Observation and simulation of fine particulate matter pollution during G20 conference in Hangzhou

NUIST

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2018.5.21

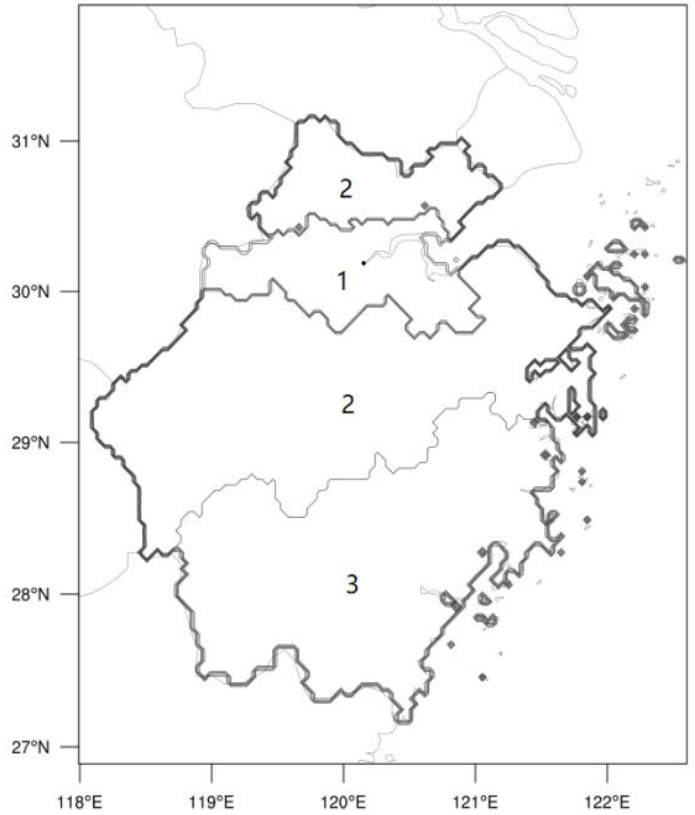
Emission control strategy:

1) power plant emission reduction from August 24 to September 6

2) "odd-even" on-road vehicle restriction (i.e. 50% vehicle emission reduction) from August 28 to September 6

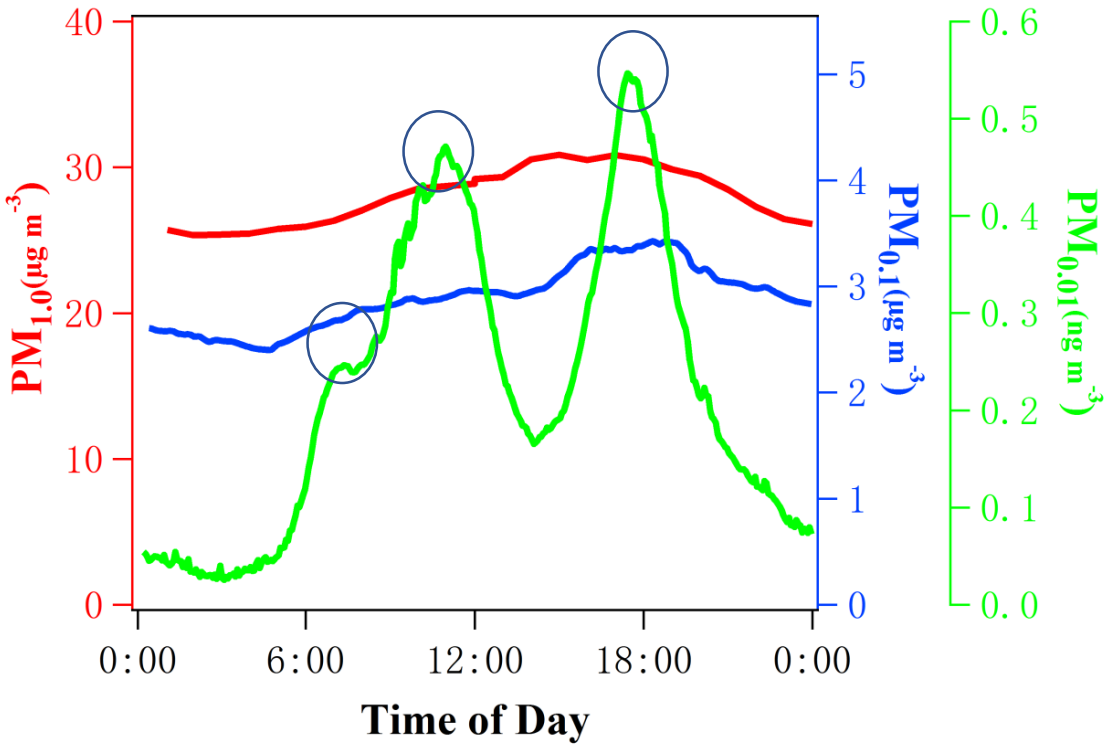
3) industrial VOC reduction from industrial sectors (e.g. refinery and chemical processes/facilities) from August 31 to September 6

region	Power plant	Indusrial reduction	Vehicle restriction
Core region （1）	Smoke, SO_2, NO_x et al. reduction 50% emission	100%	50%
Strict control region （2）	Smoke, SO_2, NO_X et al. reduction 30% emission	Smoke, SO_2, NO_X, VOCet al. reduction 50% emission	50%
Control region （3）	Smoke, SO_2, NO_X et al. reduction 30% emission	Smoke, SO_2, NO_X, VOCet al. reduction 50% emission	0%



Mean diurnal variation of PM_1, $PM_{0.1}$ and $PM_{0.01}$

1) PM_1 and $PM_{0.1}$ showed a similar unimodal diurnal variation
2) the mass concentration of $PM_{0.1}$ was 2.9 ± 0.3 μg/m^3 that accounted for 10.3±0.5% in PM_1
3) $PM_{0.01}$ Peak concentrations were 0.25, 0.47 and 0.55 ng/m^3

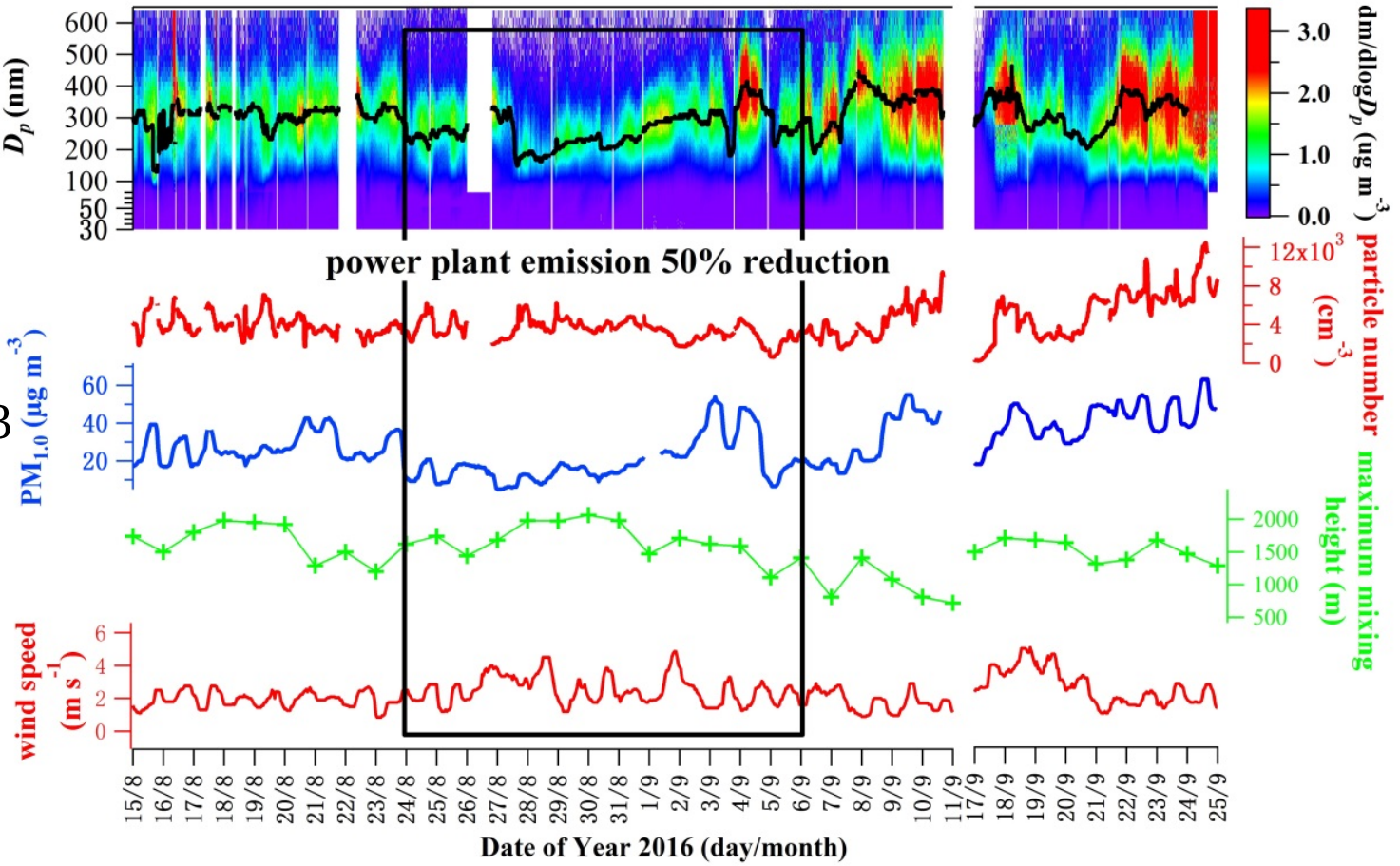


Impact of emission reductions on PM_1, $PM_{0.1}$ and $PM_{0.01}$

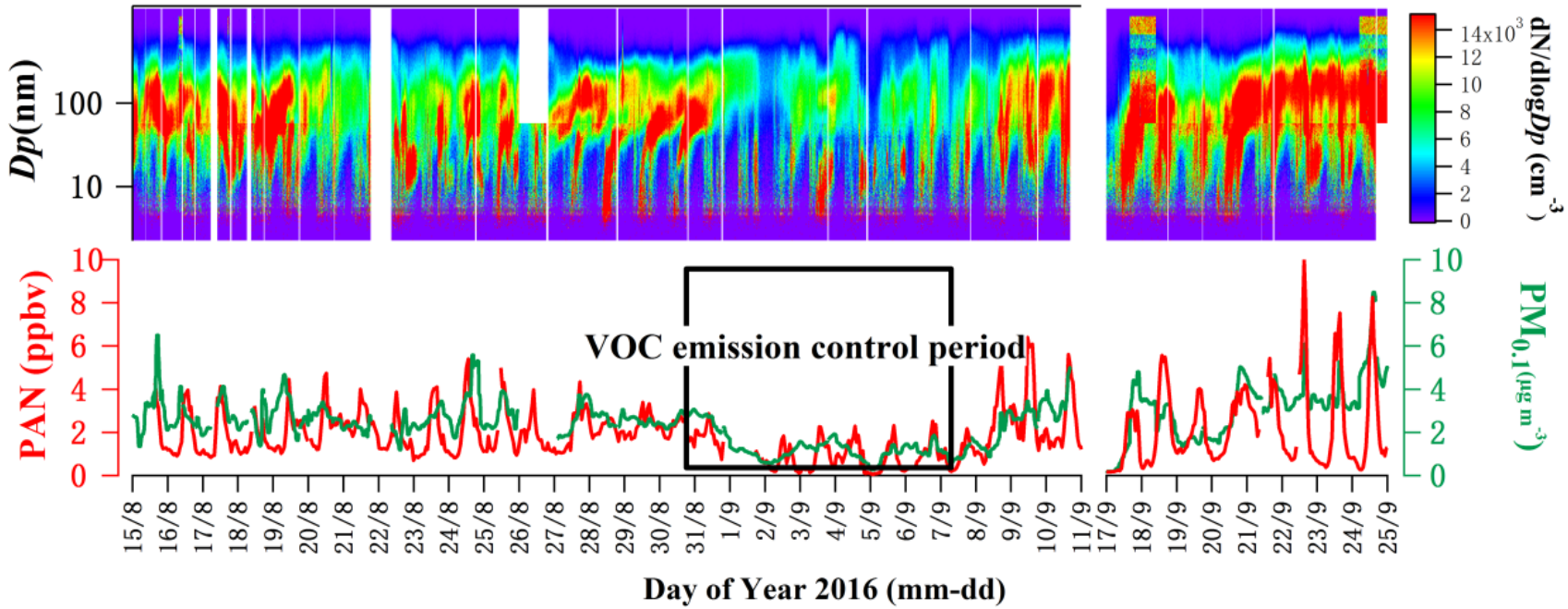
1) the mean mass concentration of PM_1 during the control period was 16±6.2 μg/m^3, which was 40% and 58% lower than the mean concentrations before and after the control period

2) 100-1000 nm aerosol contributed more than 90 % of PM_1 mass concentration from 3 nm to 1000 nm

3) the median sizes of PM_1 decreased to 253±40 nm during the control period, which was 52 nm and 80 nm lower than those before and after the control period

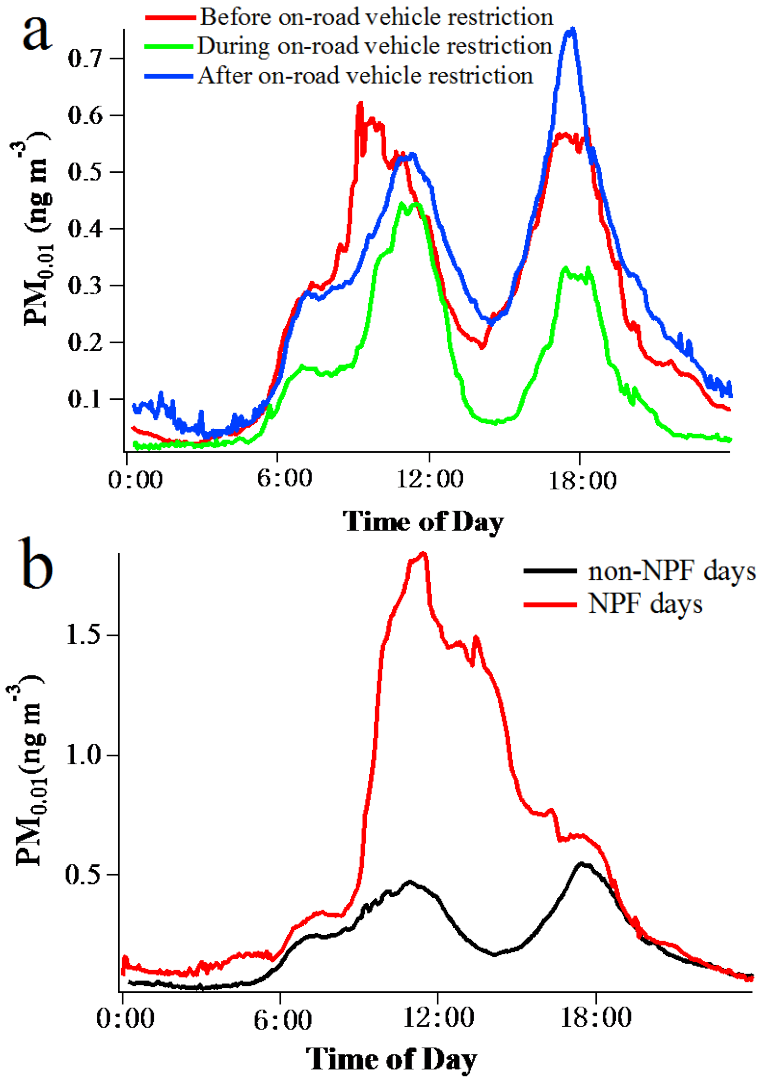


Impact of emission reductions on PM_1, $PM_{0.1}$ and $PM_{0.01}$



1) $PM_{0.1}$ accounted for 83 ±15 % in PM_1 in terms of number concentration in the daytime and 54±20% in the nighttime
2) $PM_{0.1}$ mass concentration decreased significantly by 53% to 1.3±0.6μg/m^3
3) $PM_{0.1}$ and PAN were produced from the same atmospheric oxidation process of VOC emission

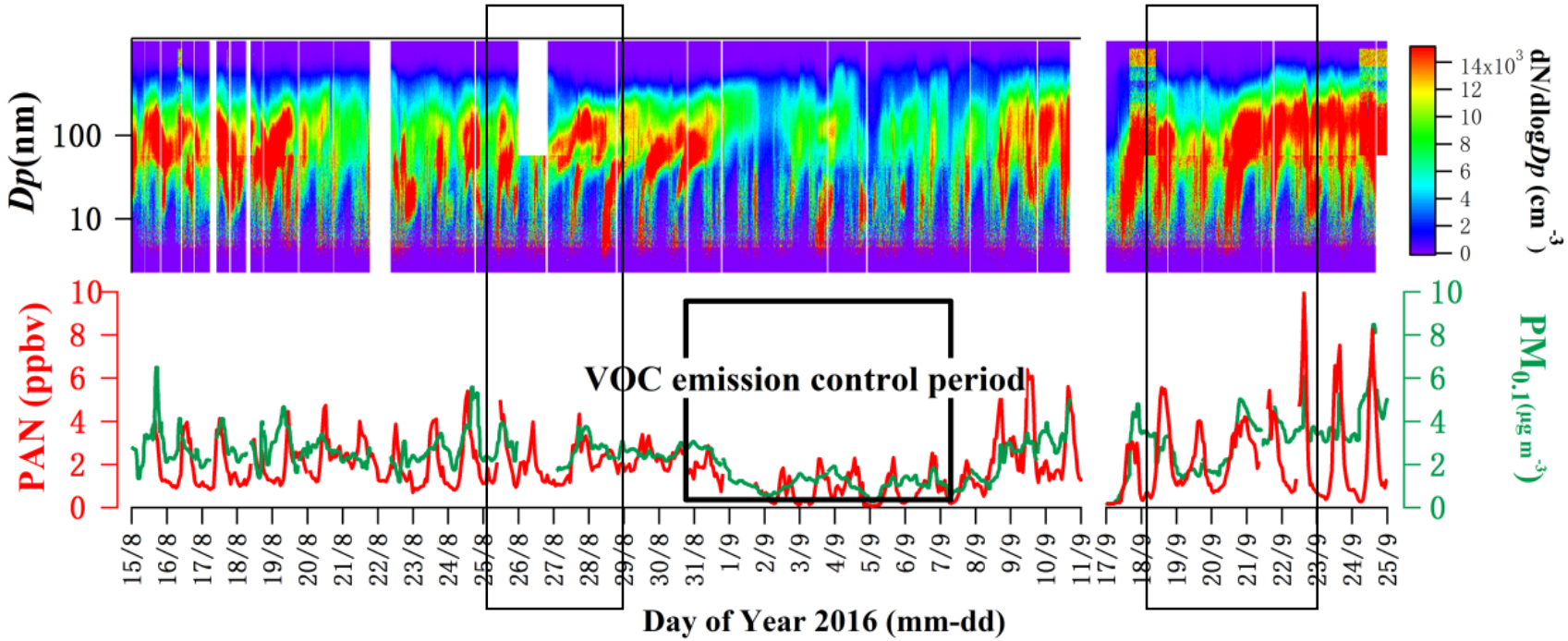
Impact of emission reductions on PM_1, $PM_{0.1}$ and $PM_{0.01}$



1) we observed that sub-10 nm nanoparticle concentrations in rush hours around 07:00 and 18:00 decreased dramatically by 48% and 42% after the enforcement of "odd-even" on-road vehicle restriction

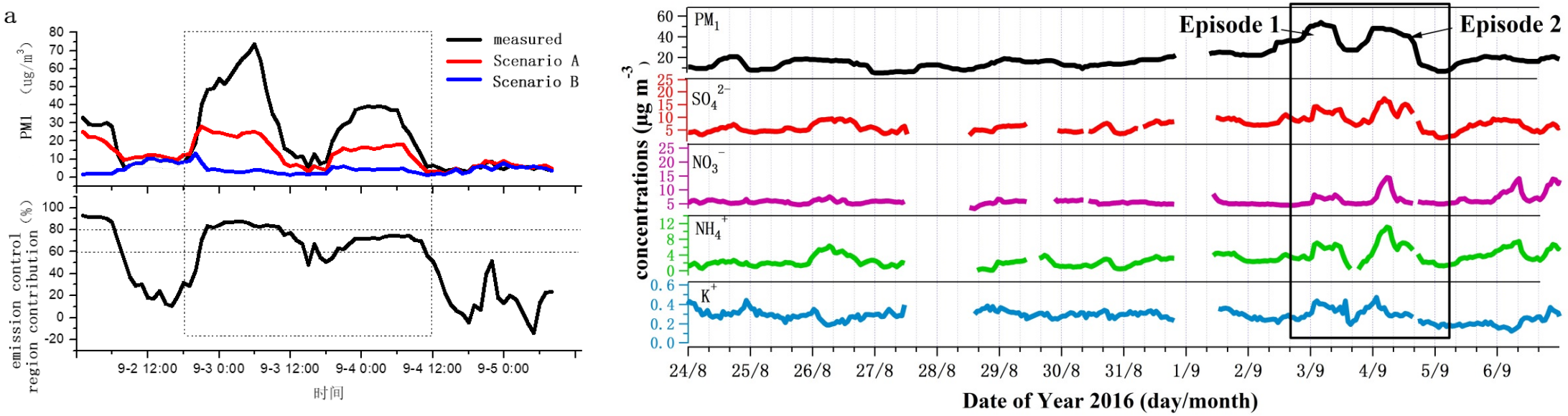
2) NPF events enhanced the second $PM_{0.01}$ peak on the NPF days by a factor of 4 compared to the non-NPF days.

Impact of emission reductions on NPF



1) 4 typical NPF events on August 25, 27, 28 and 29, and September 17 to 23
2) both nucleation precursor and coagulation sink were high

Two PM_1 episodes during the phase 3 control period

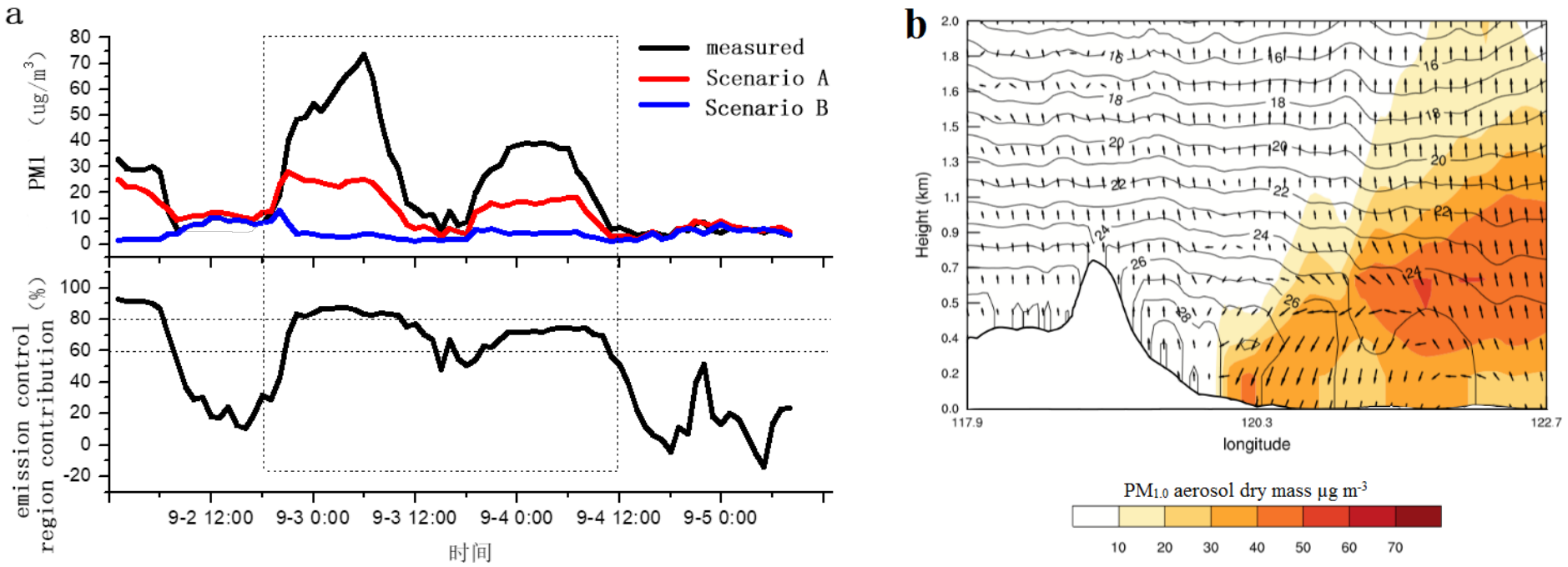


1) two PM_1 episodes were still observed on September 3 and September 4, Maximum PM_1 concentrations reached 51.9 μg/m^{3}and 48.1μg/m^3

2) the sum of secondary inorganic ions (SO_4^{2-}, NO_3^- and NH_4^+) increased by ~100% compared to the rest of phase 3 days

3) The boost of secondary inorganic ions accounted for 47 % of the total increment in PM_1. In episode 2, the sum of SO_4^{2-}, NO_3^- and NH_4^+ increased by 152% and accounted for 62.5 % of the total increment of PM_1

Two PM_1 episodes during the phase 3 control period



1) the contribution from the sources inside the emission control region was 50.4% during the simulation period without pollution episodes. This percentage increased to 73.7% in episode 1 and 2, respectively, while the remaining 26.3% were from the transport outside the region

2) the temperature gradient was weak and the atmosphere was dominated by subsidence flows up to 600 meters above ground in Hangzhou

Conclusions

1) Source emission reduction of coal-fired power plant, on-road vehicle and industrial VOCs led to reduction of PM_1, $PM_{0.01}$ and $PM_{0.1}$, respectively

2) Four typical NPF events occurred out of 7 days in Phase 1 and Phase 2, probably due to low condensation/coagulation sink. enhanced maximum $PM_{0.01}$ concentration around 11:00 AM by a factor of 4 compared to non-NPF days

3) The model simulation suggested that the two episodes were not resulted from the intrusion of pollutants outside of the emission control region

Thank you

If my answers do not make you satisfied, please contact with Professor Yu(E-mail: hyu@nuist.edu.cn).