# "APEC Blue": How Emission Controls Impacted Aerosol Composition, Sources, Formation and Optical Properties

During the 2014 Asia-Pacific Economic Cooperation (APEC) summit, Beijing and its surrounding regions implemented strict emission control measures to ensure good air quality. However, how these emission controls affect the chemical composition, sources and formation mechanisms of fine particles under variable meteorological conditions remains less understood. Dr. SUN Yele from the Institute of Atmospheric Physics, Chinese Academy of Sciences and collaborators conducted synchronous aerosol particle measurements with two aerosol mass spectrometers at two heights, i.e., ground level and 260 m on the Beijing 325-m meteorological tower to investigate the variations in particulate composition, sources and size distributions in response to emission controls.

Dr. SUN found that the blue sky days during the APEC ("APEC Blue") were mainly caused by the consistently large reductions in secondary inorganic aerosol of 61–67% and 51–57%, and in secondary organic aerosol of 55% and 37%, at 260 m and ground level, respectively. These changes were mainly caused by large reductions in accumulation mode particles and by suppression of the growth of SIA and SOA by a factor of 2–3. Dr. SUN also observed an important role of the mountain-valley breeze circulation in mitigating particulate matter (PM) levels during the APEC.


Another important finding is the substantially different aerosol composition between ground level and 260 m. They found that the reductions of primary and secondary aerosol species at 260 m were similar despite the emission controls, whereas the concentration of primary species at the ground site showed small changes. These results have significant implications by highlighting the importance of aerosol particle composition measurements at high altitudes for investigating the effects of regional transport.

Dr. SUN also found that aerosol composition change during the APEC exerted a large impact on optical properties. While single-scattering albedo remained relatively unchanged during the APEC, the mass scattering efficiency of PM was decreased from 4.7$m^2$ $g^{-1}$ to 3.5 $m^2$ $g^{-1}$. They further established an empirical relationship between chemical composition and particle extinction using a multiple linear regression model. Their results showed the largest contribution of ammonium nitrate to particle extinction (35.1% and 29.3% before and during the APEC, respectively), highlighting the important role of ammonium nitrate in the formation of severe haze pollution.

Dr. SUN proposed a conceptual framework for describing the evolution of primary and secondary species under the conditions with and without emission controls. Their results showed that regional transport contributes 66–80% of the PM pollution during normal two-day pollution episodes and still as much as 44–57% with the emission controls during the APEC. Dr. SUN's findings highlight the importance of regional atmospheric transport in the formation of severe pollution episodes in Beijing.

Overall, the studies by Sun et al. provide direct evidence that reducing the precursors of secondary aerosol over regional scales is the most effective approach to suppress the formation of secondary particulates and hence to mitigate particulate matter pollution in Beijing.