



*The CEOP Aerosol Element -  
Progress Report*

William K. M. Lau  
Laboratory for Atmospheres  
NASA/GSFC

The scientific objective of CEOP Aerosol Element (CAE) is to *unravel the physical mechanisms and multi-scale interactions associated with aerosol-continental scale water cycle interaction, with initial emphases on the monsoon regions and adjacent deserts and semi-arid regions.*

Major science issues are:

- Determination of regional and global aerosol forcing and responses of the water cycle, over different biomes, including monsoon regions, deserts, semi-deserts, vegetated land and forests.

- Aerosol transport processes linking dry regions (deserts and semi-deserts), high-mountains, e.g., Himalayas and Tibetan Plateau, to wet regions, e.g., monsoon and adjacent oceans.

- Solar attenuation effect vs. elevated heating effect in affecting continental scale water cycle dynamics.

- Possible aerosol microphysics effects on clouds and precipitation.

- Coupled aerosol-land hydroclimate processes, e.g., impact of soil moisture, snow cover, glacier processes.



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# Major Activities in 2008

- **West Africa Monsoon Model Evaluation (WAMME), New Orleans, Jan, 2008.**
- **1<sup>st</sup> Aegean Conference “ From Desert to Monsoon”, Crete, Greece, June, 2008**
- **Published milestone white paper on JAMEX in BAMS**
- **AMY/JAMEX aerosol pilot field campaign, AAF/AMF in China, jointly sponsored by DOE/NASA, March – September 2008 ( PI: Z. Li and S. C. Tsay)**
- **AMY/JAMEX NASAaeronet, Calipso Calibration experiment in Indo-Gangetic Plain, India, May-July, 2008 (PI: B. Holben)**

## Publications:

Lau, K.M, V. Ramanathan, G-X. Wu, Z. Li, S. C. Tsay, C. Hsu, R.Siika, B. Holben, D. Lu, G. Tartari, M. Chin, P .Koudelova, H. Chen, Y. Ma, J. Huang, K. Taniguchi, and R. Zhang., 2008 : the Joint Aerosol-Monsoon Experiment: A New Challenge in Monsoon Climate Research. *Bull. Am. Meteor. Soc.*, **89**, 369-383, DOI:10.1175/BAMS-89-3-369.

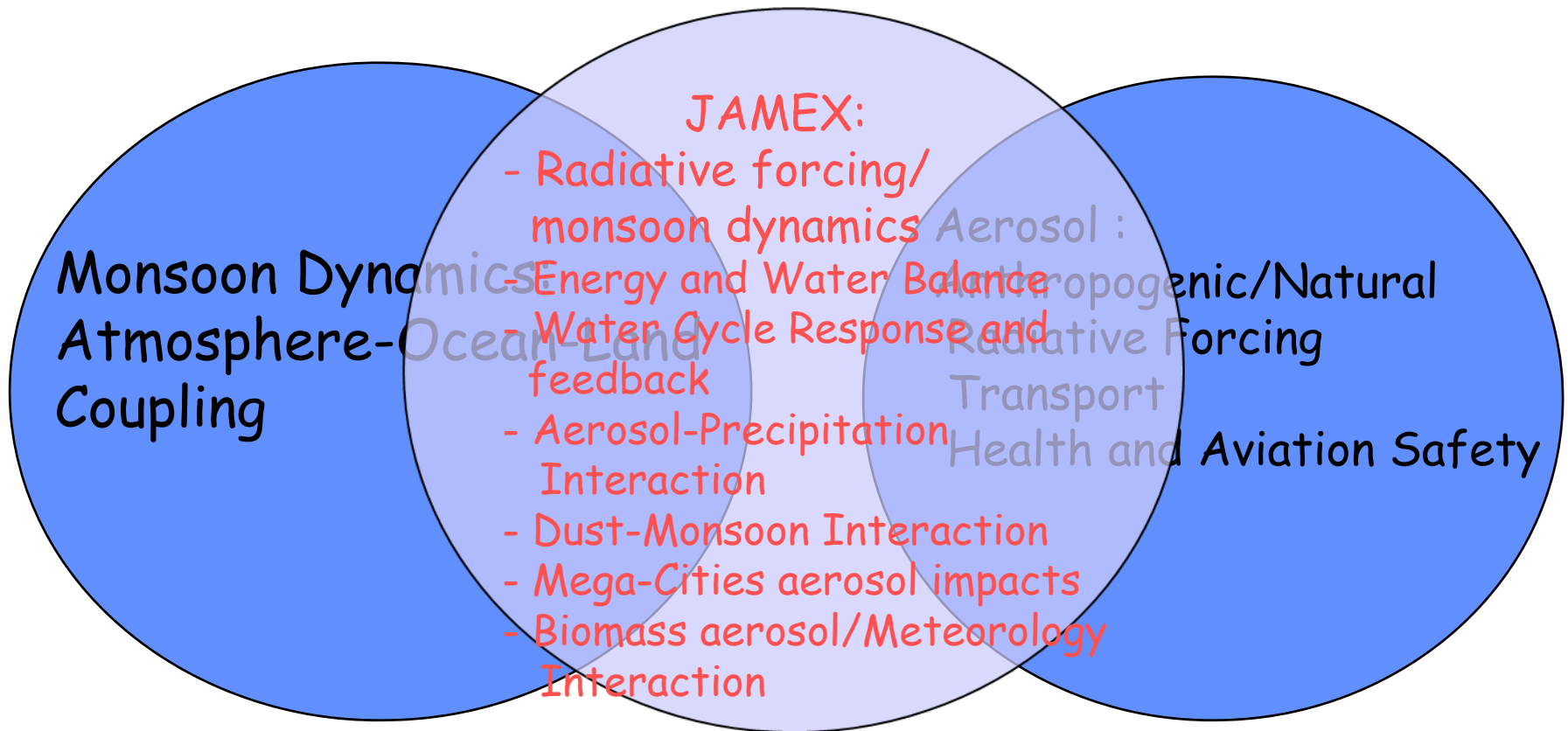
Gautam, R., N. C. Hsu, M. Kafatos, S.-C. Tsay, K. M. Lau (2008), Long-Term Satellite Record Reveals Enhanced Warming over the Himalayan-Gangetic Region, (submit to Science)

Lau, K.-M., K.-M. Kim (2008), Absorbing aerosols enhance Indian summer monsoon rainfall. *iLEAPS Newsletter*, No. 5, 22-24.

Lau, K.-M., K.-M. Kim, C. N-Y Hsu, and R. P. Singh (2008), Seasonal co-variability of aerosol and precipitation over the Indian monsoon and adjacent deserts. *GEWEX News*, 18(1), 4-6



*The Joint Aerosol-Monsoon Experiment (JAMEX) :  
A core program of the WCRP/AMY (2008-2012)  
Initiative*



Bridging Monsoon and Aerosol Research





PRAISE

MAIRS \*\*  
EAST-AIRE  
SACOL

JEPP/Tibet

PHONE08

JICA/Tibet  
ITP/TORP

MAIRS \*\*  
EAST-AIRE  
ARCS-Asia

CTMZ  
IITM/Rain  
CAIPEX

STORM

JEPP/SE Asia  
JAMSTEC

AIPO  
SCHeREX  
SoWMEX  
EAMEX

NPOIMS

CEOP  
JAMEX

TCS08

SMART-COMMIT

JAMSTEC/PALAU

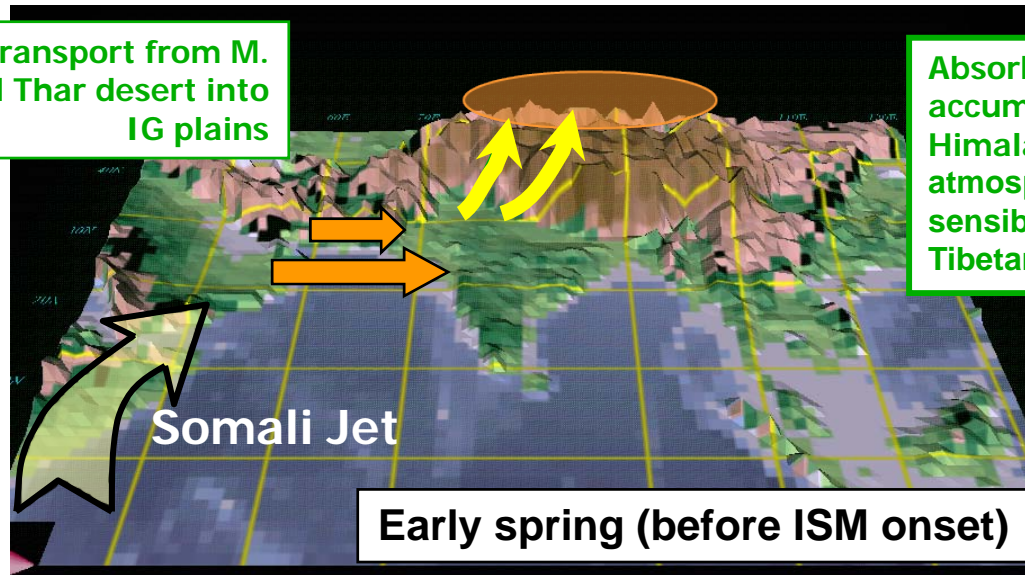
AIPO, JEPP IO/HARIMAU

# The Elevated Heat Pump (EHP) Hypothesis

(Lau et al. 2006, Lau and Kim 2006)

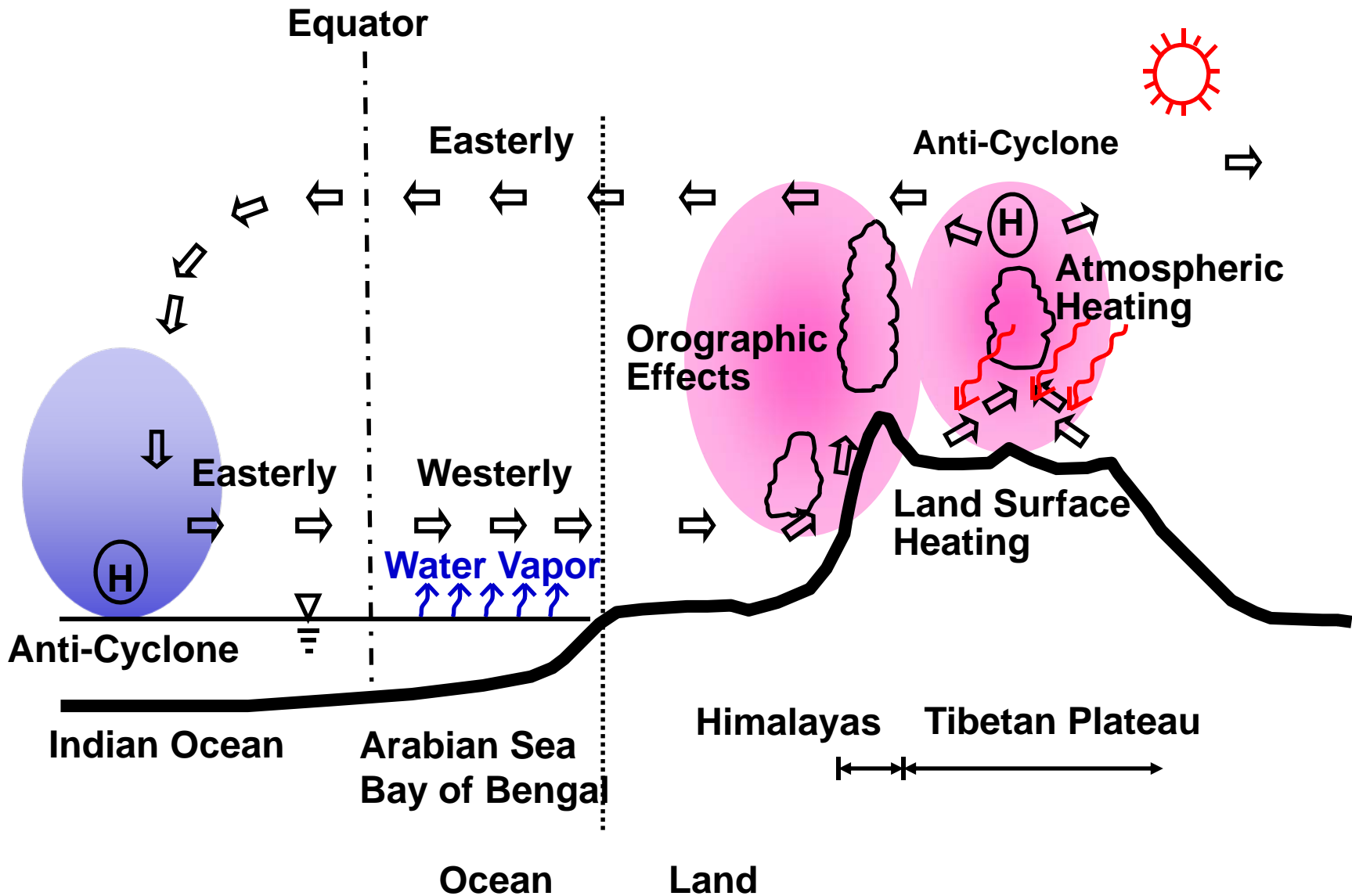
Dust transport from M. East and Thar desert into IG plains

Absorbing aerosols accumulated on foothills of Himalayas accentuate atmospheric heating by sensible heat flux over Tibetan Plateau



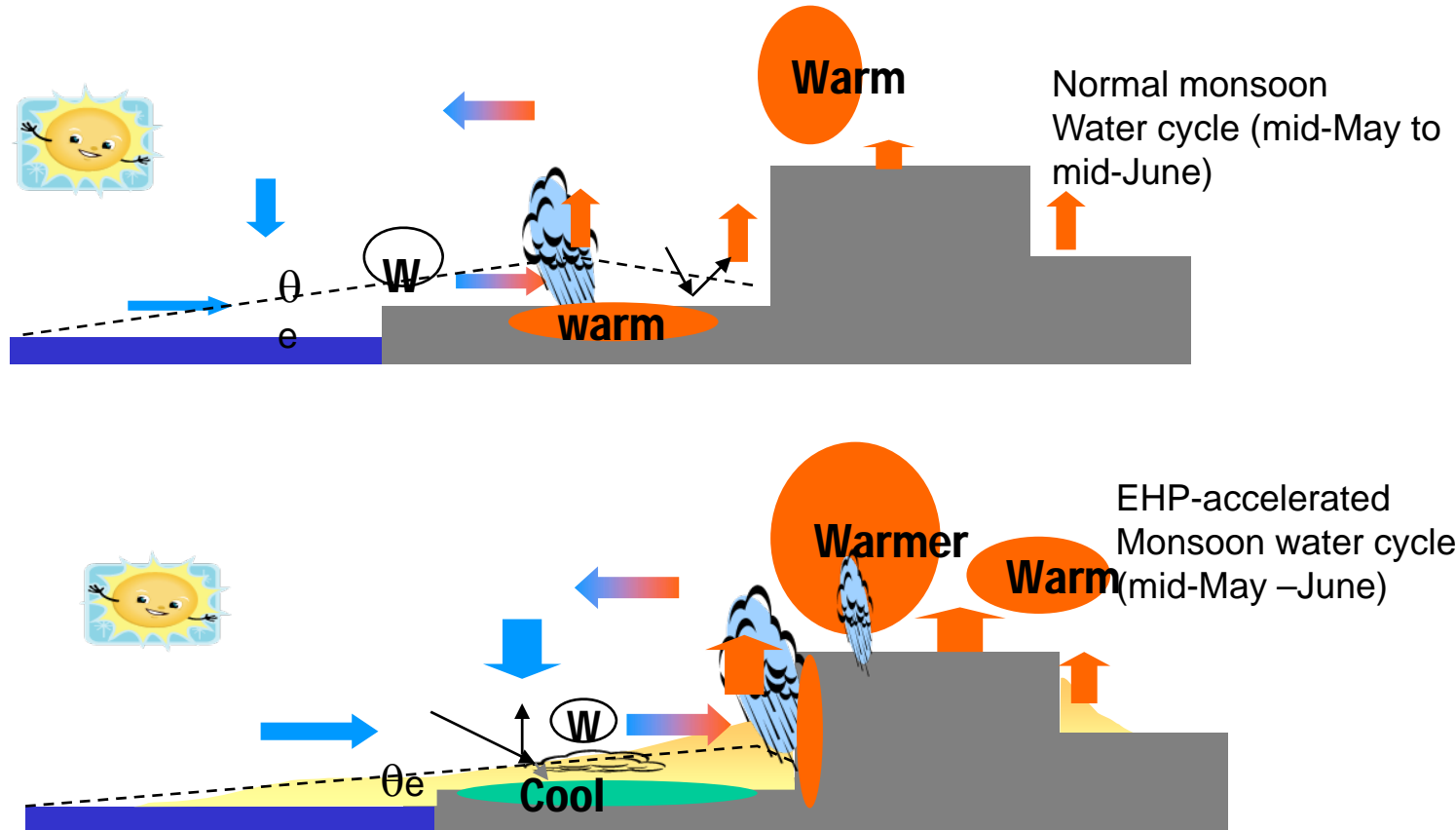
Somali Jet

Early spring (before ISM onset)



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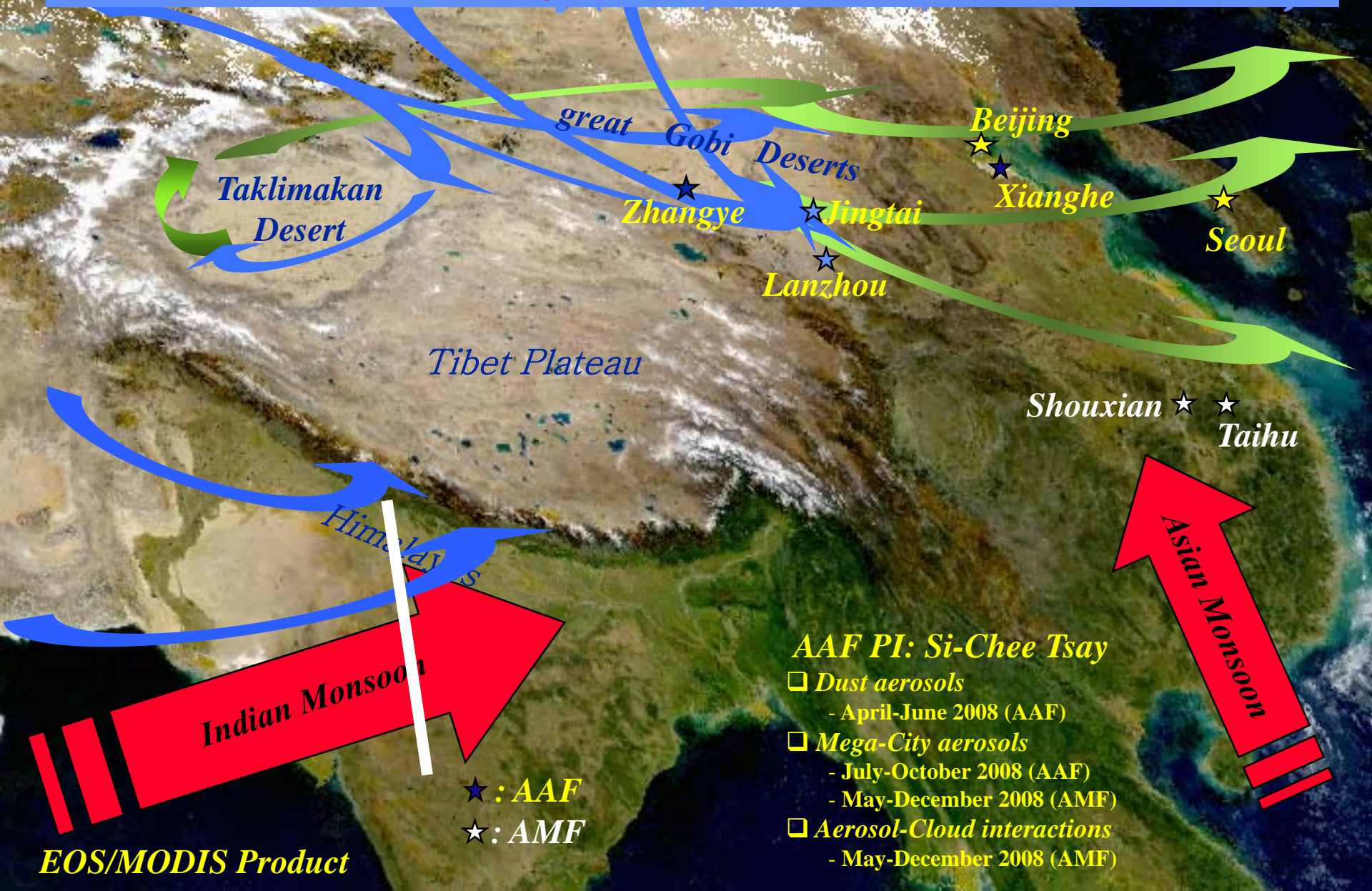


## EHP postulates:

- warming and moistening of the upper troposphere over the Tibetan Plateau
- an advance of the rainy season in northern India/Napal region in May-June
- In June-July, the increased convection spreads from the foothills of the Himalayas to central India, resulting in an intensification of the Indian monsoon.

# Asian Monsoon Year (AMY-2008):

*DoE/ARM Mobile Facility (AMF) and AAF (SMART-COMMIT)*



Taklimakan  
Desert

great Gobi  
Deserts

Zhangye

Lanzhou

Jingtai

Beijing

Xianghe

Seoul

Tibet Plateau

Shouxian ★ ★  
Taihu

Himalayas

Indian Monsoon

Asian Monsoon

EOS/MODIS Product

★ : AAF

★ : AMF

AAF PI: Si-Chee Tsay

□ Dust aerosols

- April-June 2008 (AAF)

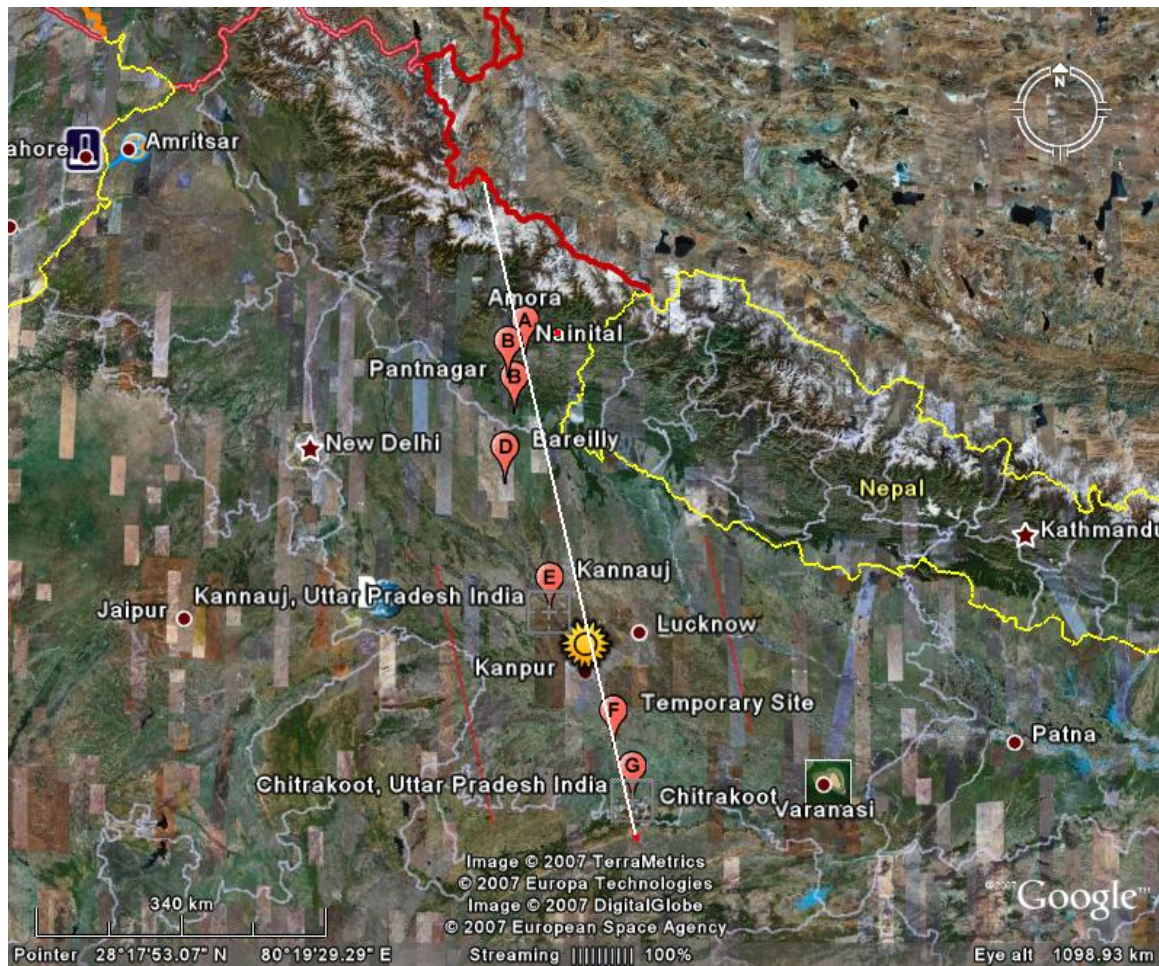
□ Mega-City aerosols

- July-October 2008 (AAF)

- May-December 2008 (AMF)

□ Aerosol-Cloud interactions

- May-December 2008 (AMF)



- Fig. 1 shows the closest daytime Calipso track to Kanpur and the eight proposed AERONET sites. A to G is approximately 450 km.





# Near Future Afternoon Constellation of the "A-Train"

1:38 PM

1:30 PM

1:15 PM



- OMI - Cloud heights
- OMI & HIRLDS - Aerosols
- MLS & TES - H<sub>2</sub>O & temp profiles
- MLS & HIRDLS - Cirrus clouds

**Cloudsat**

- MODIS/CERES - IR Properties of Clouds
- AIRS - Temperature and H<sub>2</sub>O Sounding

**CALIPSO**

**Aqua**

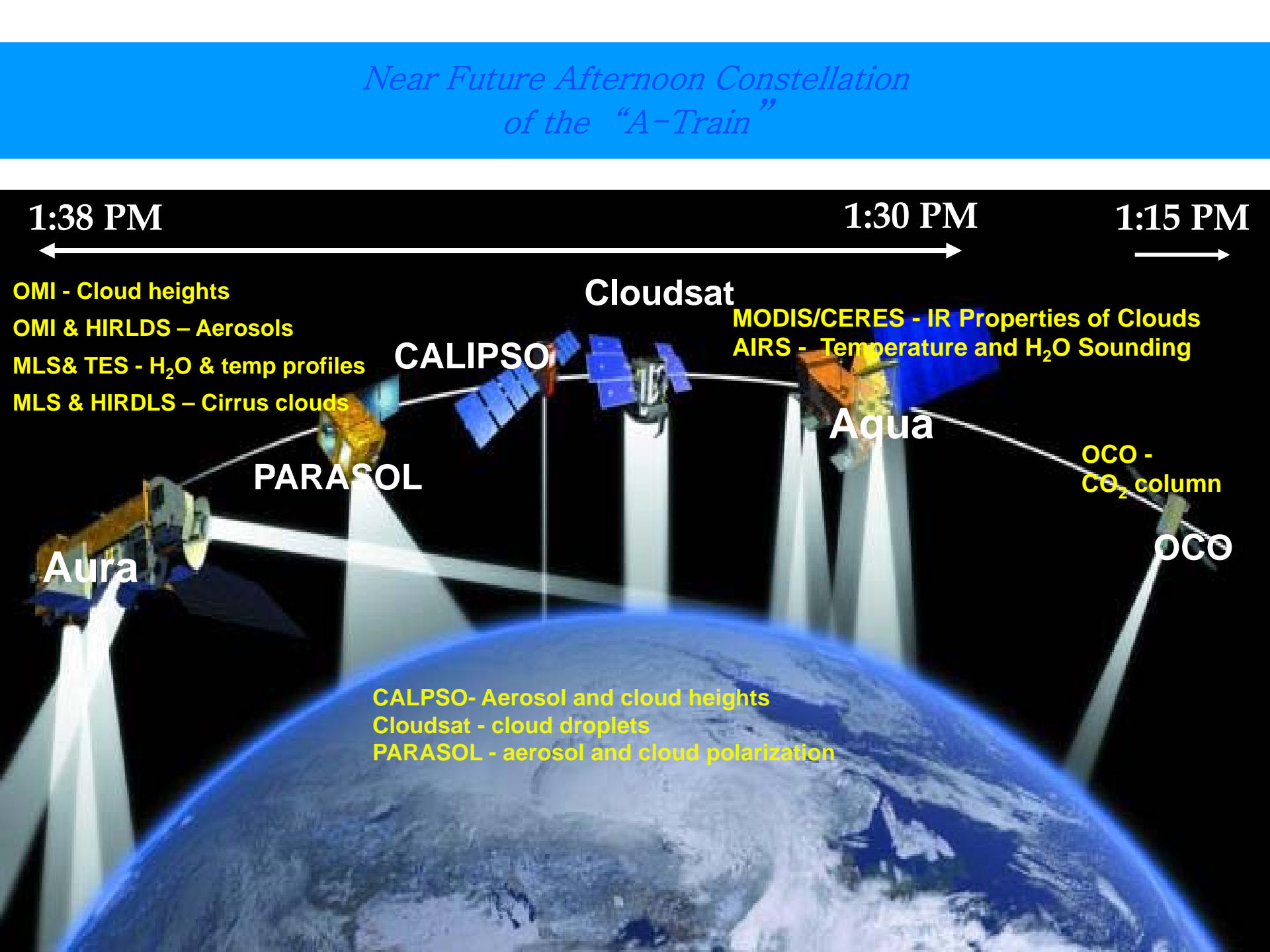
**PARASOL**

OCO -  
CO<sub>2</sub> column

**Aura**

**OCO**

- CALIPSO- Aerosol and cloud heights
- Cloudsat - cloud droplets
- PARASOL - aerosol and cloud polarization

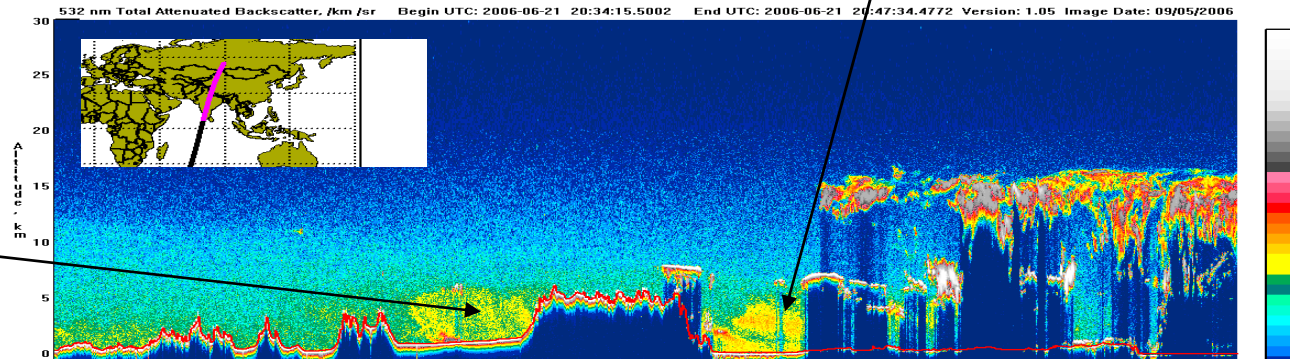


# Meridional cross-section of aerosol concentration from Calipso

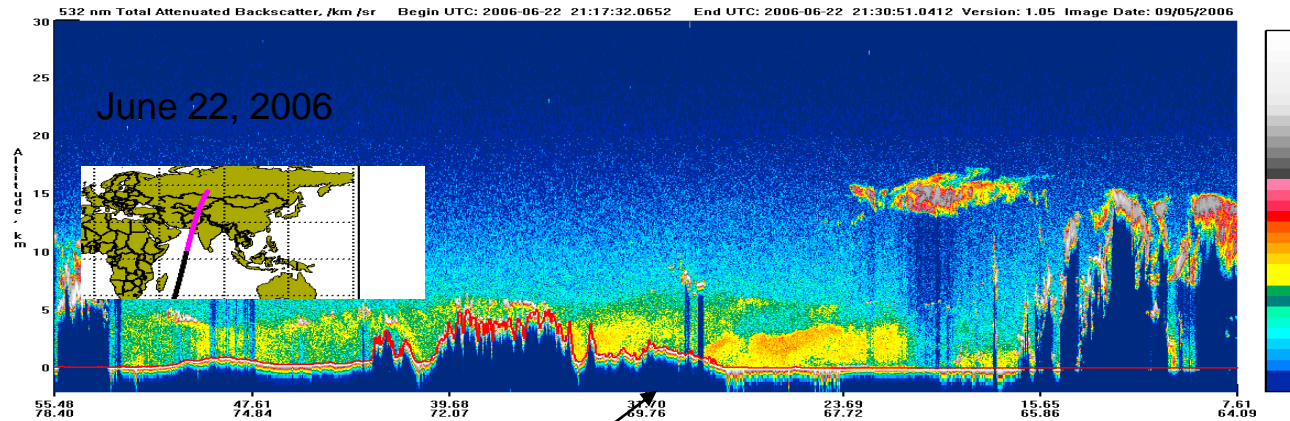
June 21, 2006

Indo-Gangetic Basin

Taklamakan Desert



June 22, 2006



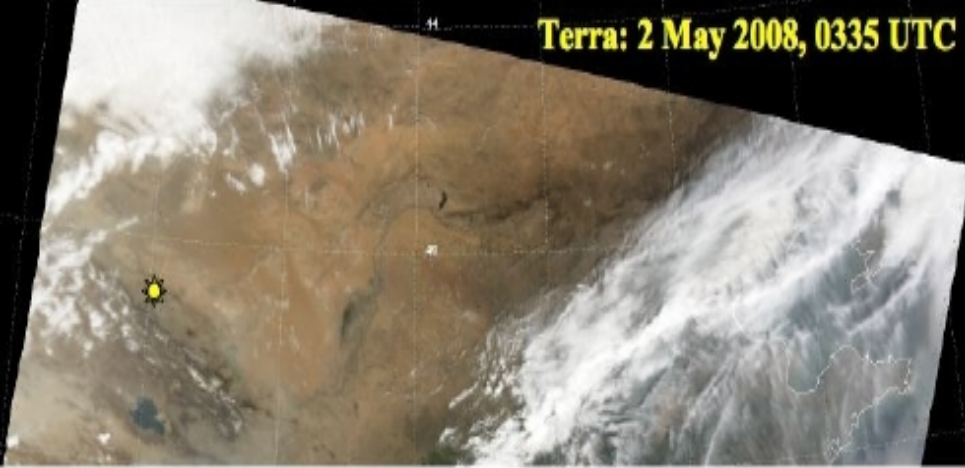
northeastern IGB

Reference

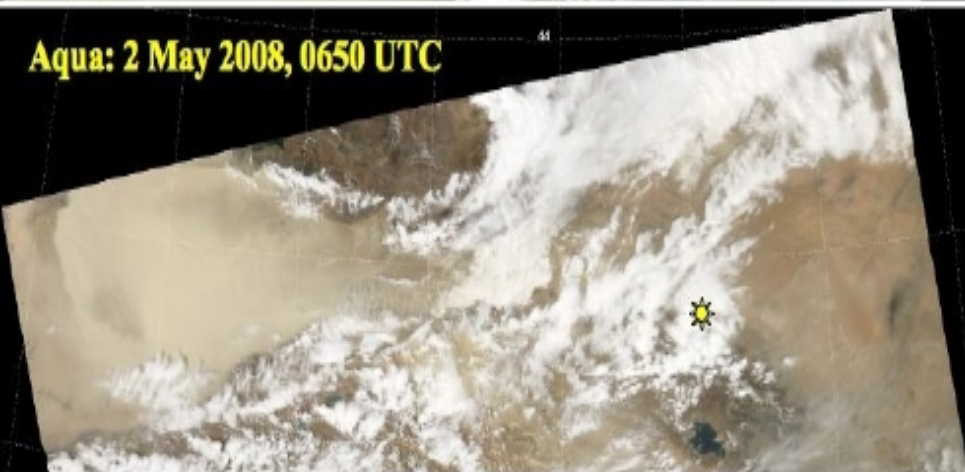
Lau, K.-M., K.-M. Kim (2008), Absorbing aerosols enhance Indian summer monsoon rainfall. iLEAPS Newsletter, No. 5, 22-24.



Terra: 2 May 2008, 0335 UTC



Aqua: 2 May 2008, 0650 UTC



AAF/SMART-COMMIT at Zhangye  
1000 UTC or ~6:00 PM local time

Due to programmatic restrictions (China/IAP-CMA vs. US/DoE, measurements are not exhibited publicly now.

□ Objective:

- » *Dust optical & microphysical properties*
- » *Dust vertical distribution*
- » *Dust effects on atmospheric & surface energetics*
- » *Dust long-range transport*



## JAMEX-related activities in 2008, funded by US (NASA and DOE)

- Preliminary joint NASA/DOE field campaigns to measure aerosol characteristics have been conducted since March 2008 and still ongoing, including AMF (Li et al) in central China, AAF (Tsay et al) in northern China, in conjunction with the international Asian-Indo-Pacific Ocean (AIPO) -Atmosphere observations in China
- TIGERZ (Holben et al) has provided enhanced aernet observations of aerosol characteristics in central and northern India along Calipso flight track, and in conjunction with CTCZ sponsored by the Indian Climate Research Programme.
- Preliminary results show strong dust storms during the pre-monsoon seasons over both India and northern China, and high-degree of mixing of dust aerosols and local pollution, producing very absorbing mixed aerosols
- Further experiments and monitoring are planned to strengthen ties with other AMY and CEOP activities in India, China and maritime continent beyond 2008-9.

### Reference:

Lau, K.M, V. Ramanathan, G-X. Wu, Z. Li, S. C. Tsay, C. Hsu, R.Siika, B. Holben, D. Lu, G. Tartari, M. Chin, P .Koudelova, H. Chen, Y. Ma, J. Huang, K. Taniguchi, and R. Zhang., 2008 : the Joint Aerosol-Monsoon Experiment: A New Challenge in Monsoon Climate Research. *Bull. Am. Meteor. Soc.*, **89**, 369-383, DOI:10.1175/BAMS-89-3-369.



- Back up slides

