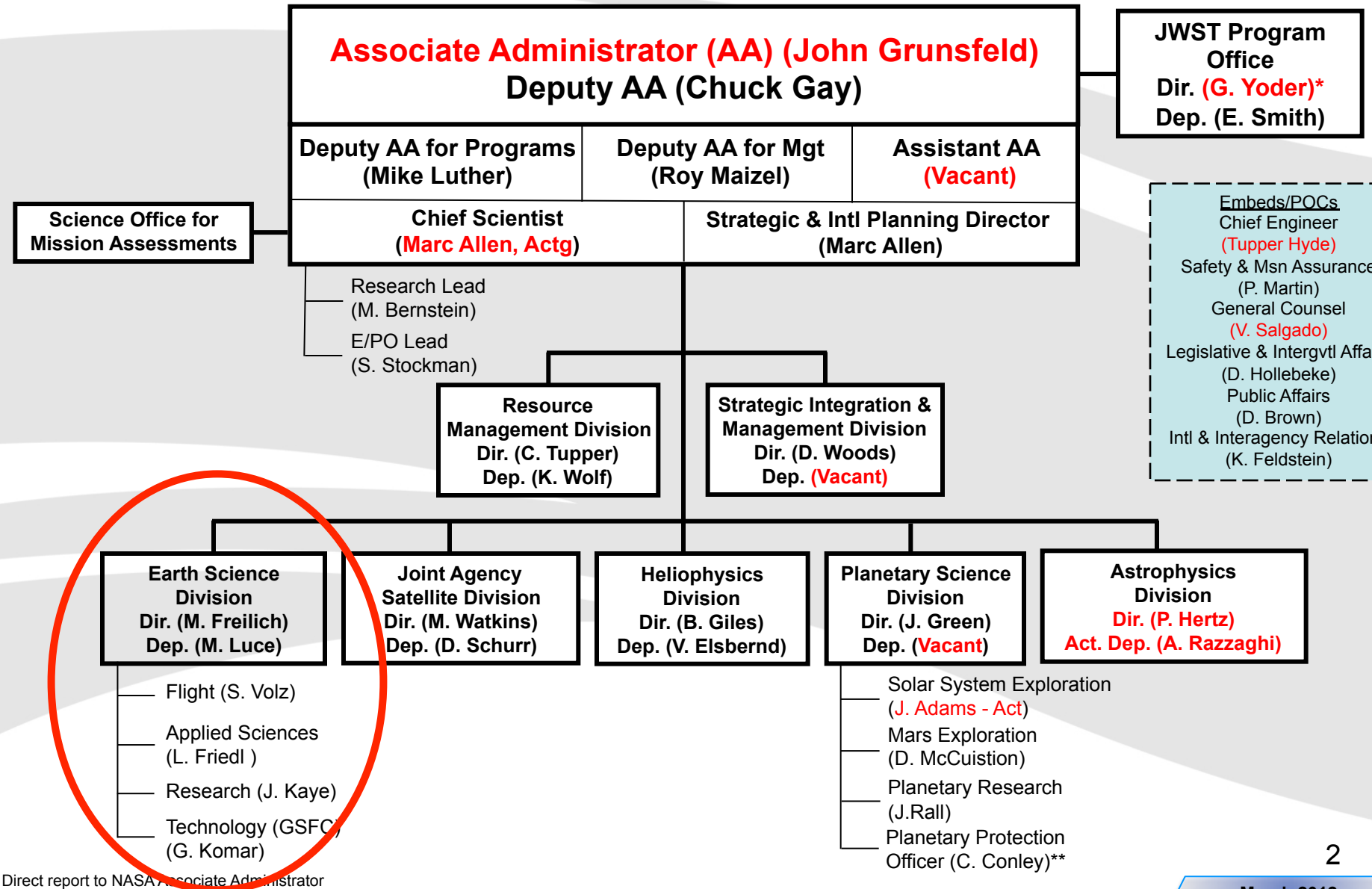
National Aeronautics and Space Administration

NASA's Earth Science Program
Overview for the HySPIRI Science Team

M. H. Freilich
16 October 2012

SMD Organization



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

ESD Operating Missions

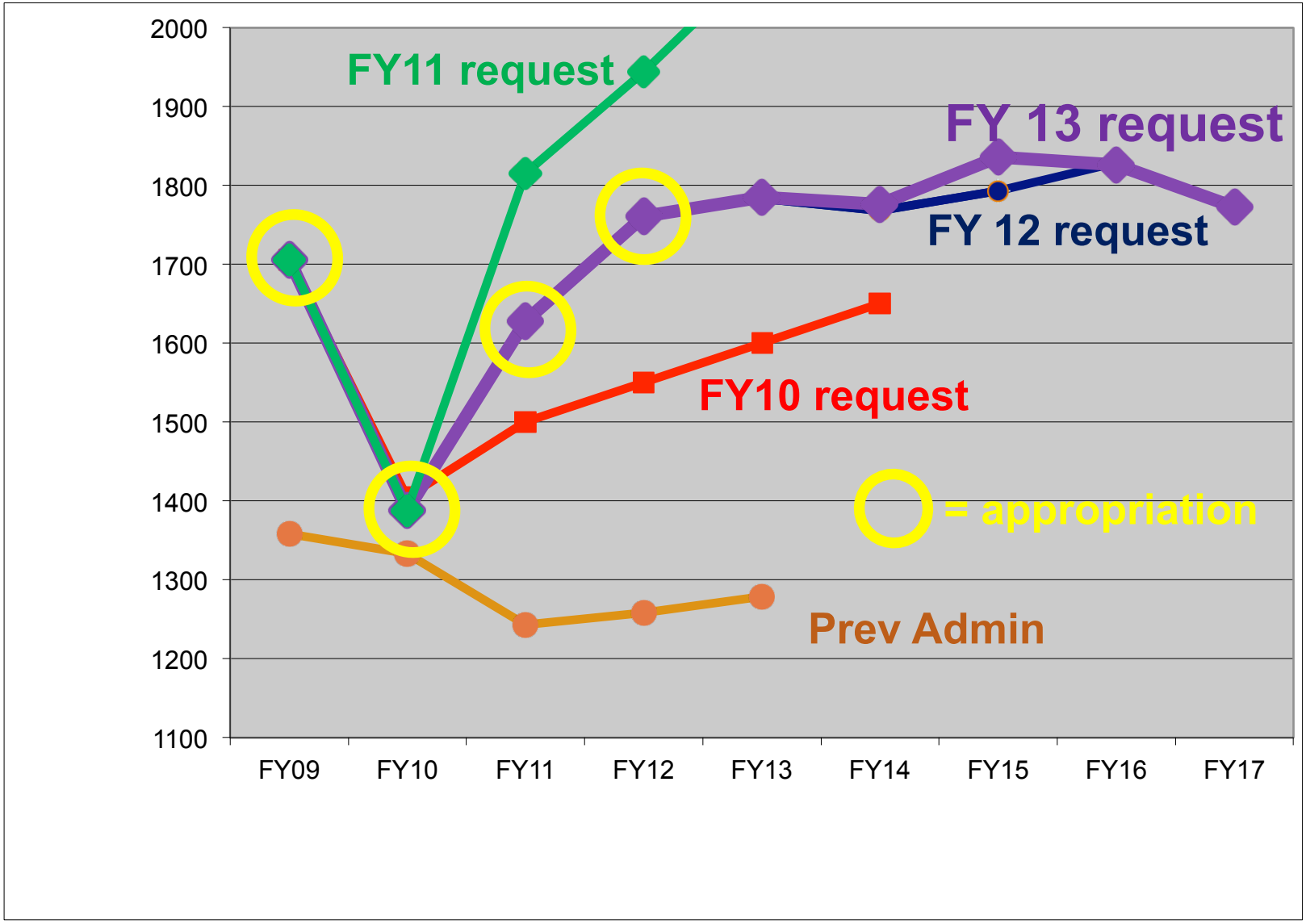
NASA “Highlights” Page from Budget Document

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

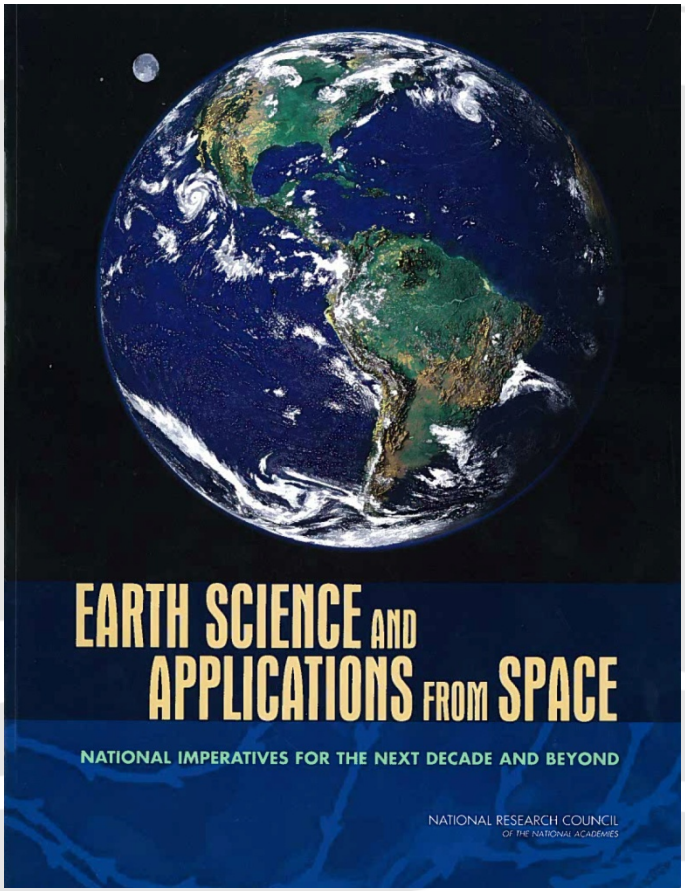
Funding Highlights:

- Provides $17.7 billion, a decrease of 0.3 percent, or $59 million, below the 2012 enacted level. While making difficult choices, the Budget builds on our existing space infrastructure, continues efforts to streamline agency operations, and preserves innovative capabilities and technologies to sustain American leadership in space.
- Implements a lower cost program of robotic exploration of Mars that will advance science and will also help lay the foundation for future human exploration.
- Invests in new space technologies, such as laser communications and zero-gravity propellant transfer, which can improve America’s ability to access and operate in space and enhance the competitiveness of the U.S. space industry.
- Leverages a Federal investment of $830 million and private sector investment and ingenuity to develop a U.S. capability to transport crews into space, thereby eliminating our dependence on foreign capabilities in this area.
- Provides continued robust funding for the development of a new heavy-lift rocket and crew capsule that will take America deeper into space than ever before, create American jobs, ensure continued U.S. leadership in space exploration, and inspire people around the world.
- Provides $1.8 billion for research and a robust fleet of Earth observation spacecraft to strengthen U.S. leadership in the field, better understand climate change, improve future disaster predictions, and provide vital environmental data to Federal, State, and local policymakers.
- Funds the highest priority astronomical observatories and robotic solar system explorers, including a successor to the Hubble telescope and a mission to return samples from an asteroid, while delaying unaffordable new missions.
- Continues the effort to turn NASA’s former Space Shuttle launch facilities at the Kennedy Space Center in Florida into a 21st Century launch complex so that they can efficiently support programs like the Space Launch System and commercial operators.
- Streamlines agency operations, resulting in over $200 million in savings.

Earth Science Budget – FY13 Request

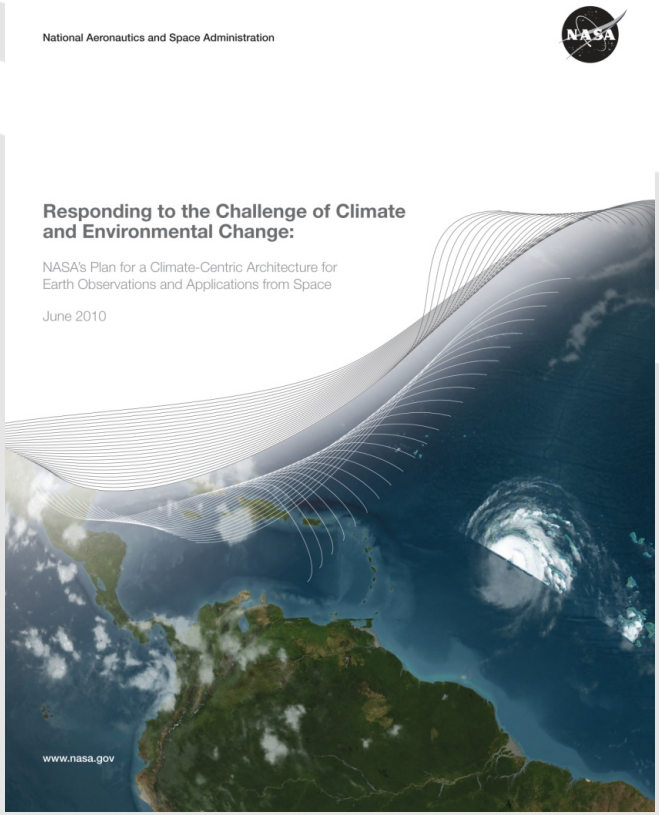


Guiding Recommendation Documents



Administration priorities and constraints

Decadal survey,
OCO-2,
climate continuity missions,
balanced program
Integrated Program



2007 Decadal Survey

- Research and Applications communities priorities
- No realistic budget constraint (calls for $2B funding [FY06 constant $$ beginning in FY10)

http://science.nasa.gov/media/medialibrary/2010/07/01/Climate_Architecture_Final.pdf

- Dec Surv + Administration priorities
- Executable for FY11 Pres. Bud.
- OSTP, USGCRP, OMB approval

VENTURE-CLASS UPDATE/STATUS

- **Venture-Class is a Tier-I Decadal Survey recommendation**
  - Science-driven, PI-led, competitively selected, cost- and schedule-constrained, regularly solicited, orbital and suborbital
  - Venture-class investigations complement the systematic missions identified in the Decadal Survey, and provide flexibility to accommodate scientific advances and new implementation approaches

- **Venture-Class is fully funded, with 3 "strands"**
  - EV-1: suborbital/airborne investigations (5 years duration)
    - Solicited in FY09 (selections in FY10) ***and every 4 years***
    - 5 investigations selected; flights began in FY11
  - EV-2: small complete missions (5 years duration)
    - Solicited in FY11 (selections in FY12) ***and every 4 years***
    - Small-sat or stand-alone payload for MoO; $150M total development cost
    - AO released 17 June, proposals received 29 Sept 2011, CYGNSS selected July 2012
  - EV-Instrument: Spaceborne instruments for flight on MoO (5 years dev.)
    - Solicited in FY11 (selections in CY12) ***and every 15-18 months thereafter***
    - Final AO release Feb 7; proposals received May 2012 (Ken Jucks is POC)
    - ~$90M development costs, accommodation costs budgeted separately

ESD Orbital Flight Portfolio – 2012-2022

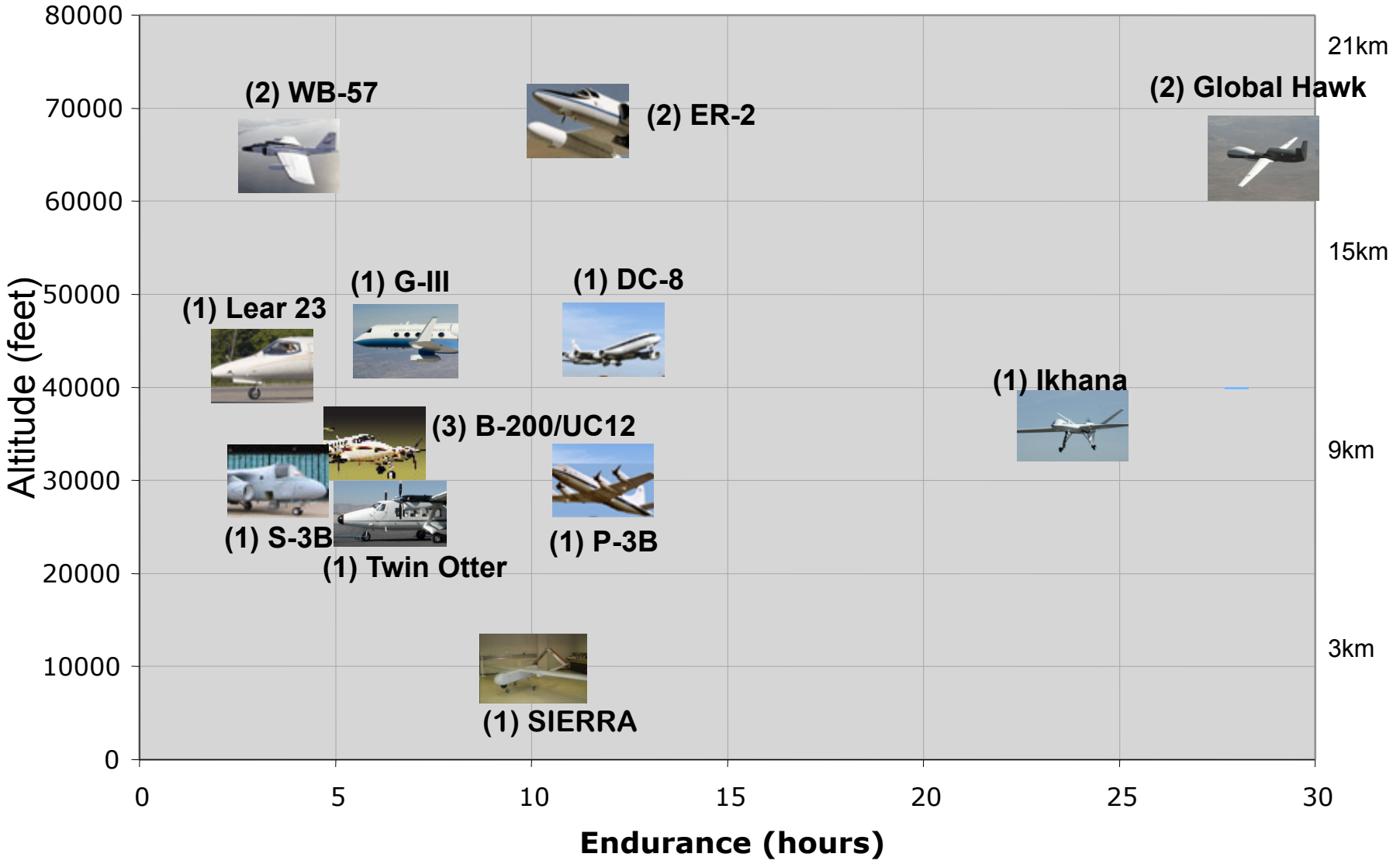
- **LDCM** (2/2013) – "Landsat-8" including thermal IR, w/USGS
- **GPM** (2/2014) – Global Precipitation mapping, w/JAXA
- **OCO-2** (7/2014) – Atmospheric CO2 monitoring, recovery mission
- **SAGE-III/ISS** (8/2014) – Ozone, Temp, Humidity profiles, w/HEOMD, ESA
- **SMAP** (10/2014) – Soil Moisture and Freeze/Thaw cycling, w/CSA (minor)
- **ICESat-2** (mid-2016) – Precision Ice Topography, Ecosystem monitoring
- **GRACE-FO** (8/2017) – Gravity/Ice Mass/Ground Water, w/GFZ & DLR
- ***OCO-3/ISS*** *(Fall 2017)* – CO2 continuity, from ISS, OCO-2 spares
- ***CYGNSS*** *(late 2016/2017)* – Venture small-sat, GPS winds in cyclones
- ***EV-Instrument/1 Venture-Class*** *(NLT 2018)*
- **SWOT** (10/2020) – Wide-swath ocean altimetry, land water, w/CNES
- ***PACE*** *(2020)* – Ocean Color and Aerosols, possibly w/ESA
- ***EV-Instrument/2 Venture-Class*** *(NLT 2020)*
- ***L-band SAR*** *(2021)* – Solid Earth, Cryosphere, Ecosystems, w/ISRO/CSA
- ***CLARREO*** *(2022?)* – Precise global radiation balance, possibly w/UK
- ***EV-Instrument/3*** *(NLT 2022)*
- "Flight-like" Airborne Missions: **ICEBRIDGE** (2009-2017)

ESD Orbital Flight Portfolio – 2012-2020

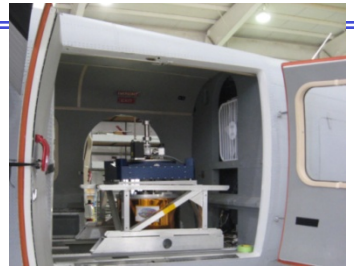
• **LDCM**	Feb 2013	Atlas-5	(USGS)
• **GPM**	Feb 2014	H-IIA	(JAXA)
• **OCO-2**	July 2014	Delta-2	
• **SAGE-III/ISS**	Aug 2014	Falcon-9	(HEOMD,ESA,ISS)
• **SMAP**	Oct 2014	Delta-2	(CSA)
• **ICESat-2**	mid-2016	Draft RLSP released	
• **CYGNSS**	late-2016	*Pegasus ?*	(Venture-class)
• **GRACE-FO**	Aug 2017	*Partner*	(GFZ, DLR)
• ***OCO-3/ISS***	*Fall, 2017*	*Falcon-9 ?*	*(HEOMD, ISS)*
• **EV-Instrument/1**	NLT 2018	---	(Venture-Class)
• ***PACE***	*2019/2020*	*??*	
• **SWOT**	2020	??	(CNES, *CSA*)
• ***EV-Instrument/2***	*NLT 2020*	---	*(Venture-Class)*

- "Flight-like" Airborne Missions: **ICEBRIDGE** (2009-2017)

NASA Airborne Science Aircraft

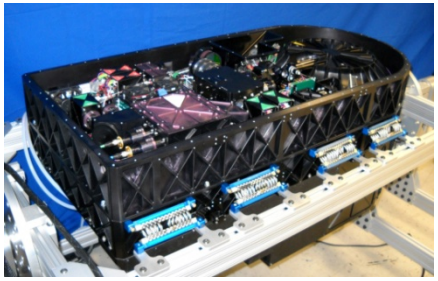


Technology Highlight
Several New Instruments See First Airborne Flights

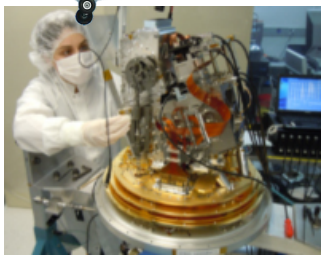


July 2012: Hyperspectral Thermal Emission Spectrometer (HyTES) – an instrument that aims to provide high spatial and spectral resolution thermal land imaging data – was integrated and flown on a Twin Otter *(PI: Simon Hook, JPL, IIP-07)*

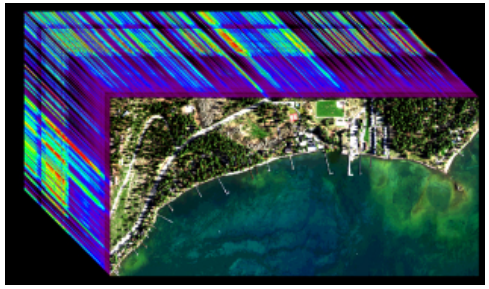
July 2012: High Spectral Resolution Lidar (HSRL-2) – a new HSRL instrument developed as a prototype for the lidar on the ACE mission concept. HSRL-2 flew on the NASA B200 as part of the DOE's Two-Column Aerosol Project (TCAP). HSRL-2 is also slated to participate in NASA's DISCOVER-AQ campaign in early 2013. *(PI: Chris Hostetler, NASA LaRC, IIP-04 / AITT-09)*



July 2012: Airborne Scanning Microwave Limb Sounder (A-SMLS) – a prototype of a next-generation MLS for measuring trace species in the upper troposphere – completed test flights near Houston, Texas, on the NASA WB-57. A-SMLS successfully acquired ozone measurements and can be configured for a variety of other trace species. (*PI: Paul Stek, JPL, IIP-07)*



April 2012: Next Generation AVIRIS (Airborne Visible/Infrared Imaging Spectrometer), AVIRIS-NG – a new instrument developed to support NASA's Terrestrial Ecology Program – successfully completed its first flight onboard NASA's Twin Otter aircraft. The data AVIRIS-NG collects could be used as a precursor data-set for the HyspIRI mission. (*PI: Robert O. Green, JPL, ATI-09)*



May – July 2012: Portable Remote Imaging Spectrometer (PRISM) coastal ocean airborne sensor completed its first test and calibration flight over Ivanpah Playa and Lake Tahoe, CA. PRISM's sensitivity, dynamic range, and polarization properties are specifically designed for the challenges of the coastal ocean environment. Currently conducting validation flights over Monterrey Bay. (*PI: Pantazis Mouroulis, JPL, ATI-09)*