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Isotope constraints of the strong influence of biomass burning to climate-forcing Black Carbon aerosols over Southeast Asia

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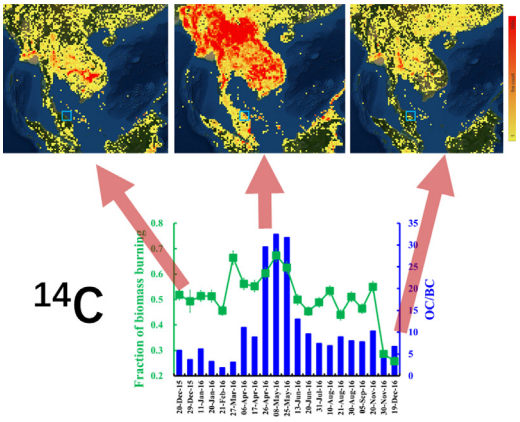
HIGHLIGHTS

- We performed a one-year sampling campaign for BC observation in a receptor site of SE Asia.
- ^{14}C measurements showed that ~50% of BC was contributed by biomass burning on average during the sampling period.
- The contribution of biomass burning in BC significantly increased in the spring season.

GRAPHICAL ABSTRACT



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ABSTRACT

Black Carbon (BC) deteriorates air quality and contributes to climate warming, yet its regionally- and seasonally-varying emission sources are poorly constrained. Here we employ natural abundance radiocarbon (^{14}C) measurements of BC intercepted at a northern Malaysia regional receptor site, Bachok, to quantify the relative biomass vs. fossil source contributions of atmospheric BC, in a first year-round study for SE Asia (December 2015–December 2016). The annual average ^{14}C signature suggests as large contributions from biomass burning as from fossil fuel combustion. This is similar to findings from analogous measurements at S Asian receptors sites (~50% biomass burning), while E Asia sites are dominated by fossil emission (~20% biomass burning). The ^{14}C-based source fingerprinting of BC in the dry spring season in SE Asia signals an even more elevated biomass burning contribution (~70% or even higher), presumably from forest, shrub and agricultural fires. This is consistent with this period showing also elevated ratio of organic carbon to BC (up from ~5 to 30) and estimates of BC emissions from satellite fire data. Hence, the present study emphasizes the importance of mitigating dry season vegetation fires in SE Asia.

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