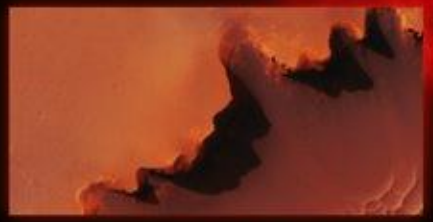
National Aeronautics and Space Administration

NASA Science

Weekly Highlights
September 6, 2013


EARTH SCIENCE


HELIOPHYSICS


PLANETARY SCIENCE


ASTROPHYSICS

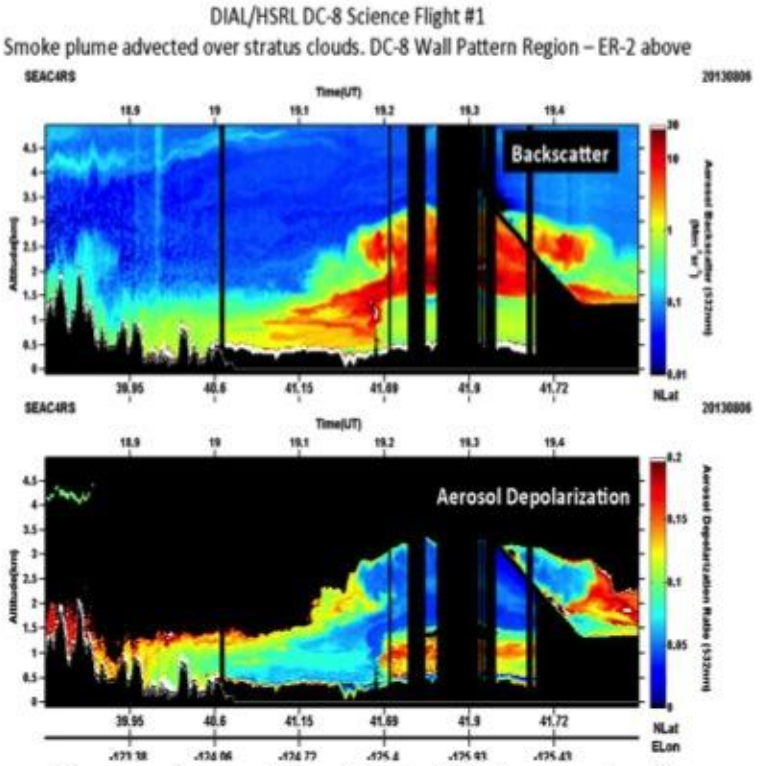
SEAC⁴RS Probes Western Wildfires

Studies of Emissions and Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys

NASA's SEA⁴CRS campaign is currently underway as planned for August – September 2013. Over 100 researchers are participating in deploying 3 aircraft in coordination with ground-based and satellite observations; 18 flights planned lasting 7-9 hours each. The objective is to answer science questions: 1. how is pollution redistributed by deep convection; 2. evolution of gases and aerosols in convective outflow; 3. influence of aerosols on meteorology and climate; and 4. calibration/validation of satellite sensors.

At least three flights to date have had significant emphasis on observing smoke from Wildfires. The flight of August 6 probed Oregon wildfires where smoke transported over low level ocean clouds. Both the ER-2 and DC-8 remotely observed the clouds/smoke with lidars and radiometers, and the ER-2 remotely sensed the clouds and smoke with multiple polarimeters and an imager. The DC-8 directly sampled the smoke with numerous in situ samplers to thoroughly sample and characterize the composition of smoke.

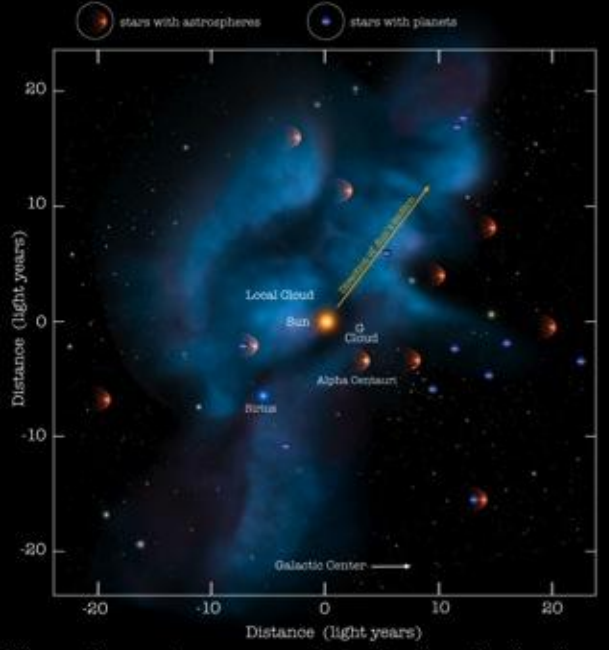
Left: 6 August 2013 MODIS satellite image of Oregon-California coastal region. Shows smoke transport westward then offshore over clouds.



Above: Aerosol lidar "curtain" along part of the NASA DC-8 flight track on 6 August 2013. High backscatter (red in upper panel) coincident with low depolarization (blue in lower panel) indicates smoke.

Data from this flight have already been useful in testing a new MODIS algorithm, and will be crucial for testing algorithms for polarimeters on future Earth Science missions.

NASA Spacecraft Show the Interstellar Wind Has Changed Direction Over 40 Years



The solar system moves through a local galactic cloud at a speed of 50,000 miles per hour, creating an interstellar wind of particles, some of which can travel all the way toward Earth. Credit: NASA/Adler/ U. Chicago/Wesleyan.

- Scientists have discovered that the particles streaming into the solar system from interstellar space have most likely changed direction over the last 40 years. The results, are based on data spanning four decades from 11 different spacecraft. The information helps us to map out our place in the galaxy surrounding us, and help us understand our place in space.

- Traces of the interstellar wind flowing into what's called the heliosphere -- the vast bubble filled by the sun's own constant flow of particles, the solar wind – help scientists observe what lies in the galactic cloud through which the solar system travels. The heliosphere is situated near the inside edge of an interstellar cloud and the two move past each other at a velocity of 50,000 miles per hour. This motion creates a wind of neutral interstellar atoms blowing past Earth, of which helium is the easiest to measure.

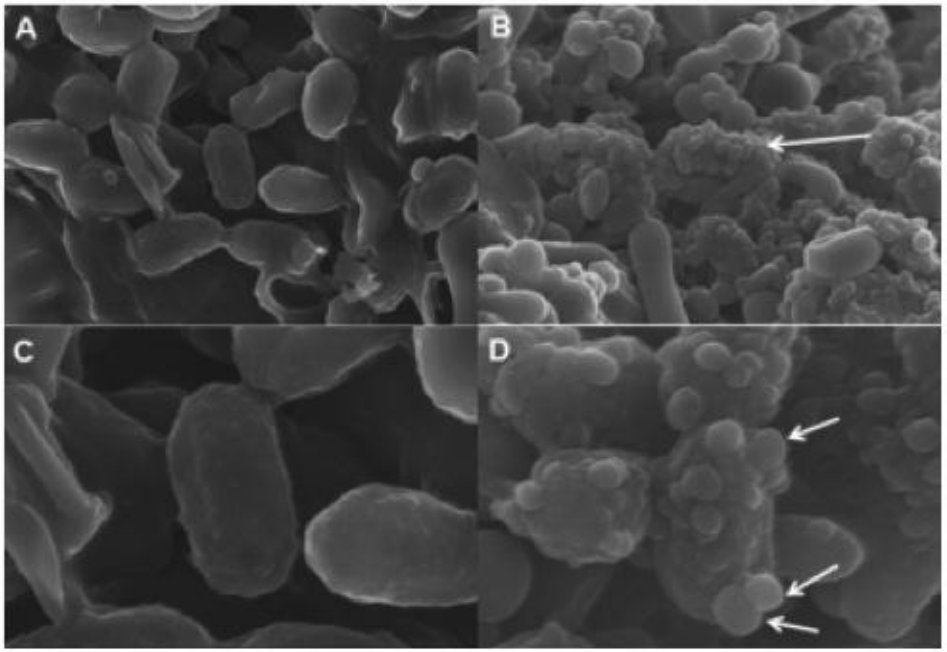
- Because the sun is moving though this cloud, interstellar atoms penetrate into the solar system. The charged particles in the interstellar wind seldom reach the inner solar system, but many of the atoms in the wind are neutral. These can penetrate close to Earth and can be measured. Results in January 2012 from NASA's Interstellar Boundary Explorer, or IBEX, showed that the interstellar wind was entering the heliosphere from a different direction than had been observed by NASA's Ulysses mission in the 1990s.

- Scientists set out to gather as much evidence from as many sources as they could to determine whether the wind direction itself changed over the years. The early data came from the 1970s from the U.S. Department of Defense's Space Test Program 72-1 and SOLRAD 11B, NASA's Mariner, and the Soviet Prognoz 6. Scientists went on to look at another seven data sets including the Ulysses information from 1990 to 2001, and more recent data from NASA's IBEX, STEREO, ACE, the Extreme Ultraviolet Explorer, and the MESSENGER mission, currently in orbit around Mercury. The eleventh set of observations came from the Japanese Aerospace Exploration Agency's Nuzomi.

- The direction of the wind obtained from the most recent data does not agree with the direction obtained from the earlier measurements, suggesting that the wind itself has changed over time. The data from these diverse sources shows that the direction of the interstellar wind has changed some 4 to 9 degrees over the last 40 years. While the reason for and the timing of the shift is unclear, scientists know our solar system is close to the edge of the local interstellar cloud and believe that additional observations will give us even more information about the galaxy that surrounds us.

Genetic Clues to Extreme Radiation Resistance in Bacteria

- Astrobiologists find **genes** that could give spores from a bacteria (*Bacillus pumilus SAFR-032*) **extreme resistance to radiation and water deprivation** (desiccation).
- *B. pumilus* is important for **planetary protection**. It was isolated **from the spacecraft assembly facility** at JPL. It's **extremely hardy** and might survive onboard **missions to other planets**. Understanding its survival in extreme environments is key to **preventing this contamination risk**.
- Study sheds light on how organisms might survive on **other planets and moons** with extreme environmental conditions.



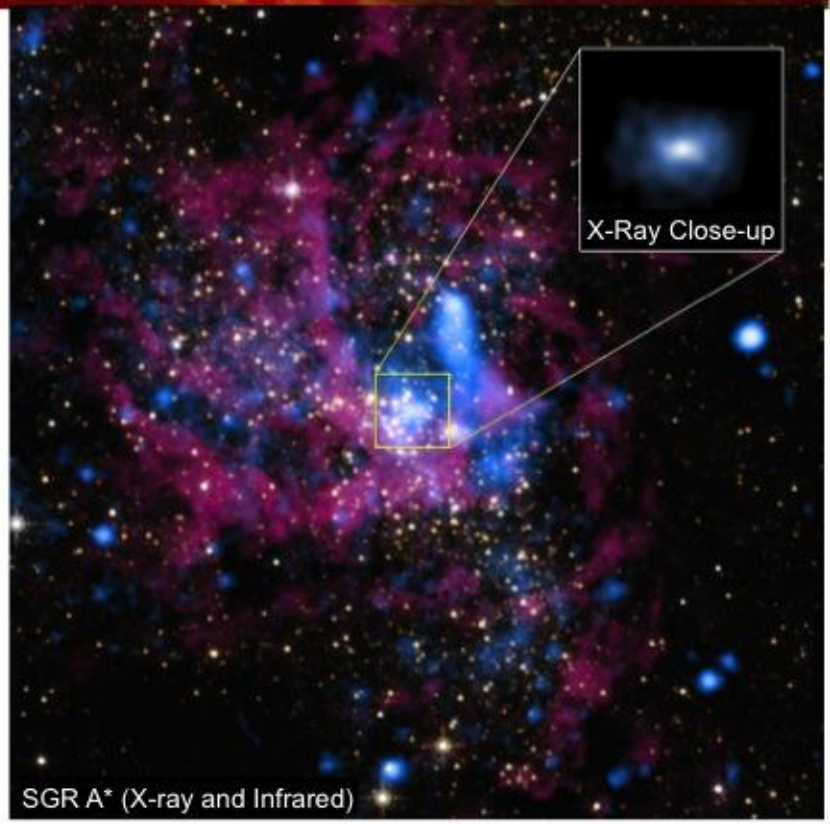
Scanning electron microscope image of *B. pumilus* spores. Control spores (A, C) and spores treated with H2O2 (B, D) Image Credit: Checinskaa et. al. 2012

The Curiosity rover in JPL's Spacecraft Assembly Facility where the bacteria used in the study were isolated. Image Credit: NASA/JPL

- *B. Pumilus* also provides clues about how life from Earth might **adapt to the space environment** beyond our planet's atmosphere.
- Papers reporting the findings of this research were recently published under lead author Madhan Tirumalai in the journals *Extremophiles* (June 2013) and *PLOS One* (June 14, 2013).

Chandra Catches Our Galaxy's Giant Black Hole Rejecting Food

- The center of the Milky Way galaxy, with the supermassive black hole Sagittarius A* (Sgr A*) located in the middle, is revealed in these images. Astronomers have used NASA's Chandra X-ray Observatory to take a major step in understanding why gas around Sgr A* is extraordinarily faint in X-rays.
- The large image contains X-rays from Chandra in blue and infrared emission from the Hubble Space Telescope in red and yellow. The inset shows a close-up view of Sgr A* only in X-rays, covering a region half a light year wide. The diffuse X-ray emission is from hot gas captured by the black hole and being pulled inwards. This hot gas originates from winds produced by a disk-shaped distribution of young massive stars observed in infrared observations.
- Chandra collected about five weeks worth of observations to capture X-ray images and energy signatures of multi-million degree gas swirling around Sgr A*, a black hole with about 4 million times the mass of the Sun. At just 26,000 light years from Earth, Sgr A* is one of very few black holes in the Universe where we can actually witness the flow of matter nearby.
- The scientists infer that less than 1% of the material initially within the black hole's gravitational influence reaches the event horizon, or point of no return, because much of it is ejected. Consequently, the X-ray emission from material near Sgr A* is remarkably faint, like that of most of the giant black holes in galaxies in the nearby Universe.
- The captured material needs to lose heat and angular momentum before being able to plunge into the black hole. The ejection of matter allows this loss to occur.



Credit: X-ray: NASA/UMass/D.Wang et al., IR: NASA/STScI

New Chandra results help explain why gas near the Milky Way's supermassive black hole is so faint in X-rays. Less than 1% of the material in the black hole's gravitational grasp appears to actually reach the event horizon. To obtain these results, Chandra performed one of its longest observing campaigns ever - equivalent to over 5 weeks of observing time.

Seven Earth Missions Join Forces to Inspire Southern California Teachers

35 upper elementary and middle school teachers from seven southern California school districts, including a number of underserved schools, participated in the first comprehensive Earth Science workshop at NASA's Jet Propulsion Laboratory. Scientists and Outreach Specialists from SMAP, OCO-2, GRACE, GRACE FO, OSTM/Jason-2, Jason-3, and AirMOSS provided unique, fun, and exciting activities and materials for the teachers to develop grade-specific lesson plans. The goal is to engage students in learning about earth and climate system science while incorporating the Next Generation Science Standards. Teachers improved their knowledge of Earth Science by over 30% by the end of the weeklong workshop.