Comprehensive observation of marine atmospheric composition on R/V Mirai: Spatio-temporal variations in ozone concentrations and comparisons with tropospheric chemistry reanalysis data set

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Atmospheric trace species such as ozone and aerosols are essential climate variables (ECVs) inducing climate change via interaction with the Earth’ s radiative field. Therefore spatio-temporal variations in their concentrations in the global scale including remote marine regions should be understood well. However, observational data over the marine regions are limited and thus critical evaluation of numerical models has been lacking. We, therefore, conduct comprehensive observations of marine atmospheric composition on R/V Mirai since 2010 during more than 20 cruises to map out their concentrations from the Arctic to the Southern Ocean aiming critical evaluation of numerical model simulations and the built-in chemical processes. In this presentation, besides overview of such baseline observations, we will discuss comparisons of observed ozone concentrations with those from tropospheric chemistry reanalysis data set (TCR-1) derived from satellite data assimilation to a global chemical transport model. Hourly observational data, after careful rejection of the ship exhaust influence, were compared with the nearest 6-hourly reanalysis data at the 995 hPa level. Reasonably high positive correlation (R^2=0.56) was found between observations and TCR-1; they also commonly showed maximum at around 30˚N in the latitudinal distribution, indicating importance of continental outflow to the ocean. On the other hand, gaps were also evident; TCR-1 tended to underestimate over the Arctic region (latitude > 70˚N), implying descent of ozone-rich air from higher altitudes was weak in the model. On the other hand, TCR-1 overestimated over the oceans south of Japan (125-165˚E, 10˚S-25˚N), implying the importance of catalytic destruction of ozone due to halogen chemistry currently excluded from standard tropospheric chemistry mechanisms.

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