Brown Carbon and Biomass Burning in the Philippines: A Decade of Satellite and Ground-Based Evidence (2012–2022)

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Abstract

Brown carbon (BrC) is a light-absorbing fraction of organic aerosol that can influence atmospheric radiation, visibility, and air quality, yet its long-term variability remains poorly characterized in the Philippines. This candidacy manuscript synthesizes decade-scale evidence (2012–2022) linking biomass-burning activity to BrC-relevant optical properties by integrating Philippine filter archives measured via multi-wavelength absorption with satellite fire products and meteorological context. The synthesis examines how emission type, transport pathways, atmospheric processing, and wet scavenging shape observed BrC signals across seasons and episodes. Building from this synthesis, the manuscript presents a meteorology-resolved framework to (i) establish national baseline BrC/BC optical indicators, (ii) identify burning-influenced BrC episodes, and (iii) assess meteorological controls that modulate BrC occurrence and intensity. The manuscript is organized into three parts: Chapter 1 reviews BrC and biomass-burning processes, Chapter 2 summarizes key observational tools and meteorological context, and Chapter 3 synthesizes Philippine evidence from 2012–2022 across local and transboundary smoke influences. These insights support a national assessment of BrC–biomass burning linkages in the Philippines and help inform monitoring and air-quality interpretation during air quality events.

Keywords: brown carbon, biomass burning, fire-weather interaction, satellite remote sensing, filter-based measurements