Abstract:

Heterogeneous uptake of atmospheric gaseous species on aerosols surfaces play important roles in determining the fate of trace gases and physico-chemical property of aerosols in the atmosphere. Previous studies suggest that the aerosol uptake is potentially effective sink for HO$_2$ radicals, thus an accurate evaluation of the uptake coefficient of HO$_2$ is of great importance in atmospheric radical chemistry studies and in regional/global air quality modeling. However, large variable values of HO$_2$ uptake coefficients have been used in previous modeling and mechanisms studies. In the present work, we evaluate the HO$_2$ uptake coefficient with a comprehensive parameterization considering the gas phase diffusion, aerosols surface accommodation and aqueous phase reactions terms. The dominant factors controlling the HO$_2$ uptake onto aerosols with different physical and chemical characters are investigated, and the impact of HO$_2$ aqueous phase productions is also evaluated. In addition, we also assess the uncertainties on the determined HO$_2$ uptake coefficients from utilizing different HO$_2$ accommodation coefficients ($\alpha_{\text{HO2}}$), since large range of $\alpha_{\text{HO2}}$ values were reported from lab studies and used in modeling studies (0.1–1). The dependence of HO$_2$ uptake coefficient on the factors including particles size, aerosols compositions, aerosols acidity, and the utilized $\alpha_{\text{HO2}}$ value are comprehensively discussed. The results emphasize the necessity of carefully treating the HO$_2$ uptake coefficients in modeling and aerosols multiphase chemistry studies.