Dangerous biomass burning emissions in highly populated regions in Vietnam

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Quantification of adverse particulate pollution is a serious problem in less-industrialized countries where environmental protection is low. Adverse health effects of air pollution and environment impacts of combustion aerosols are remaining underestimated, with a big concern in highly populated areas during dry season. Major primary national emission source of biomass burning is assessed by monitoring and characterization of smoke pollution arising due to traditional agricultural activities on the fields in the Asian region of the biggest biomass burning over the world. Measurement campaigns were performed in Son La and Ba Vi provinces, Vietnam, during the dry season of 2013 and 2015 (Popovicheva et al., 2016). PM and BC monitoring, sampling, chemical speciation, and individual particle characterization of particulate constitutes were conducted to evaluate ambient smoke levels, to relate the characteristics of local on-field emissions to regional aerosols, and to identify the bulk components of smoke and its microstructure.

The provinces Son La and Ba Vi in March-May faced severe levels of air pollution, with critical PM concentrations up to 250 μm/m^3, significantly exceeding the air quality standards. Figure 1 shows the numerous emissions on the fields and smoky atmosphere in Ba Vi in March 2015.

Fig.1. Rice-straw biomass burning activities on the fields of Ba Vi Province in May.

On the Son La observation site a wide range of PM mass concentrations was categorized according to the smoke level, supported by the evolution of carbon fractions (OC and EC) as well as ionic species and molecular tracers (K^+, levoglucosan, and mannosan). The OC/EC and individual organic compound ratios on days with high smoke levels indicated smoldering combustion of softwood biomass species, impacting aerosol composition at the regional level. Acid and non-acid carbonyls, carboxylates, and aliphatic carbon compounds were evolved with increasing smoke intensity, together with carbonates in coarse size fractions, indicating a large impact of smoke emissions and soil lifted up by the intense fires. Biomass burning influence increased the abundance of soot and organic particles in the submicron fraction from 12% at low to 59% and 68% at moderate and high smoke levels, respectively. Smoke micromarkers of local biomass burning source emissions determined the microstructure of ambient aerosols representative for northern Southeast Asia.

On-field emissions of piled-up rice-straw burning in both smoldering and flaming phases were analyzed in near-source measurements in the Ba Vi province. Monitoring of PM and black carbon (BC) concentrations was performed during the sampling at the observation Ba Vi site. The level of PM and BC concentrations was seen to be dependent on factors such as weather conditions and precipitation. Chemical analysis of local and regional PM10 samples identified carbonaceous fractions (OC, EC), ionic compounds, elements, and organic and inorganic components. Individual particle analyses provided the major groups comprising the smoke microstructure. Analysis of the collected data showed the environmentally-dangerous organic and inorganic pollutants for interpreting the impact of the sources of adverse PM in urban and rural areas of high population.

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