Quantifying Anthropogenic Emissions of Iron in Marine Aerosol in the Northwest Pacific with Shipborne Online Measurements

Tianle Zhang

College of Environmental Sciences and Engineering, Peking University, China

Author list (excluding presenting author)

Junyi Liu, Qi Ying, Mei Zheng

Abstract

The sources and deposition of iron (Fe) in marine aerosol have been widely studied over the past few decades in order to understand its role and impacts on marine ecosystem and global climate change. Previous studies to quantify anthropogenic Fe in marine aerosol mainly rely on modeling, but it is hard to verify model results due to the lack of measurement data. Such information is especially needed in the Northwest Pacific, where aerosol has been significantly affected by anthropogenic emissions from East Asia but observational data are limited. In this study, online multi-element measurements and Positive Matrix Factorization (PMF) receptor model are combined to quantify anthropogenic sources of Fe in marine aerosol in the Northwest Pacific based on three cruises from 2021 to 2022. Besides, this study develops a new method to quantify dust and anthropogenic sources of soluble Fe, which combines Fe source apportionment results by PMF and Fe solubility from different emission sources.Based on the proposed new method, the contribution of dust source, land anthropogenic source, and shipping source to total Fe and soluble Fe in marine aerosol has been quantified. The results show dust source is the main contributor to total Fe in aerosol in the Northwest Pacific, especially in open sea areas where the average contribution exceeds 70%. However, anthropogenic emissions are dominant sources of soluble Fe, with an average contribution of over 80% in different sea areas. Furthermore, it should be noted that in summer, the contribution of shipping source could reach 61-77%, becoming the main source of soluble Fe in marine aerosol. This study develops a new way to assess the impacts of human activities on marine aerosol, and serves as an important basis for future study of anthropogenic influence on marine productivity through providing soluble Fe in the Asian continental outflow regions.

Early Career Scientist

YES, I am an early career scientist.

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