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GPU-HADVPPM V1.0: a high-efficiency parallel GPU design of the piecewise parabolic method (PPM) for horizontal advection in an air quality model (CAMx V6.10)

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Supplementary Material

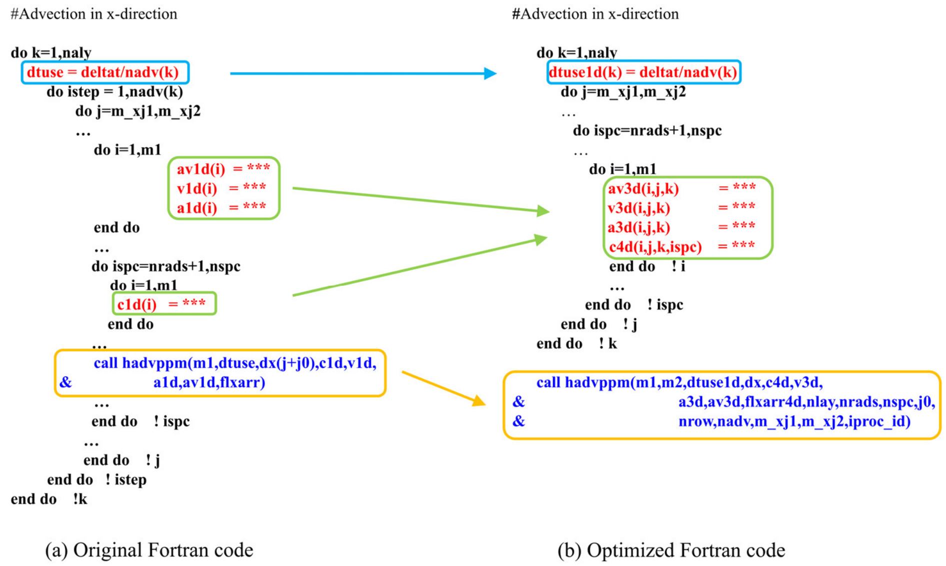

Figure S1. An example of xyadvec Fortran program optimization. (a) and (b) represent original code and optimized code, respectively.

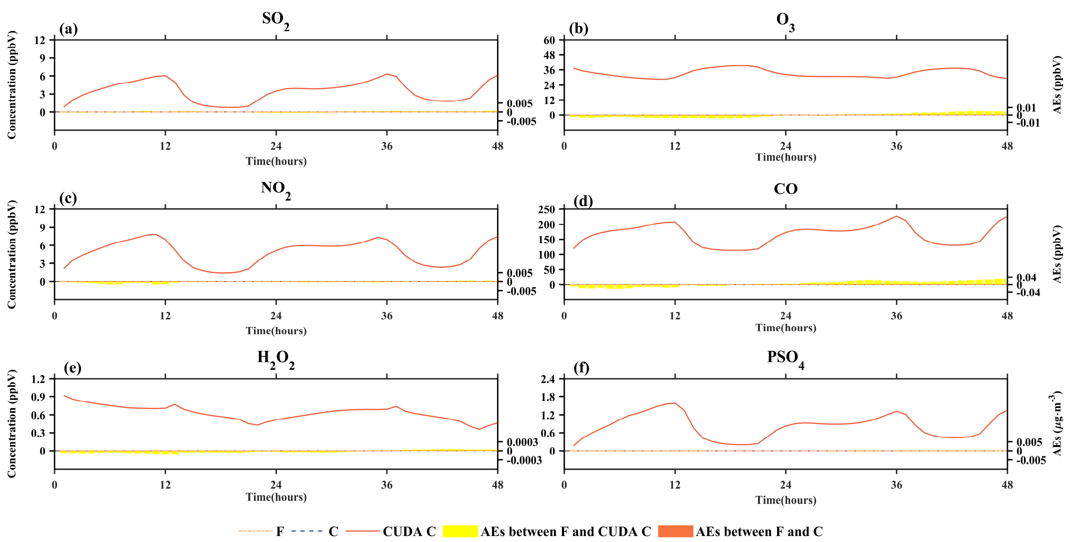

Figure S2. Time series and AEs of SO_2, O_3, NO_2, CO, H_2O_2, and PSO_4 outputted by CAMx model for Fortran, standard C, and CUDA C versions.

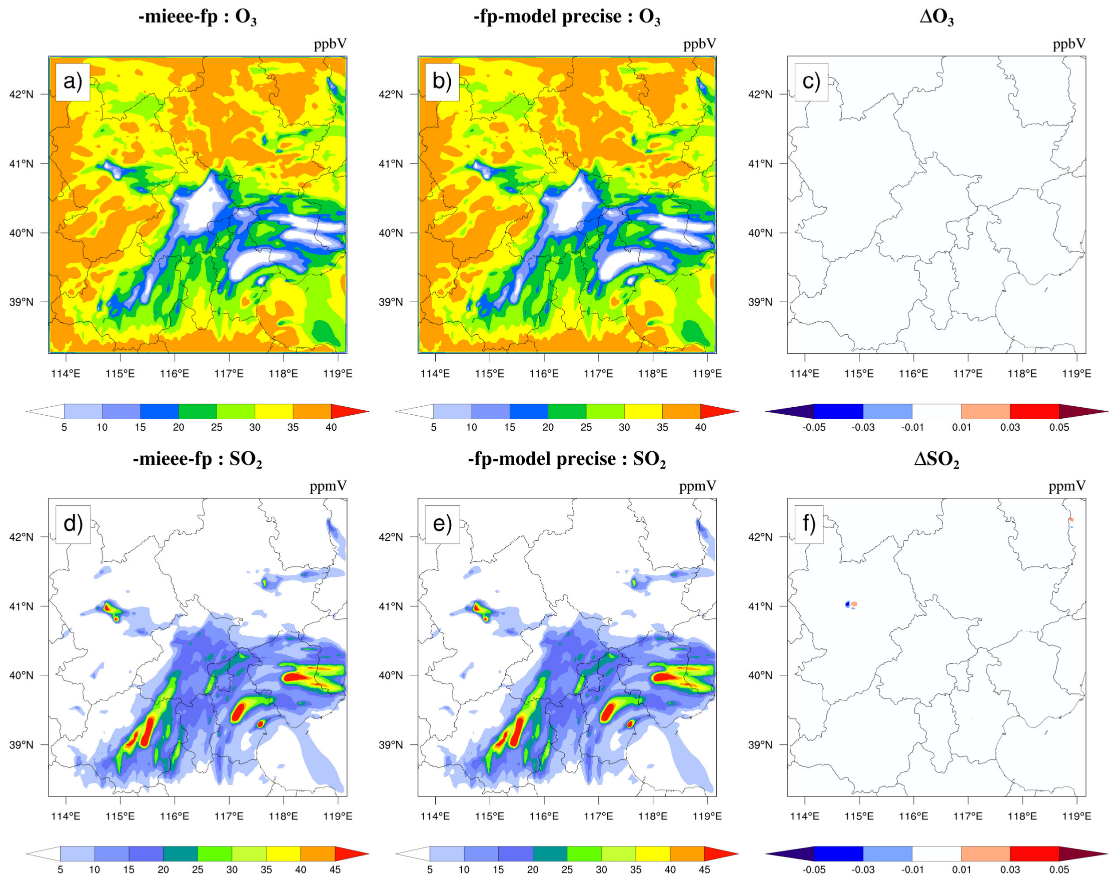

Figure S3. The absolute errors (AEs) of the simulation results between the *-fp model precise* and *-mieee-fp* compile flags.

Table S1. Variable names input into the HADVPPM program and their specific meanings.

Name	**Specific Meanings（Unit）**
nn	Number of cells
dt	Time step (s)
dx	Length of cell (m)
con	Concentration vector ($\mu mol \cdot m^{-3}$)
vel	Wind speed vector ($m \cdot s^{-1}$)

area	Cell area adjustment vector (m^{-2})
areav	Interfacial area adjustment vector (m^2)

Table S2. The physical and chemical numerical methods selected during CAMx integration

Process	Numerical Methods
Horizontal advection	PPM (Colella and Woodward, 1984)
Vertical diffusion	K-theory 1st order closure
Aqueous-phase oxidation	Regional Acid Deposition Model (RADM-AQ, (Chang et al., 1987))
Inorganic aerosol thermodynamic partitioning	ISORROPIA (Nenes et al., 1999)
Gas-Phase Chemistry	Carbon Bond 2005 (Yarwood et al., 2005) EBI solver (Hertel et al., 1993)
Dry deposition	Resistance model for gases (Zhang et al., 2003) and aerosols (Zhang et al., 2001)
Wet deposition	Scavenging model for gases and aerosols (Seinfeld et al., 1998)

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