

Breakout Session on AMF-China

Aerosols and Climate in China:

Update on AMF-China Update of the AMF-China related researches and JGR special section papers (Z. Li, 15 min)

Status of the AMF-China related data sets (M. Cribb, 15 min)

Aerosol effects on climate in China: A review (Y. Qian, 15 min)

The Effect of Aerosols on the Onset of Precipitation (Kathryn Boyd, 15 min)

A Study of Asian Dust Plumes using Satellite, Surface, and Aircraft Measurements during the INTEX-B Field Experiment (X. Dong, 15 min)

Anthropogenic pollution near dust source regions matters: results from the AAF deployment over northwestern China in spring 2008 (C. Li, 15 min)

Increase in Wintertime Fog and Weakening of the Eastern Asian Monsoon:

Impacts of Global Warming and Aerosols in China (F. Niu, 15 min)

Aerosol Indirect Effects on Clouds and Precipitation Case Studies During the AMF-China Campaign (Jiwen Fan, 15 min)

2008 AMF/EAST-AIRE Campaign Sites



Anchored by the AMF in Shouxian, additional instrumented sites to the east and north provided a comprehensive atmospheric data set for studying aerosol effects in the region.

ature (Sep 24) Feature Article on AMF-China Mission

NEWS FEATURE

DATE: 16 Jul 24 September 2009

Cloudy, with a chance of science

When American and Chinese scientists agreed to measure pollution and dust over China, nobody foresaw how difficult it would be. Jane Qiu reports.

In a meteorological haze in the sleepy town of Shouduan in eastern China was buzzing with excitement. It was May 2008, and the anxious courtyard was filled with sophisticated remote-sensing instruments that had just arrived on a plane from the United States Department of Energy (DOE). The bureau had been expecting the equipment earlier, but it had been held up by Chinese customs officials for more than two months. A group of climate researchers and government officials from China and the United States eagerly inspected the new arrivals, which included a cloud radar, a lidar made later in radar-like instruments that sends out laser beams rather than microwave and sensors for studying various features in the atmosphere and the radiation from the Sun. "We can do great things with these here," said Zhangling Li, an atmospheric scientist at the University of Maryland at College Park, who was leading the Sino-American collaboration.

Over the next few months, these instruments would be pointed up into the Chinese sky to measure and study aerosols — tiny airborne particles such as dust and soot. The researchers were particularly interested in tracking how aerosols alter the weather by reflecting and absorbing whether clouds produce rain, how they extend, how much sunlight they reflect and



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it yields a different region around the world, where it's run by an on-site technician. A team of scientists in the United States monitors each instrument remotely; they review the data for quality and then upload them in real time into the ARM data archive for use by the worldwide scientific community.

In 2007, Li and Chen Hongbin, deputy director of the Beijing-based Institute of Atmospheric Physics of the Chinese Academy of Sciences, won the bid to bring the mobile facility to China this fall following 704. The project came under the auspices of a science agreement signed in 1997 between the DOE and China's science ministry. Under that compact, the two countries are committed to sharing data and collaborating on joint field campaigns, climate modeling and strategies for adapting to climate change.

Cloud puzzle
One aim of deploying the ARM mobile facility in China was to investigate an observation that had puzzled atmospheric scientists for some time. Microwave-sensing instruments on the Joint US-Japanese Tropical Rainfall Measuring Mission satellite detect large amounts of liquid water in clouds over the coastal region of eastern China, yet the satellite radar shows that there is very little rain.

"The two satellite instruments disagree with one another, which is very unusual," says Chris Kuanerzow, an atmospheric scientist at Colorado State University in Fort Collins, who discovered the discrepancy with his colleagues (W. Berg et al., *Aggl. Meteorol.* 45, 434–454, 2006). Some researchers suspect that the high level of aerosols in the Chinese atmosphere might be the culprit. The standard thinking about rain is that the particles often serve as nuclei for condensing the moisture into which water can grow. The more of these nuclei, the more rain should fall, and the larger the droplets, the more likely they are to coalesce and fall as rain. But in the case of the Chinese atmosphere, the high level of aerosols might be interfering with the process. The rain rate is high because the data collected by the ARM programs will be used to improve the way that climate models simulate clouds and aerosols. When the program was created in 1989, it collected measurements only at fixed sites within the United States. That soon dawned on the need for a much better understanding of the weather as much information as possible from diverse climate systems around the world to build up a complete picture of global climate change," says Williams.

This resulted in a mobile facility, built in 2004, that carries most of the remote-sensing instruments present at the fixed sites. Each year,

and atmospheric circulation patterns, could influence how aerosols affect clouds. "We need a large data set from a many climate regions as possible," says Mark Miller, an atmospheric scientist at Rutgers University in New Brunswick, New Jersey. "The ARM deployment in China is an important part of that effort."

The plan was to take the measuring facility to four locations in China with different climate and aerosol types. The two earliest sites were near Shouduan, 500 kilometers northwest of Shanghai, and Taihu Lake Tai, in the industrial heartland of the Yangtze River delta region, about 100 kilometers west of Shanghai. These



The arrival of the equipment at Shouduan was a cause for celebration.

spots of problems created their hopes. "At some point we thought we wouldn't be able to get anything out of it," he says. The difficulties began right at the start, when the instruments became stuck in Chinese customs because of tightened regulations due to the Olympics. "We were not aware of some of the change in customs regulations and did not have all the paperwork necessary for getting the instruments through," says Chen. One type of that, some of the sophisticated, upward-pointing instruments, such as the cloud radar, raised much suspicion among customs officials and the public alike.

At the end of the dust-storm season in July 2008, the instruments were moved to Xianghe to study how government actions to reduce pollution during the Beijing Olympic period would affect radiation reaching the surface. "You rarely have the opportunity to do something like that in a major metropolitan," says Miller.

Steps and starts
Despite the high hopes, however, the work in China was an uphill struggle at each step, says operational manager Kim Nicholas. "Originally, our expectation was to take it to two sites, but we're extending it to get into China during the Olympics," says Williams. Then, the

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and Xianghe sites that were measuring particles of black carbon, a major component of soot. Interestingly, the CMA did not interfere with measurement after observing this, possibly because these were being jointly operated with Chinese universities.

At one point in July last year, the DOE threatened to terminate the ARM project in China, but it decided to stay on, in consideration of the effort already invested. Eventually, after lengthy negotiations, the American researchers were granted a two-week window in October 2008, during which they could connect with the instruments themselves from the United States for about four hours each day. Only then were they able to fix the broken cloud radar, enabling it to collect data during the last two months of the project.

Political problems caused headaches up to the final days of the year-long stay in China. "Even at the end of the deployment, we were not sure whether we would be able to get anything out of it," says Nicholas. "I had to do this with me on a portable hard drive, but I wasn't sure whether I would manage to get them out of China or if the Chinese government would let me take them publicly available."

The CMA did give the green light, and the original data from Sun Shouduan and Zhangye are now available from ARM's archive. Many researchers are philosophical about the difficulties encountered by ARM's China deployment. "China is going through a transition phase," says Daniel Rosenfeld, an atmospheric scientist at the Hebrew University in Jerusalem, Israel. Although the country is still not an open as people would like to be, the collaboration clearly states a move away from the old ways, he says. "The process is not complete yet, but I hope the issue of payment will be settling of the past soon." Wei-Ching Wang, a climate scientist at the State University of New York at Albany, and the United States' other scientist managing the climate-science agreement, says that the project is "one of the most successful collaborations under the agreement" 18 adds that "this unique experience in Beijing last month by the DOE and Chinese scientists is a model for other international collaborations."

Data feast
Participants in the project say they are happy with what they were able to collect. "We now have cloud data from China nobody has ever had before," says Miller. Since the data collected at Shouduan and Zhangye were made publicly available in March and April 2009,



Chen-Hongbin, a balloon and a laser radar; collaborating to participate in the collection of data.

respectively, researchers have been busy analyzing them. Co-lead Flynn, an atmospheric scientist at the Daily Pacific Northwest National Laboratory in Richland, Washington, is excited by the data. "Some of the data images are just visually breathtaking," he says of the pollution measurements.

He has plotted the lidar data to reveal the concentration and composition of aerosols at which they go through other layers," says Flynn. The data also show air masses with distinct aerosol components coming together from dust, urban, industrial and agricultural regions and mixing at different altitudes. "We don't always know these diverse sources of aerosols at high concentrations in other parts of the world," he says. The information is not only valuable for climate modelers trying to simulate those processes, Flynn adds.

Using data from radionuclide, lidar, cloud radar and weather balloon. Li and his colleagues have made some headway in understanding the water-radiant pathway of the clouds over eastern China. At a meeting jointly convened in Beijing last month by the DOE and Chinese scientists, Li showed that the effect of aerosols on rainfall depends on the amount of liquid water in the clouds. When clouds are relatively dry, adding aerosols can suppress precipitation. In wetter clouds, however, aerosols make rain more likely. This is consistent with the observation that the number of days of light rainfall has decreased by 23% in the past 30 years in eastern China, cloud modeling studies show that this can be explained by the

increased aerosol concentrations in the region ("Q. Qian et al., *Geophys. Res. Lett.* 36, D08202, 2009). What's more, data collected at Shouduan and Taihu show that aerosols apparently affect the thickness of clouds and the altitude at which they form. "If this proves to be the case, the implications of aerosols for climate change will be tremendous," he says.

Just the Chinese data have not covered all the cloud conditions. Using a computer simulation, Kuanerzow and his colleagues have piggybacked "very complicated physics" to how aerosols affect clouds. "They seem to increase precipitation in some places and decrease rainfall in others," he says. For example, the cloud radar and radiometer data from Shouduan indicate that, on days with comparable aerosol amounts, cloud liquid water content is higher and rain is less frequent.

These preliminary passes through the ARM data collected in China show how much remains to be learned there. And the scientific results are not only driving the project has yielded. To Chinese researchers such as Huang Jiangping, an atmospheric scientist at Lanzhou University in Gansu province, the ARM collaboration helped strengthen China's capability to run long-term field campaigns. Since 2005, Huang has been building up an observational site in the cloud-radar east of Zhangye, focusing on climate research of semi-arid regions. "The ARM deployment in Zhangye has allowed us to work alongside the best people in the field," says Huang. And the experience has helped spur China's scientists to set their sights higher.

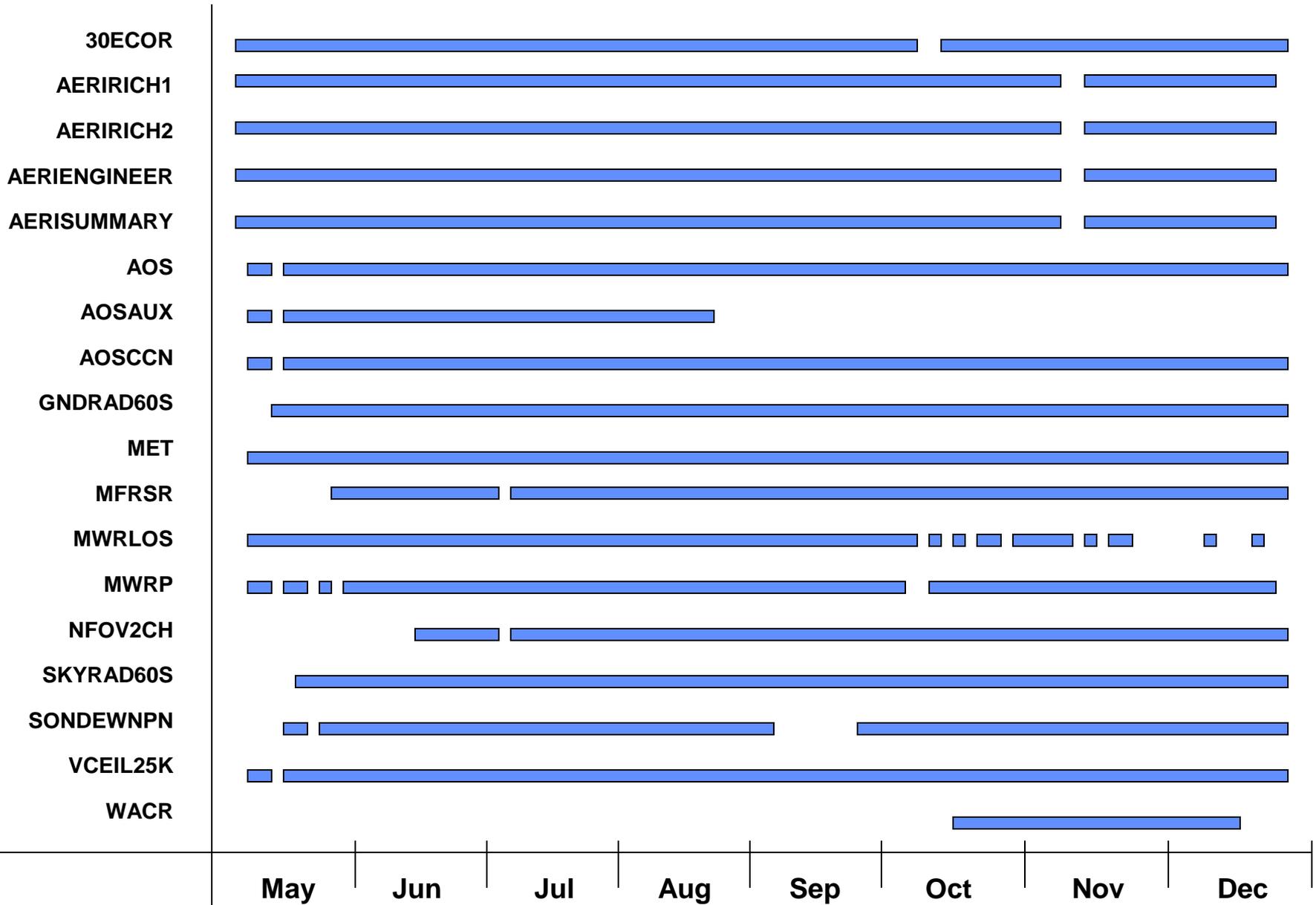
June Qiu writes from Beijing for *Scientific American*.

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ARM Mobile Facility Deployment in Shouxian



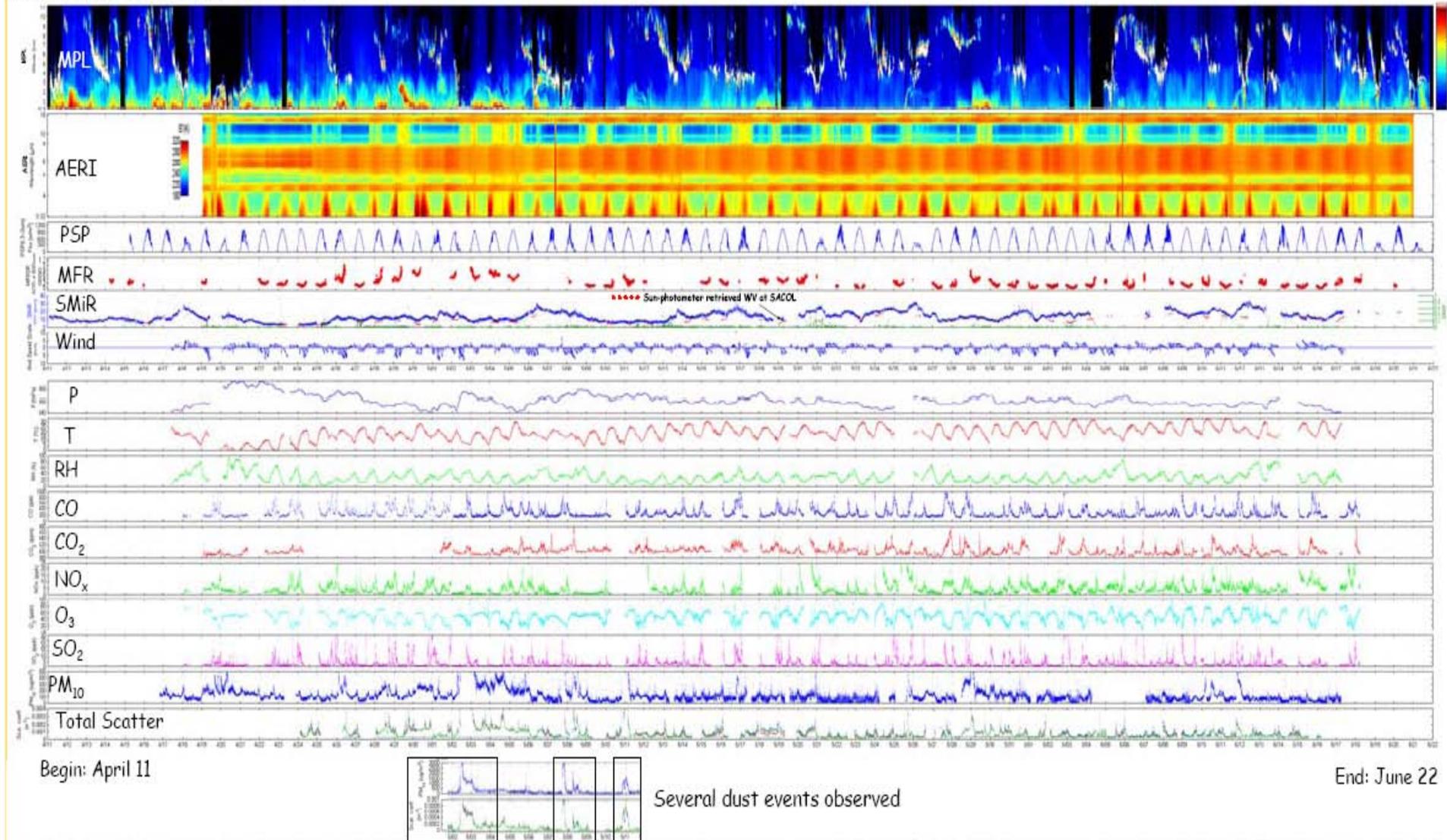
HFE Summary of Completeness: May 1, 2008 – Dec. 31, 2008





Time Series of Data from AAF

3. Selected time series



Taihu Observator

Wuxi



Suzhou

Shanghai

Hangzhou

Xianghe Observatory





Radiation Instruments



Aerosol Instruments

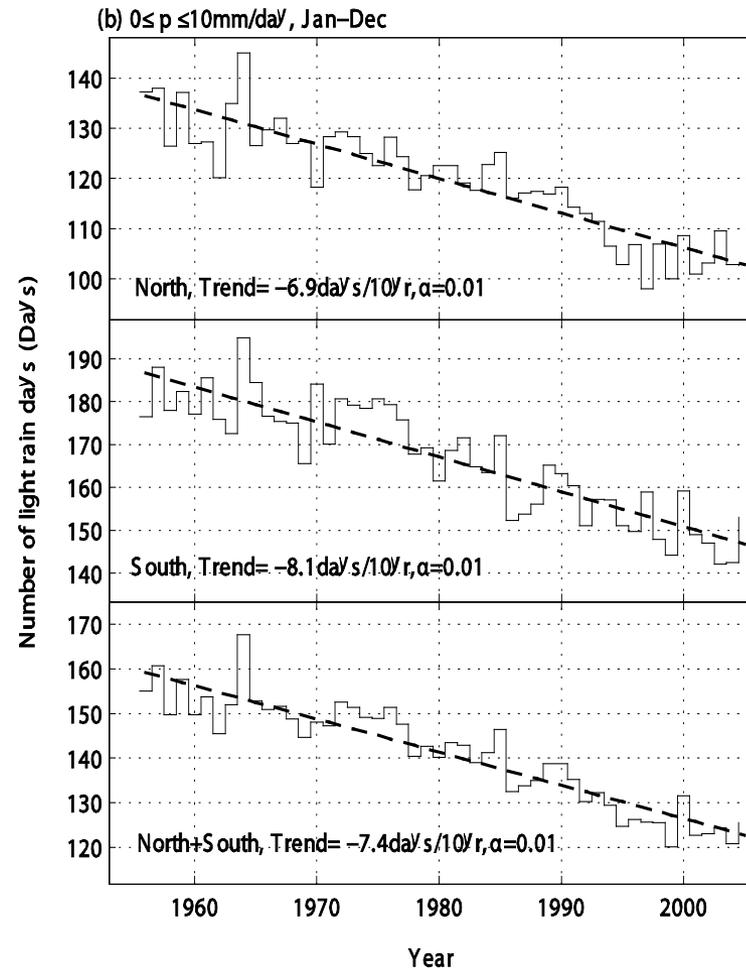
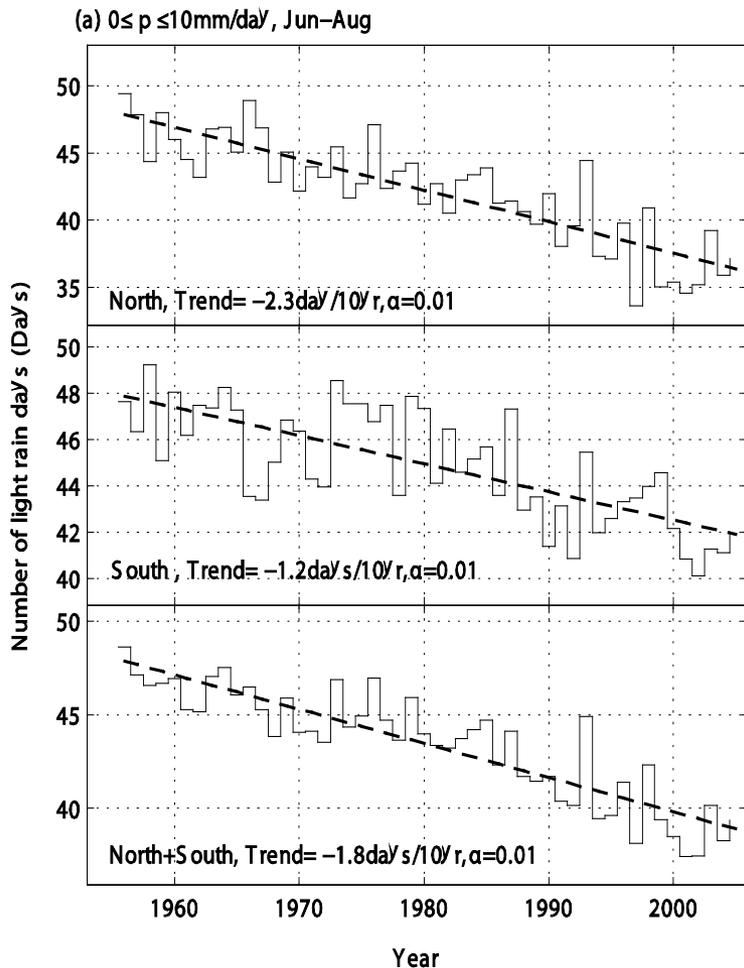


Cloud Instruments

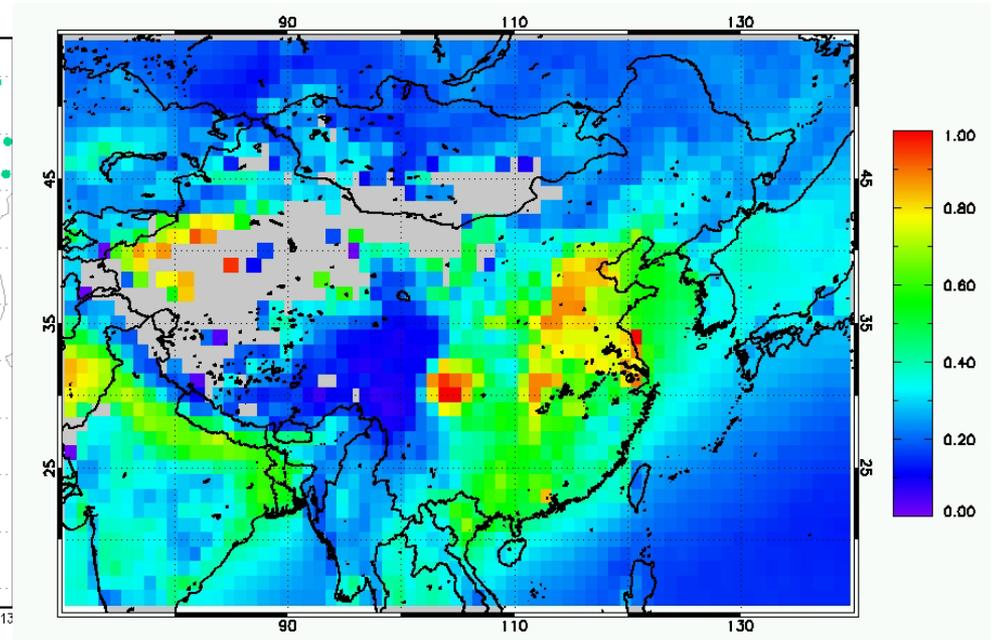
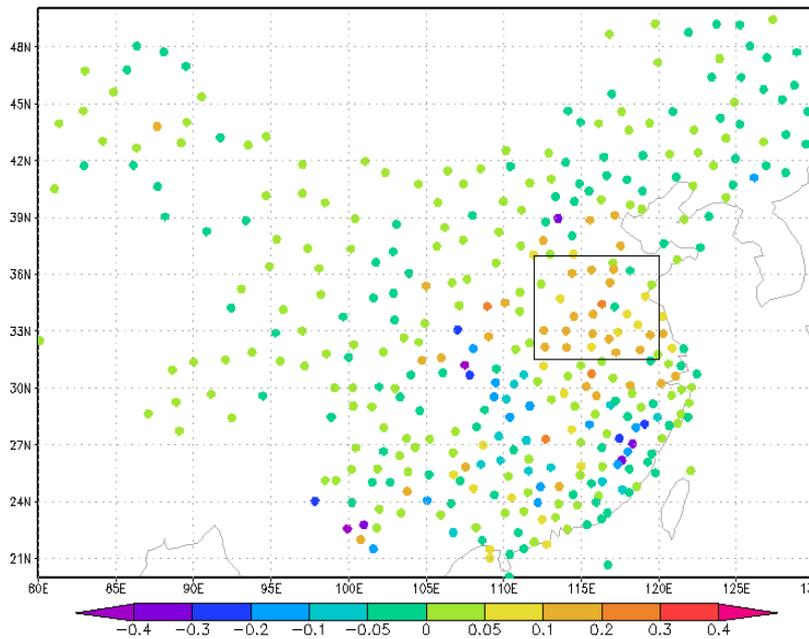
Taihu Instrumentation List 2008

Instrument	Parameters	Units	Temporal Resolution	Time Period
Cimel sunphotometer	AOD; SSA; Angstrom exponent; size distribution;	none, none none $\mu\text{m}^3/\mu\text{m}^2$	15 minutes	Jan.1/08-Oct.2/08 (V2.0) Oct.7/08-Dec.31/08 (V1.5)
ASD spectroradiometer	solar spectral radiances (350-2500 nm, 1-nm resolution)	$\text{W m}^{-2} \text{ nm}^{-1} \text{ sr}^{-1}$	1 minute	2008: Apr. 25 - May 19 Jul. 19 - Dec. 31
MFRSR	broadband fluxes; spectral fluxes (414,495,613,671,867,939 nm)	W m^{-2} $\text{W m}^{-2} \text{ nm}^{-1}$	1 minute	Apr. 27/08 - Dec.31/08
B&W pyranometer Norm. incid. pyrhelimeter PIR pyrgeometer PAR Lite sensor	diffuse solar fluxes ; direct solar fluxes ; longwave fluxes; photosynthetic photon flux	Wm^{-2} Wm^{-2} Wm^{-2} Wm^{-2}	1 minute	Jan.01/08 - May 23/08
Micro-pulse Lidar	total lidar attenuated backscatter profile; linear depolarization ratio		1 - 3 minutes	2008: Mar. 24 - May 3 May 16 - Aug. 4 Aug. 8 - 29
Microwave Radiometer	temperature profile; RH profile; vapor density profile; liquid water profile time series of: surface pressure ;RH ; surface T ; T (IR) ; cloud base height; precipitable water; liquid water; rain	K % g m^{-3} g m^{-3} mb,% K,K km cm mm, 0=no, 1=yes	1 minute	Apr. 25/08 - Dec. 31/08
Total Sky Imager	JPEG images of daytime sky		1 minute	Apr. 24/08 - Dec. 31/08
Weather Transmitter	air pressure; air temp. ; RH; wind speed/direction; rain accumulation	mb C, % m s^{-1} , degrees mm	1 second 1 second 3 seconds 1 second	Sep. 23/08 - Dec. 31/08

Time series of number of days for light rain (<10mm/day) from 1956-2005 (left: JJA; right: Jan-Dec)



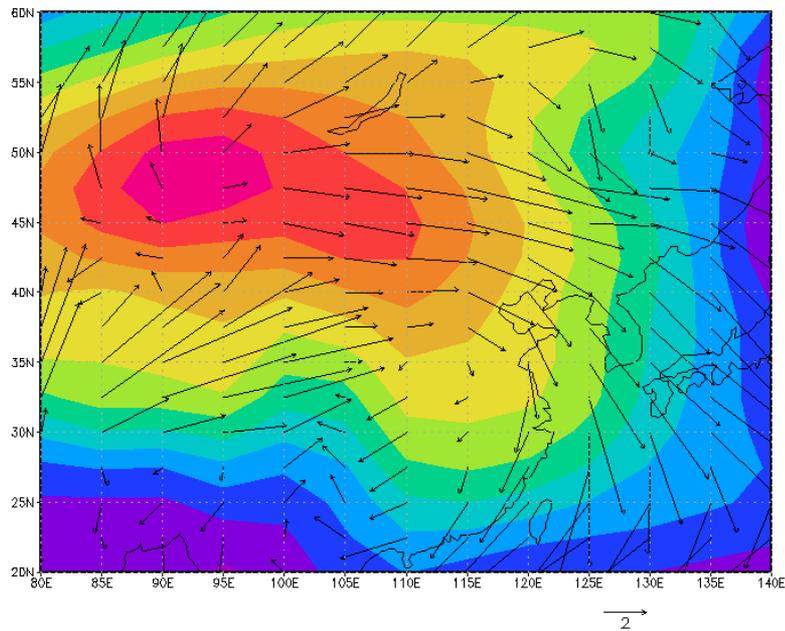
Annual Change Rate of Fog Occurrence 1976-2007



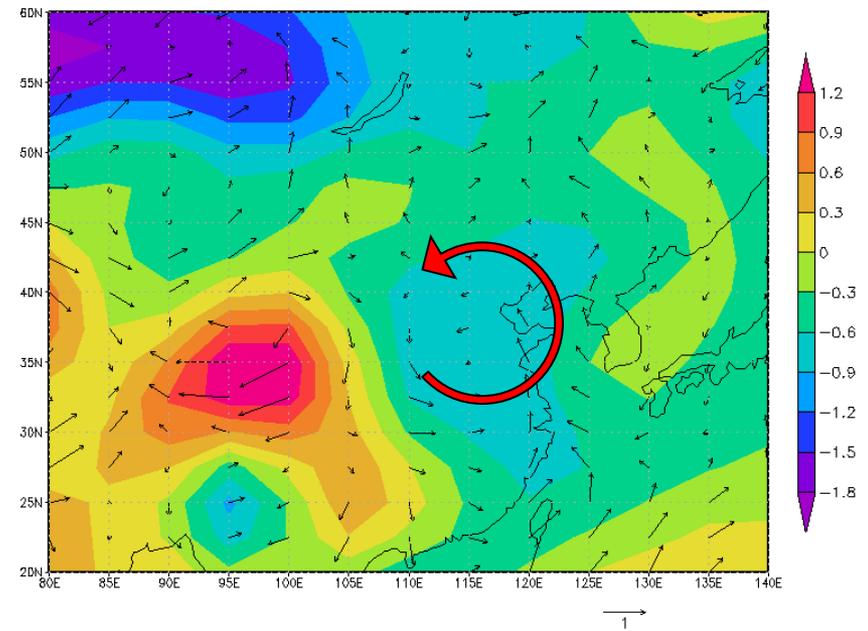
Niu et al. (2010)

Winter Sea Level and Wind (NOAA/NCAR Reanalysis)

(a) Mean Values

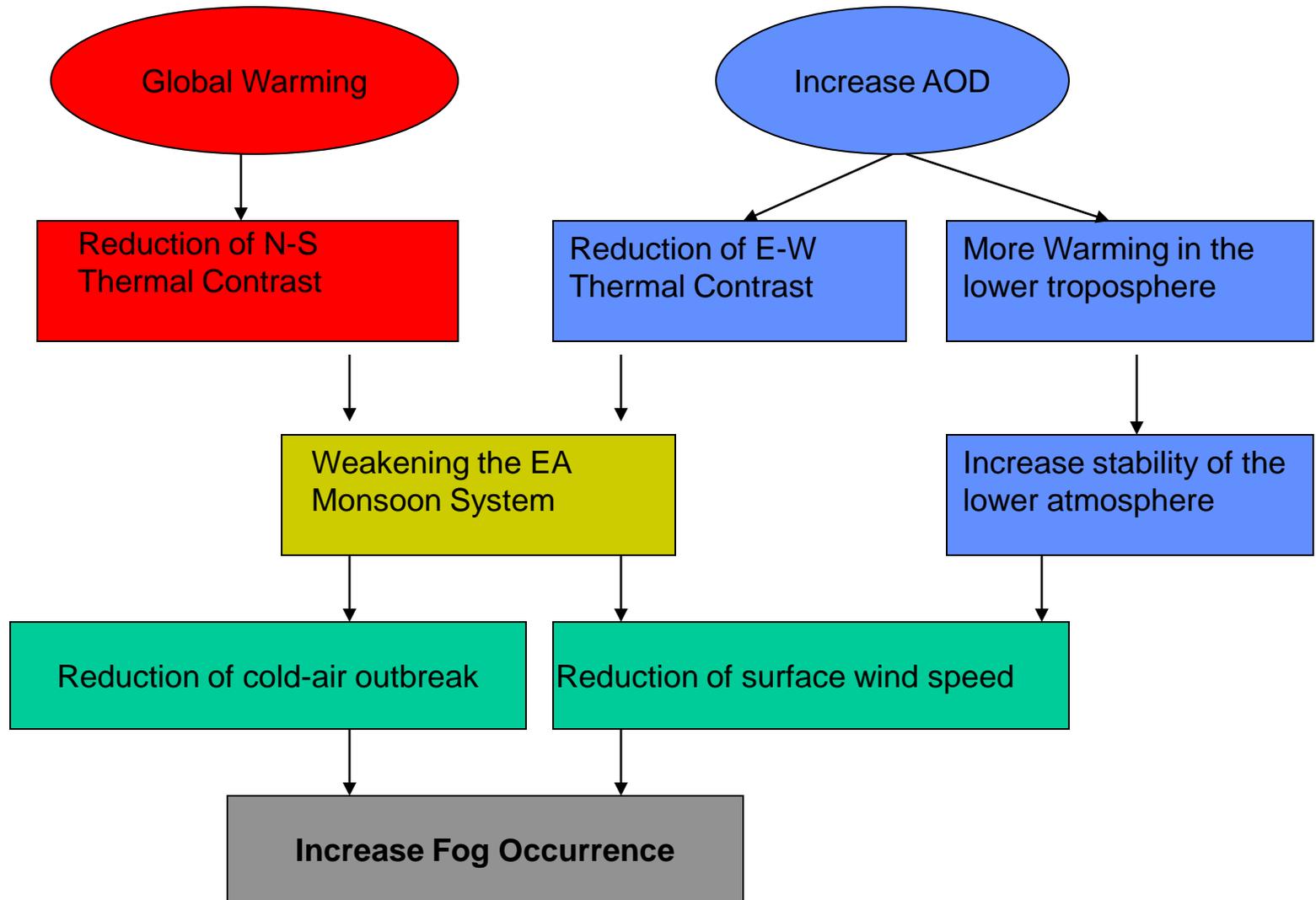


(b) Changes

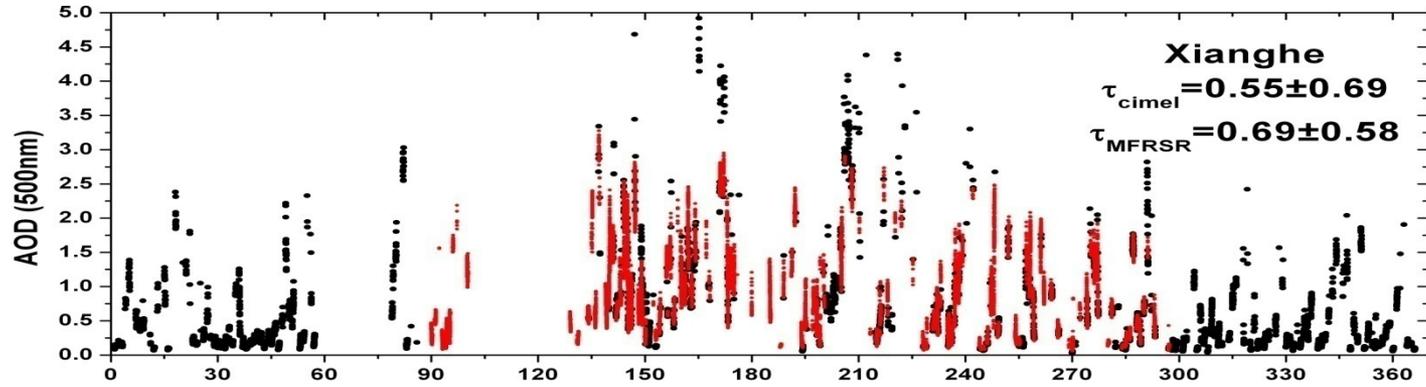


Niu et al (2010)

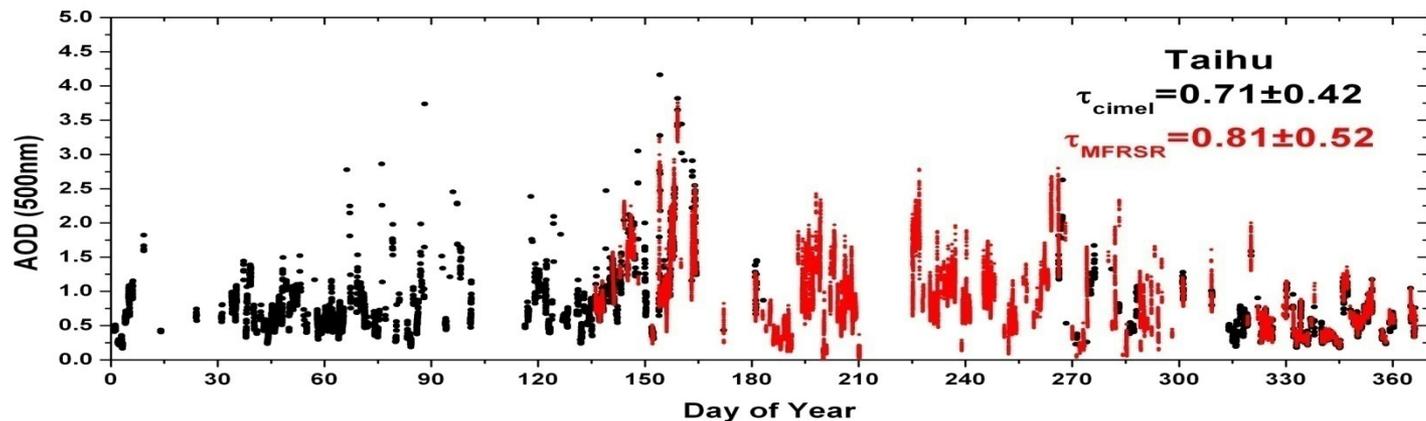
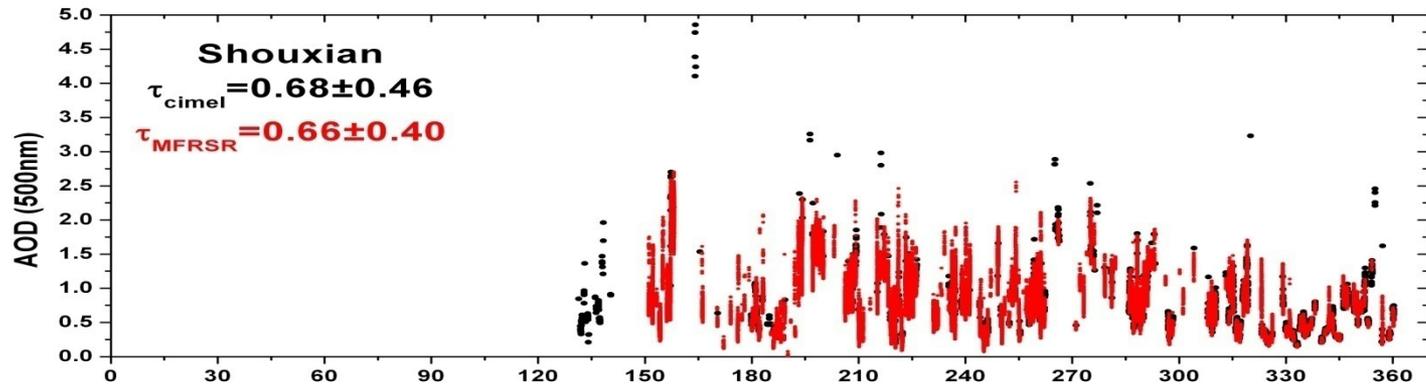
Aerosol-Monsoon Mechanisms



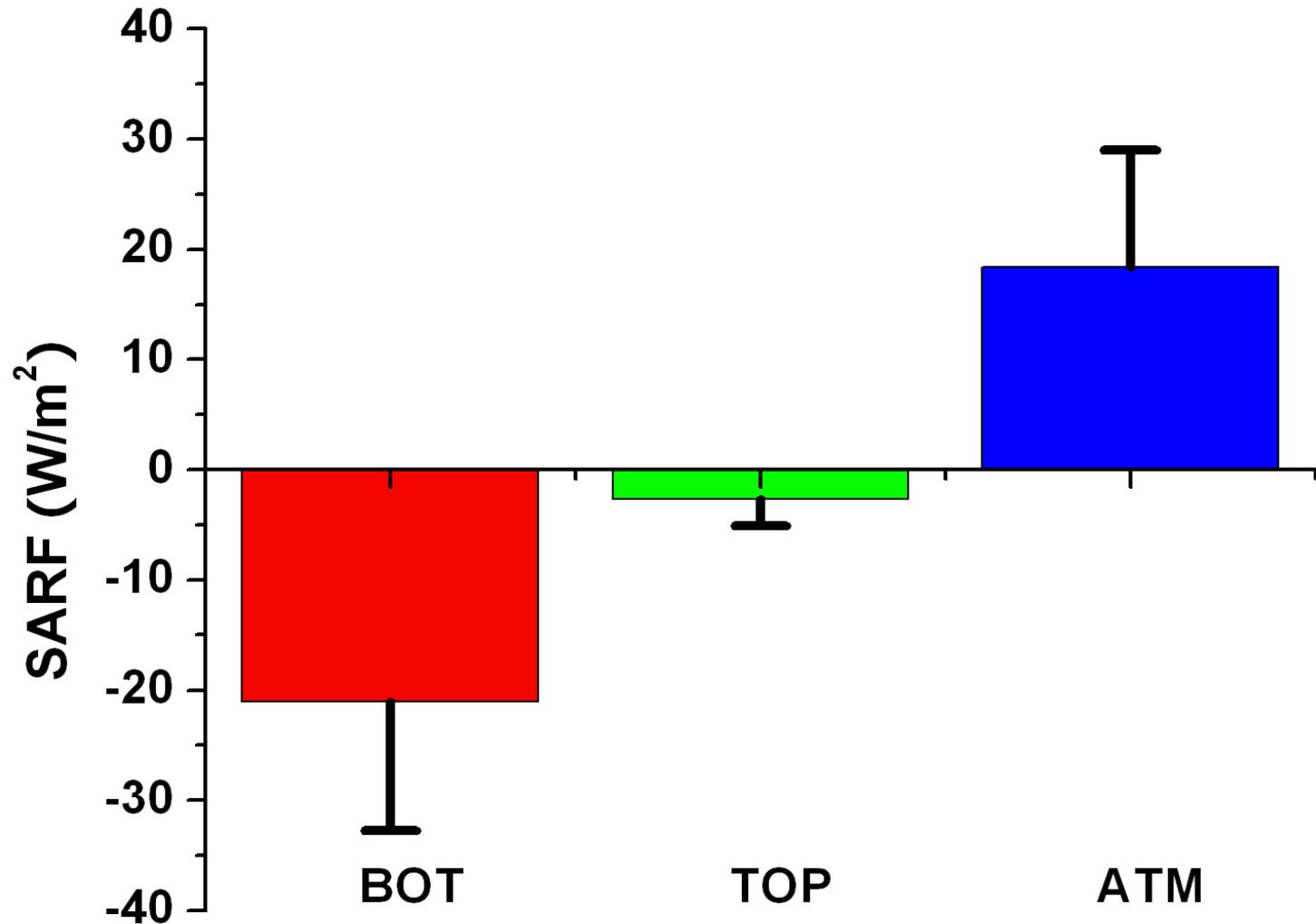
AOD records during 2008



Black: Cimel
Red: MFRSR

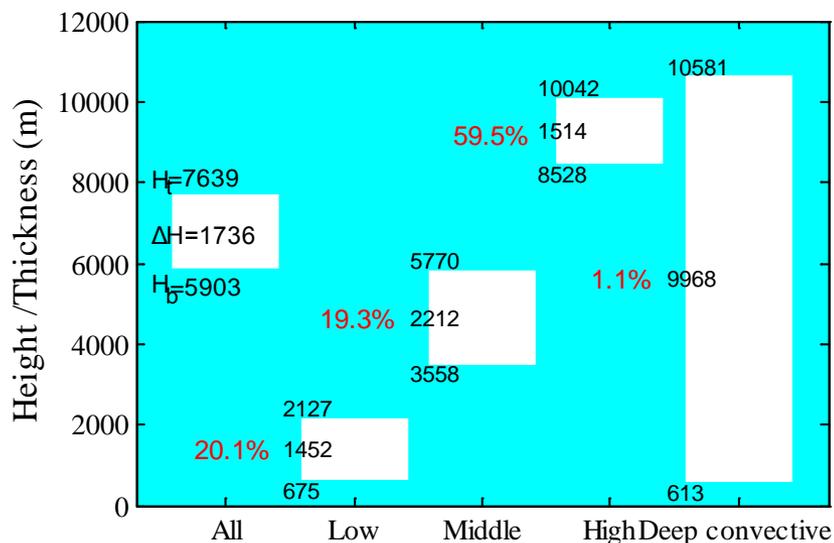
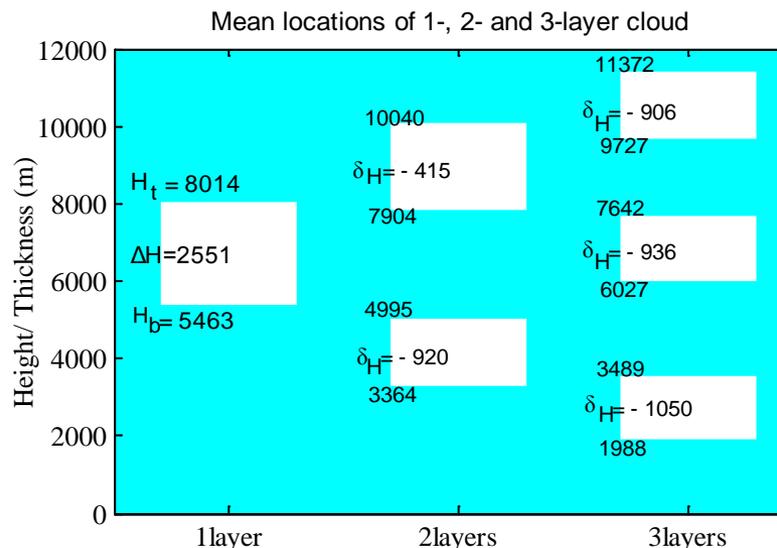
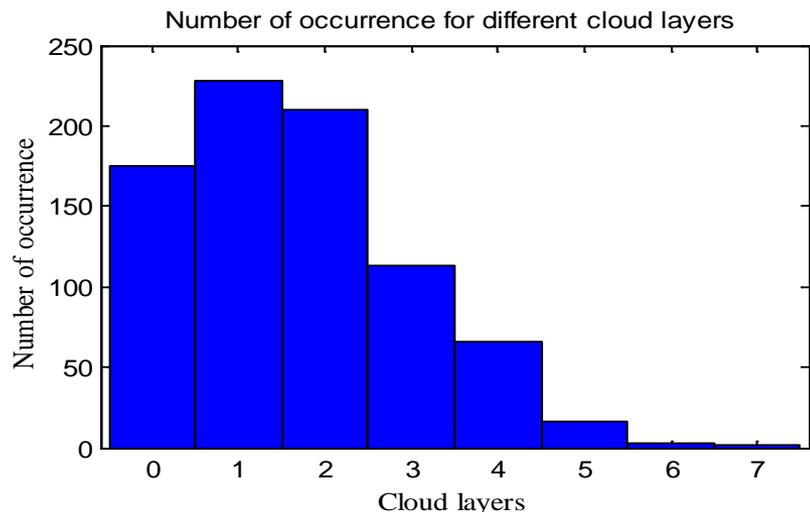


National Mean of Aerosol Radiative Forcing at the TOA, Surface and inside the Atmosphere



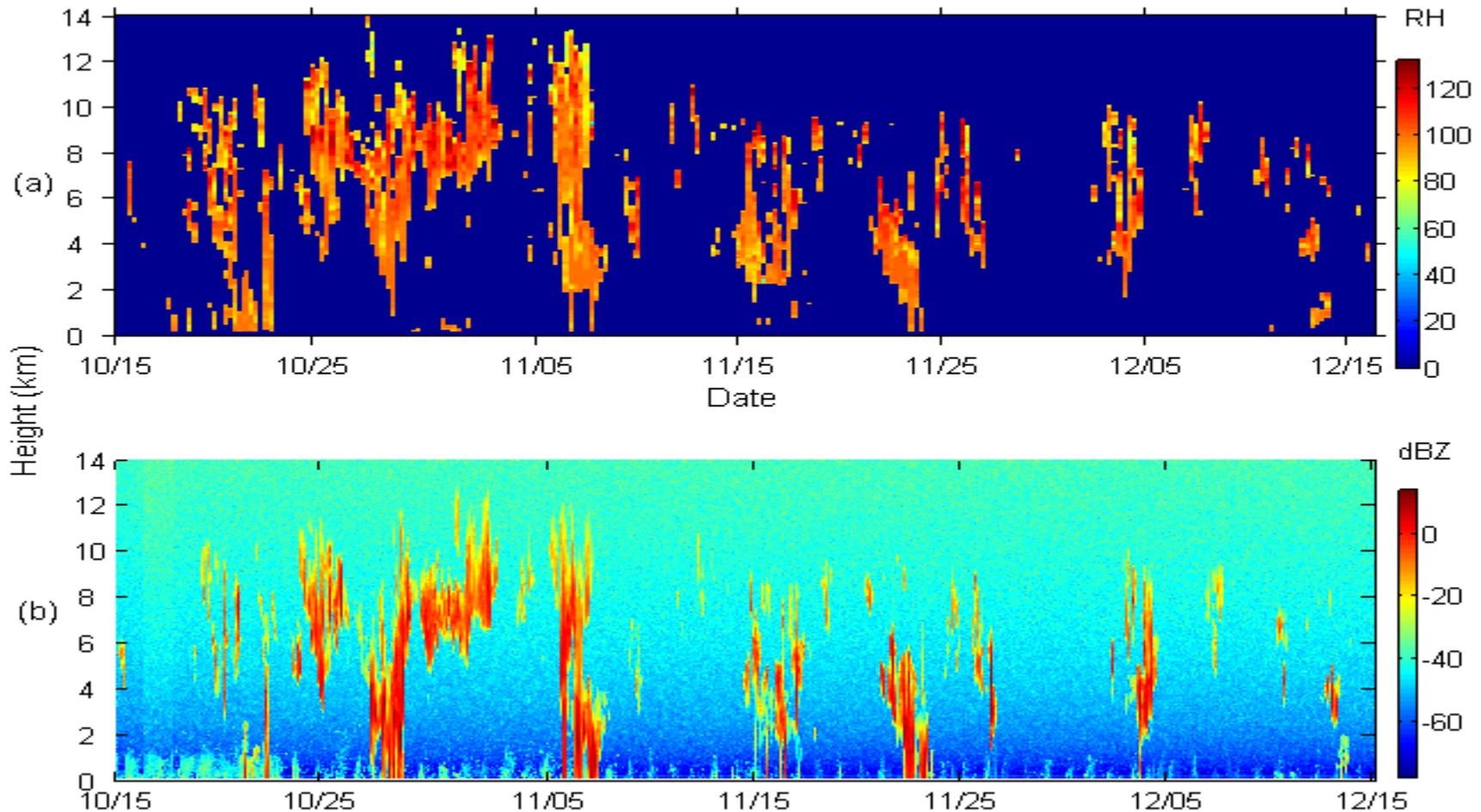
Li et al. (2010)

Cloud layer results determined by radiosonde



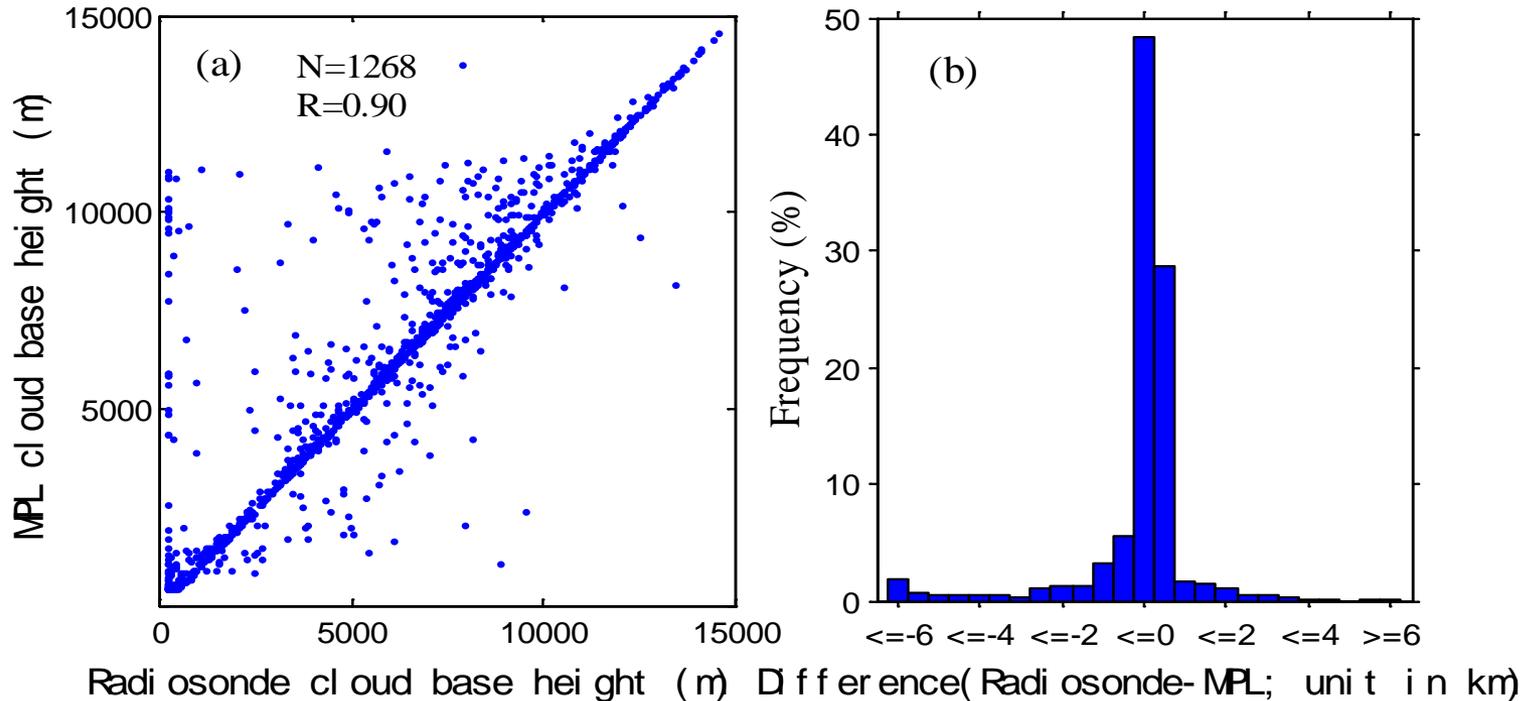
- Cloud-free cases and 1- to 3-cloud layers account for 21.5%, 28.0%, 25.8% and 13.9% of all cases, respectively.
- High clouds occurred most frequently.
- Single-layer clouds are thicker than multi-layer clouds with a mean difference of -867 m.

Comparisons between the radiosonde and the WACR



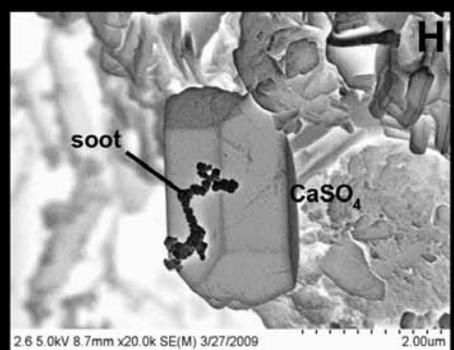
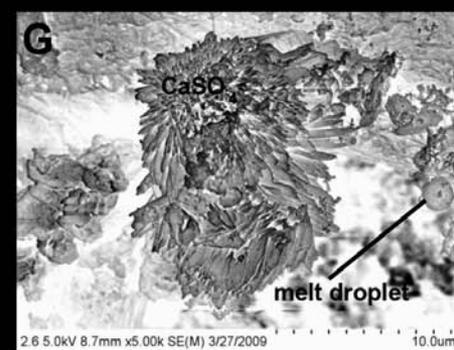
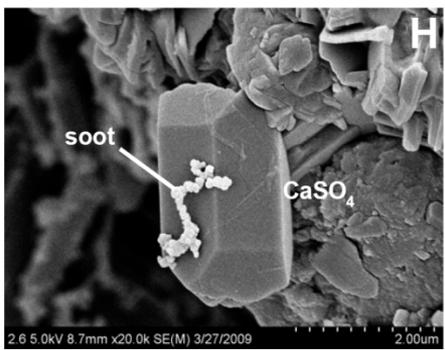
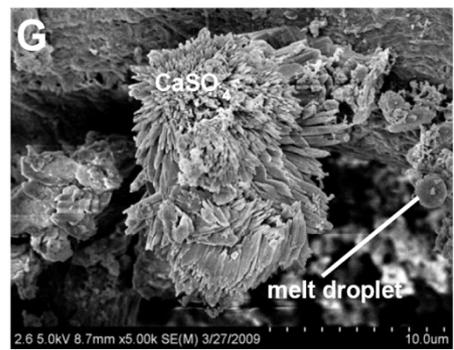
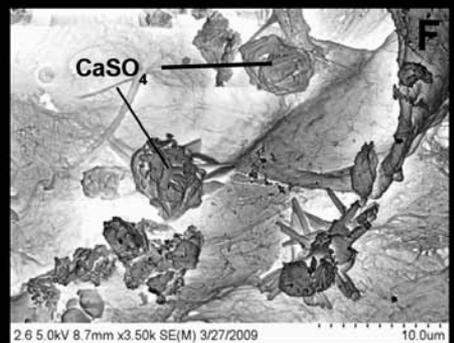
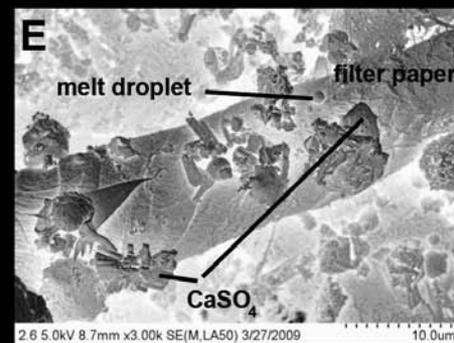
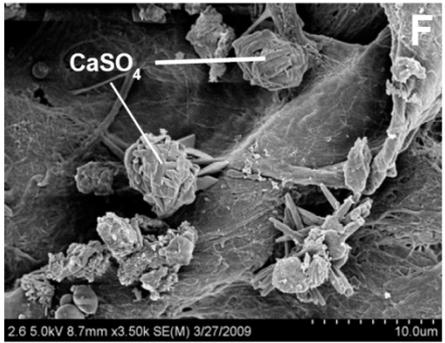
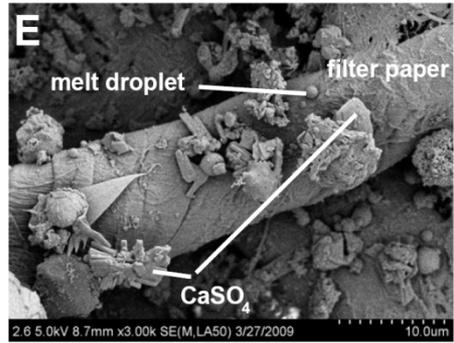
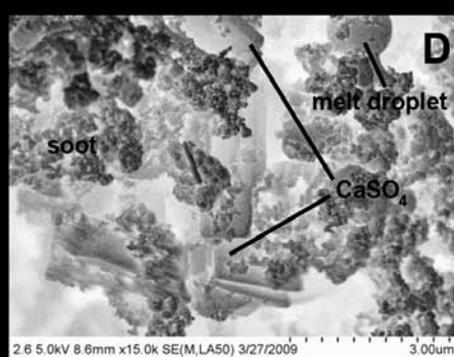
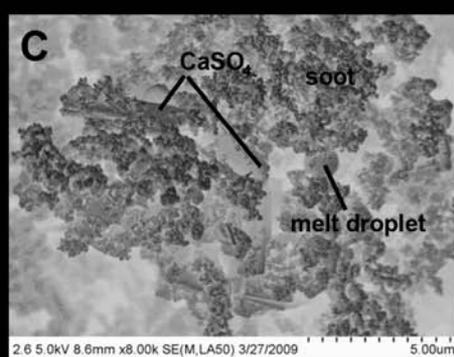
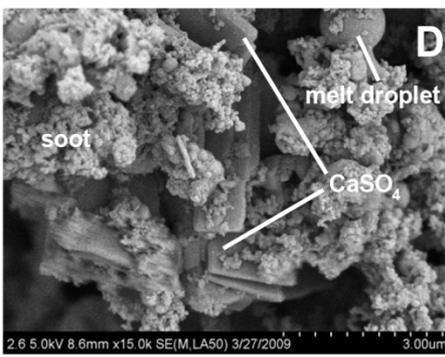
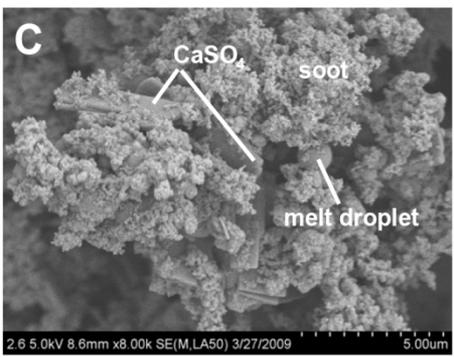
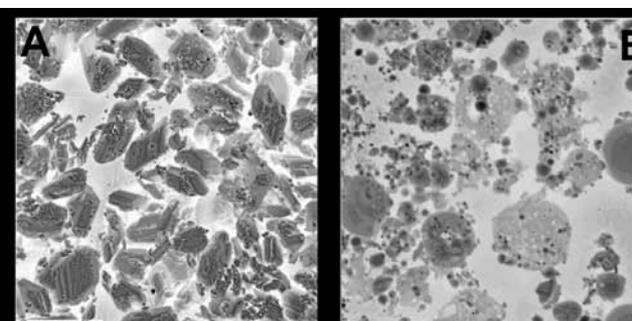
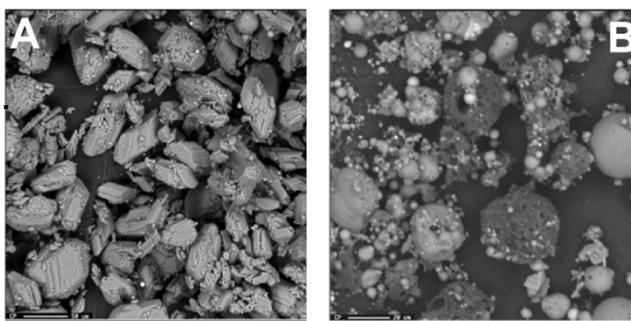
The two detections are very similar, but several thin clouds in the radiosonde observations which are not detected by the WACR.

Cloud base detection comparisons between the radiosonde and MPL



- The absolute differences (ΔH) are less than 500 m for 77.1% .
- The average ΔH is 639m, and the average difference is -389 m.

Guo et al.
(2010)



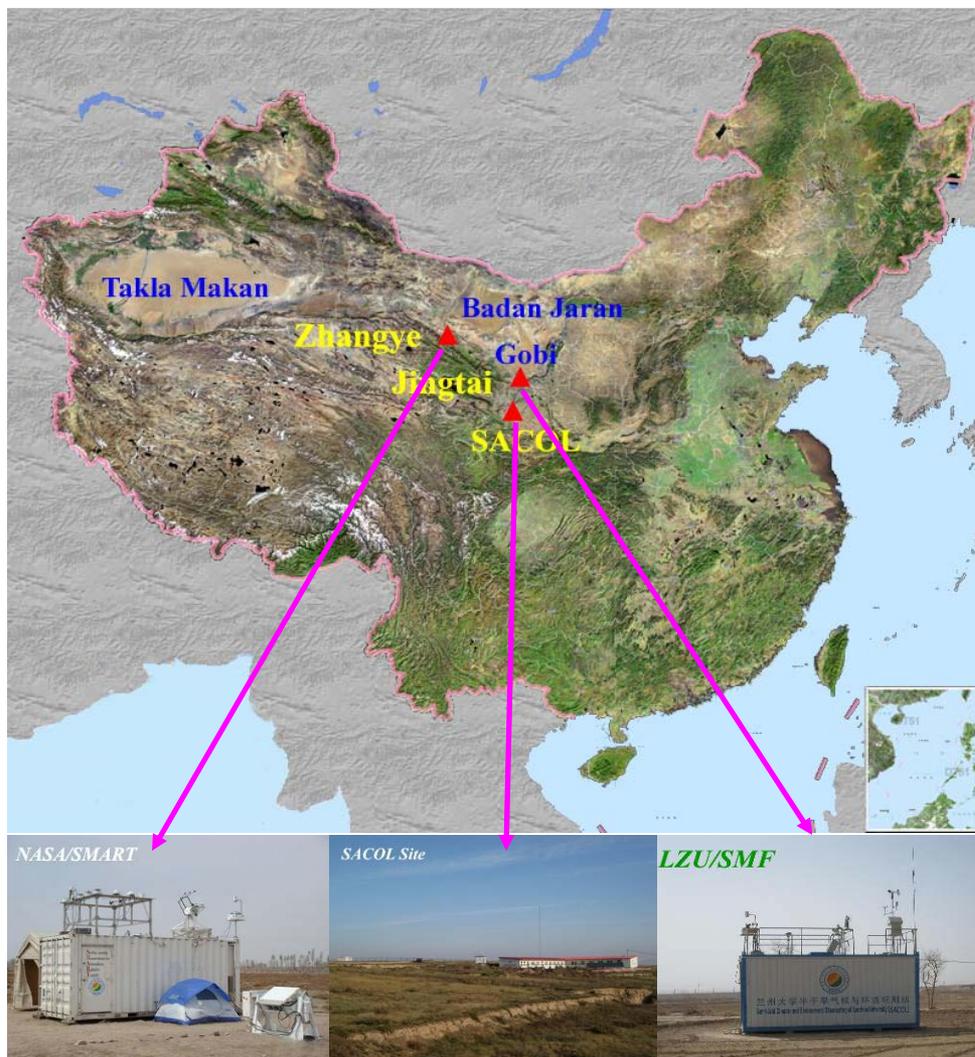
2008 China-US Joint Experimental

Jianping Huang
et al.

College of Atmospheric Sciences

Lanzhou University

P.R. China



(a) 39.08°N,100.28°E,1460m (b) 35.95°N,104.14°E,1970m (c) 37.34°N,104.14°E,1592m

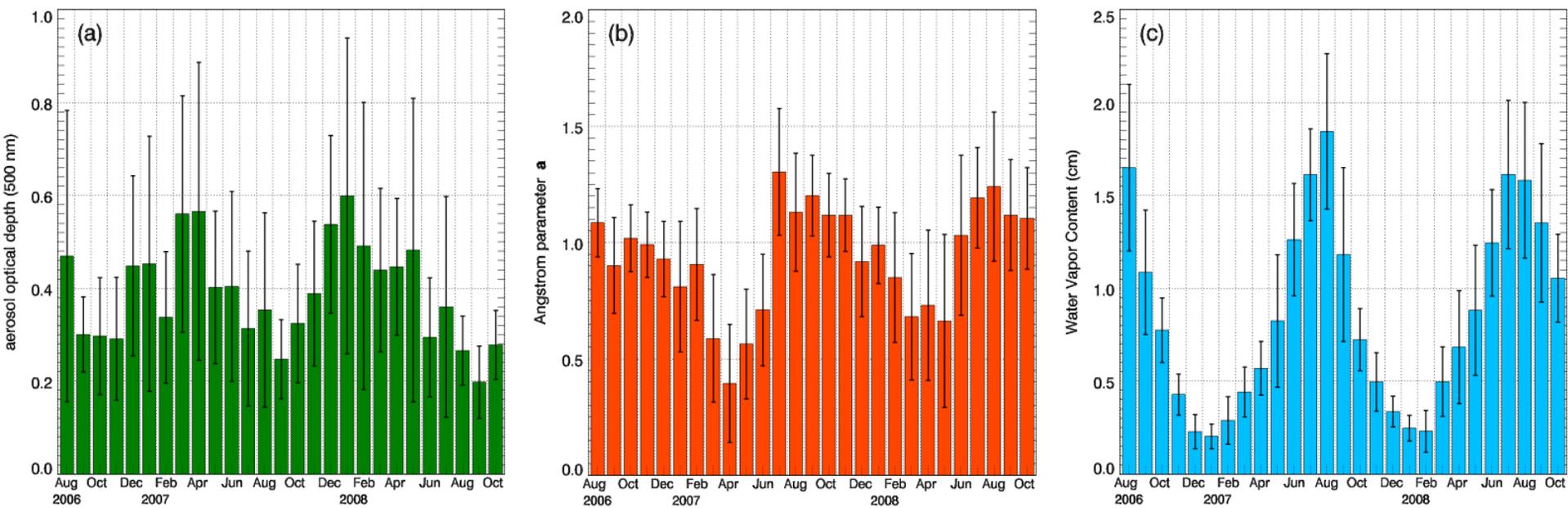
Map of three sites for 2008 Field Experiment

2008 China-US Joint Field Experiment & SACOL Observation

Jianping Huang et al.

**College of Atmospheric Sciences, Lanzhou University,
Lanzhou, 730000, PRC**





Two-year average value (SACOL):

AOD at 500nm: 0.35 ± 0.21

Ångström parameter: 0.93 ± 0.34

WVC: $0.77 \pm 0.52\text{cm}$

Fig 15. Mean monthly values of (a) AOD at 500 nm, (b) Ångström parameter, and (c) water vapor content at SACOL. The bars indicate one standard deviation.

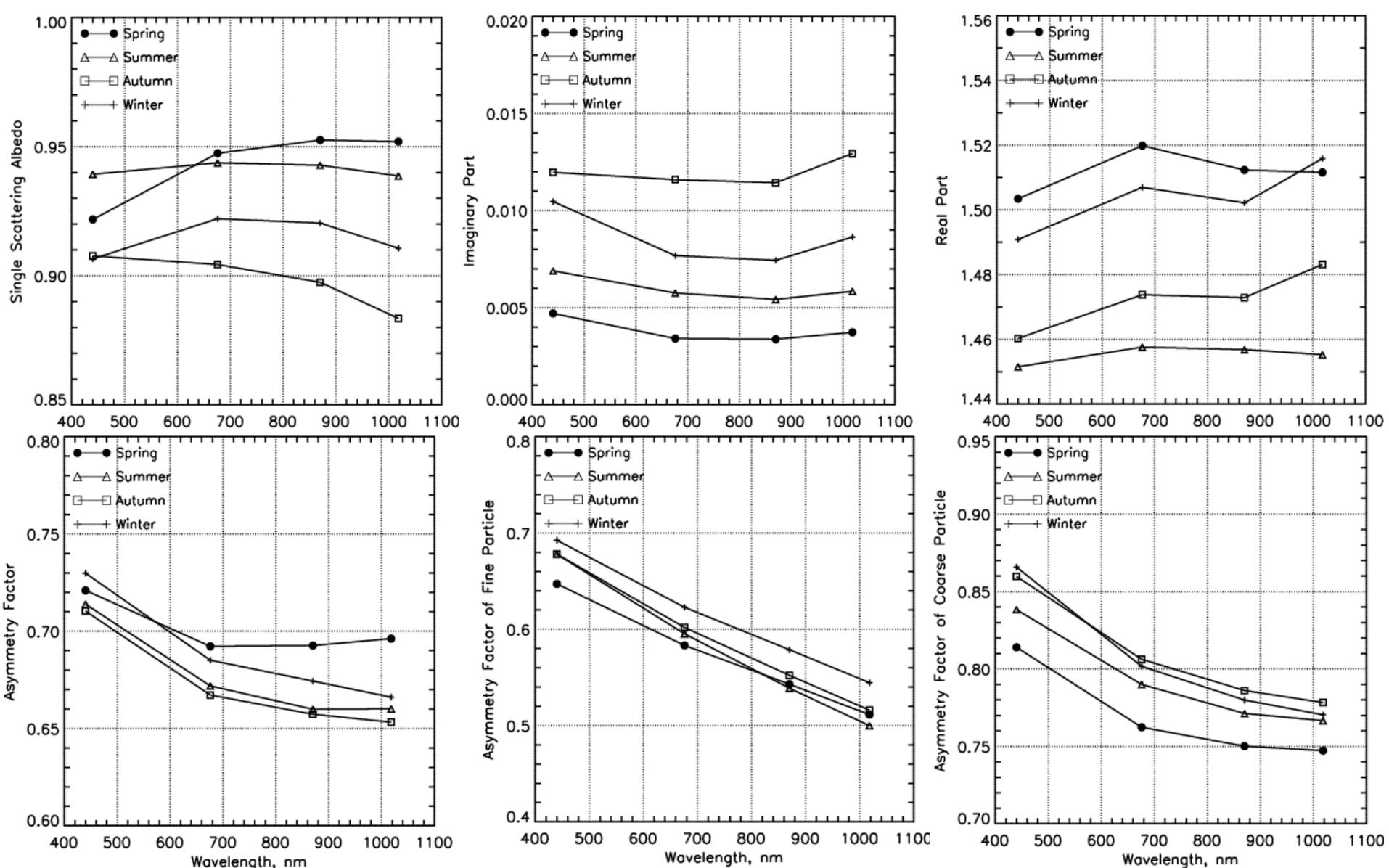


Fig 18. Seasonal spectral values of retrieved SSA, ASY, the real and imaginary parts of refractive indices, ASYs of fine and coarse particles at SACOL.

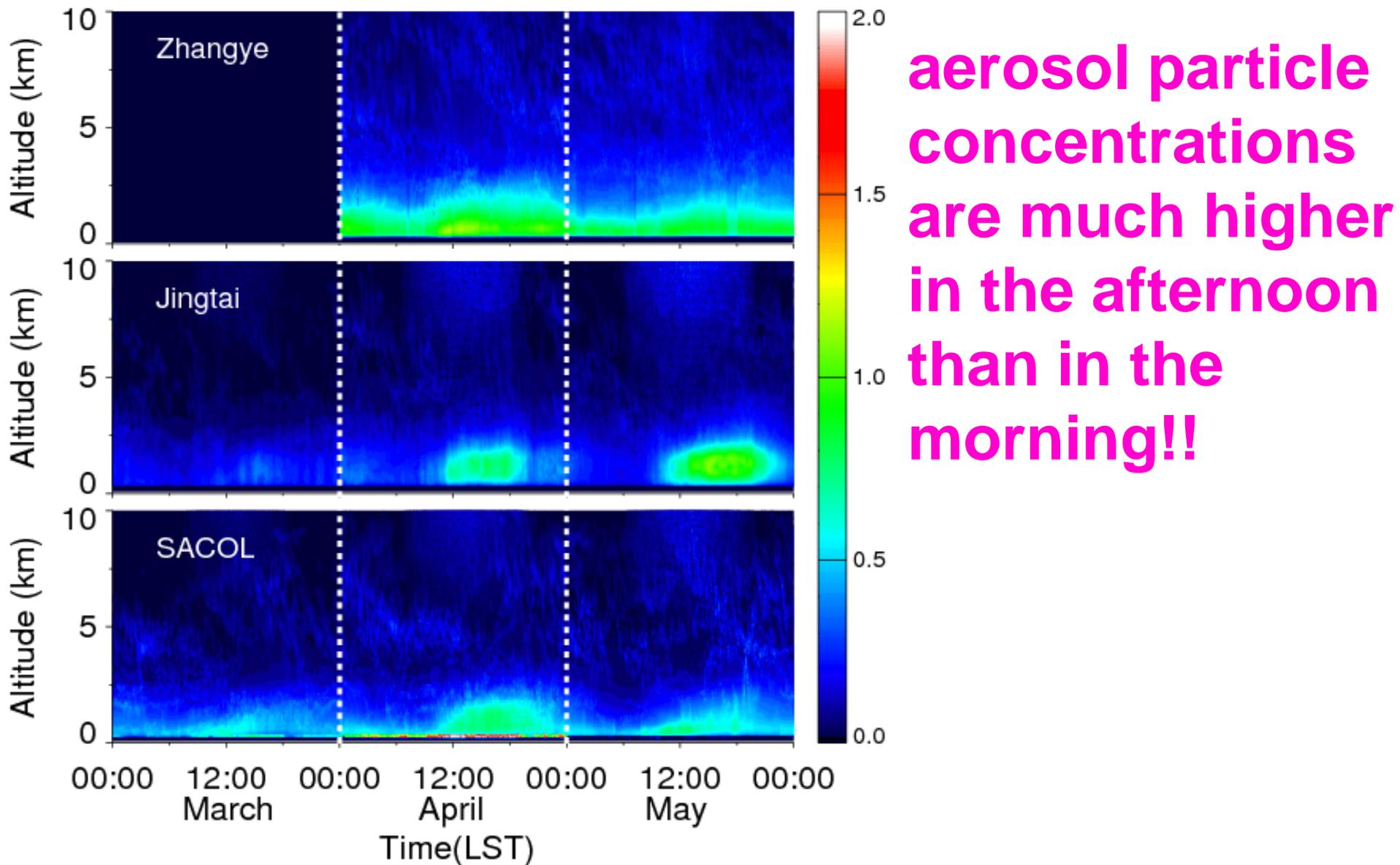


Fig 1. Diurnal cycle of monthly average aerosol vertical structure at Zhangye, Jingtai, and SACOL sites from Mar. to May 2008. [Huang et al., 2009]

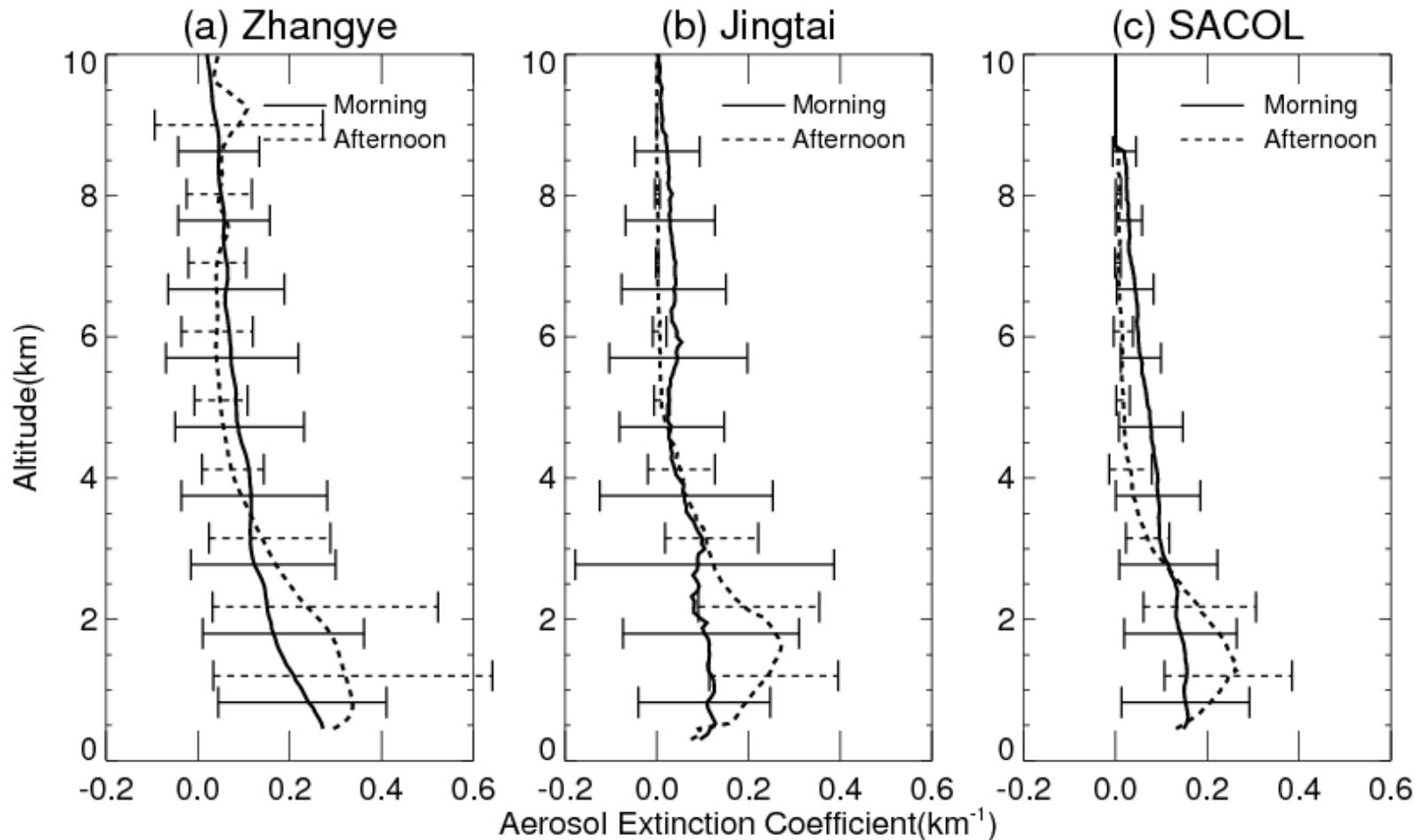
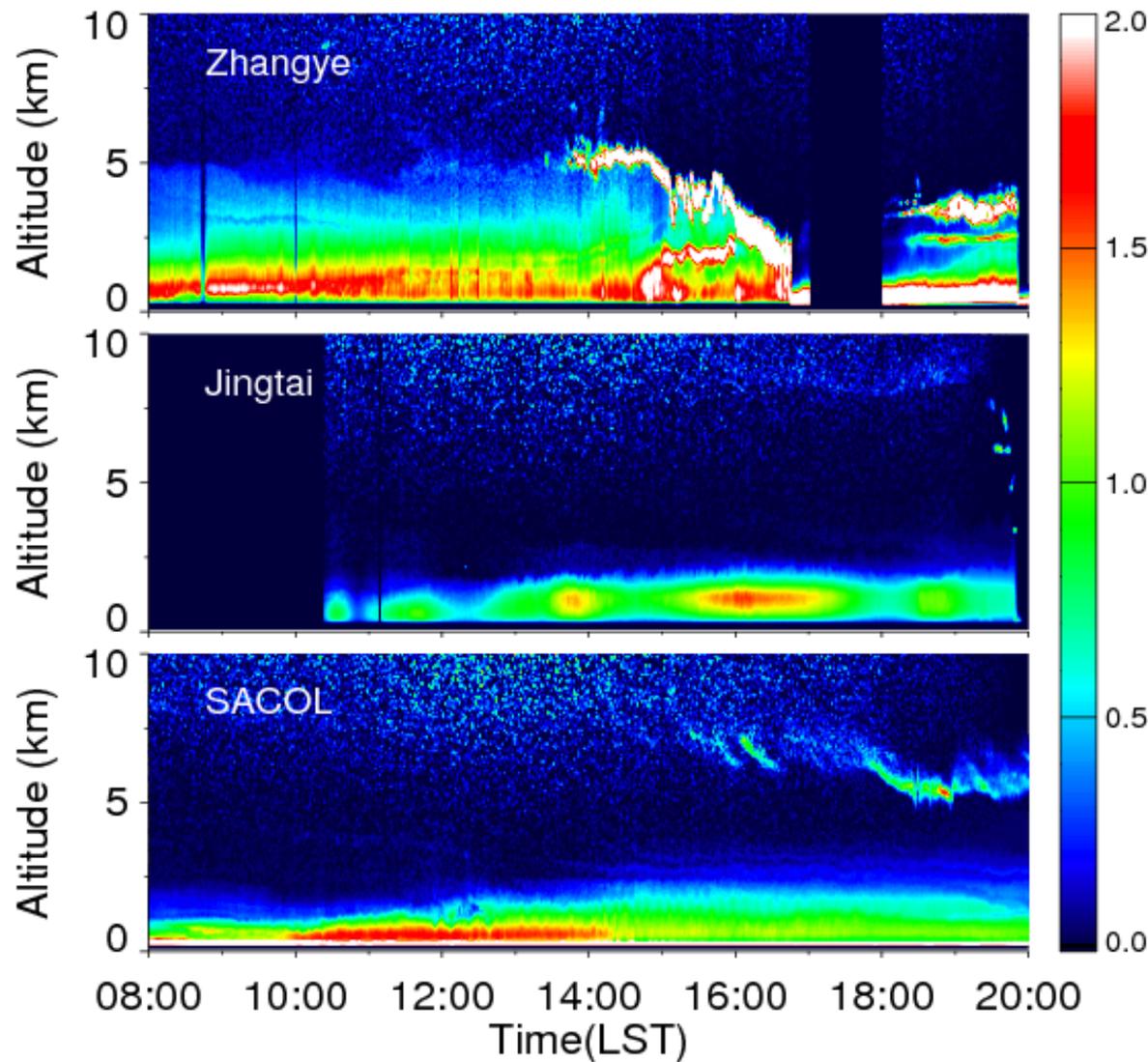
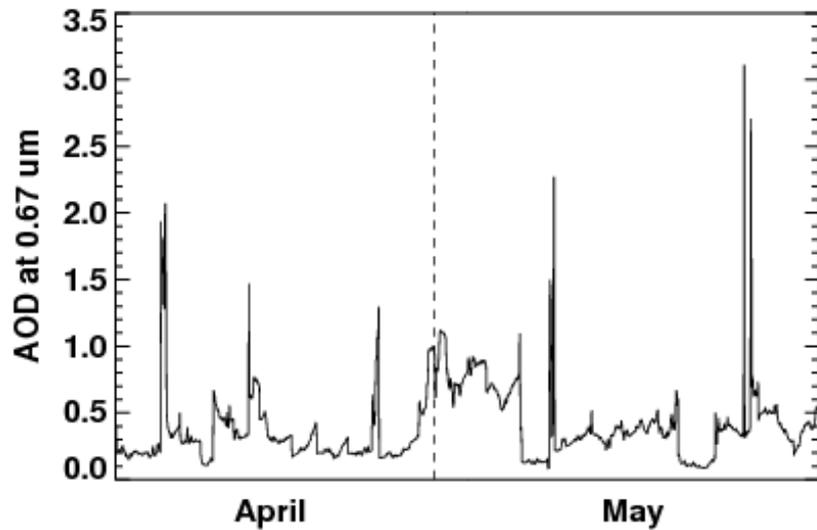


Fig 2. Seasonal average vertical profiles of aerosol extinction coefficients at three sites from Mar. to May 2008. Error bars are standard deviations computed from the vertical bins of each profile. [Huang et al., 2009]



Case Study:
A heavy dust event happens at three sites on May 2th 2008!

Fig 4. MPL normalized relative backscatter at Zhangye (39.08N, 100.27E), Jingtai (37.33N, 104.14E), and SACOL (35.95N, 104.14E) sites on May 2th 2008. [Huang et al.,2009]



**AOD ranges
from 0.08 ~ 3.1
at Zhangye site!**

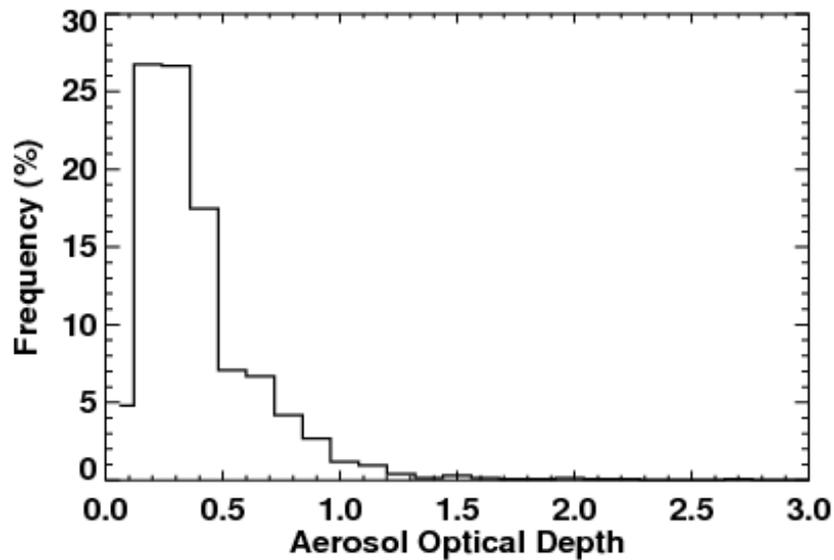


Fig 7. Time series of AOD at 0.67 μm and frequency distribution during the periods of April and May from CIMEL measurements at Zhangye site. [Ge et al., 2009]

Imaginary part: 0.02 ~ 0.008
SSA: 0.75 ~ 0.87
ASY : 0.78 ~ 0.71
[From MFRSR]

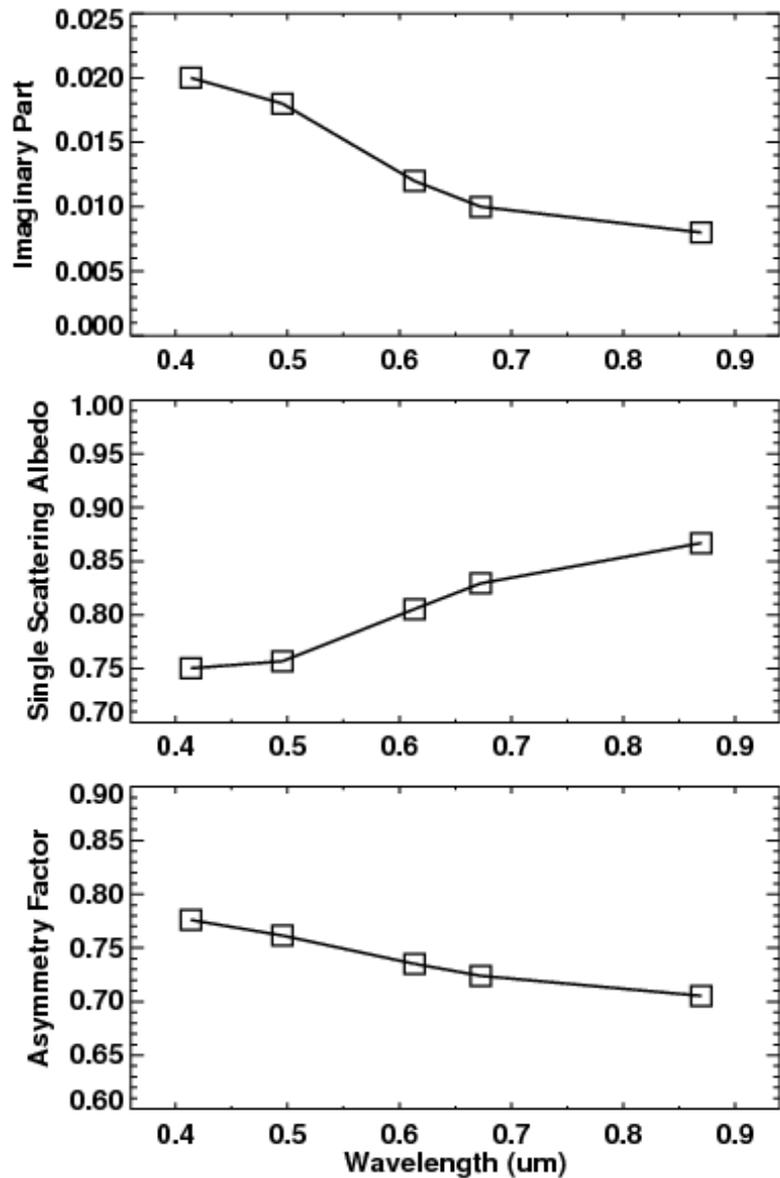
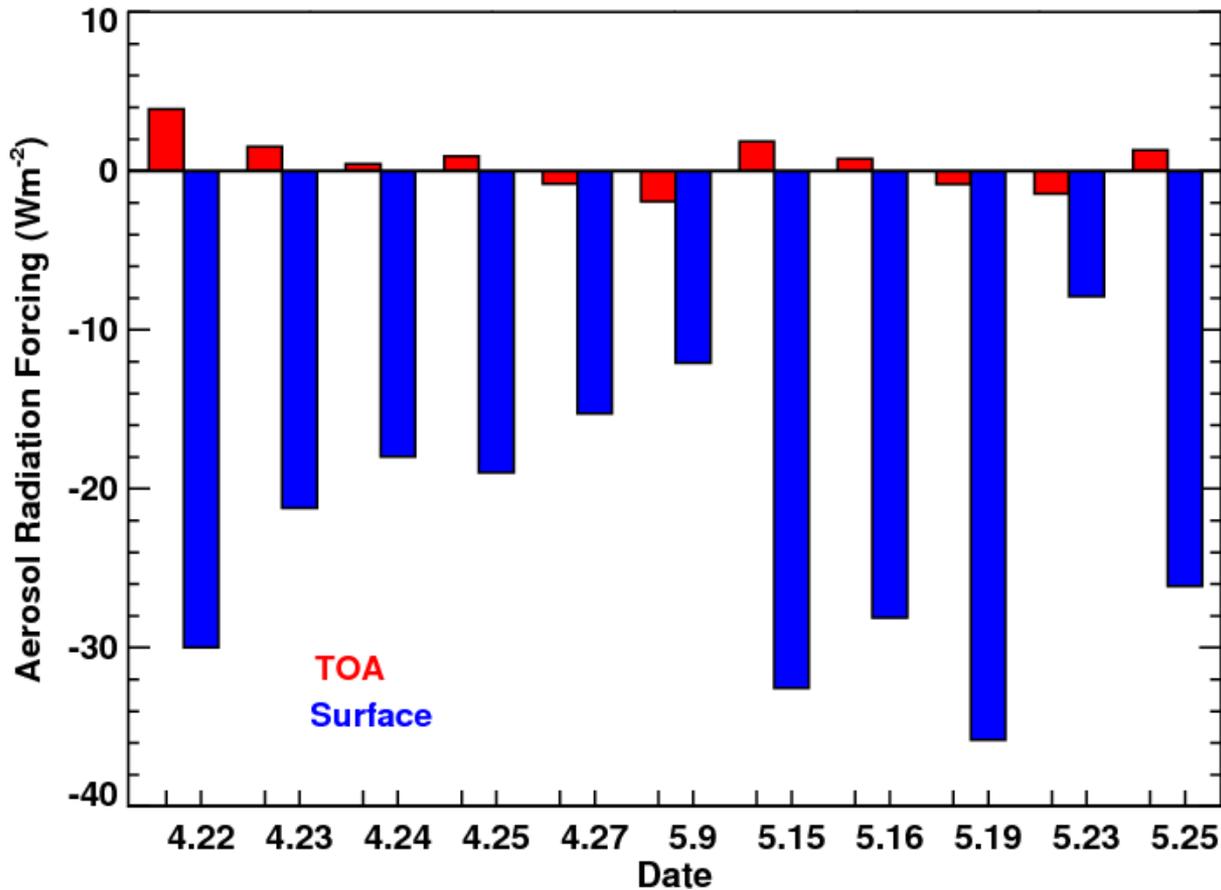


Fig 11. Retrieved spectrally-dependent values of the imaginary part of refractive indices, SSA, and the ASY for the April 24 case at Zhangye site. [Ge et al., 2009]



ARF mean value:

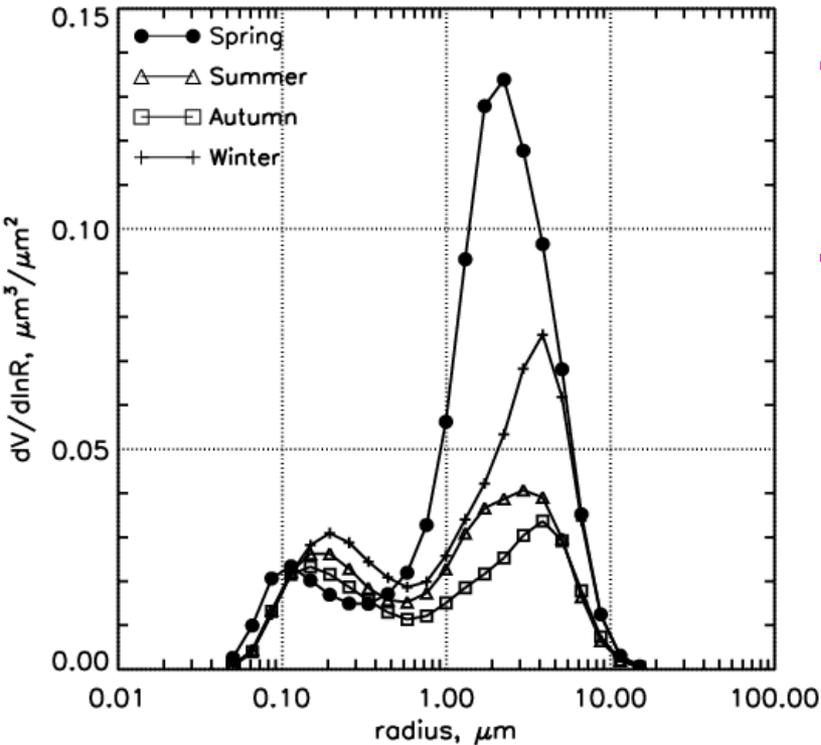
Surface:

$-22.4 \pm 8.9 \text{ Wm}^{-2}$

TOA:

$-2 \sim +4 \text{ Wm}^{-2}$

Fig 13. Daily-averaged direct aerosol radiative forcing at the surface (blue bars) and TOA (red bars) for the 11 cases. [Ge et al., 2009]



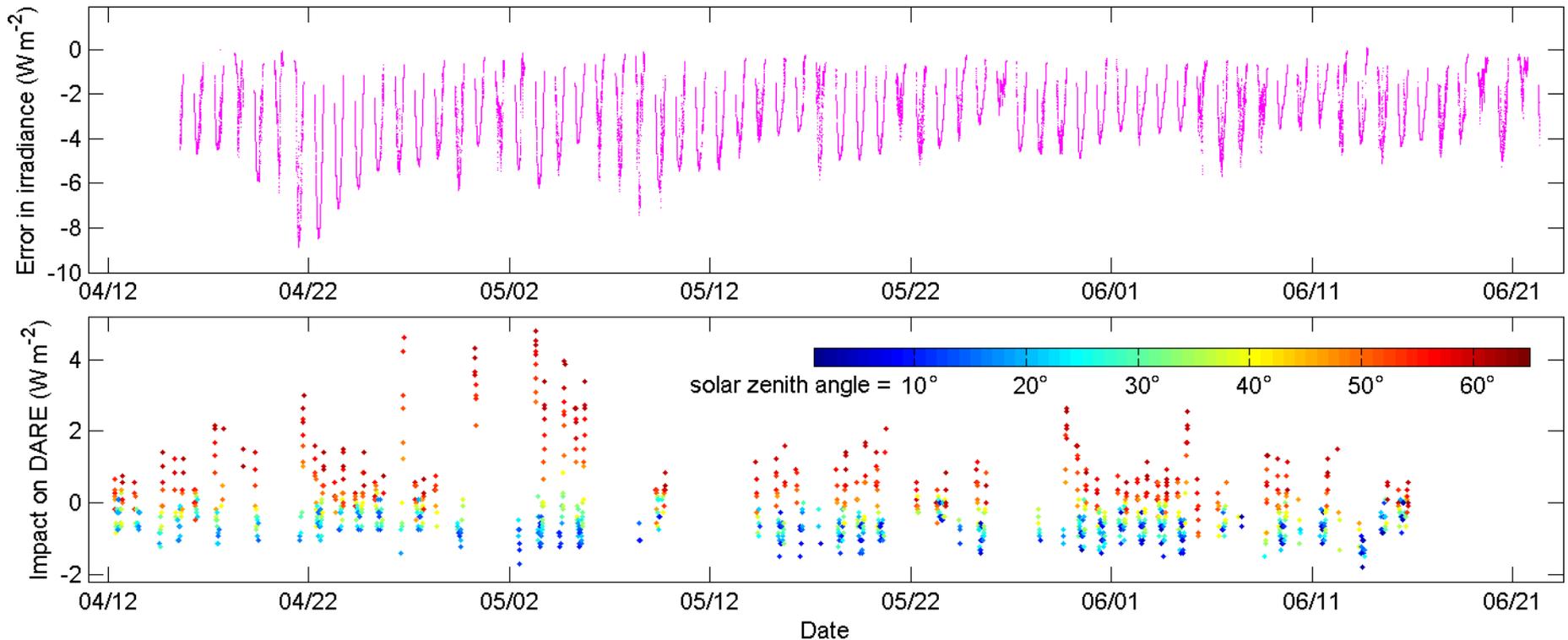
The fine mode shows relative stability, while the coarse fraction changes significantly in Spring!![due to dust events]

Fig 17. Seasonal aerosol volume size distributions in the total atmospheric column at SACOL.[from 2006 to 2008]

Studies done by S.-C. Tsay's Team

- **Pyranometer dome effect and impact on DARE**
- **MFRSR aerosol retrieval**
- **AERI cloud and dust retrieval**
- **In situ aerosol properties**
- **Satellite based study on transport and evolution of a plume (EAST-AIRE)**

Potential impact to direct aerosol radiative effect (DARE) by uncertainties in broadband solar irradiance measurements



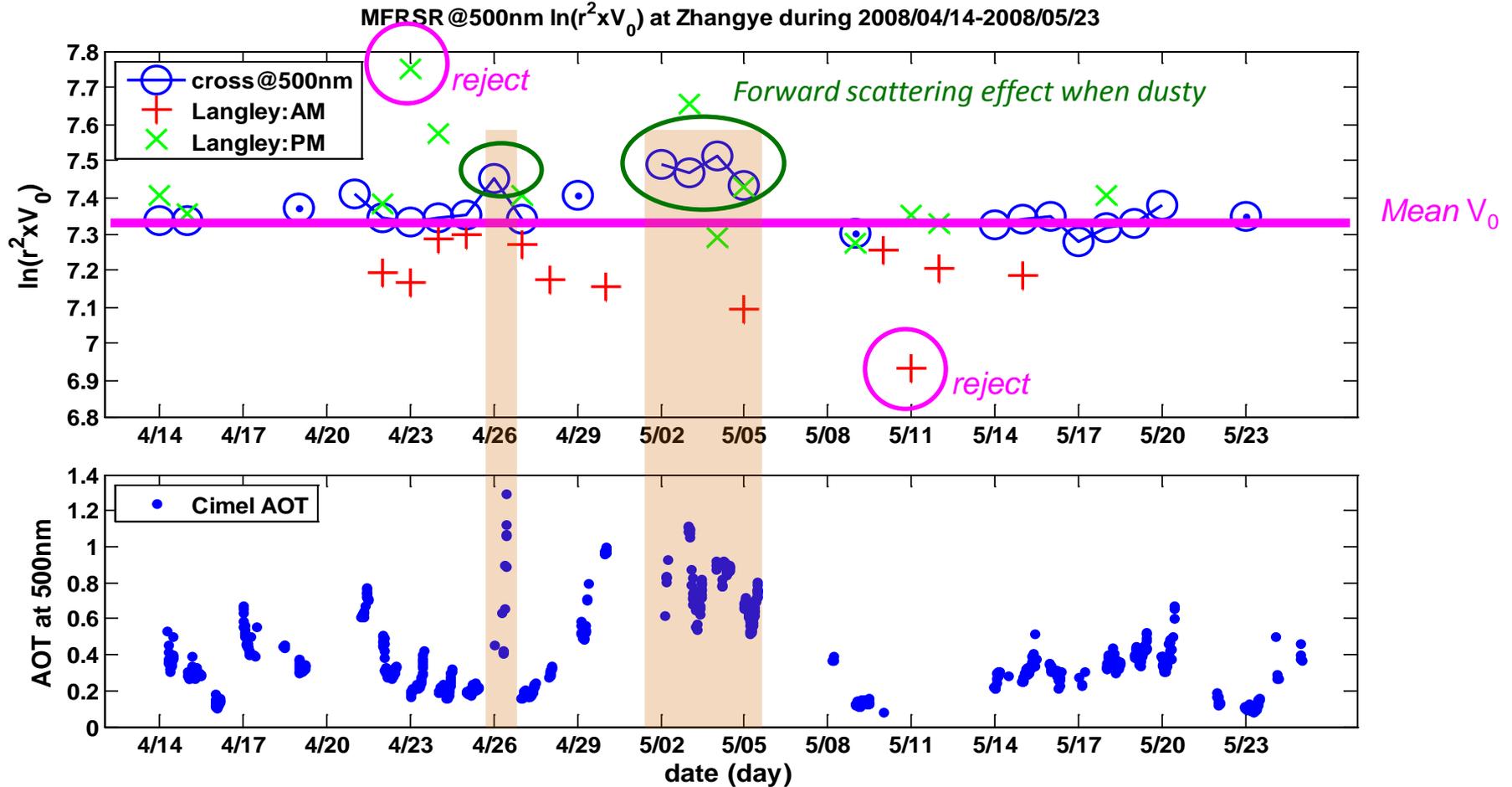
Upper: Error caused by ignoring the thermal dome effect (TDE) of a pyranometer, in Zhangye.

Lower: Resulting error in DARE; estimated with a sensitivity study based on Fu-Liou model calculations using the irradiance measurements as a constrain for selecting aerosol model.

Summary: Without accounting for TDE, DARE can be underestimated by a couple of Wm^{-2} under small SZA, but overestimated by a few Wm^{-2} under larger SZA.

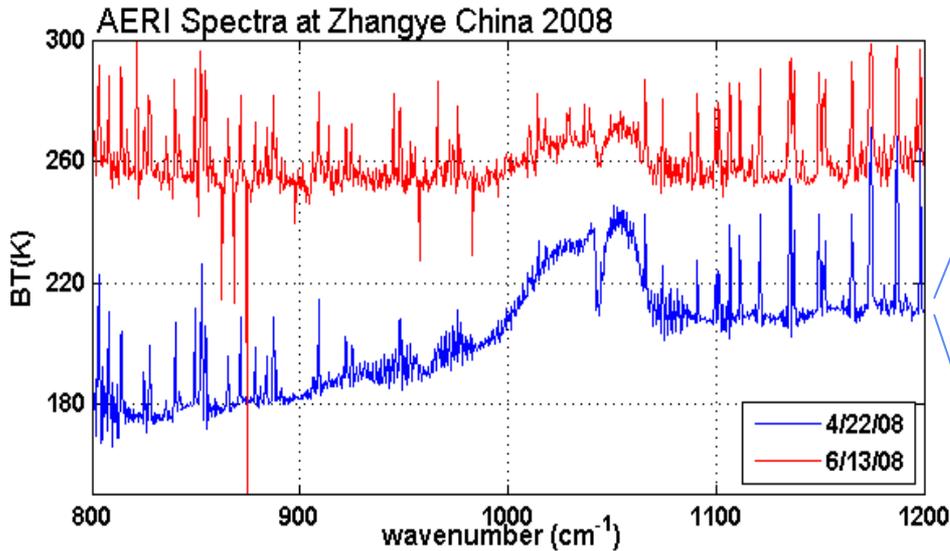
[Ji & Tsay, *JGR*, 2009, under review]

A method for improving MFRSR aerosol optical thickness retrieval

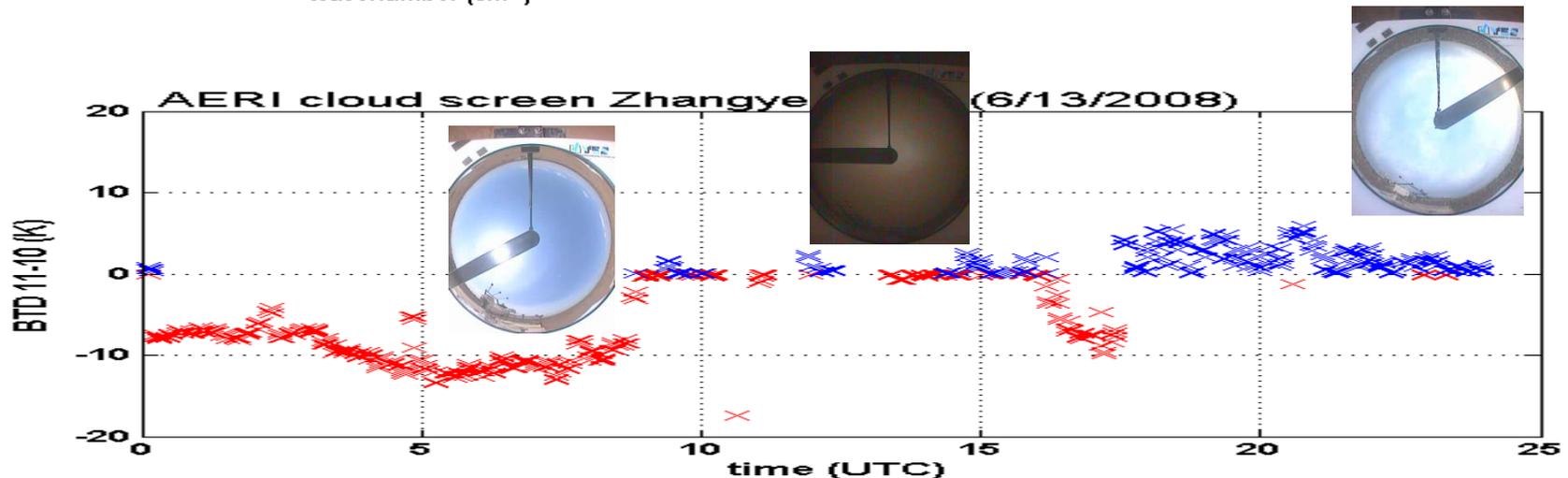


Summary: Using Cimel and MFR cross calibration, a reliable V_0 value for MFR can be determined, leading to a more accurate retrieval of AOT. Furthermore, the forward scattering from dust can also be estimated.
[S.-H. Wang et al., 2010, in preparation]

Use AERI to Derive Cloud and Dust Properties



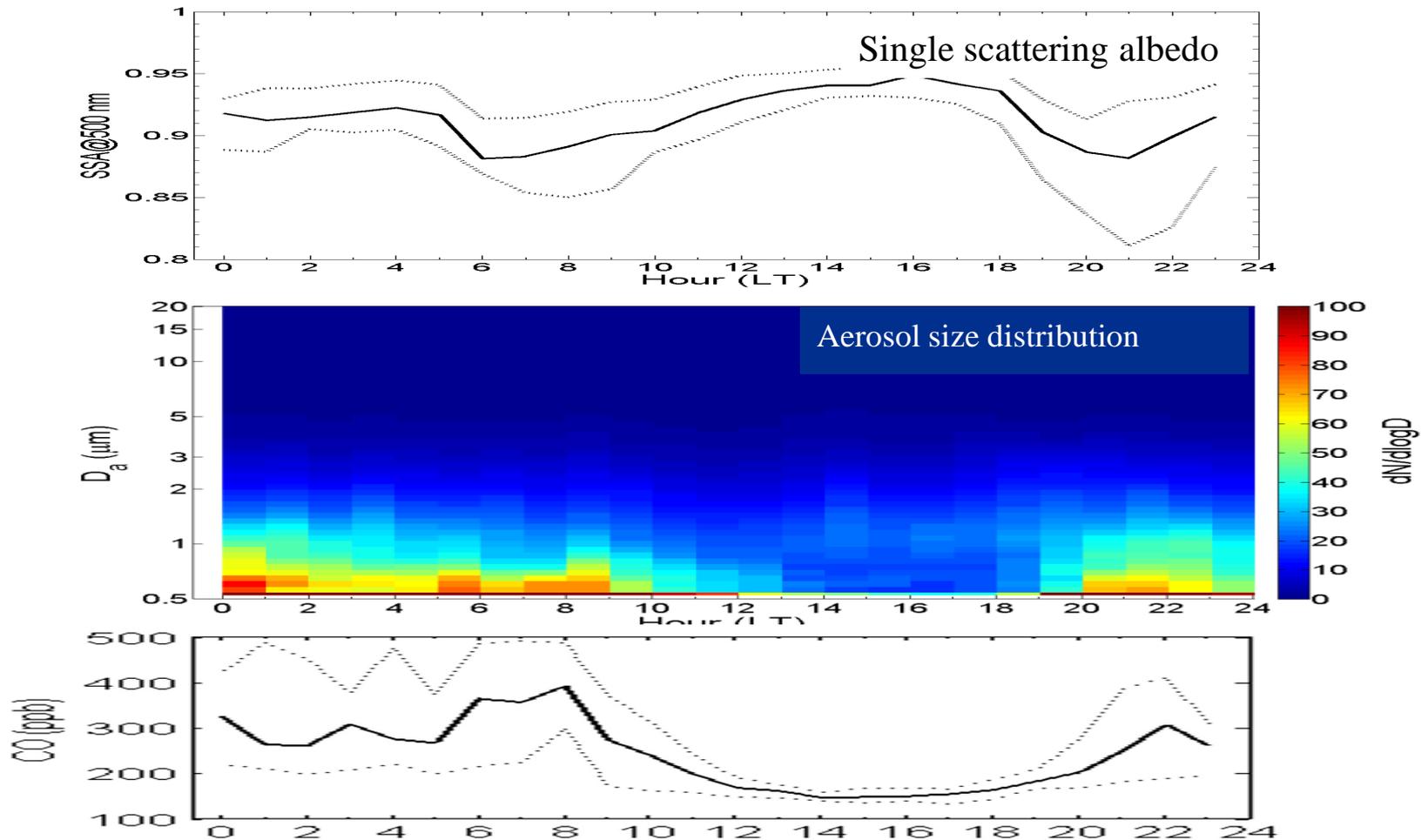
The differences in AERI spectra between 4/22 (blue, clear day) and 6/13 (red, dusty) indicate changes in both dust and cloud.



Summary: The AERI BTD 11-10 dust/cloud separation technique is robust for deriving cloud and dust properties.

[Hansell et al., *JGR*, 2010, in preparation]

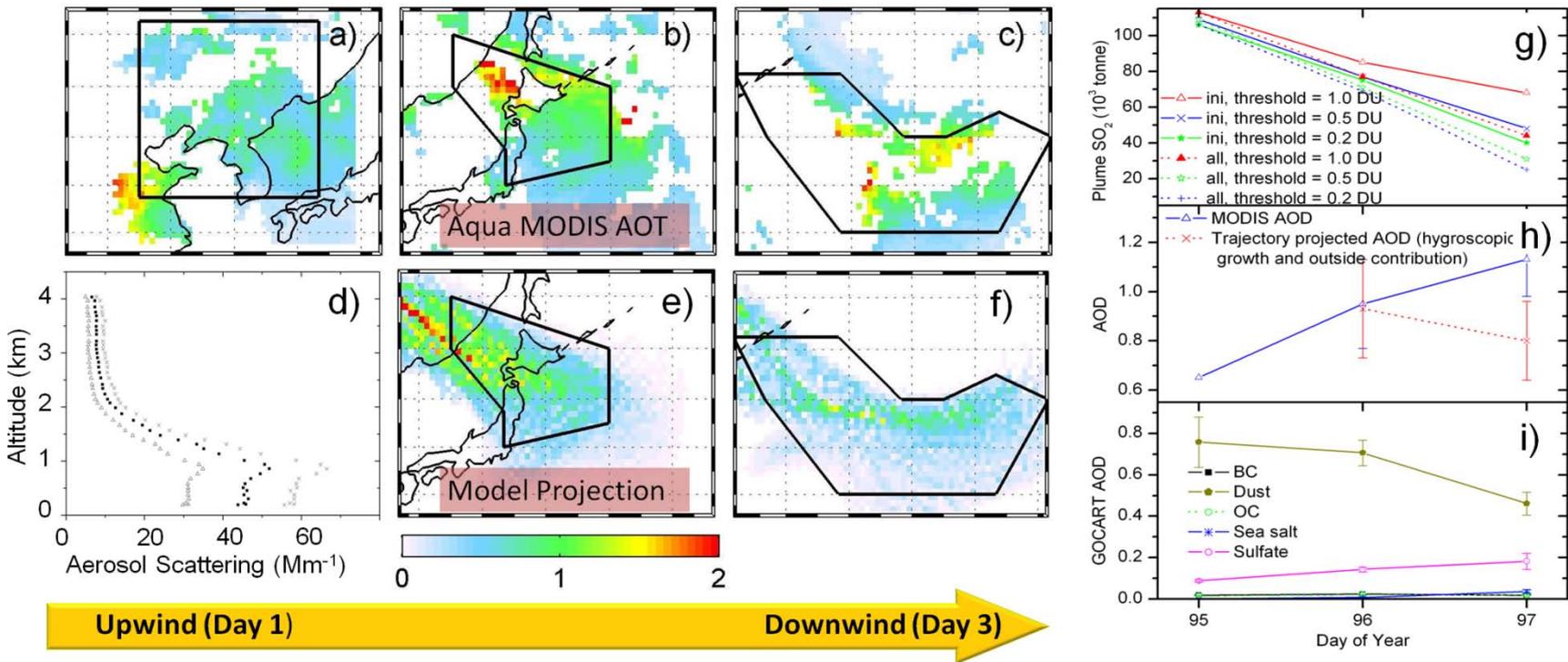
Anthropogenic Pollution Observed in Zhangye, near an Important Dust Source Region in NW China



Summary: There was a diurnal change in pollution and aerosol composition and optical properties. Mixing between dust and pollutants were observed on a daily basis, and also during strong dust storms.

[Li et al., JGR, 2010, under revision]

Combine Multiple satellites, in situ measurements, and models to study the transport and evolution of aerosol plumes



Summary: a), b), and c) Aqua/MODIS-retrieved AOD used to track the propagation of a regional aerosol plume, from its source region over NE China to the NW Pacific (Day 1-3).
d) Aerosol vertical profiles from in-situ measurements over NE China on April 5.
e) and f) The projected aerosol plume, combined with (b, c) satellite data, can be used to characterize the evolution of the plume during transport.
g) The satellite-observed decrease in SO₂ and h) change in aerosol loading implies possible conversion from aerosol precursor to aerosol particles, and i) chemical transport modeling can provide aerosol species information to help interpret the above results.

Special Section Papers in J. Geophys. Res.

EASTAIRC1- East Asian Study of Tropospheric Aerosols and Impact on Regional Climate

(42 papers submitted, 13 published & in press; 7 revised or under revision, 7 submitted, >20 rejected)

Papers published and in press (13)

- Li, C., N. A. Krotkov, R. R. Dickerson, Z. Li, K. Yang, and M. Chin (2010), Transport and evolution of a pollution plume from northern China: A satellite-based case study.
- Qian, Y., D. Gong, J. Fan, L. R. Leung, R. Bennartz, D. Chen, and W. Wang (2009), Heavy pollution suppresses light rain in China: Observations and modeling.
- Guo, Z., Z. Li, J. Farquhar, A. J. Kaufman, N. Wu, C. Li, R. R. Dickerson, and P. Wang (2010), Identification of Sources and Formation Processes of Atmospheric Sulfate by Sulfur Isotope and SEM Measurements.
- Lee, K. H., Z. Li, M.C. Cribb, J. Liu, L. Wang, Y. Zheng, X. Xia, H. Chen, and B. Li (2010), Aerosol optical depth measurements in Eastern China and a new calibration method.
- Ge, J. M., J. Su, T.P. Ackerman, Q. Fu, J.P. Huang, and J.S. Shi (2010), Dust Aerosol Optical Properties Retrieval and Radiative Forcing over Northwestern China during the 2008 China-US Joint Field Experiment.
- Huang, K., G. Zhuang, J. Li, Q. Wang, Y. Sun, Y. Lin, and J. S. Fu (2010), The mixing of Asian dust with pollution aerosol and the transformation of aerosol components during the dust storm over China in spring, 2007.
- Zhuang, G. (corresponding author) et al., Relation between optical and chemical properties of dust aerosol over Beijing, China
- Sun, Y., G. Zhuang, K. Huang, J. Li, Q. Wang, Y. Wang, Y. Lin, J. S. Fu, W. Zhang, A. Tang, and X. Zhao (2010), Asian dust over northern China and its impact on the downstream aerosol chemistry.
- Liu, Y., D. Yang, W. Chen, and H. Zhang (2010), Measurements of Asian dust optical properties over the Yellow Sea of China by shipboard and ground-based photometers, along with Satellite remote sensing: a case study of the passage of a frontal system during April 2006.

- Xiao, X. (2010), Spatiotemporal changes in sunshine duration and cloud amount as well as their relationship in China during 1954-2005.
- Zhang, L., H. Liao, and J. Li (2010), Impacts of Asian summer monsoon on seasonal and interannual variations of aerosols over eastern China.
- Zhang, Y., Q. Yu, W. Ma, and L. Chen (2010), Atmospheric deposition of inorganic nitrogen to the eastern China seas and its implication to marine biogeochemistry.

Manuscripts Revised & Under Revision (7)

- Li, Z., K.-H. Lee, J. Xin, Y. Wang, W.-M. Hao, 2010, First observation-based estimates of aerosol radiative forcing at the top, bottom and inside of the atmosphere, J. Geophys. Res., revised.
- Niu, F., Z. Li, C. Li, K. Lee, M. Wang, Increase in Wintertime Fog and Weakening of the Eastern Asian Monsoon: Potential Impacts of Global Warming and Aerosols in China.
- Jeong, M., and Z. Li, Separating real and apparent effects of cloud, humidity, and dynamics on aerosol optical thickness near clouds. Under revision.
- Li, C. et al., Anthropogenic Air Pollution Observed near Dust Source Regions in Northwestern China during Springtime 2008
- Li, C., et al. Concentrations and Origins of Atmospheric Lead and Other Trace Species at a Rural Site in Northern China
- Wang T. (corresponding author). et al., Semi-direct Radiative Forcing of Internal Mixed Black Carbon-Cloud Droplet and its Regional Climatic Effect over China, under revision.
- Zhuang, G. (corresponding author) et al., The source, long-range transport, and characteristics of the highest-recorded dust pollution occurred at Shanghai, under revision.

Submitted

- Zhang, J., H. Chen, Z. Li, X. Fan, L. Peng, Y. Yu, M. Cribb, Analysis of cloud layer structure in Shouxian, China using RS92 radiosonde and 95-GHz cloud radar data, *J. Geophys. Res.*, submitted, 2010.
- Logan, T., B. Xi, X. Dong, R. Obrecht, Z. Li, and M. Cribb, 2010, A Study of Asian Dust Plumes using Satellite, Surface, and Aircraft Measurements during the INTEX-B Field Experiment, submitted.
- Wang, B., G. Shi, Long-term Trends of Atmospheric Absorbing and Scattering Optical Depths over China Region Estimated from the Routine Observation Data of Surface Solar Irradiances
- Wang T. (corresponding author). et al., Investigations on direct and indirect effect of nitrate on temperature and precipitation in China using a regional climate chemistry modeling system
- Huang, J. (corresponding author), Dust aerosol vertical structure measurements using three MPL lidars during 2008 China-US joint dust field experiment
- Wang, X., et al., Surface Measurements of aerosol properties over Northwest China during ARM China-2008 deployment.
- Ji, Q., S.-C. Chee, A novel non-intrusive method to resolve the thermal-dome-effect of pyranometers - Part I: Instrumentation and observational basis

Summary

- **Increasing loading of aerosols in China could have significantly altered the regional climate through their direct and indirect effects**
- **Understanding the mechanisms of aerosol interactions with the dynamic system requires extensive observation and modeling studies**
- **Field campaigns in China provide insights into these complex issues, but resolving them requires close collaboration between observers and modelers.**
- **To learn about the field observation programs and what we have learned to date, visit:
www.atmos.umd.edu/~zli**

Ongoing and planned studies

- **Detection and quantification of aerosol-cloud-precipitation interaction**
- **Aerosol vertical distribution and heating profiles**
- **Aerosol and boundary-layer development and**
- **Aerosol and atmospheric vertical motion**
- **Aerosol and regional circulation**
- **Aerosol and the Asian monsoon system**
- **To learn about the field observation programs and what we have learned to date, visit:
www.atmos.umd.edu/~zli**