

Improving Daily Surface Particulate Matter Estimates during Extreme Fire Events using a Novel NASA Satellite Plume Injection Height Algorithm

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Abstract

Climate change has increased the frequency of droughts in recent decades and consequently, the occurrence and severity of wildfires have amplified, especially in the western U.S. Wildfires are important to maintain the ecological equilibrium of the landscape but smoke emissions represent a global public health problem impacting vulnerable populations and the economy. Near extreme fire events, satellite characterization of thermal anomalies is desired because it can capture the horizontal extent of the smoke plume. However, air quality (AQ) models based on satellite retrievals have been challenged during fire periods because of the limitation in detecting small fires, large fires events which consequently produce pyrocumulus clouds, and the underestimation of aerosol loading due to very rigorous fire filters in the satellite algorithm. Satellite fire radiative power provides daily burning areas but the information is very localized and not designed to estimate the transport of the plumes to other areas away from the source. With these limitations in mind, this research presents an AQ fire ratio (AQFR) which can distinguish the vertical distribution of aerosols as the smoke plumes were transported downwind, and if the smoke was able to reach the surface or penetrate the free troposphere using a combination of numerical weather prediction model outputs and a novel plume injection height algorithm from NASA ASHE VIIRS during the fire seasons of 2013-2014 in the U.S. Preliminary results in the western U.S. using the MODIS version of the ASHE algorithm have shown that differences in meteorological conditions affecting the planetary boundary layer (PBL) physics during the day can impact the percentage of confinement of the fire plumes within the PBL. The use of this novel AQFR will aid in quantifying the health effects and can improve AQ forecasting models due to wildfire smoke.