Direct observation of chemical modification of Asian Dust particles during long-range transport

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In our previous works [1-3], it was clearly demonstrated that the combined use of quantitative energy-dispersive electron probe X-ray microanalysis (ED-EPMA), known as low-*Z* particle EPMA, and attenuated total reflectance FT-IR (ATR-FT-IR) imaging technique had the great potential for detailed characterization of individual aerosol particles. In this work, individual Asian Dust particles collected during an Asian dust storm event occurred on Nov. 11, 2002 in Korea were characterized by the combined use of low-*Z* particle EPMA and ATR-FT-IR imaging technique. By the combined use of the two single-particle analytical techniques on the same individual particles, it was observed that Asian Dust particles had experienced extensive chemical modification during long-range transport, through heterogeneous reactions with nitrogen or sulfur oxide species resulting in nitrate and/or sulfate formations, respectively. On the basis of information on their morphology, elemental concentrations, and functional groups of individual particles available from the two analytical techniques, overall 109 individual particles were classified into four particle types: Ca-containing (38%); $NaNO_3$-containing (30%); silicate (23%); and miscellaneous particles (9%). Among overall 41 Ca-containing particles, the numbers of particles containing nitrate, sulfate, and both are 14, 8, and 17, respectively, whereas the number of unreacted $CaCO_3$ particles is just 2, clearly demonstrating that the Asian Dust particles had extensively experienced heterogeneous reactions during long-range transport. The combined use of the two single particle analytical techniques could provide detailed information on their physicochemical characteristics of individual Asian Dust particles, and thus the identification of airborne amorphous phase calcium carbonate particles and nitrite species in aerosol phase, and mineralogy of silicate particles on a single particle basis could be performed.

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The gully nitrogen migration and flux at northern China city

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Research Object and Results

Yitong River at a representative northern China city, Changchun, was selected as research object. We quantitatively investigated the migration path and flux of nitrogen at gully region in the city under rapid urbanization process.

The results showed that at Yitong River basin, the total nitrogen input flux was 188 kg/hm^2, following the sequence of fertilizer input> biological immobilization> feed> atmospheric deposition. the total nitrogen output flux was 102.5kg/hm^2, following the sequence of products> waste output> denitrification> surface runoff. the net nitrogen storage was 85.5kg/hm^2. The migration path and flux of nitrogen were obviously by human activities, showing an imbalance of input and output and a tendency of nitrogen accumulation and pollution.

Discussion of Results

Nitrogen migration is a combined effect from meteorology, hydrology, topography and agricultural practices, among which rainfall is the key driving force [1]. The material input and migration directly impact nutrient loss [2].

Under the background of globalization, the nitrogen migration and the biogeochemical processes become extremely complex due to the coupling effects from interfering and natural factors [3], the knowledge about nitrogen source and destination is still very limited, China is localized at monsoon area, where the highest rate of environmental change occurs. Thus, long-term monitoring and modeling regarding entire watershed ecosystem as a whole and quantitative analysis of the coupling mechanism of human activity and natural processes are required. This will provide theoretical support for the healthy evolution and development of cities.

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