NASA’s Earth Science Division

Research

Flight

Applied Sciences

Technology
ESD Budget: FY17 Request/Appropriation

<table>
<thead>
<tr>
<th>ESD Total</th>
<th>$M</th>
<th>FY16 (op plan)</th>
<th>FY17</th>
<th>FY18</th>
<th>FY19</th>
<th>FY20</th>
<th>FY21</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY16 PBS</td>
<td>$</td>
<td>1,927</td>
<td>$ 1,966</td>
<td>$ 1,988</td>
<td>$ 2,009</td>
<td>$ 2,027</td>
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<tr>
<td>FY17 PBS</td>
<td>$</td>
<td>2,032</td>
<td>$ 1,990</td>
<td>$ 2,001</td>
<td>$ 2,021</td>
<td>$ 2,048</td>
<td></td>
</tr>
</tbody>
</table>

- **ESD budget jumps significantly in FY17 – then becomes consistent with FY16 President’s Budget Request for the out-years**
The Earth System Missions (ESM) development missions in this period include:
   – ICESat-2, SAGE III, GRACE-FO, SWOT, Landsat-9, RBI, TSIS-1 and -2, OMPS-Limb, NISAR, PACE, Sentinel 6A and -B, CLARREO Pathfinder

The Earth System Missions (ESM) on-orbit* missions include:

The Earth System Science Pathfinder (ESSP) development missions in this period include:
   – OCO-3, CYGNSS, TEMPO, GEDI, ECOSTRESS, MAIA, TROPICS
   – EVS-2 and -3 and Venture Technology selections (GrAOWL, Tempest), EVM-2 & 3, EVI-4,5,6,7,8

The Earth System Science Pathfinder (ESSP) on-orbit missions include:

*On-orbit dates correspond to end-of-mission assumptions, consistent with 2015 Sr. Review
### Venture Class Selections/Solicitations

<table>
<thead>
<tr>
<th>Mission</th>
<th>Mission Type</th>
<th>Release Date</th>
<th>Selection Date</th>
<th>Major Milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVM-2</td>
<td>Full Orbital</td>
<td>FY15</td>
<td>FY16</td>
<td>Launch ~2021</td>
</tr>
<tr>
<td>EVI-4</td>
<td>Instrument Only</td>
<td>FY16</td>
<td>FY17</td>
<td>Delivery NLT 2021</td>
</tr>
<tr>
<td>EVS-3</td>
<td>Suborbital Airborne Campaigns</td>
<td>FY17</td>
<td>FY18</td>
<td>N/A</td>
</tr>
<tr>
<td>EVI-5</td>
<td>Instrument Only</td>
<td>FY18</td>
<td>FY19</td>
<td>Delivery NLT 2023</td>
</tr>
<tr>
<td>EVM-3</td>
<td>Full Orbital</td>
<td>FY19</td>
<td>FY20</td>
<td>Launch ~2025</td>
</tr>
<tr>
<td>EVI-6</td>
<td>Instrument Only</td>
<td>FY19</td>
<td>FY20</td>
<td>Delivery NLT 2024</td>
</tr>
<tr>
<td>EVI-7</td>
<td>Instrument Only</td>
<td>FY21</td>
<td>FY22</td>
<td>Delivery NLT 2026</td>
</tr>
<tr>
<td>EVS-4</td>
<td>Suborbital Airborne Campaigns</td>
<td>FY21</td>
<td>FY22</td>
<td>N/A</td>
</tr>
<tr>
<td>EVI-8</td>
<td>Instrument Only</td>
<td>FY22</td>
<td>FY23</td>
<td>Delivery NLT 2024</td>
</tr>
</tbody>
</table>

- **Open solicitation**
- **Completed solicitation**

**EVS-1:** CARVE, ATTREX, DISCOVER-AQ, AirMOSS, HS-3  
**EVM-1:** CYGNSS (10/2016 LRD)  
**EVI-1:** TEMPO (2019-; 2017 instrument delivery)  
**EVI-2:** GEDI (2019; 2018 del.); ECOSTRESS (10/2017; 5/2017 del.)  
**EVS-2:** ATom, NAAMES, OMG, ORACLES, ACT-America, CORAL  
**EVI-3:** MAIA, TROPICS  
**EVM-2:** Selection(s) likely by end of FY2016
Earth Science Research

Focus Areas
Carbon cycle and Ecosystems
Climate Variability and Change
Atmospheric Composition
Global Water and Energy Cycle
Earth Surface and Interior
Weather

ESD FY15 Research Budget by Category

- Disciplinary & Interdisciplinary Science: 58%
- Mission Science: 6%
- Airborne Science: 4%
- Space Geodesy: 4%
- Scientific Computing: 10%
- Carbon Monitoring System: 19%
- GLOBE: 2%
<table>
<thead>
<tr>
<th>Mission</th>
<th>Location(s)</th>
<th>Date(s)</th>
<th>Platform(s)</th>
<th>Summary of Mission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviris NG India</td>
<td>Hyderabad India</td>
<td>Dec 15 – Spring 16</td>
<td>B200 (ISRO aircraft)</td>
<td>Imaging spectroscopy science and application investigation over Indian territory</td>
</tr>
<tr>
<td>Korus-AQ</td>
<td>Korea</td>
<td>Spring 16</td>
<td>DC8, B200</td>
<td>Study sources of pollution in atmosphere over Korea and Western Pacific region using a mix of in situ and remote sensing capability while enhancing understanding of future geostationary atmospheric composition observations</td>
</tr>
<tr>
<td>Atmospheric Carbon and Transport – America</td>
<td>Eastern and Midwestern US</td>
<td>Summer 16, Spring 17, Fall 17, Summer 18</td>
<td>B200, C-130</td>
<td>Quantify the sources of regional carbon dioxide, methane and other gases, and document how weather systems transport these gases in the atmosphere; improve identification and predictions of carbon dioxide and methane sources and sinks over the eastern US</td>
</tr>
<tr>
<td>North Atlantic Aerosols and Marine Ecosystems Study (NAAMES)</td>
<td>Atlantic Ocean, flown from Canada</td>
<td>Sep 17, Mar/Apr 18, C-130, Ship ((UNOLS) research vessel)</td>
<td>C-130, Ship</td>
<td>Environmental and ecological controls on plankton communities in the North Atlantic Ocean</td>
</tr>
<tr>
<td>Coral Reef Airborne Laboratory (CORAL)</td>
<td>FL, HI, Mariana Is., Palau, Australia</td>
<td>Apr 16 – Jan 17</td>
<td>Contracted GIV</td>
<td>Provide critical data and new models needed to analyze the status of coral reefs and to predict their future</td>
</tr>
<tr>
<td>ObseRvations of Aerosols Above Clouds and Their Interactions (ORACLES)</td>
<td>Namibia, Africa</td>
<td>Aug/Sept 16, Jul/Aug 17, Sep/Oct 18</td>
<td>P-3, ER-2</td>
<td>Investigate how smoke particles from massive biomass burning in Africa influence cloud cover over the Atlantic.</td>
</tr>
<tr>
<td>Atmospheric Tomography Experiment (ATom)</td>
<td>Around the Globe</td>
<td>Aug 16, Jan/Feb 17, Sep/Oct 17, Apr/ May 18</td>
<td>DC-8</td>
<td>Study the optical characteristics of coral reef and volcanic systems in and around Hawaii using MASTER and AVIRIS to assess value of HysPIRI-like observations</td>
</tr>
<tr>
<td>O2/N2 Ratio and CO2 Airborne Southern Ocean (ORCAS)</td>
<td>Southern Ocean</td>
<td>Jan/Feb 16</td>
<td>GV (NSF)</td>
<td>NASA brings remote sensing (PRISM) capability to NSF-led mission to investigate the large-scale tropospheric distributions, gradients, and fluxes of O2 and CO2 over Southern Ocean.</td>
</tr>
<tr>
<td>HypsIRI</td>
<td>Hawaii</td>
<td>Summer 16</td>
<td>ER-2</td>
<td>Study ice sheet thickness, sea ice distributions, and related parameters over Arctic and Antarctic to bridge gap between ICESat-1 and ICESat-2, complement lidar observations with those using related techniques (e.g., radar) and obtain coincident data with ESA CryoSat-2</td>
</tr>
<tr>
<td>Operation IceBridge</td>
<td>Alaska, Greenland, Antarctica</td>
<td>Mar – May, Oct/Nov – FY16,17,18,19</td>
<td>P-3, DC-8</td>
<td>Radar data collected for multiple NASA focus areas (Earth Surface and Interior, Carbon Cycle and Ecosystems, Global Water and Energy Cycle, Climate Variability and Change) and for Applications Uses (e.g., levee monitoring)</td>
</tr>
<tr>
<td>UAVSAR</td>
<td>Various US and South America</td>
<td>Year round</td>
<td>C-20</td>
<td>Study processes that control sea surface salinity in higher salinity region than that sampled in SPURS / (sub-tropical North Atlantic)</td>
</tr>
<tr>
<td>SPURS II</td>
<td>Eastern Sub-Tropical Pacific Ocean</td>
<td>Starting spring 2016, multiple sailings covering 18 month period</td>
<td>Schooner Lady Amber plus in-water observations (e.g., gliders, drifters, buoys)</td>
<td>Study processes that control sea surface salinity in higher salinity region than that sampled in SPURS II (sub-tropical North Atlantic)</td>
</tr>
<tr>
<td>ABoVE</td>
<td>Alaska, NW Canada</td>
<td>Beginning 2016, continuing</td>
<td>Surface measurements; airborne to follow</td>
<td>Study vulnerability and resilience of Arctic ecosystems to environmental change in the Arctic and boreal region of western North America</td>
</tr>
</tbody>
</table>
### Applications
- Health & Air Quality
- Ecological Forecasting
- Water Resources
- Disaster Applications & Response Team
- Wildfires (through FY17)

### Capacity Building
- SERVIR (joint with USAID)
- ARSET, Applied Remote Sensing Training
- DEVELOP

### Satellite Mission Planning
- Early Adopters, Apps. Workshops

### Program-wide
- Socioeconomic Impact Analyses
- Community Utilities (ESIP, NEX, etc.)
- Communications
- GEO and USGEO Support

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**President’s FY17 Budget Request**

- Re-establishes funds for full SERVIR Applied Sciences Team FY16-18; expands Team in FY19-21 for increase to 6 SERVIR hubs by 2018
- Increases funding for Applications Areas (via internal re-allocation)
- Implements Snow & Water Availability focused activity for Western States
- Implements Food Security Consortium
- Implements Disaster Response Plan for increased preparation-based approach
- Continues activities to develop techniques to quantify social and economic benefits from Earth science applications
**Instrument Incubator Program (IIP)**
- robust new instruments and measurement techniques
- 17 new projects added in FY14 (total funding ~$71M over 3 years)

**Advanced Component Technologies (ACT)**
- critical components and subsystems for instruments and platforms
- 11 new projects added in FY14 (total funding ~$13M over 3 years)

**Sustainable Land Imaging-Technology (SLI-T)**; Managed by ESTO, funded from SLI
- new technologies and reduced costs for future land imaging (Landsat) measurements
- First solicitation released in FY16 (total funding ~$29M over 5 years from SLI budget – investigations managed by ESTO)

**Advanced Information Systems Technology (AIST)**
- innovative on-orbit and ground capabilities for communication, processing, and management of remotely sensed data and the efficient generation of data products
- 24 new projects added in FY15 (total funding ~$25M over 2 years)

**In-Space Validation of Earth Science Technologies (InVEST)**
- on-orbit technology validation and risk reduction for small instruments and instrument systems that could not otherwise be fully tested on the ground or airborne systems
- 4 new projects added in FY15 (total funding ~$21M over 3 years)