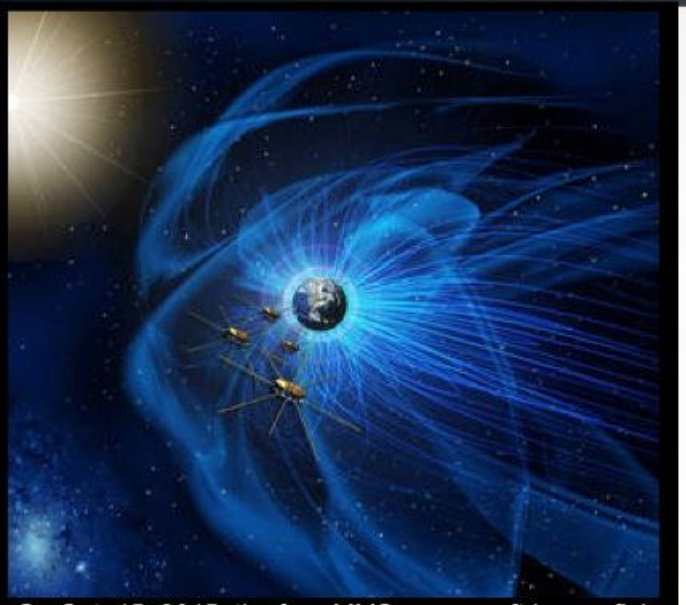
Science Mission Directorate

Weekly Highlights

October 16, 2015

NASA's Four MMS Spacecraft Achieve Tightest Flying Formation Ever!



On Oct. 15, 2015, the four MMS spacecraft began flying at their smallest separation of just six miles apart, which is the tightest multi-spacecraft formation ever flown in orbit. Credit: NASA.

- On Oct. 15, 2015, a NASA mission broke its own record: the four satellites of its Magnetospheric Multiscale mission are now flying at their smallest separation, which is the tightest multi-spacecraft formation ever flown in orbit. The spacecraft are spaced just six miles apart, flying in a tetrahedral formation, with each spacecraft at the tip of a four-sided pyramid. The close formation is all the more impressive as each spacecraft speed along at up to 15,000 miles per hour and – with their booms extended – each covers as much area as a professional baseball stadium.

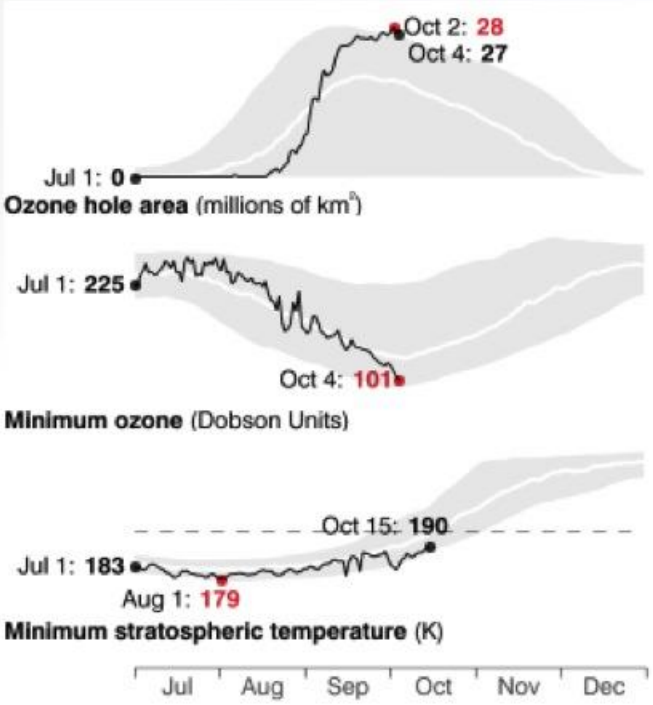
- MMS directly measures the space environment at the boundaries of Earth's magnetic bubble, the magnetosphere, where the sun's constant stream of magnetized solar wind collides with Earth's own magnetic field. As it flies through these magnetic collisions, MMS uses its four spacecraft to determine how a given event moves in three dimensions and changes over time.

- MMS gathers data to study a phenomenon called magnetic reconnection, which occurs when the magnetic field surrounding Earth connects and disconnects from the magnetic field carried by the solar wind, reconfiguring the very shape of Earth's magnetic environment. Magnetic reconnection can result in the explosive release of energy that can accelerate particles to incredible speeds – in some cases to nearly the speed of light. The MMS orbit is designed to carry the spacecraft directly though reconnection events. Reconnection is a common process throughout our universe; occurring in space near Earth, in the atmosphere of the sun and other stars, and in the vicinity of black holes and neutron stars.

- MMS first formed a tetrahedral shape in July 2015, with the spacecraft were flying about 100 miles apart. Over the past few months, MMS gradually closed that spacing to just six miles. Another mission, ESA/NASA's Cluster, had times in which two of its four spacecraft were that close, but MMS is the first mission to hold four spacecraft in such close proximity. To achieve this milestone, first the MMS spacecraft dropped down to 40 miles apart, then 15 and finally on Oct. 15 the spacing dropped to its closest point, just a little over six miles apart. After operating over that range, the MMS science team will then decide what spacing was optimal and return to that value. MMS is the fourth mission in the NASA Heliophysics Solar Terrestrial Probes Program. The goal of the STP Program is to understand the fundamental physical processes of the space environment from the sun to Earth, other planets, and the extremes of the solar system boundary.

2015 Antarctic Ozone Hole Area Approaches Annual Maximum

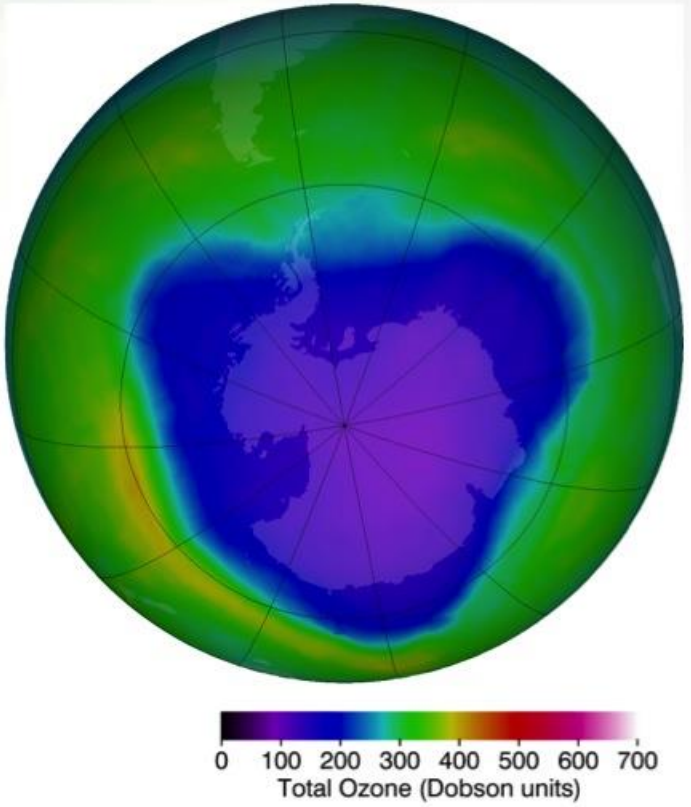
The Antarctic ozone hole, which typically reaches its annual peak area between mid-September and early October, formed more slowly this year but quickly expanded to cover a larger area of low ozone values than the past few years, according to NASA and National Oceanic and Atmospheric Administration (NOAA) scientists. While the current ozone hole area is large, this area is consistent with scientists' understanding of ozone depletion chemistry and the colder than average 2015 stratospheric weather conditions, which contribute to ozone depletion.



http://ozonewatch.gsfc.nasa.gov/

Each year for the past few decades during the Southern Hemisphere spring, chemical reactions involving chlorine and bromine cause ozone in the southern polar region to be destroyed rapidly and severely. This depleted region is known as the "ozone hole".

As of October 5, 2015

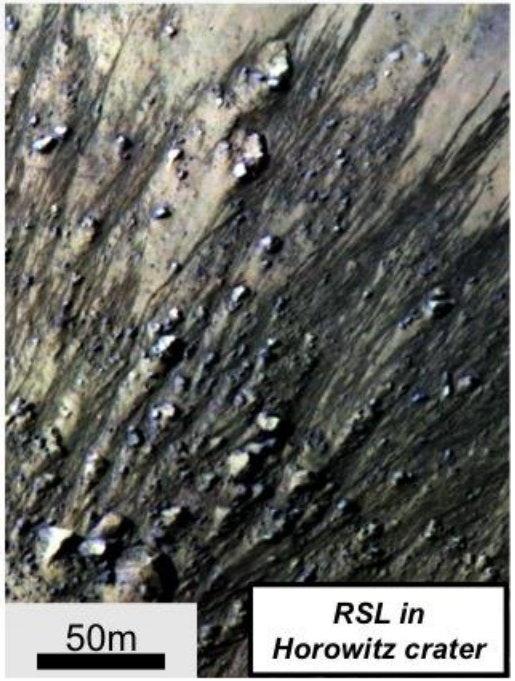


The depth and size of the Antarctic ozone hole are governed by the temperature of the stratosphere and amount of sunlight reaching the south polar region. The graphs below show the progress of this year's ozone hole, compared to the highest and lowest values measured since 1979.

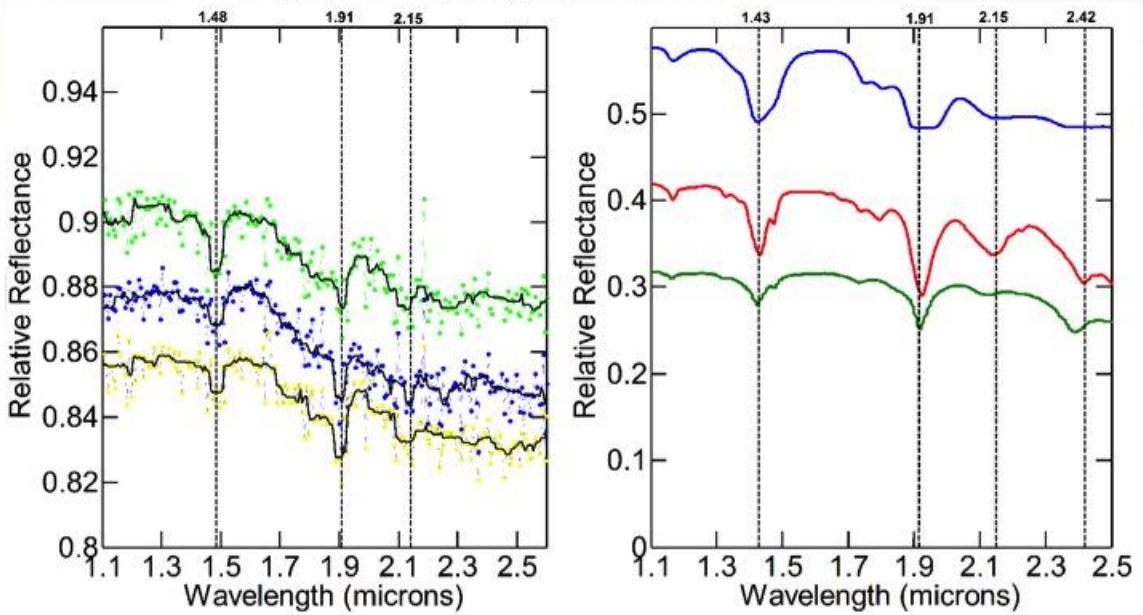
Briny Liquid Water in Recurring Slope Lineae (RSL) on Mars

Recurring slope lineae (RSL) continue to be a subject of intense study by the Mars Reconnaissance Orbiter (MRO) science team. RSL form on sunny slopes in local summer, grow downslope, and fade in autumn, consistent with flow of a liquid.

- MRO collected Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) spectra for four locations where RSL had been previously detected. These data indicated that hydrated perchlorate salts were present during the season when RSL grow.
- Perchlorates are a group of minerals that can serve as a powerful freezing point depressant, reducing the freezing point of water to as low as -78°C (-108°F). With that much freezing point reduction, plus expected daily variations in humidity, briny liquid water could be stable over part of the day and flow to form RSL.
- Perchlorate salts have been identified by Phoenix (by wet chemical analysis) and Curiosity (by the Sample Analysis at Mars, or SAM instrument), and both landing sites have exhibited possible transient brines.



Ojha, L. et al. (2015), *Nature Geoscience*



(Above left) Single-pixel CRISM spectra showing features indicative of perchlorate. (Above right) Perchlorate salts measured in the lab. The RSL are best fit by a mixture of phases.

Hubble Shears a "Woolly" Galaxy

- This new image of the spiral galaxy NGC 3521 from the NASA Hubble Space Telescope is not out of focus. Instead, the galaxy itself has a soft, woolly appearance as it a member of a class of galaxies known as flocculent spirals.
- Like other flocculent galaxies, NGC 3521 lacks the clearly defined, arcing structure to its spiral arms that shows up in galaxies such as Messier 101, which are called grand design spirals. In flocculent spirals, fluffy patches of stars and dust show up here and there throughout their discs. Sometimes the tufts of stars are arranged in a generally spiraling form, as with NGC 3521, but illuminated star-filled regions can also appear as short or discontinuous spiral arms.
- About 30 percent of galaxies share NGC 3521's patchiness, while approximately 10 percent have their star-forming regions wound into grand design spirals.
- NGC 3521 is located almost 40 million light-years away in the constellation of Leo (The Lion). The British astronomer William Herschel discovered the object in 1784. Through backyard telescopes, NGC 3521 can have a glowing, rounded appearance, giving rise to its nickname, the Bubble Galaxy.

Credit: ESA/Hubble & NASA and S. Smartt (Queen's University Belfast)
Acknowledgement: Robert Gendler

The Fourth Annual NASA Science, Engineering, Mathematics and Aerospace Academy Extravaganza

- On September 12, 2015, the Space Telescope Science Institute (STScI) education staff participated in the fourth annual NASA Science, Engineering, Mathematics and Aerospace Academy (SEMAA) Science, Technology, Engineering and Math Education (STEM) Extravaganza in partnership with the Maryland Space Grant Consortium at Morgan State University

- STScI provided hands-on activities utilizing an infrared camera to explain the operation of the James Webb Space Telescope (JWST) and how it will compare with the Hubble Space Telescope (HST)

- This free event open to all ages was attended by over 450 students, as well as nearly 200 parents, caregivers, exhibitors, and members of the general public.

SEMAA is a national project designed to increase the participation and retention of historically underrepresented K-12 youth in science, technology, engineering, and mathematics (STEM). The project seeks to develop partnerships to recognize and support students interested in STEM fields.

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