National Aeronautics and
Space Administration

Science Mission Directorate

Weekly Highlights

September 11, 2015

Hubble Survey Unlocks Clues to Star Birth in Neighboring Galaxy

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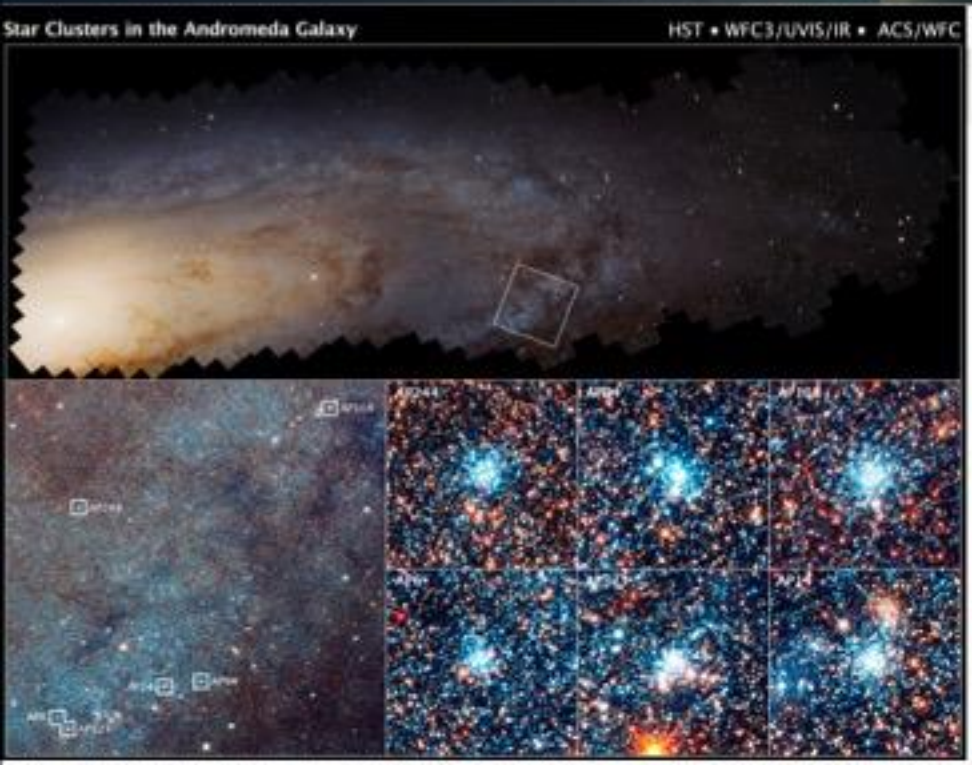


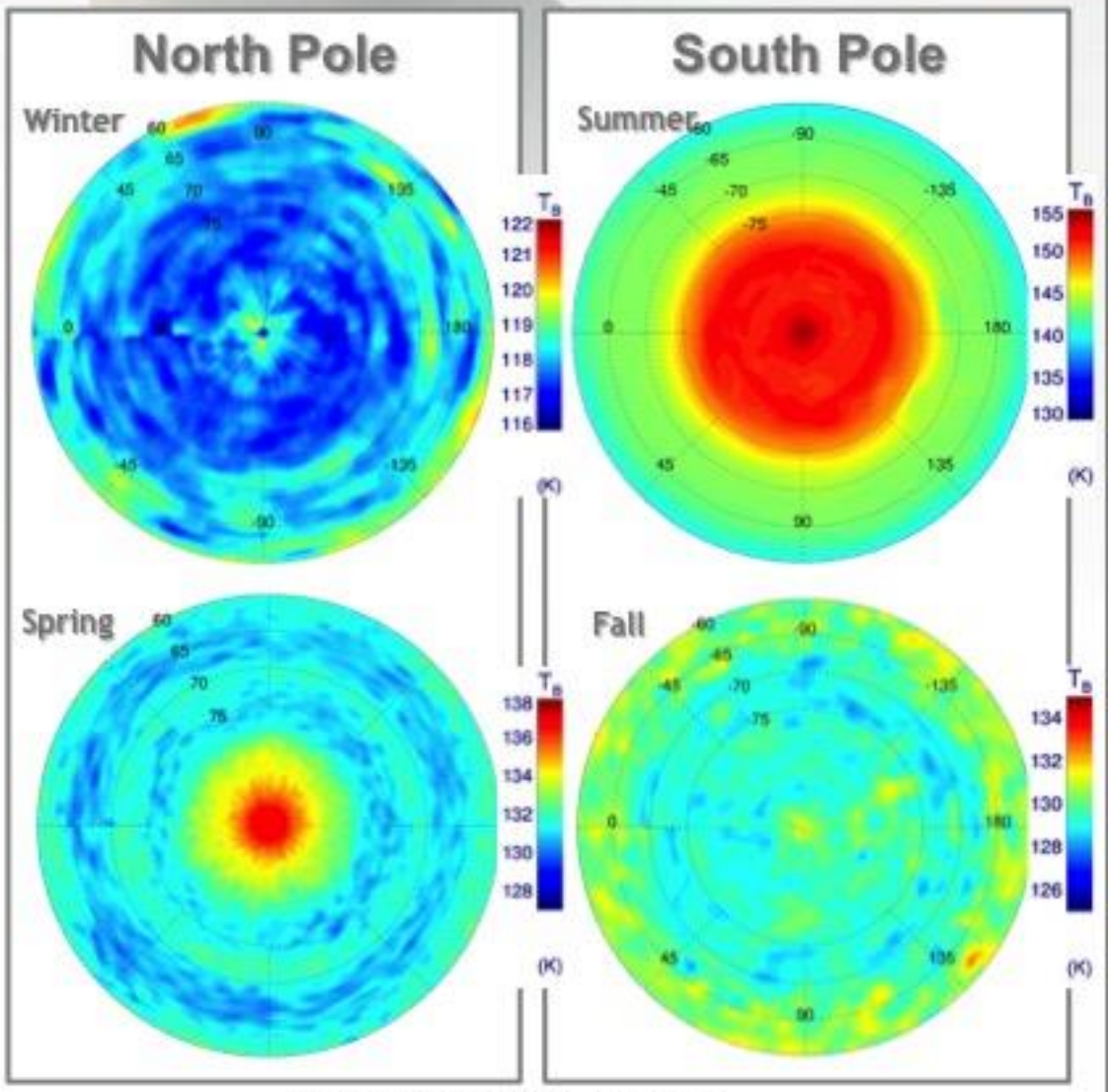
Credit: NASA, ESA, J. Dalcanton, B.F. Williams, and L.C. Johnson (University of Washington), the PHAT team, and R. Gendler

- By nailing down what percentage of stars have a particular mass within a cluster, or the Initial Mass Function (IMF), scientists can better interpret the light from distant galaxies and understand the formation history of stars in our universe.
- The intensive survey, assembled from 414 Hubble mosaic photographs of M31, was a unique collaboration between astronomers and "citizen scientists," volunteers who provided invaluable help in analyzing the mountain of data from Hubble.
- Astronomers said that the study of the IMF would not have been possible without the help of citizen scientists given the sheer volume of the Hubble images
- Measuring the IMF was the primary driver behind Hubble's ambitious panoramic survey of our neighboring galaxy, called the Panchromatic Hubble Andromeda Treasury (PHAT) program. Nearly 8,000 images of 117 million stars in the galaxy's disk were obtained from viewing Andromeda in near-ultraviolet, visible, and near-infrared wavelengths.
- Stars are born when a giant cloud of molecular hydrogen, dust, and trace elements collapses. The cloud fragments into small knots of material that each precipitate hundreds of stars. The stars are not all created equally: their masses can range from 1/12th to a couple hundred times the mass of our sun.
- The PHAT star cluster catalog, which forms the foundation of this study, was assembled with the help of 30,000 volunteers who sifted through the thousands of images taken by Hubble to search for star clusters.
- The Andromeda Project is one of the many citizen science efforts hosted by the Zooniverse organization. Over the course of 25 days, the citizen-scientist volunteers submitted 1.82 million individual image classifications (based on how concentrated the stars were, their shapes, and how well the stars stood out from the background), which roughly represents 24 months of constant human attention.
- Scientists used these classifications to identify a sample of 2,753 star clusters, increasing the number of known clusters by a factor of six in the PHAT survey region. Astronomers said that the efforts of citizen scientists will open the door to a variety of new and interesting scientific investigations.

Seasonal Extremes at Saturn's Poles

Saturn's polar regions have displayed extreme seasonal changes during the decade that Cassini's has been observing the giant planet.

- Saturn's polar stratosphere features large warm vortices (a polar hood) during the summer that has disappeared as the summer faded into fall. The South Pole cooled by about 35° C (63° F) during its fall.
- The North Pole warmed by about 20° C (36° F) as spring arrived. Cassini is still waiting for emergence of a seasonal vortex expected to appear in the northern hemisphere before the end of mission.
- The shifting temperatures depend not only on the change in sunlight, but also on enormous circulation patterns including strong vertical upwelling.
- Long-term observations are filling significant gaps in our knowledge of fundamental meteorology and chemistry of giant planet atmospheres. Cassini is providing the most comprehensive view ever obtained of seasonal change on a giant planet.



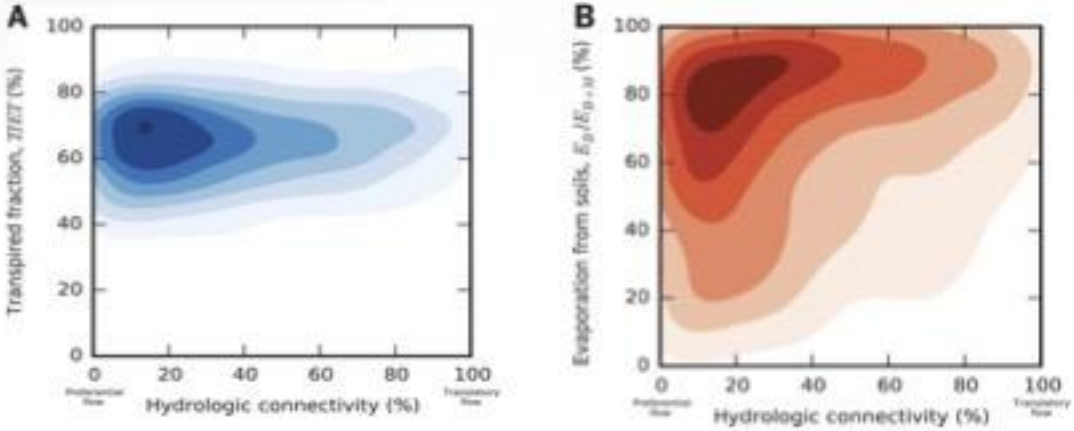
L.N. Fletcher, et al. (2015). Icarus

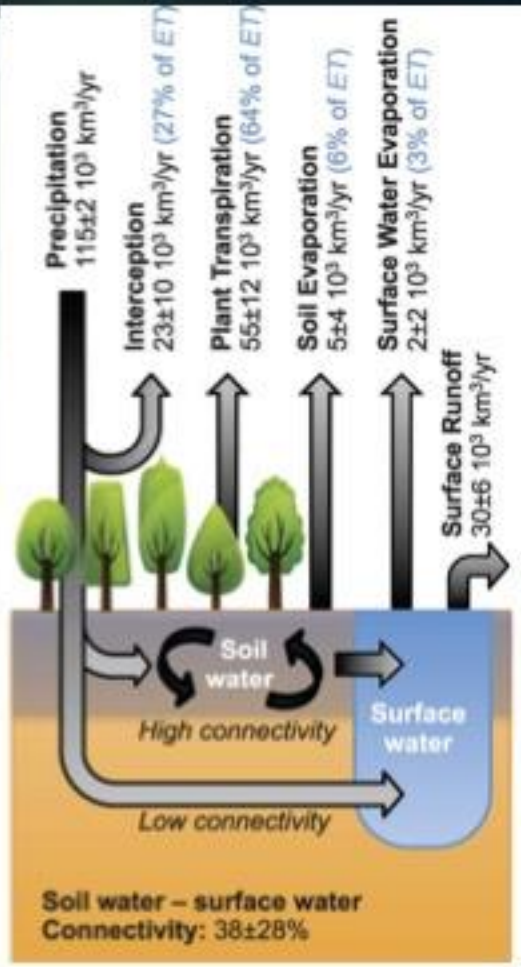
Hydrologic Connectivity Constrains Partitioning of Global Terrestrial Water Fluxes

Stephen P. Good, David Noone, and Gabriel Bowen | Science | JULY 2015 | doi: 10.1126/science.aaa5931

Researchers used data from the Tropospheric Emission Spectrometer (TES) on NASA's Aura satellite, to combine two large-scale flux-partitioning approaches and quantify evapotranspiration subcomponents and the hydrologic connectivity of bound, plant-available soil waters with more mobile surface waters. Globally, transpiration is 64 ± 13% (mean ± 1 standard deviation) of evapotranspiration, and 65 ± 26% of evaporation originates from soils and not surface waters. It is estimated that 38 ± 28% of surface water is derived from the plant-accessed soil water pool. This limited connectivity between soil and surface waters fundamentally structures the physical and biogeochemical interactions of water transiting through catchments.

Continental precipitation not routed to the oceans as runoff returns to the atmosphere as evapotranspiration. Partitioning this evapotranspiration flux into interception, transpiration, soil evaporation, and surface water evaporation is difficult using traditional hydrological methods, yet critical for understanding the water cycle and linked ecological processes.





***Left:* Relationship between hydrologic connectivity and hydrologic partitioning – darker areas more likely:** (**A**) The transpired fraction of total evapotranspiration, *T*/*ET* and (**B**) the fraction of soil and surface water evaporation that occurs from soils, E_B/E_{B+M}. ***Right:* Partitioned continental hydrologic fluxes.** Terrestrial precipitation (annual mean ± 1 SD) not intercepted by vegetation mixes into soils or flows into surface waters. Soil water is withdrawn by plant roots via transpiration, subjected to evaporation, and leaks into the surface water. Of the flux entering the surface waters, our results suggest that 38% is derived from the soils, with the remainder being consistent with precipitation routed directly via preferential flow paths. Surface water that does not evaporate returns to the ocean as runoff.

Upcoming Partial Solar Eclipse Visible from Southern Africa and Antarctica

Solar eclipses can only occur at new moon, when the moon is between Earth and the sun. But not every new moon produces an eclipse. The moon's orbit is slightly tilted, which causes the moon's shadow to miss Earth during most new moons. Credit: NASA SDO

- On Sept. 13, 2015, the moon will partially obscure the sun from view in southern Africa and much of Antarctica during a partial solar eclipse. An eclipse occurs when the moon passes directly—or nearly directly, in the case of a partial solar eclipse—between the sun and Earth. Because the moon's orbit is slightly tilted with respect to the sun-Earth line, its shadow only infrequently passes across Earth's surface.

- The Sept. 13 partial eclipse will be an example of a less dramatic eclipse – the moon will only cover about 80 percent of the sun, which will not equate to noticeable reduction in light for observers on the ground. If you're lucky enough to be in one of the areas in the Southern Hemisphere that will see the eclipse, remember that you should never look at the sun directly. A partial eclipse should only be observed by using a telescope with a special solar filter, eclipse glasses, or a pinhole projector.

- Such partial eclipses are of less scientific value than total solar eclipses, which can grant unique views of the sun's atmosphere. Scientists are gearing up for a total solar eclipse on Aug. 21, 2017. The August 2017 total eclipse will be visible from an approximately 100-mile-wide path that cuts diagonally across the United States. The August 2017 eclipse will be the first total solar eclipse visible from the contiguous United States since Feb. 26, 1979.

- During a total solar eclipse, the moon completely blocks the sun's incredibly bright face. This is possible because, though the sun's diameter is about 400 times the moon's diameter, the sun is also about 400 times farther away from us than the moon is, making them appear to be approximately the same size from Earth. With the face obscured, the sun's atmosphere—the corona, which is about a million times dimmer than the face—becomes visible to eclipse-watchers.

- It was only because of total solar eclipses that early scientists could observe the sun's wispy atmosphere, providing some of the earliest insight into our dynamic sun. Most modern solar observations of the corona are taken with an instrument called a coronagraph, which uses a disk to block the sun in a camera's field of view, but coronagraphs obscure part of the inner corona as well—which doesn't happen during a total eclipse. This means that a total eclipse can provide fantastic views of the sun's inner corona, showing the large loops of solar material that dance through it. These eclipse events provide Earth-based scientists and photographers the chance to take more detailed images of the corona than space-based satellite missions can.

American Astronomical Society (AAS) Eclipse 2017 Meeting, Portland, Oregon

- On August 21, 2017, a total eclipse of the Sun will cross the United States from coast to coast, giving tens of millions of people in a 70-mile-wide path from Oregon to South Carolina a chance to see the solar corona and experience "Darkness at Midday," weather permitting

- As the first total solar eclipse observed in the continental U.S. since 1979 and the first to span the continent since 1918, this celestial event presents a unique opportunity to excite people about science and connect them personally to the cosmos, as well as to conduct important scientific observations. To engage students in the U.S., there is only one full school year left to prepare for this exciting event

- An Eclipse 2017 Planning Workshop was held in Portland, OR on August 22 - 23, 2015. The workshop was held at the Oregon Museum of Science and Industry and featured two days of presentations by leading astronomy educators, scientists, and outreach professionals

- Many activity plans were discussed with groups and the individuals tasked with accomplishing them prior to the next workshop, which will be held in Carbondale, IL on June 11 - 12, 2016