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SMAP Mission: Soil Moisture Active Passive

Launched on Saturday, January 31st, NASA's Soil Moisture Active Passive (SMAP) satellite took to the skies and entered polar orbit. The SMAP satellite carries two L-band instruments, a radar (active) and a radiometer (passive) with shared antenna assembly. According to **Jinzheng Peng**, who works with **Priscilla Mohammed** on a collaborative team for SMAP, "The SMAP radiometer, developed at NASA Goddard Space Flight Center, measures the natural emission from Earth surface with desired spatial resolution as well as natural emission from outside the area under observation, such as the Earth sidelobe, the Sun, the Moon, the galaxy, the Earth's atmosphere and ionosphere. Any artificial Radio Frequency Interference (RFI) also impacts the measurements. The radiometer is sensitive to its own ambient temperature which varies on-orbit. To obtain measurements only from the desired area, we are working on the radiometer calibration/correction algorithms to model the natural emission, detect and remove RFI, and remove the contribution from the outside sources." Added Dr. Mohammed, "The SMAP ground processing algorithm differs from existing satellite radiometer algorithms in that SMAP's includes novel RFI detection and mitigation techniques."

Dr. Mohammed further clarified the effect of RFI: "Microwave radiometers are designed to be sensitive receivers and are thus susceptible to corruption from radio emissions from active services, such as communication and navigation systems. However, unauthorized in-band transmitters as well as out-of-band emissions from transmitters operating at frequencies adjacent to the spectrum allocated for SMAP's radiometer have been documented as sources of RFI to the L-band radiometers on SMOS and on Aquarius. To combat the corruption of the radiometer's measurements, SMAP is the first spaceborne radiometer to incorporate special flight hardware to enable detection and mitigation of RFI. Additionally, high-level RFI can be easily identified as unnatural geophysical variations but low-level RFI can be difficult to identify and remove. Since the presence of RFI increases brightness temperature measurements, unmitigated low-level RFI will be incorporated into the measurement resulting in drier than actual soil moisture retrievals. To address this problem, the SMAP radiometer includes an on-board digital detector back end with digital signal processing algorithms to produce measurements in time and frequency. About 1000 times more measurements than conventionally necessary are collected and used in the ground processing algorithm." **Gabrielle De Lannoy** is also involved with the SMAP mission, regarding the development of the SMAP Level-4 Surface and Root-Zone Soil Moisture Product.

On February 24th, JPL Mission Controllers sent commands that opened the 6-meter-wide mesh reflector on the SMAP observatory. This antenna assembly will rotate with a 1,000-km swath of Earth. For the next three years, starting in April 2015, measurements to the Earth surface from the spaceborne radar/radiometer will result in a global soil moisture map every three days. Measurements also will be used to determine if the ground is frozen or thawed in cold areas. Moisture will be measured in the top layer of the soil, where food grows and vegetation lives. In some cases, the amount of surface water on soil can indicate a risk of vector-borne diseases; monitoring soil moisture and freeze/thaw state in these regions could result in lives saved. The data acquired will provide valuable input to decision makers.

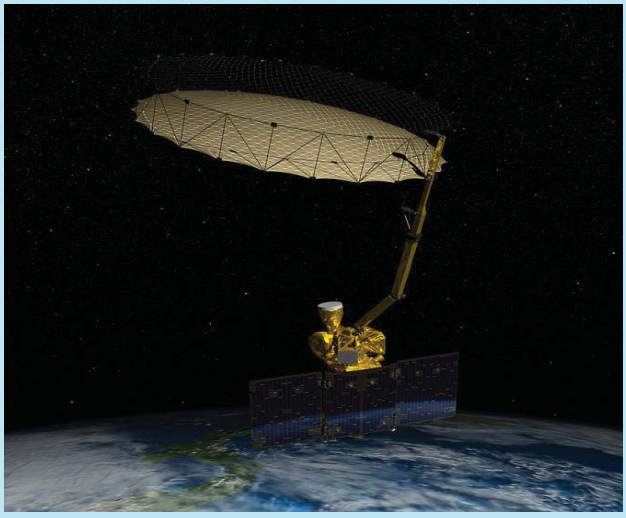

Image Credit: NASA/JPL Caltech

If soil moisture is high and near saturation, or if the ground is thawing, this indicates the possibility of flooding or landslides; flooding is the leading natural disaster occurrence in the United States. Decisions can be implemented and, again, possibly save lives. Conversely, measurements could show the presence of

(cont'd on page 2)

(SMAP, cont'd)

drought. Drought can result in a decrease in crop productivity and/or quality and in the death of livestock, which in turn can affect economic conditions. Crops rely on water; too much or too little can affect the outcome. By examining soil moisture measurements from SMAP, the agricultural community will be able to adjust crop forecasts and plan for any necessary irrigation practices. Water is essential to life; studying the data from SMAP could prevent the loss of human lives due to drought.

The water cycle plays a key role in meteorologists' forecasts due to what is happening in the atmosphere and the state of soil and moisture at the ground level. From the SMAP Mission site: "Detailed monitoring of soil moisture provides a view of how our whole Earth system works. The health of Earth's biosphere is dependent on the flow and storage of water, energy, and carbon. Our global climate and its future changes are dependent on how these major Earth cycles link and vary together. Global change is the major environmental challenge of our century, and its impacts can cause major shifts in how our societies will function in the future." For current and detailed information on the SMAP mission, please visit http://www.nasa.gov/smap/.

Discoveries on Mars

This past fall, researchers working with SAM on the MSL Curiosity Rover announced some exciting discoveries. The SAM (Sample Analysis at Mars) instrument made its first detections of organic matter when it discovered methane, an organic molecule, on the surface of Mars. **Charles Malespin**, the lead testbed operator for the SAM testbed at GSFC, is part of the MSL (Mars Science Laboratory) Science and Tactical team and serves as the SAM strategic science lead. Dr. Malespin was a co-author on "Mars Methane detection and variability at Gale crater" published in the journal Science (see Recent Publications). Research results were presented at the 2014 AGU Fall Meeting in December. SAM consists of three instruments onboard Curiosity and investigates the chemistry of the surface and atmosphere of Mars within Gale Crater. In a related video produced by NASA Goddard, MSL Participating Scientist Daniel Glavin explains that "Methane was found previously in the Martian atmosphere, … but this is the first time that we've seen a sharp increase and decrease in the abundance of methane in the atmosphere in Gale Crater." He clarifies that this production of methane could be biological or non-biological; research will continue. Several lab experiments are conducted at NASA Goddard to simulate the environment on Mars, in relation to examining research findings and results. Dr. Glavin adds that "Another exciting discovery is that of Martian organic compounds, compounds not common on Earth, in a mudstone in a lakebed environment in Gale Crater. We've been looking for organic compounds for decades on the surface of Mars." The interview with Dr. Glavin can be seen in "Need to Know: Sample Analysis at Mars Findings": https://www.youtube.com/watch?v=UN0Zj4SIz1A. The MSL was launched in November 2011 and the Curiosity rover landed in Gale Crater, Mars on August 6, 2012. Visit http://mars.jpl.nasa.gov/msl/ to learn about Curiosity's latest drilling site, view its latest self-portrait, or explore the mission, and stay tuned for continued findings.

Anyamba in South Africa

Assaf Anyamba shared the latest on his research on Rift Valley fever: Dr. Anyamba traveled for fieldwork in South Africa (10/30/14–11/10/14) to survey and identify field sites for intensive mosquito sampling, rainfall and NDVI measurements in the Free State Province. The fieldwork is a critical component of a five-year Rift Valley fever in South Africa project funded by the Defense Threat Reduction Agency (DTRA), led by EcoHealth Alliance in collaboration with South Africa's Center for Emerging and Zoonotic Disease National Institute for Communicable Diseases (CEZD-NICD) and GIMMS Group. The project's aim is to achieve a comprehensive understanding of the relationship between mosquito abundance and succession, rainfall and ecology dynamics (via satellite derived vegetation indices), wild and domestic ruminant immunity to the virus at multiple scales and in multiple species and a better understanding of the patterns of human infection with RVFV in South Africa. This research also provides the critical data needed to better predict the spread of the virus should it ever be introduced into the United States.

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SOLARIUM

"Solarium invites us to slow down." – **Genna Duberstein**

In November 2014, Genna gave a TEDxPeachtree Talk titled "Can the sun rekindle our sense of wonder?" She discussed the mix of space, time and wonder, and introduced her audience to the concept of Solarium. Almost two months later, at the Solarium event held at the NASA Goddard Visitor Center the night of February 11th, one of the speakers mused, Is it an event or an activity? It is an experience of both sound and sight, of art and science. The mesmerizing music one hears sounds like a heartbeat, but it's actually the radiation coming off of the sun converted into acoustic waves. One stands in an otherwise dark room with floor-to-ceiling images of the Sun from the Solar Dynamics Observatory projected on an immense wall, witnessing CMEs, swirls, loops, sunspots, and bursts within solar images from different wavelengths. These hoops and bubbles are being produced from charged particles in magnetic fields. According to Dr. Michael Hesse, Director, NASA/GSFC Heliophysics Science Division, "A coronal mass ejection (CME) involves the release of energy stored in the magnetic field of the sun, which, when released, accelerates charged particles into space. Some of these particles also stream back to the surface of the sun." CMEs and other solar events can have an enormous effect on space weather and in turn can affect the lives of people on Earth. It's hard to fathom, but "in diameter, CMEs are from ~1000 to 3000+ the diameter of the Earth. In volume, they are between a 100 million and a billion times the volume of the Earth."

(Left to Right) Scott Weissinger, Genna Duberstein and Tom Bridgman (Photo: A. Houghton)

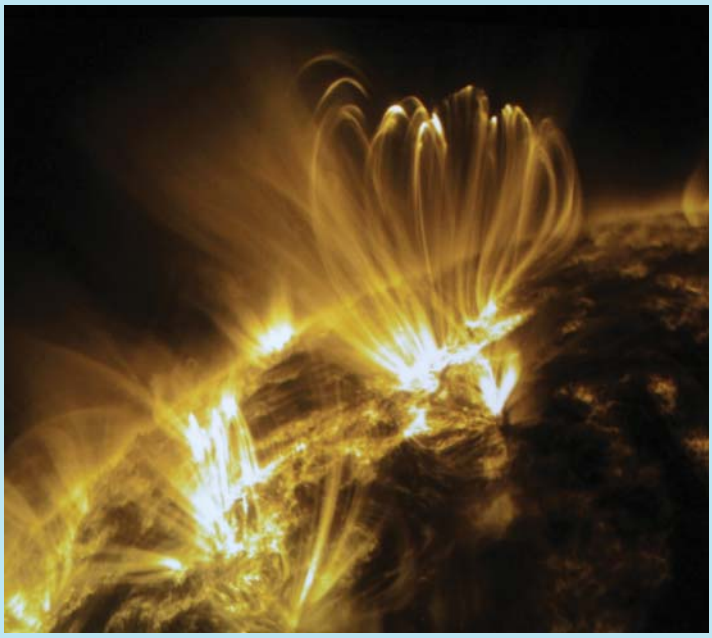

Image from Solarium exhibit (Photo: A. Houghton)

Solarium was conceived by Genna Duberstein, lead multimedia producer for Heliophysics at NASA Goddard, and created by Genna, **Scott Weissinger** and **Tom Bridgman**. Scott is a heliophysics and astrophysics video producer at Goddard, and Tom is a data visualizer at Goddard who works on animations related to the Solar Dynamics Observatory (SDO), among others. Past installations of Solarium include the King Street Arts Festival in Virginia (Sept 2014) and the Georgia State University's Window Project, Atlanta, GA (Nov 2014). It is a permanent exhibit at the NASA Goddard Space Flight Center's Visitor Center, and will be part of the "Astronomical" exhibit at the Center for Creative Photography, Tucson, AZ (Jan – May 2015).

For more information on NASA Goddard's Visitor Center, visit http://www.nasa.gov/centers/goddard/visitor/home/#.VQNMIfn-Nik. To view Genna's TEDx talk, visit https://www.youtube.com/watch?v=IyYgvo2ZJtw.

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But Wait, There's More: SDO! DSCOVR!

The opening of Solarium coincided with two other related events. February 11, 2015 marked the 5th Anniversary of the Solar Dynamics Observatory (SDO) at NASA Goddard. It was also the date of the DSCOVR launch (Deep Space Climate Observatory) from Cape Canaveral Air Force Station in Florida. Guests at the Visitor Center were able to view the launch prior to Solarium's evening events. DSCOVR, a partnership between NOAA, NASA and the U.S. Air Force, will monitor space weather. From the DSCOVR mission site: "This spacecraft will orbit between Earth and the sun, observing and providing advanced warning of particles and magnetic fields emitted by the sun (known as the solar wind) which can affect power grids, communications systems, and satellites close to Earth." Also, "DSCOVR will be used to detect and characterize the shockwaves and CME's just before they encounter Earth, permitting new predictive capabilities and a better understanding of the nature of shocks." **Yuekui Yang** is working on an algorithm to generate RGB images from data observed by the DSCOVR satellite, and **Dan Holdaway** is collaborating with the DSCOVR EPIC cloud algorithm team.

Awards Ceremonies

On Monday, February 2nd, the Global Modeling and Assimilation Office (GMAO) at NASA Goddard held their annual Awards Ceremony. Four of this year's awardees were GESTAR scientists, who received a plaque, a certificate, and individual monetary awards from GESTAR representatives.

For Scientific Achievement: **Gabrielle De Lannoy** (GESTAR/USRA): "For exceptional scientific achievements, including authoring two papers, co-authoring six scientific articles as well as the SMAP Handbook, and making nine presentations."

For Science and Technical Support (SMAP Team): **Gabrielle De Lannoy**: "For outstanding contributions in the science development and technical implementation of the algorithms to generate the SMAP Level 4 soil moisture and carbon data products." (Note, this award also was presented to SSAI's Joe Ardizzone, Purnendu Chakraborty, Qing Lui, Rob Lucchesi and Brent Smith.)

(Awards Ceremonies, cont'd)

For Outstanding Scientific Contribution by a New GMAO Member: **Brad Weir** (GESTAR/USRA): "For outstanding scientific achievement in advancing the carbon data assimilation capability in support of GMAO's contributions to NASA's carbon monitoring activities."

For Outstanding Scientific Contribution by New GMAO Members: **Min-Jeong Kim** (GESTAR/MSU) and **Jianjun Jin** (GESTAR/USRA): "For a focused effort to successfully introduce new microwave radiance data from the TRMM/GPM platforms into the GEOS-5 data assimilation system."

About two weeks later, on Friday, February 13th, Goddard's Mesoscale Atmospheric Processes Laboratory (Code 612) held its awards ceremony, where two GESTAR members were recognized for their ongoing efforts. Each recipient received a plaque, a certificate and a monetary award.

Kristen Weaver (GESTAR/USRA) was honored with a Contractor Award for Outstanding Service: "For Outstanding Service and Innovation as a GPM Education and Communication Specialist."

Mircea Grecu (GESTAR/MSU) was honored with a Contractor Award for Exceptional Scientific Achievement: "For Outstanding Scientific Contributions and Dedicated Efforts in Developing the GPM Combined Radar/Radiometer Algorithm."

Maniac Talks

GESTAR thanks the following scientists who presented talks over the past few months: John Mather, NASA/GSFC (Nov 2014), Michael Mishchenko, NASA/GISS, (Jan 2015), and Paul Newman, NASA/GSFC (Feb 2015).

If you missed any of these or other past talks, they are available online at the Maniac Talk site, where you can find the rest of the 2015 lineup: http://maniactalk.gestar.usra.edu/. Thanks to **Charles Gatebe** and Bill Hyrbyk for their continued assistance with these well-attended events.

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Highlight: Seasons of Indian Air Quality

Research into the air quality of the Indo-Gangetic Plain conducted by **Hiren Jethva** and colleague Ritesh Gautam was featured on the Earth Observatory site in November 2014. Images from MODIS showed the variety of factors that affect this river valley that is part of Pakistan, India, Nepal, and Bangladesh. According to the EO article, "In 2014, the World Health Organization listed Delhi as the city with the most polluted air in the world." Dr. Jethva pointed out that the assumption that this area is constantly in a dusty haze is not true; Dr. Gautam addressed the effect of the area's geography on the air conditions.

Dust, organic carbon, black carbon, sulfates, and nitrates all affect visibility. Whether natural or man-made, different factors result in various aerosols. Sand storms produce dust; fires produce organic carbon; and other industrial factors produce sulfates, nitrates and black carbon. The density of these aerosols varies; for example, in spring, the air is clear, until the dust sweeps in through the summer months. Monsoons clear the dust away, but then farmers burn crops in the fall, and smoke becomes a factor. In this image (see below) from Nov 4, 2010, the red dots represent fire spots. Dr. Jethva explains that "the MODIS algorithm uses fire radiate power, a strong indicator of agriculture and/or wildfires to detect fire spots." Later, thick fog and haze appear in December and January, when it's cooler. Smoke from various sources appears in rural areas, while industrial sources produce nitrates and sulfates in urban areas. The cooler weather also lends itself to fog lingering in the haze of various aerosols. Dr. Gautam discussed the role of the geography: "Air masses get hemmed in by the Himalayan mountains in the north and the Vindhya mountains in the south. When temperature inversions occur, all the smoke, dust, and industrial pollution entering the atmosphere ends up piling up over the Indo-Gangetic plain because it cannot get over the mountains." To read more about Seasons of India Air Quality or explore other items of interest, visit Earth Observatory: http://earthobservatory.nasa.gov/.

Red dots represent fire spots in the Indo-Gangetic Plain. Image from Earth Observatory.

Kurylo Presents Report of the 9th ORM

In November, **Mike Kurylo** attended the Joint Meeting of the 10th Conference of the Parties to the Vienna Convention for the Protection of the Ozone Layer and the 26th Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, held in Paris. Dr. Kurylo specifically was invited to present the Report and Recommendations of the 9th Meeting of Ozone Research Managers (9th ORM) of the Parties to the Vienna Convention, for which he was the elected Co-Chair in May 2014. He gave this presentation on November 19th at the Plenary Session attended by Delegates from hundreds of the Party Nations. These recommendations in the areas of Research Needs, Systematic Measurements, Data Archiving and Stewardship, and Capacity Building were derived in consideration of the findings of the 2014 WMO/UNEP Ozone Assessment and were recommended for acceptance by the Parties.

Dr. Kurylo continued his Emeritus Membership on the international Steering Committee for the Network for the Detection of Atmospheric Composition Change (NDACC). He helped to finalize the agenda for the committee's November 2014 meeting, held in Brussels, Belgium, which he attended. Further, he represented NDACC activities in the Network for Remote Sensing (NORS)/NDACC/Global Atmosphere Watch (GAW) international workshop that occurred as an adjunct activity to the Steering Committee Meeting. This workshop explored how the quality and validation of the products delivered by the Copernicus Atmospheric Service (CAS) could be improved using independent ground-based remote sensing data from the NDACC. **Susan Strahan** also attended the Steering Committee meeting as well as the NORS/GAW workshop, where she gave a presentation titled "Chlorine Variability in the Antarctic Vortex and Implications for Ozone Recovery".

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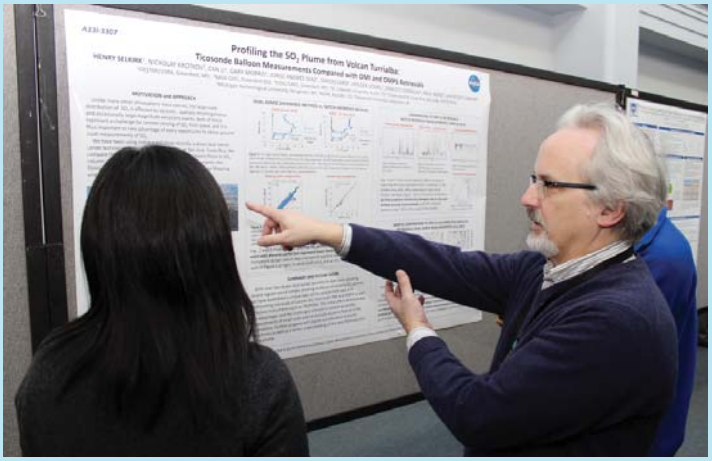
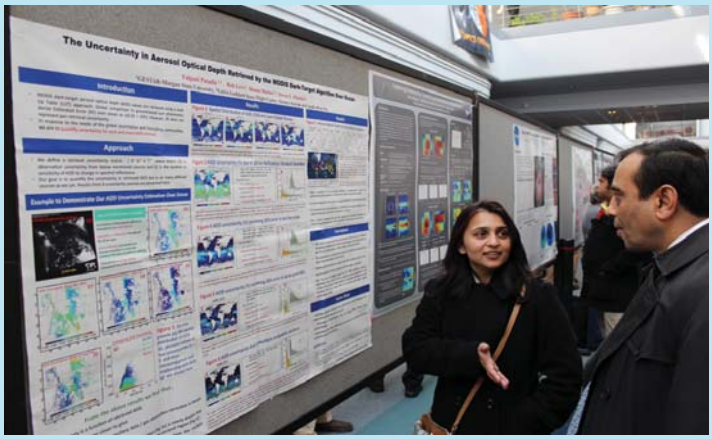
SED Poster Party

The annual Sciences and Exploration Directorate (SED) Poster Party was held in the Atrium of Building 28 at NASA GSFC on Wednesday, January 28th. Of the 149 poster presentations, 15 were presented by the following GESTAR members: **Deepthi Achuthavarier**, **Ludovic Brucker**, **Yehui Chang**, **Manuela Girotto**, **Jie Gong**, **Pawan Gupta**, **Hiren Jethva**, **Jianjun Jin**, **Young-Kwon Lim**, **Junhua Liu**, **Falguni Patadia**, **Henry Selkirk**, **Zhining Tao**, **James Wang** and **Yan Zhang**.



Dr. Selkirk discusses his poster "Profiling the SO2 Plume from Volcan Turrialba: Ticosonde Balloon Measurements Compared with OMI and OMPS Retrievals". (Image Credit: Jarrett Cohen/GST)



Dr. Patadia discusses her poster "The Uncertainty in Aerosol Optical Depth Retrieved by the MODIS Dark-Target Algorithm Over Ocean". (Image Credit: Jarrett Cohen/GST)

New Hires

GESTAR welcomes the following members:
Andrea Andrew
Amanda Armstrong
Abhishek Chatterjee
Veronika Leitold
Peter Van Oevelen
Cheng Zhang

Moving On

Jackie Phillips (leidos)
Piotr Domaszczynski
Daniel Laughlin (NASA HQ)
Julie Dalnekoff Smith
Ally Mounirou Toure
Yan Zhang

Grants Awarded

GEO-CAPE Proposal Awarded:
"Assessment of the need for corrections of remote sensing reflectances due to BRDF effects in coastal waters", PI: **Charles Gatebe**; Co-Investigators: Knut Stamnes and Wei Li (Stevens Institute of Technology); P.O.P.: Jan 2015 – Dec 2015.

NASA ROSES 2014 ACMAP Proposal Awarded:
"Global Planetary Boundary Layer Depth Trends and the Impact on Atmospheric Aerosols and Greenhouse Gases", PI: **Erica McGrath-Spangler**; P.O.P.: Jan 2015 – Jan 2018.

Recent Publications

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Kirschbaum, D., **T. Stanley**, and S. Yatheendradas (2015), Modeling landslide susceptibility over large regions with fuzzy overlay, Landslides (in press).

Lamsal, L. N., N. A. Krotkov, **E. A. Celarier**, W. H. Swartz, K. E. Pickering, E. J. Bucsela, J. F. Gleason, R. V. Martin, S. Philip, H. Irie, **A. Cede**, J. Herman, A. Weinheimer, J. J. Szykman, and T. N. Knepp (2014), Evaluation of OMI operational standard NO2 column retrievals using in situ and surface-based NO2 observations, Atmos. Chem. Phys., 14, 11587-11609, doi:10.5194/acp-14-11587-2014.

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