Source apportionment of ten years' aerosol collected at Mt. Lulin in East Asia

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Biomass burning (BB) in Indochina draws a great attention because its plume spreads in a regional scale to cause significant effects on solar radiation budget in East Asia (Street et al., 2003). Taiwan is located downstream of the prevailing westerly for receiving the air masses transported from BB source area in Indochina.

Atmospheric aerosol has been collected at Mt. Lulin (2,862 m a.s.l.) from 2003 to 2012. Comprehensive aerosol properties were resolved for $PM_{2.5}$ water-soluble ions, carbonaceous content (using the U.S. IMPROVE protocol), water-soluble/insoluble organic carbons (WSOC/WIOC), low-molecular-weight dicarboxylates (C2-C5), and monosaccharide anhydrides. In this study, K^+, NO_3^-, levoglucosan, OC3, and EC1-OP of $PM_{2.5}$ were found enhanced greatly in the transported BB plume than that of Non-BB (NBB). The aforementioned aerosol species are thus used as tracers to represent BB source contributions.

To apportion source contributions of aerosol to Mt. Lulin, a statistical method Positive Matrix Factorization (PMF) (USEPA, 2008) was adopted. Figure 1 shows that six major source types are identified for the air masses transported from BB source region during BB period. When arranged in terms of $PM_{2.5}$ contribution from high to low, these source types are secondary sulfate plus WSOM plus BB (28.7%), BB plus organic matter (OM) plus soil (25.4%), BB plus WSOM (17.6%), secondary aerosol plus dicarboxylates plus BB (12%), WSOM plus BB plus Diesel emissions (10.0%), and secondary aerosol plus sea salt (6.2%).

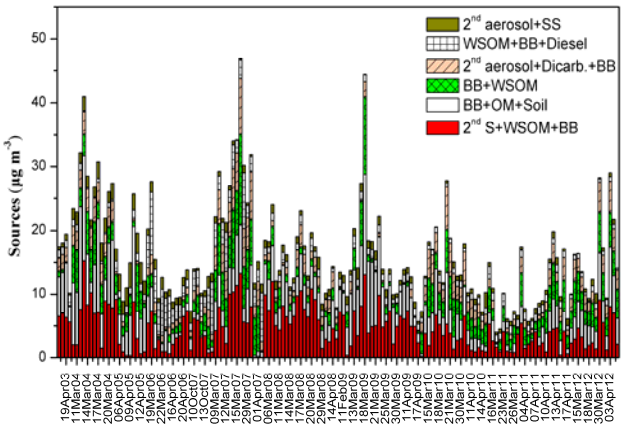

Figure 1. Time series of source contributions to the aerosol collected at Mt. Lulin for the air masses transported from BB source region during BB period.

It is noted that 93.8% of $PM_{2.5}$ mass concentration is contributed from BB source region during BB period. This confirms the consistency between PMF source apportionment and trajectory classification for the transported BB aerosol. It also implies that BB plume was mixed with other air masses during its transport before reaching the downstream Mt. Lulin site.

In contrast, WSOM, secondary sulfate, and OM contributed more than other sources to $PM_{2.5}$ during NBB period. The air masses were mostly originated from ocean (including Pacific Ocean and South China Sea) except for some mixing with marine and anthropogenic primary pollutants transported from the coastline of China mainland to the Mt. Lulin site.

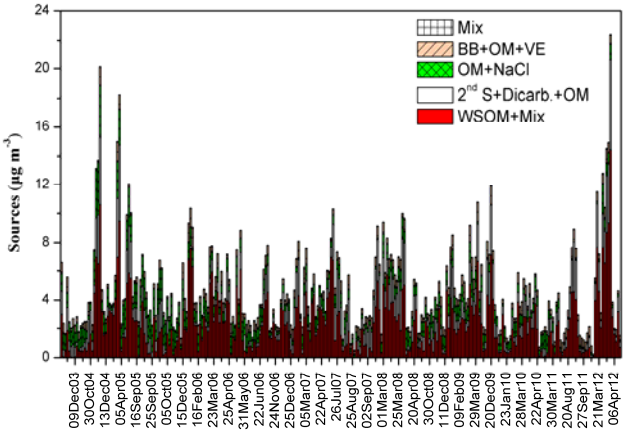

Figure 2. Time series of source contributions to the aerosol collected at Mt. Lulin for the air masses transported from non-BB source region.

In summary, ten years' aerosol data collected at Mt. Lulin shows that the air masses in the free atmosphere are enriched with organic aerosol. Meanwhile, aerosol source apportionment indicates that BB plume could mix with other minor sources during long-range transport and NBB air masses mainly contain secondary aerosol.

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USEPA (2008) EPA Positive Matrix Factorization (PMF) 3.0 Office of Research and Development, U.S. Environmental Protection Agency.