ESD Research Results Roundup

June 2018

Atmospheric Composition

For cirrus clouds in the TTL: lower, warmer clouds mean larger, more faceted ice particles; higher, colder clouds mean smaller, rounder ice particles

- **What**: A study from NASA's ATTREX campaign looked at the composition of cirrus clouds in the tropical tropopause layer (TTL), the transition layer and gateway between the troposphere and the stratosphere. Scientists learned that lower, warmer clouds are made of larger, more faceted ice particles; and higher, colder clouds are made of smaller, rounder ice particles.
- **Why is this important**: Cirrus clouds in the TTL play an important role in Earth's radiation budget, reflecting incoming solar radiation and absorbing thermal radiation from the Earth. Very few observations exist for cirrus clouds in the TTL, and their microphysical properties (i.e. the small particles that make them up) have large impacts on how Earth regulates temperature.
- **Partners**: SPEC, Inc.; NOAA; NASA Ames; NASA Langley
- **Paper**: Woods, S., Lawson, R. P., Jensen, E., Bui, T. P., Thornberry, T., Rollins, A., et al. (2018). Microphysical properties of tropical tropopause layer cirrus. *Journal of Geophysical Research: Atmospheres*, *123*, 6053-6069. https://doi.org/10.1029/2017JD028068
- **Contact**: Eric Jensen (eric.j.jensen@nasa.gov); ARC
- **Source**: June 14, 2018 Ames SG Weekly Highlight

Model study postulates deep convection plays minimal role in hydrating the stratosphere

- **What**: Contrary to previous aircraft observations that show deep convection as a significant source of stratospheric water vapor, this modeling study found that deep convection cannot easily overcome the tropopause "cold trap", thereby delivering little water to the stratosphere.
- **Why is this important**: This study seems to contradict the consensus of deep convection as a source of water vapor in the stratosphere. Water vapor in the stratosphere plays a major role in Earth's radiation budget, so this study could have large implications for our understanding of atmospheric transport and climate.
- **Partners**: Science and Technology Corporation, NASA Ames, NASA Langley, Texas A&M University
- **Paper**: Schoeberl, M.R., Jensen, E. J., Pfister, L., Ueyama, R., Avery, M., & Dessler, A.E. (2018). Convective hydration of the upper troposphere and lower stratosphere. *Journal of Geophysical Research: Atmospheres, 123*, 4583-4593. https://doi.org/10.1029/2018JD028286

- **Contact**: Melody Avery (melody.a.avery@nasa.gov); LaRC
- **Source**: June 26 – July 2, 2018 LaRC Science Directorate Key Activities and Metrics

A decade of observations from CloudSat and CALIPSO

- **What**: A summary paper of science results over a decade of integrated measurements from CloudSat and CALIPSO within the A-Train constellation of satellites.
- **Why is this important**: A good historical look-back, and it shows how monitoring the vertical structure of clouds and aerosols is essential for climate modeling and understanding atmospheric processes on Earth.
- **Partners**: JPL, NASA Langley, NASA HQ, Univ. Wisconsin-Madison, UPMC-UVSQ-CNRS
- **Paper**: Stephens, G., Winker, D., Pelon, J., Trepte, C., Vane, D., Yuhas, C., L'Ecuyer, T., Lebsock, M. (2018). Cloudsat and CALIPSO within the A-Train: Ten Years of Actively Observing the Earth System. *Bull. Amer. Meteor. Soc,* **99**, 569-581, https://doi.org/10.1175/BAMS-D-16-0324.1
- **Contact**: Graeme Stephens (graeme.stephens@jpl.nasa.gov); JPL
- **Source**: June 4-11, 2018 LaRC Science Directorate Key Activities and Metrics

Carbon Cycle and Ecosystems

New imaging techniques better identify desert biocrusts, an important type of landcover that protects against erosion

- **What**: Scientists conducted heating experiments in a lab to help identify biocrusts in the Mojave Desert using remotely sensed imaging technology, such as visible satellite bands and thermal infra-red imaging. They learned that biocrusts had "Red texture mean values between digital numbers of 95 and 131 with moderate positive tail shewness levels".
- **Why is this important**: Biocrusts help prevent erosion in the desert from things like flash floods, etc. Due to their remote location, the distribution of biocrusts is not well known and they are not well mapped. This new technique could help scientists use remotely sensed satellite data to detect biocrusts from space.
- **Partners**: BLM; NASA Ames
- **Paper**: Potter, C., Weigand, J. (2018) Imaging analysis of biological soil crusts to understand surface heating properties in the Mojave Desert of California. *Catena, 170*, 1-9, https://doi.org/10.1016/j.catena.2018.05.033
- **Contact**: Christopher Potter (chris.potter@nasa.gov); ARC
- **Source**: June 14, 2018 Ames SG Weekly Highlight

Large tree canopies can be used to estimate the amount of biomass in a given area, implications for carbon storage and LCLUC

- **What**: Scientists used high-resolution airborne lidar data to determine whether large canopy trees could be used to accurately estimate biomass volume in a neotropical forested area. They learned that within 1ha, trees greater than 27m tall with at least a 100m^2 canopy crown explained more than 75% of total forest volume variations.
- **Why is this important**: Since large trees store large amounts of carbon, this technique could help improve carbon cycle and storage estimates for global climate change models. It could also help conservation and resource development efforts in places like the Amazon.
- **Partners**: USDA, JPL, Embrapa Acre, Univ. of Missouri, Laboratoire Evolution et Diversite Biologique UMR, etc.
- **Paper**: Meyer, V., Saatchi, S., Clark, D. B., Keller, M., Vincent, G., Ferraz, A., Espirito-Santo, F., d'Oliveira, V. N., Kaki, D., & Chave, J. (2018). Canopy areas of large trees explains aboveground biomass variations across neotropical forest landscapes. *Biogeosciences*, *15*, 3377-3390, https://doi.org/10.5194/bg-15-3377-2018
- **Contact**: Victoria Meyer (victoria.meyer@jpl.nasa.gov); JPL
- **Source**: June 2018 JPL Earth Science Highlights

SMAP is providing accurate estimates of sea surface salinity in some of the most remote locations

- **What**: Remotely sensed SMAP data corresponded with in situ freshwater river discharge observations in the remote Kara Sea, which is north of Russia in the Arctic. Scientists compared the L-band microwave radiometer data from SMAP to in situ ship- and airborne-based data to determine the changes in sea surface salinity and freshwater interactions.
- **Why is this important**: Though originally intended to study soil moisture, SMAP is proving to be a useful tool to accurately estimate sea surface salinity, especially in remote locations where little in situ data exists. This potentially has implications for understanding Arctic's response to climate change, changes in ecosystems and fisheries, etc.
- **Partners**: Environment and Climate Change Canada, JPL
- **Paper**: Tang, W., Yueh, S., Yang, D., Fore, A., Hayashi, A., Lee, T., Fournier, S., & Holt, B. (2018). The Potential and Challenges of Using Soil Moisture Active Passive (SMAP) Sea Surface Salinity to Monitor Arctic Ocean Freshwater Changes. *Remote Sensing*, 10(6), 869, https://doi.org/10.3390/rs10060869
- **Contact**: Wenqing Tang (wenqing.tang@jpl.nasa.gov); JPL
- **Source**: June 2018 JPL Earth Science Highlights

Climate Variability and Change

New climate model study shows warming could be much worse than currently anticipated

- **What:** New climate model study that used longer satellite records suggests current state-of-the-art climate models underestimate critical low-cloud feedback, meaning future warming could be much greater than currently anticipated.
- **Why is this important**: If true, this will have significant impacts on various climate models and our understanding of climate forcings.
- **Partners:** UMD, NASA Goddard
- **Paper:** Oreopoulos, L., Platnick, S. E., Meyer, K. (2018). Observations of Local Positive Low Cloud Feedback Patterns and Their Role in Internal Variability and Climate Sensitivity. *Geophysical Research Letters*, *45(9)*, 4438-4445, https://doi.org/10.1029/2018GL077904
- **Contact:** Lazaros Oreopoulos (lazaros.oraiopoulos-1@nasa.gov); GSFC
- **Source:** 610AT June 2018 Science Highlights

Water and Energy Cycle

Operational-level forecasts for atmospheric rivers from climate models

- **What**: Scientists tested the European Centre for Medium-Range Weather Forecasts (ECMWF) subseasonal-to-seasonal forecast system to evaluate its ability to predict atmospheric rivers, or jets of moisture linked to extreme precipitation events, for lead times ranging from 1 week to 1 month. Scientists found that the ECMWF outperformed previous reference forecasts.
- **Why is this important**: This is the first time scientists have evaluated the ability of ECMWF to predict subseasonal atmospheric rivers on a global scale. Atmospheric rivers are incredibly wet and windy events that can cause costly flooding and wind damage. A better understanding of the atmospheric processes that cause these events will help decision-makers better anticipate and respond to them.
- **Partners**: UCLA, UCSD, European Center for Medium-Range Weather Forecasts, JPL
- **Paper**: DeFlorio, M. J., Waliser, D. E., Guan, B. et al. Clim Dyn (2018). Global evaluation of atmospheric river subseasonal prediction skill. https://doi.org/10.1007/s00382-018-4309-x
- **Contact**: Duane Waliser (duane.e.waliser@jpl.nasa.gov); JPL
- **Source**: June 2018 JPL Earth Science Highlights

NASA measures snowfall rate and density for the 2018 Winter Olympics

- **What**: NASA scientists flew two precipitation imaging package (PIP) instruments and two micro rain radars (MRR) during the ICE-POP campaign to help validate GPM satellite measurements and characterize snow falling during the 2018 Winter Olympics.

- **Why is this important**: This mission will help NASA improve its ability to measure mountain snowfall from space, which will improve weather prediction and our understanding of the hydrological cycle.
- **Partners**: Korean Meteorological Administration, World Meteorological Organization
- **Paper**: N/A
- **Contact**: David B. Wolff (David.B.Wolf@nasa.gov); GSFC Wallops
- **Source**: 610AT June 2018 Science Highlights

Meetings

A list of science team meetings and more from the past month where results were presented.

- Fourth North Atlantic Aerosols and Marine Ecosystems Study (NAAMES) Science Team Meeting: June 11-13, 2018
- 2018 Earth Science Technology Forum: June 12-14, 2018