Inter-Annual Variations of Wet Deposition in Beijing from 2014–2017: Implications of Below-Cloud Scavenging of Inorganic Aerosols

Baozhu Ge

Institute of Atmospheric Physics, Chinese Academy of Sciences, China

Author list (excluding presenting author)

Danhui Xu, OliverWild, Xuefeng Yao, Junhua Wang, Xueshun Chen, Qixin Tan, Xiaole Pan, ZifaWang

Abstract

Wet scavenging is an efficient pathway for the removal of particulate matter (PM) from the atmosphere. High levels of PM have been a major cause of air pollution in Beijing but have decreased sharply under the Air Pollution Prevention and Control Action Plan launched in 2013. In this study, four years of observations of wet deposition have been conducted using a sequential sampling technique to investigate the detailed variation in chemical components through each rainfall event. We find that the major ions, SO_4^{2-}, Ca^{2+}, NO_3^- and NH_4^+, show significant decreases over the 2013-2017 period (decreasing by 39%, 35%, 12% and 25%, respectively), revealing the impacts of the Action Plan. An improved method of estimating the below-cloud scavenging proportion based on sequential sampling is developed and implemented to estimate the contribution of below-cloud and in-cloud wet deposition over the four-year period. Overall, the below-cloud scavenging plays a dominant role to the wet deposition of four major ions at the beginning of the Action Plan. The contribution of below-cloud scavenging for Ca^{2+}, SO_4^{2-} and NH_4^+ decreases from above 50% in 2014 to below 40% in 2017. This suggests that the Action Plan has mitigated PM pollution in the surface layer and hence decreased scavenging due to the washout process. In contrast, we find little change in the annual volume weighted average concentration for NO_3^- where the contribution from below-cloud scavenging remains at ~44% over the period 2015-2017. While highlighting the importance of different wet scavenging processes, this paper presents a unique new perspective on the effects of the Action Plan and clearly identifies oxidized nitrogen species as a major target for future air pollution controls.

Early Career Scientist

NO, I am not an early career scientist.