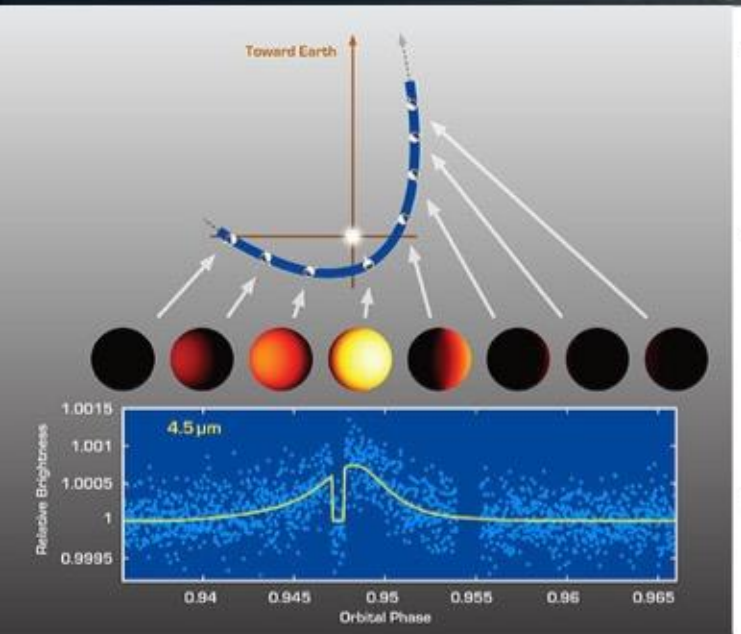
Science Mission Directorate

Weekly Highlights

April 1, 2016

Investigating the Mystery of Migrating 'Hot Jupiters'

The research paper reporting this discovery has been accepted for publication in The Astrophysical Journal Letters.



Credit: NASA/JPL-Caltech/MIT

An illustration of the planet's orbit is shown above the data, with each disk representing the hemisphere that faces Earth. The short dip in the data reflects the period when the planet passed behind the star. For that period, only the light from the star alone was observed.

- Hot Jupiters, gas giants like Jupiter but much hotter with orbits that take them close to their stars, were once considered oddballs since we don't have anything like them in our own solar system. As common as hot Jupiters are now known to be, they are still shrouded in mystery. How did these massive orbs form, and how did they wind up so shockingly close to their stars?
- The Spitzer Space Telescope found new clues by observing a hot Jupiter known as HD 80606b, situated 190 light-years from Earth. This planet is unusual in that it has a wildly eccentric orbit, swinging very close to its star and then back out to much greater distances every 111 days. One side of the planet is thought to become dramatically hotter than the other during its close approaches. When the planet is closest to its host star, the side facing the star heats up to more than 2,000 degrees Fahrenheit (1,100 degrees Celsius).
- HD 80606b is thought to be in the process of migrating from a more distant orbit to a much tighter one typical of hot Jupiters. One of the leading theories of hot Jupiter formation holds that gas giants in distant orbits become hot Jupiters when the gravitational influences from nearby stars or planets drive them into closer orbits. The planets start out in eccentric orbits, then, over a period of hundreds of millions of years, are thought to gradually settle down into tight, circular orbits.
- A key question addressed in the new study is: How long is HD 80606b taking to migrate from an eccentric to a circular orbit? One way to assess this is to look at how “squishy” the planet is. When HD 80606b whips closely by its star, the gravity of the star squeezes it. If the planet is squishier, or more pliable, it can better dissipate this gravitational energy as heat. And the more heat that is dissipated, the faster the planet will transition to a circular orbit.
- The Spitzer results show that HD 80606b does not dissipate much heat when it is squeezed by gravity during its close encounters – and thus is not squishy, but rather stiffer as a whole. This suggests the planet is not circularizing its orbit as fast as expected, and may take another 10 billion years or more to complete.
- Spitzer observed changes in the planet's brightness as the planet spun on its axis, finding a rotation period of 90 hours. A rotation rate of 90 hours is much slower than what is predicted for HD 80606b, puzzling astronomers, and adding to the enduring mystique of hot Jupiters.

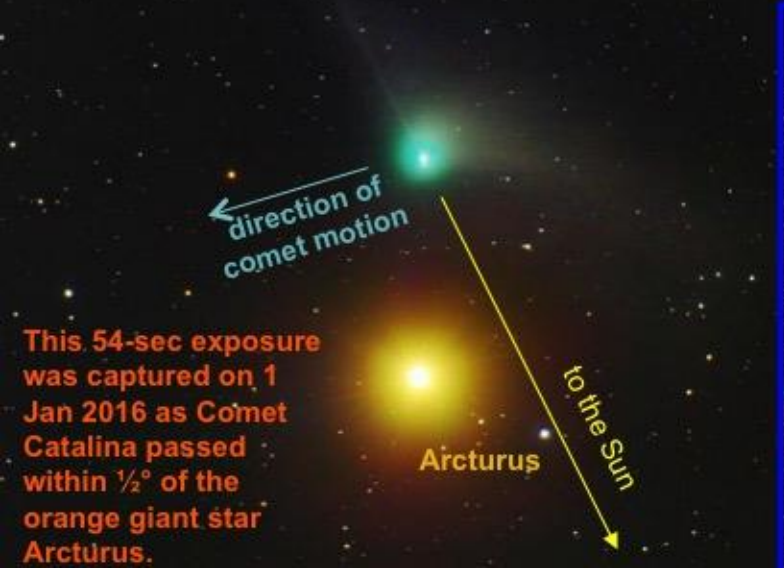
Comet Catalina (C/2013 US10) Outbound

Comet Catalina (C/2013 US10) was discovered on 31 Oct 2013 by the 0.7-m Schmidt telescope of the Catalina Sky Survey. It is a dynamic 'new' comet from the farthest reaches of our solar system, the Oort cloud.

As these icy bodies approach the inner part of the solar system, the Sun's radiation causes the volatiles sublimate and vaporize – creating the fuzzy coma and tails.

The ion tail points directly away from the Sun whereas the wispy dust trail curls towards the comet's orbital path.

The 0.7-m Schmidt telescope, located in the Catalina Mtns, north of Tucson, Arizona.



This 54-sec exposure was captured on 1 Jan 2016 as Comet Catalina passed within ½° of the orange giant star Arcturus.

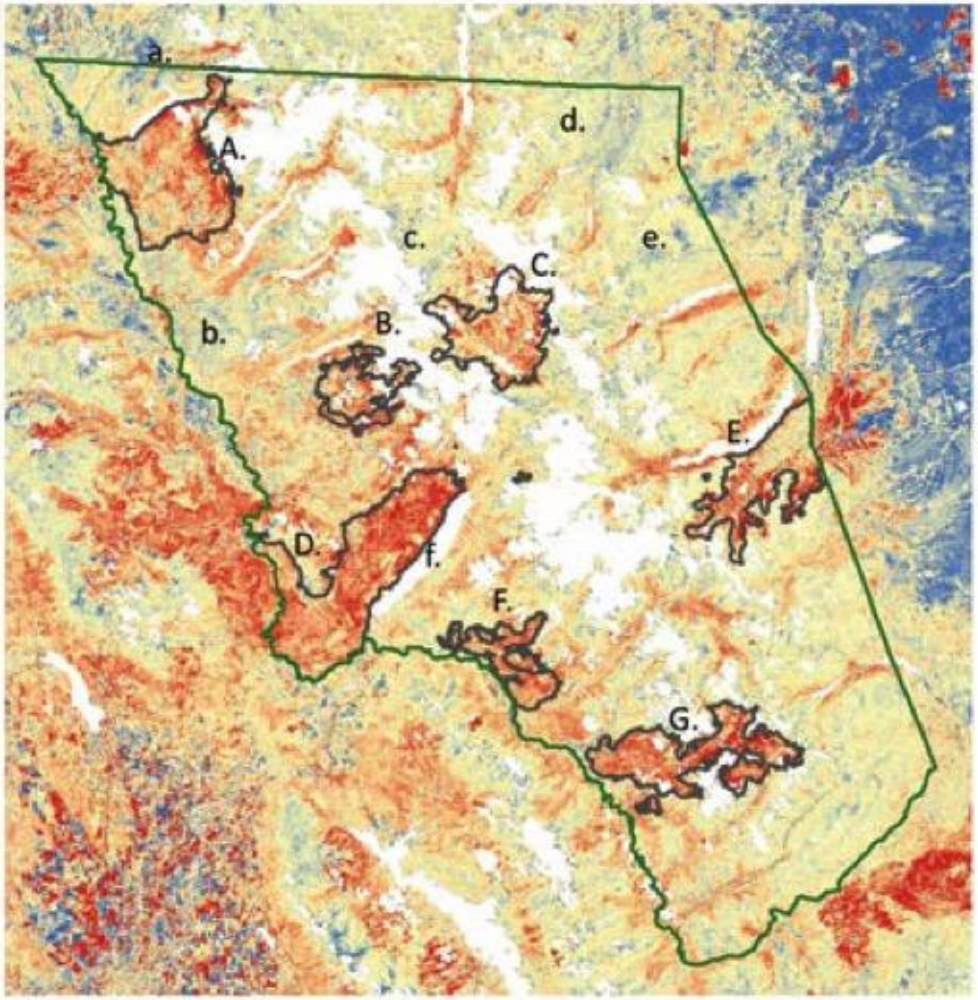
NEOWISE also imaged the comet on 28 Aug 2015, a few months before perihelion. Here, five combined images show its motion across the sky.

NEOWISE 'sees' in two IR wavelengths: 3.4 & 4.6 μm; which appear as cyan and red, respectively. The gas and dust spewed by the comet appear red in this image because they are much colder than the background stars. Having passed perihelion on 15 Nov 2015, the comet is now outbound, heading up above the plane of the ecliptic where the planets orbit.

Vegetation Cover Change in Glacier National Park Detected Using 25 Years of Landsat Satellite Image Analysis

Wilson AM, Jetz W | Journal of Biodiversity Management and Forestry | January 2016 | doi: http://dx.doi.org/10.4172/2327-4417.1000156

A NASA funded study determined the locations and timing of significant canopy green cover changes across the Glacier National Park (GNP) area in Montana since the mid- 1980s, using Landsat satellite imagery at 30-m ground resolution. Image comparisons for the years 1984 and 2010 showed that consistent increases in the normalized difference vegetation index (NDVI) have been observed at several treeline areas, some of which have been monitored for increased tree cover for more than 75 years. Significant correlations between positive NDVI change and elevation were detected between 1500 and 1800 m elevation. Nonetheless, the greatest changes in NDVI over the past three decades in GNP have been caused by wildfires that burned more than 15% of the Park's forested area over the past 10-15 years. As of 2010, less than 50% recovery of pre-fire canopy green cover was observed in most areas burned at high severity during 2003 and 2006. It is hypothesized that documented snowpack reductions and associated springtime temperature warming may be having detectable impacts on the slowing rate of post-wildfire regeneration rates of forests burned in GNP.



Right: Changes in NDVI for the GNP area (1984 -2010). Cloud, ice, and water cover was masked as white. Boundaries of wildfires that have burned within GNP since the year 2000 were outlined in dark gray and the GNP boundary outlined in green.

The Solarium Experience

A permanent exhibit at the NASA Goddard Visitor Center allows visitors to witness the awe-inspiring high definition imagery from NASA's Solar Dynamics Observatory (SDO) on a floor-to-ceiling projection.

Image from the NASA.gov Solarium Website: http://www.nasa.gov/solarium

Heliophysicists use SDO to trace how material courses through the layers of the solar atmosphere, the corona, powering gigantic burst of x-rays, called solar flares, and eruptions of solar particles, **massive eruptions of charged plasma 5, 10 and sometimes even 50 times the size of Earth** that swirl upward and fall back down — or sometimes escape the sun's gravity altogether, surging out into space.

Through SDO's impressive ability to capture stunning images of our home star, we see the sun's atmosphere dancing, giant loops swelling up, and waves sweeping through the sun's surface as they explode out into space.

With Solarium, earth-bound viewers can experience a uniquely immersive view of **how truly powerful and active the surface of our sun really is**, while taking in its breathtaking beauty. Solarium highlights the artistic side of Heliophysics data, and also shows how materials travel throughout the solar atmosphere. Viewers observe solar flares, sunspots and eruptions as plasma flows along the sun's magnetic field lines. These fiery explosions are projected in combination with soothing sounds which have been captivating audiences for over a year.

The Visitor Center at GSFC is not the only place you can enjoy the Solarium experience. There is a traveling Solarium exhibit in addition to the permanent installation in Maryland. Recently, Genna Duberstein, one of our senior editors and media producers, attended a Solarium event opening at the American Museum of Natural History's (AMNH) Black Hole Theater in New York City. This is the second year AMNH has requested Solarium to be a part of their annual Sun Earth Day event. Genna created the Solarium Installation from concept to completion with two other talented creators - video producer, Scott Wiessinger and Tom Bridgman, a data-driven visualization artist.

Solarium installations are currently being considered in London by The Natural History Museum and the Science Museum.
The London Natural History Museum, which sees 15,000 – 20,000 visitors per day, is motivated to be the first to show the installation in Europe. Venues in Singapore and Paris have also expressed interest in participating in what we hope to be a **5 year international tour**.
For more information on where you can see this stunning visual display of the sun's brilliance and power, visit: http://www.nasa.gov/solarium

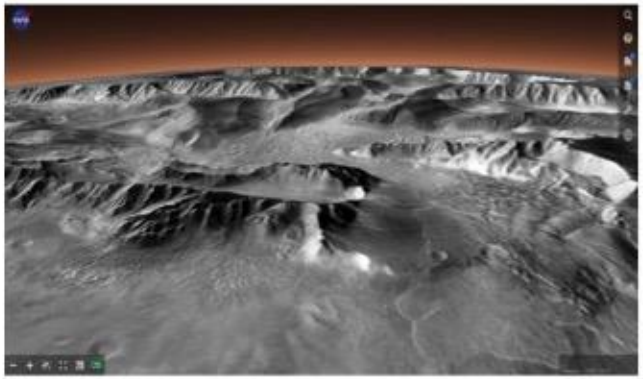
Science Mission Directorate
Public Engagement Apps to Benefit Earth

- MarsTrek is one of the web portals (MoonTours, VestaTrek) developed by NASA's Jet Propulsion Laboratory (JPL) and managed by NASA's Solar System Exploration Research Virtual Institute (SSERVI) http://marstrek.jpl.nasa.gov
- MarsTrek is being upgraded to support the Mars 2020 landing site selection, but also has down to Earth uses
- "WaterTrek" will be prototyped through the JPL Data Science Initiative to provide visualization and analysis of Earth water data sets and assimilated models for unprecedented western water availability research
- These web portals have the versatility and extensibility to be effectively leveraged across both Planetary Science and Earth Science Divisions within NASA's Science Mission Directorate
- WaterTrek is in response to a White House Call-to-Action:

  "COMMITMENTS TO ACTION ON BUILDING A SUSTAINABLE WATER FUTURE" for "*institutions and organizations from all sectors to make new commitments to build a sustainable water future in the United States.*"

  "*NASA's JPL is committing to treating western water issues with the same urgency and rigor as its spaceflight projects.*"

WaterTrek



MarsTrek