NASA Future Missions

CGMS-39 White Paper, October 2011

With the U.S. President's FY2012 budget request ($1.6B in 2012), NASA's Earth Science Program is implementing a balanced and robust plan to accomplish a broad set of critical Earth observation measurements from space. The program advances knowledge of the integrated Earth system, the global atmosphere, oceans (including sea ice), land surfaces, ecosystems, and interactions between all elements, including the impacts of humans. A balance of satellite measurements, science research, technology development and applications are needed to address a complex global Earth system. Table-1 summarizes NASA's plans through 2020 for the launch of 10 missions and 2 instruments.

Mission	Launch Readiness	Partners	Instruments	Science
NPP	Oct 2011	NOAA, DoD (USA)	CrIS, CERES, VIIRS, ATMS, OMPS	Operational polar weather and climate
LDCM	Dec 2012	USGS	OLI, TIRS	Earth resources, land surface, environmental and disaster monitoring, agriculture and forestry, ice and snow cover
OCO-2	Feb 2013		Spectrometer	Carbon Dioxide sources and sinks
GPM Core	Jul 2013	JAXA	GMI, DPR	Global precipitation, evaporation, water cycle
SMAP	Nov 2014		L-Band Radar, L-Band Radiometer	Soil Moisture, Freeze-thaw state
SAGE-III Space Station (ISS) Instrument only	Nov 2014	SOMD	Spectrometer	Stratospheric ozone, aerosols, water vapor
OCO-3 Instrument only	2015		Spectrometer	Carbon Dioxide sources and sinks
ICESat-II	2015		ATLAS	Ice sheet thickness, sea ice thickness, vegetation height, carbon and biomass
GRACE FO (Follow-On)	2016	DLR	Gravity, GPS	Ocean currents and mass, ice sheets, GPS (Pressure,Temperature,Humidity)
SWOT	2019	CNES, USGS	CO Sensor, Ka-Band Radar Interferometer	Lake levels, river discharge, ocean surface topography
ASCENDS	2019		Laser	Carbon Dioxide (day and night)
PACE (Pre-ACE)	2019	CNES, ESA	Spectrometer, Polarimeter	Aerosols, ocean color

Table 1. NASA's Future Missions and Instruments through 2020

NASA continues development of its near-term Foundational Missions, identified by the National Research Council (NRC) Earth Science Decadal Survey as necessary precursors to the new measurements to be flown on subsequent missions. These missions include the NPOESS Preparatory Project (NPP), Landsat Data Continuity Mission (LDCM), and the core Global Precipitation Measurement (GPM Core) mission. Two other Foundational Missions include Glory and Aquarius. The Glory spacecraft, focused on the measurement of aerosols and solar

irradiance to address the Earth's energy balance, failed to reach orbit after launch on March 4, 2011. NASA is currently investigating this failure and has no plans in place for a Glory replacement mission. The NASA Aquarius/SACD-D Mission, focused on sea-surface salinity, was successfully launched on June 10, 2011 and is undergoing typical commissioning procedures prior to sustained science operations.

The FY2012 budget enables launch of the first two Tier-1 Decadal Survey missions, Soil Moisture Active-Passive (SMAP) and Ice, Cloud, and Land Elevation Satellite (ICESat)-2, by CY 2016 and expands the Venture-class competitive program with annual solicitations for facility-class instruments and alternating biannual solicitations for small missions and airborne investigations. The budget supports continued development of options for the Decadal Survey's Tier-1 Deformation, Ecosystem Structure, and Dynamics of Ice (DESDynI) Radar satellite. Two climate-focused Tier-2 Decadal Survey missions--Surface Water and Ocean Topography (SWOT) for insight into the movement and distribution of fresh surface water, and Active Sensing of Carbon dioxide Emissions over Nights, Days and Seasons (ASCENDS) for atmospheric column carbon dioxide (CO2) abundance--have been initiated for launch in 2019-2020. Recognizing the broad societal and policy impact of NASA's Earth observations, NASA will continue to develop the Orbiting Carbon Observatory (OCO)-2 for launch in 2013, begin building OCO-3 as a mission of opportunity, and initiate missions to continue climate time series. NASA will refurbish a Stratospheric Aerosols and Gas Experiment III (SAGE III) instrument for flight on the ISS as early as 2014, develop the Pre-Aerosols, Carbon and Ecosystems (PACE) mission for ocean color, and initiate a Gravity Recovery and Climate Experiment (GRACE) Follow-on gap-filler mission for launch in 2016 (in collaboration with the German space agency, DLR) to continue the measurements, including observations of changes in terrestrial water storage and ice mass, now made by the aging GRACE mission.

Venture-Class Missions

The Earth Venture-class (EV) missions are part of a competitive program to select small instruments, small satellites, or airborne science campaigns to complement the larger NASA Earth science missions. In FY 2012, NASA will continue the five airborne science investigations selected through the initial Venture Class solicitation (EV-1) in FY 2010 and started in FY 2011. NASA will complete the evaluation and selection of winning proposals from two additional Earth Venture AO calls. The second Earth Venture AO call, EV-2, for small complete satellite missions will be released in FY 2011, and the initial annual call (EV-Instrument) for instruments of opportunity in support of the Climate Initiative will be released early in FY 2012. The winning proposals for each call will be selected during FY 2012. The target small mission launch date will be no more than five years after selection, and the anticipated instrument delivery as early as FY 2016 or FY 2017 (depending on the complexity of the instrument selected).

Earth Science Technology

The Earth Science Technology Program (ESTP), with an annual budget of approximately $45M, develops new remote-sensing and information systems technologies for infusion into future science missions in order to enable, or dramatically enhance, measurements and data system capabilities. A key goal of the program is to support the core Earth Science missions as defined by the Decadal Survey, along with other climate-monitoring missions that are part of the architecture plan. There are three technology focus areas supported by the ESTP: Instrument Incubator Program (IIP), Advanced Information Systems Technology (AIST) Program, and Advanced Component Technologies (ACT) Program. A summary of the current technology investments and their link to future NASA missions is shown in Table 2. Additional information about ESTP investments can be found at: http://esto.nasa.gov

Mission	IIP 2007	IIP 2010	AIST 2010	ACT 2010
SMAP			3	1
ICESat-II				2
CLARREO	3		1	1
DESDynI	1	1	6	3
SWOT	1	1		5
ASCENDS	2	2	1	4
HyspIRI	2	1	2	2
GEO-CAPE	2	3	2	3
ACE	3	4	3	6
LIST	1			2
PATH	1	1		1
GRACE-II	1	1		
SCLP	1	1		1
GACM	1	1		3
3D Winds	2		2	5

Table 2. NASA's Earth Science Technology Investments

Note 1: Each of the numbers in the table represents the quantity of tasks directly related to a mission. The total number of tasks within each investment area is IIP-2007 (21 tasks), IIP-2010 (16 tasks), AIST (20 tasks), and ACT (17 tasks). Some tasks directly relate to more than one mission.

Note 2: Several listed missions are Tier-2 and Tier-3 concepts that are not included in the funded set of missions shown in Table-1.