Research brief
Summary of research paper published in Nature Communications titled: Biomass burning aerosols in most climate models are too absorbing

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In a recent paper published in the high-impact factor journal Nature Communications, data collected at the Welgegund atmospheric monitoring station was one of 12 observational datasets utilised in a study to quantify the uncertainty in the representation of biomass burning (BB) aerosol composition and optical properties in climate models. Biomass burning aerosol make up a majority of primary combustion aerosol emissions (Andreae, 2019), with the main sources of global BB mass being Africa (~52%), South America (~15%), Equatorial Asia (~10%), Boreal forests (~9%), and Australia (~7%) (Van der Werf et al., 2010). The composition, size, and mixing state of BB aerosols determine the optical properties of smoke plumes in the atmosphere, which in turn is a major factor in dictating how they perturb the energy balance in the earth system. Depending on the model, the top-of-the-atmosphere BB aerosol effect can range from cooling to warming.

By relating aerosol absorption relative to extinction and carbonaceous aerosol composition from 12 observational datasets to nine state-of-the-art Earth system models and chemical transport models, varying degrees of overestimation in BB aerosol absorptivity by these models were identified. Modifications to BB aerosol refractive index, size, and mixing state was made in the Community Atmosphere Model version 5 (CAM5), which improved the model in agreement with observational measurements. These improvements led to a global change in BB direct radiative effect of −0.07 W.m^{-2}, while regional changes of −2 W.m^{-2} in Africa, and −0.5 W.m^{-2} in South America and Temperate regions were observed. These findings suggest that current modeled BB contributes less to warming than previously thought, largely due to treatments of aerosol mixing state.

References

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