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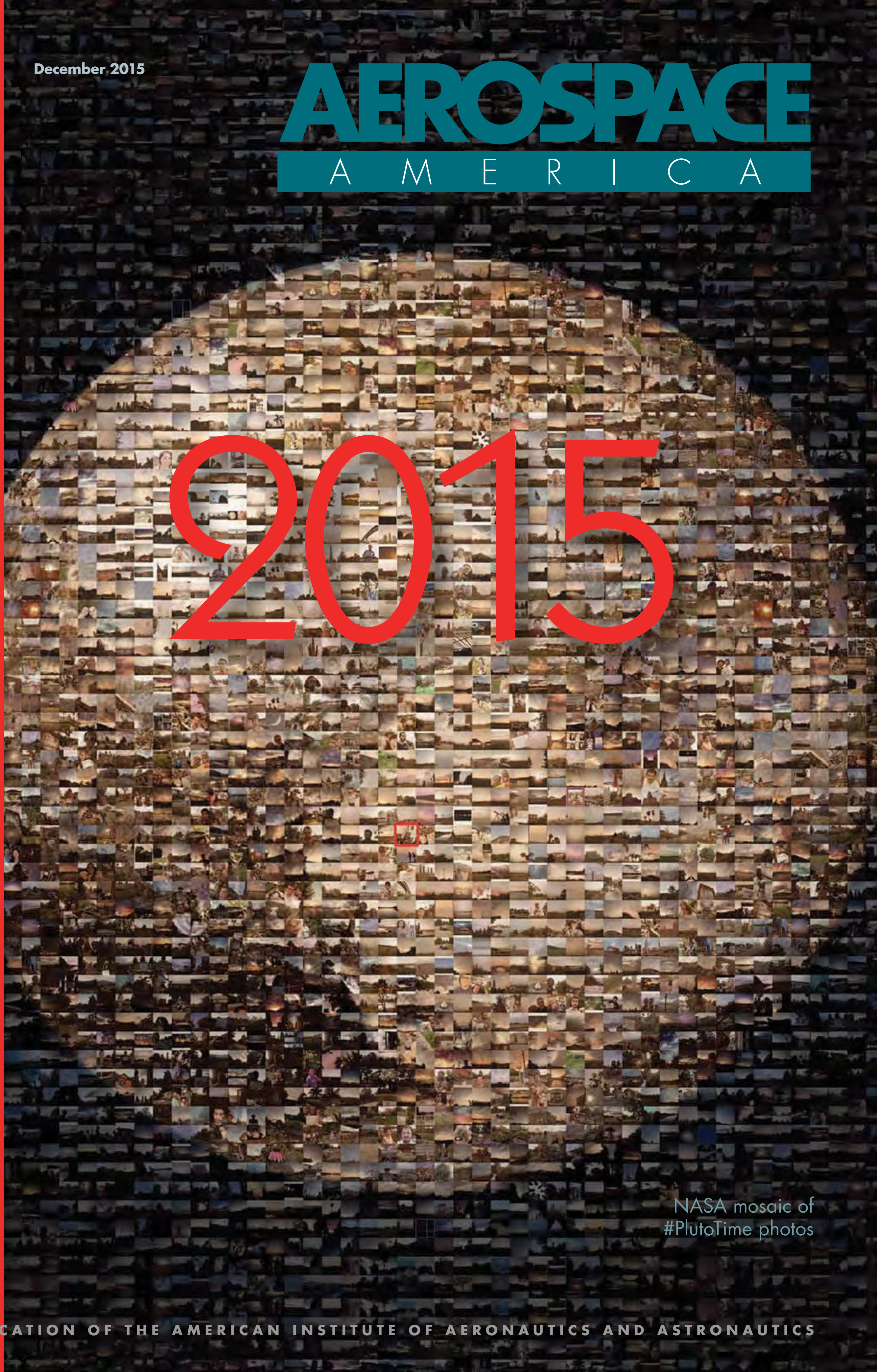

NASA mosaic of #PlutoTime photos

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Mapping Earth and imaging exoplanets

by Gregory L. Davis

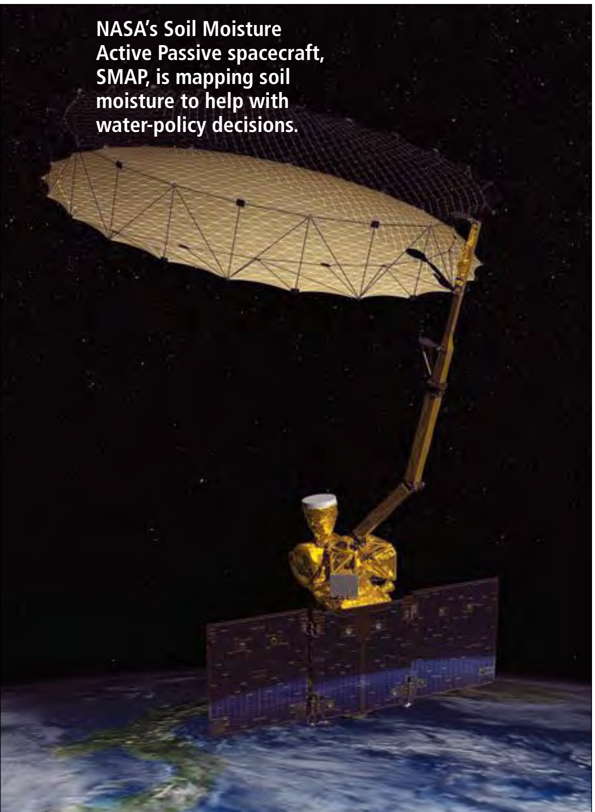
*The **Spacecraft Structures Technical Committee**, formerly the Gossamer Spacecraft Program Committee, focuses on the unique challenges associated with the design, analysis, fabrication and testing of spacecraft structures.*

The **Soil Moisture Active Passive satellite** that NASA launched in January carries a 6-meter-diameter mesh reflector that is the first large, deployable structure to rotate at a high rate relative to a de-spun spacecraft. SMAP continues to provide the first three-day revisit global maps of the Earth's hydrosphere state via its passive radiometer instrument, but its active radar stopped transmitting in July for reasons related to its power supply that are still being investigated.

The SMAP instrument is comprised of a Northrop Grumman Astro Aerospace-built deployable **AstroMesh reflector**/boom assembly and a Goddard Space Flight Center-supplied radiometer. NASA's Jet Propulsion Laboratory supplied the radar, feed, slip-ring, and structural elements. Boeing supplied the spin motor assembly and control electronics.

SMAP's flexible, deployed boom and reflector were designed to achieve exacting surface accuracy and pointing requirements at 14.6 rpm, requiring key analytical and validation methods to be developed during the engineering process. Data from on-orbit operations indicate that the deployed reflector natural frequency is within 2 percent of the prediction, and that objectives for overall antenna performance (surface figure) and rotational stability (mass properties) are achieved at 14.6 rpm.

NASA has initiated several technology developments focusing on **deployable antennas for cubesats**. A reflectarray antenna operating at K-band is baselined for the Integrated Solar Array and Reflectarray Antenna demonstration cubesat, which is scheduled for launch in 2016. An X-band version of this antenna is also baselined for the **Mars Cube One** cubesat, also scheduled for launch in 2016. These reflectarrays are stowed between the spacecraft bus and the launch canister, taking advantage of unused space in that area.

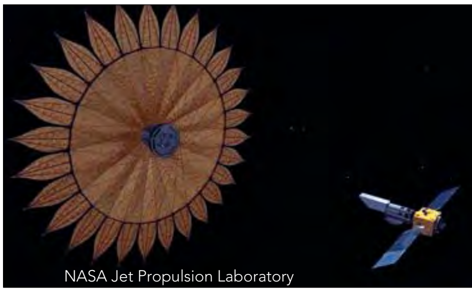


NASA's Soil Moisture Active Passive spacecraft, SMAP, is mapping soil moisture to help with water-policy decisions.

NASA Jet Propulsion Laboratory/CalTech

Preliminary development also began on an **inflatable X-band antenna** that stows in a 1U cubesat envelope. Also, radiofrequency and deployment tests have been completed on a prototype of the 42 decibel Ka-band parabolic deployable antenna; a future version is expected to be used on RainCube, a cubesat mission concept for performing radar science.

In the planetary-imaging domain, technologists from JPL, Princeton University, Northrop Grumman Aerospace Systems, and the Colorado-based companies Roccor and Tendeg made progress this year on a novel technology that would utilize a **free-flying starshade occulter** to make exoplanets visible. Once operational, this flower-shaped occulter will measure up to 40 meters tip-to-tip and will be positioned 30,000 to 50,000 kilometers in front of a space telescope. Its precise petal shape will generate diffraction patterns to mask light from the exoplanet's parent star. The team is implementing very demanding stowed-volume and deployed-dimensional requirements for a full-scale 7-meter-long starshade petal and 10 meter-diameter, half-scale inner disc testbed. It also is utilizing novel, origami-inspired large optical shields to provide the starlight suppression. Concepts based on a radially-deploying **origami "flasher" design** were fabricated this year at several scales, enabling progress toward a baseline design. A 2-meter-diameter, deployable inner disc testbed was fabricated by Roccor and is currently in testing to understand origami kinematics at the 1:10 scale. A flight-like 10 meter-diameter half-scale, micrometeorite-resistant optical shield testbed is also in development and will be completed in late 2017 based on a recent NASA technology award.



NASA Jet Propulsion Laboratory

The Starshade occulter would make exoplanets visible by masking light from the exoplanet's parent star.

Finally, the Spacecraft Structures Technical Committee is preparing the **Handbook of Testing Large, Ultra-Lightweight Spacecraft.** The handbook will provide both the theory and especially the practice of testing these unique spacecraft for project managers and technical specialists. Eleven chapters are currently under development by leading experts in the field. Expected publication by AIAA is late 2016.