
National Aeronautics and
Space Administration
SCIENCE MISSION DIRECTORATE
Weekly Highlights
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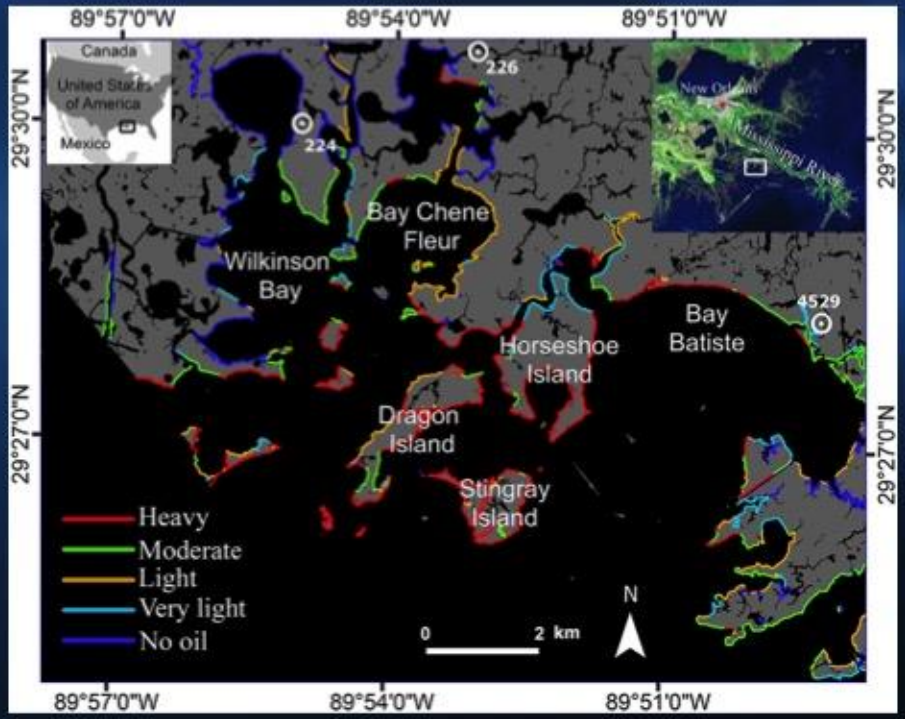
Wetland Shoreline Recession in the Mississippi River Delta from Petroleum Oiling and Cyclonic Storms

Rangoonwala, A., Jones, C. E., & Ramsey, E. | Geophysical Research Letters | November 2016 | doi:10.1002/2016GL070624

A NASA co-funded study presented an evaluation of the relative impact of petroleum spill and storm surge on near-shore wetland loss by quantifying the lateral movement of coastal shores in upper Barataria Bay, Louisiana between June 2009 and October 2012, a study period that extends from the year prior to the Deepwater Horizon spill to 2.5 year following the spill. The scientists used synthetic aperture radar (SAR) data acquired by NASA's Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) between 2009 and 2012, to quantify land loss along the marsh edge in upper Barataria Bay. They documented a distinctly different pattern of shoreline loss in the 2 years following the spill, both from that observed in the year prior to the spill, during which there was no major cyclonic storm, and from change related to Hurricane Isaac, which made landfall in August 2012. Shoreline erosion following oiling was far more spatially extensive and included loss in areas protected from wave-induced erosion. The study concluded that petroleum exposure can substantially increase shoreline recession particularly in areas protected from storm-induced degradation and disproportionally alters small oil-exposed barrier islands relative to natural erosion.

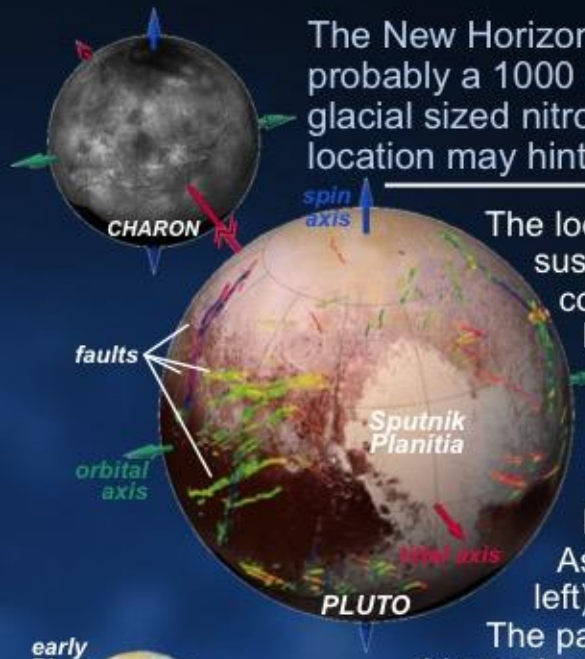


Ten percent of the world's population lives in low elevation coastal zones, primarily in heavily populated deltas where land loss threatens valuable coastal ecosystem services like flood protection and erosion control The Mississippi River Delta ranks as one of the most flood-endangered deltas in the world. Toxic spills can substantially increase shoreline loss, including in areas protected from storm-induced degradation, thereby rapidly altering the natural coastal defenses against flooding.

Left: Northeastern Barataria Bay, Louisiana, USA, showing shores oiled during May–July 2010. Map of the study area showing the shoreline oiling severity categories from the Shoreline Cleanup Assessment Techniques (SCAT) map. The inset on the left shows the study region, and the inset on the right locates the study area on a Landsat image.

Reorientation, Faulting, and an Ocean on Pluto

The New Horizons mission has revealed that Sputnik Planitia (left side of Pluto's heart), is probably a 1000 km diameter impact basin that is filled by a thick layer of actively convecting glacial sized nitrogen ice. This unique structure controls the orientation of Pluto, and its location may hint at a subsurface ocean.



The location of Sputnik Planitia is not random: it is suspiciously close to Pluto's tidal axis (the axis connecting Pluto and Charon; figure upper left). This suggests that this basin is a mascon - a location with excess mass. When this denser than average spot was created, it unbalanced Pluto and caused Pluto to roll on its side, putting Sputnik Planitia as close to the tidal axis as possible. As the dwarf planet reoriented (figure lower left) tidal/rotational stresses fractured the crust. The pattern of faults on the surface of Pluto confirms this reorientation hypothesis .

If Sputnik Planitia does have excess mass, this can be used to probe the geologic structure of the basin. This positive mass anomaly may come from volatiles in the basin, the impact ejecta, or possibly the presence of a present-day subsurface ocean (figure at right). In any case, these new findings from New Horizons suggest that the outer solar system may be far more geologically active than expected.

Keane *et al.* (2016) *Nature*
Nimmo *et al.* (2016) *Nature*

Two Highlights from the 229th Meeting of the American Astronomical Society

By combining data from NASA's Chandra X-ray Observatory, the Giant Metrewave Radio Telescope (GMRT), the NSF's Karl G. Jansky Very Large Array, and other telescopes, researchers have found out what happens when matter ejected by a giant black hole is swept up in the merger of two enormous galaxy clusters -- a stupendous cosmic particle accelerator is created. A pair of colliding galaxy clusters located about two billion light years from Earth, called Abell 3411 and Abell 3412, are both very massive, each weighing about a quadrillion times the mass of the Sun. At least one spinning, supermassive black hole in one of the galaxy clusters produced a rotating, magnetic funnel. The powerful electromagnetic fields associated with this structure have accelerated some of the inflowing gas away from the vicinity of the black hole in the form of an energetic, high-speed jet. These accelerated particles in the jet were accelerated again when they encountered colossal shock waves produced by the collision of the massive gas clouds associated with the galaxy clusters. This discovery solves a long-standing mystery detected in Abell 3411 and Abell 3412 about the origin of beautiful swirls of radio emission stretching for millions of light years. The shock waves travel across the cluster for hundreds of millions of years, the doubly accelerated particles produce giant swirls of radio emission.

An image from NASA's Chandra X-ray Observatory gives astronomers the best look yet at the growth of black holes over billions of years beginning soon after the Big Bang. This is the deepest X-ray image ever obtained, collected with about 7 million seconds of Chandra observing time. The image comes from the Chandra Deep Field-South. The central region of the image contains the highest concentration of supermassive black holes ever seen, equivalent to about 5,000 objects that would fit into the area of the full Moon and about a billion over the entire sky. About 70% of the objects in the image are supermassive black holes. Gas falling towards these black holes becomes much hotter as it approaches the event horizon producing bright X-ray emission. The researchers showed that these black holes in the early Universe grow mostly in bursts, rather than via the slow accumulation of matter. The scientists have also found hints that the seeds for supermassive black holes may be "heavy" with masses about 10,000 to 100,000 times that of the Sun. This addresses an important mystery in astrophysics about how these objects can grow so quickly to reach masses of about a billion times the Sun in the early Universe. The researchers also detected X-rays from massive galaxies at distances up to about 12.5 billion light years from Earth. Most of the X-ray emission from the most distant galaxies likely comes from large collections of stellar-mass black holes within the galaxies.

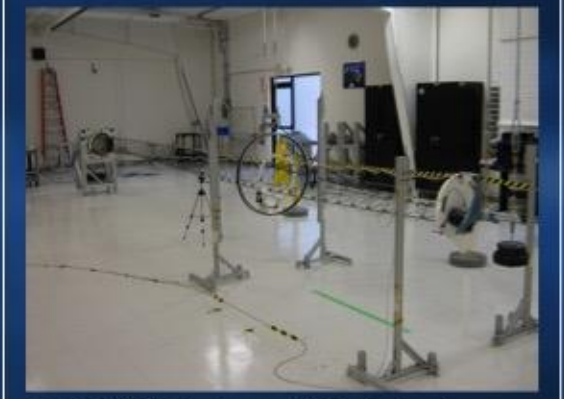
2016 Solar Storms with NASA/NOAA GOES-R Satellite Primed to Support Space Weather Predictive Capabilities

On 20 December 2016 Earth encountered a stream of energetic particles in solar wind flowing out from a giant Earth-facing coronal hole on the surface of the sun. A G2 class geomagnetic storm erupted in Earth's upper atmosphere - the thermosphere which includes the ionosphere on 21 December; this is an area many of our satellites, including the ISS, orbit. G2 storms can affect spacecraft orbit predictions by causing satellite drag. Here on the ground, long-term G2 storms can cause damage to our power systems.

Earth stayed within this steady stream of solar wind for six days, exiting it on 27 December. Not long after, on 31 December, Earth encountered another stream of solar wind causing more geomagnetic storms in our upper atmosphere. Aurora – a visible and beautiful indication of geomagnetic story activity, brilliantly colored icy polar stratospheric clouds (PSCs) and sun dogs were seen throughout the holidays.

Right: Aurora seen over Iceland on 1 January 2017. Credit: Shane Leach

Left: Icy PSCs seen on 31 December 2016. Credit: Laffen Jenson



GOES-R MAG instrument fully deployed. Credit: NOAA

Heliophysicists study visible phenomena such as aurora and PSCs as they are key manifestations of the kind of changes that can occur in Earth's upper atmosphere. This region is a multi-layered, dynamic environment affected by systems and processes originating both from Earth's surface and above in the space around us. Understanding how our atmosphere blocks and filters charged energy from the sun is crucial -- intense sun-Earth interactions can have detrimental effects on our satellites and astronauts near-Earth space orbit.

The recently launched GOES-R satellite, built in collaboration between NOAA and NASA, is designed to study Earth's atmosphere. Its data, along with data from a wide array of Heliophysics missions in near-Earth space, may allow us a deeper situational awareness of the space environment we live in as we learn to predict and respond to space weather events. Instruments on the solar-pointing platform of GOES-R, the Extreme Ultraviolet and X-ray Irradiance Sensors (EXIS), the Magnetometer (MAG) and the Solar Ultraviolet Imager (SUVI), will provide critical measurements of solar irradiance, the magnetic field of the space environment and contribute around-the-clock full-disk solar images respectively.

These kind of data are invaluable in helping us predict and prepare for impactful sun-Earth interactions. Scientists received preliminary data from the MAG instrument on 22 December 2016, which are important for space weather forecasting and modeling. All instruments will be operating by the end of January 2017. Heliophysics missions ICON and GOLD are both wholly dedicated to studying Earth's thermosphere and and ionosphere: our interface with space. They will soon be launching and contributing valuable science to help us better understand our near-Earth space environment.

Airborne Astronomy Ambassador Flights on SOFIA

Airborne Astronomy Ambassadors (AAA) are funded as part of the competitively-selected NASA Science STEM Activation activities. They include STEM immersion activities & professional development at NASA's research aircraft facility in Palmdale and other Southern California locations.

Photo Credit: NASA AFRC

October 2016 AAAs from Massachusetts, Maine, & California.

Photo Credit: NASA AFRC

November 2016 AAAs from Missouri & Ohio onboard SOFIA

Tapping current technologies to connect community to NASA assets, AAA Eric O'Dea presents a live tour of the SOFIA hangar to the Boston Museum of Science.

Photo Credit: Boston Museum of Science

NASA AAA Larry Grimes from California explains, "*One direct off-shoot of my involvement with the SOFIA program is the establishment of an astronomy course at our site, and the creation of three Star Parties a year at our district headquarters for over 600 students and their parents per year. It is no exaggeration to say that SOFIA has totally changed the focus on astronomy and space sciences in our district.*"

USRA