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Semi-continuous measurements of water-soluble inorganic ions over a high-altitude background site in central Taiwan

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To better understand the abundance and sources of water-soluble inorganic ions (WSIIs), semi-continuous measurements of WSIIs were performed during autumn 2015 and spring 2016 at a high-altitude background station (2,862 m above sea level) on the summit of Mt. Lulin in central Taiwan. During autumn, the mass concentration of $PM_{2.5}$, major WSIIs, and CO increased significantly from 12:00 to 18:00 hrs local standard time (LST), whereas the visibility and concentration of O_3 decreased at the same time. The backward trajectories analyses showed that the sampling site was under the influence of lifted air masses by the upslope wind from 12:00 to 18:00 hrs. Thus the mountain-valley (M-V) circulation could be the major driving force for the observed aerosol diurnal patterns over the study region during autumn. In sharp contrast to autumn, five high aerosol loading events were observed during spring with each event lasting for a few days. These events were synchronized with the long-range transport of biomass burning (BB) smoke emissions from the Indochina region, as revealed from the fire count map and backward trajectories. The plumes appear to mask their characteristic diurnal features that are driven by the local M-V circulation. These plumes also affected the acidity of ambient aerosol. During BB events, aerosol was found to be relatively more alkaline in nature as revealed by higher molar ratio of $[NH_4^+]_{calc}/[NH_4^+]_{meas}$ during BB events (0.88 ± 0.25) than that of the whole spring season (0.81 ± 0.33). The third BB event (BB3), March 29 to April 04, 2016, was the most prominent one among all BB events. During BB3, the mass concentration of $PM_{2.5}$, NH_4^+, K^+, NO_3^- and SO_4^{2-} increased from 8.3 to 29, 0.01 to 2.0, 0.02 to 0.4, 0.01 to 1.6, and 0.4 to 4.1 μg m^{-3}, respectively as compared to before the event. A fog event (March 31; 0:00 to 10:00 LST) was also observed during the BB3 event that decreased the mass concentration of all the species significantly. It suggested that aerosol scavenging and cloud-active processing may occur in this fog event.