

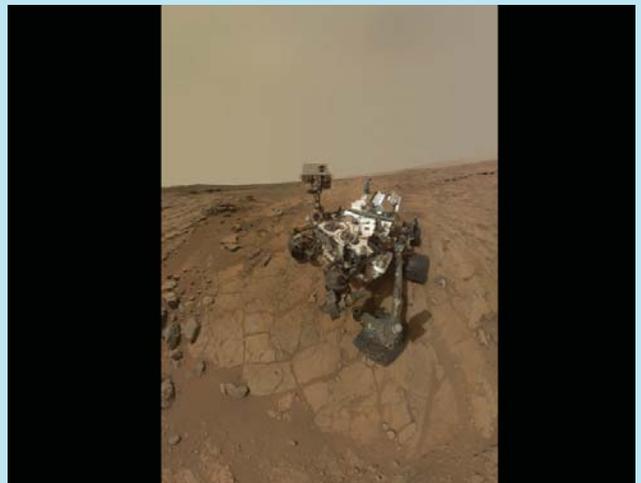
## Celebrating Curiosity's Birthday

(But first, some terms to know: MSL: Mars Science Laboratory mission; SAM: Sample Analysis at Mars instrument suite; sol: one martian day; CheMin: Chemistry and Mineralogy Instrument.)

Built and tested at NASA Goddard, SAM is one of ten scientific instruments aboard MSL's rover Curiosity, which landed on Mars on August 5, 2012 in Gale Crater near the northwestern base of Mt. Sharp. A major goal of this mission is to explore the habitability of the martian environment, assess the organic compounds from martian rock, and examine the martian atmosphere. SAM, a chemistry lab in Curiosity, has a twin on Earth known as the testbed, which is operated at NASA Goddard. Prior to conducting experiments with Curiosity on Mars, scientists and engineers conduct experiments with the SAM testbed for verification, validation and optimization before sending the final instructions to the SAM instrument on Mars. SAM team member and supporting scientist **Charles Malespin** (GESTAR) and Mars chamber operator Ariel Siguelnitzky conduct most of these experiments. Prior to the launch of Curiosity, the testbed operators were conducting experimental validation tests in the SAM Mars Chamber to guarantee that the experiments were as similar as possible to the martian environment. This custom chamber replicates the thermal and atmospheric conditions that SAM on Mars encounters. "The testing activities began at the conceptual level during science team discussions and those ideas were the basis for development of software scripts. Scripts were reviewed and software was loaded into testbed memory for execution," explained Chris Johnson, Project Engineer, on the SAM Blog. Malespin elaborates: "All scripts are dry-run on the testbed, with some requiring several iterations. After the experiment is complete, there is a thorough review of the testbed data before an experiment can be approved to be run on Mars. This ensures instrument safety and optimal science return." Malespin has been the experimental lead for several of the new, more complex experiments that have been completed recently on Mars.

Fun fact: The Martian day is 48 minutes longer than the earth day. Therefore, this time difference can have an effect on the scientists; for example, when performing the rover's software upgrades or any of several other activities required, scientists can experience something similar to jet lag. Malespin provided further insight: "For the first 90 sols, all operations personnel worked on Mars time. Every morning at 10 am, Mars time, we radiate the plan from earth to the rover for the day. However, 10 am on Mars isn't necessarily during the daytime on earth - sometimes it's at 5 am. When we upgraded the software on SAM, the software was sent in smaller bits each Mars morning over a full week. The rover re-assembled the upgraded software image, and we had it send back verification that the file didn't change or get scrambled before instructing it to load the software. Then, a few commissioning tests were done to confirm everything installed correctly."

Some highlights from the past year include Curiosity's self-portrait, data collection, and discoveries from drilling activity. SAM used its Quadrupole Mass Spectrometer and its Tunable Laser Spectrometer to analyze data of the Martian atmosphere. From Oct 31 to Nov 16, Curiosity was working at an area known as Rocknest Wind Drift, where the first scooped material was delivered to two instruments inside Curiosity, CheMin and SAM. This provided the opportunity to test SAM with a real Mars sample. When heated by SAM, this sample released the composition of the gases, one major gas being oxygen, others being chlorinated organic compounds, particularly percholate, which at high temperatures can decompose organic material. Percholates may be found throughout the martian surface, and further experiments will tell the tale. Also, in early January



*Updated Curiosity's self-portrait at John Klein, created by several exposures taken by the rover's Mars Hand Lens Imager (MAHLI). Image Credit: NASA/JPL-Caltech/MSSS*

## **Curiosity, cont'd**

2013, Curiosity famously drilled a 2-cm hole into a rock known as “John Klein”, which led to the discovery of evidence of oxidizing conditions on the interior rock, notable in the difference in color from the drilled rock and its exterior. From this sample, SAM heated up the powdered rock and examined the generated gas species and any organic molecules preserved in the rock. SAM was also looking for any subsurface volatiles.

The nominal mission finishes in one more earth year, and after that, the mission can continue indefinitely as long as the payloads remain healthy. Malespin explains, “Opportunity, the previous rover, was scheduled for a 90-day mission but has been going on the surface of Mars for 10 years now.” July 7, 2013 was the 10th anniversary of Opportunity’s launch with its sister rover, Spirit. These two rovers landed on the opposite side of Mars from where Curiosity landed. For comparison, Opportunity was smaller than a golf cart, while Curiosity is the size of an SUV; also, Curiosity has more instruments onboard. On August 5, 2013, NASA celebrated Curiosity’s first full year on Mars by releasing a video, in which a Happy Birthday message is relayed to the SAM instrument onboard Curiosity. Visit <http://www.youtube.com/watch?v=uxVVgBAosqg>. Charles Malespin makes a cameo in this video operating SAM (look for the red shirt).

As of July 11, 2013, Curiosity was heading to its main destination, Mt. Sharp (or Aeolis Mons), which stands at 5500 meters. The New York Times features an interactive site that tracks Curiosity’s progress to Mt. Sharp. You also can begin at Curiosity’s Sol 0 and experience through images the rover’s original landing: [http://www.nytimes.com/interactive/science/space/mars-curiosity-rover-tracker.html?nl=todayshadlines&emc=edit\\_th\\_20130806&r=0#sol342](http://www.nytimes.com/interactive/science/space/mars-curiosity-rover-tracker.html?nl=todayshadlines&emc=edit_th_20130806&r=0#sol342). For more information on SAM and JPL’s Mars Science Laboratory Curiosity Rover and SAM visit <http://ssed.gsfc.nasa.gov/sam/samiam.html> and <http://mars.jpl.nasa.gov/msl/>.

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## **Recent Awards**

In April, two GESTAR scientists were recognized for their contributions to the goals of the GMAO. **Cecile Rousseaux** was recognized for Outstanding Scientific Contribution by a new GMAO member, “for significant contributions to the GMAO and the wider research community in the biological sciences and use of satellite data for biology, especially through publications and conference presentations.” **Yoo-Geun Ham** was recognized for Outstanding Scientific Achievement, “for significant contributions to GMAO’s efforts in climate prediction, especially in improving predictions of the Madden-Julian Oscillation and in documenting results from GEOS-5 decadal climate predictions.”

In late June, two GESTAR members were recognized by NASA Goddard’s Code 610-AT for Outstanding Performance - Science: **Valentina Aquila** was recognized “for significant advances in our understanding of the ozone response to strong tropical volcanic eruption”. And **Mircea Grecu** was recognized “for successful completion of the “at launch” GPM combined radar-radiometer algorithm, from concept to final software, using innovative and original approaches.”

## **GESTAR’s Second Anniversary**

GESTAR combined its All Hands Meeting and Second Anniversary Celebration in early May 2013, focusing on achievements of the past year and future goals for year three.

This year’s meeting featured the beginning of a new annual tradition: select members were presented with *Excellence in GESTAR Mission Achievement Awards*: **Ritesh Gautam**; **Yoo-Geun Ham**; **Jie Gong**; **Eric Sokolowsky**; and **Helen-Nicole Kostis**, **Katie Lewis** and **Kayvon Sharghi**. Group leads are asked to review and recommend staff for awards, and upon review, selections are made. Following this year’s awards ceremony, cake and refreshments were provided.

Also, GESTAR’s second Annual Report, a compilation of research, highlights, and other items of interest, is posted on the website: <http://gestar.usra.edu/>.

## New Hires

GESTAR welcomes the following members:

Valentina Aquila  
Naeyong Cho  
David Ladd  
Allison Leidner  
Batuhan Osmanoglu  
Edoardo Pasolli  
Jackie Phillips  
Didier Rault  
Deborah Stein-Zweers

The number of GESTAR members with the GST subcontract (Global Science & Technology) has grown from its original four to a new total of 16; the GESTAR/GST group is led by **Jarrett Cohen**. GESTAR welcomes **Ronald Albright, Ryan Barker, Sally Bensusen, Steve Graham, Heather Hanson, Winnie Humberson, Marit Jentoft-Nilsen, Mark Malanoski, Debbi McLean, Kevin Miller, Cindy Trapp and Alan Ward**.

**Andrew Swanson** joined GESTAR full-time after working as a master's student intern. He conducts design work for atmospheric analysis instrumentation and performs some electrical work and assembly when needed. He worked for and continues to work with Tom Hanisco. One particular instrument he designed was their ISAF (In Situ Airborne Formaldehyde) instrument.

## Students

**Felicia Chen** (JHU) is working with **Assaf Anyamba** as a junior programmer to support various research and applications development services to sister federal agencies, including USDA Foreign Agricultural Service, USDA Agricultural Research Service and DoD Armed Forces Health Surveillance Center. This summer she has worked on programming and setup of the Rift Valley fever Monitor Website, located at the USDA Center for Medical, Agricultural, and Veterinary Entomology (CMAVE): <http://www.ars.usda.gov/Business/docs.htm?docid=23464>. Additionally, she will assist with implementing other interactive data and product portals.

**Sreeja Nag** (MIT) is working with **Charles Gatebe** as a short-term scientist investigating the minimum requirements and capabilities to manage future multiple platform

## Students, cont'd

missions and to develop and deploy such missions, all in a cost-effective manner. Her efforts will lead to a tool that will consider parameters such as number of spacecraft, communication interoperability, instrument type, launch vehicle(s), etc., and will aim at reducing the cost, size, volume, risk and the schedule of future missions, including Earth observing missions. This tool also will help measure the cost of various architectures designed in response to a given set of mission requirements.

Three Morgan State University summer interns were sponsored by GESTAR and worked on various projects at NASA Goddard: *Shaheed Baukman, Carlos Neal and Jaime Arribas*.

## Moving On

**Monique Harris**, former Administrative Assistant for GESTAR/MSU, has accepted a new position, still in the world of academia. She will be missed.

**Xiaohua Pan** was selected for a NASA NPP post-doctorate program and left GESTAR in mid-summer. We wish her well in this opportunity.

Both **Kyu-Myong Kim** and **Nathan Kurtz** are now Research Assistants with NASA Goddard, Kim with the Climate & Radiation Laboratory and Kurtz with the Cryospheric Laboratory.

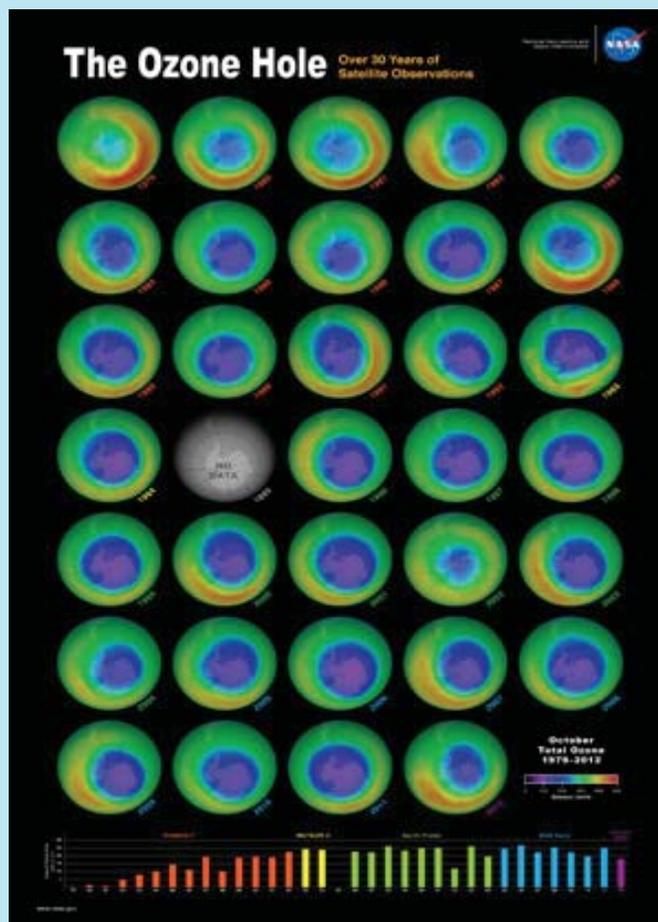
## Maniac Talk

GESTAR thanks the following scientists who have presented talks this past spring and summer: **Anne Douglass** (GSFC); **Compton J. Tucker** (GSFC); **Marc Imhoff** (Joint Global Change Research Institute); **Michael D. King** (Univ. of CO, Boulder); **Warren Wiscombe** (GSFC); **Charles McClain** (GSFC).

At least four more upcoming talks are scheduled through the end of the year. Visit the Maniac Talk site to check the schedule and to view videos of previous presentations. Thanks to **Charles Gatebe** and **Bill Hyrbyk** for continued assistance with these well-attended events.  
Maniac Talk: <http://maniactalk.gestar.usra.edu/>.

## Science Jamboree at NASA Goddard

In mid-July in the atrium of Building 28, GESTAR's Tom Kucsera and his sponsor Mian Chin participated in Goddard's Science Jamboree, an annual event when the laboratories can highlight and inform everyone what each laboratory is doing. They highlighted their work with Code 614, Atmospheric Chemistry and Dynamics. Several posters were on display, and a slide show played on a monitor for people to view as they came by the table. Postcards and posters were distributed that depicted some of the science results that Code 614 members contributed to and worked on within the laboratory. The postcards showed some of the analysis work that was done with satellite-retrieved data products. One particular poster (*image at right*), titled "The Ozone Hole: Over 30 Years of NASA Observations", showed the famous Antarctic ozone hole and was quite popular with the event's attendees. In fact, Ginger Butcher, Eric Nash and Edward Celarier (GESTAR) won a 2013 Communicator Award for Excellence in Print and Design by the International Academy of the Visual Arts for their work on this poster, which employs a stunning infographic format to highlight NASA's ozone hole observations between 1979 to 2012 from a variety of NASA missions including Aura and Suomi NPP. (To view the back of the poster, click here: <http://aura.gsfc.nasa.gov/ozonholeposter/>.)



*Image provided courtesy of Tom Kucsera*

## Selected Science Highlights on Goddard Science Research Portals

### *Atmospheric Chemistry & Dynamics*

July 2013: Lok Lamsal, co-author, "The observed response of Aura Ozone Monitoring Instrument (OMI) NO<sub>2</sub> columns to NO<sub>x</sub> emissions over the United States: 2005-2011"

### *Climate & Radiation*

March 2013: Jerry Ziemke, co-author, "Aerosol indirect effect on tropospheric ozone via lightning"

April 2013: Weidong Yang, lead author, "Particle shape matters for dust sedimentation and vertical structure"

May 2013: Jie Gong, lead author, "A Novel Technique to Retrieve Cloud Ice Water from Microwave Humidity Sounder"

July 2013: Jiansong Zhou, co-author, "Water Vapor Modulation by the Sun: Bottom Up or Top Down"

### *Mesoscale Atmospheric Processes*

May 2013: Jiun-Dar Chern, co-author, "Exploring Local Land Surface Feedbacks to Regional Circulation"

June 2013: Mei Han, lead author, "Structure of Heavy Precipitation Over California"

## SEAC4RS: Studies of Emissions and Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys

SEAC4RS, NASA's most complex airborne science study of 2013, is a field campaign where the goal is to learn more about how air pollution and natural emissions affect climate change. Using a DC-8 and an ER-2 for science aircraft, scientists will acquire data from the sensors and instruments mounted on each of these in order to study trace gases and other airborne chemicals that create pollution. The aircraft will fly from NASA Dryden to the SEAC4RS base at Ellington Field, which is operated by Johnson Space Center, near Houston, TX. Scientists also will use observations from NASA satellites and various ground sites in compiling their findings.

The field campaign runs from August 10th through October 1st. During this time period, gases and particles are pushed high into the atmosphere due to strong weather systems. The ER-2 is a high-altitude aircraft which will be able to fly into the stratosphere to capture the data scientists need to study the effects of particles and gases on climate. "The mission is targeting two major regional sources of

summertime emissions: intense smoke from forest fires in the U.S. West and natural emissions of isoprene, a carbon compound, from forests in the Southeast." (Ref. SEAC4RS website.) The DC-8 will be sampling information from the atmosphere, and a third plane, a Learjet, will measure cloud properties.

At least four GESTAR scientists are participating in SEAC4RS. **Rennie Selkirk** is part of the MET/Forecasting team. He will lead the work of the water vapor sounding project as well as support flight planning for the ER-2 and DC-8. **Richard Damoah** is part of the balloon sounding team, and **Valentina Aquila** is also participating by conducting the chemical forecast along with the GEOS5 team, producing model results that show the distribution of chemical species, which will help with flight planning. **Cynthia Randles** will be providing forecasts for field missions. Follow the progress and findings of the mission at the SEAC4RS website: [http://www.nasa.gov/mission\\_pages/seac4rs/index.html](http://www.nasa.gov/mission_pages/seac4rs/index.html).

For GESTAR/USRA employees: Information regarding Open Enrollment will be distributed in September/October.

NASA GESTAR conducts research collaboratively, mainly within GSFC's Earth Sciences Division, but also with Solar Systems Exploration Division, Office of Education, and Office of Public Affairs. Scientists and staff at GESTAR, in collaboration with NASA and other investigators, conceive and develop new, space-based missions; provide mission requirements; conduct research that explains the behavior of Earth and other planetary systems; and create engaging media that tell NASA's story of exploration and discovery on Earth and beyond.

*The GESTAR Team:* Universities Space Research Association, Morgan State University, IMSG, Johns Hopkins University, Institute for Global Environmental Strategies, and Ball Aerospace and Technologies.  
Visit us at <http://gestar.usra.edu/>.

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