

New nitrogen cycle image in the atmospheric-ocean boundary layer induced by lightning discharge

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Abstract

Lightning discharge is one of the important phenomena in atmospheric chemistry because it promotes oxidation of nitrogen in the atmosphere and is a major factor in production of nitrogen oxides derived from nature. It is known the lightning discharge occurs frequently not only in land areas but also in sea areas. In addition, tropical and subtropical sea areas, which are known as oligotrophic sea areas, are areas where the lightning discharge is particularly frequent. Recent studies have predicted an increase in the lightning discharge due to global warming and increasing in particle emissions from ships, resulting in enhancement of oceanic primary production. Consequently, the amount of nitrogen oxides deposited to the sea, which is the main nutrient supporting oceanic productivity, may increase.

Therefore, in this study, we simulated the lightning discharge near sea surface by artificial plasma discharge with various environmental factors in laboratory, and evaluated the generation/consumption of nitrogen oxides.

As a result of laboratory experiments, we confirmed that nitrogen oxides are produced by the plasma discharge significantly. In addition, based on the results, we estimated effects of the lightning discharge in a wide area of oligotrophic waters and we suggested the lightning discharge may locally activate biological production.

Key words: lightning discharge, nitrogen fixation, oligotrophic sea areas