



*Supplement of*

## **Impacts of lake on diurnal evolution of surface PM<sub>2.5</sub> concentrations around a typical megacity of China**

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64 Nolake experiment, and their differences.

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68 experiment and the differences between Lake and Nolake experiments.

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70 experiment and the differences between Lake and Nolake experiments.

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72 Lake\_emis experiment and the differences between Lake\_emis and Nolake\_emis  
73 experiments.

74 Figure S20: The vertical cross-section of  $PM_{2.5}$  concentration and wind vectors along  
75 the key path AC for the Lake\_emis experiment, Nolake\_emis experiment, and their  
76 differences.

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**Table S1.** Description of land cover data classifications

<b>Number</b>	<b>Description</b>
1	Urban
2	Dryland cropland/pasture
3	Irrigated cropland/pasture
4	Mixed Dryland/Irrigated Cropland
5	Cropland/Grassland Mosaic
6	Cropland/Woodland Mosaic
7	Grassland
8	Shrubland
9	Mixed Shrubland/Grassland
10	Savanna
11	Deciduous Broadleaf Forest
12	Deciduous Needleleaf Forest
13	Evergreen Broadleaf Forest
14	Evergreen Needleleaf Forest
15	Mixed Forest
16	Water
17	Herbaceous Wetland
18	Wooded Wetland
19	Barren or Sparsely Vegetated
20	Herbaceous Tundra
21	Wooded Tundra
22	Mixed Tundra
23	Bare Ground Tundra
24	Snow or Ice

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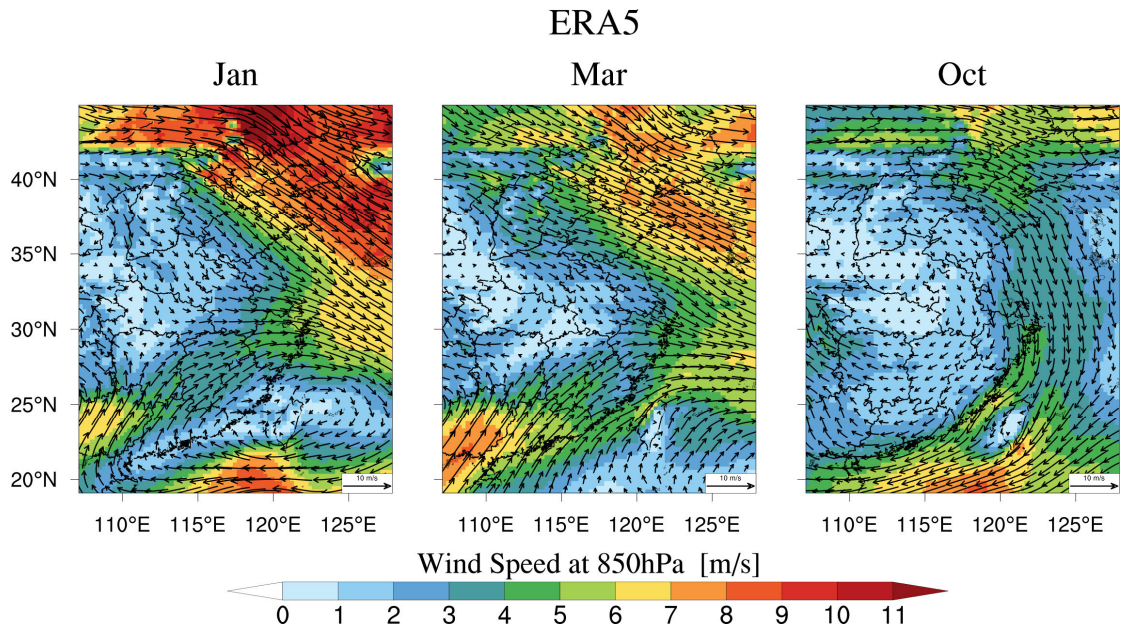
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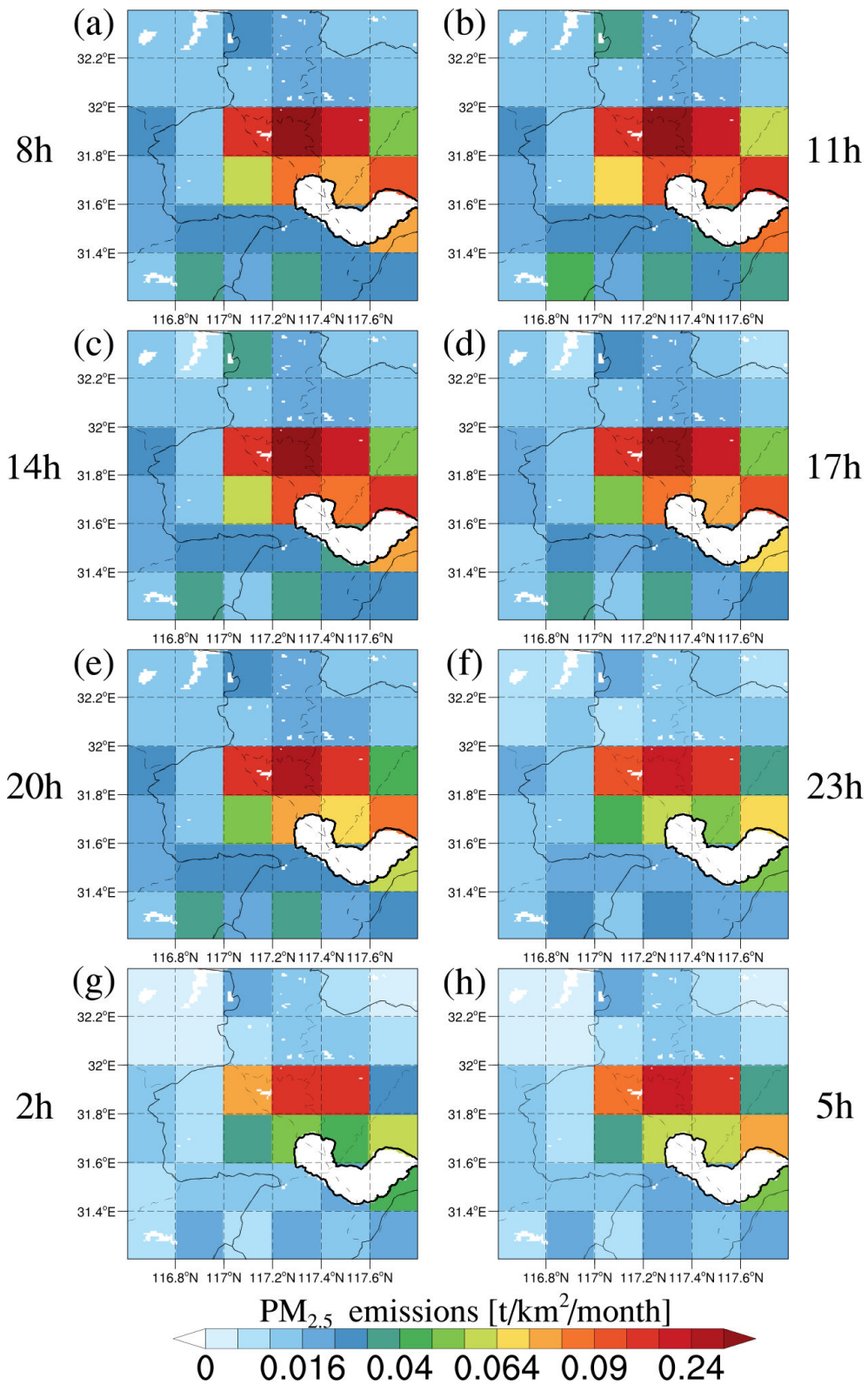
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108 **Figure S1.** Spatial distribution of wind speeds at 850 hPa from ERA5 reanalysis

109 datasets over East China averaged for January, March, and October of 2019.



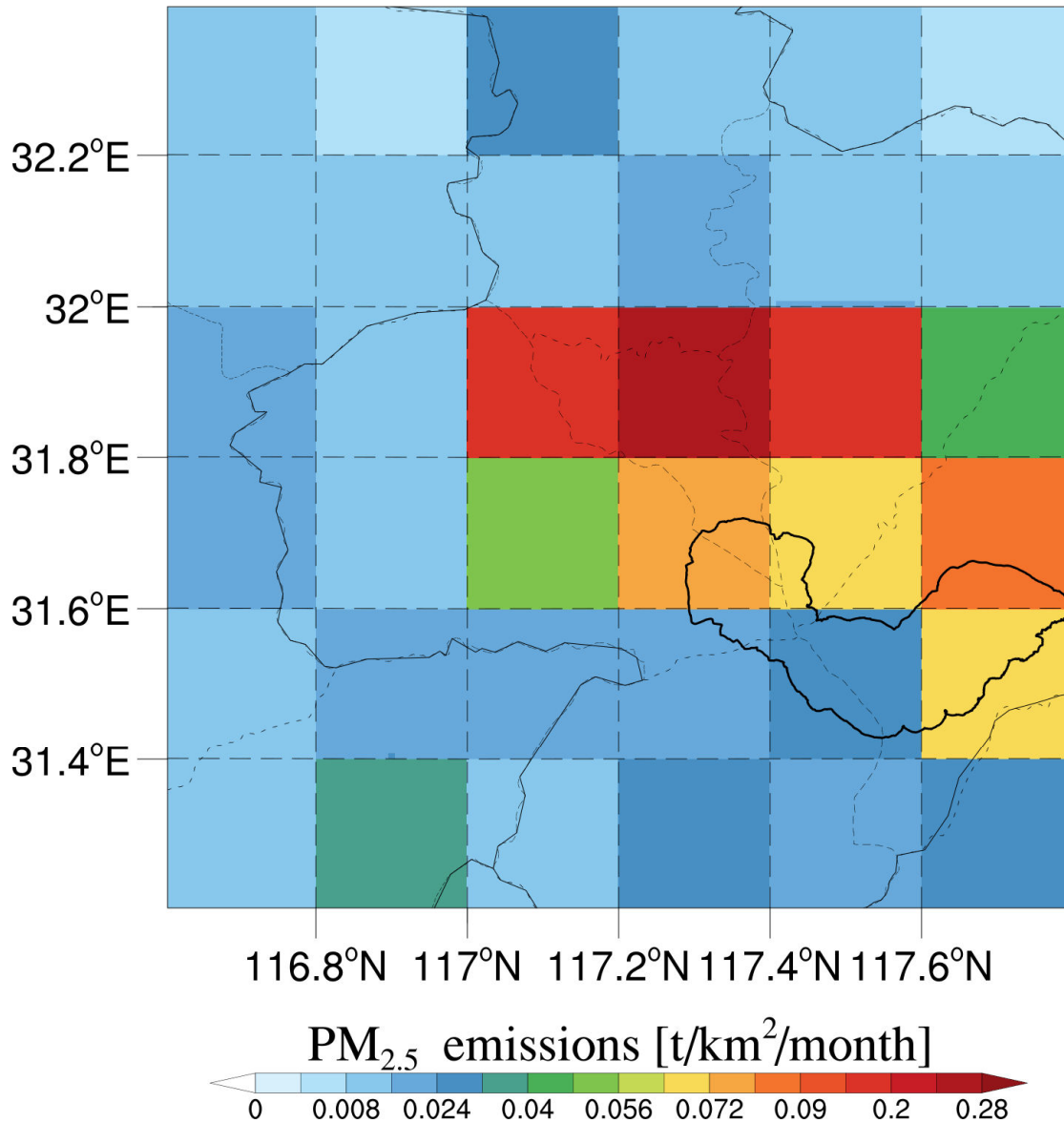
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111 **Figure S2.** Spatial distribution of  $PM_{2.5}$  emissions in both the Lake and Nolake

112 experiments at 08:00, 11:00, 14:00, 17:00, 20:00, 23:00, 02:00, and 05:00 local time

113 (LT), averaged over 10-20 March 2019, throughout the study area.

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116 **Figure S3.** The spatial distribution of PM<sub>2.5</sub> near-surface emissions in both the

117 Lake\_emis and Nolake\_emis experiments throughout the study area, averaged over 10-

118 20 March 2019.

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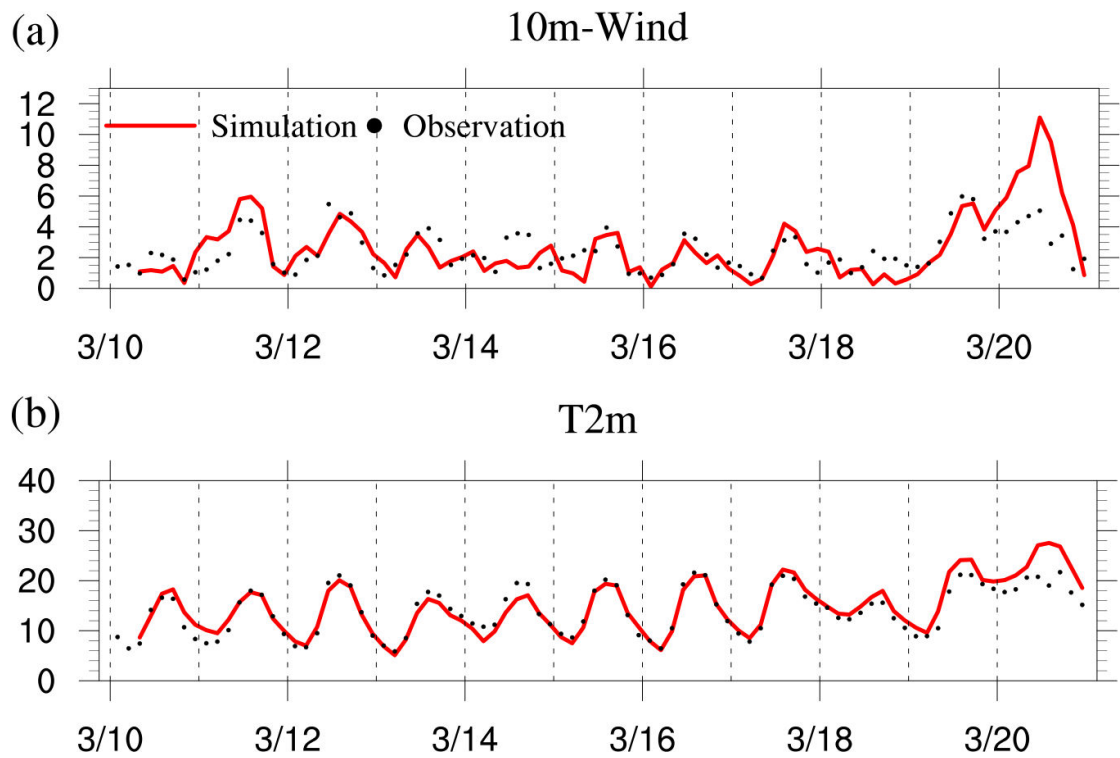
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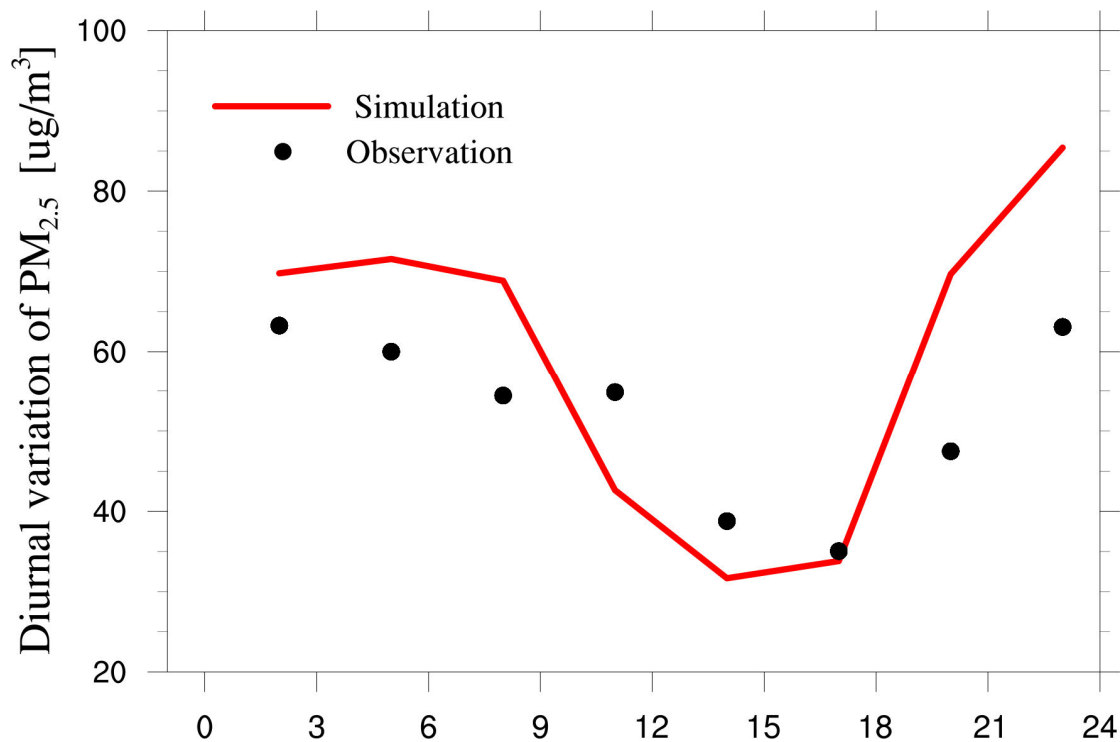
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126  
 127 **Figure S4.** Time series of observed (black dots) and simulated (red line) wind speed at  
 128 10 m (top panel,  $\text{m s}^{-1}$ ) and temperature at 2 m (middle panel,  $^{\circ}\text{C}$ ) from the Lake  
 129 experiment, averaged over 4 AWS sites in Hefei.

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146 **Figure S5.** Diurnal variation of PM<sub>2.5</sub> near-surface concentrations within 24 h averaged  
 147 over 10 MEP sites in Hefei during the study period for the Lake experiment (solid red  
 148 line) and observations (black dot). Both the simulated results and observations are  
 149 sampled at the model output frequency, i.e., 3-hourly.

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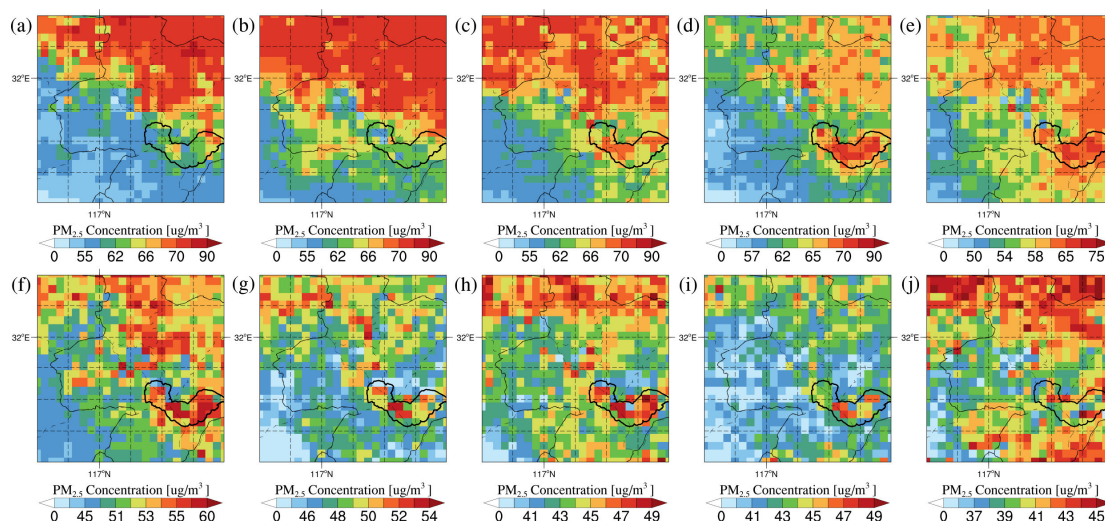
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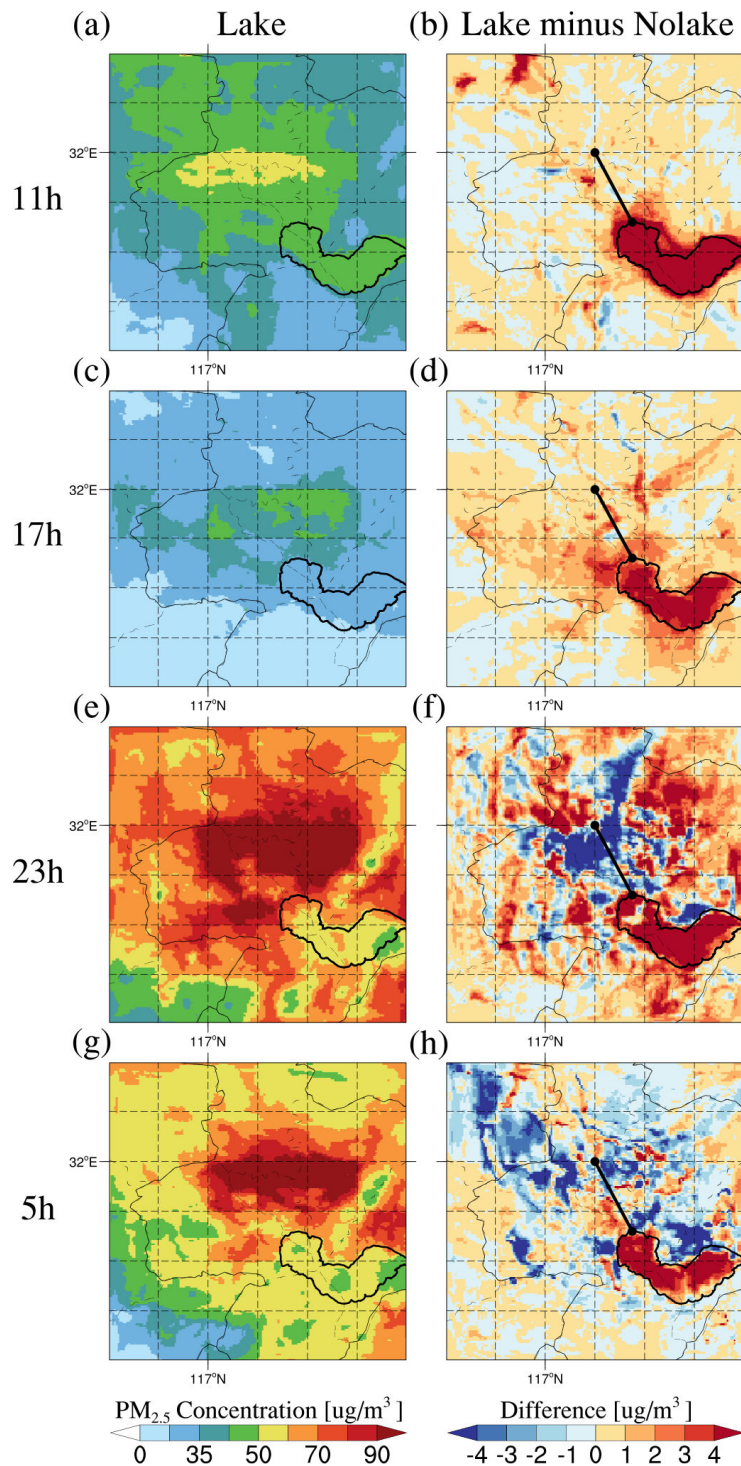
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161 **Figure S6.** The spatial distribution of PM<sub>2.5</sub> near-surface concentrations from the  
 162 ChinaHighPM<sub>2.5</sub> dataset (satellite-derived hourly 5 km resolution ground-level PM<sub>2.5</sub>  
 163 for Eastern China, 2018) at (a-j) 08:00, 09:00, 10:00, 11:00, 12:00, 13:00, 14:00, 15:00,  
 164 16:00, and 17:00 LT across the study area, averaged over the period of March 2018.  
 165 This dataset belongs to the “Long-term, Seamless, High-resolution, High-quality  
 166 Dataset of Air Pollutants in China” series (i.e., the “China High Air Pollutants” (CHAP)  
 167 dataset). The ChinaHighPM<sub>2.5</sub> dataset integrates multi-source big data (e.g., ground  
 168 observation data, satellite remote sensing products, atmospheric reanalysis, and  
 169 numerical model simulations) using artificial intelligence, fully considering the  
 170 spatiotemporal heterogeneity characteristics of air pollution.

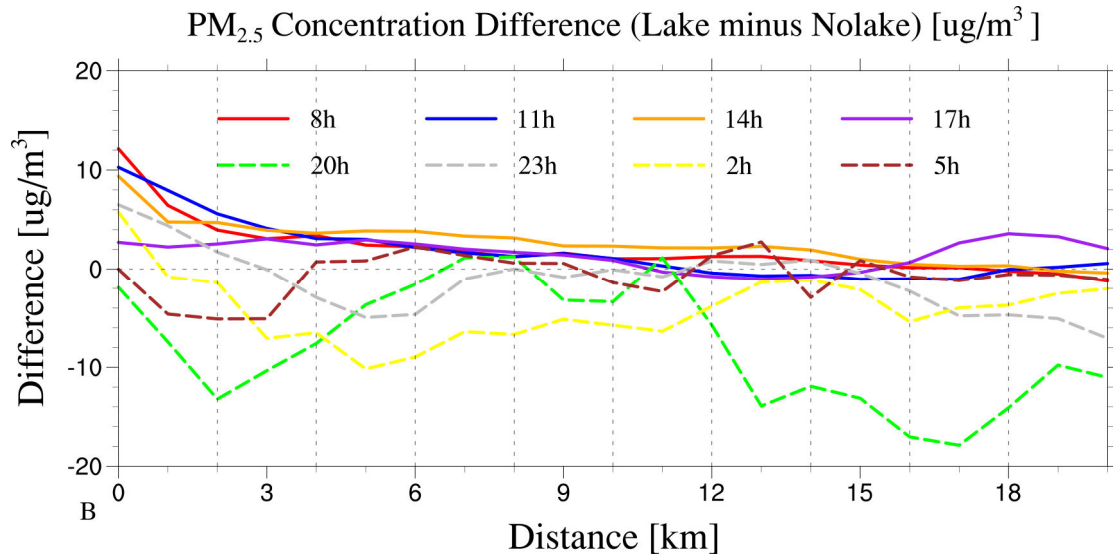
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173 **Figure S7.** The spatial distribution of PM<sub>2.5</sub> near-surface concentrations in the (a, c, e, g) Lake experiment and (b, d, f, h) the differences between Lake and Nolake  
 174 experiments (Lake minus Nolake) at 11:00, 17:00, 23:00, and 05:00 LT across the study  
 175 area, averaged over 10-20 March 2019. Note that the line segments shown in panels (b,  
 176 a, d, f, h) correspond to the AB transect marked in Figure 2.  
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180 **Figure S8.** Average PM<sub>2.5</sub> near-surface concentration differences (Lake minus Nolake)  
 181 at 08:00, 11:00, 14:00, 17:00, 20:00, 23:00, 02:00, and 05:00 LT, averaged over 10-20  
 182 March 2019, as a function of distance from point B toward A. The x-axis represents the  
 183 distance from point B along the path and the y-axis presents the concentration  
 184 difference.

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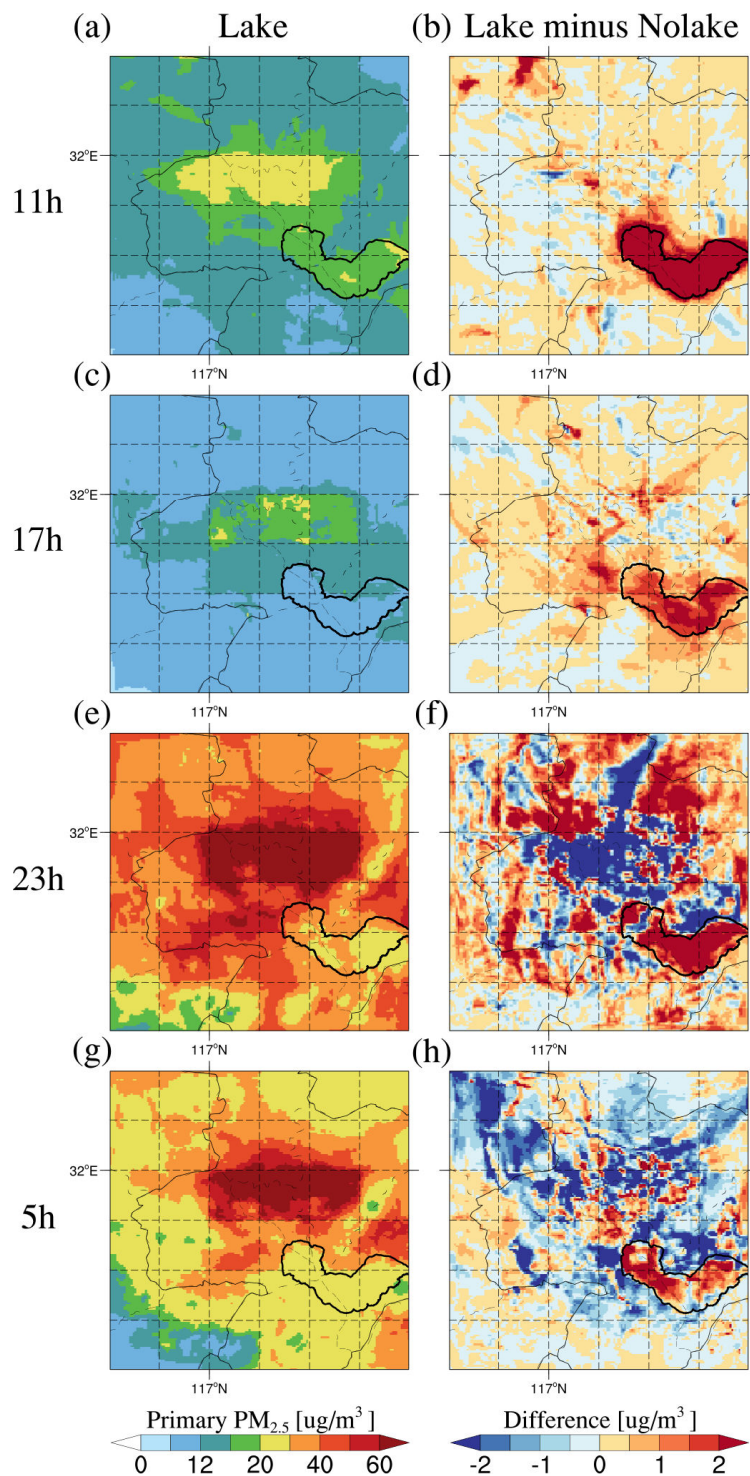
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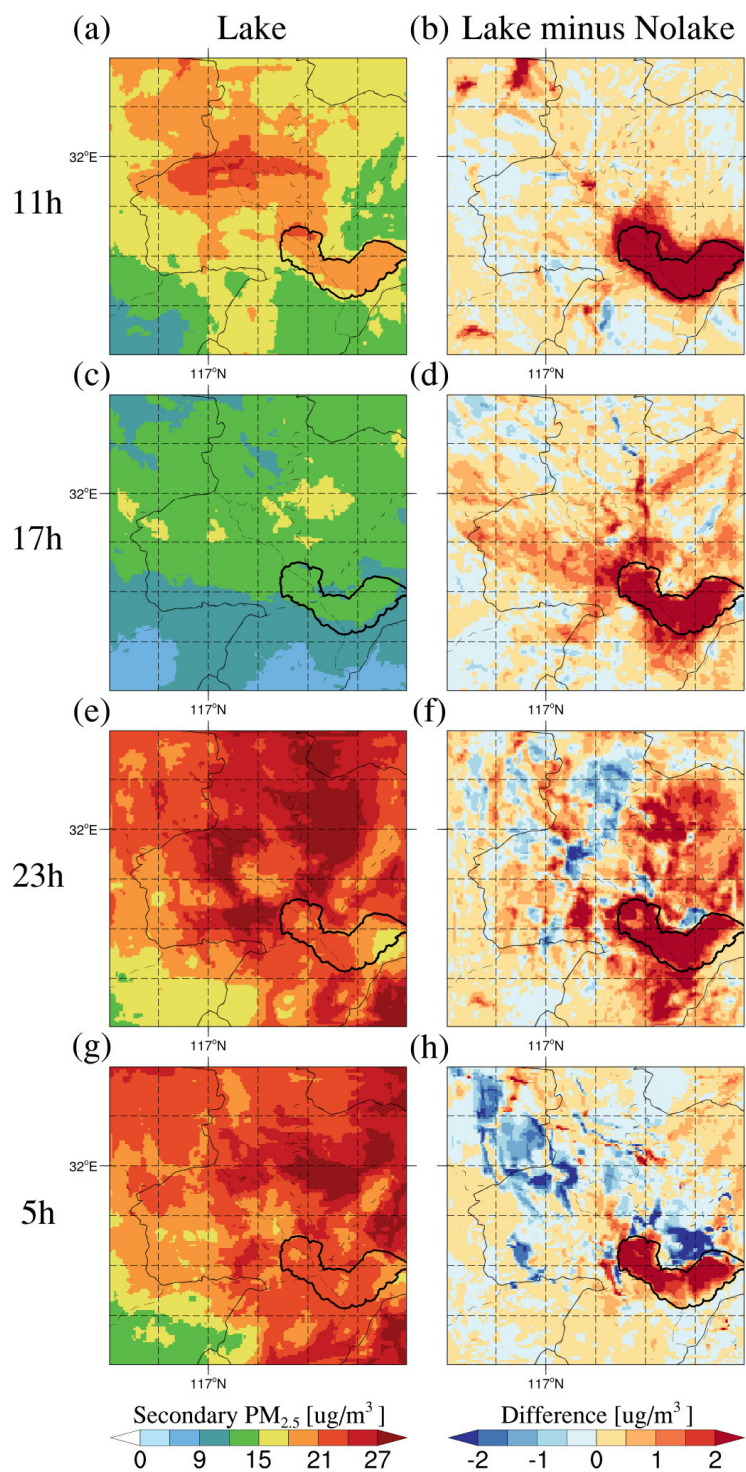
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201 **Figure S9.** The spatial distribution of primary PM<sub>2.5</sub> near-surface concentrations (sum  
 202 of black carbon (BC), organic carbon (OC), and other inorganics (OIN)) in the (a, c,  
 203 e, g) Lake experiment and (b, d, f, h) the differences between Lake and Nolake  
 204 experiments (Lake minus Nolake) at 11:00, 17:00, 23:00, and 05:00 LT across the study  
 205 area, averaged over 10-20 March 2019.

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208 **Figure S10.** The spatial distribution of secondary PM<sub>2.5</sub> near-surface concentrations

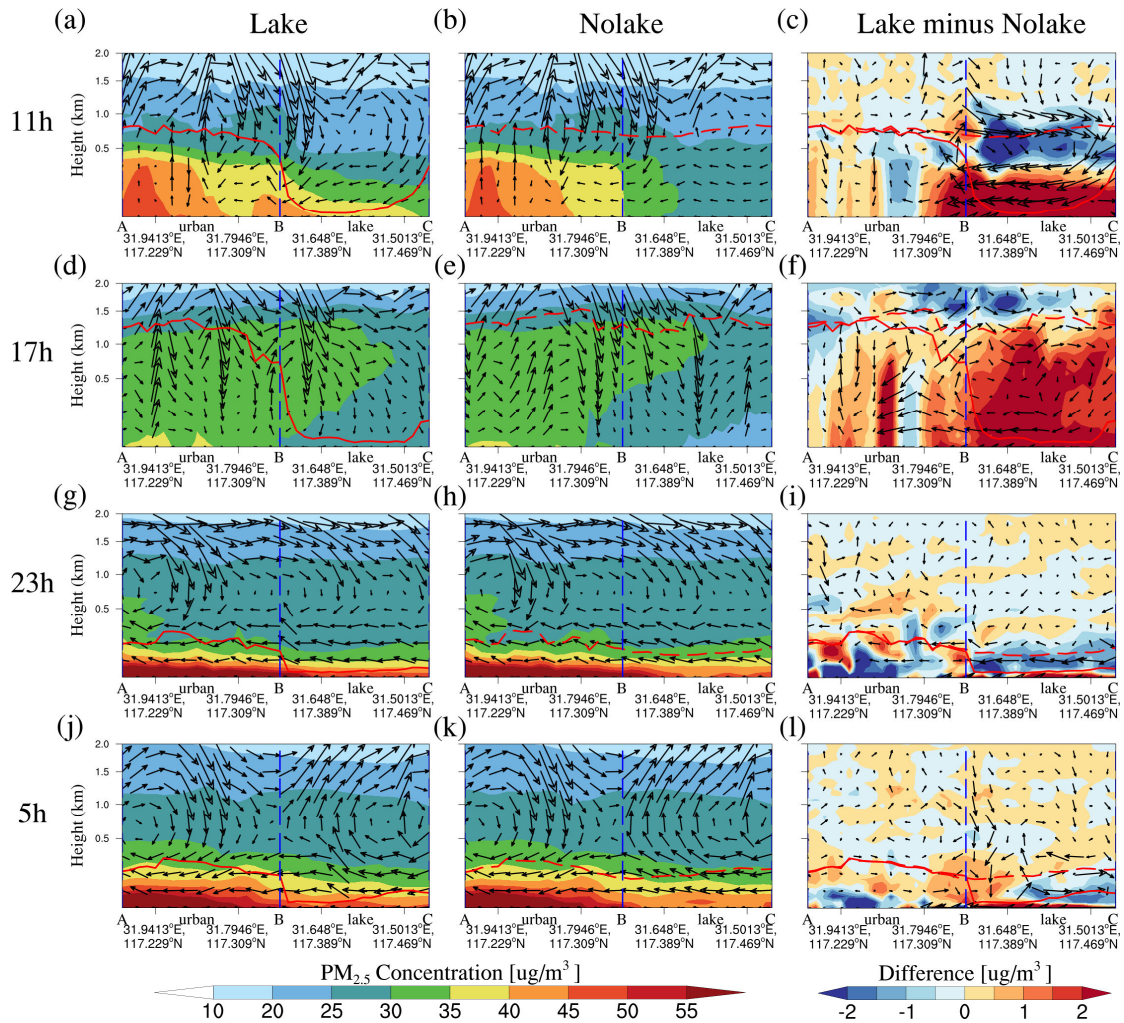
209 (sum of sulfate (SO<sub>4</sub><sup>2-</sup>), nitrate (NO<sub>3</sub><sup>-</sup>), and ammonium (NH<sub>4</sub><sup>+</sup>)) in the (a, c, e, g)

210 Lake experiment and (b, d, f, h) the differences between Lake and Nolake

211 experiments (Lake minus Nolake) at 11:00, 17:00, 23:00, and 05:00 LT across the study

212 area, averaged over 10-20 March 2019.

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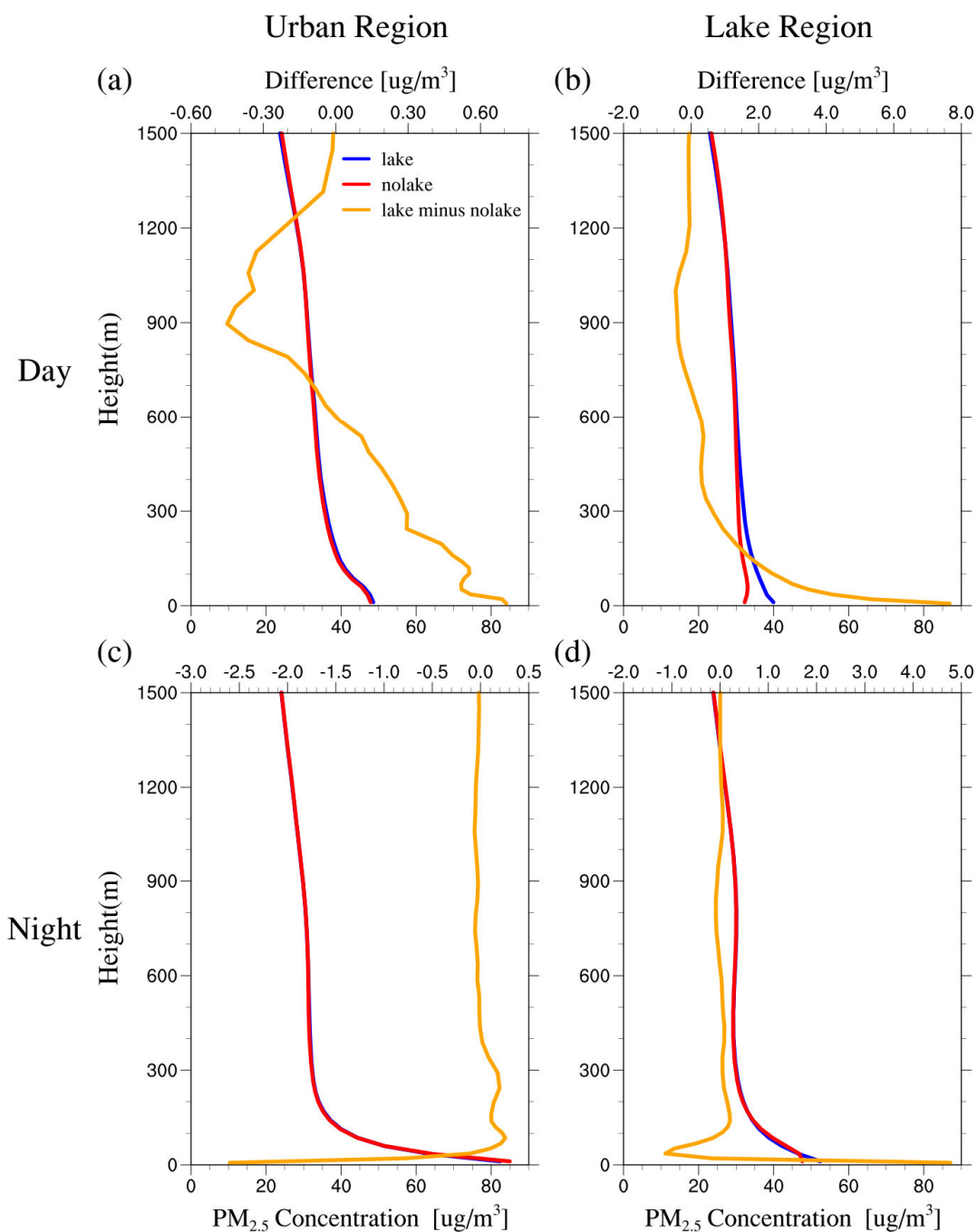


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215 **Figure S11.** The vertical cross-section of PM<sub>2.5</sub> concentration and wind vectors along  
 216 the key path AC (indicated in Figure 2) for the (a、 d、 g、 j) Lake experiment, (b、 e、  
 217 h、 k) Nolake experiment, and (c、 f、 i、 l) their differences (Lake minus Nolake) at  
 218 11:00, 17:00, 23:00, and 05:00 LT, averaged over 10-20 March 2019. The shaded  
 219 contours represent PM<sub>2.5</sub> concentrations or their differences between the two  
 220 experiments at each altitude. The black vector arrows indicate the superimposed  
 221 vertical wind field (including horizontal and vertical wind components), with the  
 222 vertical wind vector being multiplied by 50 for visibility. The red solid line represents  
 223 the planetary boundary layer height (PBLH) in the Lake experiment, and the red dashed  
 224 line represents the PBLH in the Nolake experiment. The blue dashed line represents the  
 225 lake-land boundary.

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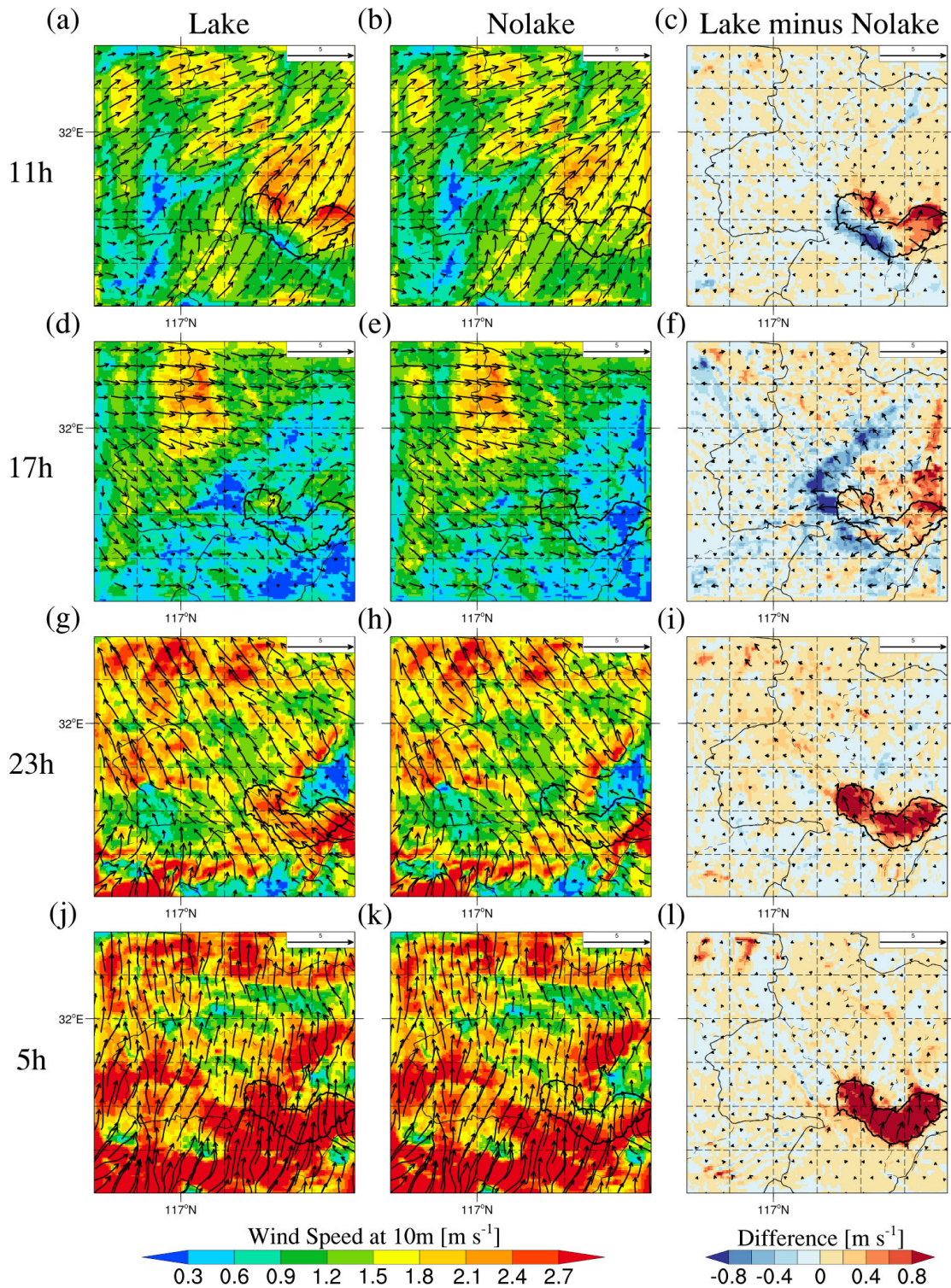
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229 **Figure S12.** The vertical profiles of  $PM_{2.5}$  concentrations simulated in the Lake  
 230 experiment (solid blue line), Nolake experiment (solid red line), and their differences  
 231 (Lake minus Nolake, solid orange line) over (a, c) urban and (b, d) lake regions during  
 232 daytime and nighttime, averaged over 10-20 March 2019. Note that “Urban Region”  
 233 represents the average value for areas with urban underlying surface within the study  
 234 domain, while “Lake Region” represents the average value for areas with lake  
 235 underlying surface within the study domain, to make the results more representative.

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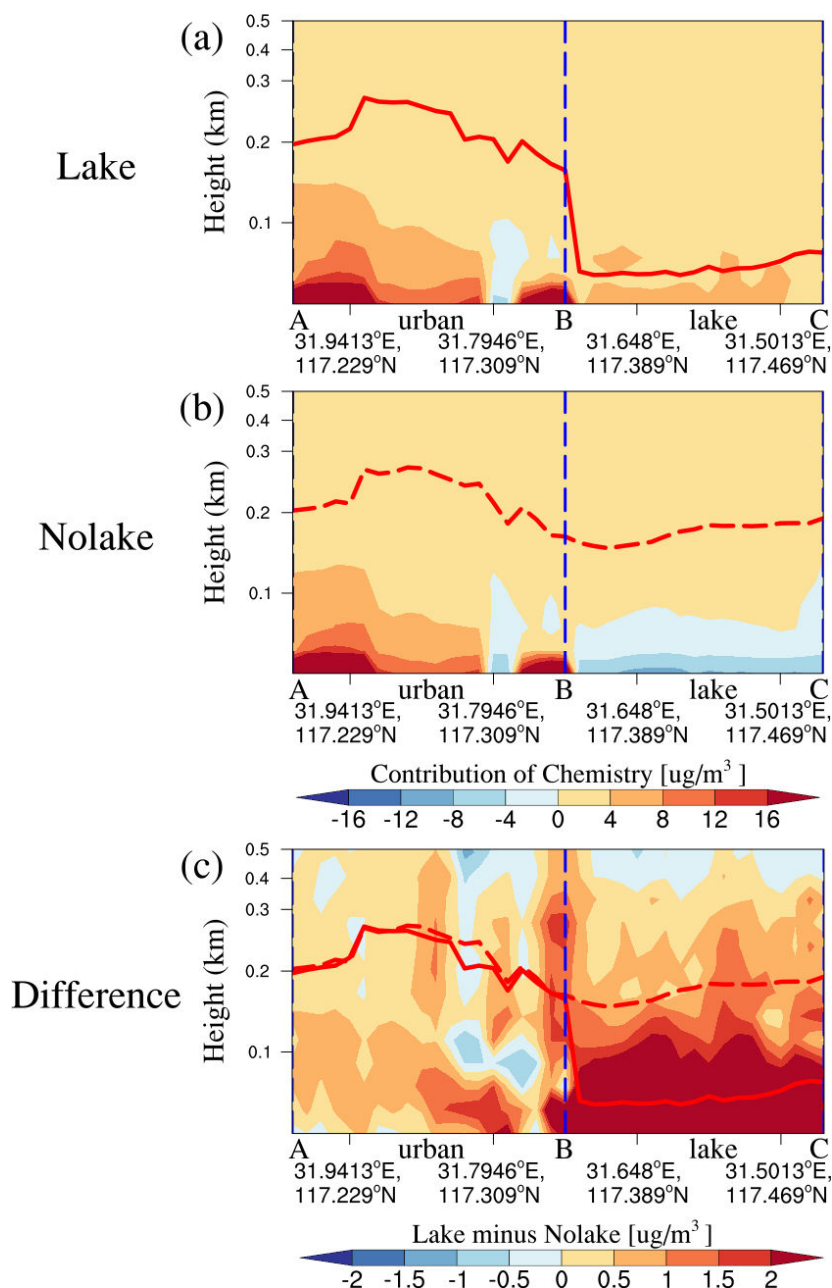


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238 **Figure S13.** The spatial distribution of 10-m wind speed in the (a, d, g, j) Lake  
 239 experiment, (b, e, h, k) Nolake experiment, and (c, f, i, l) their differences (Lake  
 240 minus Nolake) at 11:00, 17:00, 23:00, and 05:00 LT across the study area, averaged  
 241 over 10-20 March 2019.

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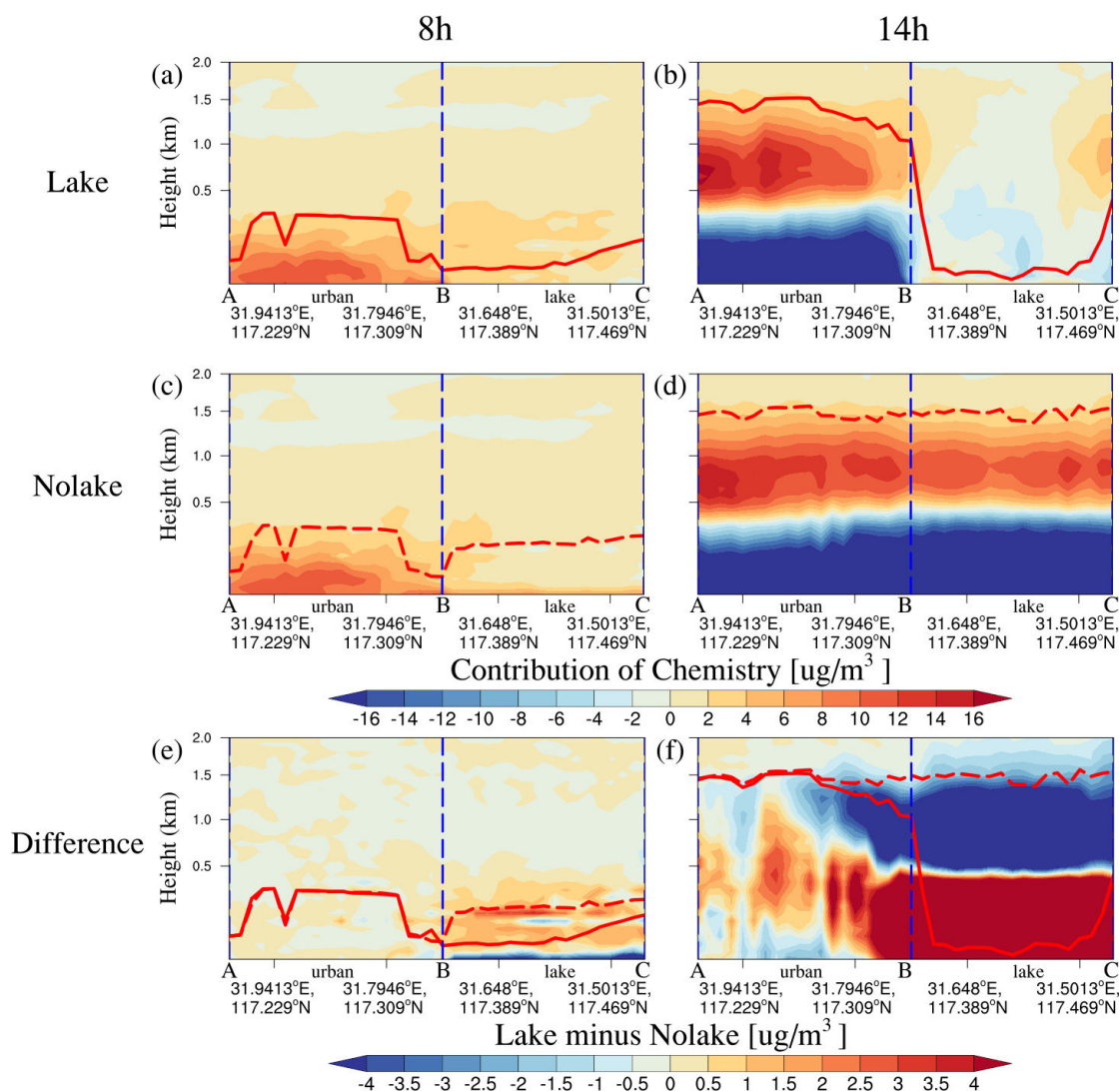
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245 **Figure S14.** The vertical cross-section of chemical process contributions to  $PM_{2.5}$   
 246 concentrations along the key path AC (indicated in Figure 2) for the (a) Lake  
 247 experiment, (b) Nolake experiment, and (c) their differences (Lake minus Nolake)  
 248 during nighttime, averaged over 10-20 March 2019. The shaded contours represent the  
 249 contribution of chemical processes to surface  $PM_{2.5}$  concentrations or their differences  
 250 between the two experiments at each altitude. The red solid line represents the PBLH  
 251 in the Lake experiment, and the red dashed line represents the PBLH in the Nolake  
 252 experiment. The blue dashed line represents the lake-land boundary.

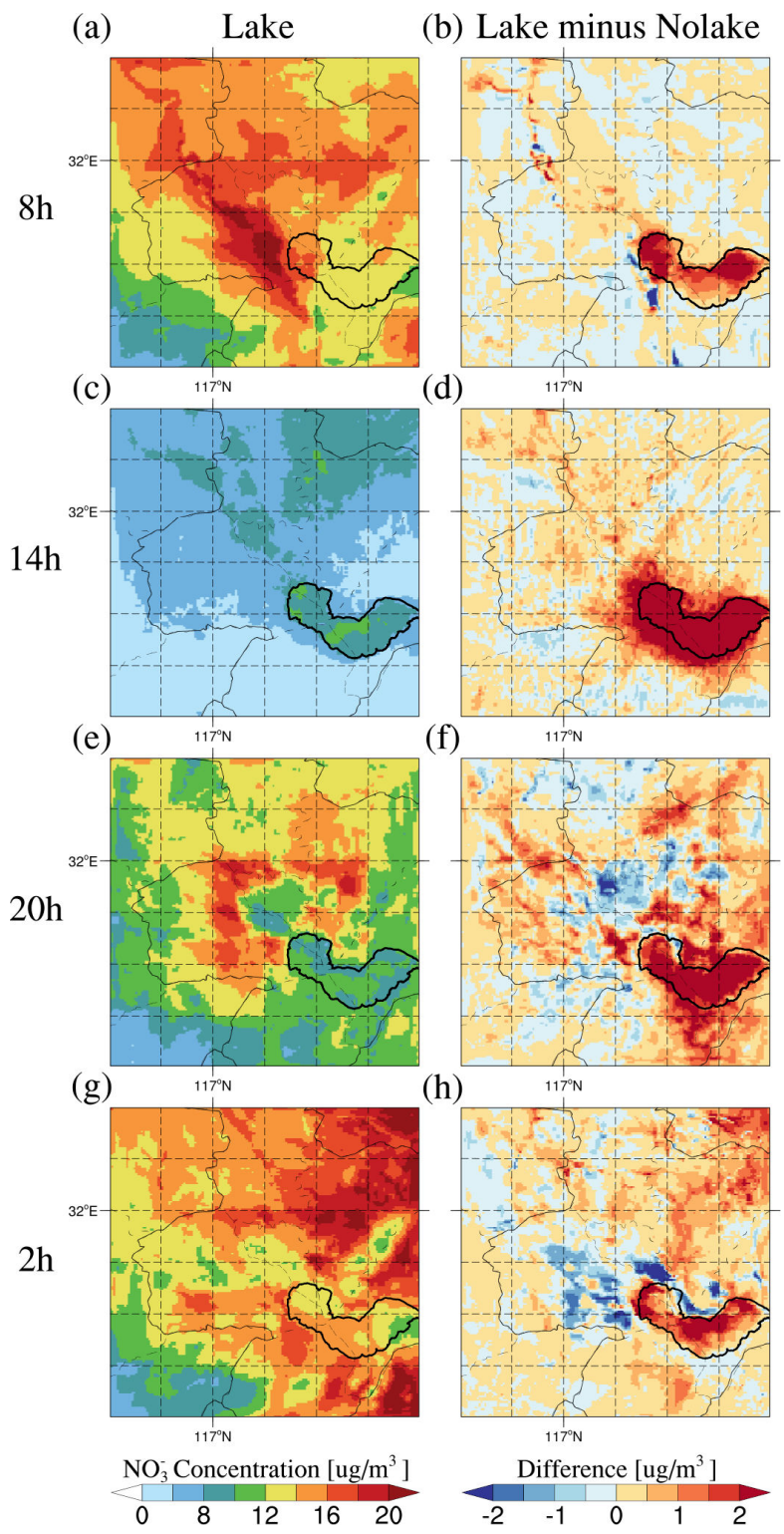
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255 **Figure S15.** The vertical cross-section of chemical process contributions to  $PM_{2.5}$   
 256 concentrations along the key path AC (indicated in Figure 2) for the (a、b) Lake  
 257 experiment, (c、d) Nolake experiment, and (e、f) their differences (Lake minus  
 258 Nolake) at 08:00 and 14:00 LT, averaged over 10-20 March 2019. The shaded contours  
 259 represent the contribution of chemical processes to surface  $PM_{2.5}$  concentrations or their  
 260 differences between the two experiments at each altitude. The red solid line represents  
 261 the planetary boundary layer height (PBLH) in the Lake experiment, and the red dashed  
 262 line represents the PBLH in the Nolake experiment. The blue dashed line represents the  
 263 lake-land boundary.

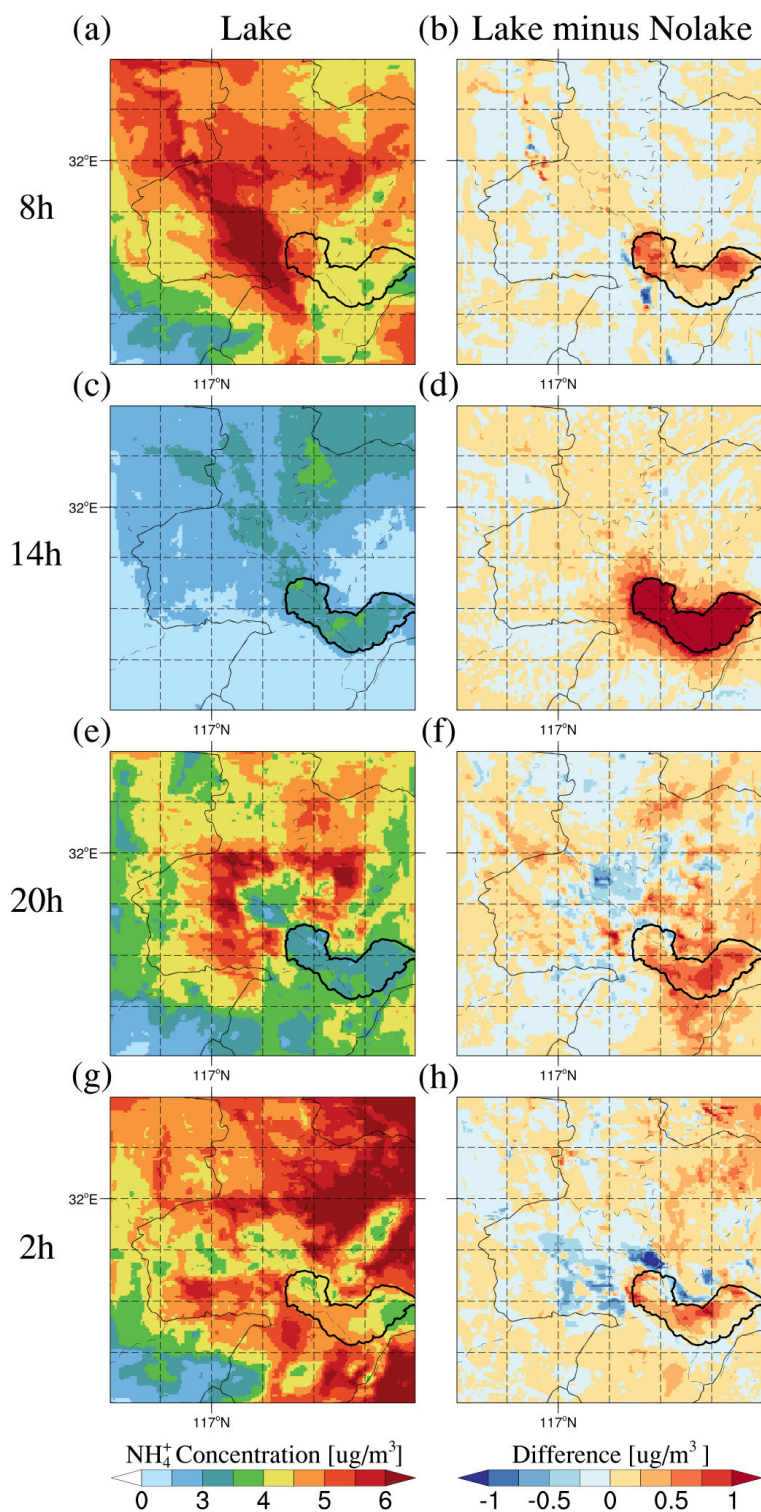
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266 **Figure S16.** The spatial distribution of  $\text{NO}_3^-$  near-surface concentrations in the (a, c,  
 267 e, g) Lake experiment and (b, d, f, h) the differences between Lake and Nolake  
 268 experiments (Lake minus Nolake) at 08:00, 14:00, 20:00, and 02:00 LT across the study  
 269 area, averaged over 10-20 March 2019.

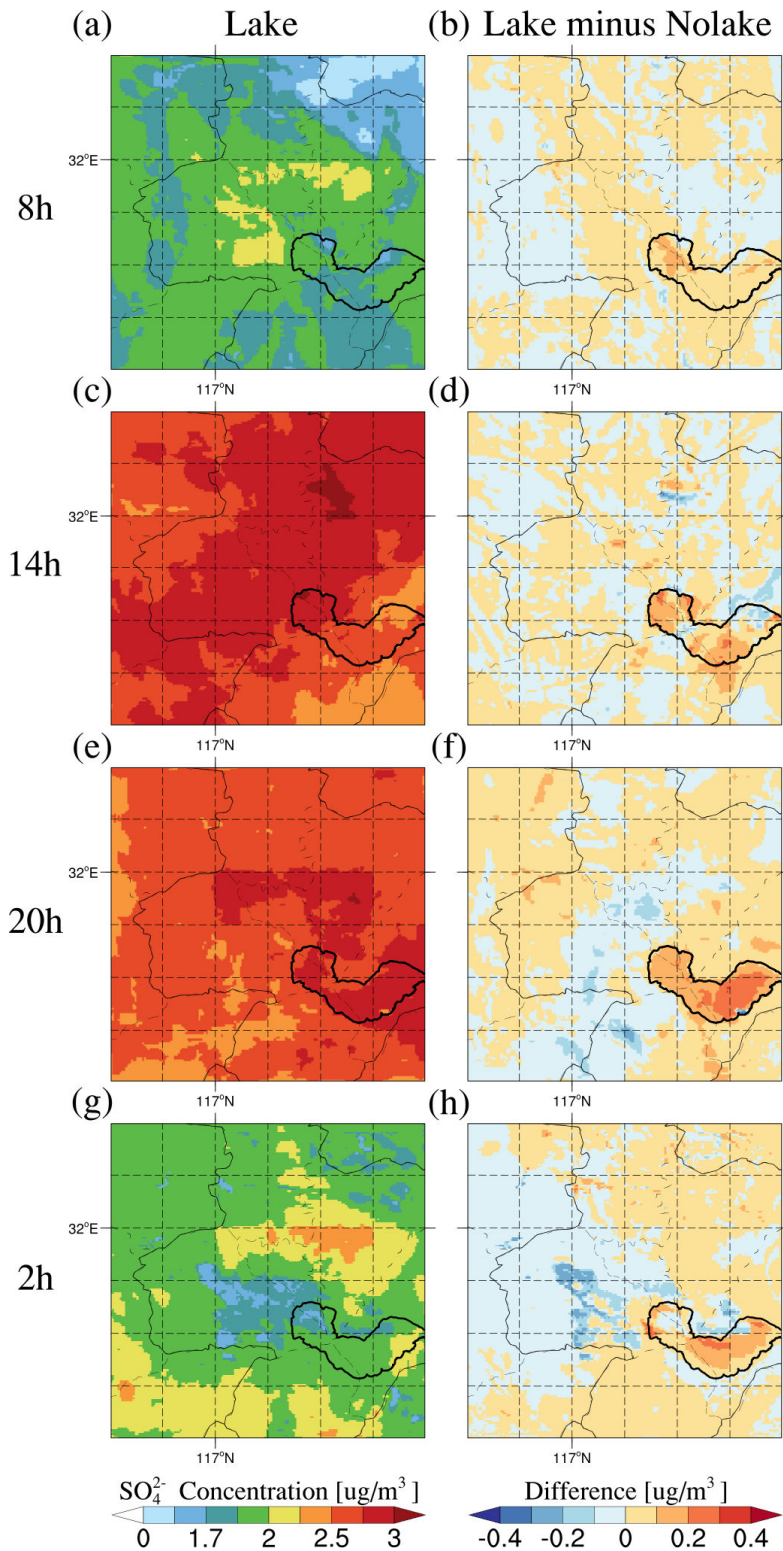
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272 **Figure S17.** The spatial distribution of  $\text{NH}_4^+$  near-surface concentrations in the (a, c,  
 273 e, g) Lake experiment and (b, d, f, h) the differences between Lake and Nolake  
 274 experiments (Lake minus Nolake) at 08:00, 14:00, 20:00, and 02:00 LT across the study  
 275 area, averaged over 10-20 March 2019.

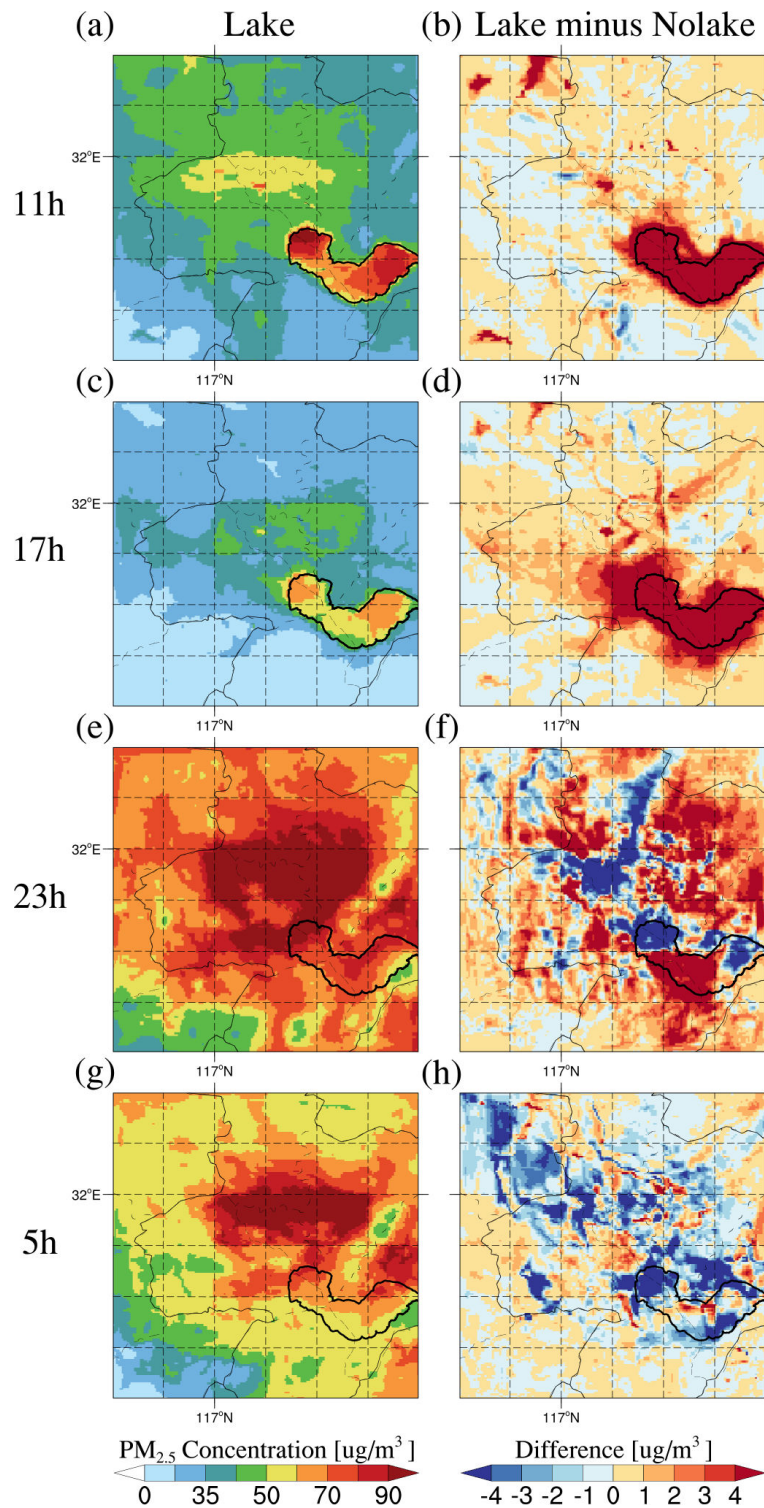
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278 **Figure S18.** The spatial distribution of  $\text{SO}_4^{2-}$  near-surface concentrations in the (a, c,  
 279 e, g) Lake experiment and (b, d, f, h) the differences between Lake and Nolake  
 280 experiments (Lake minus Nolake) at 08:00, 14:00, 20:00, and 02:00 LT across the study  
 281 area, averaged over 10-20 March 2019.

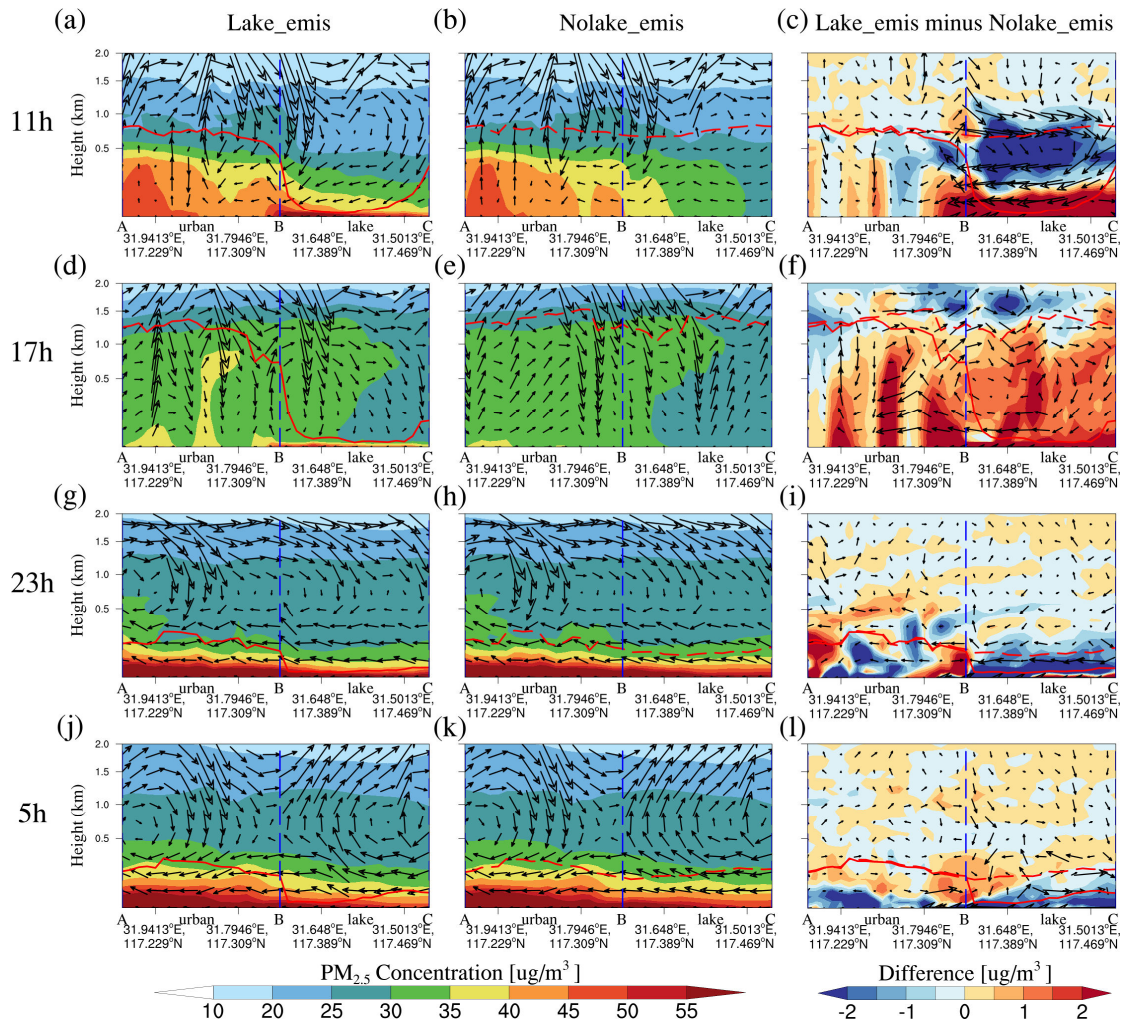
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284 **Figure S19.** The spatial distribution of  $PM_{2.5}$  near-surface concentrations in the (a, c,  
 285 e, g) Lake\_emis experiment and (b, d, f, h) the differences between Lake\_emis  
 286 and Nolake\_emis experiments (Lake\_emis minus Nolake\_emis) at 11:00, 17:00, 23:00,  
 287 and 05:00 LT across the study area, averaged over 10-20 March 2019.

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290 **Figure S20.** The vertical cross-section of  $PM_{2.5}$  concentration and wind vectors along  
 291 the key path AC (indicated in Figure 2) for the (a、d、g、j) Lake\_emis experiment,  
 292 (b、e、h、k) Nolake\_emis experiment, and (c、f、i、l) their differences (Lake\_emis  
 293 minus Nolake\_emis) at 11:00, 17:00, 23:00, and 05:00 LT, averaged over 10-20 March  
 294 2019. The shaded contours represent  $PM_{2.5}$  concentrations or their differences between  
 295 the two experiments at each altitude. The black vector arrows indicate the superimposed  
 296 vertical wind field (including horizontal and vertical wind components), with the  
 297 vertical wind vector being multiplied by 50 for visibility. The red solid line represents  
 298 the planetary boundary layer height (PBLH) in the Lake experiment, and the red dashed  
 299 line represents the PBLH in the Nolake experiment. The blue dashed line represents the  
 300 lake-land boundary.

301