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Multiphase chemistry as a key to understand air pollution and its mitigation strategies

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Multiphase chemistry plays a vital role in the formation and transformation of air pollution. Due to its complexity, current atmospheric models often simplify its description and parameterization. Based on regional and global observations and model simulations of different air pollutants, we find that such simplification is a large source of uncertainty and can even lead to one or several orders of magnitude discrepancy between model predictions and observations. We demonstrate the importance of aerosol pH and phase state in controlling the reaction rate, formation and transport of air pollutants. The new schemes accounting for the aerosol phase state and/or pH greatly improve the model performance. Our studies also suggest that multiphase chemistry can lead to regime transition of the chemical formation/degradation pathways, which should be considered in the development of optimal pollution mitigation strategies.