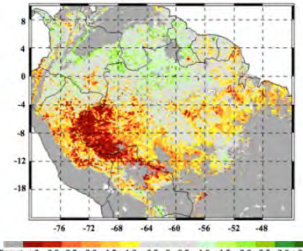
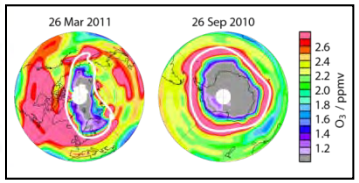
NASA Agency Update

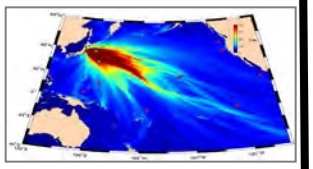
Paula Bontempi
NASA Headquarters
International Ocean Color Science Team Meeting
16 June 2015

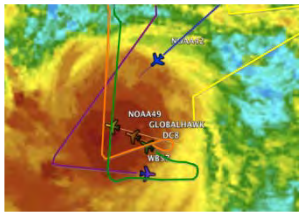
NASA's Earth Science Division

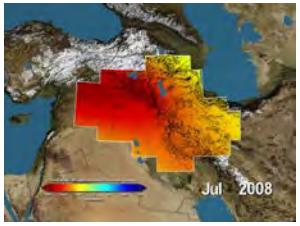
Research

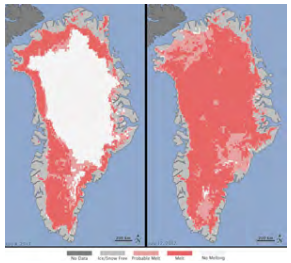




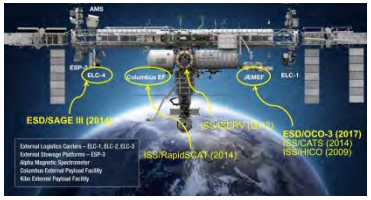




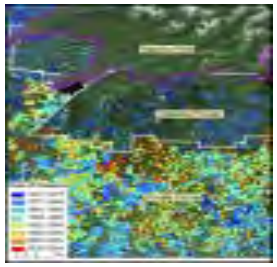


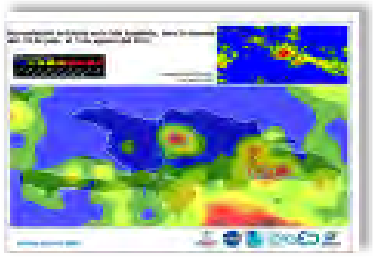


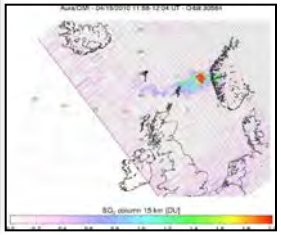
Flight

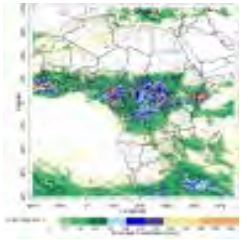


Applied Sciences

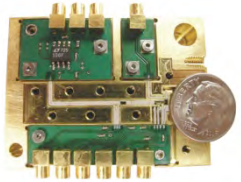


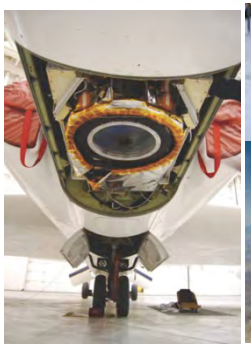


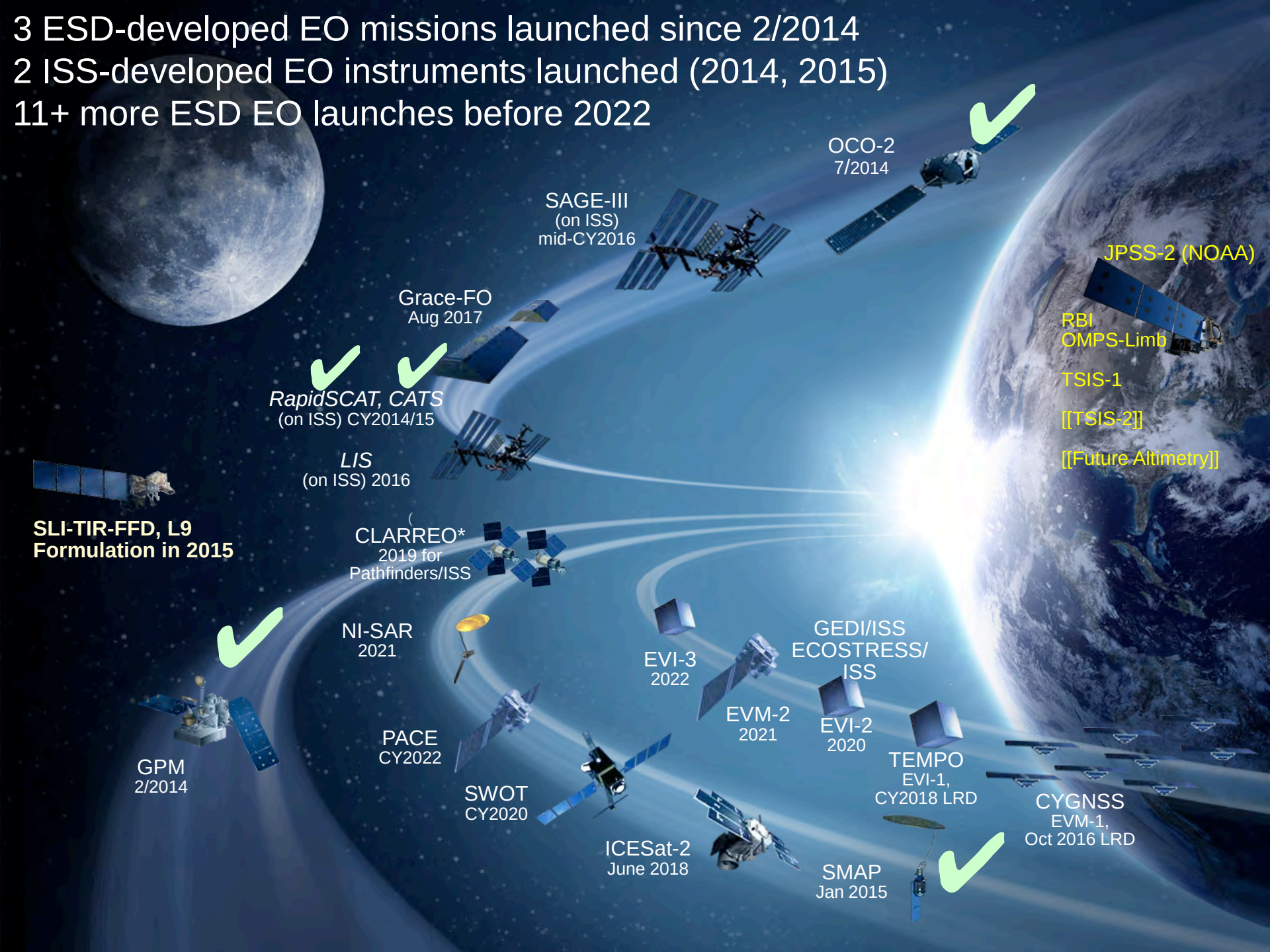




Technology



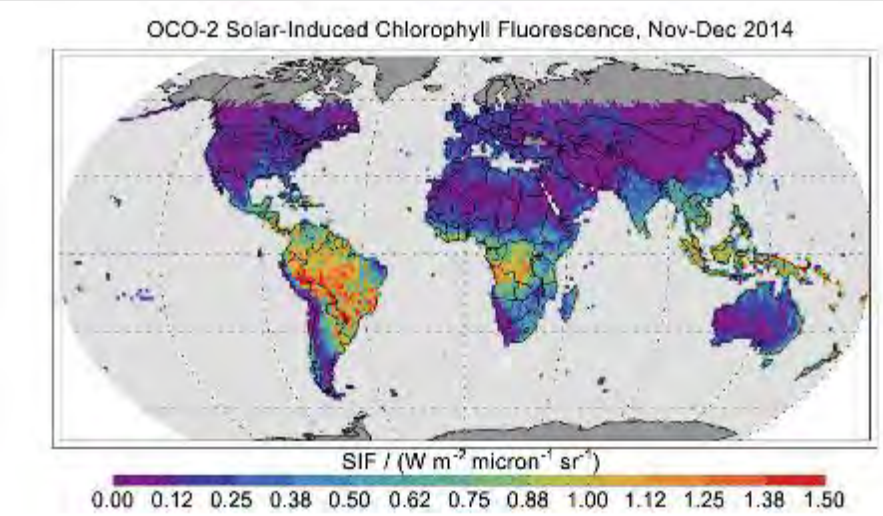



3 ESD-developed EO missions launched since 2/2014
2 ISS-developed EO instruments launched (2014, 2015)
11+ more ESD EO launches before 2022
OCO-2
7/2014
SAGE-III
(on ISS)
mid-CY2016
JPSS-2 (NOAA)
RBI
OMPS-Limb
TSIS-1
[[TSIS-2]]
[[Future Altimetry]]
Grace-FO
Aug 2017
RapidSCAT, CATS
(on ISS) CY2014/15
LIS
(on ISS) 2016
SLI-TIR-FFD, L9
Formulation in 2015
CLARREO*
2019 for
Pathfinders/ISS
NI-SAR
2021
EVI-3
2022
GEDI/ISS
ECOSTRESS/
ISS
EVM-2
2021
EVI-2
2020
TEMPO
EVI-1,
CY2018 LRD
GPM
2/2014
PACE
CY2022
SWOT
CY2020
ICESat-2
June 2018
SMAP
Jan 2015
CYGNSS
EVM-1,
Oct 2016 LRD

OCO-2 Level 2 Product Status

- OCO-2 Level 2 products (global column CO_2 (XCO2)) were released through GSFC DAAC at the end of March.
- The March 30th release also included solar-induced fluorescence (SIF) and updated L1b files. The L1b updates correcting known deficiencies including instrument artifacts (e.g. solar cosmic rays and a minor "clocking" of slit to FPA).
- A forward data stream arrived at the DAAC on March 30th, and backward processing at ~3x began shortly after. Forward data begins with March 19th. Backwards processing will extend to 9/6/14.
- The OCO-2 Science Team meeting was held Feb. 24 – 26th, 2015 in Pasadena. A broad cross section of the science team participated (118 in person, another 10 or so via webex).

- The image to the right shows a sample of the OCO-2 solar-induced fluorescence retrievals using both nadir and glint observations from 21 Nov to 29 Dec.
- The Northern Hemisphere fall is evident in the lack of plant activity and therefore solar-induced fluorescence.
- Spring plant activity is evident in the high solar induced fluorescence values over South America, sub-Saharan Africa, and Indonesia.
- Month by month time series are consistent with the changing seasons.



Planned On-Orbit Constellation

- Stratospheric Aerosol and Gas Experiment (SAGE-III/ISS)
  On Schedule for mid-2016 Launch
- Cyclone Global Navigation Satellite System (CYGNSS) (EVM)
  Formulation for launch 10/2016
- GRACE-FO
  Formulation for launch 8/2017
- ICESAT-2
  Confirmed for 6/2018
- Tropospheric Emissions: Monitoring of Pollution (TEMPO) (EVI)
  LRD 2018
- Surface Water Ocean Topography (SWOT)
  Formulation for launch 2020
- Pre-Aerosol, Cloud, ocean Ecosystem (PACE)
  LRD 2022


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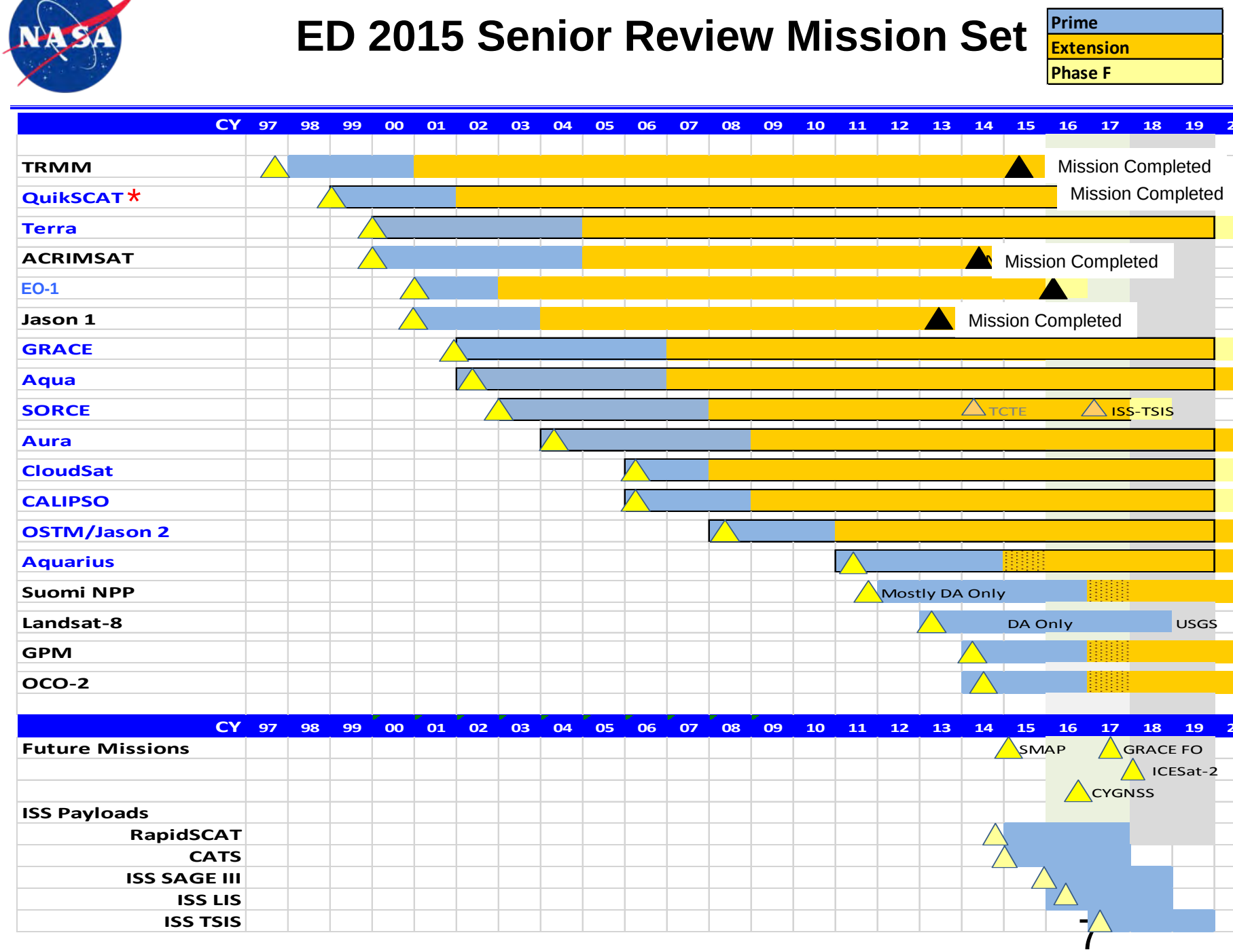
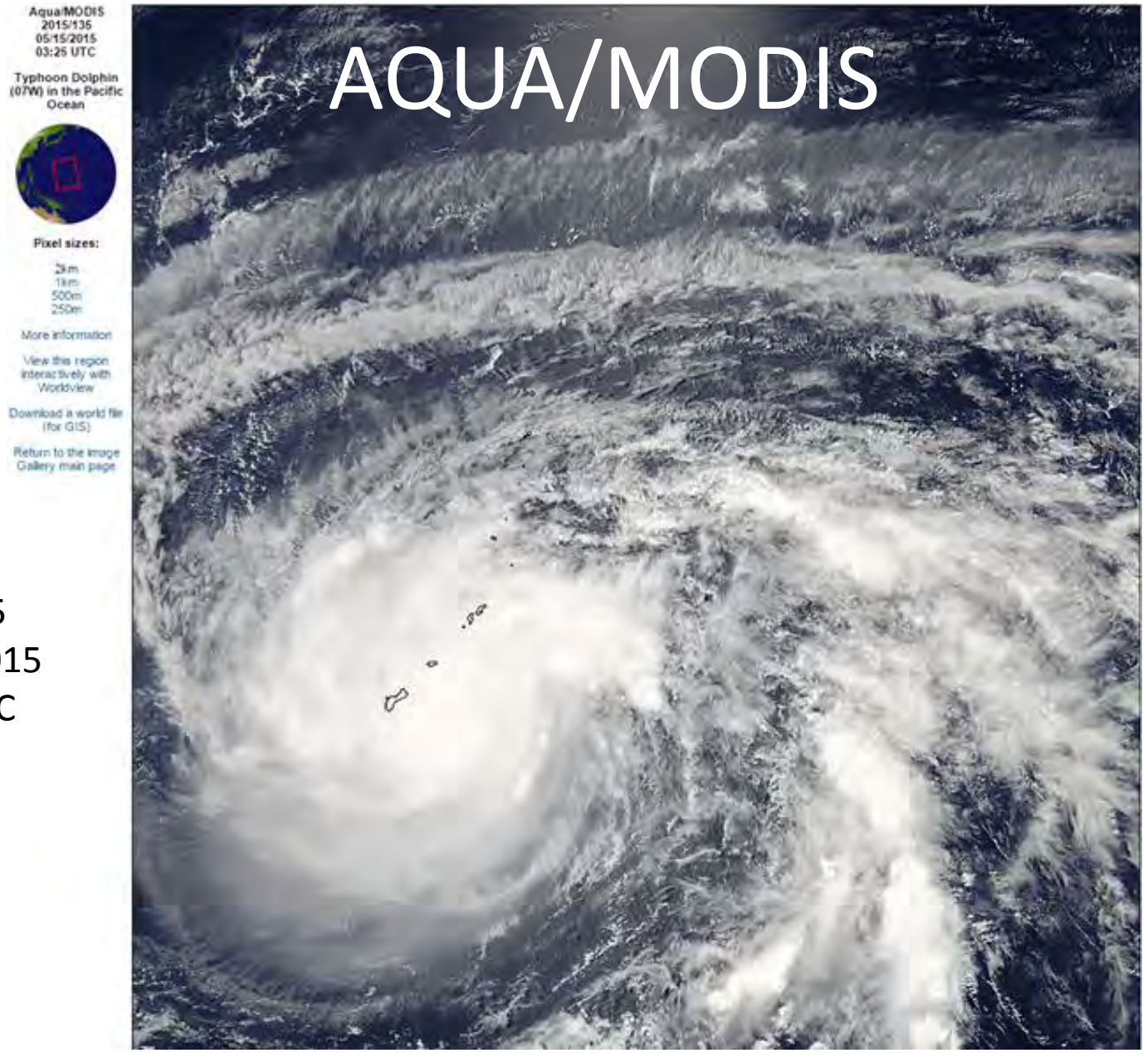
SLI-TBD
Formulation in 2015
JPSS-2 (NOAA)
RBI
OMPS-Limb
[[TSIS-2]]
[[Future Altimetry]]
NI-SAR
PACE
SWOT
TEMPO
GRACE-FO (2)
ICESat-2
CYGNSS
RapidScat, CATS,
LIS, SAGE III (on ISS)
SMAP
SORCE
TRMM
QuikSCAT
[[TCTE]]
EO-1
Landsat-7
(USGS)
Aquarius
Terra
Suomi NPP
(NOAA)
Aqua
Landsat-8
(USGS)
CloudSat
CALIPSO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

ED 2015 Senior Review Mission Set





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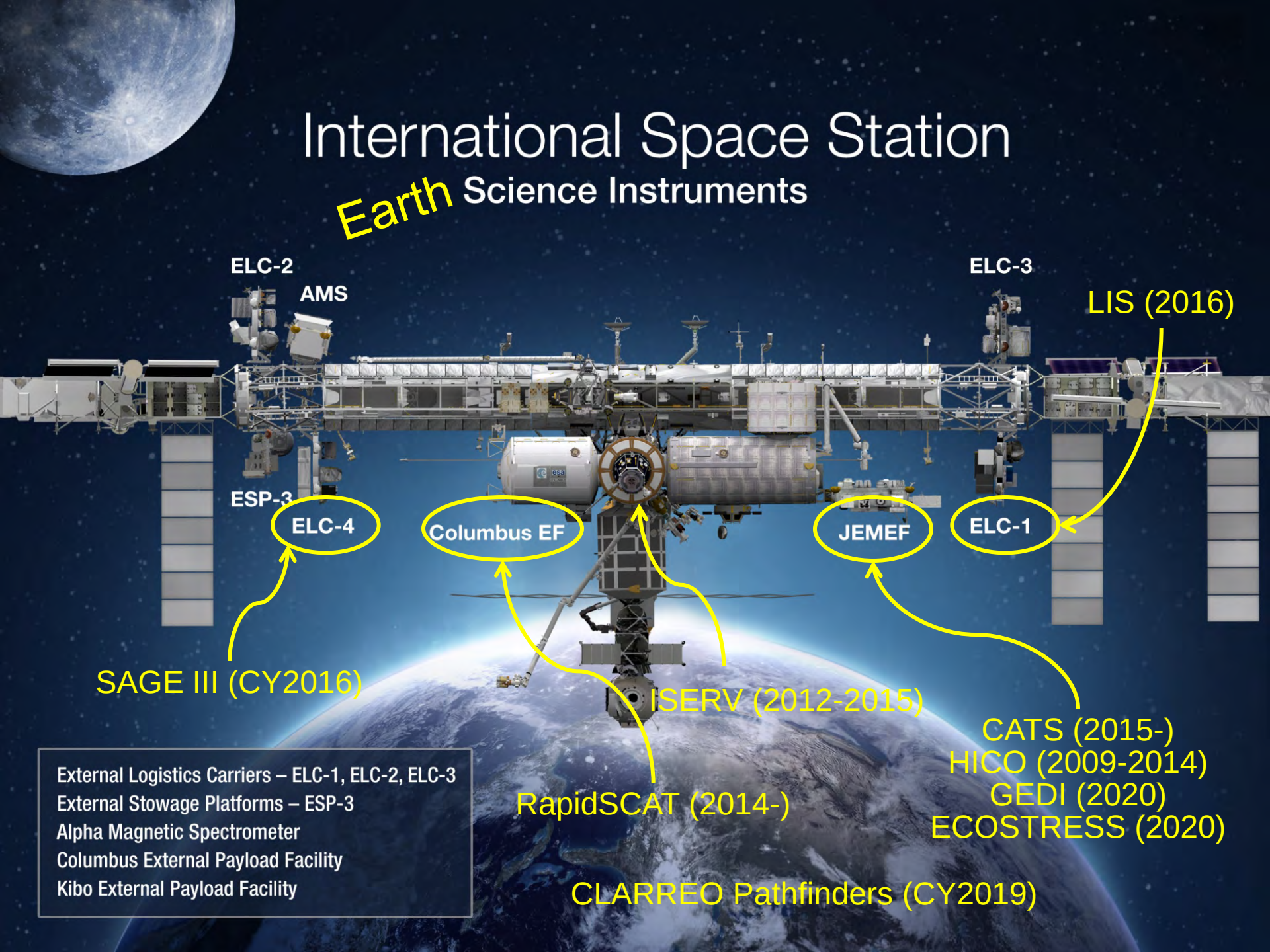
05/15/2015
03:25 UTC


International Space Station
Earth Science Instruments
ELC-2
AMS
ELC-3
LIS (2016)
ESP-3
ELC-4
Columbus EF
JEMEF
ELC-1
SAGE III (CY2016)
ISERV (2012-2015)
CATS (2015-)
HICO (2009-2014)
GEDI (2020)
ECOSTRESS (2020)
RapidSCAT (2014-)
CLARREO Pathfinders (CY2019)
External Logistics Carriers – ELC-1, ELC-2, ELC-3
External Stowage Platforms – ESP-3
Alpha Magnetic Spectrometer
Columbus External Payload Facility
Kibo External Payload Facility

Venture Class Selections/Solicitations

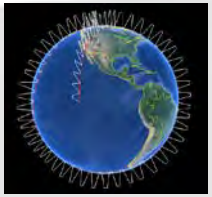
Mission	Mission Type	Solicitation Release	Proposal Selection	Major Milestone	Total Funding*
EVI-3	Instrument Only	Q2 FY2015	Q2 FY2016	Delivery NLT 2020	$130M
EVI-4	Instrument Only	Q4 FY2016	Q4 FY2017	Delivery NLT 2021	$150M
EVI-5	Instrument Only	Q2 FY2018	Q2 FY2019	Delivery NLT 2023	$182M
EVI-6	Instrument Only	Q4 FY2019	Q4 FY2020	Delivery NLT 2024	$155M
EVI-7	Instrument Only	Q2 FY2021	Q2 FY2022	Delivery NLT 2025	$185M
EVM-2	Full Orbital	Q3 FY2015	Q3 FY2016	Launch ~2021	$165M
EVM-3	Full Orbital	Q3 FY2019	Q3 FY2020	Launch ~2025	$179M
EVS-2	**Suborbital**	**Q4 FY2013**	**Q1 FY2015**	**2016-2020**	**$162M**
EVS-3	Suborbital	Q4 FY2017	Q4 FY2018	2019-2023	$176M

Most recent Selection

* Funding for future EVs is approximate and will be adapted depending on previous selections.

EVS-1: CARVE, ATTREX, DISCOVER-AQ, AirMOSS, HS-3
EVM-1: CYGNSS (2016 LRD)
EVI-1: TEMPO (2017 Instrument Delivery)
EVI-2: GEDI, ECOSTRESS (2019 Inst. Del.)
EVS-2: AtoM, NAAMES, OMG, ORACLES, ACT-America + CORAL

Earth Venture Suborbital-2 (EV-2) Investigations



Atmospheric Tomography Experiment (ATom) – Harvard University (Steve Wofsy)

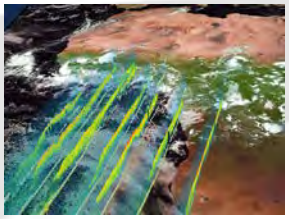
This investigation will study the impact of human-produced air pollution on certain greenhouse gases. Airborne instruments will look at how atmospheric chemistry is transformed by various air pollutants and at the impact on methane and ozone which affect climate. Flights aboard NASA's DC-8 will originate from the Armstrong Flight Research Center in Palmdale, California, fly north to the western Arctic, south to the South Pacific, east to the Atlantic, north to Greenland, and return to California across central North America.

North Atlantic Aerosols and Marine Ecosystems Study (NAAMES) – Oregon State U. (Mike Behrenfeld)

This investigation will improve predictions of how ocean ecosystems would change with ocean warming. The mission will study the annual life cycle of phytoplankton and the impact small airborne particles derived from marine organisms have on climate in the North Atlantic. The large annual phytoplankton bloom in this region may influence the Earth's energy budget. Research flights by NASA's C-130 aircraft from Wallops Flight Facility, Virginia, will be coordinated with a University-National Oceanographic Laboratory System (UNOLS) research vessel.

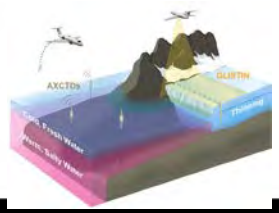
Atmospheric Carbon and Transport – America – Penn State University (Kenneth Davis)

This investigation will quantify the sources of regional carbon dioxide, methane and other gases, and document how weather systems transport these gases in the atmosphere. The research goal is to improve identification and predictions of carbon dioxide and methane sources and sinks using spaceborne, airborne and ground-based data over the eastern United States. Research flights will use NASA's C-130 from Wallops and the UC-12 from Langley Research Center in Hampton, Virginia.



ObseRvations of Aerosols Above Clouds and Their IntEractionS (ORACLES) – ARC (Jens Redemann)

ORACLES will probe how smoke particles from massive biomass burning in Africa influences cloud cover over the Atlantic. Particles from this seasonal burning that are lofted into the mid-troposphere and transported westward over the southeast Atlantic interact with permanent stratocumulus "climate radiators," which are critical to the regional and global climate system. NASA aircraft, including a Wallops P-3 and an Armstrong ER-2, will be used to conduct the investigation flying out of Walvis Bay, Namibia.



Oceans Melting Greenland (OMG) – JPL (Josh Willis)

The objective of OMG is to investigate the role of warmer saltier Atlantic subsurface waters in Greenland glacier melting. The study will help pave the way for improved estimates of future sea level rise by observing changes in glacier melting where ice contacts seawater. Measurements of the ocean bottom as well as seawater properties around Greenland will be taken from ships and the air using several aircraft including a NASA S-3 from Glenn Research Center in Cleveland, Ohio, and Gulfstream III from Armstrong.

Pre-Aerosol, Cloud, and ocean Ecosystem (PACE) Mission

Pre-Aerosol, Cloud, and ocean Ecosystem (PACE) is an ocean color, aerosol, and cloud mission identified in the 2010 report "Responding to the Challenge of Climate and Environmental Change: NASA's Plan for a Climate-Centric Architecture for Earth Observations and Applications from Space Science".

Science Objectives

- **Primary:** Understand and quantify global ocean biogeochemical cycling and ecosystem function in response to anthropogenic and natural environmental variability and change: **ocean color sensor**
- Extend key Earth system data records on global ocean ecology, biogeochemistry, clouds, and aerosols (expanded ocean color sensor similar to MODIS)
- **Secondary:** Understand and resolve/quantify the role of aerosols and clouds in physical climate (the largest uncertainty): **polarimeter**

Risk	• 8705.4 Payload Risk Class C
Launch	• 2022/2023, budget and profile driven
Orbit	• 97° inclination; ~650 km altitude; sun synchronous
Duration	• 3 years
Payload	• Ocean color instrument; potential for a polarimeter
LCC	• **$805M Cost Cap**

PACE Mission

The Fundamental PACE Science Drivers

WHY are ecosystems changing, **WHO** within an ecosystem are driving change, **WHAT** are the consequences & **HOW** will the future ocean look?

PACE will facilitate and advance research into:

- Plankton Stocks– Distinguish living phytoplankton from other constituents and identify nutrient stressors from turbid coastal waters to the bluest ocean
- Plankton Diversity – Characterize phytoplankton functional groups, particle size distributions, and dominant species
- Ocean Carbon – Assess changes in carbon concentrations, primary production, net community production and carbon export to the deep sea
- Human Impacts – Evaluate changes in land-ocean interactions, water quality, recreation, and other goods & services
- Understanding Change – Provide superior data precision and accuracy, advanced atmospheric correction, inter-mission synergies
- Forecasting Futures – Resolve mechanistic linkages between biology and physics that support of process-based modeling of future changes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OSTM/Jason 2
(NOAA)
OCO-2