Weekly Report – May 13, 2022

Satellite Climate Studies Branch (SCSB)/CISESS

NOAA/NESDIS/STAR

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HIGHLIGHTS FOR NESDIS LEADERSHIP

Use-Inspired Science

Raspberry Pi Camera Installed at Earth Networks: Joseph Patton and Daile Zhang visited the Earth Networks site at Germantown on May 9^{th}, 2022. Earth Network is a global meteorology company that owns and operates a national-wide lightning network (Earth Network Total Lightning Network, or ENTLN), and Zhang has collaborated with their scientists on various research projects over the years. The visit aimed at installing a Raspberry Pi camera at their headquarters office as part of Zhang's 2021 Seeds Grant project of lightning observations. The camera will be used to take relatively high-speed videos of lightning. The videos will be compared with the satellite sensor Geostationary Lightning Mapper (GLM) as well as the ENTLN for validation studies and thunderstorm climatological studies in the greater D.C. area and beyond. There are a total of eight cameras out in the fields for observations (six in Maryland and two in Oklahoma) for the upcoming storm season.

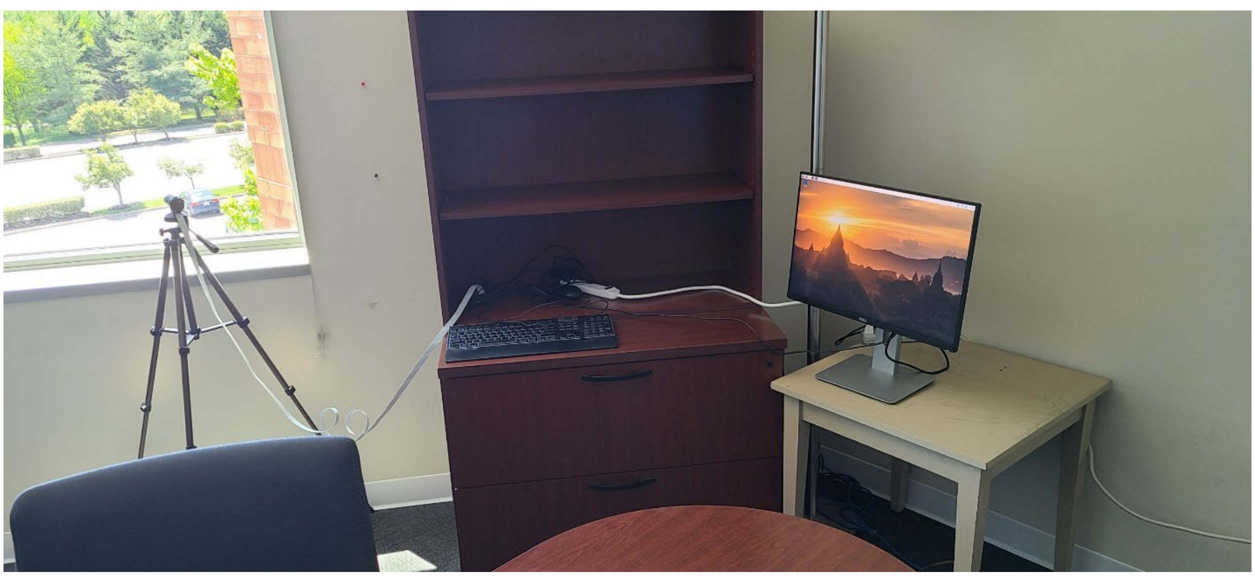

Figure: The Raspberry Pi camera setting at Earth Networks for lightning observation research.

(Daile Zhang, dlzhang@umd.edu, GOES-R AWG, GOES-R PGRR, NOAA-NASA ROSES)

PUBLICATIONS

Advanced Version of the National Air Quality Forecasting Capability (NAQFC):
Citation: *Campbell, Patrick C.; Youhua Tang, Pius Lee, Barry Baker, Daniel Tong, Rick Saylor, Ariel Stein, Jianping Huang, Ho-Chun Huang, Edward Strobach, Jeff McQueen, Li Pan, Ivanka Stajner, Jamese Sims, Jose Tirado-Delgado, Youngsun Jung, Fanglin Yang, Tanya L. Spero, and Robert C. Gilliam, 2022: Development and evaluation of an advanced National Air Quality Forecasting Capability using the NOAA Global Forecast System version 16; Geosci. Model Dev.,* ***15****, 3281–3313, https://doi.org/10.5194/gmd-15-3281-2022.* **Important Conclusions and Impacts:** This study evaluates the latest advancements to the NAQFC with the hypothesis that closer state-of-the-science meteorological and chemical transport models will improve predictions and the resulting forecasts will better protect human health. Overall performance evaluation reveals significant improvements in the advanced NAQFC and provides areas for further development.

Summary: CISESS Consortium scientists at George Mason University, Patrick Campbell and Daniel Tong, and NOAA, EPA, and other collaborators co-published an article in *Geoscientific Model Development* on April 21, 2022. Their article highlights the advancements in forecasting capabilities with version 16 of the NOAA Global Forecast System (GFS), which uses the Finite-Volume Cubed-Sphere (FV3) dynamical core and includes significant improvements to model configuration, data assimilation, and underlying model physics. The GFSv16 has been coupled with the Community Multiscale Air Quality (CMAQ) model to form an advanced version of the National Air Quality Forecasting Capability (NAQFC). The coupling of GFSv16 with CMAQ was made possible by the NOAA-EPA Atmosphere–Chemistry Coupler (NACC), which utilizes satellite-based data acquisition technology to improve land cover and soil characteristics and inline wildfire smoke and dust predictions that are vital to fine particulate matter concentration ($PM_{2.5}$) predictions during hazardous events that impact human and ecosystem health. The resulting GFS-driven NACC-CMAQ model shows generally improved near-surface ozone and $PM_{2.5}$ predictions as well as diurnal patterns. This advanced version of the NAQFC will continue to protect human and ecosystem health in the United States with meteorological and chemical predictions that are extended to 72-hour (3-day) forecasts with this system. The figure below provides an example of the air quality analysis, which focused on predictions of gaseous O_3 for late summer and early fall (September 2020) and $PM_{2.5}$ concentrations during the winter (January 2021). The figure shows the predictions using the prior NAQFC and the absolute differences between the NACC-CMAQ-NAQFC compared to the prior NAQFC.

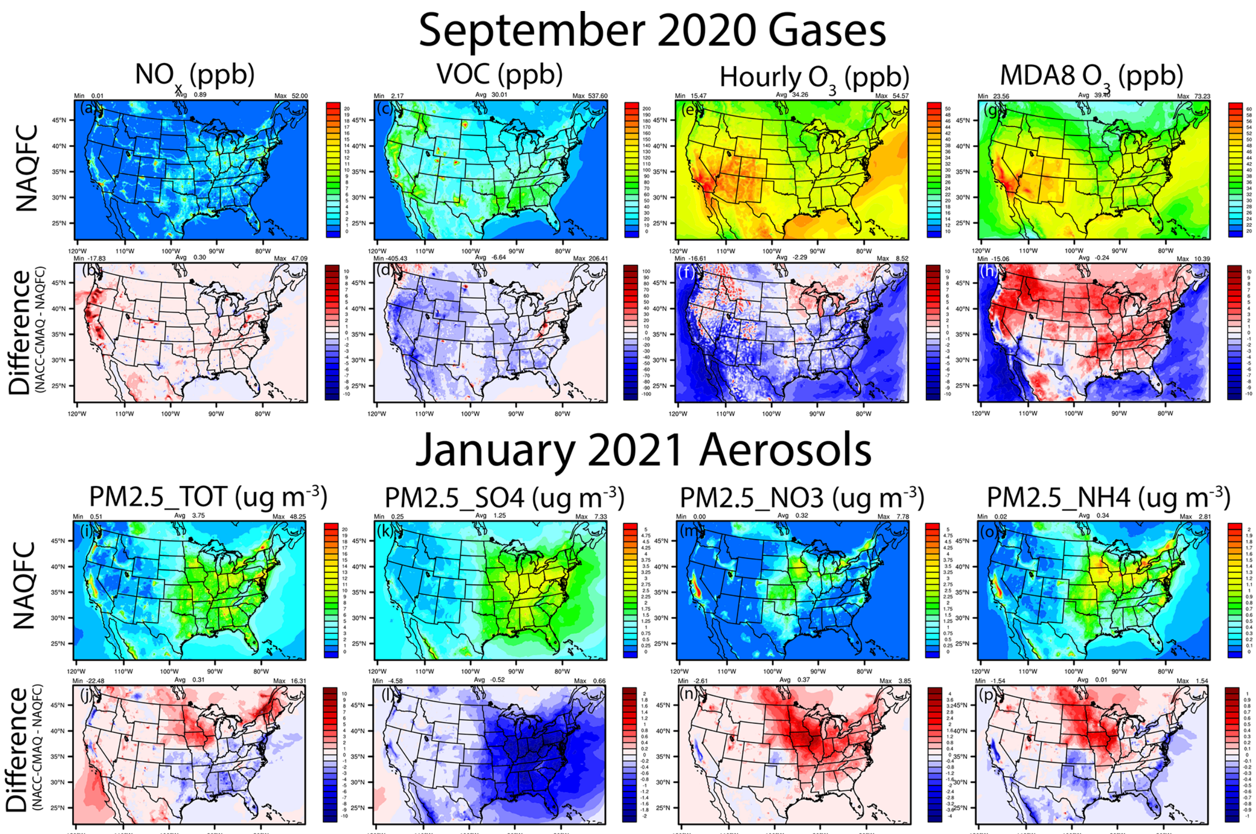

Figure: Average September 2020 NOx, total VOCs, hourly O_3, and MDA8 O_3 and January 2021 $PM_{2.5}$ total, $PM_{2.5}$ SO_4, $PM_{2.5}$ NO_3, and $PM_{2.5}$ NH_4 for the prior NAQFC and the absolute differences for the advanced version NACC-CMAQ–NAQFC.

(Patrick Campbell, patrick.c.campbell@noaa.gov, ARL; Daniel Tong, daniel.tong@noaa.gov, ARL)

An Optimized Ozone Profile Algorithm for Stratospheric Ozone Trend Analyses
Citation: *Petropavlovskikh, Irina; Koji Miyagawa, Audra McClure-Beegle, Bryan Johnson, Jeannette Wild, Susan Strahan, Krzysztof Wargan, Richard Querel, Lawrence Flynn, Eric Beach, Gerard Ancellet, and Sophie Godin-Beekmann, 2022: Optimized Umkehr profile algorithm for ozone trend analyses, Atmos. Meas. Tech.,* ***15*** *(6), 1849–1870, https://doi.org/10.5194/amt-15-1849-2022.* **Important Conclusions and Impacts:** This study focuses on a new algorithm used to optimize the Umkehr profile, evaluates the overall quality of long-term ground measurements, assesses the impacts of instrumental changes, and compares the optimized record against reference records.

Summary: CISESS scientist Jeannette Wild co-authored a study that was published in *Atmospheric Measurement Techniques* on March 28th, 2022. The long-term record of Umkehr measurements from four NOAA Dobson spectrophotometers was reprocessed after updates to the instrument calibration procedures. In addition, a new data quality-control tool was developed. The study compared Dobson Umkehr ozone profiles from NOAA ozone network stations – Boulder, the Haute-Provence Observatory (OHP), the Mauna Loa Observatory (MLO), Lauder – against several satellite records, including Aura Microwave Limb Sounder and combined solar backscatter ultraviolet (SBUV) and Ozone Mapping and Profiler Suite (OMPS) records. This study evaluated the overall quality of Umkehr long-term measurements at NOAA ground-based stations and assessed the impact of the instrumental changes on the stability of the Umkehr ozone profile record. A method designed to correct biases and discontinuities in the retrieved Umkehr profile that originate from the Dobson calibration process, repair, or optical realignment of the instrument was presented. Results include vertical and temporal changes in the Umkehr optimized ozone record and comparisons of the optimized Umkehr times series against reference records. The figure below shows an example of an optimized ozone layer plotted against operational and standardized (SLC) records as well as the biases between operational and SLC and SLC and optimized, which demonstrates the main temporal difference between the time series. The authors focused on the homogenization of the Umkehr record and discussion of the apparent stray light error in retrieved ozone profiles.

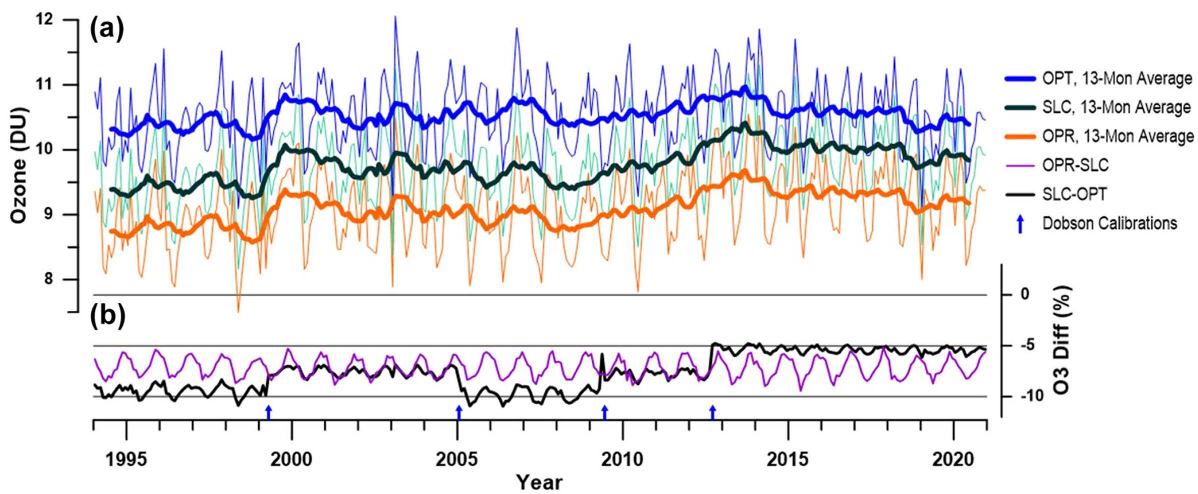

Figure: (a) The time series of Umkehr monthly averaged (thin lines) ozone in layer 8 (4–2 hPa) compared with operational (OPR), standard stray light corrected (SLC), and optimized (OPT) versions. The thick lines are a 13-month running average. (b) A difference between OPT and SLC (black line) and between OPR and SLC data (purple line).

(Jeannette Wild, jdwild@umd.edu, CPC)