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Assessing the impact of halogen chemistry on air quality: application of CMAQ model in Europe

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The chemistry of halogens, including chlorine, bromine and iodine, influences the capacity of atmospheric oxidation and the formation of air pollution. Previous research have reported the impact of individual halogen species on air quality over large spatial scales. Very little attention has been paid to the effect of the combined halogen chemistry on air quality over Europe, in which air pollution is a persistent environmental hazard. In the present study, we adopt a widely-used regional chemical transport model, the Community Multiscale Air Quality Modeling System (CMAQ), implemented with comprehensive halogen chemistry, to evaluate the role of halogens in the cycling of atmospheric oxidants and the production of secondary air pollutants. The simulation results suggest that the CMAQ model is capable of reproducing the levels and variations of O_3, NO_2, and halogen species over Europe. Halogen chemistry significantly affects the oxidative capacity by substantially enhancing the level of Cl atom, substantially reducing NO_3,decreasing HO_2 and increasing OH. Halogen chemistry significantly decreases the level of ambient O_3 throughout the domain, and decreases NO_2 in highly polluted region and increases NO_2 in other area. The maximum effects of halogen chemistry occur over oceanic and coastal regions but some non-negligible impacts also occur over continental Europe. Our study highlights the significant effect of halogen chemistry on air quality and it is recommended to consider the halogen chemistry in the formulation of air quality regulation.