Chemical markers in urban $PM_{2.5}$ aerosol during and after festival-related burning activities

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Major fire events, festival-related burning and fireworks can cause vast amounts of pollutants, affect atmospheric environments and human health (Lin et al., 2014).

The Mid-Autumn Festival (MAF) is a harvest festival celebrated by Taiwanese and Chinese peoples. The festival is held on the 15th day of the eighth month in the Chinese lunar calendars, which equates to a day in September or early October. In Taiwan, the festival is celebrated by families across the island with evening barbecues under the full moon. During the autumn in Taiwan, interactions between the winter northeast monsoon, and the summer southwest monsoon, vary greatly and determine the local wind patterns. In addition to emissions from festival activity, the autumn air quality in Tainan is affected by other local emissions and the frontal meteorological northeast monsoon. Pollutants from mainland China may accompany the northeast monsoon via long-range transport. However, the aim of this study is to characterize the influence of MAF-related burning activities on the Tainan urban air quality in southern Taiwan and also to discern the influence of the northeast monsoon. Hence, $PM_{2.5}$ was examined in the period of MAF and in the period of moderate air quality (MAQ) after this. Potential sources of $PM_{2.5}$ during the periods were identified. Sampling occurred in 2011, between 7-15 September (MAF) and 15-27 September (MAQ).

Figure 1 illustrates the relationships among the concentrations of biomarkers for tracing biomass burning during the periods studied. Backward trajectories of air parcels depicted the influence on the atmospheric environment of Tainan and the emissions from large-scale fire locations in East Asia. During MAQ, the correlation coefficient (r) of the biomarkers levoglucosan and mannosan was 0.944, whereas during the festival periods r was 0.633, and the concentrations of levoglucosan and mannosan were significantly lower. The difference in r indicates a difference in the intensity of biomass burning during the MAF-related periods and the MAQ. Moreover, the concentration of levoglucosan was highly correlated with that of PO_4^{3-}, a plant essential nutrient, during MAQ (r= 0.922). Regarding the correlation between levoglucosan and soil microbial metabolites, the r value was 0.917 and 0.744 for the correlation with erythritol and galactose (Caseiro et al., 2007), respectively. Backward trajectories depicted in Figure 1 show that air currents passed through North China, the Central Plain, and the Yangtze River basin, China, before arriving in Tainan, and burning activities were detected in these regions during the periods investigated in this study. The high correlations between levoglucosan and the chemical species related to agriculture verified that emissions were produced by the biomass burning of agricultural wastes in China during the autumn, and soil microbial metabolites were also burnt and released into the atmosphere. The aerosols produced by the burning activities in China were transported to Tainan through air currents. Contrastively, these clean air currents from the oceans contained sea salts during the MAF-related periods, diluting the atmosphere of Tainan City and reducing the effect of emissions from biomass burning and festival activities.

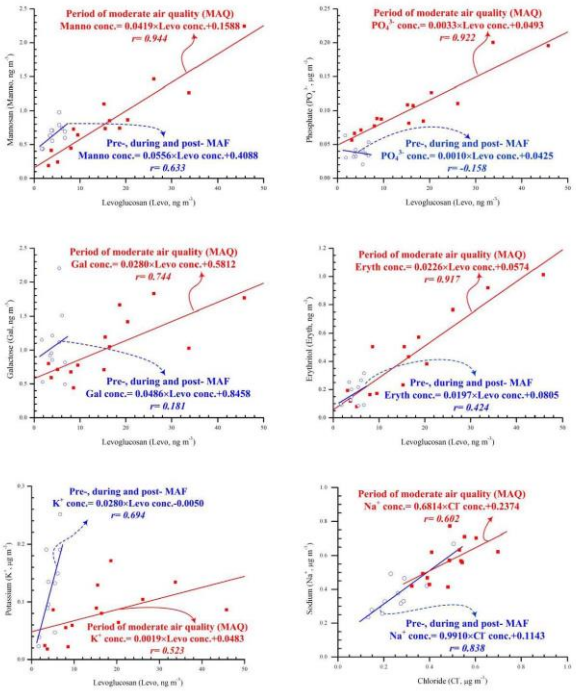

Fig. 1. Relationships of biomarkers in $PM_{2.5}$ for tracing biomass burning during the entire MAF and MAQ.

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