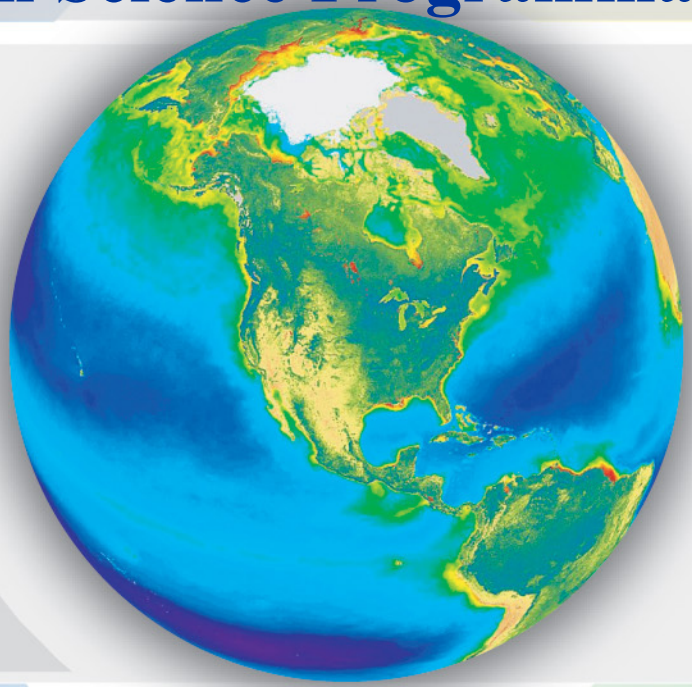
PACE Science Definition Team Kickoff Meeting

Earth Science Programmatics



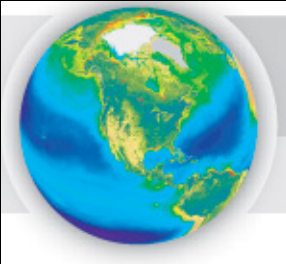
Stephen Volz
NASA Headquarters

PACE Program Schedule, Reviews & Deliverables

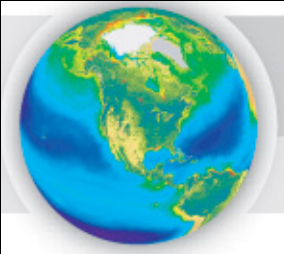
16 November 2011

Outline – Two Objectives

- Objective 1: Define the scope of the Earth Science Program and PACE's place in that program
  - Earth Science Flight Program
  - Earth Systematic Missions Program
- Objective 2: Define the Earth Science Acquisition Approach for PACE, including the SDT's role in that approach
  - ESD Acquisition Strategy, including constraints and issues
  - PACE Acquisition approach
  - PACE SDT team support and interactions
- Special Topics
  - Launch vehicle availability
  - Partnerships



EARTH SCIENCE PROGRAM SCOPE



NASA Earth Science Efforts Concentrated in 6 Areas

- Planning, Building and operating Earth observing satellite missions, most with international and/or 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
- Conducting an Applied Science program to improve the utilization of the data through the U.S.
- Developing technologies to improve Earth observation capabilities, providing the seed technologies for the next generation of earth observing instruments
- Education and Public Outreach

Flight projects

Data Systems

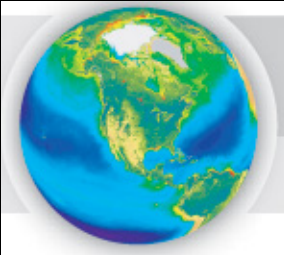
Research & Analysis

Applied Science

Earth Science Technology

E/PO

NASA Science Mission Directorate



Associate Administrator (AA) (Chuck Gay, acting)
Deputy AA (Chuck Gay)
Assistant AA (Colleen Hartman)

JWST Program Office
Dir. (Rick Howard)*
Dep. (E. Smith)

Science Office for Mission Assessments
Dir. (LaRC)

Deputy AA for Programs
(Mike Luther)

Chief Scientist
(Paul Hertz)

- Research Lead (M. Bernstein)
- E/PO Lead (S. Stockman)

Deputy AA for Management
(Roy Maizel)

Strategic & Intl Planning Director (Marc Allen)

Embeds/POCs
Chief Engineer (K. Ledbetter)
Safety & Msn Assurance (P. Martin)
General Counsel (R. McCarthy)
Legislative & Intergvtl Affairs (D. Hollebeke)
Public Affairs (D. Brown)
Intl & Interagency Relations (K. Feldstein)

Resource Management Division
Dir. (C. Tupper)
Dep. (K. Wolf)

Strategic Integration & Management Division
Dir. (D. Woods)
Dep. (G. Williams)

Earth Science Division
Dir. (M. Freilich)
Dep. (M. Luce)

- Flight (S. Volz)
- Applied Sciences (L. Friedl)
- Research (J. Kaye)
- Technology (GSFC) (G. Komar)

Joint Agency Satellite Division
Dir. (M. Watkins)
Dep. (D. Schurr)

Heliophysics Division
Dir. (B. Giles)
Dep. (V. Elsbernd)

Planetary Science Division
Dir. (J. Green)
Dep. (J. Adams)

- Solar System Exploration (J. Adams-Act)
- Mars Exploration (D. McCuistion)
- Planetary Research (J.Rall)
- Planetary Protection Officer (C. Conley)**

Astrophysics Division
Act. Dir. (G. Yoder)
Dep. (G. Yoder)

* Direct report to NASA Associate Administrator
** Co-located from the Front Office

September 2011

Earth Science Division

Michael Freilich, Director

Peg Luce, Deputy Director

Patricia Jacobberger-Jellison
Sr Adv Interorganizational Environmental Science

Research

Jack Kaye, Associate Director

Lucia Tsaoussi, Deputy Associate Director

Flight Programs

Steve Volz, Associate Director

Steve Neeck, Deputy Associate Director

Applied Sciences

Lawrence Friedl Associate Director

Earth Science Technology Office (@ GSFC)

George Komar, Associate Director

Bob Bauer, Deputy

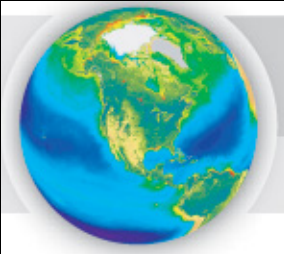
PACE is here

Earth Systematic Missions Program Office
Eleanor Silverman/PM
Goddard Space Flight Center

Earth Science System Pathfinder (ESSP) Program Office
Frank Peri/PM
Langley Reseach Center

Decadal Survey Directed Missions

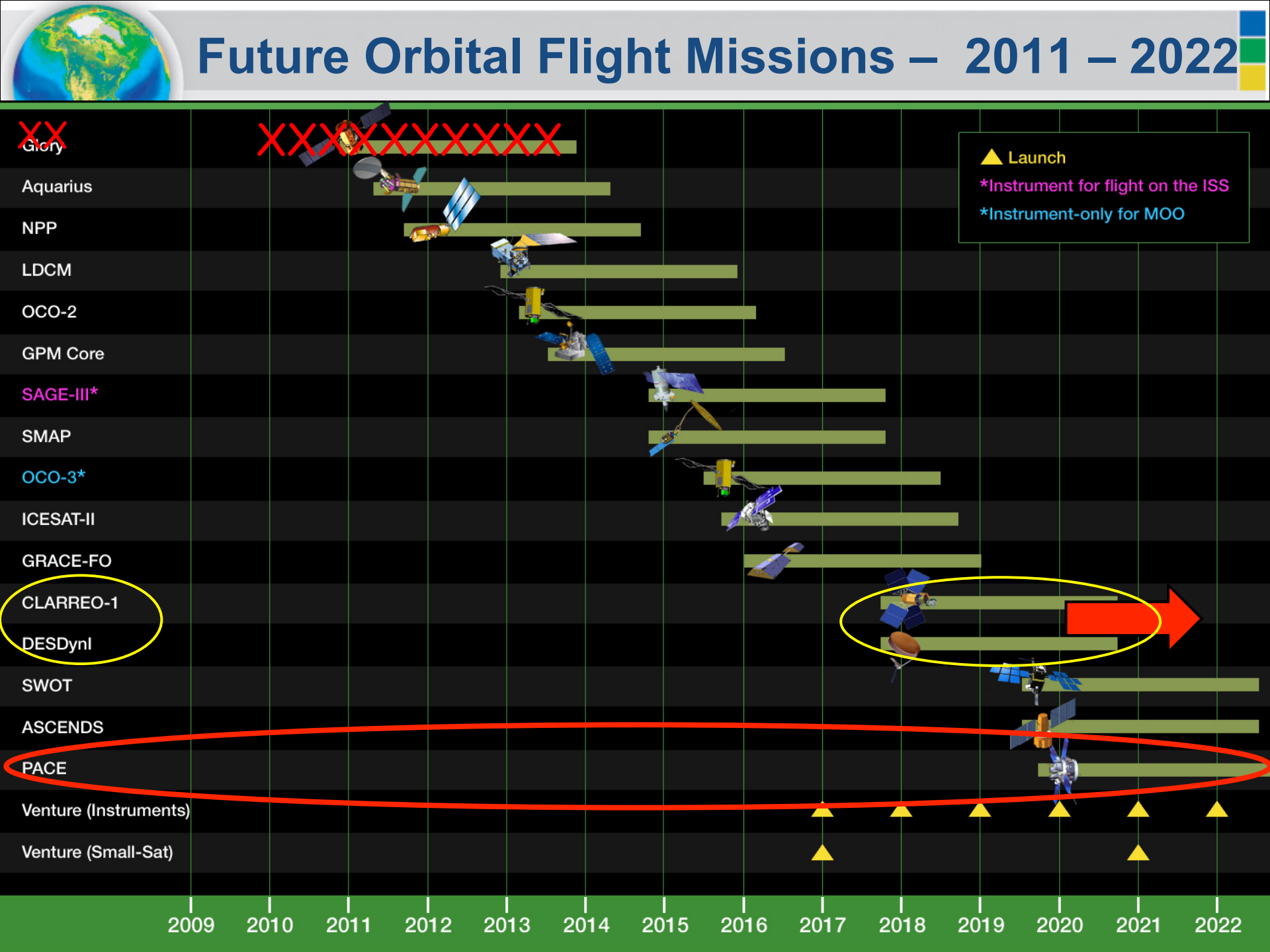
Competitively Selected Venture Class missions



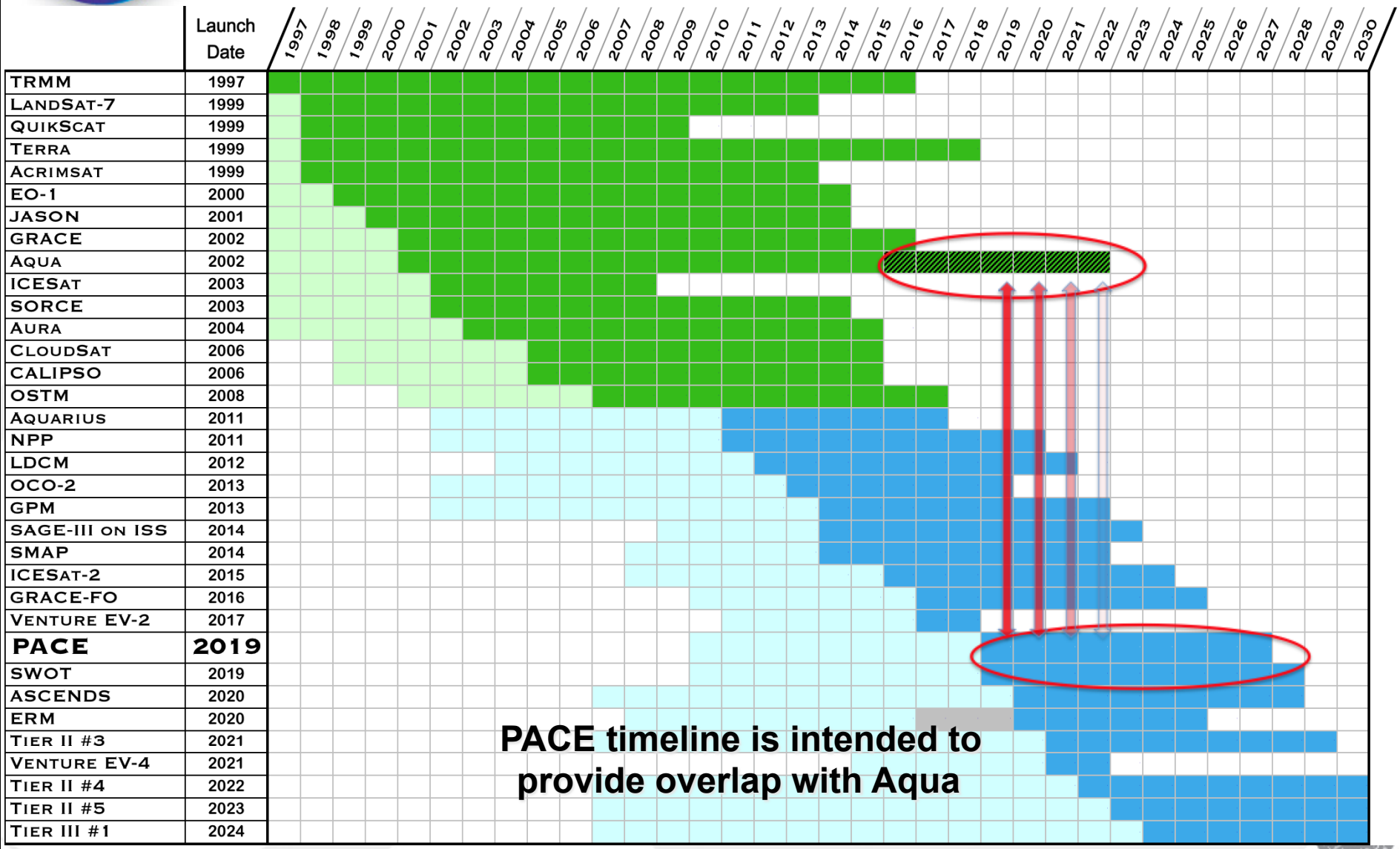
Where Does PACE Fit in NASA's Earth Science Program?

- Chronologically it is in the queue for a Phase A start in FY2014 and a launch in 2019
  - The measurements continue the Aqua record, and should overlap with Aqua if Aqua MODIS continues to operate
- Scientifically its purpose and scope are defined in the Climate Plan put forth by NASA in June 2010
  - Driven by the need for continuity of critical climate records
- Programmatically it is a part of the Earth Systematic Missions Program, managed out of the GSFC program office
  - The mission implementation is managed out of the Flight program element, led by the Program Executive at HQ
  - The Science leadership is conducted out of the Research Program Element, led by the Program Scientist at HQ
  - Mission execution will be managed by the Earth Systematic Missions Program Office, based at the GSFC

Future Orbital Flight Missions – 2011 – 2022

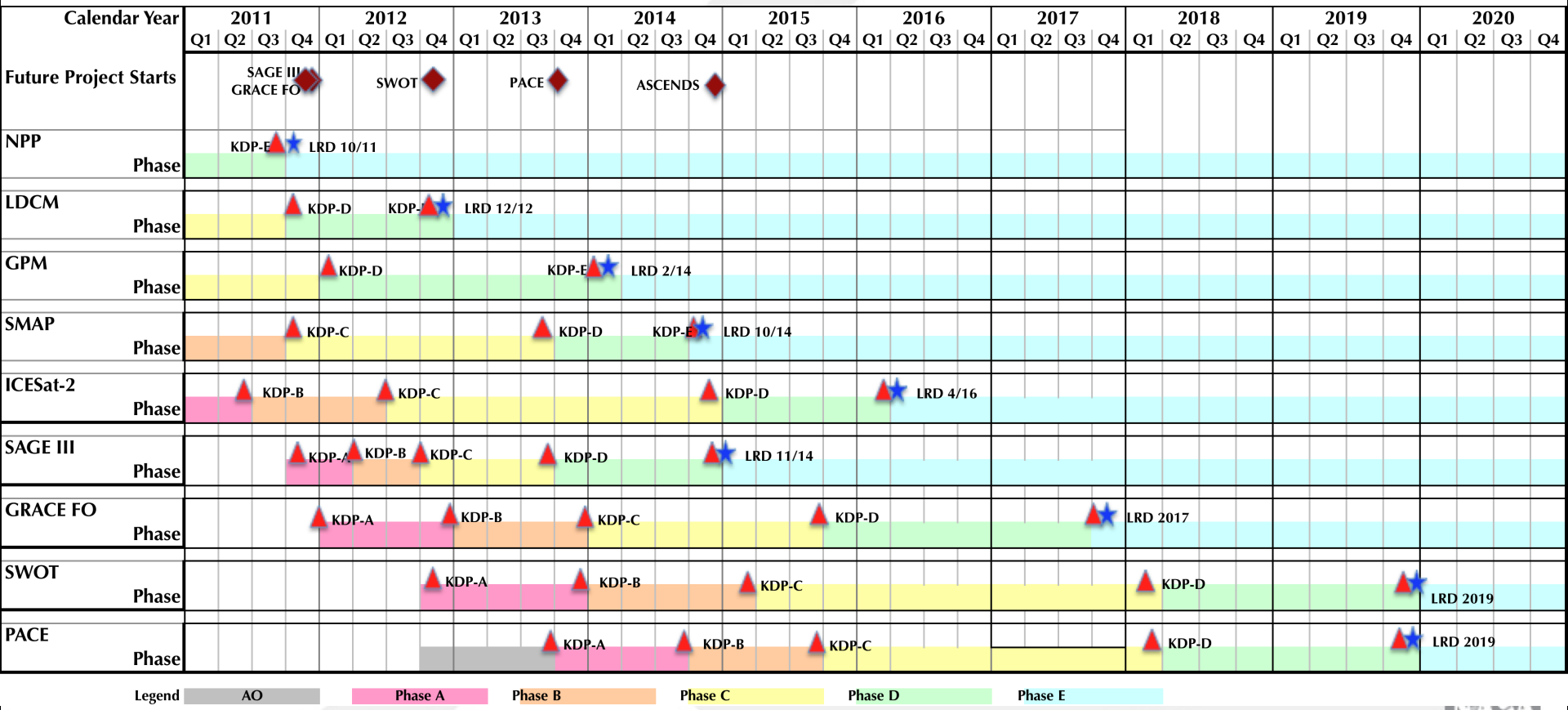


ESD's Missions in Operation



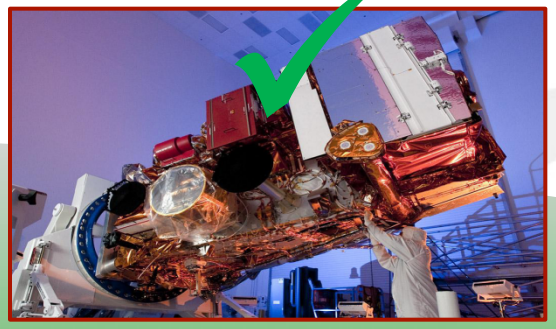
PACE is in the Earth Systematic Missions Program (ESMP)

- All Decadal Survey Missions are managed within the ESM Program, and the program has a busy portfolio

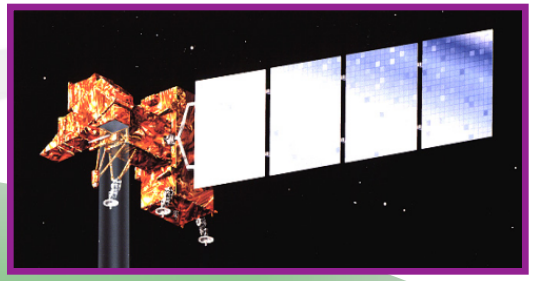


Missions in Formulation and Implementation

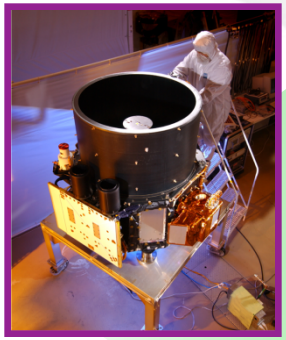
AQUARIUS
6/10/2011
w/CONAE; SSS



NPP
10/28/2011
w/NOAA; EOS cont., Op Met.



LDCM
12/2012
w/USGS; OLI, TIRS



ICESat-2
April 2016
Ice Dynamics

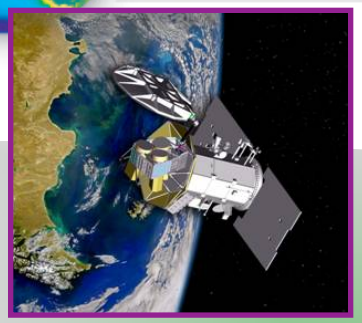
SMAP*
Oct 2014
w/CSA
Soil Moist., Frz/Thaw

GPM
Feb 2014
w/ JAXA; Precip

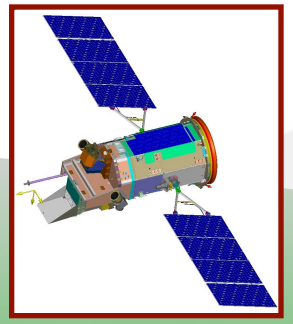
OCO-2
2013*
Global CO_2

*** LRDs in flux because of launch vehicle failures**

ESD Missions in Pre-Formulation thru 2020



Phase A
SAGE III
2014



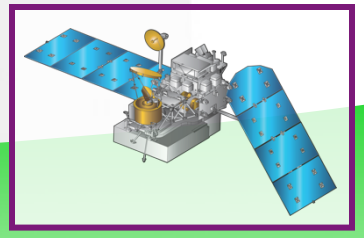
GRACE FO
2017

EV-2
2017

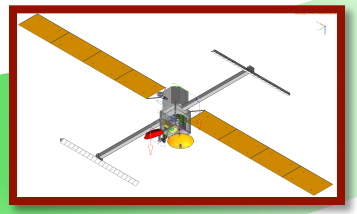
Earth Radar
Mission
TBD

All in pre-formulation, or Pre Phase A

ASCENDS
2020

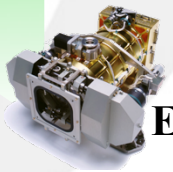


PACE
2019

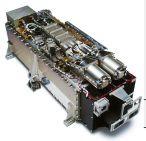


SWOT
2019

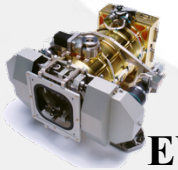
Instrument
Developments



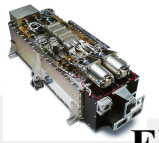
EV-I4
~2019



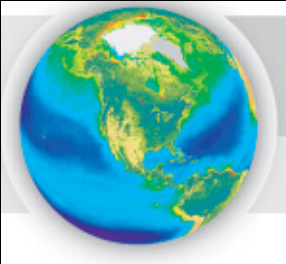
EV-I3
~2018



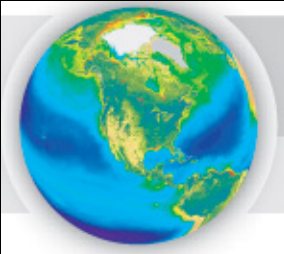
EV-I2
~2017



EV-I1
~2016



ACQUISITION STRATEGY & PACE IMPLEMENTATION

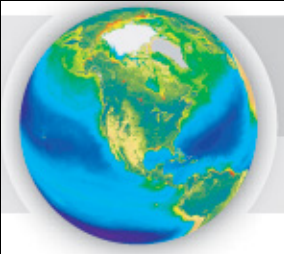


ESD Mission Acquisition Approaches

- ESD develops its missions through various approaches: **Directed** or **Competed**, and we have some flexibility in how we apply the different procurement approaches

- **Directed** Missions share several features in common, and could include:
  - Well defined, strategic or systematic measurement objectives
  - Clear or compelling delivery schedules
  - Unique or challenging technologies possible at limited or singular locations
  - International or interagency partnerships

- **Competed** missions may share some of these features, but not all. Some “typical” attributes could include:
  - Exploratory measurement approaches or objectives
  - Open to a broad range of science objectives
  - Multiple measurement techniques possible to achieve the same strategic science



PACE Acquisition Strategy

- The PACE mission development will include some elements of competition, but we have not yet defined exactly what that will be.
- The options include:
  - A competed mission with a mission PI, to include spacecraft, instrument, ground system, operations, and science delivery, or
  - A competed instrument or instruments to be delivered to and integrated on a directed mission, with the spacecraft and mission operations managed by a NASA-directed team, or
  - Some mix in between.
- It is out intention to include a competitive element, and the mission science objectives are to be established based in large part by the work of the PACE Science Definition Team

- The SDT will be officially disbanded following the delivery of the SDT Study Report to the ESD
  - To allow all members to compete if they chose to do so

PACE Mission: The Road Ahead

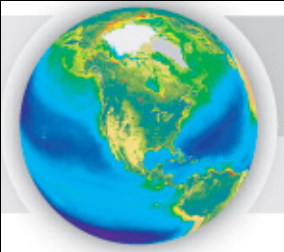
- Targeting LRD of FY19 (end 2018) – LRD +/- 1yr
- 25 July 2011 – PACE SDT DCL released
- 9 September 2011 – PACE SDT DCL applications due (50)
- 18 October 2011 – PACE SDT Selection
- 16-18 November 2011– First PACE SDT Workshop (Washington, D.C.)
- March 2012 (tentative) – Second SDT workshop (Los Angeles or San Francisco, CA)
- Spring/summer 2012 – Preliminary mission study report?
- Spring/summer 2012 – Independent review?
- June 2012 (tentative) – Third SDT workshop (NY, NY or Boston, MA)
- Summer 2012 – SDT revises report based on review?
- July 2012 – SDT final report due

SDT Activities

SDT Disbands

- August/September 2012 – Target AO release
- November 2012 – AO Proposals Due
- 2013 – ROSES Program element for PACE Science Team
- April 2013 – AO review
- July 2013 – AO Selection
- 1 October 2013 – Phase A begins for Selectees

Competition Period



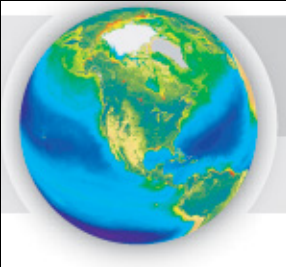
Programmatic Support for SDT Activities

- The SDT will be responsible for defining the ***PACE mission science objectives***, and this will involve some evaluation of the relative science value of the various possible mission science contributions
- The SDT will need cost, schedule and technical assessments to support some of these evaluations
- We will establish a PACE engineering team to support the SDT with necessary trades and analyses
  - All previously completed mission or instrument design studies conducted by NASA will be made available
  - Additional mission or instrument concept analyses will be provided to see the cost, schedule, complexity factors of possible measurement considerations
  - *The objective of these studies is not to come up with a reference, a "point of departure", or a "baseline" design.*
- "PACE Team" will be firewalled off from all potential organizations that may want to compete for PACE instrument or mission
- SDT should work with the PS, Paula Bontempi, and the PE, Betsy Edwards, to define their analysis needs

PACE Engineering Team Support Activities

- The timeline for interaction is short, so we should work to create efficient communications and information exchange
- The Engineering team can provide different levels of assessment and analysis, tailored to suit the SDT's needs
  - A minimum review of requirements for feasibility, clarity and consistency and a sanity check on mission definition (including cost) could be accomplished within a couple weeks
  - A more comprehensive analysis of requirements and mission definition could be accomplished with 6-8 weeks
  - A thorough review and doing some mission design tasks could take 2-3 months
- Details to be worked out

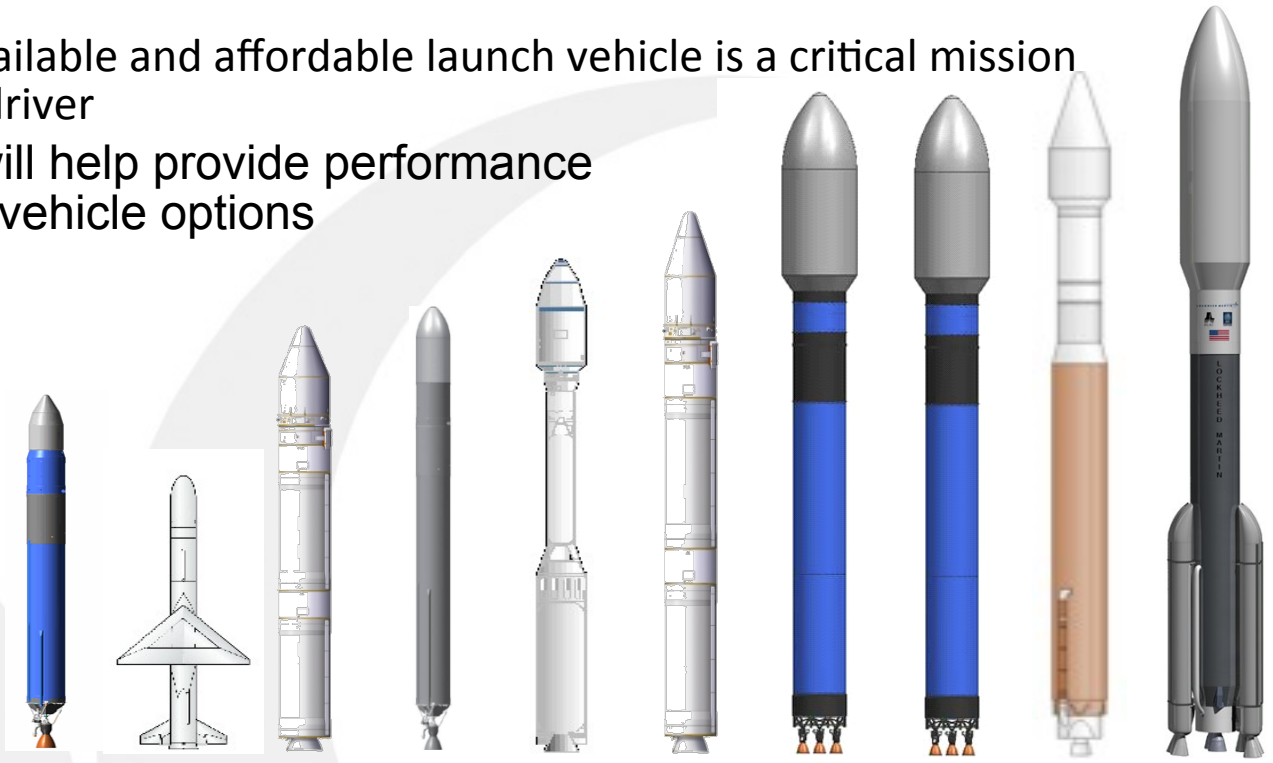
- 6-18 November 2011– First PACE SDT Workshop
  - *Target direction to team in January 2012 for analysis to be delivered prior to March workshop*
- March 2012 (tentative) – Second SDT workshop
  - *Follow-up analyses to support late Spring meeting*
- Spring/summer 2012 – Preliminary mission study report?
  - *Engineering assessment of preliminary study report items (as requested or required)*
- Spring/summer 2012 – Independent review?
- June 2012 (tentative) – Third SDT workshop
- Summer 2012 – SDT revises report based on review?
- July 2012 – SDT final report due



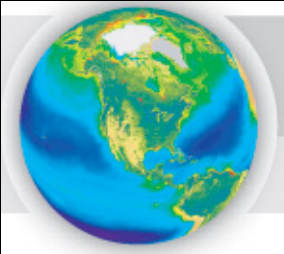
SPECIAL TOPICS

Available NLS II Launch Vehicles

- Compatibility with an available and affordable launch vehicle is a critical mission implementation design driver
- Mission design team will help provide performance parameters for launch vehicle options



Launch Vehicle	Falcon 1	Pegasus	Athena I	Falcon 1e	Taurus XL	Athena II	Falcon 9 Blk1	Falcon 9 Blk2	Atlas V 401	Atlas V 551
Offeror	SpaceX	OSC	LMSSC	SpaceX	OSC	LMSSC	SpaceX	SpaceX	ULS	ULS
Perf @ 600 km Sun Synch	175 kg	240 kg	320 kg	505 kg	950 kg	1175 kg	6490 kg	7540 kg	6640 kg	14280 kg
Certification Cat	n/a	Cat 3	n/a	n/a	Cat 2	n/a	n/a	n/a	Cat 3	Cat 3
Launch Sites	RTS	CCAFS WFF RTS VAFB	CCAFS KLC WFF	RTS	CCAFS WFF VAFB	CCAFS KLC WFF	CCAFS RTS	CCAFS RTS	CCAFS VAFB	CCAFS VAFB
	Small	Small	Small	Unproven	Troubled	Unproven	Unproven	Unproven	Big & Expensive	



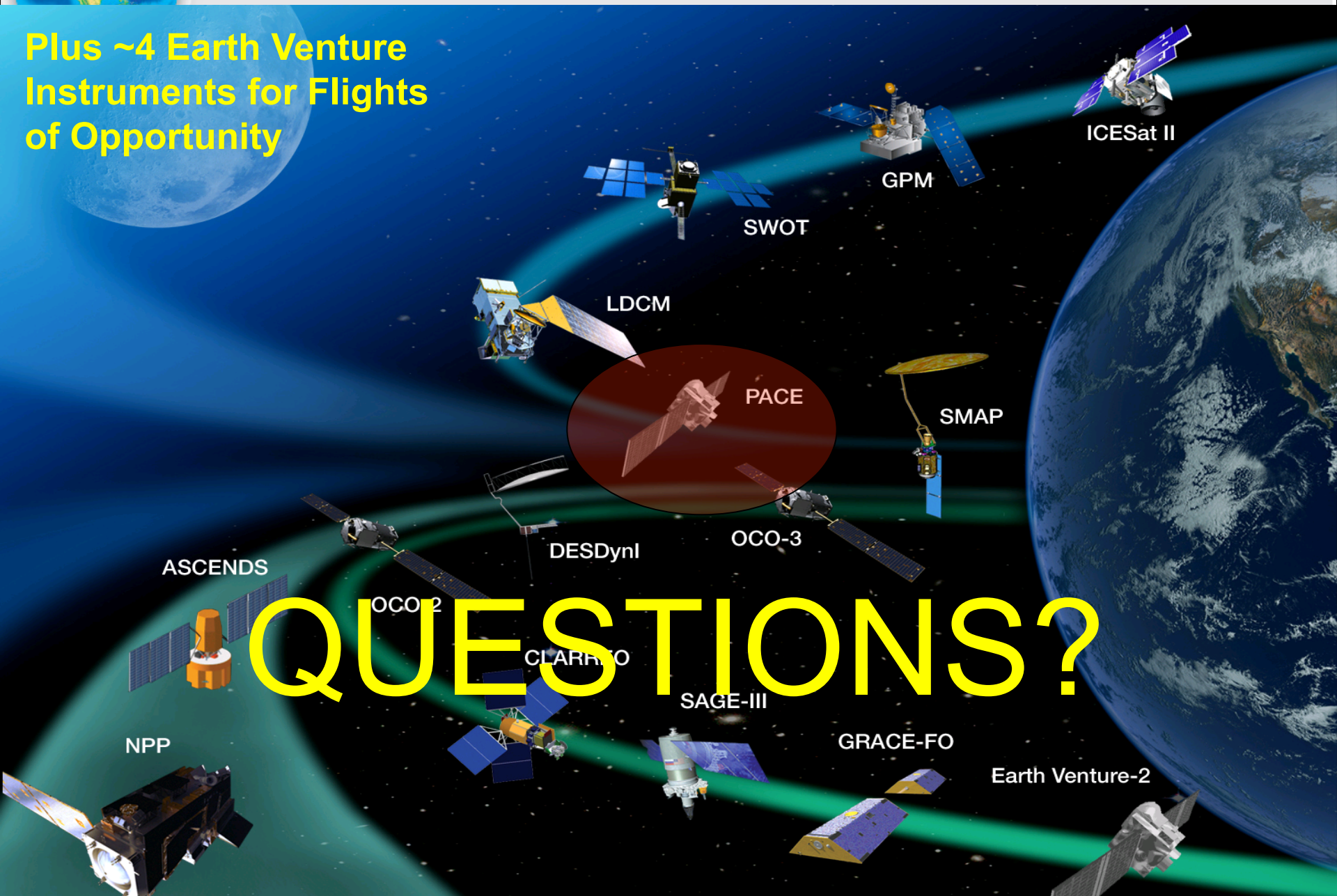
Partnerships

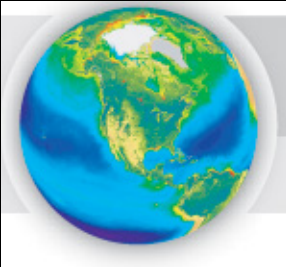
- Partnerships can definitely add to the mission's capabilities with a small increase in NASA's cost
- We have been discussing partnership opportunities with CNES and others for this mission
- We may also be able to "contribute" elements of this mission from other internal sources, such as EV-Instrument if a highly qualified and appropriate instrument is selected

- The SDT-defined science objectives should be developed independent of any thought of potential partnerships
  - Mission science objectives stand on their own, and not be written because Agency A can deliver something to NASA for free
  - Greater or lesser (but still viable) mission objectives may require different measurement capabilities

- NASA will work with potential partners and decide if a contributed element will be included in PACE, and
- NASA will define the ultimate instrument complement to be included in PACE

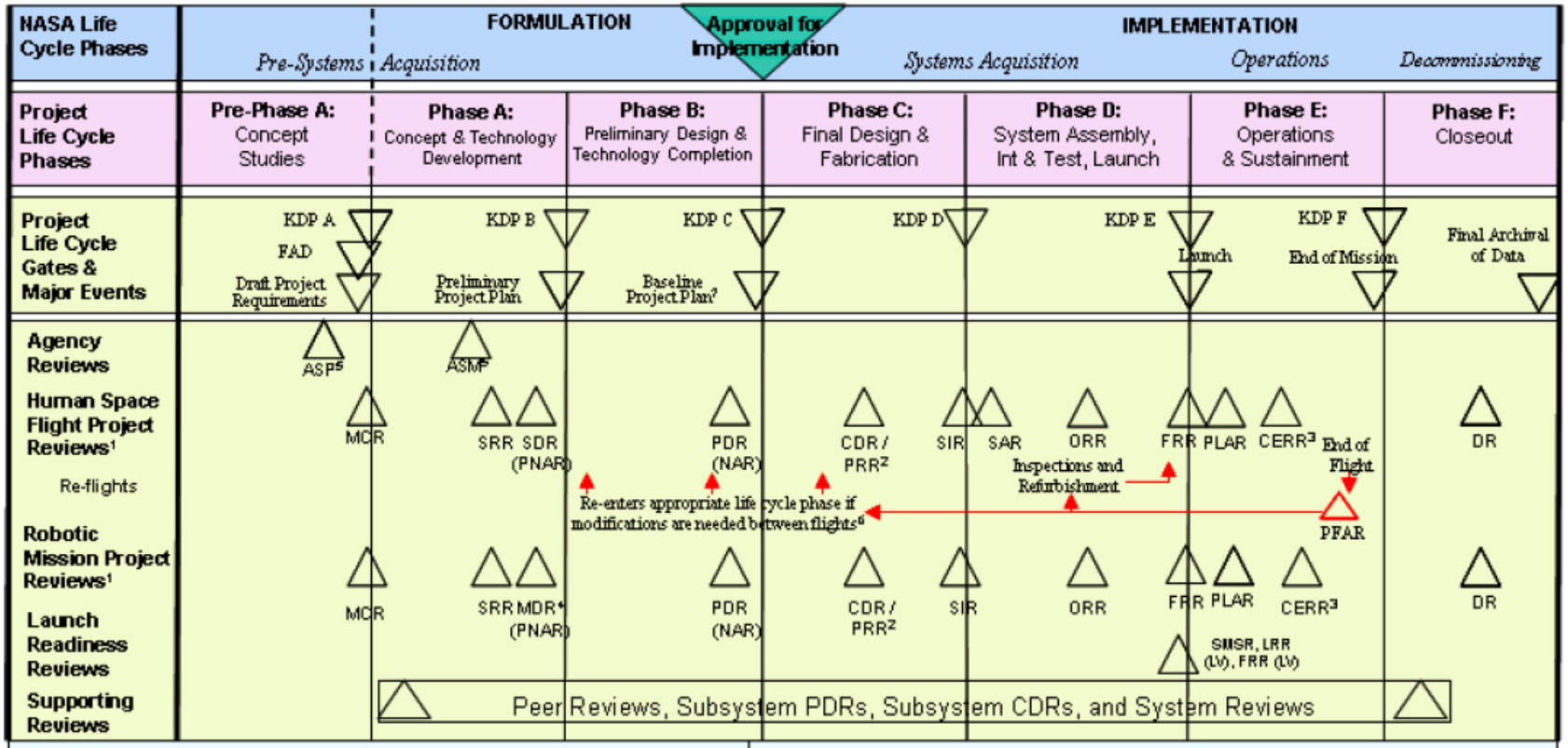
NASA Planned New Missions (2011-2022)





BACK-UP

Flight Project Life Cycle



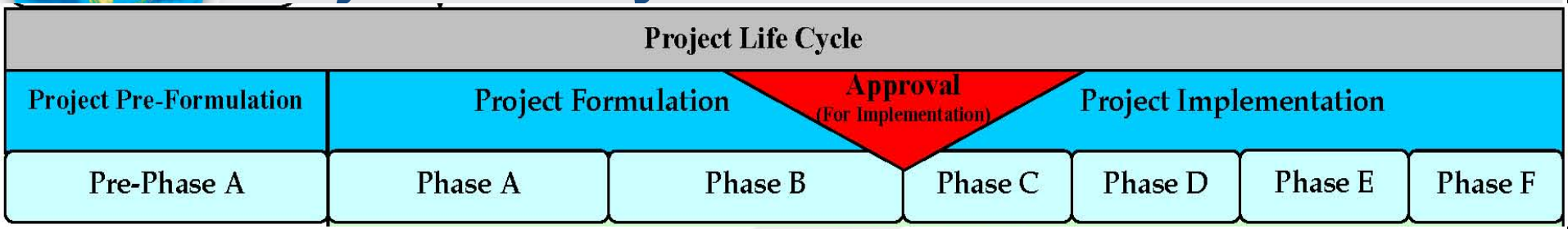
FOOTNOTES

1. Flexibility is allowed in the timing, number, and content of reviews as long as the equivalent information is provided at each KDP and the approach is fully documented in the Project Plan. These reviews are conducted by the project for the independent SRB. See Section 2.5 and Table 2-6.
2. PRR needed for multiple (≥4) system copies. Timing is notional.
3. CERRs are established at the discretion of Program Offices.
4. For robotic missions, the SRR and the MDR may be combined.
5. The ASP and ASM are Agency reviews, not life-cycle reviews.
6. Includes recertification, as required.
7. Project Plans are baselined at KDP C and are reviewed and updated as required, to ensure project content, cost, and budget remain consistent.

ACRONYMS

ASP—Acquisition Strategy Planning Meeting
ASM—Acquisition Strategy Meeting
CDR—Critical Design Review
CERR—Critical Events Readiness Review
DR—Decommissioning Review
FAD—Formulation Authorization Document
FRR—Flight Readiness Review
KDP—Key Decision Point
LRR—Launch Readiness Review
MCR—Mission Concept Review
MDR—Mission Definition Review
NAR—Non-Advocate Review
ORR—Operational Readiness Review
PDR—Preliminary Design Review
PFAR—Post-Flight Assessment Review
PLAR—Post-Launch Assessment Review
PNAR—Preliminary Non-Advocate Review
PRR—Production Readiness Review
SAR—System Acceptance Review
SDR—System Definition Review
SIR—System Integration Review
SMSR—Safety and Mission Success Review
SRR—System Requirements Review

Missions Distributed by NASA Flight Project Life Cycle



Pre-Phase A	Phase A	Phase B	Phase C	Phase D	Phase E	Phase F
NASA: DESDynI CLARREO SWOT ASCENDS ACE GEO-CAPE HysplRI PACE QuikSCAT FO **9**	NASA: SAGE III GRACE FO(soon) **2**	NASA: SMAP ICESat-2 **2**	NASA: GPM LDCM OCO-2 EV-1 **4**		**NASA Prime:** NPP Aquarius **Extended:** Aura OSTM Aqua Terra TRMM Jason EO-1 QuikSCAT SORCE Acrimsat CALIPSO CloudSat GRACE **15**	
NASA/NOAA:	NASA/NOAA: JPSS-1	NASA/NOAA: Jason-3	NASA/NOAA: GOES-R/S TSIS CERES FM6			