

Simulation	Emission perturbations	Applied to source regions	Scope
P0	No perturbations	Master zoom regions with $1^\circ \times 1^\circ$ resolution: AFR, AUS, EAS, EUR, MAM, MEA, NAM, RSA, RUS, SAM, SAS, SEA, and PAC ($3^\circ \times 2^\circ$)	Base simulation
P1	SO ₂ , NO _x , BC, POM	All 56 continental regions* + international shipping + aviation	SR matrices for BC and POM and first-order approximation for SO ₂ and NO _x , assuming negligible chemical interaction
P2	SO ₂	All 56 source regions* + shipping	Independent SR for SO ₂ , to be compared to P1 to quantify potential interference between SO ₂ and NO _x in the formation of sulfate and ozone
P3	NO _x	Representative source regions* (China, Europe, Japan, India, Germany, South Africa, USA)	Independent SR for NO _x , to verify the additivity of $P1 = P2 + P3$ and justify the use of (P1–P2) as a proxy for NO _x perturbation for all other regions
P4	NH ₃ , NMVOCs	All 56 continental source* regions + international shipping	SR matrices for NH ₃ and NMVOCs emissions, assuming little chemical interaction among the selected precursors in the formation of NH ₄ and O ₃
P5	NMVOCs, NO _x	Representative source regions* (Europe, China, India, USA)	Quantify chemical feedbacks in O ₃ formation between NO _x and NMVOCs ($P5 = P3 + P4$) additivity