GVAX: Update

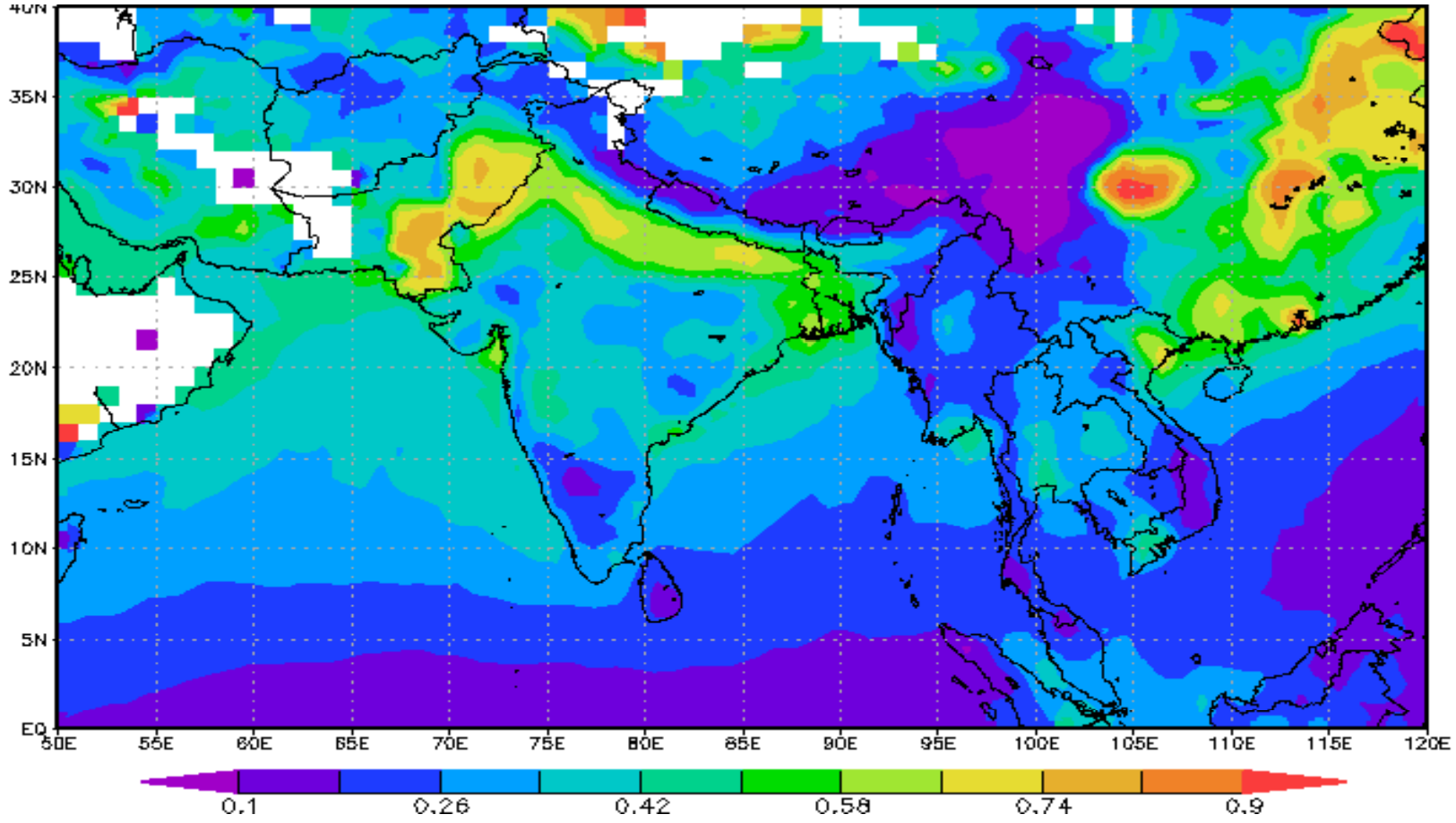
Rao Kotamarthi and Yan Feng (Argonne National Laboratory)

K. Krishnamoorthy, S. K. Satheesh, Steve Ghan, Sethu Raman, Ram Sagar, Si-Chee Tsay

Versions 1 and 2

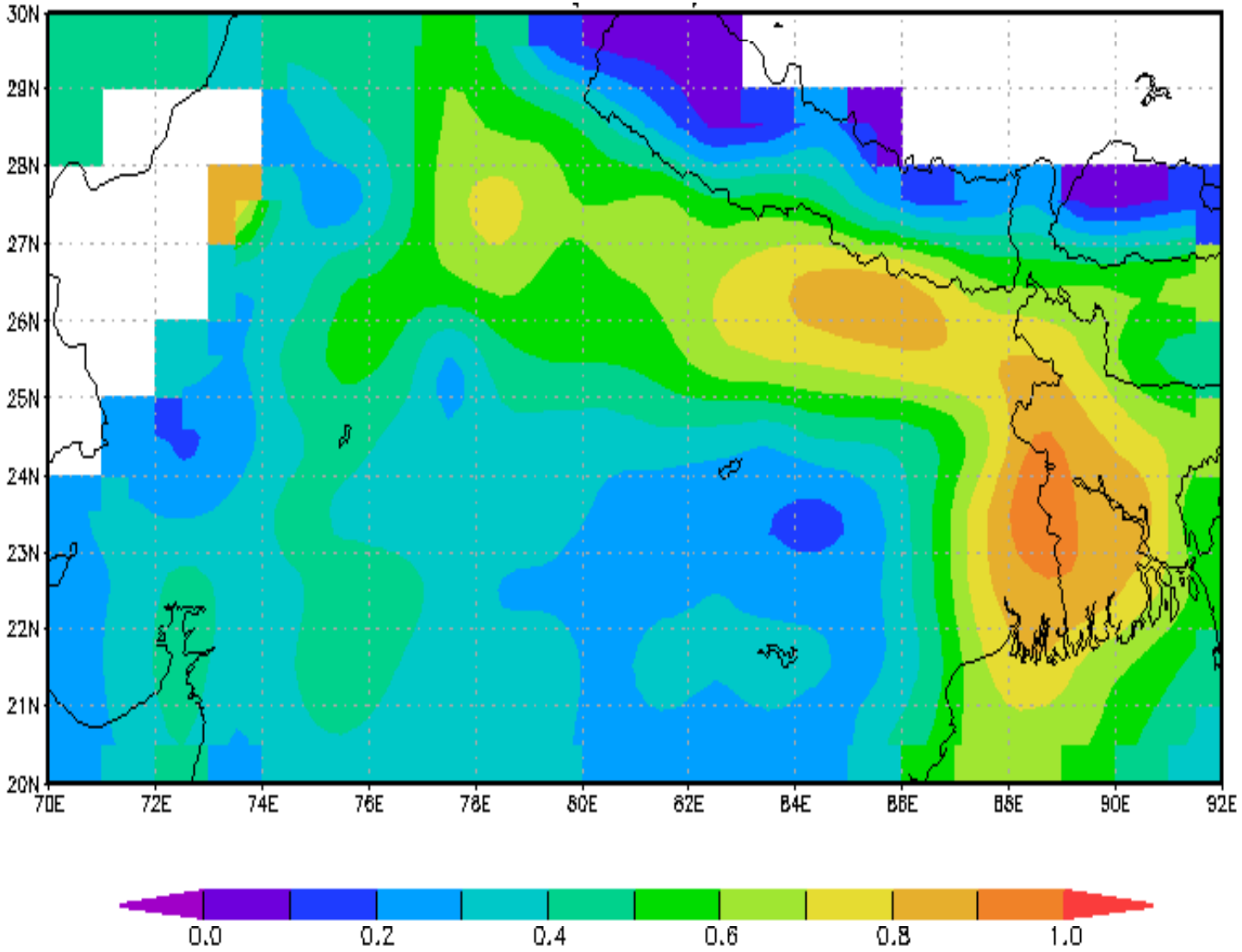
Richard Coulter, Jeff Gaffney, Lawrence Kleinman, Larry DiGiralamo, Greg McFarquahar, Ralph Kahn, Dave Turner, Mike Iacono, Doug Worsnop, Tripathi

Modis Data shows high AOD's in the Ganges Valley Region

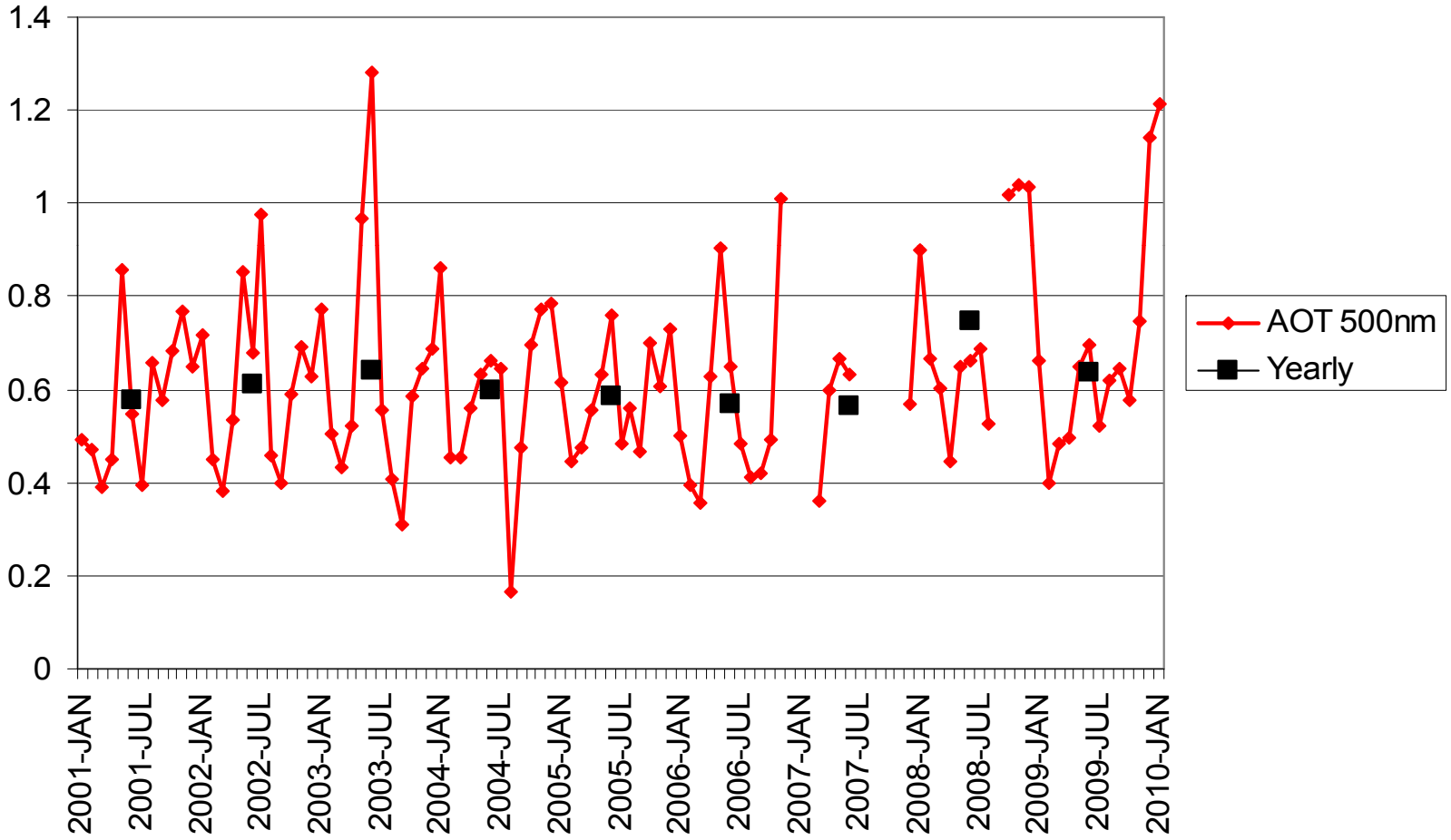


Multi-angle imaging spectroradiometer AOD values at mid visible wavelengths (558 nm) averaged over the years 2005-2008.

AOD in January 2009 (MODIS)

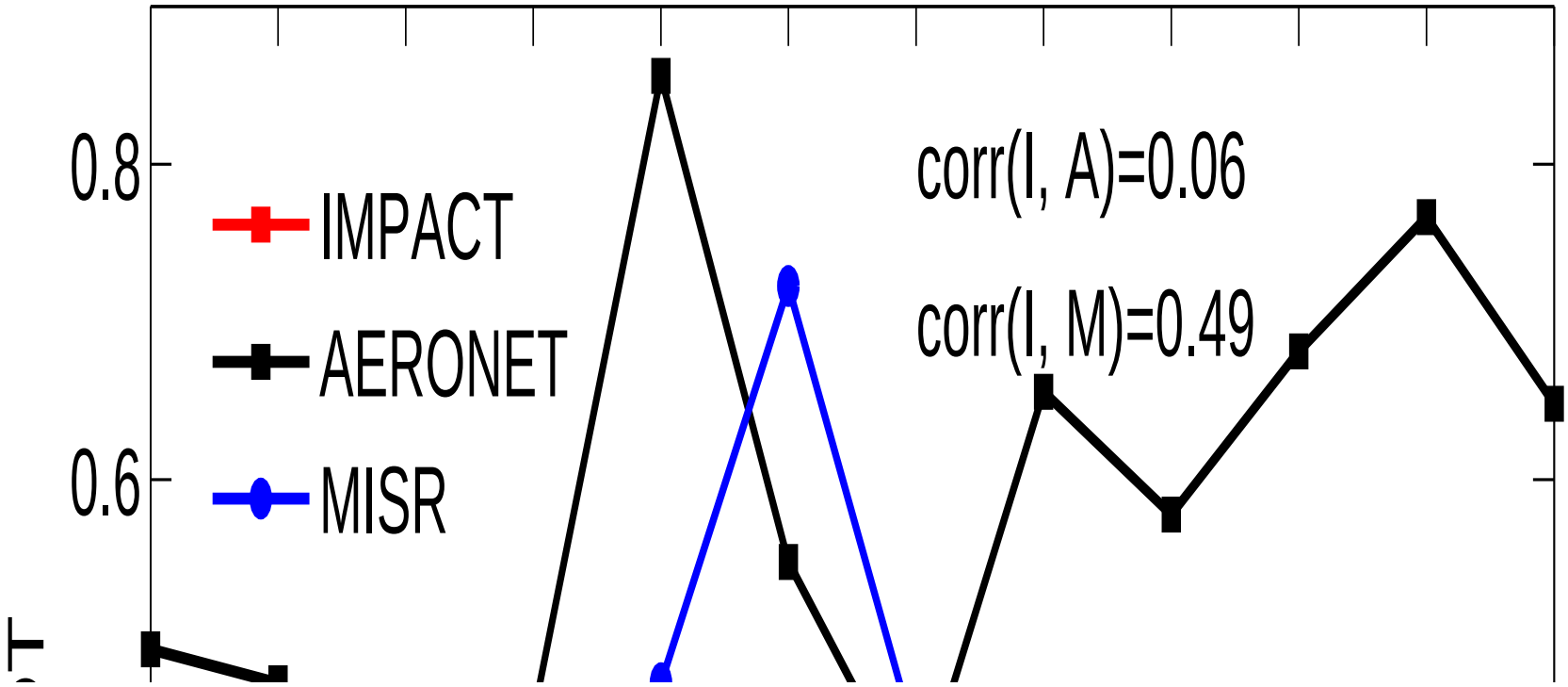


10-year AERONET AOT data at Kanpur



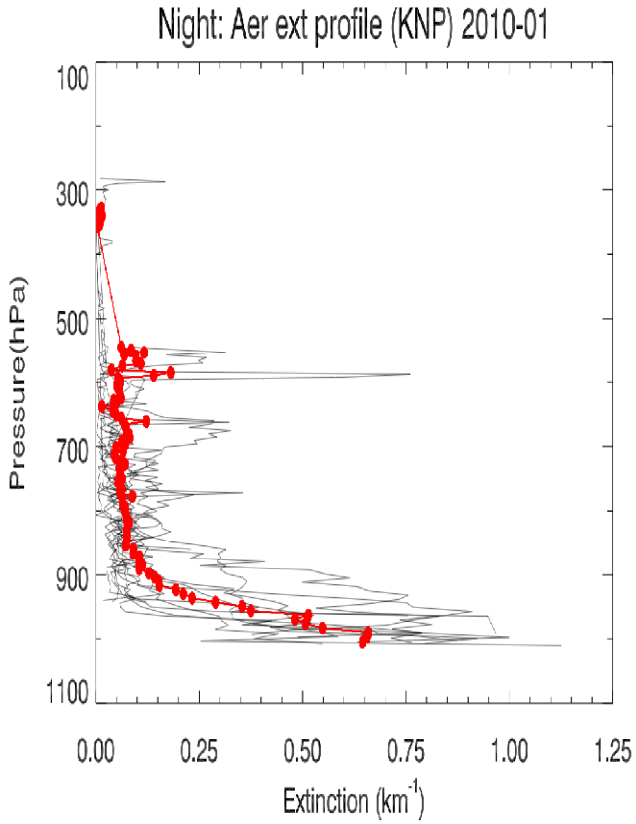
Comparison of Model (IMPACT) and Data (AERONET and MISR)

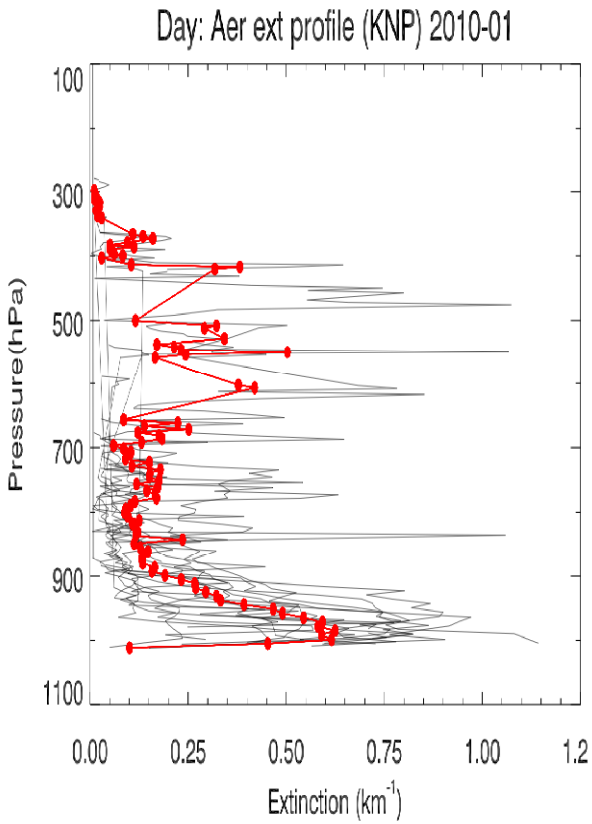
2001 Kanpur



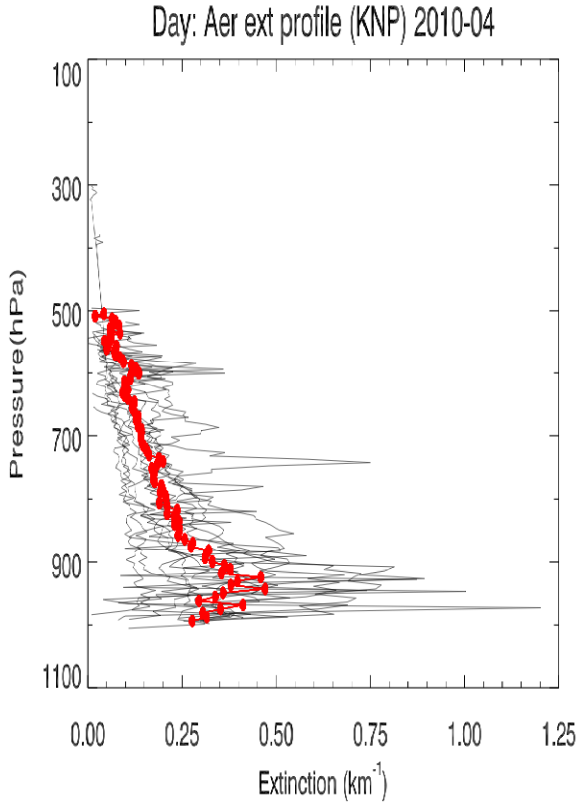
CALIPSO extinction Profiles

January

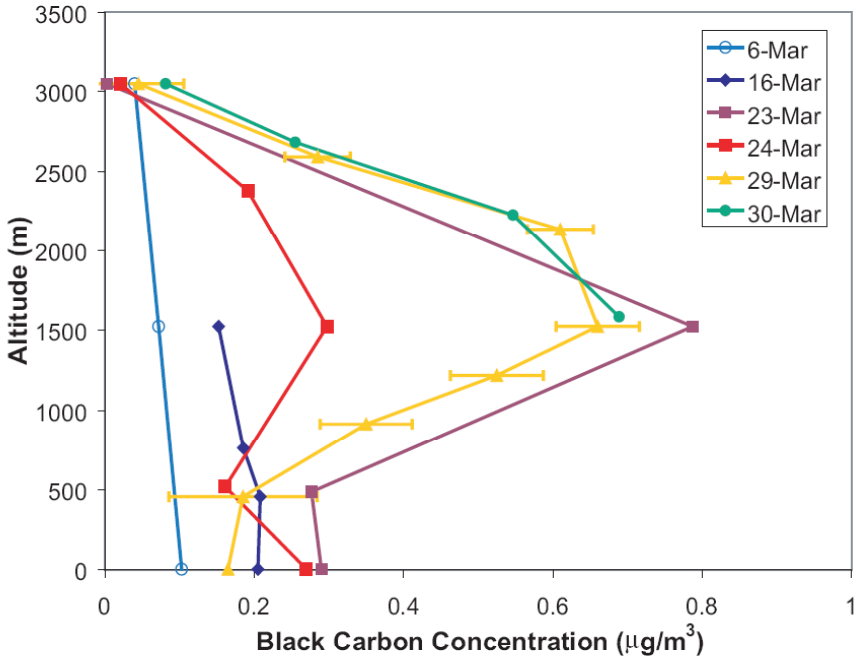




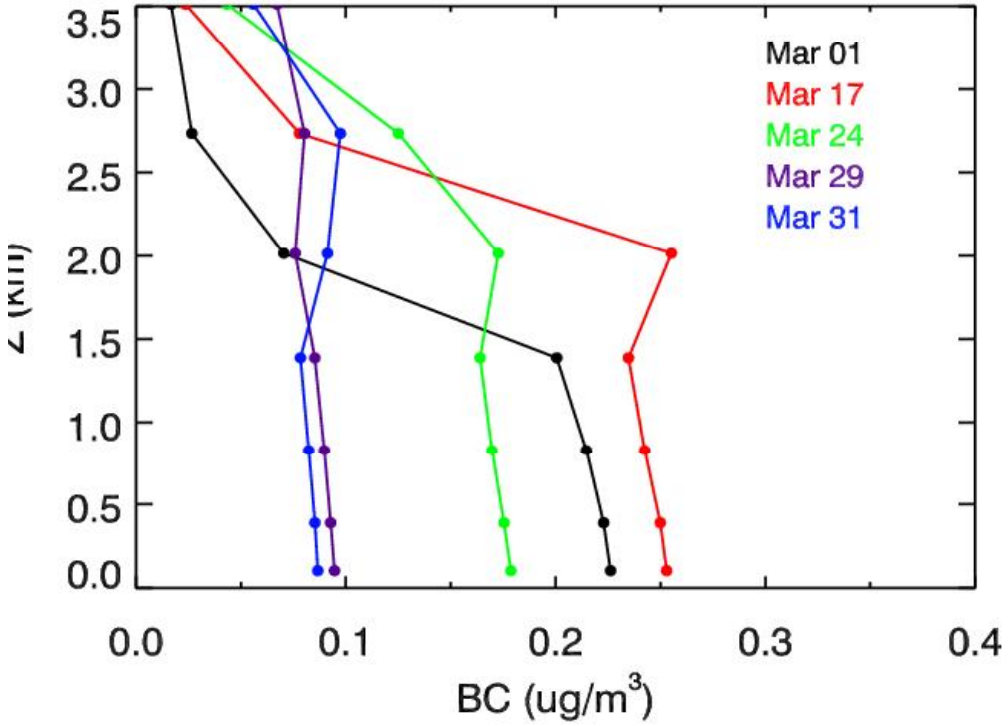
April



Observed BC profiles at MAC campaign



Simulated daily profiles of BC

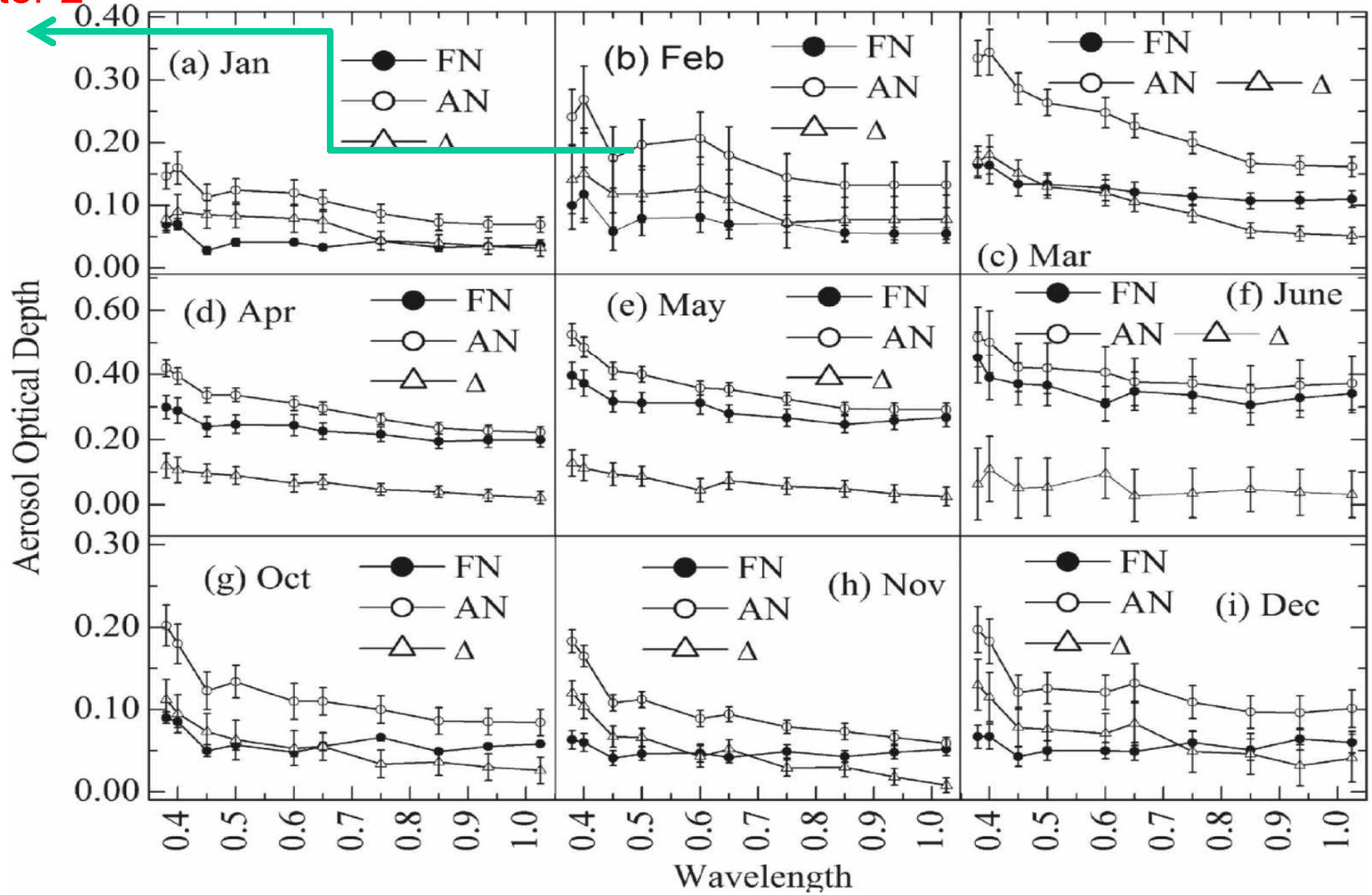


Motivation – Critical Climate Science Uncertainty

- The location of this aerosol layer leads to large uncertainties in calculating surface temperatures and obtaining a closure for convective parameterization for this region
- The composition of the aerosol layer is mostly unknown and the enhanced heating rate estimates assume black carbon

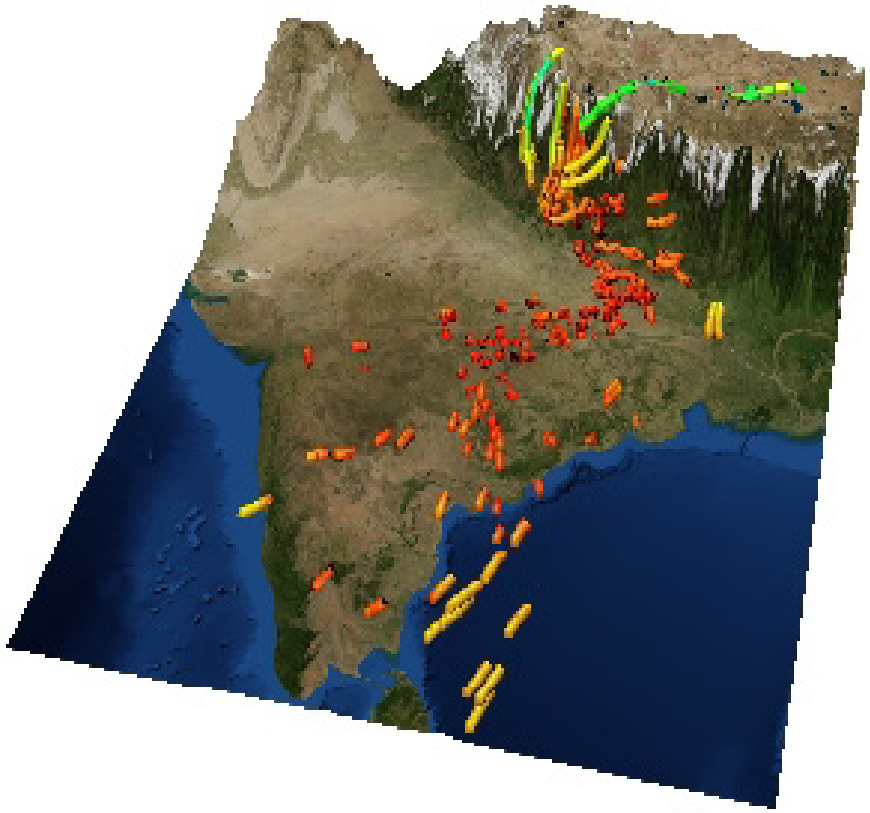
Aerosols Exhibit Observable Diurnal Variability in the PBL

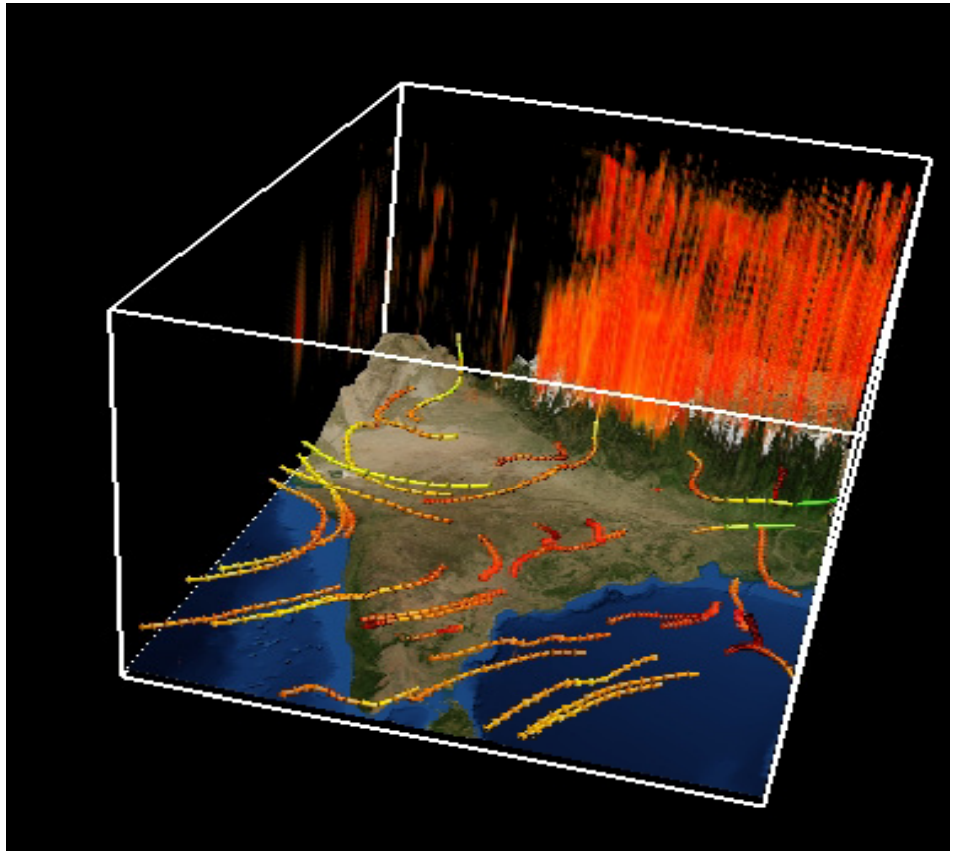
Factor 2



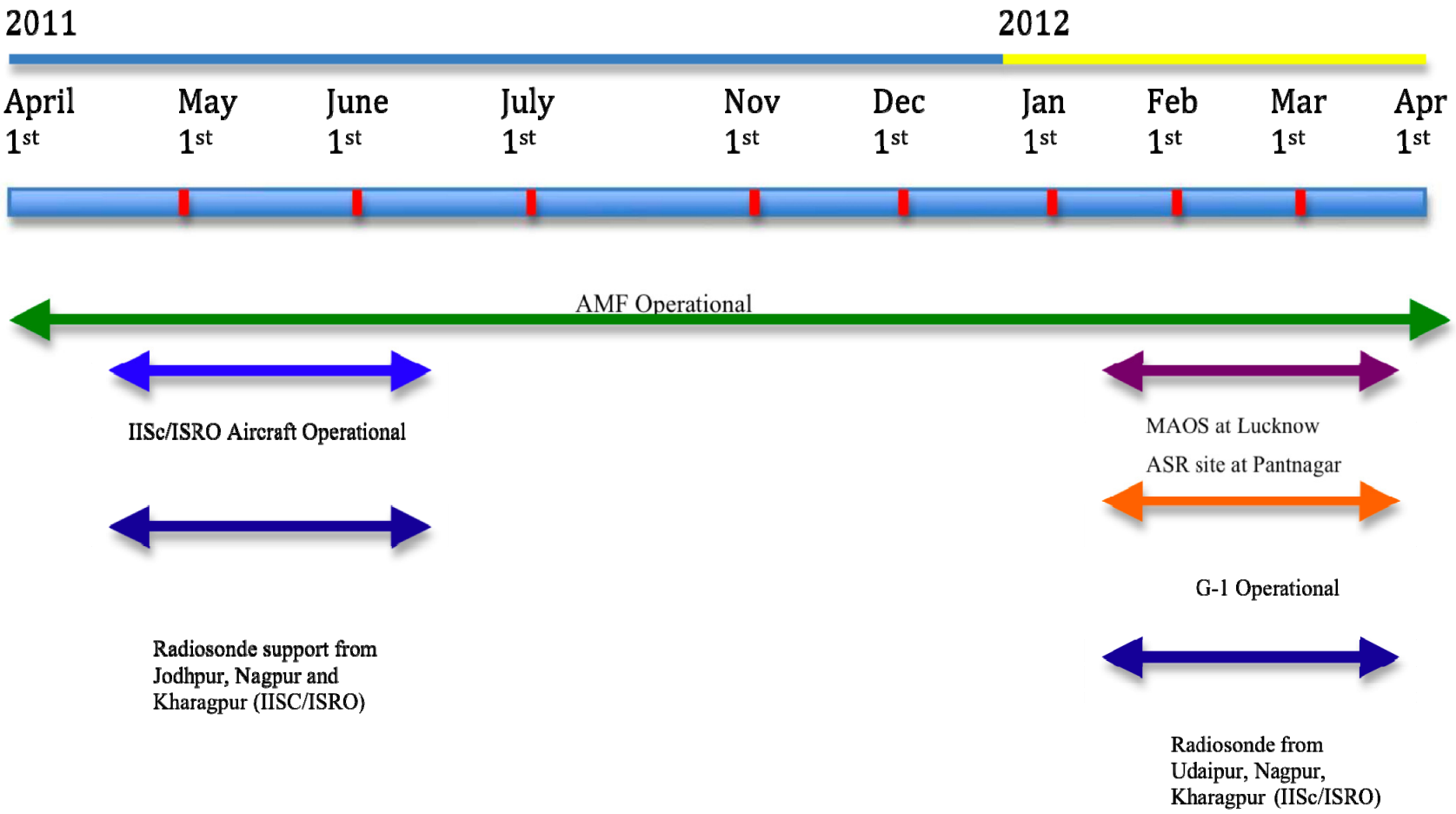
Dumka et al., 2008

Transport of particles near Nainital/Pantnagar; 2008 January

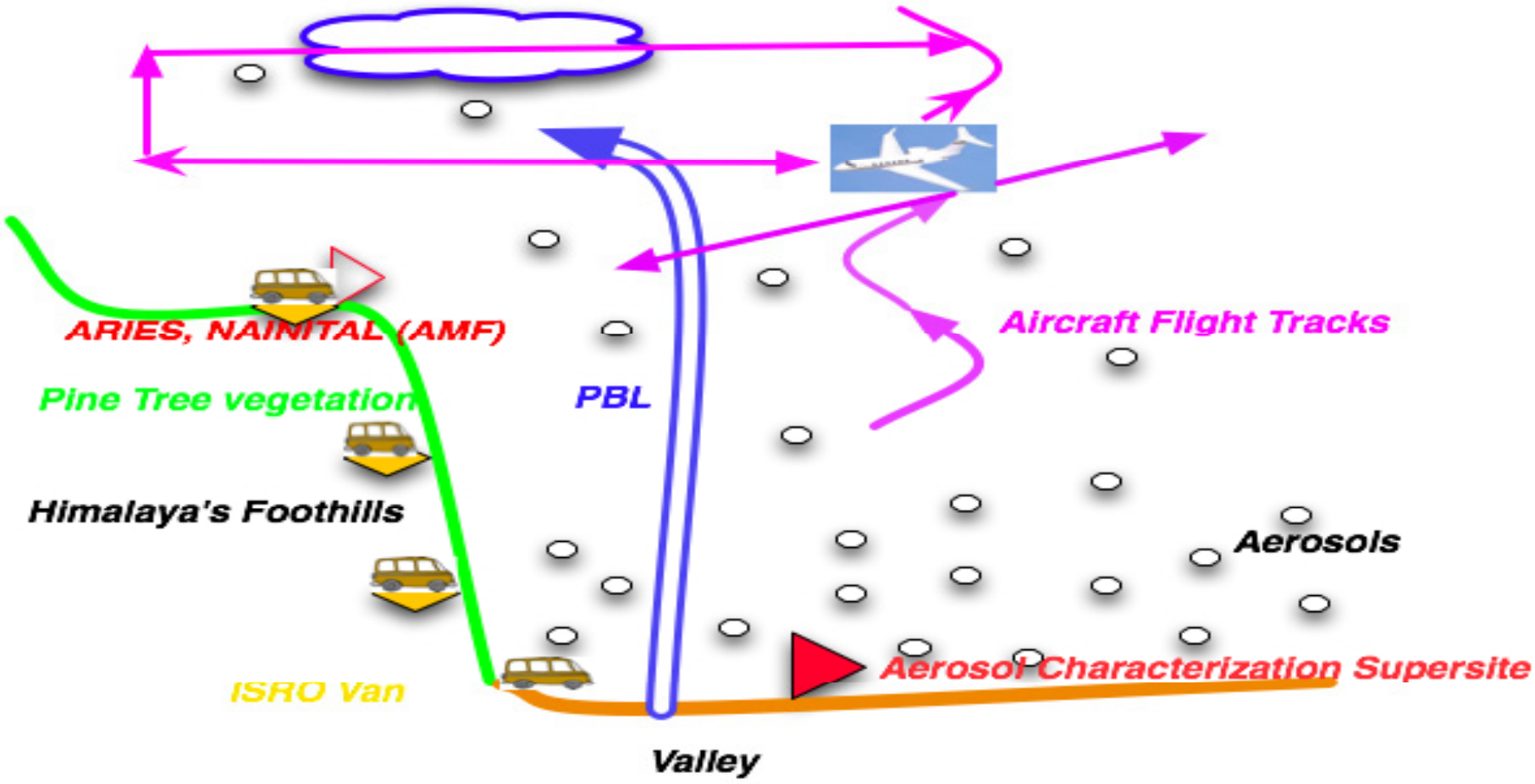




Timeline For The Study:

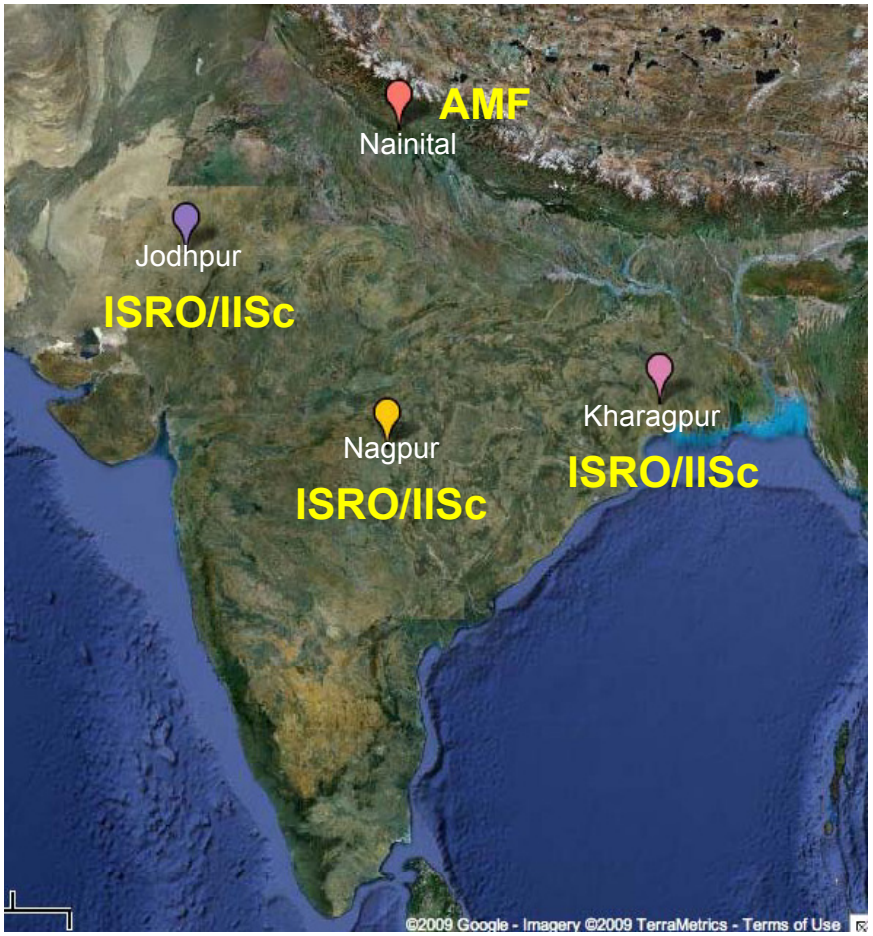


We Plan To Understand The Anthropogenic Aerosol Behavior, Aerosol Composition and its Affect on Heating Rates: (Winter)



A conceptual diagram of the proposed study

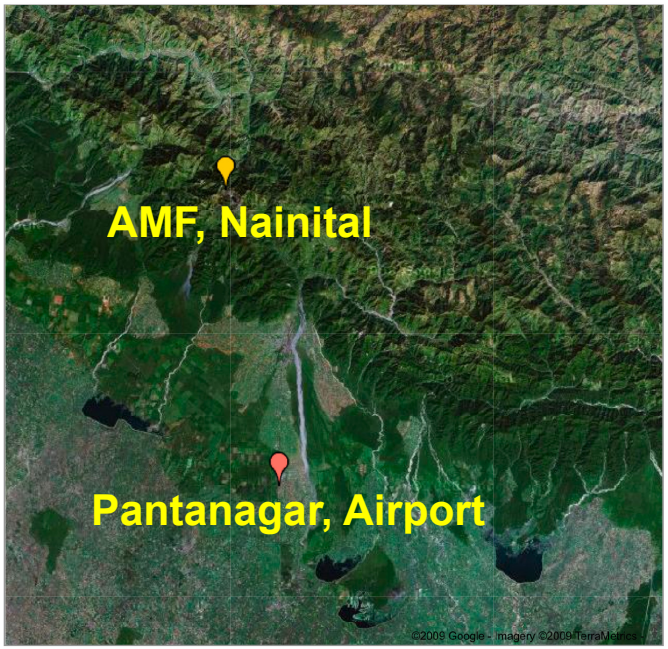
We Plan to Understand these Pre-monsoon Conditions:

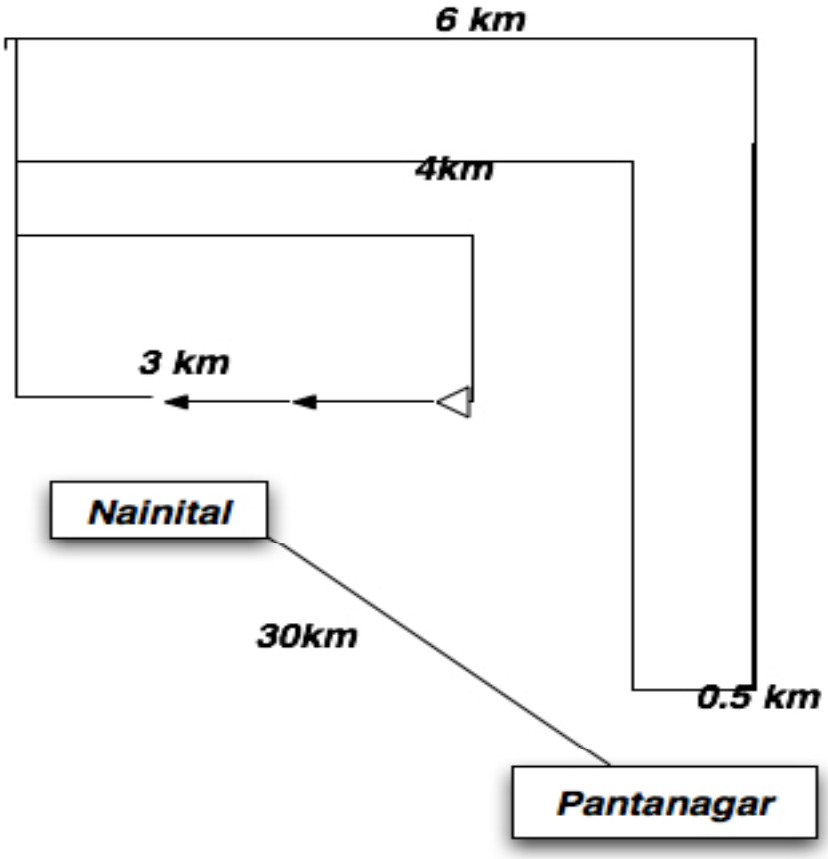


- Four times a day radiosonde launches from four sites to give regional coverage.
- IISc/ISRO aircraft equipped with Aetholometer, Optical Particle Counter, temperature, RH probes.
- Nainital will have AMF operating
- Data collection from NASA in Nepal
- AMF AERI can detect dust concentrations.
- AMF MPL will provide aerosol profile data
- AMF radiation measurements will provide energy budget constraints.

Coordinated radiosondes, AMF and the IISc/ISRO aircraft

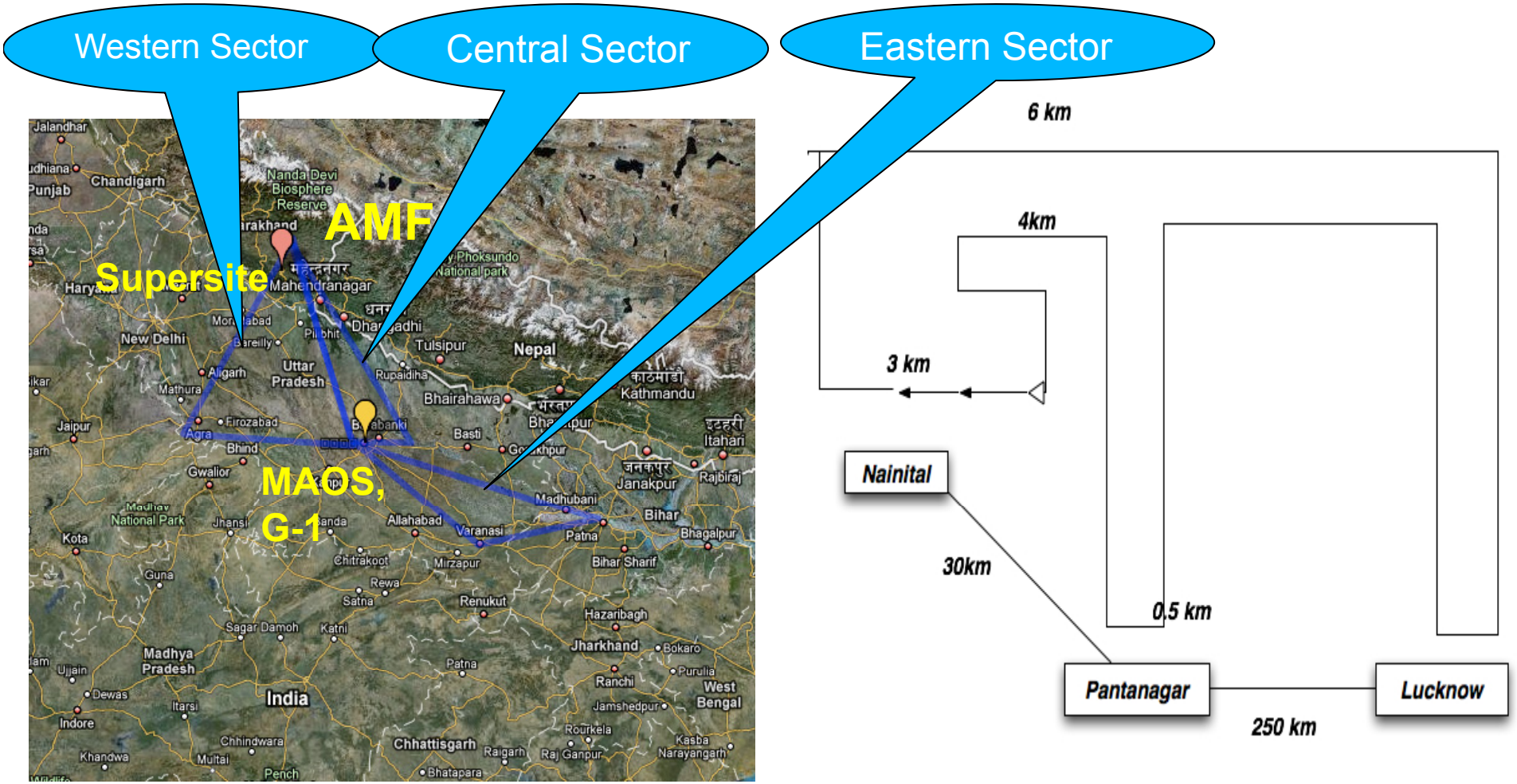
EHP Pre-Monsoon, dust and black Carbon:





Flight Plan For Pre-Monsoon

Winter Intensive will need G-1 to characterize the aerosol plume: Base of operations is Likely Lucknow



Flight Plan for the Central Sector

Potential Measurement gaps – NSF involvement

Progress and Issues

- Our partners for the is project in India are:
  - ISRO - similar to NASA
  - DST - similar to NSF
  - IISc - University for primarily post-graduate studies

- IISc / ISRO submitted request for ground sites and aircraft operations to Indian Government.

- All surface site operations have now been approved.

- Aircraft decision is pending (highest levels in government according to our collaborators in India)

- Permission for radio frequency clearances have not been submitted, pending contract.

Progress and Issues

- A contract for site work and other support activities is in the process of being signed between Indian Institute of Science and LANL – Expected completion early November

- Estimates of equipment prices are being generated by LANL for estimating custom duty costs. These will be paid by the IISc/ISRO.
  - In this context having a good idea of Pantnagar instruments is essential
- Data Access policy is under negotiations
  - Agreed – All data from Nainital AMF will be in ARM archive with a 5 minute delay – Data will be mirrored at a site in India and then sent over to ARM archives
  - Agreed – Unlimited access for the first few weeks of AMF install for instrument mentors to get operational

Progress and Issues

- Agreed – Mentor access to all instruments at AMF on request
- Negotiating - Mentor access to all instruments for MAOS and Pantanagar
- Negotiating – A four hour window each day for all instruments at Nainital for Mentor access
- Aircraft - Papers with the government. ISRO seems to have taken steps to form a committee to manage this and all GVAX and hopeful of a better outcome.
- Lots of smaller issues with contracts and data access – being smoothed out
- Expect AMF to reach India by Jan-Feb.

What DOE brings to India (AMF- Nainital)

Dynamics

Sonde's
RWP
Surface Met
MWRP
(microwave radiometer Profiler)

Energy

Total sky Imager
MFRSR
ECOR(?)
GNDRAD (upwelling broadband shortwave; longwave **)**
SKYRAD (downwelling shortwave; longwave and UV**)**
IRT (infrared thermometer**)**
AERI (Atmospheric Emitted Radiance Interferometer**)**

Clouds

MPL
MWR
NFOV (Narrow Field of View)
TSI (Total sky imager**)**
VCEIL(Ceilometer**)**
WACR (95 GHZ **)**
MMCR (35 GHZ – vu,v, w, cloud boundaries)
Ka/W scanning cloud radar (30km range, 50 m resolution)

Aerosols

AOS (Nephlometer (50% RH**);**
Nephlometer 2(20-90%RH scan**); PSAP**
(filter based at 565nm absorption**); CNC (** 10nm to 3 um**); multiple supersaturation CNC**
(6 different supersaturations**)**

What DOE brings to India (Aerosol Supersite - Pantnagar)

Dynamics

Sonde's
RWP
Surface Met

Energy

PIR (pyrogeometers)
MFRSR
SPS (soil moisture)
ECOR
IRT (infrared thermometer)

Clouds

MPL
MWR
NFOV (Narrow Field of View)
TSI (Total sky imager)
VCEIL(Ceilometer)

Aerosols

Nephlometer
MPL
AMS (?- SOA composition)
PILS (ionic composition)
BC (Aetholometer ?)

Precursor Gases

SO2
NOx,
Ozone
VOCs

What DOE brings to India (Lucknow – Source Characterization)

Dynamics

Surface Met
Sonde's

Aerosols

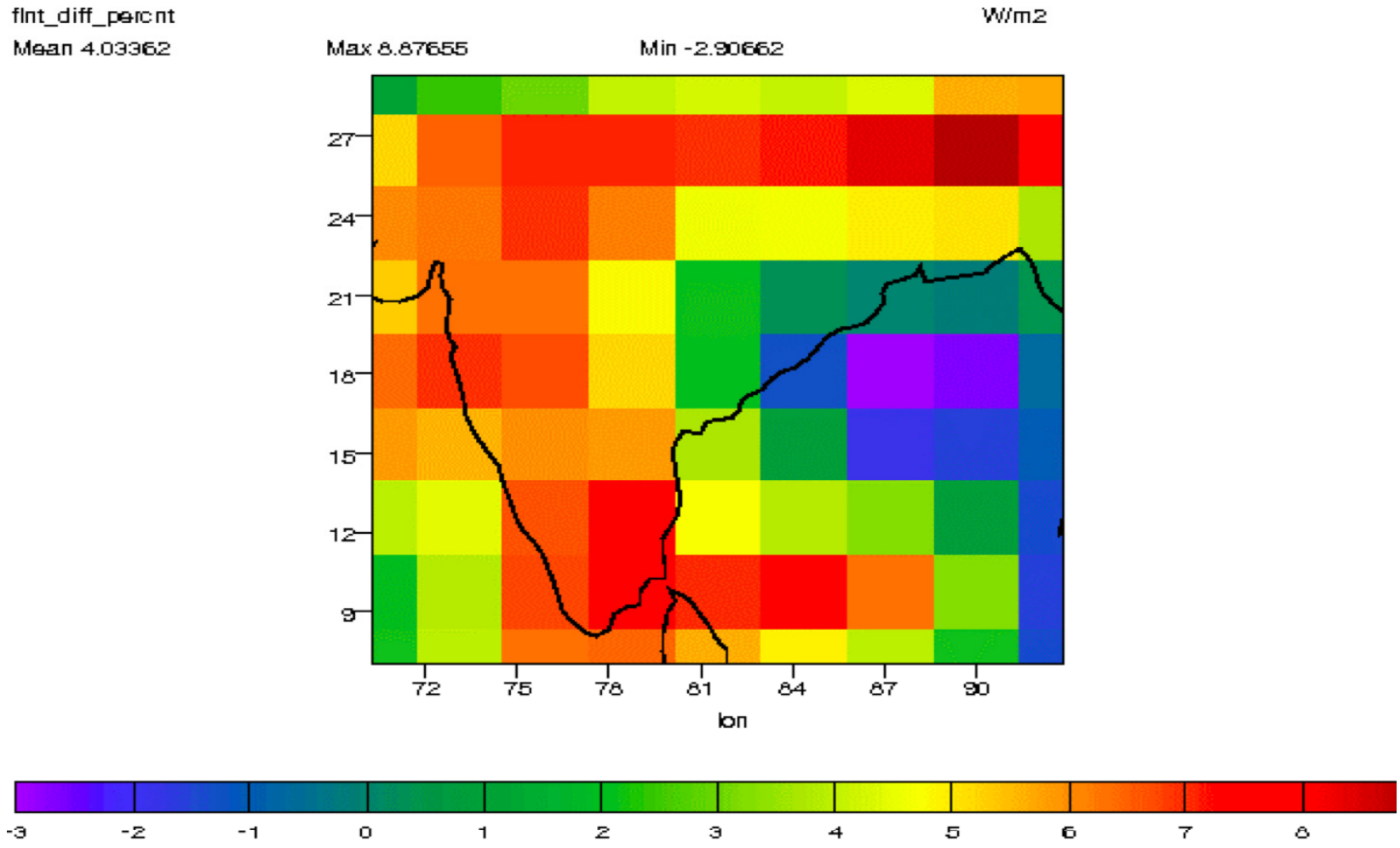
AOS-A (aerosol)
CNC
UltraFine CNC
Nephelometer
CCNHumidigraph
Particle Soot Absorption Photometer (PSAP)
Hygro-Tandem DMA (HTDMA)
MAOS-C (chemistry)

Aerosol Chemical Speciation Monitor (ACSM)
Ultra-High Sensitivity Aerosol Spectrometer (UHSAS)
Photoacoustic Absorption Spectrometer (PASS-3)
7-wavelength Aethalometer
Scanning Mobility Particle Sizer (SMPS)
Particle in Liquid Sampler (PILS)
Proton Transfer Mass Spectrometer (PTRMS)
Trace Gas Package (CO, SO_2 , O_3 , NO/NO_2 /NO_y)
Single Particle Soot Photometer (SP2)

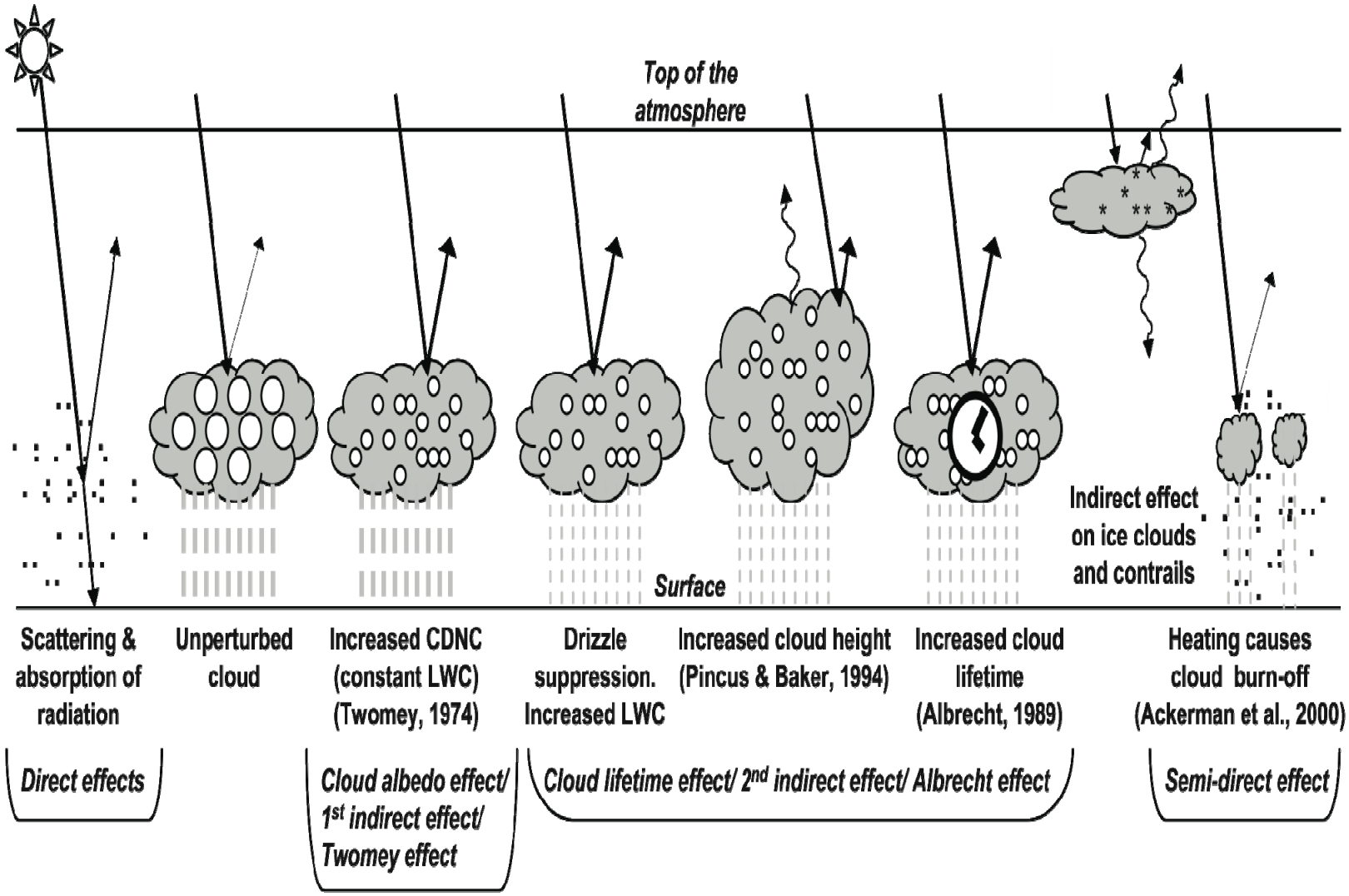
Other Active Participants (those not listed on the front page)

- Mike Ristche (ANL)
- Greg Carmichael (U Iowa)
- C. Venkatraman (IIT-Bombay; India)
- S. Menon (LBNL)
- Bill Lau (NASA)
- Pete Daum (BNL)
- Xiaohong Liu (PNNL)
- Brent Holben (NASA)
- Paul Doskey (Michigan Tech)

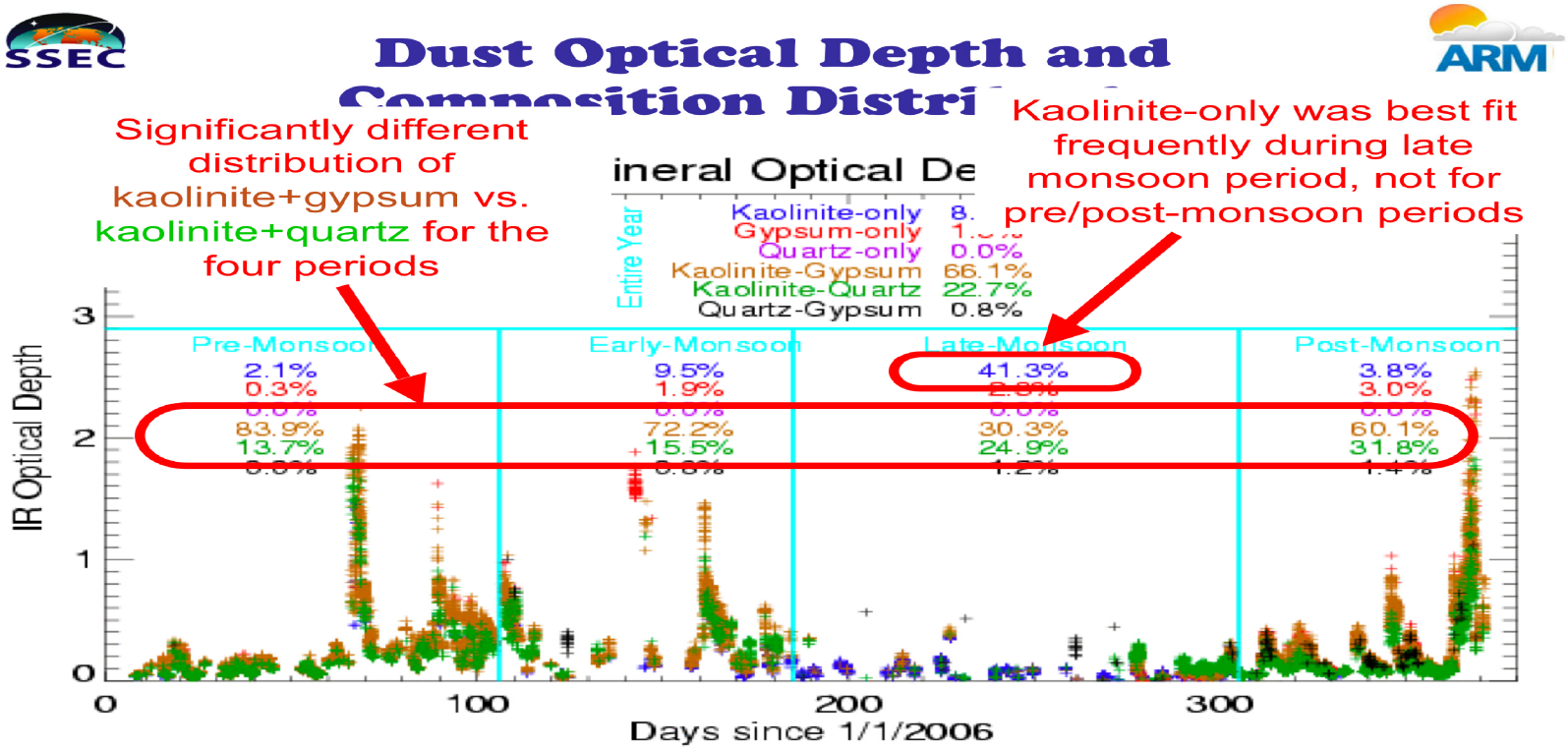
TOA Longwave Flux Difference with 10-fold increase in Sulfate (CAM Model)



Aerosols Direct and Indirect Effects – AR-4



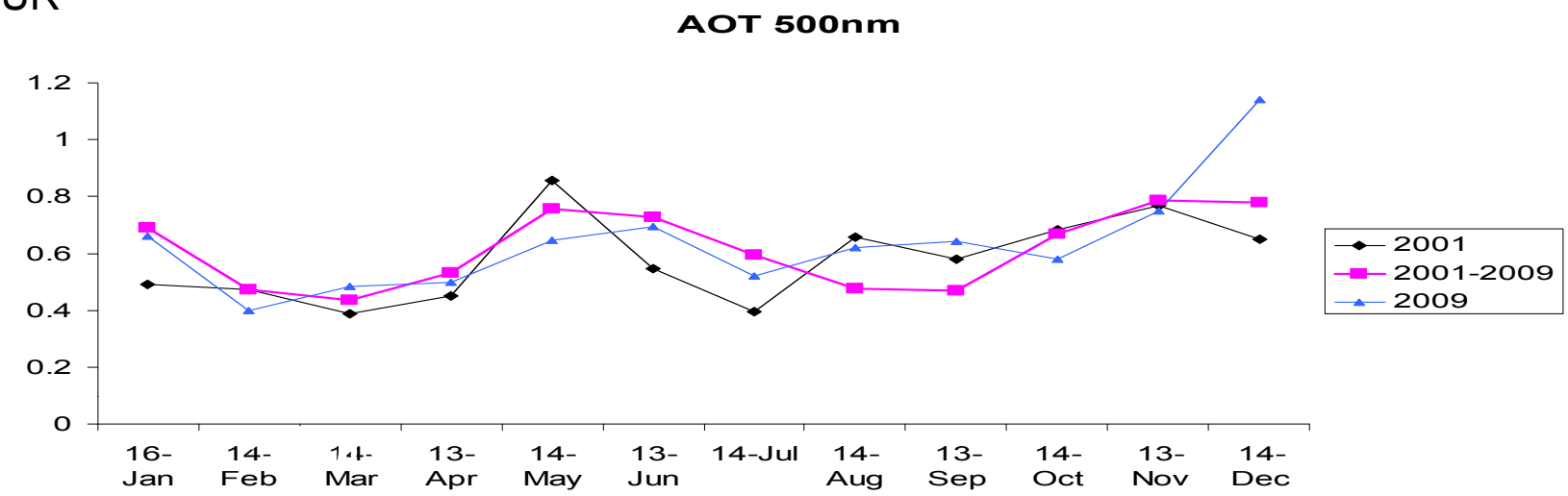
We can measure dust through the year using AERI (Turner):

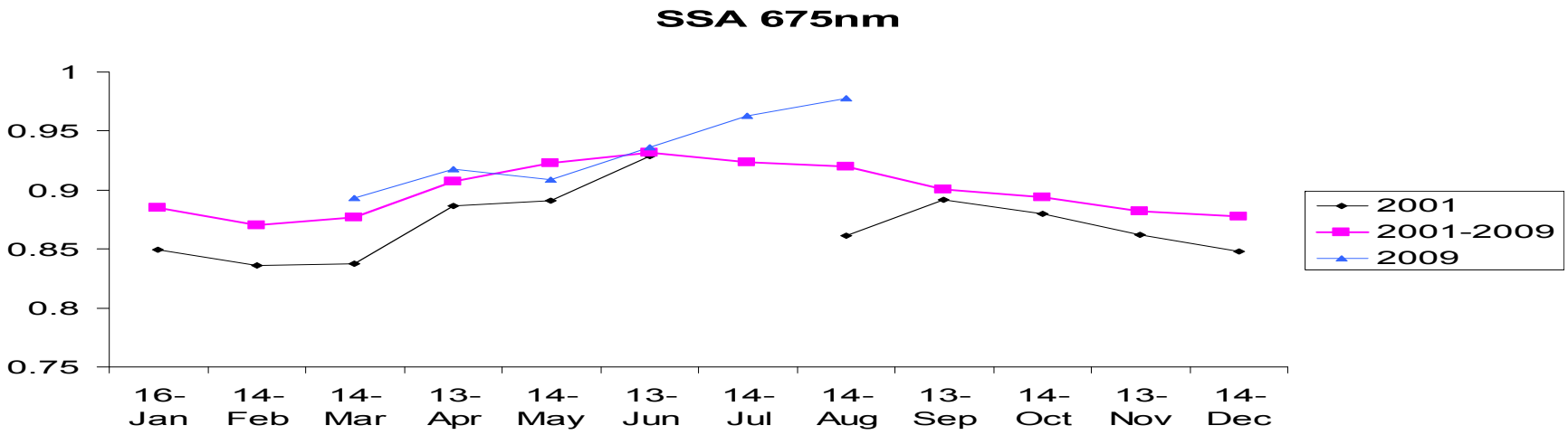


Dust optical depth and composition can be estimated; could help differentiate local sources from longrange transport

Seasonal cycle (10-year averages)

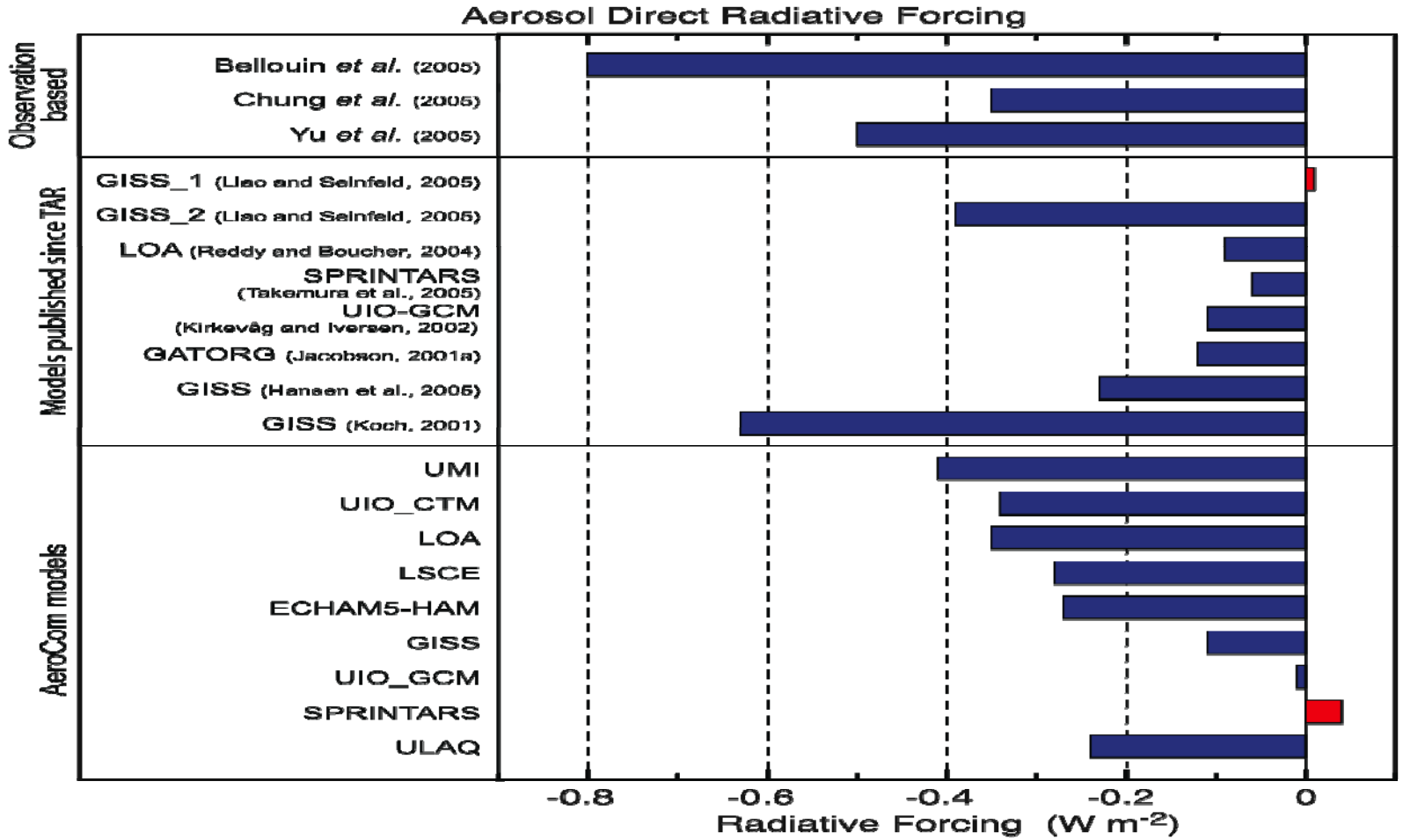
AERONET
-KANPUR





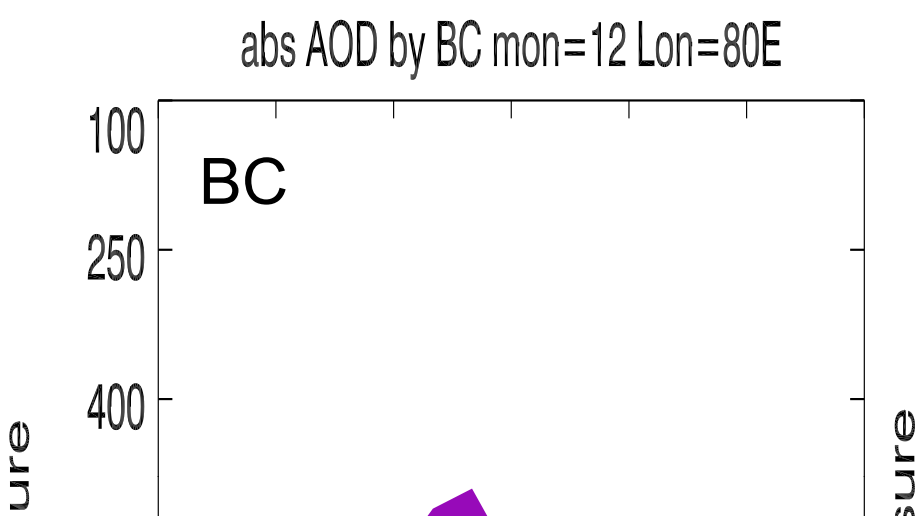
Cloud radiative forcing and aerosol radiative forcing are biggest uncertainties in climate modeling.

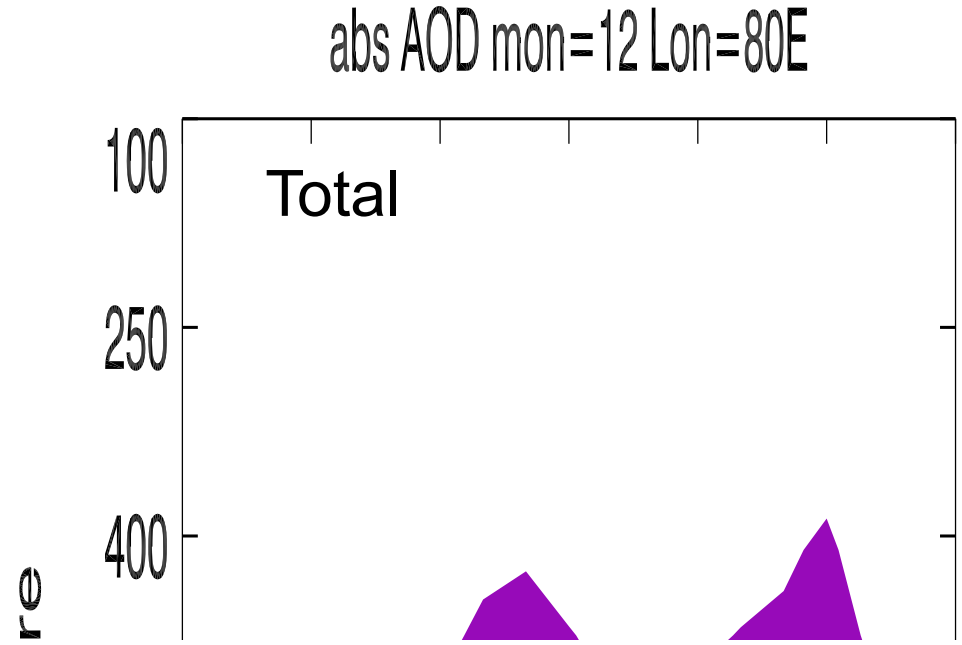
'**Even**' DRF global uncertainties are off nearly a factor of four



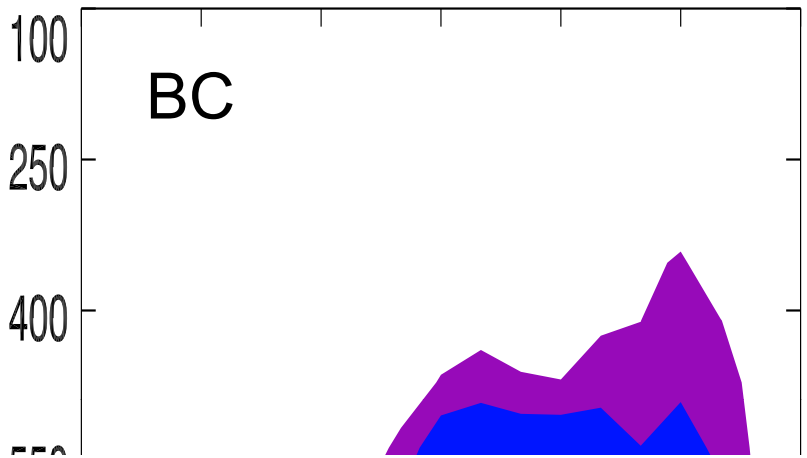
AR-4, Ramaswamy et al.,

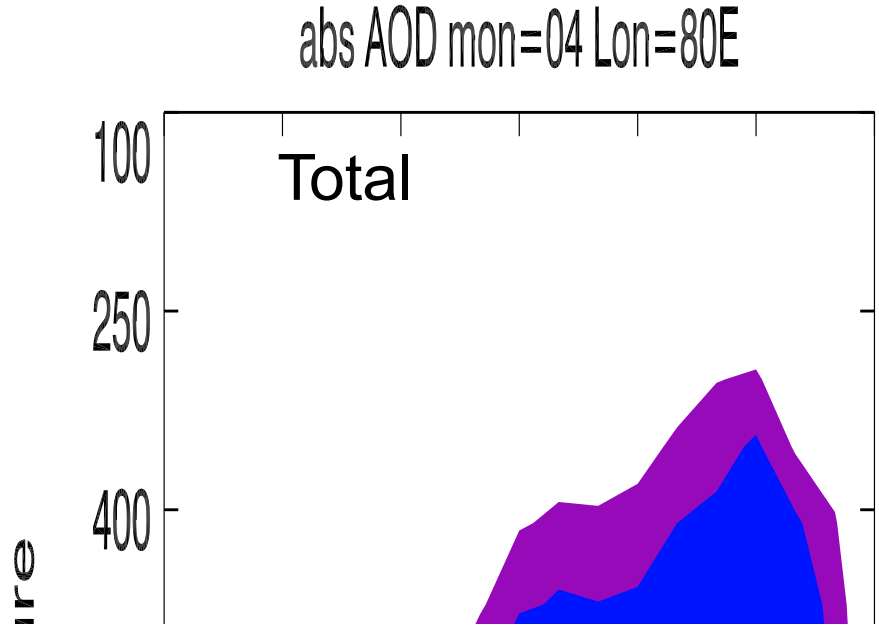
December





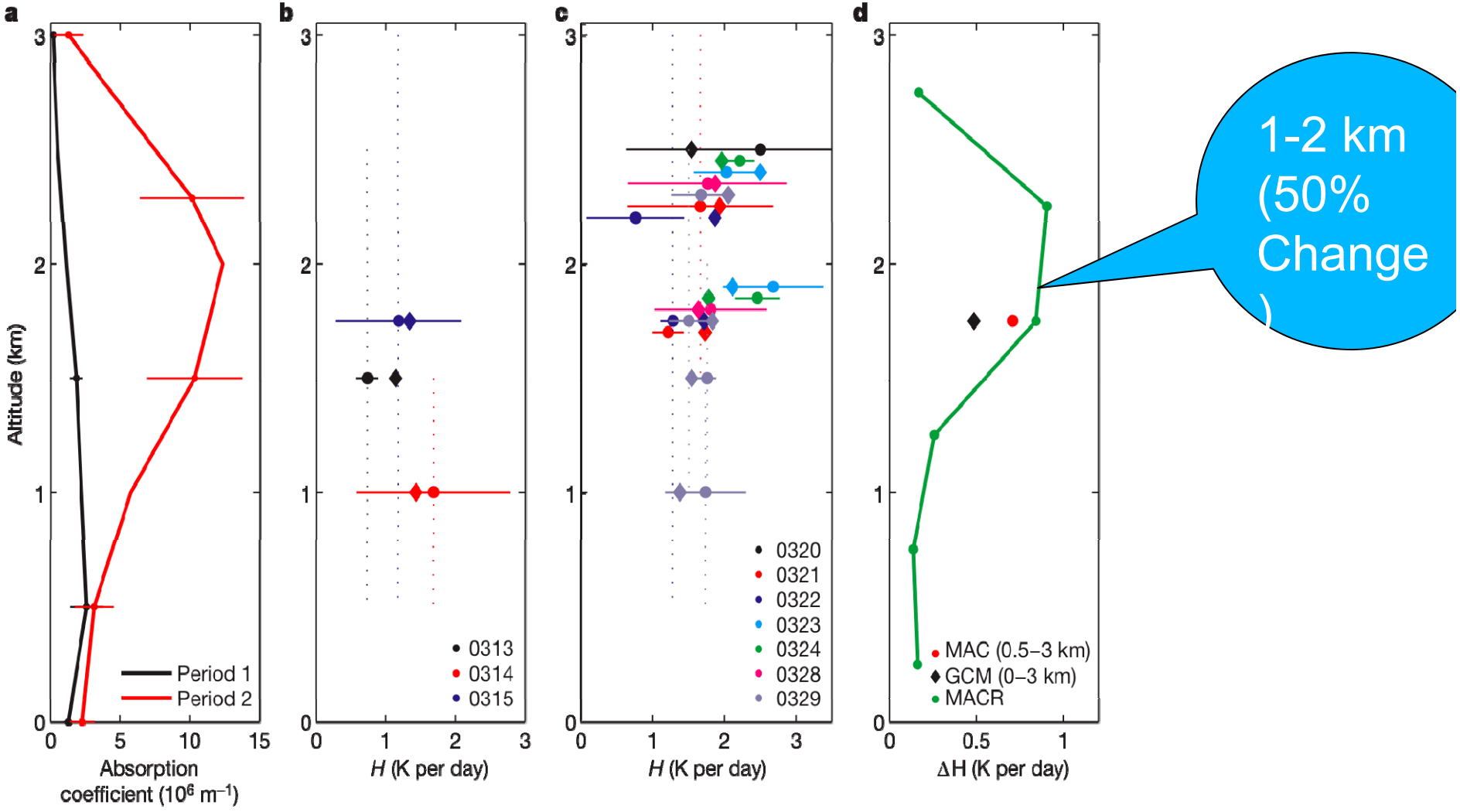
April





Argonne NATIONAL LABORATORY

Motivation- PBL and Aerosols and Heating Rates 2KM and 3 KM

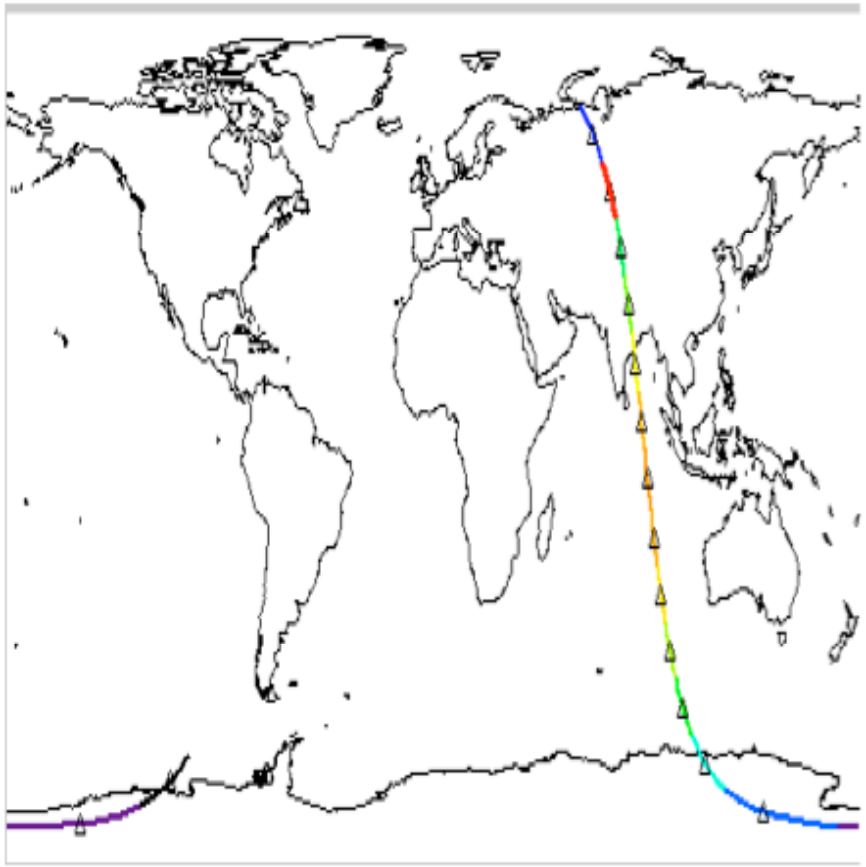


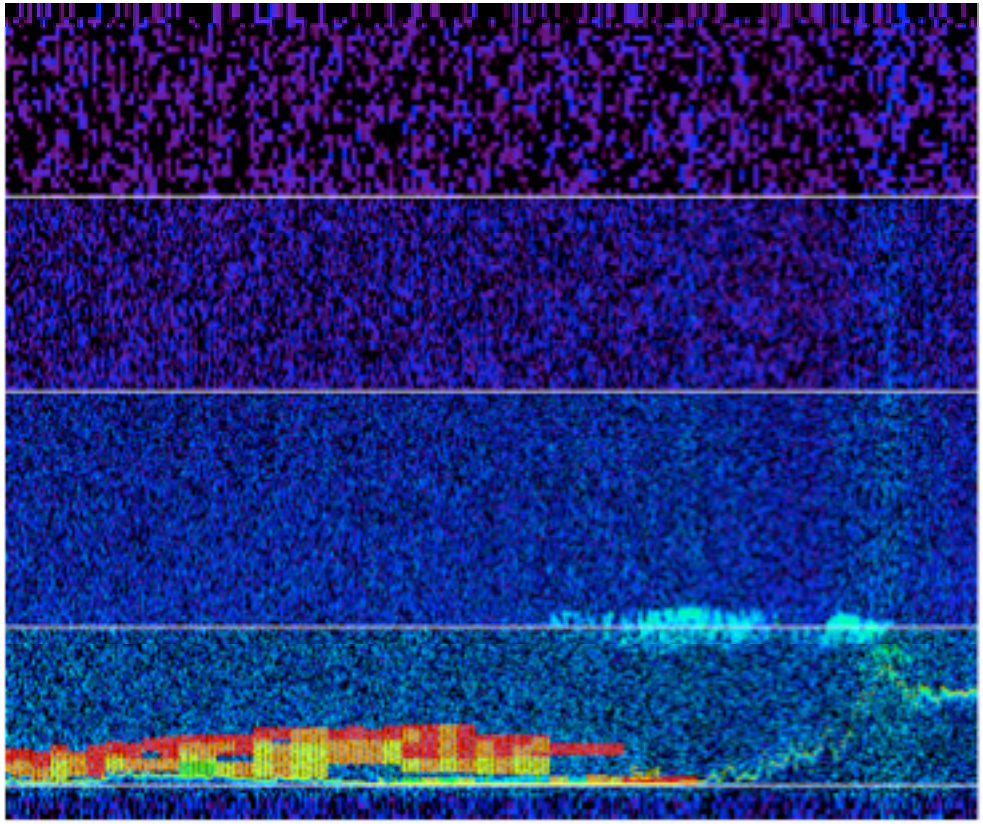
MAC Study with stacked UAV'S

Argonne NATIONAL LABORATORY

Ramanathan et al., 2007

Aerosols are abundant in the lower atmosphere in Winter





CALIPSO measurements for a path that is over India. The figures are for January 24th, 2009 at 09Z. The figure on the left shows the satellite track and the right hand side shows total backscatter at 532nm. The right hand side is a profile obtained along the segment over north easte India (highlighted in green). The right hand side shows the presence of significant amount backscattering at 532 nm from aerosols present i the boundary layer and the lower part of the atmosphere.

Where the aerosols are has large impact on surface temps, convection (Chung et al., 2004)

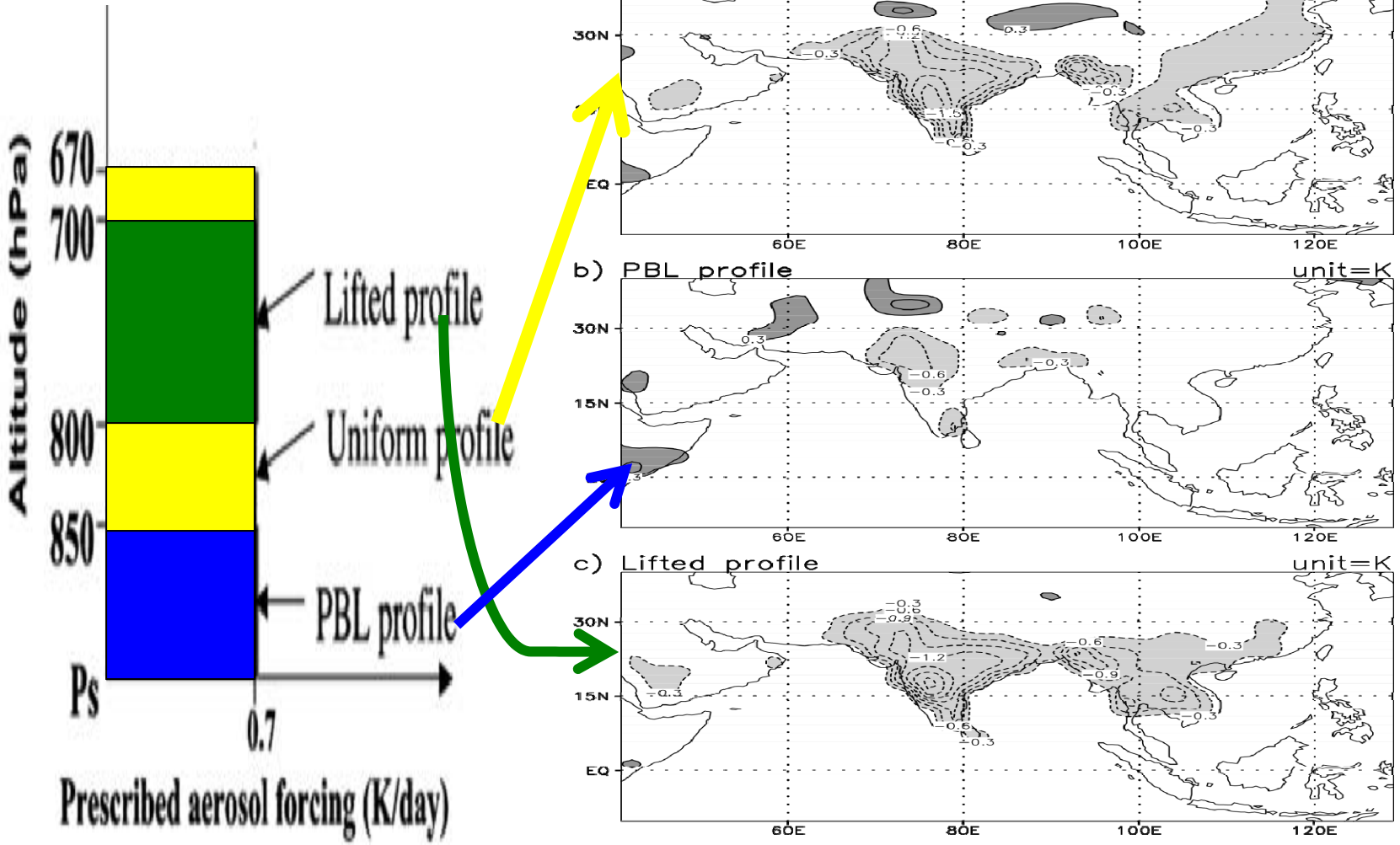


Figure 3. January–March surface temperature change by (a) uniform profile south Asian aerosol, (b) PBL profile, and (c) lifted profile. The National Center for Atmospheric Research CCM3 was used for the simulation.

What Do We Need to Know:

- The models predict big changes convective mixing over Northern/Central portions of India. Can we estimate convective mixing rates?
- What makes up these aerosols?
- What is the dust to BC ratio over India during pre-monsoon?
- What are the heating rates in the background (low aerosols) and perturbed (high aerosol) in the column over the Ganges Valley Region?