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A modeling study of the influence of sea salt on inorganic aerosol concentration, size distribution, and deposition in the western Pacific Ocean

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1 **A modeling study of the influence of sea salt on inorganic aerosol concentration, size**  
2 **distribution, and deposition in the western Pacific Ocean**

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14 **Abstract.** A regional air quality model system (RAQMS) was developed by coupling the  
15 treatment of heterogeneous reactions between sea salt aerosols (SSAs) and trace gases and  
16 applied to the investigation of aerosol properties and evolutionary features in the western  
17 Pacific Ocean in the spring of 2014. Model results for meteorological variables, PM  
18 concentrations, and size-resolved water soluble inorganic aerosol (WSIA) concentrations were  
19 compared and analyzed with a variety of observations from in situ measurements and the  
20 research cruise *Dongfanghong II*. Model validation demonstrated that the model can simulate  
21 the spatial-temporal distribution and size distribution of aerosol inorganic components in the  
22 marine atmosphere over East Asia, and the inclusion of heterogeneous reactions on SSAs  
23 apparently improved the model simulation for WSIA concentration, especially for aerosol size  
24 distribution. In the western Pacific Ocean, the non-sea salt  $\text{SO}_4^{2-}$  and  $\text{NO}_3^-$  formed on SSAs  
25 accounted for up to 30% and 90% of surface  $\text{SO}_4^{2-}$  and  $\text{NO}_3^-$  concentrations on average,  
26 respectively. The atmospheric depositions of total inorganic sulfur and nitrogen were estimated  
27 to be  $13184 \times 10^3$  kgS/d and  $10728 \times 10^3$  kgN/d, respectively. Wet deposition was the dominant  
28 removal pathway, which accounted for 75% and 68% of sulfur and nitrogen depositions,  
29 respectively. The deposition of fine-mode  $\text{SO}_4^{2-}$  exceeded that of coarse-mode  $\text{SO}_4^{2-}$ , whereas  
30 the deposition of coarse-mode  $\text{NO}_3^-$  was comparable to that of fine-mode  $\text{NO}_3^-$ . The non-sea  
31 salt  $\text{SO}_4^{2-}$  and  $\text{NO}_3^-$  formed on SSAs contributed 16% and 9% of total sulfur and nitrogen

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