ADVANCES IN ATMOSPHERIC SCIENCES, VOL. 34, FEBRUARY 2017, 226–234

• **Original Paper** •

Impact of Taihu Lake on City Ozone in the Yangtze River Delta

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(Received 27 April 2016; revised 17 August 2016; accepted 22 August 2016)

ABSTRACT

The lake-breeze at Taihu Lake generates a different specific heat capacity between the water body and the surrounding land. Taihu Lake has a significant impact on the atmospheric conditions and the air quality in the Yangtze River Delta. This phenomenon is referred to as the Taihu Lake effect. In this study, two simulations were conducted to determine the impact of the Taihu Lake effect in the reference experiment (R-E) and sensitivity experiments (NO_TH). The control simulations demonstrated that the meteorological field and the spatial distribution of ozone (O_3) concentrations over Taihu lake obviously changed once the land-use type of water body was substituted by cropland. The surface temperature of Taihu Lake was reduced under the impact of Taihu Lake, and a huge temperature difference caused a strong lake-breeze effect. The results also showed that the difference in the average concentrations of O_3 between the R-E and NO_TH experiments reached 12 ppbv in most areas of Taihu Lake, all day, on 20 May 2014. During daytime (0800–1600 LST, LST=UTC+8), the influence of the Taihu Lake effect on O_3 in the Suzhou region was not significant. However, the influence of the Taihu Lake effect on O_3 in the Suzhou region was obvious during nighttime (1800–2400 LST). The larger changes in the physical and chemical processes were horizontal and vertical advections under the influence of the Taihu Lake effect in Taihu Lake.

Key words: Taihu Lake, ozone, WRF-Chem, Yangtze River Delta

Citation: Zhang, L., B. Zhu, J. H. Gao, and H. Q. Kang, 2016: Impact of Taihu Lake on city ozone in the Yangtze River Delta. *Adv. Atmos. Sci.*, **34**(2), 226–234, doi: 10.1007/s00376-016-6099-6.

1. Introduction

With their rapid industrialization and economic development, the scale of Chinese cities is increasing. A consequence of this is that they emit large amounts of ozone (O_3) precursors [nitrogen oxides (NO_x), volatile organic compounds (VOCs) etc.] into the atmosphere, meaning atmospheric environmental problems are becoming increasingly serious and a direct threat to human health. O_3 is a secondary pollutant generated by NO_x and VOCs (Chameides and Walker, 1973; Oltmans, 1981; Logan, 1985). Currently, regional photochemical pollution is apparent in the Beijing–Tianjin–Hebei region, the Yangtze River Delta region, and the Pearl River Delta region, along with other economically developed areas. The phenomenon of high concentrations of O_3 has become the focus of many studies into urban air quality (e.g., Vingarzan, 2004; Qu et al., 2014; Han et al., 2015; Shang et al., 2015).

A number of studies have been published that have highlighted the regional transport and photochemistry of severe O_3 pollution. Ling et al. (2011) found that reducing the different sources of VOCs can control O_3 formation in the Hong Kong area. The O_3 pollution process is closely related to tropical cyclones in the Pearl River Delta region during the summer season (Huang et al., 2005; Jiang et al., 2008). Tie et al. (2013) used the WRF model coupled with Chemistry (WRF-Chem) to analyze the impacts of a megacity (Shanghai) on O_3 formation. Li et al. (2012) used the CMAQ (Community Multiscale Air Quality) model to analyze the contributions of individual physical and chemical processes on O_3 concentrations over the Yangtze River Delta. A recent study by Zhu et al. (2015) showed that Shanghai has a greater impact on a downstream city (Kunshan) regarding the formation of O_3. Chung (1977) found that the lake-breeze (lake effect) has a significant influence on concentrations of O_3. Lyons and Cole (1976) found that the lake effect changes the weather field, which results in a large quantity of ozone being transported downstream. Levy et al. (2010) found that O_3 concentrations were high over the southern Great Lakes. During the day, updrafts transport O_3 to higher altitudes over the city, and downdrafts transport O_3 to the southern Great

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Lakes. Generally, O_3 pollution is becoming increasingly serious. In the Yangtze River Delta region, although studies on regional urban photochemical pollution have been extensive, research on the impacts of the Taihu lake effect on city O_3 has been limited.

Taihu Lake is the fifth largest freshwater lake in China and is a typical large shallow lake. Taihu Lake Basin is one of the most developed, most densely populated and most industrial areas in China. Currently, air pollution is serious in Taihu Lake Basin. Industrial production, residential emissions and traffic generate large quantities of emissions (Huang et al., 2011). Due to the difference between the specific heat capacity of Taihu Lake and the land, the lake effect changes the meteorological field in the surrounding area, and then changes the concentrations of O_3. Therefore, it is necessary to study the impact of Taihu Lake on city O_3, which we did in the present study via two simulation experiments. The specific purpose was to study the temporal and spatial distribution characteristics, the physical and chemical mechanisms, and the interaction of O_3 between cities and Taihu. The ultimate aim was to provide scientific support for the control of O_3 pollution in the Yangtze River Delta region.

2. Methodology

2.1. *Model setup and input data*

The meteorological data (wind direction) for this study were from the automatic weather stations in Suzhou, Hangzhou and Shanghai; and the concentrations of O_3 and nitrogen dioxide (NO_2) were from the atmospheric pollution monitoring stations of Suzhou, Hangzhou and Shanghai.

The impact of the Taihu Lake effect was examined using the WRF-Chem model (Grell et al., 2005; Peckam et al., 2013). This model was developed by NCAR, PNNL (Pacific Northwest National Laboratory), NOAA, and other institutions. The modeling system includes two components: a dynamic module and a chemical module. The dynamic module can calculate many different dynamic parameters and microphysical variables. The chemical module includes complete transmission (advection and diffusion), dry/wet deposition and chemical processes. A detailed description of the chemical component of the model is available in Grell et al. (2005). The biggest advantage of the model is that the dynamic module and the chemical transmission module are completely coupled in time and space.

Figure 1 shows the modeling domains used in the WRF-Chem model, with horizontal grid spacing (grid numbers) of 9 km (99 × 99) and 3 km (78 × 78) for the outer and inner domains, respectively. The model was used to simulate two nested domains, and the inner domain was the Yangtze River Delta region. The central latitude and longitude of the outer and inner domain were (32°N, 119°E) and (31.16°N, 120.81°E), respectively. The projection method used was Lambert projection. The meteorological input data were from NCEP, and the grid resolution was $1^\circ \times 1^\circ$. The gas-phase chemical mechanism of the WRF-Chem model is RADM2 (Regional Acid Deposition Model, version 2) (Stockwell et al., 1990). The photolysis rate of the photochemical reaction process is calculated by the online Fast-J method. The Purdue Lin scheme was used for the microphysics (Lin et al., 1983). The RRTM scheme was used for the parametriza-

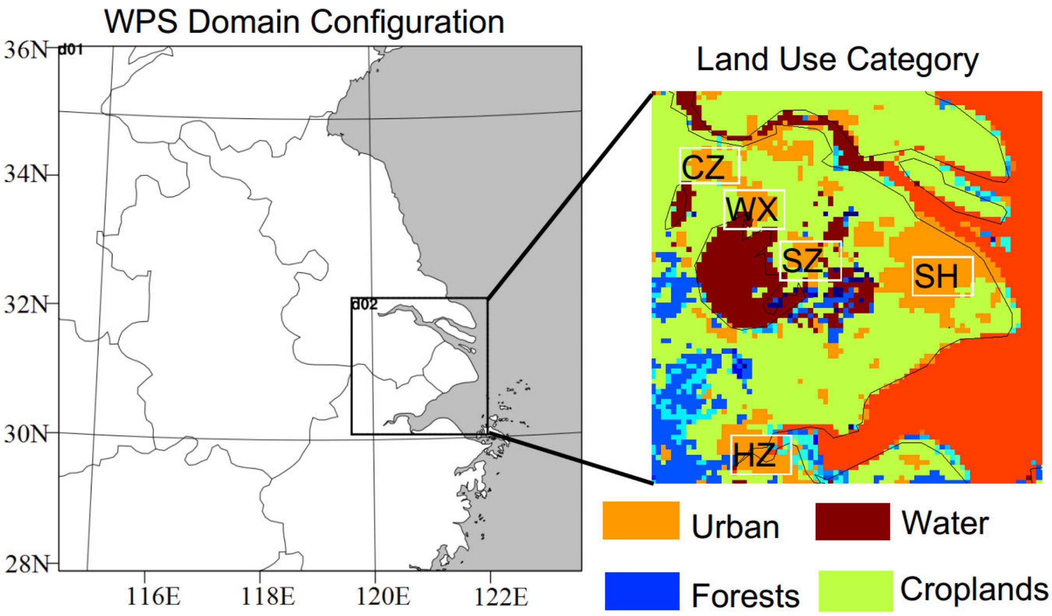

Fig. 1. (a) Modeling domains used in the WRF-Chem model, with a horizontal spacing of 9 km and 3 km for the two nested domains. (b) Land-use categories in the Yangtze River Delta in the inner domain. SH, SZ, CZ, WX and HZ represent Shanghai, Suzhou, Changzhou, Wuxi, and Hangzhou respectively. d01: the first layer of the model, d02: the inner layer of the model.

tion of longwave radiation. The Noah land surface scheme was used for the parametrization of the land surface process (Chen and Dudhia, 2001). The emission source used in this paper was INTEX-B (Intercontinental Chemical Transport Experiment-Phase B), and the initial conditions and outermost boundary conditions were provided by MOZART-4 (Model for Ozone And Related Chemical Traces, version 4) (Emmons et al., 2010). The simulation time of the study was 16–21 May 2014. The first two days were the spin-up time of the model, and the main time period for the analysis occurred on 20 May.

2.2. *Sensitivity scheme*

We evaluated the impact of the effect of Taihu Lake on the weather conditions and O_3 in the surrounding cites of Taihu. Fine-resolution (30 s) MODIS 20-category land-use data were used to optimally represent the Taihu Lake area. The land-use types of the inner domain are shown in Fig. 1. Shanghai, Suzhou, Changzhou, Wuxi, and Hangzhou abbreviated as SH, SZ, CZ, WX and HZ respectively. Two simulation experiments were conducted with different land-use types: the first was a reference experiment (R-E), in which we used the MODIS land-use categories. Then, a sensitivity experiment, NO_Taihu (NO_TH), was conducted in which we replaced the water of Taihu Lake with cropland, but retained the land-use types in other regions.

2.3. *Model evaluation*

To evaluate the performance of the model, we compared the simulation results with observational data. Figure 2 compares the simulated and observed O_3 concentrations, NO_2 concentrations and meteorological condition (wind direction) at Suzhou, Hangzhou and Shanghai during 18–21 May 2014. The locations of the three stations are shown in Fig. 3. The wind direction shifted from the northwest during the day to the south at night on 20 May. The observed wind direction was in good agreement with the model-estimated values in the three city sites. The calculated concentrations of O_3 and NO_2 were very similar to the measured values at all of the sites, but the model slightly underestimated the peak concentrations of O_3 in the three cities in the afternoon on 20 May.

Statistical methods (correlation coefficient and normalized mean error) were used to quantitatively describe the accuracy of the model results.

The calculation method of the correlation coefficient is

$$r=\frac{\sum_{i=1}^{N}(p_i-P)(o_i-O)}{\sqrt{\sum_{i=1}^{N}(p_i-P)^2}\sqrt{\sum_{i=1}^{N}(o_i-O)^2}}\,, \tag{1}$$

and that of the mean normalized error (NME) is

$$\mathrm{NME}=\frac{1}{N}\sum_{i=1}^{N}\frac{(p_i-o_i)}{o_i}\,. \tag{2}$$

In the above two equations, p_i is the simulated concentration, o_i is the observed concentration, P is the average simulated concentration, O is the average observed concentration, and N is the sample number.

According to the recommendations of the United States EPA (O'Nell et al., 2006), if the normalized mean error of O_3 is within ±15%, the results of the O_3

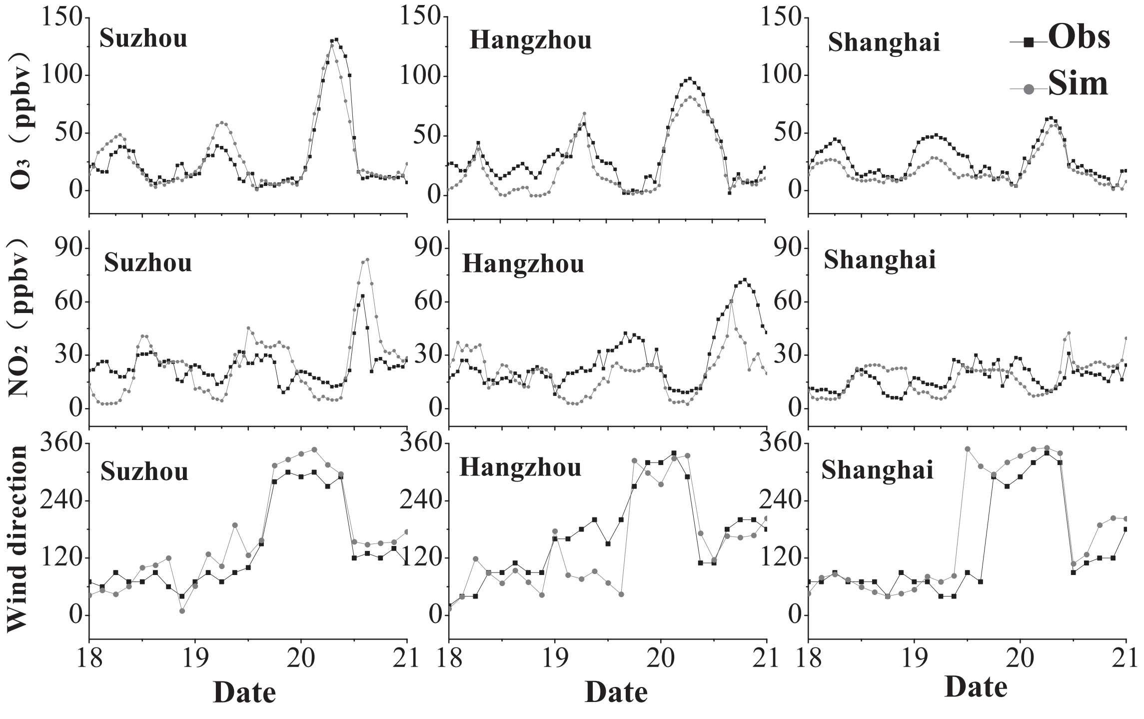

Fig. 2. Comparison of simulated (Sim; gray lines with circles) and observed (Obs; black lines with squares) O_3 concentrations (top row), NO_2 concentrations (middle row), and meteorological condition (wind direction; bottom row; units: degrees), at Suzhou (left column), Hangzhou (middle column), and Shanghai (right column), during 18–21 May 2014.

Table 1. Correlation coefficients and normalized mean error of simulated and observed O_3 and wind direction.

	Correlation coefficient		Normalized mean	
	O_3	wind	O_3	wind
Suzhou	0.91	0.89	7.63%	6.55%
Hangzhou	0.88	0.83	7.95%	7.89%
Shanghai	0.82	0.88	8.56%	7.19%

simulation can be accepted. The statistical analysis results of the O_3 and wind direction simulation and observed values are shown in Table 1.

The correlation coefficients between the simulated and observed concentrations of O_3 at Suzhou, Hangzhou and Shanghai were 0.91, 0.88 and 0.82, respectively, showing good correlation between the two. The normalized mean error of the simulation results at Suzhou, Hangzhou and Shanghai was 7.63%, 7.95% and 8.56%, respectively. The normalized mean errors of O_3 were all within ±15%, and so the results of the O_3 simulation were accepted. The statistical analysis showed that the WRF-Chem model simulation was able to reasonably reproduce the magnitude and variation in the O_3 concentrations.

3. Results and discussion

3.1. *Weather background*

A weather chart that was published by the Hong Kong Observatory shows that the period of 20–21 May 2014 was a special springtime situation (http://gb.weather.gov.hk/wxinfo/currwx/wxchtc.htm). At 0800 LST (LST=UTC+8) 20 May, the Yangtze River Delta was experiencing a high-pressure front and a low-pressure tail. The wind direction was northwest and, with the high-pressure transition, the weather became sunny. This condition was conducive to the formation of photochemical pollution in the Yangtze River Delta. On 21 May, the Yangtze River Delta was under the control of high pressure and the wind direction was southeast. The change in the weather system caused the change in the meteorological field.

3.2. *O_3 regional distribution characteristics*

Figure 3 shows the afternoon (1200–1600 LST) and evening (1800–2400 LST) average surface concentrations of O_3 and the 5-m wind fields from the R-E experiment. A northwest wind prevailed over the Yangtze River Delta during the afternoon (1200–1600 LST), as shown in Fig. 3a. However, the wind direction was affected by the high-pressure shift from the northwest to the south in the evening (1800–2400 LST), as shown in Fig. 3b. High concentrations of O_3 were distributed in Taihu, Suzhou, Wuxi, and in the downwind region in the afternoon (1200–1600 LST). The concentrations of O_3 reached 100 ppbv over most of the Yangtze River Delta region. However, most of the large cities had low concentrations of O_3 in the evening (1800–2400 LST). Vehicle exhaust produced large amounts of NO_x emissions in the urban area at night. A large amount of NO_x emissions accumulated in the urban area, and O_3 was consumed more rapidly. In contrast with the case of the city, the concentrations of O_3 in the Taihu Lake region were still high in the evening (1800–2400 LST). The distributional characteristics of O_3 in Taihu Lake were similar to the research results of Lyons and Cole (1976) and Levy et al. (2010).

Figure 4 shows the distribution of the vertical cross section of the concentrations of O_3 and the wind field through

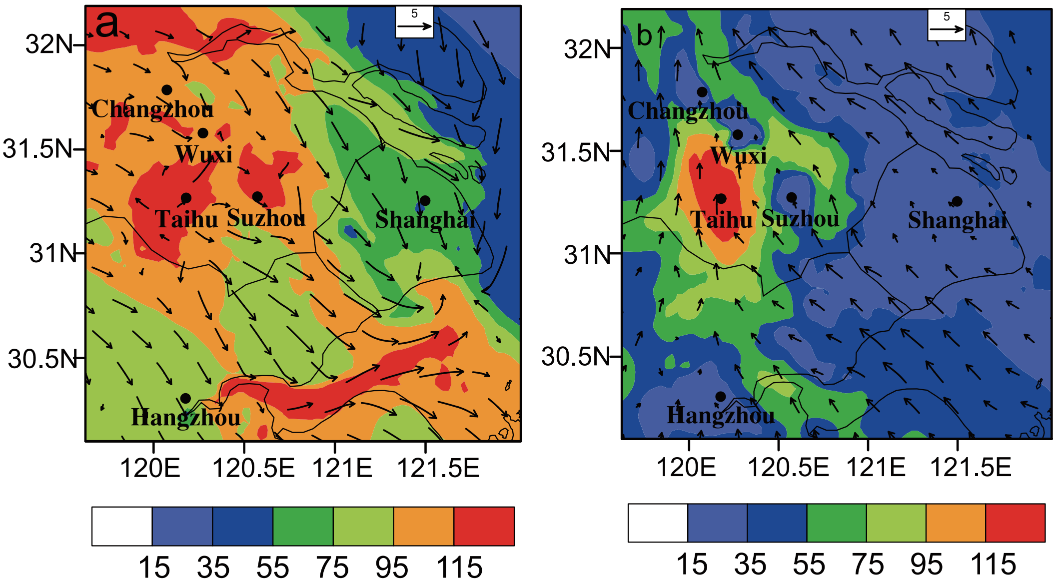

Fig. 3. Distribution of the simulated surface average concentrations of O_3 (shading; units: ppbv) and the wind field (vectors; units: m s^{-1}) in the (a) afternoon (1200–1600 LST) and (b) evening (1800–2400 LST) on 20 May 2014.

Taihu, Suzhou and Shanghai at 1500 and 2000 LST 20 May. At 1500 LST in the afternoon, it is clear that the concentrations of O_3 were still high in Suzhou and Taihu Lake at 1 km. Compared with Taihu, the concentrations of O_3 in Suzhou were significantly higher at high altitude. This phenomenon was caused by the large source of emissions and the urban heat island of Suzhou. Because of this urban heat island, the wind field showed a convergent structure and an upward flow in Suzhou. As shown in Fig. 4a, O_3 was transported to the downwind region under the influence of prevailing winds and the lake-breeze. At 2000 LST in the evening, it was clear that the concentrations of O_3 were still high in Taihu Lake at 500 m, and that the ozone residual layer was at high altitude in Suzhou, as shown in Fig. 4b. Under the influence of the lake-breeze, O_3 was transported from Taihu Lake to Suzhou and the downstream area.

3.3. *Taihu Lake effects and impact*

Next, we investigate the effects of Taihu Lake on the meteorological fields and O_3 in the surrounding area on 20 May 2014. Figure 5 shows the differences in the afternoon (1200–1600 LST) and evening (2000–2400 LST) average surface air temperature and 2-m wind fields between the R-E and NO_TH experiments. The differences were calculated by subtracting the NO_TH result from that of the R-E result. Taihu Lake had a substantial impact on the local temperature and wind field structure. As shown in Fig. 5a, because the specific heat capacity of the water body was larger than that of the land, the surface temperature of Taihu Lake was reduced by 4°C–8°C under the impact of Taihu Lake in the

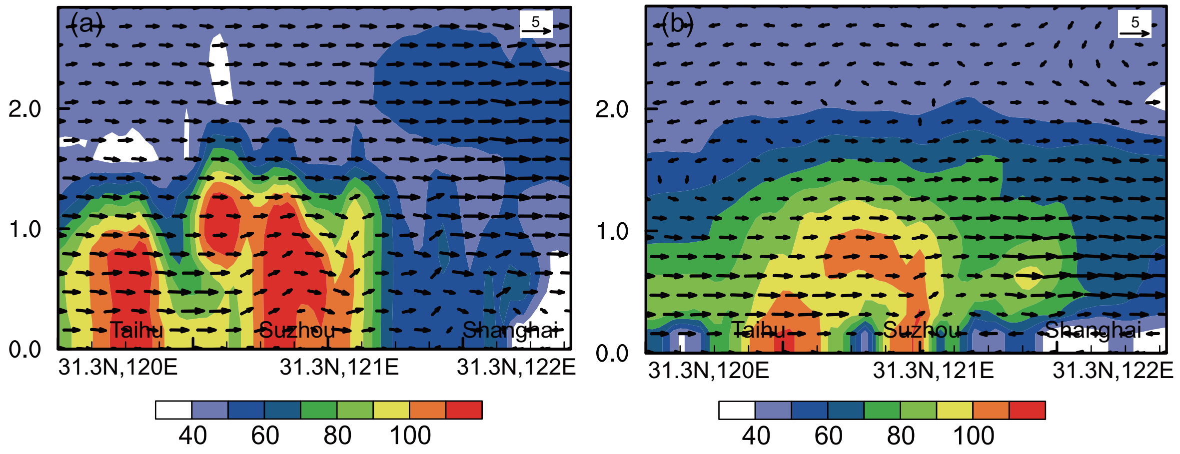

Fig. 4. The distribution of the vertical cross-section of the concentrations of O_3 (shading; units: ppbv) and the wind field (vectors; units: m s^{-1}) through Taihu, Suzhou and Shanghai at (a) 1500 LST and (b) 2000 LST 20 May 2014.

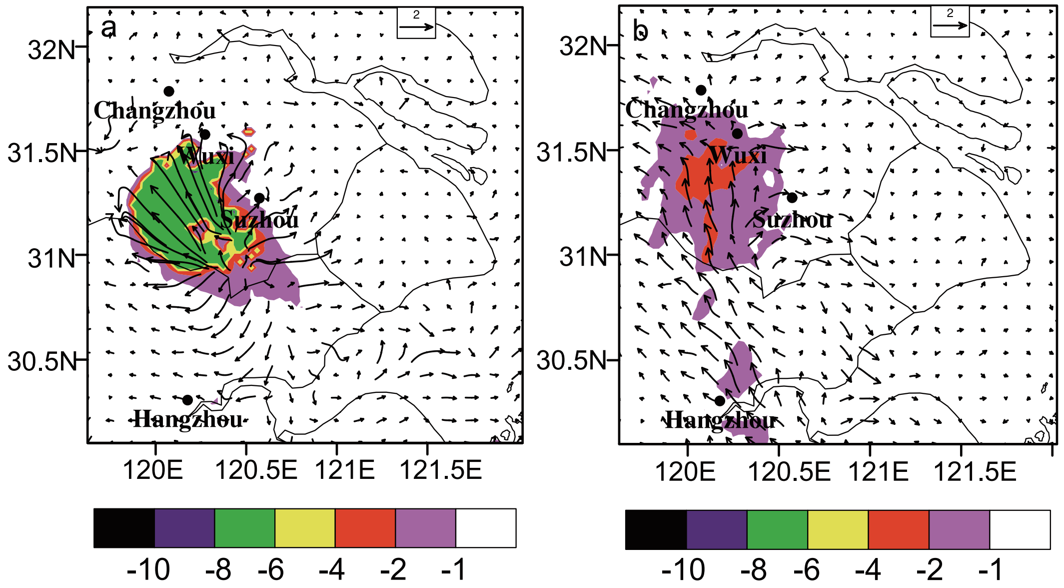

Fig. 5. The differences of in the (a) afternoon (1200–1600 LST) and (b) evening (2000–2400 LST) average surface air temperature (shading; units: °C) and the 2-m wind fields (vectors; units: m s^{-1}) between the R-E and NO_TH experiments on 20 May 2014.

afternoon (1200–1600 LST), but the influence of Taihu Lake on the urban heat island was not obvious. A huge temperature difference caused a strong lake-breeze effect; the wind speed reached 5 m s^{-1} and the wind field showed a divergent structure. The Taihu Lake effect was weakened during the evening; the difference in air temperature was smaller (approximately 2°C–4°C) and the wind field changed under the influence of the prevailing winds, as shown in Fig. 5b. This phenomenon is referred to as the Taihu Lake effect.

Figure 6 shows the differences in the afternoon (1200–1600 LST) average boundary layer height and 2-m wind fields between the NO_TH and R-E experiments. The Taihu Lake effect made the boundary layer height of the Taihu Lake region lower. The atmosphere was more stable. The Taihu Lake effect was not conducive to the diffusion of O_3 in the Taihu region. In addition, it was difficult for such high concentrations of O_3 to dissolve in the water. Therefore, these high concentrations of ozone remained over Taihu Lake for the entire day.

Figure 7 shows the differences in the afternoon (1200–1600 LST) and evening (2000–2400 LST) average surface concentrations of O_3 and the 2-m wind fields between the R-E and NO_TH experiments. In the afternoon (1200–1600 LST), Suzhou was in the right area of Taihu Lake under the influence of the prevailing wind (northwest). Therefore, Taihu Lake had less effect on the concentrations of O_3 in Suzhou region, and the difference in the average concentrations of O_3 between the R-E and NO_TH experiments just reached 6 ppbv in Suzhou. However, Taihu Lake had a significant effect on the concentrations of O_3 in the region of Taihu Lake, and the difference in the average concentrations of O_3 between the R-E and NO_TH experiments reached more than 12 ppbv in the Taihu region, as shown in Fig. 7a. However, under the influence of the background wind (south) and the lake-breeze, the impact of the Taihu Lake effect on the concentrations of O_3 in the Suzhou region and the region of Taihu Lake was obvious in the evening (2000–2400 LST), and the difference in the average concentrations of O_3 between the R-E and NO_TH experiments reached more than 12 ppbv in most regions, as shown in Fig. 7b. This phenomenon is similar to previous research results (Chung, 1977), in which the author found that lake effects influenced the concentrations of photochemical air pollution and that high concentrations

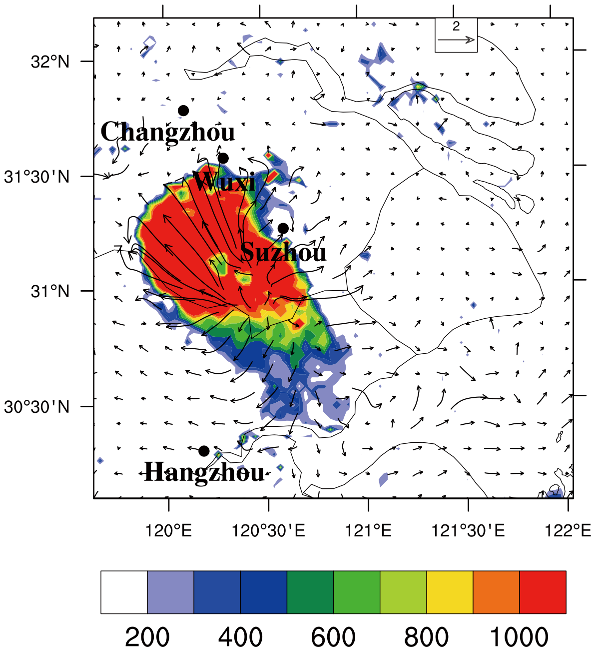

Fig. 6. The differences in the afternoon (1200–1600 LST) average boundary layer height (shading; units: m) and the 2-m wind fields (vectors; units: m s^{-1}) between the NO_TH and R-E experiments on 20 May 2014.

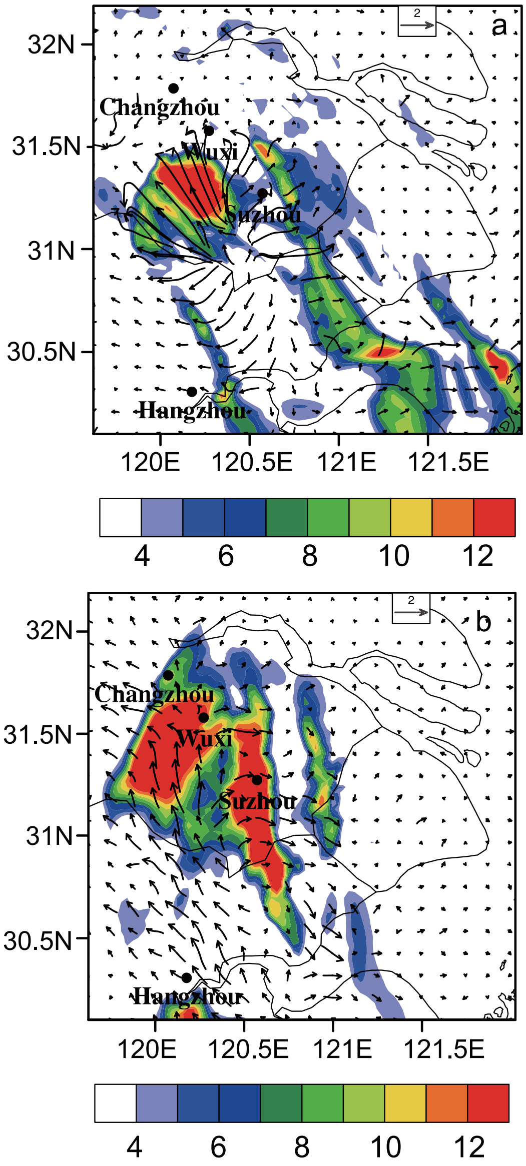

Fig. 7. The differences in the (a) afternoon (1200–1600 LST) and (b) evening (2000–2400 LST) average surface concentrations of O_3 (shading; units: ppbv) and the 2-m wind fields (vectors; units: m s^{-1}) between the R-E and NO_TH experiments on 20 May 2014.

of O_3 were frequently associated with a lake-breeze.

To study the influence of the Taihu Lake effect on O_3 formation, the contributions of the physical and chemical processes to O_3 formation were analyzed. The WRF-Chem model provided the process quantities of O_3 formation (chemical processes, vertical mixing, convection processes, vertical advection and horizontal advection). The chemical process quantity is the photochemical reaction of O_3. If the chemical process is positive, the O_3 formation rate is larger than the consumption rate in the O_3 photochemical reaction. The vertical mixing is connected with turbulence, and the vertical advection is connected with the vertical wind direction and the concentration of O_3. The horizontal advection is connected with the horizontal wind direction and the concentration of O_3. If the horizontal advection is positive, the O_3 is transported from the other regions to the local area. Figure 8 shows the contributions of the individual physical and chemical processes to the buildup of O_3 over Taihu Lake and Suzhou during the daytime (0800–1600 LST) and nighttime (1800–2400 LST) on 20 May. Due to the influence of the Taihu Lake effect, the larger changes are horizontal and vertical advections in the R-E experiment relative to the NO_TH experiment in Taihu Lake in the daytime (0800–1600 LST), as shown in Fig.8a. Research suggests that O_3 chemical production mainly occurs at high altitude in the Yangtze River Delta region (Li et al., 2012). During the daytime (0800–1600 LST), the obvious downward flows were caused by the strong divergent wind field structure in Taihu. The O_3 generated by the gas-phase chemical processes at high altitude were transported to the near-surface in Taihu. Therefore, the vertical advection was transformed from a small negative contribution (−13.4 ppbv) in the NO_TH experiment into a major positive contribution (25.9 ppbv) in the R-E experiment, to the O_3 formation in Taihu; and the horizontal advection was transformed from a small positive contribution (10.2 ppbv) in the NO_TH experiment into a major negative contribution (−34.5 ppbv) in the R-E experiment, to the generation of O_3 in Taihu. The chemical processes both constituted a small positive contribution (13.5 ppbv and 8.4 ppbv for R-E and NO_TH, respectively) to the generation of O_3 in Taihu. Vertical mixing both made a small negative contribution (−3.2 ppbv and −4.8 ppbv for R-E and NO_TH, respectively). During nighttime (1800–2400 LST), and because the Taihu Lake effect became weakened, the changes in the contributions of physical and chemical processes to the generation of O_3 were small in Taihu Lake, as shown in Fig. 8a. However, the influence of the Taihu Lake effect on O_3 was obvious. The difference in the average surface concentrations of O_3 between R-E and NO_TH reached more than 12 ppbv in most areas of Taihu Lake in the evening (2000–2400 LST).

In the afternoon (1200–1600 LST), Suzhou (the surrounding city of Taihu Lake) was in the upstream area of the prevailing wind (northwest). Therefore, the influence of the Taihu Lake effect on O_3 in Suzhou was not significant, and the difference in the average concentrations of O_3 between the R-E and NO_TH experiments just reached 6 ppbv in Suzhou. Because of the urban heat island, the wind field showed a convergent structure and an upward air current in Suzhou. The Taihu Lake effect was able to weaken the urban heat island effect in Suzhou. Therefore, the negative contribution of vertical advection to O_3 generation was smaller in the R-E experiment (−35.6 ppbv) than in the NO_TH experiment (−42.5 ppbv) in Suzhou in the daytime (0800–1600 LST). Because O_3 in Taihu Lake was transported to Suzhou under the influence of a lake-breeze, the positive contribution of horizontal advection to O_3 generation was bigger in the R-E experiment (37.4 ppbv) relative to the NO_TH experiment (29.4 ppbv) in Suzhou in the daytime (0800–1600 LST), as shown in Fig. 8b. High concentrations of surface NO_x caused a low contribution of the chemical process to the O_3 generation in Suzhou (3.5 ppbv and 3.4 ppbv for R-E and NO_TH, respectively), and the difference in the chemical pro-

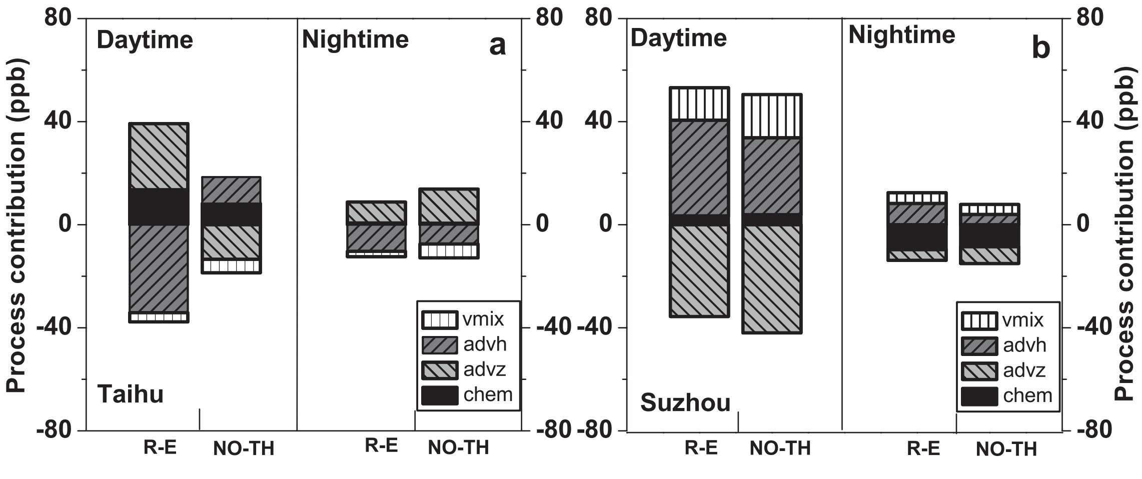

Fig. 8. The average contributions of individual physical and chemical processes to the buildup of O_3 over (a) Taihu and (b) Suzhou during daytime (0800–1600 LST) and nighttime (1800–2400 LST) on 20 May 2014. The abbreviations of the process quantities are chem (chemical processes), vmix (vertical mixing), conv (convection processes), advz (vertical advection), and advh (horizontal advection).

cesses in the two experiments was small. The vertical mixing made a small positive contribution to the O_3 generation in Suzhou (12.5 ppbv and 16.3 ppbv for R-E and NO_TH, respectively). In the evening (2000–2400 LST), Suzhou (the surrounding city of Taihu) was in the downstream area of the direction of the prevailing wind (south) and the lake-breeze of Taihu Lake. Therefore, O_3 in the Taihu Lake region was clearly transported to Suzhou. Therefore, the influence of the Taihu Lake effect on O_3 in Suzhou was significant, and the difference in the average surface concentrations of O_3 between the R-E and NO_TH experiments reached more than 12 ppbv in Suzhou in the evening (2000–2400 LST). During nighttime (1800–2400 LST), although the Taihu Lake effect became weakened, the changes in the contributions of the vertical advection and horizontal advection to O_3 generation were similar to the changes in the daytime (0800–1600 LST), as shown in Fig. 8b. With a large amount of discharged NO_x and the photochemical reaction having stopped, the chemical process resulted in a large negative contribution to the O_3 generation in Suzhou. Similar to that during the daytime (0800–1600 LST), vertical mixing made a positive contribution to the O_3 generation in Suzhou. Compared with daytime, the positive contribution of vertical mixing became smaller. The results showed that the concentrations of O_3 in the Taihu Lake region were continuously high all day, which resulted in a large quantity of O_3 being transported to the downstream area. However, a large number of O_3 precursors from human emissions caused the high concentrations of O_3 in the Taihu Lake region. So, an aim in the region must be to reduce the emissions of pollutants into the atmosphere.

4. Summary and conclusions

This study investigated the impact of Taihu Lake on the O_3 in the Yangtze River Delta region using observations and WRF-Chem model simulations. The WRF-Chem model simulation was able to reasonably reproduce the magnitude and variation in O_3 and NO_2 concentrations, as well as the meteorological condition (wind direction) at Suzhou, Hangzhou and Shanghai, during 18–21 May 2014.

Comparisons between the control and sensitivity experiments revealed the Taihu Lake effect and the impact of Taihu Lake on the O_3 in the Yangtze River Delta region. The difference in the average surface concentrations of O_3 between the R-E and NO_TH experiments reached more than 12 ppbv in most areas of Taihu Lake, throughout the day, on 20 May. During daytime (0800–1600 LST), the influence of the Taihu Lake effect on O_3 in the Suzhou region was not significant. However, the influence of the Taihu Lake effect on O_3 in the Suzhou region was obvious at nighttime (1800–2400 LST).

It was also determined that Taihu Lake had a large impact on the meteorological fields, and that the local temperature and wind field structure changed. As a result, the larger changes in the physical and chemical processes were in the form of horizontal and vertical advections under the influence of the Taihu Lake effect in Taihu Lake and Suzhou. For example, the vertical advection was transformed from a small negative contribution (NO_TH) into a major positive contribution (R-E), to the O_3 generation in Taihu Lake, during the daytime (0800–1600 LST).

Acknowledgements. This work was supported by the National Key Research and Development Program of China (Grant No. 2016YFA0602003) and the National Natural Science Foundation of China (Grant No. 91544229).

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