

Young Scientist Forum

On June 26, 2014, the second annual Young Scientist Forum was held at NASA Goddard Space Flight Center in Building 33. Initiated by John Yorks of SSAI in 2013, this forum highlights the work that young scientists have completed during the past year. The goal of the YSF is to give young scientists a platform to present their work and to foster possible collaborations. Participants consist of scientists who have obtained their degrees in the last 10 years. All oral and poster presentations summarized work on modeling of the Earth's surface and atmosphere, remote sensing of clouds and aerosols, and aerosol/trace gas modeling and observations. This year's YSF Committee consisted of John Yorks, Joe Munchak, Tianle Yuan, Leigh Munchak, **Valentina Aquila** and Can Li.

Several GESTAR scientists participated in the all-day forum. In the first session "Remote Sensing of Clouds and Aerosols", **Jie Gong** (Code 612) presented "Systematic Meridional Cloud Tilts in the Tropics Revealed by CloudSat, MLS Observations and WRF Simulations". In late morning, the Modeling and Observations of Atmospheric Composition session, chaired by Valentina Aquila, included presentations by four GESTAR scientists: **Erica McGrath-Spangler** (GMAO), "Impact of Planetary Boundary Layer Turbulence on Tracer Transport"; **Junhua Liu** (Code 614), "Source attribution of interannual variability of ozone in the troposphere and lower stratosphere using ozonesondes and satellite data compared to Global Modeling Initiative CTM hindcast simulations"; **Melanie Follette-Cook** (Code 614), "Spatial and Temporal Variability of Trace Gases Derived from WRF/Chem Regional Model Output: Planning for GEO-CAPE and TEMPO"; and **Sarah Strode** (Code 614), "Do the CCM1 simulations reproduce the MOPITT CO Trends and Variability?"

In an early afternoon session titled "Developing and Evaluating Emissions Inventories", **Lok Lamsal** (Code 614) gave a presentation titled "NO_x Trend over the United States: The view from ground and the view from space" (see page 2 for a NASA news item on this topic, featuring Dr. Lamsal's research contributions). In the final session of the day, "Global Modeling of Surface and Atmosphere", also chaired by Valentina Aquila, four GESTAR scientists gave presentations: **Tepei Yasunari** (Code 613), "Up-to-date summary of the GOddard SnoW Impurity Module (GOSWIM) for the NASA GEOS-5 Model"; **Deepthi Achuthavarier** (GMAO), "North Pacific Decadal Variability in the GEOS-5 Atmosphere-Ocean Model"; **Manuela Giroto** (GMAO), "Assimilation of GRACE terrestrial water storage observations into the Catchment land surface model for improved soil moisture estimation", and **Gabrielle De Lannoy** (GMAO), "Assimilation of SMOS brightness temperatures in preparation for GMAO's SMAP surface and root-zone soil moisture product (L4-SM). (cont'd on page 2)

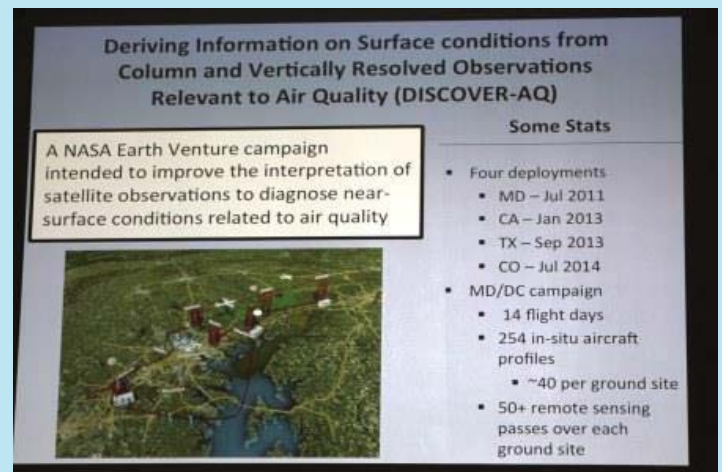


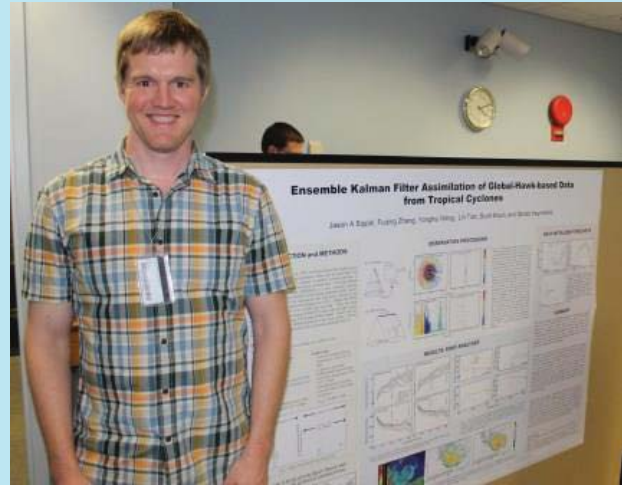
Image: Slide from Dr. Follette-Cook's presentation, using information derived from the DISCOVER-AQ campaign to evaluate regional model estimates of what could be observed by GEO-CAPE and TEMPO.



Dr. Yasunari addresses a question from Dr. Aquila. (Photo: A. Houghton)

(YSF, cont'd)

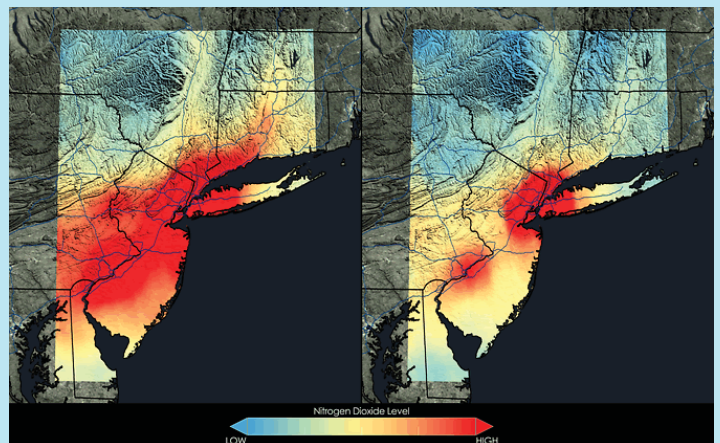
A poster session followed the talks, and included in these presentations were **Pawan Gupta**, “Urban Aerosol Retrieval in MODIS Dark Target Algorithm”; **Hiren Jethva**, “Global Assessment of OMI Aerosol Single-scattering Albedo using Ground-based AERONET inversion”; **Jason Sippel**, “Ensemble Kalman filter assimilation of Global-Hawk-based data from tropical cyclones”; **Sergey Korkin**, “Update on vector radiative transfer code”; **Nayeong Cho**, “A study of global MODIS cloud regimes”; and **Mei Han**, “A model and observational comparison study of a GCPEX snowstorm”. Anyone interested in 2015’s Young Scientist Forum should watch for notices from Lab Chiefs regarding dates and location of the forum as well as how to sign up. All of this year’s sessions were very well attended and informative.



Dr. Sippel stands beside his poster presentation. (Photo: A. Houghton)

Highlight: Improvement in U.S. Air Quality

On the same day that **Lok Lamsal** gave his presentation on the trend of nitrous oxides over the U.S. at the Young Scientist Forum, an article posted on NASA Goddard Space Flight Center’s website, “New NASA Images Highlight U.S. Air Quality Improvement”, detailed the improvement in U.S. air quality over parts of the country from 2005 to 2011 and caught nationwide attention. On NASA’s Aura satellite, the OMI (Ozone Monitoring Instrument) has been providing measurements of nitrogen dioxide (NO₂), a gas produced from gasoline used to power vehicles and coal used in power plants. The EPA protects human health by regulating this pollutant, as it affects the respiratory system and also helps to form other particulate matter, harmful to all living things. In addition to the OMI measurements, another NASA mission, DISCOVER-AQ, studies air quality. DISCOVER-AQ (Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality) will take to the skies for its final flight from July - August, flying over Denver, Colo. The DISCOVER-AQ team focused on areas across the U.S. that routinely experience poor air quality, previously flying in 2011 over the Baltimore-Washington corridor, in 2013 over San Joaquin Valley, Calif., and also in 2013 over Houston, TX. Scientists suggest that this decrease in air pollution is the result of regulations, among other contributing factors; however, there exists a high percentage of Americans living in areas where the air pollution remains alarmingly high. Based on data from NASA GSFC atmospheric scientists Yasuko Yoshida, Lok Lamsal, and Bryan Duncan, **Trent Schindler** of NASA’s Scientific Visualization Studio created visualizations that, with the use of a sliding bar, show how NO₂ concentrations during spring and summer months, averaged from 2005-2007, compare to the average from 2009-2011 over several U.S. cities. Trent also produced still images that show side-by-side comparisons (see image above). A photo stream is available to view changes over other cities on www.flickr.com. The original NASA article is available here: <http://www.nasa.gov/content/goddard/new-nasa-images-highlight-us-air-quality-improvement/#.U71Jfvn-Meg>.



Satellite data details the 32% decrease in NO₂ in New York City between the periods of 2005-2007 (left) and 2009-2011 (right). (Image Credit: NASA Goddard’s Scientific Visualization Studio/ Trent Schindler)

NASA Viz News!

Three years ago, when NASA Goddard launched the NASA Visualization Explorer app, also known as NASA Viz, the app was available exclusively for the iPad. In early March 2014, the app became universally available for the iPhone and all Apple iOS devices. The NASA Visualization Explorer app features the data visualization work of NASA's Scientific Visualization Studio, Earth Observatory, Science @ NASA and others, and publishes two stories a week, every Tuesday and Thursday, about the full range of NASA's astrophysics, planetary, heliophysics and Earth science missions.

The NASA Viz has been tested in and is now used in several educational settings. Helen-Nicole Kostis, the app's project manager, explains "We worked hard to maintain the quality of interaction within the visual story on smaller screens. With this release we welcome new users to enjoy the experience and to follow the fascinating world of NASA science and research through our stories and data visualization work." To download the NASA Visualization Explorer app, visit <http://svs.gsfc.nasa.gov/nasaviz/> or the iTunes app store.

New Hires

GESTAR welcomes the following members:

Junchang Ju
 David Lagomasino
 Frederic Lipschultz
 Brian Monroe
 Joy Ng
 Max Suarez
 Samuel Teinturier
 Tian Yao

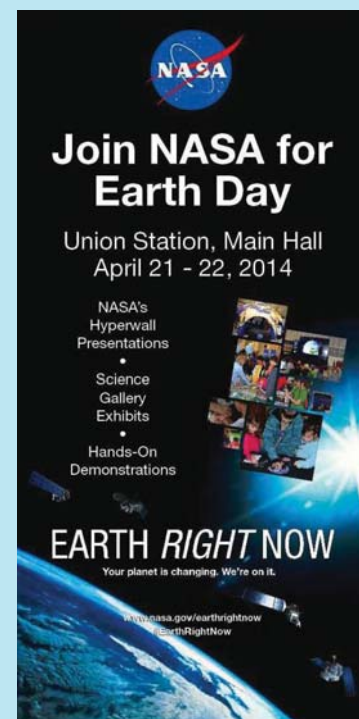
Rhonda Billingslea (Contracts, MSU)
 Frank Hornbuckle (Prog. Mgr., MSU)

Moving On

Kelly Brunt is now working with ESSIC at UMCP.
 Patrick McBride returned to Colorado in early May 2014.
 Sarah Smith joined Sigma Space as a Support Scientist at NASA GSFC.
 The tasks for both Ritesh Gautam and Seungkuk Lee ended in April 2014.

Earth Day with NASA

At Union Station in Washington, DC, on April 21-22, NASA celebrated Earth Day with the public through various demonstrations, talks, and hands-on activities. For this large-scale event, Winnie Humberson (GST) coordinated the Science Gallery Exhibits and Hyperwall activities, allowing NASA to relay Earth science by using visuals and stories. Allison Leidner and Ed Celarier both gave Hyperwall talks, and Erica McGrath-Spangler helped with an exhibit. Kristen Weaver hosted a table dedicated to GPM information and activities. Heather Hanson and Steve Graham (GST) served as Docents to the Science Gallery. Other GST staff assisted with set-up and participation, and created communication items: Ryan Barker, Sally Bensusen, Marit Jentoft-Nilsen, Mark Malanoski, Debbi Mclean, Kevin Miller, and Cindy Trapp.



MSU holds Town Hall at Goddard

On Wednesday, May 21st, Morgan State University held a Town Hall hosted by President Wilson and the Division of Research and Economic Development along with the GESTAR/MSU Group Leads, Xiaowen Li and Roger Shi. Following Dr. Wilson's talk, a session of one-on-one discussions were held between administrative representatives and GESTAR members. Items reviewed included Procurement, Travel, Employee Benefits, Software, Visas and PEARL.

GESTAR Celebrates its Third Anniversary

On Friday, May 30th, GESTAR celebrated its third anniversary, with an All Hands meeting preceding the festivities. **Dr. Bill Corso**, GESTAR Director, reviewed the program's achievements over the past year, which included highlighting the H-index of certain scientists and the vast array of research by GESTAR members. This year, fourteen people, consisting of scientists and staff, were recognized for their efforts and were presented with a GESTAR Mission Achievement Award:

Tom Bridgman
Ludo Brucker
Tom Eck
Dongchul Kim
Hyokyung Kim
Lok Lamsal
Young-Kwon Lim

Cynthia Randles
Andy Sayer
Trent Schindler
Cindy Starr
Ernie Wright
Amy Houghton
Julie Smith

Additionally, the GESTAR 3rd Annual Report was submitted to NASA in June and is available on the GESTAR site. We hope you will peruse the many research topics, highlights, outreach, and accomplishments from 2013 – 2014.

Monthly Science Highlights

March 2014:

“The quasi-biennial oscillation is disrupted by geoengineering aerosols”, by **Valentina Aquila**, C. I. Garfinkel, P. A. Newman, L. D. Oman, and D. W. Waugh.

“Initial in situ measurements of Perennial Meltwater storage in the Greenland firn Aquifer”, by **Lora Koenig**, **Clement Miega**, **Richard Forster**, and **Ludovic Brucker**.

May 2014:

“Accounting for snow darkening over land surface in NASA's GEOS-5 Model” based on the recent publication “The Goddard Snow Impurity Module (GOSWIM) for the NASA GEOS-5 Earth System Model: Preliminary comparisons with observations in Sapporo, Japan”, published online in SOLA, an online journal by the Meteorological Society of Japan, authored by **Tepei Yasunari**, K.M. Lau, S. Mahanama, P. Colarco, A. daSilva, T. Aoki, K. Aoki, N. Murao, S. Yamagata, and Y. Kodama. (See T. Yasunari in YSF, page 1.)

(*Monthly Science Highlights, cont'd.*)

June 2014:

“Scattering Computations of Snow Aggregates from Simple Geometrical Particle Models”, by **Liang Liao** and **Robert Meneghini**.

“MCRS: A novel tool for simulating radiometer observations from model data”, by G. Wind, A. da Silva, **Peter Norris**, and S. Platnick.

“The effect of dust absorption on its transport and lifecycle”, by P. Colarco, E. Nowottnick, **Cynthia Randles**, B. Yi, P. Yang, K.-M. Kim, J. Smith and C. Bardeen.

Education/Public Outreach

Sreeja Nag, a doctoral student at Massachusetts Institute of Technology won a NASA Earth and Space Science Fellowship (NESSF) for the 2014-2015 academic year. Her proposal is entitled “Evaluation and Optimization of Nano-Satellite Clusters for Bi-Directional Reflectance Estimation.” **Charles Gatebe** serves on Sreeja's PhD committee along with MIT professors Olivier de Weck, Kerri Cahoy, and David Miller (on detail at NASA HQ as the New Chief Technologist). NASA received a total of 410 applications in Earth Science Research and selected 54 for award.

Benjamin Johnston, a graduate student from Texas A&M Corpus Christi, will be a summer intern for **Santiago Gassó**. Benjamin will work on the analysis of meteorological and satellite data over high latitude dust sources in Alaska and in Patagonia desert.

NASA's Hyperwall was at the U.S. Department of State, Washington, DC, on June 16-17 to support the “Our Ocean Meeting 2014” hosted by John Kerry, Secretary of State. The event was attended by HQ Earth Science senior management, Piers Sellers, and supported by the GSFC Hyperwall team (**Winnie Humberson**, **Steve Graham**, **Eric Sokolowski**, **Marit Jentoft-Nilsen**, **Heather Hanson**, **Kevin Miller**, **Mark Malanoski**, **Cindy Trapp**, and **Ryan Barker**), who were on board from planning to delivery of NASA's ocean science messages on the Hyperwall stage.

Recent Publications

- Brucker, L.,** D. J. Cavalieri, T. Markus, and A. Ivanoff (2014), NASA Team 2 Sea Ice Concentration Algorithm Retrieval Uncertainty, *IEEE Transactions on Geoscience and Remote Sensing*, 52 (11), 7336-7352, doi:10.1109/TGRS.2014.2311376.
- Brucker, L.,** E. P. Dinnat, G. Picard, and N. Champollion (2014), Effect of Snow Surface Metamorphism on Aquarius L-Band Radiometer Observations at Dome C, Antarctica, *IEEE Transactions on Geoscience and Remote Sensing*, 52 (11), 7408-7417, doi:10.1109/TGRS.2014.2312102.
- Brucker, L.,** E. P. Dinnat, and L. S. Koenig (2014), Weekly gridded Aquarius L-band radiometer/scatterometer observations and salinity retrievals over the polar regions – Part 1: Product description, *The Cryosphere*, 8 (3), 905-913, doi:10.5194/tc-8-905-2014.
- Brucker, L.,** E. P. Dinnat, and L. S. Koenig (2014), Weekly gridded Aquarius L-band radiometer/scatterometer observations and salinity retrievals over the polar regions – Part 2: Initial product analysis, *The Cryosphere*, 8 (3), 915-930, doi:10.5194/tc-8-915-2014.
- Cheng, Y.-B., **Q. Zhang**, A. I. Lyapustin, Y. Wang, and E. M. Middleton (2014), Impacts of light use efficiency and fPAR parameterization on gross primary production modeling, *Agricultural and Forest Meteorology*, Vol. 189 - 190, pp. 187-197.
- Chin, M., T. Diehl, **Q. Tan**, J.M. Prospero, R. A. Kahn, L. A. Remer, H. Yu, A. M. Sayer, H. Bian, I. V. Geogdzhayev, B. N. Holben, S. G. Howell, B. J. Huebert, N. C. Hsu, **D. Kim**, T. L. Kucsera, R. C. Levy, M. Mishchenko, X. Pan, P. K. Quinn, G. L. Schuster, D. G. Streets, S. A. Strode, O. Torres, and X.-P. Zhao (2014), Multi-decadal aerosol variations from 1980 to 2009: a perspective from observations and a global model, *Atmos. Chem. Phys.*, 14, 3657-3690, doi:10.5194/acp-14-3657-2014.
- Cooper, O. R., D. D. Parrish, **J. R. Ziemke**, N. V. Balashov, M. Cupeiro, I. Galbally, S. Gilge, L. Horowitz, N. R. Jensen, J.-F. Lamarque, V. Naik, S. J. Oltmans, J. Schwab, D. T. Shindell, A. M. Thompson, Y. Wang, and R. M. Zbinden (2014), Global distribution and trends of tropospheric ozone: An observation-based review, *Elementa*, in press.
- Dumka, U. C., S. N. Tripathi, A. Misra, D. M. Giles, T. F. Eck, R. Sagar, and B. N. Holben (2014), Latitudinal variation of aerosol properties from Indo-Gangetic Plain to central Himalayan foothills during TIGERZ campaign, *JGR – Atmospheres*, doi:10.1002/2013JD021040.
- Franz, H. B., M. G. Trainer, M. H. Wong, H. L. K. Manning, J. C. Stern, P. R. Mahaffy, S. K. Atreya, M. Benna, P. G. Conrad, D. N. Harpold, L. A. Leshin, C. A. Malespin, C. P. McKay, J. T. Nolan, and E. Raaen (2014), Analytical techniques for retrieval of atmospheric composition with the quadrupole mass spectrometer of the Sample Analysis at Mars instrument suite on Mars Science Laboratory, *Planetary and Space Science*, 96, pp. 99-113, doi:10.1016/j.pss.2014.03.
- Gatebe, C. K.,** C. M. Ichoku, R. Poudyal, M. O. Román, and E. Wilcox (2014), Surface albedo darkening from wild-fires in northern sub-Saharan Africa, *Environ. Res. Lett.*, 9 (065003), doi:10.1088/1748-9326/9/6/065003.
- Gong, J.,** and D. L. Wu (2014), Cloudsat-constrained cloud ice water path and cloud top height retrievals from MHS 157 and 183.3 GHz radiances, *Atmos. Meas. Tech.*, 7, doi:10.5194/amt-7-1-2014.
- Gregg, W. W., N. W. Casey and **C. S. Rousseaux** (2014), Sensitivity of Simulated Global Ocean Carbon Flux Estimates to Forcing by Reanalysis Products, *Ocean Modelling*, 80, pp. 24-35.
- Horton, R., G. Yohe, W. Easterling, R. Kates, M. Ruth, E. Sussman, A. Whelchel, D. Wolfe, and **F. Lipschultz** (2014), Chapter 16: Northeast, pp. 371-395 in *Climate Change Impacts in the United States: The Third National Climate Assessment*, eds. J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, U.S. Global Change Research Program. On the Web: <http://nca2014.globalchange.gov/report/regions/northeast>.

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Hurwitz, M.M., N. Calvo, C.I. Garfinkel, A.H. Butler, S. Ineson, C. Cagnazzo, E. Manzini, and C. Peña-Ortiz (2014), Extra-tropical atmospheric response to ENSO in the CMIP5 models, *Climate Dynamics*, doi: 10.1007/s00382-014-2110-z.

Kirtman, B., D. Min, J. M. Infanti, J. L. Kinter III, D. A. Paolino, **Q. Zhang**, H. van den Dool, S. Saha, M. P. Mendez, E. Becker, P. Peng, P. Tripp, J. Huang, D. G. DeWitt, M. K. Tippett, A. G. Barnston, S. Li, A. Rosati, S. D. Schubert, M. Rienecker, M. Suarez, Z. E. Li, J. Marshak, **Y.-K. Lim**, J. Tribbia, K. Pegion, W. J. Merryfield, B. Denis, and E. F. Wood (2014), The North American multi-model ensemble (NMME): Phase-1 seasonal to interannual prediction, Phase-2 toward developing intra-seasonal prediction, *Bull. Amer. Meteor. Soc.*, 95, 585-601.

Leong, J.-A., J. J. Marra, M. L. Finucane, T. Giambelluca, M. Merrifield, S. E. Miller, J. Polovina, E. Shea, M. Burkett, J. Campbell, P. Lefale, **F. Lipschultz**, L. Loope, D. Spooner, and B. Wang (2014), Chapter 23: Hawai'i and U.S. Affiliated Pacific Islands, pp. 537-556 in *Climate Change Impacts in the United States: The Third National Climate Assessment*, eds. J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, U.S. Global Change Research Program. On the Web: <http://nca2014.globalchange.gov/report/regions/hawaii-and-pacific-islands>.

Li, Z., **T. F. Eck**, Y. Zhang, Y. Zhang, D. Li, L. Li, H. Xu, W. Hou, Y. Lv, P. Goloub, and X. Gu (2014), Observations of residual submicron fine aerosol particles related to cloud and fog processing during a major pollution event in Beijing, *Atmospheric Environment*, 86, 187-192, dx.doi.org/10.1016/j.atmosenv.2013.12.044.

Matsui, T., C. Ichoku, **C. Randles**, T. Yuan, A. M. da Silva, P. Colarco, **D. Kim**, R. Levy, **A. Sayer**, M. Chin, D. Giles, B. Holben, E. Welton, **T. Eck**, and L. Remer (2014), Current and Future Perspectives of Aerosol Research at NASA Goddard Space Flight Center, *Bull. Am. Met. Soc.*, doi:10.1175/BAMS-D-13-00153.1 (in press).

Misra, S. and **P. de Mattheis** (2014), Passive Remote Sensing and Radio Frequency Interference (RFI): An Overview of Spectrum Allocations and RFI Management Algorithms, *IEEE Geoscience and Remote Sensing Magazine*, 2(2), 68-73. doi: 10.1109/MGRS.2014.2320879.

Reale, O., K. M. Lau, A. da Silva, and T. Matsui (2014), Impact of assimilated and interactive aerosol on tropical cyclogenesis, *Geophysical Research Letters*, 41, 3282-3288, doi:10.1002/2014GL059918.

Note: This GRL article has been selected as an AGU Research Spotlight.

Schafer, J. S., **T. F. Eck**, B. N. Holben, K. L. Thornhill, B. E. Anderson, A. Sinyuk, D. M. Giles, E. L. Winstead, L. D. Ziemba, A. J. Beyersdorf, P.R. Kenny, A. Smirnov, and I. Slutsker (2014), Intercomparison of aerosol single-scattering albedo derived from AERONET surface radiometers and LARGE in situ aircraft profiles during the 2011 DRAGON-MD and DISCOVER-AQ experiments, *JGR – Atmospheres*, doi:10.1002/2013JD021166.

Soebiyanto, R.P., W. Clara, J. Jara, L. Castillo, O. R. Sorto, et al. (2014), The Role of Temperature and Humidity on Seasonal Influenza in Tropical Areas: Guatemala, El Salvador and Panama, 2008-2013, *PLoS ONE* 9(6), E100659, doi:10.1371/journal.pone.0100659.

Wang, H., L. Long, A. Kumar, W. Wang, J.-K. E. Schemm, M. Zhao, G. A. Vecchi, T. E. LaRow, **Y.-K. Lim**, S. D. Schubert, D. A. Shaevitz, S. J. Camargo, N. Henderson, D. Kim, J. A. Jonas, and K. J. E. Walsh (2014), How well do global climate models simulate the variability of Atlantic tropical cyclones associated with ENSO?, *J. Climate*, doi:10.1175/JCLI-D-13-00625.1, early online release.

Weaver, K., D. Janney, and H. Davis (2014), Engaging Audiences about Rain, Snow and Storms: The Global Precipitation Measurement Mission's Rain EnGAUGE, online in *The Earth Scientist*, the Journal of NESTA (National Earth Science Teachers Association), Volume XXX, Issue 2, Summer 2014, pp. 23-27.

(Publications, cont'd)

Yasunari, T. J., K.-M. Lau, S. P. P. Mahanama, P. R. Colarco, A. M. da Silva, T. Aoki, K. Aoki, N. Murao, S. Yamagata, and Y. Kodama (2014), The GOddard SnoW Impurity Module (GOSWIM) for the NASA GEOS-5 Earth System Model: Preliminary Comparisons with Observations in Sapporo, Japan, SOLA, Meteorological Society of Japan, Vol. 10, pp 50-56.

Zhang, Q., Y.-B. Cheng, A. I. Lyapustin, Y. Wang, X. Xiao, A. Suyker, S. Verma, B. Tan and E. M. Middleton (2014), Estimation of crop gross primary production (GPP): I. impact of MODIS observation footprint and impact of vegetation BRDF characteristics, Agricultural and Forest Meteorology, Vol. 191, pp. 51–63.

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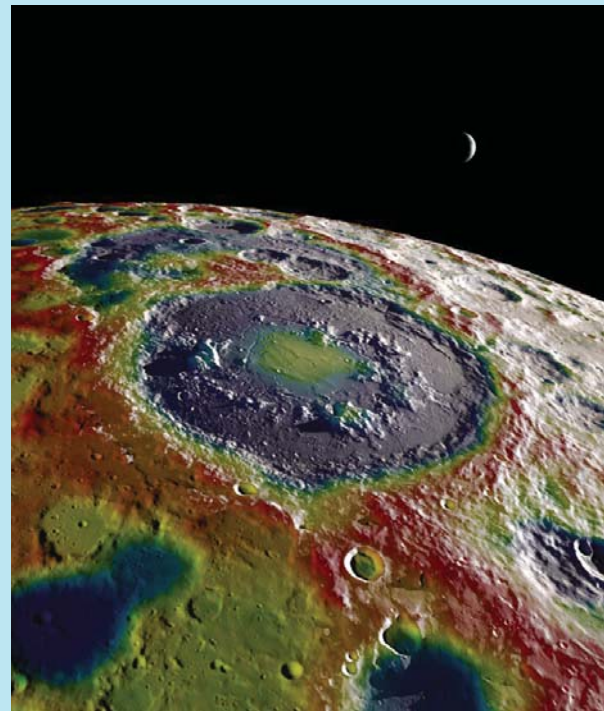
Ziemke, J. R., M. A. Olsen, J. C. Witte, A. R. Douglass, S. E. Strahan, K. Wargan, X. Liu, M. R. Schoeberl, K. Yang, T. B. Kaplan, S. Pawson, B. N. Duncan, P. A. Newman, P. K. Bhartia, and M. K. Heney (2014), Assessment and applications of NASA ozone data products derived from Aura OMI/MLS satellite measurements in context of the GMI Chemical Transport Model, J. Geophys. Res. Atmos., 119, 5671-5699, doi:10.1002/2013JD020914.

GRAIL Gravity Map for the cover of GRL

Ernie Wright created this print-resolution still image (at right) for the cover of the May 28, 2014 issue of Geophysical Research Letters.

“A high-resolution free-air gravity map based on GRAIL data, overlaid on terrain based on LRO altimeter (LOLA) and camera (LROC) data. The view is south-up, with the south pole near the horizon in the upper left and the crescent Earth in the distance. The terminator crosses the eastern rim of the Schrödinger basin. Gravity is painted onto the areas that are in or near the night side. Red corresponds to mass excesses and blue to mass deficits.”

(Image Credit: Scientific Visualization Studio/Ernie Wright)



The GESTAR Team: Universities Space Research Association (USRA), Morgan State University (MSU), I.M. Systems Group (IMSG), Johns Hopkins University (JHU), Global Science & Technology, Inc.(GST), Institute for Global Environmental Strategies (IGES), and Ball Aerospace and Technologies.
 Visit us at <http://gestar.usra.edu/>.

The GESTAR Newsletter is published by GESTAR/USRA. Any comments/suggestions/ideas can be forwarded to Amy Houghton, Editor at ahoughton@usra.edu.