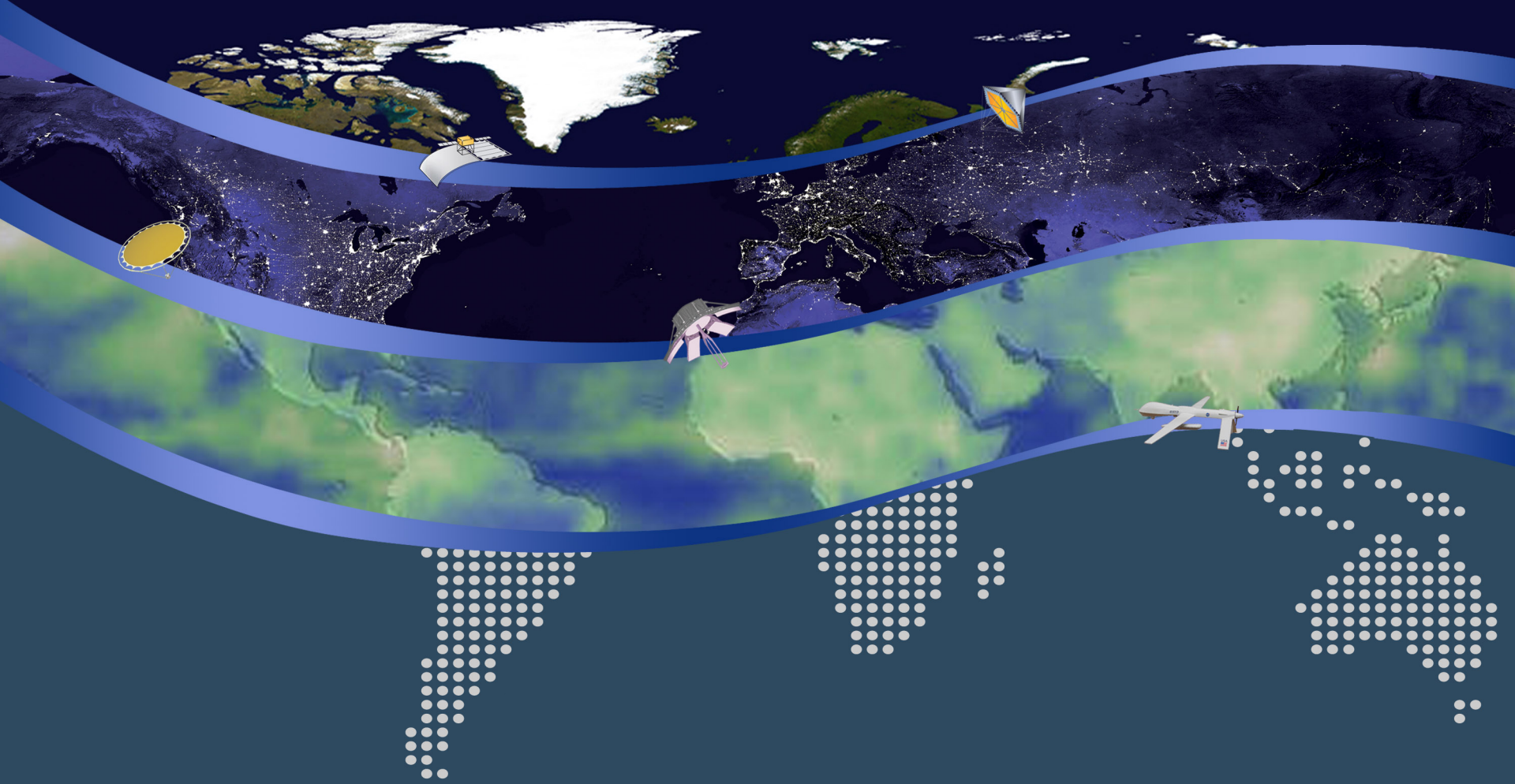


NASA Update

Earth Science Technology Forum
ESTF 2014

October 29, 2014

George J. Komar
Associate Director/Program Manager
NASA Earth Science Technology Office

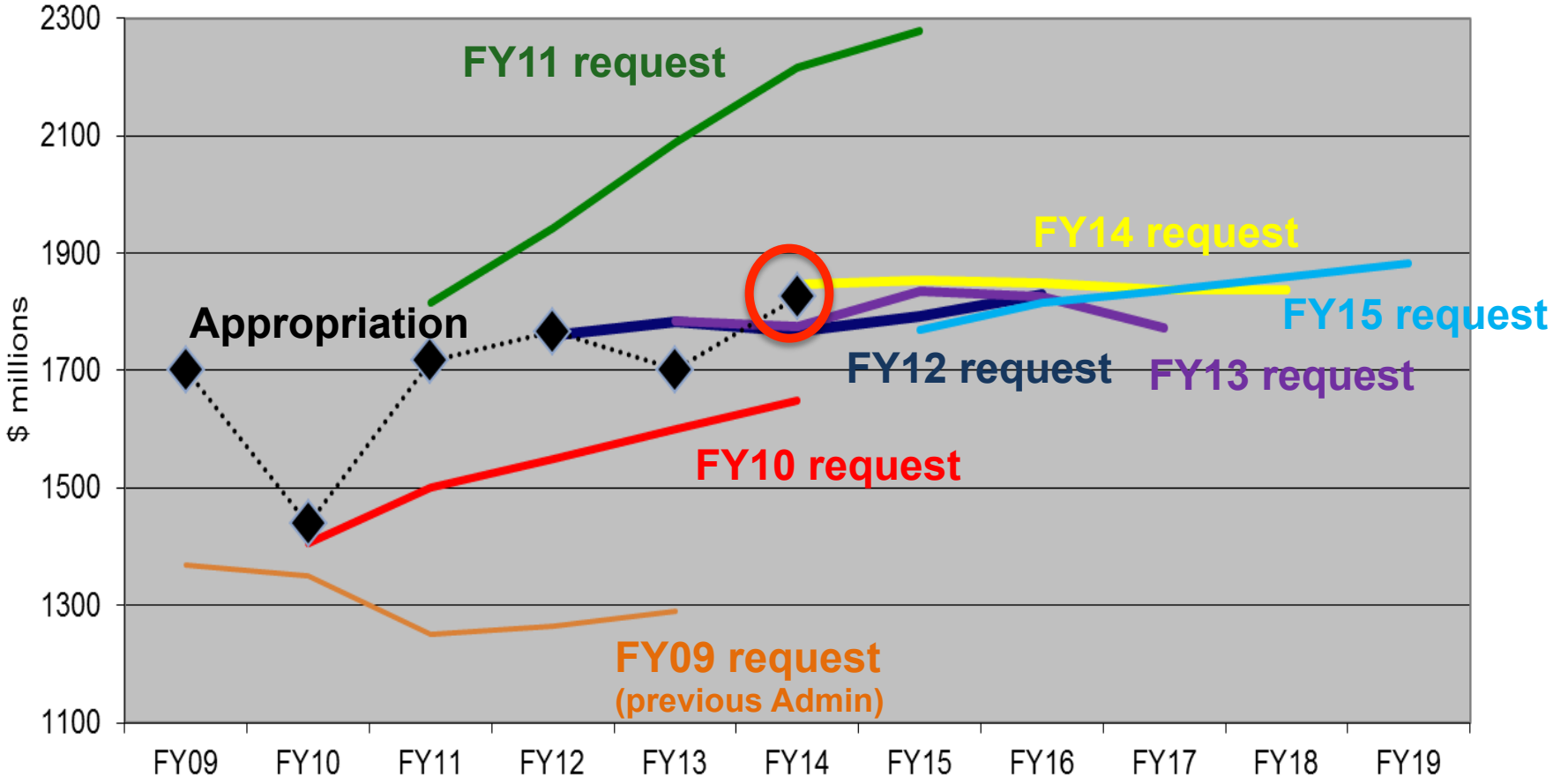
Introduction

- *Earth Science Overview*
- *Planned Future Activities*
- *Earth Science Technology*
- *Future Directions*

Strategy

- *Maintain a balanced program*
- *Advance overall Earth System Science*
- *Deliver societal benefits through Application Development*
- *Develop and demonstrate technologies for next generation of measurements*
- *Provide essential global spaceborne measurements now and in the future supporting science and operations*
- *Complement and coordinate with activities of other agencies and international partners*

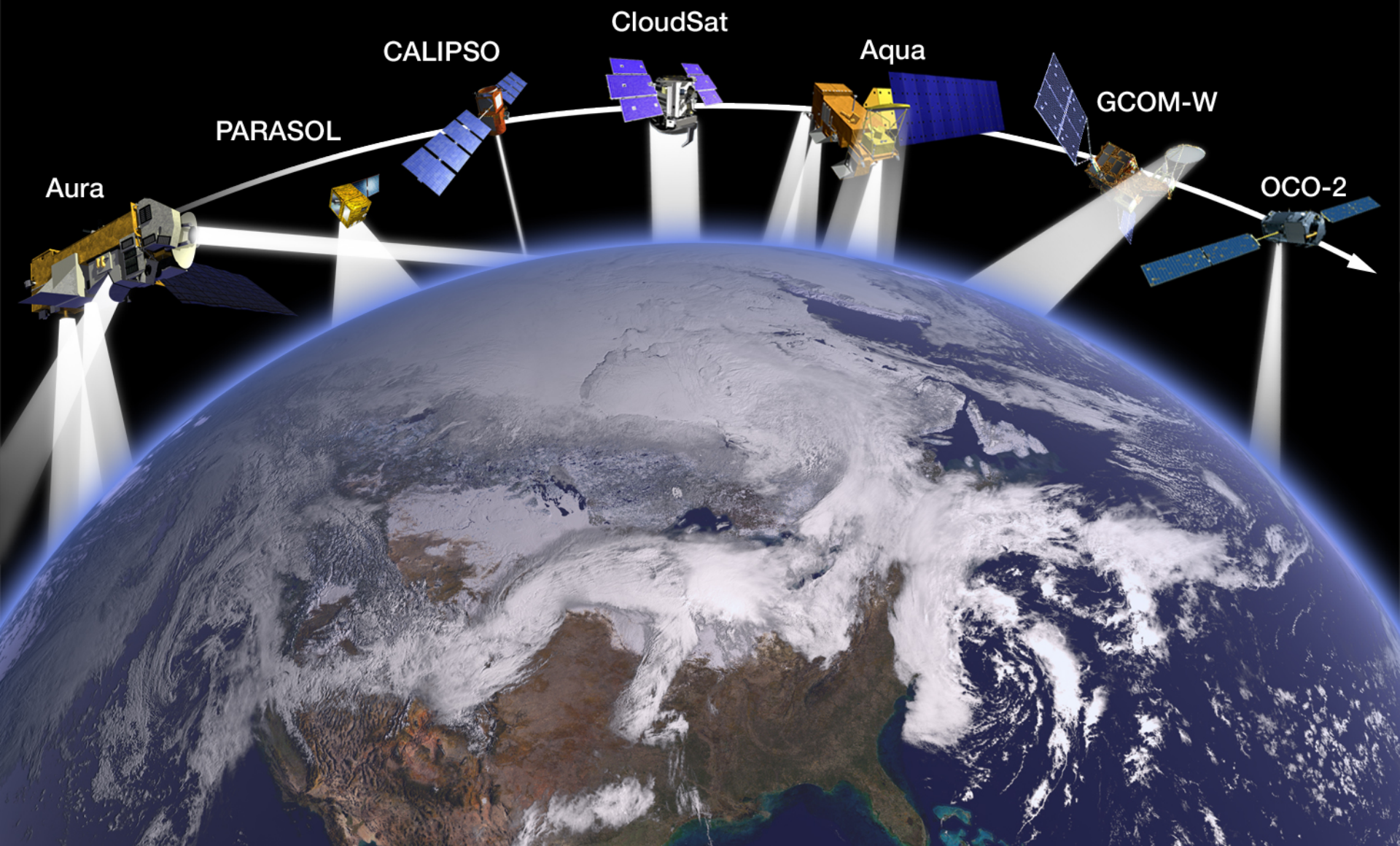
Earth Science Budget: FY15 Request/Appropriation




Formulation
Implementation
Primary Ops
Extended Ops
SLI-TBD
Formulation in 2015
JPSS-2 (NOAA)
RBI
OMPS-Limb
[[TSIS-2]]
NI-SAR
PACE
SWOT
TEMPO
GRACE-FO (2)
ICESat-2
CYGNSS
RapidScat, CATS,
LIS, SAGE III (on ISS)
SMAP
SORCE
TRMM
QuikSCAT
[[TCTE]]
EO-1
Landsat-7
(USGS)
Aquarius
Terra
Suomi NPP
(NOAA)
Aqua
Landsat-8
(USGS)
CloudSat
CALIPSO
GPM
Aura
GRACE (2)
OSTM/Jason 2
(NOAA)
OCO-2

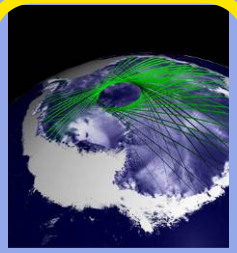
2 ESD-developed EO missions launch in 2014
2 ISS-developed EO instruments in 2014, 1 in 2016
10 more ESD EO launches before 2022

A-Train

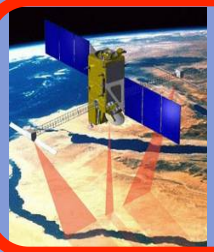


NASA Earth Science Decadal Survey Measurements

Soil Moisture Active Passive **(SMAP)**

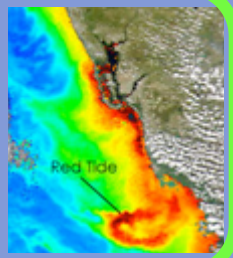


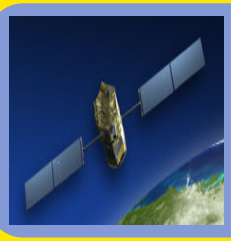
Ice, Cloud,and land Elevation Satellite II **(ICESat-II)**



Surface Water and Ocean Topography **(SWOT)**

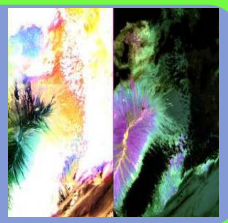
Pre-Aerosol - Cloud - Ecosystems ***(PACE)***





Active Sensing of CO2 Emissions **(ASCENDS)**

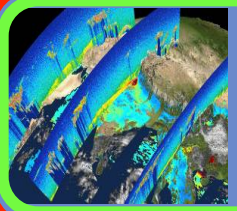
Hyperspectral Infrared Imager **(HYSPIRI)**



Geostationary Coastal and Air Pollution Events **(GEO-CAPE)**

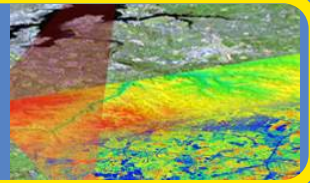
Deformation, Ecosystem Structure and Dynamics of Ice (Radar) **(DESDynI -R)**

Climate Absolute Radiance and Refractivity Observatory **(CLARREO)**



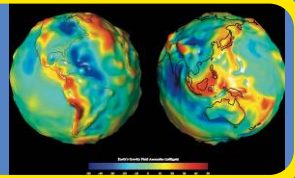
Aerosol - Cloud - Ecosystems **(ACE)**

LIDAR Surface Topography **(LIST)**



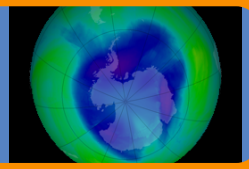
Precipitation and All-Weather Temperature and Humidity **(PATH)**

Gravity Recovery and Climate Experiment - II **(GRACE - II)**



Snow and Cold Land Processes **(SCLP)**

Global Atmospheric Composition Mission **(GACM)**



Three-Dimensional Winds from Space Lidar **(3D-Winds)**

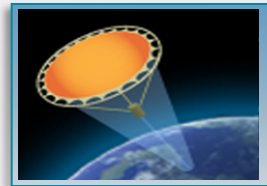
Lasers | Radars | Passive Optics | Passive Microwave

Technology Program Thrust

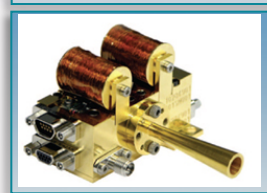
The Earth Science Technology Office (ESTO) is a ***targeted, science-driven, competed, actively managed, and dynamically communicated technology program*** and serves as a model for technology development.

Competitive, peer-reviewed proposals enable selection of best-of-class technology investments that ***retire risk*** before major dollars are invested: a cost-effective approach to technology development and validation. ESTO investment elements include:

Observation



Instrument Incubator Program (IIP)
provides robust new instruments and measurement techniques
15 new projects added in FY14 (total funding approximately $72M over 3 years)



Advanced Component Technologies (ACT)
provides development of critical components and subsystems for instruments and platforms
15 new projects added in FY11 (total funding approximately $16M over 3 years)

Information

Advanced Information Systems Technology (AIST)
provides innovative on-orbit and ground capabilities for communication, processing, and management of remotely sensed data and the efficient generation of data products
18 new projects added in FY12 (total funding approximately $23M over 3-4 years)

Validation

In-Space Validation of Earth Science Technologies (InVEST)
provides in-space, orbital technology validation and risk reduction for small instruments and instrument systems that could not otherwise be fully tested on the ground or in airborne systems *4 new projects added in FY13 (total funding approximately $13M over 3 years)*

Technology Program Budget/Schedule

($M)	FY15	FY16	FY17	FY18	FY19	FY20
Q	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
ROSES Solicitations	▲	▲	▲	▲	▲	▲
ATI/ACT Solicitation NRA Release	InVEST-15 ▲		ACT-17 ▲	(InVEST-18) ▲		ACT-20 ▲
Budget	16.8	13.1	14.1	15.0	15.0	15.2
IIP Solicitation NRA Release		IIP-16 ▲			IIP-19 ▲	
Budget	27.8	28.3	28.9	28.9	28.9	29.5
AIST Solicitation NRA Release		AIST-16 ▲		AIST-18 ▲		AIST-20 ▲
Budget	13.6	14.3	14.2	14.2	14.2	14.5
In-Guide Totals ($M)	**58.2**	**55.7**	**57.2**	**58.1**	**58.1**	**59.1**

Total ESD Budget ($M)	1,770	1,797	1,819	1,842	1,867	1,886
% of ESD Budget	3.3%	3.1%	3.1%	3.2%	3.1%	3.1%

Instrument Incubator Program (IIP)
2013 Solicitation Awards

17 proposals awarded in 1/2014
Total value approximately $71 million

ACTIVE

Microwave


Wide-swath Shared Aperture Cloud Radar (WiSCR)
- Lihua Li, GSFC

Three Band Cloud and Precipitation Radar (3CPR) - Gregory Sadowy, JPL

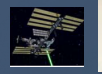

Enhancement, Demonstration, and Validation of the Wideband Instrument for Snow Measurement (WISM) - Tim Durham, Harris Corporation

Optical

HSRL for Aerosols, Winds, and Clouds using Optical Autocovariance Wind Lidar (HAWC-OAWL)
-Sara Tucker, Ball Aerospace


2-Micron Direct Detection Airborne Lidar For Simultaneous and Independent CO2 and H2O Colum Measurement
- Upendra Singh, LaRC

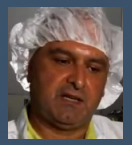
Multi-wavelength Ocean Profiling and Atmospheric Lidar
- Chris Hostetler, LaRC



Other

High Accuracy Vector Helium Magnetometer (HAVHM) –Andy Brown, Polatomic, Inc.

Cold Atom Gravity Gradiometer for Geodesy- Babak Saif, GSFC



PASSIVE

Microwave

UWBRAD: Ultra Wideband Software Defined Microwave Radiometer for Ice Sheet Subsurface Temperature Sensing
- Joel Johnson, Ohio State University

Snow and Water: Imaging Spectroscopy for coasts and snow cover (SWIS)
- Pantazis Mouroulis, JPL

A Compact Adaptable Microwave Limb Sounder for Atmospheric Composition - Nathaniel Livesey, JPL

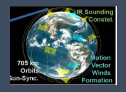

Wide-band Millimeter and Sub-Millimeter Wave Radiometer Instrument to Measure Tropospheric Water and Cloud ICE (TWICE)
- Steven Reising, Colorado State University

Ka-band Doppler Scatterometer for Measurements of Ocean Vector Winds and Surface Currents (DopplerScatt)
- Dragana Perkovic-Martin, JPL


Signals of Opportunity Airborne Demonstrator (SoOp-AD)
- James Garrison, Purdue University

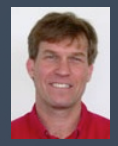
Optical

MISTiC Winds: Midwave Infrared Sounding of Temperature and Humidity in a Constellation for Winds - Kevin Maschhoff, BAE Systems




TIRCIS: A Thermal Infrared, Compact Imaging Spectrometer for Small Satellite Applications
- Robert Wright, University of Hawaii

Development of a Compact Solar Spectral Irradiance Monitor with High Radiometric Accuracy and Stability
- Erik Richard, University of Colorado

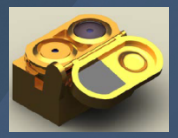


In-Space Validation of Earth Science Technologies Program (InVEST)
2012 Solicitation Awards

4 proposals awarded in 5/2013
Total value approximately $13 million

Passive Microwave

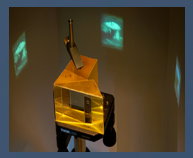
Advancing Climate Observation: Radiometer Assessment using Vertically Aligned Nanotubes (RAVAN)
- William Swartz, JHU-APL

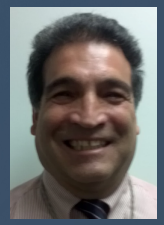


The Microwave Radiometer Technology Acceleration (MiRaTA) Cubesat
- Kerry Cahoy, MIT Space Systems Lab

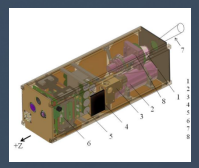
Passive Optical

HyperAngular Rainbow Polarimeter HARP-CubeSat
- Jose Valderlei Martins, University of MD





A Cubesat Flight Demonstration of a Photon Counting Infrared Detector (LMPC CubeSat)
-Renny Fields, Aerospace



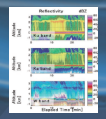
Airborne Instrument Technology Transition Program (AITT)
2012 Solicitation Awards

6 proposals awarded in 1/2014
Total value approximately $6 million

ACTIVE

Microwave

A three-frequency atmospheric radar for the NASA DC-8 aircraft
- Stephen Durden, JPL

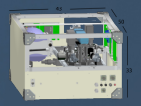


Optical

Flight Demonstration of Global Ozone Lidar Demonstrator (GOLD) Instrument on the B200 and Global Hawk
- Johnathan Hair, LaRC

Other

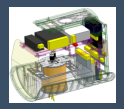
High Altitude In Situ Airborne Formaldehyde
- Thomas Hanisco, GSFC



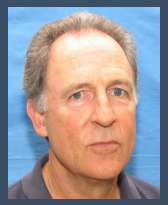
PASSIVE

Optical

Upgrading HyTES to Campaign-Ready Configurations
- Simon Hook, JPL



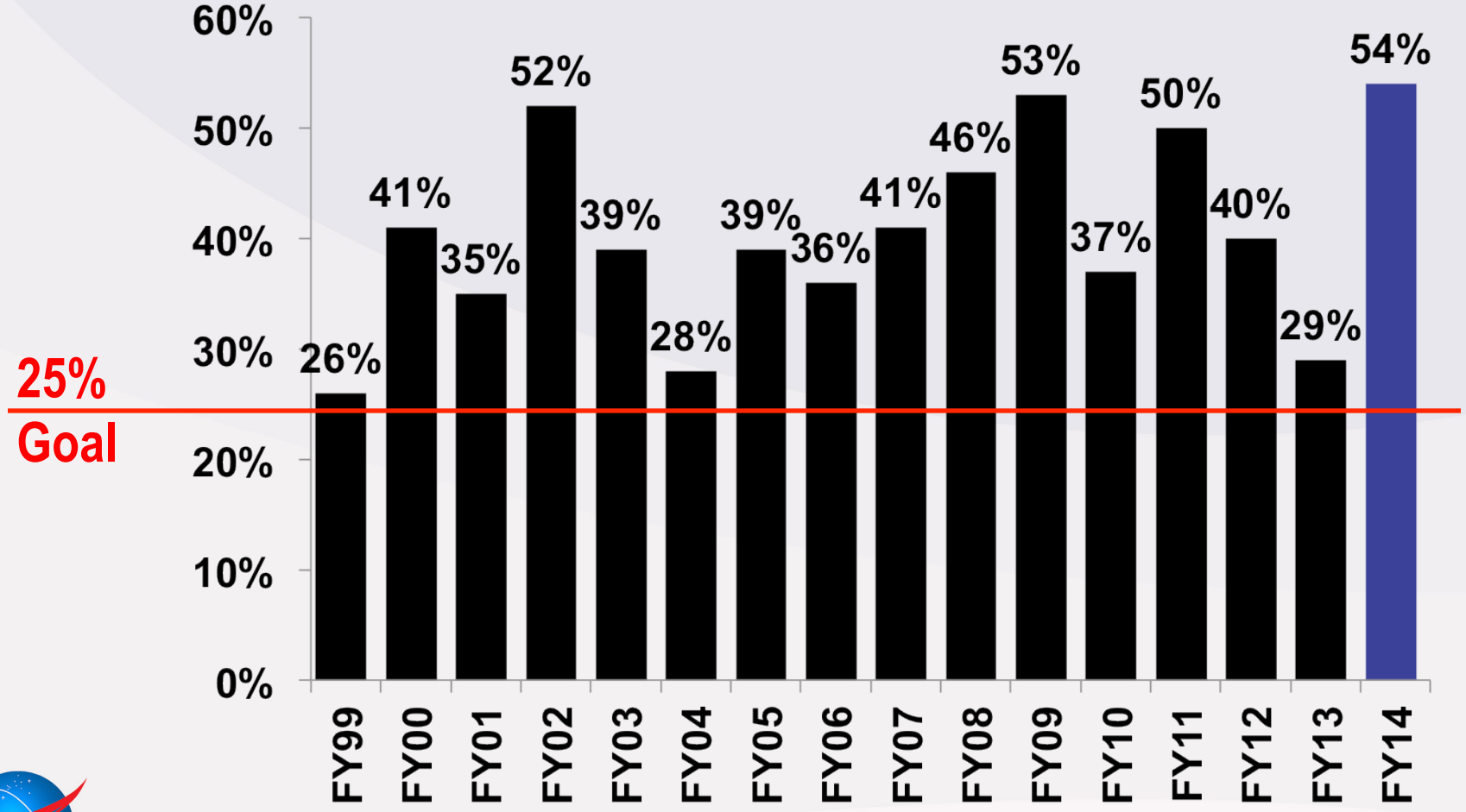
Enhancing the Utility of the Portable Remote Imaging Spectrometer to Coastal Ocean Science
- Pantazis Mouroulis, JPL



Upgrade of 4STAR for Full Science Capability of Sun-Sky-Cloud-Trace Gas Spectrometry in Airborne Science Deployments
- Philip Russell, ARC

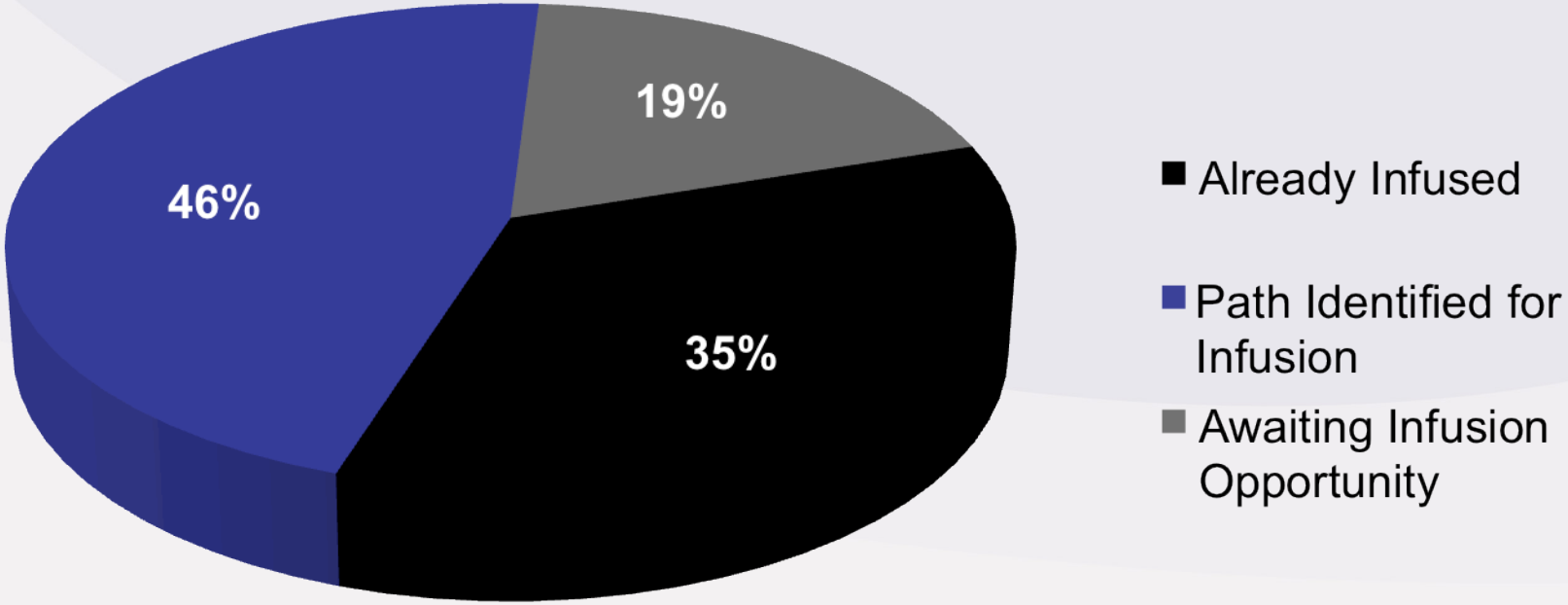
FY2014 Metrics

Goal: Annually advance 25% of currently funded technology projects at least one TRL.



FY2014 Metrics

Goal: Mature two to three technologies to a point where they can be demonstrated in space or in a relevant operational environment.



ESTO's infusion success, drawn from the over 600 completed projects through the end of FY14.

FY2014 Metrics

Goal: Enable a new science measurement or significantly improve the performance of an existing technique.

An Example:

(In FY2013) progress made by the Hyperspecral Imager for Climate Science (HySICS, PI: Greg Kopp, University of Colorado). This instrument made a groundbreaking high-altitude balloon flight in September 2013 (and again this year in August 2014). During these flights, HySICS collected the most accurate radiance measurements that have ever been made of the Earth – calibrated to the Sun to better than 0.2% radiometric accuracy.

Summary

Earth Science maintains a balanced program

The armada continues

4 – formulation

5 – development

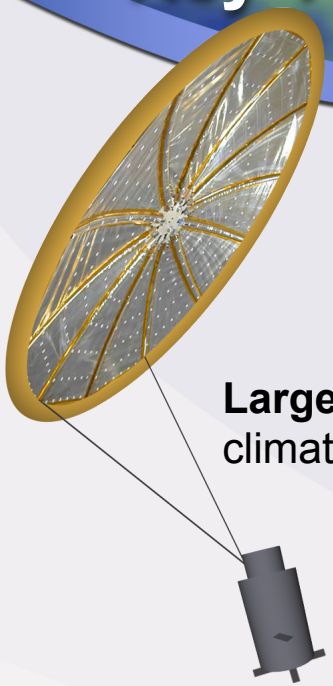
5 – primary operations

12 – extended operations

Active remote sensing is a key technology for NASA's Earth Science Programs through surface-, aircraft-, and space-based observations

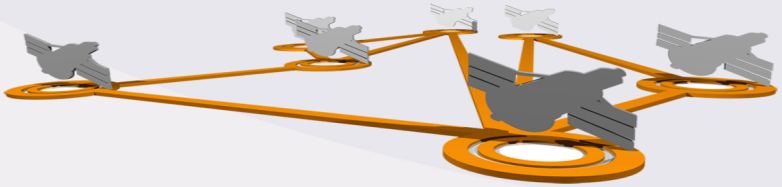
There are still significant technology challenges

Key Technology Challenges

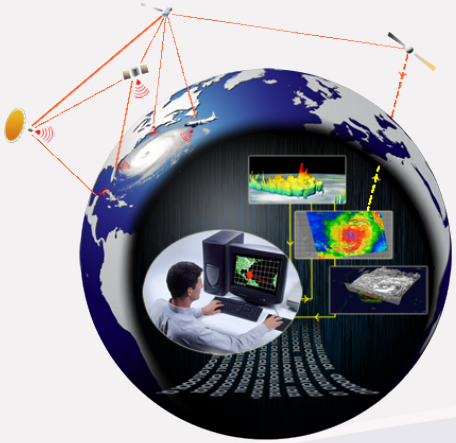


Active Remote Sensing Technologies to enable atmospheric, cryospheric and earth surface measurements

Large Deployables to enable future weather, climate and natural hazards measurements



Intelligent Distributed Systems using advanced communication, on-board processors, autonomous network control, data compression, and high density storage



Information Knowledge Capture through 3-D visualization, holographic memory and seamlessly linked models.

Technology Empowers our Future

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