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Spatial and temporal heterogeneity in aerosol radiative effects over ecological area in south China: Composition and transmission implications

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Abstract: Ecological region in southern China has been perennially affected by monsoon climate and anthropogenic emissions, resulting in complex aerosol components and frequent long-range transport. In this study, a Santa Barbara DISORT Atmospheric Radiative Transfer (SBDART) model is applied to estimate aerosol radiative forcing (ARF) and multiple aerosol observation datasets is used to estimate the aerosol chemical components and optical properties. The aerosol loading and the radiative effects in the ecological region exhibited strong seasonal changes. The average major components (NH_4^+, NO_3^-, SO_4^{2-}) in Total water soluble ionic (TWSI) ,organic carbon (OC) concentration, the ratio of organic carbon to element carbon (OC/EC) and biogenic secondary organic aerosol (BSOA) tracers were 3.20±1.22 μg·m^{-3}, 2.19±1.39 μg·m^{-3}, 3.17 and 74.00±35.23 ng·m^{-3} in the dry season and 2.22±0.91 μg·m^{-3}, 3.14±1.62 μg·m^{-3}, 7.13 and 186.34±113.82 ng·m^{-3} in the wet season, respectively. The average radiative forcing at the top of atmosphere (TOA) is -11.73±11.36 W/m^2 and -0.41±10.08 W/m^2 in dry and wet season. When the aerosol single scattering albedo (SSA) less than 0.9, the retrieve frequency in wet season reached account for 75%. The increase of OC and BSOA transformed by forests in the wet season weaken the cooling effects. However, the dry season is mainly composed of anthropogenic inorganic aerosols, which enhances the scattering effect. The aerosol observation baseline also verified the seasonal variation of ARF in the ecological region. Driven by multiple factors such as meteorological conditions, emission sources, and the mixed state of particulate matter, the transport patterns of air masses in ecological area exhibits completely opposite affects to ARF.