Supplement of "Measurement report: Long-term 2D MAX-DOAS observations of HONO vertical distributions in a rice–wheat rotation agricultural region in Shouxian, China"

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Table S1. TUV model configuration and input data.

Parameter	Value or source	Notes
Model	TUV v5.3.1	Photolysis-frequency calculation
Total column ozone	ERA5: kg m^{-2} Converted to DU	1 DU = 2.1415×10^{-5} kg m^{-2}
NO_2 column	MAX-DOAS NO_2 VCD: molecules cm^{-2} Converted to DU	1 DU = 2.687×10^{16} molecules cm^{-2}
AOD	MAX-DOAS AOD at 360 nm Converted to AOD at 550 nm	$AOD_{(550)} = AOD_{(360)} (360 / 550)^{\theta}$
θ	Baseline: 1.0	Sensitivity values: 0.8, 1.2, 1.5
SSA	Baseline: 0.95	Sensitivity values: 0.90, 0.98
τ_{cld}	ERA5: TCLW + TCIW	$\tau_{cld} = 150$ TCLW + 3 TCIW / $(2 \times 917 \times 30 \times 10^{-6})$
z_{base}	ERA5: CBH (m) Converted to km	$z_{base} = z_{site}$ + CBH / 1000
z_{top}	H_{layer} and Δz were assigned based on the dominant ERA5 cloud-cover category (low, medium or high).	$z_{top} = \max(H_{layer}, z_{base} + \Delta z)$ H_{layer}: low (2.0 km), medium (6.0 km), high (12.0 km); Δz: low (0.5 km), medium (1.0 km), high (1.0 km)
Clear-sky or cloudy	ERA5: TCC τ_{cld}: Calculated as described above	clear-sky: TCC < 0.05, $\tau_{cld} = 0$ cloudy: TCC ≥ 0.05, $\tau_{cld} > 0$
Height grid	0.05–2.00 km	0.05, 0.20, 0.40, 0.60, 0.80, 1.00, 1.20, 1.40, 1.60, 1.80, and 2.00 km
Resolution	Hourly	UTC+8

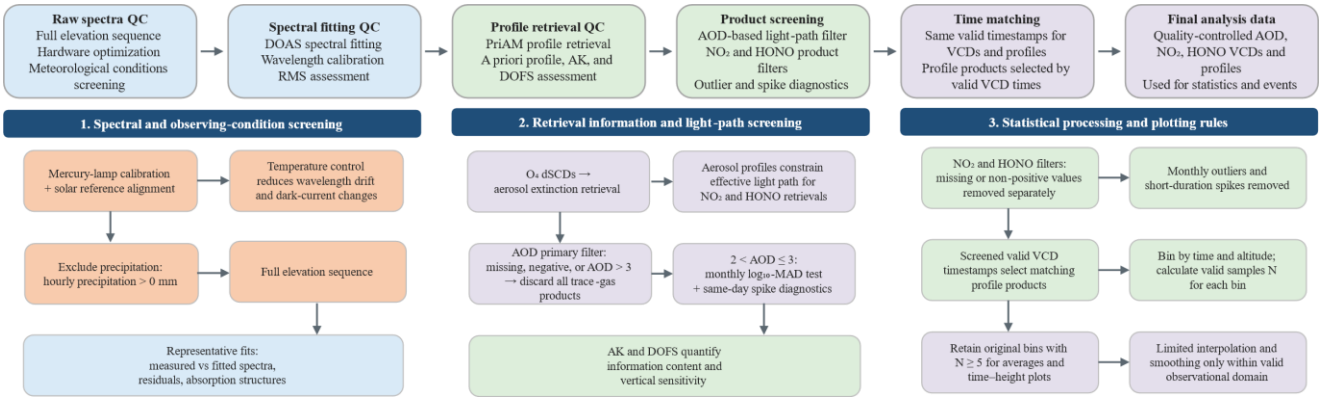

Figure S1. Quality-control workflow for the 2D MAX-DOAS retrieval products. The workflow summarizes spectral and observing-condition screening, retrieval-information and light-path screening, and statistical processing and plotting rules.

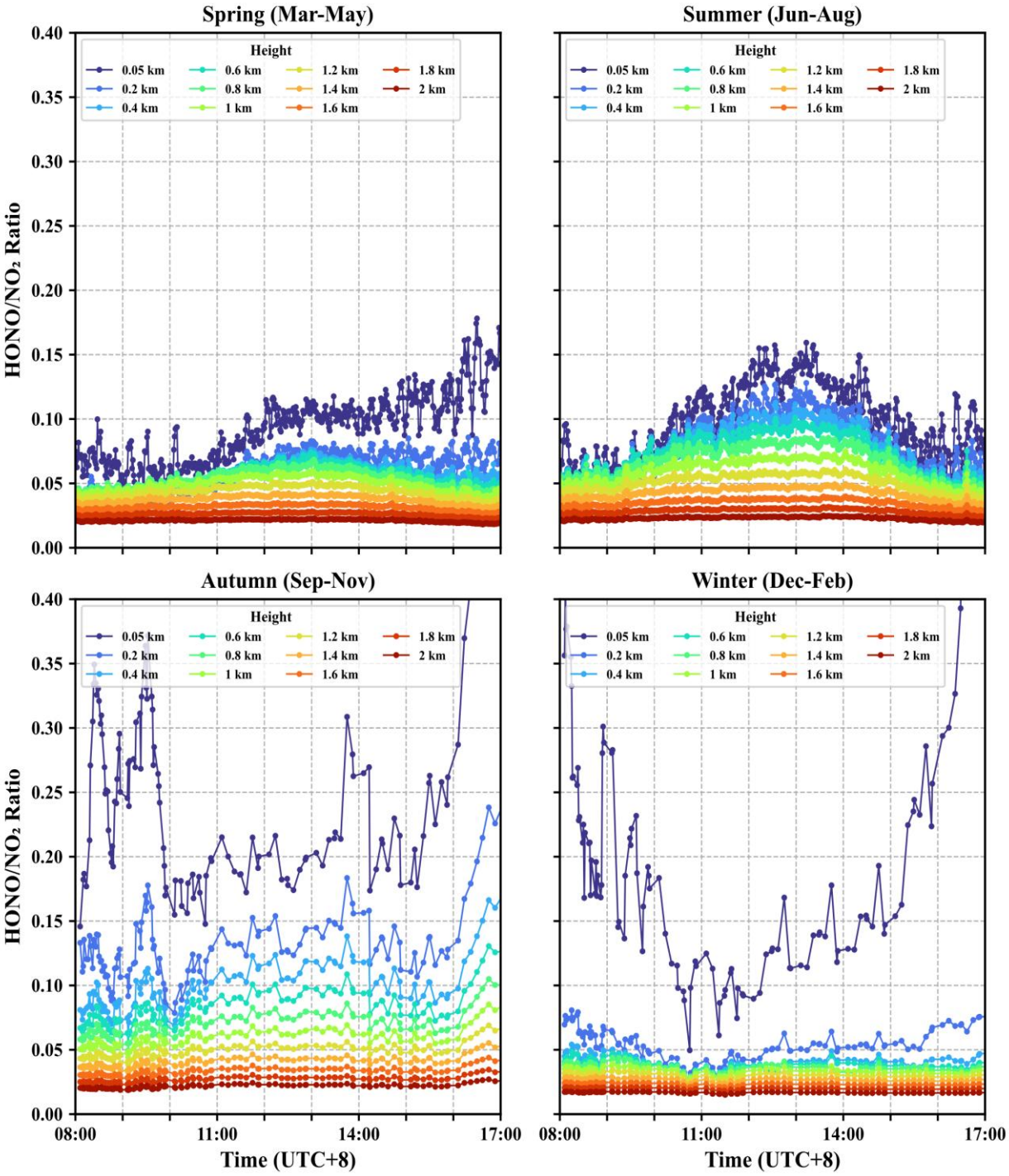

Figure S2. Seasonal daytime variations in the HONO/NO_2 ratio at different heights over Shouxian, averaged over 2022–2023. Panels show spring, summer, autumn, and winter, respectively. Curves represent height layers from 0.05 to 2.00 km, and time is given in Beijing time (UTC+8).

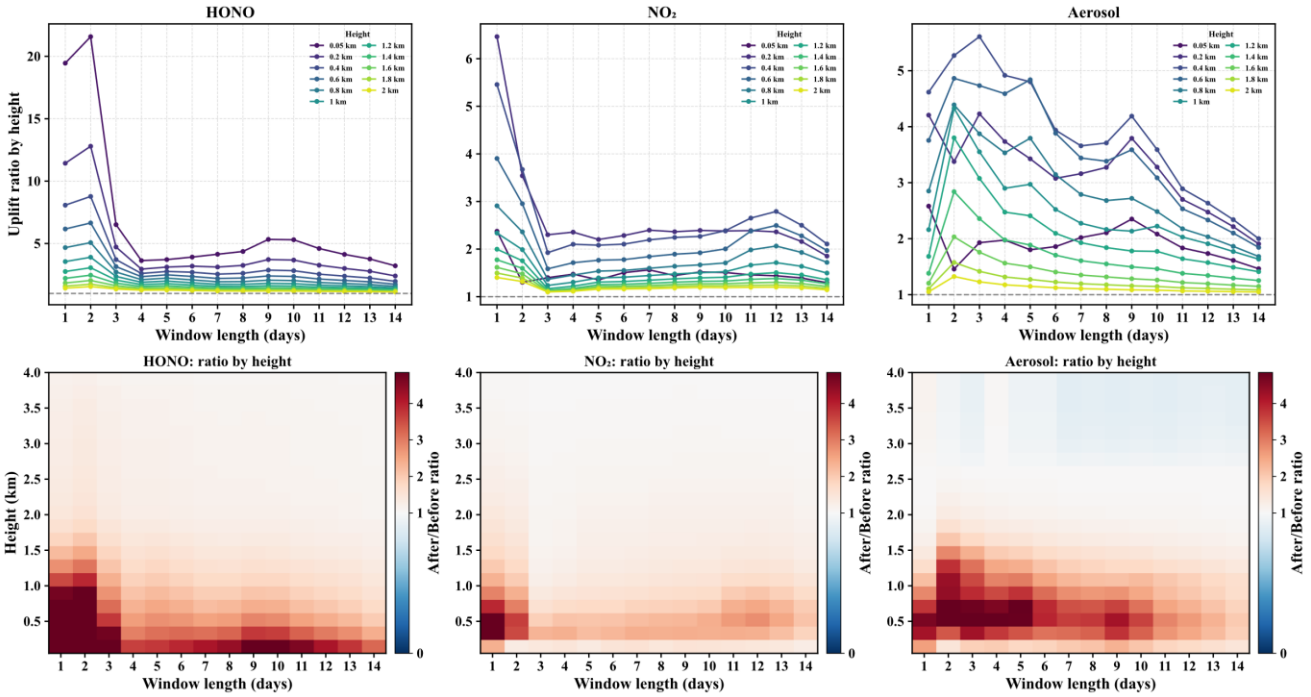

Figure S3. Sensitivity of post-/pre-fertilization ratios to the averaging window. Ratios of HONO, NO_2, and aerosol extinction were calculated using sequential equal-length averaging windows of 1–14 d around the recorded fertilization date of 15 March 2023. For each window length, the pre-fertilization period ends on 14 March and the post-fertilization period begins on 15 March. The upper panels show height-resolved ratios, and the lower panels show the corresponding height–window distributions. Ratios greater than 1 indicate post-fertilization enhancement; the grey dashed line denotes no change.

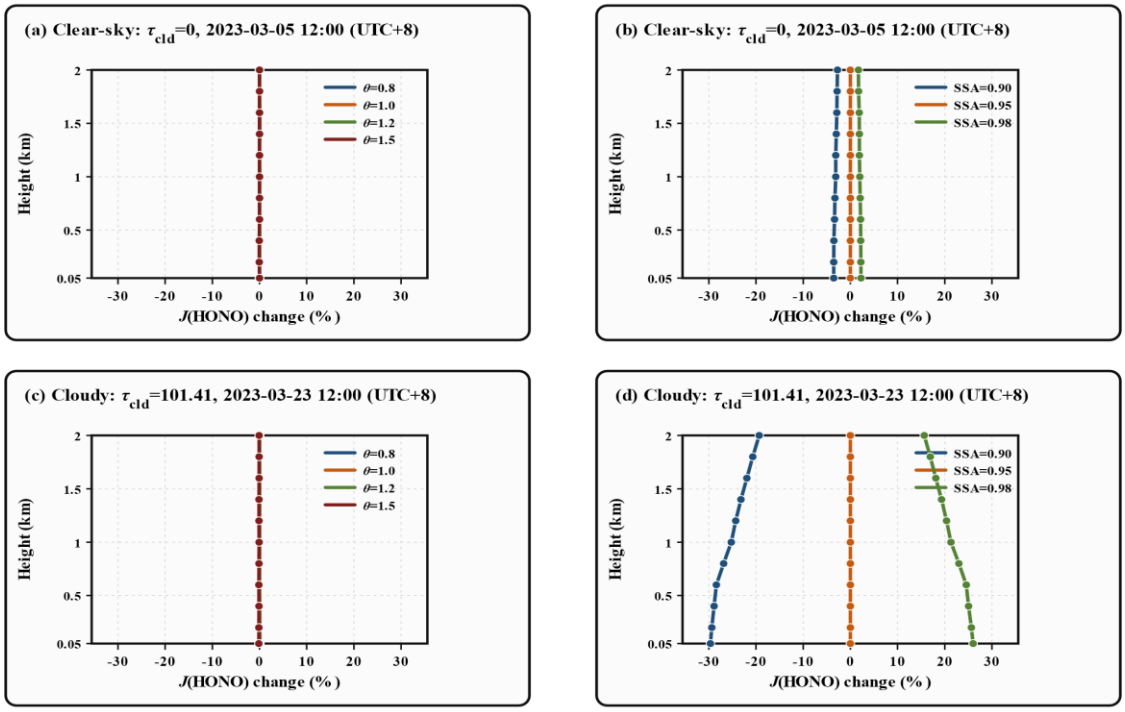

Figure S4. Sensitivity of *J*(HONO) to θ and SSA for representative clear-sky and cloudy cases. Panels (a, b) show the clear-sky case at 12:00 (UTC+8) on 5 March 2023 (τ_{cld} = 0), and panels (c, d) show the cloudy case at 12:00 (UTC+8) on 23 March 2023 (τ_{cld} = 101.41). Panels (a, c) show sensitivity to θ, and panels (b, d) show sensitivity to SSA. The horizontal axis indicates the percentage change relative to the baseline case (θ = 1.0, SSA = 0.95).

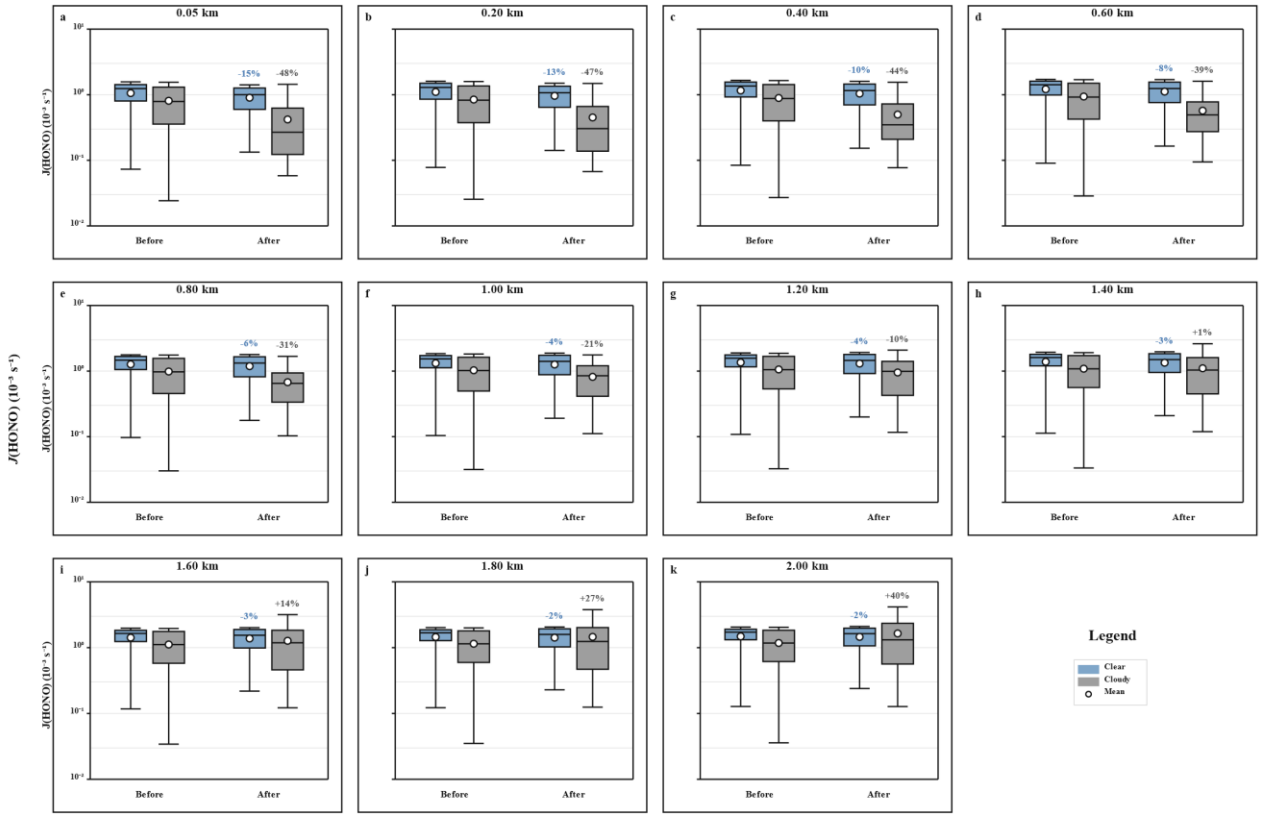

Figure S5. Height-resolved changes in HONO photolysis frequency during the 10 d before and 10 d after fertilization. Box plots show hourly *J*(HONO) at 0.05–2.00 km for the periods 5–14 March and 15–24 March 2023. Blue and grey boxes represent clear-sky and cloudy conditions, respectively. Panels (a–k) correspond to 0.05, 0.20, 0.40, 0.60, 0.80, 1.00, 1.20, 1.40, 1.60, 1.80, and 2.00 km. Centre lines, box edges, whiskers, and open circles denote the median, interquartile range, non-outlier range, and mean, respectively. Percentage labels indicate the relative change in mean *J*(HONO) after fertilization compared with the corresponding 10 d pre-fertilization period.