



Decadal Survey Mission Planning

Presentation to HypIRI Workshop

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NRC Recommended Near-Term Missions (Tier 1)



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



NRC Recommended Mid-Term Missions (Tier 2)



Mission	Mission Description	Orbit	Instruments
HypIRI	Land surface composition for agriculture and mineral characterization; vegetation types for ecosystem health	LEO, SSO	Hyperspectral spectrometer TIR multispectral scanner
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	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



NRC Recommended Late-Term Missions (Tier 3)



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



ESD Decadal Survey Mission Development Objectives



- ☞ Advance the science maturity and overall development of all missions, prioritized by their order in the the three groupings
 - ❑ *For Near-Term missions build on the Science workshops of 2007*
 - ❑ *For Mid-Term missions build on the results of the mission studies*
 - ❑ *For Late-Term missions leverage off development activities on the other mission activities*

- ☞ This entails defining/refining scientific requirements, developing mission/instrument requirements, and risk reduction

- ☞ 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



ESD Execution of Decadal Survey Missions



- ☞ All Decadal Survey Missions concepts studies are directed by the ESD and will be managed by the Earth Systematic Missions (ESM) Program Office at GSFC
- ☞ All mission development will have a study management team, led from HQ ESD by the HQ Program Scientist and Program Executive, and including representatives from ESTO, data systems, applied sciences, and the ESM program office

	Mission	Program Scientist		Program Executive	Data Systems	Applied Science	Resources	ESTO Technology	ESM PO
		Primary	Backup						
Tier 1	ICESat II	Martin	Wickland	Yuhas	Lindsay	Turner	Black	Bauer	Savinell
	SMAP	Entin	Kakar	Ianson		Haynes			Loiacono
	DESDynI	Labrecque	Wickland	Volz	Maiden	Ambrose		Smith	Walker
	CLARREO	Anderson	Kakar	Carson		Friedl		Parminder G	Smith
Tier 2	SWOT	Lindstrom	Entin	Neeck	Maiden	Haynes	Black	Smith	Bolton
	HyspIRI	Turner	LaBrecque			Haynes			
	ASCENDS	Jucks	Emanuel			Turner			
	GEO-CAPE	Jucks	Bontempi			Friedl			
	ACE	Maring	Bontempi			Friedl			
Tier 3	LIST	Wickland	Emanuel			Ambrose	Pasciuto	TBD	
	PATH	Kakar	Maring			Haynes			
	GRACE-II	LaBrecque	Martin			Ambrose			
	SCLP	Entin	Martin			Ambrose			
	GACM	Jucks	Hilsenrath			Friedl			
	3D-Winds	Kakar	Anderson			Ambrose			



NASA Decadal Survey Community Activity



- ☞ NASA is conducting the definition studies with science community involvement welcomed and desired
- ☞ NASA is actively engaging the broad science and research communities to help definitize the objectives of the Decadal Survey mission concepts

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
Octobr 29-31	DESDynI	Applications Workshop	Sacramento, CA	Steve Ambrose	sambrose@nasa.gov
November XX	DS Tier 1 & 2	Decadal Survey Initial Analyses	Washington, DC	Steve Volz	svolz@nasa.gov
January XX	SWOT	Science Workshop	TBD	Eric Lindstrom	eric.j.lindstrom@nasa.gov



SMAP, ICESat II, DESDynI & CLARREO



- ☞ SMAP, implemented out of JPL
 - ❑ *Transition review to Formulation (KDP A) September 12, 2008*
 - ❑ *Science Definition Team competitively selected, announcements within weeks*
 - ❑ *Initial Confirmation Review (ICR) targeted for mid 2009*

- ☞ ICESat II, implemented out of GSFC
 - ❑ *Mission Concept Review (MCR) & KDP-A in Spring 2009*
 - ❑ *Initial Confirmation Review targeted for late 2009*

- ☞ CLARREO, led by LaRC
 - ❑ *Draft level 1 requirements & initial international partnership discussions, Fall 2008*
 - ❑ *Initial mission concepts, Spring 2009, MCR October 2009*

- ☞ DESDynI, led by JPL
 - ❑ *Draft level 1 requirements & initial international partnership discussions, Fall 2008*
 - ❑ *Mission configuration down select, Spring 2009*
 - ❑ *MCR October 2009*



Objectives for the Next DS Missions



- ☞ Advance the maturity and development of all missions, prioritized roughly by their order in the launch queue as defined by the DS;
 - ☐ *Tier 2 missions build on the results of the earlier mission concept studies,*
 - ☐ *Tier 3 missions leverage off development activities on the Tier 1 & 2 missions*
- ☞ Conduct the studies in an integrated fashion, with coordination at multiple levels
- ☞ The PS/PE study leads should collect and prioritize the needed activities geared to the appropriate “starting point” for the start FY10 activities.
 - ☐ *These proposed activities should be collected at HQ, with Flight and Science jointly preparing a proposed implementation, then presented through the ESD steering committee for selection.*
- ☞ To refine the mission and DS program definition sufficiently by the end of FY09 to inform directed mission development planning for the next mission starts to follow SMAP and ICESat II.



Close Interactions Are Mandatory Through Phase A



- ☞ All mission design trades we will consider are significant and the optimizations we arrive at will define the final scope for each mission
- ☞ Close coordination between and among each Project, the Program Office, and the Earth Science Division is essential to ensure the final mission design put forward at the Confirmation Review (KDP-B) is robust scientifically, financially and programmatically
 - ☐ *Will include the Mission Level 1 Requirements, etc.*
- ☞ The ESM Program Office, working with the ESD and the Projects, will define a schedule of mission definition milestones leading to MCR and KDP-B for the all mission concepts



Overall Decadal Survey Study Funding



		All funds in \$K	
		FY08	FY09
372217	SMAP	9,600	49,300
883151	ICESat II	9,600	8,365
304029.01.04	Decadal Mission Studies	5,000	20,000
	304029.01.04.01 – Cross Cutting		TBD
	304029.01.04.02 – CLARREO	1,618	5,000
	304029.01.04.03 – DESDynI	1,500	5,000
	304029.01.04.04 – ACE	455	2,000
	304029.01.04.05 – ASCENDS	342	2,000
	304029.01.04.06 – GEOCAPE	308	2,000
	304029.01.04.07 – HypSIRI	550	2,000
	304029.01.04.08 – SWOT	625	2,000

- ☞ SMAP and ICESat II have individual budget lines. DESDynI, CLARREO and the five 2nd Tier missions concepts are funded from a common budget line and we are able to move funds between the concept studies if the mission studies warrant it
- ☞ Funding levels for FY10 and beyond will be determined as part of the normal budget process, informed by the progress and outcome of these many studies

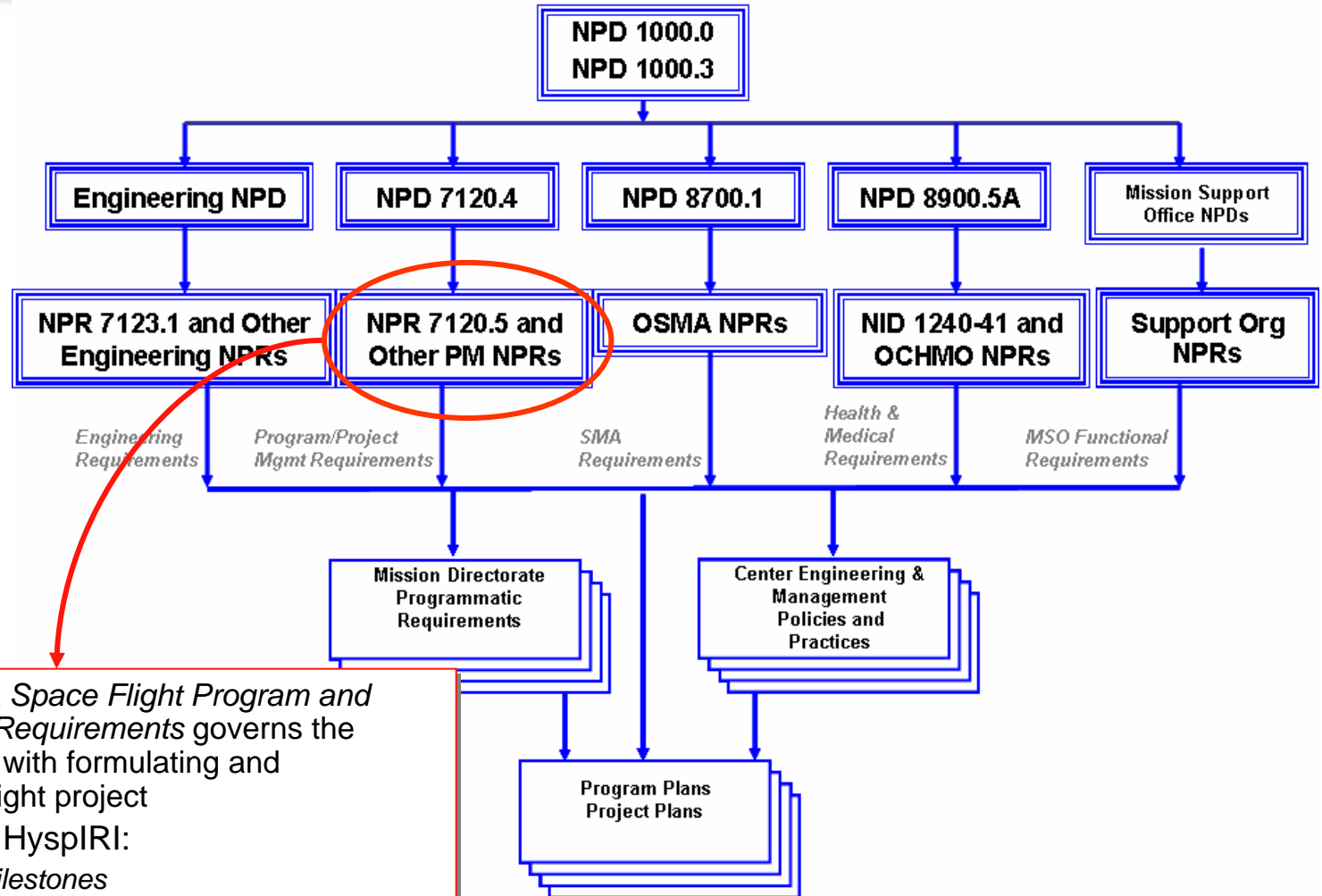


Where do we expect to be by October 1, 2009?

- ☞ For each of the Near- and Mid-Term (Tiers 1 & 2) missions in the DS:
 - ☐ *Quantitative assessment of the readiness to proceed to Formulation (Phase A)*
 - ◆ 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



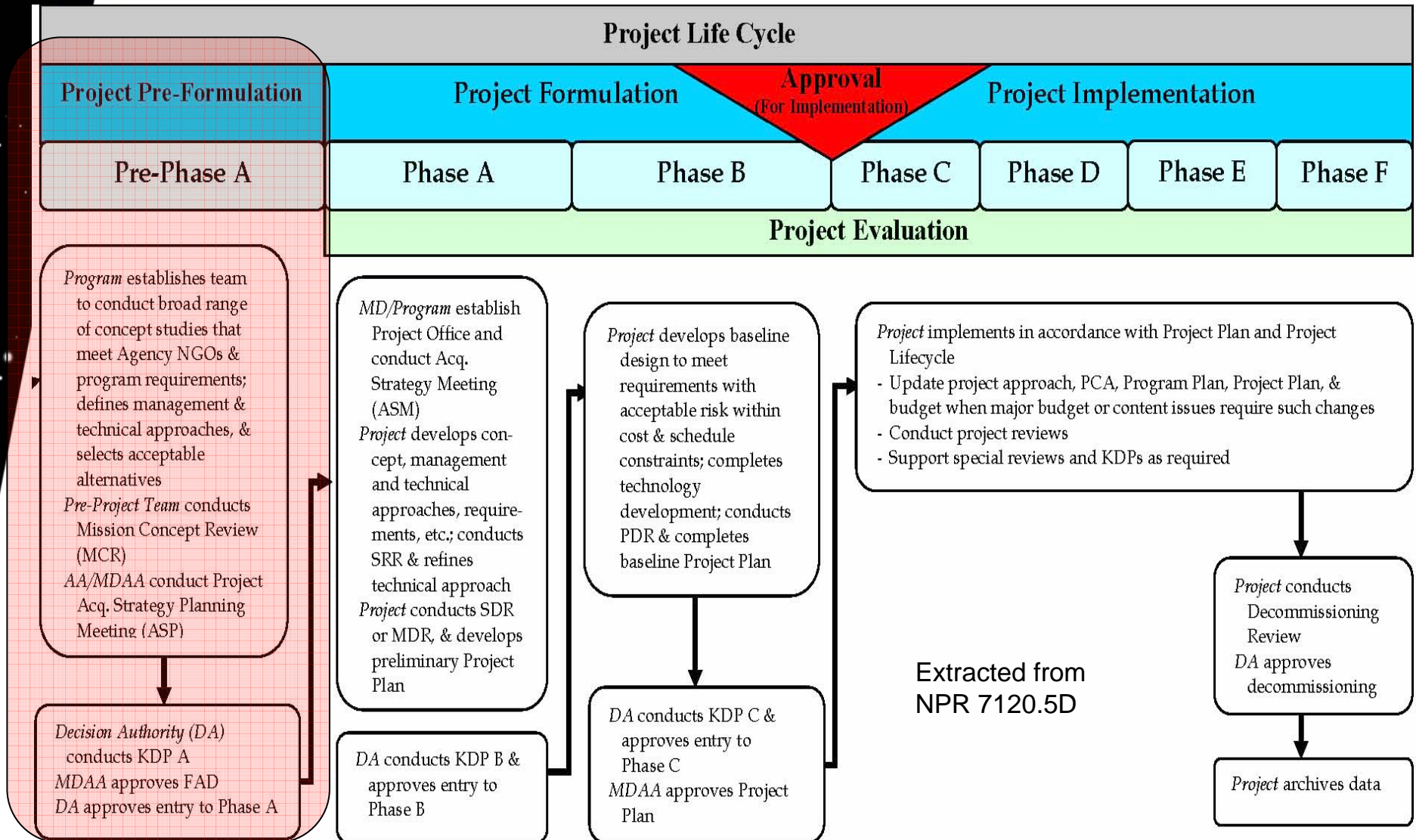
NASA Hierarchy of Directives



- ☞ **NPR 7120.5D - NASA Space Flight Program and Project Management Requirements** governs the processes associated with formulating and implementing a new flight project
- ☞ Important details for HypIRI:
 - ☐ Defines the Major Milestones
 - ☐ Identifies all requirements for each phase of the Project
 - ☐ Identifies all gate products for each phase
 - ☐ Defines roles and responsibilities
 - ☐ Identifies all major reviews



Flight Project Life Cycle





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:

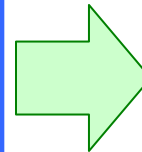
- ☞ Develop and document preliminary mission concepts
- ☞ Conduct internal Reviews
- ☞ Conduct Mission Concept Review Project Planning, Costing and Scheduling
- ☞ Develop and document a DRAFT Integrated Baseline, including:
 - ☐ *High level WBS*
 - ☐ *Assessment of Technology Readiness Levels*
 - ☐ *Assessment 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 DRAFT Level 1 Science Requirements
- ☞ Support development of preliminary mission concepts
- ☞ Support the assessment of Technical Readiness Levels
- ☞ Identify potential partnerships





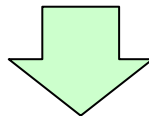
Key Pre-Phase A Questions



☞ What science **MUST** this mission achieve?

- ☐ *What specific measurements?*
- ☐ *To what accuracy?*
- ☐ *What are the required data products?*

Should be resolved ~ 12 months prior to KDP A



☞ What mission parameters can achieve the science?

- ☐ *What orbit (inclination/altitude)?*
- ☐ *Which instruments?*
- ☐ *What is the baseline mission duration?*

☞ How can NASA achieve these measurements?

- ☐ *Are there other missions required/desired to achieve the science?*
- ☐ *Who can NASA partner with to achieve this mission?*

Should be resolved ~ 6 months prior to KDP A

Year	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9	N+10
Notional Mission Schedule	KDP A		KDP B		KDP C		LAUNCH				
	MCR		SRR	MDR	PDR	CDR		SIR	TRR	ORR	PLAR
Major Reviews		▽	▽	▽	▽		▽	▽	▽	▽	▽



HyspIRI Study Status



- In advance of and then in response to the Decadal Survey, two separate mission concept studies were completed in FY2007.
 - *HyspIRI - Plant Physiology and Functional Types*
 - *HyspIRI - Thermal Infrared Scanner*
- An initial look at combined mission made last summer and continued refinement of the HyspIRI combined mission is underway.
- FY2009 study plan
 - *Refining HyspIRI mission requirements to ensure the scientific objectives can be met with sufficient cost, schedule and performance margin.*
 - Science requirements
 - Mission requirements
 - Instrument requirements
 - *Holding HyspIRI scientific workshop to engage science community and verify mission concept meets the science requirements*
 - October 21-23, 2008 Monrovia, CA
 - *Preparing for KDP-A (Phase A)*
 - Draft level 1 science requirements, baseline mission concept, cost, schedule, draft formulation authorization document, partnership evaluations, technology readiness level assessments



BACKUP



Science Management and Requirements Definition



- ☞ For all mission concepts, the overall mission science requirements and objectives will be defined by the Earth Science Division, with the discipline area Program Scientist as the lead and working closely with the individual mission concept science team
- ☞ For SMAP and ICESat II individual Science Definition Teams (SDT) will be selected based on competitive proposals solicited through a special Amendment to ROSES 2008.
- ☞ For DESDynI and CLARREO and Tier 2 Decadal Survey mission concepts, a similar approach is envisioned, but the SDTs will be initiated later as those mission concepts mature



Role of the Earth Systematic Missions Program Office



- ☞ All Decadal Survey Missions are directed missions and will be managed by the Earth Systematic Missions (ESM) Program Office, housed at GSFC.
 - ☐ *This is former EOS Program Office renamed and re-envigorated for the Decadal Survey*
- ☞ While housed at GSFC the ESM shall incorporate expertise from across NASA
 - ☐ *In particular including science and instrument expertise from LaRC and JPL*
- ☞ Level of interaction and involvement by the ESM PO with the individual mission development activities will vary with the maturity of the mission and mission study
 - ☐ *For all mission development activities the ESM PO will conduct cross-mission studies and investigate synergies, working with the ESD*
 - ☐ *For SMAP & ICESat II, the PO will have significant direct involvement*
 - ☐ *For CLARREO & DESDynI, the PO will co-lead the mission maturation activities with the PS/PE leadership team from HQ*
 - ☐ *For Tier#2 and Tier #3 missions, the individual mission activities will be led by the PS/PE, supported by the PO*



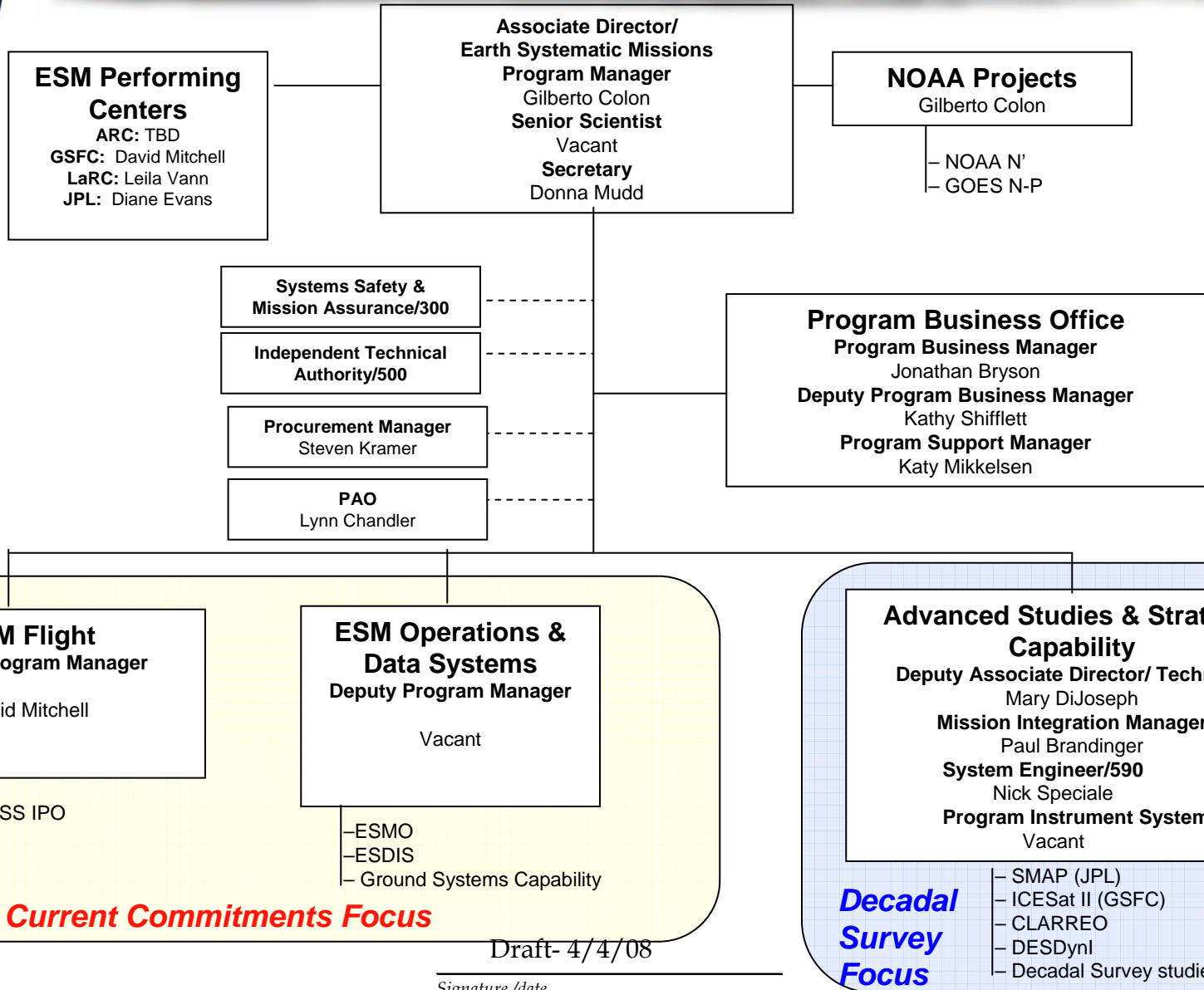
Cross & Common Mission Activities



- ☞ Identified under Cross Cutting items in WBS breakout and coordinated through the ESM Program office
 - ☐ *Data systems*
 - ☐ *GPS on each mission*
 - ☐ *Downlink capacity and impacts on data latency*
 - ☐ *Geodetic networks*
- ☞ Common Mission study features
 - ☐ *Launch vehicle availability and options*
 - ☐ *Technology assessments made with consistency*
- ☞ Instrument Incubator Program
 - ☐ *IIP Award Announcement April 2, 2008*
 - ☐ *Future solicitations*
- ☞ Advanced Component Technology solicitation released



Earth Systematic Missions Program Office



Current Commitments Focus

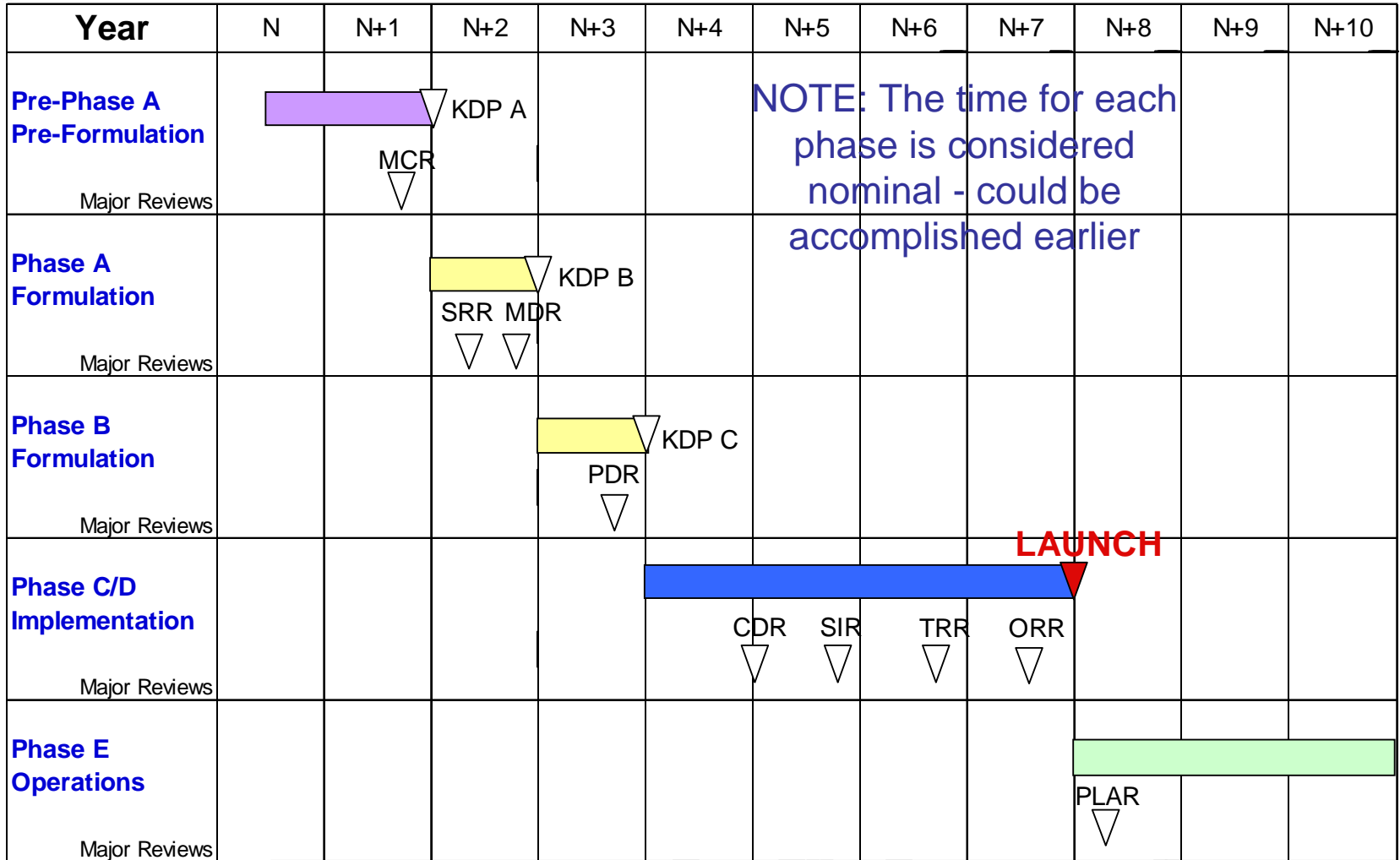
Decadal Survey Focus

Draft- 4/4/08

Signature /date



Notional Mission Timeline





Mission Requirements for Phase A



Scope of Major Phase A Activities:

Headquarters

- ☞ Establish Baseline Level 1 Requirements
- ☞ Conduct Acquisition Strategy Meeting
- ☞ Initiate Interagency and International Agreements

Technical Activities:

- ☞ Develop preliminary system level requirements
- ☞ Develop/document Baseline Mission Concept
- ☞ Develop preliminary mission operations concept
- ☞ Initiate technology developments
- ☞ Develop initial orbital debris assessment
- ☞ Conduct System Requirements Review
- ☞ Conduct Mission Definition Review

Project Planning, Costing and Scheduling

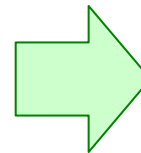
- ☞ Prepare a preliminary Project Plan
- ☞ Conduct required Integrated Baseline Reviews
- ☞ Develop/document preliminary Integrated Baseline
- ☞ Identify Export Controlled technical data

KDP Readiness

- ☞ Obtain KDP B Readiness products
- ☞ Approval through the governing PMC

Areas the Mission Science Team must work:

- ☞ Concur with Level 1 Science Requirements
- ☞ Support development of preliminary system-level requirements
- ☞ Support development of mission baseline concept
- ☞ Support Development of preliminary mission operation concept

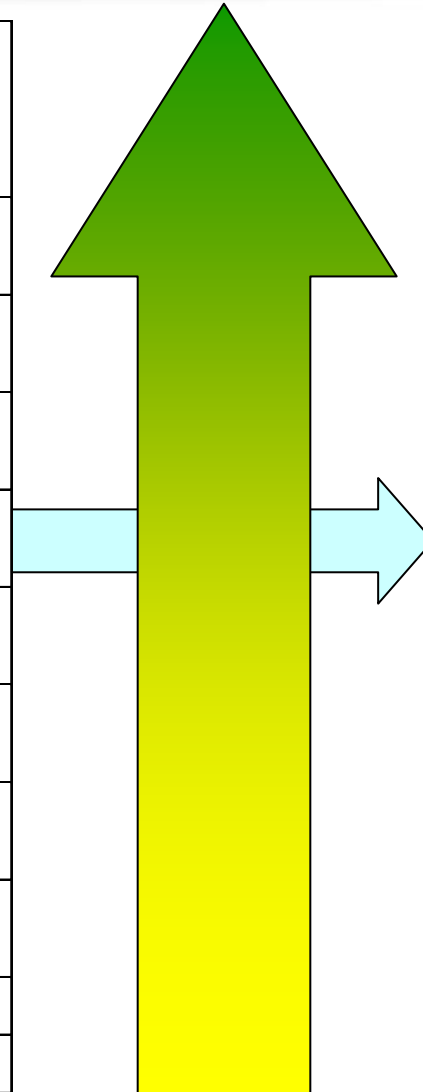




Technology Readiness Level



Technology Readiness Level - (TRL)	Definition
9	Final product validated through successful mission operations (ground, airborne or space).
8	Final product in mission configuration qualified through test and evaluation
7	High-fidelity functionality and scaled form/fit demonstrated in its operational environment
6	Mid-fidelity functionality and scaled form/fit demonstrated in a relevant environment
5	Mid-fidelity functionality demonstrated in a relevant environment
5	Mid-fidelity functionality demonstrated in a relevant environment
4	Low-fidelity functionality demonstrated in laboratory
3	Analytical and/or experimental proof-of-concept demonstrated
2	Application and/or operating concept formulated
1	Basic principles observed and reported.



TRL levels defined in NPR 7123.1A

High Maturity

TRL 6 is the desired minimum level for integration of new technology

Low Maturity

New Decadal Survey-Related IIP Awards

2007 Instrument Incubator Awards versus Decadal Survey Missions

	CLARREO	SMAP	ICESat-II	DESDynI	HypIRI	ASCENDS	SWOT	GEO-CAPE	ACE	LIST	PATH	GRACE-II	SCLP	GACM	3D-Winds	CLARREO-NOAA	GPSRO	XOVMW
Abshire/GSFC - column CO2, lidar						■												
Diner/JPL - aerosols and clouds, polarimetric imager									■									
Durden/JPL - clouds and precipitation, profiling radar									■									
Folkner/JPL - time-varying gravity, laser frequency stabilization												■						
Fu/JPL - surface water and ocean topography, Interferometric SAR							■											
Grund/Ball - tropospheric winds, Doppler lidar															■			
Hackwell/Aerospace - mineral and gas, TIR spectrometer					■													
Heaps/GSFC - column CO2, lidar						■												
Hook/JPL - mineral/water resources, hyperspectral TIR spectrometer					■													
Kavaya/LaRC - tropospheric winds, Doppler lidar															■			
Kopp/CU - radiation balance, UV-SWIR hyperspectral imager	■																	
Lambrigtsen/JPL - T, water vapor, precipitation; microwave sounder											■							
McClain/GSFC - ocean color, UV-SWIR radiometer									■									
Mlynczak/LaRC - radiation balance far-IR spectrometer	■																	
Nell/LaRC - boundary laser CO, gas correlation radiometer								■										
Papapolymerou/GT - snow-water equivalent, X-band phased array													■					
Revercomb/UWM - radiation balance, SI-traceable IR calibration	■																	
Sander/JPL - air pollution and coastal imaging, panchromatic FTS								■										
Stek/JPL - atmospheric composition, microwave limb sounder														■				
Weimer/Ball - vegetation canopy, steerable lidar					■													
Yu/GSFC - topography and vegetation structure, swath-mapping lidar										■								





Major Pre-Formulation Events



Review	Description
Acquisition Strategy Planning (ASP) Meeting	The ASP meeting is integral to the annual budget submission process. The ASP meeting is structured to allow Agency senior management to review major acquisitions that evolve from Needs, Goals, and Objectives, as well as requirements introduced to the Agency from external sources (e.g., The President's Vision for Space Exploration) and internal sources (e.g., major acquisitions initiated by MDs/MSOs). The purpose of the ASP meeting is to identify and define roles and responsibilities of Mission Directorate(s), Centers, major partnerships, and associated infrastructure (workforce and facilities) with the focus on maintaining ten healthy Centers.
Acquisition Strategy Meeting (ASM)	The ASM applies to both programs and projects. The ASM should be convened as early as practicable and prior to partnership commitments. The purpose of an ASM is to obtain senior management approval of acquisition strategy (e.g., make-or-buy, Center assignments, and targeted partners) for programs and projects. The ASM meeting also delineates if a Procurement Strategy Meeting (PSM) is required for each acquisition under consideration. The Project ASM may be held in conjunction with the project SRR, but must be held prior to KDP B. The supporting materials for the ASM include appropriate program/project documentation that covers budget, schedule, requirements, and risk.



Major Formulation (Phase A/B) Events



Review	Description
Mission Concept Review (MCR)	The MCR will affirm the mission need and examine the proposed mission's objectives and the concept for meeting those objectives. Technologies will be assessed and identified. It is an internal review (SRB may not have been formed) that usually occurs at the cognizant organization for system development. ROM budget and schedules will be presented.
System Requirements Review (SRR)	The SRR examines the functional and performance requirements defined for the system and the preliminary program or project plan and ensures that the requirements and the selected concept will satisfy the mission.
Mission Definition Review (MDR)	The MDR examines the proposed mission/system architecture and the flow down to all functional elements of the system. Technology planning with off-ramps will be described. The preliminary description of the management approach and initial budget and schedule will be presented. Risk assessment and management will be presented as well as initial de-scope plan.
Preliminary Design Review (PDR)	The PDR demonstrates that the preliminary design meets all system requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design. It will show that the correct design option has been selected, interfaces have been identified, and verification methods have been described. Full baseline cost and schedules as well as all risk assessment, management systems and metrics will be presented.