



Supplement of

Analysis of CO₂ spatio-temporal variations in China using a weather–biosphere online coupled model

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Table S1. WRF-VPRM Model Configuration

Attribute	Configuration	Reference
Short wave radiation	Duhia algorithm	Dudhia (1989)
Long wave radiation	Rapid radiative transfer model (RRTM)	Mlawer et al. (1997)
Boundary layer	Yonsei University (YSU) scheme	Hong et al. (2006)
Microphysics	Morrison scheme	Morrison et al. (2009)
Cumulus	Grell-3 scheme	Grell and Devenyi (2002)
Land surface model	Noah land-surface scheme	Chen and Dudhia (2001)
Vertical levels	47	-
Model top	10hPa	-
Horizontal resolution	20 km × 20 km with 234 (south-north) × 285 (west-east) grid points; 4km × 4km with 215 (south-north) × 280 (west-east) grid points	-
Time step	60s	-
Meteorological initial and lateral boundary conditions	NCEP/DOE Reanalysis 2 (R2)	-
Interior nudging	Spectral nudging	-
Nudging variables	horizontal wind components, temperature, and geopotential height	-
Nudging coefficient	$3 \times 10^{-5} \text{ s}^{-1}$	-
Nudging height	above PBL	-
Wave number	5 and 3 in the zonal and meridional directions, respectively	-

Table S2. VPRM Parameter Values Used in This Study

	Evergreen forest	Deciduous forest	Mixed forest	Shrub	Savanna	Crop	Grass
PAR_0 ($\mu\text{mol PAR}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$)	745.306	514.13	419.5	590.7	600	1074.9	717.1
λ ($\mu\text{mol CO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}/\mu\text{mol PAR}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$)	0.13	0.1	0.1	0.18	0.18	0.085	0.115
α ($\mu\text{mol CO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}\cdot^\circ\text{C}^{-1}$)	0.1247	0.092	0.2	0.0634	0.2	0.13	0.0515
β ($\mu\text{mol CO}_2\cdot\text{m}^{-2}\cdot\text{s}^{-1}$)	0.2496	0.843	0.27248	0.2684	0.3376	0.542	-0.0986

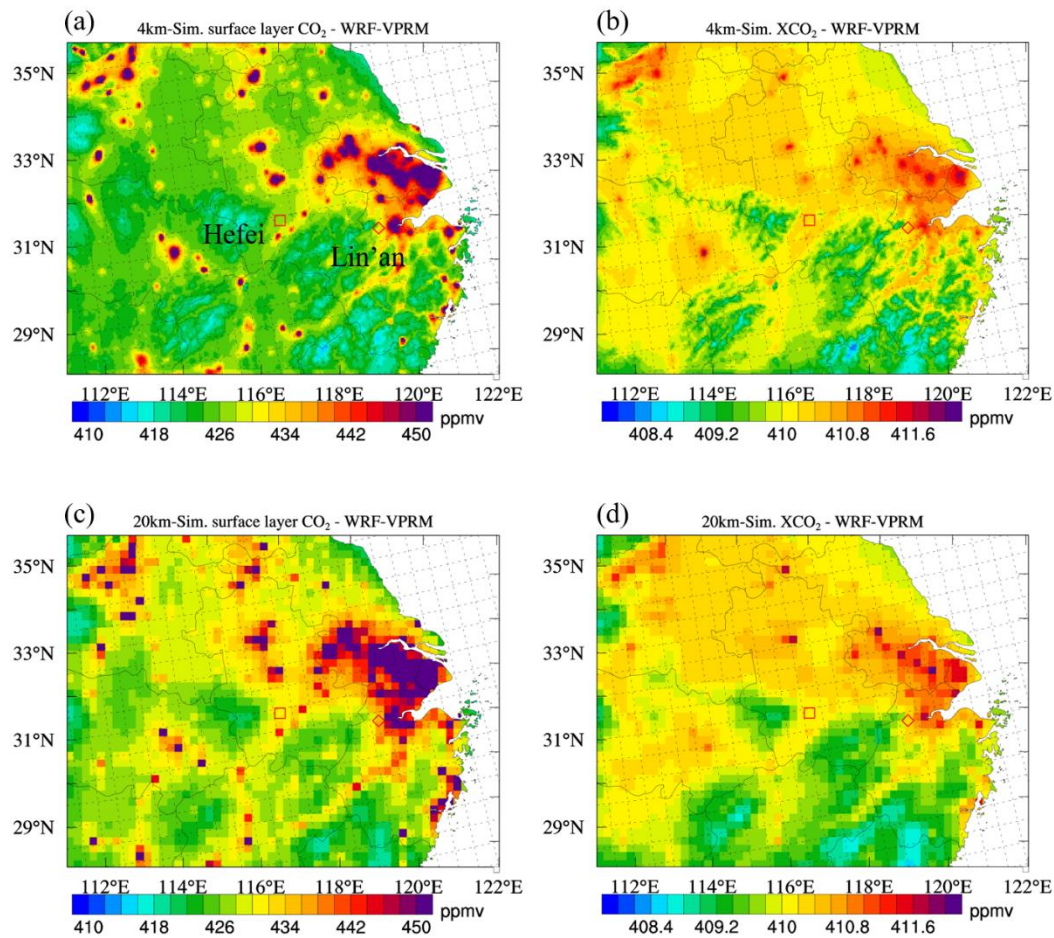


Figure S1: Annual averaged CO₂ (left column) and XCO₂ (right column) from WRF-VPRM 4km-grid simulation (top row) and 20km-grid simulation (bottom row). Locations of Hefei and Lin'an are presented with red rectangle and diamond.

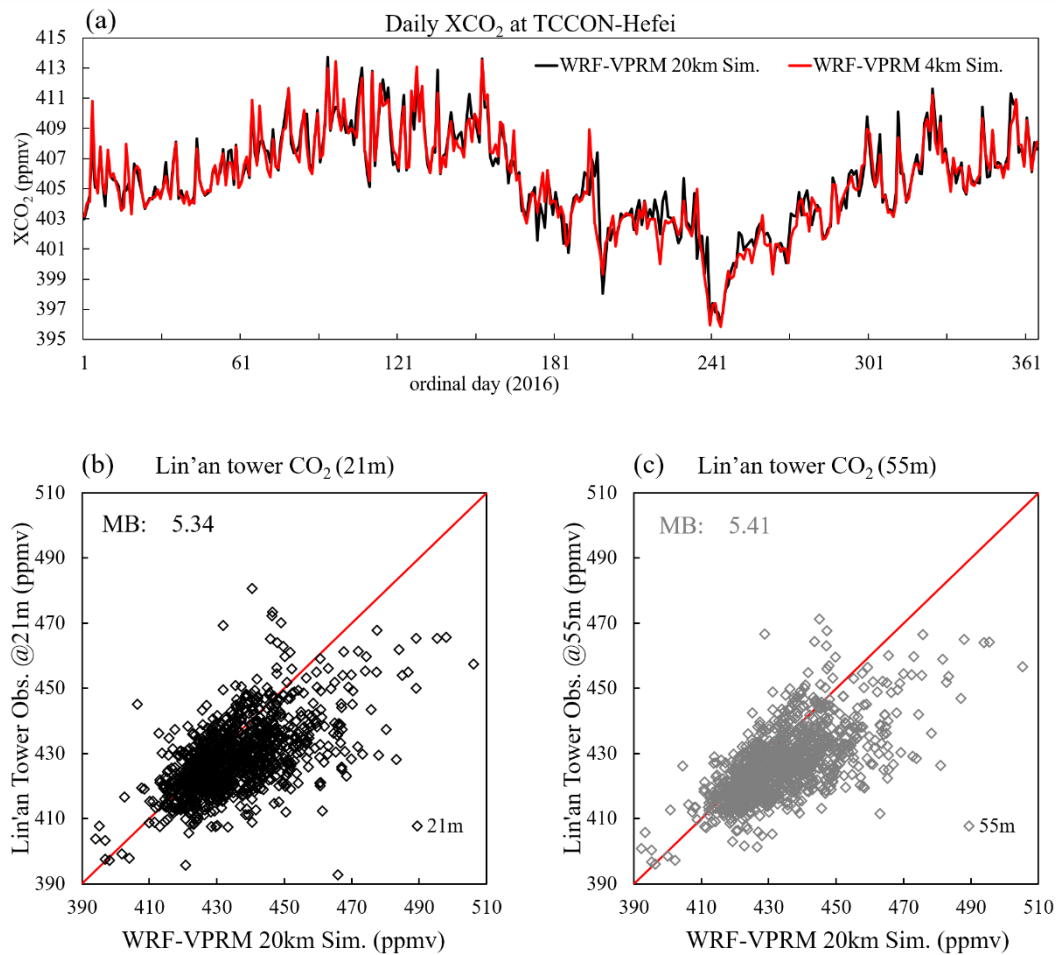


Figure S2: (a) Comparison of 20km-grid and 4km-grid simulations at TCCON Hefei site; WRF-VPRM 20km-grid simulation evaluation against Lin'an tower observations at hourly scale at (b) 21m and (c) 55m.

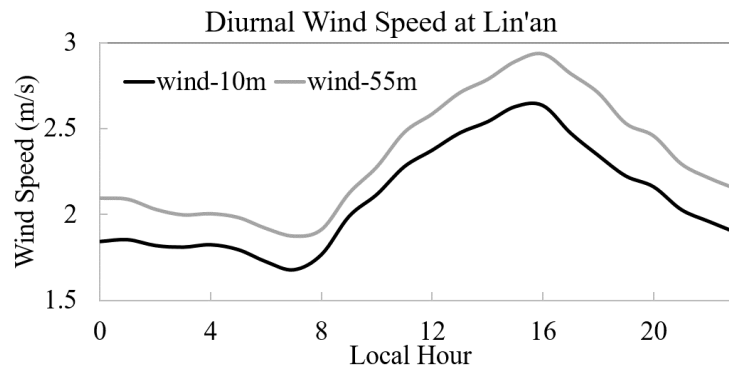


Figure S3: Observed diurnal profiles of wind speed at Lin'an.

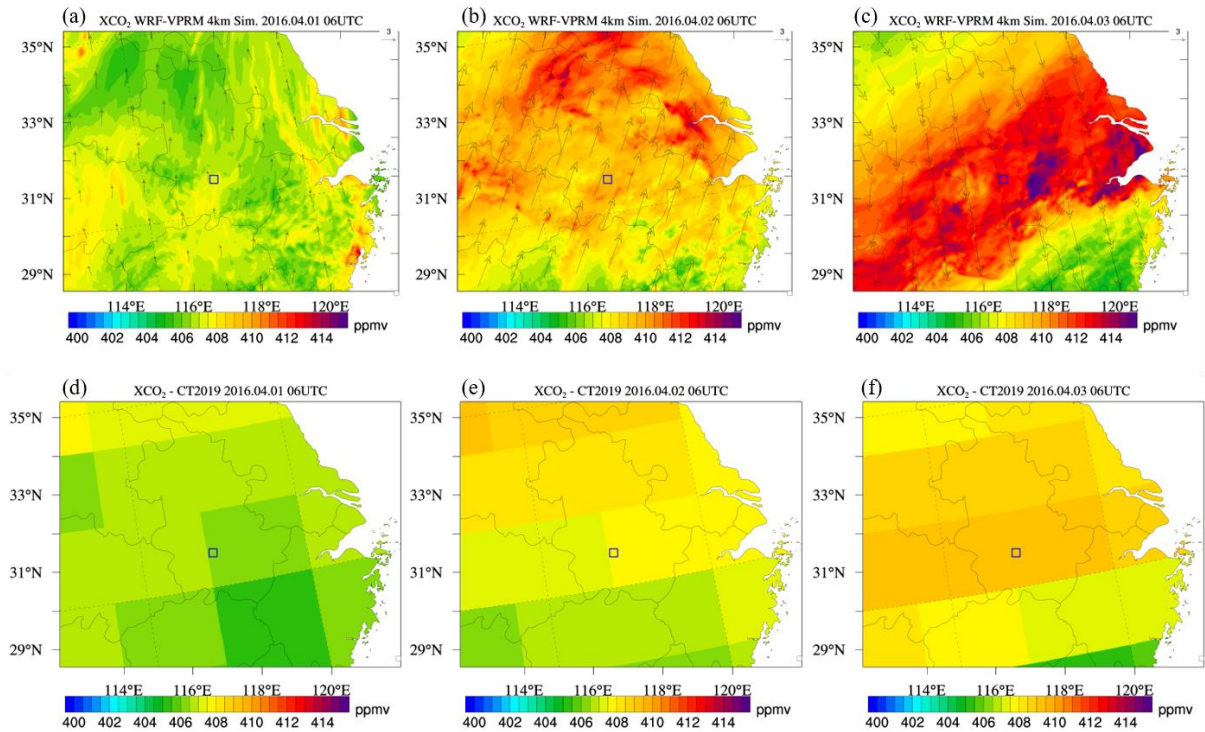


Figure S4: Same as Figure 6 but using WRF-VPRM 4km-grid simulation data

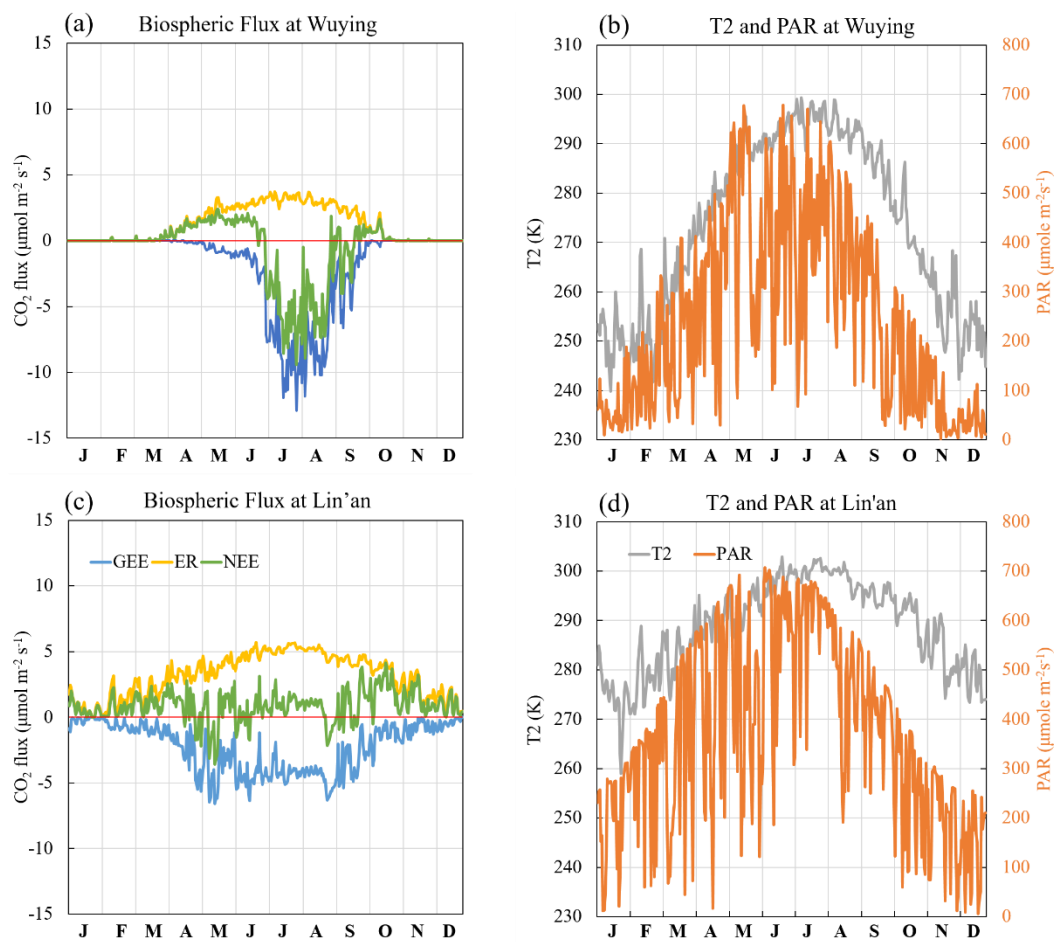


Figure S5: Comparison of WRF-VPRM simulated daily variations of biospheric fluxes (left column) and meteorology (right column) between Wuying (top row) and Lin'an (bottom row).