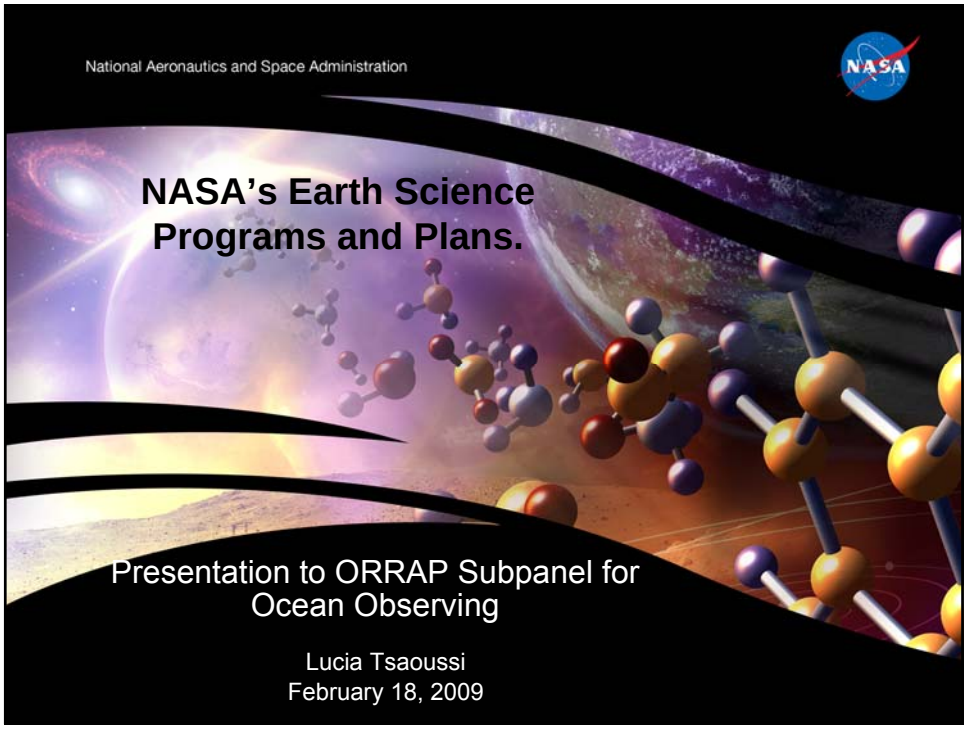
National Aeronautics and Space Administration



NASA's Earth Science Programs and Plans.

Presentation to ORRAP Subpanel for Ocean Observing

Lucia Tsaoussi
February 18, 2009

OUTLINE

NASA's decade-long plans for geophysical data collection and for transitioning science to operations.

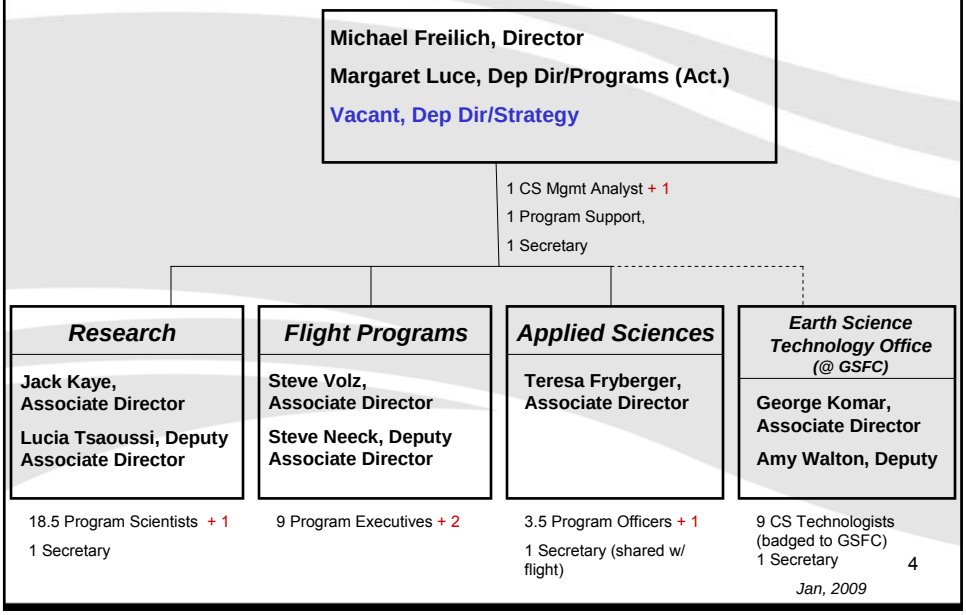
- Program objectives
- Organization and programs
- High-level budget summary
- Mission line-up/summary
- Decadal Survey Missions & Activities
- Research to Operations Transition
- 2006 Workshop Recommendations
- Current Issues

From the ESD Presentations to the NAC Earth Science Subcommittee (ESS) Jan. 7-8, 2009

Earth Science Division Overview

- Overarching goal: to advance Earth System science, including climate studies, through space-based observations, research and analysis, and predictive modeling
- Six major activities:
  - Building and operating Earth observing satellite missions, many with international and interagency partners
  - Making high-quality data products available to the broad science community
  - Conducting and sponsoring cutting-edge research in 6 thematic focus areas
    - Field campaigns to complement satellite measurements
    - Modeling
    - Analyses of non-NASA mission data
  - Applied Science
  - Developing technologies to improve Earth observation capabilities
  - Education and Public Outreach

Earth Science Division



Jan, 2009

Earth Science Budget

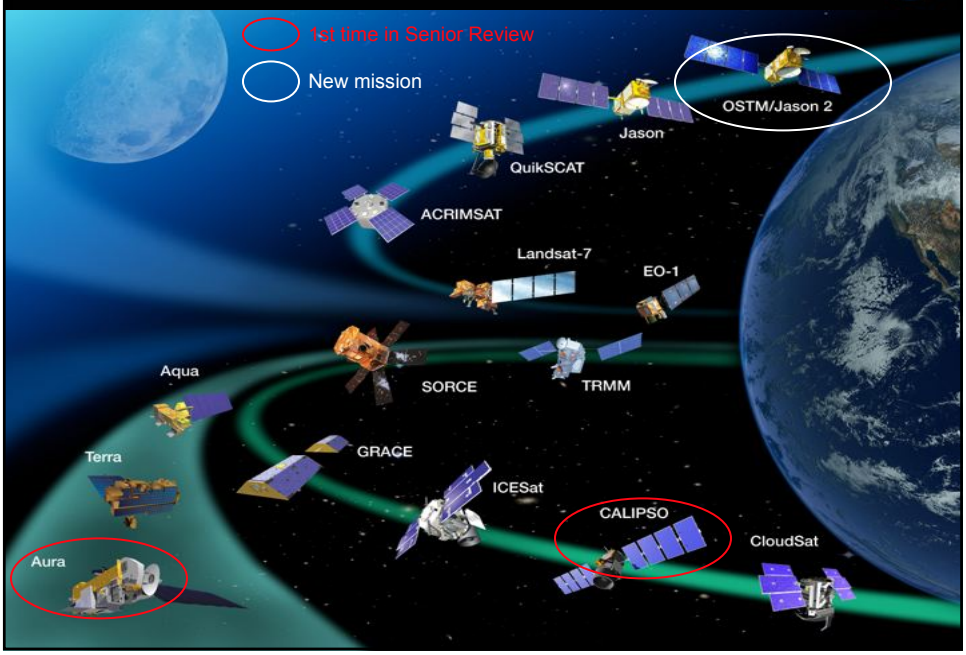
2009 President's Budget Submit + Current FY08 Op Plan

PROGRAM / PROJECT	FY 2008 *	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Earth Science with Directorate Support (matches NASA PBS)	$ 1,240,701	$ 1,367,506	$ 1,350,659	$ 1,250,935	$ 1,264,420	$ 1,290,256
Earth Science w/o Directorate Support (internal budgeting)	$ 1,199,215	$ 1,323,433	$ 1,307,140	$ 1,205,929	$ 1,218,568	$ 1,244,244
Earth Science Research with Directorate Support	$ 361,602	$ 380,554	$ 388,234	$ 390,604	$ 400,676	$ 409,261
Earth Science Research w/o DS	$ 320,116	$ 336,481	$ 344,715	$ 345,598	$ 354,824	$ 363,249
Earth Systematic Missions	$ 546,118	$ 677,915	$ 661,515	$ 583,157	$ 563,588	$ 569,581
Decadal Survey Missions (304029) **	$ 35,994	$ 103,202	$ 116,205	$ 150,042	$ 250,222	$ 290,729
Global Precipitation Measurement (GPM) (378289)	$ 74,351	$ 125,841	$ 161,697	$ 129,759	$ 139,963	$ 113,323
Glory Mission (387055)	$ 82,291	$ 29,672	$ 9,088	$ 9,789	$ 2,717	$ -
Landsat Data Continuity Mission (LDCM) (933126)	$ 127,279	$ 139,380	$ 127,063	$ 96,048	$ 11,311	$ 2,681
NPOESS Preparatory Project (NPP) (935096)	$ 46,110	$ 94,410	$ 46,338	$ 8,620	$ 8,886	$ 9,174
Terra (921266)	$ 33,905	$ 39,120	$ 39,439	$ 41,763	$ -	$ -
Aqua (720817)	$ 32,462	$ 42,573	$ 41,351	$ 42,422	$ -	$ -
Aura (583998)	$ 36,159	$ 38,028	$ 36,328	$ -	$ -	$ -
Earth System Science Pathfinder	$ 106,777	$ 88,592	$ 58,752	$ 37,357	$ 49,980	$ 54,895
ESSP Senior Review Competed Science (013622)	$ -	$ 2,000	$ 3,000	$ 13,500	$ 16,000	$ 17,000
Earth Explorer Future Mission (625978)	$ -	$ -	$ -	$ -	$ 30,000	$ 35,000
Orbiting Carbon Observatory (OCO) (634847)	$ 49,530	$ 25,427	$ 8,971	$ 1,409	$ -	$ -
Aquarius (978481)	$ 33,370	$ 33,802	$ 27,884	$ 5,149	$ 3,980	$ 2,895
Earth Science Multi-Mission Operations	$ 142,991	$ 140,519	$ 159,099	$ 157,938	$ 166,517	$ 170,862
Earth Science Technology	$ 42,985	$ 46,087	$ 49,229	$ 50,556	$ 51,580	$ 52,808
Applied Sciences	$ 40,228	$ 33,839	$ 33,830	$ 31,323	$ 32,079	$ 32,849

NOTES

* FY 2008 represents the current approved 2008 Op Plan.

NASA Operating Research Missions



Operating Missions

Mission	Program Sci	Launch	Phase	Extension to	Oct	Nov	Dec	Comments
TRMM	R. Kakar	11/27/1997	Extended	9/30/2009				
QuikSCAT	E. Lindstrom	6/19/1999	Extended	9/30/2009				Power Control Unit 2 failed; now single string
Terra	G. Gutman	12/18/1999	Extended	9/30/2009				ASTER SWIR remains off
ACRIMSat	D. Anderson	12/20/1999	Extended	9/30/2009				
NMP EO-1	G. Gutman	11/21/2000	Extended	9/30/2009				
Jason	E. Lindstrom	12/7/2001	Extended	9/30/2009				Jason orbit change starts Jan 26
GRACE	J. Labrecque	3/17/2002	Extended	9/30/2009				DLR funding for GRACE ops ends Mar2009
Aqua	R. Kakar	5/3/2002	Extended	9/30/2009				Successful EOPM Review Dec 2-3
ICESat	S. Martin	1/12/2003	Extended	9/30/2009				Laser 2 Operating since Nov 25
SORCE	D. Anderson	1/25/2003	Extended	9/30/2009				
Aura	E. Hilsenrath	7/15/2004	Prime thru 9/10	Ends 9/30/10				HIRDLS autonomous restart attempts continue
Cloudsat	H. Maring	4/28/2006	Extended	9/30/2009				
CALIPSO	H. Maring	4/28/2006	Prime thru 4/09	Ends 4/30/09				Laser transition plan complete; switch Feb 24
OSTM	E. Lindstrom	6/20/2008	Prime thru 6/11	Ends 5/1/09				

OSTM Was launched June 2008
CloudSat, SORCE, and Aqua all completed their primary missions and transitioned into extended mission operations
All missions continue in normal operating mode, with expected normal "wear & tear" showing on them
Significant anomalies during CY2008 included

- Failure of ICESat Laser unit #3 in November
- Loss of redundant Power Control Unit on QuikSCAT in November
- Increasing timing faults on CALIPSO laser, corrected with S/W

We will conduct our third annual Senior Review of our operating missions in April 2009

Technical Assessment Results

Mission	Risk of failure within 2 years	Risk of failure within 4 years	Primary Risk Factor	Age (years) in 2011
ACRIMSAT	Low	Low	Age	13
Aqua	Low	Medium	Spacecraft Operations	9
CloudSat	Low	Medium	Klystron	5
EO-1	Medium	High	Spacecraft	11
GRACE	Low	Low	Age	10
ICESat	Medium	High	Laser	8
Jason	Medium	High	Spacecraft	10
QuikSCAT	Medium	Medium	Spacecraft	13
SORCE	Low	Medium	XPS/SOLSTICE	8
Terra	Low	Medium	SSR	13
TRMM	Low	Low	Age	15

Comments

- **"Age" means there was no overriding failure mechanism identified, but the advancing age placed the satellite at general risk**
- **SORCE SIM and TIM are low risk to continue for 4 years, but the overall mission is at medium risk if XPS & SOLSTICE are critical to mission success**
- **Terra is at medium risk if no operational workarounds are possible for the degrading Solid State Recorder (SSR)**

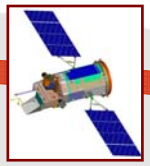
Earth Science Missions in Formulation and Development

NPOESS Preparatory Project[1] Strategic mission - Systematic measurement	Required for continuity of several key climate measurements between EOS and NPOESS
Landsat Data Continuity Mission Strategic mission - Systematic measurement	Required for continuity of long-term global land cover change data; plan for post-LDCM acquisition operational agency in work
Glory Strategic mission - Initiate New Measurement and Continue Systematic Measurement	Addresses high priority objective of the US Climate Change Science Program and provide continuity for total solar irradiance
Orbiting Carbon Observatory Competed mission - Earth System Science Pathfinder	First dedicated global measurement of CO_2 from space
Aquarius[2] Competed mission - Earth System Science Pathfinder	First dedicated global measurement of sea surface salinity from space
Global Precipitation Measurement[2] Initializes a systematic measurement	Extend spatial coverage to global and temporal coverage to every 3 hours with constellation
Soil Moisture Active / Passive First Decadal Survey directed mission	Measurement of global, high-resolution soil moisture and its freeze/thaw state

[1] Represents International Partnership [2] Represents Interagency Partnership

Missions in Formulation and Development

OCO
Feb 23, 2009



GLORY
10/2009 (TBR)

AQUARIUS
5/2010

NPP
12/2010 (TBR)

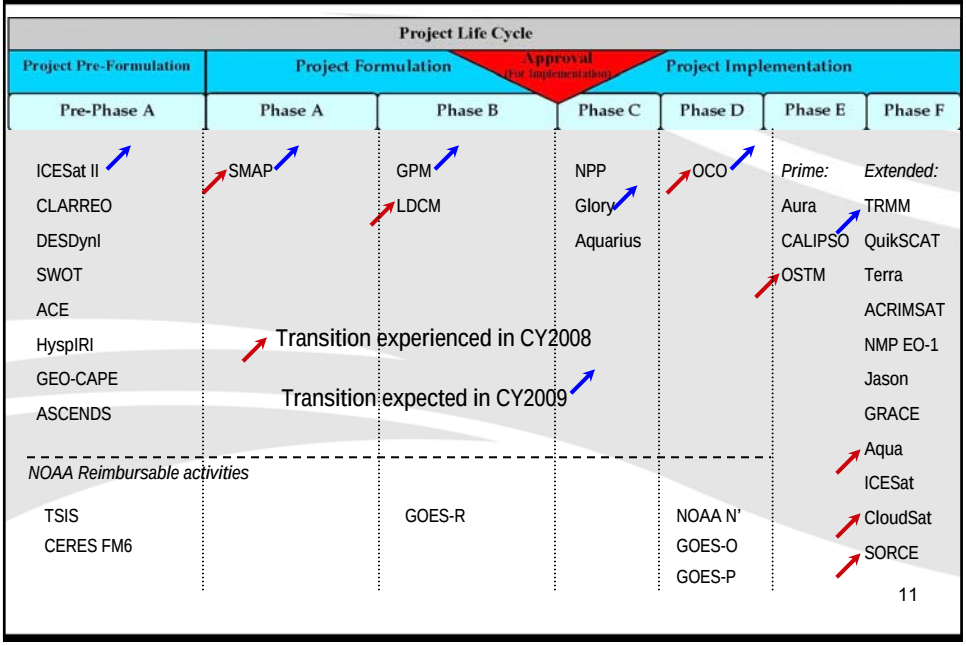
ICESat-II
2014/2015
Still Pre-formulation

GPM
7/2013, 11/2014

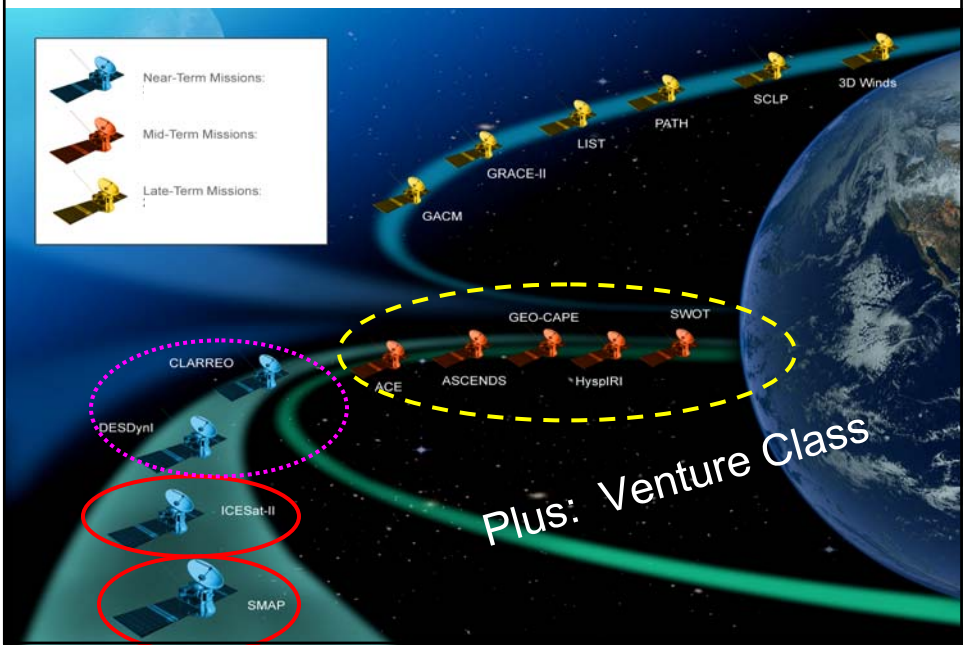
SMAP
2013 (TBR)

LDCM
12/2012

Earth Science Missions in the Life Cycle



Decadal Survey Missions Next Generation



NASA Near-Term Missions (4/15 total)

Decadal Survey Mission	Mission Description	Orbit	Instruments
CLARREO (NASA portion)	Solar and Earth radiation: spectrally resolved forcing and response of the climate system	LEO, Precessing	Absolute, spectrally-resolved interferometer
SMAP	Soil moisture and freeze/thaw for weather and water cycle processes	LEO, SSO	L-band radar L-band radiometer
ICESat-II	Ice sheet height changes for climate change diagnosis	LEO, Non-SSO	Laser altimeter
DESDynI	Surface and ice sheet deformation for understanding natural hazards and climate; vegetation structure for ecosystem health	LEO, SSO	L-band InSAR Laser altimeter

NASA Mid-Term Missions (5/15 total)

Decadal Survey Mission	Mission Description	Orbit	Instruments
HyspIRI	Land surface composition for agriculture and mineral characterization; vegetation types for ecosystem health	LEO, SSO	Hyperspectral spectrometer
ASCENDS	Day/night, all-latitude, all-season CO_2 column integrals for climate emissions	LEO, SSO	Multifrequency laser
SWOT	Ocean, lake, and river water levels for ocean and inland water dynamics	LEO, SSO	Ka-band wide swath radar C-band radar
GEO-CAPE	Atmospheric gas columns for air quality forecasts; ocean color for coastal ecosystem health and climate emissions	GEO	High and low spatial resolution hyperspectral imagers
ACE	Aerosol and cloud profiles for climate and water cycle; ocean color for open ocean biogeochemistry	LEO, SSO	Backscatter lidar Multiangle polarimeter Doppler radar

NASA Far-Term Missions (6/15 total)

Decadal Survey Mission	Mission Description	Orbit	Instruments
LIST	Land surface topography for landslide hazards and water runoff	LEO, SSO	Laser altimeter
PATH	High frequency, all-weather temperature and humidity soundings for weather forecasting and SST*	GEO	MW array spectrometer
GRACE-II	High temporal resolution gravity fields for tracking large-scale water movement	LEO, SSO	Microwave or laser ranging system
SCLP	Snow accumulation for fresh water availability	LEO, SSO	Ku and X-band radars K and Ka-band radiometers
GACM	Ozone and related gases for intercontinental air quality and stratospheric ozone layer prediction	LEO, SSO	UV spectrometer IR spectrometer Microwave limb sounder
3D-Winds (Demo)	Tropospheric winds for weather forecasting and pollution transport	LEO, SSO	Doppler lidar

*Cloud-independent, high temporal resolution, lower accuracy SST to complement, not replace, global operational high-accuracy SST measurement

Mission Requirements for Pre-Phase A

Scope of Major Pre-Phase A Activities:

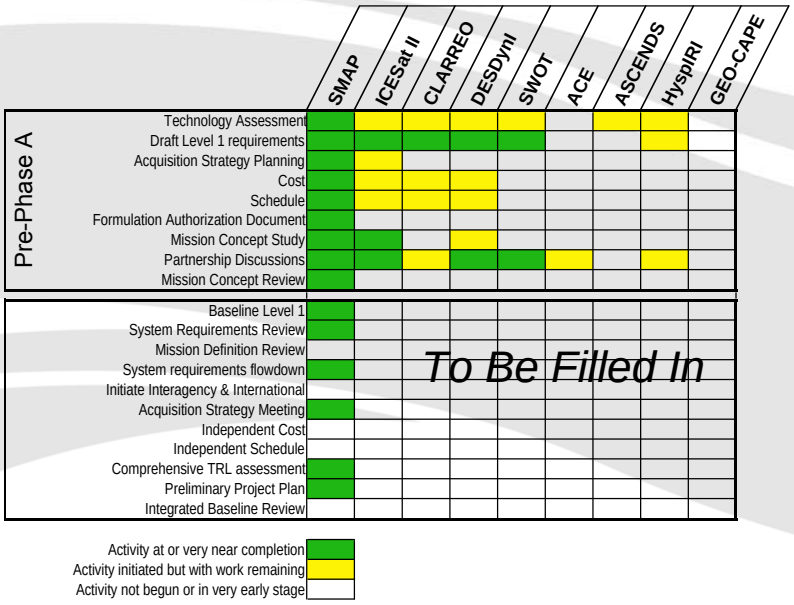
Headquarters
Approve a Formulation Authorization Document
Develop DRAFT Level 1 Requirements
Conduct Acquisition Strategy Planning Meeting
Technical Activities:
Develop and document preliminary mission concepts
Conduct internal Reviews
Conduct Mission Concept Review Project Planning, Costing and Scheduling
Develop and document a DRAFT Integrated Baseline, including:
- High level WBS
- Assessment of Technology Readiness Levels
- Assessment of Infrastructure and Workforce needs
- Identification of potential partnerships
- Identification of conceptual acquisition strategies for proposed major procurements

KDP Readiness
Obtain KDP A Readiness products
Approval through the governing PMC

Areas the Science Community must work:

Development of Level 1 Science Requirements
Support development of preliminary mission concepts
Support the assessment of Technical Readiness Levels
Identify potential partnerships

Where are we now?



Start and Expected End points vary with DS Tier

For Near-Term, Tier 1 missions

- **Build on the Science workshops of 2007**
- **Conduct focused studies, analyses, partnership investigations**
- **Establish science study teams, first with ad hoc and then with competitively selected Science Definition Teams (SDT)**
- **Conduct Mission Concept Review by close of FY09**

For Mid-Term, Tier 2 missions

- **Build on the results of the in-house mission studies**
- **Conduct Science workshops**
- **Establish mission study teams, with ad hoc Science study teams led by NASA but including Academia**
- **Determine the mission readiness to proceed to Phase A**

For Late-Term, Tier 3 missions

- **Utilize Earth Science Technology Office (ESTO) calls to advance the technology readiness of the measurement technique, and**
- **Leverage off science and mission definition development activities Tier 1 and 2 mission activities**

DS Mission Concept Development

All named Decadal Survey missions are Strategic, directed missions

- Mission management will be assigned to a Facility (almost always a NASA Center)
- Venture Class missions and ESTO technology initiatives are competed and will be addressed later in this presentation

During Pre-Phase A activities the study teams will allocate their energies and resources to address the mission development data products as identified earlier

Elements of the missions will be competed, some hardware built in house and other procured or developed in partnership with industry. Possible competed elements should include but are not limited to:

- Science Definition Teams
- Instruments
- Spacecraft (through RFP or RSDO approach)

NASA Community Engagement

Date	Mission	Subject	Location	Contacts	
June 5-6	DESDynI	Science Steering Committee	Greenbelt, MD	John LaBrecque	john.labrecque@nasa.gov
June 19-20	ACE	Opening Science Workshop	Greenbelt, MD	Hal Maring	hal.maring@nasa.gov
July 23-25	ASCENDS	Opening Science Workshop	Ann Arbor, MI	Ken Jucks	kenneth.w.jucks@nasa.gov
August 18-20	GEO-CAPE	Opening Science Workshop	Chapel Hill, NC	Ken Jucks	kenneth.w.jucks@nasa.gov
October 21-23	CLARREO	Science Working Group Mtg	Washington, DC	Don Anderson	donald.anderson-1@nasa.gov
October 21-23	HyspIRI	Opening Science Workshop	Pasadena, CA	Woody Turner	woody.turner@nasa.gov
October 29-31	DESDynI	Applications Workshop	Sacremento, CA	Steve Ambrose	sambrose@nasa.gov
December 18	DS Tier 1 & 2	Decadal Survey Town Hall	San Francisco, CA	Steve Volz	svolz@nasa.gov
January 26-28, 2009	SWOT	Science Workshop	Paris, France	Eric Lindstrom	eric.j.lindstrom@nasa.gov
February 11-12, 2009 (TBR)	DS Tier 1 & 2	Decadal Survey Implementation Update	Washington, DC	Steve Volz	svolz@nasa.gov

- **NASA is conducting the definition studies with science community involvement welcomed and desired**
- **Most meetings are open, some are not. But all progress is being reported on the individual mission websites**
- **NASA is actively engaging the broad science and research communities to help definitize the objectives of the Decadal Survey mission concepts**
- **The Program Scientist for each mission is the primary POC for questions related to science requirements and objectives**
- **The Program Executive is POC for all mission development execution**

Management and Budget Allocations

We are doing Tier 1 missions first

- Of the Tier 1, SMAP and ICESat II were identified as the first two missions because of technology and mission concept maturity
- CLARREO and DESDynI will be the next two following ICESat II and SMAP

We will fund the Tier 2 missions at a lower level, but still significant level.

- All five tier 2 missions currently are funded at an equal level, as we assess their mission readiness.
- At the end of FY09 we will make the initial sequencing of the Tier 2 missions

The available funding for FY10 and beyond will strongly influence this prioritization.

Earth Science Division Budget & Decadal Survey

PROGRAM / PROEJCT	FY 2008	FY 2009	FY 2010
ESD 2010 PPBE Request	$ 1,209,554	$ 1,326,638	$ 1,297,073
Earth Science Research (without DS)	$ 320,396	$ 333,267	$ 332,079
Earth Systematic Missions	$ 537,157	$ 691,635	$ 669,573
Decadal Survey Missions (304029)	$ 16,793	$ 37,214	$ 13,745
DESDynI	$ 1,500	$ 5,000	TBD
CLARREO	$ 1,500	$ 5,000	TBD
ACE	$ 400	$ 2,000	
ASCENDS	$ 400	$ 2,000	
GEO-CAPE	$ 400	$ 2,000	
SWOT	$ 400	$ 2,000	
HyspIRI	$ 400	$ 2,000	TBD
Cross Cutting Activities	$ -	$ 2,000	TBD
SMAP	$ 9,600	$ 49,300	$ 80,500
ICESat II	$ 9,600	$ 18,000	$ 13,984
Earth System Science Pathfinder	$ 111,797	$ 83,103	$ 66,767
Venture	$ -	$ -	$ -
Earth Science Multi-Mission			
Earth Science Technology			
Advanced Technology Initiatives	$ 7,875	$ 8,325	$ 8,961
Instrument Incubator	$ 24,939	$ 25,866	$ 28,235
Advanced Info Systems Technology	$ 11,671	$ 11,896	$ 9,033
Applied Sciences	$ 42,728	$ 34,539	$ 32,480

These are included in FY DS Missions total

All figures in $K

The Venture Program funding starts in FY12 in the current budget. We are funding the initial Venture AO development with existing funding.

Venture Class Mission line

Venture missions will be aligned to the recommendations of the National Academy of Science 2007 Decadal Survey:

Restore more frequent launch opportunities

Foci:

- Measurement and observation innovation
- Demonstration of innovative ideas with potentially higher-risk technologies
- Establish new research avenues
- Demonstrate key application-oriented measurements

May include:

- stand-alone missions that use simple, small instruments, spacecraft, and launch vehicles;
- more complex instruments of opportunity flown on partner spacecraft and launch vehicles; or
- complex sets of instruments flown on suitable suborbital platforms

"…Key to the success …will be maintaining a steady stream of opportunities for community participation in the development of innovative ideas, which requires that strict schedule and cost guidelines be enforced …" [Decadal Survey]

Implementation of Venture Mission Line

Venture will address **exploratory** science and open to all science areas (not the "named" missions that are covered by the Earth Systematic Missions program)

Venture Class will include the following programmatic features:

- Yearly calls as recommended by the NRC decadal survey
- AO driven, competitively selected, PI-led projects, with science potentially be open to all earth science themes
- Optimal mix of sub-orbital, instrument and orbital mission opportunities, alternating between orbital and sub-orbital for yearly calls
  - Multiple sub-orbital awards executed within same yearly budget
- Completion schedule required in less than 5 years from award
- Projects will be cost capped
  - Key Decision Points will gauge performance *and continued funding*
  - Total orbital mission project Life Cycle Cost of $100M - $200M

Space-based calls will allow possible overlaps with decadal survey strategic missions, if they meet the other criteria (innovation, cost, schedule and science driven)

Current budget indicates a first orbital launch of NET 2014, but we are developing the AO to be ready for release in FY2009.

Tier 1: SMAP and ICESat II

SMAP, implemented out of JPL

Completed to Date

- Transition review to Formulation (KDP A) September 12, 2008
- Science Definition Team competitively selected

Planned for FY09

- Acquisition strategy definition - January 2009
- Initial Confirmation Review (ICR) targeted for mid 2009

ICESat II, implemented out of GSFC

Completed to Date

- Science Definition Team selected
- Draft level 1 science requirements completed
- RFI for lidar approaches conducted with industry

Planned for FY09

- Mission Concept Review (MCR) & KDP-A in Spring 2009
- Initial Confirmation Review targeted for late 2009

Tier 1: DESDynI and CLARREO

CLARREO, implemented out LaRC

Completed to Date

- Science requirements workshop - Oct 2008
- Draft level 1 requirements & initial partnership discussions, Fall 2008

Planned for FY09

- Initial mission concepts, Spring 2009, MCR October 2009
- Science Definition Team call - summer 2009
- MCR - September 2009

DESDynI, implemented out of JPL

Completed to Date

- Mission configuration study (with ICESat II) - Oct 2008
- Draft level 1 requirements - December 2008
- DLR partnership TIMs - July & November 2008

Planned for FY09

- Radar configuration downselect - January 2009
- Single vs dual platform downselect - February 2009
- MCR September 2009
- Science Definition Team call - summer 2009

Tier 2: HyspIRI and ACE

HyspIRI

Completed to Date

- Science workshop - October 2008
- Partnership discussions initiated

Planned for FY09

- Draft level 1 requirements development
- HyspIRI workshop - August 2009
- MCR target - December 2009

ACE

Completed to Date

- Science team development meetings - June & November 2008
- Partnership discussions with JAXA - October 2008

Planned for FY09

- Initial instrument complement OSSEs conducted
- MDL & Team X studies - summer 2009

Tier 2: ASCENDS, SWOT, GEO-CAPE

ASCENDS

Completed Science workshop - August 2008

Planned for FY09

- OSSE & preliminary level 1 requirements development
- TBD field campaign

SWOT

Completed to Date

- Multiple mission & science studies (water storage, orbit config, wet troposphere, ..)
- Draft level 1 science requirements
- CNES partnership discussions

Planned for FY09

- Ground data system requirements
- MCR readiness - September 2009

GEO-CAPE

Completed Science Workshop - August 2008

Planned for FY09

- Hosted payload options study
- Draft level 1 requirements
- Instrument capability studies

Cross Cutting Mission & Science Studies

In addition to the the individual mission configuration and implementation studies, we are starting several investigations with potential cross mission applicability.

Current list, frequent updates coming

1. Downlink and Ground Network requirements analysis and assessment
2. Data standards/guidelines and Data System planning
3. EOS Ground System requirements (mission operations and data processing/distribution) – use results of 1) above to assess necessary upgrades and evolution path from the current ESDIS and ESMO facilities & operations to the required future system
4. Geodetic Network capabilities and DS-driven requirements
5. Common spacecraft architecture
6. Common launch vehicle interface and access issues
7. Constellation opportunities and potential requirements on individual DS missions

ESTO Technology Investments

Since 2007, and the release of the Decadal Survey, all three components of the ESTO program have been redirected to focus on Decadal Survey missions, measurements and technologies

As a result, 57 technology projects have been competitively selected, with a three year investment of $105M

The products from these investments will be felt in all Tier 2 and Tier 3 missions, and even in some Tier 1 missions (CLARREO & DESDynI)

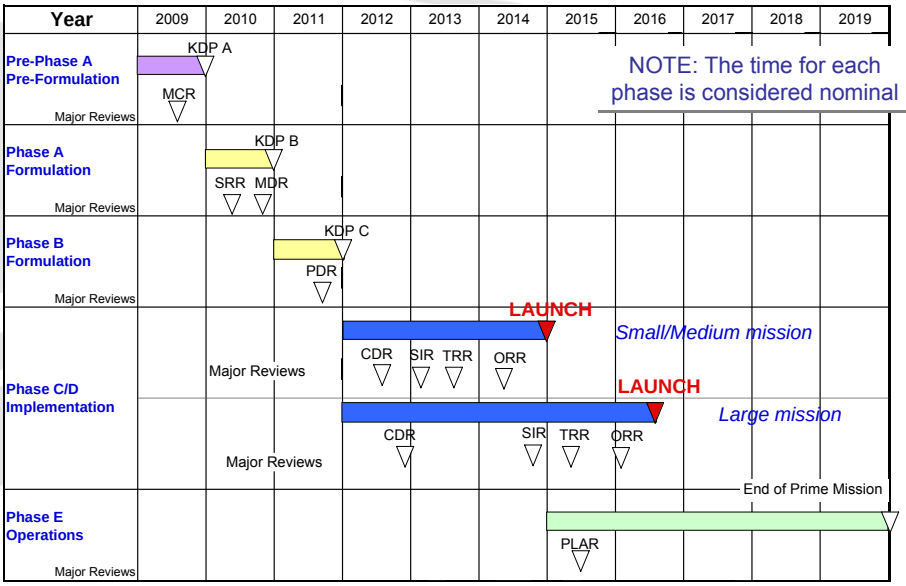
Mission Study Results

* Updated to FY07 $

Missions	NASA ESD Study Costs*	Decadal Survey Cost*	Delta (%)
CLARREO	437.0	206.4	112%
SMAP	393.5	309.6	27%
ICESat-II	607.0	309.6	96%
DESDynI	760.0	722.4	5%
HysplRI	452.0	309.6	46%
ASCENDS	473.0	412.8	15%
SWOT	698.0	464.4	50%
GEO-CAPE	1276.2	567.6	125%
ACE	1627.9	825.6	97%
LIST	609.9	309.6	97%
PATH	521.0	464.4	12%
GRACE-II	471.4	464.4	2%
SCLP	512.0	516.0	-1%
GACM	1036.9	619.2	67%
3D-WINDS	797.7	670.8	19%
Total:	**10673.5**	**7172.4**	**49%**

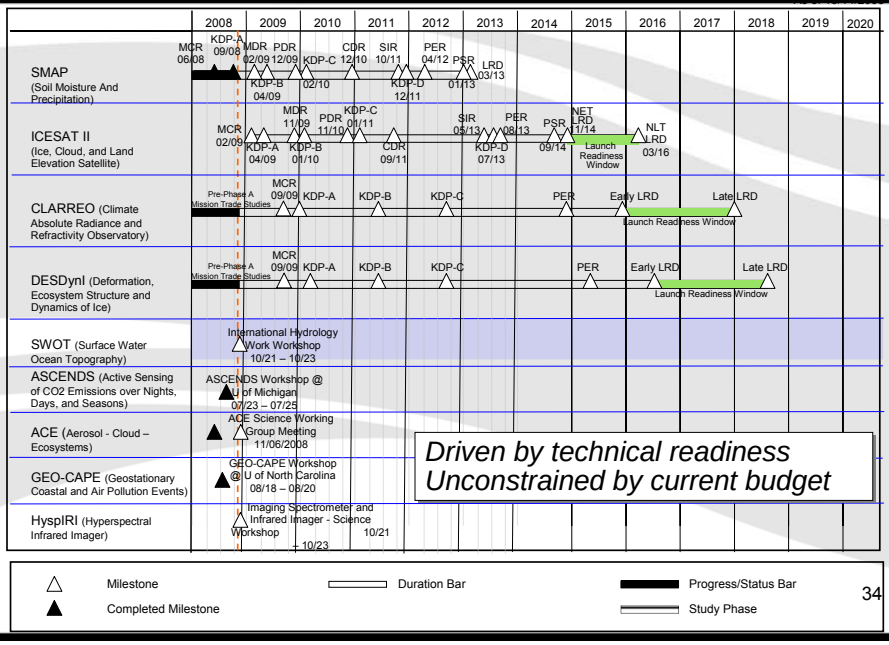
NASA Earth Science analyses and the Decadal Survey assessments used very different input assumptions

Notional Mission Timeline



Tier 1 & Tier 2 Notional Mission Readiness:

When could we be ready to fly?



R2O Transition Process

Executive Coordination, NASA - NOAA Roundtable

- Co-chairs: NASA ESD Director + NOAA AA NESDIS
- Oversight of NASA-NOAA Joint Working Group on Research and Operations (established in response to Section 306(c) of 2005 NASA Authorization Act)
  - JWGR2O Co-chairs: NASA ESD Associate Director for Research + NOAA Climate Program Director
- January 2008, Roundtable selected satellite nadir altimetry sea surface topography measurement capability to be the first demonstration of a transition of a successful NASA satellite measurement capability to NOAA for operational utility to achieve NOAA's mission
- Ocean vector winds and ocean color are additional satellite measurement capabilities suitable for R2O transition
- R2O activities are transmitted annually to Congress in a joint NASA and NOAA report on NASA and NOAA coordination (Section 306(b) of 2005 NASA Authorization Act)

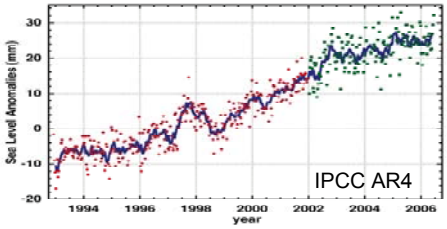
R2O Transition Candidate

A NASA-proven satellite measurement capability, including associated ground systems and data product generation and utilization

Operational implementation by NOAA of a NASA-proven satellite measurement capability

Operational implies that the observational capability in question has been justified in terms of meeting NOAA mission needs and is in the process of being implemented by NOAA on a sustained and systematic basis, well beyond that associated with a single mission

R2O: Satellite Nadir Altimetry Sea Surface Topography Measurement Capability



- TOPEX/Poseidon
  - Aug 1992 - Oct 2005
  - NASA, CNES
- Jason
  - Dec 2001 - present
  - NASA, CNES
- OSTM/Jason-2
  - Jun 2008 - present
  - NASA, CNES, NOAA, EUMETSAT
  - Oct 2008, NOAA operates Jason-2
  - Dec 2008, NOAA distributes operational data products
  - NASA provided 3 instruments and launch vehicle
  - NASA supports scientific studies
- Jason-3
  - Launch Readiness Date, tbd
  - NOAA, EUMETSAT, CNES, NASA
  - NASA will continue to support scientific studies

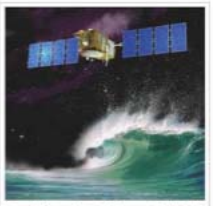
NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

Jason-2 Satellite Data to Help NOAA Track Global Sea Level

May 20, 2008

A new satellite set to launch next month will monitor the rate of sea-level rise and help measure the strength of hurricanes, according to a leading NOAA scientist.

At a press briefing today, Laury Miller, chief of NOAA's Laboratory for Satellite Altimetry, said NOAA will use data from the Jason-2/Ocean Surface Topography Mission (OSTM) to extend a 15-year record from two earlier altimeter missions that currently show sea level is rising at a rate of 3.2 mm/year — nearly twice as fast as the previous 100 years. "This rate, if it continues unchanged over the coming decades, will have a large impact on coastal regions, in terms of erosion and flooding," said Miller.



Jason-2/Ocean Surface Topography Mission (OSTM).
High resolution (Credit: NOAA)

The Jason-2/OSTM is scheduled for lift off June 15 at 1:47 a.m. from Vandenberg Air Force Base, Calif. The spacecraft is a joint, international effort between NOAA, NASA, France's Centre National d'Etudes Spatiales (CNES), and the European Organisation for the Exploitation of Meteorological Satellites (Eumetsat).

Like its predecessor missions TOPEX/Poseidon and Jason-1, Jason-2/OSTM is designed to extend the climate data record by providing a long-term survey of Earth's oceans, tracking ocean circulation patterns and measuring sea-surface heights and the rate of sea-level rise. These are all key factors in understanding climate change.

The satellite will use a radar altimeter instrument attached to it and fly in a low Earth orbit allowing it to monitor 95 percent of Earth's ice-free oceans every 10 days.

In addition to detecting climate change factors, Jason-2/OSTM will also be used in the prediction of short-term, severe weather events, such as hurricanes and tropical storms. According to Miller, NOAA will use the altimeter measurements to monitor ocean conditions that trigger changes in the strength of tropical cyclones, as they move over the ocean towards the land. The technique involves mapping the ocean heat content — the fuel that feeds a storm's intensity — along the storm's predicted track.

"Using data received in earlier altimeter missions during hurricanes with wind speeds in excess of 155 miles per hour, we've been able to reduce our intensity prediction error by an average of five percent – and in some cases as much as 20 percent," Miller said. "If we increase the accuracy of intensity predictions, we help save lives."

Recommendations for NASA on Regional Needs for Coastal Remote Sensing

Workshop October 3-5, 2006

Immediate actions:

- *Pursue technology development and implementation to ensure that there are high data volume telecommunication capabilities for transmitting data to the RAs;*

ESTO competitive program component Advanced Information Systems Technology (AIST) pursues technology development, particularly suited to the next generation of ES missions (generally solicited every 3 years).

The primary objective of the Advancing Collaborative Connections for Earth System Science (ACCESS) program is to enhance, extend and improve existing components of NASA's distributed and heterogeneous data and information systems infrastructure.

1. **The ACCESS program supports the deployment of data and information capabilities that enable the freer movement of data and information within our distributed environment of providers and users. This often requires the utilization of needed tools and services to aid in making measurable improvements of Earth science data access and data usability.**
2. **ACCESS projects increase the interconnectedness and reuse of key information technology software, techniques and services underpinning the advancement of Earth science research.**
3. **The ACCESS solicitation is offered once every two years and funds 10-15 projects per solicitation.**
4. **Recent ACCESS selected project: Earth Science Datacasting: Informed Data Pull and Visualization**
   (Bingham, Andrew / JPL) : This project has developed an online data subscription service designed to support physical oceanography research. Using RSS (Really Simple Syndication – a technology used commonly for news and reporting) this tool allows ocean researchers to pull data sets of interest to their local computer. Once a 'feed' has been established the science user is alerted to new data as it becomes available.

Recommendations for NASA on Regional Needs for Coastal Remote Sensing

Workshop October 3-5, 2006

Immediate actions:

- ***Support research and development of remote sensing based climatologies;***

MEaSURES program competes every 5 years for the development of Remote sensing Earth System Data Records (ESDRs) including Climate Data Records, providing the research community with data products as part of the NASA data holdings for wide use and distribution.

Mission and Measurement Science Teams, competitively selected generally every 3 years: particularly the Terra and Aqua Science Team, NPP science team.

Active research on enhanced retrievals of altimetry and OVW in coastal regions to recover a climatology.

- ***Ensure archiving capabilities satisfy the requirements/needs of the RAs;***
- ***Provide representation to regional meetings organized by the RAs to address the needs of users for satellite data and data product;***

NASA will pursue venues for communicating RA requirements, e.g. applied sciences program.

- ***Support improved communication and coordination of information and existing activities/projects within and between agencies and RAs vis-à-vis remote sensing by participating on the IOOS RS Technical Committee discussed above;***

Committee not formed?

Recommendations on Regional Needs for Coastal Remote Sensing

Workshop October 3-5, 2006

Immediate actions:

- ***Work with NOAA and other partners to facilitate the transition of successful R&D technologies for use in operations and other applications.***

NASA/NOAA Round Table is meeting regularly and a robust R2O activity is supported by both agencies (Congressional reports)

Research to Operations transition an active area of consideration and participation across all Decadal Survey mission studies.

Joint Center for Satellite Data Assimilation (JCSDA)

- Focus on 2-10 days global weather forecast & data assimilation

Short-term Prediction and Research Transition (SPoRT) Center

- Focus on 0-24 hours local to regional forecast

Direct Broadcast (DB), Direct Readout

- Focus on real time and near real time data processing and dissemination

Acceleration of Operational Use of Research Data (ROSES 2007 NRA element AOU)

- Focus on transition of research data into operational environment

National Aeronautics and Space Administration

The Joint Center for Satellite Data Assimilation:

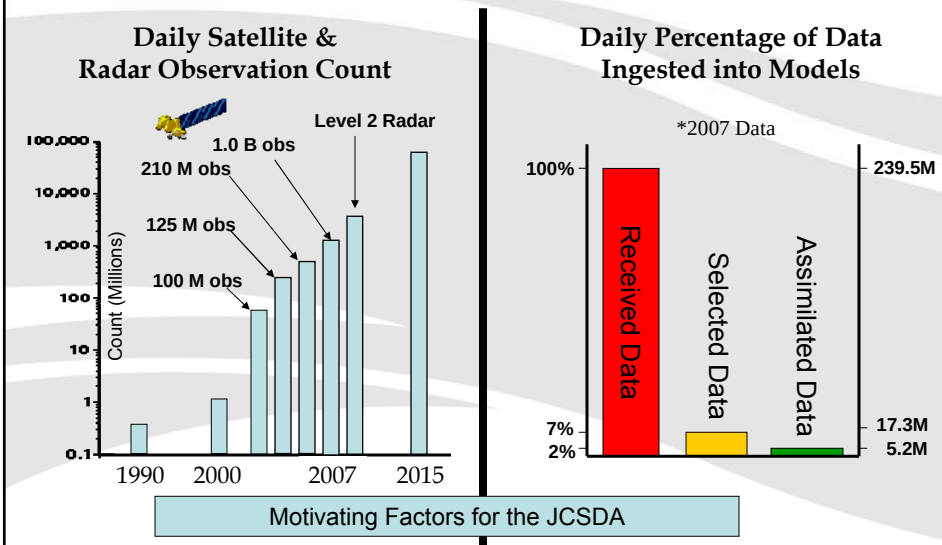
A Research to Operations transition organization

Lars Peter Riishojgaard
Director, JCSDA

JCSDA mission:

…to accelerate and improve the quantitative use of research and operational satellite data in weather, ocean, climate and environmental analysis and prediction models.

JCSDA Satellite Data Ingest



Motivating Factors for the JCSDA

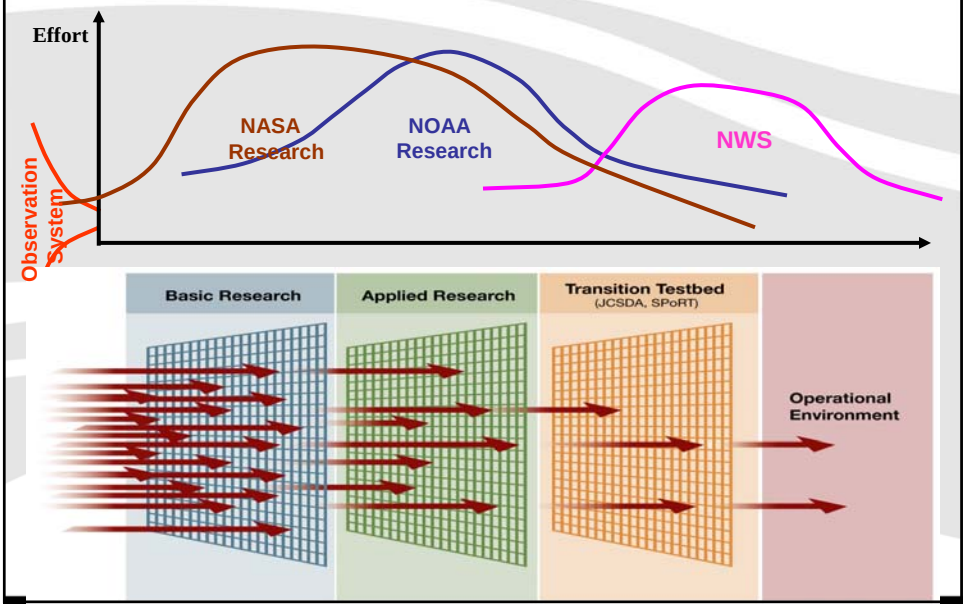
Five Order of Magnitude Increases in Satellite Data Over Fifteen Years (2000-2015)

Received = All observations received operationally from providers
Selected = Observations selected as suitable for use
Assimilated = Observations actually used by models

NASA-NOAA-DOD Joint Center for Satellite Data Assimilation (JCSDA)

- **NOAA, NASA, DOD partnership**
- **Mission**
  - **Accelerate and improve the quantitative use of research and operational satellite data in weather and climate prediction models**
    - **Current generation data**
    - **Prepare for next-generation (NPOESS, METOP, research) instruments**
- **Supports applied research**
  - **Partners**
  - **University, Government and Commercial Labs**

Roles in the R&O Process



A.15 of ROSES 2007 Accelerating Operational Use of Research Data

Program Element Science/Scope: Weather and Climate, Ecological Forecasting

This solicitation offers investigators an opportunity to collaborate with the operational centers to analyze, assess, and increase the impact of NASA data in the operational environments (e.g., models), particularly in the areas of weather, climate and ecological forecasting (e.g., fisheries).

1.2 Weather and Climate

To accelerate and improve the quantitative use of research and operational satellite data in weather, climate, ocean and environmental analysis, and prediction models.

Enhancing the scope of the JCSDA and SPoRT centers, focusing on the final phases of the transition process.

Providing an opportunity for scientists to work with operational centers on the transition of research results into the operational environment.

1.3 Ecological Forecasting

Advance existing ocean ecological forecasts by assimilating multi-scale physical, chemical, and ecological remotely sensed observations in to regional and global ecosystem models.

Blend use of global remote sensing and observational data across ecologically relevant scales (in prediction)

Assimilation of existing observational databases and new observations and insights in to ecological forecasts, to advance the state-of-the-art in ecological modeling and forecast potential.

A.15 of ROSES 2007 Accelerating Operational Use of Research Data

Requirements

To be of interest, studies must take advantage of unique NASA capabilities and/or make substantial use of remote sensing observations.

Proposers must identify prior research results, data, models, etc. that show the potential positive impact of the NASA research data on operational forecasts. Citations should be included.

Transition to Operational Centers – proposers must identify a clear and direct connection with an operational center; letters of support are required to verify participation of and resource requirements (costs) for the centers to be involved

Transition Schedule – proposers must include a schedule that identifies the timeline to full transition of NASA research data to an operational center (two-year limit)

A.15 of ROSES 2007 Accelerating Operational Use of Research Data

Schedule of Events

Solicitation Released: 16 February 2007

Total Available Funding: up to $2.5 M total; up to $750K for each of two program sub-elements

Proposals Due: 18 September 2007

Duration of Awards: 2 years

Received 16 proposals total

Accelerating Operational Use of Research Data: Weather, Climate, and Ecological Forecasting

PI	PI Institution	Partners	Issue	Key Data Set(s)
William Rossow	The City University of New York/The City College	NCDC	Continue a cloud climate data record at climate data center	ISCCP
Jorge Vazquez	JPL	SPoRT & WFOs in NWS Southern Region	Short-term marine weather forecast	GHRSST-PP
Alyn Lambert	JPL	JCSDA, NCEP, GMAO	Medium-range weather forecast	AURA MLS
Victor Zlotnicki	JPL	NOAA NWS OPC and	Tropical analysis and hurricane forecast Hurricane center	altimetry
Andrew Thomas	University of Maine	Atlantic States Marine Fisheries Commission (ASMFC)	Lobster Settlement Forecasting in the Gulf of Maine	QuikScat, MODIS, AVHRR
Hongsheng Bi	NOAA - Fisheries (Oregon State University)	NOAA Fisheries	ecological forecasts of salmon returns in the northern California Current off Washington and Oregon	SSH & SST

Recommendations for NASA on Regional Needs for Coastal Remote Sensing

Workshop October 3-5, 2006

Longer-term actions:

- Develop and launch in the earliest possible timeframe the next generation R&D ocean missions that will provide greater understanding of processes and phenomena in coastal regions through new and improved (e.g., increased spatial, temporal, spectral resolution) observations, including:
  - The "SWOT" mission concept identified in the NRC Decadal Survey (NRC, 2007) for improved measurements of sea level, circulation, river discharge, and bathymetry in coastal regions;
  - The Geostationary Hyperspectral Imaging Radiometer concept identified in the (draft) advance plan of NASA's Ocean Biology and Biogeochemistry Research Program, or the related "GEOCAPE" mission concept in the NRC Decadal Survey (NRC, 2007);
  - The Multi-Spectral High Spatial Resolution Imager concept identified in the (draft) advance plan of NASA's Ocean Biology and Biogeochemistry Research Program, or the related "HyspIRI " mission concept in the NRC Decadal Survey (NRC, 2007), assuming the latter has suitable specifications for aquatic applications;

These are all in pre Phase A studies – Tier 2 missions

Recommendations for NASA on Regional Needs for Coastal Remote Sensing

Workshop October 3-5, 2006

Longer-term actions:

- ***Develop and utilize sub-orbital platforms and instruments for coastal investigations, including as identified in the (draft) advance plan of NASA's Ocean Biology and Biogeochemistry Research Program;***

GASEx participation last year and ROSES 2009 solicitation for field campaign to study biology and biogeochemistry of the Arctic ocean.

- ***Pursue technology development and research investigations into microwave and LIDAR remote sensing approaches to provide novel and improved coastal observing capabilities;***

Joint solicitation in ROSES2007 with the Suborbital program -- award had been tentatively given to the JPL's ocean color scanner sensor the Portable Remote Imaging SpectroMeter (PRISM) for Ocean Biology research. Currently is under negotiation for cost and technical ability to meet the goals of the ROSES call. Analysis is related to the need to make the atmospheric corrections and if a SWIR capability is required. The budget is $3.5M over 4 years.

Director's Top Issues

Long-Term data acquisition to support ESD research
- NPOESS status and evolution
- NOAA interactions/cooperation

Decadal Survey recommendations (not simply missions)

Launch Vehicle availability (access to space)

Mission cost evolution and control

BACKUP

Where do we expect to be by October 1, 2009?

For each of the Tier 1 and Tier 2 missions in the DS:

- Into Phase B for SMAP
- Into Phase A for ICESat II
- Ready to go into Phase A for CLARREO and/or DESDynI, with a quantitative assessment of the readiness to proceed to Formulation
  - Draft level 1 science requirements, baseline mission concept, draft formulation authorization document, partnership evaluations, technology readiness level assessments
- Mission maturation plan for FY10 and beyond, through launch and ops
  - Life Cycle Cost, independent cost and schedule estimates

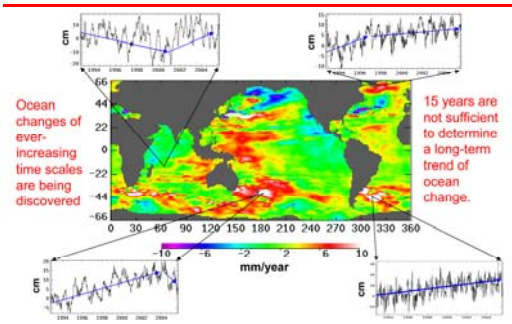
Decadal Survey *Program* assessment, including:

- Cross cutting mission analyses, constellation measurement requirements, ground systems, platform, and ground networks

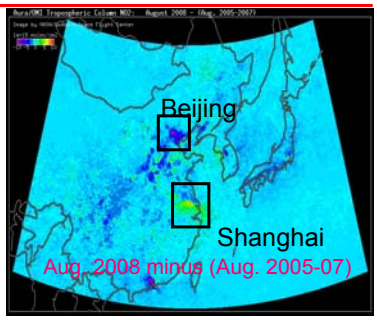
Definition of scope and implementation approach for the Venture Class of small mission opportunities

- Groundwork completed to have released first AO for suborbital science (budget driven for actual release)

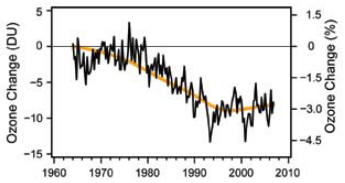
Examples from the Research Program



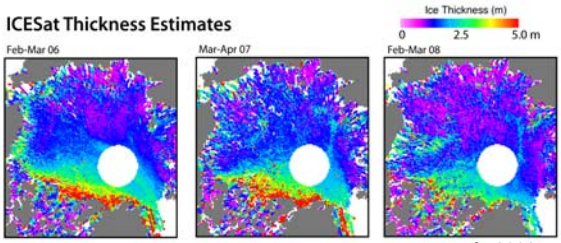
Fu et al., 2008



Witte et al., 2008



Kurylo et al., 2008

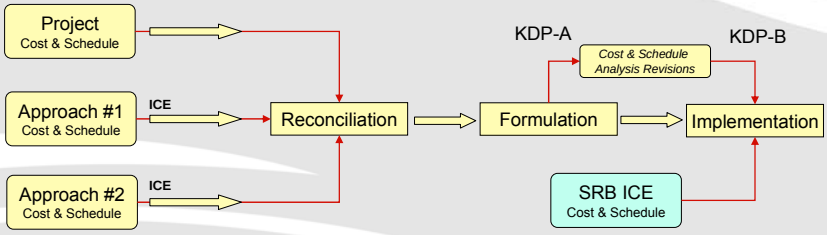


Kwok, 2008

Cost & Schedule Analysis Approach

Each mission team will develop a grass roots Life Cycle Cost, based on the implementing Center principles, monitored and approved by NASA HQ

The ESD, working through the Earth Systematic Mission (ESM) program office, will conduct parametric ICE to augment the grass roots assessment and to improve the overall Decadal Survey program planning

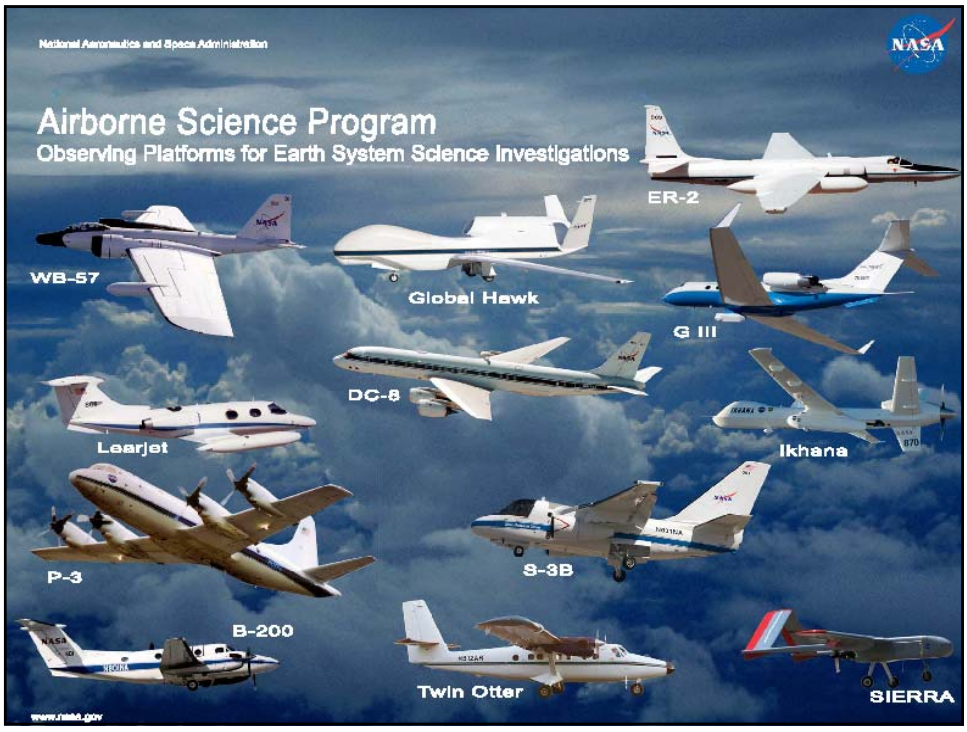


The required SRB ICE will be done as part of the standard major mission milestone gate reviews (KDP-B, -C, ...)NASA missions typically are subject to Independent Cost Analyses (ICE) prior to mission confirmation (transition from formulation to implementation)

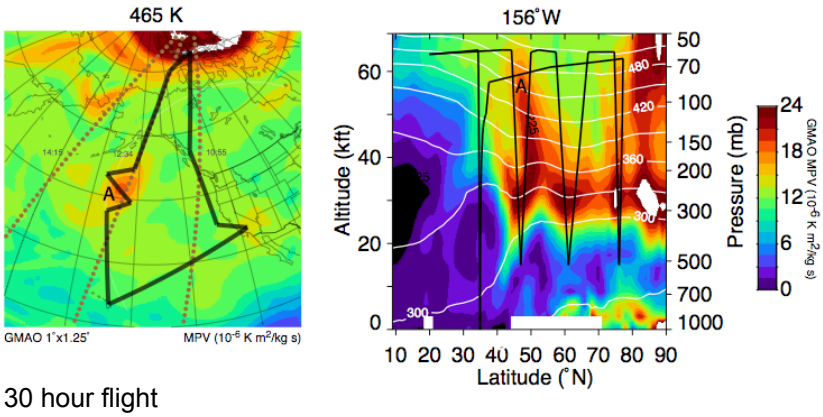
- ICE conducted to determine the 70% confidence level for LCC & LRD

CY08 ESD Airborne Missions

AVIRIS Hawaii		Twin Otter	59 hours	
CLPX II		Twin Otter	233 hours	
ARCTAS Spring		P-3, DC-8, B-200	263 hours	
CARB		P-3, DC-8, B-200	50 hours	
ARCTAS Summer		P-3, DC-8, B-200	225 hours	
HSRL Calipso/Cloudsat Cal/Val	B-200		76 hours	
MASTER North America		ER-2, B-200, TO	138 hours	
AVIRIS North America		ER-2, Twin Otter	74 hours	
PALS		Twin Otter		92 hours
NOVICE		WB-57	9 hours	
Western States Fire Mission 08	Ikhana		20 hours	
AMISA		DC-8	59 hours	
ACCLAIM		B-200	34 hours	
UAVSAR baseline		G-III	156 hours	
ATM/PARIS Antarctica		P-3	69 hours	
Ice Roughness Profilometer testflights		SIERRA	20 hours	
SMAP-VEX		P-3	18 hours	
CO2 Laser Sounder		Lear 25	16 hours	
LVIS		B-200	36 hours	
GIFS		P-3	20 hours	
Total				**1667 hours**
60% increase from 07				



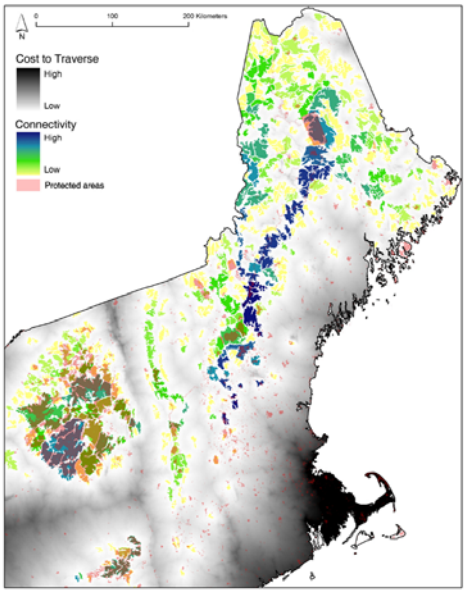
Coming Attractions (2009): GH UAS-AVE vortex fragment flight



30 hour flight
Objective 1: sample remaining polar vortex for ozone depleted air
Objective 2: sample polar fragment over Pacific
Objective 3: Coordination with Aura satellite overpass
Objective 4: Pole-to-tropics sampling of air masses

Freilich

Applied Sciences Example: NASA & NPS



Products for National Parks Service's *Inventory and Monitoring Program*

Habitat value, connectivity, and inter-area traverse cost determined from multiple moderate-resolution satellite imagery products

High connectivity (blue) provides dispersal paths in the face of climate change; development isolates even protected areas and renders their ecosystems more vulnerable and fragile to changing conditions

Goetz & Hansen, 2008

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1/2009: Program Accomplishments and Plans

- OSTM/Jason-2 launched 20 June 2008
  - OCO, Glory scheduled for 2009
  - Aquarius, NPP(?) scheduled for 2010, LDCM for late 2012, GPM for 2013 and 2014
- Airborne campaigns for science (ARCTAS …), natural hazards (California wildfires); acquired 2 Global Hawks
- Focused Earth Science Technology Office solicitations on Decadal Survey mission needs
- Decadal Survey missions:
  - SMAP initiated, in formulation (Phase A), tentative 3/2013 launch
  - ICESAT-II initiated, pre-formulation (KDP-A in Spring), tentative 2015 launch
  - Community workshops, early mission studies for DESDynI, CLARREO
  - Community workshop, preliminary mission studies for ACE, ASCENDS, GeoCAPE, HYSPIRI, SWOT
  - Established ESSP Program Office at LaRC – competitive missions, incuding future Venture Class
- NASA and NOAA collaborated to remanifest CERES, OMPS-Limb on NPP
- Earth Science Division is operating better
  - Mean (median) proposal selection times reduced from 290 (220) days for ROSES 2006 to 189 (170) days for ROSES 2007 (ROSES 2008 so far is 134 (145)
  - ~33% selection rates
  - Essentially all FY08 funds were obligated by December 2008

Freilich

- 2009 Senior Review in Spring – All missions except Landsat-7, OSTM/Jason-2

History, Context & Schedule for Senior Review

1st SR convened April 2005

- Included: TRMM, Terra, ICESat, TOMS, Jason-1, ERBE, GPS, UARS, SAGE III, QuikSCAT, GRACE, Acrimsat
- Resulted in termination recommendation for UARS and ERBS; GPS moved to R&A program for review. SAGE III, ERBS, TOMS, and UARS failed or were terminated before end of 2006.

2nd SR convened April 2007

- Included: CloudSat, Aqua, SORCE, EO-1, TRMM, Terra, ICESat, Jason-1, QuikSCAT, GRACE, Acrimsat. All missions continued through FY2008 & FY2009.

3rd SR to be convened April 2009, and will include:

- Aura, CALIPSO, CloudSat, Aqua, SORCE, EO-1, TRMM, Terra, ICESat, Jason-1, QuikSCAT, GRACE, Acrimsat

2009 Senior Review Schedule of Activities

Activity	Schedule	
	2007 Review	2009 Plan
Draft call for proposals issued	19-Nov-04	12-Dec-08
Community feedback at AGU meeting	14-Dec-06	17-Dec-08
Call for Proposals issued	12-Jan-07	12-Jan-09
Proposals Received/Due	16-Mar-07	early March 2009
CoMRP panel review	16-Apr-07	April 2009
E/PO panel review	18-Apr-07	
Senior Science Review panel meets	April 25-27, 2007	
Coordination w/International & Agency ŅPartnersÓ	May - Jul 2007	May 2009
Mission operations plans reviews @ GSFC, JPL, LASP	May - Jun 2007	
Release of Senior Review Science Panel report	15-Jun-07	
ESD budget guidelines to missions	31-Jul-07	June 2009
ProjectsÕ responses to new guidelines	September 2007	July 2009
Final mission budgets established	October 2007	September 2009

Transition and Long-term Data Acquisition

- ***Earth System science and environmental monitoring and prediction require effective, multi-decadal data acquisition systems. The long-term system is needed to:***
  - Justify initiating new measurements
  - Support and advance science programs for studying climate-scale phenomena
  - Encourage and support applications development through assured data availability
- ***The U.S. must develop a predictable, cost-effective mechanism for civilian long-term data acquisition that encourages technology infusion and that enables climate monitoring, delivery of expanded societal benefits, and advances understanding of the Earth System***

NPOESS Update

NPOESS requirements have changed per JARC/EXCOM
- EXCOM must concur when capabilities fall below IORD-2 thresholds
- Breach occurs when capabilities fall below "legacy" actual performance
  - "Legacy" actual performance defined as best of POES and DMSP

ATMS, CERES, OMPS (with Limb Profiling) integrated onto NPP; CrIS integration to be completed within weeks
- CERES, TSIS implementations being pursued by NASA for NOAA (reimbursable) for flights on C1; Continuing resolution complicates NOAA funding
- OMPS-Limb, APS, Altimeter remain demanifested from NPOESS
- MIS status uncertain

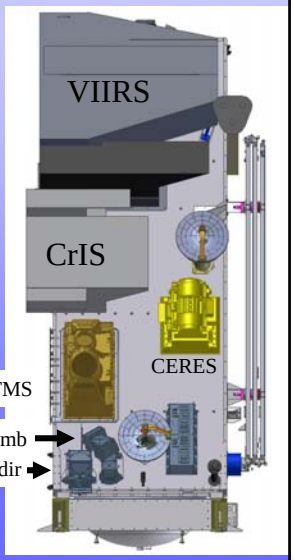
VIIRS delays are pacing the entire NPP/NPOESS program
- DoD, NOAA available funding insufficient
- Continuity for ***short-term forecasting*** is in jeopardy in the post-2013 timeframe
- T-JAT examining impacts and mitigation scenarios
- Role of NPP (NASA research mission, also risk reduction for NPOESS)

NPP Developers

Segments/ Elements	Contractor	Agency	Contract Type	Status
ATMS	NGES	NASA-GSFC	CPAF	EDU Complete PFM Complete
CrIS	NGST/ ITT	IPO	CPAF	EDU Complete Flight Development
OMPS	NGST/ Ball Aerospace	IPO	CPAF	Flight Development
CERES	NGST	NASA-LaRC	CPFF	Flight Development
VIIRS	NGST/ Raytheon	IPO	CPAF	Flight Development
Satellite	Ball Aerospace	NASA-GSFC	FFP	S/C Qualification Complete / Finalizing 1394 Risk Reduction
Launch Vehicle	Boeing	NASA-KSC	FFP	ATP Issued
C3	NGST/ Raytheon	IPO	CPAF	Site Acceptance Complete
IDPS	NGST/ Raytheon	IPO	CPAF	Development
ADS/CLASS	CSC	NOAA	CPAF	Development
SDS	Various	NASA-GSFC	Various	Development

NPP after Recent Level 1 Changes

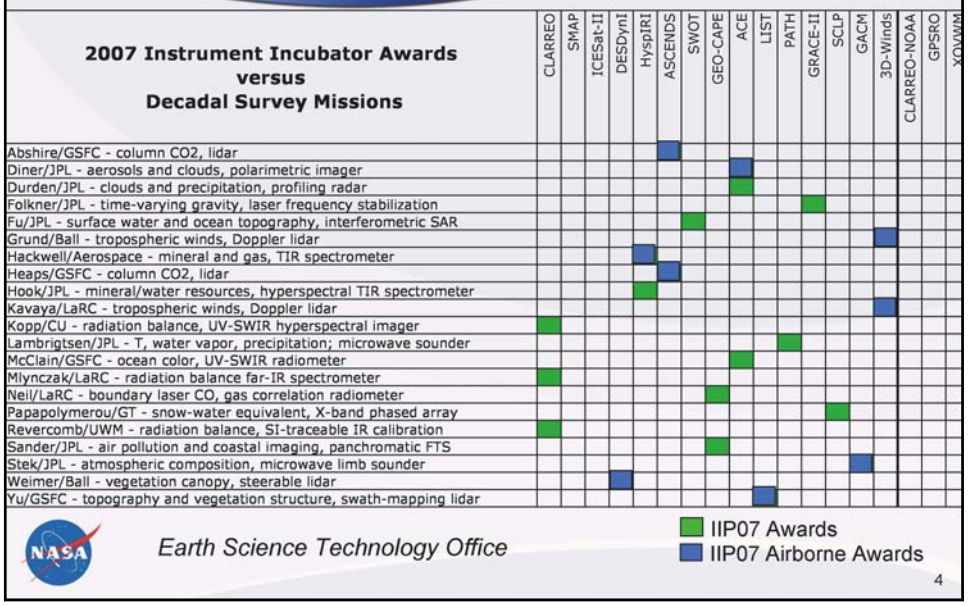
- **OMPS-Limb restored**
- **Orbit Equator Crossing Time changed to 1330**
- **New LRD June 2010**
  - **Results from VIIRS delivery/test delays**
- **CERES added to NPP Mission**
  - **Instrument refurbishment underway**
  - **On-the-hook October 31, 2008**



Earth Science Technology Office (ESTO)

- *Science-driven, competed, actively managed and dynamically communicated program*
  - Competitive, peer-reviewed proposals enable selection of best-of-class technology investments
  - Risk are retired before major dollars are invested: a cost-effective approach to technology development and validation
- Since the Earth Science Decadal Survey was published in 2007, ESTO has focused its Instrument, Component and Information Technology solicitations on Decadal Survey measurements
- ***This has resulted in the award of 57 technology projects representing an investment of over $105M directly related to the Earth Science Decadal Survey.***

Instrument Incubator Program (IIP) 2007 Awards vs. Decadal Survey Missions, Showing Airborne Components



Earth Science Technology Office

Advanced Component Technology Program 2008 Awards vs. Decadal Survey Missions

2008 Advanced Component Technology Awards versus Decadal Survey Mission	CLARREO	SMAP	ICESat-II	DESDynI	HyspIRI	ASCENDS	SWOT	GEO-CAPE	ACE	LIST	PATH	GRACE-II	SCLP	GACM	3D-WINDS	CLARREO-NOAA	GPSRO	XOVWM
Dobbs/ITT - corrugated mirror telescope array for lidar			■	■		■			■	■				■	■			
Fang/JPL - large deployable reflector for Ka- and W-band									■									
Hoffman/JPL - thermal packaging for RF hybrids, radar				■			■											
Illing/Ball - polarization scrambler, spectroscopy					■			■	■					■				
Janz/GSFC - visible NIR blind GaN focal plane array, hyperspectral								■										
Krainak/GSFC - NIR optical receiver, lidar			■	■		■			■	■					■			
Marx/GSFC - hybrid doppler wind lidar transceiver															■			
McGill/GSFC - detector technology for cloud aerosol lidar									■						■			
Meehan/JPL - RF ASIC for digital beamforming, GNSS															■		■	
Mlynczak/LaRC - FIR detectors for Earth radiation	■																	
Phillips/LockMart - CO2 laser absorption spectroscopy						■												
Reising/Colo. St. Univ.- radiometer for wet-tropospheric correction							■											
Rider/JPL - analog to digital converter from UV to mid-IR					■		■	■						■				
Siqueira/Univ. Mass. - low power, high BW receiver, Ka-band							■											
Taylor/Composite Tech. Dev. - large aperture, deployable reflector		■					■				■		■					■
Thomson/JPL - deployable Ka-band reflect array							■											

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Advanced Information Systems Technology 2008 Awards vs. Decadal Survey Missions

2008 Advanced Information Systems Technology Awards Versus Decadal Survey Missions	CLARREO	SMAP	ICESat-II	DESDynI	HyspIRI	ASCENDS	SWOT	Geo-CAPE	ACE	LIST	PATH	GRACE-II	SCLP	GACM	3D-Winds	CLARREO-NOAA	GPSRO	XOVWM	Broad App.
Bock / Scripps, UCSD – Solid Earth – Data fusion				■															
Braverman / JPL – Carbon/eco – Data fusion						■													
Donnellan / JPL – Solid Earth – Cloud computing				■															
Flatley / GSFC – Broad app. – On-board data/signal processing									■										
French / USC/ISI – Broad app. – On-board data & signal processing		■																	
Goodman / MSFC – Climate – Data manipulation								■											
Ivancic / GRC – Atm. comp. – Sensor web enablement																			■
Leptoukh / GSFC – Atm. Comp. - Ontology								■											
Lou / JPL – Solid Earth – On-board data & signal processing				■															
Mandl / GSFC – Carbon/eco – Data manipulation					■														
Moghaddam / U. Michigan – Water/energy – Mission/system simulation & design		■																	
Nemani / ARC – Carbon/eco – Mission management		■																	
Norton / JPL – Climate – On-board data & signal processing									■										
Peters-Lidard / GSFC – Water/energy – Algorithms & modeling		■																	
Rosen / JPL – Climate – Algorithms & modeling				■															
Schneider / U. Florida – Weather – Data manipulation															■				
Seablom / GSFC – Climate – Mission management															■				
Shen / UMBC – Weather – High-performance computing	■																		
Tanelli / JPL – Climate – Mission/system simulation & design									■										
Von Allmen / JPL – Solid Earth – Algorithms & modeling				■															

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ESD Decadal Survey Mission Development Approach

Conduct the studies in an integrated fashion, led by the Program Scientist and Program Executive and coordinating across multiple levels within the Earth Science Community

	Mission	Program Scientist		Program Executive	Data Systems	Applied Science	ESTO Technology	ESM Program Office
		Primary	Backup					
Near-Term	ICESat II	Martin	Wickland	Yuhas	Lindsay	Turner	Bauer	DiJoseph
	SMAP	Entin	Kakar	Ianson	Maiden	Haynes		DiJoseph
	DESDynI	LaBrecque	Wickland	Volz		Ambrose	Smith	TBD
	CLARREO	Anderson	Kakar	Carson		Friedl	Ghuman	TBD
Mid-Term	SWOT	Lindstrom	Entin	Neeck	Maiden	Haynes	Bob Smith	DiJoseph
	HyspIRI	Turner	LaBrecque			Haynes		
	ASCENDS	Jucks	Emanuel			Turner		
	GEO-CAPE	Jucks	Bontempi			Friedl		
	ACE	Maring	Bontempi			Friedl		
Late-Term	LIST	Wickland	Emanuel	Neeck	Maiden	Ambrose	Pasciuto	-
	PATH	Kakar	Maring			Haynes		
	GRACE-II	LaBrecque	Martin			Ambrose		
	SCLP	Entin	Martin			Ambrose		
	GACM	Jucks	Hilsenrath			Friedl		
	3D-Winds	Kakar	Anderson			Ambrose		