Supplement of

Exploring the processes controlling secondary inorganic aerosol: Evaluating the global GEOS-Chem simulation using a suite of aircraft campaigns

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Supplemental Table 1. Complete list of instruments and associated PI for all species data included in this paper across all the campaigns.

|	SNA + Cl⁻	HNO3	NH3	SO2	HCl	Na⁺
ADRIEX	Hugh Coe (Q-AMS)	-	-	-	-	-
MILAGRO	Jose L. Jimenez (HR-ToF-AMS)	Paul Wennberg, John Crounse (CIT CIMS)	-	Paul Wennberg, John Crounse (CIT CIMS)	-	Rodney Weber (PILS-IC)
EUCAARI	Hugh Coe (C-ToF-AMS)	-	-	-	-	-
CalNex	Ann Middlebrook, Roya Bahreini (C-ToF-AMS)	Andy Neuman, John B. Nowak (CIMS)	John B. Nowak, Andy Neuman (CIMS)	John S Holloway (UV Pulsed Fluorescence)	Greg Huey (GT CIMS)	-
DC3	Jose L. Jimenez (HR-ToF-AMS)	Paul Wennberg, John Crounse (CIT CIMS)	-	Greg Huey (GT CIMS)	-	Jack Dibb (SAGA-AERO)
SENEX	Ann Middlebrook, Jin Liao, Andre Welti (C-ToF-AMS)	Andy Neuman, John B. Nowak (CIMS)	John B. Nowak, Andy Neuman (CIMS)	John S Holloway (UV Pulsed Fluorescence)	-	-
WINTER	Jose L. Jimenez, Pedro Campuzano-Jost (HR-ToF-AMS)	Joel Thornton, Felipe Lopez-Hilfiker (CIMS)	-	Marc N. Fiddler, Jaime R. Green, Solomon Bililign (UV Pulsed Fluorescence)	Joel Thornton, Felipe Lopez-Hilfiker (CIMS)	-
KORUS-AQ	Jose L. Jimenez, Pedro Campuzano-Jost, Benjamin A. Nault (HR-ToF-AMS)	Paul Wennberg, John Crounse, Michelle Kim (CIT CIMS)	-	Greg Huey (GT CIMS)	Greg Huey (GT CIMS)	Jack Dibb (SAGA-AERO)
EMeRGe-EU	Johannes Schneider, Stephan Borrmann, Katharina Kaiser (C-ToF-AMS)	-	-	Hans Schlager, Lisa Eirenschmalz (CIMS)	-	-
EMeRGe-AS	Johannes Schneider, Stephan Borrmann, Katharina Kaiser (C-ToF-AMS)	-	-	Hans Schlager, Lisa Eirenschmalz (CIMS)	-	-
FIREX-AQ	Jose L. Jimenez, Pedro Campuzano-Jost, Benjamin A. Nault (HR-ToF-AMS)	Paul Wennberg, John Crounse, Krystal Vasquez, Lu Xu (CIT CIMS)	-	Andrew Rollins (LIF)	-	Jack Dibb (SAGA-AERO)
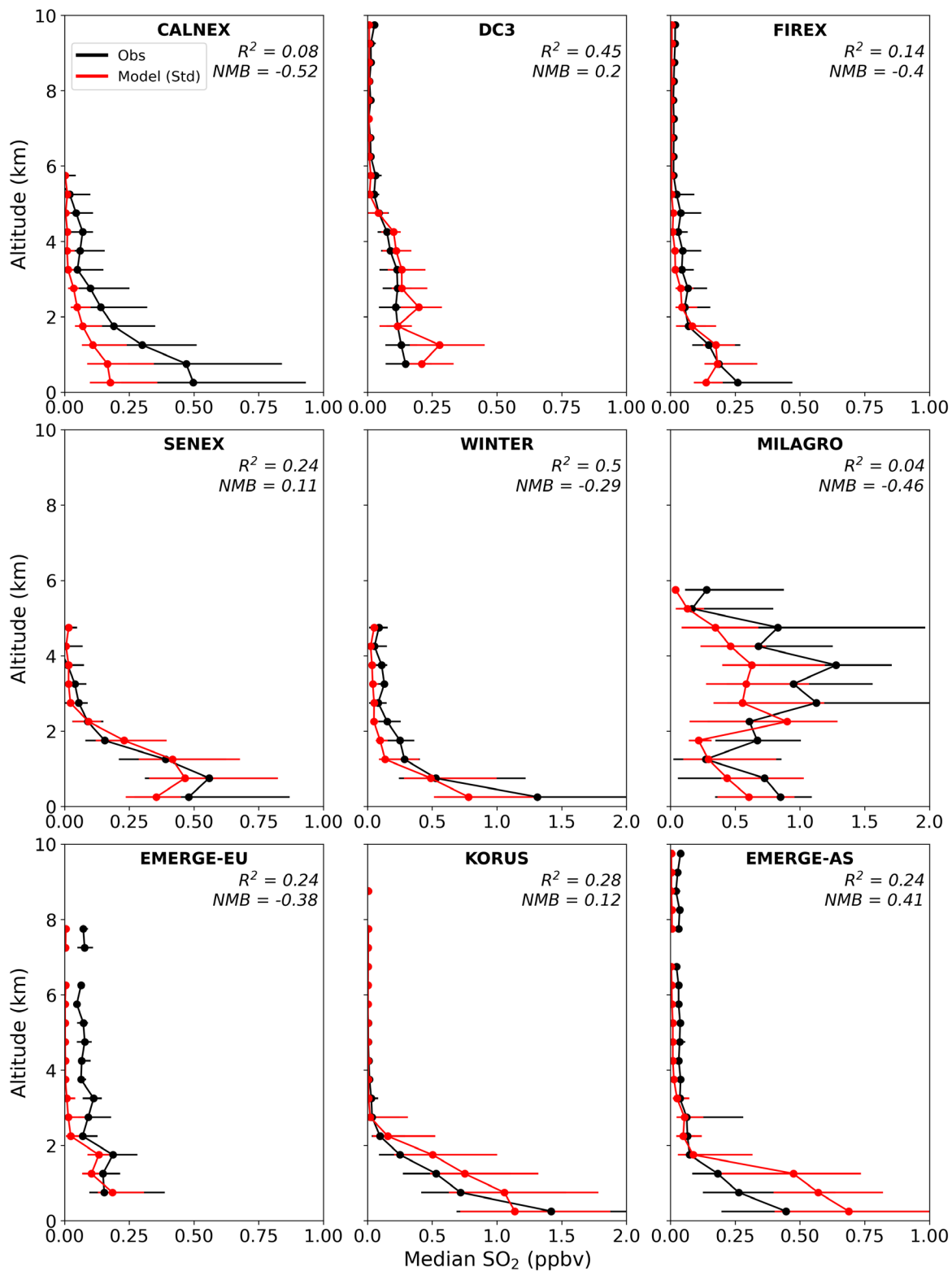
Figure S1. Median vertical profile of observed (black) and simulated (red) SO$_2$ concentrations. Points are binned to the nearest 0.5 km. Error bars represent the interquartile range (IQR). Altitude bins with less than 10 points per bin are not shown.
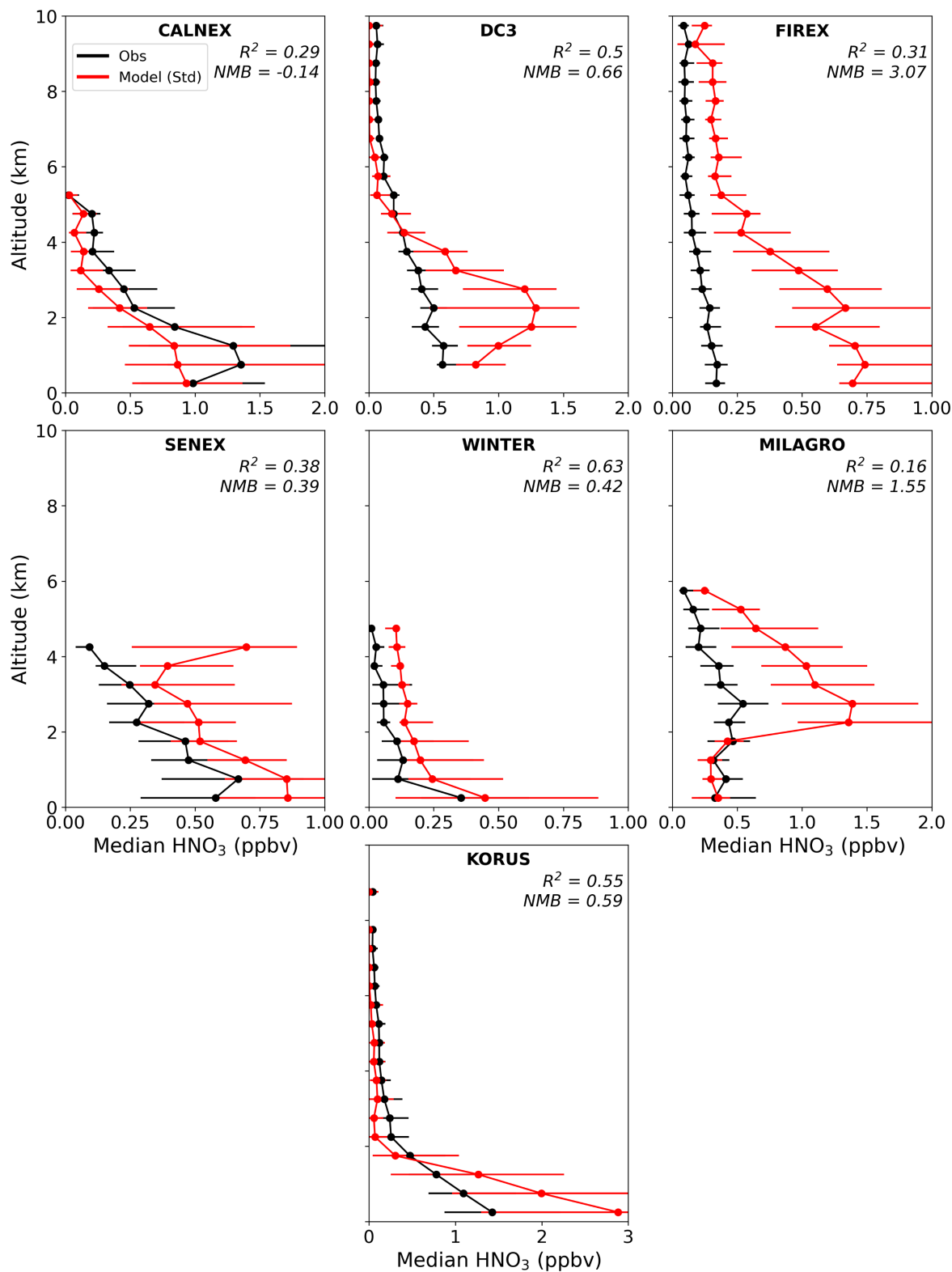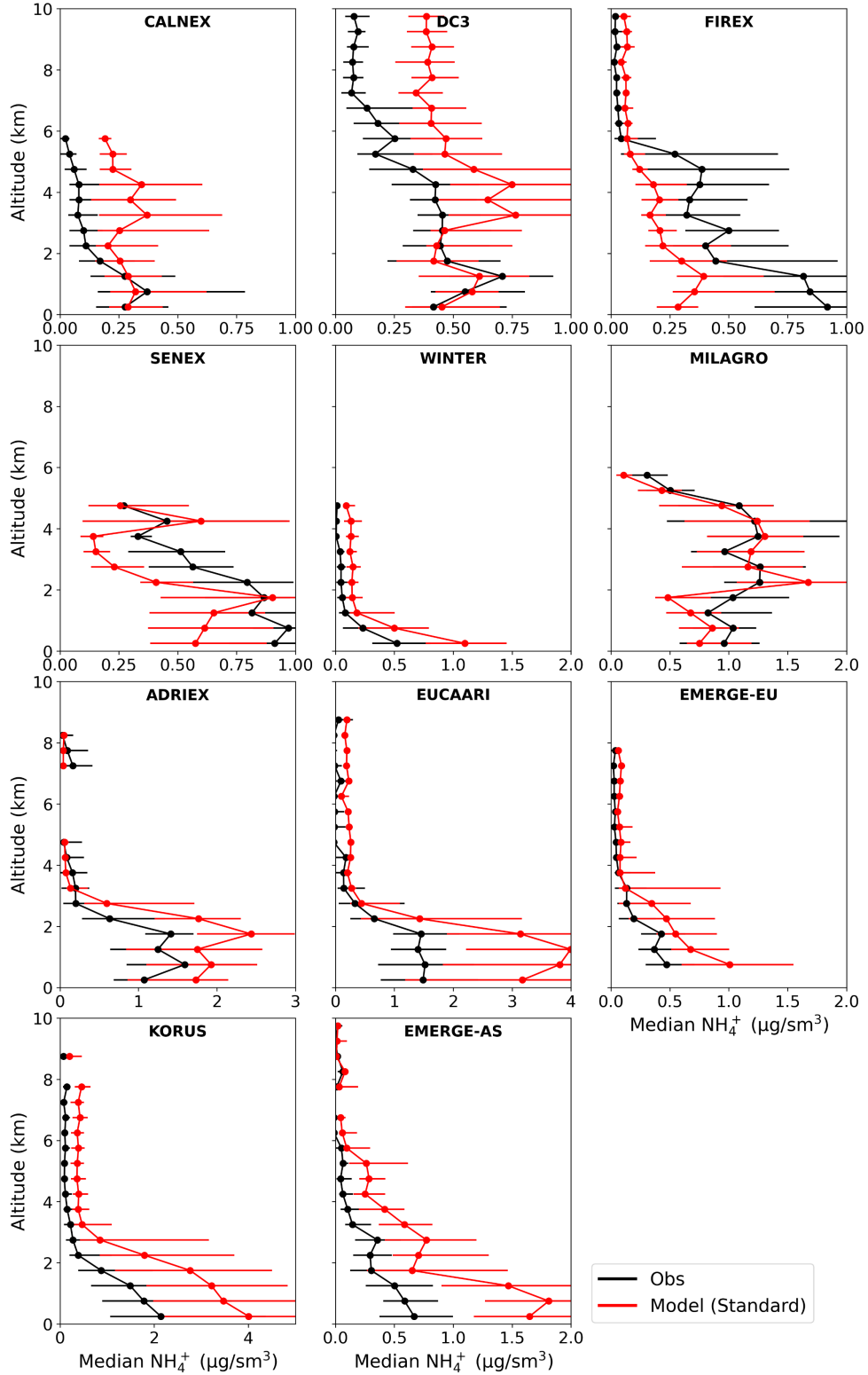
Figure S2. Median vertical profile of observed (black) and simulated (red) HNO₃ concentrations. Points are binned to the nearest 0.5 km. Error bars represent the interquartile range (IQR). Altitude bins with less than 10 points per bin are not shown.

Figure S3. Median vertical profile of observed (black) and simulated (red) ammonium concentrations. Points are binned to the nearest 0.5 km. Error bars represent the interquartile range (IQR). Altitude bins with less than 10 points per bin are not shown.
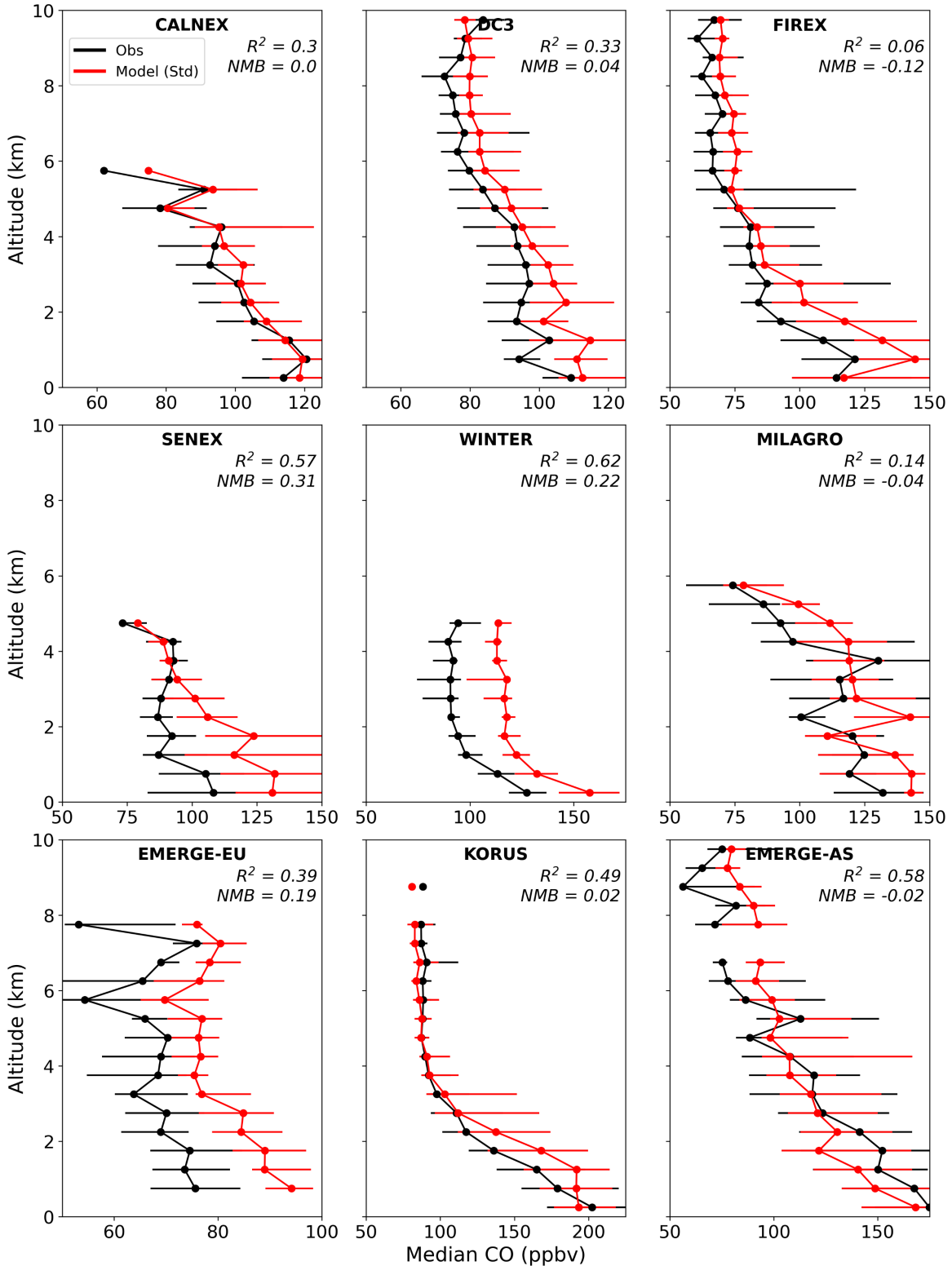
Figure S4. Median vertical profile of observed (black) and simulated (red) CO concentrations. Points are binned to the nearest 0.5 km. Error bars represent the interquartile range (IQR). Altitude bins with less than 10 points per bin are not shown.
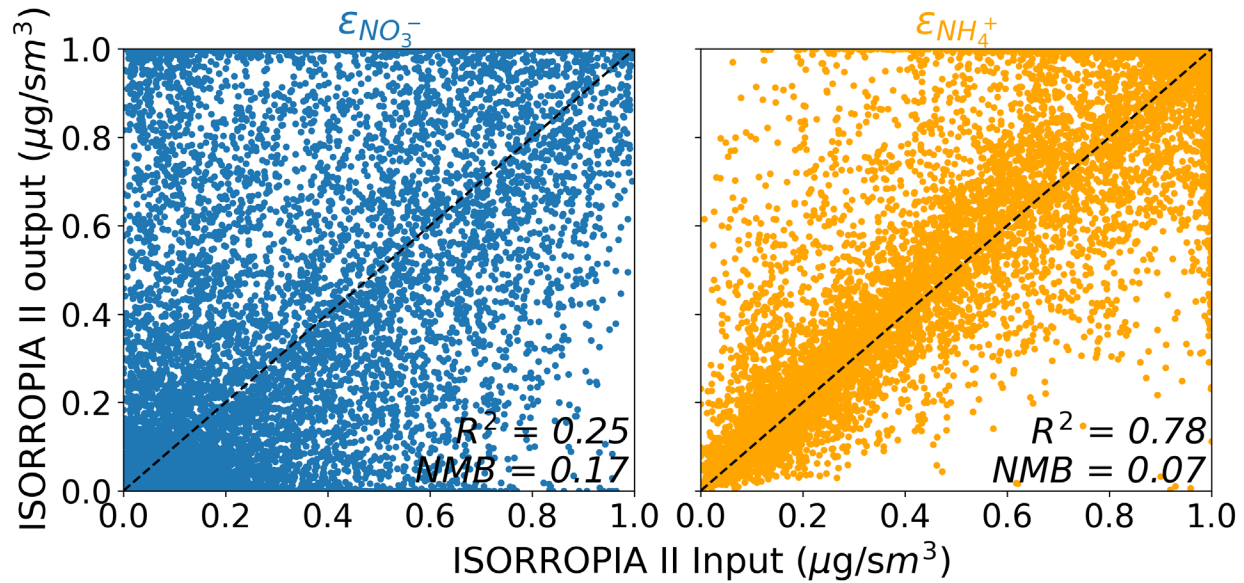
Figure S5. Comparison of the expected (x-axis) to ISORROPIA II-predicted (y-axis) $\varepsilon(NO_3^-)$ and $\varepsilon(NH_4^+)$. Observations of T, RH, SO_4^{2-}, NO_3^-, NH_4^+, HNO_3, and Cl^- are used as inputs into ISORROPIA II. Only the campaigns that made measurements of these inputs are represented. Data is filtered to retain points where model T < 300 K and $15 \leq$ model RH < 90%.
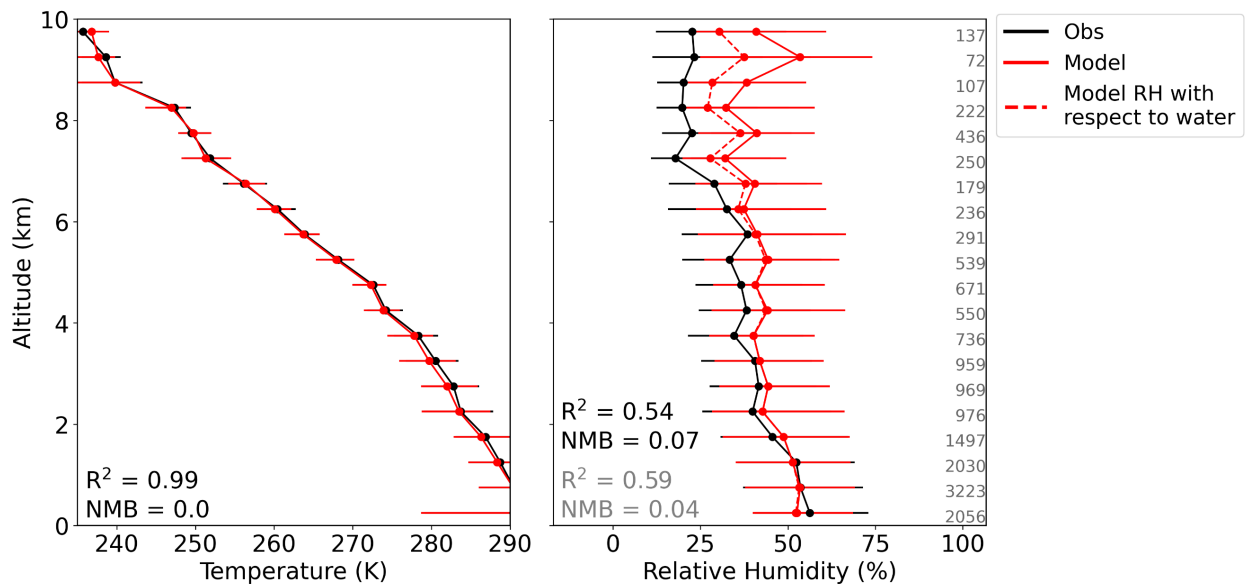

Figure S6. Temperature and RH vertical profiles for all the campaigns combined for observations (black) and model (red, solid). Model RH refers to the default RH in the model (with respect to both ice and/or water depending on the temperature). Calculated model RH with respect to only water, matching the observed RH definition, is shown with the red, dashed line. The number of points per each 0.5km altitude bin is on the right edge. R^2 and NMB are reported for each.
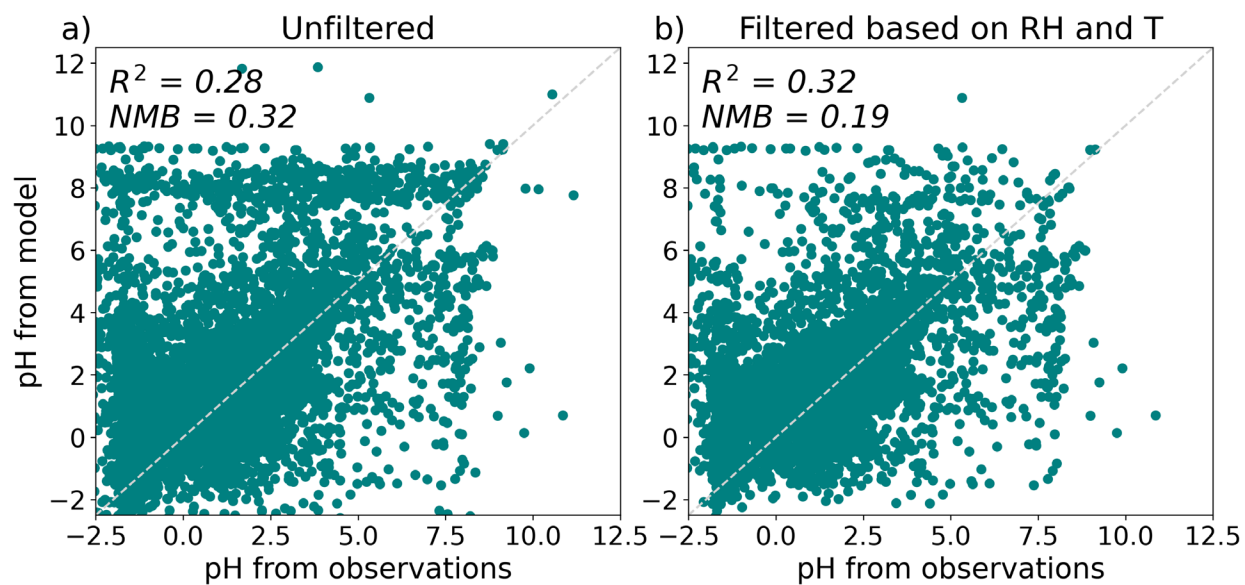
Figure S7. pH calculated using all available observed values (i.e. SNA, HNO_3, Na^+, RH, temperature, Cl^-) and using model values from GEOS-Chem as an input to standalone ISORROPIA II. Agreement between pH from observations and model is calculated a) without any filtering and b) after filtering points to remove T > 300 K and $15 \leq RH < 90\%$.