Volume 5, Issue 3
Summer/Fall 2016
GESTAR Newsletter
http://gestar.usra.edu/

Allison Leidner at IUCN Quadrennial Meeting

From September 1-10, 2016, the International Union for the Conservation of Nature (IUCN) held its quadrennial World Conservation Congress in Honolulu, Hawaii. This year's theme was "Planet at the Crossroads". **Allison Leidner** (610/USRA) participated in the meeting in several ways. She initiated, organized and moderated the Jane Goodall Institute (JGI) event titled "Satellite Remote Sensing for Conservation Actions: A Jane Goodall Institute Case Study", which was held on September 2nd and attended by hundreds. Jane Goodall, Ph.D., DBE (Dame of the British Empire), founder of the JGI, and UN Messenger of Peace, provided inspiring remarks and highlighted the importance of new technologies, including remote sensing, for conservation, and discussed her own conservation work in Gombe National Park, Tanzania. Dr. Lilian Pintea, a NASA-funded scientist and Vice President for Conservation Science at the JGI, presented on how he uses satellite remote sensing to advance chimpanzee conservation and highlighted specific research in western Tanzania, Uganda and eastern Democratic Republic of the Congo. Woody Turner (NASA Headquarters) and Allison Leidner both provided an overview of NASA's contributions to conservation practices. This hour-long event is available online: https://www.youtube.com/watch?v=dGJxa5RPXmU. The day prior to this event, Dr. Leidner brought Jane Goodall to view the hyperwall visualizations before the exhibit opened, and they had the opportunity to discuss Earth science for conservation.

On September 4th, Dr. Leidner also initiated, organized, and ran a two-hour knowledge café that introduced participants to remote sensing Essential Biodiversity Variables (EBV). Co-organizers included Woody Turner and Dr. Gary Geller (NASA JPL). According to Dr. Leidner, The Group on Earth Observation (GEO) Biodiversity Observation Network has initiated the identification of EBVS that are "derived measurements required to study, report and manage biodiversity change." EBVs are modeled off of Essential Climate Variables, which support the UN Framework Convention on Climate Change and the Intergovernmental Panel on Climate Change. For example, EBVs include species distribution and ecosystem extent and fragmentation. Additionally, Dr. Leidner worked along with Booz Allen staff to assemble an online special feature about uses of remote sensing for conservation; she identified content and provided technical editing, while Booz Allen staff provided the design and writing. (Visit http://appliedsciences.nasa.gov/system/files/docs/NASA_2016_IUCN_WCC.pdf.)

At the request of the State Department, Science Project Support Office staff **Winnie Humberson** and **Steve Graham** (both GESTAR/GST) brought the NASA Hyperwall to the event, and worked in conjunction with the State Department. They worked with hyperwall speakers to perfect visualizations and to ensure smooth operations of the hyperwall, which was a centerpiece of the U.S. exhibit. Dr. Leidner considers their contributions crucial to the success of the event. In all, there were 20 hyperwall talks; four were given by Dr. Leidner: two during the meeting and two on Student Day to large groups of middle and high school students. Winnie Humberson and Steve Graham also led activities for Congress attendees and student attendees that included the Tree of Thoughts.

When Allison Leidner is at NASA Headquarters, about a third of her time is spent working with the biodiversity program, work that includes helping to develop research accomplishments, acting as a go-between with the conservation remote sensing community, working with CEOS Biodiversity and Essential Biodiversity Variables, organizing symposia, etc. She also takes the NASA science lead for 'special events', such as the IUCN World Conservation Congress, the IUCN World Parks Congress, and the Society for Conservation Biology meetings. For more information on the World Conservation Congress, visit http://iucnworldconservationcongress.org/.

Viewing hyperwall visualizations. Jane Goodall, seated at front; Allison Leidner, standing. (Photo Credit: Lilian Pintea)

Volume 5, Issue 3
Summer/Fall 2016
GESTAR Newsletter
http://gestar.usra.edu/

OSIRIS-REx Begins its Seven-Year Journey

OSIRIS-REx (also known as the Origins Spectral Interpretation Resource Identification Security - Regolith Explorer spacecraft) launched from Cape Canaveral, Florida on September 8, 2016 to begin its journey to Bennu, a near-Earth asteroid. OSIRIS-REx will reach Bennu in 2018 and return a sample from the asteroid to Earth for analysis in 2023. This mission will help scientists investigate how planets formed and how life began, as well as improve the understanding of asteroids that could impact Earth. The 20-foot-tall spacecraft, which will conduct several complex maneuvers in deep space, was designed and built at NASA Goddard Space Flight Center. **Michelle Handleman** (130/USRA) helped to coordinate live shots held on the day of the launch, which included Goddard Chief Scientist Jim Garvin being interviewed by "NASA Man" on KOVR-Sacramento, and she arranged WUSA-DC's visit to the Goddard Visitors Center for reporting on the launch and conducting interviews. Also, launch coverage was broadcast live on NASA TV.

Mission planning required an incredible amount of accuracy. After a two-year journey, OSIRIS-REx should arrive at the asteroid in 2018. In order to rendezvous with Bennu, the spacecraft will use rocket thrusters to match the asteroid's velocity in its orbit around the sun. OSIRIS-REx needs to reach the asteroid at the same time and same location, moving at the same speed and in the same direction! Another year will be spent exploring the asteroid and then sample site selection will begin.

In July 2020, OSIRIS-REx will get into position to collect a sample of Bennu's surface material – a critical point of the mission. The spacecraft will lower itself near Bennu's surface and use a robotic arm to touch the surface. The TAGSAM (Touch-And-Go Sample Acquisition Mechanism) consists of a robotic arm with an attached sampler head. Once the TAGSAM makes contact with the surface, for five seconds it will release nitrogen gas, stirring up loose rocks and surface material, subsequently collecting this in the sampler head. The TAGSAM head then will be stowed in the Sample Return Capsule (SRC).

In March 2021, OSIRIS-REx will leave the asteroid and head home. The spacecraft will be on its route to intersect Earth's orbit, and then follow these precise steps, according to the mission's site: "Four hours before reaching Earth's atmosphere, OSIRIS-REx will jettison the SRC, placing it on a trajectory to Earth. The spacecraft will then perform a deflection maneuver of 39 mph that places the spacecraft on a stable orbit around the sun. After entry the SRC will freefall until it reaches an altitude of 20.8 mi, when the drogue parachute deploys. At 1.9 mi, the main parachute will be released, bringing the capsule in for a soft landing in the Utah desert on September 24, 2023, concluding a seven-year journey to Bennu and back." Once the SRC is opened, scientists will analyze the material sampled from Bennu to determine the chemical composition, looking for organic compounds.

Image: OSIRIS-REx before tagging Bennu's surface. Credit: NASA/OSIRIS-REx mission page.

For more information on this incredible mission, watch "Bennu's Journey" (see profile on animator Michael Lentz following this article) and visit the home-page for OSIRIS-REx: http://www.asteroidmission.org/.

Volume 5, Issue 3
Summer/Fall 2016
GESTAR Newsletter
http://gestar.usra.edu/

Interview with Michael Lentz, art director, ci labs

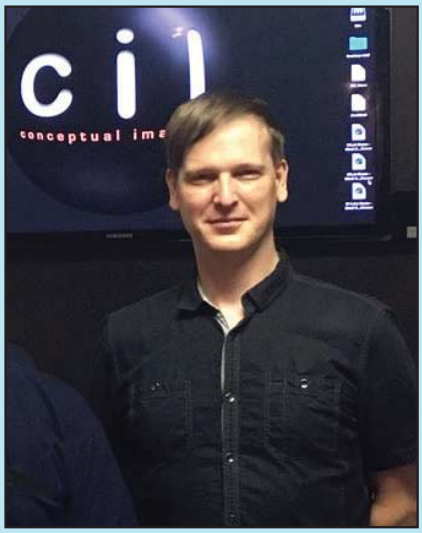


Image provided by M. Lentz.

Michael Lentz (130/USRA) has been an animator and visualizer, and, as of September 2016, is now Art Director for the Conceptual Image Lab (CI Lab), reporting to Walt Feimer, the Department Head of CI Lab. We spent some time getting to know more about Michael's experiences before and within Goddard.

First of all, congratulations! Second, how does the CI Lab work in conjunction with NASA Goddard's Scientific Visualization Studio (SVS)?
Thank you, I am happy to be taking on this new role at NASA Goddard's Conceptual Image Lab. The CI Lab does work on a regular basis with NASA Goddard's SVS on projects. The difference is the SVS uses actual data generated from spacecraft and other instruments and turns that numerical data into visualizations. The CI Lab artists create animations and conceptual renderings in order to depict objects and scenes that do not actually exist or where there is no data.

What are the major changes from your previous job to this new position?
In my previous position, I created art and animation as part of the CI lab team of animators for various NASA missions. As Art Director, I will continue to create art and animation while also guiding the day-to-day creative work of our team of animators within the lab. My goal is to ensure high quality production in our art and animation, provide effective communication between animators and the department head, and to help producers integrate our work into their productions.

What have been some of your favorite and/or challenging projects/items that you have worked on while with Goddard?
My favorite project is "Bennu's Journey," a 6-minute animated movie that I worked on with Walt Feimer which showed the history of how the asteroid, Bennu, evolved within the solar system (http://svs.gsfc.nasa.gov/20220). This was in support of the OSIRIS-REX mission. My biggest challenge is finding fresh new ways to translate raw science into a visually compelling animation that the general public will find interesting and engaging, which involves a lot of creative design and storytelling.

Prior to Goddard, where did you work and obtain your training?
I obtained most of my training on the job in the Art Department at National Geographic Television, where I worked under the Art Director for 10 years. I learned how to manage and work on projects in addition to developing artistic skills specific to animation. Next, I had a freelance career for 8 years, creating a wide range of art and animation for clients such as Discovery Channel, Smithsonian Channel, Animal Planet, National Geographic Channel, PBS, and the History Channel.

What advice would you give someone who is interested in pursuing a career in graphic design/visualization mixed with science/space?
You have to have a deep-rooted love and appreciation for both science and art. Everyone on our team is an accomplished artist with strong technical skill sets. But the key to success is being curious, enthusiastic, and genuinely interested about learning from the scientists about a new missions or findings.

The 4k UHD element has really taken off – any insight as to what the next big thing will be in visualization/graphics?
I'm really excited about augmented and virtual reality as a new medium for storytelling. It's a big buzz word these days but it has great storytelling potential for some of the work we do.

For more information on the CI Lab, visit its website: http://svs.gsfc.nasa.gov/cilab/index.html. And to see more of Michael's work, visit his webpage: http://svs.gsfc.nasa.gov/cgi-bin/search.cgi?person=1074.

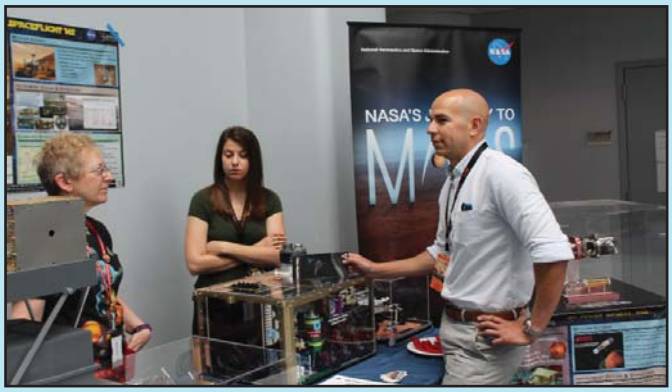
Volume 5, Issue 3
Summer/Fall 2016
GESTAR Newsletter
http://gestar.usra.edu/

Science Jamboree at NASA GSFC

On Wednesday, July 27th, NASA Goddard's Sciences and Exploration Directorate (SED) held the annual Science Jamboree in the Building 28 Atrium. Scientists and representatives across the codes manned booths, presenting research, technology, and discoveries. The Jamboree included hyperwall presentations, virtual reality experiences, a Goddard Scavenger Hunt, plus tours of the NCCS, the Goddard TV Studio and the Conceptual Imaging Lab. Food trucks were onsite as well. The Goddard Film Festival was held during the Jamboree in Building 3 from 1-2pm. The event kicked off with remarks by Colleen Hartman, SED Director, and Piers Sellers, SED Deputy Director.

GESTAR GMAO scientists **Oreste Reale** and **Erica McGrath-Spangler** along with Will McCarty (GSFC) contributed a slide titled "Tropical Cyclone representation in the GEOS-5 resulting from assimilation of adaptively thinned cloud-cleared AIRS radiances", and **Young-Kwon Lim** submitted a slide highlighting his research titled "The southwestern US flood (early January 2016) by El Nino storm". For viewing at the GMAO table, **Cecile Rousseaux** prepared a movie titled "Recent decadal trends in global phytoplankton composition" as did **Brad Weir**, whose movie was titled "Assimilation of OCO-2 average-column carbon dioxide (XCO2) data into the GEOS-5 model". Additionally, a team of five GMAO scientists won second prize in the Scavenger Hunt! Be sure to check the 2017 calendar for next year's Jamboree.

Representing Code 614, Atmospheric Chemistry & Dynamics. L-to-R: Ed Celarier (USRA), Sarah Strode (USRA) and Jackie Witte (SSAI). Photo Credit: A. Houghton



Above: Charles Malespin (USRA) at Code 699's exhibit, Planetary Environments Laboratory, which promoted NASA's Journey to MARS. Photo Credit: A. Houghton

At left: Second-place team in the Scavenger Hunt! Erica McGrath-Spangler and Emma Knowland (USRA), along with Oscar Hendrick (IT for GMAO), Allison Collow (USRA) and Brent Smith (SSAI). Photo Credit: A. Houghton

Volume 5, Issue 3
Summer/Fall 2016
GESTAR Newsletter
http://gestar.usra.edu/

Best of Goddard Film Festival 2016

The Goddard Film Festival, which was shown in Building 3 on July 27th, was produced by **Genna Duberstein**; **Lisa Poje** created the opening animation. Several GESTAR members were involved with these videos. The following is a list of the videos included in the festival. The visualizations are available for viewing here: https://www.youtube.com/playlist?list=PL_8hVmWnP_O1UaMQFjXCAkfrxZuJ77x2z.

*2016 Film Festival Poster, created by Lisa Poje and Genna Duberstein. (Image provided by **G. Duberstein**.)*

1) NASA - Turning Black Holes into Dark Matter Labs: **Scott Wiessinger** (USRA), Producer & Editor, Animator; **Tom Bridgman** (GST), Animator
2) Electric Wind of Venus: **Genna Duberstein** (USRA): Lead Producer & Editor; **Brian Monroe** (USRA): Lead Animator & Lead Graphic Designer
3) NASA Tracks Volcanic Ash with Satellites: **Matthew Radcliff** (USRA): Lead Producer and one of the Writers; **Kel Elkins** (USRA), Lead Animator; **Jefferson Beck** (USRA): Narrator
4) NASA - Mapping Mars' Upper Atmosphere: **Dan Gallagher** (USRA), Producer & Editor; **Brian Monroe** (USRA), Animator; **Michael Lentz** (USRA), Animator; **Kel Elkins** (USRA), one of the Data Visualizers; **Dan Gallagher** (USRA), Editor
5) James Webb Space Telescope: Ready for Mirror Assembly by James Webb Space Telescope (JWST)*
6) NASA - Massive Black Hole Shreds Passing Star: **Brian Monroe** (USRA), Lead Animator; **Scott Wiessinger** (USRA), Lead Producer
7) NASA - Human Fingerprint on Global Air Quality: **Kayvon Sharghi** (USRA), Producer; **Sophia Roberts** (USRA), Producer & Video Editor; **Trent Schindler** (USRA), Animator
8) NASA - Arching Eruption: **Genna Duberstein** (USRA), Lead Producer; **Tom Bridgman** (GST), Lead Data Visualizer
9) Hubble's New View of Mars and Planets: **Katrina Jackson** (USRA), Lead Producer, Editor, & one of the Hosts
10) NASA - Arctic Sea Ice Reaches 2015 Minimum Extent: **Cindy Starr** (GST), Data Visualizer; **Sophia Roberts** (USRA), Lead Producer
11) NASA's MMS Captures Magnetic Reconnection in Action: **Genna Duberstein** (USRA), Lead Producer & Lead Editor; **Brian Monroe** (USRA), Lead Animator; **Tom Bridgman** (GST), Lead Data Visualizer
12) NASA - Supermoon Lunar Eclipse: **David Ladd** (USRA), Lead Producer & Lead Editor; **Krystofer Kim** (USRA), Lead Animator
13) NASA - Lakes On A Glacier: **Matthew Radcliff** (USRA), Lead Editor & Lead Producer
14) NASA Launches Super-Pressure Balloon: **Joy Ng** (USRA), Lead Producer; **Robert Garner** (USRA); Support
15) NASA - Solar Wind Strips Martian Atmosphere: **Ernie Wright** (USRA), one of the Visualizers; **Dan Gallagher** (USRA), Producer & Editor; **Joy Ng** (USRA), Narrator; **Michael Lentz** (USRA), Animator; **Brian Monroe** (USRA), Animator
16) NASA - Laser Focus: The Receiver: **Ryan Fitzgibbons** (USRA): Lead Producer, Lead Videographer & Lead Video Editor
17) Reflections on JWST - May 4, 2016 by James Webb Space Telescope (JWST)*

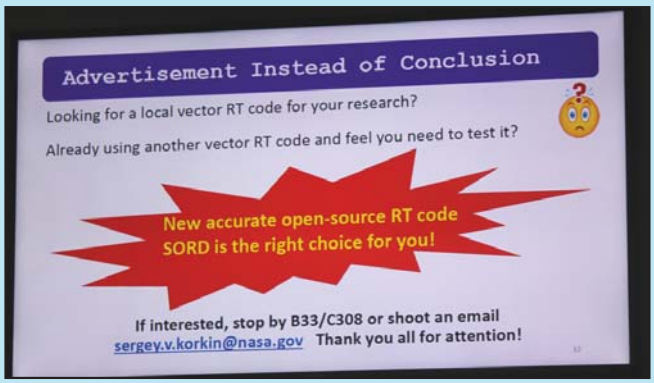
* - *video credits do not include any GESTAR affiliations*

Volume 5, Issue 3
Summer/Fall 2016
GESTAR Newsletter
http://gestar.usra.edu/

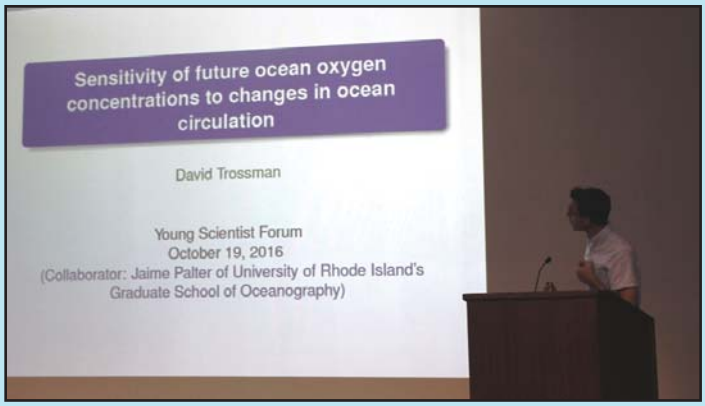
Young Scientist Forum

On October 19, 2016, an all-day event called the Young Scientist Forum was held in GSFC Building 33/H114. **Jie Gong** and **Valentina Aquila** were the Chairs of the Atmospheric Composition session, while **Manuela Girotto** chaired the Remote Sensing and Modeling of Precipitation and Hydrology Session. A special session was held at noon, Conversations with Senior Fellows, which included panel speakers Jim Garvin (GSFC/600), Steve Platnick (GSFC/610) and Gail Skofronick Jackson (GSFC/612). Throughout the day, several GESTAR scientists contributed talks to this forum: **Ed Nowottnick** (Code 612): "CATS near real time data products and applications for data assimilation"; **David Trossman**'s (Code 610.1): "The sensitivity of future ocean oxygen concentrations to changes in ocean circulation"; **Eunjee Lee** (Code 610.1); "The effect of different time scales of atmospheric CO2 variability on the estimation of the global terrestrial carbon cycle"; **Sergey Korkin** (Code 613): "Performance of vector RT code SORD in the IPRT benchmarks"; **Valentina Aquila** (Code 614): "Effects of volcanic eruption on stratospheric ozone"; **K. Emma Knowland** (Code 610.1): "Regional Differences in stratospheric intrusions over the USA investigated using the NASA MERRA-2 reanalysis"; **Allison Collow** (Code 610.1): "Changes in large-scale atmospheric circulation associated with increased extreme precipitation events in the northeast U.S."; and **Askash Ahamed** (Code 617): "Assessing the utility of a satellite-based flood inundation and socio-economic impact tool for the lower Mekong River basin".

In addition, once the talks concluded, a poster session was held and many GESTAR scientists participated: **Manuela Girotto** (Code 613): "Changes in India's land surface water balance during the GRACE mission years: A data assimilation perspective"; **Monique Walker** (Code 612): "Inter-comparison and validation of NOAA-Unique Combined Atmospheric Processing System water vapor retrievals and case study on Howard Univeristy Beltsville site state best estimate"; **Manika Gupta** (Code 613): Influence of fire-induced surface albedo darkening on hydrological flux simulations in Africa"; **Yingxi Shi** (Code 613): "Constructing an event based aerosol product under high aerosol loading conditions"; and **Sarah Strode** (Code 614): "Analysis of Ozone in cloudy versus clear sky conditions".



Sergey Korkin at left (Code 613) discusses his work on vector RT code SORD at the Young Scientist Forum. (Photo: A. Houghton)



David Trossman at left (Code 610.1) begins his presentation at the Young Scientist Forum. (Photo: A. Houghton)

(Young Scientist Forum, cont'd)

From top to bottom: Eunjee Lee (Code 610.1), Emma Knowland (Code 610.1) and Ed Nowottnick (Code 614) also presented at the Young Scientist Forum. (Photos: A. Houghton)

Maniac Talks

GESTAR thanks the following scientists who presented talks this past summer: *Charles Ichoku*, NASA/GSFC (July 2016), *Stephen Ungar*, NASA/GSFC (August 2016), and *Alexander Kashlinsky*, NASA/GSFC (September 2016). When possible, each talk is videotaped and posted on the Maniac Talk website at http://maniactalk.gestar.usra.edu/ and at the SED Highlights page under Presentations: http://science.gsfc.nasa.gov/sci/presentations.

Note: in the coming year, please refer to the SED Highlights page for the list and videos of the 2017 speakers. Thanks to **Charles Gatebe** and Bill Hrybyk for coordinating and capturing these well-attended events.

New Hires

GESTAR welcomes the following members:
Katie Mersmann, Earth Science Multimedia Fellow
Yuni Lee, Scientist II

Moving On

Veronika Leitold (Univ. of MD)
Debbie Belvedere
Kristen Weaver (SSAI)
Kayvon Sharghi
Joanna Pelc

In the Press

Assaf Anyamba, quoted in an Earth Observatory Image of the Day (EO IOTD) article titled "Nairobi Swells with Urban Growth" (Sept 13, 2016): http://earthobservatory.nasa.gov/IOTD/view.php?id=88822

Santiago Gasso', featured in an EO IOTD article titled "Iron in the Wind" (Nov 1, 2016): http://earthobservatory.nasa.gov/IOTD/view.php?id=89021&src=eoa-iotd

Charles Gatebe, quoted in NASA Cutting Edge article titled "SnowEx Challenges the Sensing Techniques…Until 'They Break'" (Fall 2016, Vol. 13, Issue 1, pp. 12-13): https://gsfctechnology.gsfc.nasa.gov/

(cont'd on page 8)

(In the Press, cont'd)

Pawan Gupta, quoted in a Bloomberg.com article titled "NASA Data Shows Toxic Air Threat Choking Indian Subcontinent" (July 6, 2016): https://www.bloomberg.com/news/articles/2016-07-06/nasa-images-show-toxic-air-challenge-choking-indian-subcontinent

Pawan Gupta, interviewed for DownToEarth article titled "ISRO has capabilities to build geostationary satellites for air quality monitoring" (Sept 29, 2016): http://www.downtoearth.org.in/search/isro-has-capabilities-to-build-geostationary-satellites-for-air-quality-monitoring

Michael Kurylo, along with Anne M. Thompson and Martine De Mazière, authored "The Network for the Detection of Atmospheric Composition Change: 25 Years Old and Going Strong" in the Sept/Oct issue of The Earth Observer: http://eospso.nasa.gov/sites/default/files/eo_pdfs/Sept-October%202016%20color%20508.pdf

David Ladd, featured in NASA Goddard View article titled "LRO Mission Presents 'The Moon and More'", (Sept 2016, p.3): https://www.nasa.gov/content/goddard-view-magazine

Thomas Stanley, quoted in an EO IOTD article titled "Another Typhoon Hits the Phillippines" (Oct 20, 2016): http://earthobservatory.nasa.gov/IOTD/view.php?id=88966&eocn=home&eoci=iotd_image

Thomas Stanley, quoted in AGU publication EOS article titled "Tracking Landslide Hazards around the World, Pixel by Pixel" (Oct 6, 2016): https://eos.org/articles/tracking-landslide-hazards-around-the-world-pixel-by-pixel

Ernie Wright, created a still image of the Orientale Impact Basin based on data from the GRAIL mission for the cover of Science (Vol. 354, Issue 6311, Oct 2016): http://svs.gsfc.nasa.gov/4499.

Science Highlights (SED at GSFC)

2016 – Atmospheric Science

July: "Effects of DSCOVR Temporal Sampling Frequency Quantified with GEOS-5 Nature Run", **Daniel Holdaway** (610.1/USRA) and **Yuekui Yang** (613/USRA)

August: "Engaging Audiences about Rain, Snow and Storms: GPM's Rain EnGAUGE", **Kristen Weaver** (612/USRA), D. Janney, and H. Davis

August: "Alaska, Greenland, Iceland and Patagonia are Active Dust Producing Regions", **Santiago Gassó** (613/MSU)

September: "Nonspherical Ice Particle Models for Precipitation Remote Sensing", K.-S. Kuo, W. Olson, B. Johnson, **Mircea Grecu** (612/MSU), **Lin Tian** (612/MSU), T. Clune, B. van Aartsen, A. Heymsfield, **Liang Liao** (612/MSU), R. Meneghini

2016 – Hydrospheric and Biospheric Sciences

July: "Harmonizing Landsat and Sentinel-2 Reflectances for Better Land Monitoring", J. Masek, E. Vermote, B. Franch, J.-C. Roger, S. Skakun, **Junchang Ju** (618/USRA), M. Claverie, J, Dungan

July: "AERONET Version 3 Release—Providing significant improvements for multi-decadal global aerosol database and near real-time validation", B. Holben, I. Slutsker, D. Giles, **Thomas Eck** (618/USRA), A. Smirnov, A. Sinyuk, J. S. M. Sorokin, J. Rodriguez, J. Kraft, A. Scully

July: "Hydrological Impacts from Fire-Induced Surface Albedo Darkening in Africa", M. Gupta, J. D. Bolten, **Charles Gatebe** (613/USRA), and C. Ichoku

August: "First Image Products from EcoSAR - Osa Peninsula, Costa Rica", B. Osmanoglu, **SeungKuk Lee** (618), R. Rincon, L. Fatoyinbo, **Tobias Bollian** (618/USRA), J. Ranson

August: "From toes to top-of-the-atmosphere: Fowler Sneaker Index", B. A. Crooke, L.I.W. McKinna, **Ivona Cetinić** (616/USRA)

(cont'd, next page)

(SED Highlights, cont'd)

September: "Lower Mekong Real Time Flood Monitoring and Impact Assessment System", **Aakash Ahamed** (617/USRA), J. D. Bolten

September: "The oceans are full of barriers for small organisms", E. A. Mousing, K. Richardson, J. Bendtsen, **Ivona Cetinić** (616/USRA) and M. J. Perry

September: "Monitoring Ecosystem Gross Primary Production (GPP) with Space-Based, Hyperspectral Sensors", **Qingyuan Zhang** (618/USRA)

October: "A method for improving MODIS hotspot directional signatures", M. O. Román, Z. Wang, **Charles Gatebe** (613/USRA), and R. Poudyal.

Awards

On October 13, 2016, at NASA's Jet Propulsion Laboratory, the "SMAP Science Data System Team" received a 2016 NASA Group Achievement Award "for outstanding achievement in the development of the SMAP Science Data System and algorithm, producing science data for the science community and general public".

Among the many members of the SMAP Team, **Jinzheng Peng** (555/USRA) was one of the award recipients. His contributions to the team included developing the SMAP radiometer L1B TA2TB (from antenna temperature to the Earth's surface brightness temperature) algorithm, and implementing the TA2TB algorithm using Matlab. Post-launch, Dr. Peng calibrated the SMAP radiometer and the calibration result is being used by the SMAP radiometer L1B data products. His work is an important contribution to the success of this mission. For more information on the SMAP mission, visit http://smap.jpl.nasa.gov/.

The 2016 Hydrospheric and Biospheric Sciences (HOBI) Annual Awards Ceremony was held September 1, 2016 at NASA Goddard in Building 33, Room H114. Four GESTAR members were recognized in different categories, and each awardee received a plaque with a citation of their achievement.

Ludovic Brucker (615/USRA), Outreach: "For exceptional public outreach and mentoring of students in the field of remote sensing of the cryosphere."

Thomas Stanley (617/USRA), Scientific and Technical Support: "For outstanding support in developing a dynamic landslide hazard model."

Joseph Lyu (617/IMSG), Scientific and Technical Support: "For science characterization of JPSS-1 ATMS."

Qingyuan Zhang (618/USRA), Scientific Achievement: "For developing and implementing at canopy and satellite scales an important new vegetation parameter (fAPARchl) to improve the spectrally based remote sensing estimates of absorbed radiation used for photosynthesis."

On August 29, 2016, Code 670 held its Annual Awards ceremony at NASA GSFC. **Genna Duberstein** (130/USRA) was presented with a Peer Award by Michael Hesse, Director of the Heliophysics Science Division: "Genna Duberstein plays a vital role in Goddard's heliophysics media outreach efforts. From dazzling videos of SDO imagery; to overseeing full production movies on cutting-edge research; to working with the helio animators and visualizers to portray interesting science results; to supporting press releases and mission advances – Ms. Duberstein is a key part of the helio outreach team. Indeed, at a time when imagery and videos serve as the main way of not just attracting attention – and in many cases also for conveying information – Ms. Duberstein's work is crucial to what has been a phenomenal year of wide successes for heliophysics communications. For these reasons, Genna Duberstein is presented with this 2016 Heliophysics Science Division Peer Award."

News re: Solarium: Solarium now has its third long-term commitment since its inception in February 2015. Starting October 22, 2016, Solarium will be running at the Clark Planetarium in Salt Lake City, Utah for ten years.

Volume 5, Issue 3
Summer/Fall 2016
GESTAR Newsletter
http://gestar.usra.edu/

Funding Announcements

NASA-ROSES 2015 Science Utilization of the Soil Moisture Active-Passive Mission Proposal Awarded: "Use of SMAP observations in conjunction with OCO-2 data to improve understanding of the coupled carbon and water cycle within the GEOS-5 modeling system", PI: **Abhishek Chatterjee**; P.O.P.: 08/11/16 – 08/10/19.

Ocean Biology and Biogeochemistry Program Proposal Awarded: "Observation-System Simulation Experiments (OSSEs) and seasonal forecasts to support EXPORTS", PI: **Cecile Rousseaux**; Co-Investigators **Ivona Cetinic**, Watson Gregg, and Anastasia Romanou, plus Collaborators Steven Pawson and Lesley Ott; P.O.P.: 07/01/16 – 06/30/19.

Defense Threat Reduction Agency (DTRA) Proposal Awarded: "CHIKRISK: Global Monitoring and Mapping of Chikungunya Risk", PI: **Assaf Anyamba** and Co-PI: **Radina Soebiyanto**; team members include William Crosson, Mohammad Alhamdan, and Kenneth J. Linthicum; P.O.P: 10/01/16 – 09/30/19.

USRA IRAD Proposal Awarded: "To develop a low-cost 3D imaging camera for capturing and recording detailed field measurements", PI: **David Lagomasino**, P.O.P: July 2016 – Dec 2016. According to Dr. Lagomasino, "The goal of this project is to develop the Terrestrial Recording of 3-dimensional 360-degree Surveys (TR33S) instrument, which will combine SfM 3D modeling, stereo-photogrammetry, and 360-degree camera technology. The final product will be a lightweight and cost-effective instrument that can measure forestry field data and provide others with a virtual immersion into remote field locations around the world."

Richard Damoah's project for the Carnegie African Diaspora Fellowship Program (CADFP) has been selected for funding. The project involves Analysis of Earth Observation Data for Climate Change Monitoring in West Africa. This fellowship will fund his 28-day-long visit (June 1-28, 2017) to All Nations University College in Ghana while undertaking research involving the use of the AERONET at ANUC. CADFP is a fellowship call to fund a short project (14 days to 3 months) one intends to undertake in an Africa institution.

Publications

Abdi, H. A., A. Vrieling, G. T. Yengoh, **A. Anyamba**, J. Seaquist, C. C. Ummenhofer, and J. Ardo (2016), The El Niño – La Niña cycle and recent trends in supply and demand of net primary productivity in African drylands., Climate Change, Vol. 138, No. 1. 111-125, doi:10.1007/s10584-016-1730-1.

Achuthavarier, D., S. D. Schubert, and **Y. V. Vikhliaev** (2016), North Pacific Decadal Variability: Insights from a Biennial ENSO Environment, Climate Dynamics, doi:10.1007/s00382-016-3391-1.

Carroll, M., C. M. DiMicelli, J. R. Townshend, R. A. Sohlberg, A. I. Elders, S. Devadiga, **A. M. Sayer,** and R. C. Levy (2016), Development of an operational land water mask for MODIS Collection 6, and influence on downstream data products, International Journal of Digital Earth, doi:10.1080/17538947.2016.1232756.

Cetinic, I., N. Poulton, and W. H. Slade (2016), Characterizing the Phytoplankton Soup: Pump and Plumbing effects on the particle assemblage in underway optical seawater systems, Optics Express, Vol. 24, No. 18. 20703-20715, doi:10.1364/OE.24.020703.

Collow, A. B., M. A. Miller, and L. C. Trabachino (2016), Cloudiness over the Amazon rainforest: Meteorology and thermodynamics, JGR - Atmospheres, Vol. 121, 7990–8005, doi:10.1002/2016JD024848.

Conrad, P., **C. A. Malespin**, H.B. Franz, R.O. Pepin, M.G. Trainer, S.P. Schwenzer, S.K. Atreya, C. Freissinet, J.H. Jones, H. Manning, T. Owen, A.A. Pavlov, R.C. Wiens, M.H. Wong, and P.R. Mahaffy (2016), In situ measurement of atmospheric krypton and xenon on Mars with Mars Science Laboratory, Earth and Planetary Science Letters, Vol. 454, 1-9, doi:10.1016/j.epsl.2016.08.028.

de Matthaeis, P. (2016), Sea ice thickness retrieval at L-band: Comparison between results from Aquarius and SMAP data, Microwave Radiometry and Remote Sensing of the Environment (MicroRad), doi:10.1109/MICRORAD.2016.7530512.

(Publications, cont'd)

Field, R. D., G. R. van der Werf,, T. Fanin, E. J. Fetzer, R. Fuller, **H. Jethva**, R. Levy, N. J. Livesey, M. Luo, O. Torres, and H. M. Worden (2016), Indonesian fire activity and smoke pollution in 2015 show persistent nonlinear sensitivity to El Niño-induced drought, Proc. Natl. Acad. Sci., Vol. 113, No. 33, 9204-9209, doi:10.1073/pnas.1524888113.

Gassó, S. and O. Torres (2016), The role of cloud contamination, aerosol layer height and aerosol model in the assessment of the OMI near UV retrievals over the ocean, Atmos. Meas. Tech., 9, 3031-3052, doi:10.5194/amt-93031-2016.

Gautam, R., **C. Gatebe**, M. Singh, T. Varnai, and R. Poudyal (2016), Radiative characteristics of clouds embedded in smoke derived from airborne multi-angular measurements, JGR - Atmospheres, Vol. 121, No. 15, doi:10.1002/2016JD025309.

Gong, J., and D. Wu (2016), Microphysical Properties of Frozen Particles Inferred from Global Precipitation Measurement (GPM) Microwave Imager (GMI) Polarimetric Measurements, Atmos. Chem. Phys. Disc., 1-24, doi:10.5194/acp-2016-787.

Gupta, P., J. Joiner, A. Vasilkov, and P. K. Bhartia (2016), Top-of-the-atmosphere shortwave flux estimation from satellite observations: an empirical neural network approach applied with data from the A-train constellation, Atmos. Meas. Tech., 9, 2813-2826, doi: 10.5194/amt-9-2813-2016.

Gupta, P., R. Levy, S. Mattoo, L. Remer, and L. Munchak (2016), A surface reflectance scheme for retrieving aerosol optical depth over urban surfaces in MODIS Dark Target retrieval algorithm, Atmos. Meas. Tech., 9, 3293-3308, doi:10.5194/amt-93293-2016.

Han, R., H. Wang, Z.-Z. Hu, A. Kumar, W. Li, L.N. Long, J.-K.E. Schemm, P. Peng, W. Wang, D. Si, X. Jia, M. Zhao, G.A. Vecchi, T.E. LaRow, **Y.-K. Lim**, S.D. Schubert, S.J. Camargo, N. Henderson, J.A. Jonas, and K.J.E. Walsh (2016), An assessment of multi-model simulations for the variability of western North Pacific tropical cyclones and its association with ENSO, J. Climate, 29, No. 18, 6401-6423, doi:10.1175/JCLI-D-15-0720.1.

Ibrahim, A., A. Gilerson, J. Chowdhary, and S. Ahmed (2016), Retrieval of macro- and micro-physical properties of oceanic hydrosols from polarimetric observations, Remote Sens. Environ., 186, 548-566, doi:10.1016/j.rse.2016.09.004.

Jethva, H., O. Torres, L. Remer, J. Redemann, J. Livingston, S. Dunagan, Y. Shinozuka, M. Kacenelenbogen, M. Rosenheimer, and R. Spurr (2016), Validating MODIS above-cloud aerosol optical depth retrieved from "color ratio" algorithm using direct measurements made by NASA's airborne AATS and 4STAR sensors, Atmos. Meas. Tech., Vol. 9, 5053-5062, doi:10.5194/amt-9-5053-2016.

Koster, R. D., **Y. Chang**, H. Wang, S. D. Schubert (2016), Impacts of Local Soil Moisture Anomalies on the Atmospheric Circulation and on Remote Surface Meteorological Fields During Boreal Summer: A Comprehensive Analysis over North America, J. Climate, 29 (20), doi.org/10.1175/JCLI-D-16-0192.1.

Lee, J., N. C. Hsu, C. Bettenhausen, **A. M. Sayer**, C. J. Seftor, M. Jeong, S. Tsay, E. J. Welton, S. Wang, and W. Chen (2016), Evaluating the Height of Biomass Burning Smoke Aerosols Retrieved from Synergistic Use of Multiple Satellite Sensors over Southeast Asia, Aerosol & Air Quality Research, Vol. 16, No. 11, 2831-2842, doi:10.4209/aaqr.2015.08.0506.

Leinonen J., M. Lebsock, L. Oreopoulos, and **N. Cho** (2016), Interregional differences in MODIS-derived cloud regimes, J. Geophys. Res., 121, doi:10.1002/2016JD025193.

Lim, Y.-K., S. Schubert, **O. Reale**, A. Molod, and **M. Suarez** (2016), Large-scale controls on Atlantic tropical cyclone activity on seasonal time scales, J. Climate, 29, 6727-6749, doi:10.1175/JCLI-D-16-0098.1.

Linthicum, K., **A. Anyamba**, S. C. Britch, J. L. Small, and C. J. Tucker (2016), Climate Teleconnections, Weather Extremes, and Vector-Borne Disease Outbreaks, Chapter A7, in Global Health Impacts of Vector-Borne Diseases, ed. Alison Mack, The National Academies Press, Washington, DC (*includes Cover Image Credit), https://www.nap.edu/catalog/21792/global-health-impacts-of-vector-borne-diseases-workshop-summary, 202-220, doi: 10.17226/21792.

(Publications, cont'd)

Loftus, A. M., S. Tsay, P. Pantina, C. Nguyen, P. M. Gabriel, X. A. Nguyen, **A. M. Sayer**, W. Tao, and T. Matsui (2016), Coupled Aerosol-Cloud Systems over Northern Vietnam during 7-SEAS/BASELInE: A Radar and Modeling Perspective, Aerosol & Air Quality Research, Vol. 16, No. 11, 2768-2785, doi:10.4209/aaqr.2015.11.0631.

Mohammed, P., M. Aksoy, J. R. Piepmeier, and J. T. Johnson (2016), SMAP L-Band Microwave Radiometer: RFI Mitigation Prelaunch Analysis and First Year On-Orbit Observations, IEEE Transactions on Geosciences and Remote Sensing (TGRS), Vol. 54, No. 10, 6035-6047, doi:10.1109/TGRS.2016.2580459. *Editors selected an image from this paper for the issue's cover. (See image at right.)

Mousing, E., K. Richardson, J. Bendtsen, **I. Cetinić**, and M. Perry (2016), Evidence of small-scale spatial structuring of phytoplankton alpha- and beta-diversity in the open ocean, J. Ecol., doi:10.1111/1365-2745.12634.

Nag, S., **C. K. Gatebe**, D. W. Miller, and O. Weck (2016), Effect of satellite formations and imaging modes on global albedo estimation, Acta Astronautica, Vol. 126, 77-97, doi:10.1016/j.actaastro.2016.04.004.

Nag, S., **C. K. Gatebe**, and T. Hilker (2016), Simulation of Multiangular Remote Sensing Products Using Small Satellite Formations, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, doi:10.1109/JSTARS.2016.2570683.

Nash, E. R., **S. E. Strahan**, N. Kramarova, C. S. Long, M. C. Pitts, P. A. Newman, B. Johnson, M. L. Santee, I. Petropavlovskih, and G. O. Braathen (2016), Antarctic ozone hole [in "State of the Climate in 2015"], Bulletin of AMS, Vol. 97, No. 8, S168-S172.

Norris, P. M. and A. M. da Silva (2016), Monte Carlo Bayesian inference on a statistical model of sub-gridcolumn moisture variability using high-resolution cloud observations - Part 1: Method, Q. J. R. Meteorol. Soc., 142: 2505–2527, doi:10.1002/qj.2843.

Norris, P. M. and A. M. da Silva (2016, Monte Carlo Bayesian inference on a statistical model of sub-gridcolumn moisture variability using high-resolution cloud observations - Part 2: Sensitivity tests and results, Q. J. R. Meteorol. Soc., 142: 2528–2540, doi:10.1002/qj.2844. ***See contributed piece by Peter Norris on these CDA articles on page 14.*

Oman, L. D., A. R. Douglass, R. J. Salawitch, T. P. Canty, **J. R. Ziemke**, and M. Manyin (2016), The effect of representing bromine from VSLS on the simulation and evolution of Antarctic ozone, Geophys. Res. Lett., 43, doi:10.1002/2016GL070471.

Pantina, P., S. Tsay, T. Hsiao, A. M. Loftus, F. Kuo, C. Ou-Yang, **A. M. Sayer**, S. Wang, N. Lin, N. C. Hsu, S. Janjai, S. Chantara, and A. X. Nguyen (2016), COMMIT in 7-SEAS/BASELInE: Operation of and Observations from a Novel, Mobile Laboratory for Measuring In-Situ Properties of

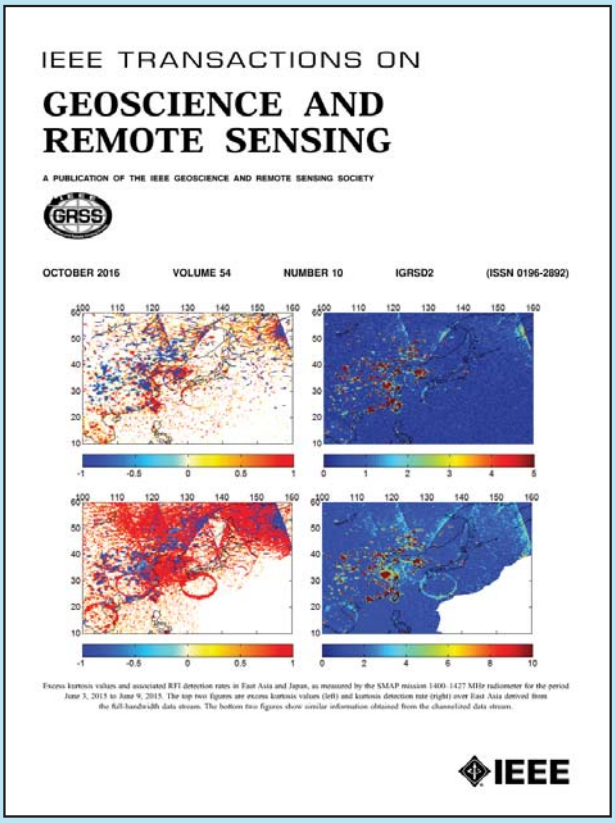


Image from Priscilla Mohammed's lead author paper, SMAP L-Band Microwave Radiometer: RFI Mitigation Prelaunch Analysis and First Year On-Orbit Observations.

(Publications, cont'd)

Aerosols and Gases, Aerosol & Air Quality Research, Vol. 16, No. 11, 2728-2741, doi:10.4209/aaqr.2015.11.0630.

Platnick, S., **K. G. Meyer**, M. D. King, G. Wind, N. Amarasinghe, **B. Marchant**, G. T. Arnold, Z. Zhang, P. A. Hubanks, *et al.* (2016), The MODIS cloud optical and microphysical products: Collection 6 updates and examples from Terra and Aqua, IEEE Trans. Geosci. Remote Sens., doi:10.1109/TGRS.2016.2610522.

Rasool, Q. Z., R. Zhang, B. Lash, D. S. Cohan, E. J. Cooter, J. O. Bash, and **L. N. Lamsal** (2016), Enhanced representation of soil NO emissions in the Community Multiscale Air Quality (CMAQ) model version 5.0.2, Geosci. Model Dev., 9, 3177-3197, doi:10.5194/gmd-9-3177-2016.

Sayer, A. M., N. C. Hsu, T. Hsiao, P. Pantina, F. Kuo, C. Ou-Yang, B. N. Holben, S. Janjai, S. Chantara, *et al.* (2016), In-Situ and Remotely-Sensed Observations of Biomass Burning Aerosols at Doi Ang Khang, Thailand during 7-SEAS/BASELInE 2015, Aerosol & Air Quality Research, Vol. 16, No. 11, 2786-2801, doi:10.4209/aaqr.2015.08.0500.

Silva, R., J. J. West, J. Lamarque, D. Shindell, W. Collins, S. Dalsoren, G. Faluvegi, G. Folberth, L. W. Horowitz, T. Nagashima, V. Naik, S. T. Rumbold, K. Sudo, T. Takemura, D. Bergmann, P. Cameron-Smith, I. Cionni, R. M. Doherty, V. Eyring, B. Josse, I. A. MacKenzie, D. Plummer, M. Righi, D. S. Stevenson, **S. Strode**, S. Szopa, and G. Zengast (2016), The effect of future ambient air pollution on human premature mortality to 2100 using output from the ACCMIP model ensemble, Atmos. Chem. Phys., Vol. 16, doi:10.5194/acp-16-9847-2016.

Strahan, S.E., A.R. Douglass, and **S.D. Steenrod** (2016), Chemical and Dynamical Impacts of Stratospheric Sudden Warmings on Arctic Ozone Variability, J. Geophys. Res., 121, doi: 10.1002/2016JD025128.

Tong, D., L. Pan, W. Chen, **L. N. Lamsal**, P. Lee, Y. Tang, H. Kim, S. Kondragunta, and I. Stajner (2016), Impact of the 2008 Global Recession on air quality over the United States: Implications for surface ozone levels from changes in NOx emissions, Geophys. Res. Lett., 43, doi:10.1002/2016GL069885.

Tsay, S., H. B. Maring, N. Lin, S. Buntoung, S. Chantara, H. Chuang, P. M. Gabriel, C. S. Goodloe, **A. M. Sayer**, *et al.* (2016), Satellite-Surface Perspectives of Air Quality and Aerosol-Cloud Effects on the Environment: An Overview of 7-SEAS/BASELInE, Aerosol & Air Quality Research, Vol. 16, No. 11, 2581-2602, doi:10.4209/aaqr.2016.08.0350.

Werner, F., G. Wind, Z. Zhang, S. Platnick, L. Di Girolamo, G. Zhao, N. Amarasinghe, and **K. Meyer** (2016), Marine boundary layer cloud property retrievals from high–resolution ASTER observations: Case studies and comparison with Terra–MODIS, Atmos. Meas. Tech. Disc., doi:10.5194/amt-2016-265.

Wind, G., A. M. da Silva, **P. M. Norris**, S. Platnick, S. Mattoo, and R. C. Levy (2016), Multi-sensor cloud retrieval simulator and remote sensing from model parameters – Part 2: Aerosols., Geosci. Model Dev., Vol. 9, 2377-2389, doi:10.5194/gmd-9-2377-2016.

Wolfe, G. M., M. Marvin, S. Roberts, K. Travis, and **L. Liao** (2016), The Framework for 0-D Atmospheric Modeling (F0AM) v3.1, Geosci. Model Dev. Discuss., 1-21, doi:10.5194/gmd-2016-175.

Yang, W., A. Marshak, P. J. McBride, J. C. Chiu, Y. Knyazikhin, K. S. Schmidt, C. Flynn, and E. R. Lewis (2016), Observation of the spectral-invariant properties of clouds in cloudy-to-clear transition zones during the MAGIC Field Campaign, Atmos. Res., 182, doi:10.1016/j.atmosres.2016.08.004.

Yorks, J. E., M. J. McGill, S. P. Palm, D. L. Hlavka, P. A. Selmer, **E. P. Nowottnick**, M. A. Vaughan, S. D. Rodier, and W. D. Hart (2016), An overview of the CATS level 1 processing algorithms and data products, Geophys. Res. Lett., 43, 4632–4639, doi:10.1002/2016GL068006.

Zhang, Q., E. M. Middleton, Y.-B. Cheng, K. F. Huemmrich, B. D. Cook, L. A. Corp, W. P. Kustas, A. L. Russ, J. Prueger, and **T. Yao** (2016), Integrating fAPARchl and PRInadir from EO-1/Hyperion to predict cornfield daily gross primary production (GPP), Remote Sens. Environ., Vol. 186, 311-321, doi:10.1016/j.rse.2016.08.026.

Volume 5, Issue 3
Summer/Fall 2016
GESTAR Newsletter
http://gestar.usra.edu/

Addressing the Thorny Problem of Cloud Data Assimilation

by Peter Norris

Drs. **Peter Norris** (USRA/GESTAR) and Arlindo da Silva (NASA/GSFC) recently published a two-part article [1,2] on cloud data assimilation (CDA). The assimilation of satellite cloud data into numerical weather prediction (NWP) models is a particularly difficult task, because clouds are often small compared with the model resolution, and because clouds are typically more noisy and non-linear than many other components of the atmosphere. Small errors in weather system location are also much more serious for CDA than for the assimilation of smoother continuous fields such as temperature, since assimilation algorithms typically work better when the first guess is already reasonably close to the observations. Even if cloud data can be ingested into an NWP model, it is not uncommon for the clouds to quickly disappear because they are not in equilibrium with the model weather. Nevertheless, it is very important for NASA to use the cloud data its satellites gather in weather and climate modeling, since clouds (1) are very useful markers of weather patterns and their underlying moisture distributions, (2) have a strong correlation with precipitation, and (3) help to moderate the diurnal temperature range and climate.

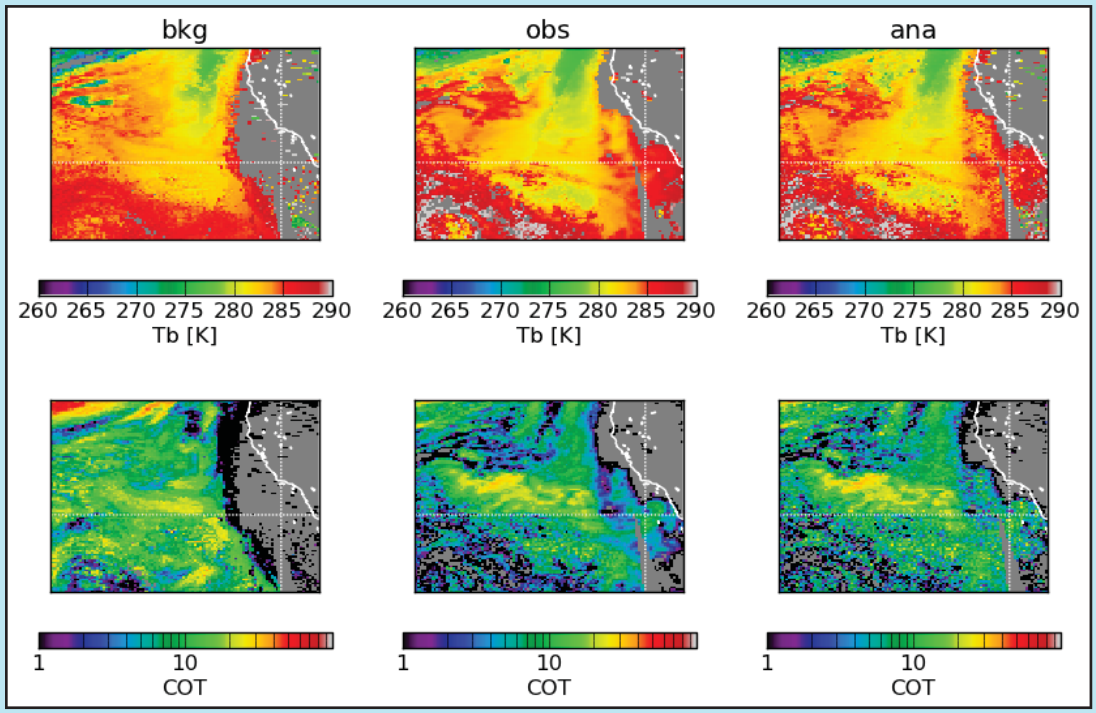


Figure 1: A case study of marine stratocumulus off the coast of California and Baja California (1 July 2011, at 2100 UTC). The upper panels (a–c) show brightness temperature Tb and the lower panels (d–f) all-sky cloud optical thickness (COT). The background (a,d) is absent the stratocumulus near the Southern or Baja Californian coast that is present in the observations (b,e). The analysis (c,f) is able to restore this stratocumulus, albeit with a slightly higher COT than observed. The somewhat noisier appearance of the analysis comes from the fact that each gridcolumn analysis is currently independent of its neighbors. *(Credit: P. Norris)*

(CDA, cont'd)

In Part [1] Norris and da Silva present a new Monte Carlo method for constraining the moisture variability inside of an NWP model grid-column using high-resolution MODIS (Moderate Resolution Imaging Spectroradiometer) cloud data. In Part [2] they perform some basic testing of the new approach, verifying that it does indeed significantly reduce mean and standard deviation errors with respect to the ingested data, and that it also improves the model against independent (non-ingested) OMI (Ozone Monitoring Instrument) data.

Of particular interest, the new Monte Carlo method shows skill in the especially difficult case where the NWP model predicts clear sky but the observations are cloudy. Traditional linearized data assimilation methods have a big problem with such cases, since they are gradient-based and since a subsaturated (clear) first guess cannot produce clouds via any infinitesimal equilibrium perturbation. But the Monte Carlo approach works well because it is not gradient-based and allows quasi-random jumps into regions of non-zero cloud probability. In the example provided (Fig. 1), the method is able to restore marine boundary layer clouds near the Californian coast where the NWP model had a large clear swath.

Norris and da Silva are now working on a third paper in the series that will perform a validation of the solar and thermal radiation budget of the new post-CDA state against NASA Clouds and the Earth's Radiant Energy System (CERES) data. The ultimate goal is to produce an operational CDA system for the NASA Global Modeling and Assimilation Office (GMAO)'s Goddard Earth Observing System Model (GEOS-5) that will have improved cloud and moisture properties in nowcast as well as forecast and climate modes.

[1] Norris, P. M. and A. M. da Silva: Monte Carlo Bayesian inference on a statistical model of sub-gridcolumn moisture variability using high-resolution cloud observations. Part 1: Method. Q. J. R. Meteorol. Soc., 142: 2505–2527, doi:10.1002/qj.2843, 2016.

[2] Norris, P. M. and A. M. da Silva: Monte Carlo Bayesian inference on a statistical model of sub-gridcolumn moisture variability using high-resolution cloud observations. Part 2: Sensitivity tests and results. Q. J. R. Meteorol. Soc., 142: 2528–2540, doi:10.1002/qj.2844, 2016.

Happy New Year from all of us at GESTAR!

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), and Science and Technology Corporation (STC).
Visit us at http://gestar.usra.edu/.

The GESTAR Newsletter is published by GESTAR/USRA. Forward any comments or suggestions to Amy Houghton, Editor at ahoughton@usra.edu.