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Trace gases and organic aerosol at a rural site in Vietnam during large scale biomass burning

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Open biomass burning (BB) is a globally widespread phenomenon. The fires release pollutants, which are harmful for human and ecosystem health and alter the Earth's radiative balance. Yet, the impact of various types of BB on the global radiative forcing remains poorly constrained concerning greenhouse gas emissions, BB organic aerosol (OA) chemical composition and related light absorbing properties. Fire emissions composition is influenced by multiple factors (e.g., fuel and thereby vegetation-type, fuel moisture, fire temperature, available oxygen). Due to regional variations in these parameters, studies in different world regions are needed. Here we investigate the influence of seasonally recurring BB on trace gas concentration and air quality at the regional Global Atmosphere Watch (GAW) station Pha Din (PDI) in rural Northwestern Vietnam. PDI is located in a sparsely populated area on the top of a hill (1466 m a.s.l.) and is well suited to study the large-scale fires on the Indochinese Peninsula, whose pollution plumes are frequently transported towards the site [1]. We present continuous trace gas observations of CO_2, CH_4, CO, and O_3 conducted at PDI since 2014 and interpret the data with atmospheric transport simulations. Annually recurrent large scale BB leads to hourly time-scale peaks CO mixing ratios at PDI of 1000 to 1500 ppb around every April since the start of data collection in 2014. We complement this analysis with carbonaceous $PM_{2.5}$ chemical composition analyzed during an intensive campaign in March-April 2015. This includes measurements of elemental and organic carbon (EC/OC) and more than 50 organic markers, such as sugars, PAHs, fatty acids and nitro-aromatics [2]. For the intensive campaign, we linked CO, CO_2, CH_4 and O_3 mixing ratios to a statistical classification of BB events, which is based on OA composition. We found increased CO and O_3 levels during medium and high BB influence during the intensive campaign. A backward trajectory analysis confirmed different source regions for the identified periods based on the OA cluster. Typically, cleaner air masses arrived from northeast, i.e., mainland China and Yellow sea during the intensive campaign. The more polluted periods were characterized by trajectories from southwest, with more continental recirculation of the medium cluster, and more westerly advection for the high cluster. These findings highlight that BB activities in Northern Southeast

Asia significantly enhances the regional OA loading, chemical $PM_{2.5}$ composition and the trace gases in northwestern Vietnam. The presented analysis adds valuable data on air quality in a region of scarce data availability.

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