### NASA Ocean Biology & Biogeochemistry Program

Paula Bontempi and Laura Lorenzoni NASA Headquarters US OCB Summer Workshop 26-29 June 2017



# ESD Budget/Program Overview

- The FY17 Appropriation :
  - NASA's Earth Science Division \$1.92 billion (same as FY2016)
  - \$90 million for the Pre-Aerosol, Cloud, and Ocean Ecosystem, or PACE, mission
- FY18 President's Budget
  - <u>https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/budget/fy2018/2018</u>
     <u>blueprint.pdf</u>
  - The President's 2018 Budget requests \$19.1 billion for NASA, a 0.8 percent decrease from the 2017 annualized CR level, with targeted increases consistent with the President's priorities.
  - Provides \$1.8 billion for a focused, balanced Earth science portfolio that supports the priorities of the science and applications communities, a savings of \$102 million from the 2017 annualized CR level. The Budget terminates five Earth science missions (PACE, OCO-3, DSCOVR Earth-viewing instruments, and CLARREO Pathfinder, Radiation Budget Instrument (RBI)) and reduces funding for Earth science research grants.
  - Eliminates the \$115 million Office of Education (Space Grant, EPSCor, and MUREP), resulting in a more focused education effort through NASA's Science Mission Directorate. The Office of Education has experienced significant challenges in implementing a NASA-wide education strategy and is performing functions that are duplicative of other parts of the agency. Phase out by FY19.

# ESD Budget/Program Overview

- NASA's work is reenergizing the pioneering spirit of America to move toward deep space exploration and provide the capabilities for America to maintain a constant presence in low-Earth orbit and beyond.
- We remain committed to studying our home planet with the resource we have been given.
- Our Earth science program uses 18 cutting-edge missions on orbit, including instruments mounted to the International Space Station, and airborne operations to collect and analyze data that informs the scientific community's discussion of all factors contributing to our global environment and ecosystems. NASA stands ready to bring the data captured through our missions to aid the president's focus on better understanding the science behind carbon dioxide and its impact on our changing world.



# **Earth Science**

**ICESat-2** 

**FY18** 

NI-SAR SWOT FY20 FY22

OMPS-L FY18/21 RBI FY19/21

CLARREO PF FY19 ECOSTRESS FY19 GEDI FY18/20 TSIS-1 FY18 TSIS-2 FY20/22 OCO-3 FY18

**GRACE-FO** 

**FY18** 

**TEMP0** FY20/22

15

CYGNSS Launched



PACE FY22

> **2007** Decadal Survey

Sentinal-6A/B

FY20/24

### NASA Ocean Biology and Biogeochemistry & DS Advanced Planning

- Ocean Biology and Biogeochemistry Advanced Planning (2015-2017)
  - From 2005 2007, NASA developed an OBB Advance Plan with a volunteer writing team
  - Evolution of the NASA 2007 OBB Advanced Plan (2007) Earth's Living Ocean The Unseen World
  - Kick off at Ocean Carbon and Biogeochemistry Summer Workshop (20-23 July, WHOI) D.
     Schimel (NASA JPL) & Natassa Romanou (NASA GISS) lead an open planning process
  - One writing team (Group 1) and one review team (Group 2) all volunteer
  - Public vetting/comment process original timeline evolved posted on CC&E Web page for public comment
  - Preparation for the next NRC Decadal Survey (to be delivered in 2017)
  - https://cce.nasa.gov/ocean\_biology\_biogeochemistry/index.html
- Decadal Survey for Earth Science and Applications from Space (2015-2017)
  - Co-chairs are Waleed Abdalati (University of Colorado, Boulder) & William Gail (Global Weather Corporation) – Delivery of draft July 2017



# Plankton, 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 & quantify global aerosol & cloud dynamics, aerosol-ocean interactions, ocean biogeochemical cycling, and ecosystem function due to natural & anthropogenic forcings from environmental/climate variability and change: OCI (expanded SeaWiFS, MODIS heritage)
- Primary: Extend key Earth system data records on global ocean ecology, ocean biogeochemistry, clouds, and aerosols (SeaWiFS, MODIS heritage)
- Secondary: Understand and resolve/quantify the role of aerosols and clouds in physical climate (the largest uncertainty): polarimeter (MISR heritage)
- Applied Sciences: enable carbon monitoring and management, contribute to better weather forecasting, and delineate the impacts of weather events on coastal ecosystems to enable resource management (early returns for ACE mission)

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

# **NASA PACE Opportunities in ROSES**

• Research Opportunities in Space and Earth Sciences - <u>http://nspires.nasaprs.com/</u> - Annual release mid-February

- Ocean Biology and Biogeochemistry generally an annual competition
- ROSES 2013 A.25 PACE Science Team \$3M/yr for three years [2014-2017]
  - IOPs
  - Atmospheric Correction
  - Science Team Leader Emmanuel Boss w/Lorraine Remer, Deputy
- ROSES 2014 A.3 Ocean Biology and Biogeochemistry ~\$10M/three years [2014-2017] Ocean color vicarious calibration approach and instrumentation competition
- Future competitions (tentative)
  - ROSES 2018 PACE Calibration and Validation Vicarious calibration system(s) OC; cal/val aerosols/clouds (OCI), plus polarimeter (TBD)
  - ROSES 2018 PACE Science Team science team for algorithm development
  - Future science team for new algorithms, science data analyses, (vicarious) & calibration approaches, data validation, field campaigns



- ROSES <u>http://nspires.nasaprs.com/</u> Anticipated in 2017
  - New (Early Career) Investigator Program In Earth Science (NIP) A.35 ~\$1.0M/yr for three years [every 1-2 yrs]
    - Outstanding scientific research and career development of scientists and engineers at the early stage of their professional careers (no longer an E/PO requirement)

#### ROSES 2017 - <u>http://nspires.nasaprs.com/</u>

- NASA EARTH AND SPACE SCIENCE FELLOWSHIP (NESSF) PROGRAM 2016 ACADEMIC YEAR – each fellowship raised to \$45K/yr in 2017 [try to do annually – selection target for May 2017]
  - accredited U.S. Universities Masters or Doctoral degrees in Earth and space sciences
  - Financial support from the Science Mission Directorate's divisions: Earth Science, Heliophysics, Planetary Science, Astrophysics.
  - Students admitted to, or already enrolled in, a full-time Masters and/or Ph.D. program at accredited U.S. universities eligible (non-US citizens welcome)
  - Students may enter the fellowship program at any time during their graduate work
  - 2017 700+ applications to SMD, 391 to ESD, 159 in CC&E
  - ESD received 425 in 2016; 391 in 2015; 410 in 2014; 330 in 2013



- ROSES 2015 A. 3 Ocean Biology and Biogeochemistry \$8.3M/3 yrs [15/71 selected]
  - Research in ocean ecology; Data mining for EXPORTS; Galway Statement on Atlantic Ocean Cooperation; Successor studies
- ROSES 2016 A.29 NASA Data for Operation and Assessment up to \$2M/yr. 15/56 selected
  - Operational Short-term Weather Prediction; Joint Center for Satellite Data Assimilation
  - Data and Methodology for Climate Projection Assessment Data for Climate Projection Assessment; Methodologies for Climate Model Improvement
  - Ecosystem and coupled ecosystem-climate modeling
- ROSES 2016 A.5 Carbon Cycle Science 4 federal agencies, \$21.5M/3 yrs (NASA: \$6.3 M; USDA-NIFA: \$1.67M; DOE: \$1 M; NOAA: \$0.2M) 28/135 Selected
  - Carbon research in critical regions (NASA, DOE, USDA-NIFA);
    - Carbon Dynamics in Tropical Terrestrial Ecosystems (moist forests and, woodlands/ savannas) (NASA)
    - Carbon Dynamics in Arctic/Boreal Terrestrial Ecosystems (NASA, DOE)
    - North American Continental Margins (NASA, USDA-NIFA)
  - Blue Carbon and Carbon in Associated Ecosystems (USDA-NIFA, NASA) ;
  - Carbon dynamics across managed landscapes, specifically: urban-rural, forestedagricultural and terrestrial-aquatic (USDA-NIFA, NASA);
  - The Impact of Rising CO<sub>2</sub> on Ocean Ecology (NASA, NOAA); and
  - Carbon cycle science synthesis research (NASA, USDA-NIFA)

- ROSES 2016 A.28 Interdisciplinary Research in Earth Science \$34M/3 yrs 28/96 Selected
  - Understanding the Global Sources and Sinks of Methane
  - Ecology at Land/Water Interfaces Human and Environmental Pressures
  - Understanding the Linkages Among Fluvial and Solid Earth Hazards
  - Life in a Moving Ocean
  - Partitioning of Carbon Between the Atmosphere and Biosphere
- ROSES 2016 A.30 Remote Sensing of Water Quality (Terrestrial Hydrology and OBB programs) up to \$2.3M/yr across the three topics [Target Selection June 2017]
  - Techniques to improve remote sensing of water quality
    - Atmospheric Corrections
    - Improving understanding of the link between optical and water-body properties
  - Employing remotely sensed water quality information to understand watershed dynamics and the impact on nearshore ecology and ecosystem health in the Arctic
  - Algorithm refinement to assess harmful algal blooms across North America



#### • ROSES 2017 A.7 Carbon Monitoring System- \$3.7M/yr - [selection on hold]

• Continuing development towards a Carbon Monitoring System (CMS). CMS initiative directed by Congress in 2010, NASA initiated pre-Phase A, pilot studies, a scoping effort for a CMS (<u>http://carbon.nasa.gov/index.html</u>).

• Studies to produce and evaluate prototype monitoring, reporting and verification system approaches and/or calibration and validation data sets for future NASA missions, including, but not limited to, MRV work in support of REDD, REDD+, or SilvaCarbon projects.

• Studies that address research needs to advance remote sensing-based approaches to monitoring, reporting, and verification (e.g., quantification of forest degradation; independent assessment of the accuracy of airborne remote sensing observations of biomass and carbon stocks; use of airborne flux observations and satellite remote sensing, as alternative methods for quantifying net carbon emissions/storage).

• Studies that build upon, extend, and/or improve the existing CMS products for biomass and flux resulting from NASA's first phases of CMS pilot studies; such studies may include, for example, product improvements, refined characterization and quantification of errors and uncertainties, and/or preparation and delivery of a mature product for long- term archive at an established NASA DAAC or equivalent data center.

• Studies that can evaluate and enhance national reported carbon emissions inventories from bottom-up estimates from various sectors of emissions within the United States, and have the potential to be applied to reported national inventories from other nations.

- **ROSES 2017** A.37 The Science of Terra (ASTER, CERES, MISR, MODIS, MOPITT) and Aqua (AIRS, AMSR-E, CERES, MODIS)
  - Science Data Analysis including Multiplatform and Sensor Data Fusion
  - Algorithms New Data Products
  - Real- or Near-Real-Time Data Algorithms
- ROSES 2017 <u>http://nspires.nasaprs.com/</u>
  - Rapid Response and Novel Research in Earth Science A.29 (Laura Lorenzoni, POC) [rolling deadline] - No budget for this –funded out of core
  - **Caveat to Proposers:**
  - Read solicitation in its entirety. It has a number of specific requirements. Failure to meet them will result in a proposal being returned without review.
    - Rapid Response to Earth System Events
    - Novel Ideas in Earth Remote Sensing
- ROSES 2017 <u>http://nspires.nasaprs.com/</u>
  - Topical Workshops, Symposia, Conferences E.2 (Max Bernstein, POC) [rolling]
  - Topical workshops, symposia, conferences, other scientific/technical meetings that advance goals of Earth Science, Heliophysics, and Planetary Science.



- Earth Venture Suborbital (AO) \$150M/5 yr [every two years, target 5 selections]
  - complete, suborbital, principal investigator-led investigations to conduct innovative, integrated, hypothesis or science question-driven approaches to pressing Earth system science issues.
  - North Atlantic Aerosol and Marine Ecosystems Study (NAAMES) M. Behrenfeld (OSU)
  - COral Reef Airborne Laboratory (CORAL) E. Hochberg (BIOS)



### **EXPORTS Timeline EXport Processes in the Ocean from Remote Sensing Timeline (Tentative)**

- June 2014 Draft Science Plan Delivered to NASA
- July-August 2014 Draft Science Plan posted for public comments
- January 2015– Peer review of public comments
- 18 May 2015 Science Plan Finalized
- 24 July 2015– NASA competition/Dear Colleague Letter for EXPORTS Science Definition Team and Team Leader – tasked to draft Implementation Plan(s) based on estimated EXPORTS program budget (31 Aug 2015)
- September 2015– SDT Selected, work begins on Implementation Plan (Oct 2015)
- July 2016 vetting of draft Implementation Plan at OCB Meeting (w/NSF BoBP)
- August 2016 public comment period of Implementation Plan/SDT report
- October 2016– SDT delivered final Implementation Plan to NASA
- November 2016 NSF releases Dear Colleague Letter (BoBP)
- January 2017 NASA competition for EXPORTS Science Lead, Science Team
- April 2017 EXPORTS proposals due
- June 2017 EXPORTS Science Lead and Science Team selected
- August/September 2017 EXPORTS begins (kick off meeting in Washington, DC second half of September)
- 2017-2022– EXPORTS Program NE Pacific Field Campaign August-Sept 2018 (R/V Revelle & R/V Sally Ride)