Concentration distribution of atmospheric particulate nitrogen and phosphorus over the North Pacific Ocean

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Introduction

Atmospheric deposition of long-range transport of nitrogen and phosphorus from continents to ocean may have profound impact on marine biogeochemistry. To probe the distribution characteristics of concentrations and compositions of nitrogen and phosphorus in marine aerosols, samples were collected during the cruise in the autumn of 2019 from the coast of China through the Yellow Sea and the East China Sea to the northwestern Pacific Ocean. We measured the concentrations of different forms of nitrogen and phosphorus species and discussed the impact of Asian dust events on the nitrogen and phosphorus species in aerosols, which helps us to understand the formation, transformation and transmission mechanism of nitrogen and phosphorus species in the biogeochemical cycle, and also could clarify the impact of atmospheric nitrogen and phosphorus inputs on marine ecosystems.

Methodology

Sampling: 14 sets of Total Suspended Particles (TSP) samples, including 3 samples affected by dust events, were collected using KC-1000 high-volume aerosol sampler (Qingdao Laoshan Electronics Co., Ltd., China) at an airflow rate of 1.05 m$^3$ min$^{-1}$ during a round-trip cruise in the December 2019 from the eastern China seas (ECSs: the Yellow Sea and the East China Sea) to the northwestern Pacific Ocean (NWPO).

Analyzing: The analysis methods of nitrogen and phosphorus species are as following:

- $\text{DON} = \text{DTN} - \text{DIN}$
- $\text{DOP} = \text{DIN} - \text{DTP}$
- $\text{DIN} = \text{NO}_3^- + \text{NH}_4^+ + \text{NO}_2^- + \text{N}$

Results and discussion

**Part 1: Concentrations of nitrogen and phosphorus species in the marine aerosols during the non-dust events.**

<table>
<thead>
<tr>
<th>Sample category</th>
<th>DIN (μg·m$^{-3}$)</th>
<th>DTN (μg·m$^{-3}$)</th>
<th>TN (μg·m$^{-3}$)</th>
<th>DIP (μg·m$^{-3}$)</th>
<th>DTP (μg·m$^{-3}$)</th>
<th>TP (μg·m$^{-3}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSs</td>
<td>1.42±0.34</td>
<td>1.53±0.39</td>
<td>1.82±0.27</td>
<td>1.34±0.50</td>
<td>3.44±0.83</td>
<td>4.88±0.71</td>
</tr>
<tr>
<td>NWPO</td>
<td>0.50±0.20</td>
<td>0.33±0.21</td>
<td>0.45±0.25</td>
<td>0.61±0.69</td>
<td>1.75±1.90</td>
<td>3.36±2.45</td>
</tr>
</tbody>
</table>

The geographical distribution of non-dust aerosols concentrations of nitrogen and phosphorus species observed during the cruise in the ECSs and NWPO.

The concentrations of nitrogen and phosphorus species gradually decreased due to the increase of distance from shore.

The analysis of backward trajectory shows that the source of air mass may have some effect on the concentrations of nitrogen and phosphorus in aerosols.

**Part 2: Influence of dust weather on nitrogen and phosphorus**

**Acknowledgments**

This work was supported by the National Natural Science Foundation of China (NSFC) under grant Nos. 41775148 and U1906215 and the Fundamental Research Funds for the Central Universities (No. 201760606).

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Conclusions

1. The concentrations of nitrogen and phosphorus species gradually decreased due to the increase of distance from shore.
2. The analysis of backward trajectory shows that the source of air mass may have some effect on the concentrations of nitrogen and phosphorus in the aerosols.
3. During the dust period, the concentrations of nitrogen and phosphorus species gradually decreased due to the increase of distance between sample location and shore, but the contribution of DTN to TN and DTP to TP gradually increased, which meant that dust aerosols could be an important nutrient source in some remote regions.