Science Mission Directorate

Weekly Highlights

June 6, 2014

Opportunity Identifies the Oldest Habitable Environment on Mars

The 10-year-old Opportunity rover has found evidence of an ancient environment on Mars where life could have survived.

In the Endeavour Crater in the Meridiani Planum, Opportunity has detected evidence of an ancient clay-forming, subsurface aqueous environment that is much older than the habitable environment found by Curiosity rover in Yellowknife Bay. While Yellowknife Bay was deposited during the Hesperian period, which began 3.7 billion years ago, the Meridiani Planum was deposited in the Noachian period, and is at minimum, older than 3.7 billion years.

NASA's Mars Rover Opportunity catches its own late-afternoon shadow in this dramatically lit view eastward across Endeavour Crater on Mars.

Tracks left by Opportunity en route to Endeavour Crater on Mars.

Opportunity also found evidence for water-rock interactions before and after the impact that created Endeavour crater.

The findings show that ancient Mars was habitable for life as we know it – though they do not show that life actually existed. For that, future missions will need to look for biosignatures, such as microfossil evidence for microorganisms.

Arvidson et al. (2014) *Science*

Some Highlights from the 224th Meeting of the American Astronomical Society

(Above) Astronomers using NASA's Hubble Space Telescope have assembled a comprehensive picture of the evolving universe. The Hubble Ultra Deep Field 2014 image has combined the full range of colors available to Hubble, stretching all the way from ultraviolet to near-infrared light. The resulting image contains about 10,000 galaxies, extending back in time to within a few hundred million years of the Big Bang.

(Below) Astronomers have been observing M51 (Whirlpool Galaxy) using NASA's Chandra X-ray Observatory for about a decade. In a new dataset, using about 900,000 second of Chandra observing time, they have revealed nearly 500 X-ray sources. Much of X-ray emission in M51 comes from gas that has been superheated by supernova explosions of massive stars.

Kepler

A Search for Habitable Planets

Two worlds orbiting a distant star are about to become a snack of cosmic proportions. Astronomers announced this week that the planets Kepler-56b and Kepler-56c will be swallowed by their star in a short time by astronomical standards. Their ends will come in 130 million and 155 million years, respectively.

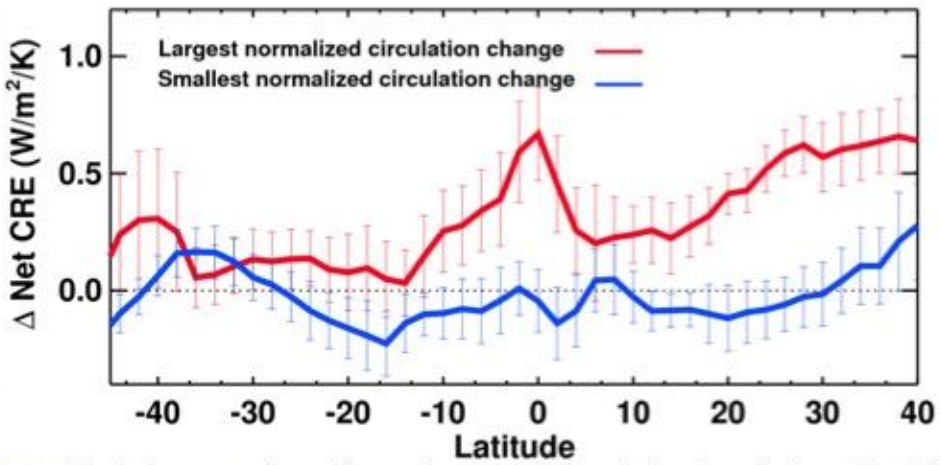
Astronomers announced that they have discovered a new type of planet -- a rocky world weighing 17 times as much as Earth. The newfound mega-Earth, Kepler-10c, circles a Sun-like star once every 45 days. It is located about 560 light-years from Earth in the constellation Draco. The Kepler-10 system is about 11 billion years old, which means it formed less than 3 billion years after the Big Bang.

Weakening and Strengthening Structures in the Hadley Circulation Change Under Global Warming and Implications for Cloud Response and Climate Sensitivity

Hui Su, Jonathan H. Jiang, Chengxing Zhai, Tsaepyng J. Shen, J. David Neelin, Graeme L. Stephens and Yuk L. Yung, Journal of Geophysical Research: Atmospheres 20 MAY 2014, DOI: 10.1002/2014JD021642.

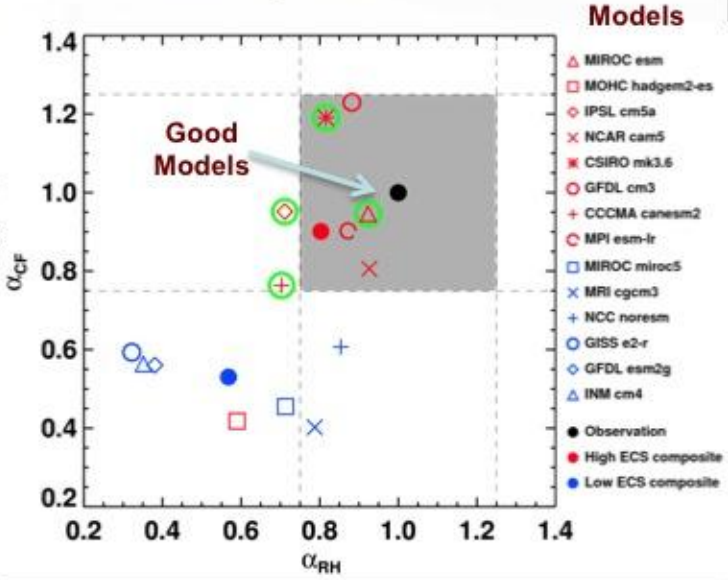
It has long been recognized that differences in climate model-simulated cloud feedbacks are a primary source of uncertainties for the model-predicted surface temperature change induced by increasing greenhouse gases such as CO_2. A NASA JPL study used NASA satellite observations to narrow the range of the climate projections. Based on the observations, it is shown that the models which best represent these observations are at the higher end of the modeled warming.

Large-scale circulation broadly determines when and where clouds form and how they evolve. However, the linkage between large-scale circulation change and cloud radiative effect (CRE) change under global warming has not been thoroughly studied. JPL scientists analyzed 15 climate models, to show that the change of the Hadley Circulation exhibits meridionally varying weakening and strengthening structures, physically consistent with the cloud changes in distinct cloud regimes. The simulated Hadley Circulation structure changes per degree of surface warming differ greatly between the models, and the intermodel spread in the Hadley Circulation change is well correlated with the intermodel spread in the TOA CRE change. This correlation underscores the close interactions between large-scale circulation and clouds and suggests that the uncertainties of cloud feedbacks and climate sensitivity reside in the intimate coupling between large-scale circulation and clouds.

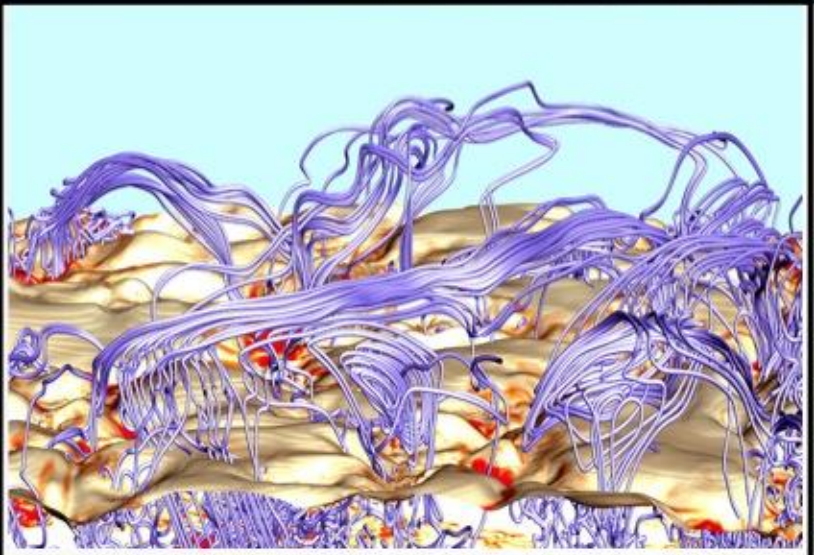


Above: Model composites of zonal-mean TOA net cloud radiative effect (CRF) change for the 5 models with the largest (red) and smallest (blue) Hadley circulation change per degree of surface warming.

Right: Model performance metrics that capture the spatial variations of zonal-mean cloud fraction and relative humidity associated with the Hadley Circulation. Regression slopes (αCF) of model zonal-mean cloud fraction profiles onto the joint CloudSat/CALIPSO cloud fraction versus the regression slopes (αRH) of model zonal-mean relative humidity profiles onto the combined AIRS/MLS relative humidity.



Supercomputers Help Reveal the Sun's Hidden Mysteries



Above: "Magnetic carpet" on the sun, simulated using NASA's Pleiades supercomputer. The "carpet" consists of small-scale magnetic fields generated by turbulent action just beneath the solar surface. This image shows a sample of magnetic field lines forming magnetic loops, with footpoints in the solar photosphere (horizontal wavy surface). Orange-red patches on the surface show concentrations of the magnetic field (color intensity is proportional to field strength). Credit: NASA Ames.

- Bursting from the sun at up to 2,000 miles per second, explosive clouds of plasma and radiation can extend millions of miles into space with the energy of nearly a billion atomic bombs. The most powerful of these coronal mass ejections (CMEs) are associated with sunspots—short-lived dark areas of intense magnetic activity that can be bigger than the Earth—but scientists are not yet sure how the phenomena are related.

- Solving these mysteries will help scientists forecast space weather events that can impact Earth: magnetic storms caused by CMEs and other solar activity can disrupt radio and satellite communication, prompt airplanes to divert from polar routes, and even cause power blackouts.

- To learn more about the conditions that lead to severe space weather, researchers are using the Pleiades supercomputer at the NASA Advanced Supercomputing (NAS) Facility at Ames Research Center, to run simulations of the solar surface, interior, and atmosphere. These realistic computer models help researchers calibrate and interpret data from space- and ground-based observatories, such as NASA's Solar Dynamics Observatory (SDO).

- Using high-resolution instruments like SDO's Helioseismic and Magnetic Imager (HMI), scientists have observed small-scale, localized magnetic fields that carpet the entire surface of the sun. This "magnetic carpet" swirls in dynamic patterns, as turbulent plasma flowing through the subsurface layers stretches and twists the magnetic field lines. Simulation results show that the turbulent plasma flows can efficiently amplify initially weak magnetic fields in the sun's convection zone. This helps explain the dramatic changes that occur near the surface, providing a better understanding of the mechanisms that lead to the formation of sunspots.

- A new era of space weather research is emerging due to the high-quality observations, with incredible resolution that have become available at the same time as advances in parallel computing and realistic physics software. These advances enable simulations that were previously impossible—a transformative step in understanding solar magnetic activity, and crucial for modeling space weather events to improve prediction capabilities.

Visualizing Vesta

Dawn Mission: Igniting Imaginations!

Imaginations are becoming engrossed in the story of our Solar System as illustrated by the *Dawn* mission. Fans are empowered to visualize Vesta as they join scientists and engineers sharing knowledge and answering questions related to the mission in our Google+ Hangouts; explore glorious high-resolution maps and videos of the giant asteroid; engage in activities that help them make sense in what they see; and are inspired to contribute to the mission through our citizen science project, Asteroid Mappers.

Visit http://dawn.jpl.nasa.gov to:

Discover our image galleries

- Vesta Atlas
- Vesta by Dawn
- Image of the Day

Tour videos

- Hangout with Scientists
- Vesta's Greatest Hits
- Virtual Vesta

Explore Cool Activities

- Vesta Mosaic
- Visualizing Vesta
- Art & the Cosmic Connection

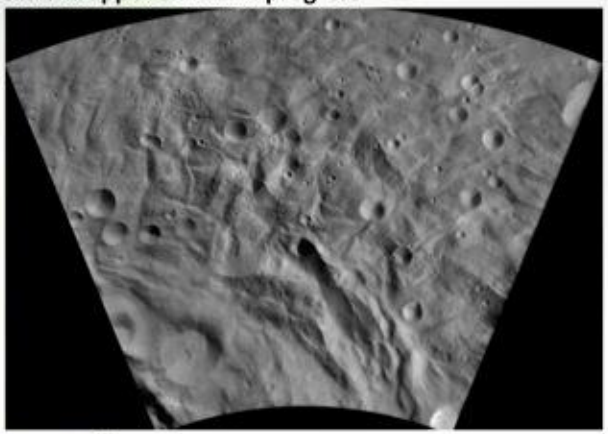
Become an Asteroid Mapper

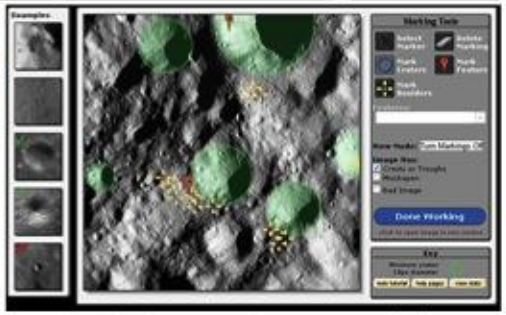
- Join our citizen science project

Keep up through Social Media

- Twitter, Google+, Facebook
  Followers tripled in past 15 months
- G+ Hangouts
  Over 700 viewers so far!

Clockwise from top left—Student creating art inspired by a Vesta image; Vesta Atlas: Justina Quadrangle; Vesta fans having fun exploring *Vesta Mosaic*; and an Asteroid Mapper's work in progress





"Before, Vesta was just another rock in the sky to me. Now I am helping make sense of these amazing images of a mysterious world sent by a real spacecraft!"

Koryeh, high school student & Asteroid Mapper