Changes in Atmospheric Parameters Due to Dust Storm Using AIRS Data

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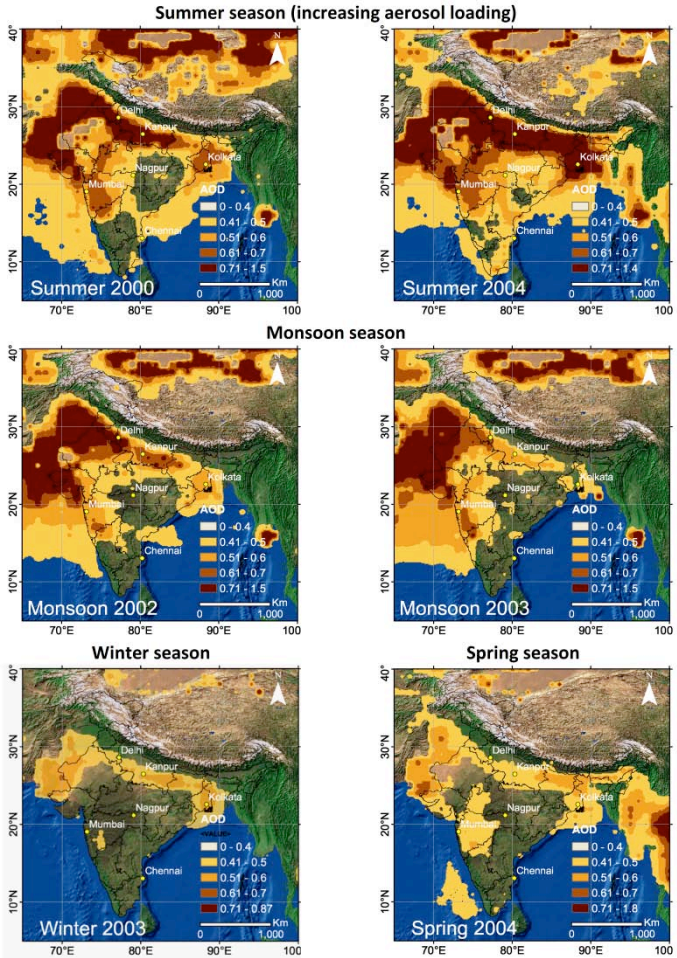
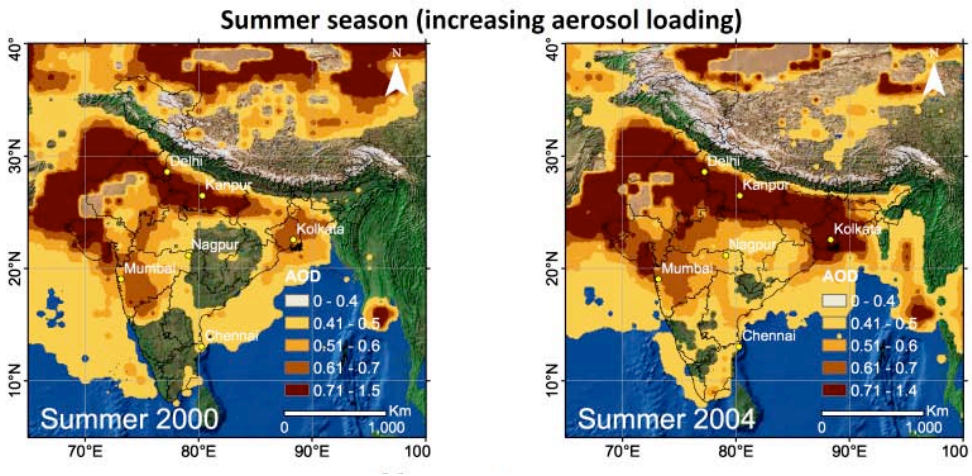
- Ritesh Gautam and C. Hsu (NASA)
- Partha S. Bhattacharjee
- Menas Kafatos


Summer season (increasing aerosol loading)
Summer 2000
Summer 2004
Monsoon season
Monsoon 2002
Monsoon 2003
Winter season
Winter 2003
Spring season
Spring 2004
Delhi
Kanpur
Nagpur
Kolkata
Mumbai
Chennai
AOD
0 - 0.4
0.41 - 0.5
0.51 - 0.6
0.61 - 0.7
0.71 - 1.5
0.71 - 1.4
0.71 - 0.87
0.71 - 1.8
Km
0
1,000
70°E
80°E
90°E
100
10°N
20°N
30°N
40°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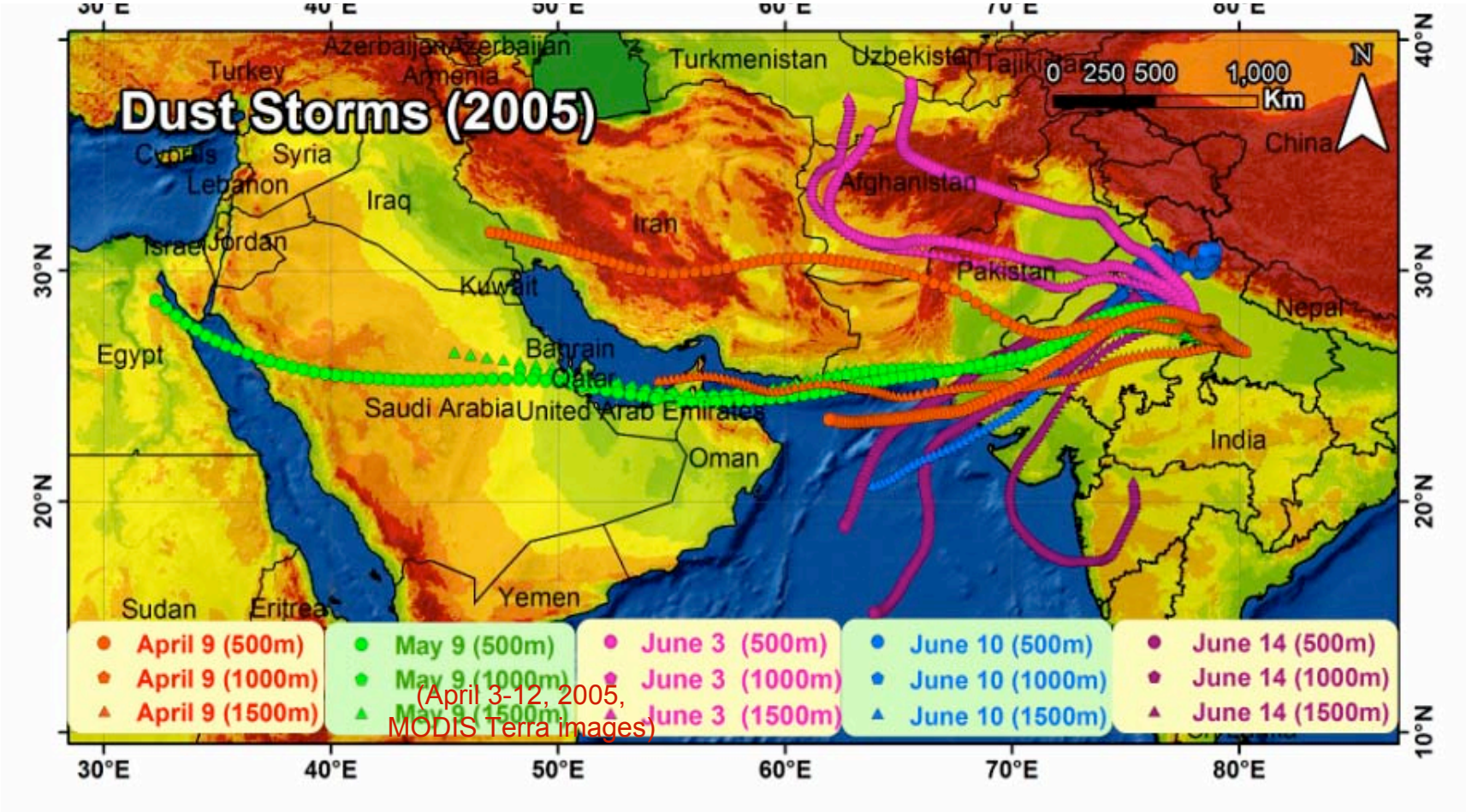
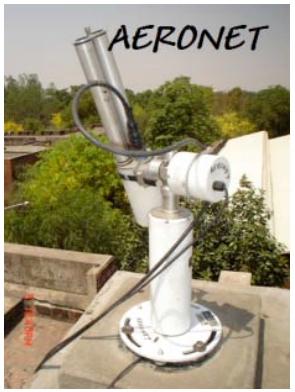
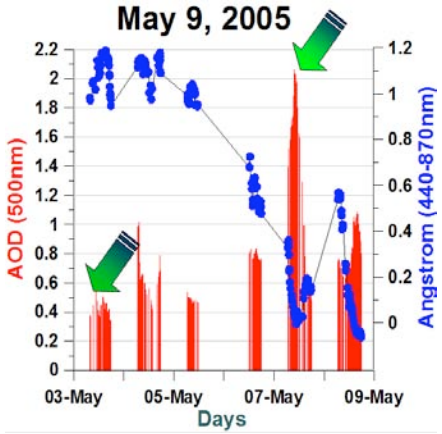
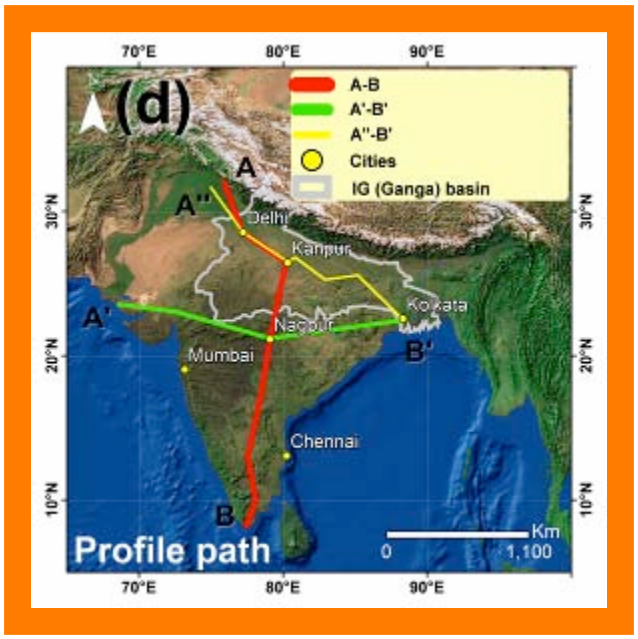
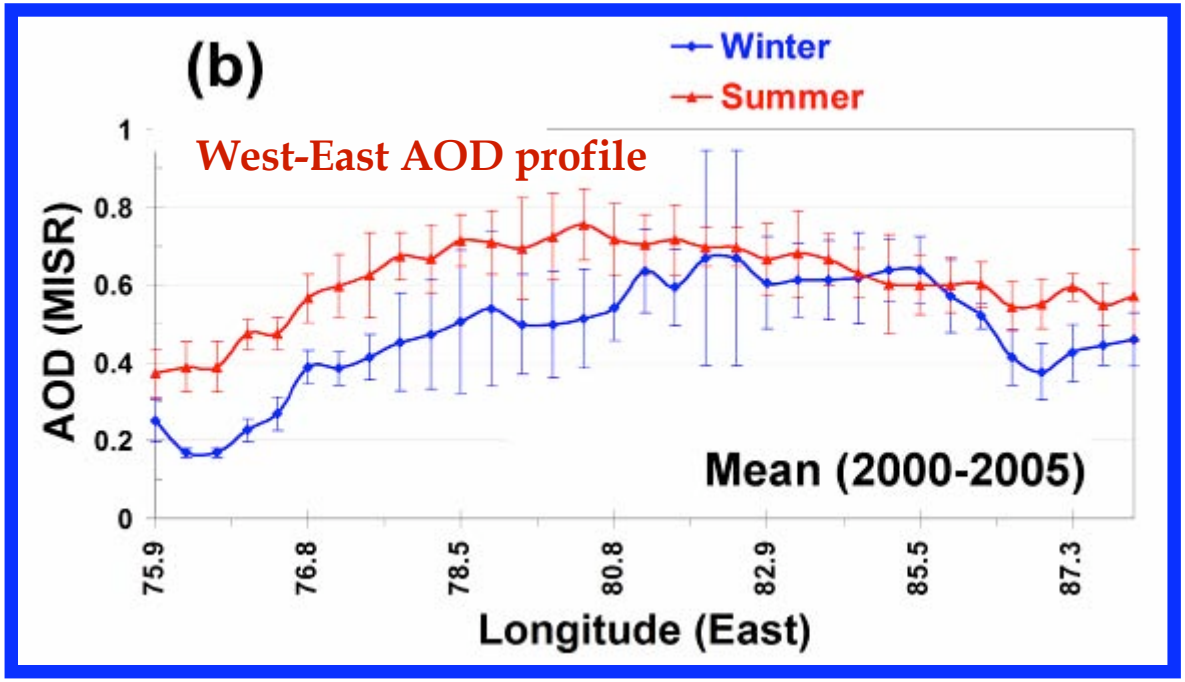


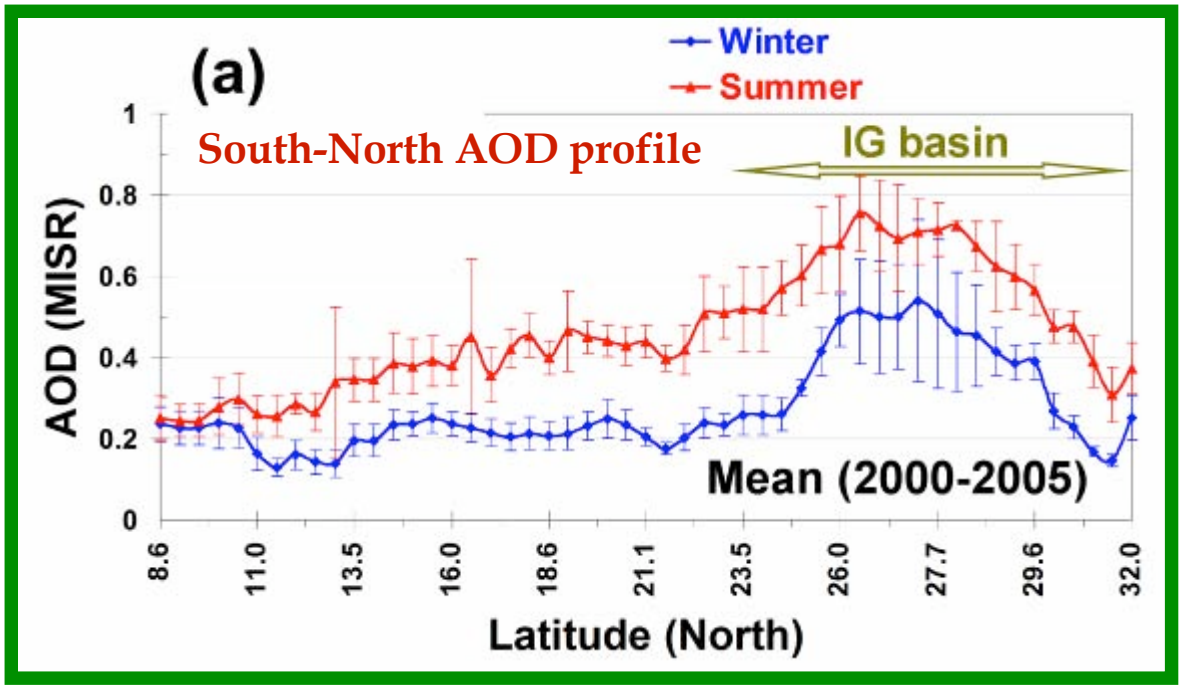


Ground based
CIMEL
Sun-
photometer

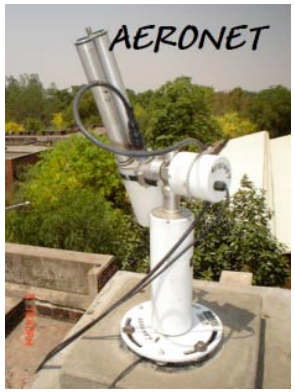


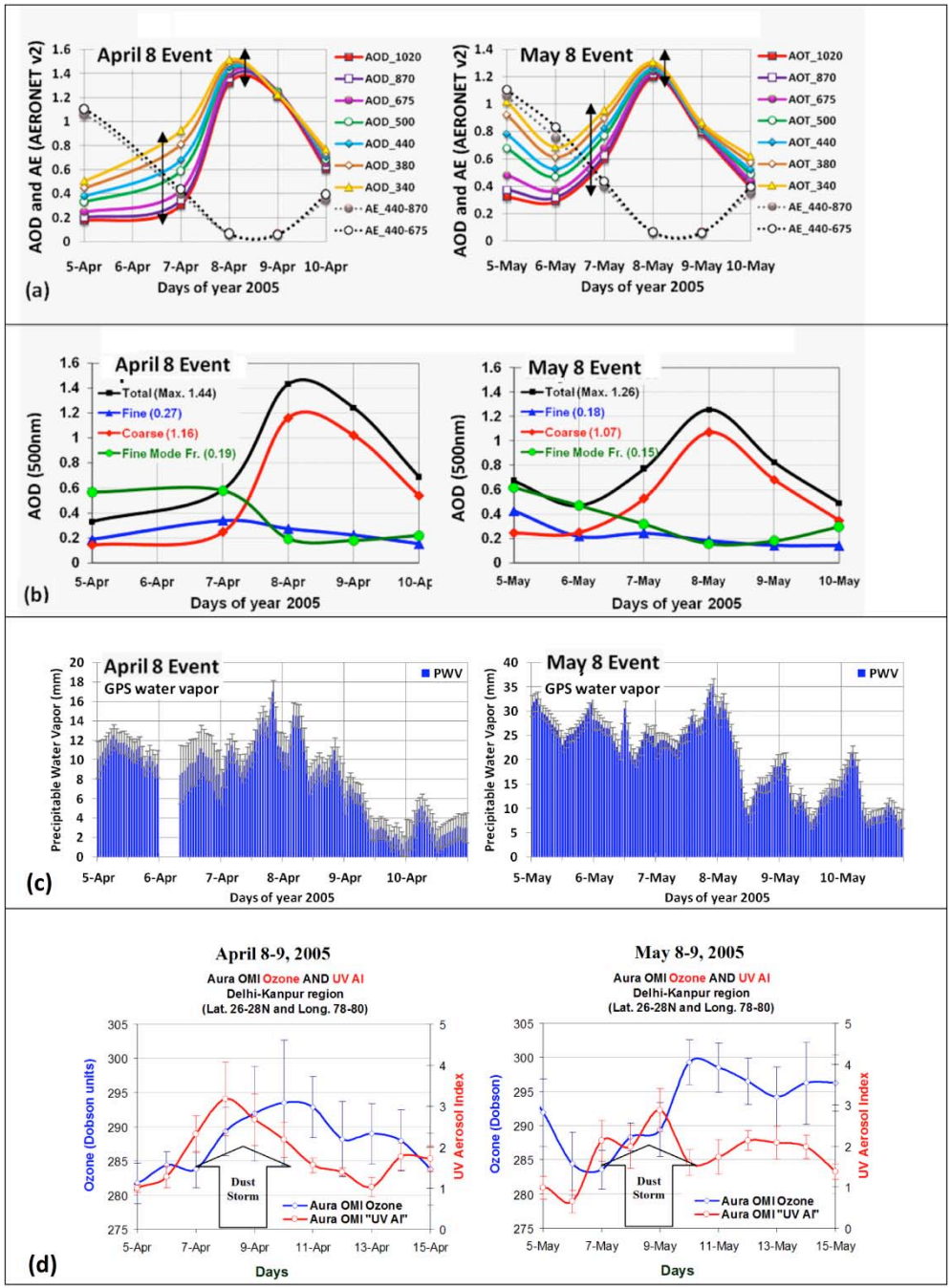

(d)
A-B
A'-B'
A''-B'
Cities
IG (Ganga) basin
A
A''
A'
B
B'
Delhi
Kanpur
Kolkata
Nagpur
Mumbai
Chennai
Profile path
Km
0
1,100
70°E
80°E
90°E
30°N
20°N
10°N


(b)
Winter
Summer
West-East AOD profile
AOD (MISR)
Mean (2000-2005)
Longitude (East)
75.9
76.8
78.5
80.8
82.9
85.5
87.3

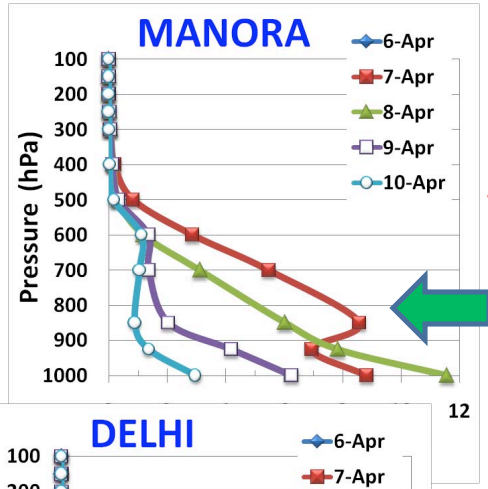

(a)
Winter
Summer
South-North AOD profile
IG basin
AOD (MISR)
Mean (2000-2005)
Latitude (North)
8.6
11.0
13.5
16.0
18.6
21.1
23.5
26.0
27.7
29.6
32.0

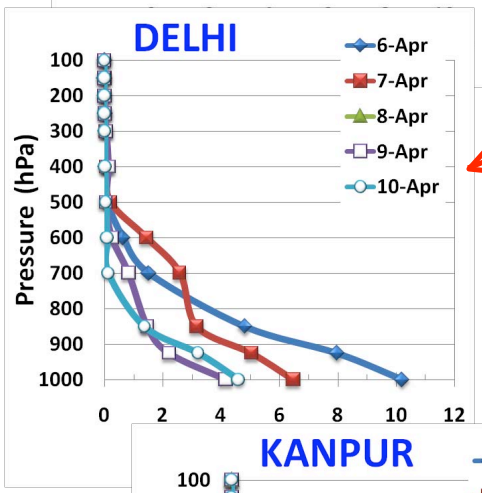
AERONET

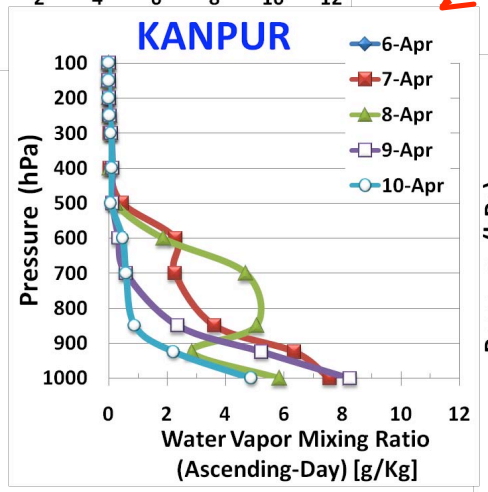

AERONET

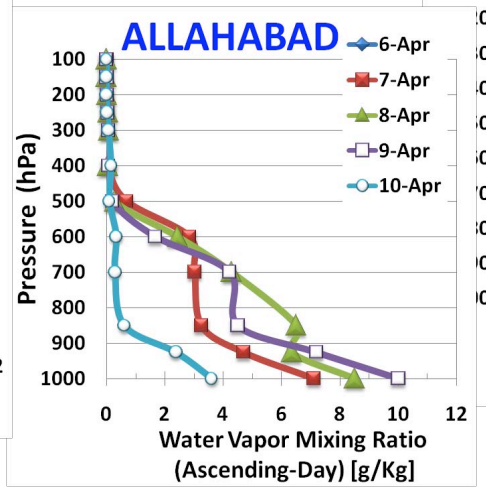

April 8 Event
May 8 Event
AOD and AE (AERONET v2)
AOD_1020
AOD_870
AOD_675
AOD_500
AOD_440
AOD_380
AOD_340
AE_440-870
AE_440-675
AOT_1020
AOT_870
AOT_675
AOT_500
AOT_440
AOT_380
AOT_340
5-Apr 6-Apr 7-Apr 8-Apr 9-Apr 10-Apr
5-May 6-May 7-May 8-May 9-May 10-May
Days of year 2005
(a)
AOD (500nm)
Total (Max. 1.44)
Fine (0.27)
Coarse (1.16)
Fine Mode Fr. (0.19)
Total (Max. 1.26)
Fine (0.18)
Coarse (1.07)
Fine Mode Fr. (0.15)
(b)
GPS water vapor
PWV
Precipitable Water Vapor (mm)
(c)
April 8-9, 2005
May 8-9, 2005
Aura OMI Ozone AND UV AI
Delhi-Kanpur region
(Lat. 26-28N and Long. 78-80)
Ozone (Dobson units)
UV Aerosol Index
Dust Storm
Aura OMI Ozone
Aura OMI "UV AI"
Days
(d)

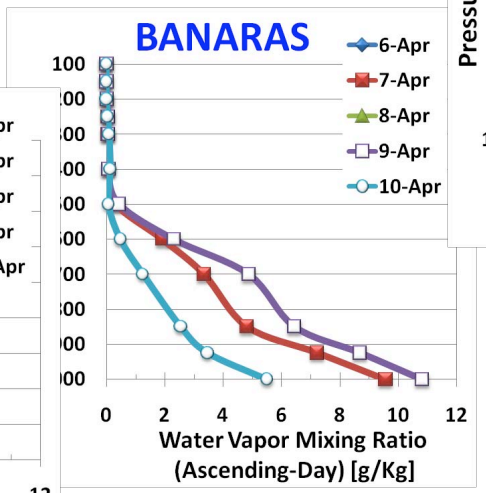
AIRS – Water Vapor Mixing Ratio (g/Kg)

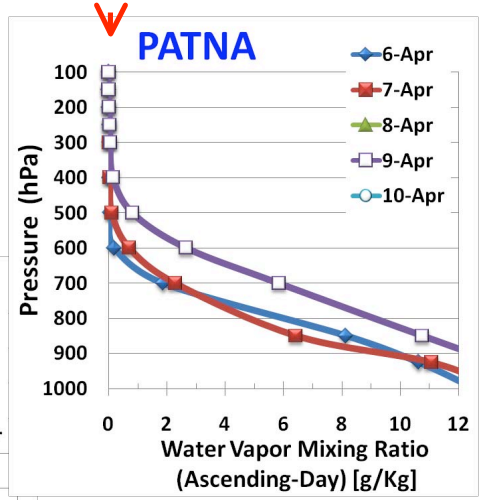


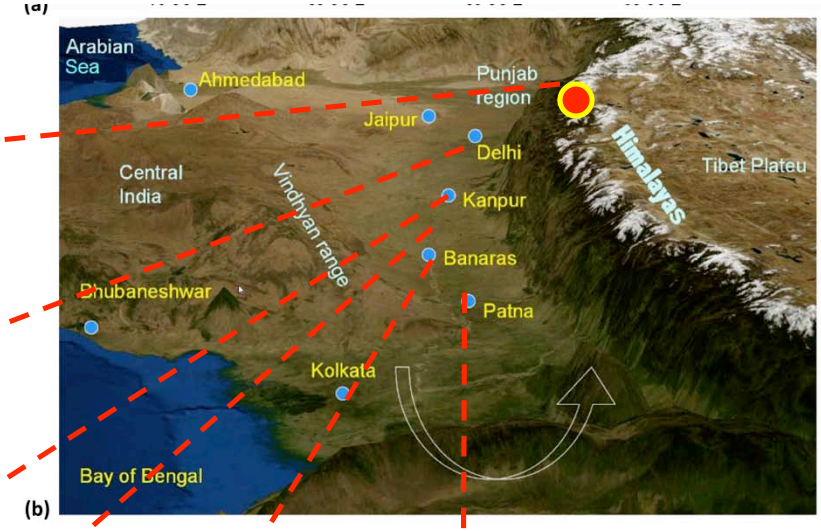








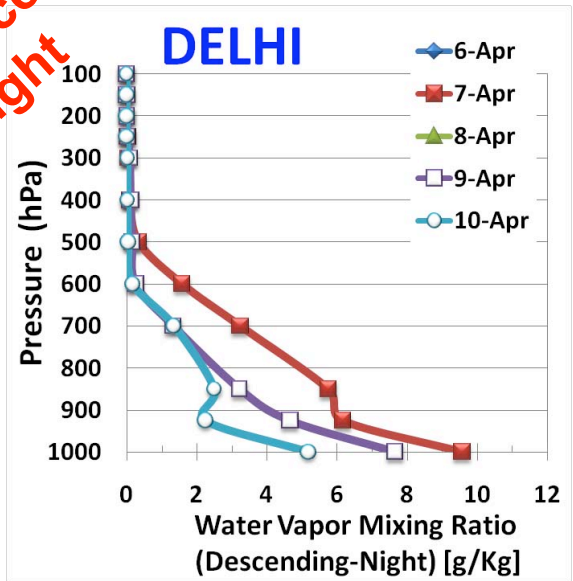


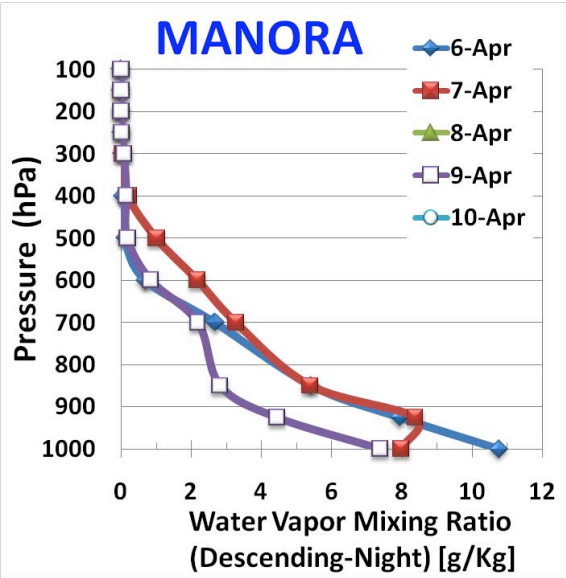


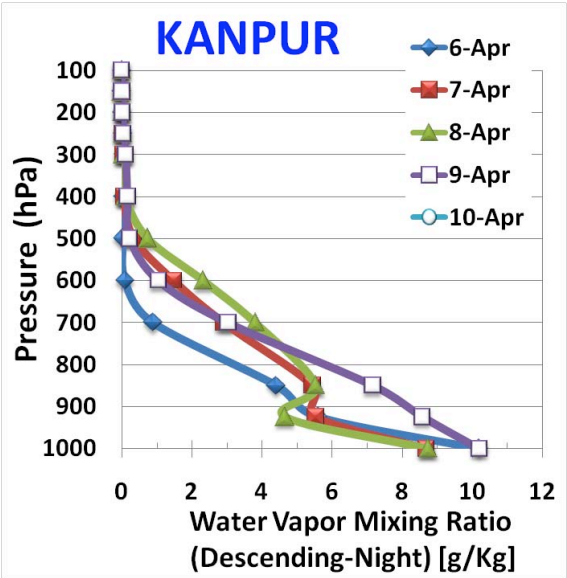
Ascending - Day

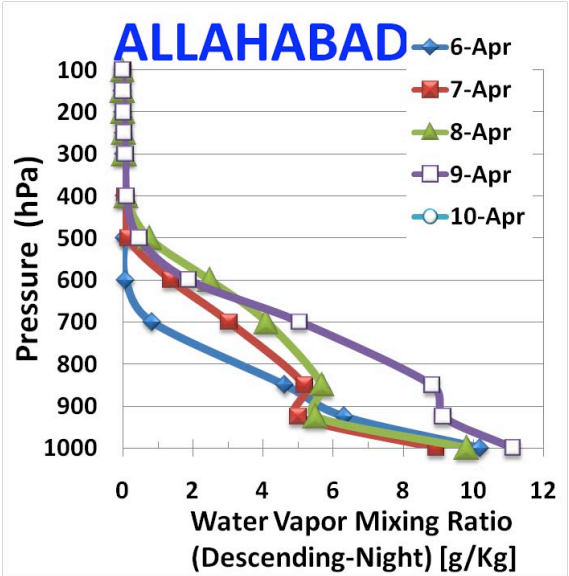
AIRS – Water Vapor Mixing Ratio (g/Kg)

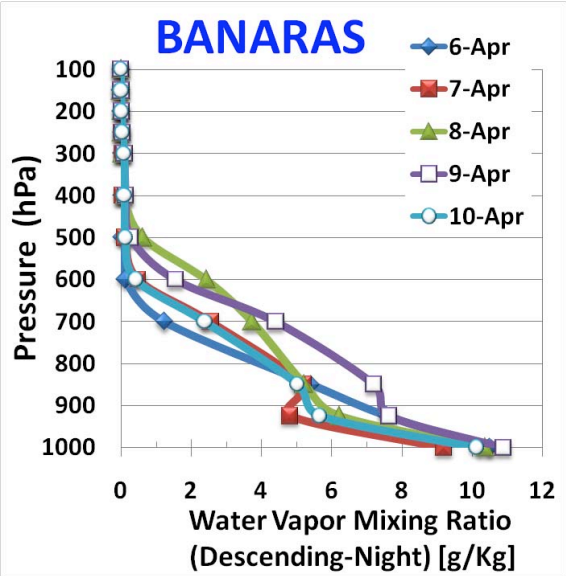
Descending - Night

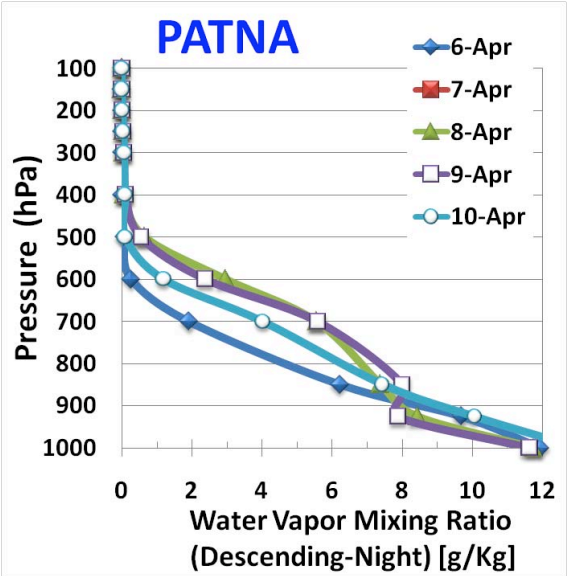






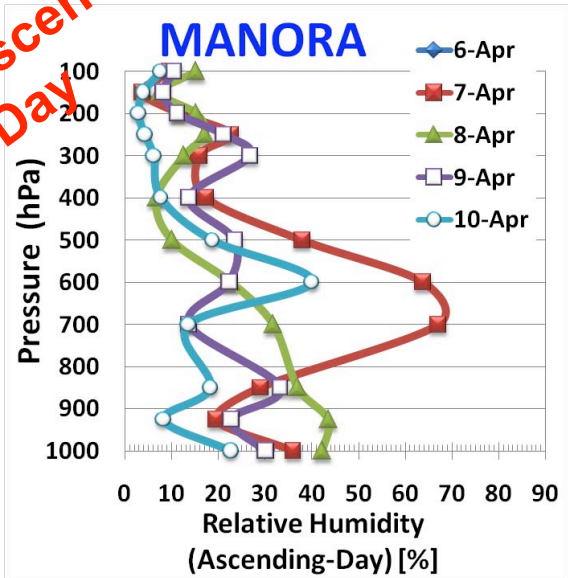


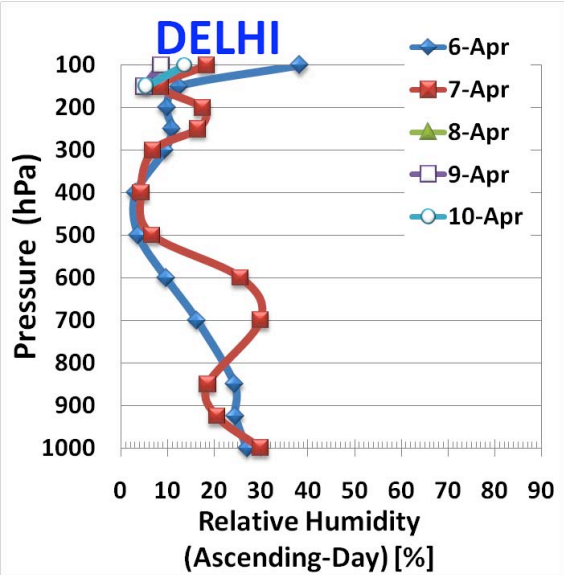


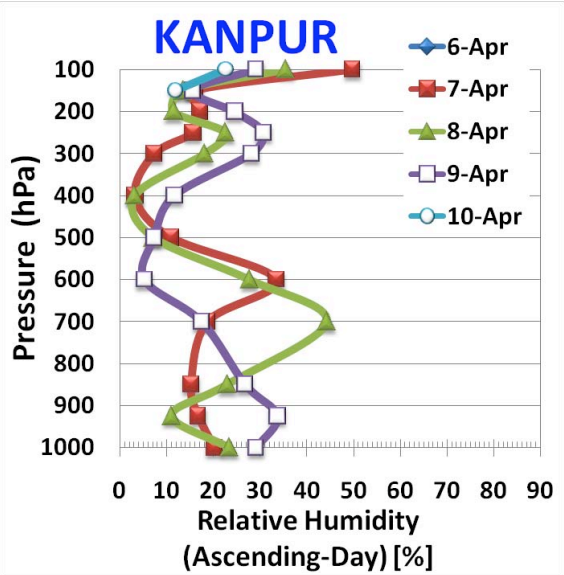


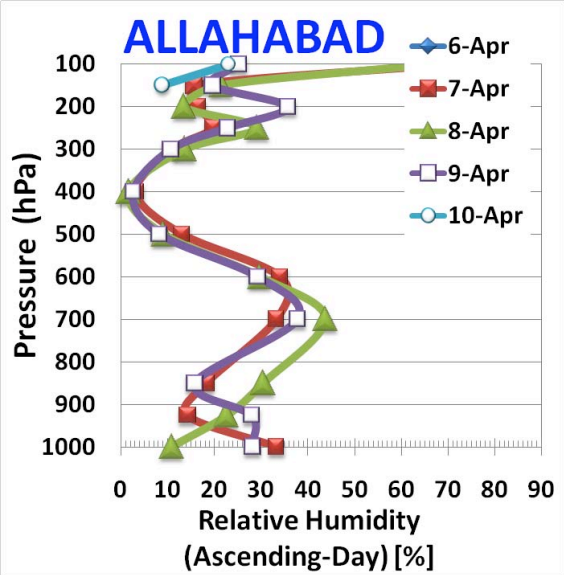
AIRS – Relative Humidity (%)

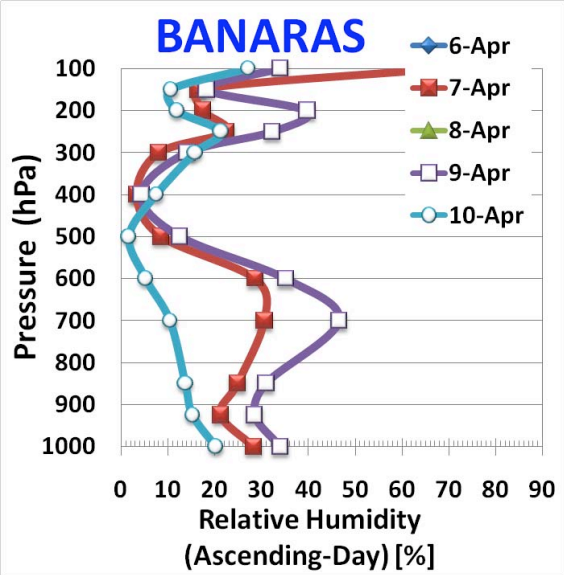
Ascending - Day

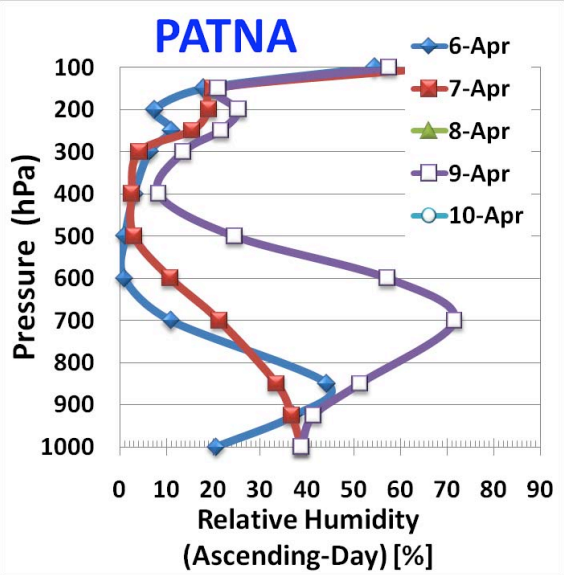






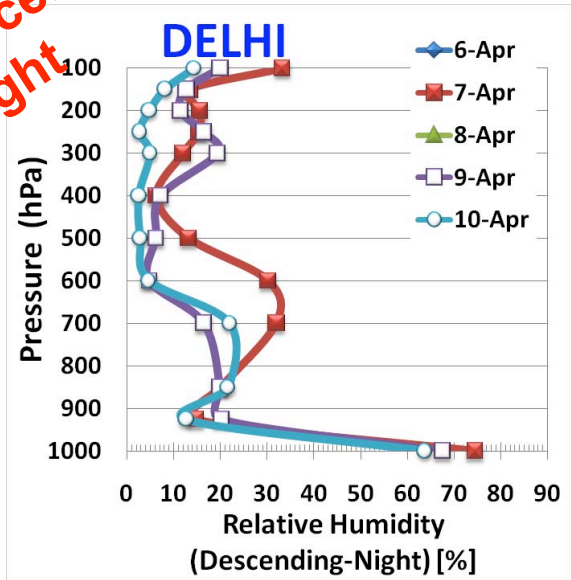


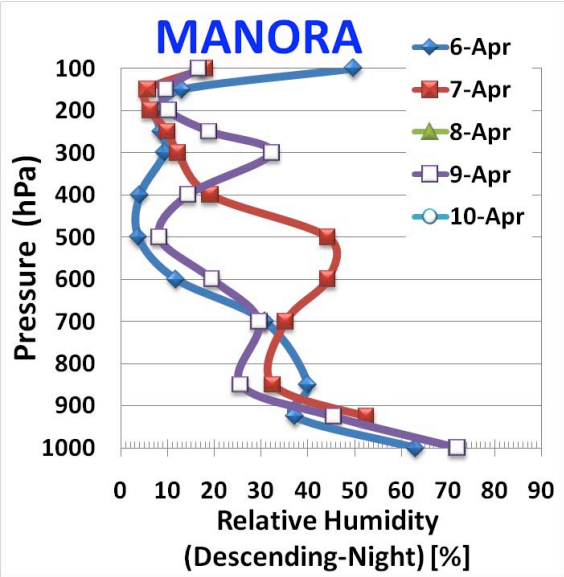


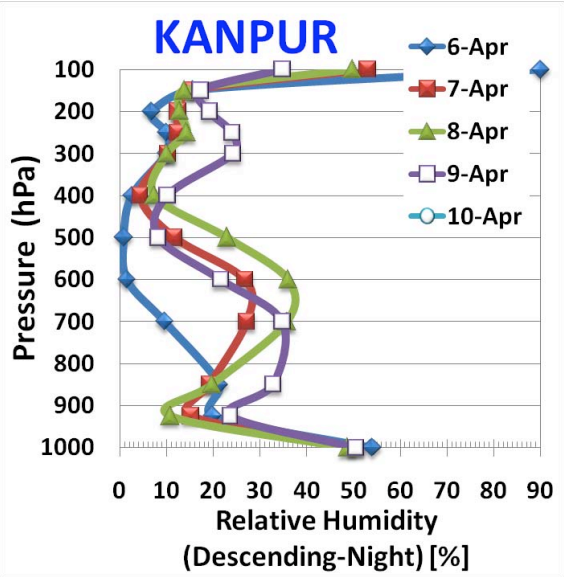


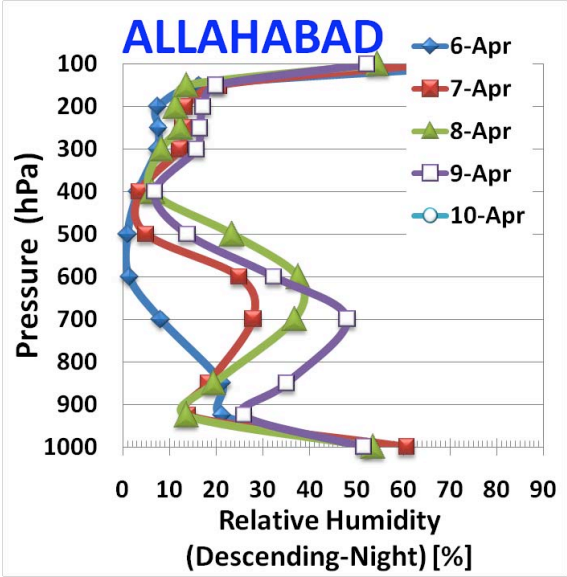
AIRS – Relative Humidity (%)

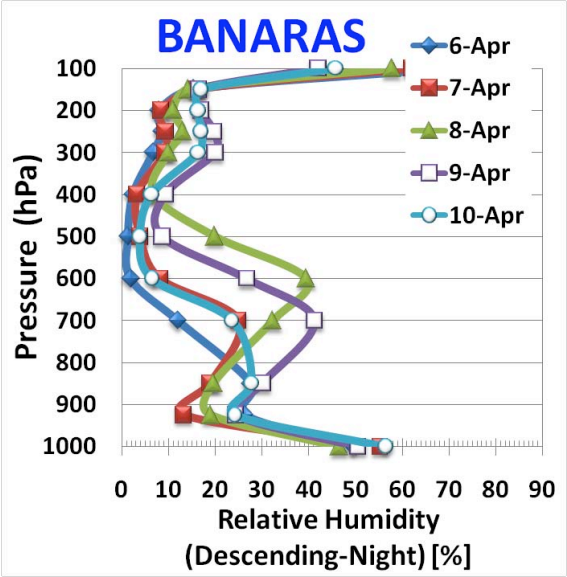
Descending - Night

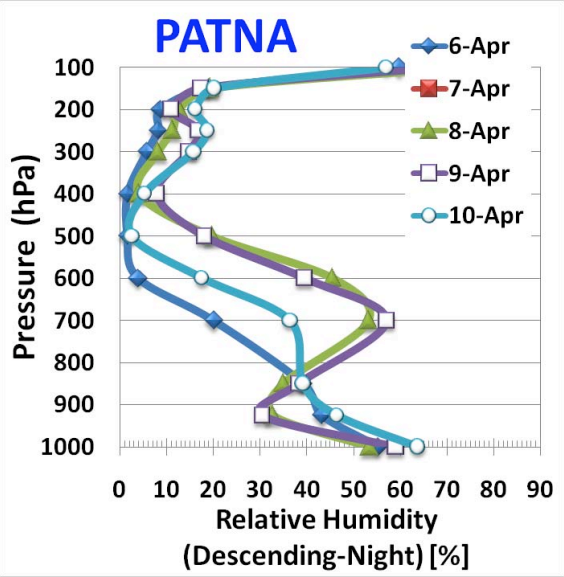






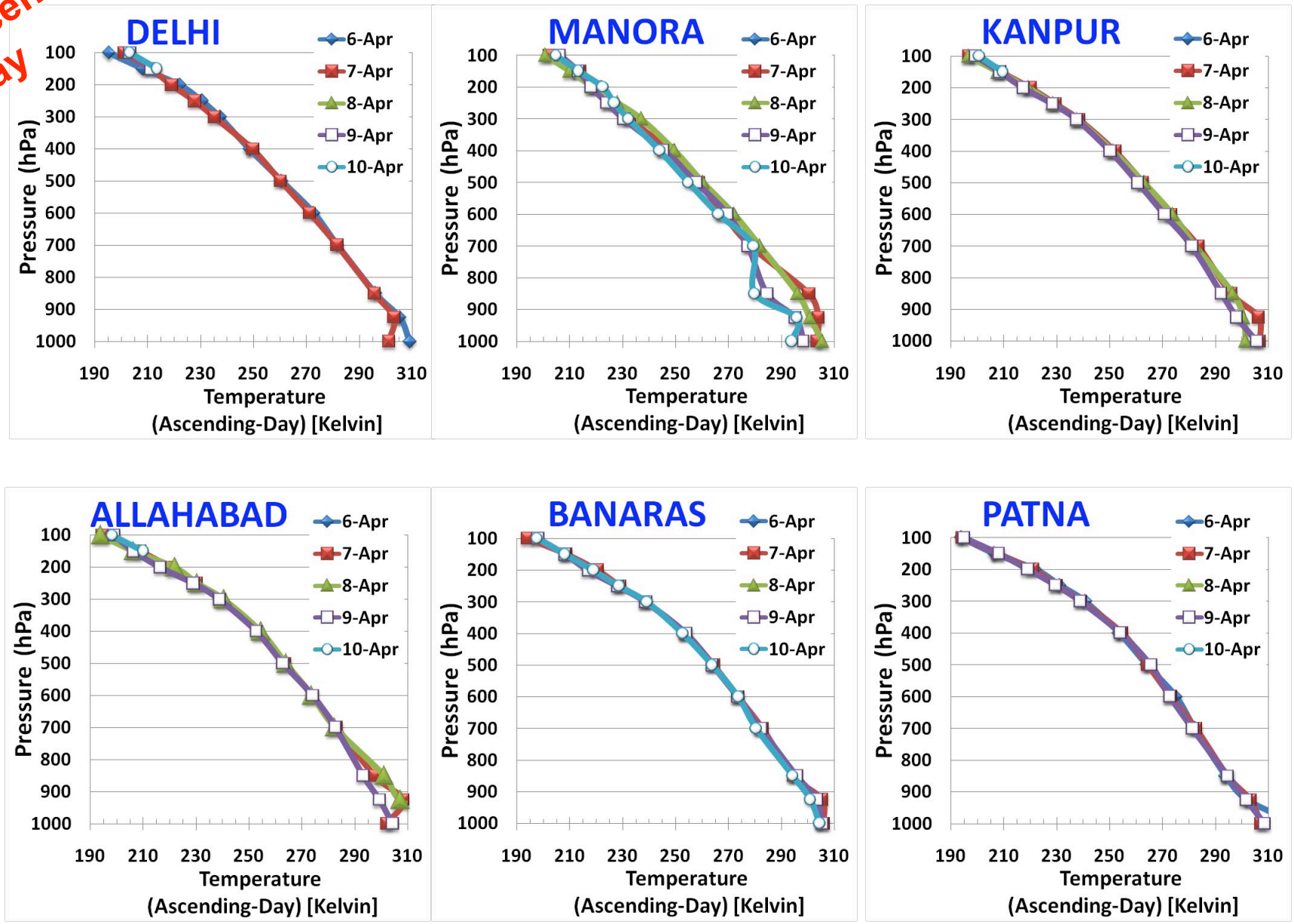






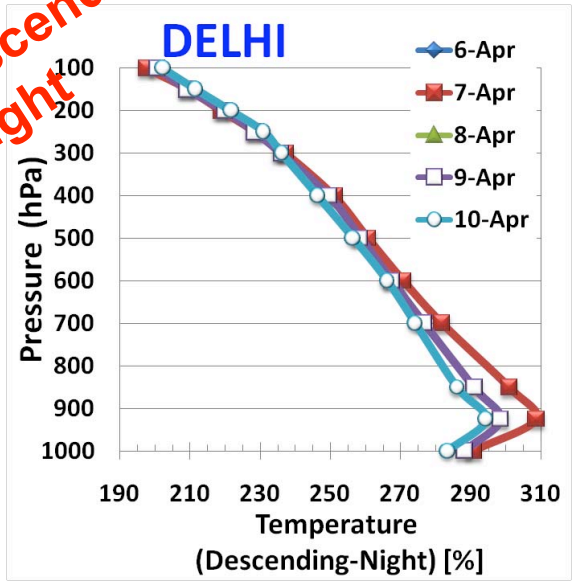
AIRS – Temperature (Kelvin)

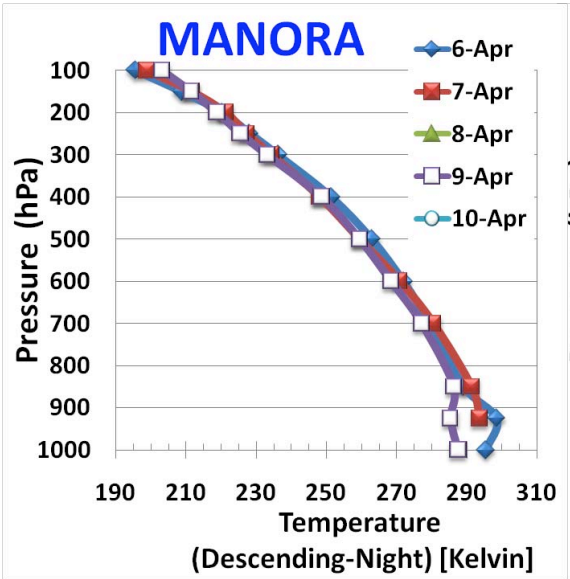
Ascending - Day

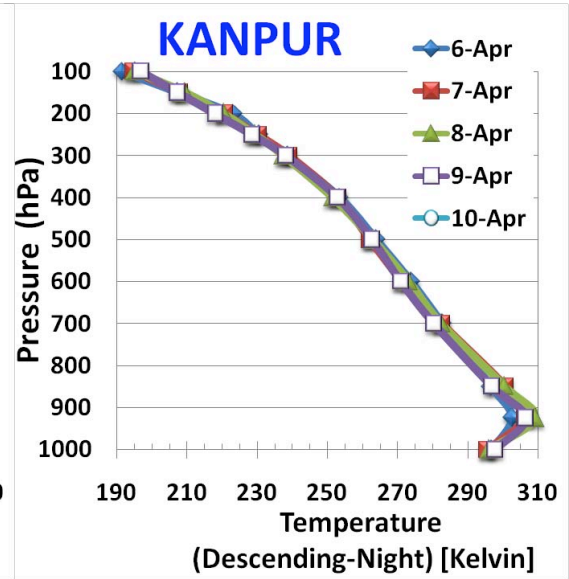


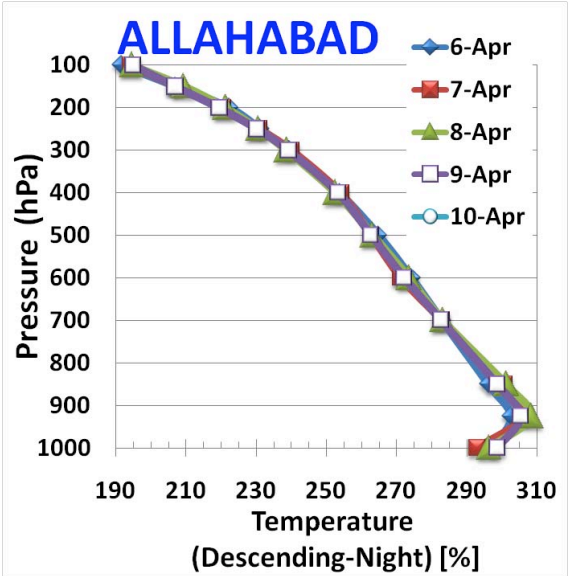
AIRS – Temperature (Kelvin)

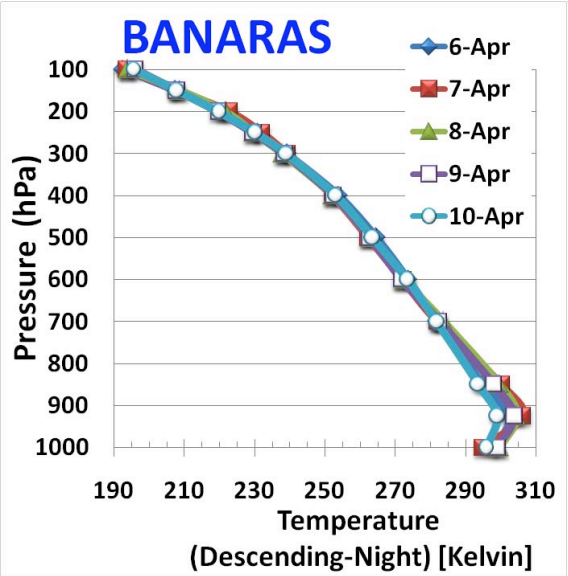
Descending - Night

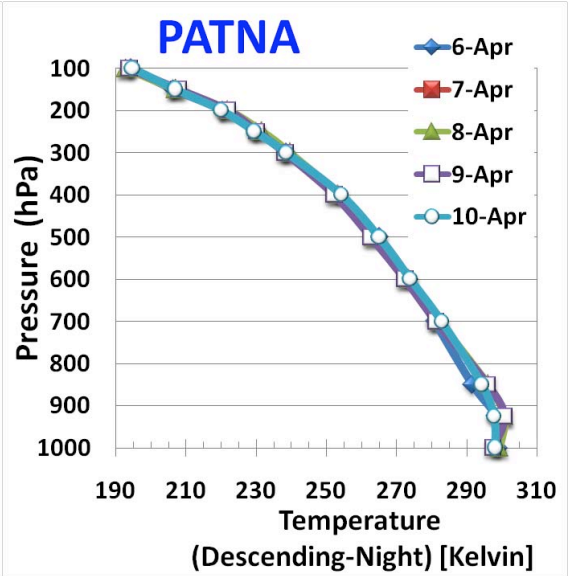




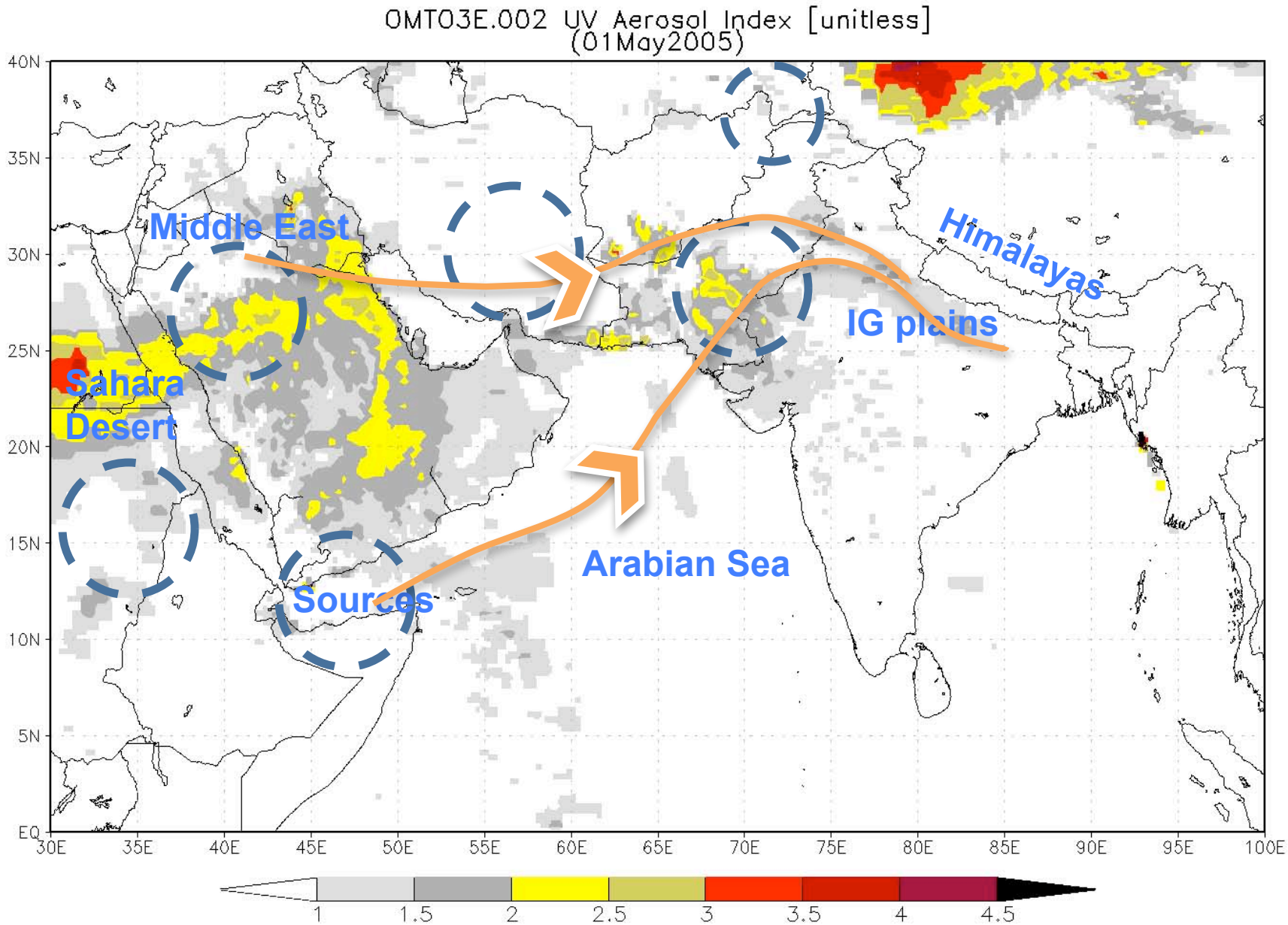


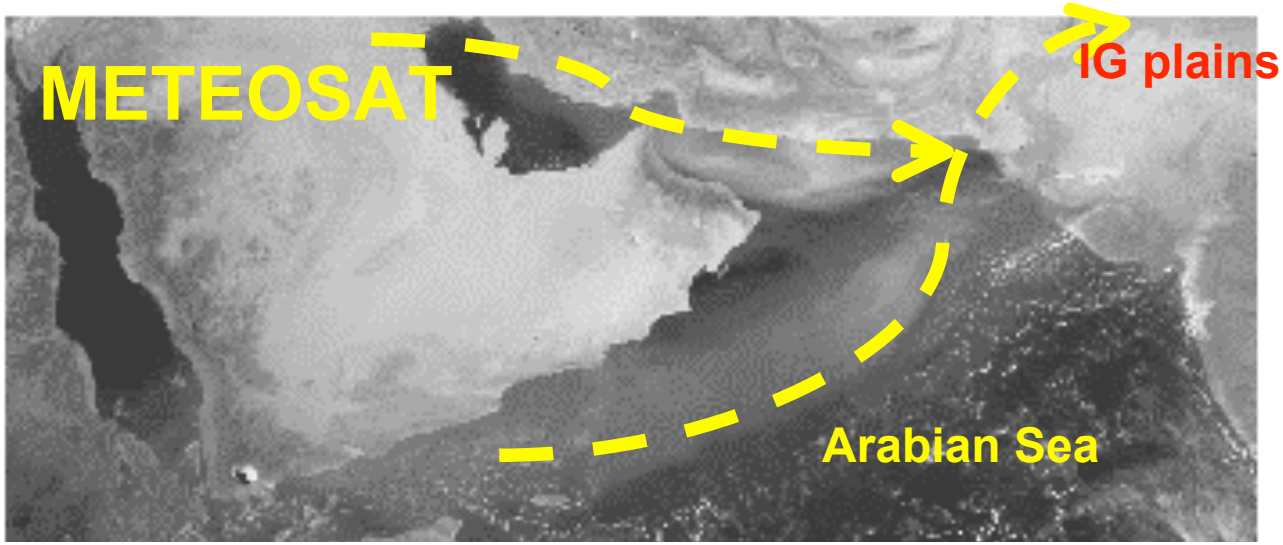






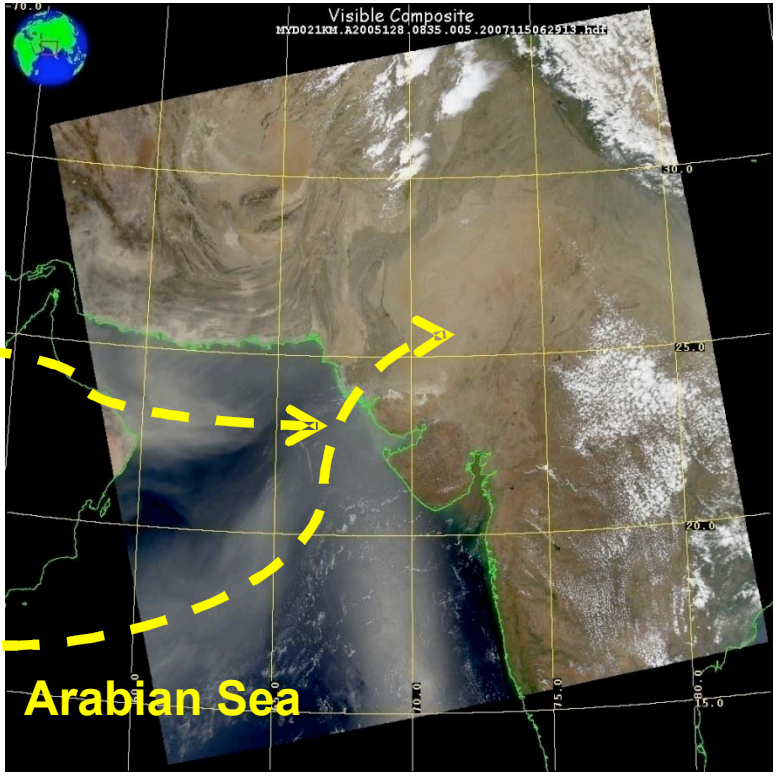
Dust storms (May 7-8-9, 2005)

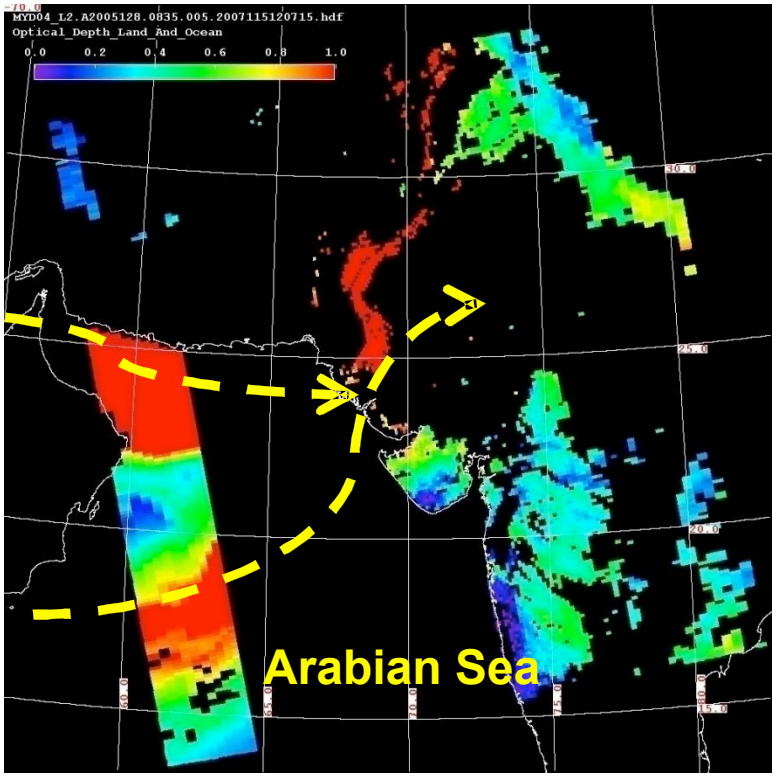


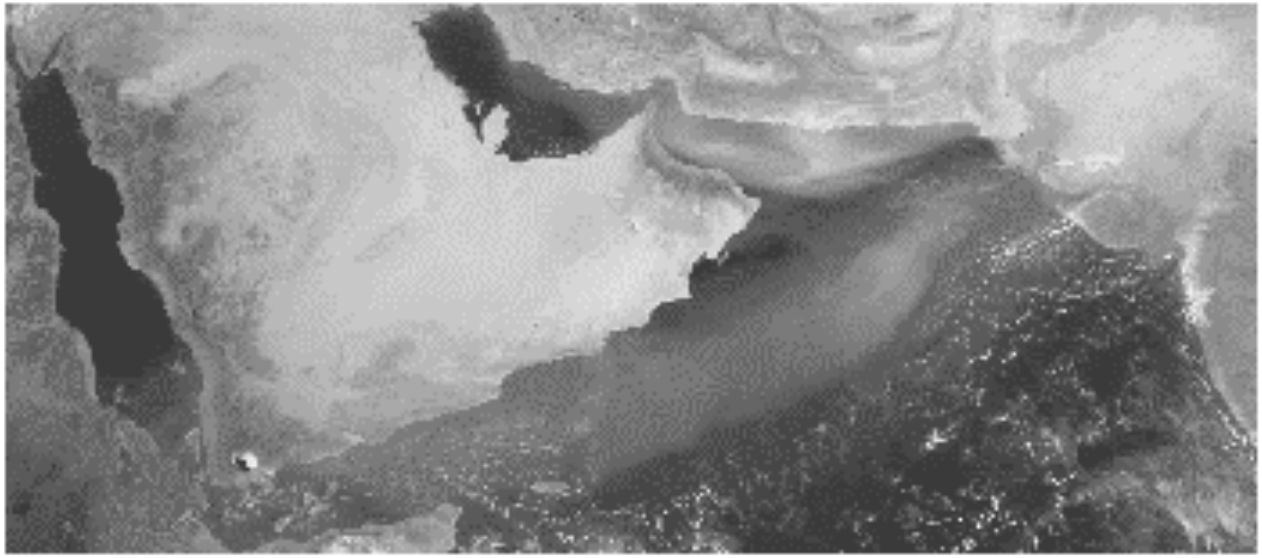


Path of Dust storm

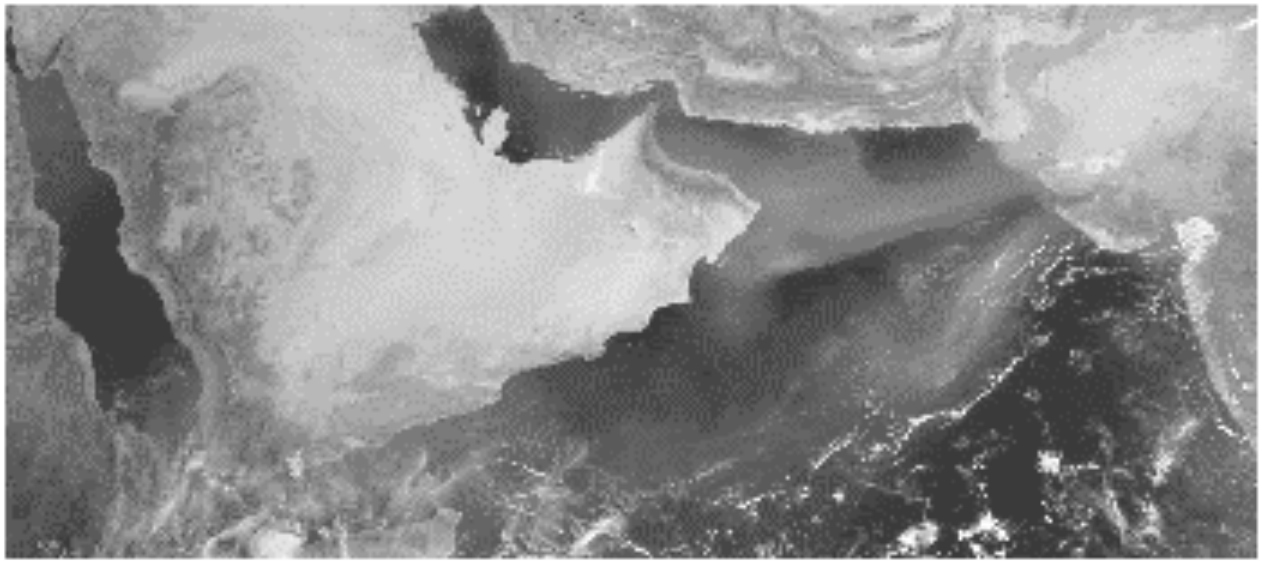
May 8, 2005







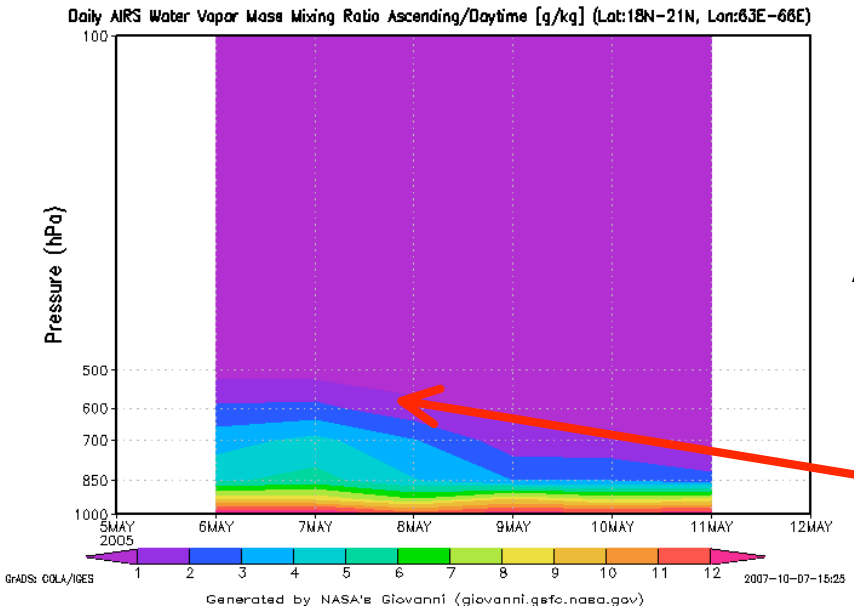
8 May 2005

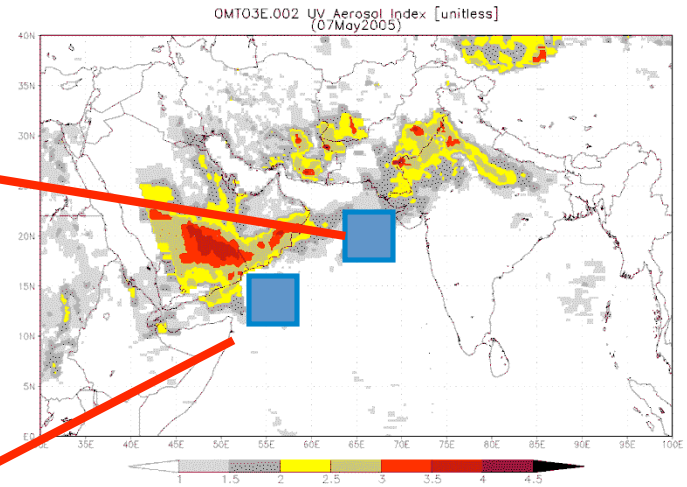


9 May 2005

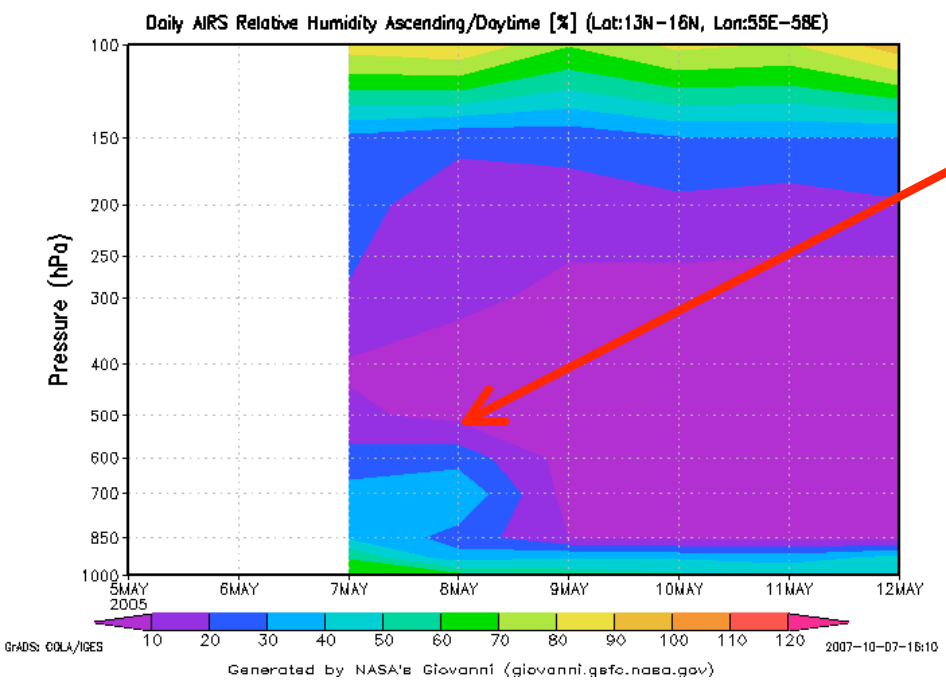
AIRS profile over ocean

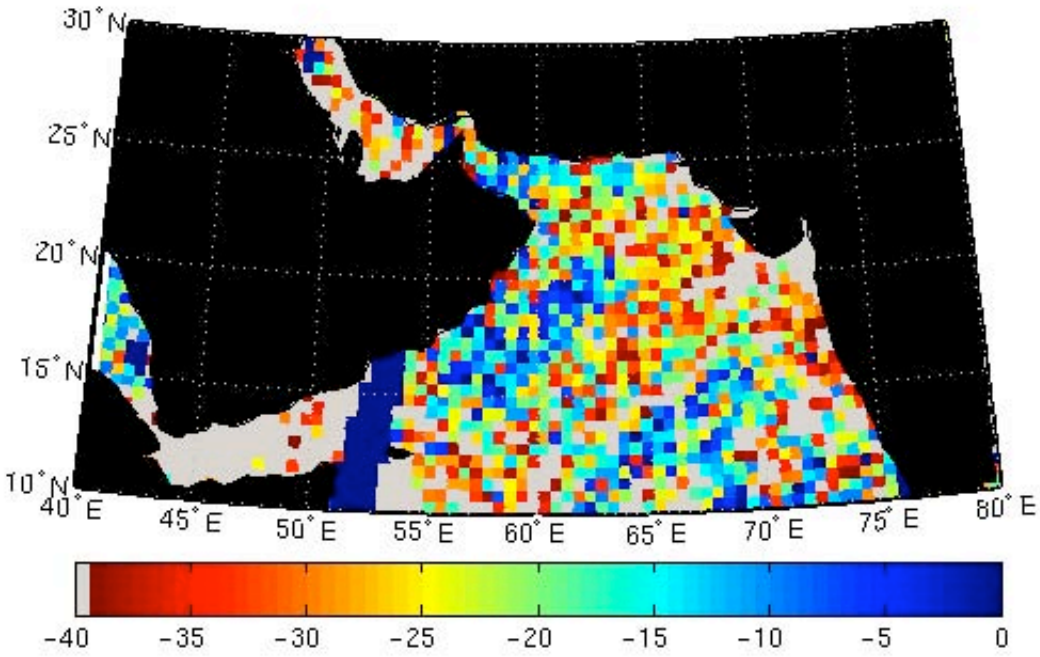
AIRS Water vapor (day)



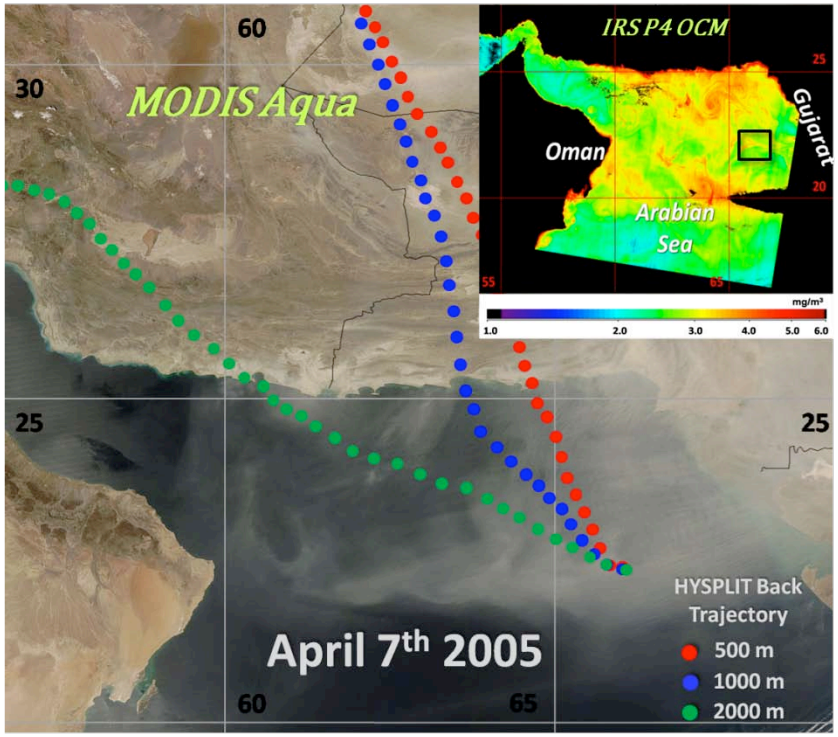


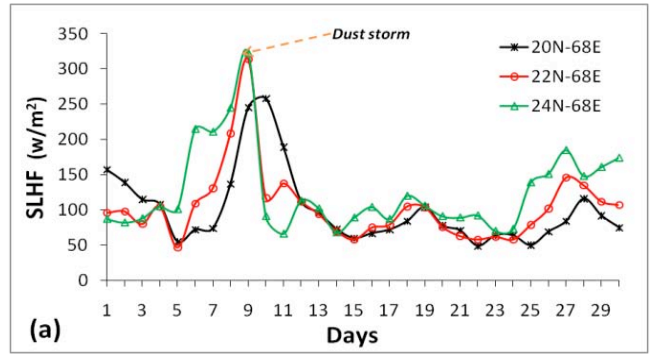
AIRS RH (day)

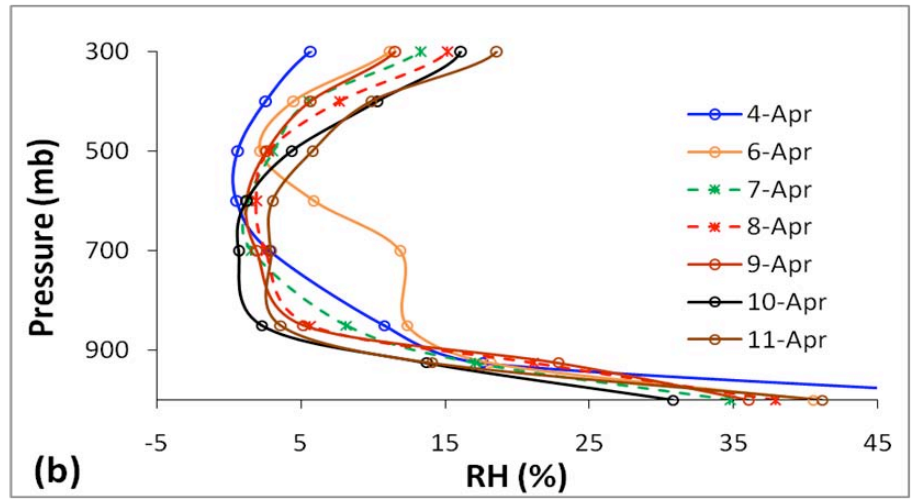




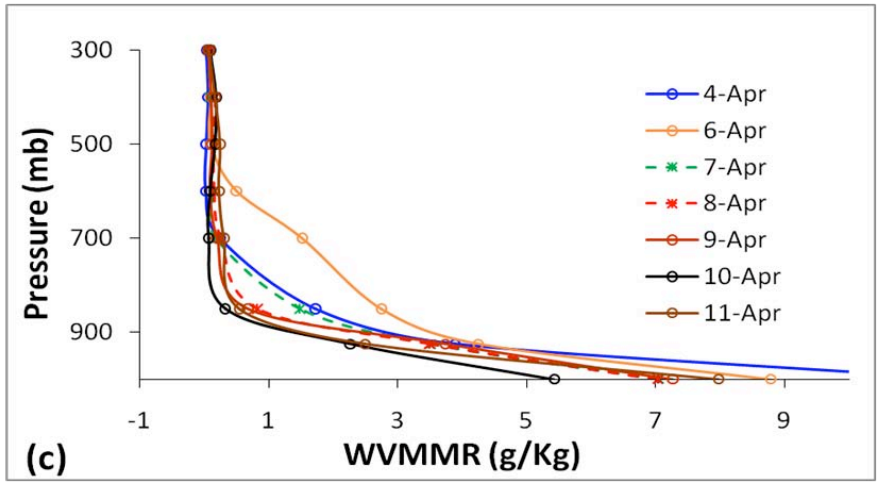
Instantaneous shortwave top of the atmosphere forcing for 8th May 2005 based on CERES SSF Edition 2 data. High negative forcing in the regions of dust loading is quite evident.

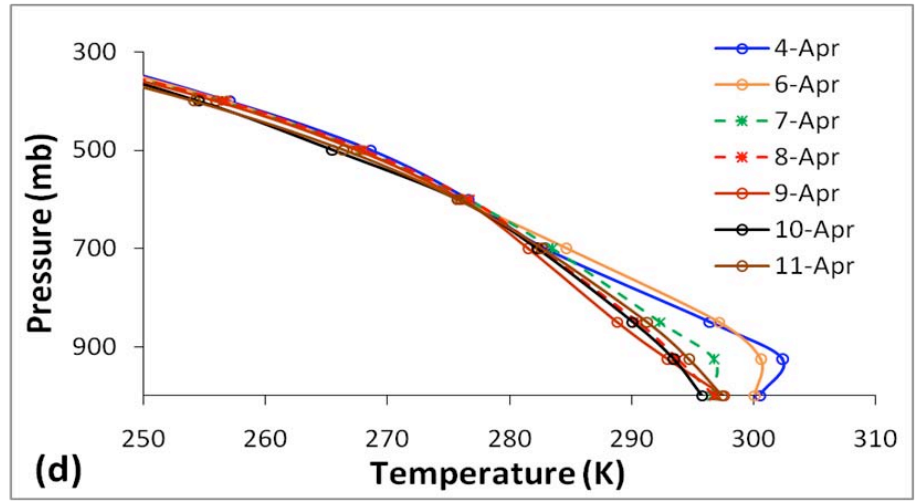

MODIS Aqua
IRS P4 OCM
Oman
Arabian Sea
Gujarat
mg/m³
1.0
2.0
3.0
4.0
5.0
6.0
60
30
25
25
60
65
April 7th 2005
HYSPLIT Back Trajectory
500 m
1000 m
2000 m


Dust storm
20N-68E
22N-68E
24N-68E
SLHF (w/m²)
Days
(a)


Pressure (mb)
RH (%)
4-Apr
6-Apr
7-Apr
8-Apr
9-Apr
10-Apr
11-Apr
(b)

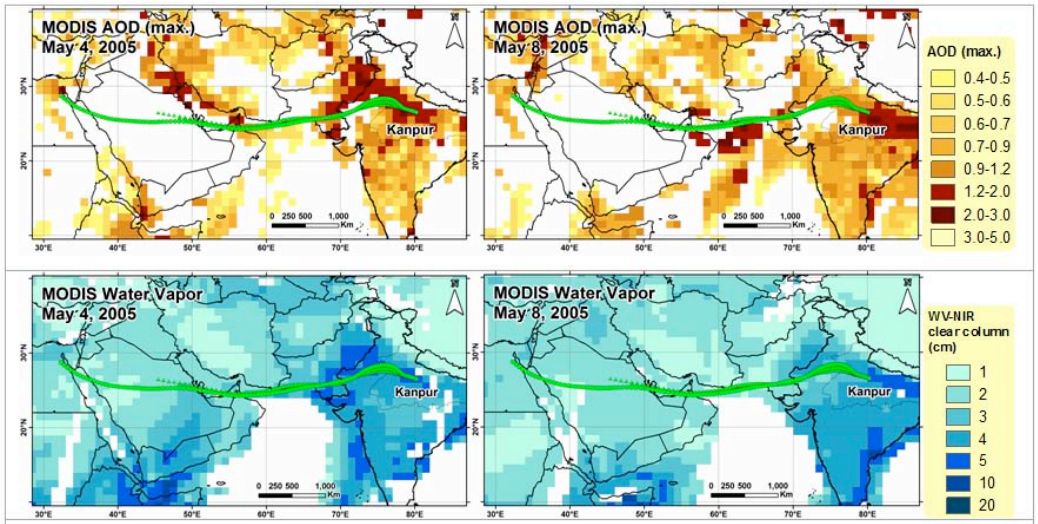
AIRS

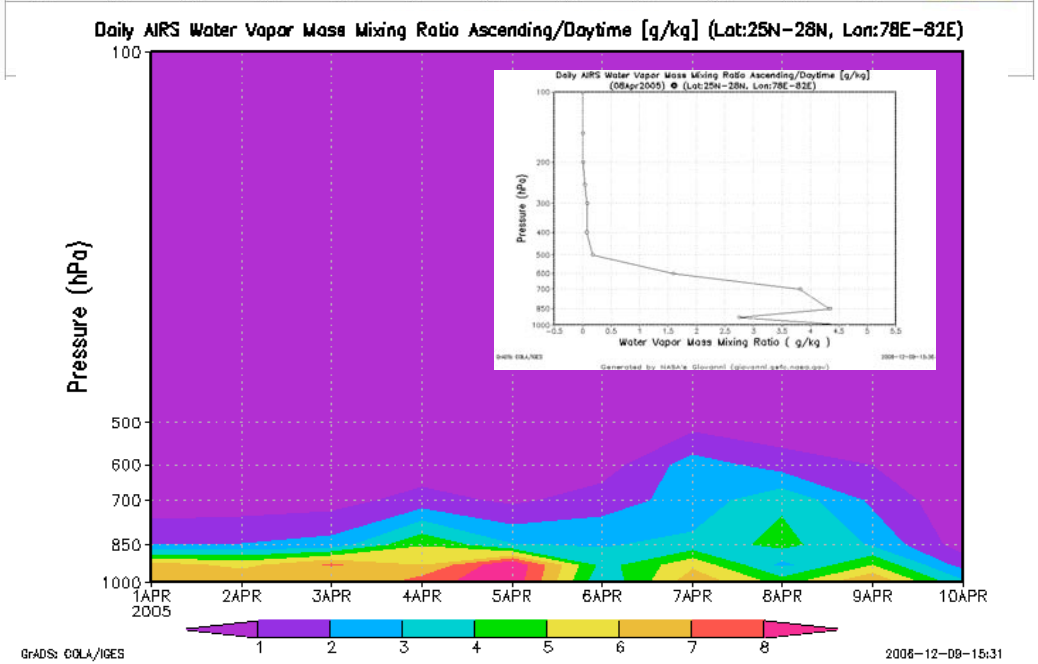

Pressure (mb)
WVMMR (g/Kg)
4-Apr
6-Apr
7-Apr
8-Apr
9-Apr
10-Apr
11-Apr
(c)

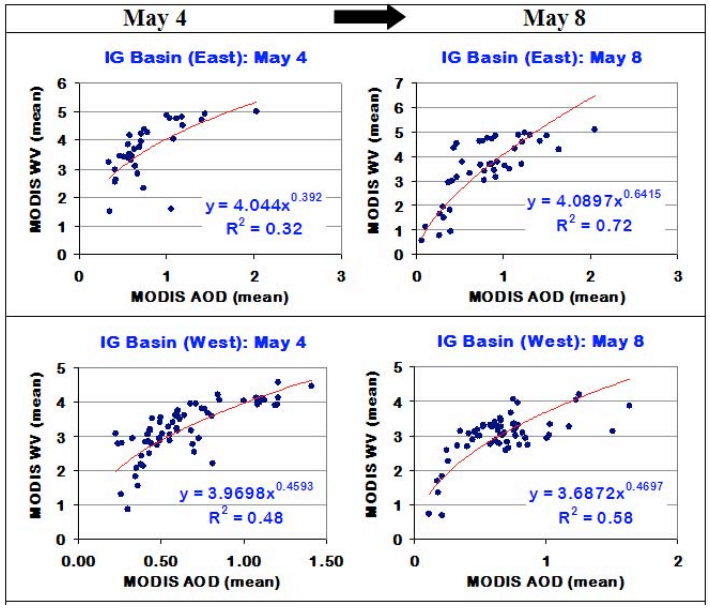

Pressure (mb)
Temperature (K)
4-Apr
6-Apr
7-Apr
8-Apr
9-Apr
10-Apr
11-Apr
(d)

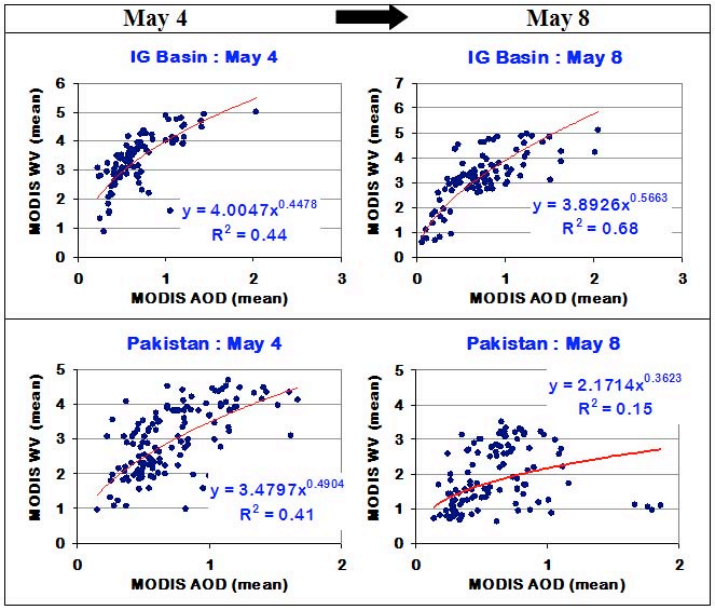
Dust storms: Association of water vapor with high AOD (Dust)

Maximum AOD (550nm) | **Mean Water vapor (cm) NIR-CC**









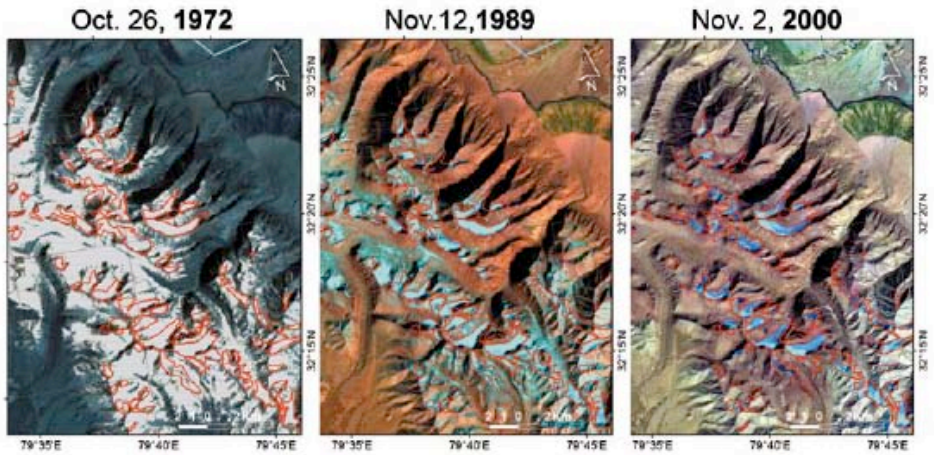


Fig. 1. Change in the snow and glacier cover in the western Himalayan region as shown in Landsat multispectral scanner (1972), thematic mapper (1989), and Enhanced Thematic Mapper Plus (2000) images. Areas outlined in red indicate information from the GLIMS database.

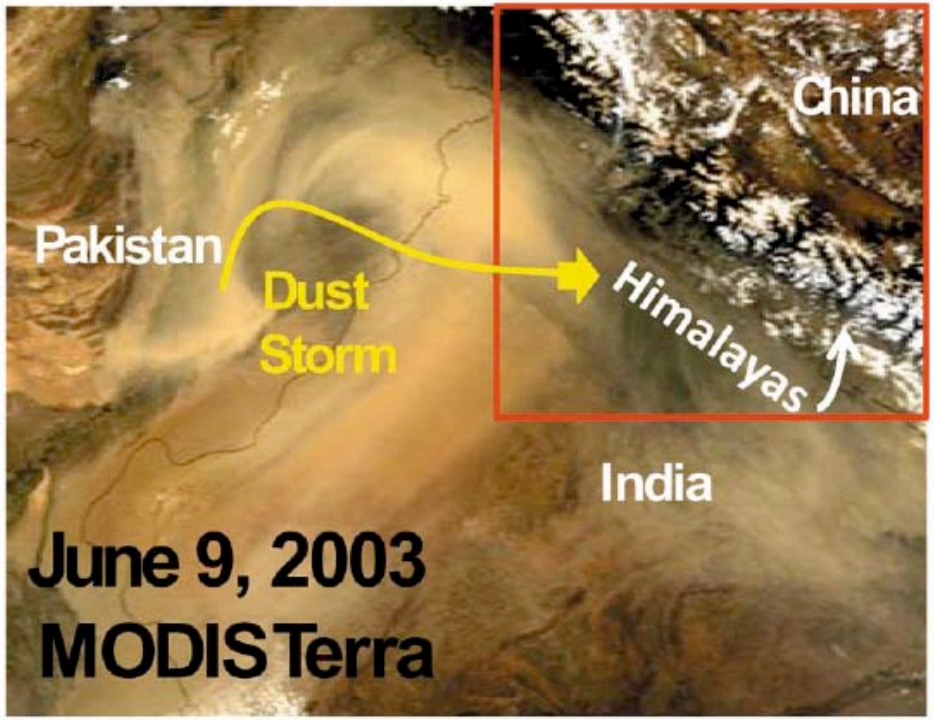


Fig. 2. Dust storms reach up to snow and glacier of Himalayas (box outlined in red) as visible in this 9 June 2003 MODIS Terra image obtained from the MODIS Web site (http://modis.gsfc.nasa.gov/).

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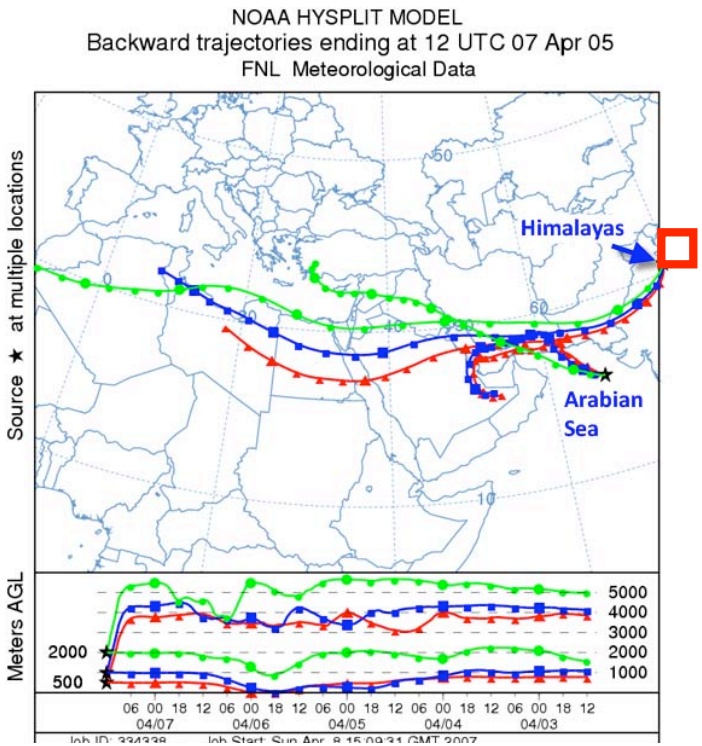
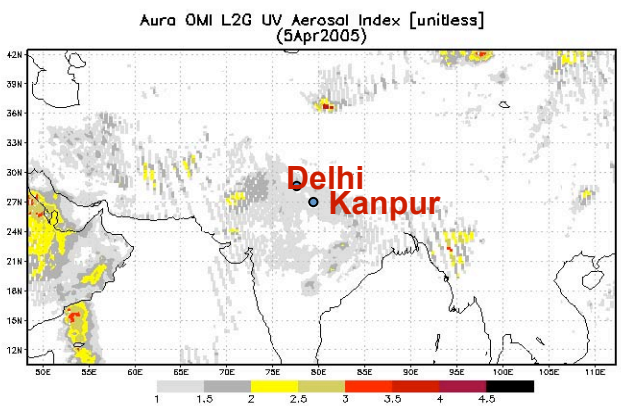
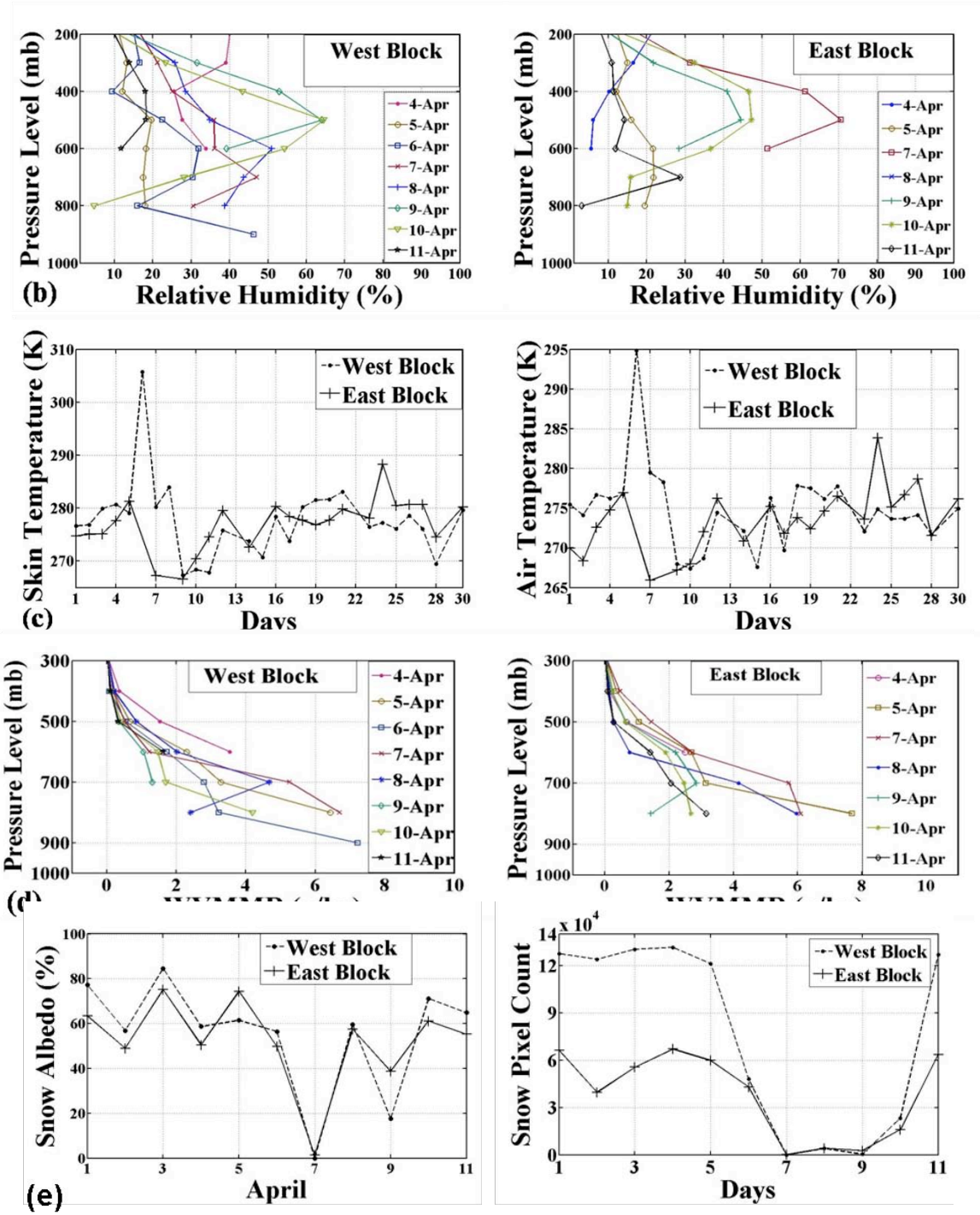
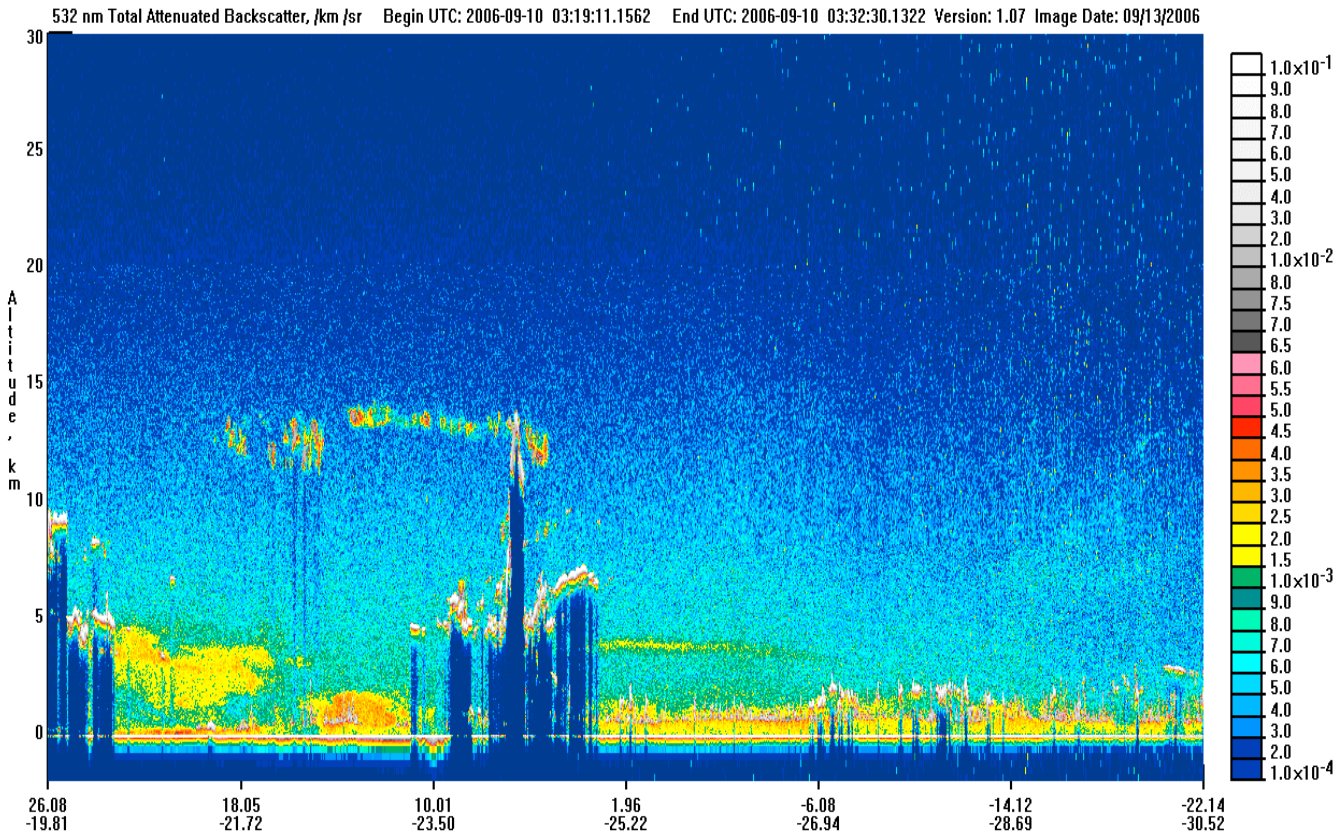
over Himalayas during dust storm



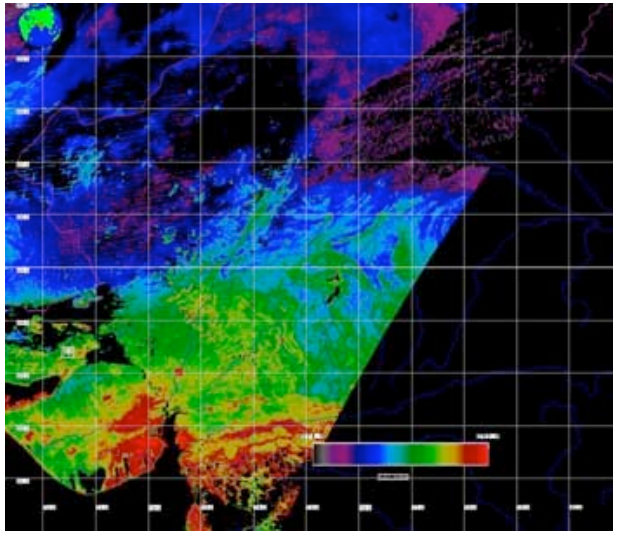




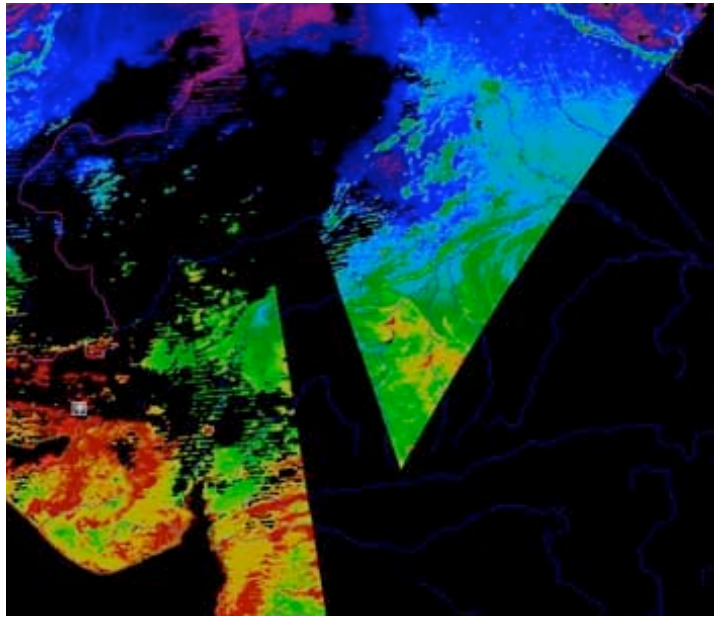
Vertical Distribution of Aerosols



Blues correspond to molecular scattering and weak aerosol scattering, aerosols generally show up as yellow/red/orange. Stronger cloud signals are plotted in gray scales, while weaker cloud returns are similar in strength to strong aerosol returns and coded in yellows and reds. Just above the surface, in a layer several kilometers deep, a layer of aerosol particles is shown in shades of orange and red.



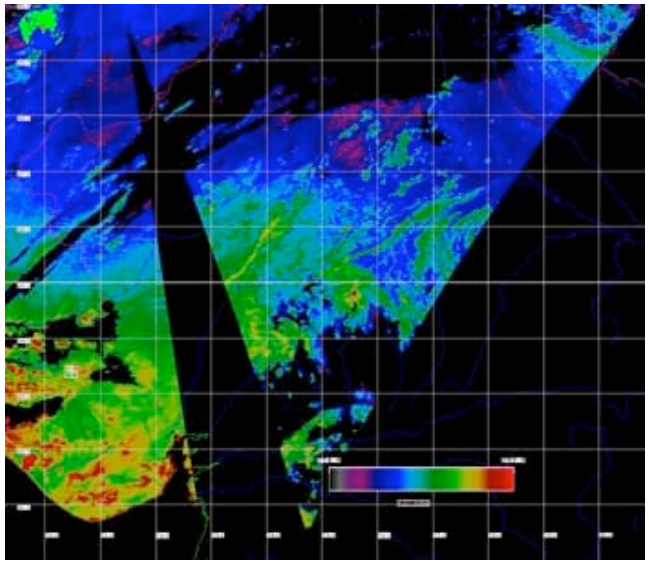
Jan 6, 2001



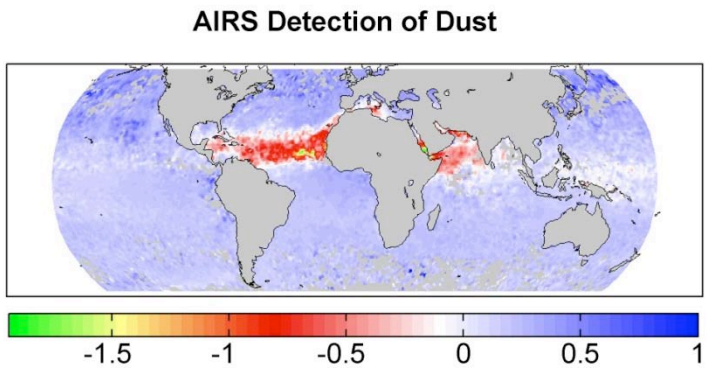
Jan 21, 2001

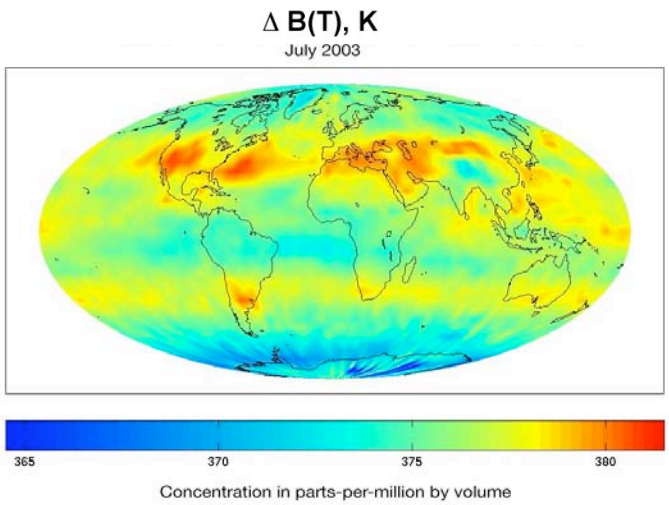
MODIS IR THERMAL IMAGES

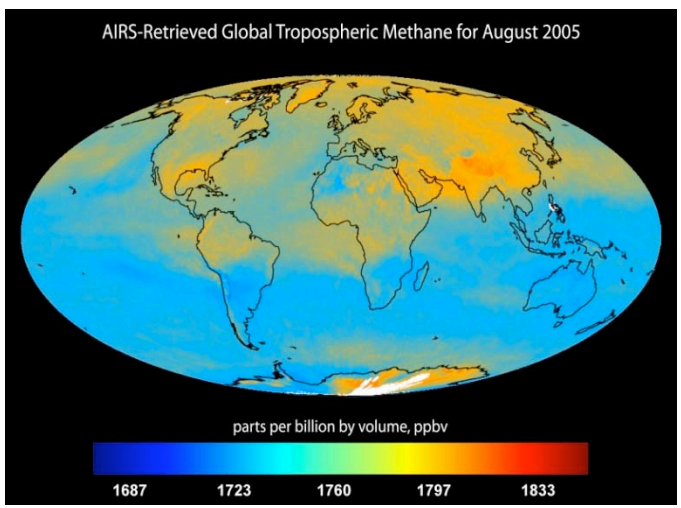
Jan 28



NASA findings about the Thermal anomaly associated with Gujarat earthquake







New AIRS products

OZONE
CARBON MONOXIDE
METHANE
SULFUR DIOXIDE
DUST AND AEROSOLS

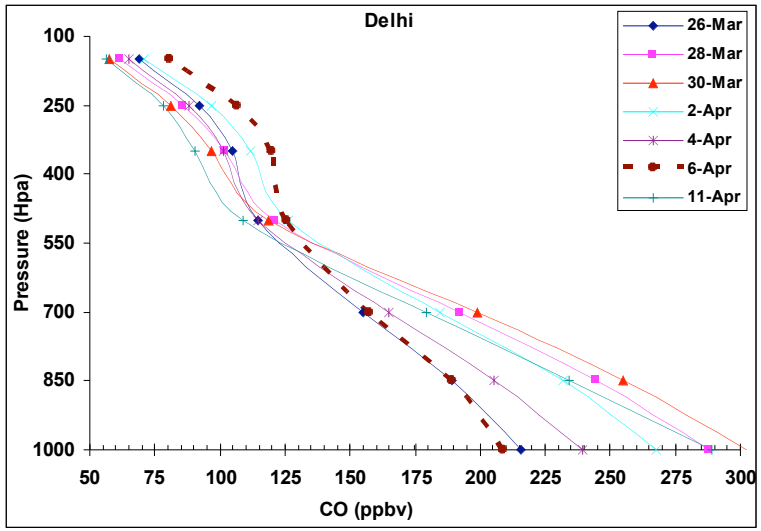
VALIDATION AND COMPARISION WITH OTHER SENSOR RETRIEVALS!

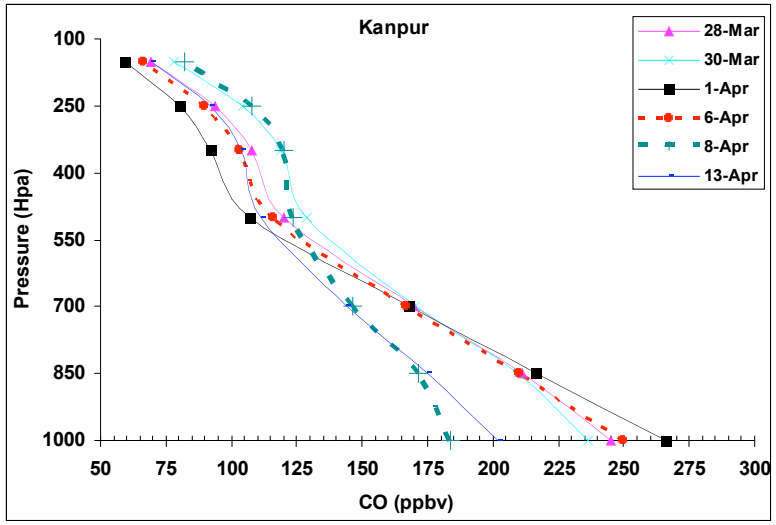
-OMI, TOMS, MOPITT

- GPS water vapor

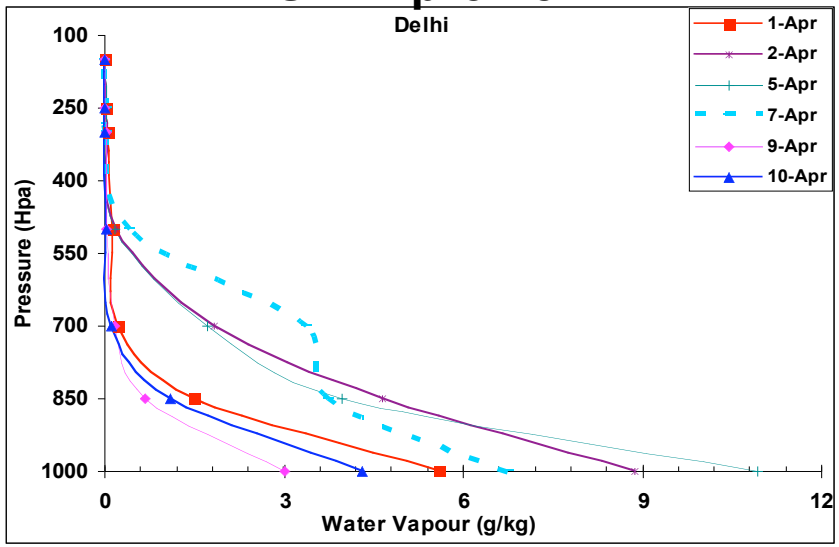
dust storm (April 2007) over the IG plains

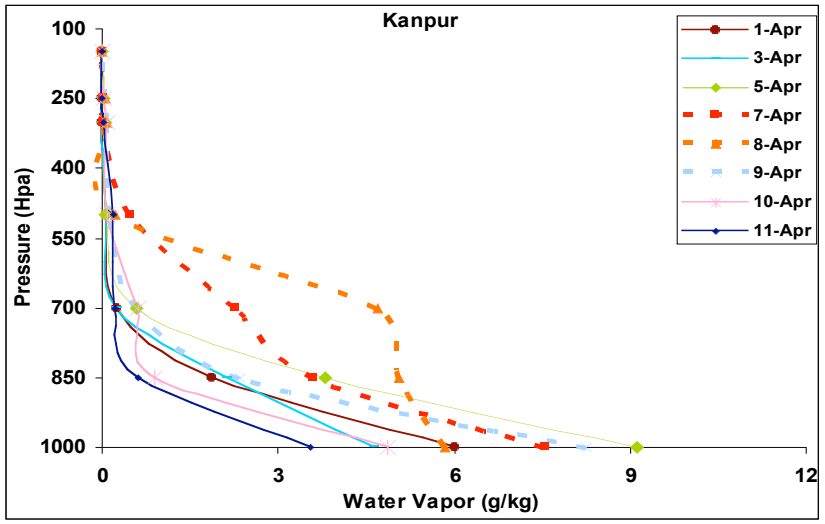
MOPITT CO profile





AIRS WV profile





AIRS CO ?

Acknowledgements

- Science Teams
  - MODIS
  - MISR
  - AIRS
  - OMI

- NCEP
- GEC-HRI
- ISRO-GBP
- GIOVANNI Team
- SEADAS & Ocean color team

Thank you for your attention