Emissions, Transport, and Chemistry of Smoke from the Oct. 2017 Northern California Fires

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The Oct. 2017 wildfires in the northern California counties of Sonoma, Napa, Solano, and Mendocino killed 44, destroyed 8889 structures, and resulted in reported losses of $9 billion. Air quality forecasts using regional chemical models provide key information for affected communities and smoke management efforts, yet many models fail to accurately predict ozone and particulate matter levels during fire events. A large source of model uncertainty is the satellite-based emissions, which for the Oct. 2017 Northern California Fires range among inventories by four orders of magnitude. This study utilizes the first CO and NH_3 fire emissions estimates based on airborne absorption measurements with the University of Colorado Solar Occultation Flux (CU SOF) instrument, which reduce the emissions uncertainty to about a factor of two. We combine the SOF-based emissions estimates with WRF-Chem simulations and satellite retrievals of Fire Radiative Power (FRP) to study emissions diurnal and spatial variability, and plume transport and chemistry. We included fire diurnal cycle, size, and spatial variation information obtained from Geostationary Operational Environmental Satellite (GOES)-16 FRP observations in the WRF-Chem emissions and plume rise, and scaled the emissions to the SOF-based emissions estimate, resulting in significant improvement in model/measurement comparisons. WRF-Chem tracers are used to calculate smoke age. The WRF-Chem simulations are compared with satellite retrievals of aerosol optical depth, and show that ozone and secondary aerosol mass were produced from the N. California fire emissions. This study is helping to inform aircraft sampling and modeling needs during the 2018 NSF/CSU Western wildfire Experiment for Cloud chemistry, Aerosol absorption and Nitrogen (WE-CAN) and NSF/CU Biomass Burning Fluxes of Trace Gases and Aerosols using SOF on the Wyoming King Air (BB-FLUX), and 2019 NOAA/NASA Fire Influence on Regional and Global Environments Experiment – Air Quality (Fire-X-AQ) field campaigns. We discuss plans for modeling studies incorporating data from the 2018 and 2019 field experiments.