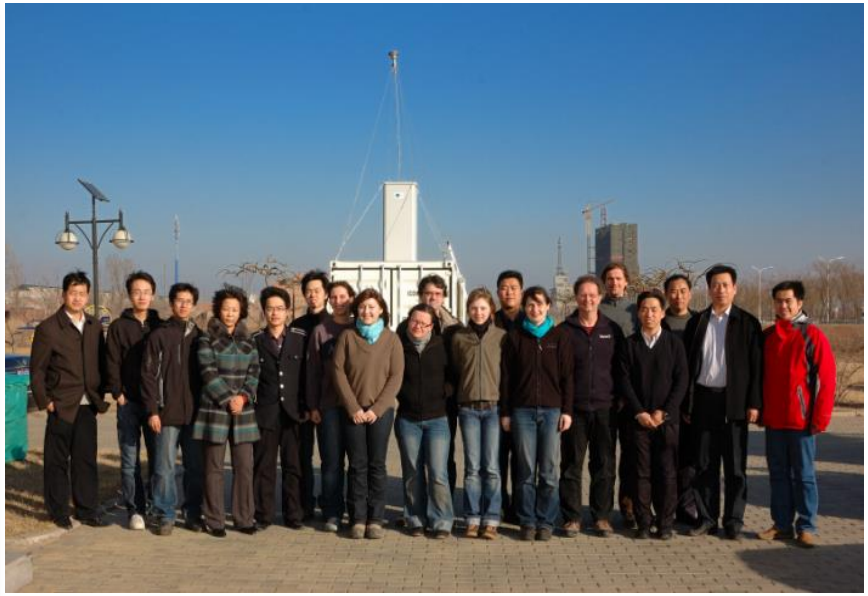
Study of rediative effects within HaChi project

ZHAO Chunsheng 赵春生
Cloud Physics and Atmospheric Chemistry (CPAC)
School of Physics, Peking University
zcs@pku.edu.cn
http://www.atmos.pku.edu.cn/zcs/

HaChi (Haze in China) Project

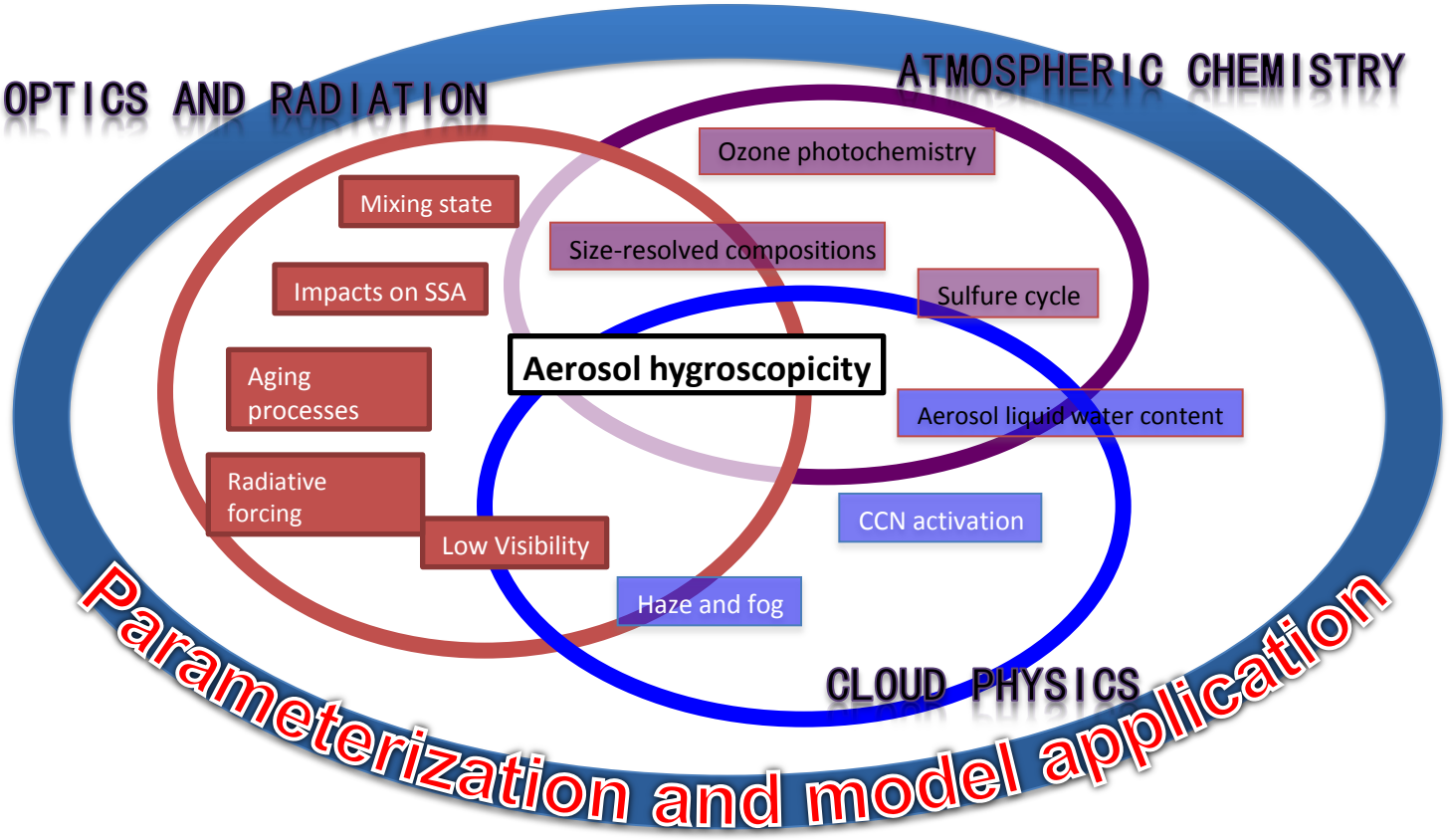
Chunsheng Zhao
Peking Univ.

Alfred Wiedensohler
TROPOS



Aerosol hygroscopic properties at high RH in North China Plain and its relationship to aerosol optics, visibility, CCN activation and ozone chemistry

HaChi (Haze in China) project



ACP special issue

Haze in China (HaChi 2009-2010)

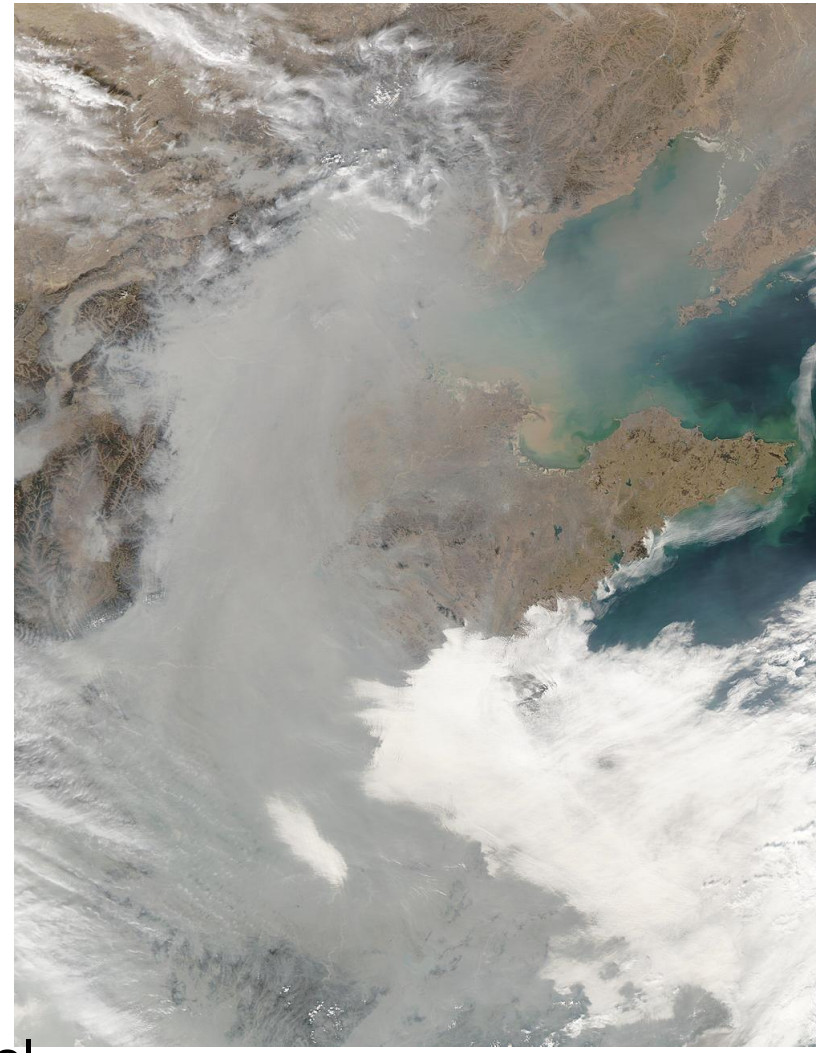
http://www.atmos-chem-phys.net/special_issue226.html

Content

- A new method to describe LAC mixing state
- Significant diurnal variation of aerosol optical parameters
- Role of RH on SSA and the NO2 photolysis rate coefficient
- What we are doing now

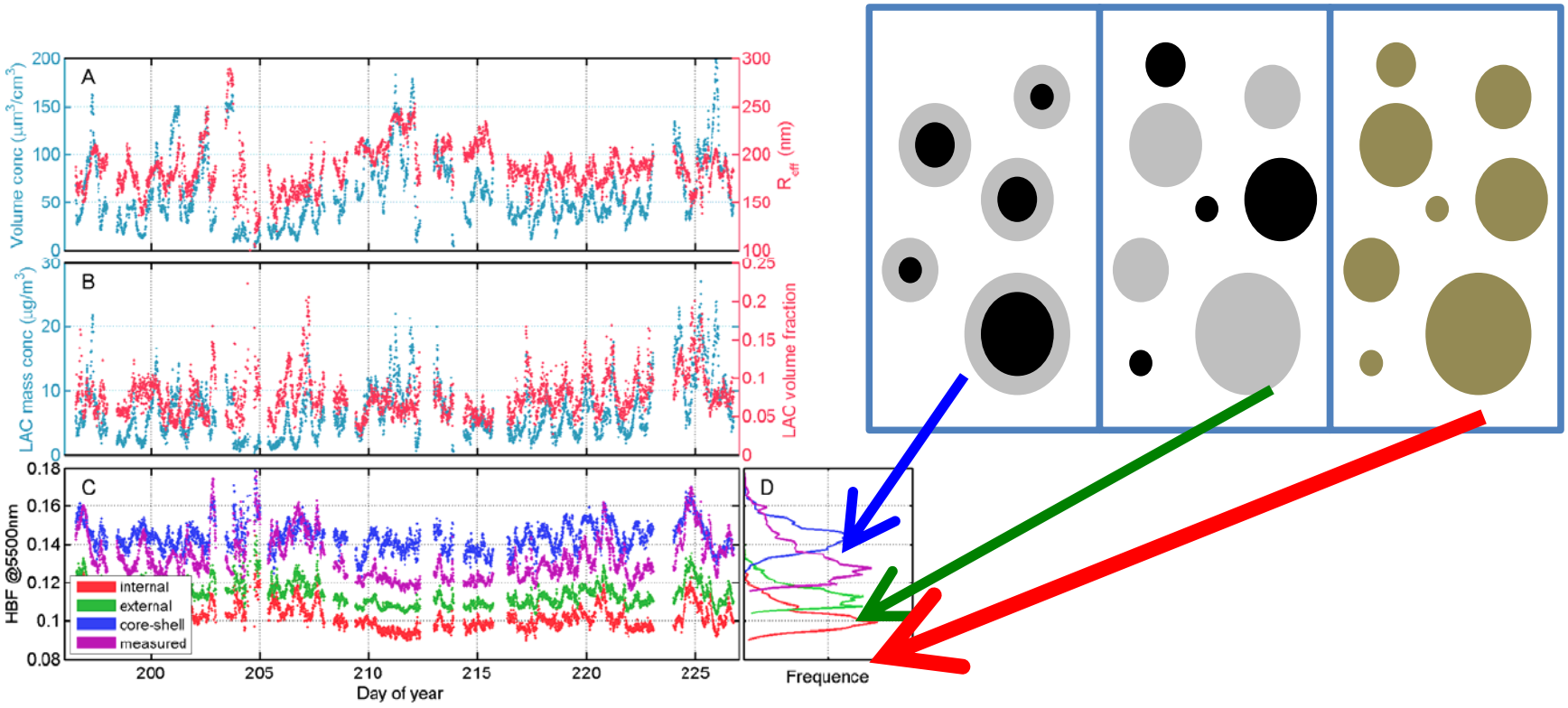
Challenges we are facing in China

- Huge coverage of pollutants
- Strong hygroscopic growth properties
- High aerosol (or LAC) loading
- Complicated aerosol aging process
- Significant diurnal variation
- …….



- Bridge the gap between measurements and the ambient
- Reduce the uncertainties of direct aerosol radiative forcing calculation

A new method to describe LAC mixing state



- b is very sensitive to LAC mixing state
- $b_{core\text{-}shell} > b_{measured} > b_{external} > b_{internal}$
- External + core-shell for aerosol optics

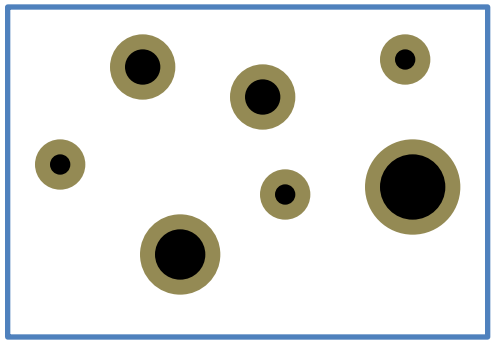
Ma, et al., ACP, 2012

A new method to describe LAC mixing state

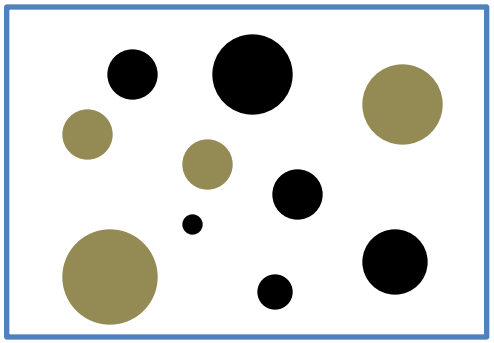
$$r_{\text{ext-BC}} = \frac{M_{\text{ext-BC}}}{M_{\text{BC}}}$$

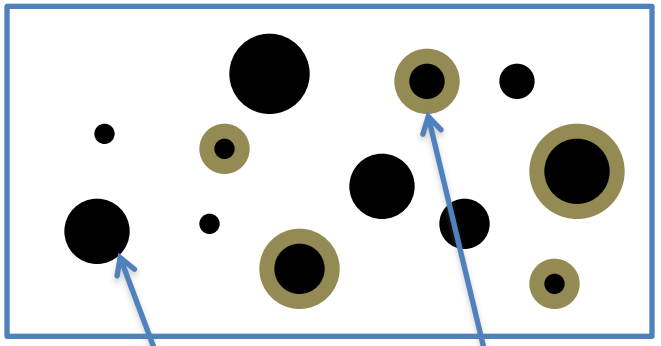
$$0 \le r_{\text{ext-BC}} \le 1$$

r=0



r=1





σ_{sp} and σ_{bsp} measured by Nephelometer

BC mass concentration measured by MAAP

PNSD measured by TDMPS and APS

Based on Mie model

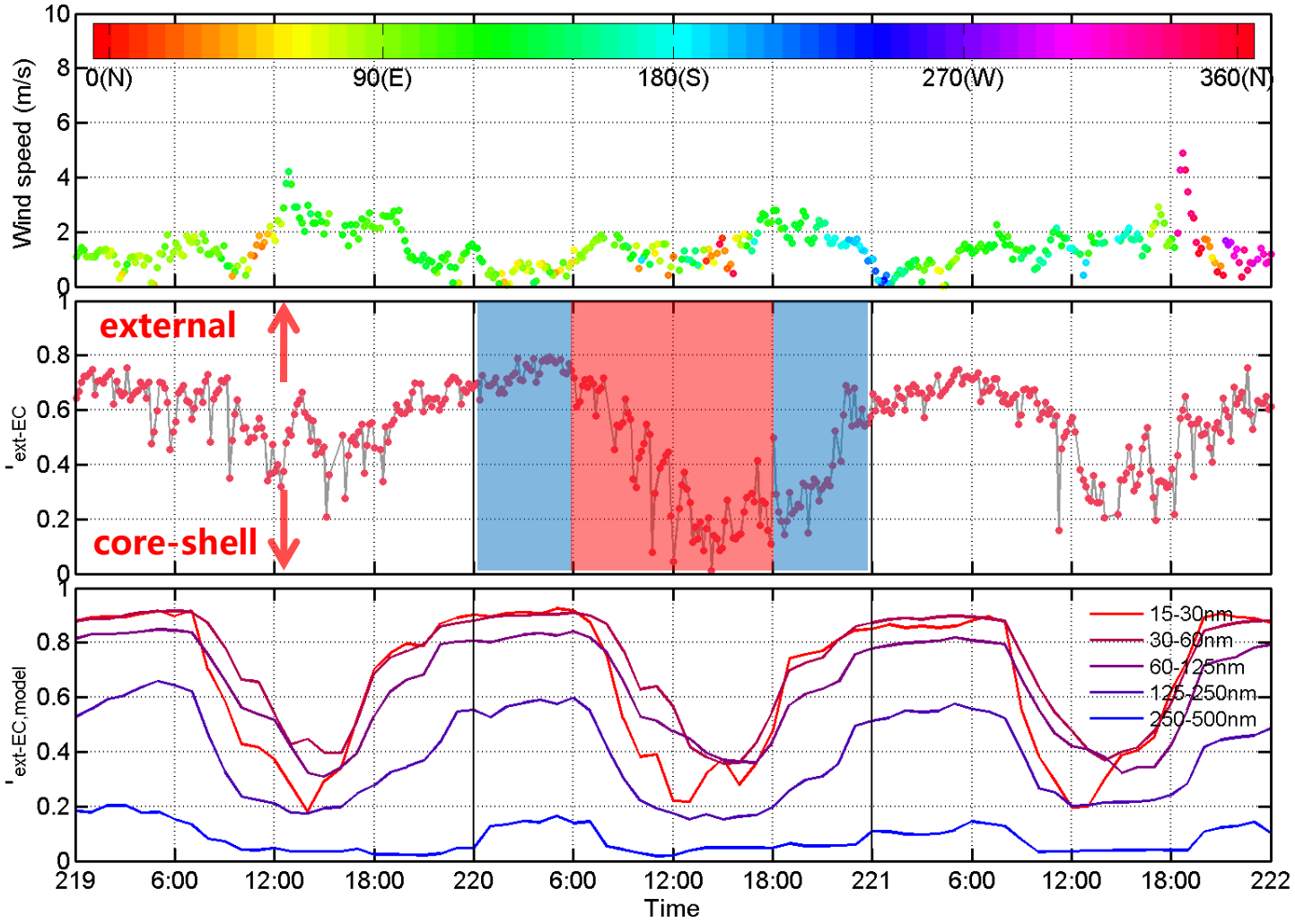
$$F = \sum_{i=1}^{3} \left(\frac{b_{i,calc} - b_{i,meas}}{b_{i,meas}} \right)^2$$

Find $r_{\text{ext-BC}}$ to make F get its minimum

$r_{\text{ext-BC}}$

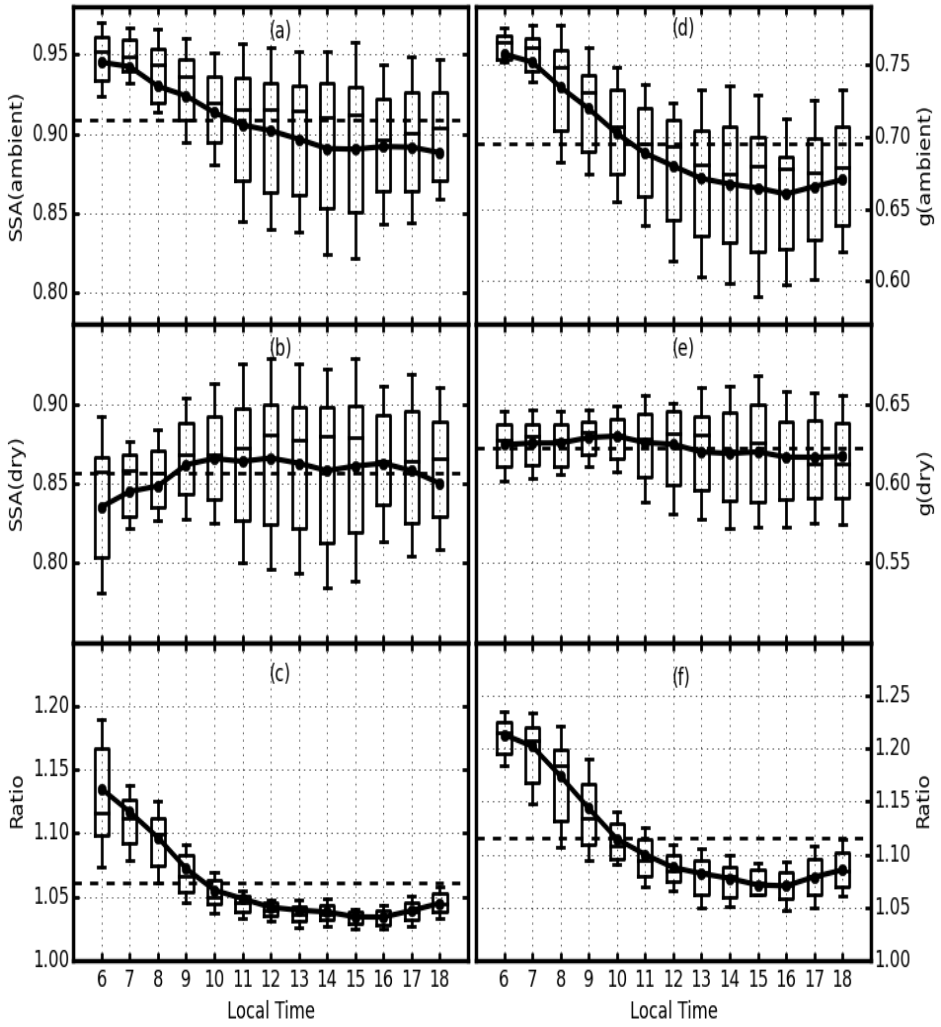
Ma, et al., ACP, 2012

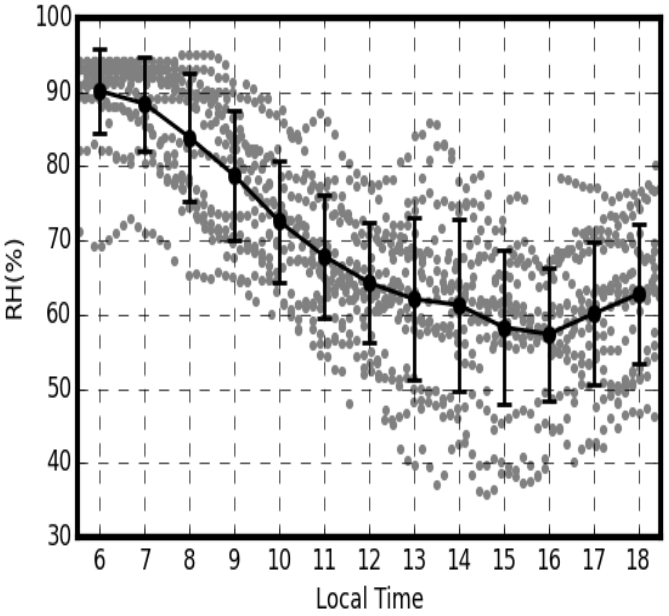
Significant diurnal variation of LAC mixing state



Ma, et al., ACP, 2012

Impacts of RH on diurnal variation of SSA and g

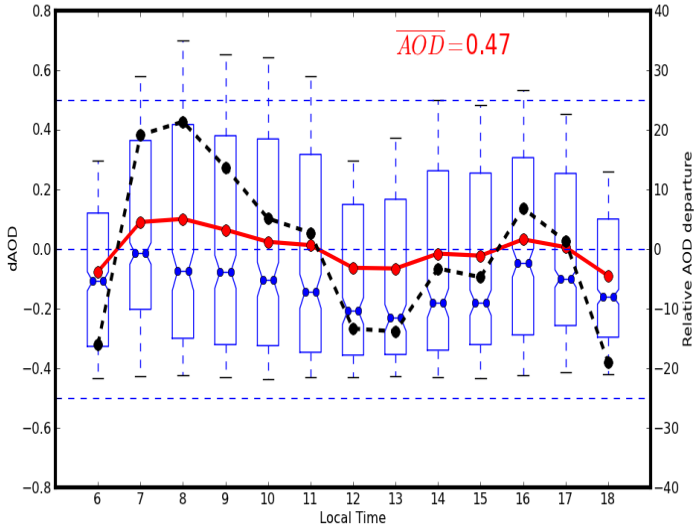


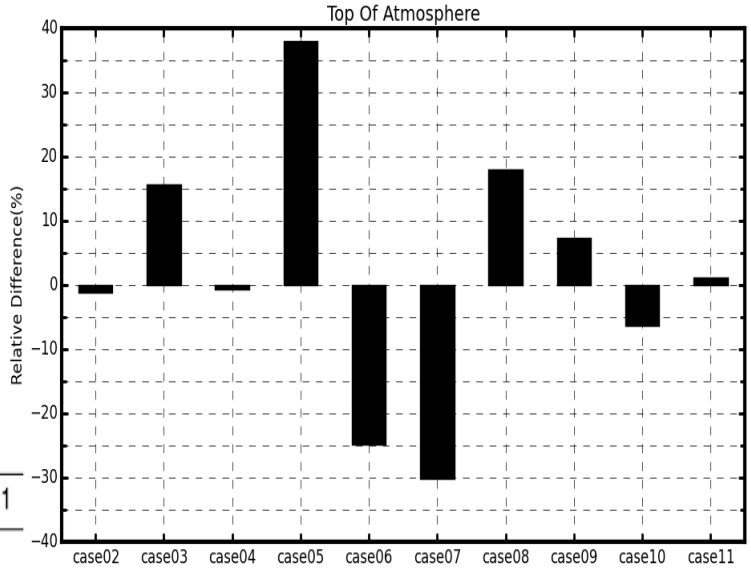


Kuang et al., ACP, 2015

Impacts of diurnal variation of SSA and g on DARF

- AOD（550nm）@Xianghe





- Case design

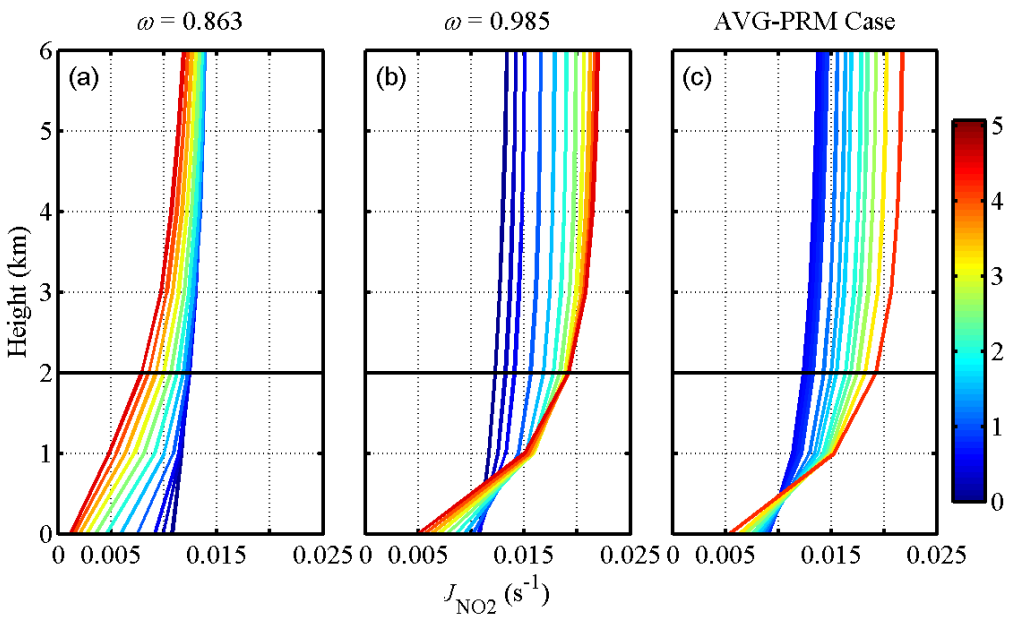
	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11
AOD	abt	$\overline{dt}$	$\overline{am}$	$\overline{pm}$	$\overline{dt}$	$\overline{dt}$	$\overline{dt}$	$\overline{dt}$	$\overline{dt}$	$\overline{dt}$	$\overline{dt}$
SSA	abt	$\overline{dt}$	$\overline{dt}$	$\overline{dt}$	$\overline{am}$	$\overline{pm}$	$\overline{dt}$	$\overline{dt}$	$\overline{am}$	$\overline{pm}$	$\overline{ap}$
g	abt	$\overline{dt}$	$\overline{dt}$	$\overline{dt}$	$\overline{dt}$	$\overline{dt}$	$\overline{am}$	$\overline{pm}$	$\overline{am}$	$\overline{pm}$	$\overline{ap}$

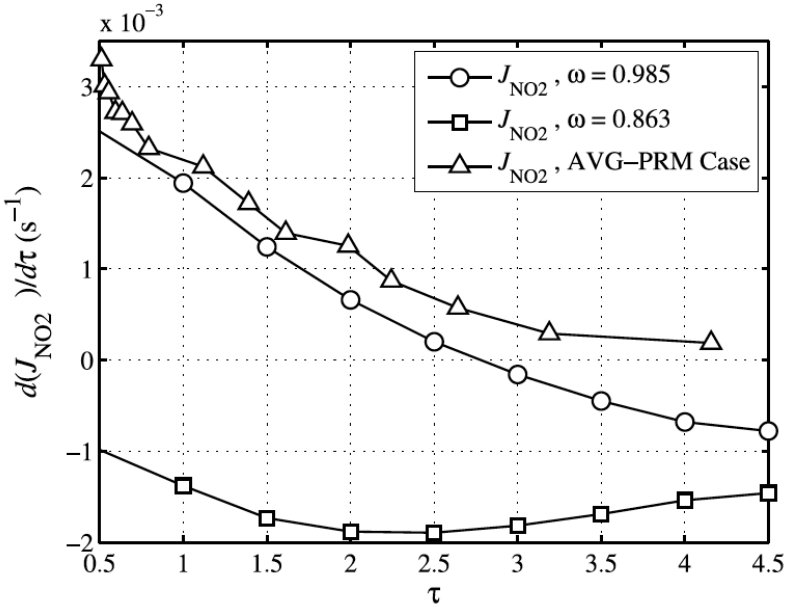
abt: ambient; $\overline{dt}$: averaged over daytime (06:00 to 18:00), $\overline{am}$: averaged over early morning; $\overline{pm}$: averaged over late afternoon; $\overline{ap}$: averaged over early morning and late afternoon; early morning: $50^\circ \leq SZA \leq 70^\circ$ in the morning; late afternoon: $50^\circ \leq SZA \leq 70^\circ$ in the afternoon.

Kuang et al., ACP, 2015

High aerosol loading and High ozone concentration

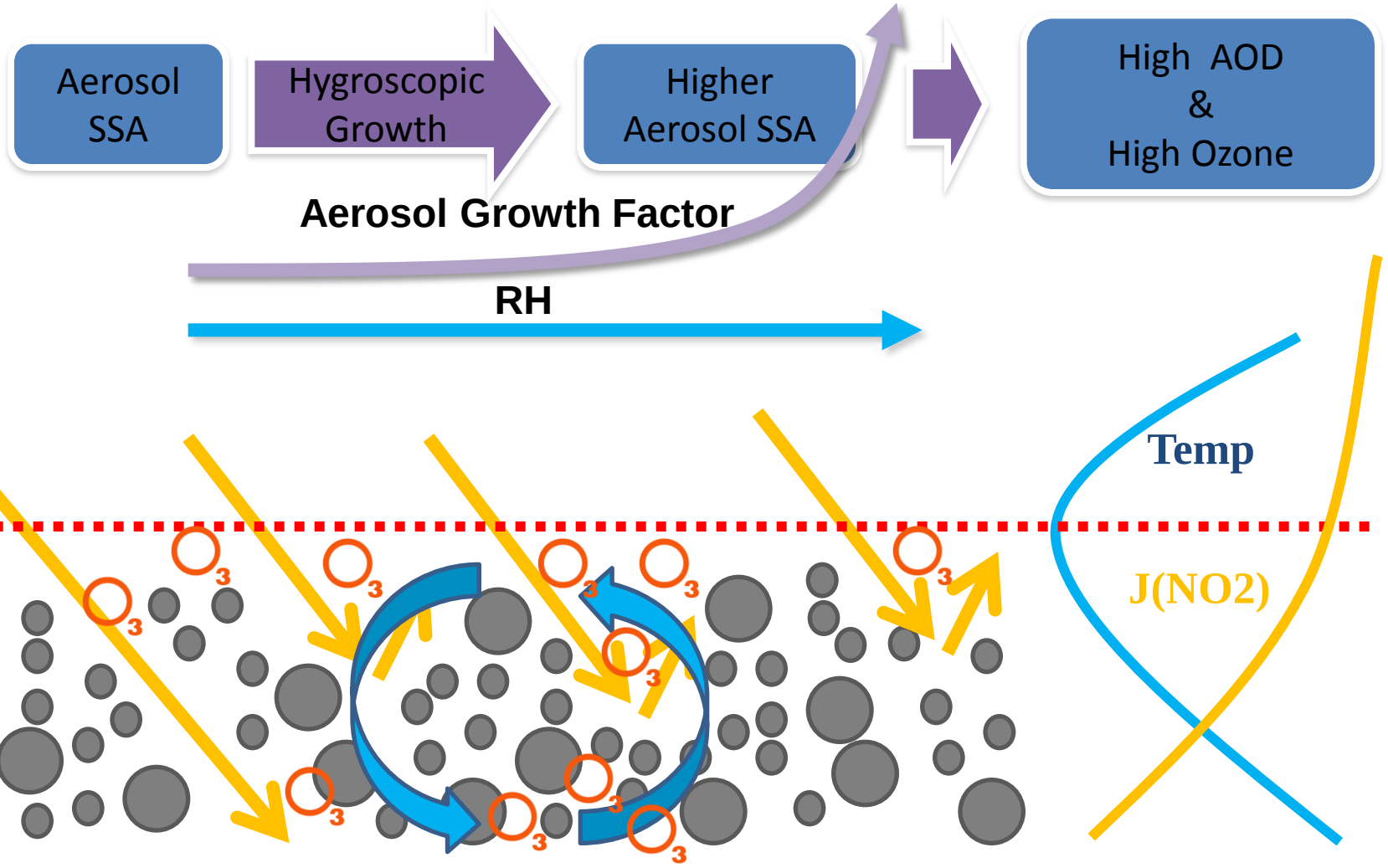
Impact of aerosol hygroscopic growth on SSA and the NO2 photolysis rate coefficient



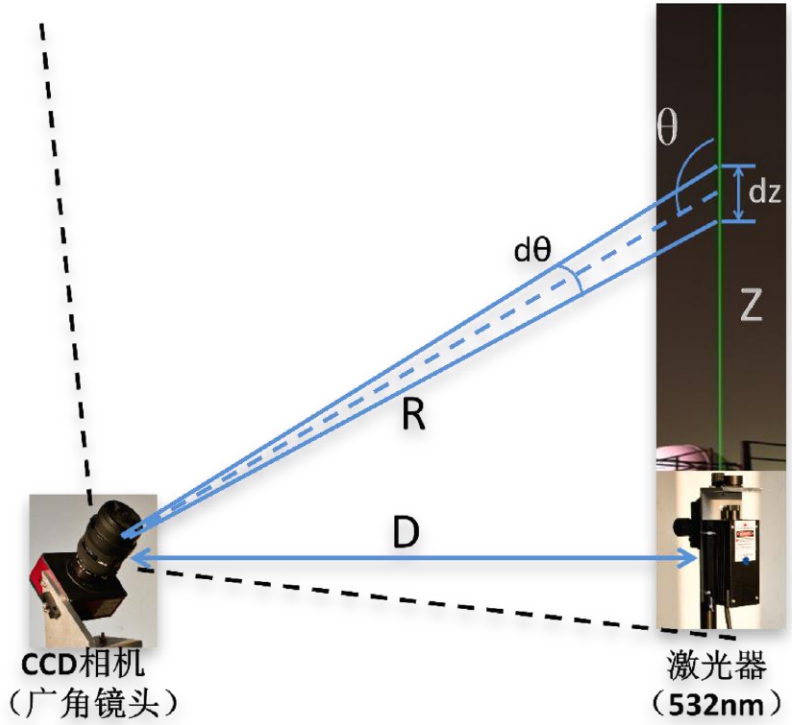


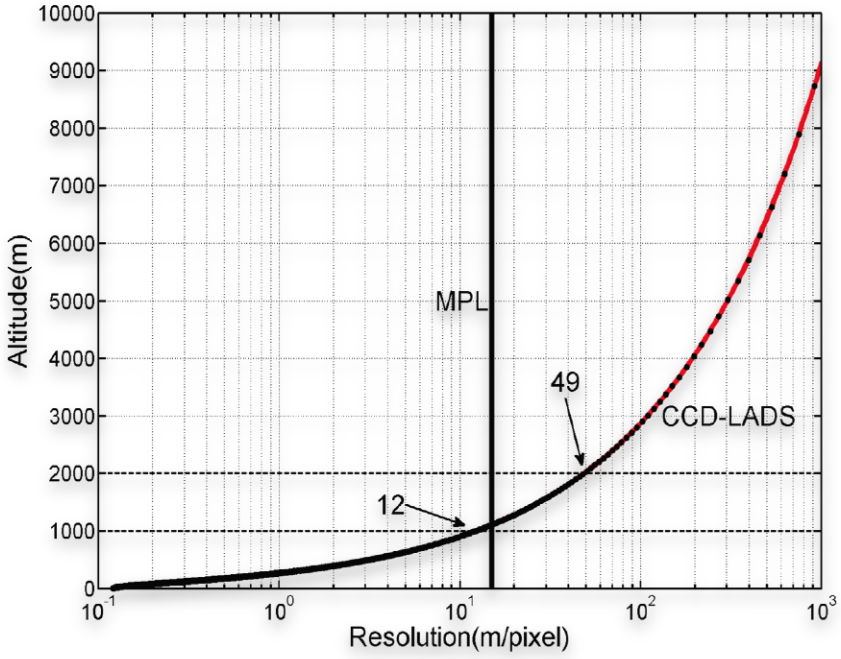
Tao et al., ACP, 2014

High aerosol loading High Ozone



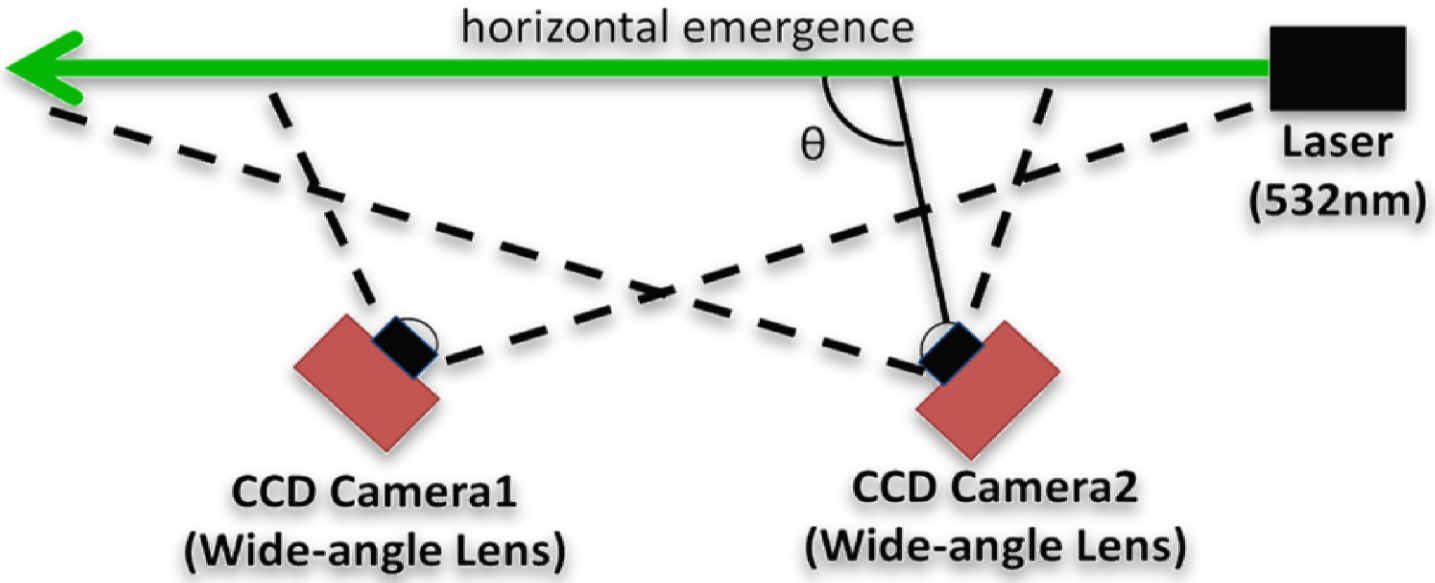
What we are doing now





CCD - Laser Aerosol Detective System

What we are doing now



CCD – Laser Aerosol phase function detective system

Thank you!