NOAA Chemical Sciences Laboratory
FY25 Q2 Peer-Reviewed Publications

33 articles sorted alphabetical by first author; generated 31 March 2025

Acharya, A., S. Tilmes, E.M. Bednarz, and S. Fadnavis, South Asian summer monsoon under stratospheric aerosol intervention, *npj Climate and Atmospheric Science*, doi:10.1038/s41612-024-00875-z, 2025.

The South Asian summer monsoon (SAM) bears significant importance for agriculture, water resources, economy, and environmental aspects of the region for more than 1.5 billion people. To minimize the adverse impacts of global warming, Stratospheric Aerosol Intervention (SAI) has been proposed to lower surface temperatures by reflecting a portion of solar radiation back into space. However, the effects of SAI on SAM are still very uncertain and demand more research. We investigate this using the Stratospheric Aerosol Geoengineering Large Ensemble datasets. Our study reveals a reduction in the mean and extreme summer monsoon precipitation under SAI in this scenario, and explores in detail the underlying drivers and mechanisms. As the interest in SAI research grows, our results demonstrate the urgent need to understand SAM variability under different SAI scenarios, which is essential for sustainable development and disaster preparedness in South Asia.

Ahern, A.T., C.A. Brock, M. Lyu, K. Slovacek, R.H. Moore, and D.M. Murphy, Direct measurements and implications of the aerosol asymmetry parameter in wildfire smoke during FIREX-AQ, *Journal of Geophysical Research*, doi:10.1029/2024JD042091, 2025.

Smoke from wildfires affects how much sunlight is absorbed by the planet and its atmosphere by scattering some of that light into space. Usually, which direction the light scatters (into space vs. towards Earth) is based on models or inferred from indirect measurements of the smoke optical properties. We measured the direction of the light scattering directly, and show that more light is scattered into space than is typically thought.

Berberich, J., S.A. Jacoby, G. Michailoudi, J.P. Schwarz, S. Viciani, F. D'Amato, G. Bianchini, M. Barucci, T. Campos, K. Ullman, J.R. Podolske, C. Gurganus, W.P. Smith, R. Ueyama, S.B. Honomichl, L.L. Pan, S. Woods, B. Wienzierl, M. Dollner, and A.E. Perring, Black carbon reflects extremely efficient aerosol wet removal in monsoonal shedding events, *Journal of Geophysical Research*, doi:10.1029/2024JD042692, 2025.

Black carbon is an airborne particulate material that absorbs sunlight and contributes to global warming. Calculations of the amount of global warming that comes from black carbon depend on our ability to predict how long it stays in the atmosphere and where it travels. While we have reasonable information about where black carbon comes from (any kind of combustion), it has been harder to measure how fast it is removed from the air. Many models assume that airborne black carbon is not as easily removed by convection as it actually is, and therefore predict that it will travel long distances and hang around in the air for a long time. This leading to overpredictions in black carbon's warming effect. We measured black carbon in the air that comes out the top of a huge storm system (the Asian Summer Monsoon) and found that almost all of it had been removed in the storm. This is valuable information for models aimed at predicting global black carbon transport and calculating global radiative forcing.

Chouza, F., T. Leblanc, P. Wang, S.S. Brown, K. Zuraski, W. Chace, C.C. Womack, J. Peischl, J. Hair, T. Shingler, and J. Sullivan, The Small Mobile Ozone Lidar (SMOL): instrument description and first results, *Atmospheric Measurement Techniques*, doi:10.5194/amt-18-405-2025, 2025.

Ozone is one of the most important trace gases in Earth's atmosphere, serving as a greenhouse gas and air pollutant as well as a major oxidant in the lower atmosphere. Techniques to measure its concentrations and vertical distribution are needed to understand its sources, sinks and transport. Here, a new compact instrument is described to measure ozone vertical profiles using a technique known as lidar. The instrument is smaller, lower in power consumption and easier to operate compared to current ozone lidar instruments. It has the potential to facilitate more robust, frequent and lower cost measurements of ozone in the lower atmosphere.

DeMott, P.J., J.A. Mirrielees, S.S. Petters, D.J. Cziczo, M.D. Petters, H.G. Bingemer, T.C.J. Hill, K. Froyd, S. Garimella, A.G. Hallar, E.J.T. Levin, I.B. McCubbin, A.E. Perring, C.N. Rapp, T. Schiebel, J. Schrod, K.J. Suski, D. Weber, M.J. Wolfe, M. Zawadowicz, J. Zenker, O. Möhler, and S.D. Brooks, Field

intercomparison of ice nucleation measurements: the Fifth International Workshop on Ice Nucleation Phase 3 (FIN-03), *Atmospheric Measurement Techniques*, doi:10.5194/amt-18-639-2025, 2025.

A study of ice nucleating behavior of ambient aerosols measured on a Colorado mountain top. Various instrumentation to characterize the aerosol and the ice-active subset (via multiple nucleation mechanisms) were applied to extending understanding of the sources and impacts of ice nuclei in this region.

Eastman, R., I.L. McCoy, P. Zuidema, H. Schulz, and P. Barrett, Increased occurrence of stratiform clouds in the Caribbean dry season since 1971 from surface observations, *Journal of Geophysical Research*, doi:10.1029/2024JD042563, 2025.

This study uses surface observations of cloud types from human observers made at weather stations over fifty years to examine trends in Caribbean low clouds. During the dry season (December-April), when low clouds are dominant, we observe an exchange between cloud organization types, with stratiform clouds increasing at the expense of cumulus clouds. This is accompanied by an overall increase in low cloud cover and a higher frequency of rainfall in the Caribbean dry season. This cloud cover trend is associated with a warming, stabilizing, and drying atmosphere within and upwind of the Caribbean islands. Warming is more pronounced at higher atmospheric levels compared to at the surface. This cloud and precipitation response to warming and drying may act as a local de-amplifying mechanism to observed climate changes in the Caribbean.

Eckman, R.S., H. Tanimoto, I. Petropavlovskikh, I. Simpson, S. Kazadzis, K. Tørseth, T. Oda, J.-C. Lambert, S. Houweling, K. Lakkala, J. Geddes, J. Walker, O.R. Cooper, M. van Weele, S. Moreno, L. Dulguerov, Y. Cui, O. Tarasova, J. Turnbull, R. Thompson, and L. Zhou, Critical review of the atmospheric composition observing capabilities for monitoring and forecasting, World Meteorological Organization (WMO), Geneva, (2025).

The World Meteorological Organization (WMO) Global Atmosphere Watch (GAW) Expert Team on Atmospheric Composition Network Design and Evolution has produced a new report that provides a critical review of GAW's atmospheric composition observing capabilities for monitoring and forecasting. The report describes the current limitations and gaps in the global observing system for trace gases, aerosols and total atmospheric deposition, and makes science-based recommendations for improving the observing system.

Eytan, E., J. Gristey, and G. Feingold, The net radiative effect of the ill-defined clear-sky in the vicinity of clouds, *AGU Advances*, doi:10.1029/2024AV001407, 2025.

Clouds play a crucial role in Earth's climate system, significantly altering the radiative flux at the top-of-the-atmosphere and creating large deviations from clear-sky fluxes. As a result, atmospheric science often separates the sky into cloudy and clear regions, studying each independently. Here we analyze multi-spectral images of cloud fields measured by a satellite, alongside co-located measurements of radiative flux at the top of the atmosphere from a different, lower-resolution instrument. We re-cast the equation for radiative fluxes at the top of the atmosphere and use machine learning to estimate cloud effects in the "clear sky" for the first time. Our findings indicate that the local radiative effect of marine clouds on their surroundings is very large. In the solar part of the spectrum, clouds significantly enhance the aerosol radiative effect. In the longwave infrared spectrum, we confirm that the near-cloud radiative effect is equivalent to a substantial increase in greenhouse gases. Finally, we advocate for categorizing the sky into three regimes — cloudy, cloud-influenced, and pure clear-sky. Moreover, we demonstrate that expanding our suggested method could be a step toward eliminating the need to define 'a cloud' in spaceborne remote sensing data.

Finewax, Z., E. Assaf, A.W. Rollins, and J.B. Burkholder, Rate coefficient measurements for the CH3SCH2OO radical + NO reaction between 313 and 413 K, *International Journal of Chemical Kinetics*, doi:10.1002/kin.21784, 2025.

This laboratory experimental study measured the rate coefficient for the CH3SCH2OO radical + NO reaction over a range of temperature. The CH3SCH2OO radical plays an important role in the formation of SO2 and sulfate aerosol in the atmospheric degradation of dimethyl sulfide (DMS). The results from this study resolves discrepancies in previously reported kinetic studies and provides atmospheric climate chemical models kinetic data needed to improve modeling climate change.

Fuchs, H., A. Stainsby, F. Berg, R. Dubus, M. Färber, A. Hofzumahaus, F. Holland, K.H. Bates, S.S. Brown,

M.M. Coggon, G.S. Diskin, G.I. Gkatzelis, C.M. Jernigan, J. Peischl, M.A. Robinson, A.W. Rollins, N.B. Schafer, R.H. Schwantes, C.E. Stockwell, P.R. Veres, C. Warneke, E.M. Waxman, L. Xu, K. Zuraski, A. Wahner, and A. Novelli, Advances in OH reactivity instruments for airborne field measurements, *Atmospheric Measurement Techniques*, doi:10.5194/amt-18-881-2025, 2025.

The hydroxyl radical, OH, is the atmosphere's natural "detergent", leading to the removal of many common pollutants. A related quantity is the reactivity of the OH radical, or the rate at which OH reacts with atmospheric trace gases. This quantity can be calculated or measured directly by sensitive instrumentation. This paper describes a new instrument for direct measurement of OH reactivity from an aircraft and presents data from the recent NOAA led AEROMMA field campaign.

Garfinkel, C.I., Z.D. Lawrence, A.H. Butler, E. Dunn-Sigouin, I. Statnaia, A.Y. Karpechko, G. Koren, M. Abalos, B. Ayarzaguena, D. Barriopedro, N. Calvo, A. de la Cámara, A. Charlton-Perez, J. Cohen, D.I.V. Domeisen, J. García-Serrano, N.P. Hindley, M. Jucker, H. Kim, R.W. Lee, S.H. Lee, M. Osman, F.M. Palmeiro, I. Polichtchouk, J. Rao, J.H. Richter, C. Schwartz, S.-W. Son, M. Taguchi, N.L. Tyrrell, C.J. Wright, and R.W.-Y. Wu, A process-based evaluation of biases in extratropical stratosphere-troposphere coupling in subseasonal forecast systems, *Weather and Climate Dynamics*, doi:10.5194/wcd-6-171-2025, 2025.

We evaluate the coupling between the troposphere and the stratosphere in operational forecast systems on subseasonal to seasonal (S2S) timescales. Inability to simulate this coupling adequately could result in reduced forecast skill. We find that the interactions between atmospheric waves and wind in the troposphere and stratosphere are systematically biased. In particular, the stratospheric circulation is too strongly coupled to tropospheric waves in the Southern Hemisphere, while not coupled enough in the Northern Hemisphere. In both hemispheres, particularly during polar vortex extremes, the coupling of the lower stratospheric circulation to the troposphere is over-estimated.

Goren, T., G. Chourdhury, J. Kretzschmar, and I. McCoy, Co-variability drives the inverted-V sensitivity between liquid water path and droplet concentrations, *Atmospheric Chemistry and Physics*, doi:10.5194/acp-25-3413-2025, 2025.

Warm, liquid clouds occurring over the ocean reflect sunlight back to space, helping to cool the climate. These clouds interact with small particulates, known as aerosols, that are emitted from both natural and anthropogenic sources. These interactions alter the number of droplets present in the cloud and the amount of liquid water that the cloud is able to retain. When more aerosol is introduced to a cloud, it leads to more, smaller droplets which brightens the cloud. Changes in liquid water are more varied, either increasing or decreasing depending on the characteristics of the cloud, leading to a brighter or dimmer cloud. The inverted-V relationship between the variability in droplet number and liquid water path has been theorized to tell you about how the climate has responded to industrialization. That is, that the change in cloud brightness driven by cloud interactions with an increasing amount of anthropogenic aerosol can be inferred from this relationship. We find that this relationship is correlative not causal in regards to inferring how much industrialization has influenced clouds and thus the climate. This is because the inverted-V is in part reflecting the climatological evolution of clouds as they move further away from the coast and the accompanying anthropogenic emissions over land. It is better to account for the co-variability between droplet number and liquid water path, and how this influences the evolution of these clouds as a whole, when trying to understand the influence of industrialization.

Gristey, J.J., and G. Feingold, Stratospheric aerosol injection would change cloud brightness, *Geophysical Research Letters*, doi:10.1029/2024GL113914, 2025.

The deliberate release of particles in the stratosphere - to reflect a small amount of sunlight back to space and thereby cool the surface - is a controversial but increasingly common topic of debate in the face of ongoing global warming. One known side-effect is that the sunlight below these particles would be spread out into different directions. We demonstrate that this spreading of sunlight into different directions can make low-level marine clouds substantially brighter. The importance of this cloud brightening does not appear to have been appreciated in previous studies on the topic. Yet, this cloud brightening is crucial to understand the overall amount of sunlight that would be reflected and has profound implications for potential implementation of any such approach in the future.

Gristey, J.J., G. Feingold, W.M. Angevine, and Y.-S. Chen, Large eddy simulation of shallow cumulus

clouds in the southern great plains with an interactive land surface model, *Journal of Advances in Modeling Earth Systems*, doi:10.1029/2024MS004658, 2025.

Shallow cumulus clouds are ubiquitous over continental land masses in summertime. They impart complex and evolving patterns of solar heating on the surface below. These patterns are dominated by cloud shadows, which drive spatial variability in the surface latent and sensible heat fluxes via surface energy balance. This, in-turn, generates spatial variability in buoyancy that has been suggested to modulate cloud formation and evolution. Despite the tight coupling between the land surface and clouds, it is commonplace to model continental shallow cumulus cloud fields with large eddy simulation (LES) using spatially uniform prescribed surface latent and sensible heat fluxes. Here we present new LES of shallow cumulus cases from the LES Atmospheric Radiation Measurement (ARM) Symbiotic Simulation and Observation (LASSO) activity that are run with an interactive land surface model. The interactive land surface model is coupled to a 1D radiation scheme and therefore provides dynamic, heterogeneous surface latent and sensible heat fluxes that correspond to the evolving 1D surface solar heating pattern. We find that the dynamic heterogeneous surface fluxes have limited impact on the evolution of the cloud field, relative to assuming uniform surface fluxes. Specifically, when comparing LES run with spatially-homogenized surface fluxes, we find no evidence of systematic differences in the timing or magnitude of radiatively relevant cloud field properties including: cloud fraction, cloud liquid water, cloud drop number concentration, cloud size, or distance between clouds. We therefore conclude that the dynamic component of the surface fluxes responding to continental shallow cumulus cloud shading is not sufficient to influence cloud evolution alone. This finding suggests that recently reported large responses in continental shallow cumulus cloud evolution when invoking coupled 3D radiative transfer could be a unique response to 3D radiative effects. The new LES configuration developed in this study permits coupling with 3D radiative transfer in the future to further explore the mechanisms at play.

He, T.-L., G.-M. Oomen, W. Tang, I. Bouarar, K. Chance, C. Clerbaux, D.P. Edwards, H. Eskes, B. Gaubert, C. Granier, M. Guevara, D.J. Jacob, J. Kaiser, J. Kim, S. Kondragunta, X. Liu, E.A. Marais, K. Miyazaki, R. Park, V.-H. Peuch, G. Pfister, A. Richter, T. Stavrakou, R.M. Suleiman, A.J. Turner, B. Veihelmann, Z.-C. Zeng, and G.P. Brasseur, Challenges and opportunities offered by geostationary space observations for air quality research and emission monitoring, *Bulletin of the American Meteorological Society*, doi:10.1175/BAMS-D-23-0145.1, 2025.

Space-borne remote sensing of atmospheric chemical constituents is crucial for monitoring and better understanding global and regional air quality. Since the 1990s, the continuous development of instruments onboard low-Earth orbit (LEO) satellites has led to major advances in air quality research by providing daily global measurements of atmospheric chemical species. The next generation of atmospheric composition satellites measures from the geostationary Earth orbit (GEO) with hourly temporal resolution, allowing the observation of diurnal variations of air pollutants. This work provides an overview of satellite missions for atmospheric composition monitoring and the state of the science in air quality research. We cover recent advances in retrieval algorithms, the modeling of emissions and atmospheric chemistry, data assimilation, and the application of machine learning based on satellite data. We discuss the challenges and opportunities in air quality research in the era of GEO satellites, and provide recommendations on research priorities for the near future.

Huang, J., I. Stajner, R. Montuoro, F. Yang, K. Wang, H.-C. Huang, C.-H. Jeon, B. Curtis, J. McQueen, H. Liu, B. Baker, D. Tong, Y. Tang, P. Campbell, G. Grell, G. Frost, R. Schwantes, S. Wang, S. Kondragunta, F. Li, and Y. Jung, Development of the next-generation air quality prediction system in the Unified Forecast System framework: Enhancing predictability of wildfire air quality impacts, *Bulletin of the American Meteorological Society*, doi:10.1175/BAMS-D-23-0053.1, 2025.

This study marks a historic milestone as NOAA leads the development of an online coupled meteorology-air quality model (AQM) prediction system within the Unified Forecast System (UFS) framework. The innovative UFS-AQM online system improves the representation of wildfire emissions and their impacts on air quality predictions. The system shows significant improvements in forecasting fine particulate matter (PM2.5) and ozone (O3) exceedance events compared to the current operational system during wildfire events. The development of the UFS-AQM online system has significantly improved wildfire-driven air quality predictions and will potentially benefit weather forecasting in the near future via improvements of meteorology-chemistry feedbacks in the models.

June, N.A., E.B. Wiggins, E.L. Winstead, C.E. Robinson, K.L. Thornhill, K.J. Sanchez, R.H. Moore, D.

Pagonis, H. Guo, P. Campuzano-Jost, J.L. Jimenez, T. Shingler, M.M. Coggon, J. Peischl, A. Dayalu, M. Mountain, S.H. Jathar, M.J. Alvarado, and J.R. Pierce, Look within: Intraplume differences on smoke aerosol aging driven by concentration gradients, *Journal of Geophysical Research*, doi:10.1029/2024JD042359, 2025.

Wildfires are an important source of aerosol particles to the atmosphere. These aerosol particles are important for climate and human health. A 2019 field campaign flew an aircraft through wildfire smoke plumes in the western United States to take measurements of gasses and aerosol particles in the plume. We use these measurements and a high-resolution model to study the fine scale details of the evolution of the aerosol particles in the plume. In our case study, we find that there are differences in the evolution within the plume as a function of height due to temperature and concentration effects in the plume. These fine scale details have implications for large-scale air quality and climate models, which cannot resolve these plumes explicitly.

Kim, J., W.M. Berelson, N.E. Rollins, N. Asimow, C. Newman, R.C. Cohen, J.B. Miller, B.C. McDonald, J. Peischl, and S.J. Lehman, Observing anthropogenic and biogenic CO2 emissions in Los Angeles using a dense sensor network, *Environmental Science & Technology*, doi:10.1021/acs.est.4c11392, 2025.

In this study we investigate a simple method to quantify emissions using a high-density observation network. We show seasonal pattens in anthropogenic and biogenic CO2 emissions in Los Angeles. Additionally, we demonstrate the capability to effectively constrain annual emission trends.

Lang, V.A., S.F. Camilleri, S. van der Lee, G. Rowangould, B. Antonczak, T.M. Thompson, M.H. Harris, C. Harkins, D. Tong, M. Janssen, Z.E. Adelman, and D.E. Horton, Intercomparison of modeled urban-scale vehicle NOx and PM2.5 emissions – implications for equity assessments, *Environmental Science & Technology*, doi:0.1021/acs.est.4c09777, 2025.

Accurate characterization of emissions is essential for understanding variations of air pollutants and their societal impacts, including population exposure, health outcomes, and environmental justice implications. Characterizing emissions from the transport sector is particularly challenging due to uncertainties in emission-producing processes and in fleet composition and activity – factors that lead to differences across modeled vehicle emissions datasets. Here, we compare four datasets – Fuel-Inventory Vehicle Emissions, Neighborhood Emission Mapping Operation, Lake Michigan Air Director Consortium-Northwestern University, and University of Vermont– over the Greater Chicago region at three shared spatial resolutions (1.0, 1.3, and 4 km2). While dataset agreement is strongest at the coarsest resolution, at finer resolutions we find higher variation and disagreement. At 1 km2, simulated domain total NOx emissions differ by up to 82% across the four datasets, while grid cell maximum PM2.5 emissions vary up to 272%. Our intercompared emissions datasets share many similar inputs; however, divergent outcomes arise from differences in emission factors, simulated vehicle processes, and characterization of traffic data. Despite differences, inequities in the distribution of traffic emissions are largely consistent – in 3 of the 4 datasets, the highest emissions are simulated in areas with majority non-white residents.

Lee, J., A.H. Butler, J.R. Albers, Y. Wu, and S.H. Lee, Impact of sudden stratospheric warmings on the stratosphere-to-troposphere transport of ozone, *Geophysical Research Letters*, doi:10.1029/2024GL112588, 2025.

Sudden stratospheric warmings (SSWs) are an extreme event which occur every few years in the Arctic stratosphere (the second layer of Earth's atmosphere). SSWs can have a significant impact on weather systems in the troposphere below, and can improve forecasts several weeks to months ahead. Within the stratosphere lies the ozone layer, and it has been shown that SSWs can affect the transport of ozone into the troposphere. The stratosphere-to-troposphere transport (STT) of ozone can be an important source of ozone near the surface. While ozone is beneficial in the stratosphere, it is harmful near the surface, and can lead to poor air quality, increased mortality and reduced plant production. However, little is known about where and when the impact of SSWs on the STT of ozone occurs. We find significant increases in lower tropospheric ozone both before and after the SSW onset in the extratropics, particularly over the Arctic, North America, and Europe. The influence of SSWs on near-surface ozone concentration lasts up to 2 to 3 months after the SSW onset.

Link, M.F., M.S. Claflin, C.E. Cecelski, A.A. Akande, D. Kilgour, P.A. Heine, M. Coggon, C.E. Stockwell, A. Jensen, J. Yu, H.N. Huynh, J.C. Ditto, C. Warneke, W. Dresser, K. Gemmell, S. Jorga, R.L. Robertson, J.d. Gouw, T. Bertram, J.P.D. Abbatt, N. Borduas-Dedekind, and D. Poppendieck, Product ion

distributions using H3O+ proton-transfer-reaction time-of-flight mass spectrometry (PTR-ToF-MS): Mechanisms, transmission effects, and instrument-to-instrument variability, *Atmospheric Measurement Techniques*, doi:10.5194/amt-18-1013-2025, 2025.

This study is a first attempt to evaluate the reproducibility of Vocus PTR_ToF-MS responses to analytes. This study evaluates major causes for variability in product ion distributions (PIDs) and how PIDs might vary across instruments from the same manufacturer.

Maloney, C.M., R.W. Portmann, M.N. Ross, and K.H. Rosenlof, Investigating the potential atmospheric accumulation and radiative impact of the coming increase in satellite reentry frequency, *Journal of Geophysical Research*, doi:10.1029/2024JD042442, 2025.

The coming decades are anticipated to bring the construction of numerous satellite megaconstellations in low Earth orbit (500 km – 2000 km). It is estimated that the number of domestic US satellites in low Earth orbit could exceed 60,000 individual units by 2040. The increase in the annual emissions of man-made material from this activity into the upper atmosphere projects to rival the natural occurring emissions from meteorite vaporization. Unfortunately, little is known about the aerosols that will be produced by reentry, which makes estimating the climate impacts difficult. Aluminum is a primary satellite component that will likely be emitted during reentry vaporization. In this study we simulate a projected year 2040 emission of 10,000 metric tons/yr of alumina. We investigate how the location of atmospheric accumulation, aerosol size distribution, and radiative properties of reentry alumina impacts the middle-to-upper atmosphere. We fin d that 20,000 to 40,000 metric tons of alumina aerosol accumulates poleward of 30 degrees latitude between 10 km and 30 km in both hemispheres. Small but statistically significant changes in mesospheric heating rates lead to 1.5 K temperature anomalies in the mesosphere and stratosphere at southern hemisphere high latitudes. These temperature anomalies are accompanied by a 10% reduction in wind speed in the southern hemisphere polar vortex, leading to an increase in springtime ozone concentration. Some reentry scenarios also experience a strengthening of the northern hemisphere polar vortex and decreased springtime ozone concentration.

Norman, O.G., C.L. Heald, S. Bililign, P. Campuzano-Jost, H. Coe, M.N. Fiddler, J.R. Green, J.L. Jimenez, K. Kaiser, J. Liao, A.M. Middlebrook, B.A. Nault, J.B. Nowak, J. Schneider, and A. Welti, Exploring the processes controlling secondary inorganic aerosol: Evaluating the global GEOS-Chem simulation using a suite of aircraft campaigns, *Atmospheric Chemistry and Physics*, doi:10.5194/acp-25-771-2025, 2025.

Inorganic particle mass concentrations calculated with a global chemistry model developed by MIT were evaluated using aircraft data from eleven field projects. Across all the campaigns, the model performs best for sulfate and worst for nitrate, indicating problems with modeling atmospheric aerosol nitrate and gas phase nitric acid. While modeling the particle phase nitrate is fairly well-simulated, the amount partitioning between the gas and aerosol phase is not. The reason for this discrepancy is that there are limited measurements of gas phase ammonia, which is important for determining the nitrate phase partitioning. The model is also sensitive to changes in the loss processes despite having improvements in additional loss and production pathways. More work is needed to improve the model.

Schill, G.P., K.D. Froyd, D.M. Murphy, C.J. Williamson, C.A. Brock, T. Sherwen, M.J. Evans, E.A. Ray, E.C. Apel, R.S. Hornbrook, A.J. Hills, J. Peischl, T.B. Ryerson, C.R. Thompson, I. Bourgeois, D.R. Blake, J.P. DiGangi, and G.S. Diskin, Widespread trace bromine and iodine in remote tropospheric non-sea-salt aerosols, *Atmospheric Chemistry and Physics*, doi:10.5194/acp-25-45-2025, 2025.

Halogens in the atmosphere are responsible for both the stratospheric ozone hole and also the capacity of tropospheric air to oxidize molecules and surfaces. While chlorine is the most abundant atmospheric halogen, bromine and iodine can be important contributors because of their unique chemistry. Despite their importance, bromine and iodine are poorly constrained in global climate models. In part, this is because it is unknown how much reactive bromine and iodine is in the gas phase and how much is contained within aerosol particles. This is especially true in the remote atmosphere, where measurements of bromine and iodine in aerosol are sparse. In this work, we find that bromine and iodine are ubiquitous in aerosol throughout the remote atmosphere. Despite this ubiquity, bromine and iodine are generally much less than 1% of the total mass of the aerosol. From these measurements, we find that accounting for iodine aerosol partitioning is important for the reactive iodine budget. Conversely, bromine aerosol partitioning contributes to only a small portion of the reactive bromine budget. We compared our measurements to a state-of-the-art global climate model that includes detailed iodine chemistry.

We find that our measurements of iodine aerosol mass compares well in the background atmosphere; however, the model does not capture our measurements in special areas of the atmosphere, e.g., near the ocean surface, in the stratosphere, or in biomass burning plumes.

Sicard, M., A. Baron, M. Ranaivombola, D. Gantois, T. Millet, P. Sellitto, N. Bègue, H. Bencherif, G. Payen, N. Marquestaut, and V. Duflot, Radiative impact of the Hunga stratospheric volcanic plume: Role of aerosols and water vapor over Réunion Island (21° S, 55° E), *Atmospheric Chemistry and Physics*, doi:10.5194/acp-25-367-2025, 2025.

This study attempts to quantify the radiative impact over Reunion Island (21°S, 55°E) in the southern tropical Indian Ocean of the aerosols and water vapor injected in the stratosphere by the eruption on 15 January 2022 in the South Pacific of the Hunga Tonga-Hunga Ha'apai underwater volcano. Ground-based lidar and satellite passive instruments are used to parametrize a state-of-the-art radiative transfer model for the first thirteen months after the volcano eruption. The descending rate of the aerosol volcanic plume is -0.008 km day-1. At this rate, aerosols are expected to be present in the stratosphere until the first half of 2025. The overall aerosol and water vapor impact on the Earth's radiation budget for the whole period is positive (warming) and dominated by the aerosol impact. However, the decreasing rate with time of the aerosol warming effect is larger than that of the water vapor cooling effect, so that, in the long run, the impact on the Earth's radiation budget might reduce to quasi-neutral, or even become slightly negative. At the Earth's surface, aerosols are the main driver and produce a negative (cooling) radiative impact with also a decreasing tendency with time. Heating/cooling rate profiles show a clear vertical difference in the stratosphere between the aerosol warming impact (17 to 25 km) and the water vapor cooling one (25 to 40 km).

Stockwell, C.E., M.M. Coggon, R.H. Schwantes, C. Harkins, B. Verreyken, C. Lyu, Q. Zhu, L. Xu, J.B. Gilman, A. Lamplugh, J. Peischl, M.A. Robinson, P.R. Veres, M. Li, A.W. Rollins, K. Zuraski, S. Baidar, S. Liu, T. Kuwayama, S.S. Brown, B.C. McDonald, and C. Warneke, Urban ozone formation and sensitivities to volatile chemical products, cooking emissions, and NOx upwind of and within two Los Angeles Basin cities, *Atmospheric Chemistry and Physics*, doi:10.5194/acp-25-1121-2025, 2025.

In urban areas, emissions from volatile chemical products (VCPs) and non-traditional sources like cooking are an important fraction of the volatile organic compound (VOC) budget that impact air quality. This study used detailed box modeling to evaluate how these emissions impact ozone in the Los Angeles Basin during the summer of 2021. The findings highlight the major role of VCPs, and for the first time, quantify the impact of cooking emissions. Accurate representation of these anthropogenic VOCs in emissions inventories is crucial for effective air quality policies and NOx control.

Tang, W., L.K. Emmons, C. Wiedinmyer, D.B. Partha, Y. Huang, C. He, J. Zhang, K.C. Barsanti, B. Gaubert, D. Jo, J. Zhang, R. Buchholz, S. Tilmes, F. Vitt, C. Granier, H.M. Worden, and P.F. Levelt, Disproportionately large impacts of wildland-urban interface fire emissions on global air quality and human health, *Science Advances*, doi:10.1126/sciadv.adr2616, 2025.

Fires in the wildland-urban interface (WUI) are a global issue with growing importance. However, the impact of WUI fires on air quality and health is largely understudied and less understood at the global scale compared to that of fires in remote wildland. Building on the recent progress, the paper presents the first global analysis of the effects of WUI fires on air quality impacts and health using an atmospheric chemistry model to quantify the effects of increasingly prevalent WUI fires. WUI fires have notable impact on surface concentrations of key air pollutants. The global health impact of WUI fire emission is disproportionately large compared to wildland fires primarily because WUI fires are closer to human settlement. At the global scale, the fraction of WUI fire-caused annual premature deaths (APD) to all fire-caused APD is about 3 times of the fraction of WUI fire emissions to all fire emissions. The developed model framework can be easily updated and applied to address critical needs in the context of understanding and mitigating fires in the WUI and their impacts.

Van Hoomissen, D., A. Chattopadhyay, S.A. Montzka, and J.B. Burkholder, CHF3 (HFC-23) and CF3CHO quantum yields in the pulsed laser photolysis of CF3CHO at 248, 266, 281, and 308 nm, *ACS Earth and Space Chemistry*, doi:10.1021/acsearthspacechem.4c00316, 2025.

This study addressed the production of atmospheric HFC-23 (CHF3) in the UV photolysis of CF3CHO, which is a compound produced in the atmosphere in the degradation of some anthropogenically emitted HFCs, HCFCs, and haloolefins. Laboratory measurements of CF3CHO photolysis were performed at four UV wavelengths (248,

266, 281, and 308 nm) over a range of bath gas pressure (100 to 650 Torr). This work reports a direct measurement of CHF3 production in the photolysis of CF3CHO at an atmospherically relevant wavelength, 308 nm. The CHF3 yield was determined to be very small, 0.0017 at 650 Torr). It is shown that CHF3 production from this photolysis source is small compared to present-day industrial emissions.

Voet, F., F. Ploeger, J. Laube, P. Preusse, P. Konopka, J.-U. Grooß, J. Ungermann, B.-M. Sinnhuber, M. Höpfner, B. Funke, G. Wetzel, S. Johansson, G. Stiller, E. Ray, and M.I. Hegglin, On the estimation of stratospheric age of air from correlations of multiple trace gases, *Atmospheric Chemistry and Physics*, doi:10.5194/acp-25-3541-2025, 2025.

The stratospheric circulation is an important element in the climate system, but observational constraints are prone to significant uncertainties due to the low circulation velocities and uncertainties in available trace gas measurements. Here, we propose a method to calculate mean age of air as a measure of the circulation up to a height of about 25 km from observations of multiple trace gas species, like trichlorofluoromethane (CFC-11), dichlorodifluoromethane (CFC-12), chlorodifluoromethane (HCFC-22), methane (CH4), nitrous oxide (N2O) and sulfur hexafluoride (SF6). The method is based on the compact correlations of these trace gases with mean age. The age calculation method is evaluated in a model environment and compared against the true model age. We show that combination of the six chosen species reduces the resulting uncertainty of the derived mean age to below 0.3 years throughout most regions in the lower stratosphere. Comparison between observation-based and model simulated mean age indicates a slow-biased circulation in the ERA5 reanalysis data used to drive the model in the lower stratosphere. Overall, the proposed mean age calculation method shows promise to substantially reduce the uncertainty in mean age estimates from satellite trace gas observations.

Wang, X., R.K. Chakrabarty, J.P. Schwarz, S.M. Murphy, E.J.T. Levin, S.G. Howell, H. Guo, P. Campuzano-Jost, and J.L. Jimenez, Dark brown carbon from biomass burning contributes to significant global-scale positive forcing, *One Earth*, doi:10.1016/j.oneear.2025.101205, 2025.

GEOS-CHEM Model evaluation of the radiative impacts of "dark brown carbon" with some constraints from observations.

Zhang, J., Y.-S. Chen, E. Gryspeerdt, T. Yamaguchi, and G. Feingold, Radiative forcing from the 2020 shipping fuel regulation is large but hard to detect, *Communications Earth & Environment*, doi:10.1038/s43247-024-01911-9, 2025.

At the beginning of 2020, the International Maritime Organization (IMO) implemented a strict regulation that reduces the sulfur content in ship fuel by 85% by mass (hereafter IMO2020). Although a source of pollution, these shipping emissions act as cloud condensation nuclei for marine warm clouds – a class of clouds that have large spatial coverage and that cool the Earth effectively by reflecting sunlight. Using a data-driven ensemble of neural networks that learn the climatological relationship between meteorology and cloud, we estimate a global radiative forcing of 0.09 W m-2 (warming) from the implementation of IMO2020. Despite the substantial radiative forcing, we find the detectability of the perturbation in cloud radiative effect is only ~3%. We demonstrate that the low detectability is a result of natural variability exerting a strong confounding effect, in particular acting as a source for “false detections” and “missed detect ions”. Our findings raise concerns about accelerated warming resulting from future aerosol cleanup and the challenge of detecting advertent aerosol perturbations such as marine cloud brightening at regional-to-global scales.

Zhou, X., D. Painemal, A. Gettleman, and G. Feingold, Exploring causal relationships and adjustment timescales of cloud-aerosol interactions in geostationary satellite observations and CAM6 using wavelet phase coherence analysis, *Geophysical Research Letters*, doi:10.1029/2024GL111961, 2025.

We introduce wavelet phase coherence analysis to understand how changes in cloud water and cloud droplet concentration are related to each other over time. By analyzing satellite data and climate model output, we study when one variable leads or lags the other and how quickly they adjust to one another. Our findings show that during the day cloud water and cloud droplet concentration often change in the same direction, indicating cloud development and precipitation processes. This effect usually happens within 1 hour. Sometimes cloud water and cloud droplet concentration can change in opposite directions. This is due to clouds being more prone to evaporate at their tops when there is an increase in smaller droplets. Typically this effect takes approximately 2-4 hours to occur. We also compared our observations with a climate model, which shows too rapid and overly strong negative cloud water response to the change in cloud droplet concentration.

Zuraski, K., C. Harkins, J. Peischl, M. Coggon, C. Stockwell, M.A. Robinson, J. Gilman, C. Warneke, B.C. McDonald, and S.S. Brown, On-road measurements of nitrogen oxides, CO, CO2, and VOC emissions in two southwestern U.S. cities, *Environmental Science & Technology Air*, doi:10.1021/acsestair.4c00316, 2025.

This study explores the impact of vehicles on air pollution in urban areas, focusing on nitrogen oxides (NOx) and volatile organic compounds (VOCs), which are significant contributors to tropospheric ozone levels. Conducted in Los Angeles, CA, and Las Vegas, NV, during Summer 2021, the research utilized advanced instrumentation to measure vehicle exhaust in real-time. The measurements showed that the average ratios of NO2 to NOx from vehicle emissions, which are an important parameter in assessing air pollution emissions, were consistent with results from previous studies. The emission factors derived from on-road measurements for NOx were in agreement with values from the Fuel-based Inventory of Vehicle Emissions (FIVE), verifying the accuracy of the inventory. Additionally, this study identified distinct patterns in the ratios of VOCs to other pollutants, revealing that Las Vegas had lower emissions of certain compounds compared to Los Angel es. Overall, these findings provide valuable insights into how vehicles contribute to air quality issues, helping to identify trends and baselines for pollution levels in major cities, ultimately supporting efforts to promote healthier environments for residents.