

Variability in CCN activity of atmospheric aerosols in the North China related to mitigation of SO₂ emissions and occurrence of strong El Niño

JIAJIA QI¹, XIAOHONG YAO^{1,2,*}

¹Key Lab of Marine Environmental Science and Ecology,
Ministry of Education, Ocean University of China, Qingdao
266100, China

²Qingdao Collaborative Center of Marine Science and
Technology, Qingdao 266100, China

In the last two years, SO₂ emissions were reduced by ~20% in the North China. Strong El Niño occurred in 2015, leading to a warmer and more humid, but more polluted winter. The two factors are expected to greatly affect cloud condensation nuclei (CCN) activity of atmospheric aerosols, which were investigated by comparing measurements made in winter 2015 and in winter 2013 at a semi-urban site of Qingdao in the North China. Concentrations of CCN during a heating period from 29 November to 29 December 2015 were 0.4±0.3 (mean ± standard deviation), 0.8±0.4, 1.7±0.7, 5.0±1.5, 9.0±2.6 in unit of ×10³cm⁻³ at super-saturation (SS) of 0.05%, 0.1%, 0.2%, 0.4% and 0.6%, respectively. The corresponding CCN activities were 0.02±0.02, 0.04±0.03, 0.09±0.06, 0.26±0.13, 0.45±0.21, respectively. The frequency to observe SO₂-rich plumes significantly reduced relative to the observations in winter 2013. However, the CCN activities of aerosols in SO₂-rich plumes were larger in 2015 at SS of 0.2%, 0.4% and 0.6% than those in 2013 because of the existence of larger dominant particle mode at 136±47 nm.

A wet-haze pollution event lasted for six days on 20-26 December due to a weak weather system caused by El Niño. During the event, concentrations of CCN were 0.8±0.3, 1.3±0.4, 2.4±0.5, 5.8±0.9, 10±1.6 in unit of ×10³ cm⁻³ at SS of 0.05%, 0.1%, 0.2%, 0.4% and 0.6%, respectively. The ARs at most SS were larger than those at lower SS and the difference gradually narrowed down with increasing SS. However, the AR values at SS<0.04% both in wet-haze and dry haze events in 2015 were smaller than those in 2013. The complicated results were discussed in terms several factors to determine the AR values.