Polychlorinated dibenzo-p-dioxin and dibenzofurans (PCDD/Fs) in cloud water collected on Mt. Bamboo in northern Taiwan during the northeast monsoon season

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Polychlorinated dibenzo-p-dioxin and dibenzofurans (PCDD/Fs) are considered as a group of persistent and bioaccumulative toxicants which drawn lots of attention. PCDD/Fs can transport through atmospheric long-range transport from where anthropogenic sources were, including biomass burning, automobile emission, and incinerators, to remote regions.

In this study, cloud water samples were collected on Mt. Bamboo, in Yangmingshan national park, in northern Taiwan. The sample site is often immersed in clouds, which formed primarily due to north-easterly monsoonal flow during winter season. When a northerly flow prevails during cloud events, the cloud water collected at this site is typically not contaminated by local anthropogenic emissions (Sheu and Lin, 2011). Cloud water samplings were conducted during January 26th to March 5th, 2015 by using two cloud water samplers placed next to each other. The two individual cloud water samples were then combined into one to reach 20 litres due to the low solubility of PCDD/Fs in water and detection limit of PCDD/Fs. The samples were divided by cloud events, and a total nine events were collected during the sampling time, which can be ranging from 17 hours to 58 hours, with a mean of 34 hours. PCDD/Fs were analyzed by HRGC/HRMS.

The total suspended particles (TSP) concentrations and PCDD/Fs TEQ concentrations in the nine cloud water samples were depicted in Fig. 1. The TSP concentrations ranged from 0.03 mg/L to 0.28 mg/L except for sample G, which was 2.38 mg/L. The trend of PCDD/F concentrations in cloud water seems to not consistent with that of TSP concentrations. For example, the sample G had the extremely high TSP concentration (2.38 mg/L) and also high TEQ concentration (1.60 pg WHO-TEQ/L), while the subsequent sample H had the common TSP concentration (0.15 mg/L) but highest TEQ concentration (2.52 pg WHO-TEQ/L). The reason should be related to the origins and transport paths of air masses that arrived at Mt. Bamboo. Our previous study showed the air masses could pass and/or remain over eastern, central, and southern China, the major coal burning regions, or they could origin from Mongolia, passing over northern China, the Yellow Sea, and the East China Sea, before arriving at Mt. Bamboo. On the other hand, air masses could also transport from marine air (Sheu and Lin, 2011).

No matter which samples, the cloud water collected during northeastern monsoon were dominated by particulate phase PCDD/Fs, as shown in Fig. 2. The trend of the contributed percentages of particulate phase PCDD/Fs was consistent with that of PCDD/F TEQ concentrations in the cloud water. Samples G and H had the highest PCDD/F TEQ concentrations and greater contributions from particulate phase PCDD/Fs, while Samples D and E had the lowest PCDD/F TEQ concentrations and also lowest particulate phase PCDD/F percentages. In conclusion, the origin and transport paths of fine particles that finally arrived at Mt. Bamboo should be the decisive factor affecting the PCDD/F concentrations in the cloud water because the fine particles were usually combustion-originated and their high specific surface area was also favourable for the adsorption of gaseous PCDD/Fs during long-range transport.

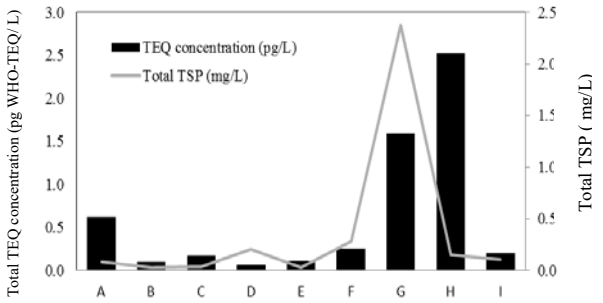

Figure 1. Total TEQ concentration (pg WHO-TEQ/L) and TSP concentration (mg/L) in cloud water

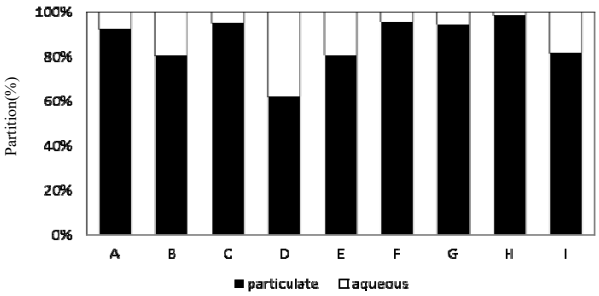

Figure 2. Percentage of particulate and aqueous phase PCDD/Fs in cloud water

References

Sheu, G. R., & Lin, N. H. (2011). *Atmos Environ*, 45(26), 4454-4462.