Effects of Topography and Aerosols on Deep Convective Clouds as Observed from A-Train

Tianle Yuan and Zhanqing Li

Univ. of MD

ARM CPWG meeting, Annapolis, MD

Data description

- MODIS Level-2 aerosol product (AOD)
  - Only retrievals with 0 cloudy pixel are used
  - Only high quality retrievals are used
- MODIS Level-2 cloud product (DER)
  - Only clouds with top brightness temperature less than -40 are used
  - Cloud optical depth has to be larger than 40 to remove possible cirrus
  - Cirrus are screened out based on the product

Motivation

There’re numerous factors influencing cloud formation, growth and its microphysical properties. Here we study factors that are linked with deep convective cloud’s ice particle sizes utilizing the contrasts among aerosol properties, surface elevation and regional differences.

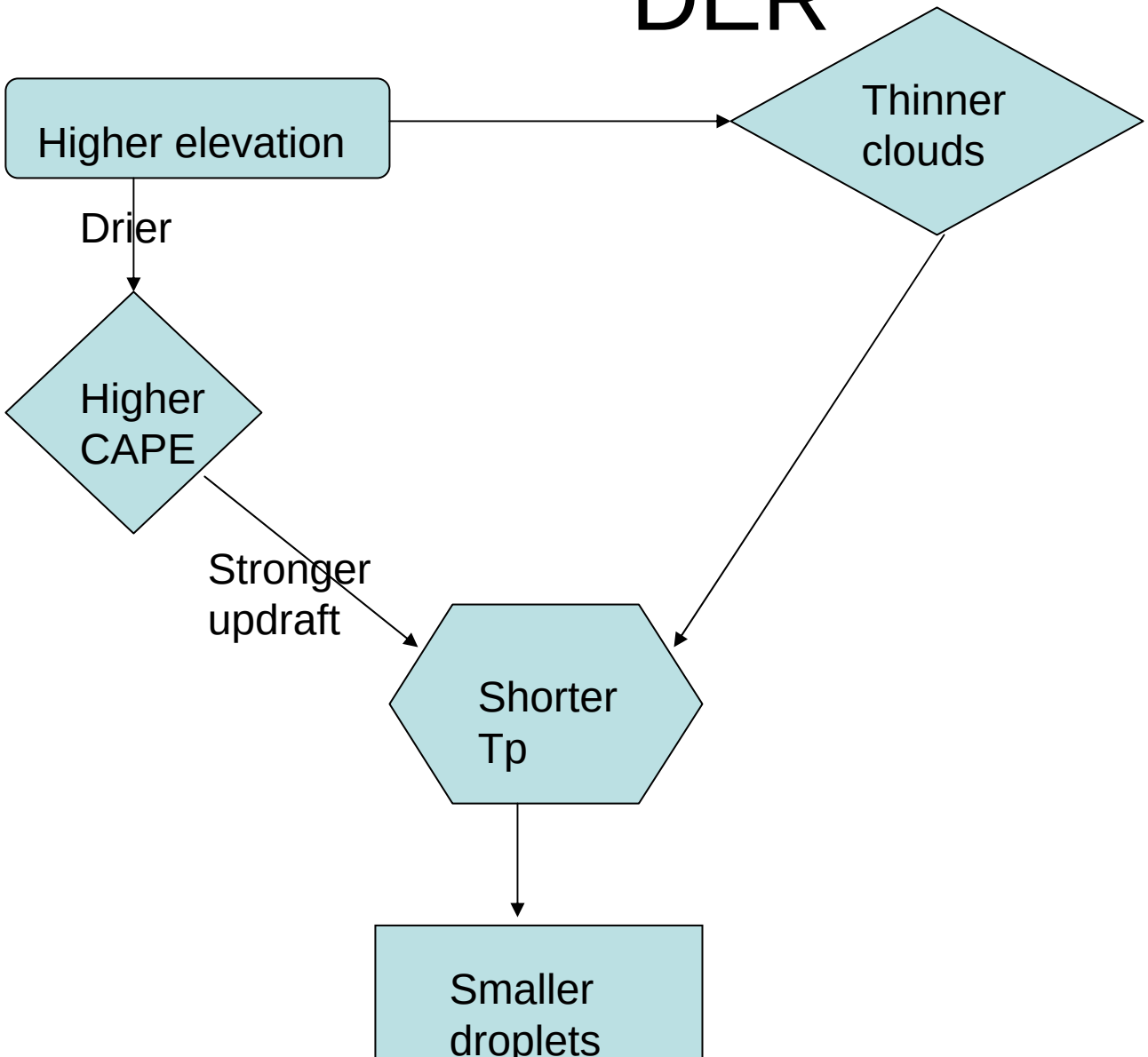
Ice particle size influencing factors

- Air parcel in-cloud Lagrangian time, Tp
- CCN and IN (aerosol) number concentration
- CCN and IN (aerosol) size distribution

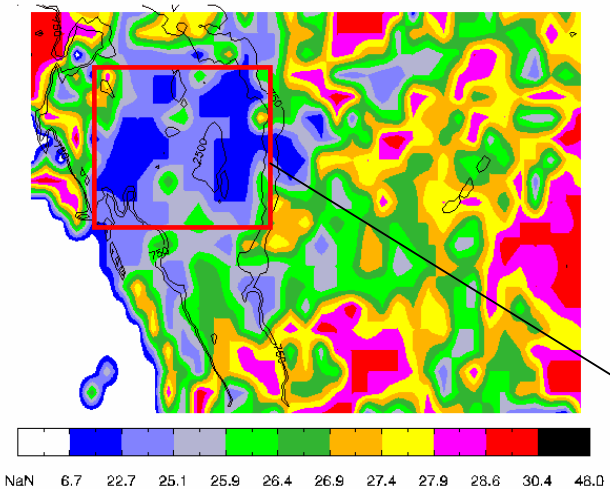
Factors influencing Tp

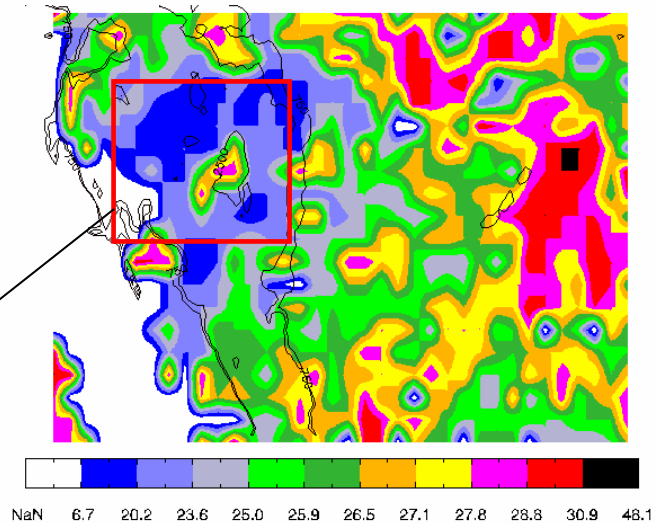
- Updraft velocity
  - Atmospheric stability
  - Cloud microphysics
  - General circulation
- Cloud thickness
  - Surface elevation
  - Atmospheric stability

Connection between elevation and DER

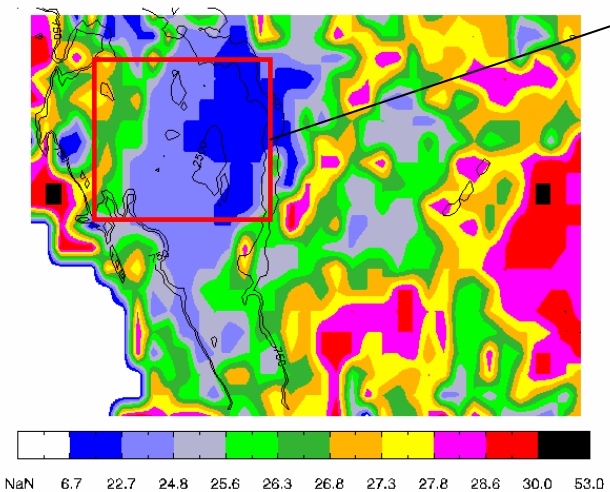


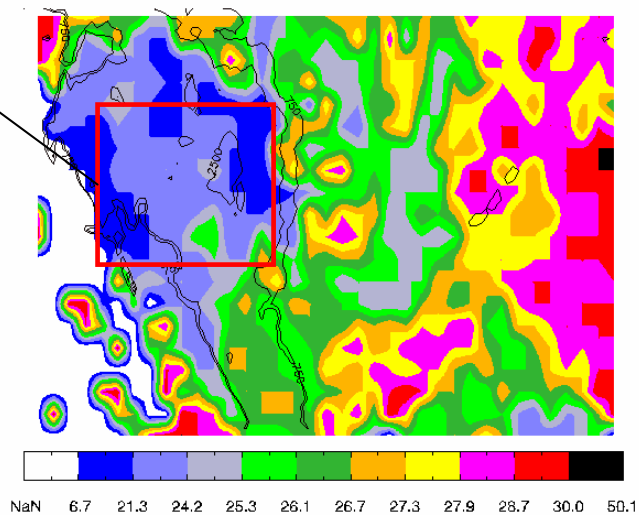
Evidence of this connection





Rocky Mountains

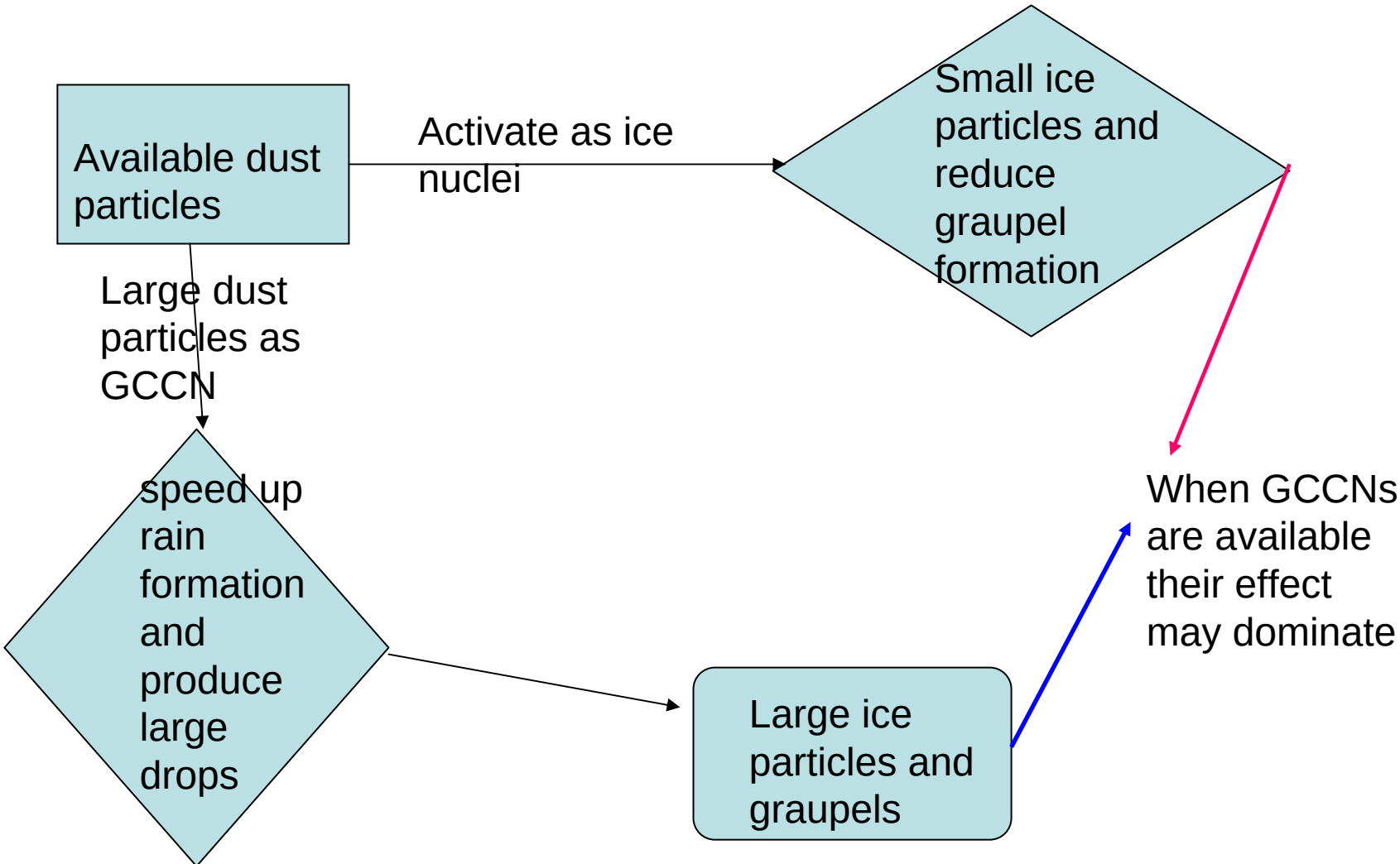




Also note that large values of DER are visible over Atlantic and Gulf of Mexico

Connection between dust concentration and DER (cont.)

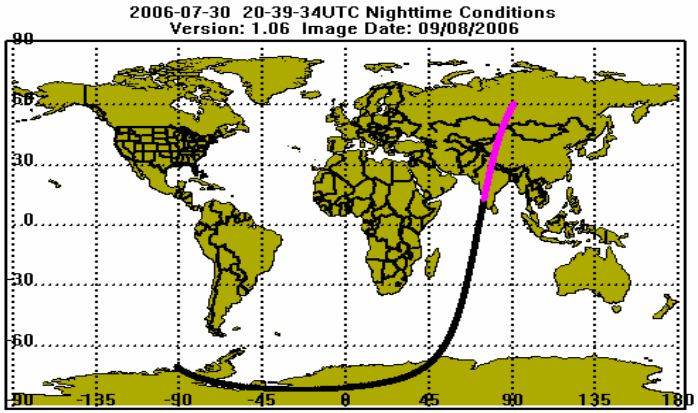
Microphysical pathway

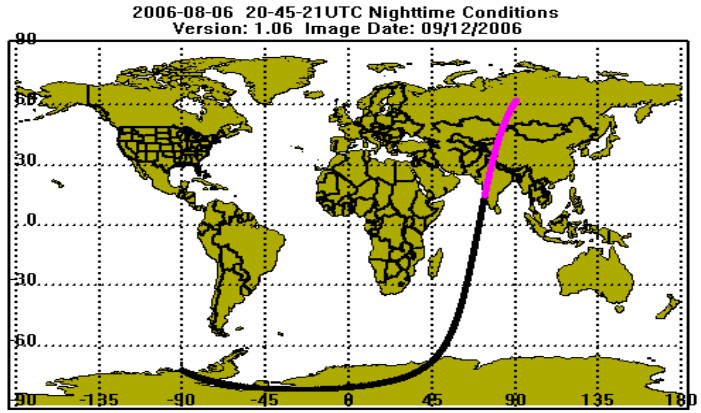


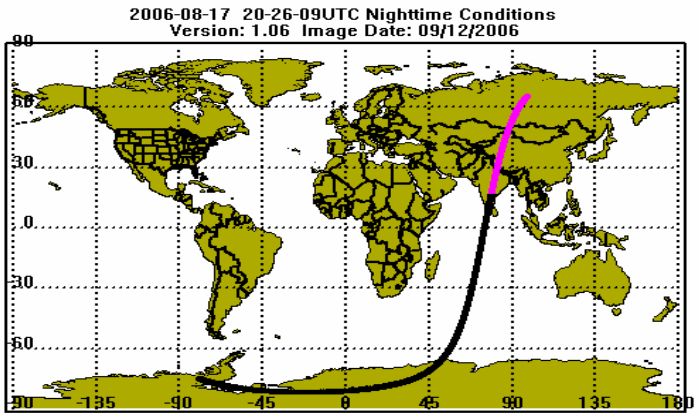
Evidence of this connection

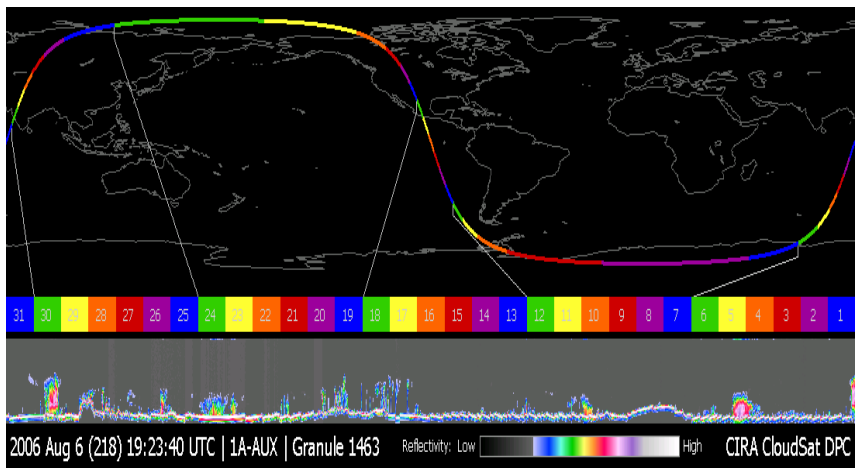
- The band of large DER in northwestern China and it’s correspondence with the desert distribution
- CLIPSO observed dust distribution over Taklamakan desert and its interaction with convective clouds together with CloudSat observation

CALIPSO Pathes

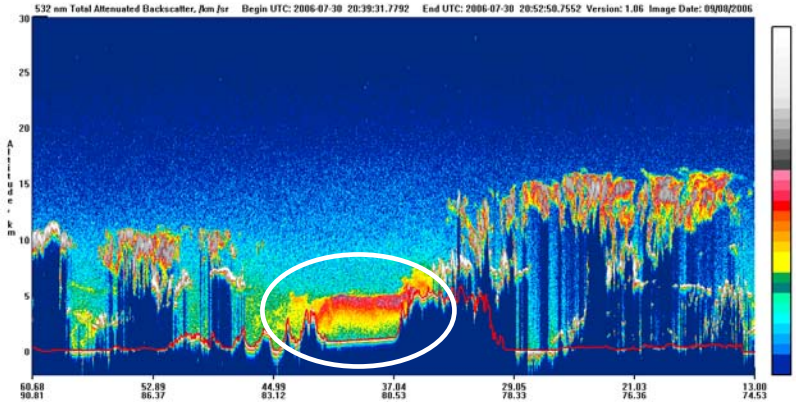


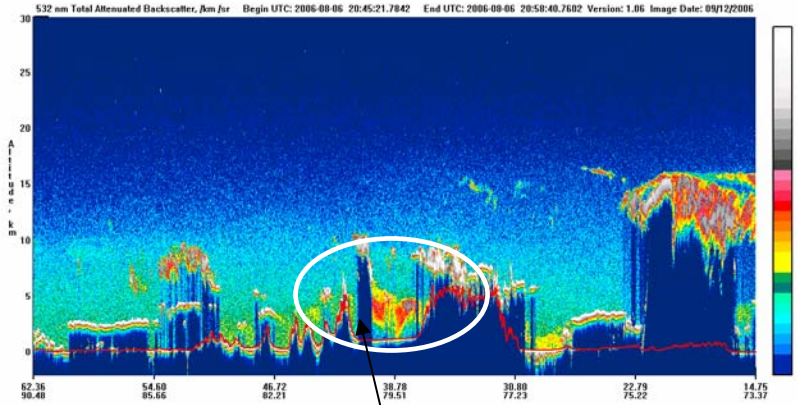




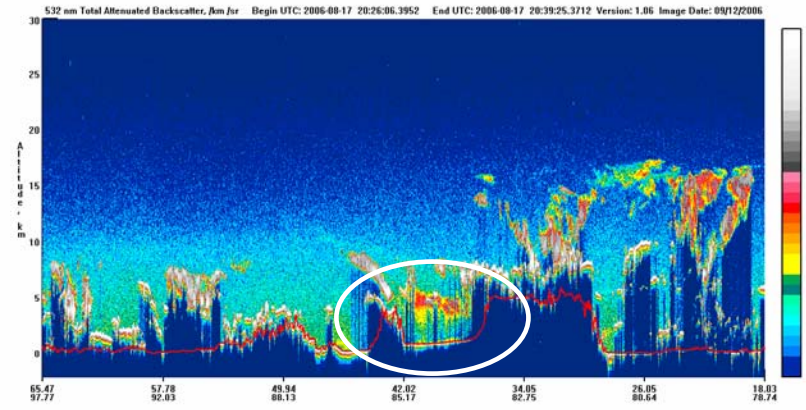


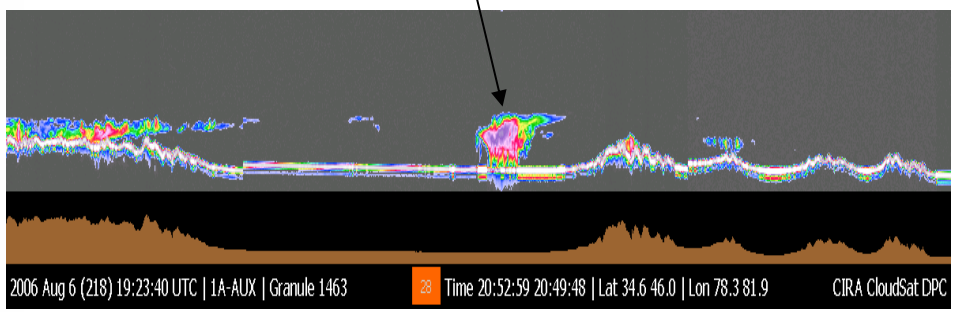
Elevated dust layers in Tarim Basin (Taklamakan desert)

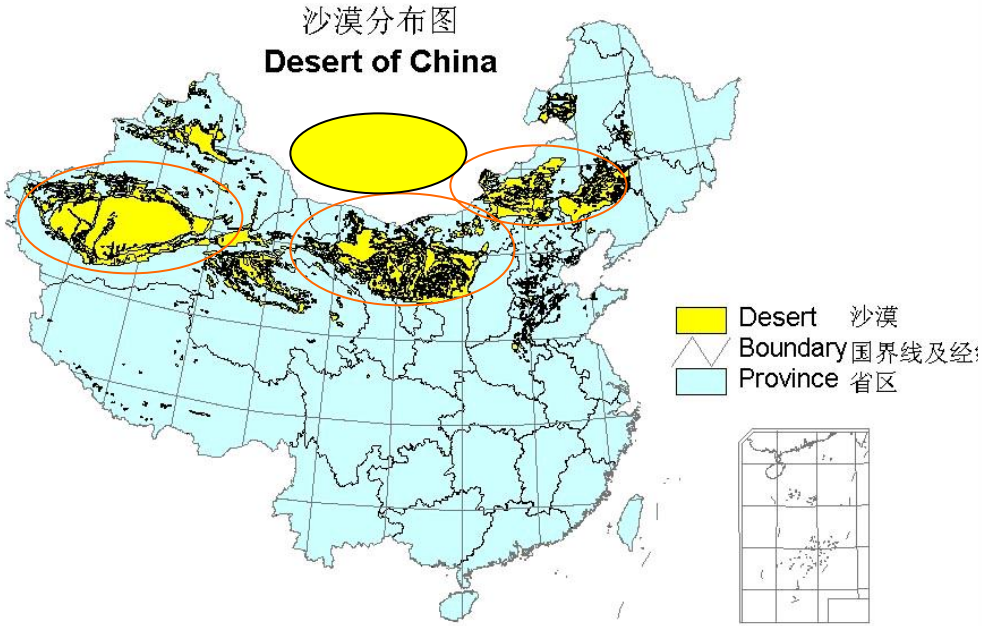


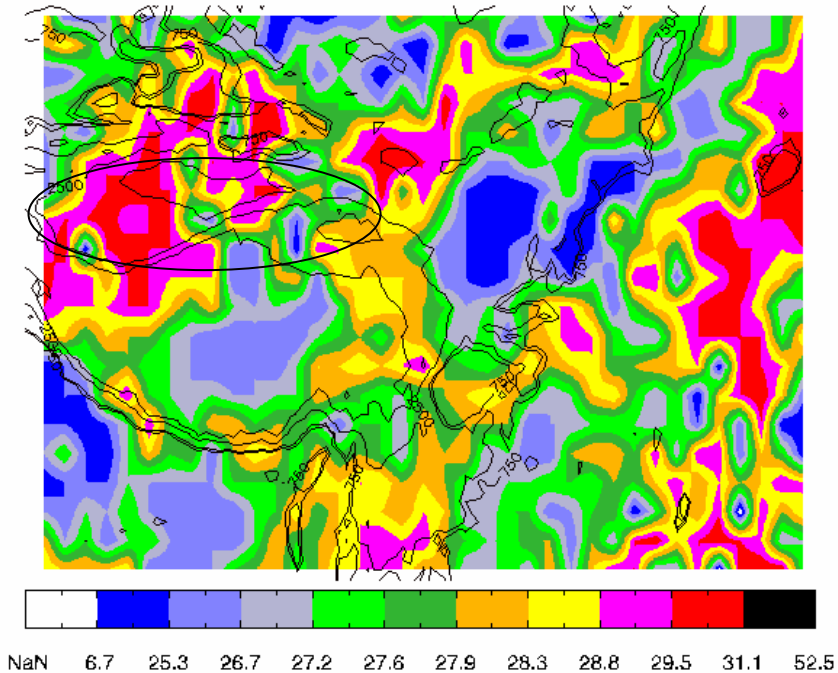


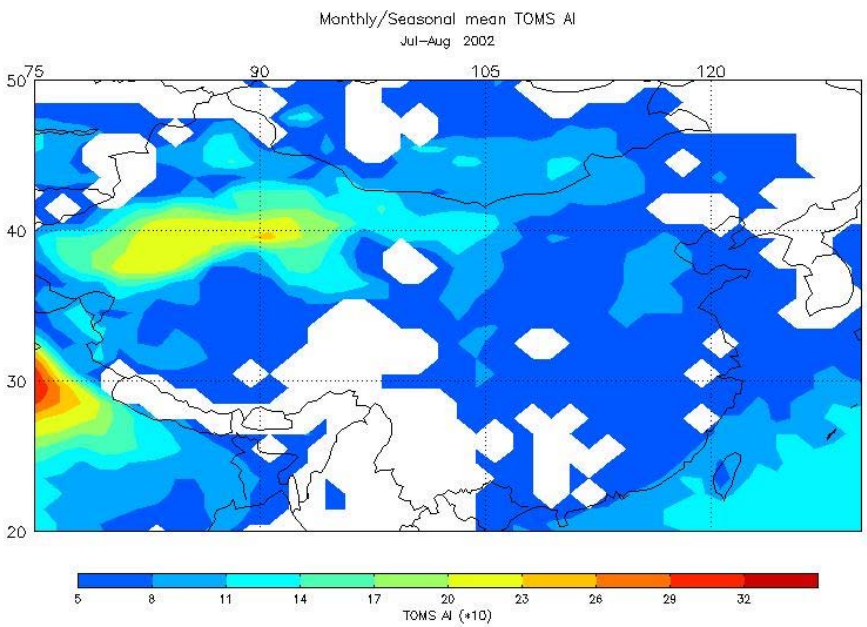
The same convective cell









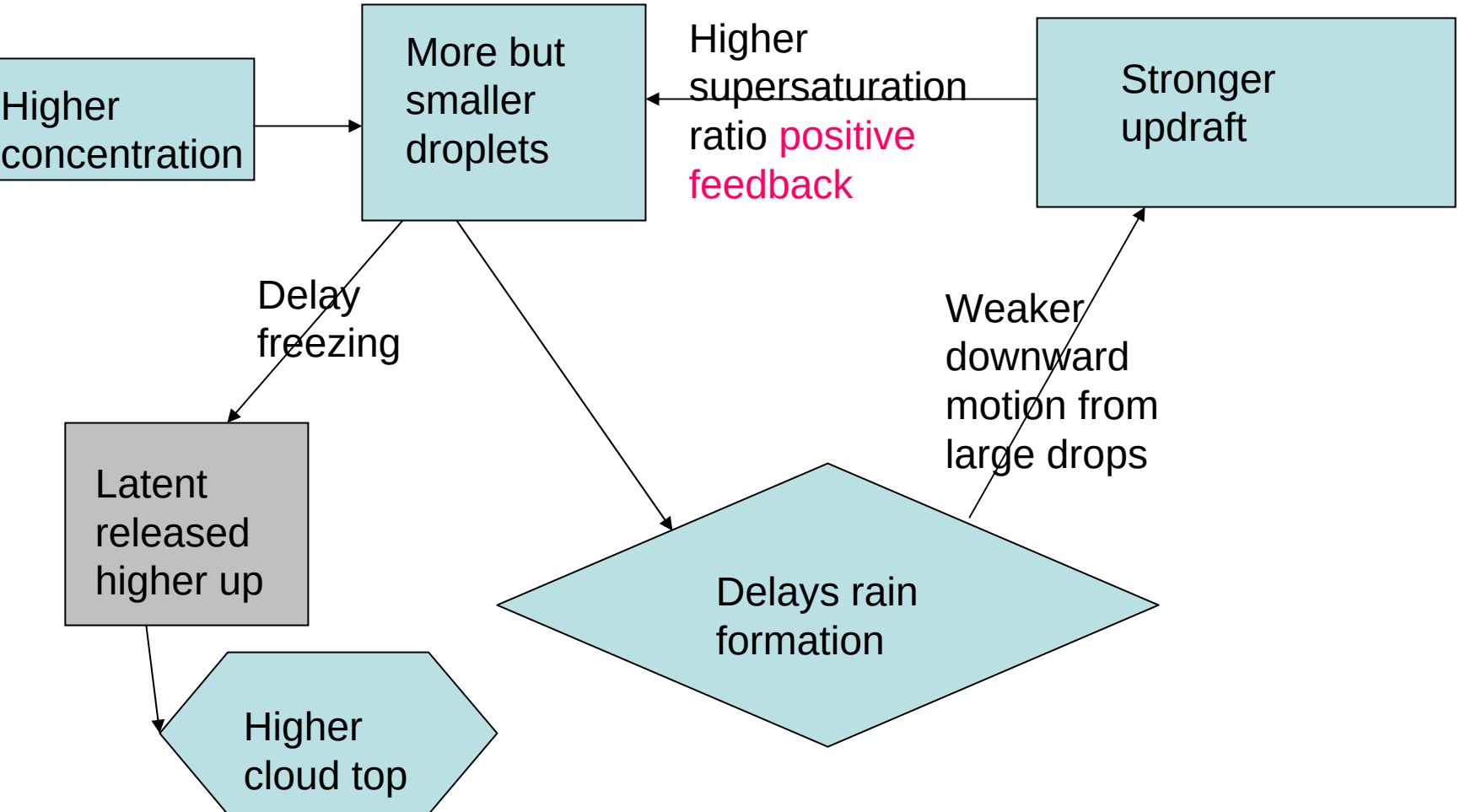


Features to notice

- Correspondence between areas with large AI value and desert distribution
- In Northwestern China and southern Mongolia there is a band of area with large ice particle sizes
- There’s an established land-sea contrast in terms of DER size

Connection between aerosol concentration and DER (cont.)

Thermodynamics pathway

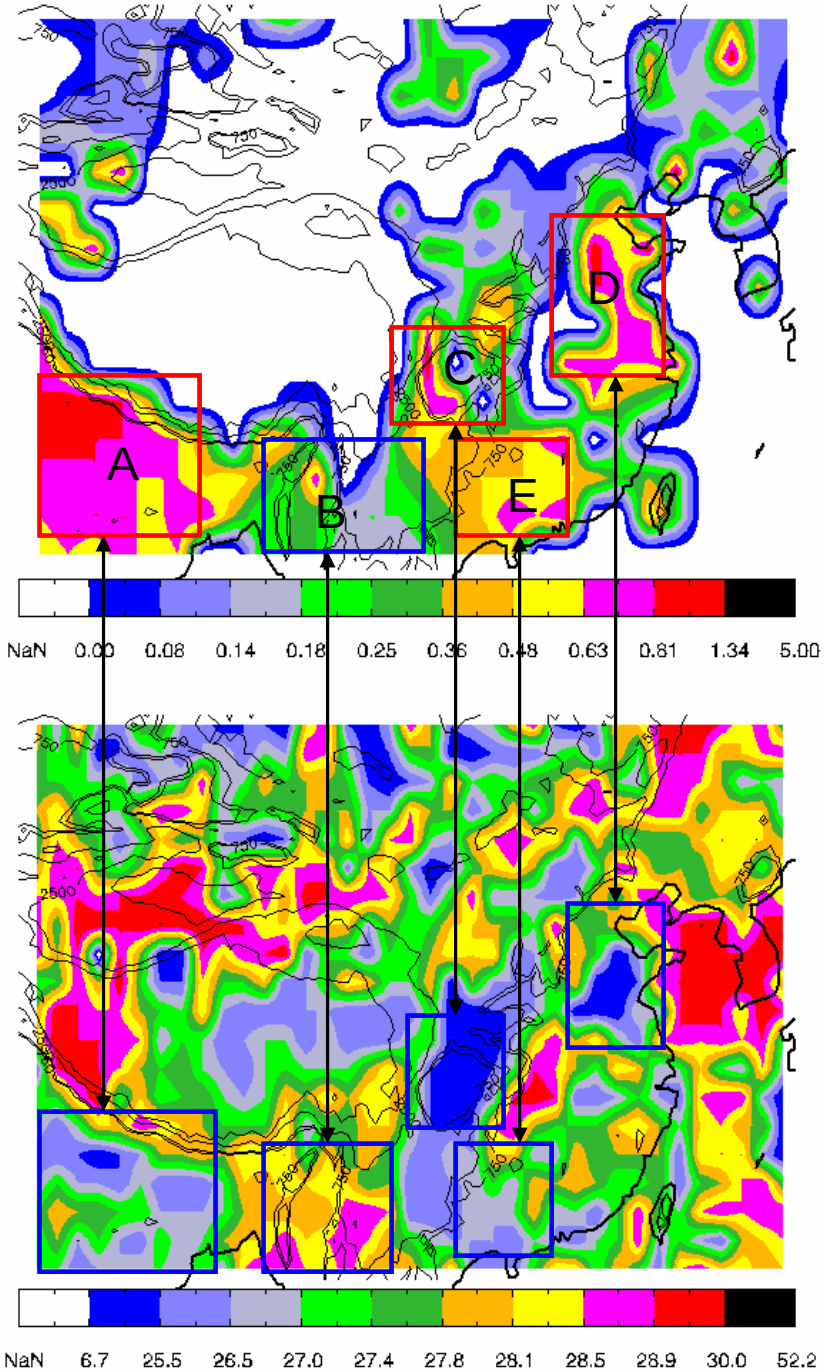


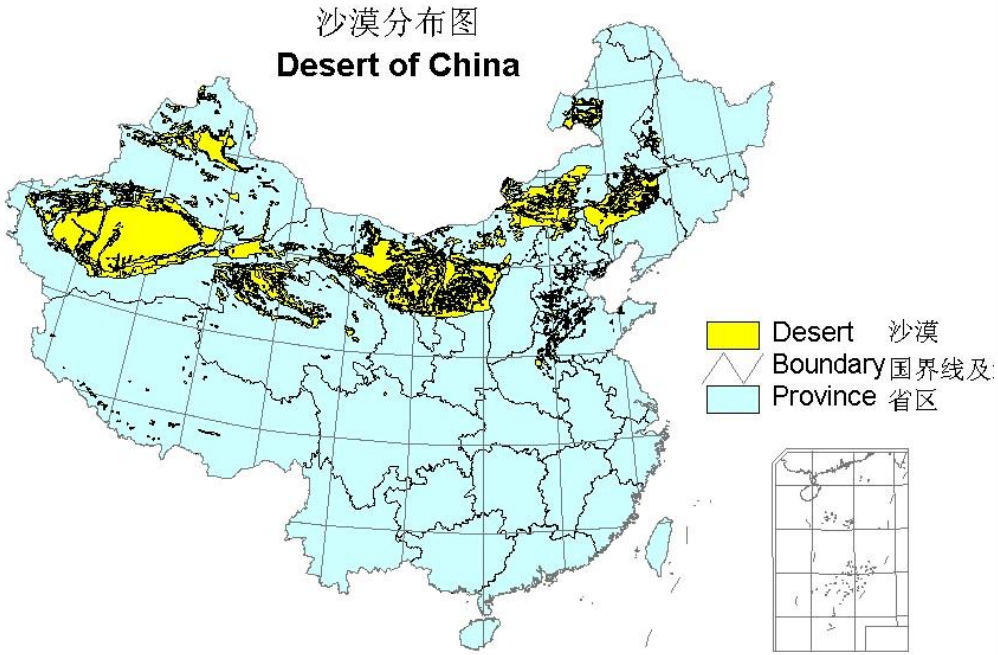
Evidence of this connection

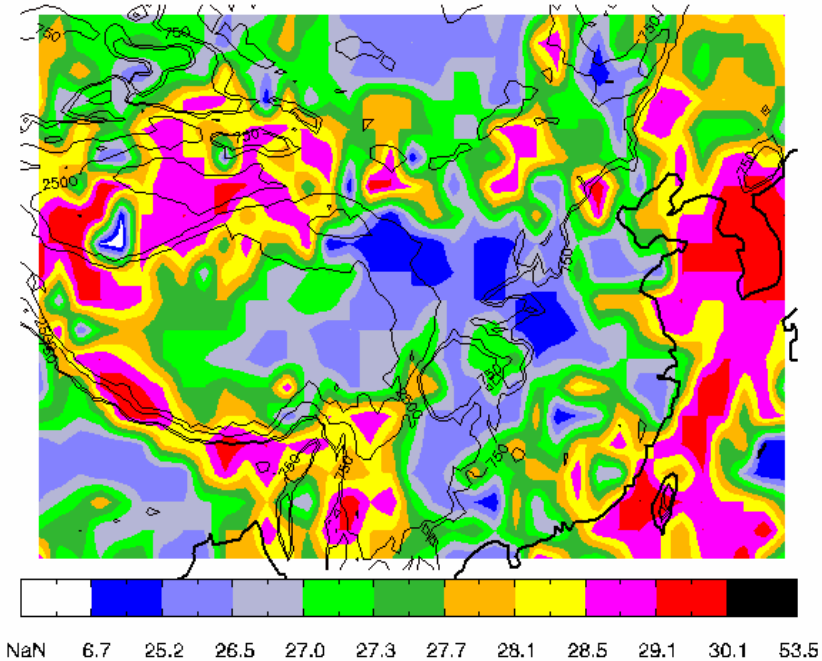
- Seesaw pattern in next slide
- DER – AOD connection between areas ‘C’ ‘D’ and ‘E’ for China in next three slides. However, notice that ‘D’ and ‘E’ are coastal regions and thus likely influenced by maritime clouds especially Typhoons in the summer season, for which the data are used here.

Features to notice

- ‘A’: Northern India valley with high AOD
- ‘B’: Southwestern China and northeast India with low AOD [The contrast will produce a corresponding seesaw pattern in DER]
- ‘C’: Sichuan basin with high AOD
- ‘D’: Central and eastern China with high AOD
- ‘E’: Industrialized province of Guangdong with high AOD




沙漠分布图
Desert of China
Desert 沙漠
Boundary 国界线及
Province 省区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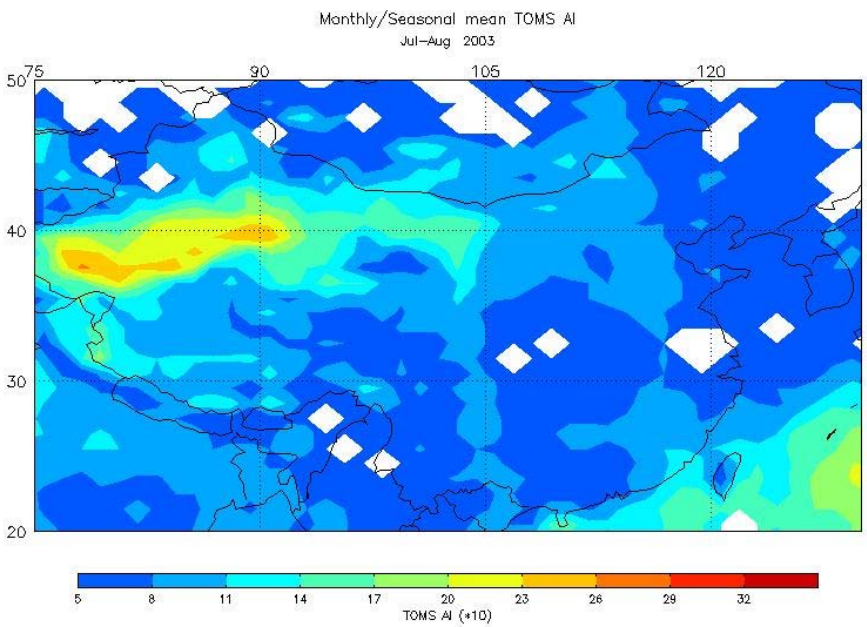
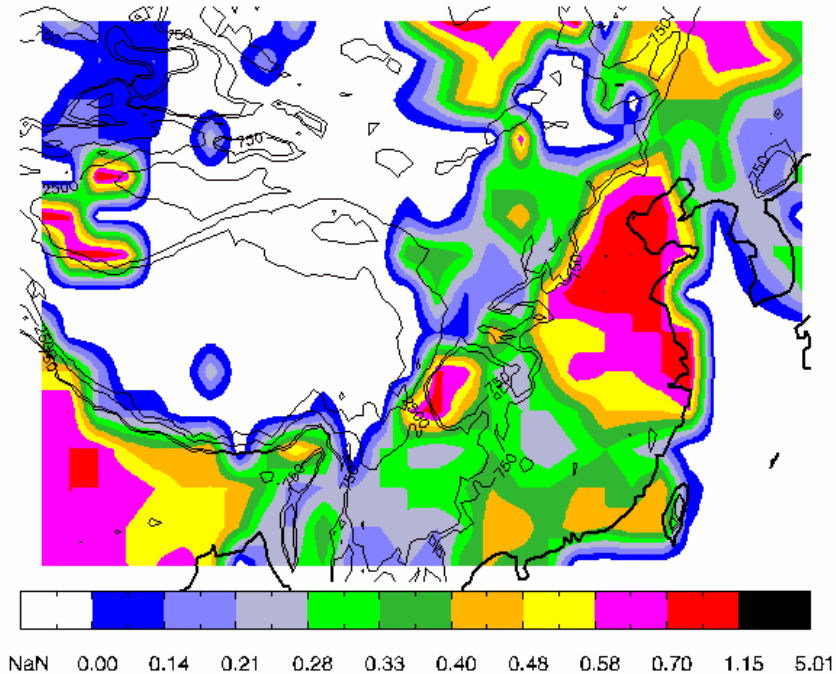

Monthly/Seasonal mean TOMS AI
Jul–Aug 2003
75
90
105
120
50
40
30
20
5 8 11 14 17 20 23 26 29 32
TOMS AI (*10)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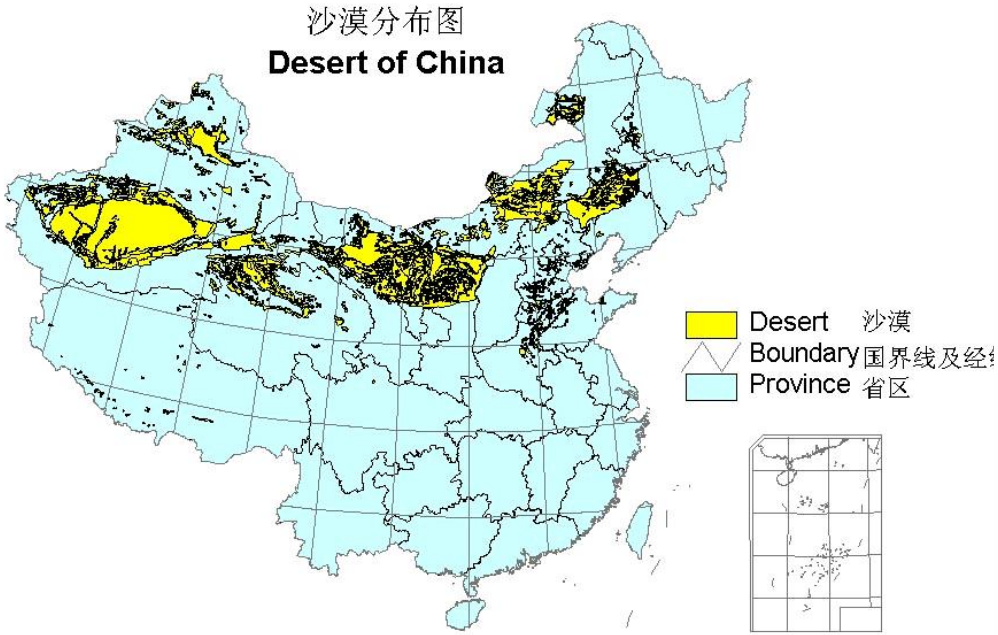
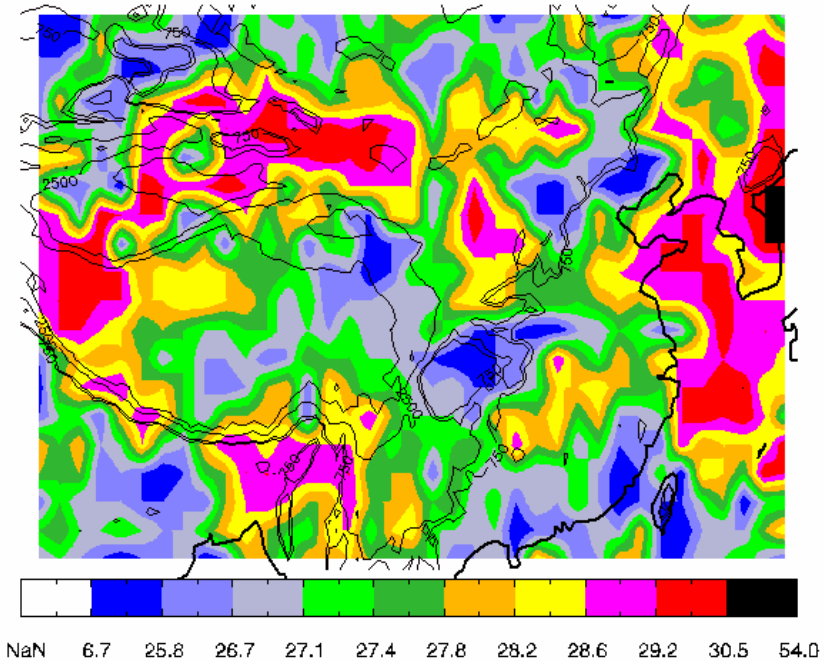
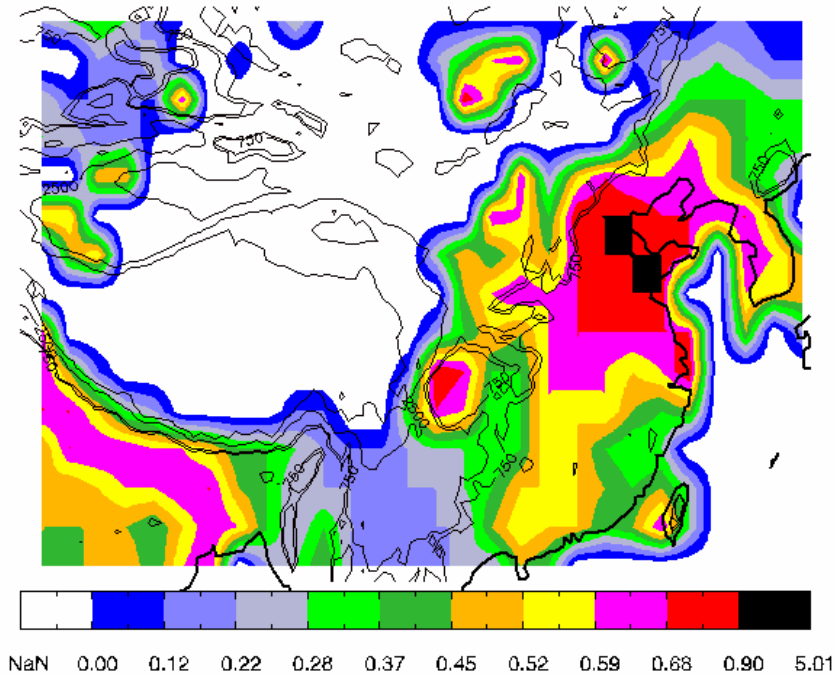
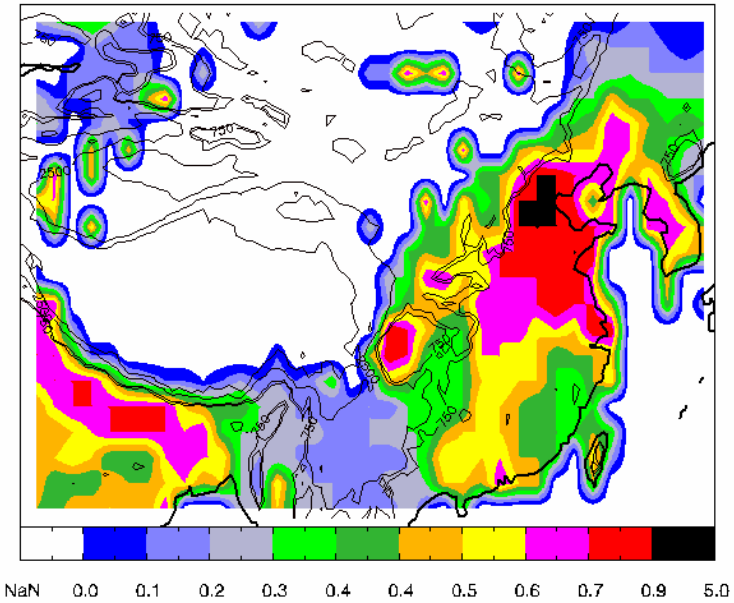
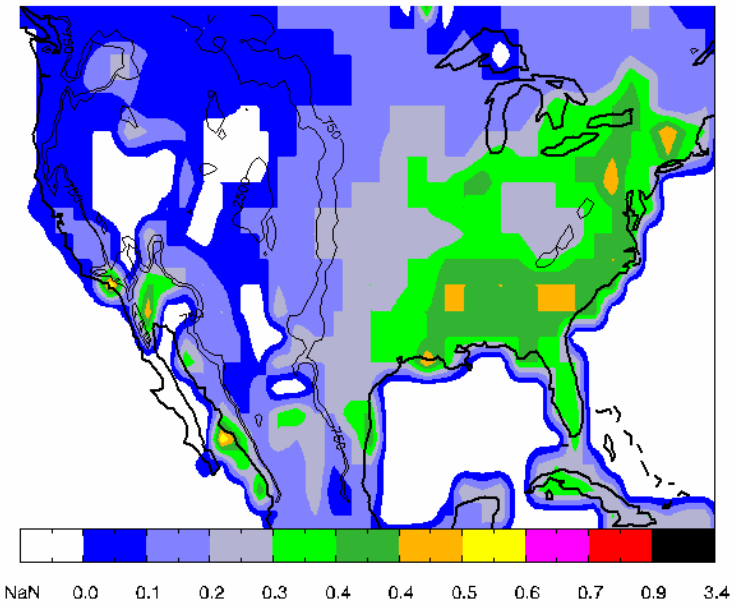
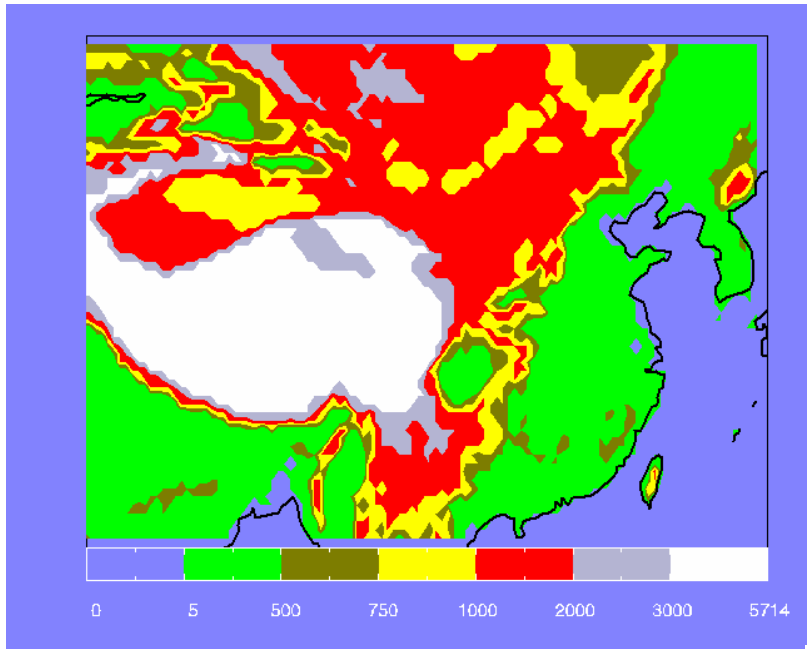
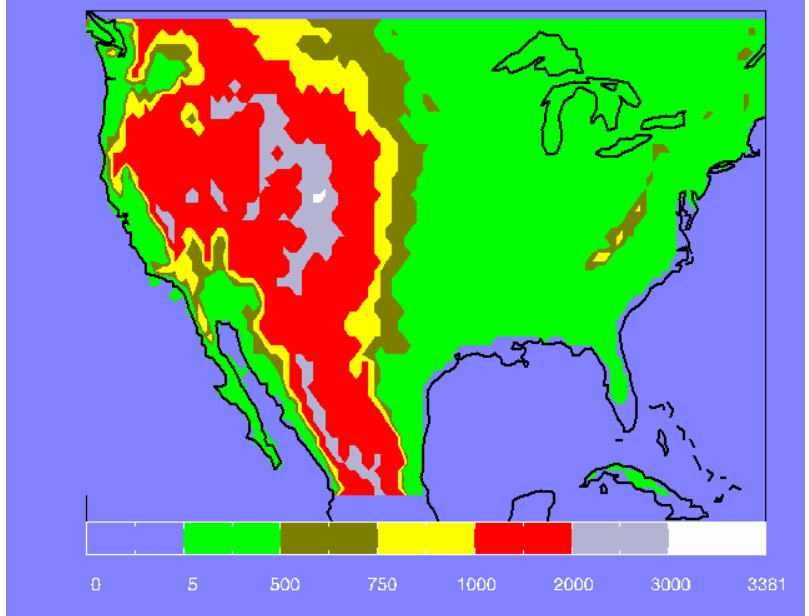




TOMS Plot not available this year



Contrasts between US and China