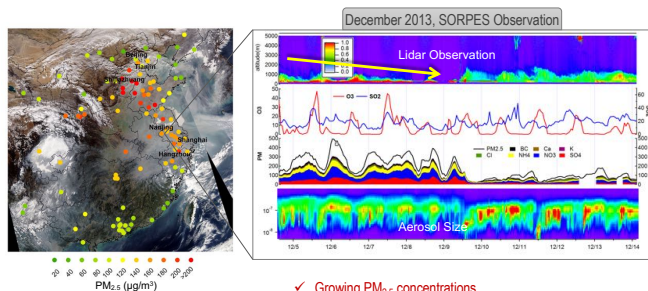




Aerosol-PBL interaction in megacities

- Thick haze covered East China in Dec. 2013



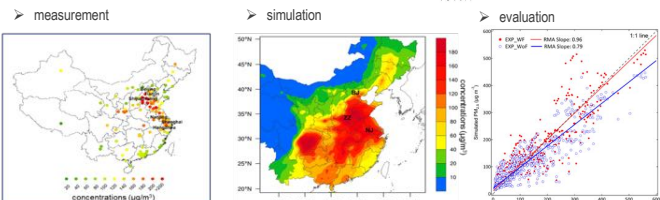
- Growing PM_{2.5} concentrations
- Rapidly declining PBL height

Ding & Huang et al. 2016@GRL

Aerosol-PBL interaction in megacities

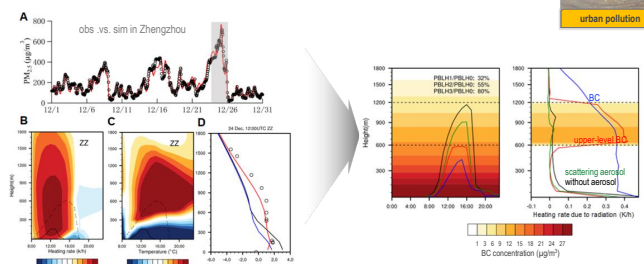
Model setup and validation

- EXP_WoF: without aerosol feedback
- EXP_WF: with all aerosol feedback
- EXP_WFexBC: with aerosol's feedback except BC



Ding & Huang et al. 2016@GRL

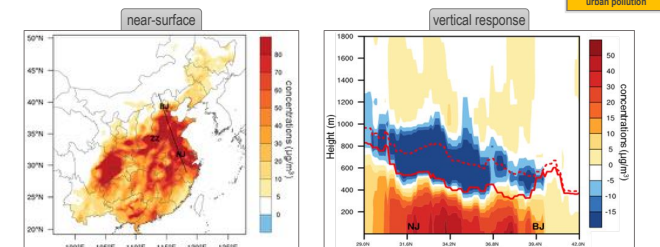
Aerosol-PBL interaction in megacities



- BC induces heating in the upper PBL, and the decreased surface heat flux substantially depresses the development of PBL.

Ding & Huang et al. 2016@GRL

Aerosol-PBL interaction in megacities

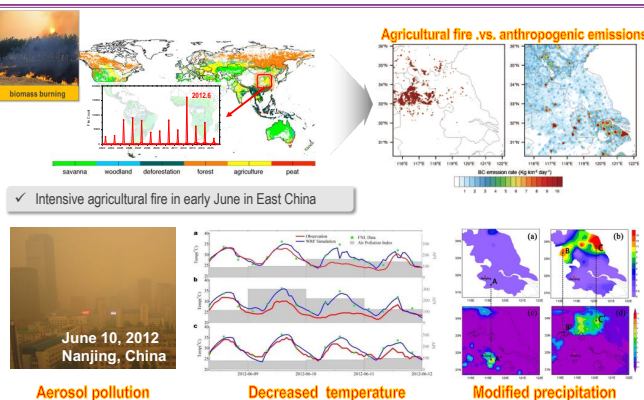


- Dome effect of BC: heating in the upper BL and the decreased surface heat flux substantially depresses the development of PBL and consequently enhances the occurrences of extreme haze pollution.



Ding & Huang et al. 2016@GRL

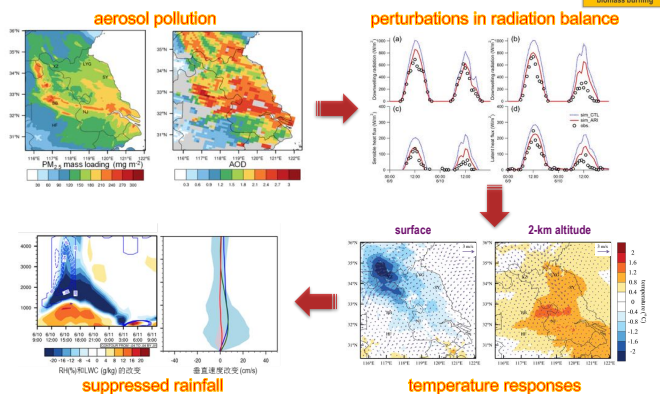
Aerosol-PBL interaction in regional scale



- Heavy haze pollution with inaccurate weather forecasting

Huang et al. 2012@ERL; Ding et al. 2012@ACP

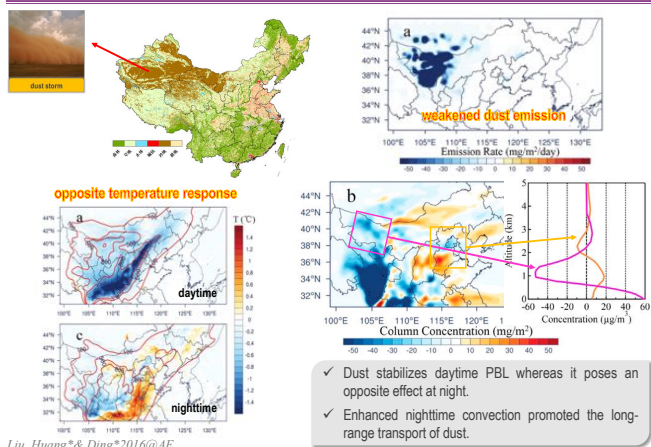
Aerosol-PBL interaction in regional scale



Huang et al. 2012@ERL; Ding et al. 2012@ACP

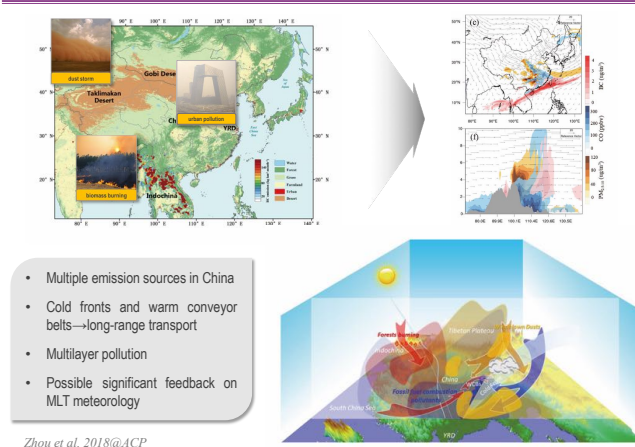


Aerosol-PBL interaction in regional scale



Liu, Huang* & Ding*2016@AE

Aerosol-PBL interaction in regional scale



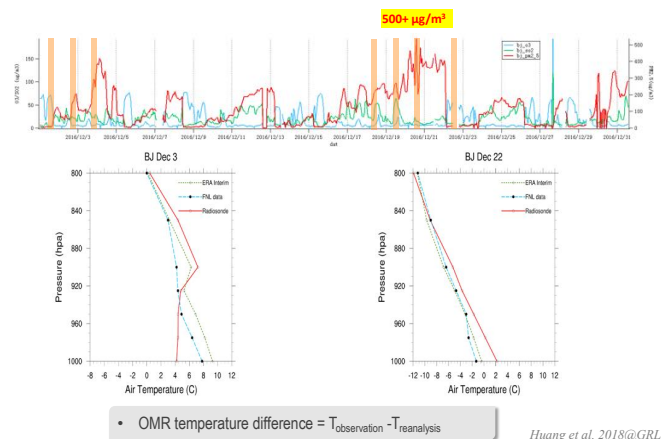
Zhou et al. 2018@ACP

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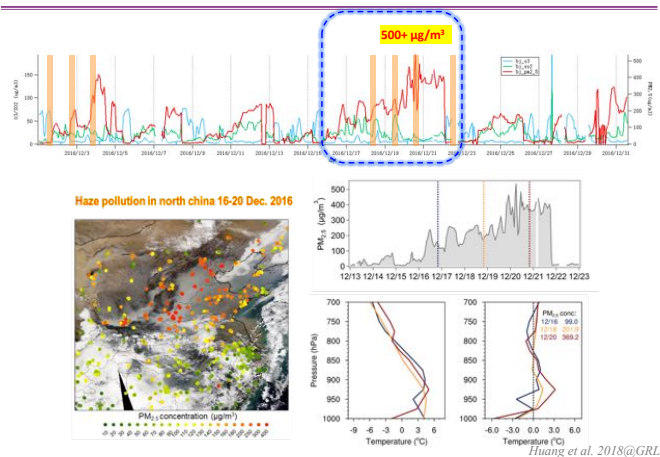
01 Aerosol-PBL Interaction from megacities to regional scale



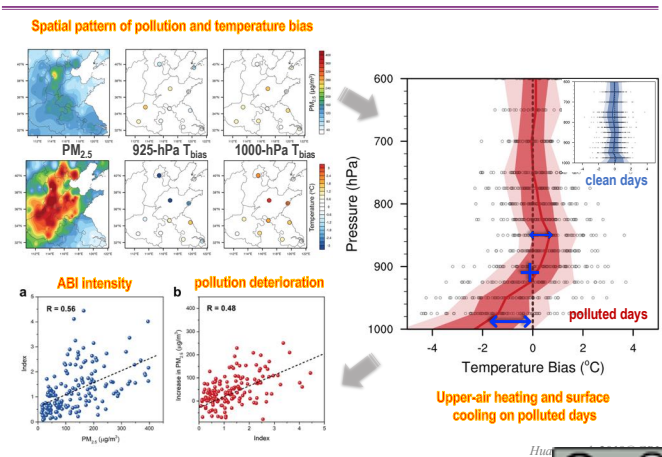
Observational evidence of aerosol-PBL interaction



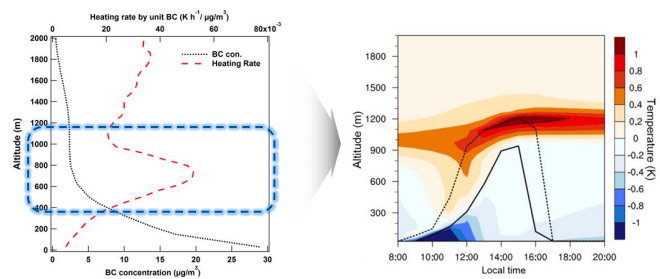
Observational evidence of aerosol-PBL interaction



Observational evidence of aerosol-PBL interaction



Key factors influencing aerosol-PBL interaction

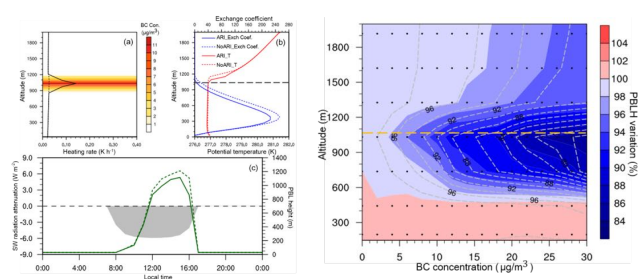


Sensitivity simulations

- Sounding observations in Beijing
- in-situ observation of aerosol
- 1-D online coupled WRF-Chem simulation

Wang, Huang, Ding, 2018@ACP

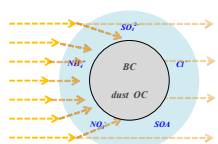
Key factors influencing aerosol-PBL interaction



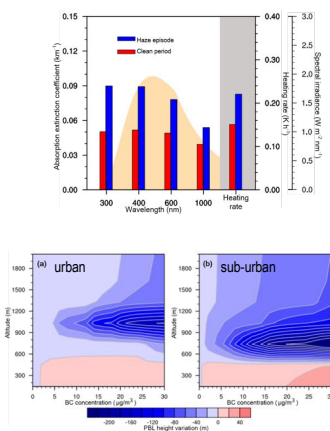
- ✓ Aerosol-boundary layer interaction is extremely sensitive to aerosol vertical profile
- ✓ Emission control of BC emission from coal-fired power plants and industrial boilers it is an efficient way to mitigate near-surface air pollution

Wang, Huang, Ding, 2018@ACP

Key factors influencing aerosol-PBL interaction



- Dome effect of BC can be significantly intensified when BC gets internally mixed with scattering aerosol
- PBL top decrease in rural area could be 15% greater than the corresponding value in the urban area.



Wang, Huang, Ding, 2018@ACP

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01 Aerosol-PBL Interaction from megacities to regional scale

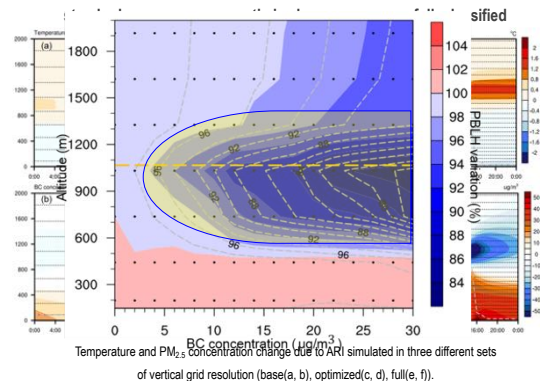
02 Long-term observational evidences and influencing factors

03 Technical and policy implications

Implications on air quality modeling

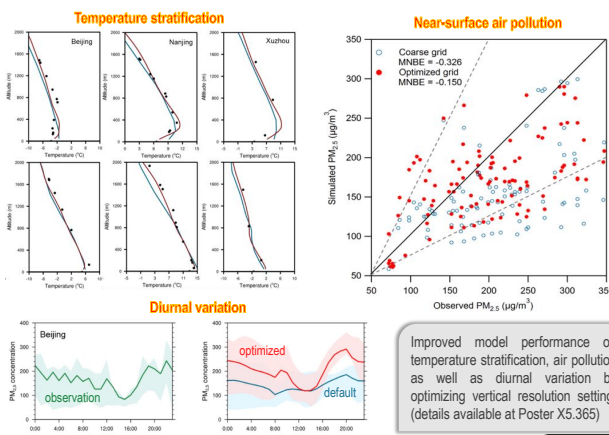


Optimized vertical resolution



Wang, Huang, Ding@AE,2019

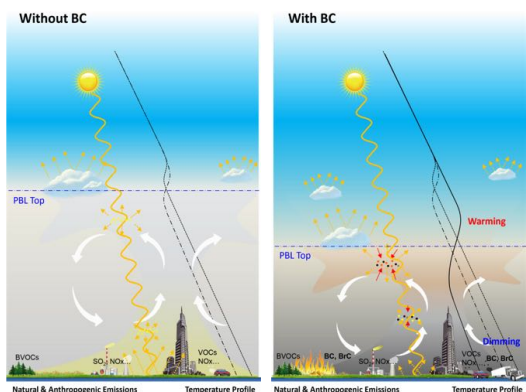
Implications on air quality modeling



Improved model performance on temperature stratification, air pollution as well as diurnal variation by optimizing vertical resolution setting. (details available at Poster X5.365)

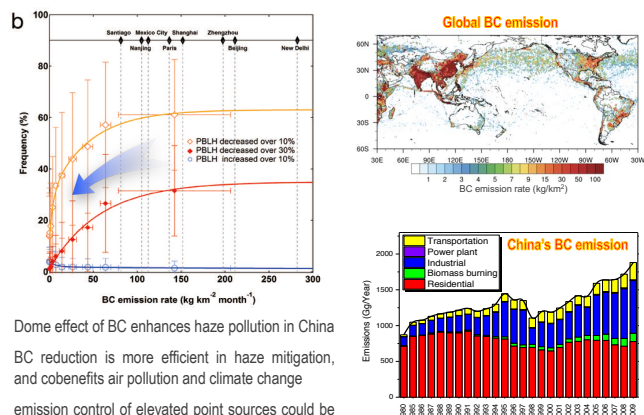


Implications on air pollution mitigation



Ding & Huang et al. 2016@GRL

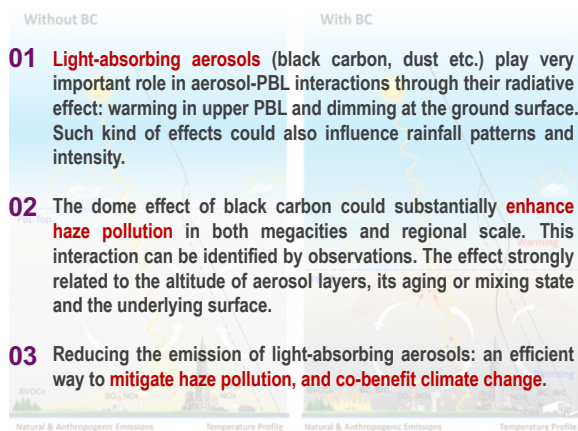
Implications on air pollution mitigation



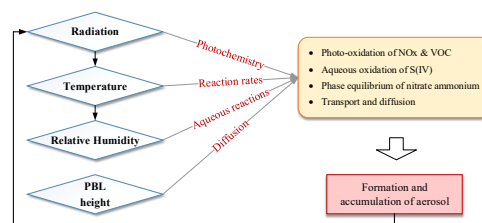
- Dome effect of BC enhances haze pollution in China
- BC reduction is more efficient in haze mitigation, and cobenefits air pollution and climate change
- emission control of elevated point sources could be a cost-effective way to reduce regional air pollution

Ding & Huang et al. 2016@GRL

Summary



Next

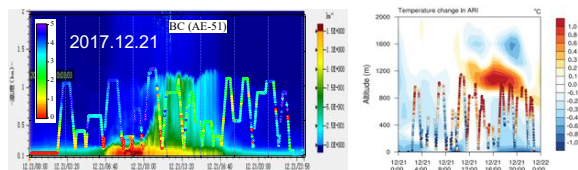


- ✓ Quantifying respective contribution from different pathways of aerosol-PBL interaction
- ✓ Improving numerical descriptions on key factors like aerosol mixing state, light-absorbing OC
- ✓ Understanding the role of aerosol-PBL interaction on regional transport



Next

- ✓ Direct vertical measurements on radiative active aerosols and secondary component using airship platforms. Aerosol-PBL interaction may enhance secondary pollution through heterogeneous and aqueous-phase chemical reaction.
- ✓ Observational-based 1-D model or large eddy model for better and quantitative understanding on the detailed physical and chemical processes.
- ✓ Improvements on parameterization and multiple-scale meteorology and chemistry coupled simulation to better understand aerosols' impacts on regional and global climate.



Thanks!

References

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