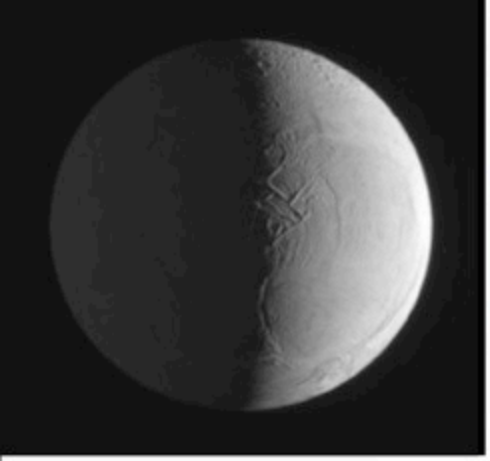
Science Mission Directorate

Weekly Highlights

September 18, 2015

Enceladus' Ocean is Global
(and its ice shell is thicker than previously thought)

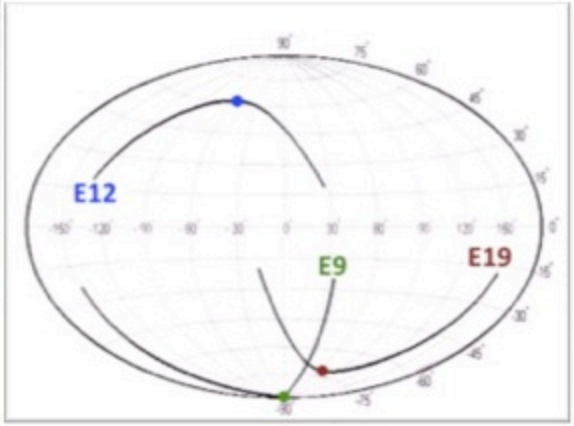
Shape is measured from limb profiles



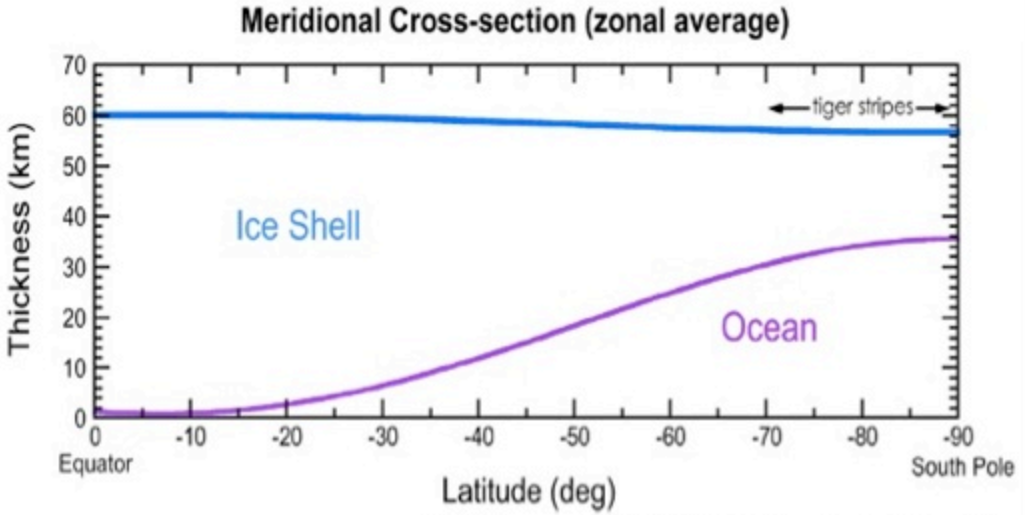
Three passes of the small Saturnian moon, Enceladus, by Cassini dedicated to measuring its gravitational field have yielded new information about the internal structure of the moon.

- Prior to these passes, gravity measurements and shape profiles indicated that Enceladus was differentiated (it has a rocky core) and likely has a floating ice shell of varying thickness.
- Taken together, a regional (possibly global) south polar sea is implied.

Cassini gravity passes



- Re-analysis of Cassini gravity data using a higher-order theory of figures indicate new features of the model of Enceladus' interior:
  - The satellite's core is somewhat smaller and slightly denser than previously thought.
  - Average global depth of compensation (or ice shell thickness) is about 50 km.
  - The ice shell substantially thinner at south pole (<25 km).
  - There is a global ocean, but it is nearly grounded near the equator.

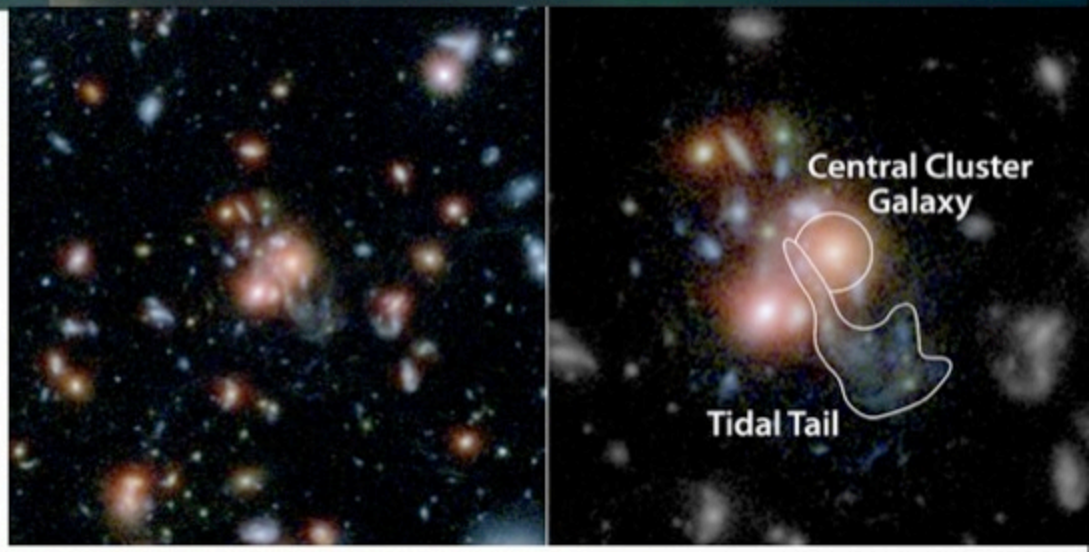


McKinnon, W.B. (2015). *Geophys. Res. Lett.*

NASA Telescopes Find Galaxy Cluster with Vibrant Heart

Published on August 21, 2015 in The Astrophysical Journal

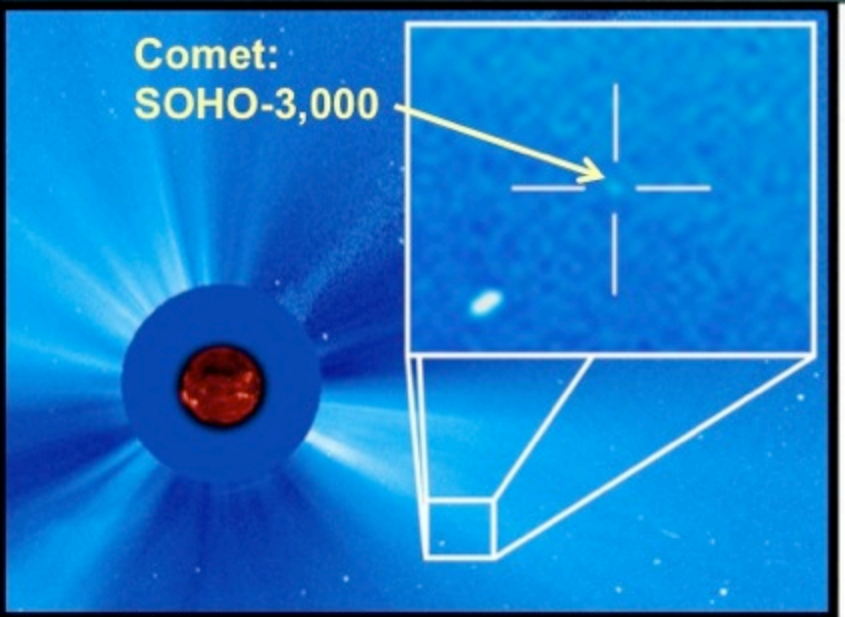
- Astronomers have discovered a rare galaxy cluster whose heart is bursting with new stars. The unexpected find, made with the help of NASA's Spitzer and Hubble space telescopes, suggests that behemoth galaxies at the cores of these massive clusters can grow significantly by feeding off gas stolen from another galaxy.
- The cluster SpARCS1049+56 has at least 27 galaxy members, and a combined mass equal to nearly 400 trillion suns. It is located 9.8 billion light-years away in the Ursa Major constellation. The object was initially discovered using Spitzer and the Canada-France-Hawaii telescope, located on Mauna Kea in Hawaii, and confirmed using the W.M. Keck Observatory, also on Mauna Kea.



Credit:NASA/ESA/STScI/JPL-Caltech/McGill

- What makes this cluster unique is its luminous heart of new stars. At the core of most massive galaxy clusters lies one hulking galaxy that usually doesn't produce new stars very quickly. The galaxy dominating the cluster SpARCS1049+56 is rapidly spitting out an enormous number of stars -- about 860 new ones a year. Our Milky Way makes only about one to two stars per year.
- Using Spitzer's infrared camera the scientists were able to detect the ferocious heat from the hot young stars. Follow-up studies with Hubble in visible light helped confirm the source of the fuel, or gas, for the new stars. A smaller galaxy seems to have recently merged with the monster galaxy in the middle of the cluster, lending its gas to the larger galaxy and igniting a fury of new stars.
- Hubble detected features in the smaller, merging galaxy called "beads on a string," which are pockets of gas that condense where new stars are forming. Beads on a string are telltale signs of collisions between gas-rich galaxies, a phenomenon known to astronomers as wet mergers, where "wet" refers to the presence of gas. In these smash-ups, the gas is quickly converted to new stars. Dry mergers, by contrast, occur when galaxies with little gas collide and no new stars are formed. Typically, galaxies at the centers of clusters grow in mass through dry mergers at their core, or by siphoning gas into their centers.
- The new discovery is one of the first known cases of a wet merger at the core of a distant galaxy cluster. Hubble previously discovered another closer galaxy cluster containing a wet merger, but it wasn't forming stars as vigorously.
- The researchers are planning more studies to find out how common galaxy clusters like SpARCS1049+56 are. The cluster may be an outlier, or it may represent an early time in our universe when gobbling up gas-rich galaxies was the norm.

SOHO Discovers its 3,000 Comet!



The small dot in the crosshairs is a comet streaming toward the sun, as seen on Sept. 13, 2015, by the joint ESA/NASA Solar and Heliospheric Observatory. This is the 3,000th comet discovered in SOHO data since it launched in 1995. Credits: ESA/NASA/SOHO

- On Sept. 13, 2015, the Solar and Heliospheric Observatory, a joint project of the European Space Agency and NASA, discovered its 3,000th comet, cementing its standing as the greatest comet finder of all time. Prior to the 1995 launch of the observatory, known as SOHO, only a dozen or so comets had ever even been discovered from space, while some 900 had been discovered from the ground.

- The 3,000th comet was originally spotted in the data by Worachate Boonplod of Thailand. SOHO's mission is to observe the sun and interplanetary space from above Earth's atmosphere that blocks so much of the sun's radiation. From there, SOHO watches the solar disk itself and its surrounding environment, tracking the constant outward flow of particles known as the solar wind, as well as giant explosions of solar material called coronal mass ejections, or CMEs.

- In its almost two decades in orbit, SOHO has opened up a new era of solar observations, dramatically expanding our understanding of the sun. The telescope's comet prowess, however, was unplanned and has turned out to be an unexpected benefit. SOHO's great success as a comet finder is dependent on the people who sift through its data – a task open to the world as the data is publicly available online in near-real time. While scientists often search SOHO imagery for very specific events, various members of the astronomy community comb through all of the imagery in fine detail. The result: 95 percent of SOHO comets have been found by these citizen scientists.

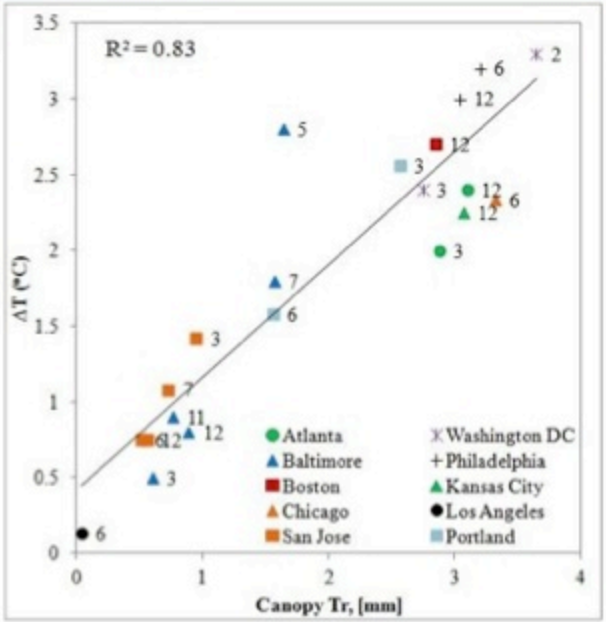
- More than just a celebrated bright vision in the night sky, comets can tell scientists a great deal about the place and time where they originated and also improve our understanding of our sun's magnetic field and the solar wind. At almost 20 years old, the SOHO mission is a respected elder in NASA's Heliophysics System Observatory – the fleet of spacecraft that watches the sun and measures its interactions with Earth and throughout the solar system to the interstellar boundary.

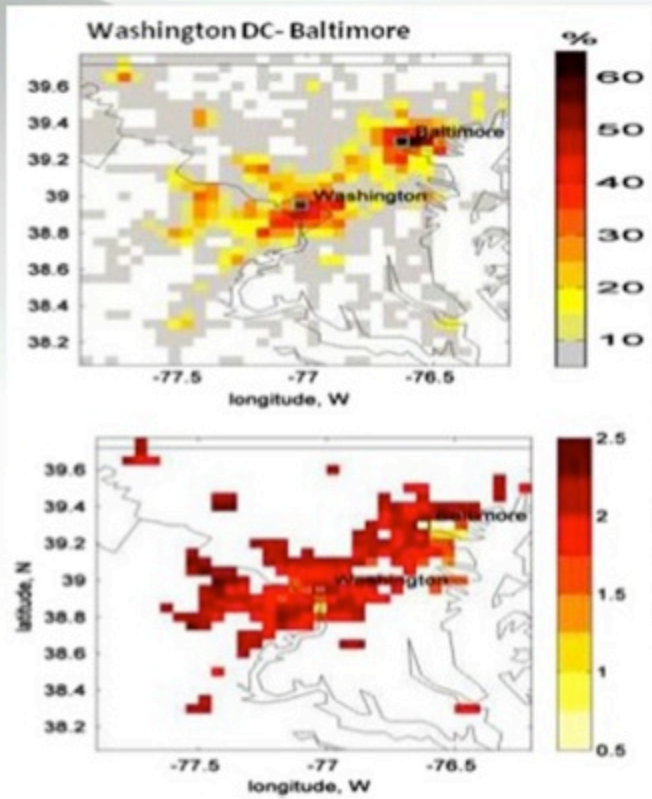
Impact of Urbanization on US Surface Climate

Lahouari Bounoua, Ping Zhang, Georgy Mostovoy, Kurt Thome, Jeffrey Masek, Marc Imhoff, Marshall Shepherd, Dale Quattrochi, Joseph Santanello, Julie Silva, Robert Wolfe, and Ally Mounirou Toure. *| Environmental Research Letters | AUGUST 2015 | doi: 10.1088/1748-9326/10/8/084010*

NASA funded scientists combined Landsat and MODIS data in a land model to assess the impact of urbanization on US surface climate. For cities built within forests, daytime urban land surface temperature (LST) is much higher than that of vegetated lands. For example, in Washington DC and Atlanta, daytime mean temperature differences between impervious and vegetated lands reach 3.3 and 2.0 °C, respectively. Conversely, for cities built within arid lands, such as Phoenix, urban areas are 2.2 °C cooler than surrounding shrubs. The study found that the choice and amount of tree species in urban settings play a commanding role in modulating cities' LST. At continental and monthly scales, impervious surfaces are 1.9 °C ± 0.6 °C warmer than surroundings during summer and expel 12% of incoming precipitation as surface runoff compared to 3.2% over vegetation. The scientists also showed that the carbon lost to urbanization represents 1.8% of the continental total, a striking number considering urbanization occupies only 1.1% of the US land.

Despite the small areal extent, urbanization has significant effects on surface energy, water and carbon budgets and reveals an uneven impact on surface climate that should inform upon policy options for improving urban growth including heat mitigation and carbon sequestration.





Above: Spatial distribution of impervious surface area- ISA (upper panel) and temperature difference (°C) between the urban and vegetation classes co-existing within each climate modeling grid. ***Left:*** Relationship between daytime mean surface temperature difference (ΔT) between urban and vegetation classes within selected model grids versus canopy transpiration (Tr) for June-July-August. Numbers next to markers indicate corresponding vegetation classes (2: Broadleaf Deciduous, 3: Mixed Forest, 5: 4 Needleleaf deciduous, 6: Savanna, 7: Grassland, 11: Barren, 12: Cropland).

Mars: Back to Earth's Future
Western Alliance Conference Workshop

- On July 29, 2015, Mars Atmosphere and Volatile Evolution Mission (MAVEN) Informal Science Educator Workshop was conducted as part of the Western Alliance Conference (WAC) of Planetariums at the New Mexico Museum of Natural History and Science
- Twenty eight planetarium professionals, six planetary science college students, three planetary scientists, and six NASA education and communication specialists participated in a day-long workshop about Mars and MAVEN science
- Presentations were presented by Mars scientists: Dr. Dave Brain, LASP, *"What Happened to the Ancient Martian Atmosphere?"* Dr. Larry Crumpler, New Mexico Museum of Natural History and Science *"A Decade of Water Prospecting on Mars: Mars Exploration Rovers"* and Dr. Horton Newsom, University of New Mexico, *"Curiosity: Results from the Mars Science Laboratory"*
- Participants viewed MAVEN online resources and demonstrations, Mars activities, and enjoyed a planetarium presentation of the *Invisible Mars* show developed for Science on a Sphere
- Evaluations were extremely positive with participants expressing strong interest in learning more about NASA's Journey to Mars.