Chemical Characterization of Biomass-Burning Aerosols in Remote Northern Thailand

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Atmospheric particulate matter (PM) is importantly contributed from the marine pathway, biomass burning, agriculture burning, automotive exhaust emission and anthropogenic emission. Biomass burning is recognized as one of the major factors affecting the regional-to-global weather and climate. Anhydrosugars are the primary products from the thermal degradation of the cellulose and hemicellulose containing material, thereby there are tracers for PM from biomass burning. Forest fires produce large amounts of PM anhydrosugars (Tsai et al., 2013). Levoglucosan (Levo) in PM was the most dominant anhydrosugar species.

Air pollution in the northern Thailand is one of the most serious environmental problems in the region. Especially during the dry season of the year (December to March) ambient PM_{10} level in Chiang Mai is often exceeding the ambient air quality standards of 120 μg/m^3 for 24 hrs and 50 μg/m^3 for the annual average authorized by Pollution Control Department, Thailand. The major source of air pollution in the northern Thailand includes open burning such as biomass burning, agriculture waste burning and forest fires (Tsai et al., 2013). Meanwhile, the size distributions of PM are yet understood completely. The sampling site as well as fire spots of biomass burning derived from satellite data for sampling period were shown in Figure 1. The aerosol samples were collected at Doi Ang Khang (ca. 1900 m asl, a mountain site), Chiang Mai, Northern Thailand during 23 Feb.–7 April 2013, corresponding to the monsoonal dry season and a maximum in agricultural and forest fire activity, by using MOUDI and Nano MOUDI. Characteristics and provenance of saccharides in the mountain aerosols were investigated to identify the contribution of biomass burning.

The mass size distributions of PM with main inorganic salts and saccharides are shown in Figure 2. The mass distributions of PM mass and the corresponding inorganic salts and saccharides were dominated by the droplet mode, with a concentration peak in the size range of 0.1–2.5 μm significantly. Peak concentrations of Levo occurred at 0.54 μm. The peak concentrations of erythritol and arabitol, which can act as indicators for soil biota, fungi and lichens, were in the size range of 1.8–10 μm. The mountain aerosols were contributed by the emission from biomass burning and biogenic activity of forest. Additionally, peak concentrations of photochemical sulphate and ammonium also occurred at 0.54 μm. The high correlation with the correlation coefficient of 0.99 between size-segregated sulphate and ammonium suggested the significant contribution of photochemical products to the mountain ambient environment. An accordant result indicated biomass burning, biogenic activity and photochemical products of anthropogenic activity were mainly sources of PM at Doi Ang Khang.

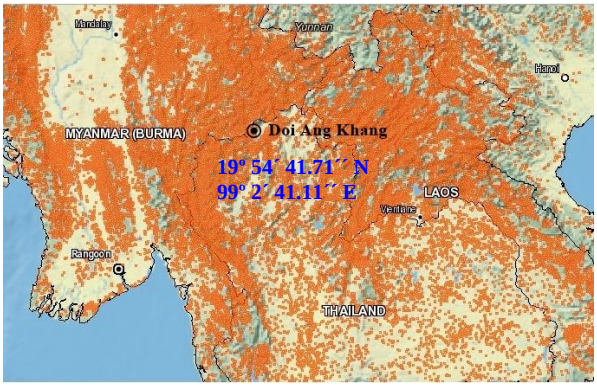

Figure 1. The fire spots and sampling site at Doi Ang Khang, Chiang Mai, Thailand in March, 2013 (http://maps.geog.umd.edu/firms).

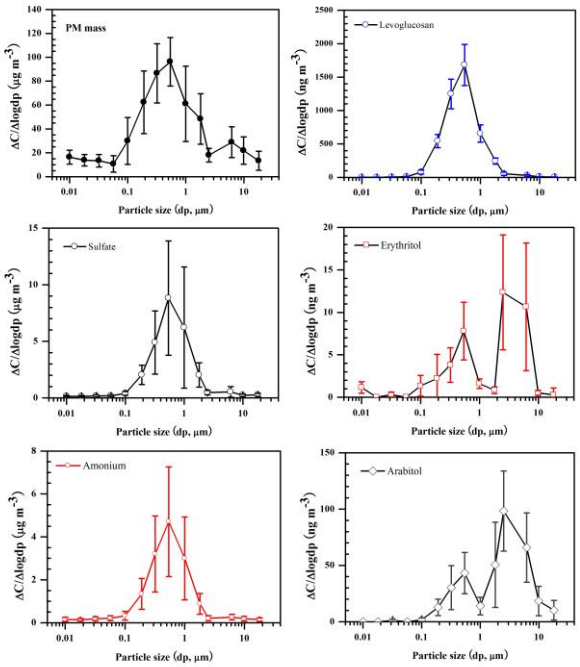

Figure 2. Mean size distributions of PM mass and the related species at Doi Ang Khang, Thailand.

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