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Characterization of the Optical Properties of Biomass-Burning Aerosols in Two High Andean Cities, Huancayo and La Paz, and Their Effect on Radiative Forcing

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Atmospheric aerosols alter Earth's radiative balance and influence climate. Quantifying aerosol-induced radiative forcing remains challenging. We characterize optical properties of biomass-burning (BB) and non-biomass-burning (NB) aerosols and quantify BB radiative forcing at two AERONET sites in Huancayo (Peru) and La Paz (Bolivia) during 2015–2021. From AERONET data, we derive aerosol optical depth (AOD), Ångström exponent (AE), single-scattering albedo (SSA), and asymmetry parameter (ASY). We employ the SBDART model to calculate aerosol radiative forcing (ARF) on monthly and multiannual timescales. BB aerosols peak in September (AOD: 0.230 at Huancayo; 0.235 at La Paz), while NB aerosols reach maxima in September at Huancayo (0.109) and November at La Paz (0.104). AE values exceeding unity for BB aerosols indicate fine-mode dominance. Huancayo exhibited the highest BB ARF in November: +16.4 W m−2 at the top of the atmosphere (TOA), −18.6 W m−2 at the surface (BOA), and +35.1 W m−2 within the atmospheric column (ATM), driven by elevated AOD and scattering efficiency. At La Paz, where SSA data was available for September, BBARF values were significant (+15.16 at TOA, −17.52 at BOA, and +32.73 W m−2 within ATM). This underscores the importance of quantifying ARF, particularly over South America where data is scarce.

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