parts

Certification process for HIAPER instrumentation



Glossary of abbreviations
RAF: NCAR Research Aviation Facility
DER: Designated Engineering Representative

ICAP Update
ICCAGRA Meeting
May 23, 2006
CIRPAS

ICAP Update

- Interagency Committee for Aviation Policy
- 18 Civilian Agencies, DOD invited participant
- GSA makes policies for managing the acquisition, use, and disposal of a/c that federal civilian agencies own or hire. GSA also sponsors ICAP (formed at the direction of OMB)

ICAP Update

- ICAP has a number or responsibilities, including the following:
  - Management overview and FAIRS reporting
  - Safety of Government aircraft, including ARMS and ASO
  - A/C regulations and Guidance Overview, which includes

ICAP Update

- A/C regulations and Guidance Overview, which includes 41 CFR 102-33 and 41 CFR 300-3; 301-10, and 301-70; A-126 (Improving the Management and Use of Government Aircraft)
- Re-write (in progress) of AC 00.1-1 FAA Advisory Circular on Public Aircraft (Government Aircraft Operations)

ICAP Update

- Sponsors workshops on topics such as:
  - OMB A-11, Exhibit 300 Planning for Aviation Assets and Lessons Learned
  - A/C lifecycle and cost benefit analysis
  - FAIRS training
  - Exchange or sales programs
- Sponsors events: FEDFLEET Fed Aviation Workshops June 19-22 in Los Angeles

ICCAGRA Meeting
23 May 2006: Marina, CA

NOAA Aircraft Operations Center

MacDill AFB, FL

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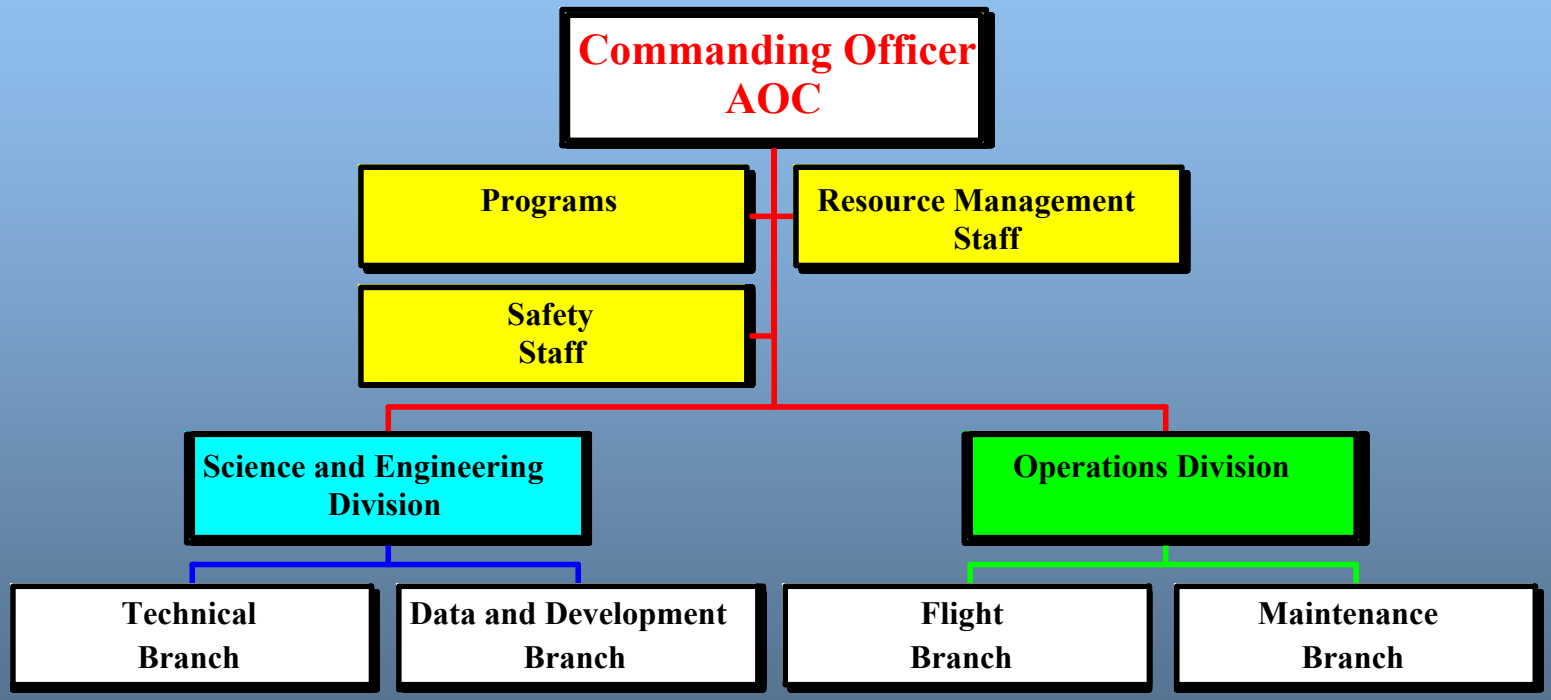
Aircraft Operations Center



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AOC FACILITIES

MACDILL AIR FORCE BASE, FL.

HANGAR #5 MacDILL AFB

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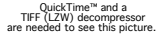
HANGAR #5
MacDILL AFB




ED STATES DEPT. OF COMMERCE
UNITED STATES DEPT. OF COMMERCE
NOAA
N46RF

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AOC AIRCRAFT

AIRCRAFT OPERATIONS CENTER AIRCRAFT 2004

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AIRCRAFT OPERATIONS CENTER AIRCRAFT 2006

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N44RF

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ICCAGRA - 2006

FY05 PROGRAMS

ICCAGRA - 2006

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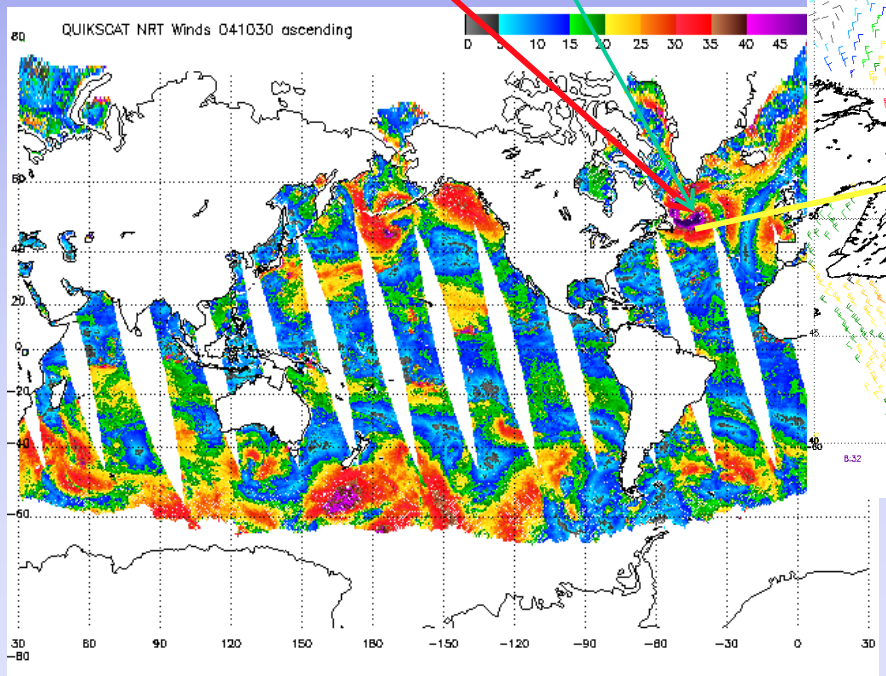
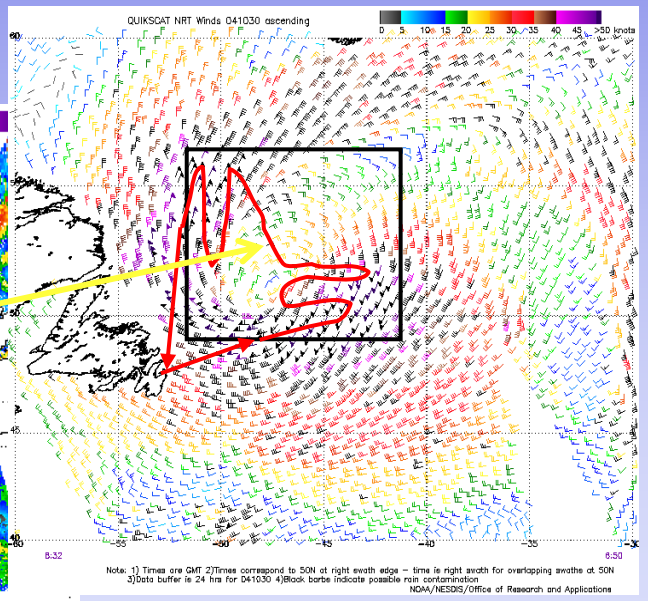
Ocean vector winds from QuikSCAT





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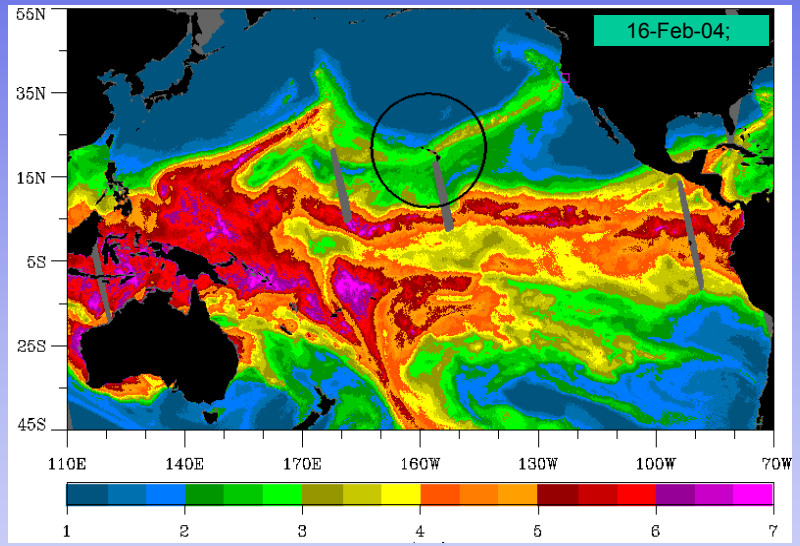
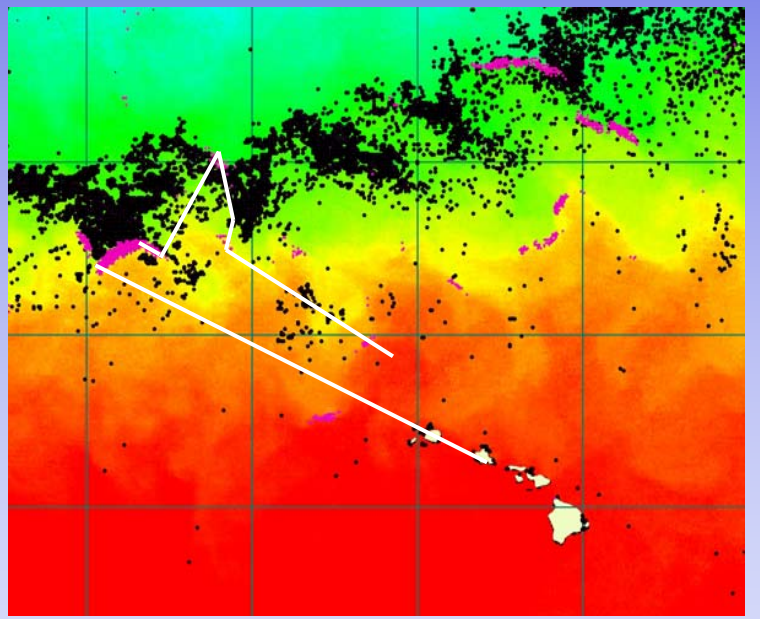
OCEAN WINDS WINTER

ICCAGRA - 2006

Atmospheric Rivers



Ghostnet

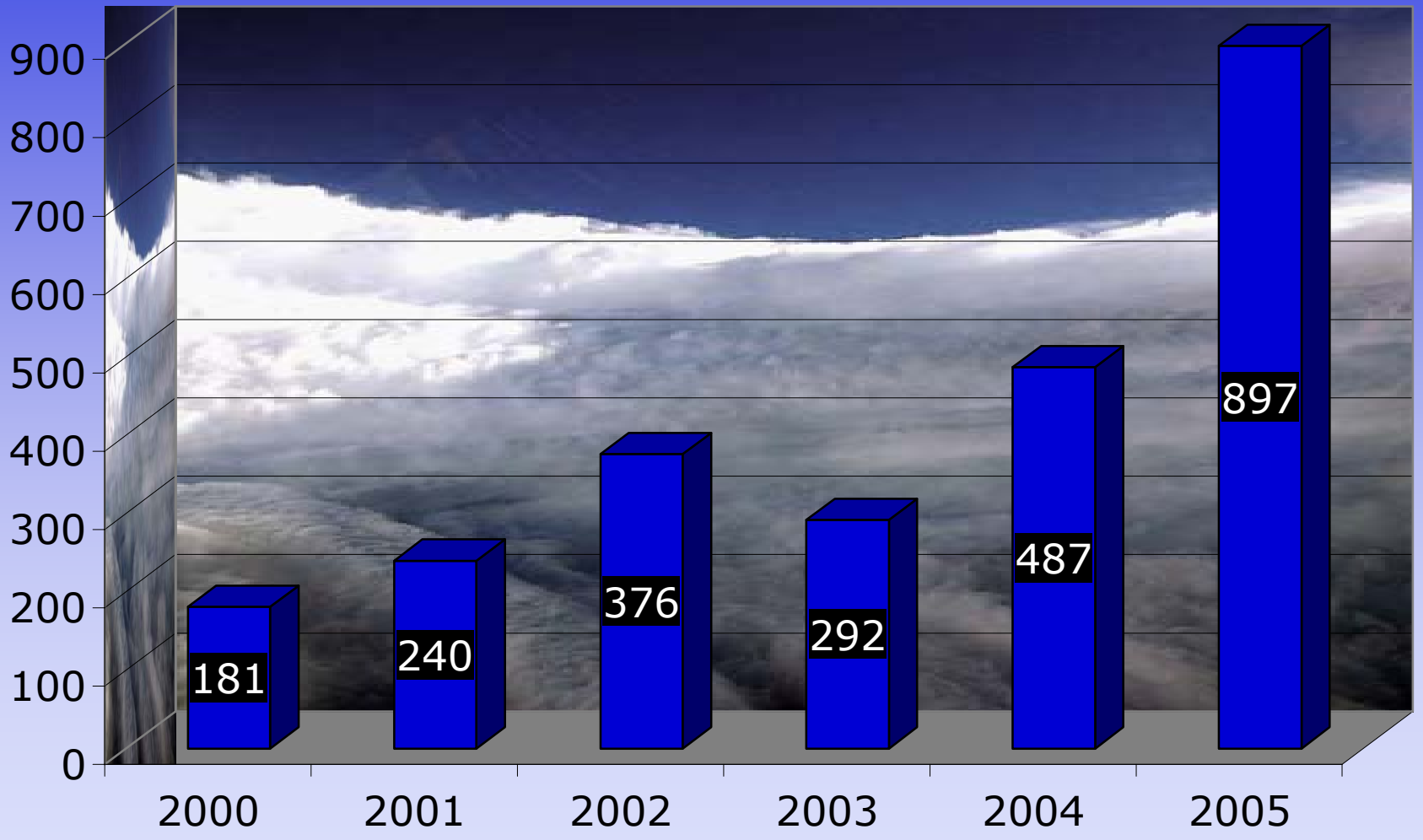


FY05 Programs

ICCAGRA - 2006

2005 HURRICANE SEASON

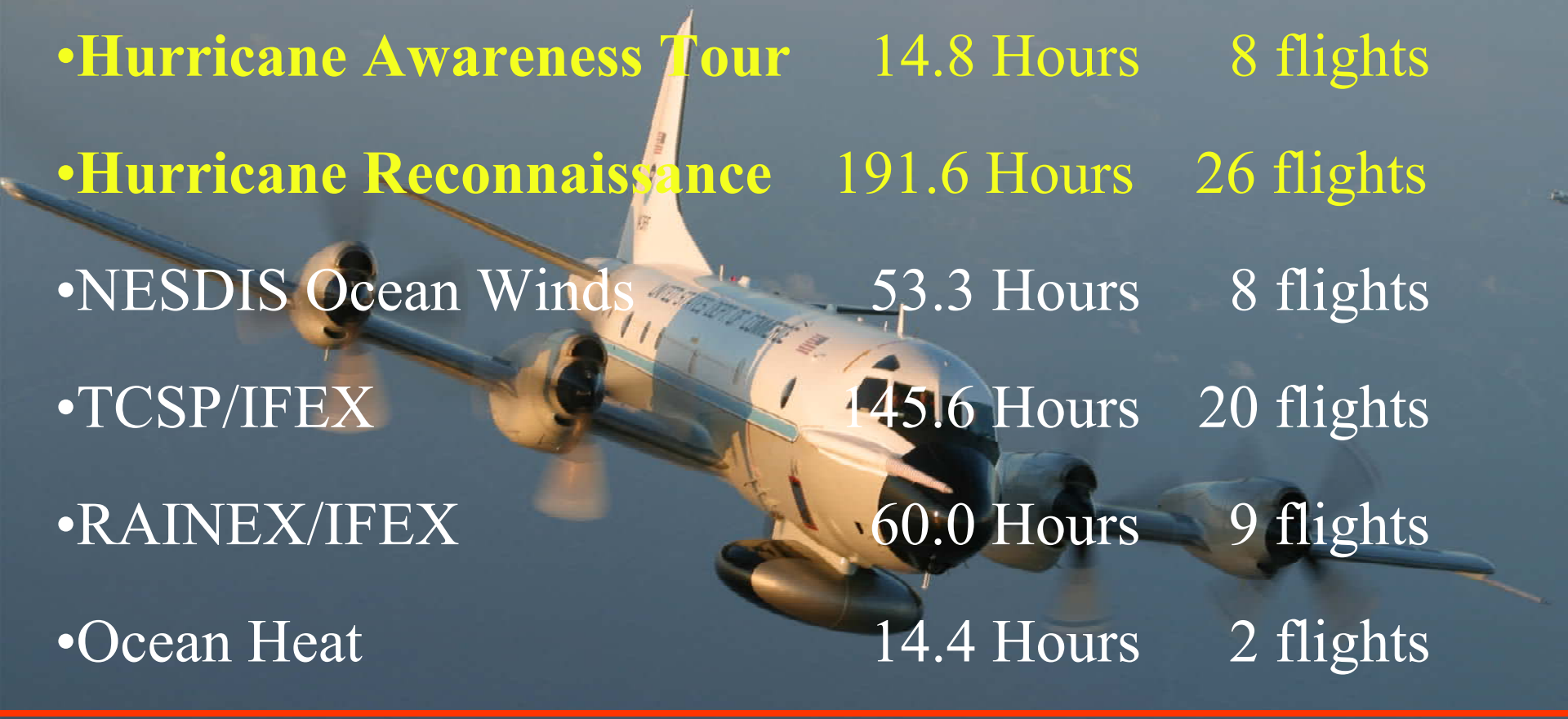
2000-2005 Hurricane Flight Hours - P-3 and G-IV



2005 Hurricane Season
P-3 and G-IV

•Hurricane Reconnaissance	191.6 Hours	26 flights
•Hurricane Surveillance	388.3 Hours	50 flights
•Hurricane Research	263.9 Hours	39 flights
•NESDIS Ocean Winds	53.3 Hours	8 flights
•Total	897.1 Hours	123 flights

2005 Hurricane Season P-3 (Operational/Research Missions)

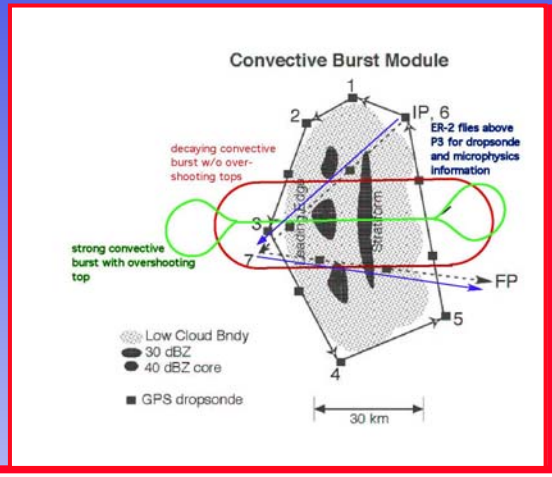


•**Hurricane Awareness Tour**	14.8 Hours	8 flights
•**Hurricane Reconnaissance**	191.6 Hours	26 flights
•NESDIS Ocean Winds	53.3 Hours	8 flights
•TCSP/IFEX	145.6 Hours	20 flights
•RAINEX/IFEX	60.0 Hours	9 flights
•Ocean Heat	14.4 Hours	2 flights
•Total	479.7 Hours	73 flights

2005 Hurricane Research

- TCSP/IFEX
- RAINEX/IFEX
- Ocean Winds
- Ocean Heat Content

noaa research
NOAA'S OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH


Convective Burst Module
1
2
IP, 6
ER-2 flies above P3 for dropsonde and microphysics information
decaying convective burst w/o over-shooting tops
Leading Edge
Stratiform
3
7
strong convective burst with overshooting top
FP
5
4
Low Cloud Bndy
30 dBZ
40 dBZ core
GPS dropsonde
30 km

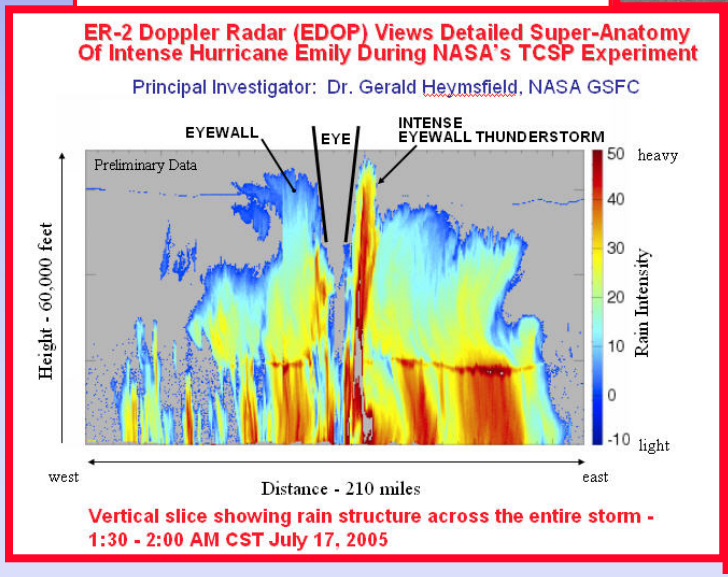

ER-2 Doppler Radar (EDOP) Views Detailed Super-Anatomy Of Intense Hurricane Emily During NASA's TCSP Experiment
Principal Investigator: Dr. Gerald Heymsfield, NASA GSFC
EYEWALL
EYE
INTENSE EYEWALL THUNDERSTORM
Preliminary Data
Height - 60,000 feet
50 heavy
40
30
20
10
0
-10 light
Rain Intensity
west
east
Distance - 210 miles
Vertical slice showing rain structure across the entire storm - 1:30 - 2:00 AM CST July 17, 2005


Photo Credit: O. Gomez

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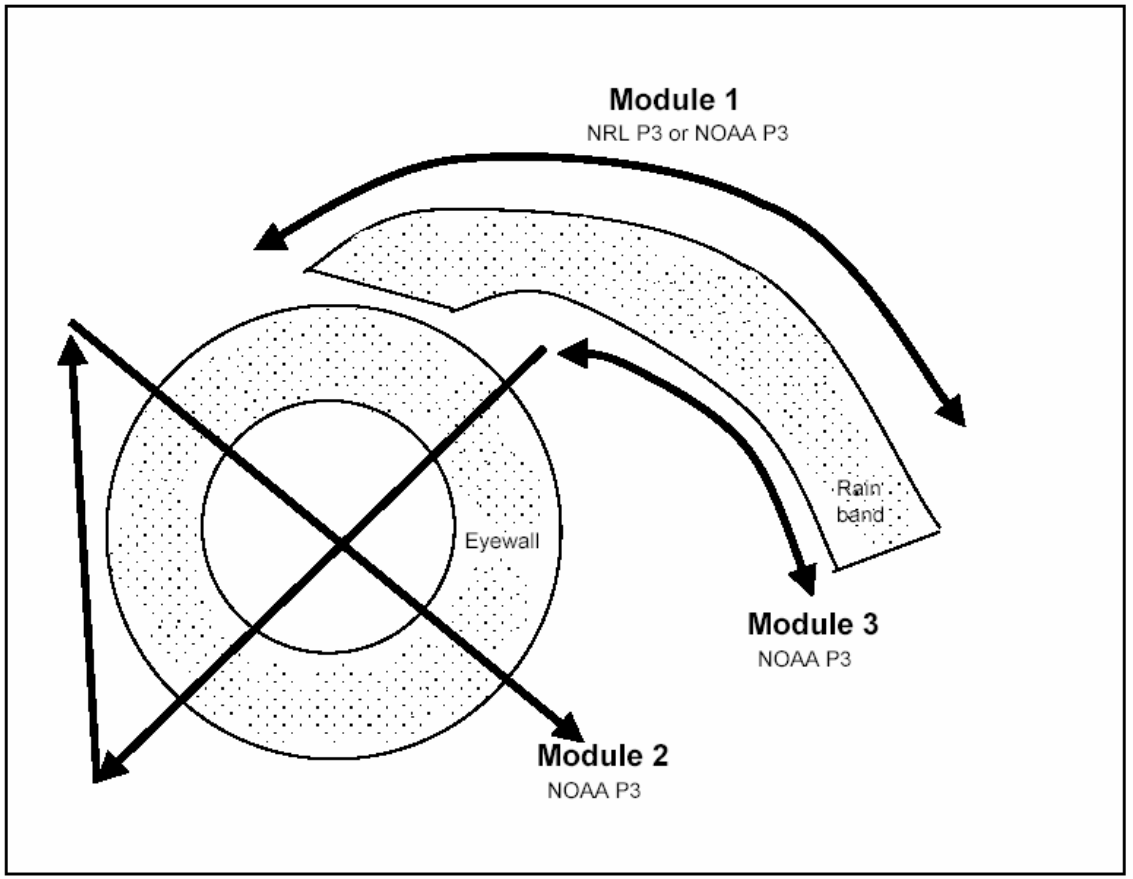
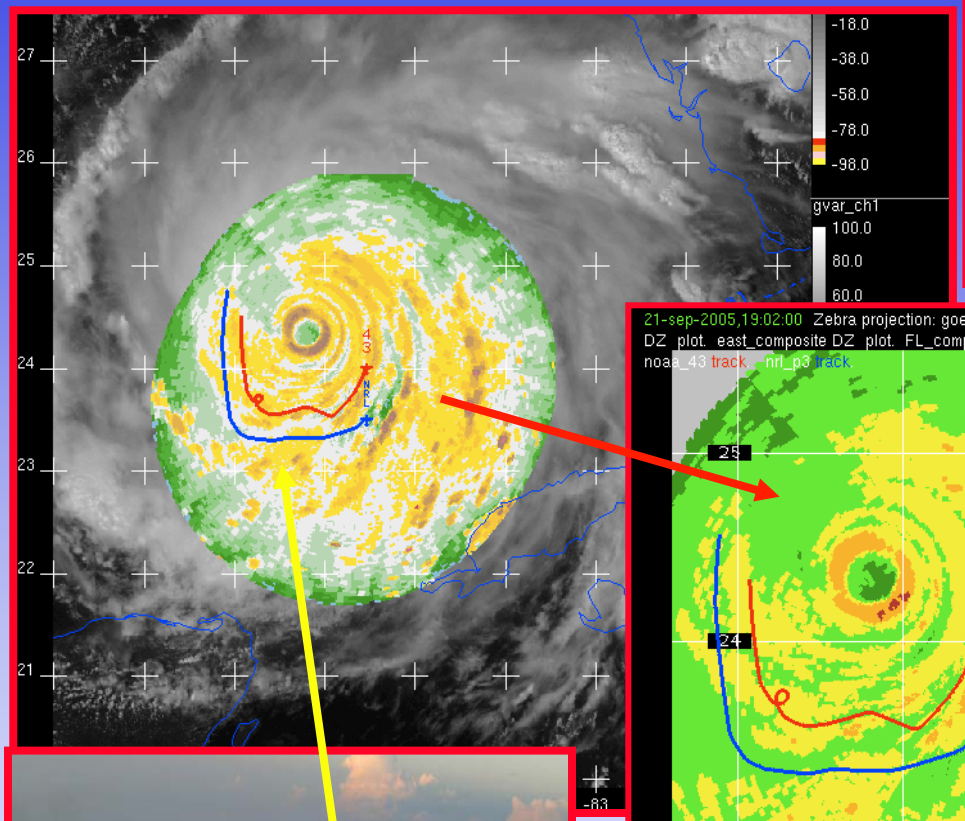
RAINEX FLIGHT TRACKS



RAINEX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-98.0
gvar_ch1
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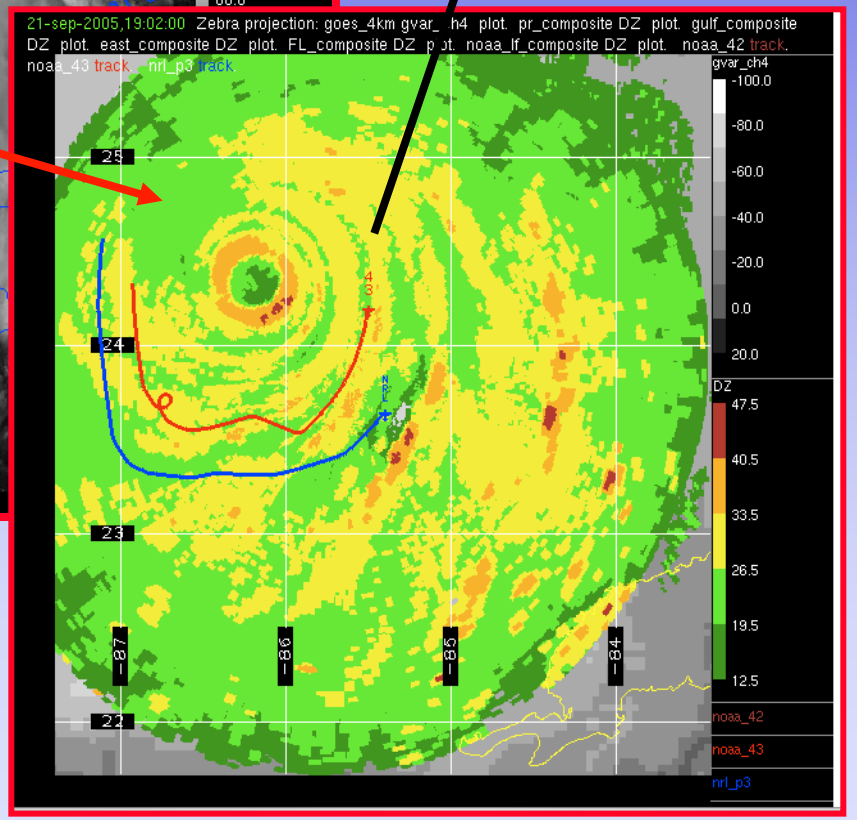
80.0
60.0


21-sep-2005,19:02:00 Zebra projection: goes_4km gvar_ h4 plot. pr_composite DZ plot. gulf_composite
DZ plot. east_composite DZ plot. FL_composite DZ p ot. noaa_lf_composite DZ plot. noaa_42 track.
noaa_43 track. nrl_p3 track.
gvar_ch4
-100.0
-80.0
-60.0
-40.0
-20.0
0.0
20.0
DZ
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40.5
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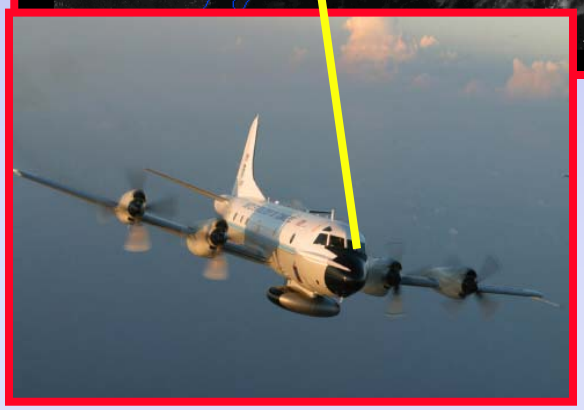

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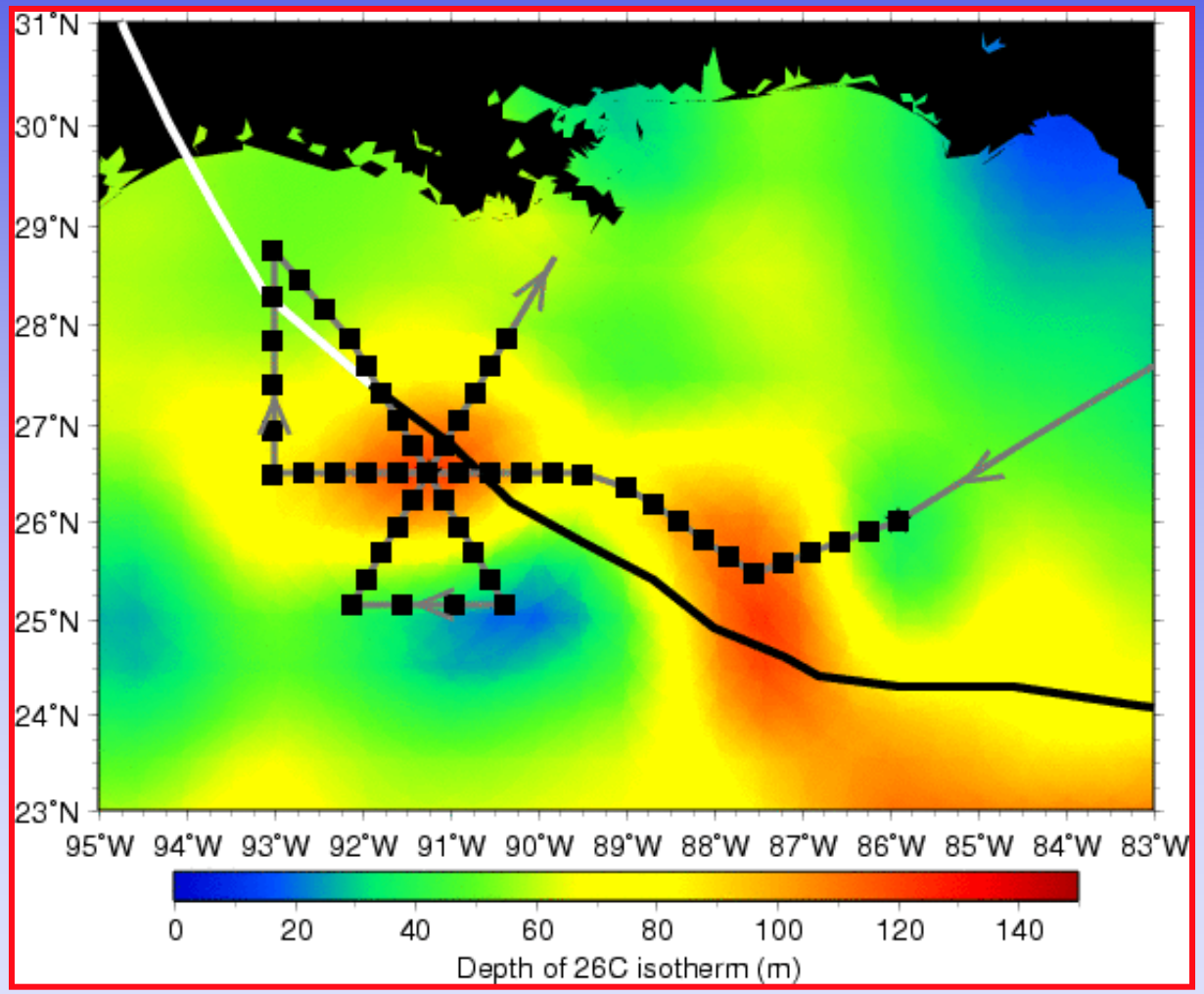
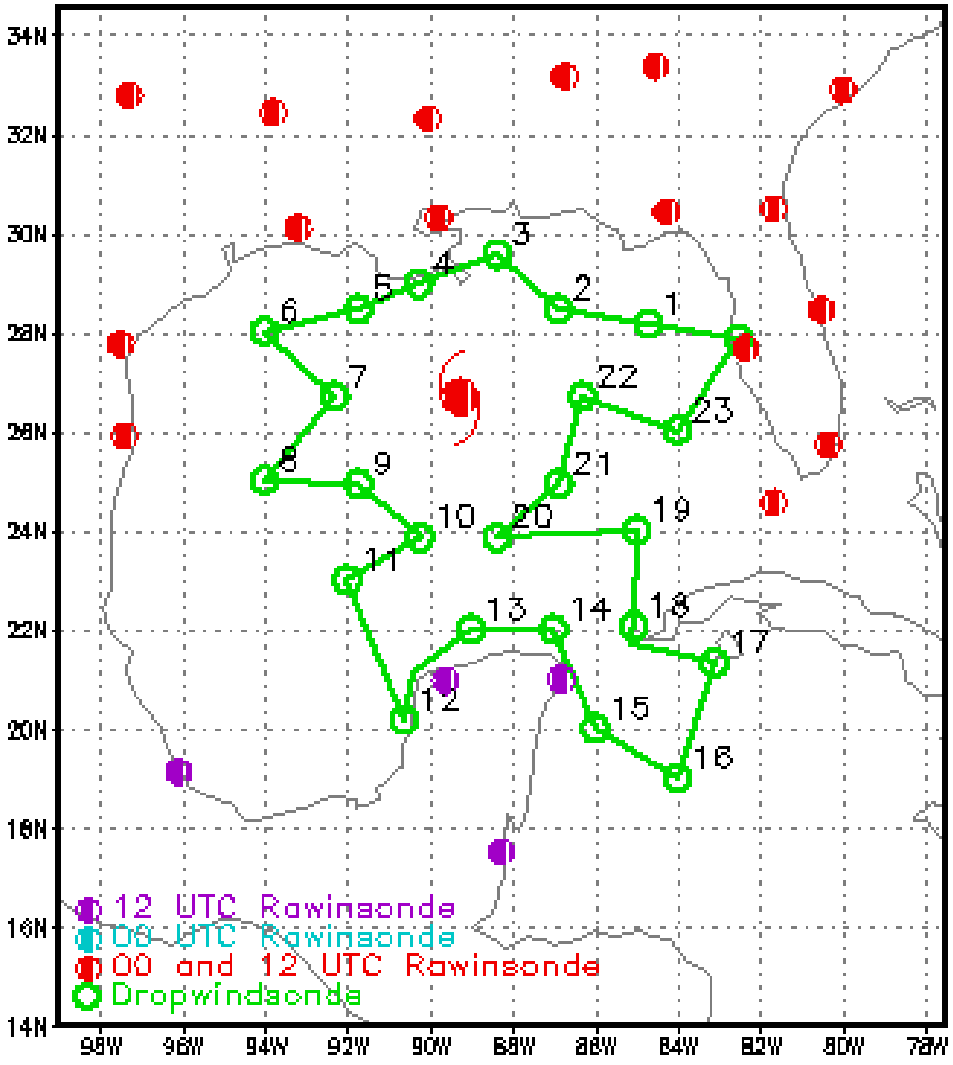


OCEAN HEAT CONTENT

SYNOPTIC FLOW MISSION G-IV



Katrina

27 Aug

GrADS: COLA/IGES

2005-08-27-08:38

2005 NOAA G-IV Hurricane Season
Flight Hour Summary (SALEX)

- 2 Deployments
- 4 Missions
- 44 Hours
- 115 Dropwindsondes

NOAA Citation Damage Photography

7000 Photos taken in 7 days -- Images available within 24 Hours

5 Million Photos (27 TBs) Downloaded Daily by the Public!

AOC Helicopter Support After Katrina Landfall

33 Flights

84 Hours

Less than 21 days!

Missions Flown:

- Humanitarian Relief
- Damage Assessment
- Hazmat Support
- Tide Gauge Repair

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KATRINA SUPPLEMTAL

Replacement of Dropsondes	$1,000K
Fuel costs	$ 250K
Dropsonde and Rcvr. Upgrade	$ 600K
Data Collection/Transmission Upgrade	$1,900K
Cloud Physics System Upgrades	$ 660K
Liquid and Total Sensors Upgrade	$ 100K
Radiometric Temp. Sensor Upgrade	$ 120K
Data System Standard. and Devel.	$ 250K
Redesign of AVAPS	$ 170K

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KATRINA SUPPLEMTAL (Continued)

High-speed LAN/ SATCOM Transmission	$ 600K
P-3 Radar Altimeter Replacement	$ 400K
P-3 Radar and Data System Upgrade	$2,700K
P-3 Aircraft	$9,000K
Medium Format Airborne Digital Camera	$ 300K
TOTAL (before taxes)	$18,050K
(after taxes)	$16,373K

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FY06 PROGRAMS

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are needed to see this picture.

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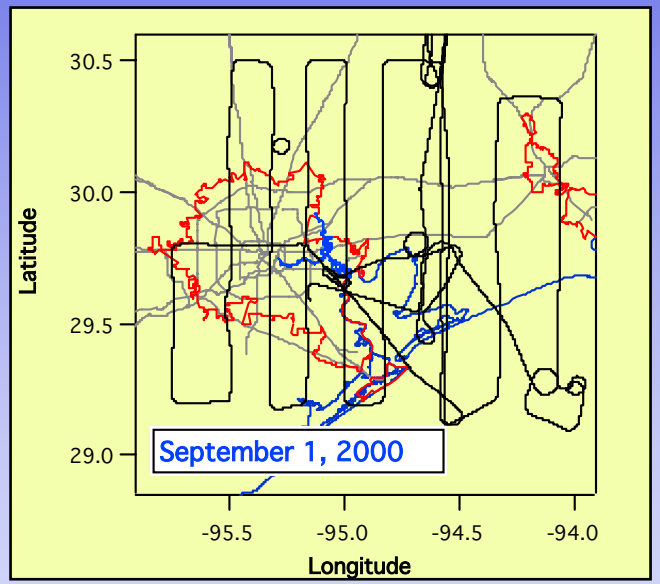
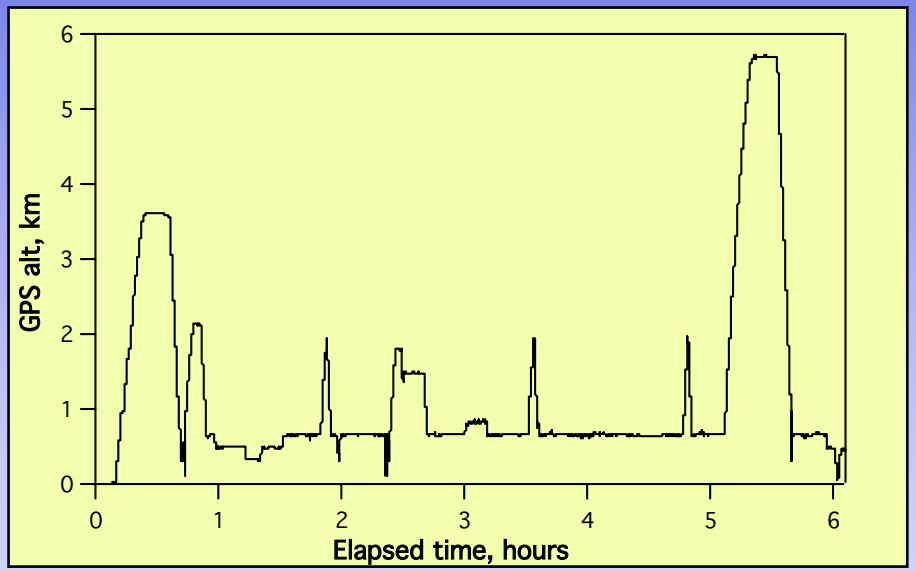
Texas Air Quality Study



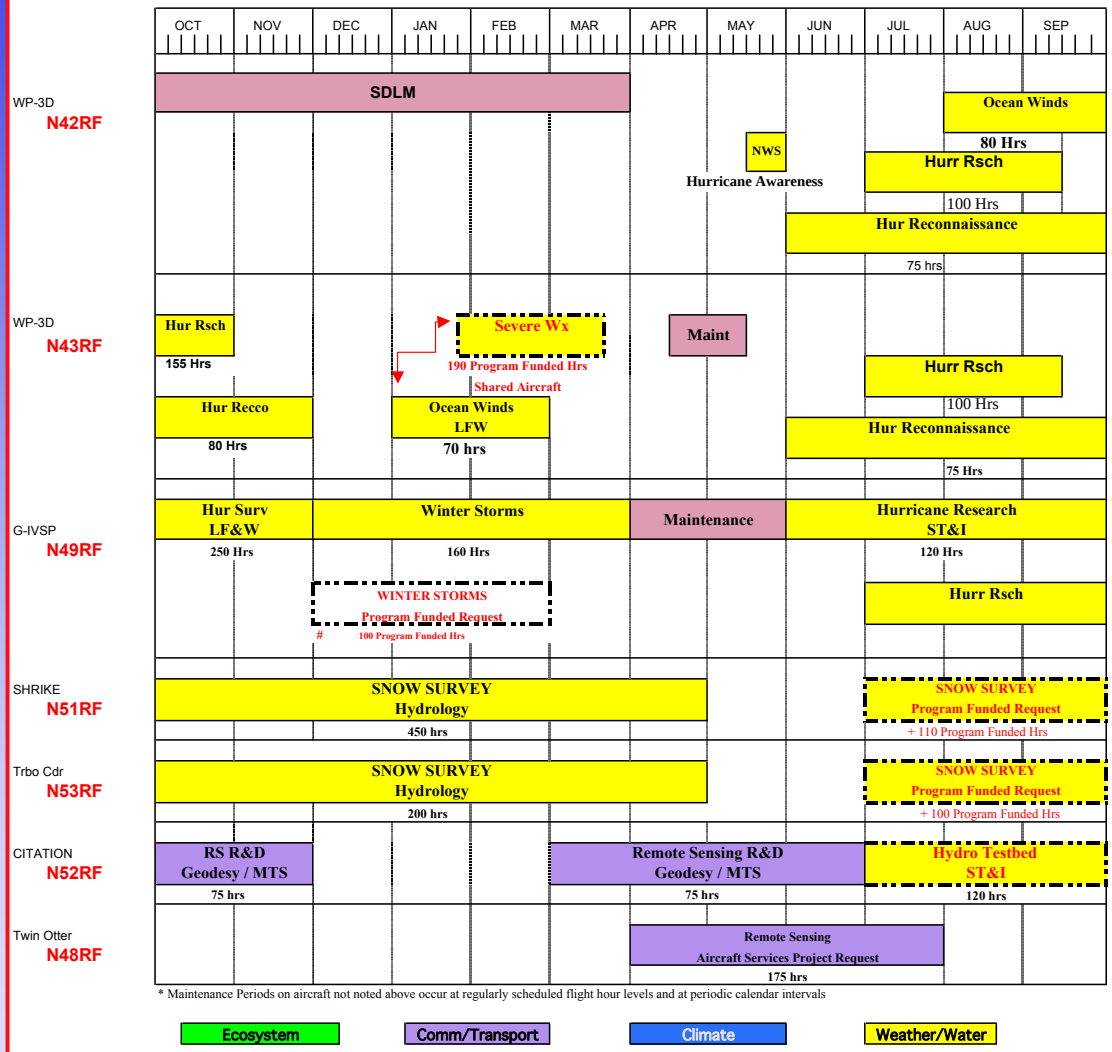


CIRPAS AND NOAA TWIN OTTERS

ICCAGRA 2006

PROPOSED FY07 PROGRAMS

FY 2007 DRAFT Allocation Plan (100% Requirements)
NOAA AIRCRAFT SERVICES FUNDED PROJECTS

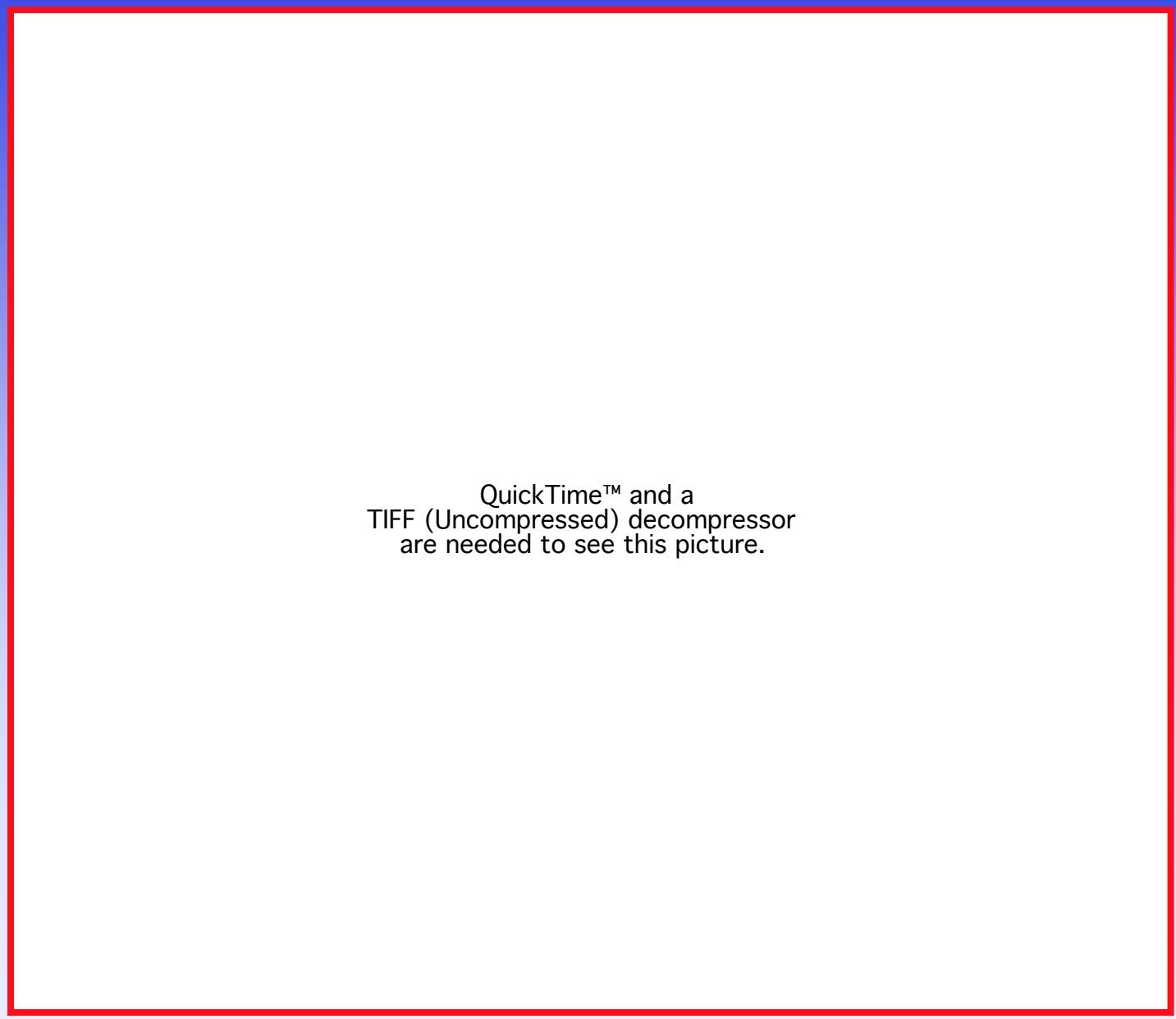


* Maintenance Periods on aircraft not noted above occur at regularly scheduled flight hour levels and at periodic calendar intervals

Ecosystem | Comm/Transport | Climate | Weather/Water

Approved by: _____ Date: _____

FY07 Proposed Schedule - P-3s and G-IV



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FY07

Proposed Schedule

Twin Otters

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FY08 OUTLOOK

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- Installation of G-IV Tail Doppler Radar
- Introduction of N44RF into Service
- Possible construction of New AOC Facilities

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- Introduction of 4th Twin Otter

- Replacement of the Citation with a King Air

Science Mission Directorate

Suborbital Science Program

R&A Retreat
30 March 2006
Cheryl Yuhas

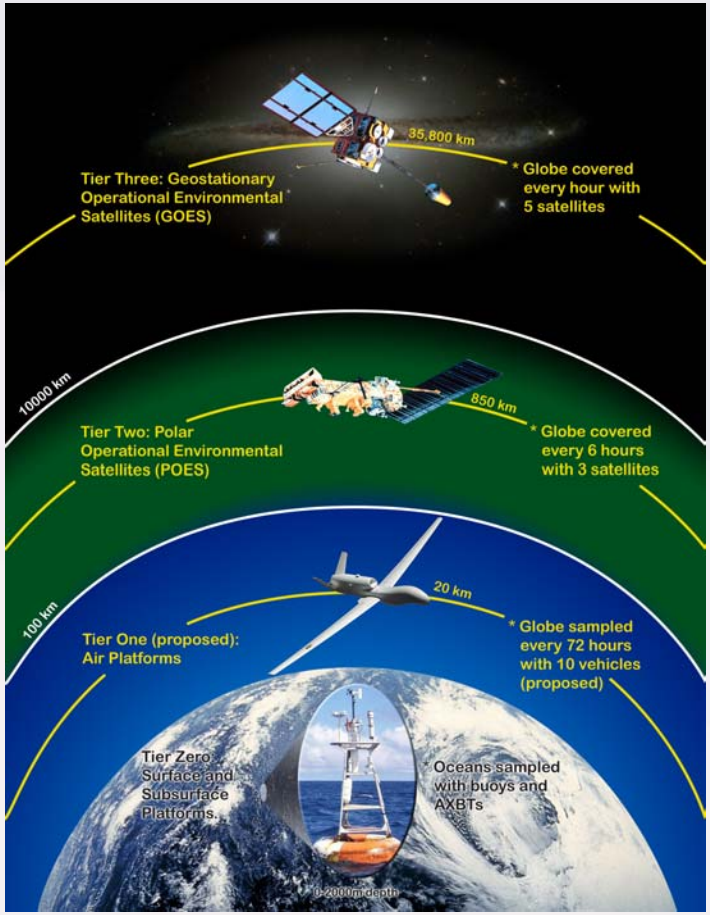
Suborbital Science Programs

Add to the understanding and prediction of the Earth system. Suborbital observations fill time and space gap between surface observing networks and orbital platforms.

Sounding Rocket Program

Balloon Program

Aircraft & UAS Program



Objectives

- Development of new space sensors and new remote-sensing techniques.
- Satellite calibration/validation.
- Targeted observations of ephemeral phenomena with variable temporal and spatial scales.
- Atmosphere/near-space in-situ observations.
- Improvement and evaluation of predictive Earth process models using satellite data.
- Next-generation scientists with hands-on sensor hardware and field experiment experience.

Restructure Objectives

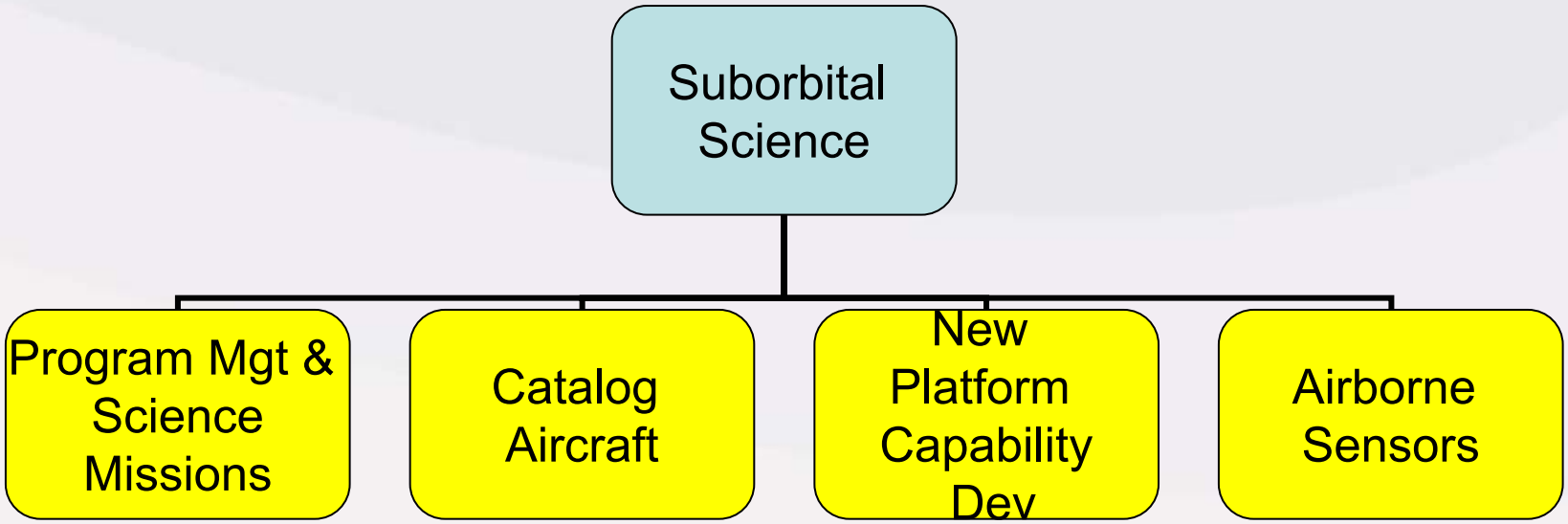
- Support focused science missions for satellite cal/val and process understanding
- Maintain and evolve an adaptive suite of platforms selected according to requirements of the science focus areas.
- Infuse new airborne technologies based on advances and developments in aeronautics, information technologies and sensor systems.
- Transfer proven capabilities to research, operational or commercial operators as widely available facilities for community-driven experiments or operational decision support systems.

Program Overview

- Successful science missions accomplished & new capabilities introduced
- New structure & team in place, with added focus on technology infusion of new capabilities
- Renew emphasis on improving reliability and responsiveness now that restructure is complete

Agenda

- ❑Missions
- ❑Aircraft Catalog
- ❑New Technology Platform
- ❑Airborne Sensors
- ❑Interagency activities
- ❑Plans



2005 Suborbital Science Missions

DATE	TITLE	FOCUS AREA	INSTRUMENT	Platform	Location	Investigator
Jan	NASA LBA-NACP Imaging Spec Studies	Carbon	AVIRIS	Twin Otter	HI	Asner
May	Arctic Ice Mapping and ICESAT Cal/Val	Climate	ATM/GPS	Twin Otter	Greenland, Arctic CA	Krabill
Feb-Apr	CARTA-II	Collaboration	MASTER, HYMAP, AVEMS, RC-30	WB-57	Costa Rica	Andres-Diaz
Mar	Lidar RS of Topography and Veg Structure	Collaboration	LVIS	B-200	Costa Rica	Blair
Apr-Nov	NOAA Altair Flt Demo	Collaboration	OC-PMVS, GCOI, DCS, REVEAL	Altair	CA	Fahey
Oct-Nov	Validation of SSMIS w/ CoSMIR	Collaboration	CoSMIR, MAS	ER-2	CA	Wang
Jun-Jul	Isotope Intercomparison	Atm. Comp	IRIS, Harvard H2O, ALIAS, ARGUS, Panther	WB-57	TX	Jensen
Jun	Houston AVE	Atm. Comp	19 sensors	WB-57	TX	Newman
Sept	Hurrican Katriana Damage Assessment	Collaboration	AVIRIS, DCS	WB-57	MS, LA	Suthar
Jan	Polar AVE	Atm. Comp	21 sensors	DC-8	NH	Schoeberl
Sept	Hubbard Glacier and Yakutat Foreland	Climate	ATM/GPS	Twin Otter	AK, CA	Krabill
Oct	Mount St Helens	Earth Surface & Interior	MASTER, Optech Lidar	Caravan	OR	Realmuto, Hook
Jun-Jul	Tropical Cloud Systems and Processes	Weather	9 sensors	ER-2	Costa Rica	Hood

2006 SMD Missions

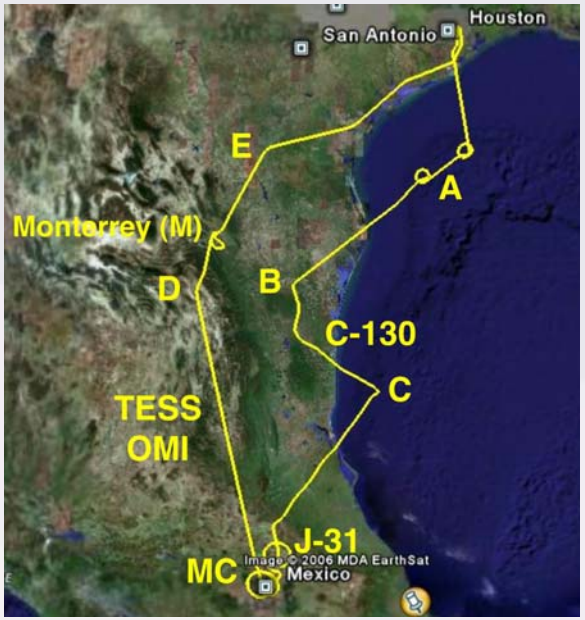
- Costa Rica AVE
- Stardust Re-entry
- INTEX-B
- Arctic 2006
- Maldives AUAV Campaign (NSF w/NOAA & NASA)
- Low-altitude AVIRIS
- Wildfire Response
- Cloudsat/Calipso Validation
- NASA-African Monsoon Multidisciplinary Analysis
- NOAA/NASA Aerosonde low-level hurricane sampling

SUBORBITAL SCIENCE UPDATE - INTEX-B
NASA DC-8, Sky Research J-31, NSF C-130, DOE G-I, LaRC B200

Intercontinental Chemical Transport Experiment (Part B) – Deployment Schedule:

Houston:	Mar 1-20
Hawaii:	Apr 18-27
Alaska:	May 1-12

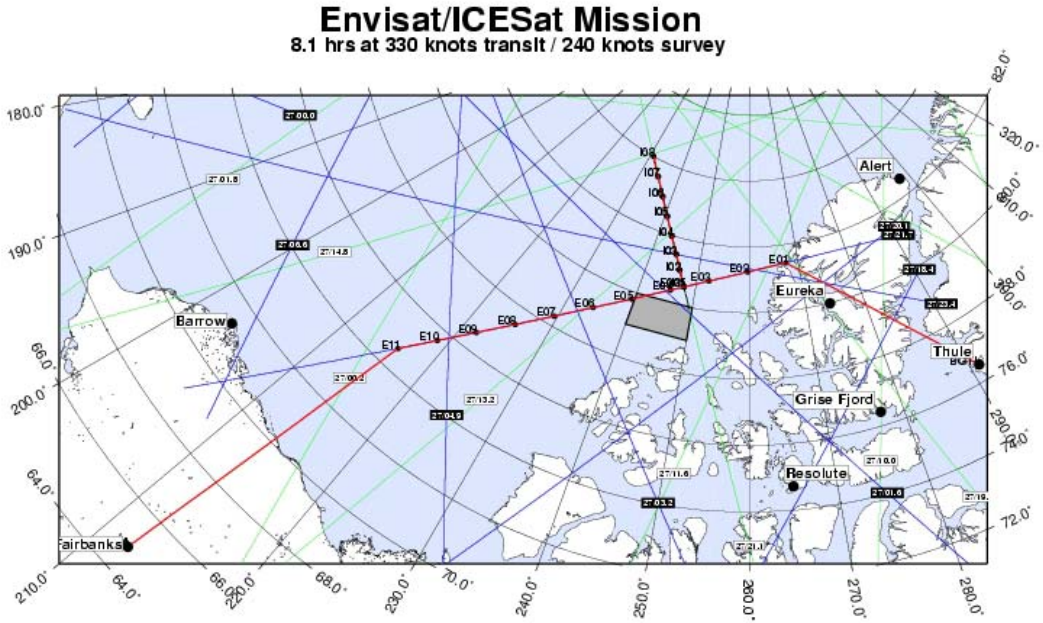
21 sensors
- 11 probes
- 2 lasers
- Species measured:
  - HOX, NOX,HNO4, SO2, O3, HCHO, H2O, CO, CO2, CH4
  - Aerosols



March 19 Flight Plan:
- Intercomparison with NSF C-130
- Coordinated spiral with J-31
- Validation of EOS Aura TES & OMI

INTEX-B Mexico City Pollution from DC-8, Mar 16

SUBORBITAL SCIENCE UPDATE – Arctic 2006
NASA P3-B



Chukchi – 21 Mar

Alaska & Greenland:

- P3-B with Kansas U snow radar, NOAA PSR, IIP D2P radar altimeter, ATM 4 laser altimeter
- Validate EOS Aqua AMSR-E, ICESat, Envisat

SUBORBITAL SCIENCE UPDATE – NSF Maldives Autonomous UAV Campaign, ACR Manta UAS

Maldives Hanimadhoo Island

- 3 Manta UAS in stacked formation, above, in, and below cloud
- Aerosol properties
- Black carbon
- cloud microphysics
- Broadband & spectral irradiances

Manta UAS

- Advanced Ceramics Research, Arizona
- Payload 15 lbs, 775 cu.in.
- Endurance 6+ hours
- Ceiling 16K ft
- Airspeed 40kts

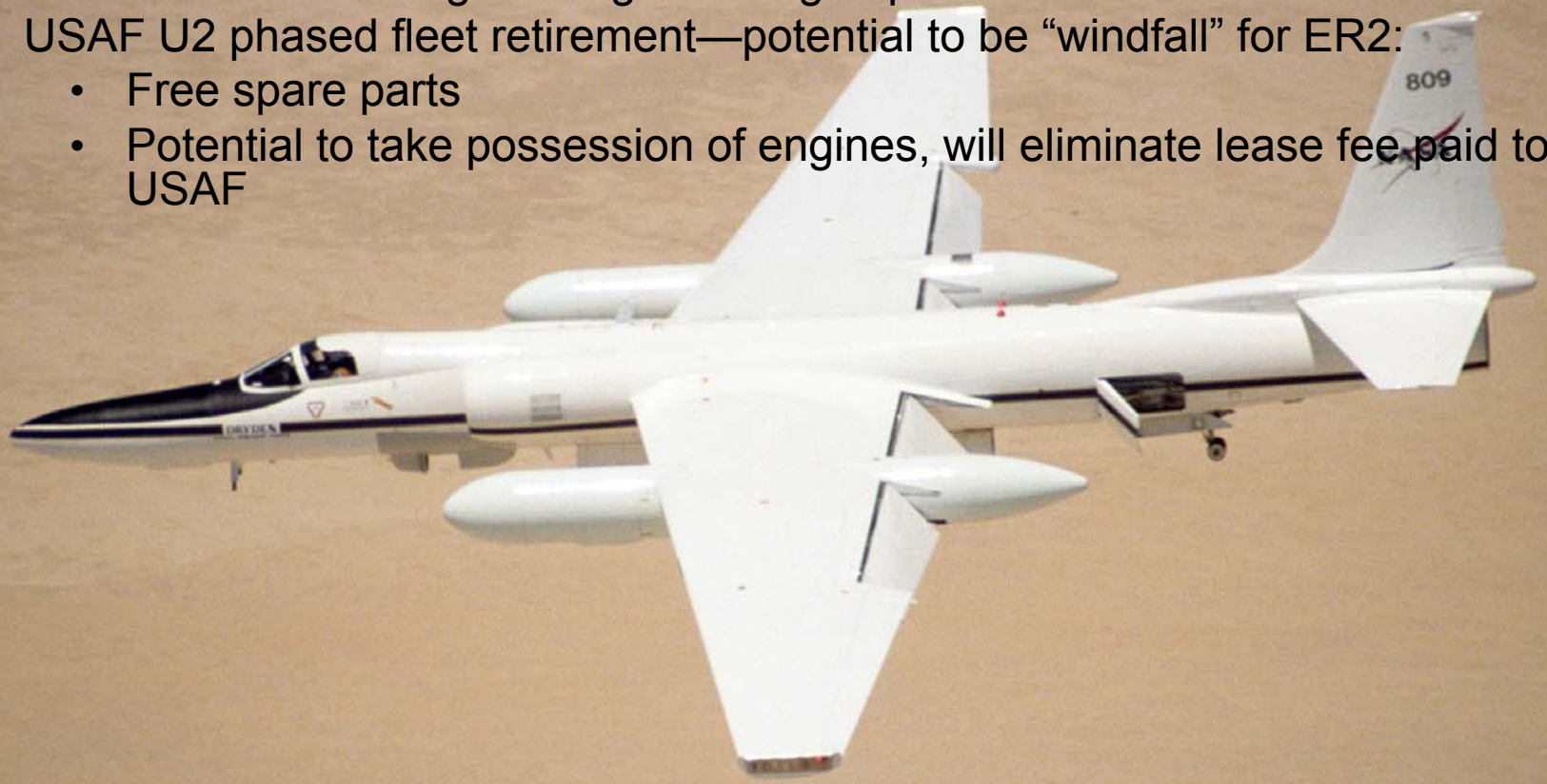
NASA contributed funding, advised on mission success and flight operations procedures. Lessons learned report coming.

Catalog Aircraft

		Hrly Rate
NASA		
ER-2	DFRC	$3700
WB-57	JSC	$3500
DC-8	UND	$5000
P-3	WFF	$3000
Other NASA		
G-3, S-3, Learjet, KingAir		$1K-$4K
Commercial		
Twin Otter/J-31/Caravan		$1K-$2.5K
Other Govt		
DOE, NRL, NSF, NOAA		$2.5K-$8K

ER-2 Update

- Periodic Depot Maintenance (PDM) complete on NASA 806
- New Business Model: Integration of ER2 into Dryden Aircraft Pool
  - More cost savings through sharing of personnel and resources
- USAF U2 phased fleet retirement—potential to be “windfall” for ER2:
  - Free spare parts
  - Potential to take possession of engines, will eliminate lease fee paid to the USAF



WB-57 Upgrades Status

- Avionics Upgrade (accomplished)
- Main Landing Gear Upgrade (in work)
- Gross Weight Increase (in-work – funding approved)
- Superpods (in-work – funding approved)
- Autopilot with RVSM (on hold))

P-3 Back in Service!

- Maintenance issues finally resolved, new aircraft services arranged
- Completed Arctic 2006 mission
- Due for Overhaul within next year

DC-8 Transition - Objective

Establish the National Suborbital Education and Research Center to expand access to and utilization of the DC-8 flying laboratory to a broader segment of the Airborne Science Community. Seek efficiencies in operating cost and explore the effectiveness of collaborative operations embedding a NASA aircraft in a research university setting.

DC-8 Transition - Accomplishments

- Agency team approach to try this new model for airborne research utilizing expertise & capabilities across Centers
- Maintained rigorous safety standards which produced a history of safe DC-8 operations & missions while at Ames and Dryden
- Key experienced maintenance personnel and pilots continued with the program to provide continuity of corporate knowledge
- Safely and successfully executed DC-8 Stardust Mission and first phase of INTEX-B mission

DC-8 Transition - Challenges

- Demonstrating the ability to perform new science on the aircraft while reducing cost to NASA (how large is the science demand for the DC-8 without NASA subsidized rates?)
- Providing a reliable long-term housing plan for the aircraft which is not subject to impact by Air Force priorities
- Delegating appropriate responsibility to UND to allow innovation while preserving standard of excellence in safety and mission success
- Effective management structure clearly defining roles and responsibilities at NASA and UND

New Platform Technology Infusion

Earth Science Capability Demonstrations (ESCD) Project

The ESCD project is a partnership between the Science Mission Directorate and Aeronautics Research Mission Directorate

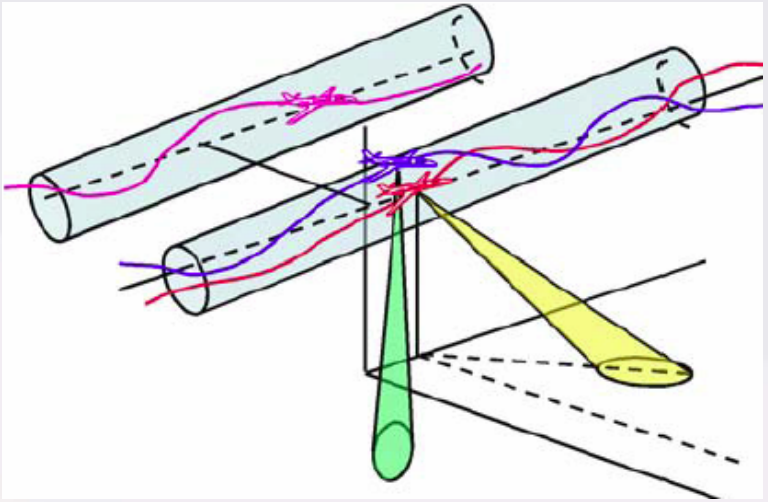
ESCD Projects:

- ❑ Precision Trajectories (UAVSAR)
- ❑ UAS Mission Demonstrations
- ❑ UAS Platforms
- ❑ Civil UAS Capability Assessment
- ❑ Over-the-Horizon Communications Development

Precision Trajectories

Project: Precision Trajectories (component of UAVSAR program)

Objective: Develop & demonstrate precision navigation capability required to support Repeat Pass Interferometry (RPI) data missions



Minimum rqmt - ability to repeatedly navigate the aircraft within a predefined ten meter tube flight path
Ultimate goal - one meter tube precision
Schedule – CDR April 21, First Flight Nov 2006

UAS Mission Demonstrations

- NOAA/NASA Altair UAV Demo (2005)
- NOAA/NASA Aerosonde Ophelia Demo (2005)
- REASoN WRAP Project (2006)
  - Small UAS Demo - June
  - Western States Fire Mission - August
- Joint NOAA/NASA Hurricane Boundary Layer Sampling (2006)
- UAS Aura Validation Experiment (2007)
- Potential IPY experiment (2008?)

UAS Platforms

Objective: Acquire/operate UAS platforms for science missions

2005 Accomplishments:

- Altair lease supported NASA/NOAA UAV Demo Mission
- Ikhana (Predator B)
  - July 06 delivery of Aircraft & Ground Control Station (ARMD Funded)
  - Aircraft to be flown by NASA pilots
- Small UAS: Aerosonde, Sierra
- Global Hawk
  - Completed Operations Concept Study
  - Continued discussions with Air Force to acquire flight test aircraft

Airborne Sensors

Airborne Science & Technology Lab Overview:

Resides in the NASA Ames University-Affiliated Research Center under the Ames Earth Science Division

Staffed by Univ. of California, Santa Cruz

Joint funding from Suborbital, EOS, and other programs

Provides Earth science mission support through:

- Instrument/platform integration services
- Data collections with Digital Tracking Cameras (DCS), MODIS and ASTER Airborne Simulators (MAS, MASTER)
- Community use of POS/AV precision navigation systems
- Development of interface standards & cross-platform portability
- Enabling technologies for UAV instruments & sensor webs
- NIST-traceable calibration lab for spectro-radiometers

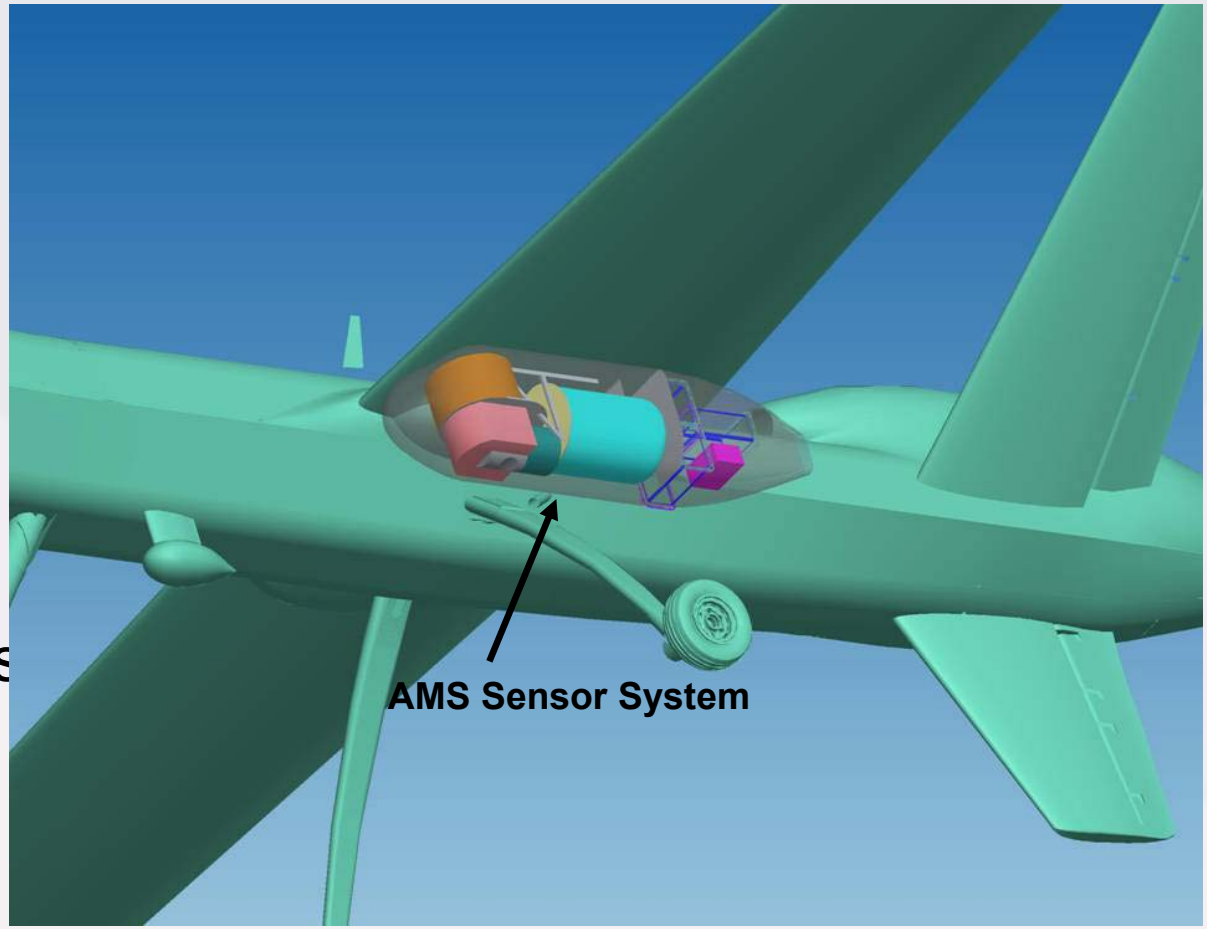
Modular Sensor Pod for Altair or Ikhana (Predator-B)

Design collaboration with DFRC and General Atomics

Modular fairings

Standard electrical & Mechanical interfaces

1,500 lb capacity



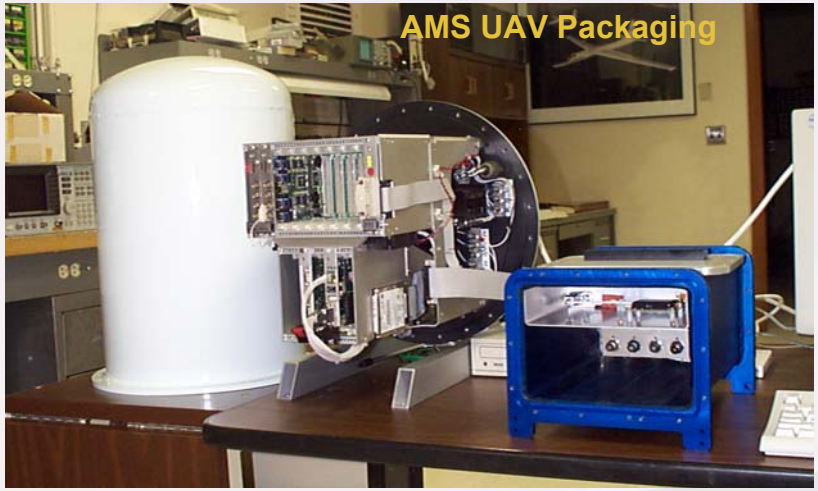
Airborne Sensors

Utility Equipment for the High-Altitude Environment

Pressurized Sub-system Housings (Static tested)

Low-Pressure Heater Unit

Heater-Blower for Altair Pod



Interagency Activities

- NOAA/NASA/DOE collaboration on UAS
  - MOU in final review
  - Workshops http://uas.noaa.gov/interagency/index.html
  - Collaborative missions (Maldives, etc)

- Interagency Coordinating Committee for Airborne Geoscience Research & Applications (ICCAGRA)
  - NSF, NOAA, NRL, ONR/CIRPAS, DOE, USGS
  - Data Systems subcommittee/interoperability standards
  - Next meeting May 23 Monterey, CA at CIRPAS

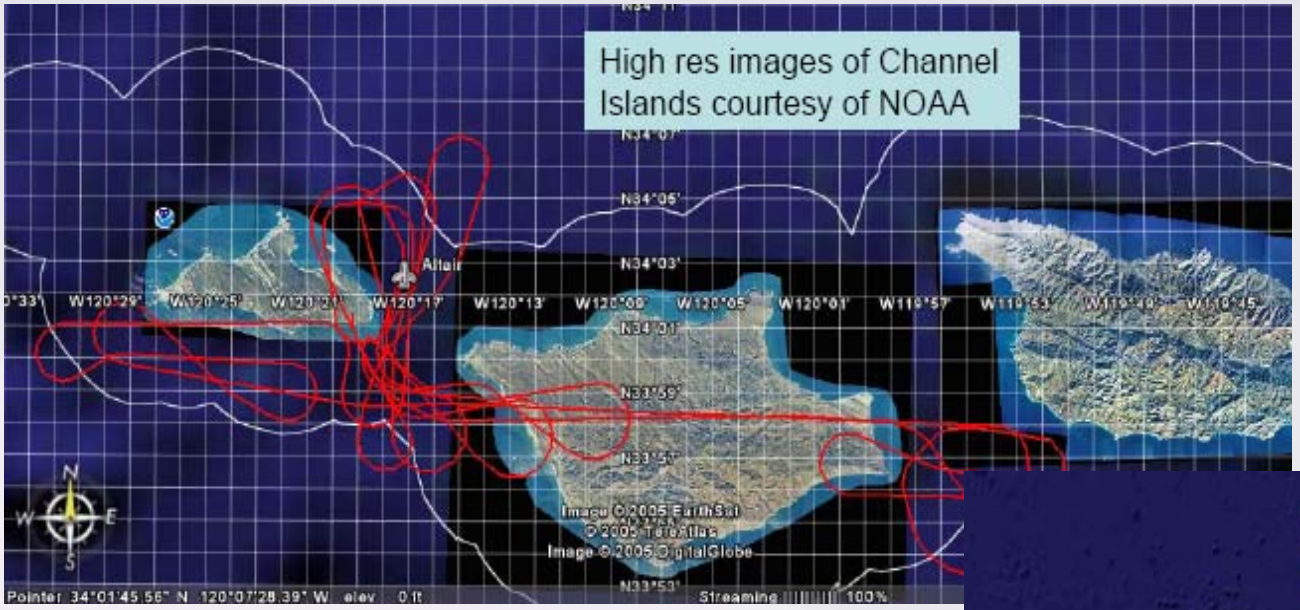
Plans

- Call Letter/website April 7, improve coordination with ROSES
- Studies & Requirements Analyses
  - Congressional UAS Report: March
  - Civil UAS Assessment: April
  - Telemetry/Communications Requirements: May
  - 5-Year plan: June
  - Altair/Ikhana Polar Operations Feasibility Study: September
  - Gap Analysis and Technology Roadmap in 2007
- 2007 platforms anticipated to be same as 2006, with the addition of the Ikhana UAS; priority is to balance platform availability with science mission priorities
- Remaining major 2006 missions:
  - Cloudsat/Calipso Validation
  - N-AMMA
  - Western States Fire
  - NOAA/NASA Aerosonde low-level hurricane sampling

Science Mission Directorate

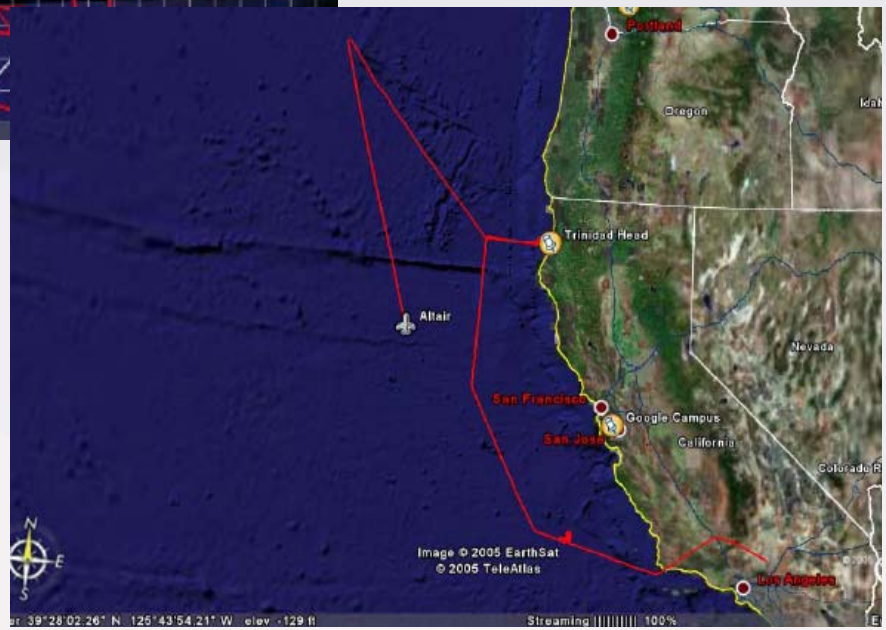
Suborbital Science Backup

NOAA Altair UAV Demo



NASA/NOAA Channel Islands mission

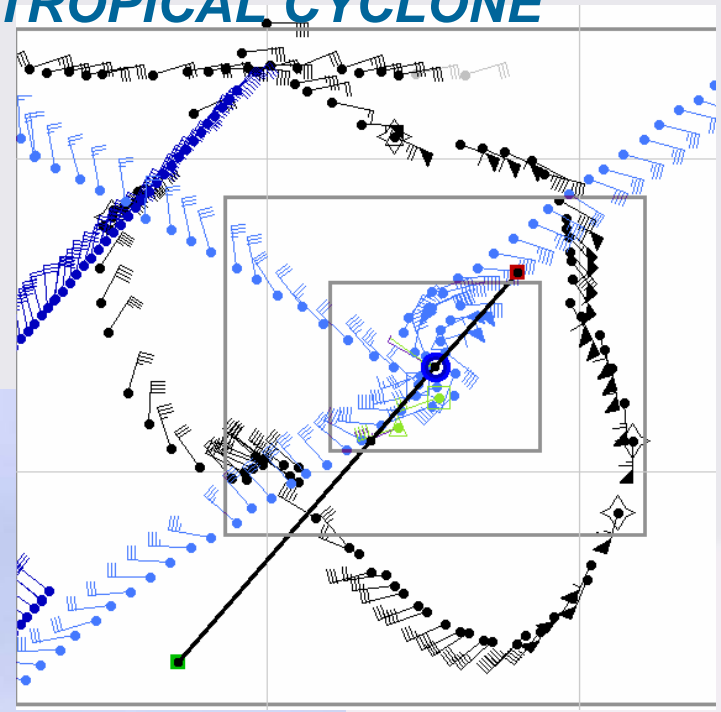
NASA/NOAA 18.4 hour mission



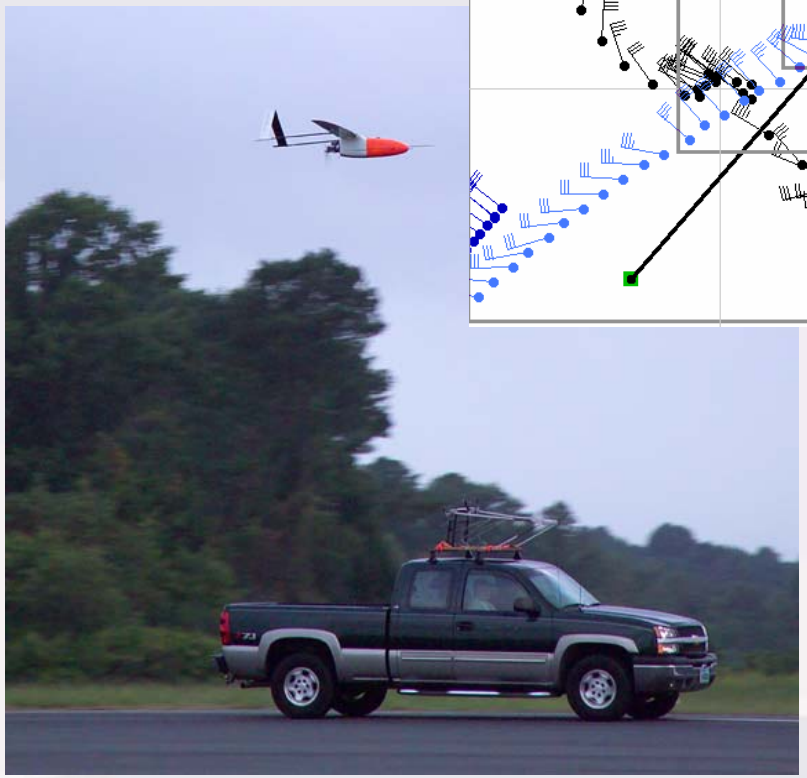
Low-level Hurricane Winds
Aerosonde Flight - Ophelia 16 Sep. 2005

FIRST EVER UAV TO FLY INTO A TROPICAL CYCLONE

•NOAA WP-3D Stepped Frequency Microwave Radiometer (SFMR) Surface winds in light blue, Aerosonde winds in black, buoy winds in dark blue.



•Aerosonde closest approach to wind center was 30 nm southwest and 25 nm northeast. Peak winds at 2500 ft were 65 kt southeast of center and 75 kt north of center.

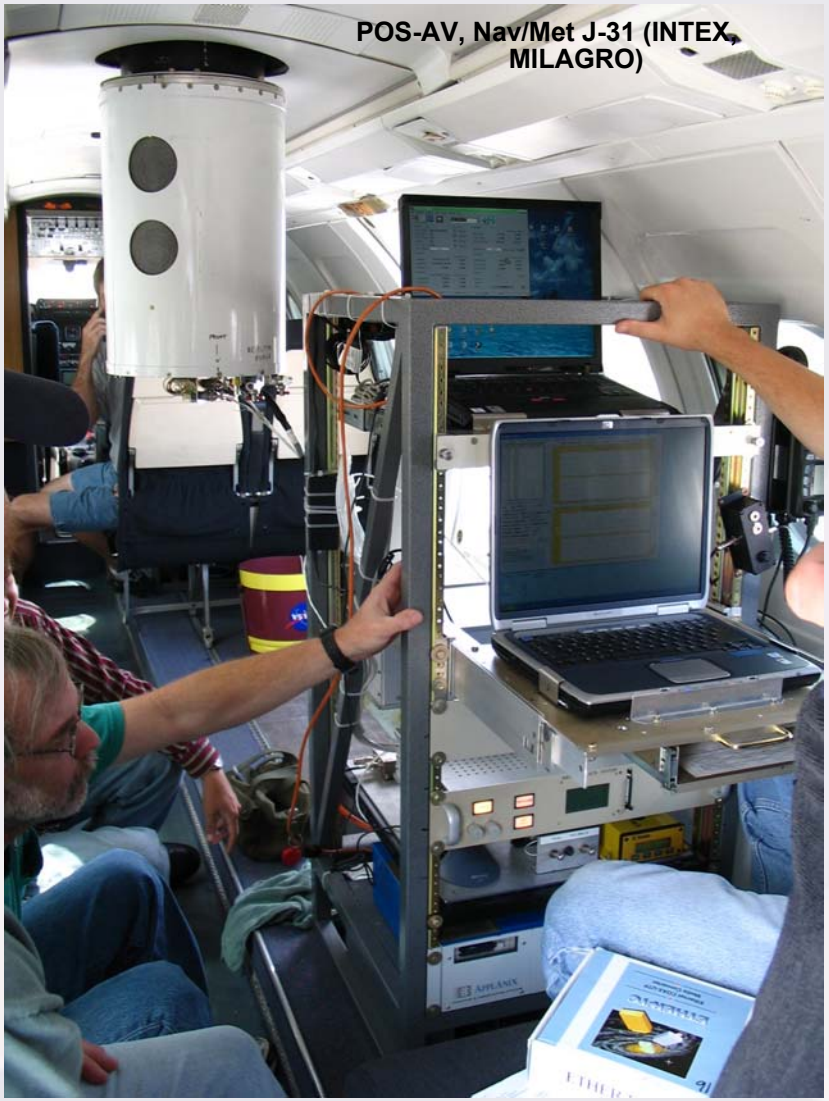


•Excellent agreement was found between buoy, SFMR and Aerosonde winds adjusted to surface values. SFMR winds SW of center were within 10 min of aerosonde.

Science Support: New Instrument Integrations

CAR J-31 (MILAGRO)

DCS Camera Altair (NOAA)



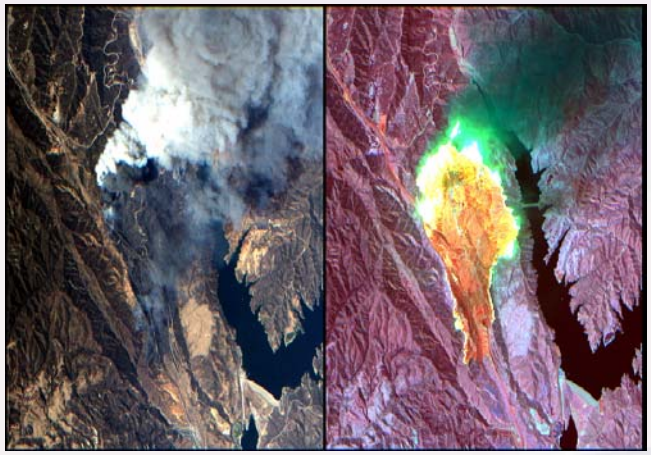
POS-AV, Nav/Met J-31 (INTEX, MILAGRO)

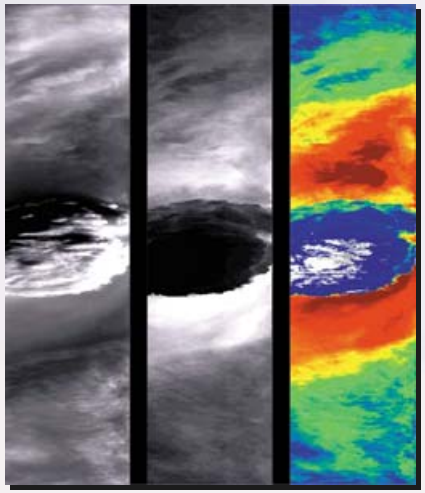
Enabling Technologies

Autonomous Modular Sensor System (AMS)

A technology test-bed for UAV instrumentation, demonstrating:

- **Extended high-altitude operation of electronic subsystems**
- **Autonomous and Sensor Web operating modes**
- **On-board processing for real-time data reduction**
- **Sterling & TE-cooled IR detectors**
- **Compatible with Altair, Ikhana, Global Hawk**
- **Spectrometers for Land, Ocean, Atmospheres**

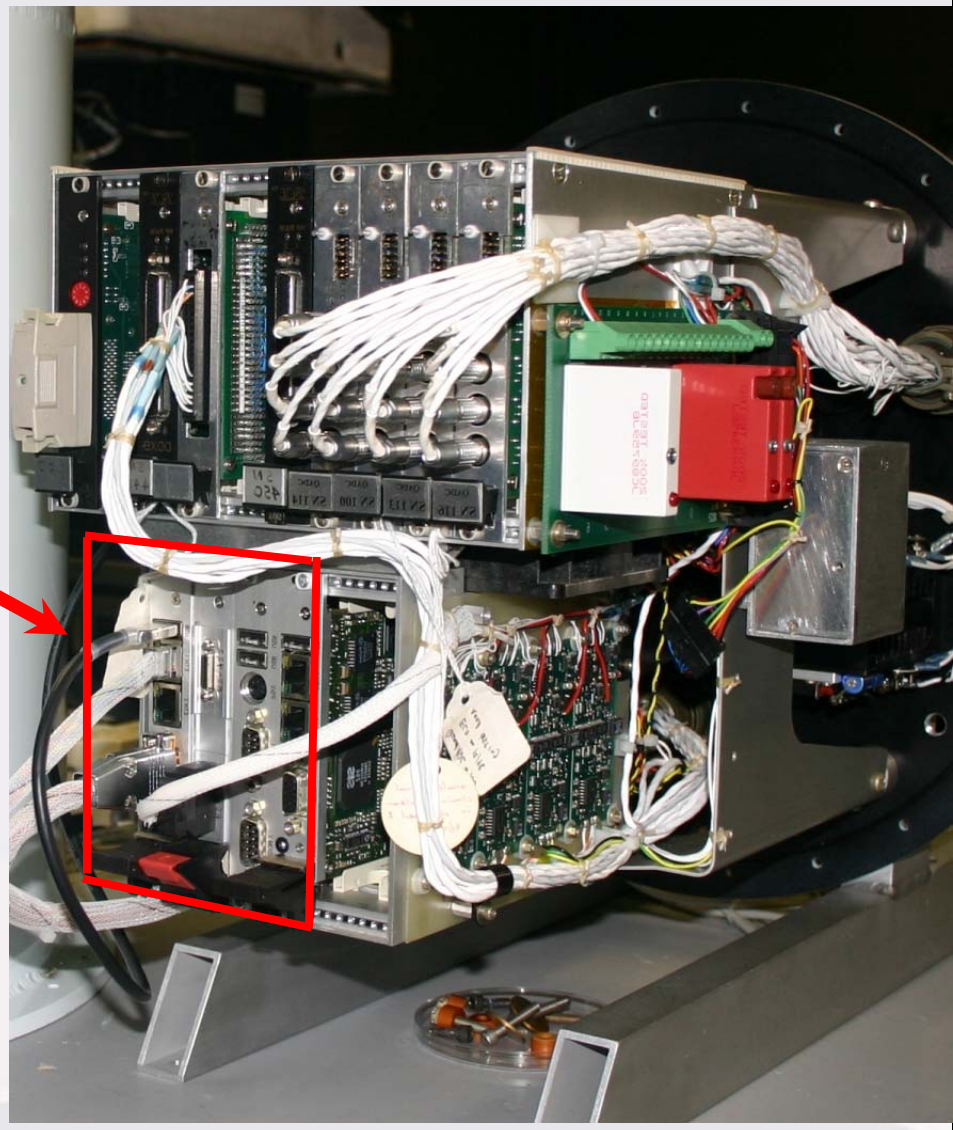




Enabling Technologies

Telemetry Link Module:

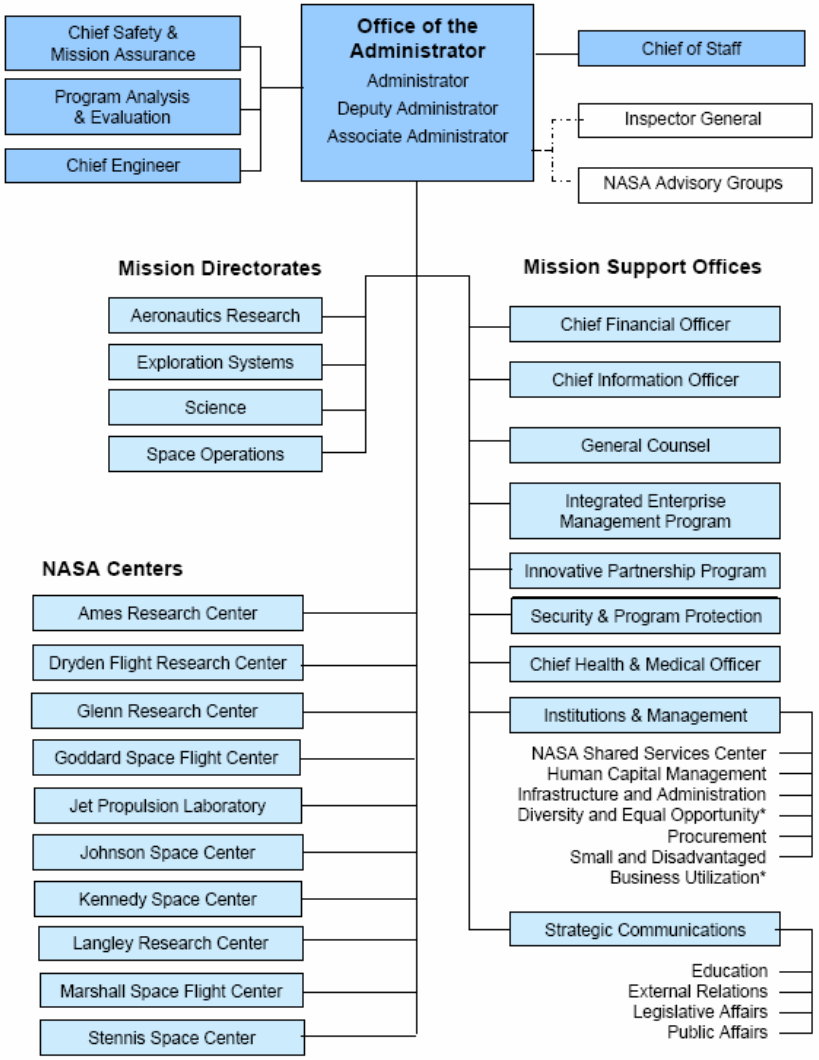
- A Universal Interface to the Altair Ku-Band Telemetry System
- Inputs for >20 instruments; Up To 40 Mbs Throughput
- S/W Configurable, Multiple Interface Protocols
- Fast CPUs & Solid State Storage For Experimenter Data & Algorithms
- Developed under the UAV Wildfire REASON-CAN & AMS Sensor Project
- Initial deployment on the Western States Fire Mission



ICCAGRA
May 2006

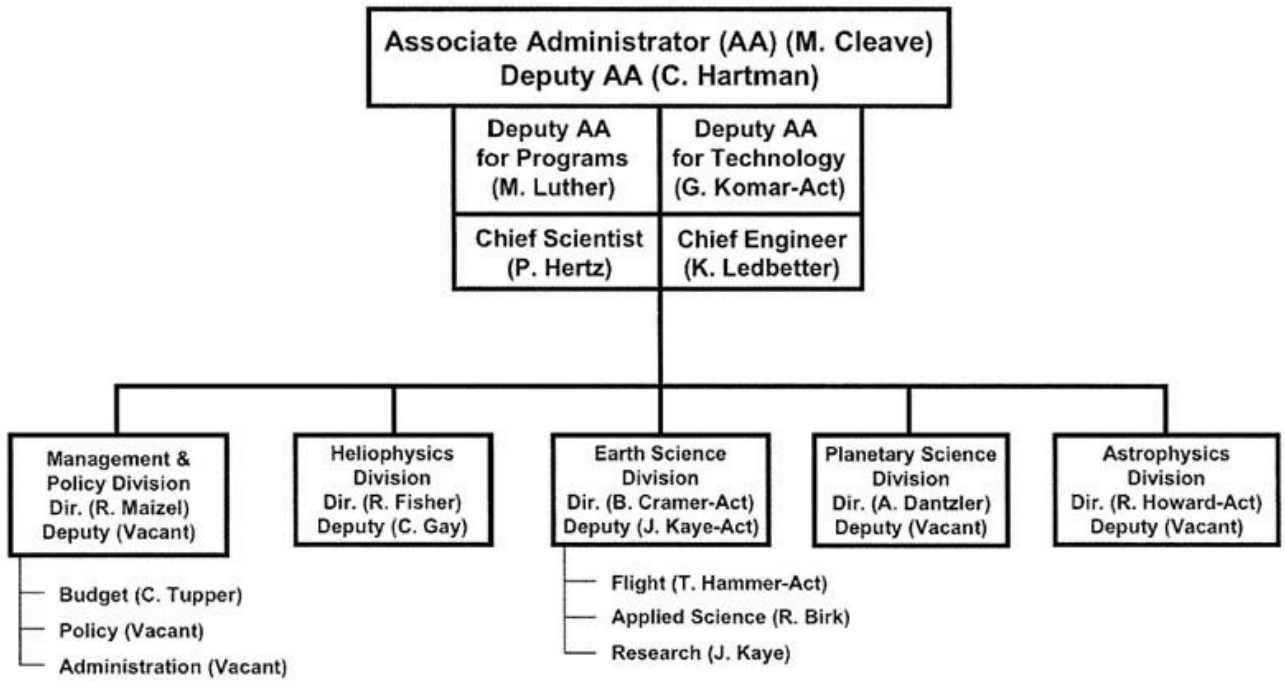
NASA Update

AGENCY UPDATE



AGENCY UPDATE

Science Mission Directorate
New Organization Chart



Effective: May 14, 2006

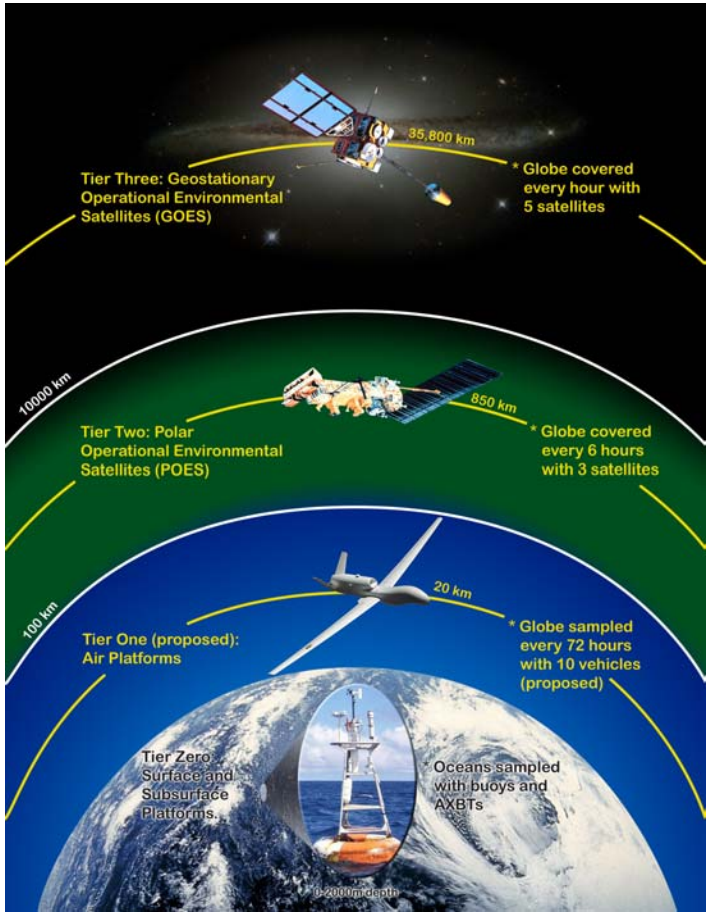
Suborbital Science Programs

Add to the understanding and prediction of the Earth system. Suborbital observations fill time and space gap between surface observing networks and orbital platforms.

Sounding Rocket Program

Balloon Program

Aircraft & UAS Program



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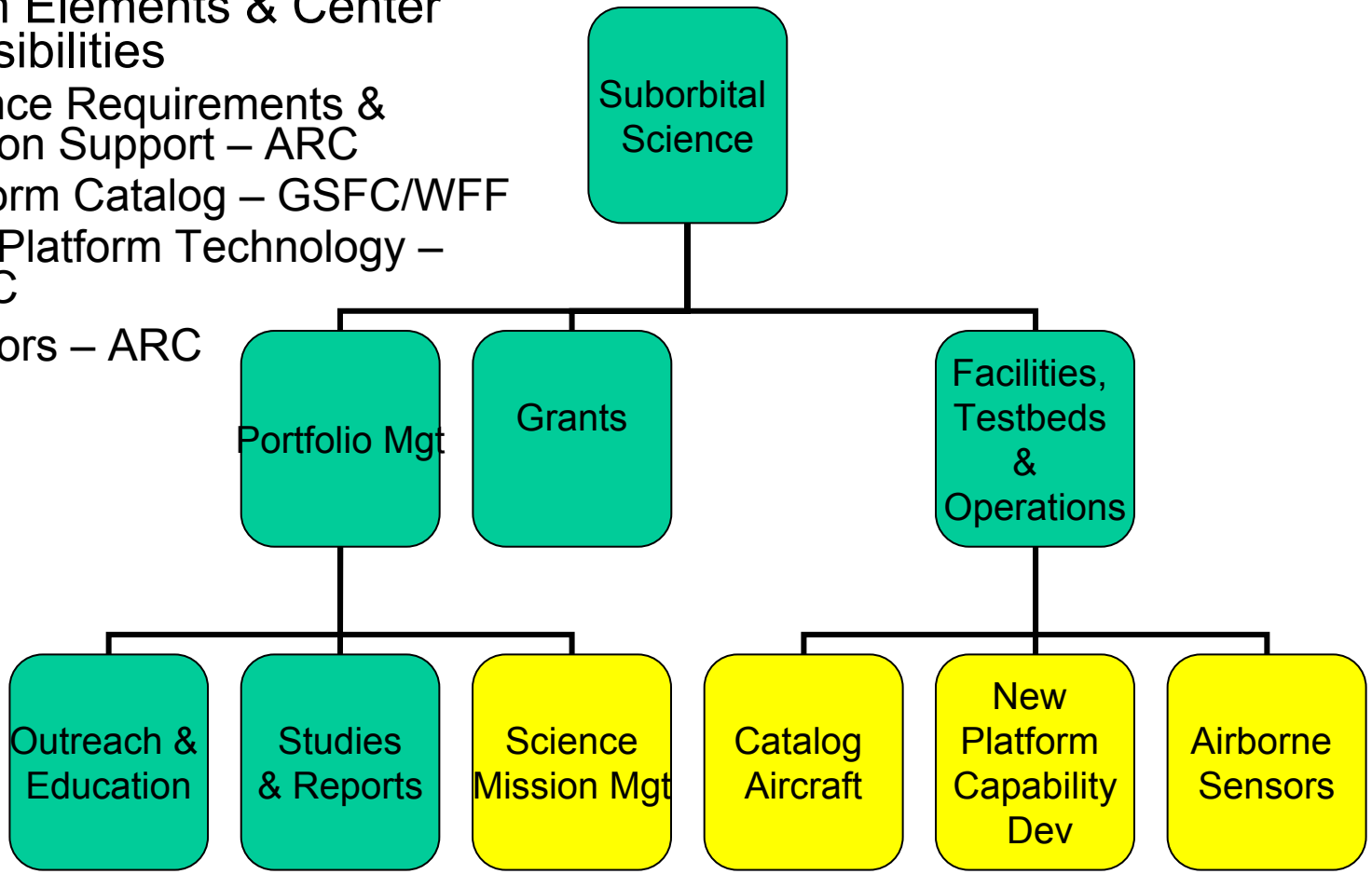
- Atmosphere/near-space in-situ observations.
- Improvement and validation of predictive Earth process models using satellite data.
- Next-generation scientists with hands-on sensor hardware and field experiment experience.

Program Structure & Organization

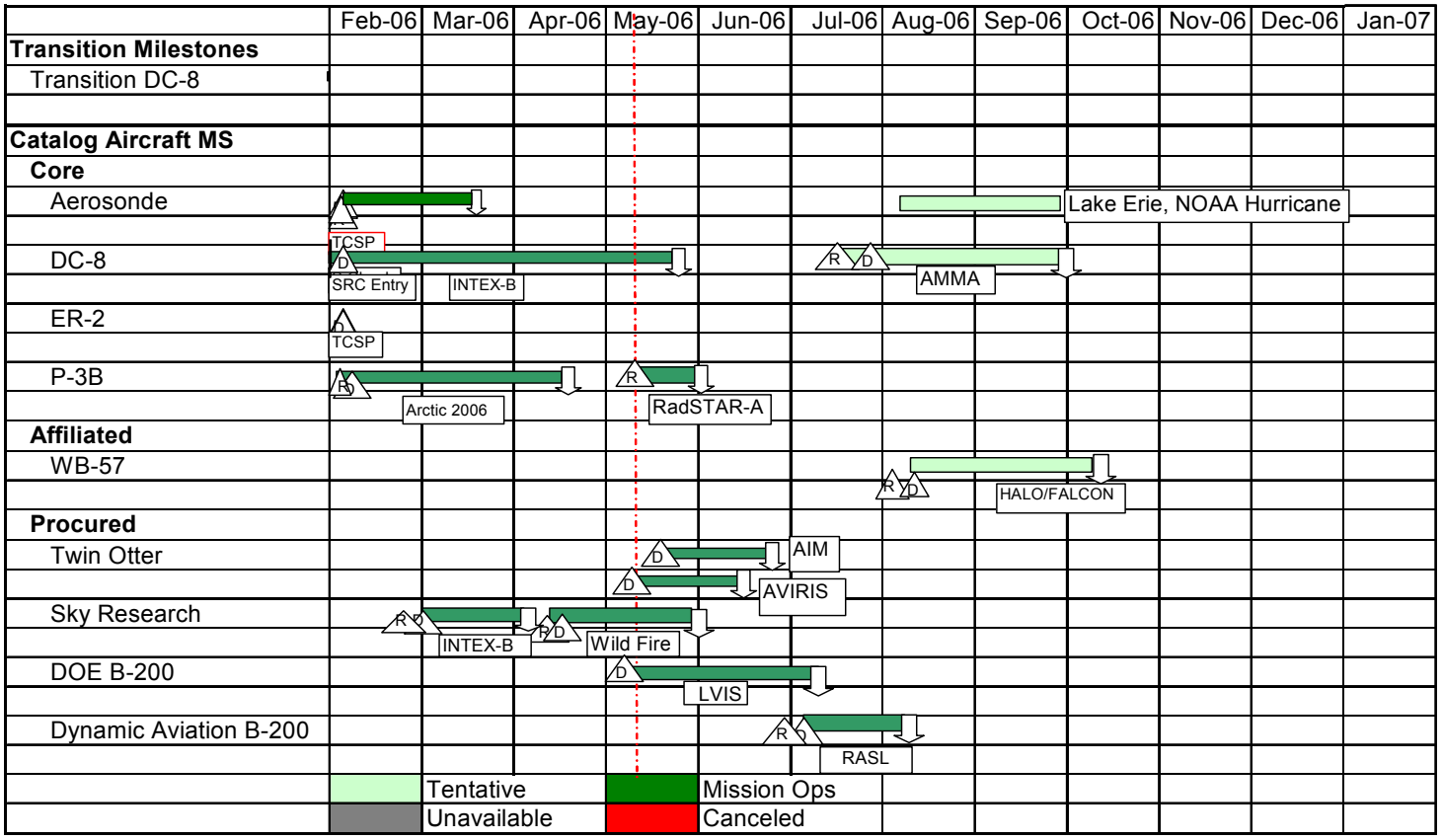
- Program Elements & Center Responsibilities
  - Science Requirements & Mission Support – ARC
  - Platform Catalog – GSFC/WFF
  - New Platform Technology – DFRC
  - Sensors – ARC



Program Baseline Budget

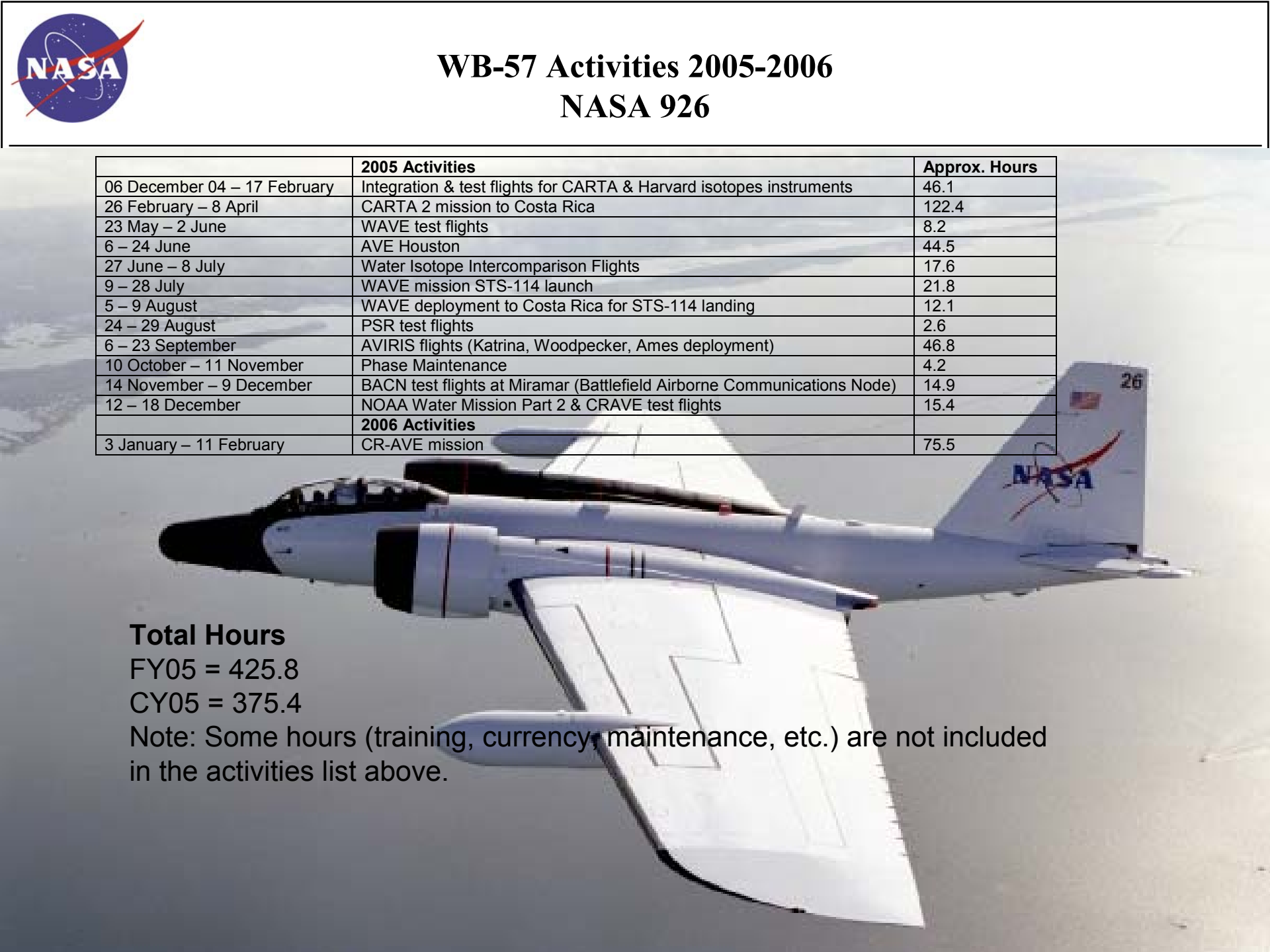
	FY05	FY06	FY07	FY08	FY09	FY10	FY11
FY06 PFP	**36.04**	**34.96**	**32.63**	**32.59**	**30.08**	**30.17**	
FY05 Op Plan Changes	**4.5**						
FY05 WB57 Upgrades	**3.8**						
FY07 PFP	**44.3**	**34.17**	**35.31**	**35.28**	**32.81**	**32.89**	**32.89**

Aircraft Milestones



WB-57 Activities 2005-2006
NASA 926

	2005 Activities	Approx. Hours
06 December 04 – 17 February	Integration & test flights for CARTA & Harvard isotopes instruments	46.1
26 February – 8 April	CARTA 2 mission to Costa Rica	122.4
23 May – 2 June	WAVE test flights	8.2
6 – 24 June	AVE Houston	44.5
27 June – 8 July	Water Isotope Intercomparison Flights	17.6
9 – 28 July	WAVE mission STS-114 launch	21.8
5 – 9 August	WAVE deployment to Costa Rica for STS-114 landing	12.1
24 – 29 August	PSR test flights	2.6
6 – 23 September	AVIRIS flights (Katrina, Woodpecker, Ames deployment)	46.8
10 October – 11 November	Phase Maintenance	4.2
14 November – 9 December	BACN test flights at Miramar (Battlefield Airborne Communications Node)	14.9
12 – 18 December	NOAA Water Mission Part 2 & CRAVE test flights	15.4
	2006 Activities	
3 January – 11 February	CR-AVE mission	75.5



Total Hours
FY05 = 425.8
CY05 = 375.4
Note: Some hours (training, currency, maintenance, etc.) are not included in the activities list above.

ER-2 Accomplishments and Plans

- FY05 Major Accomplishments:
  - TCSP: July '05. 16 missions, 107.2 hours from Costa Rica.
    - Payload: AMPR, CRS, EDOP, HAMSR, LIP, MTP, MAS
- FY06 Major Activities:
  - Periodic Depot Maintenance (PDM) complete on NASA 806
  - Calipso validation mission this summer
  - TC4 deployment to Guam Jan '07
  - New Business Model: Integration of ER2 into Dryden Aircraft Pool
    - More cost savings through sharing of personnel and resources
- USAF U2 phased fleet retirement--"windfall" for ER2:
  - Free spare parts – lower flight hour fees
  - Potential to take possession of engines
    - Eliminate lease fee paid to the USAF – lower flight hour fees
  - Upgraded Airframes for NASA?

P-3B

Mission	Dates	Flt Hrs
Arctic Ice	Mar 2006	50

DC-8 Accomplishments

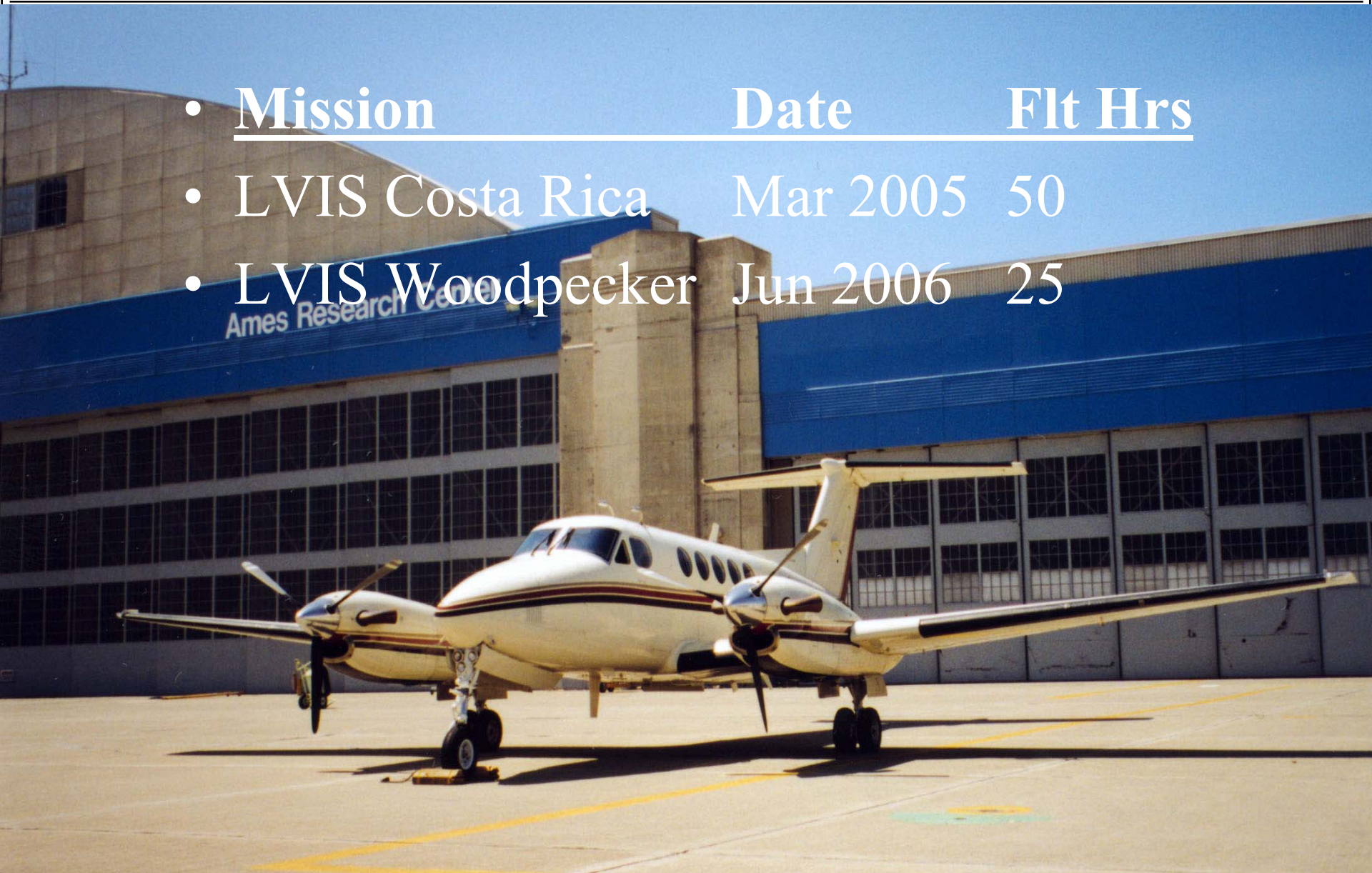
Mission	Dates	Flt Hrs
PAVE	Jan2005	88
Stardust	Jan 2006	16

Twin Otter 2005

Mission	Dates	Flt Hrs
• AVIRIS Hawaii	Feb 2005	48
• ATM Alaska	Aug-Sep 2005	98
• AVIRIS Fall 2005	Oct-Nov 2005	64
• AVIRIS Coral Reef	Dec 2005	52
• AVIRIS Spring	May 2006	

Sky Research Caravan

DOE B-200



Mission	Date	Flt Hrs
LVIS Costa Rica	Mar 2005	50
LVIS Woodpecker	Jun 2006	25

Hurricane Wind Comparison
Aerosonde Flight - Ophelia 16 Sep. 2005

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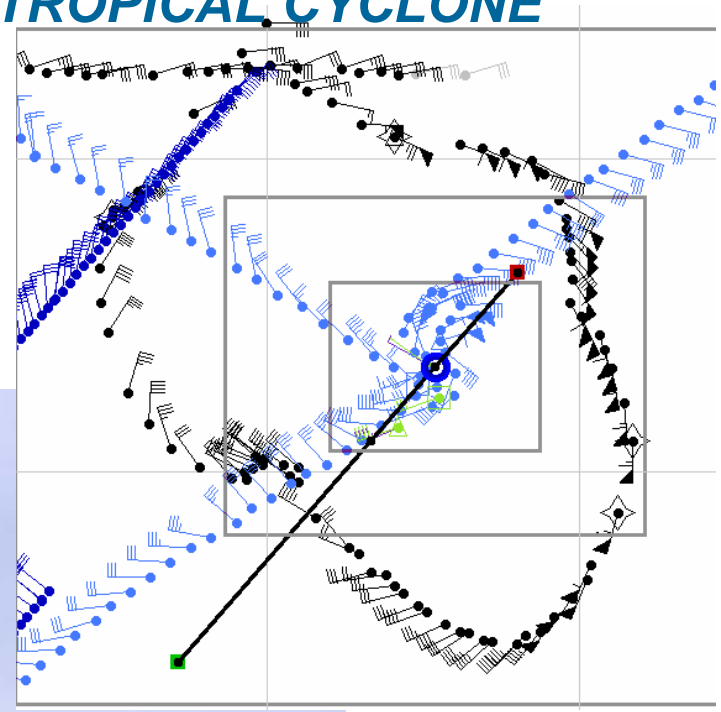
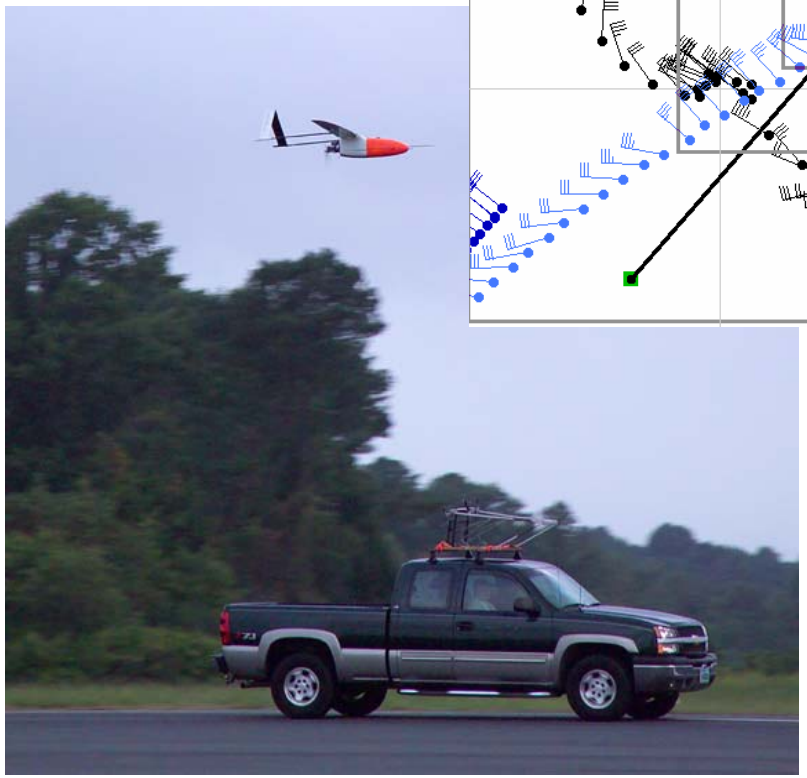
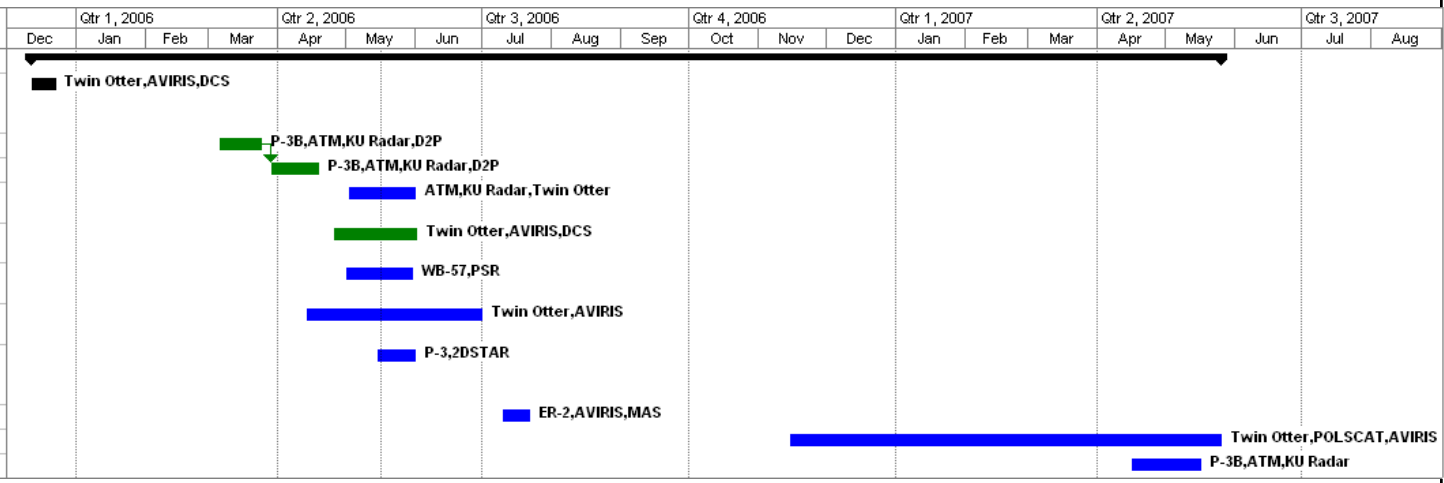


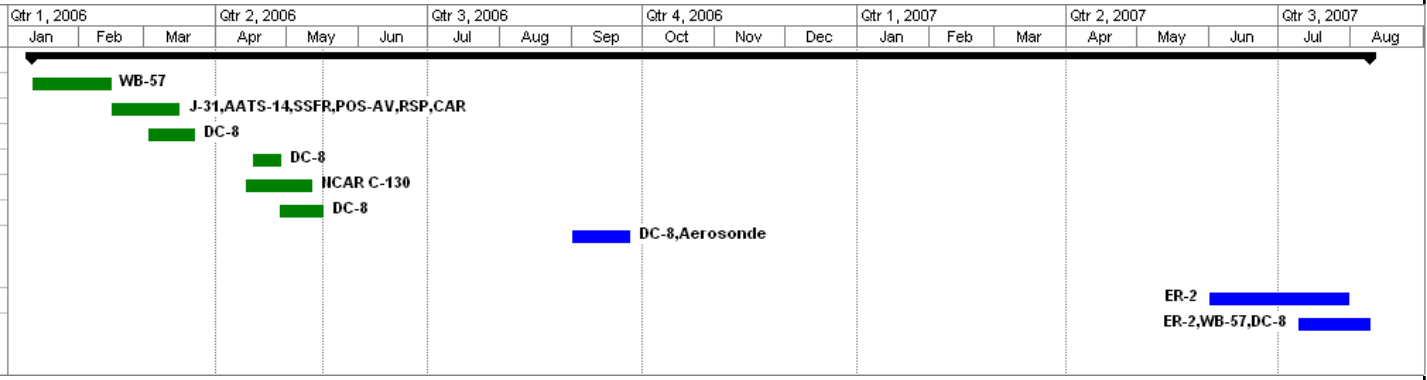


Science Schedule

ID	Task Name	Hyperlink
26	**Water**	
27	NASA AVIRIS Assessment of the 2005 Caribbean Coral Bleaching Event	6T008
28	Arctic Sea Ice 2006	6P001
29	Envisat Validation with Artic 2006 Pa	6P005
30	Artic Ice Mapping - AIM Greenland	6T204
31	Multi-resolution Snow Products for the Hydrologic Sciences	6T010
32	NOAA NPOESS CMIS airborne simulator (test)	6W004
33	Global Estimation of Canopy Water Content	6T011
34	Passive/Active Microwave Measurements of Soil Moisture and Forest Biomass	6P004
35	Harmful Algal Bloom Ecology	62002
36	CLPX Cold Land Process Experiment	7T001
37	GISMO: Global Ice Sheet Mapping Or	7P001

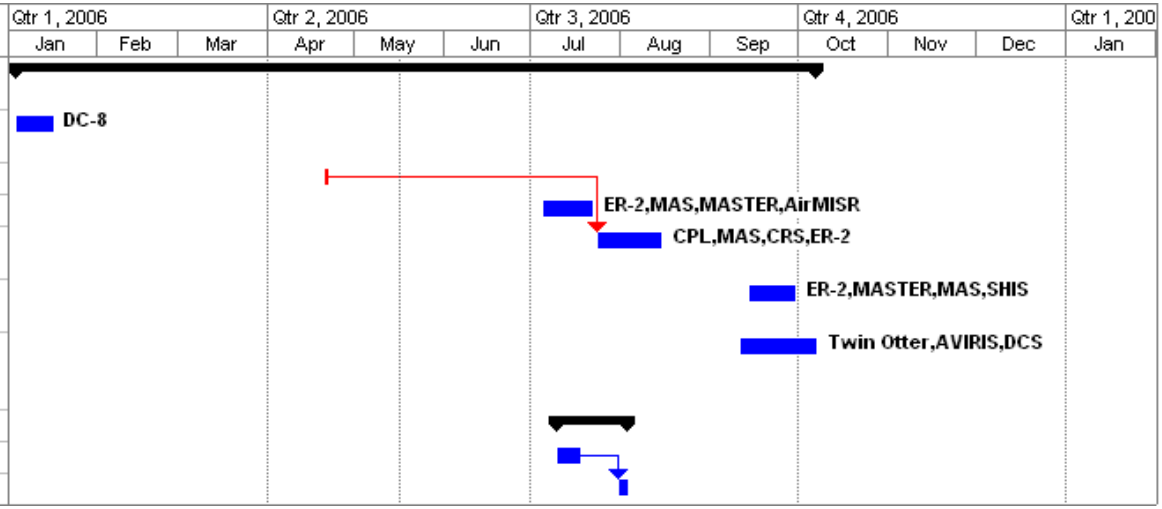


ID	Task Name	Hyperlink
1	**Atmosphere**	
2	Costa Rica AVE	6W001
3	INTEX-B/MILAGRO	6J001
4	INTEX-B Houston	68001
5	INTEX-B Hawaii	68001
6	IMPEX: NOAA INTEX-B Seatle	
7	INTEX-B Alaska	68001
8	NASA African Monsoon Multidisciplinary Analyses (AMMA)	68205 6A205
9	DOE-CLASIC	72002
10	TC-4 Costa Rica	72301, 7W301, 78301

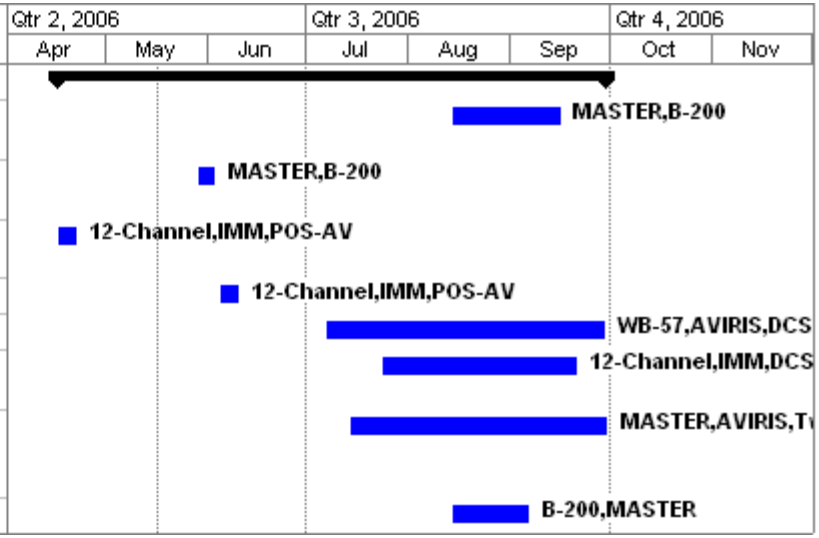


Science Schedule

ID	Task Name	Hyperlink
49	**Satellite Validation**	
50	Stardust ReEntry Observation Campiagn	68002
51	CALIPSO/Cloudsat Launch	
52	EOS Cross Validation VNIR-SWIR	62003
53	CALIPSO/Cloudsat Cal/Val	62008
54	Validation of EOS Mid and Thermal Infrared Data	62004
55	Studies of Biosphere Atmosphere Interactions with a MODIS GCM	6T012
56	**WAVE 2 - STS-121**	
57	WAVE Patrick deployment	
58	WAVE Reentry (possible deplo	

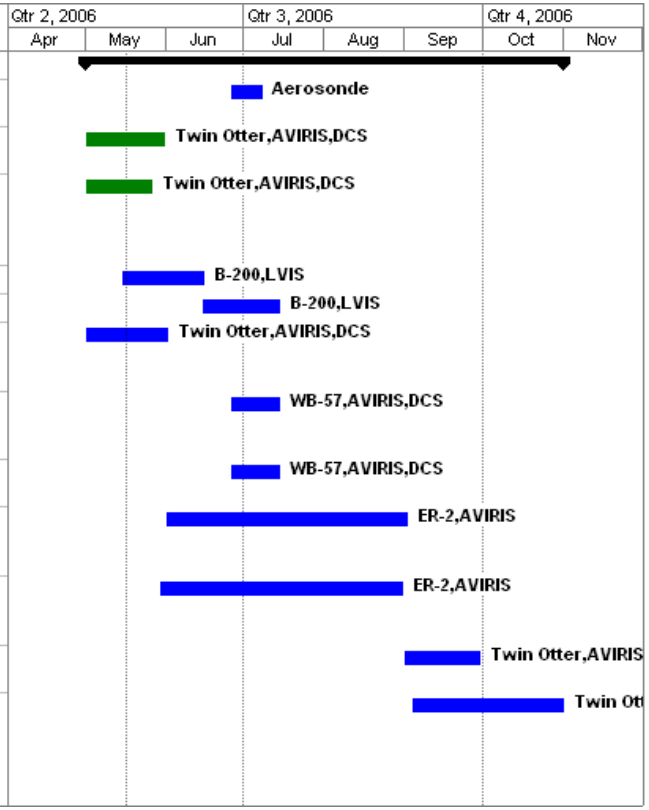


ID	Task Name	Hyperlink
39	**Surface**	
40	Validation of MASTER on B200 at Lake Tahoe CA/NV	6B002
41	Southern California Fault Assesment	6B003
42	Test Flights of UAS Wildfire Sensor and IMM/CDE	6M001
43	Test Flights of UAS Wildfire Sensor :	6M001
44	An AVIRIS Study to Support the Reb	6W301
45	Western States 24 Hour UAS Wildfire Mission	6U001
46	ASTER Mapping Improvements by Modeling Spectral-Spatial Scaling of HIS	6B303 6T303 62303
47	Carbon Capture Program	6B004



Science Schedule

ID	Task Name	Hyperlink
12	**Carbon**	
13	UAV for Sub-Pixel Land Cover Attributes and Dynamics	6A001
14	Fluxnet Global Network of Carbon, Water and Energy Flux	6T014
15	Mechanisms Controlling Annual, Interannual, and Decadal Changes in Calfornia's Carbon Budget	6T016
16	LVIS Mapping Ivory Billed Woodpeck	6B001
17	LVIS Sequoia National Forest	6B001
18	Multisite Integration of LIDAR and Hyperspectral data for Improved Estimation of Carbon Stocks and	6T006
19	Habitat Identification of the Ivory Billed Woodpecker using Hyperspectral Imaging	6W007
20	Huricane Katrina Hyperspectral and Cirrus DCS Damage Assesment	6W005
21	Scaling and Saturation of Ecosystem Carbon UptakeThrough Integration of Multi-Scale Remote	62006
22	Effects of insect defoliation on regional carbon dynamics of forests	62007
23	In-flight Fusion of Hyperspectral and LIDAR Data for NASA TEP	6T009
24	Hyperspectral Measurements of Surface Soil Inorganic Carbon and Biological Crust under Climate Change Treatments at the NDFF and MGCF	6T015

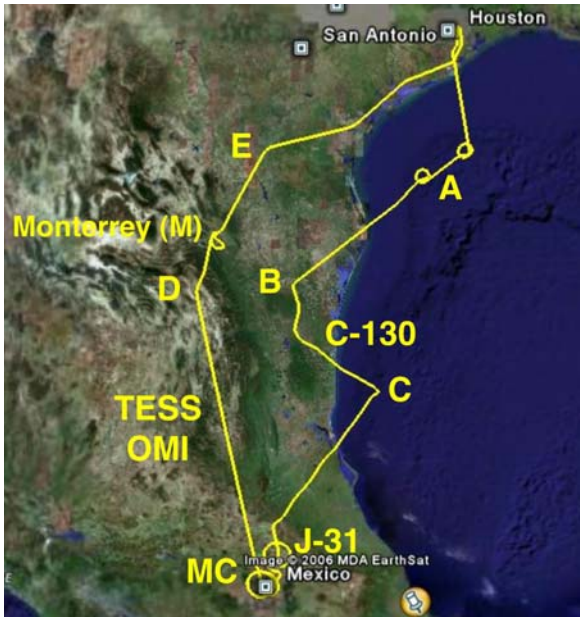


SUBORBITAL SCIENCE UPDATE - INTEX-B
NASA DC-8, Sky Research J-31, NSF C-130, DOE G-I, LaRC B200

Intercontinental Chemical Transport Experiment (Part B) – Deployment Schedule:

Houston:	Mar 1-20
Hawaii:	Apr 18-27
Alaska:	May 1-12

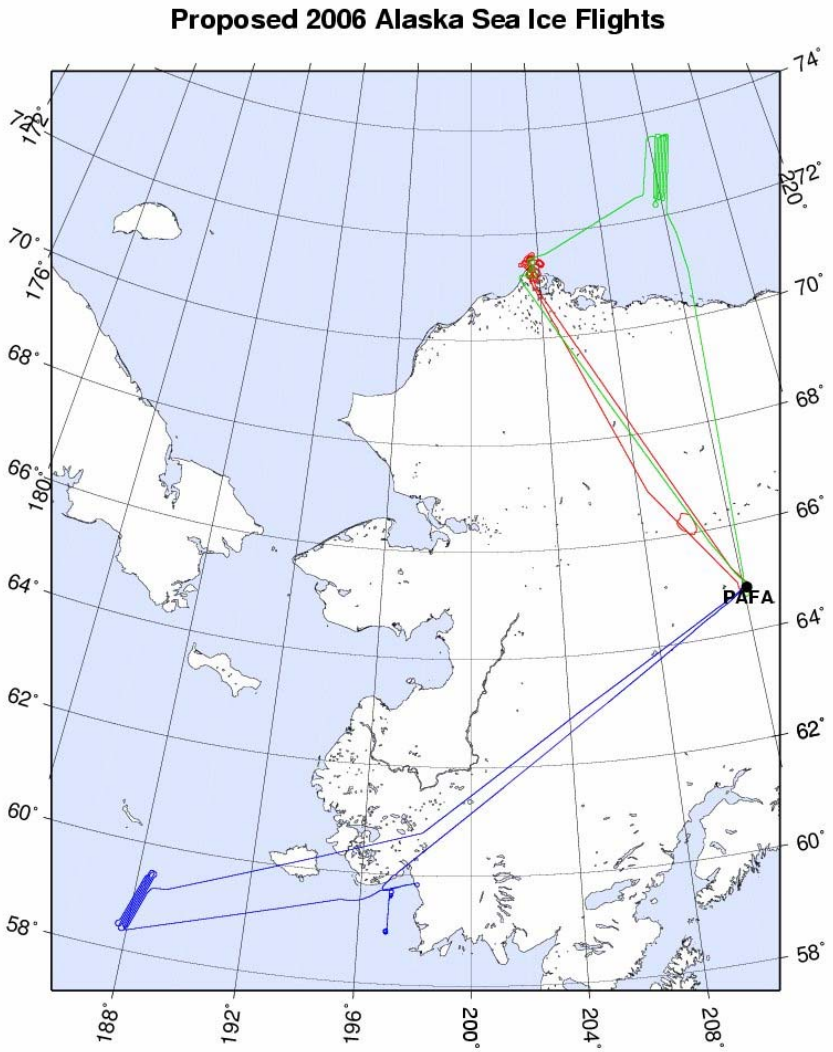
21 sensors
- 11 probes
- 2 lasers
- Species measured:
  - HOX, NOX,HNO4, SO2, O3, HCHO, H2O, CO, CO2, CH4
  - Aerosols



March 19 Flight Plan:
- Intercomparison with NSF C-130
- Coordinated spiral with J-31
- Validation of EOS Aura TES & OMI

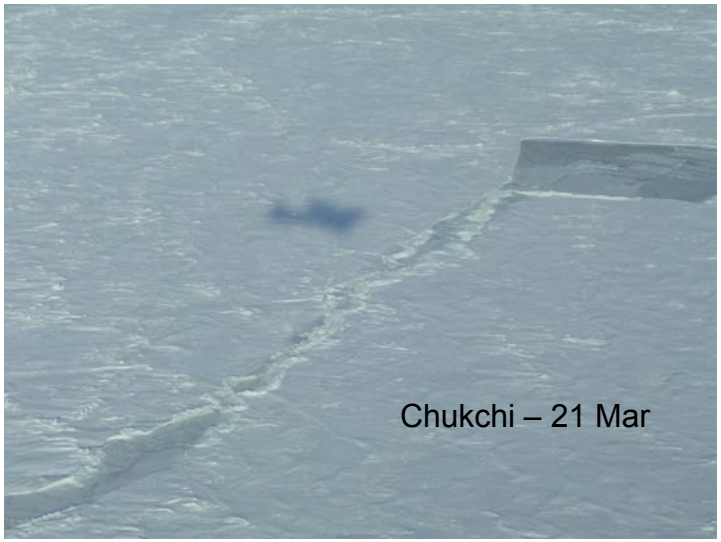
INTEX-B Mexico City Pollution from DC-8, Mar 16

SUBORBITAL SCIENCE UPDATE – Arctic 2006
NASA P3-B



Alaska & Greenland:

- P3-B with Kansas U snow radar, NOAA PSR, IIP D2P radar altimeter, ATM 4 laser altimeter
- Validate EOS Aqua AMSR-E, ICESat, Envisat
- All planned flight tracks achieved



SUBORBITAL SCIENCE UPDATE – NSF Maldives Autonomous UAV Campaign, ACR Manta UAS

Manta UAS

- •Advanced Ceramics Research, Arizona
- •Payload 15 lbs, 775 cu.in.
- •Endurance 6+ hours
- •Ceiling 16K ft
- •Airspeed 40kts

Maldives Hanimadhoo Island

- •3 Manta UAS in stacked formation, above, in, and below cloud
- •Aerosol properties
- •Black carbon
- •cloud microphysics
- •Broadband & spectral irradiances

NASA contributed funding, advised on mission success and flight operations procedures. Lessons learned report coming.

IWGADTS
Interagency Working Group for Airborne Data and Telecommunication Systems

Briefing at Joint Meeting of

UNOLS Scientific Committee for Oceanographic Aircraft Research (SCOAR)
and
Interagency Coordinating Committee for Airborne Geosciences and Applications (ICCAGRA)

May 23rd, 2006
CIRPAS Facility, Marina California

Larry Freudinger, NASA Dryden Flight Research Center
Chris Webster, National Center for Atmospheric Research

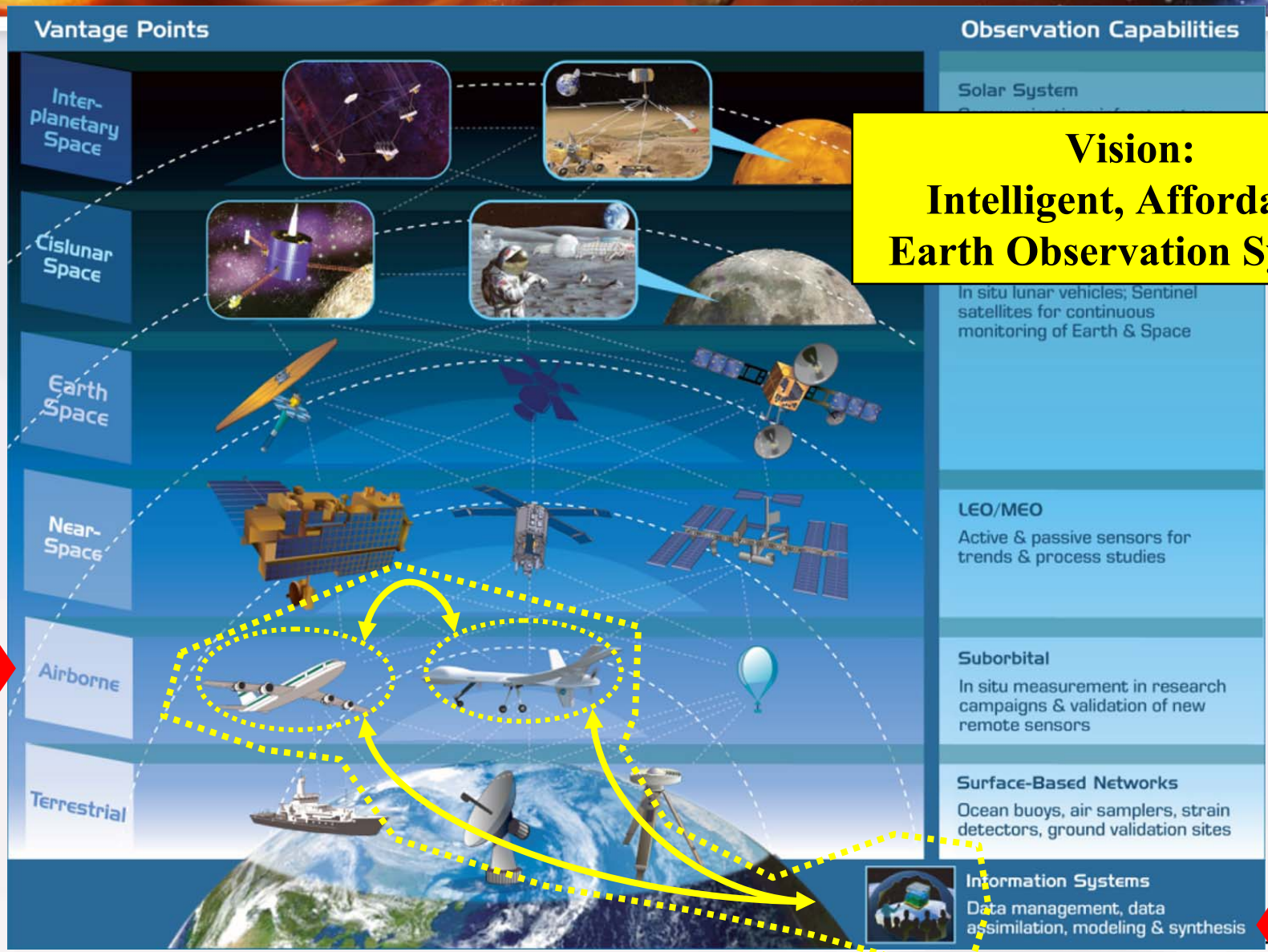
Abstract

The Interagency Coordinating Committee for Airborne Geosciences Research and Applications (ICCAGRA) was established to improve cooperation, foster awareness, facilitate communication among sponsoring agencies having airborne platforms and instruments for research and applications, and serve as a resource to senior level management on airborne geosciences issues. The Interagency Working Group for Airborne Data and Telecommunications Systems (IWGADTS) is organized as a subgroup to ICCAGRA for the purpose of developing recommendations leading to increased interoperability amongst airborne platforms and instrument payloads, to produce increased synergy with DoD research programs with similar goals, and to enable the suborbital layer of the Global Earth Observing System of Systems. The purpose of this paper is to introduce the reader to the objectives of the IWGADTS and its strategy for achieving these objectives.

IWGADTS: Background

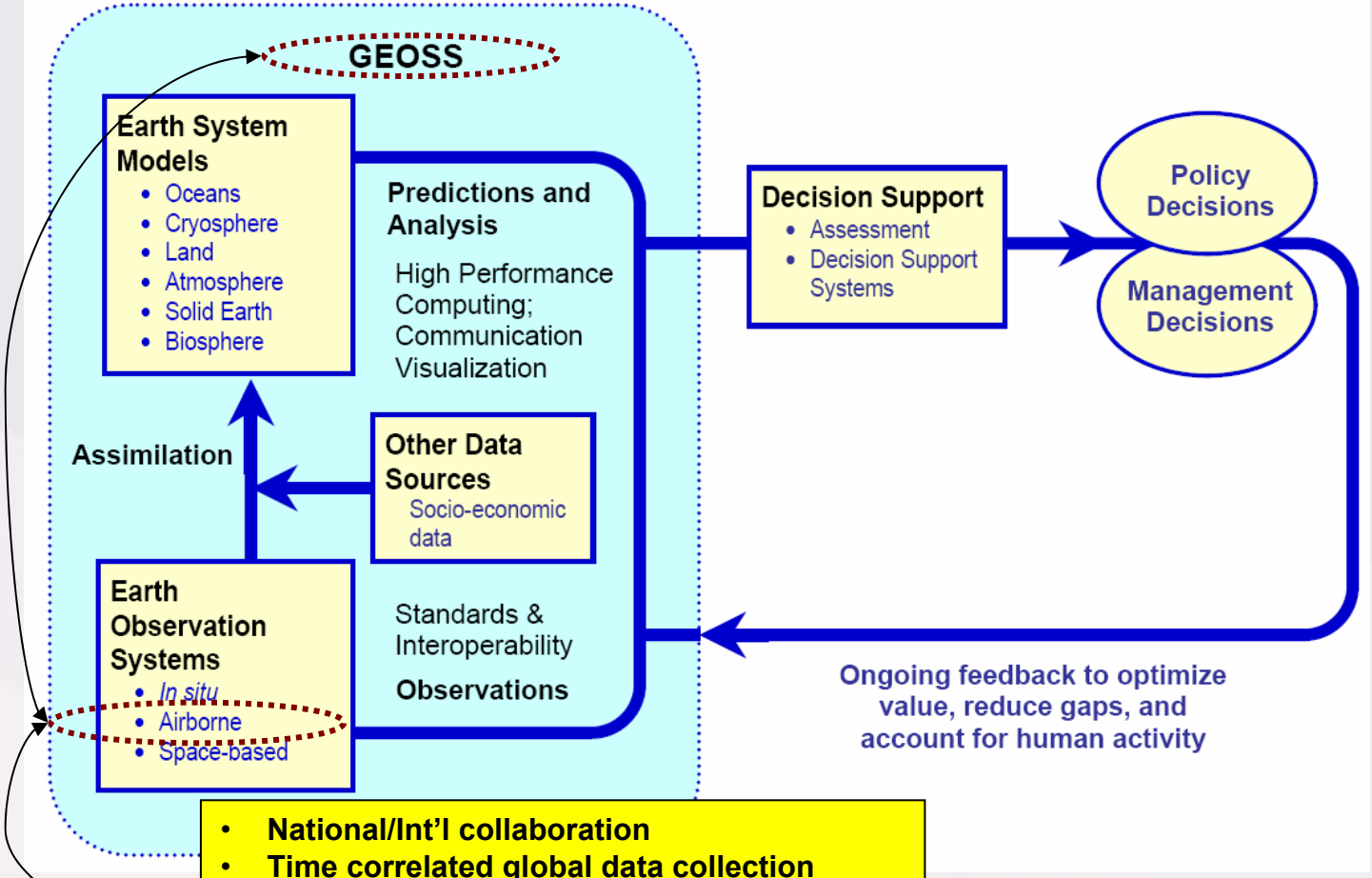
Background discussion

Future = Layered Sensor Webs



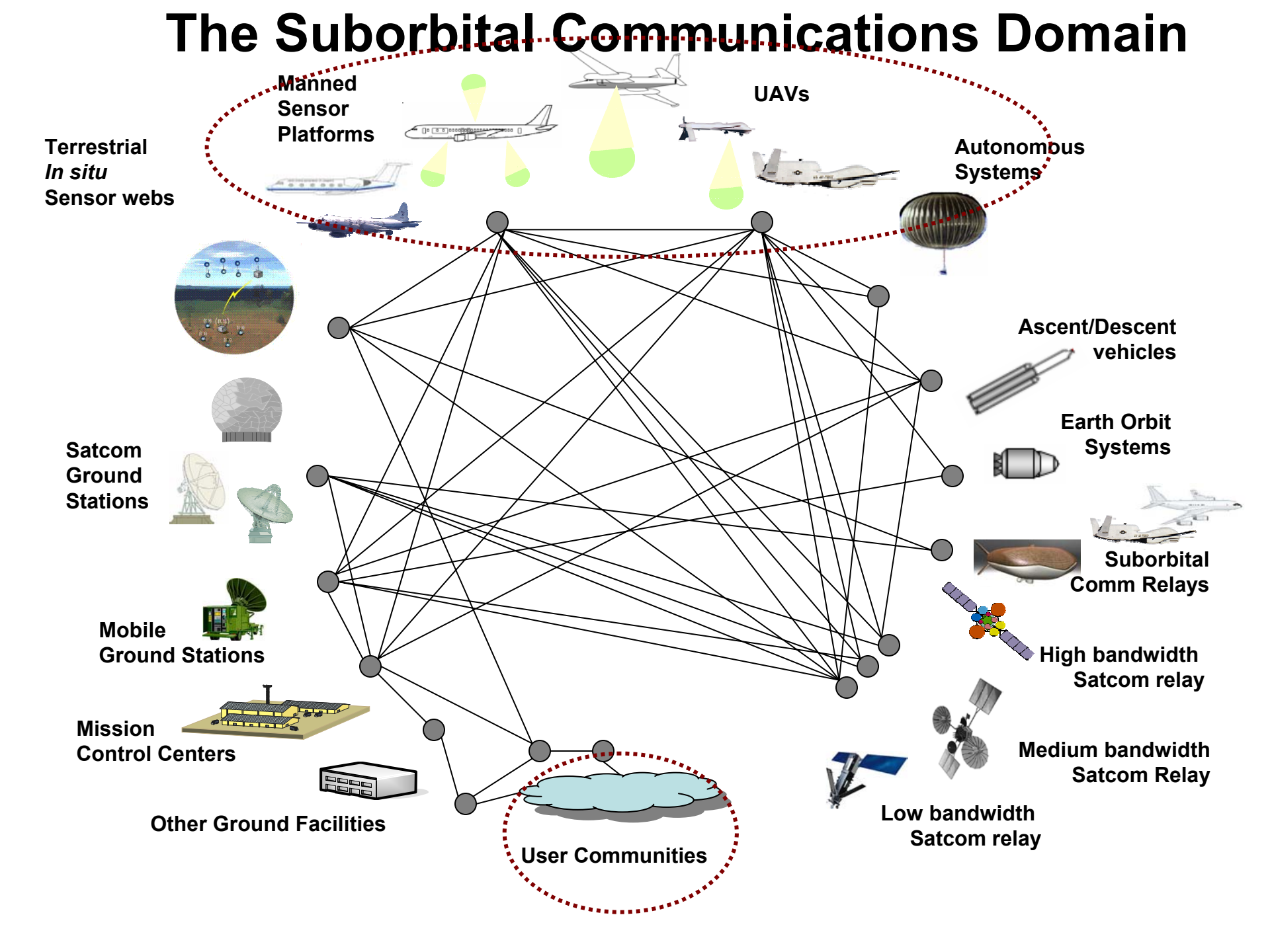
Vision:
Intelligent, Affordable Earth Observation System

Global Earth Observing System of Systems



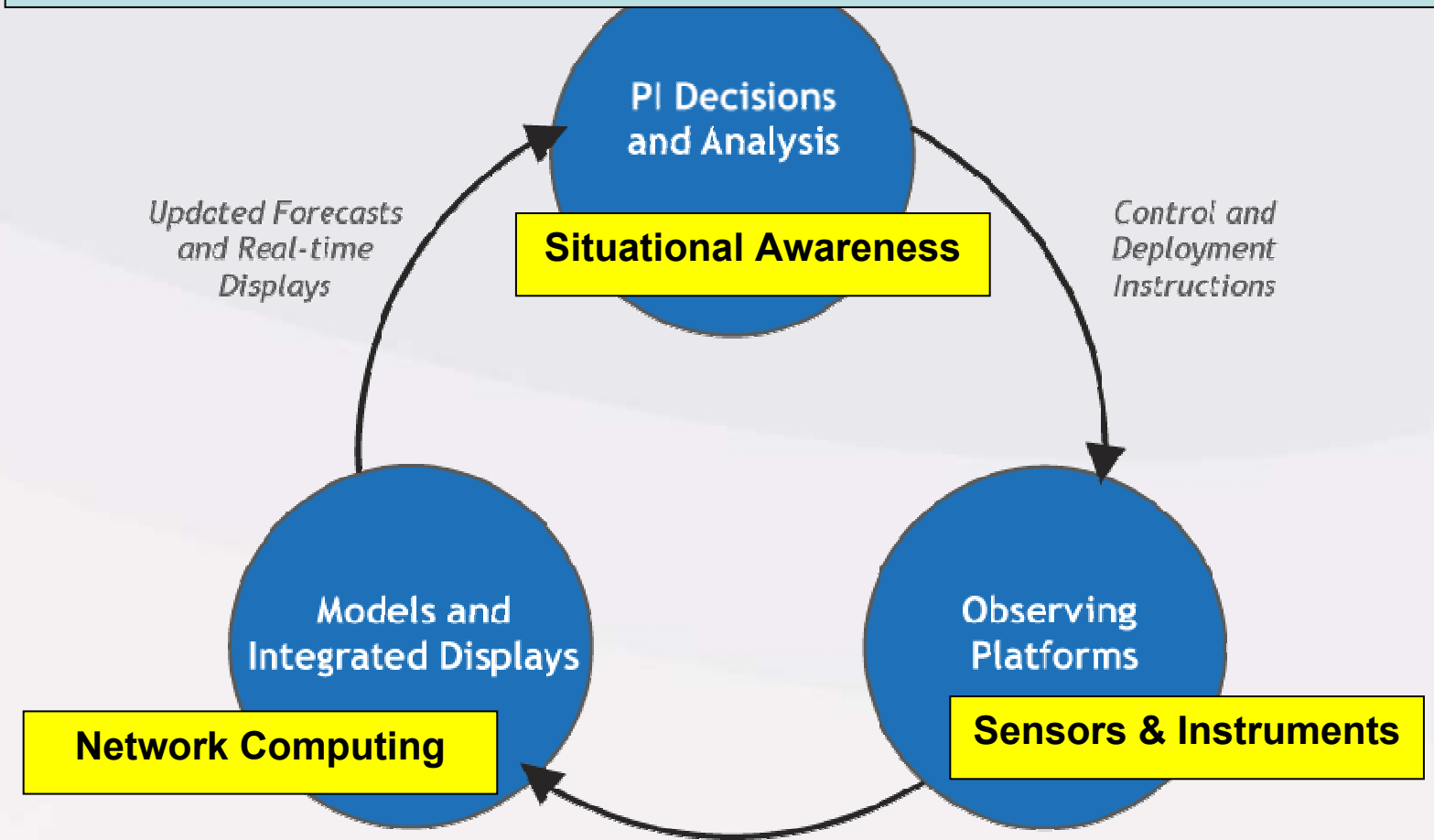
- National/Int'l collaboration
- Time correlated global data collection
- Integrated metadata
- Integrated system analysis
- Reliable long term archival
- Easy access but secure archive
- Near realtime observation

The Suborbital Communications Domain



IWGADTS: Themes

Goal: make the best possible use of available time…
better capabilities… greater capacity



Credit: NCAR/EOL - Mike Daniels

IWGADTS: Themes

- Work toward a suborbital platform fleet that is an effective and sustainable component of the to-be-implemented Integrated Earth Observation System

- Interoperability occurs over networks; important contributions emerge through software interfaces and protocols, not through the hardware systems that generate that information.

- Telecommunication implies interactive connectivity with the airborne networks. Over time, instrument networks on suborbital platforms migrate toward being observation nodes on a suborbital “sensor web”.

IWGADTS: Charter

Charter discussion

IWGADTS: Charter (Purpose)

- Identify interagency needs for data and networked systems
- Improve interoperability of airborne platforms between agencies
- Enhance opportunities for interagency sharing of aircraft resources, airborne instrumentation and data to minimize duplication, and to expand science investigators' access to interagency assets
- Provide technical standards *recommendations* to senior level decision makers
- Evaluate the current state of interoperability and recommend, as appropriate, “best practices” to facilitate the development of common data and networking systems leading to a fully interoperable global observing system which includes suborbital and space-based components

IWGADTS: Charter (administrative)

Membership

- Principal geosciences research aircraft sponsoring agencies (NSF, NOAA, NASA, ONR, DOE, DOI,…)
- Academia & other platform representatives
- Leadership via elected chairman & executive secretary

Meetings & correspondence

- Twice per year
- Inter-meeting communication via iwgadts@eol.ucar.edu

Review the charter every three years (2008)

Participation is voluntary (no direct funding source)

IWGADTS: Progress

Status & Progress discussion

Progress: Data Exchange – ASCII packet

IWGADATS is developing extensible “standard packets” for sharing commonly used information. First cut at ASCII Specification:

- String will be prefaced with ‘IWG1’ as the magic-cookie to identify this stream.
- DateTime (UTC) will use iso-8601 which is of the form 'yyyy-mm-ddThh:mm:ss'.
- Values will be comma separated. This will allow for little loss of bandwidth for missing values.
- Data values other than date will be in any format acceptable to the ANSI C string-to-double function strtod(3).
  - Recommend to implementers to use appropriate significant figures.
  - 'inf' and 'nan' are acceptable.
  - Fields not supplied or available will be left empty (e.g. '...,4.523,,48.234,...).
- String will be terminated by \r\n (carriage return, newline).
- IWG1,yyyy-mm-ddThh:mm:ss,value,value,……,value,,value\r\n
- The list of variables will be fixed in the following order, these are all platform 'best' values:

ASCII Realtime Packet Definition

IWG1,yyyy-mm-ddThh:mm:ss,value,value,……,value,,value\r\n
IWG1,yyyy-mm-ddThh:mm:ss,value,value,……,value,,value\r\n
IWG1,yyyy-mm-ddThh:mm:ss,value,value,……,value,,value\r\n
…
…

IWG1
Date/Time
Lat (dec deg)
Lon (dec deg)
GPS_Alt (m)
Press_Alt (feet)
Radar_Alt (feet)

Grnd_Spd (m/s)
True_Airspeed (m/s)
Indicated_Airspeed (knots)
Mach_Number
Vert_Velocity (m/s)
True_Hdg (degrees_true)
Track (degrees_true)
Drift (degrees)
Pitch (degrees)
Roll (degrees)
Side_slip(degrees)
Angle_of_Attack (degrees)
Ambient_Temp (degrees_C)
Dew_Point (degrees_C)
Total_Temp (degrees_C)
Static_Press (mbar)
Dynamic_Press (mbar)
Cabin_Pressure (mbar)
Wind_Speed (m/s)
Wind_Dir (degrees_true)
Vert_Wind_Spd (m/s)
Solar_Zenith_Angle (degrees)
Sun_Elev_AC (degrees)
Sun_Az_Grd (degrees_true)
Sun_Az_AC (degrees_true)

IWGADTS

…

Progress: Interface Descriptions

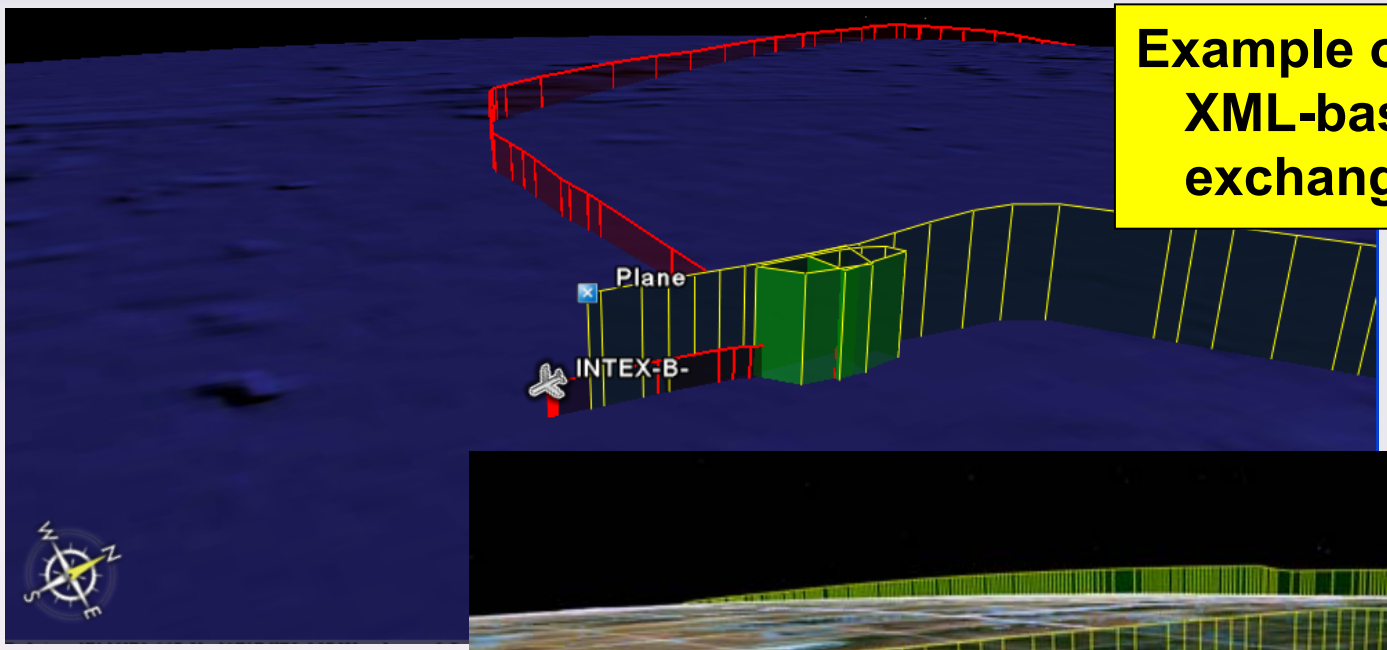
IWGADTS has discussed XML schema as part of interface control and data exchange documentation

- Common language for describing data enables interoperability
- Machine-readable interface descriptions is important for *automating* interoperability
- Portability, platform, language, vendor independence
- Structured, tailorable, extensible
- Widely implemented & growing
- Widely available tools

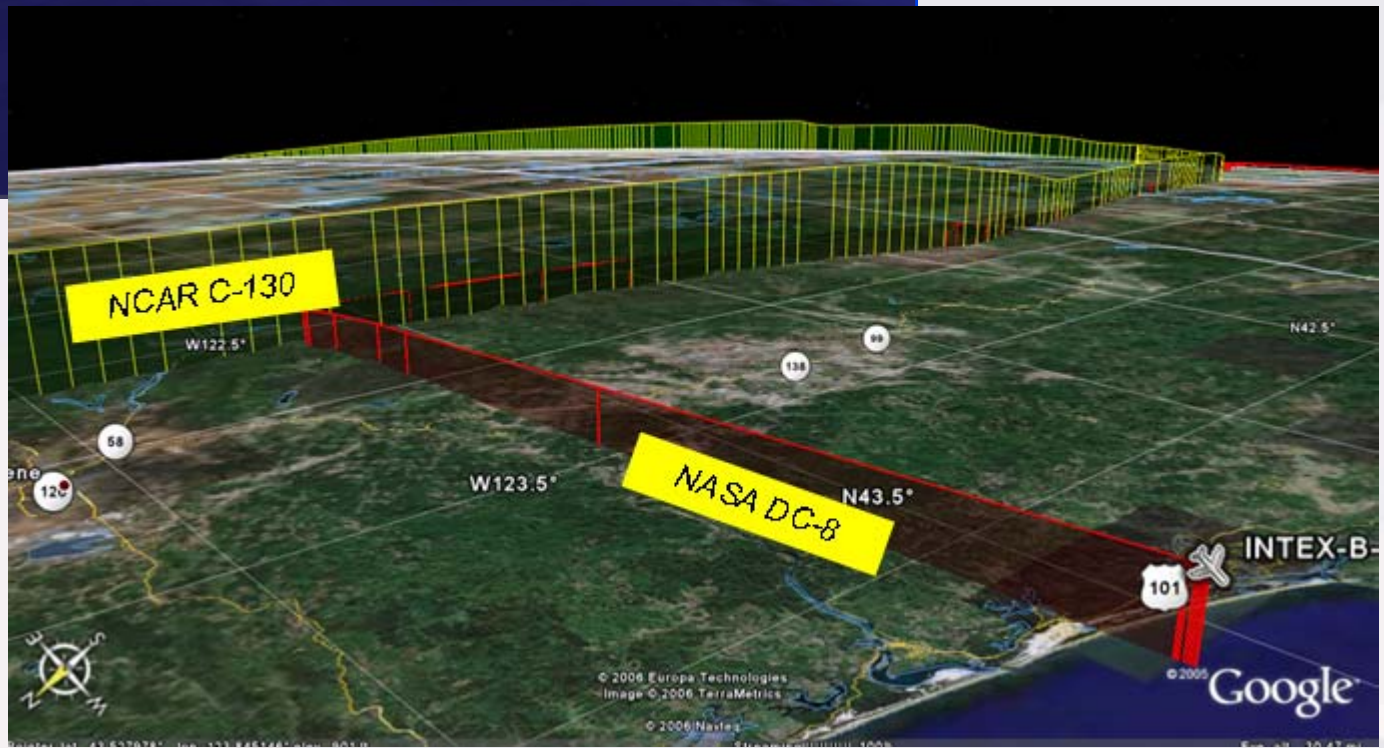
Interface Descriptions: NcML example

```
<netcdf format="classic">
<variable name="magic-cookie" shape="Time" type="String">
  <attribute name="long_name" type="String" value="Keyword identifying this
    output"/>
  <attribute name="units" type="String" value="IWG1"/>
</variable>
<variable name="Time" shape="Time" type="String">
  <attribute name="long_name" type="String" value="time of measurement"/>
  <attribute name="standard_name" type="String" value="time"/>
  <attribute name="units" type="String" value="iso-8601"/>
</variable>
<variable name="Lat" shape="Time" type="float">
  <attribute name="units" type="String" value="degree_N"/>
  <attribute name="long_name" type="String" value="GPS Latitude"/>
  <attribute name="valid_range" type="float" value="-90.0, 90.0"/>
  <attribute name="standard_name" type="String" value="latitude"/>
</variable>
<variable name="Lon" shape="Time" type="float">
  <attribute name="units" type="String" value="degree_E"/>
  <attribute name="long_name" type="String" value="GPS Longitude"/>
  <attribute name="valid_range" type="float" value="-180.0, 180.0"/>
  <attribute name="standard_name" type="String" value="longitude"/>
</variable>
…
```

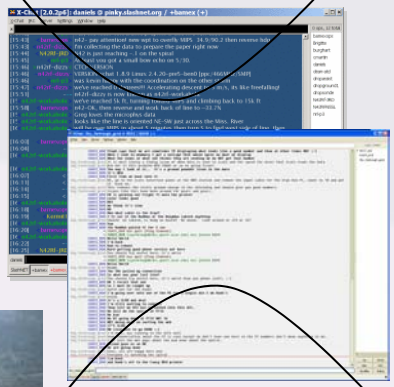
Progress: Multi-Aircraft Displays



Example of leveraging XML-based data exchange interface



Progress: Network Chat



Concluding Comments

- IWGADTS assembled in Jan 2005
- Met twice since accepted under ICCAGRA
- Demonstrating ability to coordinate ongoing activities for mutual benefit
- Demonstrating viable consensus approach to joint innovation
- More to come!
- Email us at *iwgadts@eol.ucar.edu*

Parting thought: Why Network Computing?

"…to enable men and computers to *cooperate* in making decisions and controlling complex situations without inflexible dependence on predetermined programs"

- J. C. R. Licklider, 1960

IRE Transactions on Human Factors in Electronics,

volume HFE-1, pages 4–11, March 1960. http://memex.org/licklider.pdf

The lack of situational awareness causes lost opportunity.
Sensor webs to enhance decisionmaking are the reason the Internet exists!!!

DLR Falcon 20 Research Aircraft

Concept Proposal for Transfer to U.S. Airborne Research Fleet

Michael Poellot
University of North Dakota

University of North Dakota Airborne Research

- UND Citation II Aircraft
- Operational History: 1981 – 2005
- Agencies: Interior, FAA, NOAA, DOE, NSF, NASA, AID, EPA, DoD, Private Industry
- Studies: Cloud Microphysics, Turbulence, Air Chemistry, Aerosol, Water Vapor, Electric Field, Boundary Layer, Thunderstorms, Icing, Wind Shear, Photogrammetry

University of North Dakota Airborne Research

- Education Programs
  - B.S., M.S., Ph.D.
- Research
  - Cloud Microphysics, Aerosol, Aviation Weather, Electric Field
- Replacement Aircraft
  - Citation II
  - Falcon 20

DLR Falcon 20

DLR Falcon vs. Citation II

	Falcon 20-E5	Citation II
Max Altitude	13.7 km (45,000')	13.1 km (43,000')
Max Range	2000 nm	1200 nm
Max Endurance	5.5 hours	4.5 hours
Max Payload	4600 lbs.	1380 lbs.
Cabin Volume	700 ft^3	263 ft^3
Max Airspeed	495 knots	340 knots
Min Airspeed	160 KIAS	140 KIAS
Research Power	16.8 KW	4.3 KW

DLR Falcon 20 Mods

Proposed DLR Falcon Acquisition Schedule

- 2007-2009 Shared Operational Use
- 2009 Transfer to U.S.
- 2009 - Operated by University of North Dakota

Transition/Shared Use

- Two projects per year
- U.S. scientists may propose use
- UND personnel actively involved in deployment/operation

Costs

- Transition
  - UND personnel
  - Ferry
- Acquisition
  - Final cost
  - UND cost share
- Operating
  - Multi-agency support

Issues

- Airworthiness Certificate
- Ownership
- Shared Use Transition
- Costs

DLR Falcon 20

National Science Foundation

No Single Platform can be Expected to Meet All Science Requirements and it is Important to Factor that into Facility Requests

How Heavy?

How Severe?

How High?

Flight Profiles Affect Life Cycle of Airframe

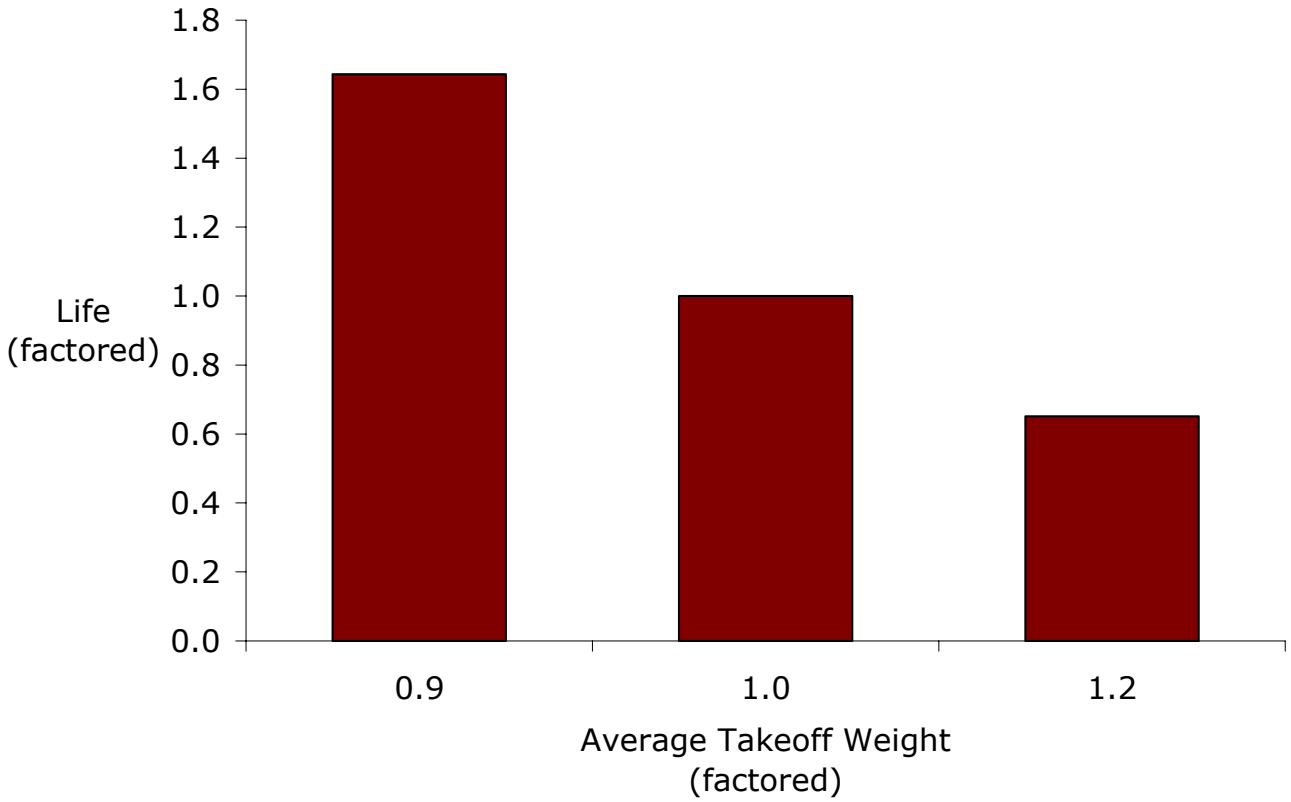
- Using statistics for Citation Jet Aircraft effect of flying different flight profiles analyzed
- New aircraft are designed for specific flight; older aircraft had much larger flight window because engineering was not as fine tuned
- Recommended Service Life Increase/Decrease
- Develop Fleet Management Plan With Options & Alternatives
  - Route Change
  - Modification To Mission Profiles
  - Fatigue Tracking Program

Comparative Analysis

- Analyze for crack growth life (inspections)
- What happens if:
  - Average Cruise Altitude changes?
  - Gross Weight is changed?
  - Usage (maneuvers) changes?

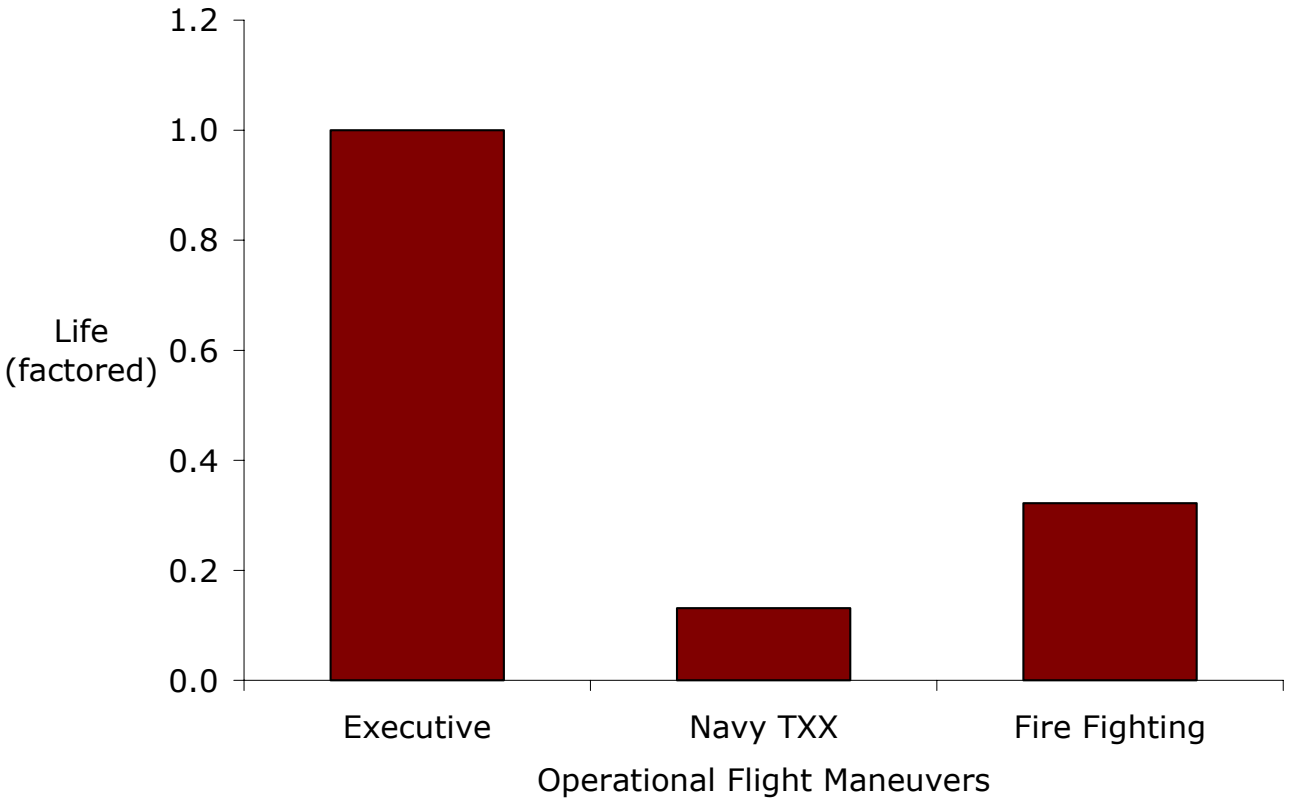
National Science Foundation

Weight



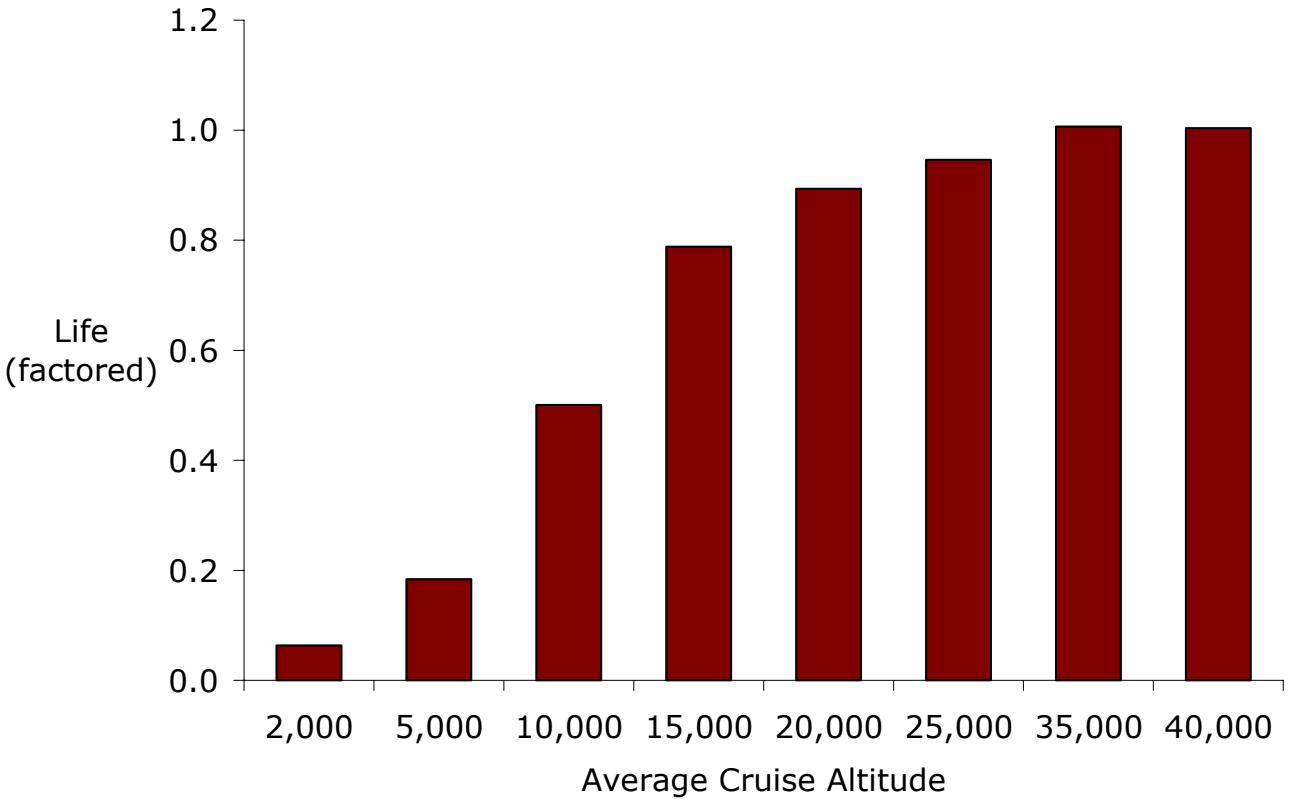
National Science Foundation

Maneuvers



National Science Foundation

Altitude



University-National Oceanographic Laboratory System

UNOLS Report to the Scientific Committee for Oceanographic Aircraft Research

Mike Prince
UNOLS Executive Secretary

May 24, 2006
CIRPAS
Marina, CA

Outline of Presentation
University-National Oceanographic Laboratory System

I. Budget Shortfalls and Impact on Future Fleet Operations
   - A. Utilization and Cost Trends
   - B. 2006 Fleet Utilization
   - C. 2007 Fleet Projections
   - D. UNOLS Subcommittee Formed

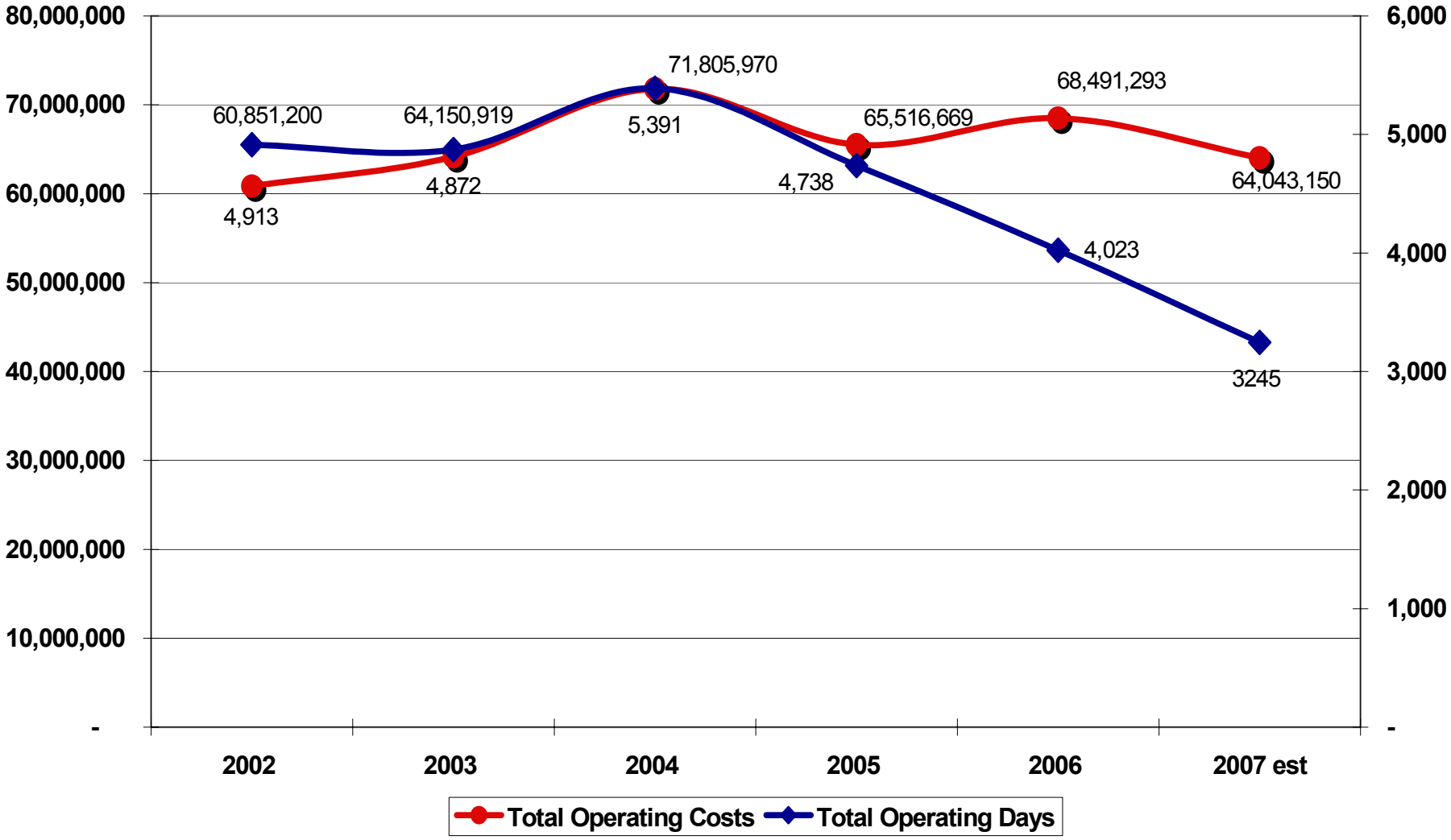
II. Academic Fleet Renewal

III. Other UNOLS Activities

IV. UNOLS Committee Activities

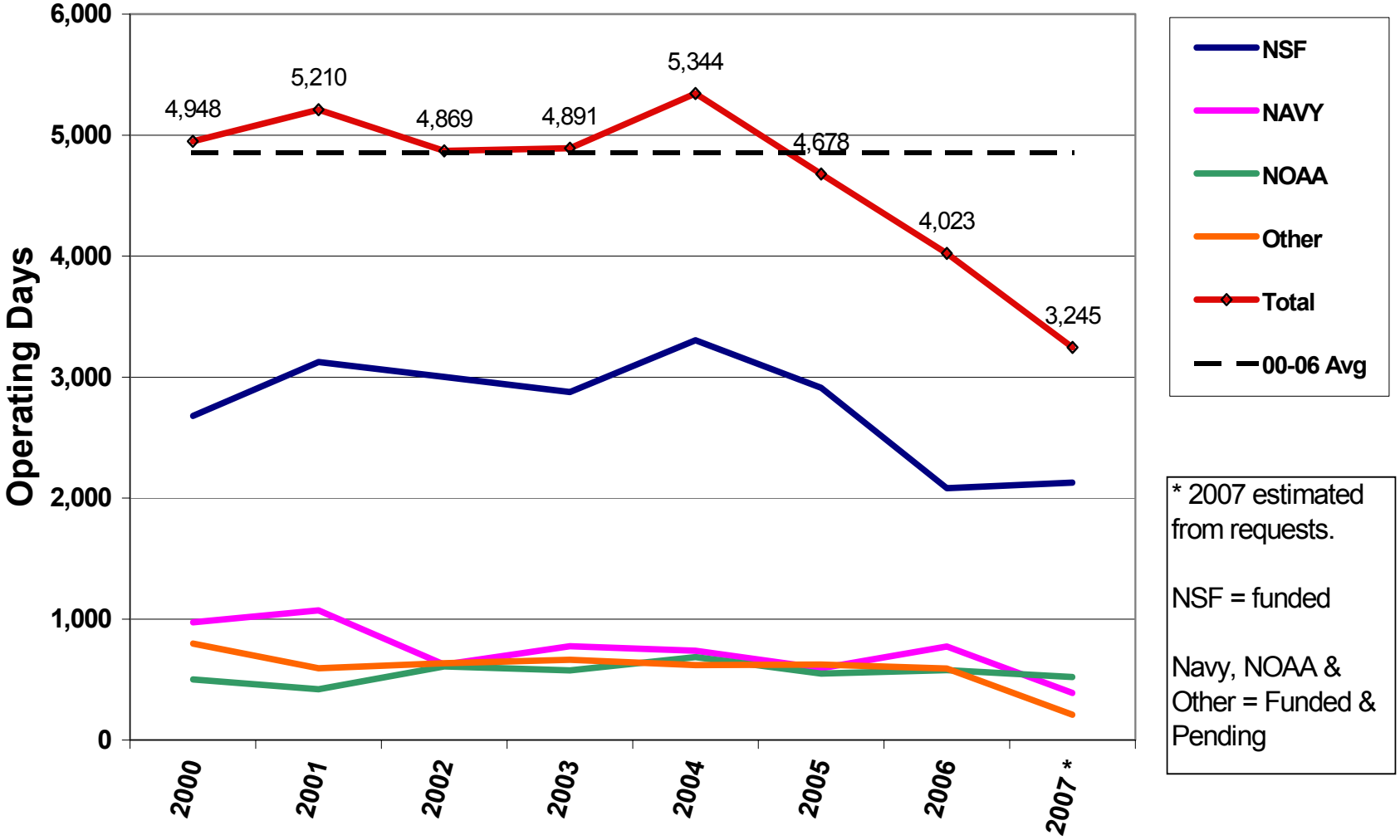
2002 – 2007 UNOLS Fleet Operating Days and Costs

University-National Oceanographic Laboratory System



Fleet Utilization by Federal Agency

University-National Oceanographic Laboratory System



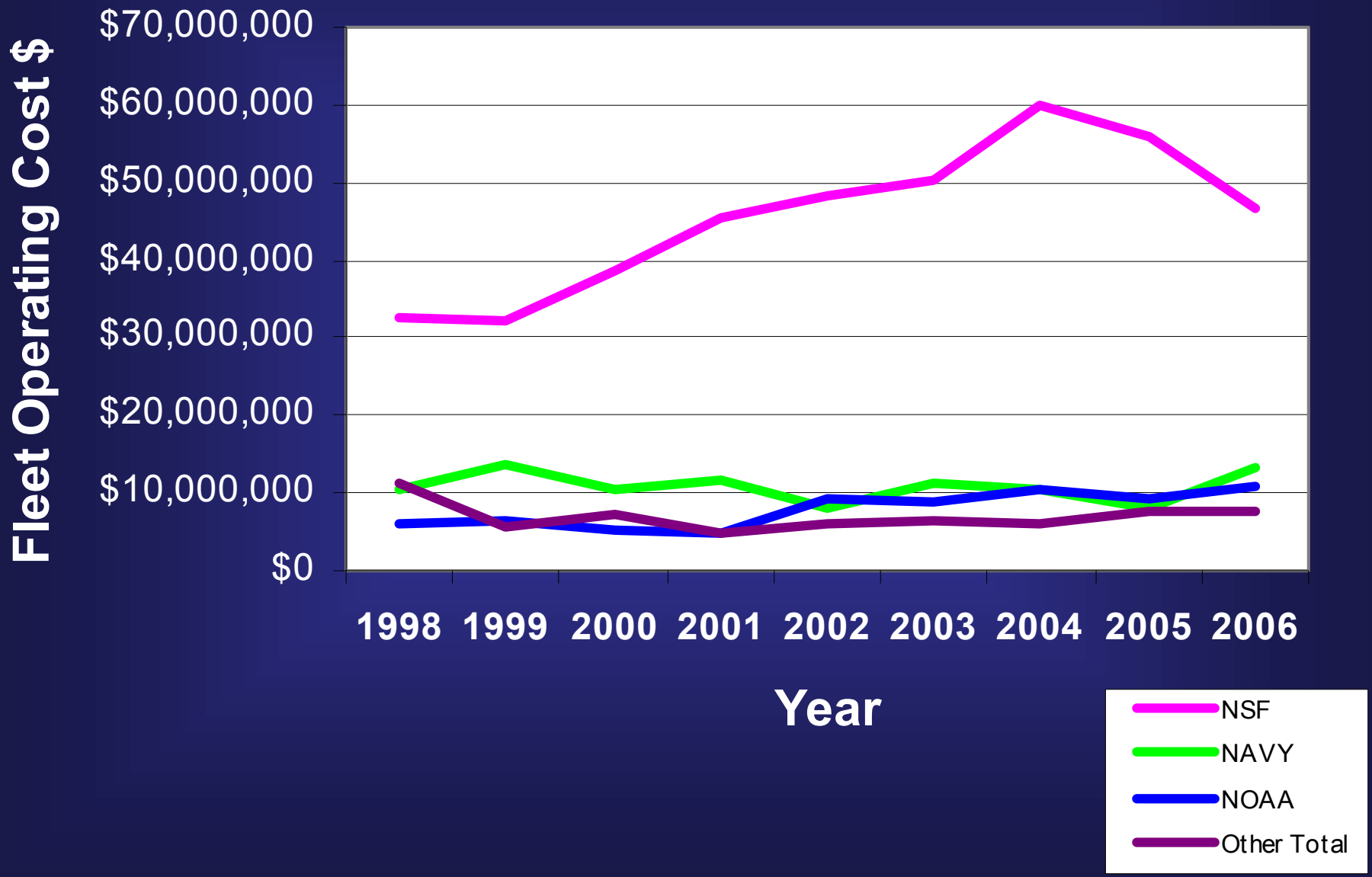
* 2007 estimated from requests.

NSF = funded

Navy, NOAA & Other = Funded & Pending

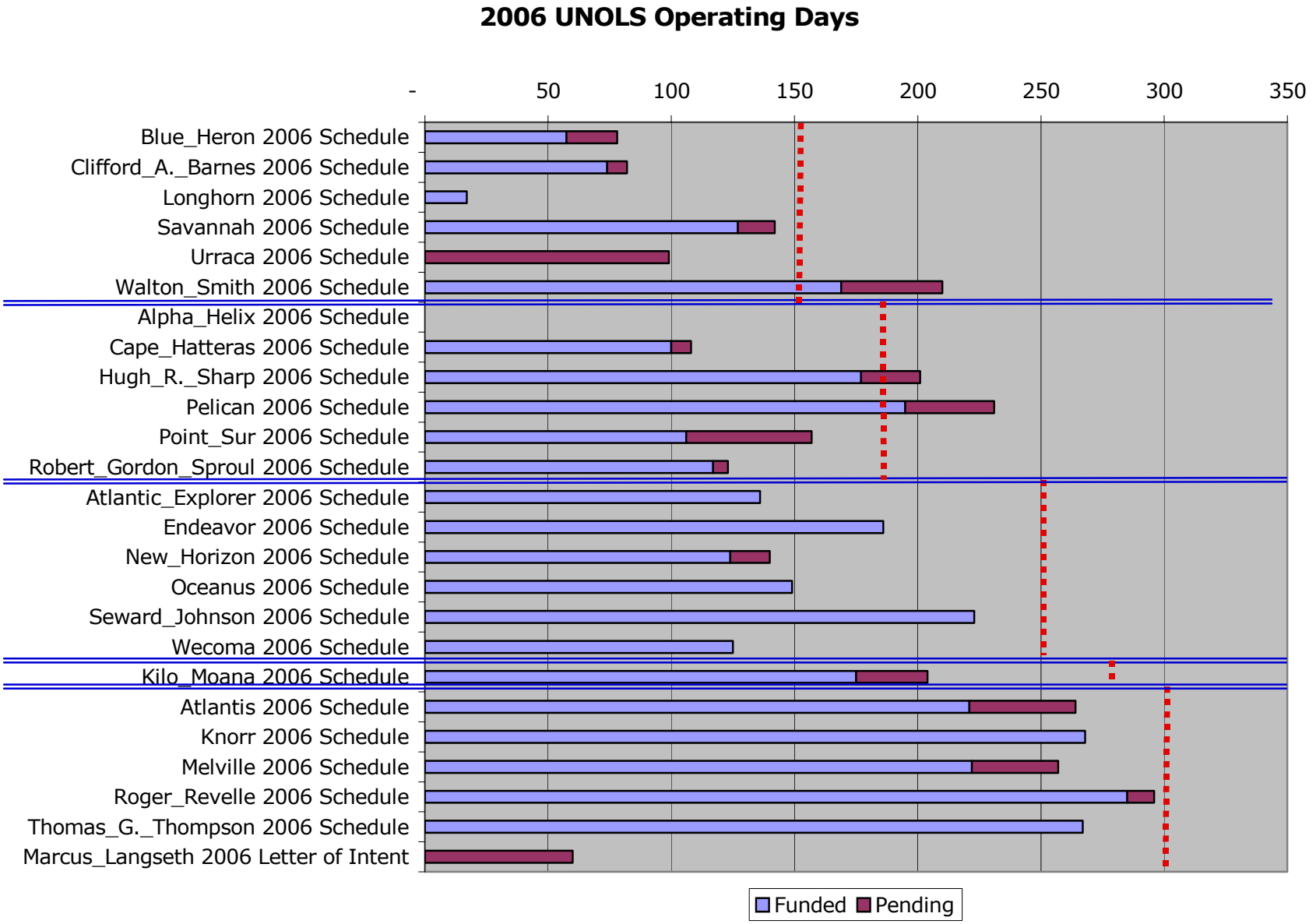
Fleet Costs by Federal Agency

University-National Oceanographic Laboratory System



2006 Scheduled Ship Time

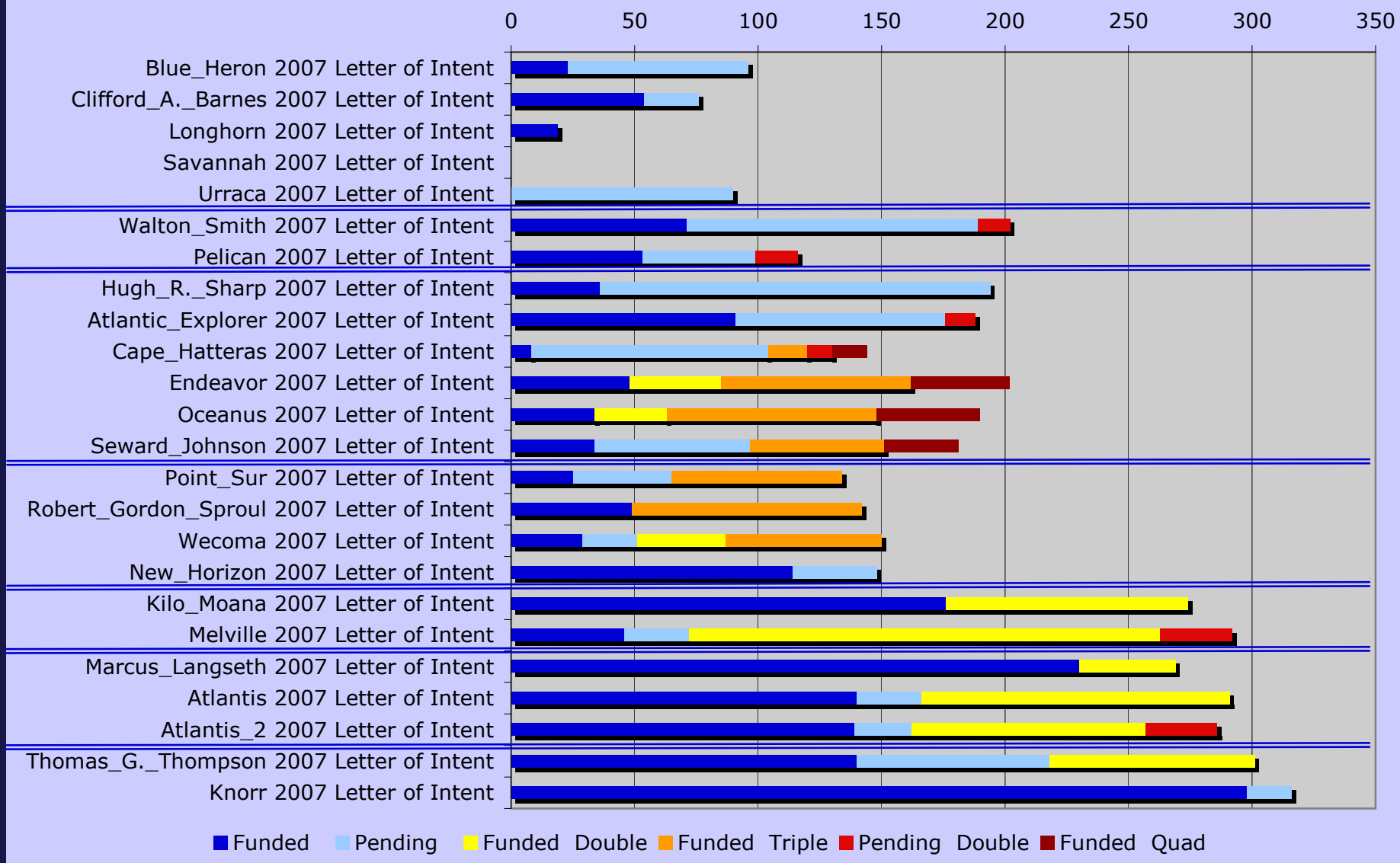
University-National Oceanographic Laboratory System



2007 Ship Time

University-National Oceanographic Laboratory System

2007 Schedules - Showing Double, Triple & Quadruple Bookings



UNOLS Subcommittee Formed

University-National Oceanographic Laboratory System

- March 2006 – Council forms subcommittee to prepare guidelines that would be used by the Council to make recommendations regarding ship lay-ups or retirements from the Fleet
- Subcommittee:
  - **Marcia McNutt (MBARI), Chair**
  - **Wilf Gardner (TAMU)**
  - **Peter Ortner (U. Miami)**
- Subcommittee Charge: Develop a short white paper to focus UNOLS Council discussion and agreement upon an equitable and defensible process to be followed by UNOLS to arrive upon a recommendation by July 2006 as to which UNOLS vessels would be laid up in 2007 or beyond or retired.

Subcommittee Questions to Operators

University-National Oceanographic Laboratory System

1. Is there any difference in the operations or maintenance costs of the older Global-class ships (*Melville* and *Knorr*) versus the younger ones (*Thompson, Revelle*, and *Atlantis*)? Is there any difference in the science that can be accommodated on the older ones versus the younger ones?
2. Can the special purpose ships, such as the *Atlantis* and the *Langseth*, conduct in a cost effective manner the same programs that are usually put on the other global class ships? Or is there a major penalty paid by "filling out their schedules" with general purpose work?
3. Are there any arguments for maintaining a geographic distribution of global class ships, or is the home port immaterial in terms of meeting the community's needs?

Subcommittee Questions to Operators

University-National Oceanographic Laboratory System

4. What are the tradeoffs, financial and otherwise, of having many versus fewer ship operators? e.g., Is there any indication that multi-ship operations are most cost effective? Does having more operators bring in more state and other funding to the fleet?

5. What are the nominal retirement dates for each of the Intermediate class ships and how many of them are likely to be replaced?

6. Are there other values or criteria that should be used as factors in recommending lay-ups or retirements?

Outline of Presentation

University-National Oceanographic Laboratory System

I. Budget Shortfalls and Impact on Future Fleet Operations

II. Academic Fleet Renewal
   - A. Regional Class
   - B. Ocean Class
   - C. Alaska Region Research Vessel
   - D. New Construction/Conversions
   - E. Global Science Mission Requirements
   - F. Fleet Improvement Plan

III. Other UNOLS Activities

IV. UNOLS Committee Activities

Regional Class Acquisition Status

University-National Oceanographic Laboratory System

- April 27, 2006 - Contract awards for Phase I of the Regional Class Research Vessel (RCRV) program:
  - Dakota Creek Industries, Anacortes, WA
  - Nichols Brothers Shipbuilders, Freeland, WA
- Phase I is preliminary/contract design - twelve month period and a firm fixed price of ~ $1 Million each.
- Phase II is detail design and construction.
- Based on proposals submitted by the two Phase I Contractors, a single Phase II contract for detailed design and construction is anticipated to be awarded at the end of Phase I (second quarter CY2007). The Phase II contract will be for a lead ship with options for up to two more.

Ocean Class - Timeline

University-National Oceanographic Laboratory System

7/2002	Ocean Class SMR Community Workshop
3/2003	Ocean Class Science Mission Requirements (SMRs) finalized
4/04-7/04	Ocean Class Concept Definition Task
10/04–3/05	Hull Evaluation (Monohull, SWATH, X-Craft
3/05	UNOLS provides hull recommendation to Navy (monohull)
FY2006	Funds Appropriated for Ocean Class Design
Spring 06	Navy forms Naval Research Advisory Committee to provide recommendation regarding Navy's role in acquisition of Ocean Class

Alaska Region Research Vessel (ARRV)

Length: 236 feet

Beam: 48 feet

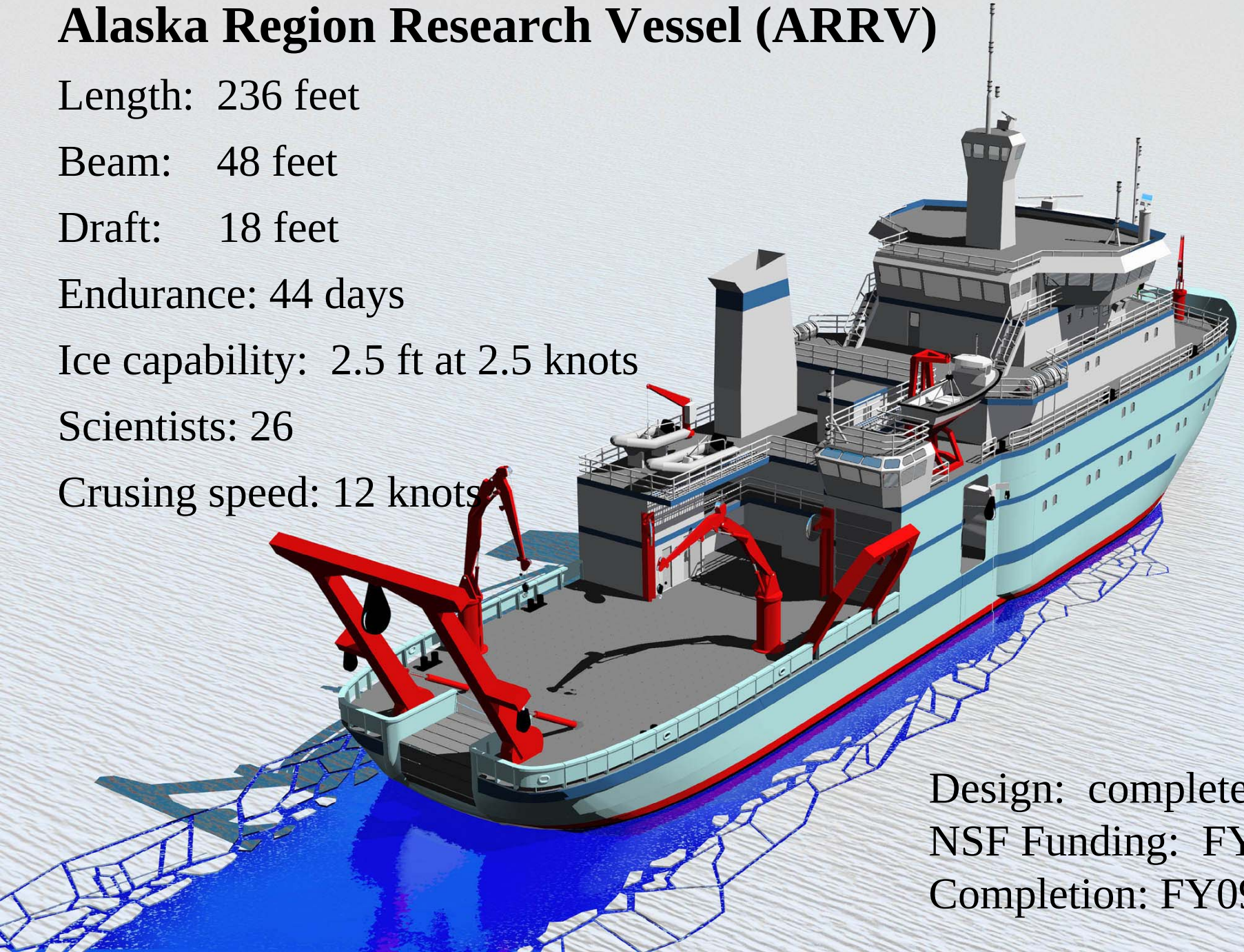
Draft: 18 feet

Endurance: 44 days

Ice capability: 2.5 ft at 2.5 knots

Scientists: 26

Crusing speed: 12 knots



Design: complete

NSF Funding: FY07?

Completion: FY09+

Global Class SMRs and Mid-Life Considerations

University-National Oceanographic Laboratory System

2006 - *THOMPSON*

- Steering Committee formed to update Global Vessel General Purpose SMRs.
- Incorporate Heavy Lift considerations to address ocean observatory and long coring needs.
- Community On-line Survey regarding science needs – coming soon.

2011 – *REVELLE*

2012 – *ATLANTIS*

New Ships Recently Constructed or Converted
University-National Oceanographic Laboratory System

R/V Hugh R Sharp (U. Delaware)

- Owner – U. Delaware
- March 2006 – entered UNOLS Fleet
- Length = 146 feet
- Modular design to enhance flexibility of use.
- Design also may allow for testing and fitting to incorporate new fuel-cell technologies.
- Designed for quiet operation.

R/V Marcus Langseth (LDEO)

- Owner = NSF
- Length = 235 feet
- Ready for Service in late 2006.
- Will operate Globally in support of seismic operations and general purpose research.
- Geophysical capabilities include a sound source array towed in four "strings" that can be configured either as a single, 2D source or dual, alternating 3D source arrays.

Ship Transfer and Retirements
University-National Oceanographic Laboratory System

R/V Atlantic Explorer begins operations at Bermuda Biological Station for Research

- BBSR acquired *R/V Seward Johnson II* from HBOI in October 2005.
- The ship underwent a modification and maintenance period
- April 2006 – *Atlantic Explorer* began operations from BBSR.

Ships Retired from UNOLS Fleet:

Gyre – August 2005

Cape Henlopen – October 2005

Weatherbird II – December 2005

UNOLS Fleet Improvement Plan Outline

University-National Oceanographic Laboratory System

- **Executive Summary / Intro**
- **Identify Future Science Initiatives** – includes Major Science Disciplines, Education/Outreach, and Cross cutting initiatives.
- **Current Fleet Composition and Utilization Trends** - includes updated vessel retirement dates and SLEP estimates.
- **Future Fleet Projections**
  - Evaluate other future facility projections (Ocean observatory, Event Response, etc)
  - Other Facilities – aircraft, deep submergence facilities
  - Define Future Fleet Composition
- **Fleet Budget Projections and Requirements**
- **Recommendations**

Final Draft – Fall 2006

Outline of Presentation

University-National Oceanographic Laboratory System

I. Budget Shortfalls and Impact on Future Fleet Operations

II. Academic Fleet Renewal

III. Other UNOLS Activities
   - A. ADA Committee
   - B. UNOLS Briefing PAckage
   - C. HOV Safety Standards

IV. UNOLS Committee Activities

Americans with Disabilities Act (ADA) Guidelines for Research Vessels

Background:

- NSF has indicated the need for new ship construction and ship conversion efforts to address ADA requirements.
- Vessels that support Federally funded academic research should be equipped and arranged as feasible to accommodate persons with disabilities.
- In turn, procedural guidelines to carry out shipboard operations by persons with disabilities are needed.

ADA Guidelines for RVs

University-National Oceanographic Laboratory System

Tasks:

- Draft Preliminary ADA Guidelines for the Regional Class Acquisition effort. (Need ASAP)
- Convene a Workshop (if needed) to define shipboard and procedural guidelines required to accommodate sea-going scientists with disabilities.
- Establish General ADA Guidelines for new ship construction/conversion.
- Draft procedural guidelines for at-sea research operations by seagoing scientists with disabilities.

ADA Guidelines for RVs
University-National Oceanographic Laboratory System

Membership :

- FIC Member - Terry Whitledge (UAF) [Chair]
- Risk Manager - Dennis Nixon (URI)
- Marine Superintendent & FIC – Al Suchy (WHOI)
- *Langseth* Conversion Rep & FIC – Jim Cochran (LDEO)
- RVTEC Representative – Joe Ustach (Duke)
- Seagoing scientists with disabilities – Amy Bower (WHOI) and Terry Glover (contributing member)
- Ship Master – Eric Buck (SIO)
- UNOLS Safety Committee Rep – Matt Hawkins (UDel)
- David Chapman (UDel)
- Ex-officio members – agency reps

UNOLS Briefing Package

University-National Oceanographic Laboratory System

1) What is UNOLS? Description of UNOLS. Committee structure and tasks. Ships descriptions, distribution, and utilization.
2) Status of the UNOLS fleet today and challenges in terms of:
    1) Funding shortfalls and consequences
    2) Future oceanographic scientific community needs: OOI and IOOS etc.
3) Fleet Renewal – Plans and Status
4) Discussion topics:
    1) How to stay on top of the planning process

Outline of Presentation

University-National Oceanographic Laboratory System

I. Budget Shortfalls and Impact on Future Fleet Operations

II. Academic Fleet Renewal

III. Other UNOLS Activities

IV. UNOLS Committee Activities
    I. RVOC
    II. RVTEC
    III. AICC
    IV. DESSC
    V. MLSOC

RVOC and RVTEC
University-National Oceanographic Laboratory System

Research Vessel Operators' Committee

- Annual Meeting – April, 25-27, 2006 at U. Washington (Deb Kelley guest speaker)
- Issues addressed and activities:
  - Update of Research Vessel Safety Standards
  - Security plans, Safety, and ISM
  - Uniformity for port and EEZ fees (who pays for what – science v.s. operator)
- Alcohol, Drugs, and Sexual Harassment Policies

Research Vessel Technical Enhancement Committee

- Annual Meeting and INMARTECH 2006 – October 16-19, 2006, WHOI
  - Includes session on Advanced Instrumentation and Vehicle Systems.

- Arctic Icebreaker Coordinating Committee
  - HEALY U/W for 2006 Field program
  - AICC providing prioritized recommendations for instrumentation, science support and science space utilization based on debriefs with PI's
  - Starting to think about long term upgrades such as multibeam replacement

DEep Submergence Science Committee

University-National Oceanographic Laboratory System

- Meeting on May 24-25, 2006 at Woods Hole Oceanographic Institution – The agenda includes:
  - Feedback from science users of the National Deep Submergence Facility vehicles
  - NDSF Operator report on vehicle upgrades, improvement plans, schedules, and operations.
  - New Facility Updates:
    - Replacement Human Occupied Vehicle (2009 estimated completion)
    - Hybrid ROV – (Ready for service in 2007)
    - AUV *Sentry*
- Other DESSC Activities:
  - Establishing Criteria for Adding Assets to the NDSF
  - Formed Subcommittee to establish HOV Safety Standards

Marcus Langseth Science Oversight Committee
University-National Oceanographic Laboratory System

- **New UNOLS Standing Committee – Formed in October 2005**

- **Membership:**
  - Dr. Steven Holbrook, U of Wyoming (MLSOC Chair)
  - Dr. Michael Enachescu, Memorial University of Newfoundland
  - Dr. Graham Kent, Scripps Institution of Oceanography, UCSD
  - Dr. Nancy Grindlay, University of North Carolina at Wilmington
  - Dr. Mitch Lyle, Boise State University
  - Dr. Ray Schmitt, Woods Hole Oceanographic Institution
  - Dr. Peter Tyack, Woods Hole Oceanographic Institution
  - Dr. H. Paul Johnson, University of Washington
  - Dr. Peter Littlewood, Shell International Exploration & Production, Inc
  - Dr. Tom Shipley, University of Texas IG

- **First Meeting - 31 May and 1 June at the Shelburne Nova Scotia shipyard. (Joint with ERROC)**

Associated Scientists at Woods Hole
Box 721 3 Water Street
Woods Hole, MA 02543
www.aswh.org

PETITION FOR EXEMPTION

18 November 2004

U.S. Department of Transportation
Docket Management System
400 7th Street, SW.
Room PL 401
Washington, DC 20591–0001

SUBJECT: PETITION FOR GRANT OF EXEMPTION

Pursuant to Section 11.25 of the Federal Aviation Regulation (FAR), Associated Scientists at Woods Hole (ASWH) hereby petitions the Federal Aviation Administration (FAA) for exemption from FAR Section 21.191(g), to the extent necessary to permit ASWH to utilize a Leza-Lockwood AirCam twin-engine, slow-flight aircraft certificated as Experimental, Amateur-Built, for the purposes of scientific research, including environmental monitoring, wildlife conservation, and photographic documentation.

NATURE AND EXTENT OF RELIEF

The use of an Experimental, Amateur-Built aircraft for scientific research purposes will require exemption to FAR Section 21.191(g).

FAR §21.191(g) states, in pertinent part "Operating an aircraft the major portion of which has been fabricated and assembled by persons who undertook the construction project *solely for their own education or recreation*." (Emphasis added)

This relief is requested in order to operate an AirCam aircraft for other than the stated purposes of education or recreation under which an experimental certificate is issued for an amateur-built aircraft, specifically, to operate an AirCam aircraft for scientific research, as described in this petition.

PUBLIC INTEREST

Granting of this petition for exemption to permit the use of an experimental, amateur-built AirCam aircraft for scientific research purposes is in the public interest for reasons of safety, economics, and the conservation of natural resources, including assisting with the recovery of an endangered species.

As with most aspects of science, conservation, and technology, those pursuing it always seek better and more effective ways of doing the work. ASWH developed the use of both blimps and aerostats (tethered balloons) for aspects of scientific research, principally studies on whales and other marine

species. In addition to the foregoing, we began explorations in 2001 to identify and utilize slow-flight aircraft with good station-keeping ability, good observational and photographic capabilities, relatively quiet and unobtrusive operations, excellent safety characteristics, and reasonable cost. This search has led to the AirCam. This aircraft was originally purpose-built for *National Geographic* research and photography in Africa. In June 2001, we participated in a demonstration flight. Since then, we have continued to evaluate this aircraft, including correspondence with current *National Geographic* researchers/photographers/videographers, who have written, "[for your purposes] it is undoubtedly the ideal plane … ."

Based on the successful match of capabilities to requirements, the use of this aircraft in conservation efforts with right whales and other species will be valuable. Built for slow flight, the aircraft's stall speed is 39 mph and V_{yse} is 60 mph. The 912S Rotax engines are equipped with a reduction-drive gear providing more thrust than direct drive, and allowing a lower rotation speed for the three-bladed prop. This coupled with an exhaust muffler system produces minimal noise from the engines. The slow flight, quiet operation, and excellent photo-platform features will greatly improve our ability to obtain the required photo-images and documentation of the highly endangered Right whale while at the same time minimizing potential disturbance to the whales, particularly, in some cases, sensitive situations of mothers and young calves, and other nearby marine wildlife.

A significant percentage of the work we plan to undertake with the AirCam is publicly funded. Thus, more effective use of these funds is in the public interest. For near-shore, short range, localized surveys and photography, the "all-in" cost of operating this aircraft will be less than other aircraft currently in use or available. We know of no other aircraft that combines the features of safety, capabilities, and cost as does the AirCam.

In addition to right whale surveys, we envision application to other wildlife projects (e.g., dolphins, manatees, etc.), atmospheric sampling, and aerial photography of habitat and land use. At the national level, this program will be linked to the Scientific Committee for Oceanographic Aircraft Research (SCOAR) - a subcommittee of the University National Oceanographic Laboratory System (UNOLS), the Network of Airborne Environmental Research Scientists (NAERS), and the Small Environmental Research Aircraft (SERA) program.

EQUIVALENT LEVEL OF SAFETY

Considering the aircraft characteristics, the requested exemption will provide a level of safety equivalent to and in excess of what is authorized for General Aviation or Restricted category aircraft engaged in similar missions.

Aircraft Characteristics. This twin-engine aircraft was originally designed and built for wildlife surveys in Africa over large areas of forest and habitat where emergency landing options are severely limited and the requirement for a high level of safety and reliability was paramount. The AirCam has built-in redundancy, with separate electrical and fuel systems. At 60 mph, the aircraft has an endurance of 6 hours plus reserve. It has a very high horsepower to weight ratio. In flight, the large vertical stabilizer provides excellent control under single-engine operation should it ever become necessary. Unlike most twin-engine aircraft, the checklist to secure the AirCam for single-engine operation is very short and quickly accomplished. Furthermore, the AirCam is capable of not only maintaining level flight on a single engine, but is rated to climb at 300 fpm at gross weight.

Mission Profile. This 2-seat aircraft will be flown by a single pilot with a scientist/photographer in the second seat. Flight duration will be 2 to 4 hrs, typically at altitudes of 750 to 1500 ft, following a pre-defined survey pattern.

Pilot Experience. The pilot will have a commercial certificate with multi-engine and tail-wheel endorsements.

Crew Training. All pilots will undergo initial qualification/orientation training that includes the typical mission profile, slow flight over whales for photography, and complete emergency procedures. Refresher training and orientation will be conducted routinely (e.g., monthly), and emergency procedures will be included in pre-flight checks.

Crew Safety. For all overwater operations, we will be in compliance with FAR 91.205(b)(12) and all persons will wear Mustang survival/float suits. A flare kit will be onboard the aircraft. For missions with distances greater than 5 miles from shore, an EPIRB/ELT will be onboard the aircraft.

SUMMARY

As required by FAR Section 11.25(d), a summary of the petition is as follows:

Associated Scientists at Woods Hole requests an exemption from FAR Section 21.191(g) to permit the use of an AirCam aircraft (experimental category) for purposes of scientific research, including environmental monitoring, wildlife conservation, and photographic documentation.

Sincerely,

James H. W. Hain
Senior Scientist
Associated Scientists at Woods Hole

The twin-engine Leza-Lockwood Air-Cam was designed as a reliable slow-flight observation and photo-imaging airborne platform. It was originally built for use by *National Geographic* researchers Des & Jen Bartlett in Africa for wildlife studies.

Jim Hain – Senior Scientist

Associated Scientists at Woods Hole, Woods Hole, Massachusetts
www.aswh.org
jhain@earthlink.net

Jim Hain received his Ph.D. in biological oceanography from the University of Rhode Island in 1975. He has conducted research from Newfoundland to South America, with emphasis on the U.S. outer continental shelf and coastal habitats of endangered marine mammals. One of his areas of expertise is in aerial surveys, with experience in fixed-wing aircraft, helicopters, blimps, and most recently, with aerostats. He routinely uses statistical analyses and geographic information system (GIS) methods. While with Associated Scientists, Jim has been awarded grants or contracts from the U.S. Army Corps of Engineers, Marine Mammal Commission, Minerals Management Service, National Science Foundation, and the Office of Naval Research. He is a member of the Society for Marine Mammalogy, and serves on the editorial board of *Right Whale News*. In October 1997, he received a Coastal America Award for his research relating to the mitigation of ship strikes on right whales on their wintering calving grounds. Jim is a Senior Member of the American Institute of Aeronautics and Astronautics, and a member of the Experimental Aircraft Association (EAA).

Examples of publications and reports

Hain, J.H.W. and L.E. Harris. 2004. Aerostats for oceanographic and atmospheric research. *Sea Technology* 45(2): 75-80.

Hain, J.H.W. 2000. Lighter-than-air Platforms (Blimps and Aerostats) for Oceanographic and Atmospheric Research and Monitoring. Proceedings Oceans2000 MTS/IEEE Conference, 11-14 September 2000, Providence, Rhode Island.

Hain, J.H.W, S.L. Ellis, R.D. Kenney, and C.K. Slay. 1999. Sightability of right whales in coastal waters of the southeastern United States with implications for the aerial monitoring program. Pp. 191-207, *In*, Marine Mammal Survey and Assessment Methods, G.W. Garner, S.C. Amstrup J.L. Laake, B.F.J. Manley, L.L. McDonald, and D.G. Robertson (eds). A.A. Balkema: Rotterdam, Netherlands.

Hain, J.H.W, S. L. Ellis, R. D. Kenney, B. K. Gray, P. J. Clapham, M. T. Weinrich, and I. G. Babb. 1995. Apparent bottom feeding by humpback whales on Stellwagen Bank. *Marine Mammal Science* 11: 464-479.

Hain, J.H.W, M.J. Ratnaswamy, R.D. Kenney, and H.E. Winn. 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. *Reports of the International Whaling Commission* 42: 653-669.

Hain, J.H.W. 1992. Airships for marine mammal research: Evaluation and recommendations. Publication No. PB92-128271. National Technical Information Service, Springfield, VA. 34 pp.

Associated Scientists at Woods Hole
Box 721 3 Water Street
Woods Hole, MA 02543
www.aswh.org

Associated Scientists at Woods Hole, Inc. (ASWH) is a non-profit 501(c)(3) organization formed for the purpose of enhancing the development and conduct of scientific studies of all kinds. ASWH, established in 1979, is composed of about 12 members that include engineers and scientists from the Woods Hole community. The organization is steered by a six-member board of directors; Mr. Richard H. Campbell is president. Associated Scientists' has promoted multinational marine research in South American waters in cooperation with Spain and the Organization of American States, and has hosted a number of international workshops and visiting scholars. ASWH has in the past provided a stateside office and administrative facilities for the Bermuda Biological Station. ASWH has provided writing, editorial, and publications production services to the Ocean Drilling Program, Texas A&M University; and to the Minerals Management Service, U.S. Department of the Interior. Some of ASWH's activities are, or have been, oceanographic studies of Spanish coastal waters including the Alboran Sea and the continental shelf; studies of volcanology and sea floor processes in the Mediterranean and the Pacific; analysis of marine mammal feeding requirements on the outer continental shelf; R&D on airborne science technology; and studies of right whales, with emphasis on habitat characterization and mitigation of human impacts, off the coast of northeastern Florida.

Board of Directors: (6) Mr. Richard H. Campbell, Dr. James H. W. Hain, Dr. Philip L. Richardson, Mr. F. William Sargent, Dr. Floyd W. McCoy, and Dr. Llewellya Hillis.

Officers: Mr. Richard H. Campbell, president; Dr. Floyd W. McCoy, vice-president; Dr. James H. W. Hain, clerk/treasurer.

Incorporated as a Section 501(c)(3) non-profit in the Commonwealth of Massachusetts 15 March 1979.

ASWH is tax exempt under Massachusetts Department of Revenue # 042-678-301.

ASWH is listed by Dunn & Bradstreet under DUNS # 13-083-4369