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Supporting Information for

Atmospheric Convection and Aerosol Absorption Boost Wildfire Smoke Injection

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Introduction

This supporting information provides a comparative analysis of collocated smoke plume observations from CALIOP and MISR shown in Figure S1, a comparison between collocating CALIOP and MODIS within 1.0˚ and 0.5˚ pixels in Figure S2, and results of sensitivity experiments showing the contribution of AOD_{BC} and CAPE in the improvement of model performance in Table S1.

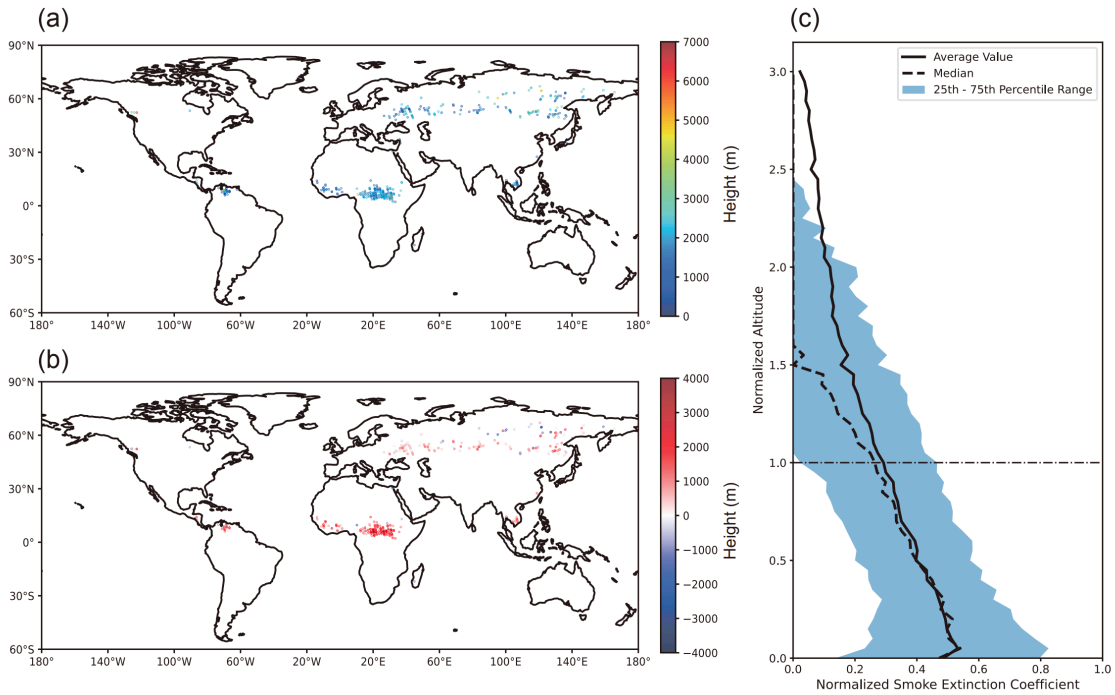

Figure S1. Comparison of CALIOP and MISR observations for collocated smoke cases. (**a**) MISR stereo height distribution map of matched cases between CALIOP and MISR observations (m a.m.s.l). (**b**) Height differences between CALIOP and MISR observations for these matched cases (m a.m.s.l). (**c**) Normalized smoke extinction coefficient profiles for the matched cases. In (**c**), the solid line represents the average value, the dashed line represents the median, and the shaded area indicates the 25th to 75th percentiles of the smoke extinction coefficient. The normalized altitude of 1.0 corresponds to the MISR-observed height. The normalized smoke extinction coefficient of 1.0 corresponds to the vertical maximum smoke extinction coefficient of each plume.

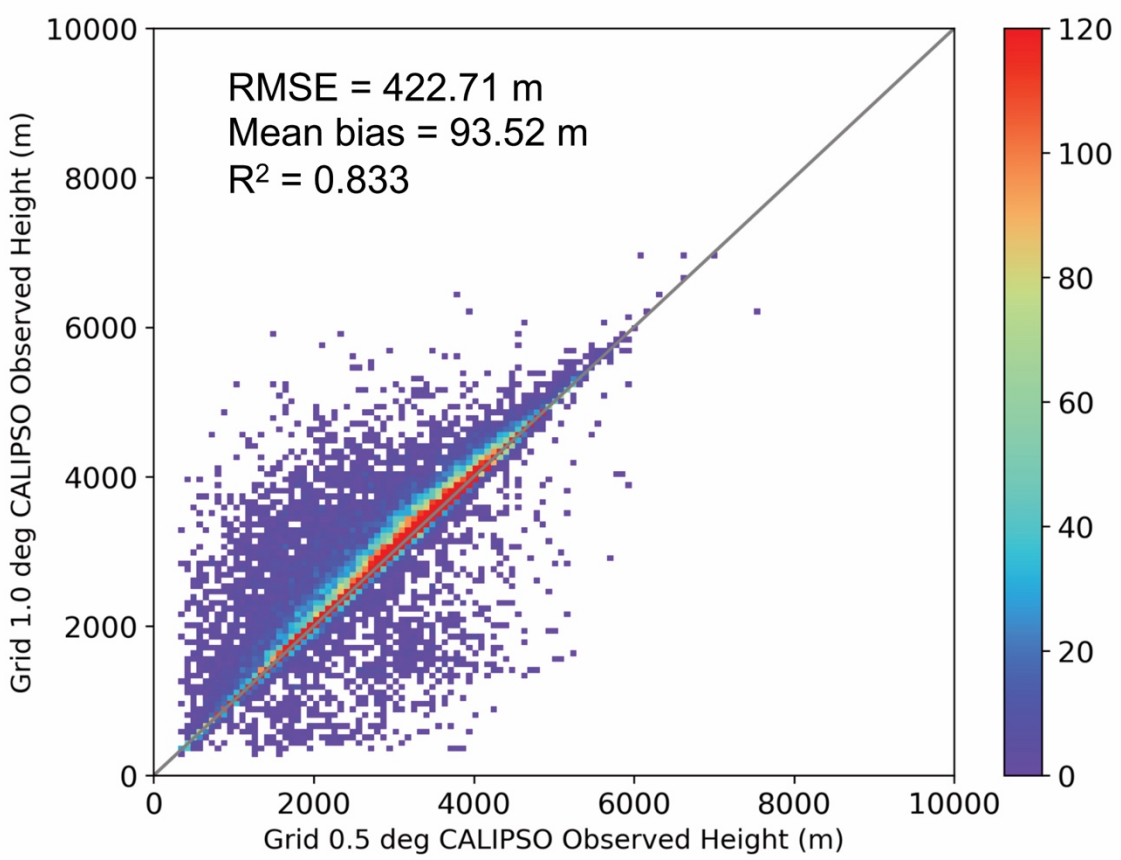

Figure S2. Joint occurrence (number of cases) of CALIOP height obtained from 0.5˚ and 1˚ pixels collocated over MODIS active fires.

Table S1. Contribution of AOD_{BC} and CAPE to the model performance improvement. In each set of simulation, the parameters are optimized using the RMSE-based loss function.

Purpose	Experiment setup	Formulas	RMSE (m)	Mean bias (m)	R^2
Benchmark	Sofiev model optimized using RMSE loss function	(2)	748.131	-31.249	0.458
Contribution of AOD_{BC}	Two-step model	(7) & (8)	674.324	-4.219	0.537
	Without AOD_{BC}	(7) & (8) without AOD_{BC}	739.396	-64.096	0.476
Contribution of CAPE	Two-step model where H_{detect} > LFC	(7) & (8)	729.224	-46.566	0.457
	Without CAPE where H_{detect} > LFC	(7) & (8) without CAPE	777.474	-273.030	0.459