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Bridging observations and models simulations to determining ozone photochemical regimes in China

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Despite recent reductions in emissions, ozone pollution remains a significant challenge in China. While rapid reductions in NOx emissions can suppress NO2-OH termination reactions, they may also intensify VOC-OH initiation, paradoxically promoting ozone formation under NOx-saturated photochemical conditions. Accurately identifying relevant photochemical regimes relies heavily on the choice of observational data and emission inventories.

Toward this direction, this study investigates ozone photochemical regimes using in situ measurements of ozone mixing ratios, along with satellite-derived columns of HCHO and NO2. Ozone mixing ratios and related chemical processes were simulated using WRF-Chem, driven by a regional emission inventory—the integrated inventory of anthropogenic emissions for China (CINEI) and four global inventories. The results show that simulations based on CINEI exhibit better agreement with observational data than the ones driven by the global inventories.

The analysis reveals that ozone photochemistry in the studied regions in China is predominantly NOx-saturated during both July (summer) and January (winter). Variations in the determination of the local photochemical regimes across simulations are mainly due to differences in the ozone precursor emissions specified in each inventory. Our results suggest that ozone control strategies should consider shifting NOx-saturated areas toward NOx-limited ones.