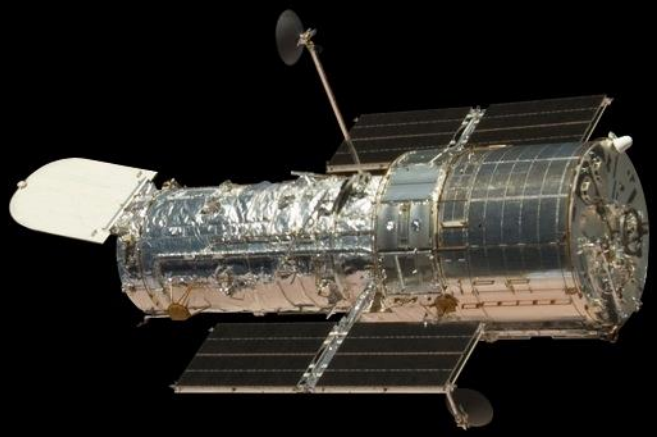
National Aeronautics and
Space Administration

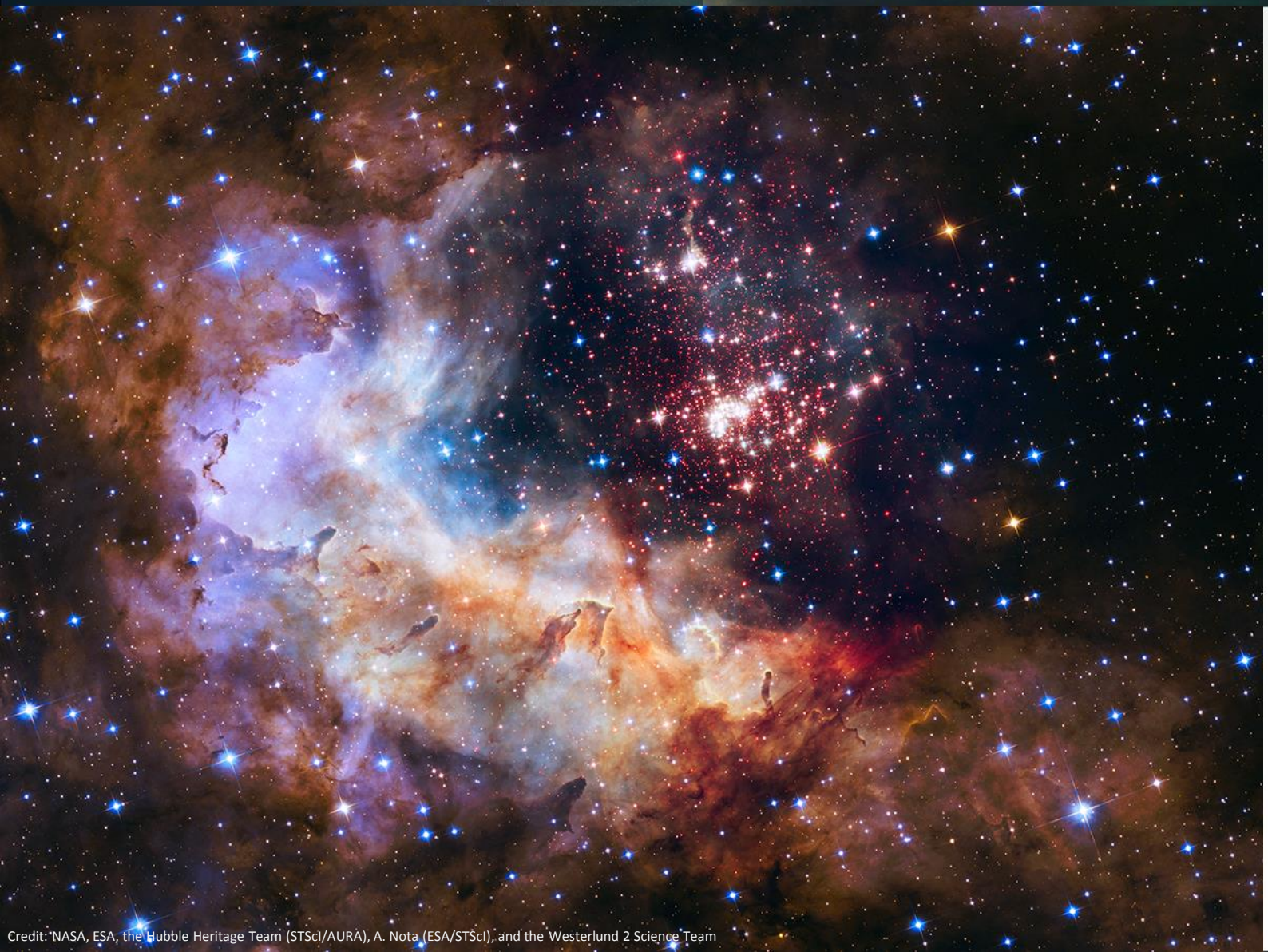


Science Mission Directorate

Weekly Highlights

April 24, 2015

Hubble Space Telescope Celebrates 25 Years of Unveiling the Universe



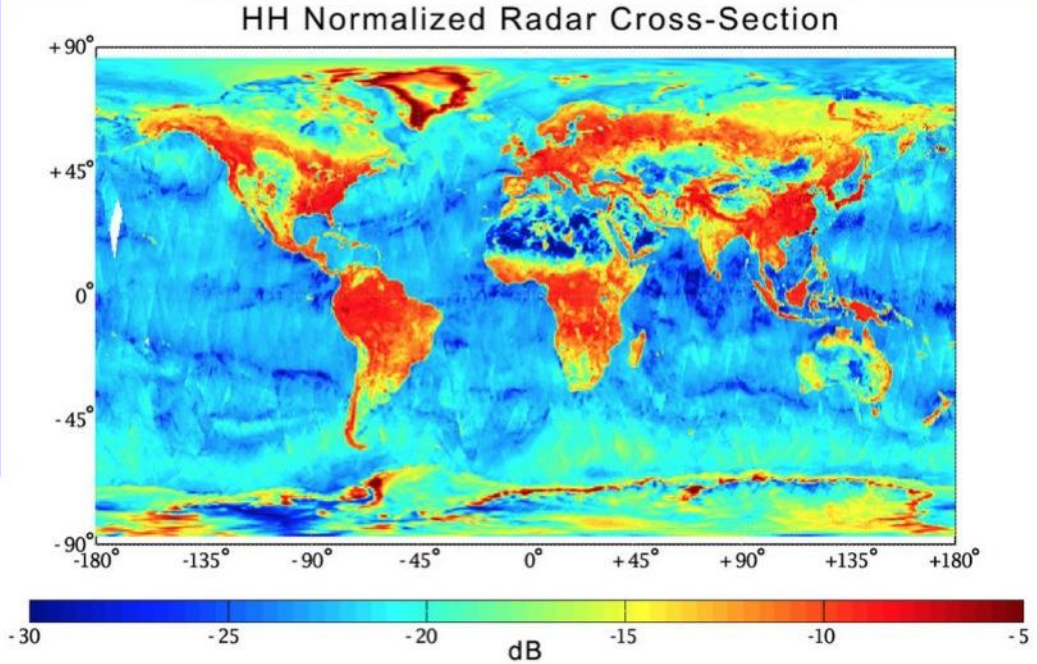
Credit: NASA, ESA, the Hubble Heritage Team (STScI/AURA), A. Nota (ESA/STScI), and the Westerlund 2 Science Team

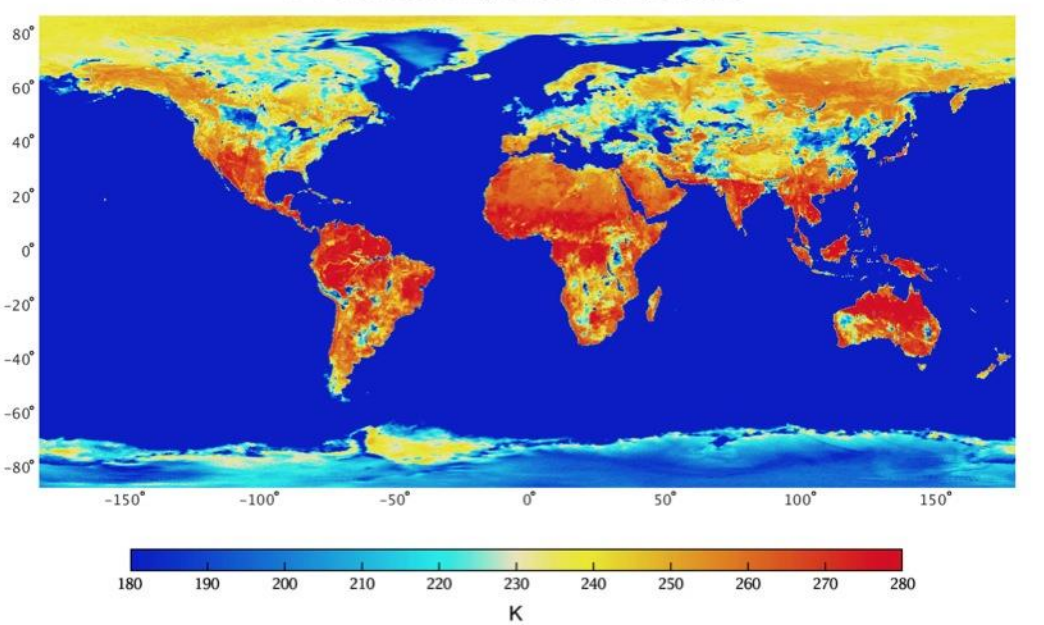
NASA and ESA are celebrating the Hubble Space Telescope's silver anniversary of 25 years in space by unveiling some of nature's own fireworks — a giant cluster of about 3,000 stars called Westerlund 2. The cluster resides inside a vibrant stellar breeding ground known as Gum 29, located 20,000 light-years away in the constellation Carina. The comparatively young, 2-million-year-old star cluster contains some of our galaxy's hottest, brightest, and most massive stars. The largest stars are unleashing a torrent of ultraviolet light and hurricane-force winds that etch away the enveloping hydrogen gas cloud. This creates a fantasy celestial landscape of pillars, ridges, and valleys.

NASA Soil Moisture Mission Produces First Global Maps

http://www.nasa.gov/jpl/smap/nasa-soil-moisture-mission-produces-first-global-maps

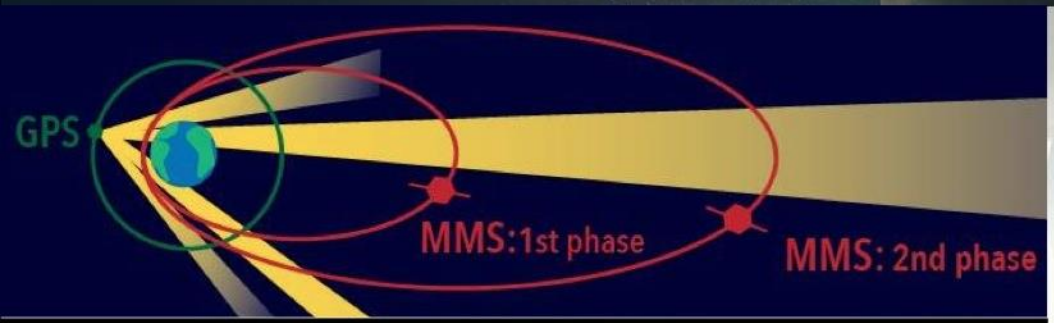
NASA's new Soil Moisture Active Passive (SMAP) observatory has generated its first global maps, a key step to beginning routine science operations next month. In late March, mission controllers at JPL successfully spun SMAP's antenna up to its full speed of 14.6 revolutions per minute in a two-step process. With its spin-up activities complete, the observatory's radar and radiometer instruments were powered on from March 31 to April 3 in a test designed to verify the pointing accuracy of the antenna and the overall performance of the radar and radiometer instruments. The radar data acquired from the test have been processed to generate data products with a spatial resolution of about 19 miles (30 kilometers).





Top Right: SMAP radar image acquired from data from March 31 to April 3, 2015. Weaker radar signals (blues) reflect low soil moisture or lack of vegetation, such as in deserts. Strong radar signals (reds) are seen in forests. SMAP's radar also takes data over the ocean and sea ice. SMAP's radar has two data acquisition functions: one for synthetic aperture radar (SAR) processing to produce radar measurements at a spatial resolution of 0.6 to 1.9 miles, and another for low-resolution processing to produce radar measurements at a spatial resolution of 19 miles. Since the SAR function was only turned on for limited durations during the March 31 - April 3 test, mission scientists did not obtain enough SAR data to produce global high-resolution maps. Beginning April 13, SMAP will start conducting regular SAR observations that will enable high-resolution global mapping of land surfaces about every two to three days. ***Bottom Right:*** SMAP radiometer image from March 31 - April 3, 2015 data maps surface microwave emissions as brightness temperatures in Kelvin, with strong emissions in reds and weaker emissions in blues. Vegetated rainforests and dry deserts show strong emissions; Greenland and Antarctica have weak emissions. A desert emits microwaves at about three times the rate a lake does. Because the difference is so large, even a small amount of moisture in soil causes a change that a radiometer can measure accurately.

MMS Navigation System Setting Records!



The red ellipses show the MMS orbit paths during the first and second phases of the mission. Each spacecraft uses GPS signals – which come from satellites situated along the green circle shown surrounding Earth -- from the far side of Earth to track its position. Credit: NASA, MMS.

- The Magnetospheric Multiscale (MMS) spacecraft launched on March 12, 2015 to study how magnetic fields around Earth connect and disconnect explosively releasing energy via a process known as magnetic reconnection. The four MMS spacecraft fly in an adjustable formation to study reconnection regions in Earth's space environment.

- A precise tracking system is crucial for MMS, which requires extremely sensitive position and orbit calculations. The four spacecraft must fly in a tight pyramid formation to gather science data as they move through Earth's magnetic environment. The formation is required to obtain 3-dimensional observations of reconnection regions that can allow energy and solar material to funnel into near-Earth space. With instrument booms deployed, each spacecraft is the size of a baseball field and they fly as close as six miles apart!

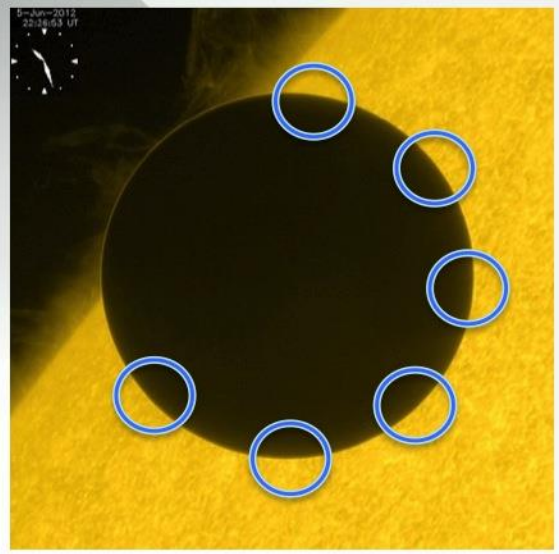
- The onboard navigation tool on the MMS spacecraft had never before flown on a spacecraft with an orbit traveling so far from Earth. In the month and a half since launch, the MMS Navigator system has set the record for the highest GPS use in space. At the highest point of the MMS orbit, at more than 43,500 mile above the surface of Earth, Navigator set a record for the highest-ever reception of signals and onboard navigation solutions by an operational GPS receiver in space. Also, at the lowest point of the MMS orbit, Navigator set a record as the fastest operational GPS receiver in space, at velocities over 22,000 miles per hour.

- Using GPS on Earth by such things as cars and smart phones isn't nearly as simple for something like MMS. For one thing, the bulk of its highly-elliptical orbit occurs above where the GPS transmitters orbit. So MMS must have specialized, extremely sensitive receivers to capture GPS signals. In addition the MMS spacecraft spin; each one makes three revolutions per minute. There are four GPS antennas on each spacecraft; as the spacecraft rotate, there is an algorithm running that allows for a hand off from one antenna to the next without losing the signal. Even if the receiver loses all GPS signals for part of the orbit, Navigator's integrated software can still compute the orbit by incorporating information including drag force, gravity, and solar radiation pressure.

- This system will be even more important during the second phase of the MMS mission when the orbit will double in size and travel all the way out to 95,000 miles from Earth. Now that the MMS team knows it works so well, Navigator can be used for other missions that travel in similar high orbits.

Super Sonic Winds Seen in the Upper Atmosphere of Venus as Day Turned to Night

- NASA researchers used the James Clerk Maxwell telescope (JCMT) on Mauna Kea, HI to view Venus during a rare transit of the Sun on June 5, 2012.
- Their just completed analysis is extremely important for potential use on exoplanets atmospheres.
- From the Earth, the global day-night terminator is seen encircling the night-side disk of Venus.
- As Venus passed in front of the Sun, its atmospheric edge was backlit by intense solar radiation.
- Strong absorption lines of carbon monoxide (CO) in the Venus atmosphere were observed over the night side disk and around this terminator region, and Doppler shifts of those absorption lines were a measure of wind speed.
- Extreme, super sonic winds were measured across the terminator from day into night on Venus. These winds drive a chaotic night side circulation in the Venus upper atmosphere.
- It was critical to test this technique out since the next Venus transits of the Sun will not occur again until 2117.



Venus Solar Transit Image from JAXA Hinode spacecraft

JCMT fields-of-view (blue circles) pointed around the Venus disk where super sonic winds were measured during the ~5 hour Venus transit. This technique pioneers a new approach to the study of exoplanet atmospheres.

Clancy et al. 2015, Icarus, in press.

NASA's Earth Minute

- Developed as part of the **Earth Right Now** campaign, **NASA's Earth Minute** is a new video series about Earth science. It utilizes hand drawn whiteboard animation as a conversational and entertaining method to reach the general public regarding NASA's Earth science missions and the concepts of climate change.

- Each **Earth Minute** takes 60-75 seconds to "boil down" a complex subject into simple language and graphics targeted at non-scientific audiences. Seven episodes are currently available with 15 more in production.

- Videos are distributed via the NASA Climate Change website http://climate.nasa.gov/ and social media channels.