Press Releases

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JAMSTEC
Kobe University
National Institute for Environmental Studies

Atmospheric PM2.5 Nitrogen Components Increase Phytoplankton Levels - A link between atmospheric matter and ocean ecosystems -

1.Overview
Nitrogen compounds emitted from East Asia, including atmospheric PM2.5 aerosol particles*, play a significant role in increasing the amount of phytoplankton in the western North Pacific subtropical area. This new result was determined by numerical simulations and satellite data analysis in a study led by Dr. Fumikazu Taketani of the Research and Development Center for Global Change at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC: Asahiko Taira, President) in cooperation with Kobe University and the National Institute for Environmental Studies.

Nutrients such as nitrogen compounds, which control the amount of phytoplankton near the ocean's surface, are mostly supplied by deep ocean circulation (Figure 1). However, in the western North Pacific subtropical area, the amount of nutrients supplied to the ocean's surface in this manner is extremely small, indicating the importance of nutrients sourced from the atmosphere instead. Until now, the effects of the nutrient supply process from the atmosphere have only been estimated based on the amount of nutrients deposited into the ocean; quantitative evaluations considering marine ecosystems as well have not been previously undertaken.

To better understand this process, the research team developed improved numerical models by combining atmospheric chemical transport models and marine ecosystem models. Next, they ran these models on JAMSTEC's Earth Simulator supercomputer to accurately estimate the response of phytoplankton in the western North Pacific to deposition of nitrogen compounds emitted in East Asia (Figure 2).

The results show that the amount of phytoplankton near the surface of the western North Pacific subtropical area is 2.3 times larger when the supply of nitrogen compounds from the atmosphere is taken into consideration, consistent with the estimations from satellite analysis (Figure 3). This indicates that the nitrogen compounds in PM2.5 are likely to play an important role in increasing the amount of phytoplankton in the western North Pacific subtropical area. These findings are the first to clarify this direct relationship between atmospheric matter and marine ecosystems.

Dr. Taketani says, "*With the accumulation of more observation data, we will continue further investigations to identify how changes in the absorption of carbon dioxide and the amount of zooplankton are influenced by the supply of atmospheric nitrogen compounds.*"

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The above results were published in *Scientific Reports* on June 29, 2018 (JST).
Title: Seasonal Response of North Western Pacific Marine Ecosystems to Deposition of Atmospheric Inorganic Nitrogen Compounds from East Asia

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*Aerosol particles: Liquid and solid particles suspended in the atmosphere. PM2.5 is a general term for such particles that are less than 2.5 ㎛ in diameter.

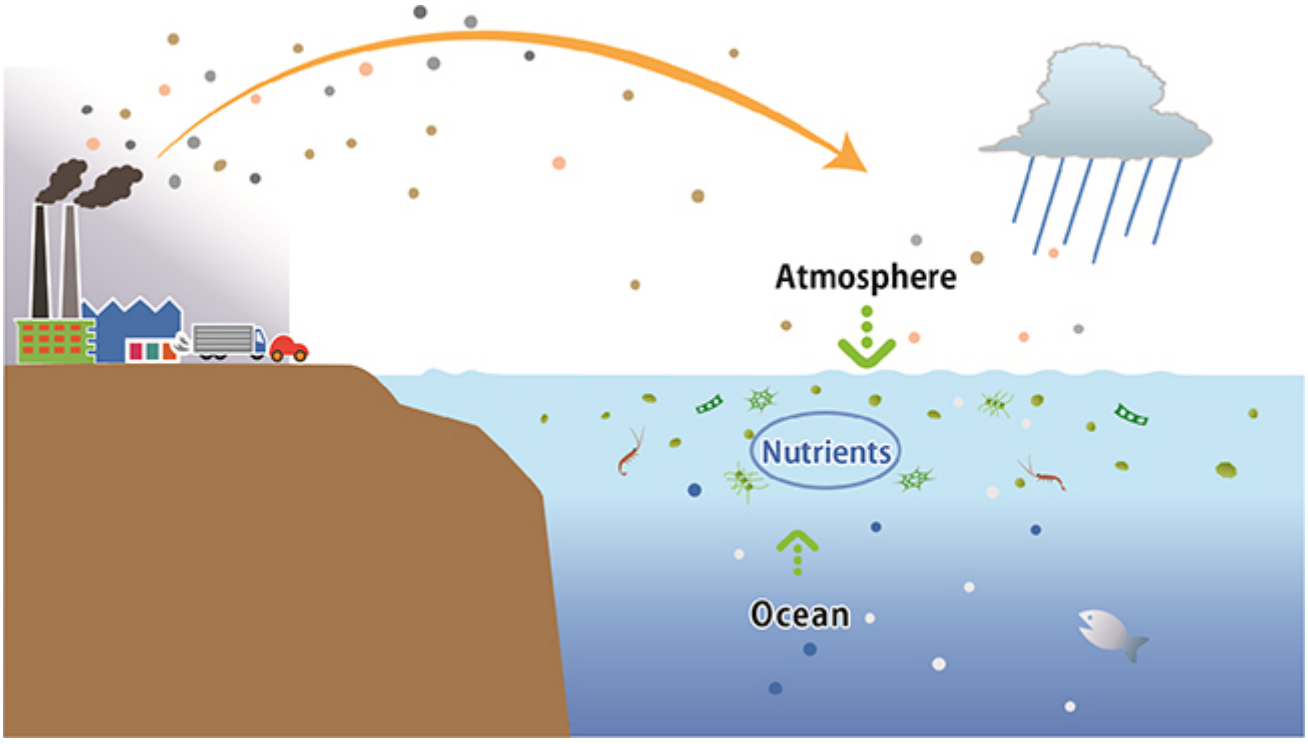

Figure 1. Schematic diagram of processes supplying nutrients to the ocean's surface, including atmospheric deposition and ocean circulation; these control the concentration of phytoplankton. This study foucused on nitrogen compounds (nitrates, ammonium, etc.) in the PM2.5 matter transported to the western North Pacific.

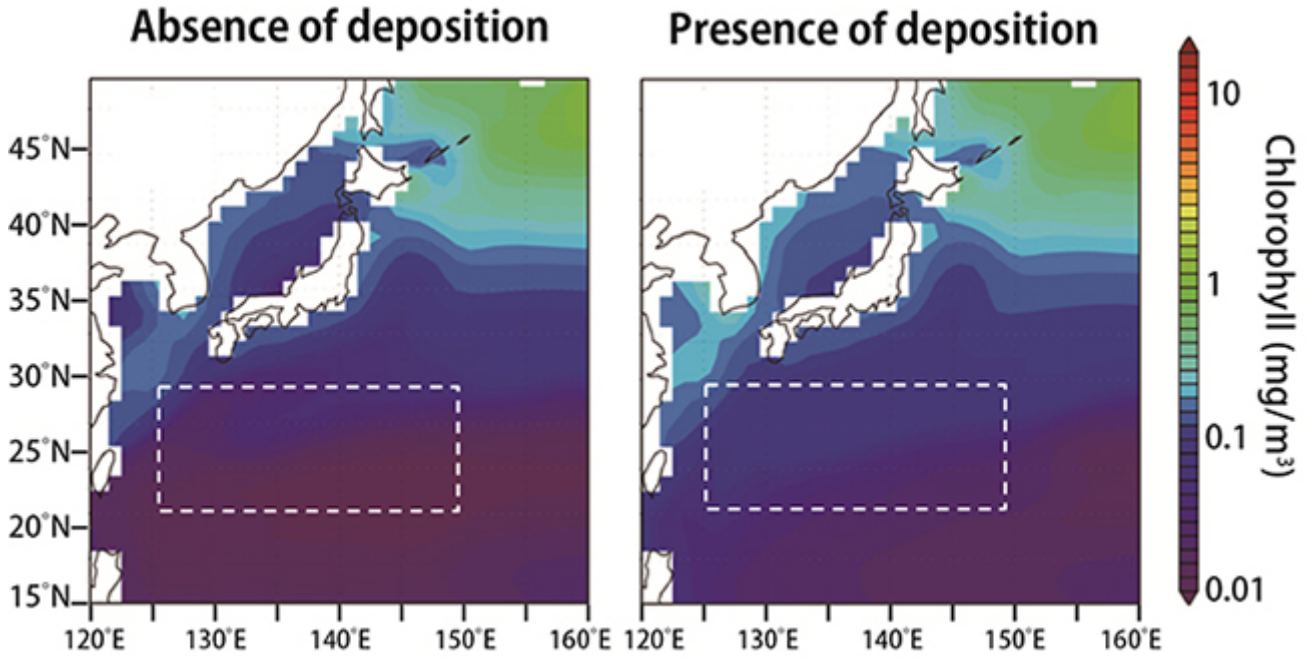

Figure 2. Annual mean spatial distribution of phytoplankton (chlorophyll a) mass concentration in the surface of the western North Pacific calculated with and without nitrogen deposition from the atmosphere into the ocean. Phytoplankton concentration hardly changes in high-latitude regions (subarctic areas), but increases noticeably in low- to mid-latitude regions (subtropical areas). White dotted rectangle is the subtropical focus area of this sutudy (20–30°N, 125–150°E).

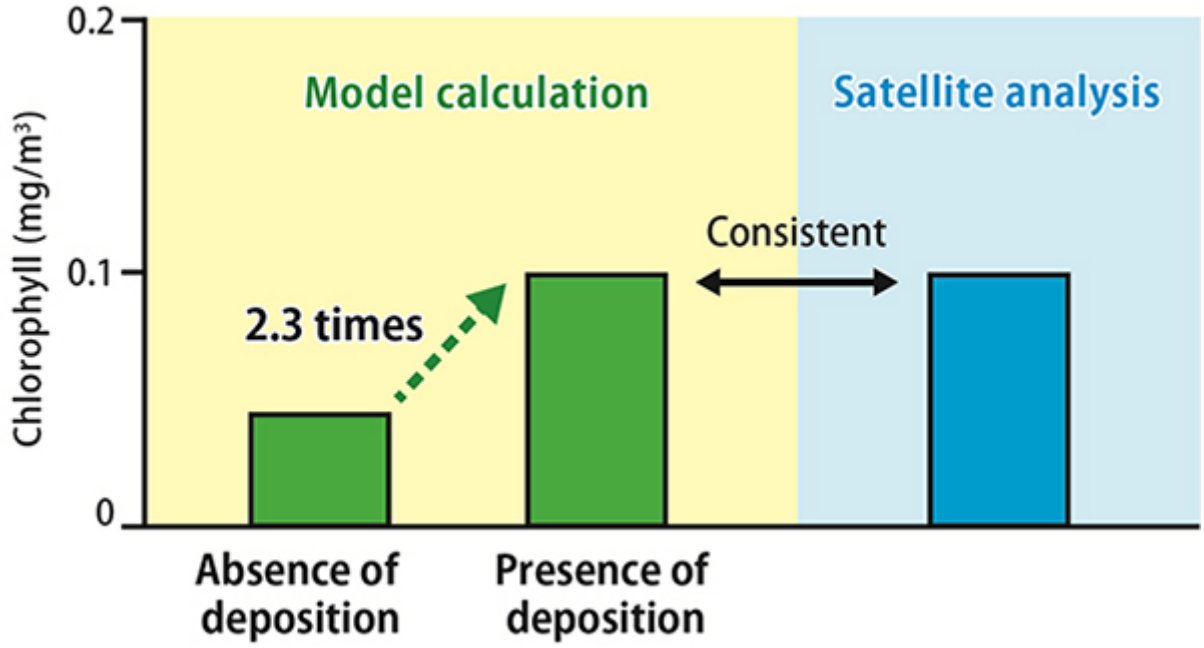

Figure 3. Comparison of calculated and satellite-derived phytoplankton quantities in the subtropical area defined in Figure 2. When the deposition of nitrogen compounds from the atmosphere is not considered, the calculation results are underestimated relative to the satellite-derived results. However, when such deposition is considered, the results clearly become consistent. This indicates that atmospheric nitrogen compounds play an important role as a source of nutrients for phytoplankton growth.

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