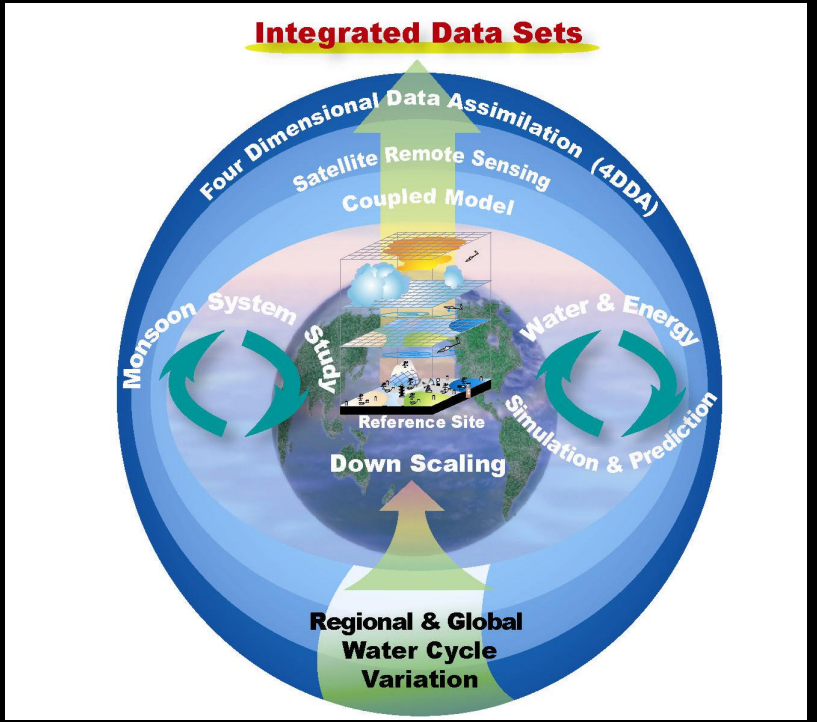
CEOP Inter-Monsoon Studies (CIMS)

Objectives:

- To provide better understanding of fundamental physical processes (diurnal cycle, annual cycle, intraseasonal oscillations) in monsoon regions around the world
- To demonstrate the synergy and utility of CEOP data in providing a pathway for model physics evaluation and improvement



Ad hoc CIMS working group: W. Lau, J. Masumoto, R. Mechoso, J. Marengo, H. Berbery, M. Bollasina, T. Yasunari, Y. K. Xue, T. Satomura , P. Glecker, Y. Wang, J. Potter, B.K. Basu, B. Burton, A. Barros…

Ongoing and emerging CIMS research activities and coordination

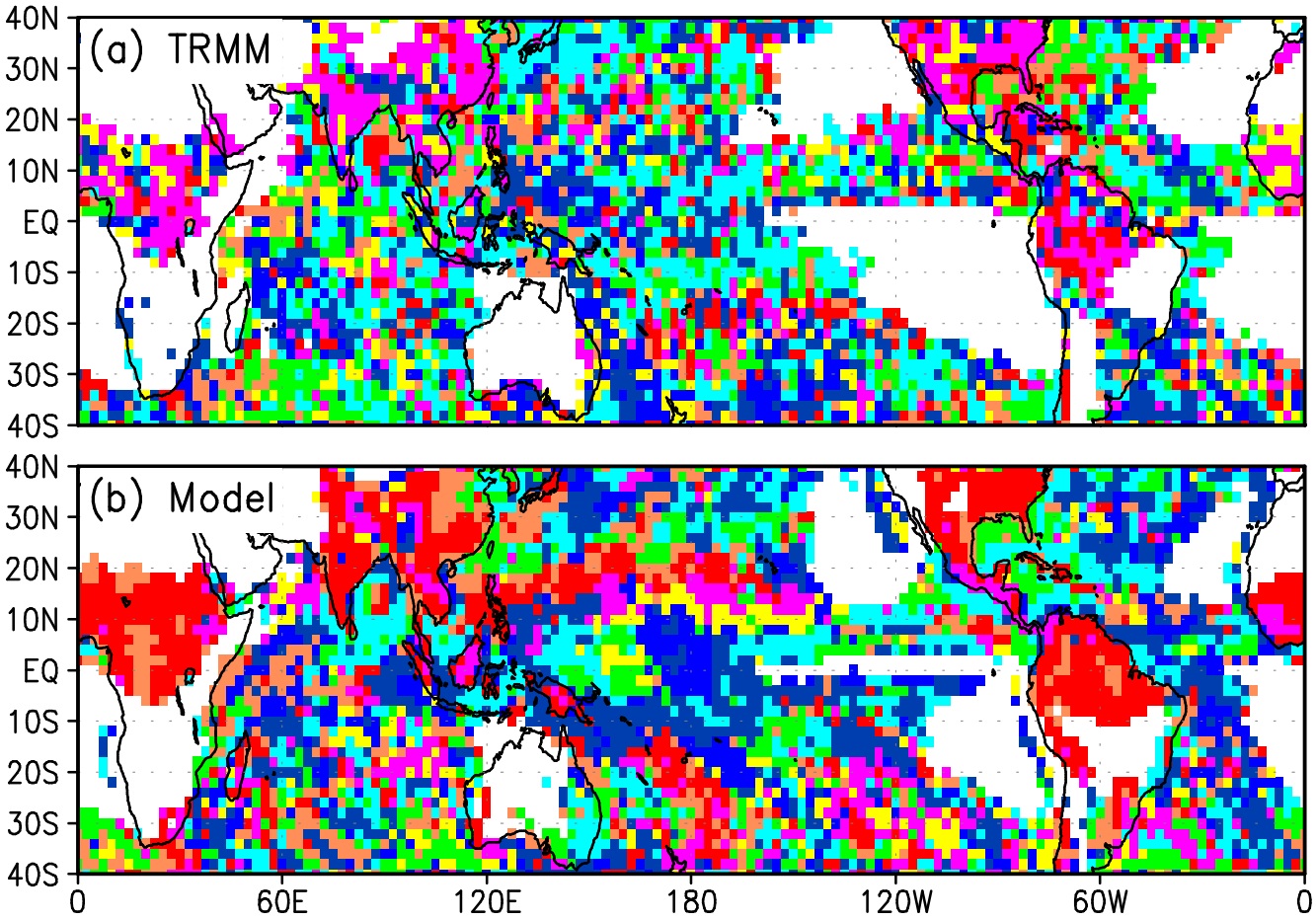
Phase-I

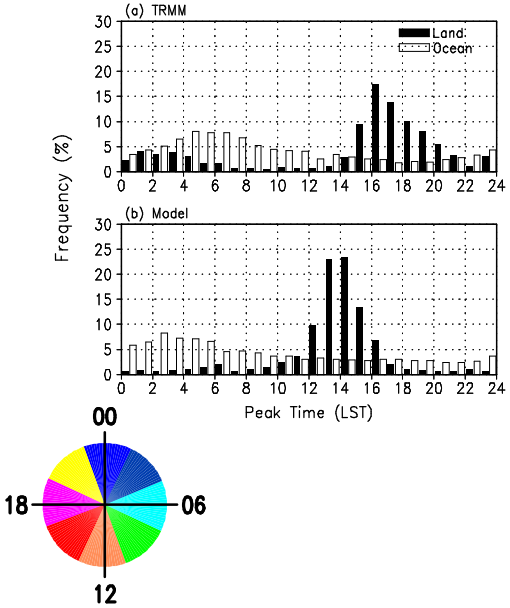
- **East Asian monsoon region: Regional Atmospheric Inter-Model Evaluation (RAIME) Project for the Diurnal Cycle of Clouds and Precipitation (10 RCM groups, Y. Wang, U. Hawaii)**
- **Classification of monsoon systems around the world, based on diurnal and seasonal characteristics(NASA Energy and Water cycle studies – NEWS, PI: Bosilovich)**
- **Pyramid reference site, SHARE-Asia project (Tatari et al, EV-K2-CNR, Italy)**

Phase -II

- **CIMS proposed the "Elevated Heat Pump" Hypothesis for aerosol monsoon-water cycle interaction**
- **International field campaign - Rajo-Megha (Dust Cloud) experiment to study effects of aerosols-chemistry-cloud-rainfall-hydrology interaction in elevated, complex terrains- Himalayas, Tibet on monsoon regions (US, China, Italy, India, Napal, Japan, Korea…)**
- **NASA, AMMA proposal to study atmospheric dust land-ocean interactions over West Africa, and downstream effects (PI. Lau, pending)**
- **West Africa Monsoon Model Evaluation (WAMME) project – Xue et al**

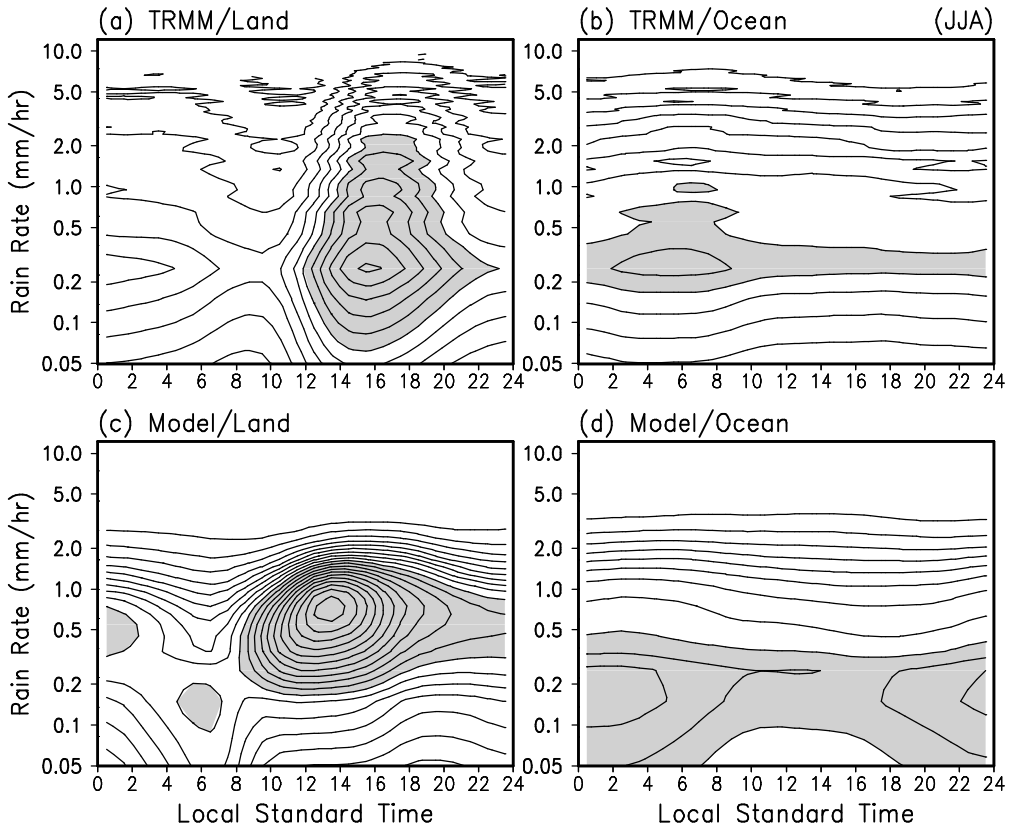
Global distribution of diurnal rainfall peak





Model produces diurnal rainfall peak 2-3 hour too early

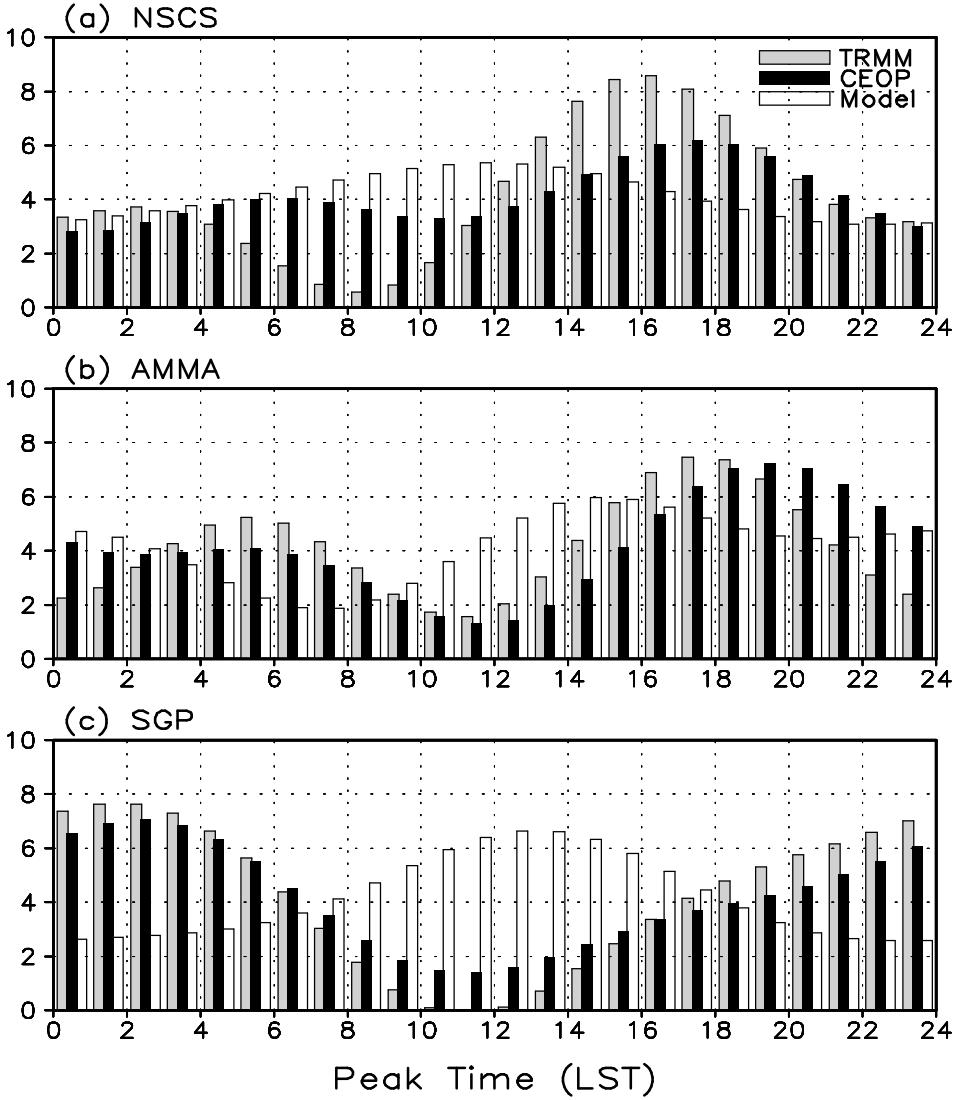
Diurnal precipitation spectra



Over land: model produces too early peak.
Too narrow spectrum, concentrate on moderate rain
Over ocean: too early peak, too much drizzle,
not enough moderate to heavy rain.

→

Need better resolution, better representation of shallow, middle raining clouds, boundary layer processes and microphysics of warm, and mixed phase rain

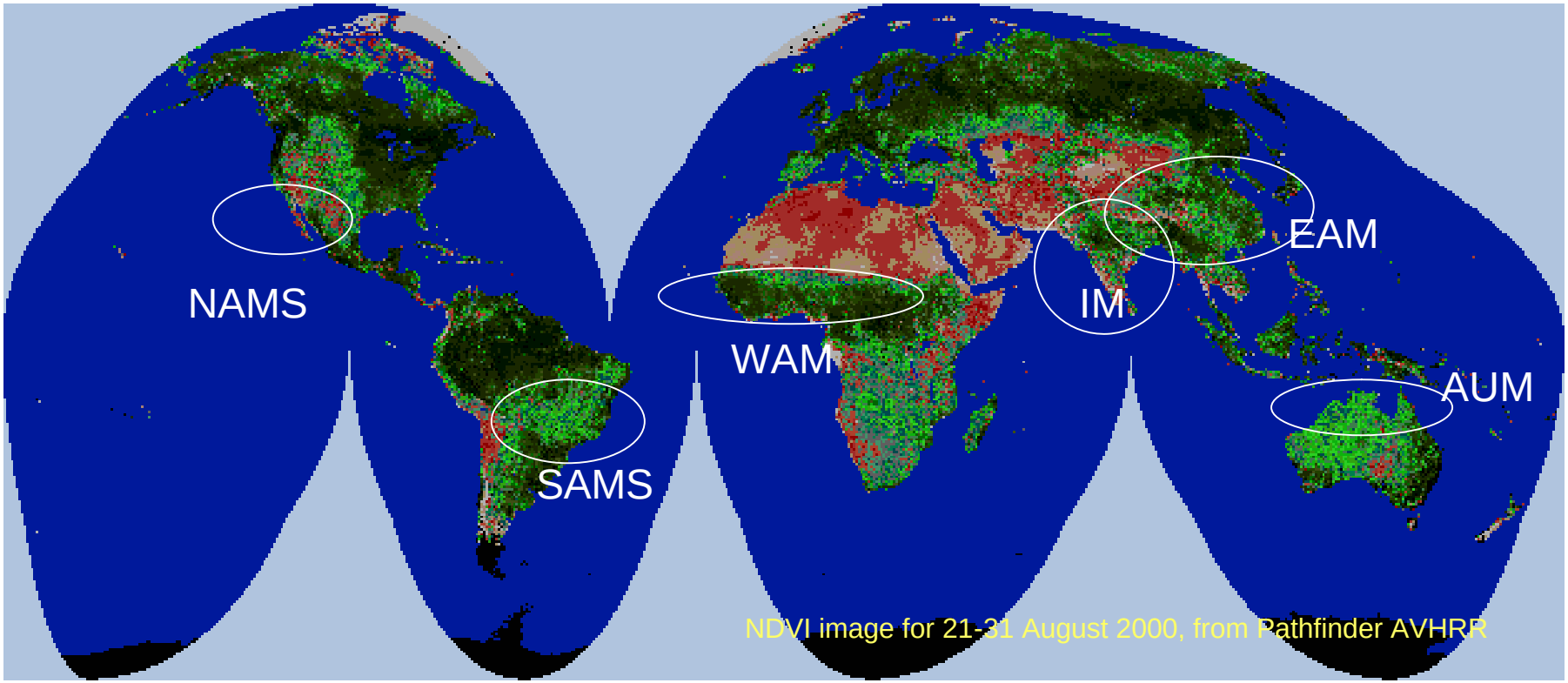


coastal area

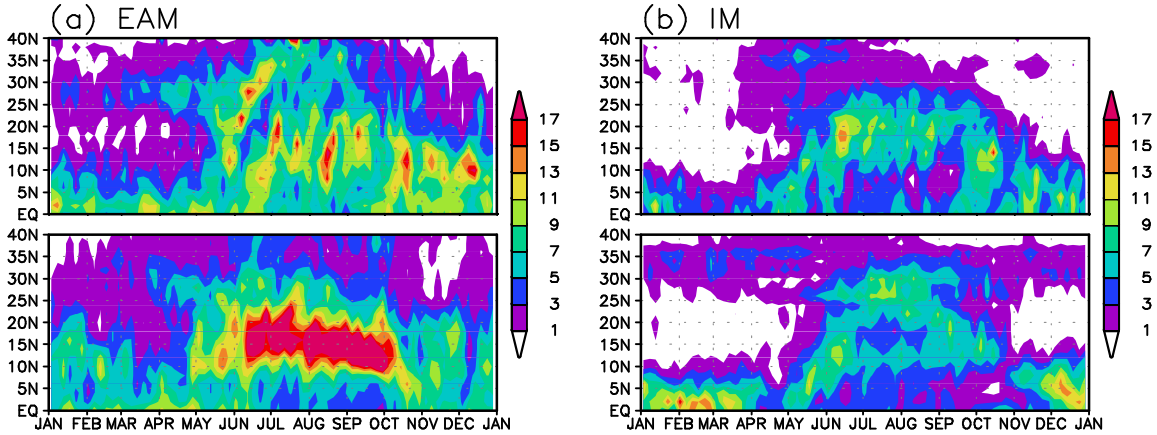
continental region

LLJ region

CEOP Inter-Monsoon Studies (CIMS): vegetation distribution in different monsoon regions around the world.

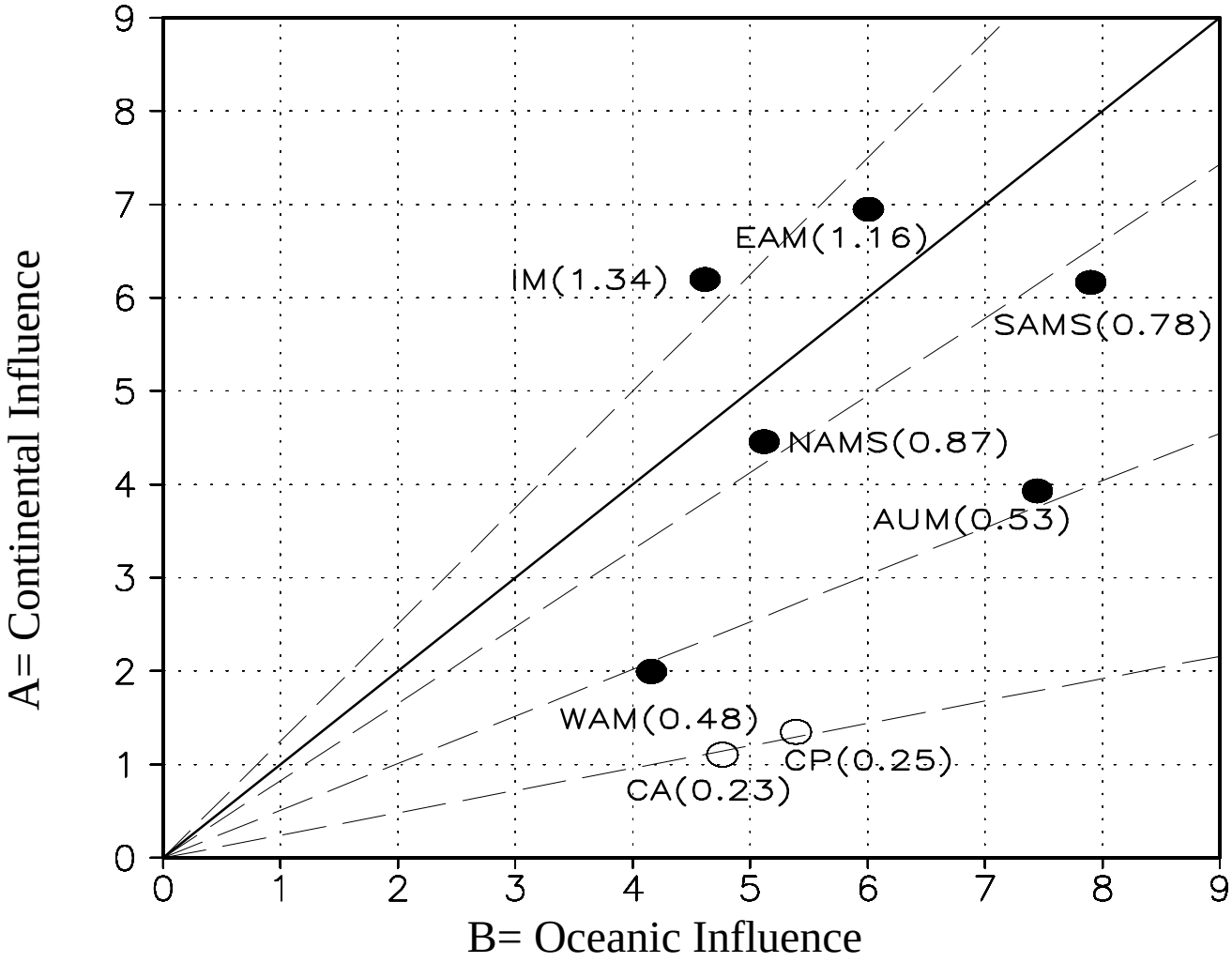


NDVI surface vegetation



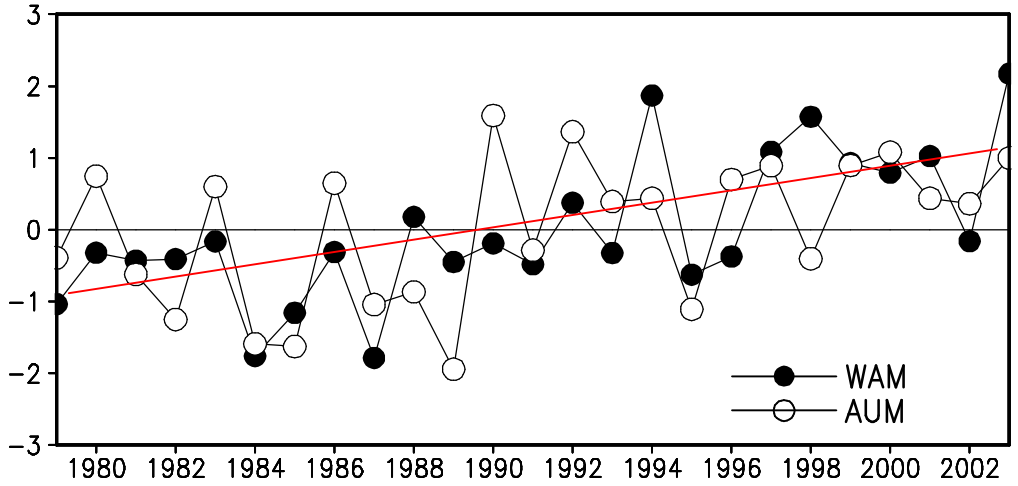
Obs: Top Panel
Model: Lower Panel

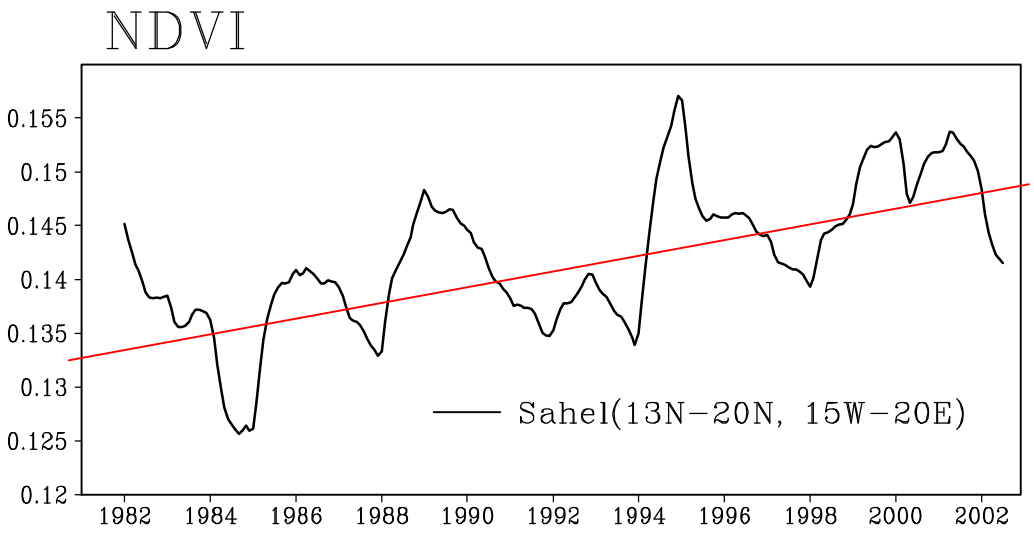
Classification of Monsoon Systems



Continentality, $\Omega = A/B$

Continentality Index





Recovery of the Sahel rainfall as indicated by the increasing WAM continentality index, and NDVI from 1980 - 2002

CIMS-II Aerosol-monsoon water cycle focus:

- *(a) To provide better understanding of the mechanisms of extreme events that affect water availability in monsoon regions around the world (Asia, Australia, Africa, Americas), and their relationships to oceanic, land, atmospheric (including aerosols) forcings.*

- *(b) To unravel the effects of natural and anthropogenic aerosols on the monsoon water cycle and their interaction with the atmosphere-land-ocean system, from diurnal, intraseasonal, interannual, and interdecadal time scales*

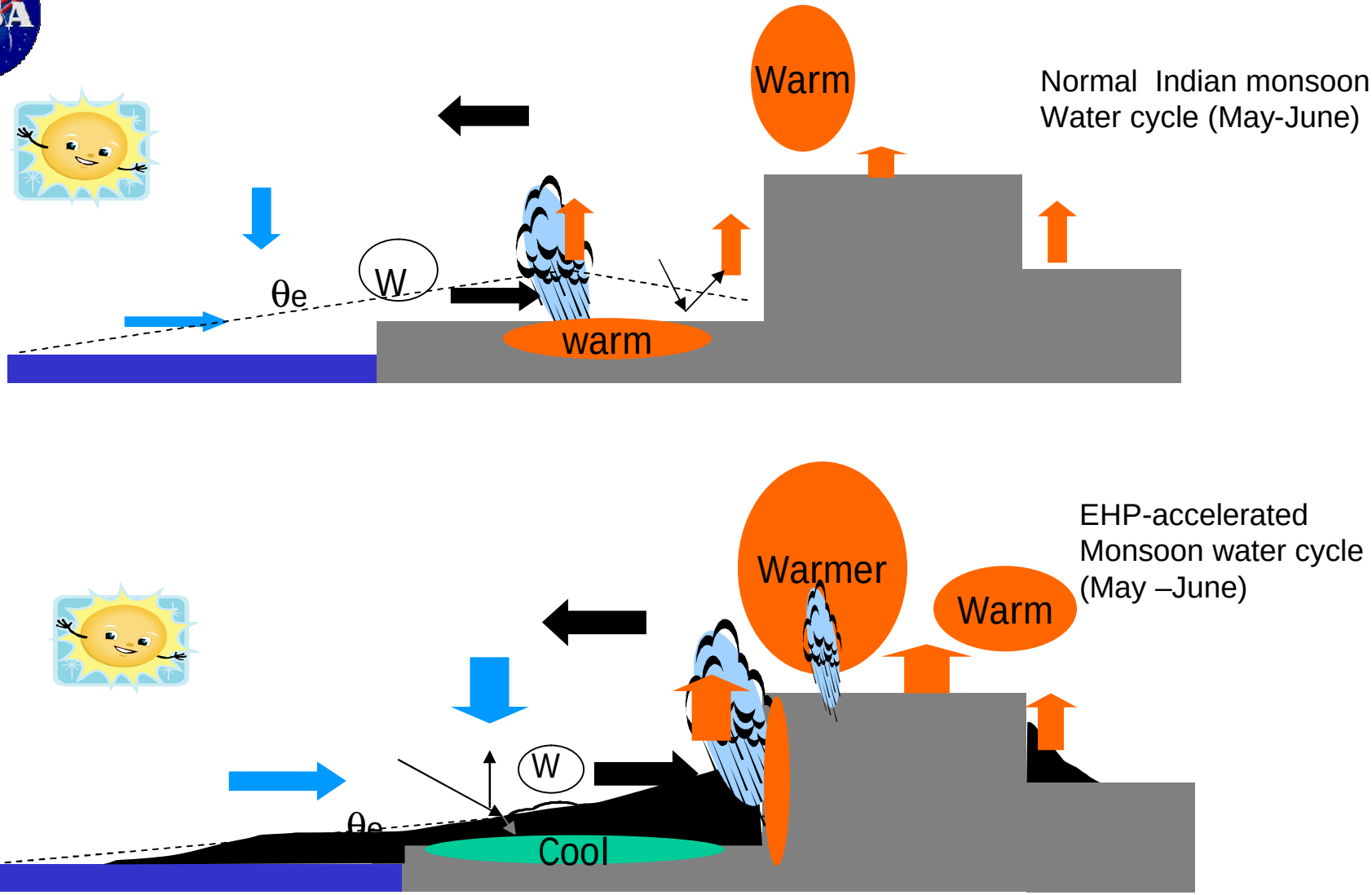
Current emerging initiatives with common themes, but different regionality:

a) Dust cloud experiment over Indo-Gangetic Plain (Rajo-Megha)

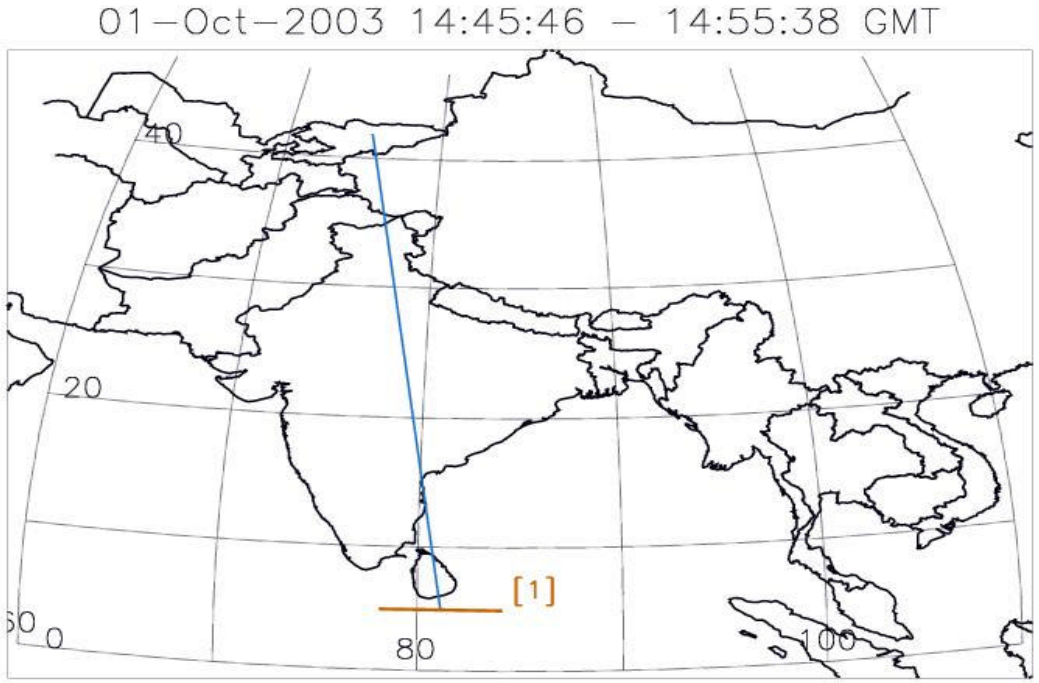
b) West Africa Monsoon Modeling and Evaluation (WAMME)

c) Biomass burning effects on South American Monsoon (TBD, ???)

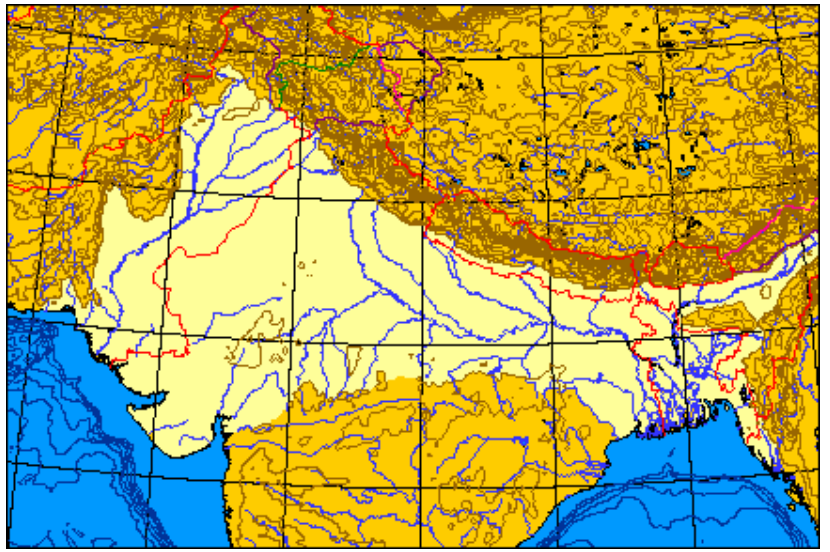
The Aerosol- Elevated Heat Pump (EHP) hypothesis (Lau et al 2006)

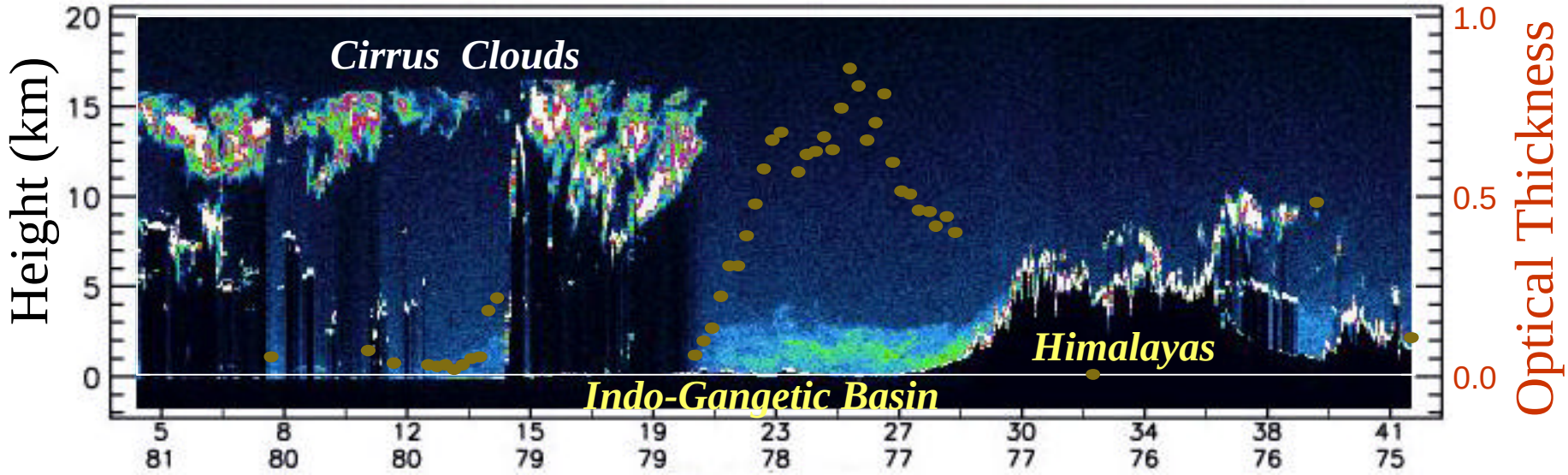


In July-August, the increased convection spreads from the foothills of the HImalayas to central India, resulting in an intensification of the Indian monsoon.


01–Oct–2003 14:45:46 – 14:55:38 GMT
40
20
0
80
100
[1]

GLAS/ICESat




Height (km)
20
15
10
5
0
Cirrus Clouds
Himalayas
Indo-Gangetic Basin
5 8 12 15 19 23 27 30 34 38 41
81 80 80 79 79 78 77 77 76 76 75
1.0
0.5
0.0
Optical Thickness

RAJO-MEGHA (“dust cloud” in Sanskrit)

(Radiation, Aerosol Joint Observations - Monsoon Experiment in Gangetic-Himalayan Area):

An Initiative (Phase$_0$) to NASA Roadmap on Global Fresh Water Redistribution

Si-Chee Tsay and W.Lau,

*and the GSFC Team**

NASA Goddard Space Flight Center

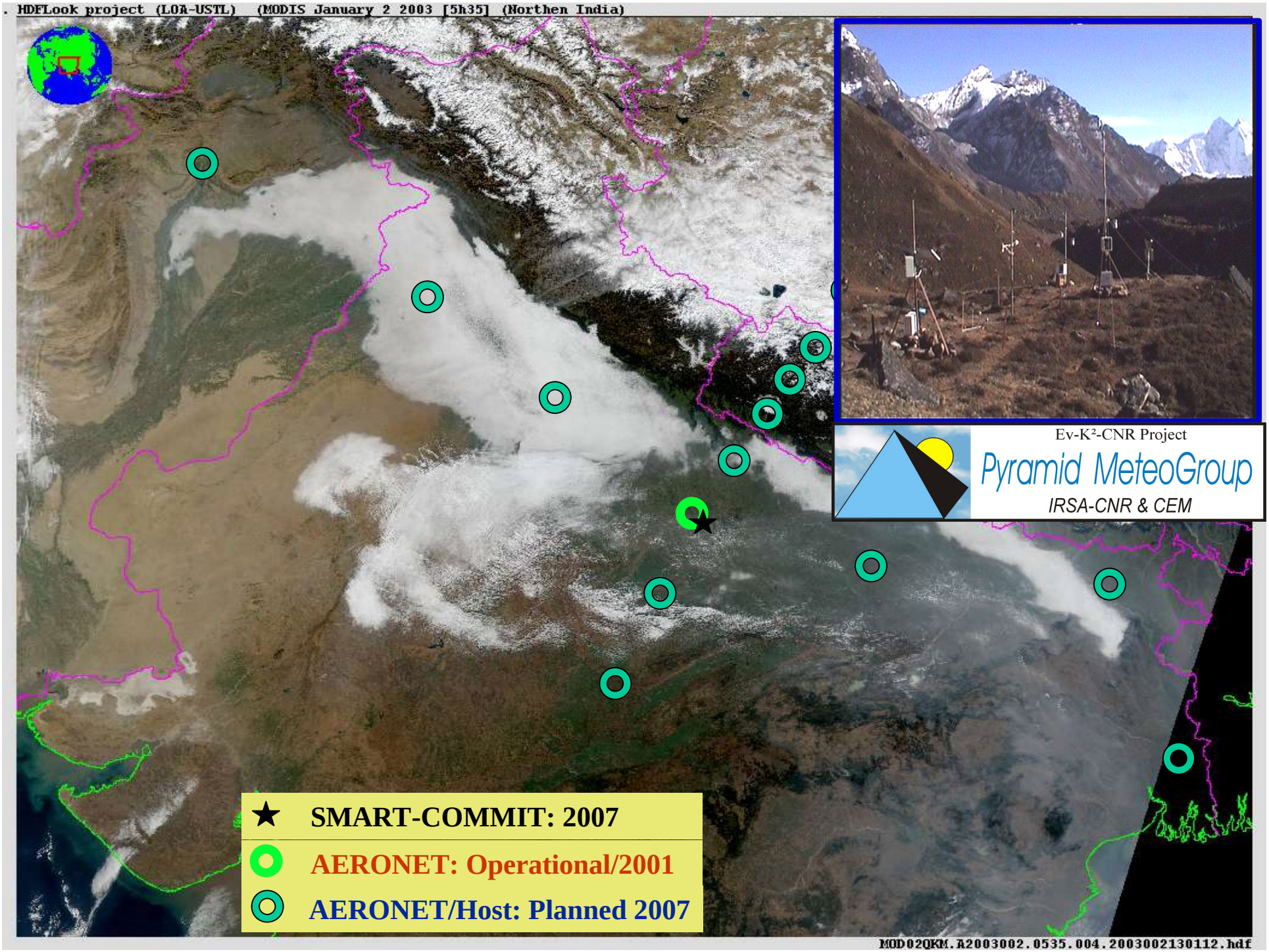
***P. K. Bhartia, B. N. Holben, N. C. Hsu, Q. Ji, Y. Sud,**
M. D. King, L. A. Remer, J. S. Schafer, E. J. Welton,
V. Ramanathan (UCSD),T. Koike (Japan), G. Tartari (Italy), P. Ginoux (NOAA),
R. Singh (India), G. Wu (China)…

Objective of Rajo-Megha

- *To determine the role of absorbing aerosols, especially with regarding to elevated heat sources and interaction with black carbon, in affecting the water-cycle dynamics of the Indian summer monsoon*

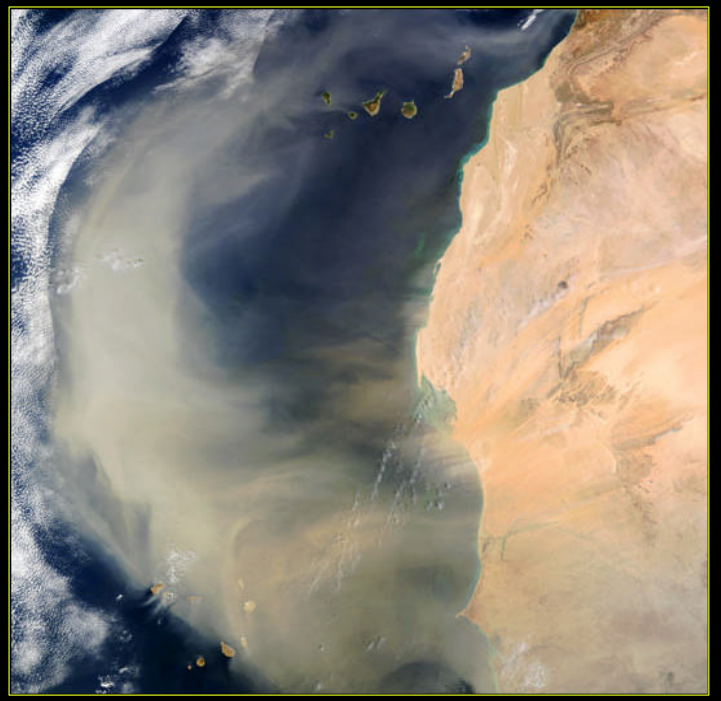
Integrated (aerosol, cloud, precipitation, chemistry hydrology and large scale dynamics) measurements approach:

- Aerosol and cloud characteristics
- Sources/sinks, and transport processes
- Elevated vs. boundary layer; AERONET, ground-based, radar/lidar, local aircraft, and satellite remote sensing
- Tibetan Plateau and slope complex hydrology, including snow-ice and glacier.
- Phase-I (April-May, aerosol forcing), Phase-II (May-June, water cycle response)
- Monitoring in surrounding regions, by collaborating with other international programs, i.e., ABC, Indian Ocean Monitoring (CLIVAR), GEWEX, and CEOP.


. HDFLook project (LOA-USTL) (MODIS January 2 2003 [5h35] (Northen India)
Ev-K²-CNR Project
Pyramid MeteoGroup
IRSA-CNR & CEM
SMART-COMMIT: 2007
AERONET: Operational/2001
AERONET/Host: Planned 2007
MOD02QKM.A2003002.0535.004.2003002130112.hdf

Saharan Dust and WAM water cycle interaction: a special kind of land-atmosphere interaction

- Flux of African dust has increased dramatically since 1970 due to the ongoing drought in the Sahara and Sahel regions.
- The dust flux from Africa to the atmosphere has been estimated to be approximately one billion tons per year.
- It is hypothesized that the differential heating of the atmosphere, and land surface due to dust may modulate rainfall variability of the West Africa monsoon. Caribbean and southeast US.



MODIS Image - March 2, 2003

WAMME (West African Monsoon Model Evaluation) – a joint CEOP/AMMA modeling initiative:

1). The monsoon water cycle and associated drought initiation and recovery processes, impacts of oceanic and land processes, and aerosols are not well understood;

2). Improve dynamical models used for drought and fresh water supply prediction through intercomparison and evaluation against AMMA and CEOP data, focusing on diurnal and seasonal cycles

3) Conduct numerical experiments in climate variability and change, unravel possible natural vs. anthropengic effects, and their interactions

WAMME Participants (Core group)

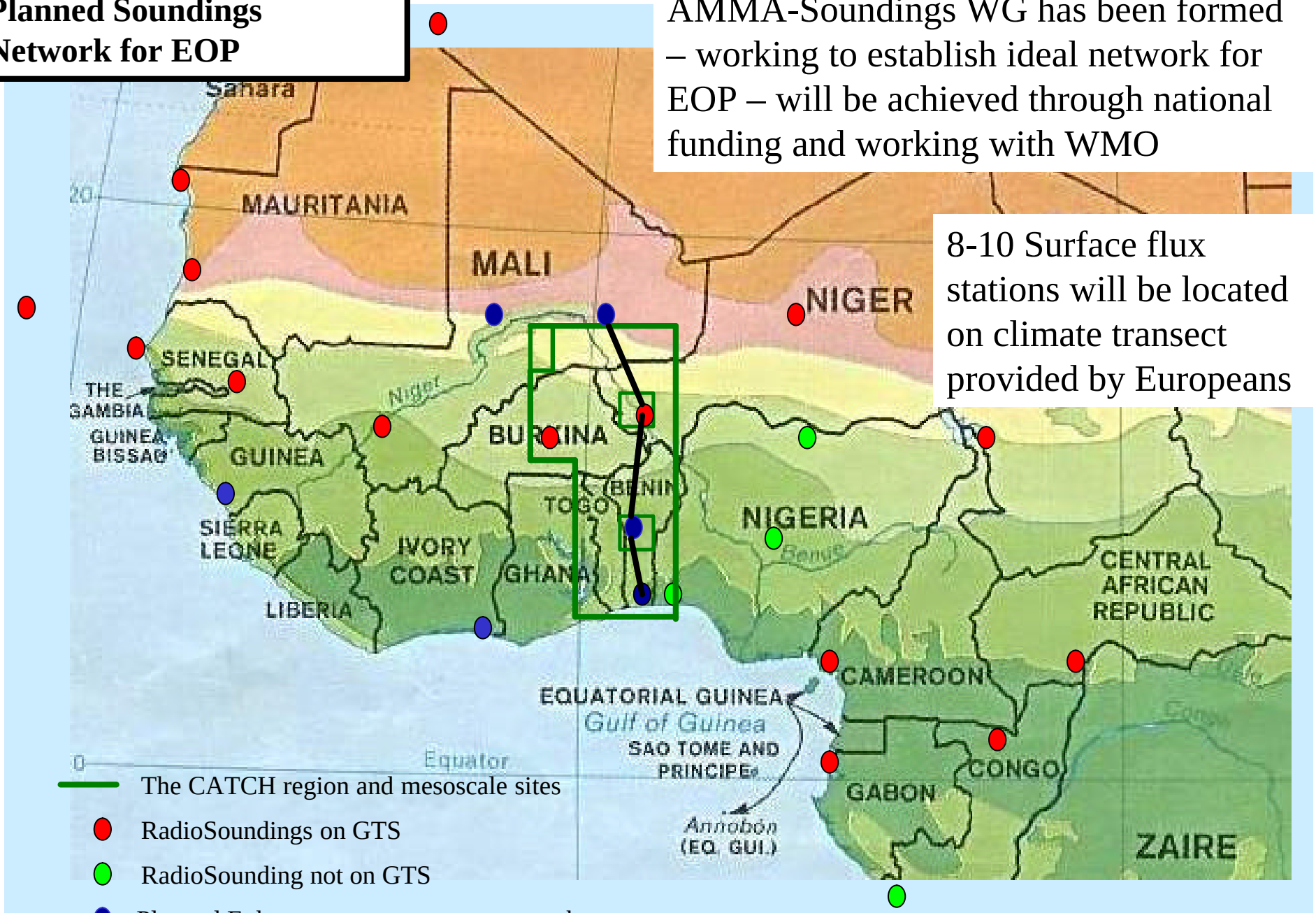
Institution	Contact Person	Models
Cornel University	Kerry Cook	MM5
GISS, NASA	Len Druyan , Mat Fulakeza	Regional, GCM
GSFC, NASA	William Lau	NASA AGCM
IRI, Columbian University	Sylwia Trzaska	IRI GCM
MRI, Japan	Akio Kitoh	GCM (MRI-CGCM2.3), AGCM (MRI/JMA)
NCAR	Benjamin Lamptey	NCAR GCM
NCEP	Wassila Thiaw	NCEP GCM
UCLA	Yongkang Xue	AGCMs, Eta
U.K. Met. Hadley Center	Dave Rowell	To be confirmed

Coordinators: Y. K. Xue, Kerry Cook, W. Lau

Planned Soundings Network for EOP

AMMA-Soundings WG has been formed – working to establish ideal network for EOP – will be achieved through national funding and working with WMO

8-10 Surface flux stations will be located on climate transect provided by Europeans



Both CIMS-II Initatives (Rajo-Megha and WAMME) will make extensive use of the afternoon constellation the "A-Train" – CEOP data integration is essential