Size distributions and CCN activities of marine aerosols obtained in the longitudinal observation over the Pacific Ocean

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Atmospheric aerosols play an important role in controlling radiative properties and lifetime of clouds by acting as cloud condensation nuclei (CCN). Given that the ocean covers about 70% of the Earth’s surface, oceanic aerosols contribute significantly to the CCN budget in the marine environment. Marine particulate organics and precursor gases generated by marine biota may affect concentrations, size and chemical composition of the oceanic aerosols. Thus, it is important to understand the relationship between marine primary productivity and aerosol properties related to CCN activities over the open ocean. In this study, size distributions and CCN activities of aerosols over the Pacific Ocean are characterized, and factors controlling the spatial variation of the aerosol characteristics are discussed.

Atmospheric measurements were conducted during R/V Hakuho-maru KH-13-7 and leg 2 of KH-14-3 cruises. Ambient air was sampled continuously through the inlets via silicon tubing and then dried with a diffusion dryer. The dried air samples were introduced to a scanning mobility particle sizer to measure number size distributions of the ambient aerosols. CCN concentrations were measured with a continuous flow thermal gradient CCN counter during the leg 2 of KH-14-3. Concentrations of atmospheric trace gases (O_3 and CO) and radon daughters, those can be tracers for land-origin and/or anthropogenic air masses, were also measured continuously along the cruise tracks.

The aerosol number concentrations varied from <100 to 3000 cm^{-3} and the spatial variations could not be explained only by the transport of land-origin air masses. This result suggests that it is necessary to consider the supply of marine origin material to the atmosphere. The aerosol number size distributions showed bimodal with a gap around 100 nm in diameter, which is characteristic of clean maritime air, in most of the oceanic region. The Aitken mode (diameter less than 100 nm) contributed greatly to the number of aerosols in the regions where the influence of land-origin air masses were small, indicating that the regions were suitable for the condensation and growth of fresh particles. Actually, a few typical events of new particle formation were observed in the South Pacific. In the arctic region, a spontaneous enhancement of aerosols with diameter around 100 nm was observed. Because there were not major anthropogenic sources of pollutants around the arctic region, the enhanced particles might be come from biogenic sources. Analysis based on CCN activation ratio suggests that these increased fine particles were rich in organics.

