Case studies of aerosol indirect effects over East China sea

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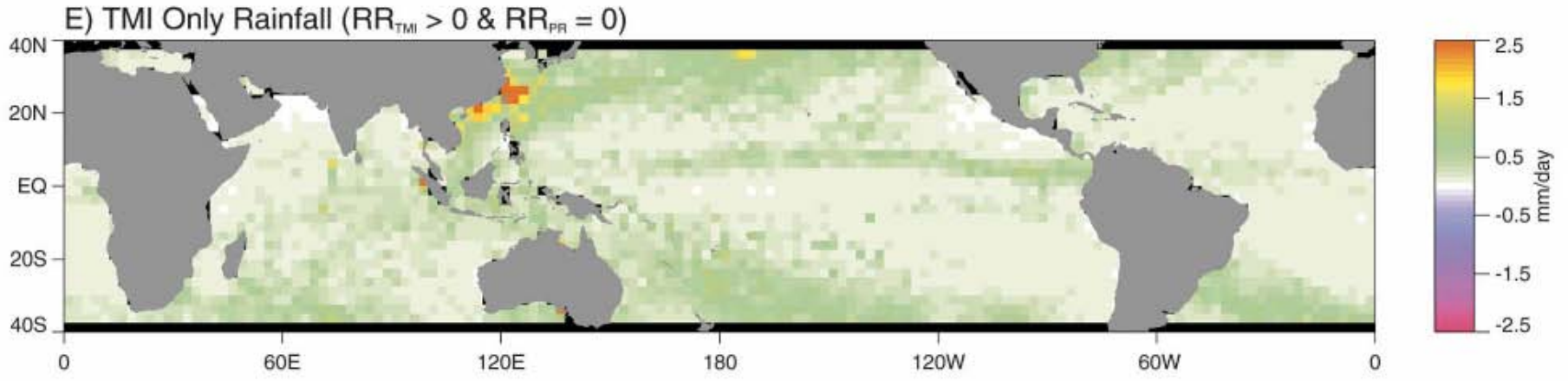
Case Studies of Aerosols Indirect Effect over China

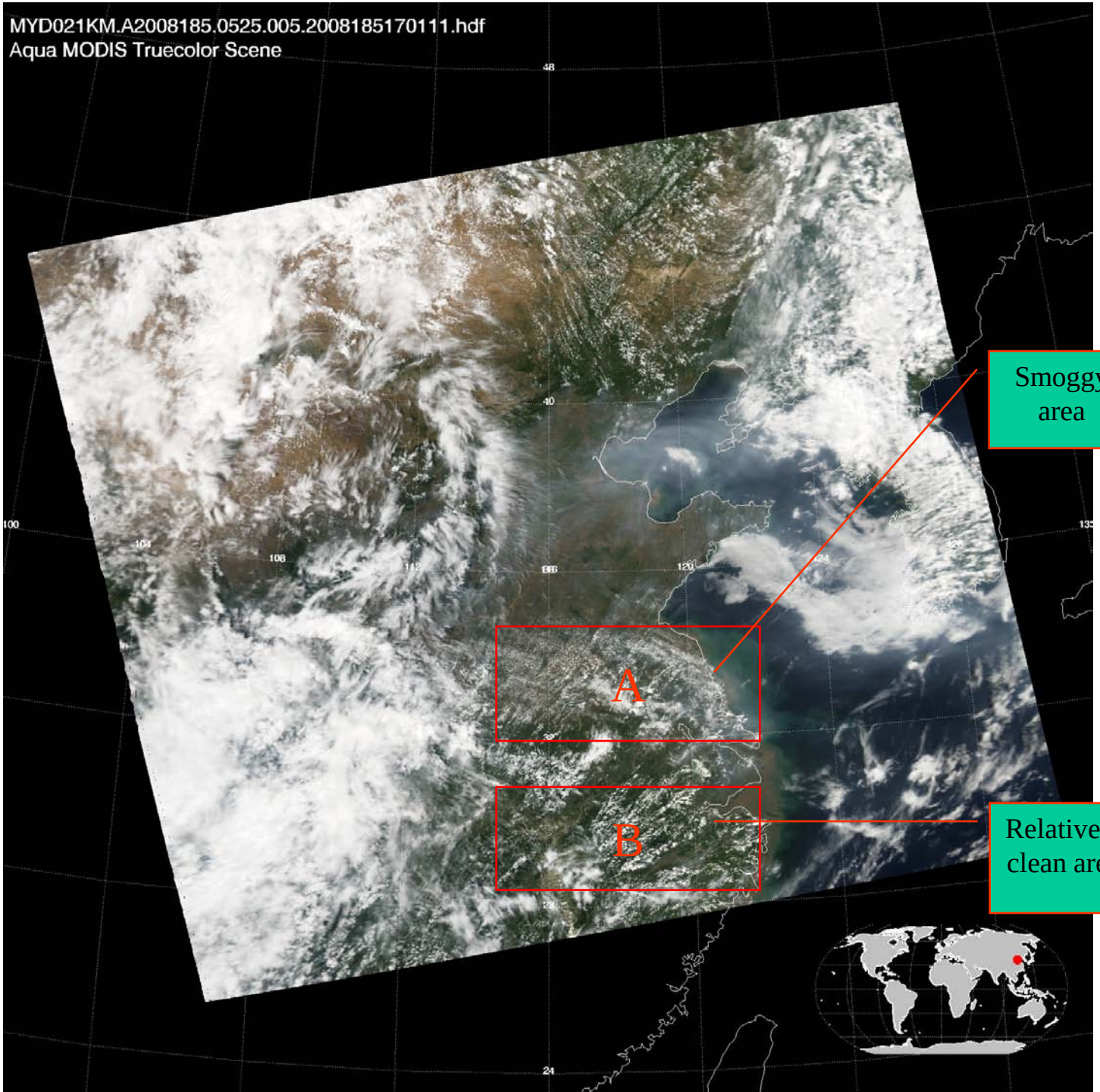
- Motivation



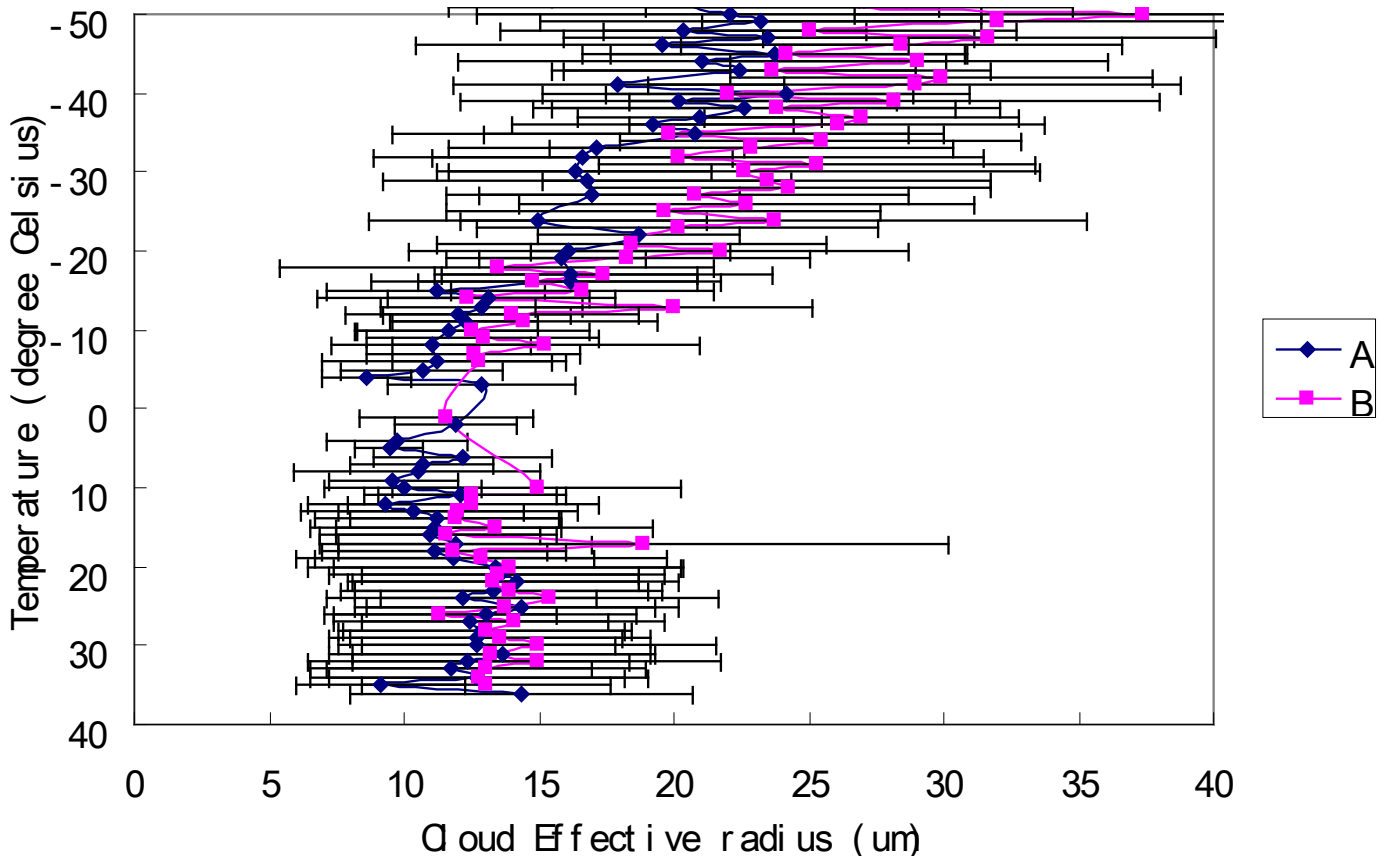
- TMI (TRMM microwave imager): Emission based, sensitive to the amount of liquid water
- PR (Precipitation radar) : Scattering based, sensitive to particle size

Tools

07/03/2008
Aqua modis
image



By averaging the cloud particle sizes on the same vertical layer (represented by temperature), “vertical distribution” of cloud particle size can be shown (some assumptions needed and only used by Rosenfeld on convective clouds) .
Area A shows smaller particle size compared with Area B.

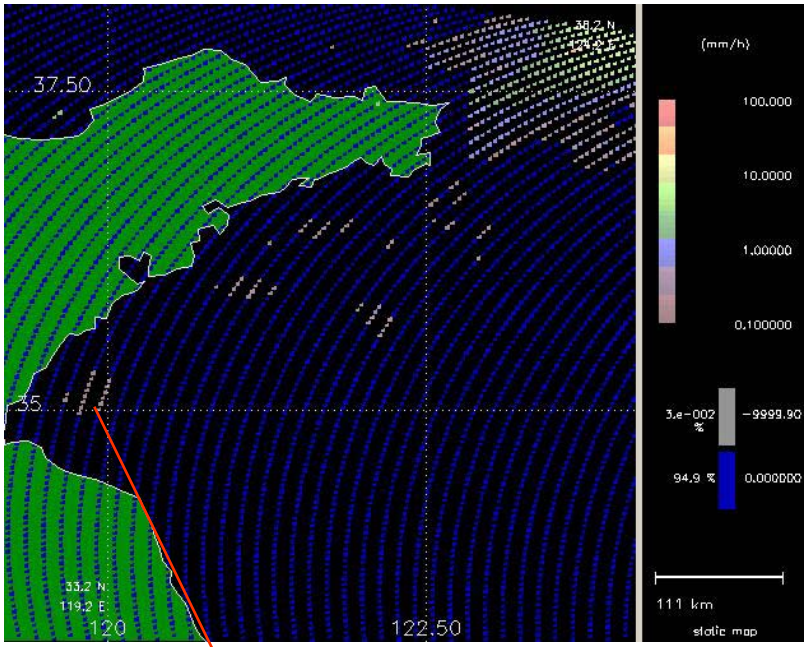


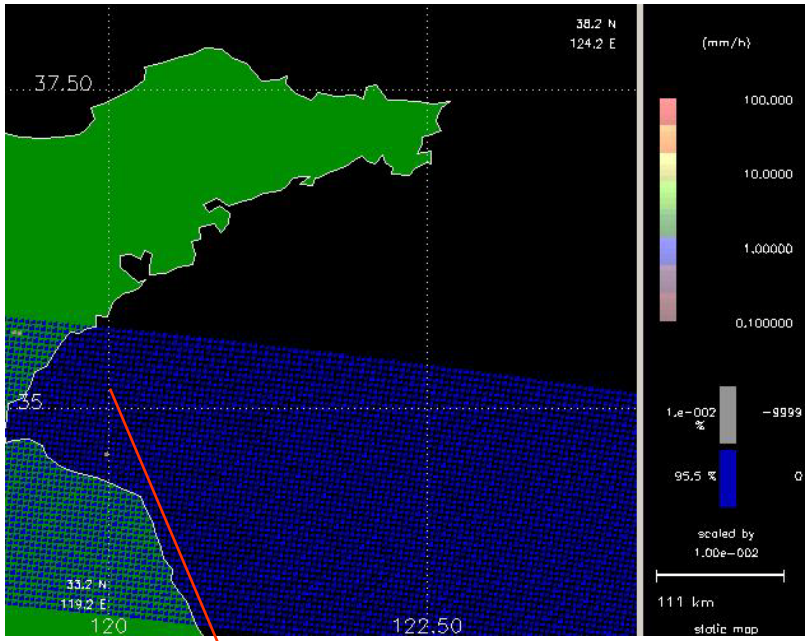
Methods

- Identify areas with discrepancy between TMI and PR rainfall detections.
- Co-locate with MODIS. Use the technique above to “simulate” the development of clouds
- By comparing areas with or without discrepancy, try to find direct evidences of the underlying reasons.

Case 1: TMI and PR rainfall detection

July 24, 2008





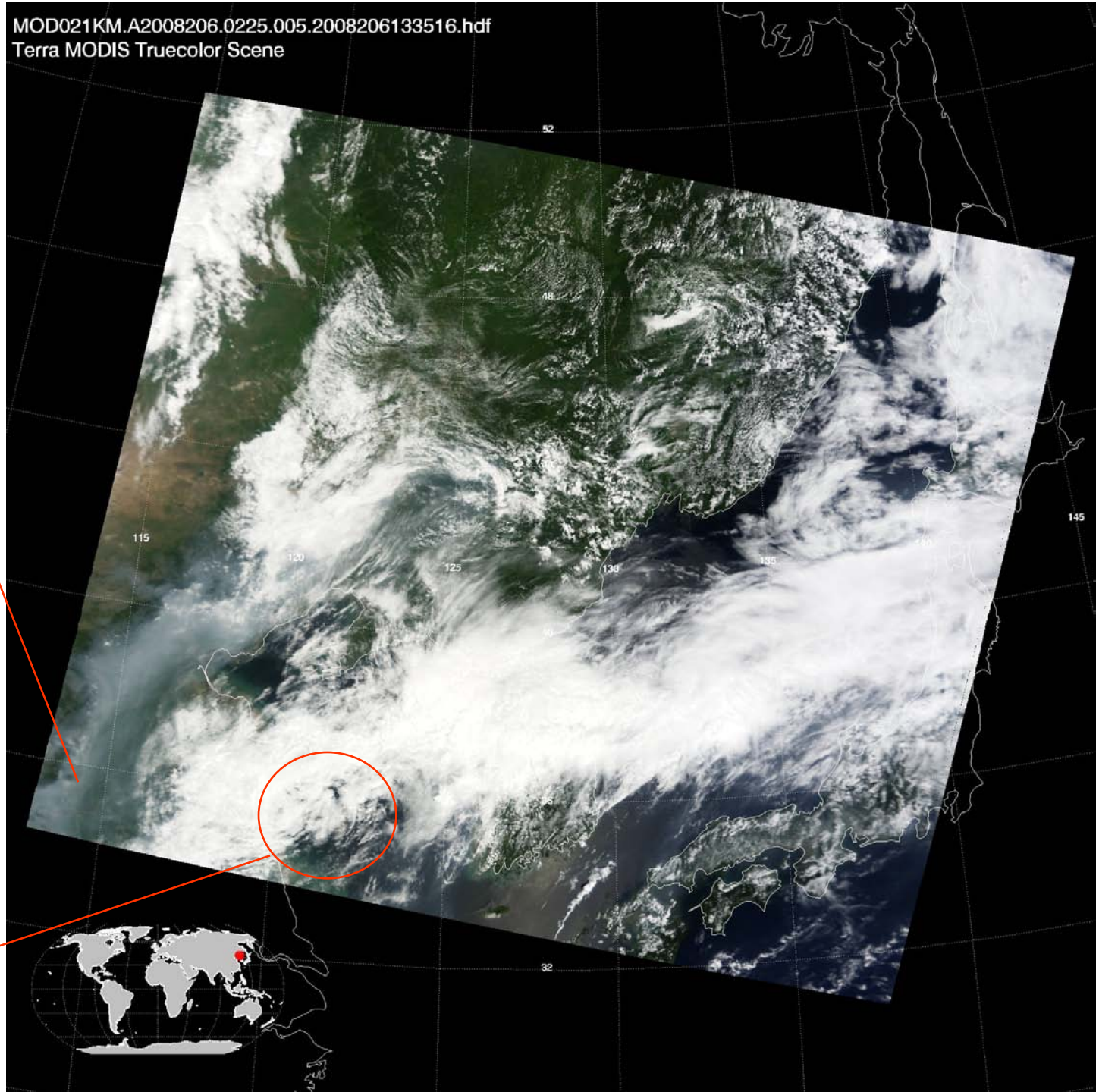
TMI rainfall

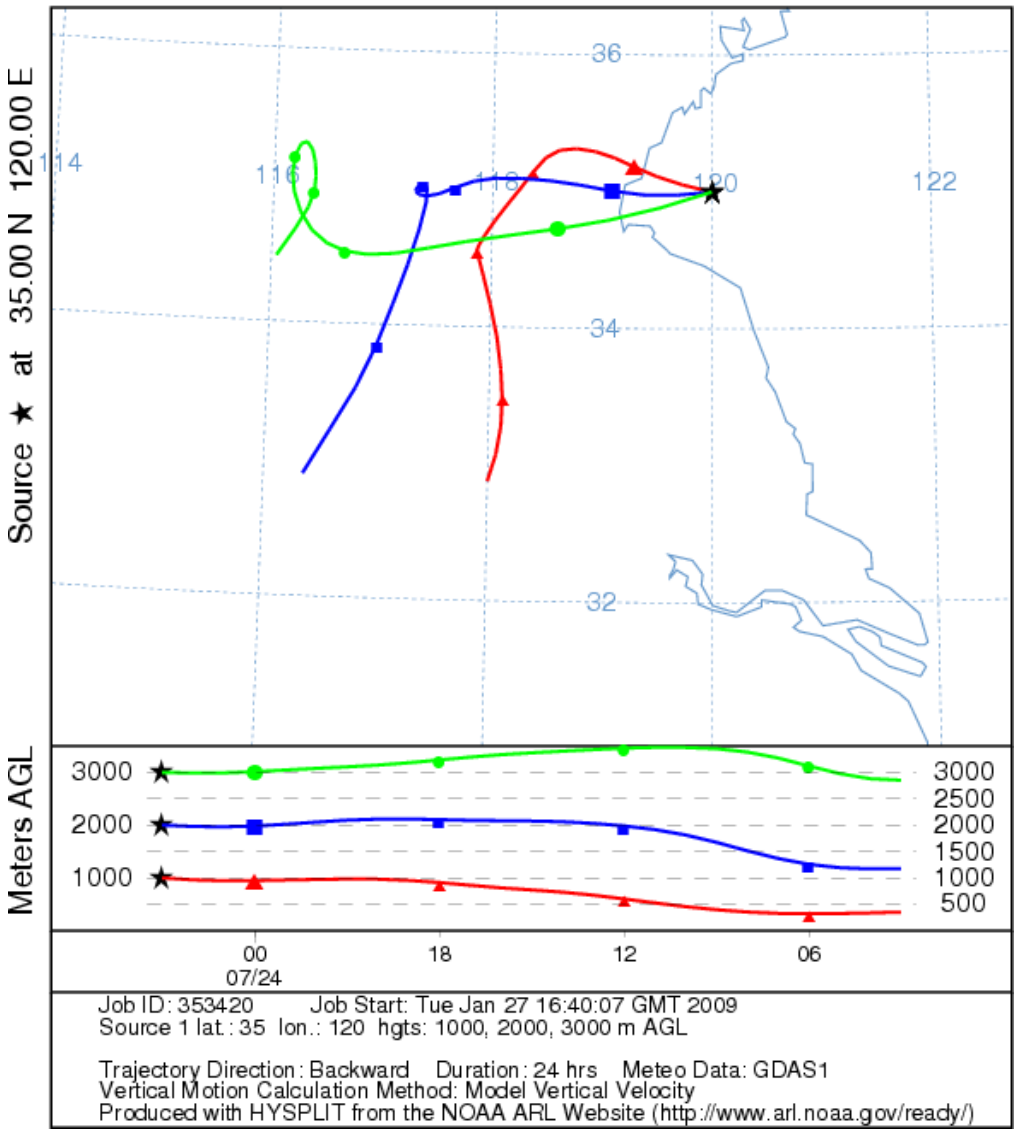
PR saw nothing

MODIS image at almost the same time

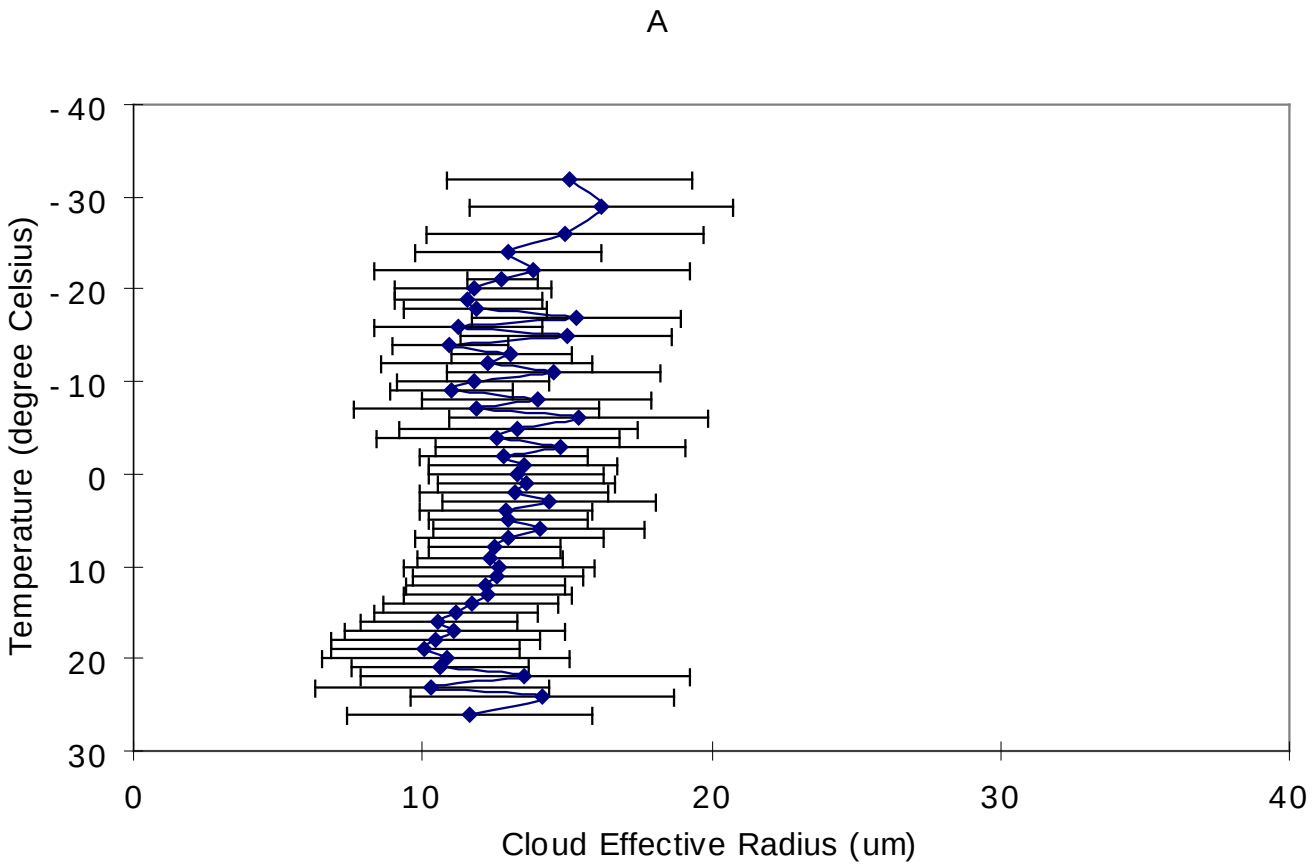
Heavy pollution

The same area shown in the previous slide

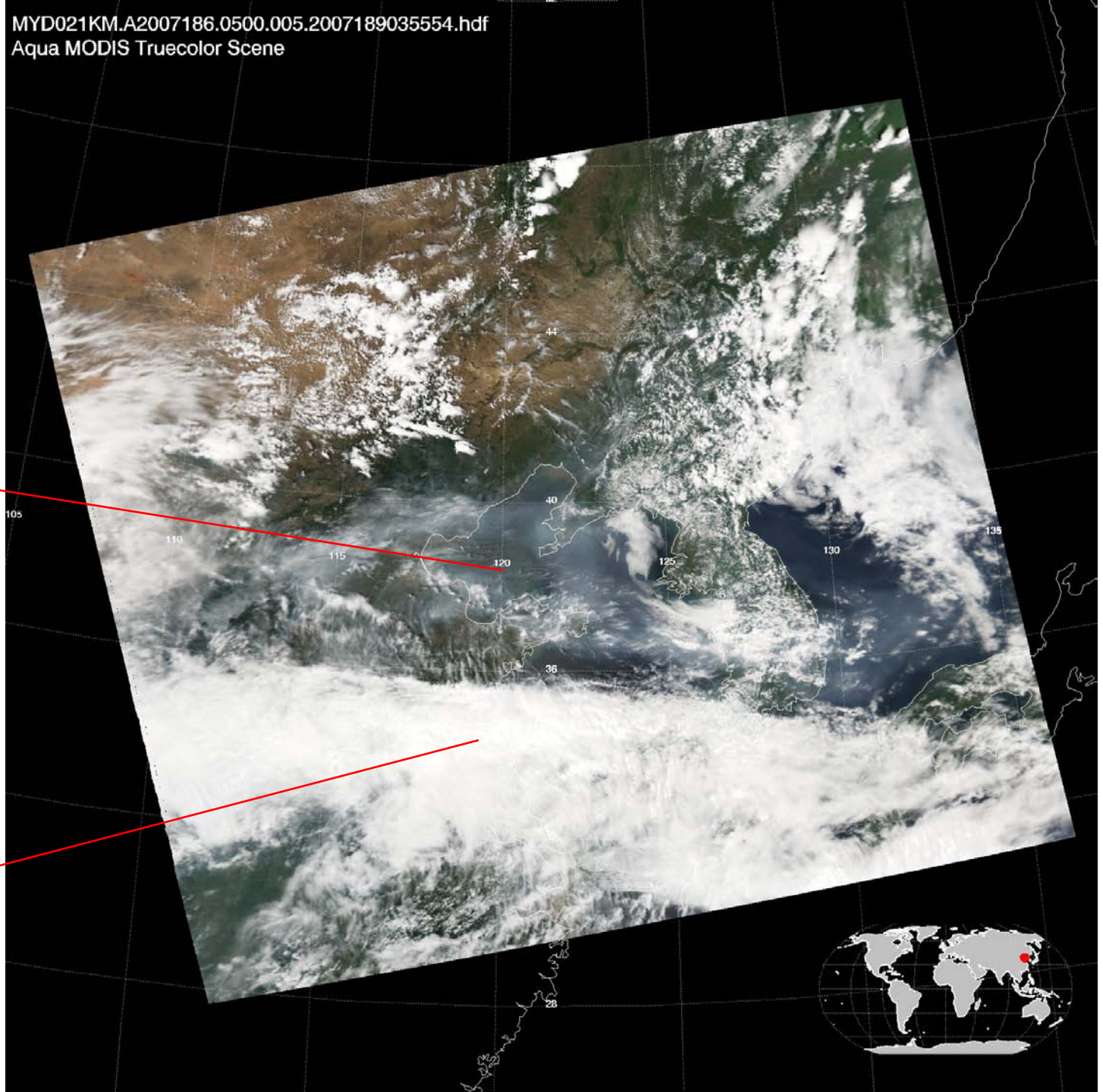



NOAA HYSPLIT MODEL
Backward trajectories ending at 0300 UTC 24 Jul 08
GDAS Meteorological Data
Source ★ at 35.00 N 120.00 E
36
34
32
114
116
118
120
122
Meters AGL
3000
2000
1000
3000
2500
2000
1500
1000
500
00
07/24
18
12
06
Job ID: 353420 Job Start: Tue Jan 27 16:40:07 GMT 2009
Source 1 lat.: 35 lon.: 120 hgts: 1000, 2000, 3000 m AGL
Trajectory Direction: Backward Duration: 24 hrs Meteo Data: GDAS1
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)

The particle size in Area A is very small and has almost no increase with the increase of altitude (the decrease of temperature)



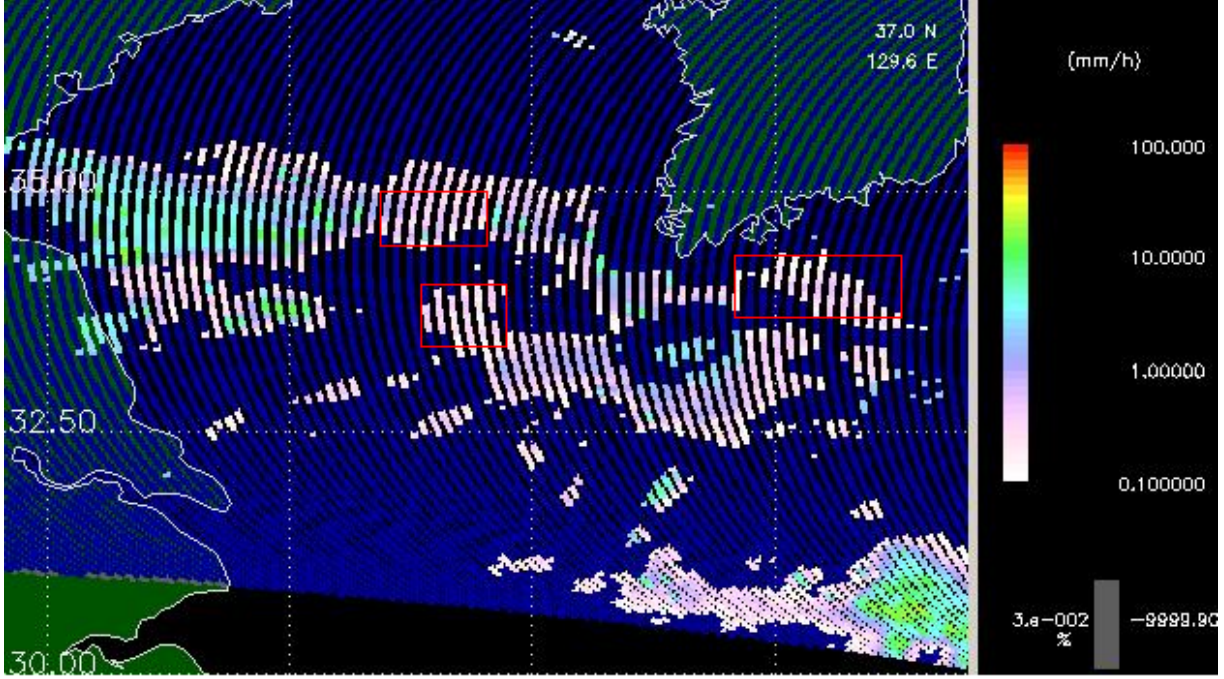
Case 2



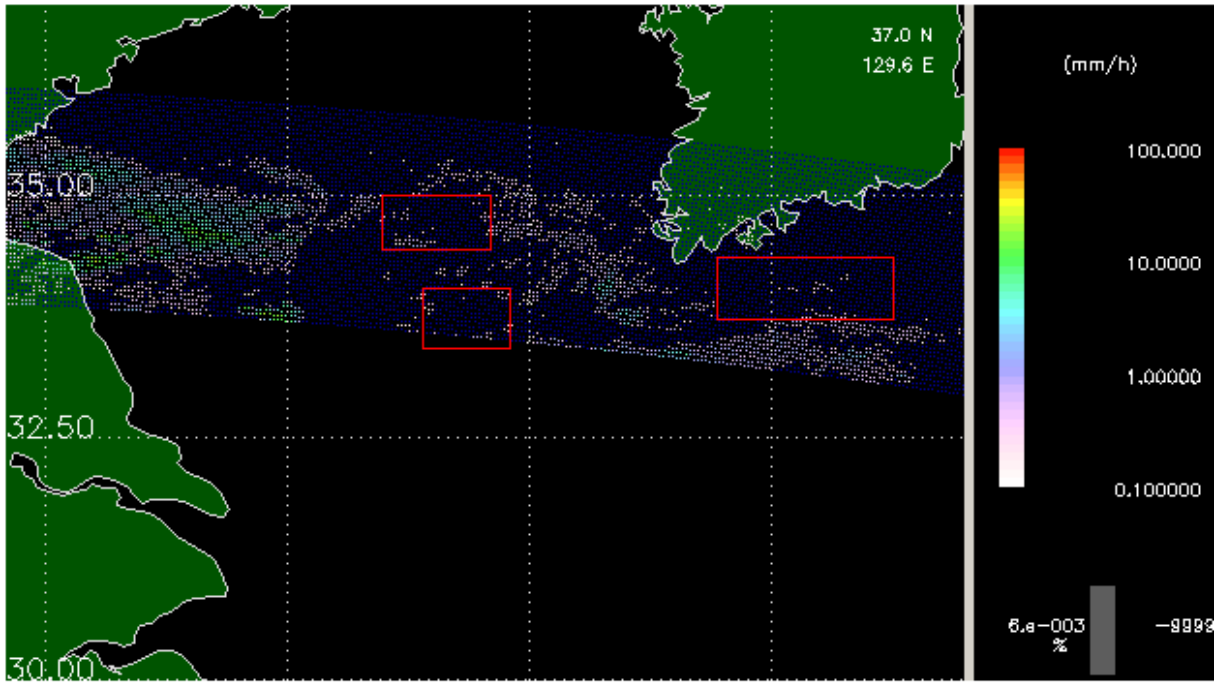
Heavy pollution

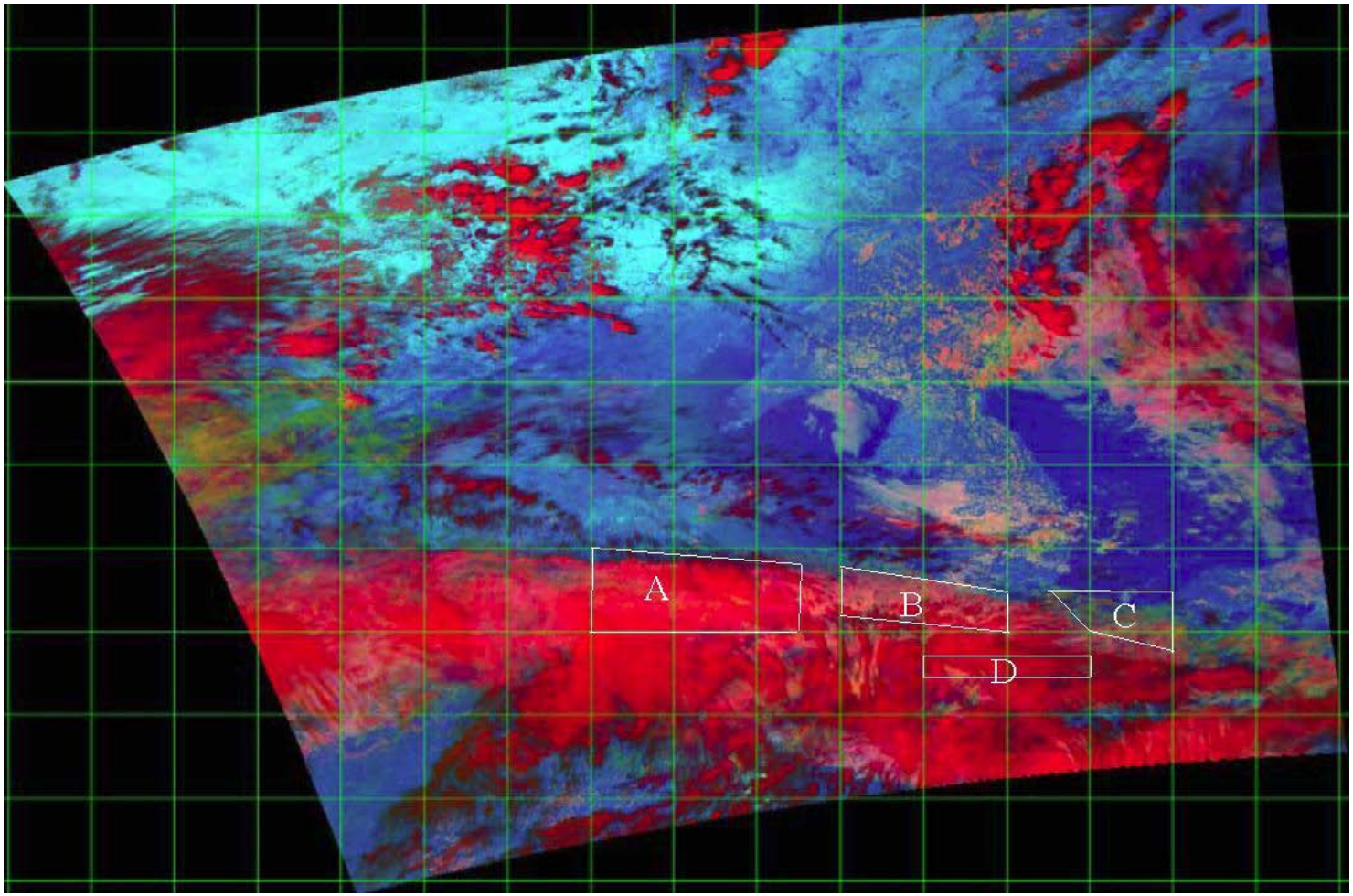
Typical summer monsoon rain belt

TMI
Rainfall



PR
Rainfall





Area	Rain/non-Rain	Discrepancy	RH	Cloud top T
A	Rain	19.94%	95.65%	Low
B	Rain	61.95%	80.43%	High
C	non-Rain	N/A	53.25%	High
D	Rain	3.64%	76.31%	Low

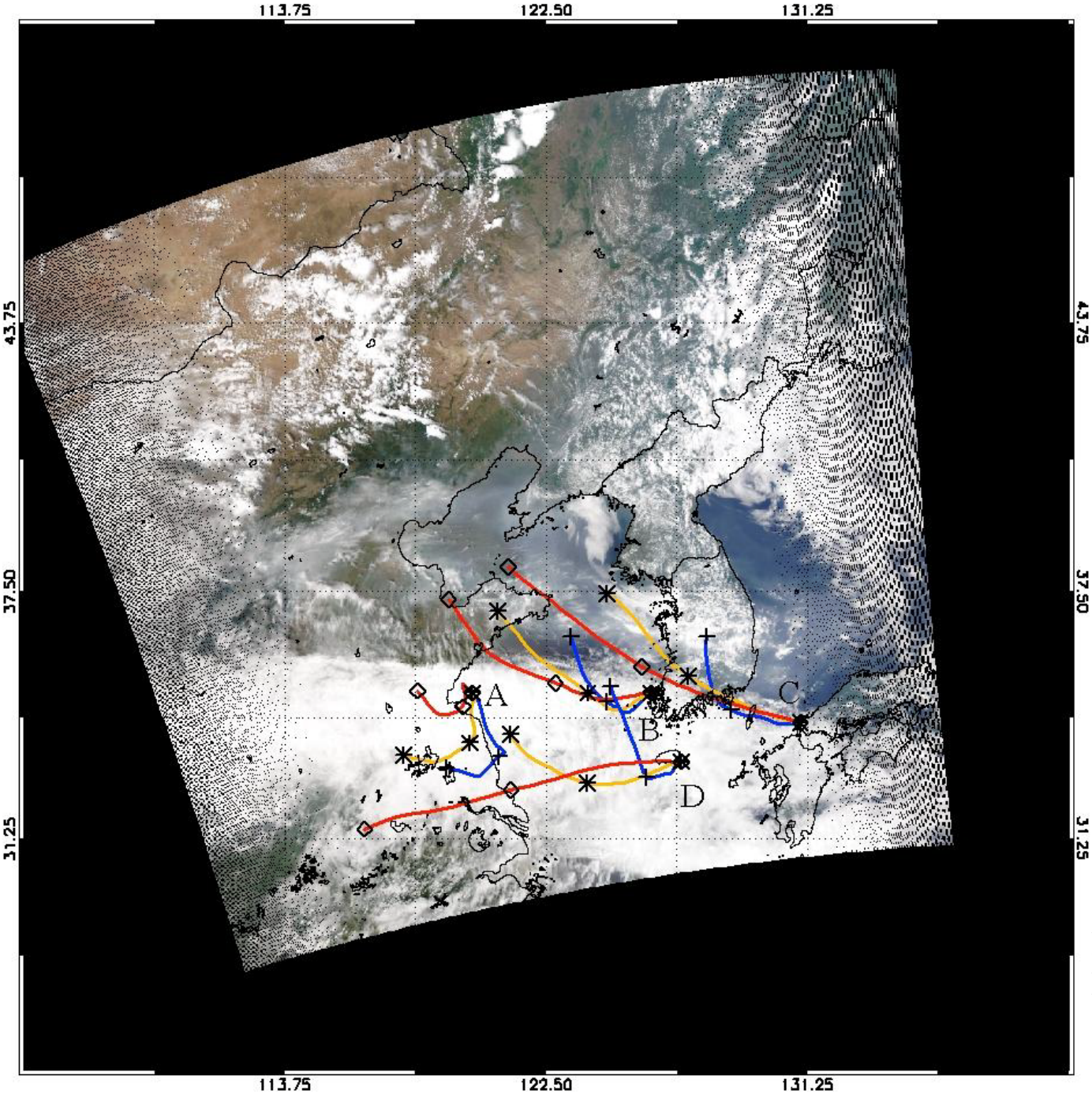
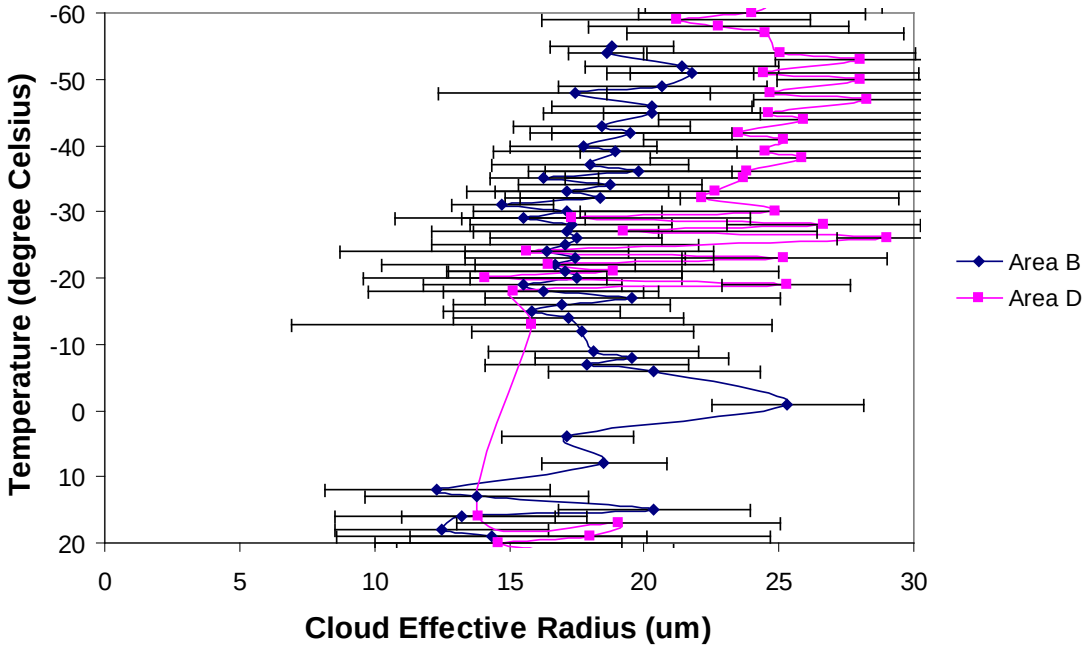
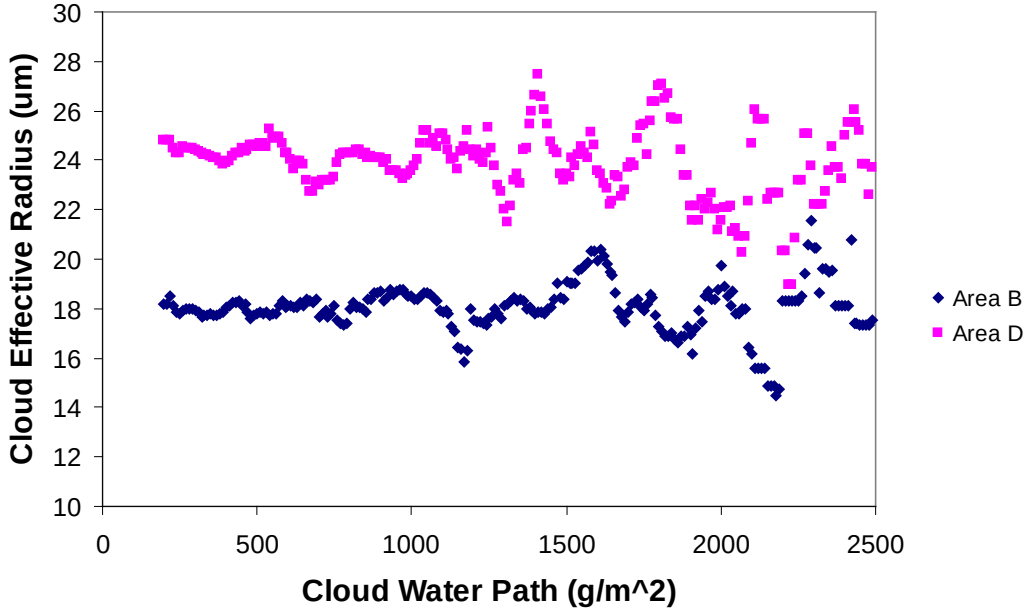


Figure from
Kwon-Ho Lee


Temperature (degree Celsius)
-60
-50
-40
-30
-20
-10
0
10
20
0
5
10
15
20
25
30
Cloud Effective Radius (um)
Area B
Area D


Cloud Effective Radius (um)
30
28
26
24
22
20
18
16
14
12
10
0
500
1000
1500
2000
2500
Cloud Water Path (g/m^2)
Area B
Area D

Conclusions and future work

- The discrepancies between TMI and PR rainfall detection happened in the areas under the influence of heavy pollutants.
- Cloud particles are smaller and barely increase with height in these areas compared with areas without discrepancy.
- Future work includes combining ground-based measurement to further address the reasons.