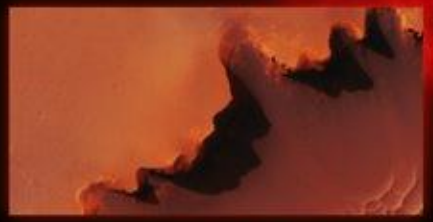
National Aeronautics and Space Administration

NASA Science

Weekly Highlights
September 20, 2013


EARTH SCIENCE


HELIOPHYSICS


PLANETARY SCIENCE


ASTROPHYSICS

Firestation Experiment: Exploring the Tops of Thunderstorms

Above: The Firestation instrument can observe thunderstorms at multiple wavelengths simultaneously. Various detectors allow it to record the radio static from lightning, measure its optical glow, and detect the gamma-rays and electrons associated with TGFs and antimatter events. *Credit: NASA*

- We all know what comes out of the bottom of thunderstorms: bolts of lightning. Jagged columns of light plunge Earthward, heating the air to 50,000 degrees F, about five times hotter than the surface of the sun. Claps of thunder announce this process somewhere on Earth as often as 50 times a second. Have you ever wondered, though, what comes out of the top?

- In recent decades researchers have discovered some interesting things happening in the cloud tops. High above ordinary lightning, exotic forms known as red sprites and blue elves shoot toward the heavens, cold cousins to the fiery bolts below. In some places jets of antimatter fly upwards, triggering the detectors on NASA's orbiting high-energy observatories. And as often as 500 times a day, Earth mimics a supernova, producing a brief powerful blast of gamma-rays called a Terrestrial Gamma-ray Flash (TGF).

- No know knows exactly how these phenomena are related either to each other or to the lightning down below. A new experiment called "Firestation" onboard the International Space Station (ISS) aims to find out. Firestation is a package of sensors designed to explore the links between TGFs, ordinary lightning, and sprites.

- The space station's orbit will carry Firestation directly above thousands of active thunderstorms during the one-year lifetime of the experiment. Unlike previous experiments in upper atmospheric lightning, Firestation has the unique ability to observe thunderstorms at multiple wavelengths simultaneously. It can record the radio static from lightning, measure its optical glow (including the red and blue light of sprites and elves), and detect the gamma-rays and electrons associated with TGFs and antimatter events.

- Researchers expect Firestation to observe up to 50 lightning strokes per day, at least one TGF every few hours, and a large TGF every couple of days. Such a firehose of multi-wavelength data will allow researchers to sort out cause-and-effect connections impossible to see in previous studies. The experiment was delivered to the ISS on August 3, 2013, by the Japanese robotic cargo vessel "Kounotori-4." It has since been installed on the station's exterior by the station's robotic arm. All of the sensors were checked out at the end of August and full-time science operations are slated to begin in September 2013.

Spring Rain on Saturn's Moon Titan

- A huge cloud observed on Titan in Sept. 2010 (B) was quickly followed (C) by extensive changes on the surface: >500,000 square km, roughly the combined area of Arizona and Utah.
- In these images bright, light grey features are methane clouds, darker grey shades are surface features.
- The best explanation for the changes in widespread methane rainfall from the storm making the surface wet, perhaps even causing flooding in some places.
- The observation of recent rain suggests that the climate on Titan is similar to the southwestern U.S., where infrequent rain carves washes and riverbeds.
- Titan's weather is changing with the seasons, now early northern spring (like April on Earth), and storms have become more common at low latitudes.

9/20/13

Largest Known Group of Star Clusters Uncovered

Published in the September 20th 2013 edition of The Astrophysical Journal.

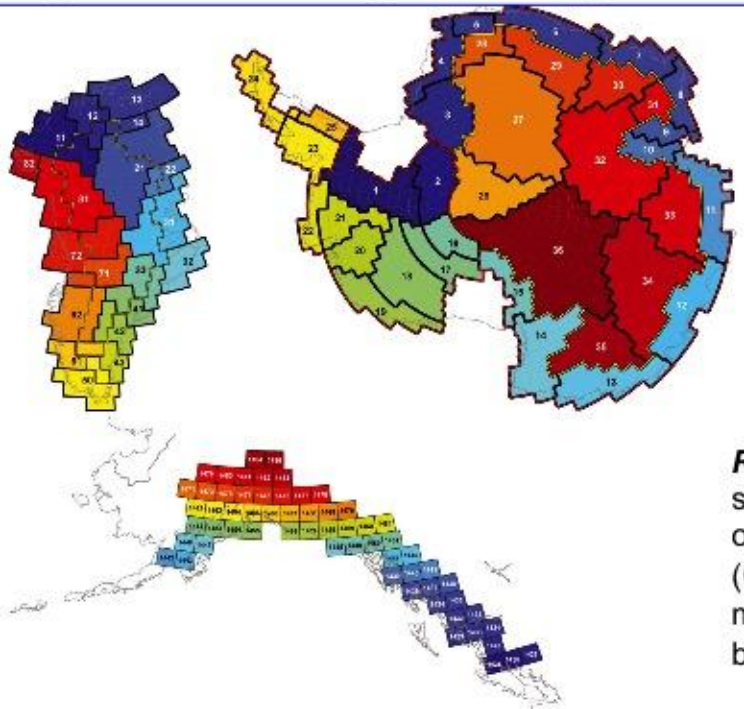
The left image, taken by Hubble's Advanced Camera for Surveys, shows the numerous galaxies that make up Abell 1689. The box near the center outlines one of the regions sampled by Hubble. The right monochromatic view, taken at visible wave-lengths, zooms into the region packed with globular clusters. They appear as thousands of tiny white dots, which look like a blizzard of snowflakes. The larger white blobs are entire galaxies of stars.

- An international team of astronomers used Hubble's Advanced Camera for Surveys to uncover the largest known population of globular star clusters, an estimated 160,000, inside the crowded core of the giant grouping of galaxies known as Abell 1689. They also confirmed that such compact groupings can be used as reliable tracers for dark matter.
- Globular clusters, dense bunches of hundreds of thousands of stars, are the homesteaders of galaxies. They contain some of the oldest surviving stars in the universe. Almost 95 percent of globular cluster formation occurred within the first 1 billion to 2 billion years after our universe was born in the theorized Big Bang 13.8 billion years ago.
- Studying globular clusters is critical to understanding the early, intense star-forming events that mark galaxy formation. Understanding dark matter can yield clues on how large structures such as galaxies and galaxy clusters were assembled billions of years ago.
- The globular star cluster in Abell 1689 is roughly twice as large as any other population found in previous globular cluster surveys — in comparison, our Milky Way galaxy hosts about 150 — and constitutes the most distant such systems ever studied, at 2.25 billion light-years away. The Hubble study shows most of the globular clusters in Abell 1689 formed near the center of the galaxy grouping, which contains a deep well of dark matter. The farther away from the galaxy core Hubble looked, the fewer globular clusters it detected. This observation corresponded with a comparable drop in the amount of dark matter, based on previous research.
- Peering deep inside the heart of Abell 1689, Hubble detected the visible-light glow of 10,000 globular clusters, some as dim as 29th magnitude, which is 1 one-billionth the faintness of the dimmest star that can be seen with the naked eye. Based on that number, astronomers estimated that more than 160,000 globular clusters are huddled within a diameter of 2.4 million light-years.

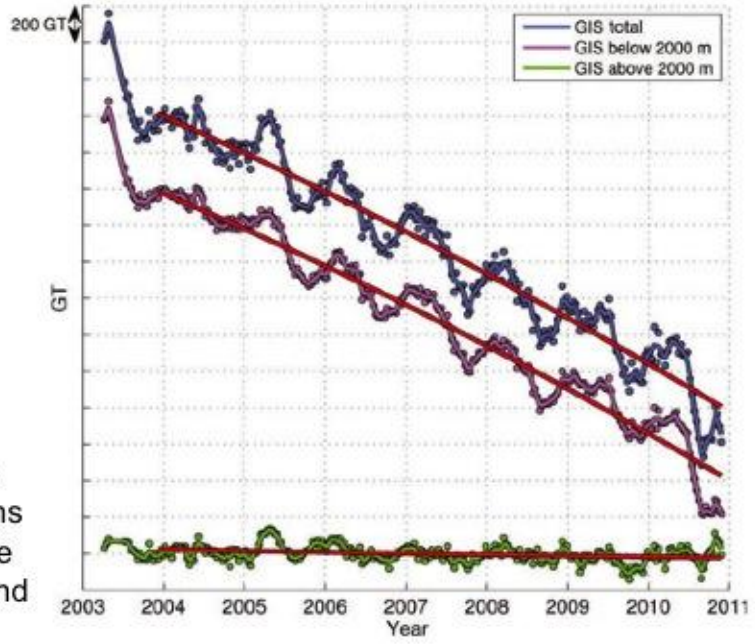
Antarctica, Greenland And Gulf Of Alaska Land-ice Evolution from an Iterated GRACE Global Mascon Solution

Scott B. LUTHCKE, T.J. SABAKA, B.D. LOOMIS, A.A. ARENDT, J.J. McCARTHY, J. CAMP , Journal of Glaciology, Vol. 59, No. 216, 2013 doi:10.3189/2013JoG12J147

NASA funded research determined the ice mass evolution of the Antarctic and Greenland ice sheets (AIS and GIS) and Gulf of Alaska (GOA) glaciers from a new GRACE global solution of equal-area surface mass concentration parcels (mascons) in equivalent height of water. The mascons were estimated directly from the reduction of the inter-satellite K-band range-rate (KBRR) observations, taking into account the full noise covariance, and formally iterating the solution. The new solution increases signal recovery while reducing the GRACE KBRR observation residuals. The mascons were estimated with 10 day and 1 arcdeg equal-area sampling, applying anisotropic constraints. The estimated mass trend over the total GIS, AIS and GOA glaciers for the time period 1 December 2003 to 1 December 2010 is –380 ± 31 Gt per year, equivalent to –1.05 ± 0.09 mm per year sea-level rise. The trends and accelerations determined over the study period have been shown to be highly dependent on significant seasonal and annual balance anomalies, making it difficult to predict future land-ice mass balance and its contribution to sea level. The iterated global mascon solution provides the spatial and temporal monitoring of land-ice evolution to aid in improved understanding and modeling.



Left: Land-ice mascon configurations and drainage systems



Right: The time series for the sum of the GIS mascons (GIS total), and the mascons above and below 2000m

Global Precipitation Measurement (GPM) Mission Presents their "Survivor" Module at the GLOBE Annual Partner Meeting at GSFC

GPM educators were asked to present their newly developed "Survivor" module ,which incorporates several GLOBE protocols into Outdoor Environmental Education activities. On Aug. 13th and 15th, 2013.

Trainings took place outside around GSFC's pond and wooded areas. Participants from all around the world were taught how to take students outside and help them collect data to determine how much freshwater was present in the atmosphere, the biosphere, the geosphere, and the hydrosphere.

We were happy to have Ming-Ying Wei join us for part of our module.

These young ladies from Thailand were delighted upon finding acorns and pinecones! They had never seen them outside of movies!

Reading the surface and soil temperatures