Science Mission Directorate

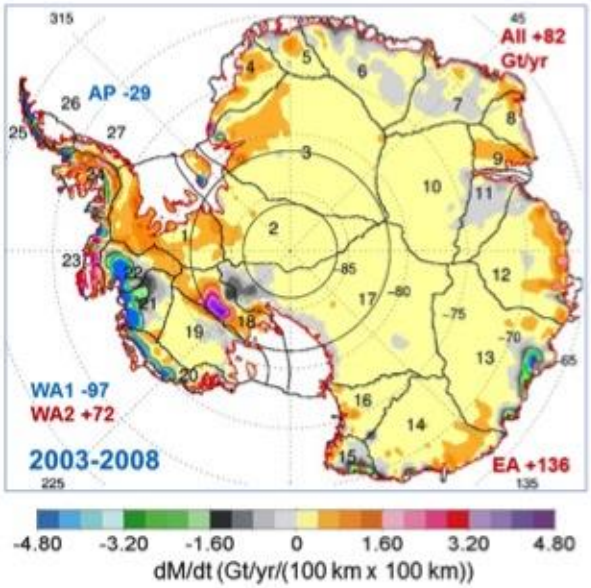
Weekly Highlights

November 6, 2015

Mass Gains of the Antarctic Ice Sheet Exceed Losses

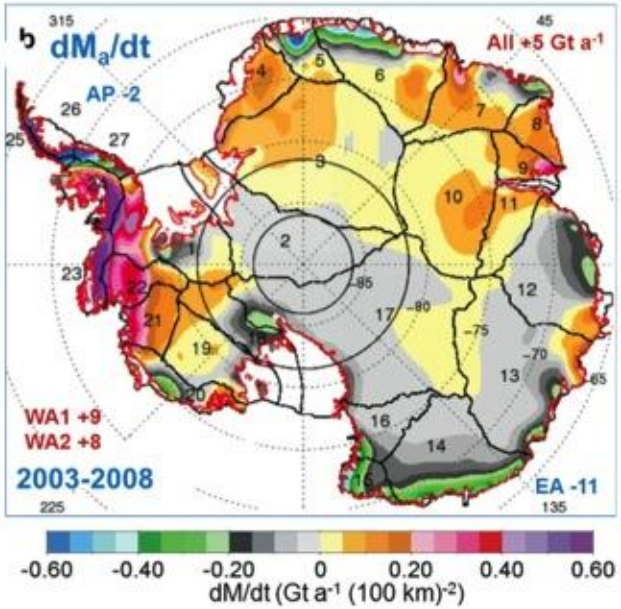
Zwally, H. J., Li, J., Robbins, J. W., Saba, J. L., Yi, D., & Brenner, A. C. | OCTOBER 2015 | doi: 10.3189/2015JoG15J071

Mass changes of the Antarctic ice sheet impact sea-level rise as climate changes, but recent rates have been uncertain. A new NASA study found that an increase in Antarctic snow accumulation that began 10,000 years ago is currently adding enough ice to the continent to outweigh the increased losses from its thinning glaciers. Ice, Cloud and land Elevation Satellite (ICESat) data show that mass gains from snow accumulation exceeded discharge losses between 2003 and 2008, reducing global sea-level rise by 0.23 mm per year, contrary to the findings of the 2013 Intergovernmental Panel on Climate Change report. European Remote-sensing Satellite (ERS) data give a similar gain of 82 billion tons of ice per year from 1992 to 2001. Mass gains in East Antarctica (EA) and in four drainage systems in West Antarctic (WA) exceed losses from three coastal drainage systems (WA1) and the Antarctic Peninsula (AP). EA dynamic thickening is a continuing response to increased accumulation, since the early Holocene. Recent accumulation loss in EA indicates thickening is not from contemporaneous snowfall increases; similarly, the WA2 gain is mainly dynamic thickening. In WA1 and the AP, increased losses from increased dynamic thinning from accelerating glaciers are 50% offset by greater WA snowfall. The decadal increase in dynamic thinning in WA1 and the AP is approximately one-third of the long-term dynamic thickening in EA and WA2, which should buffer additional dynamic thinning for decades. The results highlight the difficulty in accurately measuring changes in the surface height of the Antarctic ice sheet, and contribute to the understanding of the problem in Antarctica's mass balance.



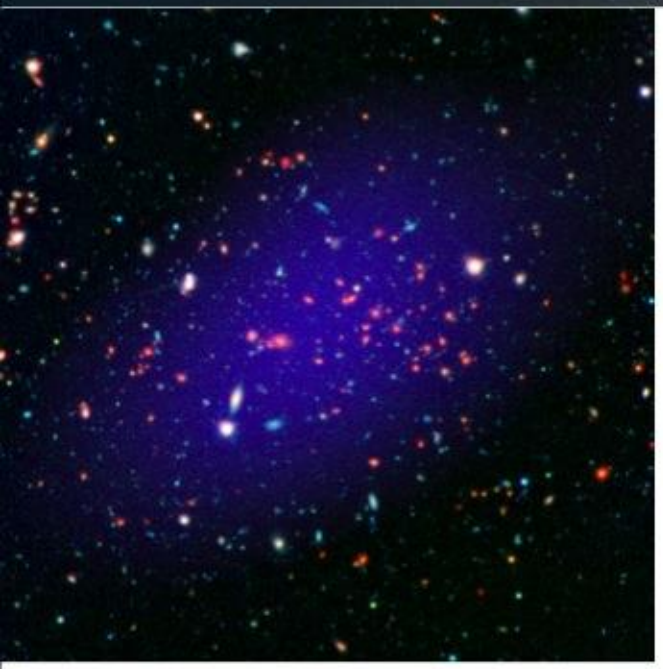
Right: Map of accumulation-driven mass changes (dM_a/dt) during 2003-2008 from ICESat. In WA1, the accumulation-driven mass increase of 14 Gt a-1 partially offset the 51Gta-1 increase in dynamic thinning.

Left: Map of total mass changes, dM/dt from ICESat during 2003-08 over Antarctica, with +82± 25 Gta $^{-1}$ mainly due to a 51 Gta^{-1} increase in dynamic thinning (note inland spreading of mass loss).



Whopping Galaxy Cluster Spotted with Help of NASA Telescopes

Published in the October 20, 2015 issue of the Astrophysical Journal Letters



Credit: NASA/JPL-Caltech/Gemini/CARMA

This color image is constructed from multi-wavelength observations: Infrared observations from NASA's Spitzer Space Telescope are shown in red; near-infrared and visible light captured by the Gemini Observatory atop Mauna Kea in Hawaii is green and blue; and radio light from the Combined Array for Research in Millimeter-wave Astronomy, near Owens Valley in California, is purple.

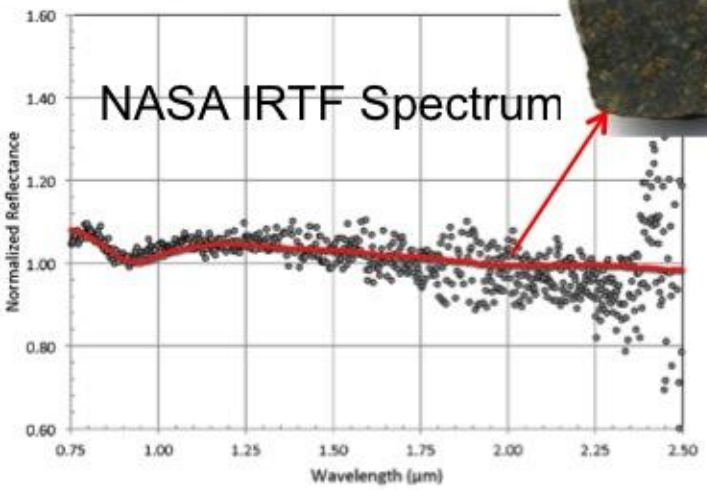
- Astronomers have discovered a giant gathering of galaxies in a very remote part of the universe, thanks to NASA's Spitzer Space Telescope and Wide-field Infrared Survey Explorer (WISE). The galaxy cluster, located 8.5 billion light-years away, is the most massive structure yet found at such great distances.
- Galaxy clusters are gravitationally bound groups of thousands of galaxies, which themselves each contain hundreds of billions of stars. The clusters grow larger over time as they acquire new members.
- How did these clusters evolve over time? What did they look like billions of years ago? To answer these questions, astronomers look back in time to our youthful universe. Because light takes time to reach us, we can see very distant objects as they were in the past. For example, we are seeing the newfound galaxy cluster -- called Massive Overdense Object (MOO) J1142+1527 -- as it existed 8.5 billion years ago, long before Earth formed.
- As light from remote galaxies makes its way to us, it becomes stretched to longer, infrared wavelengths by the expansion of space. That's where WISE and Spitzer help out.
- For infrared space telescopes, picking out distant galaxies is like plucking ripe cherries from a cherry tree. In the infrared images produced by Spitzer, these distant galaxies stand out as red dots, while closer galaxies look white. Astronomers first combed through the WISE catalog to find candidates for clusters of distant galaxies. WISE catalogued hundreds of millions of objects in images taken over the entire sky from 2010 to 2011.
- Scientists then used Spitzer to narrow in on 200 of the most interesting objects, in a project named the “Massive and Distant Clusters of WISE Survey,” or MaDCoWS. Spitzer doesn't observe the whole sky like WISE, but can see more detail. From these observations, MOO J1142+1527 jumped out as one of the most extreme.
- The W.M. Keck Observatories and Gemini Observatory on Mauna Kea in Hawaii were used to measure the distance to the cluster at 8.5 billion light-years. Using data from the Combined Array for Research in Millimeter-wave Astronomy (CARMA) telescopes near Owens Valley in California, the scientists were then able to determine that the cluster's mass is a quadrillion times that of our sun -- making it the most massive known cluster that far back in space and time.
- MOO J1142+1527 may be one of only a handful of clusters of this heft in the early universe, according to the scientists' estimates. In the coming year, the team plans to sift through more than 1,700 additional galaxy cluster candidates with Spitzer, looking for biggest of the bunch.

Smallest Near-Earth Asteroid

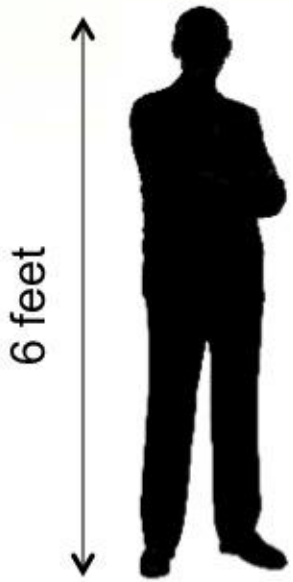
NASA IRTF Animation

Just two days after its discovery on October 11, 2015, asteroid 2015 TC25 made a very close pass by the Earth at a distance of about 69,300 miles (111,000 kilometers), or 29% of the distance to the Moon. Using data obtained at NASA's Infrared Telescope Facility, scientists supported by the Near Earth Objects Observation Program determined that 2015 TC25 is very similar to a rare class of carbon-rich stony meteorites, called Ureilites, found on Earth. ***2015 TC25, which rotates once every 133 seconds, is only about 6 feet (2 meters) in diameter, making it the smallest asteroid ever mineralogically characterized with a ground-based telescope.***

Ureilite

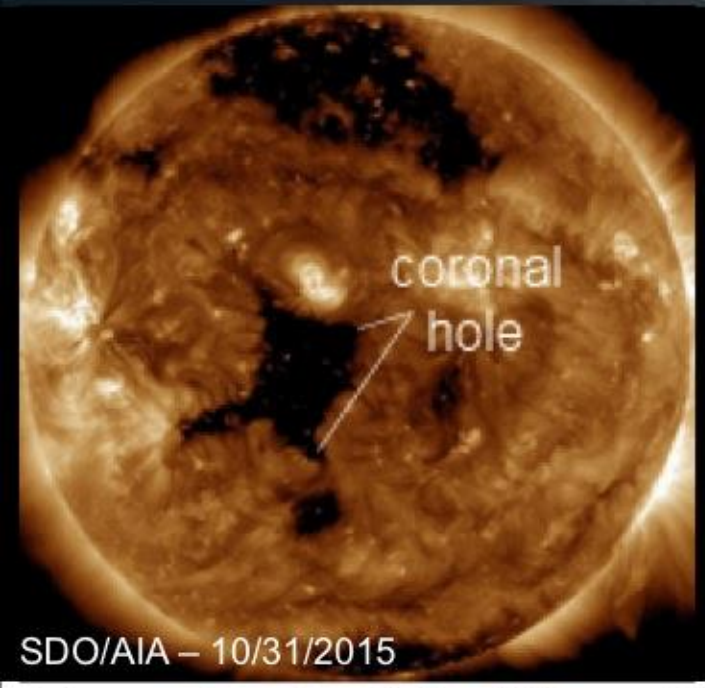


Reddy et al. In Prep.



2015 TC25 animation
(artist's concept)

High-Speed Solar Streams Spark Beautiful Aurora



Left: The high-speed solar wind stream flowing from this coronal hole observed by NASA's Solar Dynamics Observatory on October 31, 2015 reached Earth on Nov. 3. Credit: SDO/AIA.

Right: Rocky Raybell photographed this auroral display—with a Taurid Meteor from Keller, Washington, during the early hours of Nov. 3rd. Every year, the Earth passes through a stream left by Comet Encke, producing the Taurid Meteor Shower. These fireballs can light up an entire countryside when they are at their brightest.

- The aurora borealis or Northern Lights are at their most dynamic during geomagnetic storms—often the result of coronal mass ejections, or CMEs, that originate from the sun. A powerful CME can contain a billion tons of matter that can be accelerated to several million miles per hour. Rather than being caused by CMEs, this week's auroras were the result of a high-speed solar wind stream flowing from what's called a coronal hole—an area where the sun's magnetic field opens and thus has lower density allowing solar material to escape.

- Once a high-speed stream arrives at Earth, it effects the magnetosphere similar to a CME, sending charged particles rocketing down towards Earth's surface, where they collide with the atmosphere and create glowing auroras. Magnetic fields inside the October 31, 2015 solar wind stream were not well-connected to Earth's magnetic field, and that mismatch mitigated its impact. Despite the mismatch, sky watchers still observed beautiful auroras on November 3, 2015. In the United States, auroras were sighted in Michigan, Wisconsin, Montana, and even Ohio. High speed solar streams are becoming more prevalent as we have passed solar maximum and are heading toward the next solar minimum. These beautiful aurora remind us that space weather events occur throughout the solar cycle.

NASA's Next Mars Mission: Over 826K People Can Send Their Name To Mars!

- NASA's next mission to Mars, the InSight lander, will be the first mission dedicated to studying the deep interior of the planet to advance understanding of the early history of all rocky planets, including Earth

- From August 18, 2015 - September 8, 2015, over 826K people registered to send their names to Mars aboard InSight, which is scheduled to launch from Vandenberg Air Force Base, California, no earlier than March 2016

- The fly-your-name opportunity came with frequent-flier points to reflect an individual's personal participation in NASA's Journey to Mars, which will span multiple missions and multiple decades

"Our next step in the Journey to Mars is another fantastic mission to the surface," said Jim Green, Director of Planetary Science at NASA Headquarters in Washington. "By participating in this opportunity to send your name aboard InSight to the Red Planet, you're showing that you're part of that journey and the future of space exploration."

Full Cast of "The Martian" Movie Get Boarding Passes!