

National Aeronautics and
Space Administration



Science Mission Directorate

Weekly Highlights

December 4, 2015



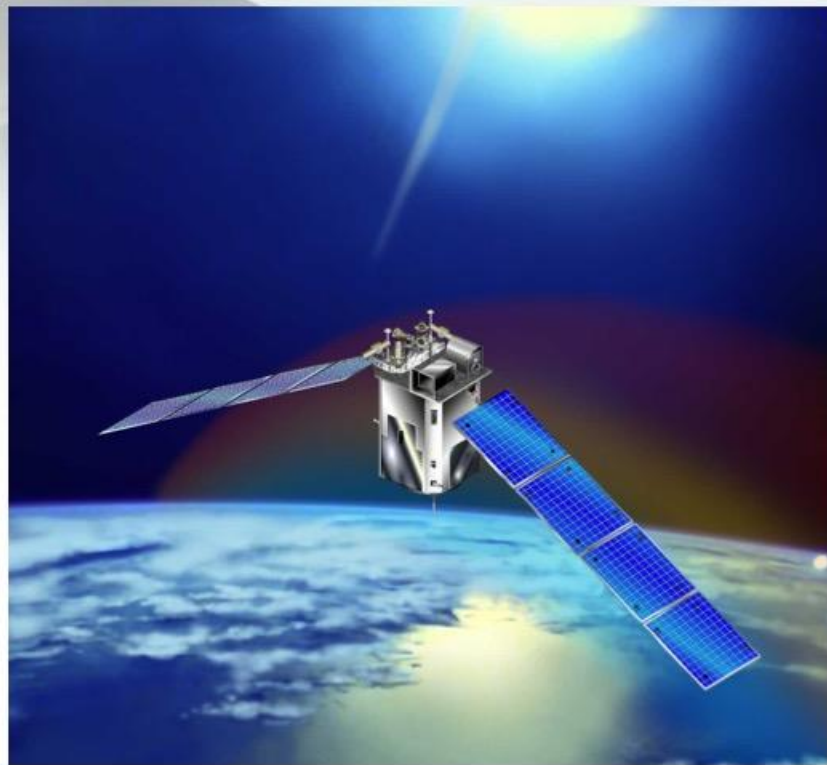
NASA's TIMED mission celebrates 14 years of continuous upper atmosphere observations

The NASA TIMED (Thermosphere Ionosphere Mesosphere Energetics and Dynamics) spacecraft, which studies the impact of solar- and human-induced disturbances on Earth's upper atmosphere, celebrated 14 years continuous data collection on Dec. 7. During that time, the spacecraft completed more than 75,000 Earth orbits and accumulated more than 9 terabytes of data, served by the TIMED Mission Science Data Center located at the Johns Hopkins University Applied Physics Laboratory (APL) and now archived at the Space Physics Data Facility at the NASA Goddard Space Flight Center.

The TIMED spacecraft was launched in December 2001 and recently approved for a sixth extended mission, during which scientists hope to further their study of some of Earth's least-understood atmospheric variability. The data collected from the TIMED mission is helping scientists understand the energy transfer into and out of the mesosphere and lower thermosphere/ionosphere region of Earth's atmosphere, which is located between approximately 40 and 110 miles above the Earth's surface. The mission is also providing valuable information on the basic structure of pressure, temperature and winds that result from the global energy balance.

During its current mission, TIMED is especially focused on the comparison between the current solar cycle and those in the previous solar cycle. The solar and geomagnetic activity during the current solar cycle is about half as active as the previous one, an event that only occurs every 100 to 200 years. The solar cycle is the periodic variations of high and low activity on the sun that repeat approximately every 11 years. These variations drive the chemistry and dynamics of our upper atmosphere and the near-Earth space environment. Collecting uninterrupted observations of multiple solar cycles has given scientists the unique ability to differentiate solar cycle contributions from the long-term decadal changes in the ionosphere-thermosphere-mesosphere system.

The mission is the first in NASA's Heliophysics Solar Terrestrial Probes Program, which targets unsolved scientific questions necessary to understand fundamental physical processes in the solar system from the sun to planetary bodies, including Earth, and to the interstellar boundary. TIMED is managed by NASA's Goddard Space Flight Center in Greenbelt, Maryland. APL designed, built and operates the spacecraft and leads the project's science effort for NASA during the mission.

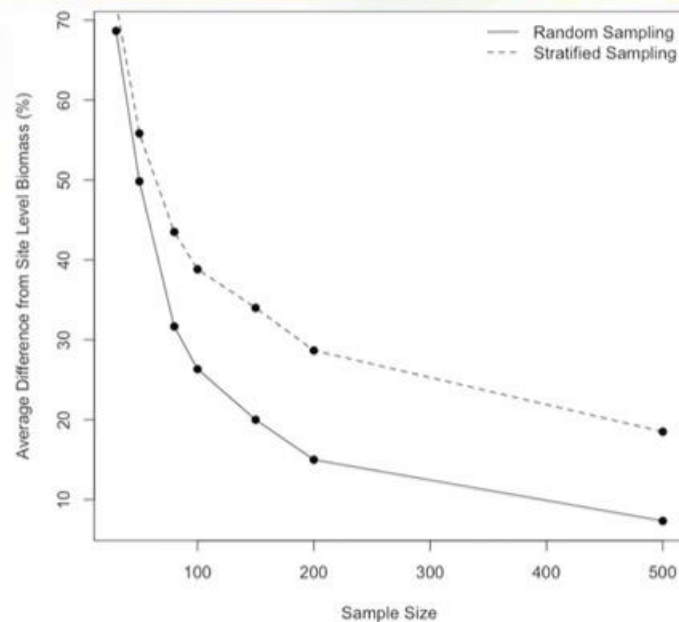
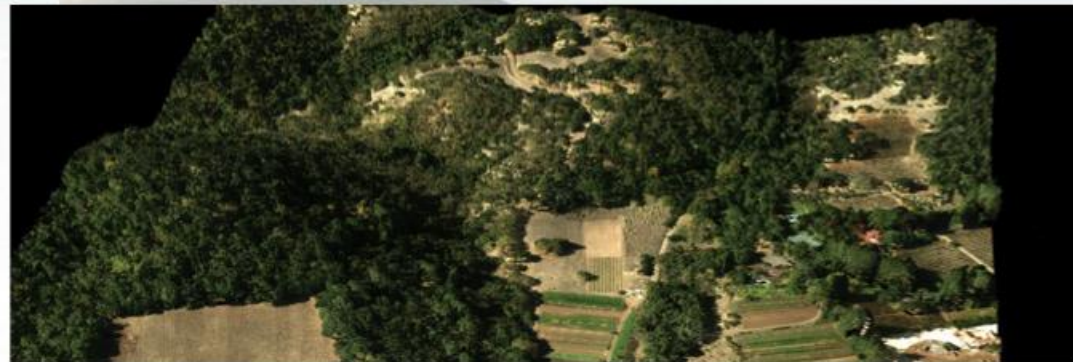


An artist's depiction of the TIMED spacecraft, which is part of NASA's Heliophysics Great Observatory. The TIMED spacecraft launched on Dec. 7, 2001, from Vandenberg Air Force Base, California, aboard a Delta II launch vehicle with the Jason-1 spacecraft. Credit: Johns Hopkins University Applied Physics Laboratory

Small Sample Sizes Yield Biased Allometric Equations in Temperate Forests

Duncanson, L., Rourke, O., and Dubayah, R. | NOVEMBER 2015 | doi: 10.1038/srep17153

A new NASA-funded study suggests that past research efforts may have systematically overestimated the amount of carbon stored by temperate U.S. forests, through the application of allometric equations developed with small sample sizes. The study used lidar data acquired by NASA GSFC's Lidar, Hyperspectral and Thermal Imager to provide a quantitative assessment of the sensitivity of allometric parameters to sample size, isolating between 10,000 to more than 1,000,000 tree height and crown radius measurements per site in six U.S. forests. The findings indicated that fitted allometric parameters are highly sensitive to sample size, producing systematic overestimates of height. The analysis was also extended to biomass through the application of empirical relationships from the literature, showing that given the small sample sizes used in common allometric equations for biomass, the average site-level biomass bias is about 70%. These findings underscore the importance of increasing the sample sizes used for allometric equation generation. Global forests cover approximately 30% of the land's surface and have been estimated to store approximately 1.03 million megatons of carbon. Accurate quantification of forest carbon stocks is not only important for constraining the global carbon cycle and its impacts on climate, but also integral to the mitigation of climate change through market-based initiatives.



Above: 3-D visualization obtained using lidar and aerial imagery. Lidar is a remote sensing technique that can be used to digitally measure the heights and crown dimensions of trees, not just for a small sample but for every tree across a landscape. Credits: NASA/University of Maryland

Above: The deviation from the site-level biomass estimated using the full sample size, as a function of sample size. As sample size increases, errors in biomass estimation decrease because a higher number of large trees is sampled.

Two New Binary Asteroid Systems

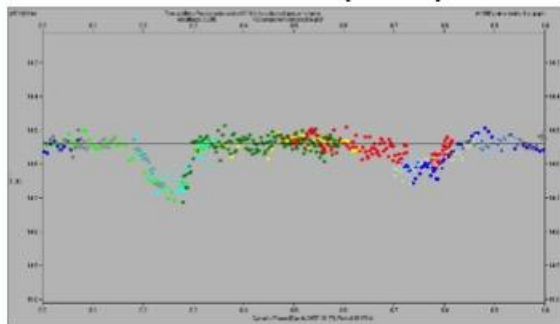
A pair of binary asteroids were discovered by astronomers operating NASA's Infrared Telescope Facility (IRTF) on Mauna Kea, Hawaii.

- The two newly discovered binary asteroid systems (4514) Vilen and (4541) Mizuno, in the main asteroid belt, orbiting the Sun between Mars and Jupiter, were likely formed by the splitting of the primary asteroid due to solar radiation pressure.
- Dips in lightcurve observations of (4514) Vilen obtained by Pray *et al.* (IAU Circulars; below, right) indicated that two bodies were passing in front of each other, revealing it to be a binary system. The moonlet travels around its primary every ~ 16.8 hours. (4541) Mizuno was similarly found to be binary.

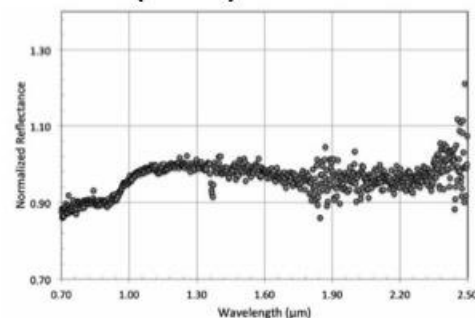
This artist rendition shows the secondary in orbit around the primary after fission.



Photometric Lightcurve Observations of (4514) Vilen



NASA IRTF Spectrum of (4514) Vilen



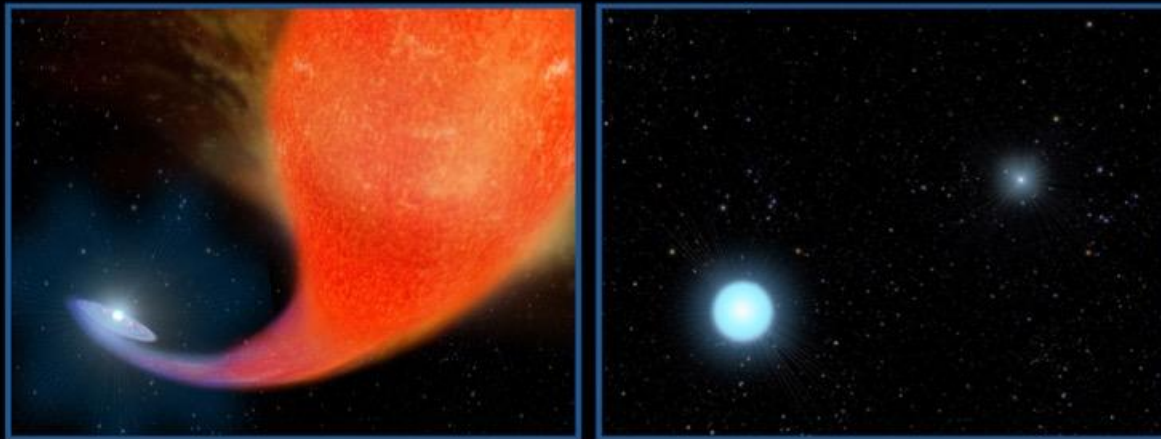
(Reddy, *et al.* – in preparation).

- Spectroscopic observations indicate that (4514) Vilen is a M/X-type asteroid (right image at left), similar to carbonaceous chondrite meteorites. (4541) Mizuno is an S-type asteroid with composition similar to ordinary chondrite meteorites.

Hubble Helps Solve Mystery of 'Born Again' Stars

Published in the December 1, 2015 issue of The Astrophysical Journal.

Birth of a Blue Straggler Star



[Left] - A normal star in a binary system gravitationally pulls in matter from an aging companion star that has swelled to a bloated red giant that has expanded to a few hundred times its original size.

[Right] - After a couple hundred million years, the red giant star has burned out and collapsed to the white dwarf that shines intensely in ultraviolet wavelengths. The companion star has bulked up on the hydrogen siphoned off of the red giant star to become much hotter, brighter, and bluer than it was previously.

Credit: NASA, ESA, and A. Feild (STScI)

- For the past 60 years, astronomers have been puzzled by an unusual type of star that looks hotter and bluer than it should for its age. It has been dubbed a "blue straggler" because it seems to lag behind the evolution of neighboring stars. Blue stragglers dwell inside ancient star clusters that should have stopped making youthful and short-lived blue stars billions of years ago.
- The most popular explanation among several competing theories is that an aging star spills material onto a smaller companion star. The small star bulks up on mass to become hotter and bluer, while the aging companion burns out and collapses to a white dwarf — a burned out cinder.
- To test this theory, astronomers used the Hubble Space Telescope to conduct a survey of the open star cluster NGC 188 that has 21 blue stragglers. They found that seven had white dwarf companions, by identifying their ultraviolet glow that is detectable by Hubble. Of the remaining 14 blue stragglers, a further seven show evidence of mass transfer between stars. This was the first time astronomers could place limits on the fraction of blue stragglers formed through mass transfer. This discovery sheds light on the physical processes responsible for changing the appearance of 25 percent of evolved stars.

#Hour of Code Workshop in Holliston, Massachusetts

- On December 8, 2015, Kimberly Arcand conducted two 1-hour #HourofCode workshops for 45 grade 6 students at an elementary school in Holliston, MA
- The workshops consisted of discussions of light, Chandra & astronomy before moving to “Recoloring the Universe” (NASA-product reviewed/approved) activity created with Chandra, Google & American Astronomical Society (AAS) on Pencilcode open access platform
- Chandra materials were handed out on coding, women in science/technology, light and the Chandra mission to 45 students and 3 teachers



<http://chandra.si.edu/edu/pencilcode/>