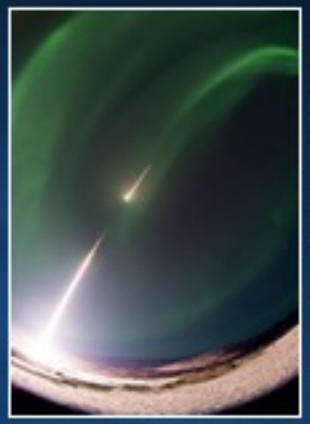

NASA
National Aeronautics and
Space Administration
SCIENCE MISSION DIRECTORATE
Weekly Highlights
March 3, 2017

NASA Heliophysics 2017 Poker Flat Sounding Rocket Campaign Ends Successfully in Alaska

Three sounding rockets from the Poker Flat Sounding Rocket Campaign successfully launched in the early morning hours of 2 March - two within 90 seconds of one another!



Polar Night Nitric Oxide (PolarNOx) Mission: *The processes associated with aurora create nitric oxide, but in the polar night there is no significant process for destroying the nitric oxide. We believe it builds up to large concentrations. The purpose of our rocket is to measure the abundance and altitude of peak abundance for the nitric oxide.*
– PI, Scott Bailey, Virginia Tech

Ionospheric Structuring: In Situ and Ground based Low Altitude StudieS Mission (ISINGLASS): *The visible light produced in the atmosphere as aurora is the last step of a chain of processes connecting the solar wind to the atmosphere. We are seeking to understand what structure in these visible signatures can tell us about the electrodynamics of processes higher up.*
– PI, Kristina Lynch, Dartmouth College

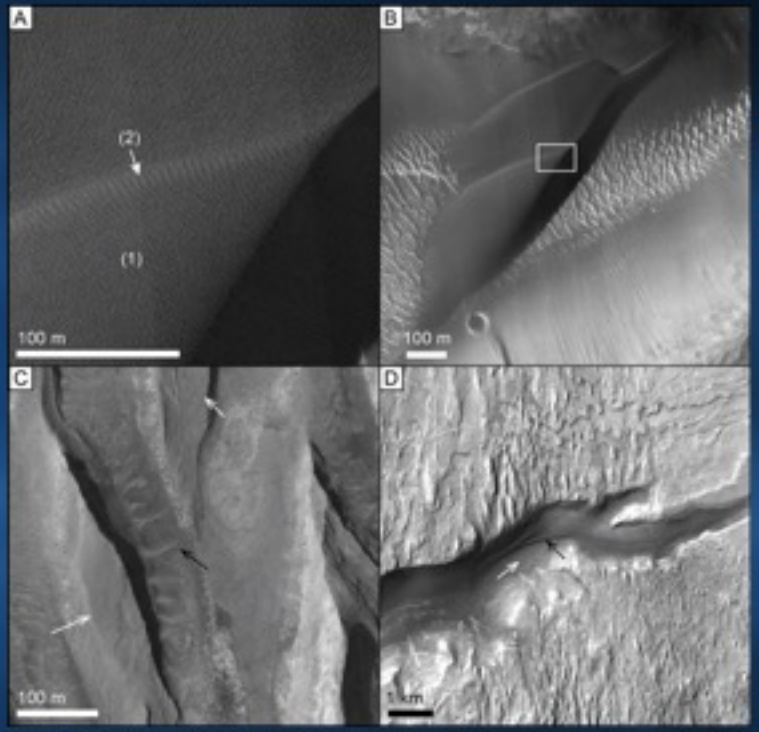
Neutral Jets in Auroral Arcs Mission (Jets): *Energy comes down into the upper atmosphere and creates the beautiful aurora but it also heats the upper atmosphere, sets it in motion, and drives a lot of physical processes that you can't see with your eye. We're going to be measure some of these processes with the Jets mission to better understand these interactions.*
- PI, Rob Pfaff, NASA GSFC

A panel discussing the Poker Flat campaign missions studying aurora, sounding rocket technology and Alaskan Native cultural connections to aurora was held in Utqiaġvik, Alaska on 10 February 2017. This event, which connected NASA with students and educators from all over the Arctic, was part of an effort to build the STEM-pipeline between Arctic students with Arctic science.

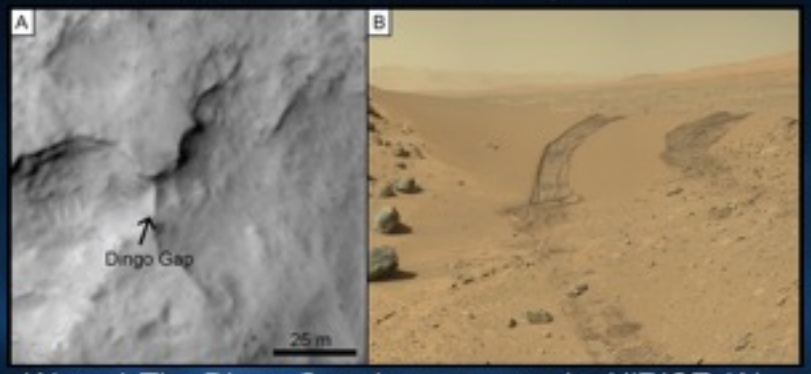
Top left image: The first ISINGLASS rocket launching on 22 February. Bottom left image: Both JETS rockets launching on 2 March.
Top right image: PolarNOx payload before it was launched on 27 January.

Understanding Aeolian Activity In Gale Crater

Wind has modified the landscapes on Mars for billions of years, and continues to do so today, despite the low-density atmosphere. By combining data from the Curiosity Rover and the High Resolution Imaging Science Experiment (HiRISE) on the Mars Reconnaissance Orbiter, we can form a more complete understanding of the effect of wind in Gale Crater.

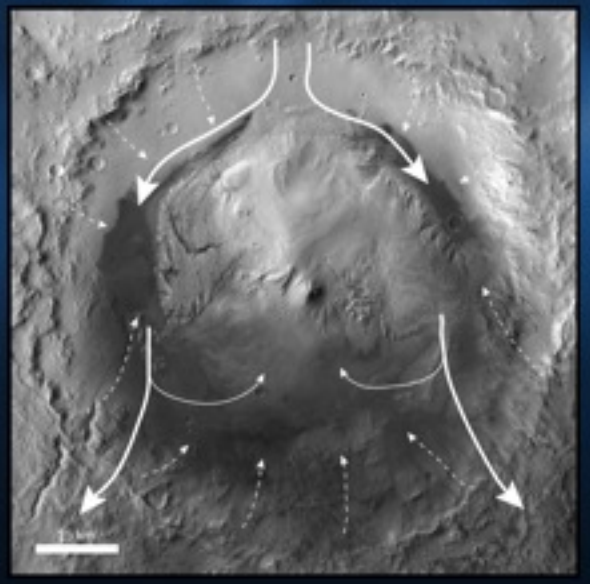


Wind is actively changing the landscape of Mars today.



(Above) The Dingo Gap dune as seen by HiRISE (A) and Curiosity (B).

(Right) Major wind circulation patterns in Gale crater reconstructed from wind-sculpted features (left) at the surface show how regional and slope winds eroded the central mound.



(Above) Wind-sculpted features helped reconstruct wind circulation in Gale crater. A) Fluid drag ripples form on the windward (1) and reworked leeward (2) faces of a dune. B) The same dune from A (white box) migrating over a field of transverse aeolian ridges (TARs). C) TARs (black arrow) between yardangs (white arrow). D) TARs (white arrow) with a dune (black arrow) in a canyon cut through a yardang field.

Day and Kocurek, *Icarus*.

Fermi Finds Possible Dark Matter Ties in Andromeda Galaxy

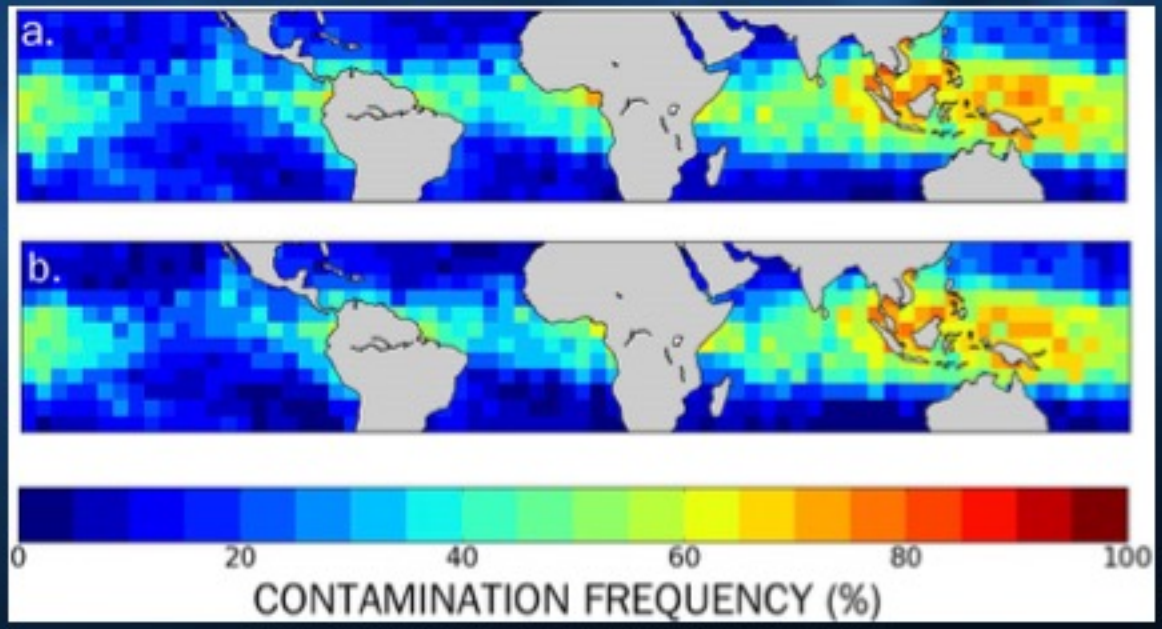
The gamma-ray excess at the heart of Andromeda is shown in yellow-white.
Credits: NASA/DOE/Fermi LAT Collaboration and Bill Schoening, Vanessa Harvey/REU program/NOAO/AURA/NSF

- NASA's Fermi Gamma-ray Space Telescope has found a signal at the center of the Andromeda galaxy that could indicate the presence of the mysterious stuff known as dark matter. The gamma-ray signal is similar to one seen by Fermi at the center of our own Milky Way galaxy.
- Gamma rays are the highest-energy form of light, produced by the universe's most energetic phenomena. They're common in galaxies like the Milky Way because cosmic rays, particles moving near the speed of light, produce gamma rays when they interact with interstellar gas clouds and starlight.
- The latest Fermi data shows the gamma rays in Andromeda are confined to the galaxy's center instead of spread throughout. To explain this unusual distribution, scientists are proposing that the emission may come from several undetermined sources. One of them could be dark matter, an unknown substance that makes up most of the universe. Scientists expect dark matter to accumulate in the innermost regions of galaxies.
- Another possible source for this emission could be a concentration of pulsars in Andromeda's center. These spinning neutron stars weigh as much as twice the mass of the sun and are among the densest objects in the universe. One teaspoon of neutron star matter would weigh a billion tons on Earth. Some pulsars emit most of their energy in gamma rays. Because Andromeda is 2.5 million light-years away, it's difficult to find individual pulsars. To test whether the gamma rays are coming from these objects, scientists can apply what they know about pulsars from observations in the Milky Way to new X-ray and radio observations of Andromeda.
- Now that Fermi has detected a similar gamma-ray signature in both Andromeda and the Milky Way, scientists can use this information to solve mysteries within both galaxies. For example, Andromeda emits few gamma rays from its large disk, where most stars form, indicating fewer cosmic rays roaming there. Because cosmic rays are usually thought to be related to star formation, the absence of gamma rays in the outer parts of Andromeda suggests either that the galaxy produces cosmic rays differently, or that they can escape the galaxy more rapidly.
- While more observations are necessary to determine the source of the gamma-ray excess, the discovery provides an exciting starting point to learn more about both galaxies, and perhaps about the still elusive nature of dark matter.

Estimating Infrared Radiometric Satellite Sea Surface Temperature Retrieval Cold Biases in the Tropics due to Unscreened Optically Thin Cirrus Clouds

Marquis, J. W., Bogdanoff, A. S., Campbell, J. R., Cummings, J. A., Westphal, D. L., Smith, N. J., & Zhang, J. | Journal of Atmospheric and Oceanic Technology | February 2017 | doi: http://dx.doi.org/10.1175/JTECH-D-15-0226.1

NASA funded scientists investigated passive longwave infrared (IR) radiometric satellite–based retrievals of sea surface temperature (SST) for cold bias caused by unscreened optically thin cirrus (OTC) clouds. SST retrievals over tropical oceans from the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor aboard NASA's Aqua satellite are collocated with cloud profiles from the Cloud–Aerosol Lidar with Orthogonal Polarization (CALIOP) instrument aboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO). OTC clouds were present in approximately 25% of tropical quality-assured (QA) Aqua-MODIS data, representing over 99% of all contaminating cirrus clouds. Further, OTC contamination characteristics from collocated Aqua-MODIS/CALIOP data pairs were used to estimate corresponding IR nonlinear sea surface temperature (NLSST) retrieval cold biases for MODIS, the Advanced Very High Resolution Radiometer (AVHRR), and the Visible Infrared Imaging Radiometer Suite (VIIRS), as well as triple-window retrievals in AVHRR and VIIRS. The study found cold biases to be constant across the Pacific and Indian Oceans, owing to relatively common cirrus cloud macrophysical properties. Absolute cold biases were lowest over the Atlantic Ocean, corresponding to lower overall cirrus frequency, but relative biases were found to be higher, indicating that this issue persists globally.



SST measurements are a core input for a host of meteorological and oceanographic modeling systems. Tropical cyclone intensity forecasting represents one area of significance for SST assimilation. Further, El Niño–Southern Oscillation forecasts are highly dependent on SST. While the spatial and temporal coverage of in situ SST measurements is improving, high-resolution global daily measurements remain unavailable. SSTs retrieved from passive radiometric remote sensors aboard Earth-orbiting satellites are the primary source of global estimates.

Left: Relative frequencies of collocated Aqua-MODIS SST retrieval contamination, as identified by CALIOP for (top) all cloud and (bottom) all cirrus.

STEM Student's Success!

The Smoky Mountains STEM Collaborative (SMSC) funded under SMD's STEM Science Activation Program is designed to help students in rural areas make use of community college as a stepping stone in pursuing STEM-related careers.

Pictured (L to R): James Howe, Jesse Moore

- In June 2016, James Howe attended a summer research experience at Appalachian State University that produced a research paper that won in February 2017, the honor of "Best Undergrad Student Paper" from the North Carolina Section of the American Association of Physics Teachers (NCS-AAPT)

  https://www.southwesterncc.edu/news/student-wins-award-research-paper

- In January 2017, Jesse Moore was awarded a $2,500 scholarship from NASA/NC Space Grant

  https://www.southwesterncc.edu/news/student receives- scholarship

- Both students are active members of Southwestern Community College's STEM Club and High Altitude Ballooning Team and are participating in the 2017 Total Solar Eclipse Ballooning Project.