

Beijing Air Pollution Study from Multi-Satellite Measurements

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- Beijing Haze, January 2013
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AIR POLLUTION IN CHINA

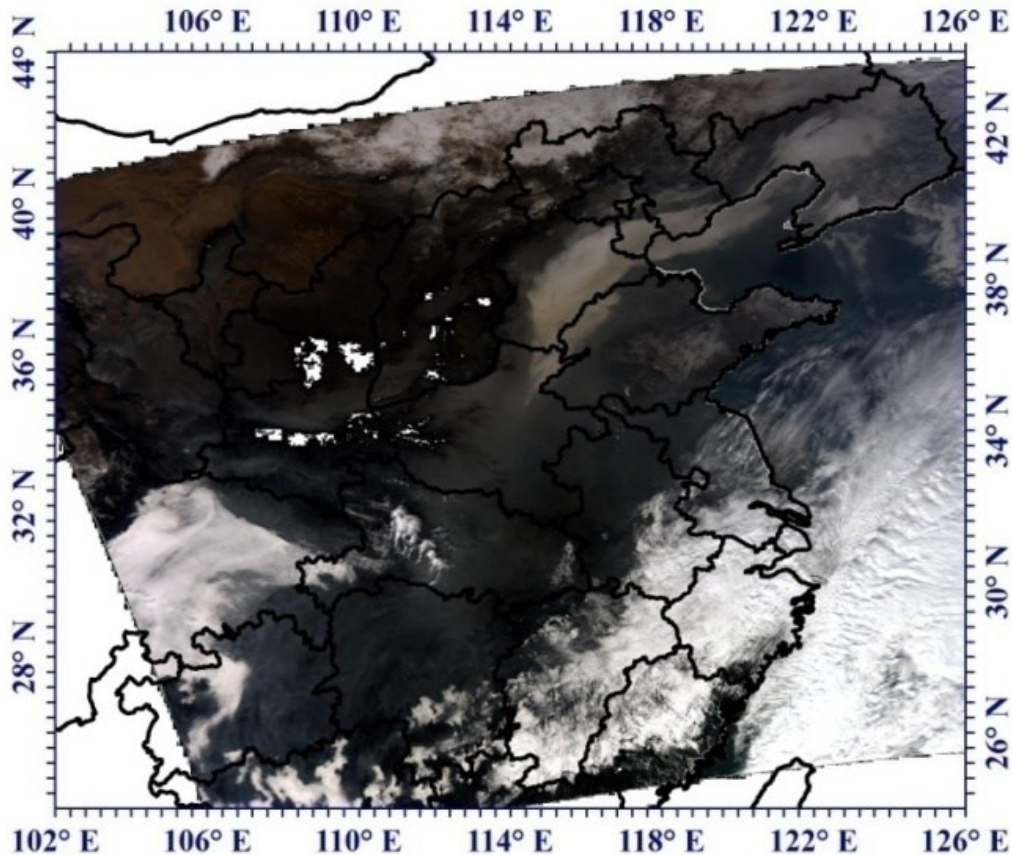
- China's environmental protection ministry published a report in November 2010 which showed that about a third of 113 cities surveyed failed to meet national air standards.
 - The northeast industrial town of Benxi is so polluted that it once disappeared from satellite photos. Its residents have the highest rate of lung disease in China.
- Coal is the number one source of air pollution in China. China gets 80 percent of electricity and 70 percent its total energy from coal, much of it polluting high-sulphur coal.
 - Around six million tons of coal is burned everyday to power factories, heat homes and cook meals.
- Expanding car ownership, heavy traffic and low-grade gasoline have made cars a leading contributor to the air pollution problem in Chinese cities.

Introduction

- Haze is traditionally an atmospheric phenomenon where dust, smoke and other dry particles obscure the clarity of the sky.
- Haze has great effects to regional climate system such as monsoon and atmospheric environment such as air quality and visibility, thus affect human health, especially the old and children, even the new-born children.
- Local and transporting emission densities together with the synoptic patterns complex dominate the occurrence of haze episodes.

Introduction

A prolonged haze event attacked the northeast part of China in January 2013



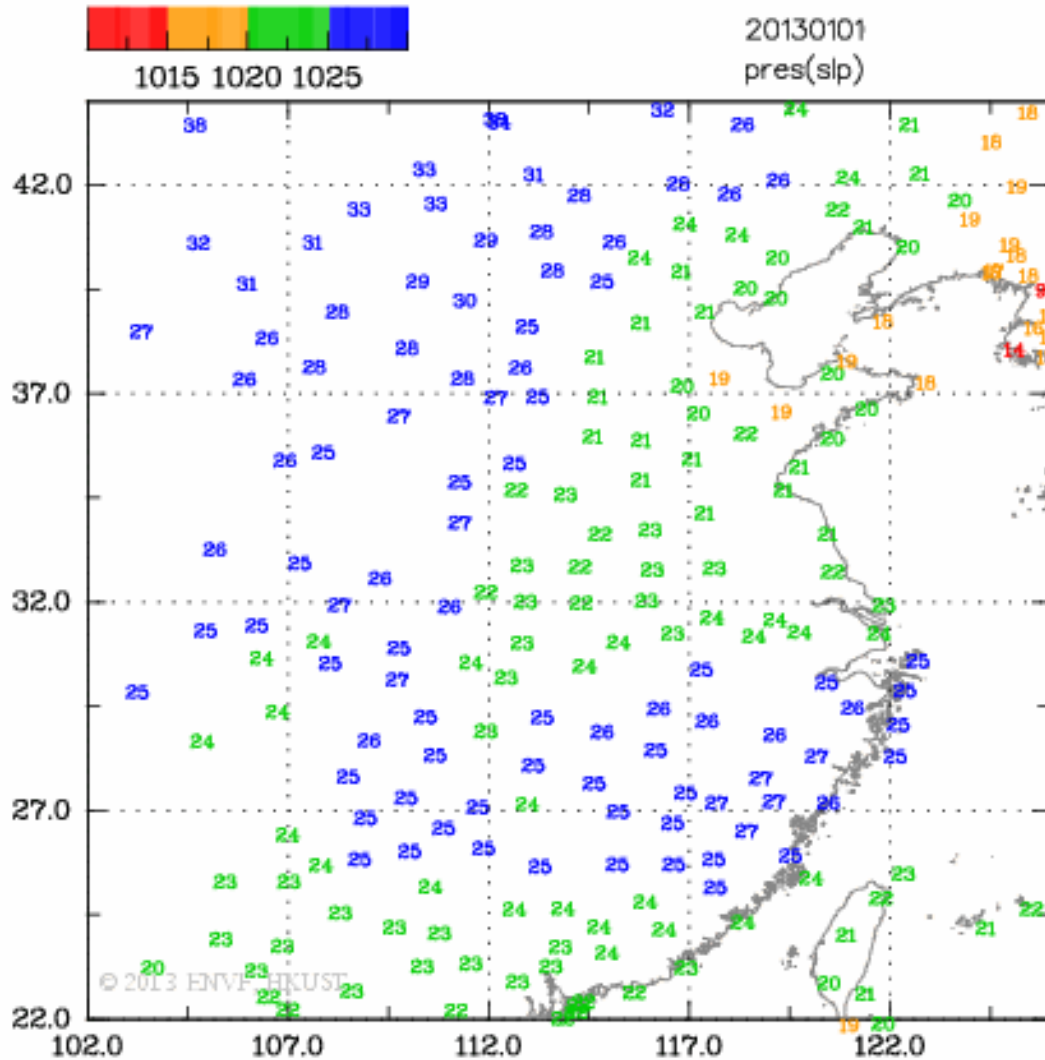
HAZE 2013 Jan 13

AQUA/MODIS Band 1,4,3,2013 Jan 13 17:23 UTC

Copyright(C) NASA & IRSA/TGP (2013 Jan 27 23:26 UTC)



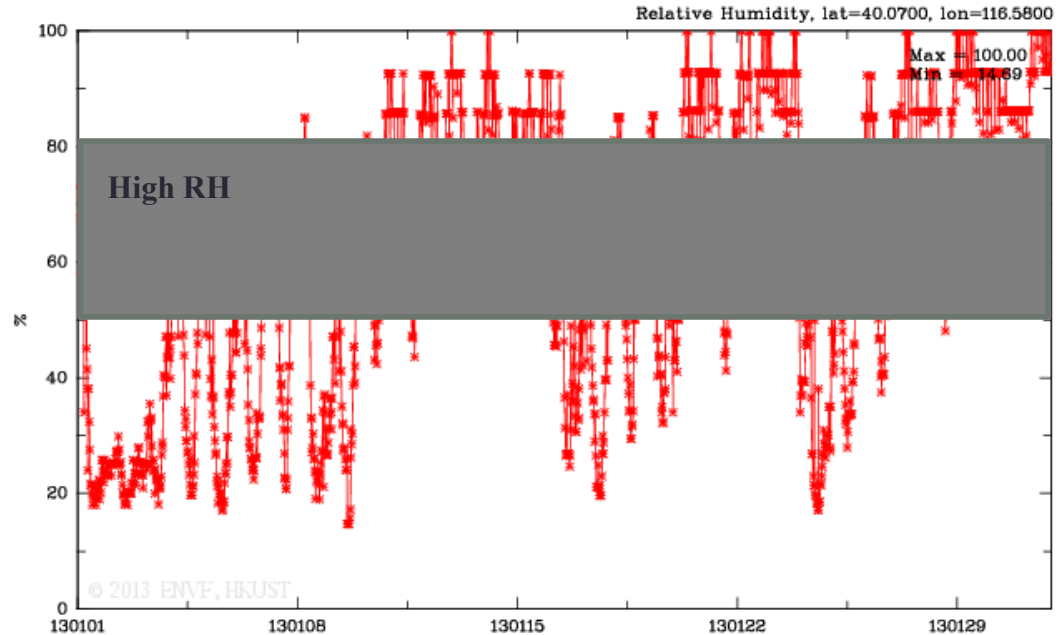
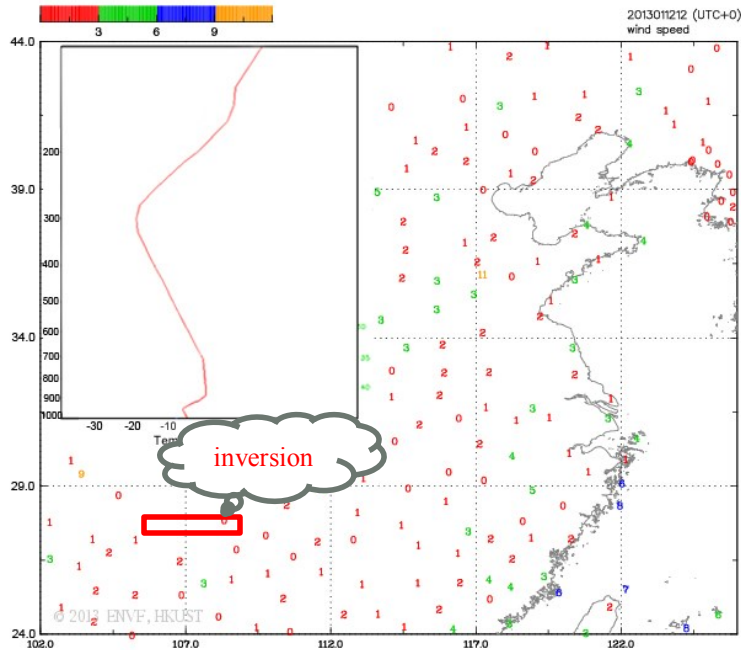
Formation of the 2013 Beijing haze



Low pressure dominate
Beijing compared with
surround, which is not
benefit for the pollutant
dispersion

<http://envf.ust.hk/>

Formation of the 2013 Beijing haze



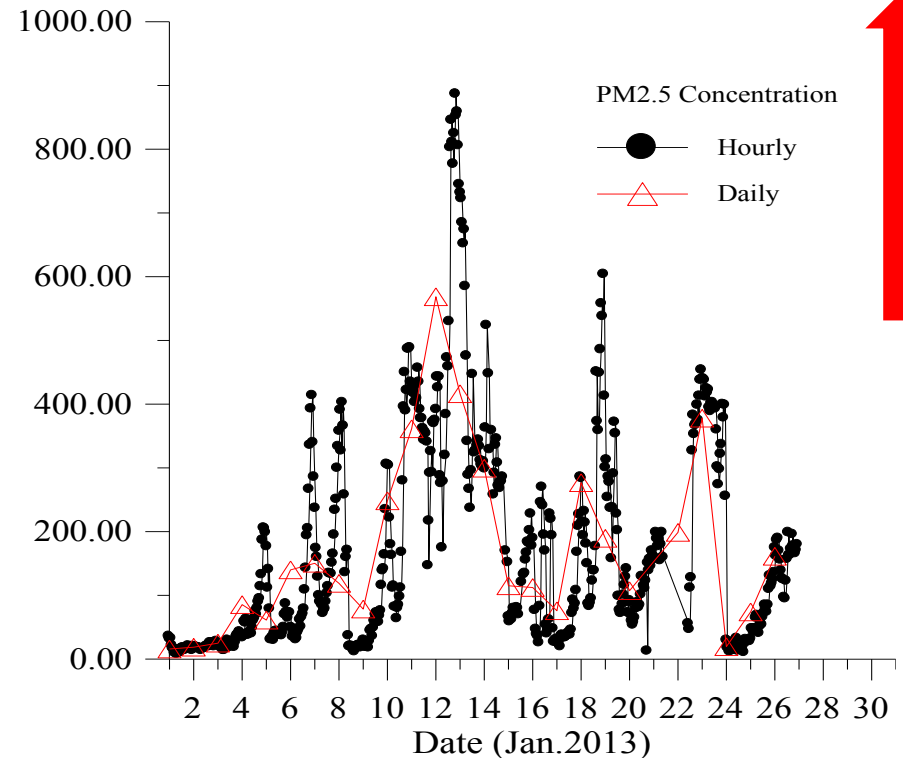
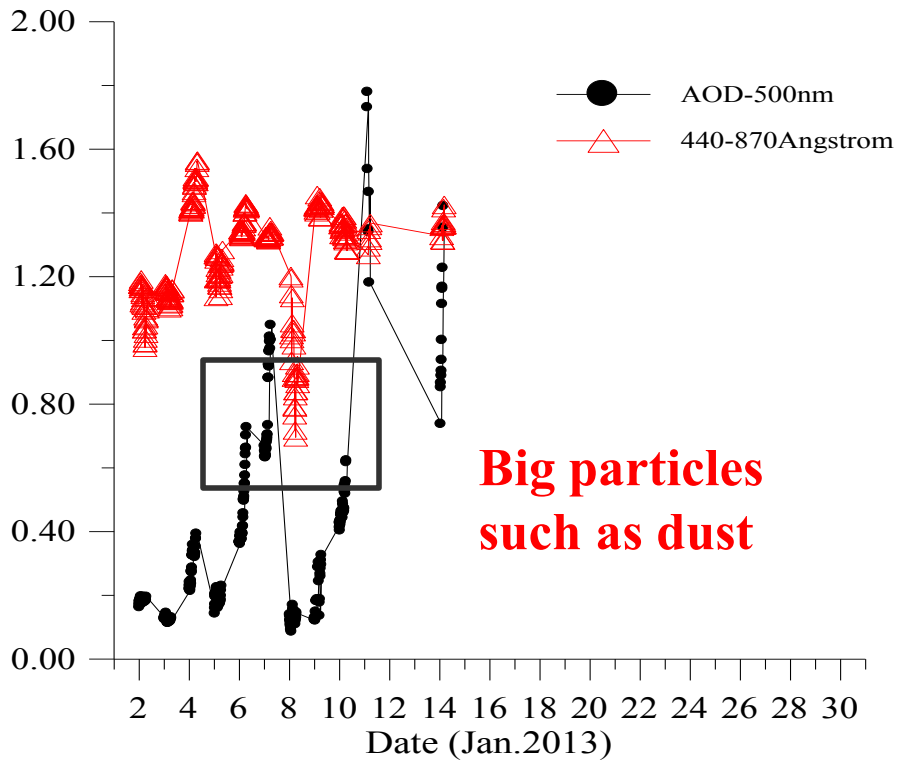
(<http://envf.ust.hk/>)



- (1) Particles from North China Plain regions
- (2) Local emissions
- (3) The stable meteorological condition (No wind and temperature inversion)
- (4) High relative humidity.

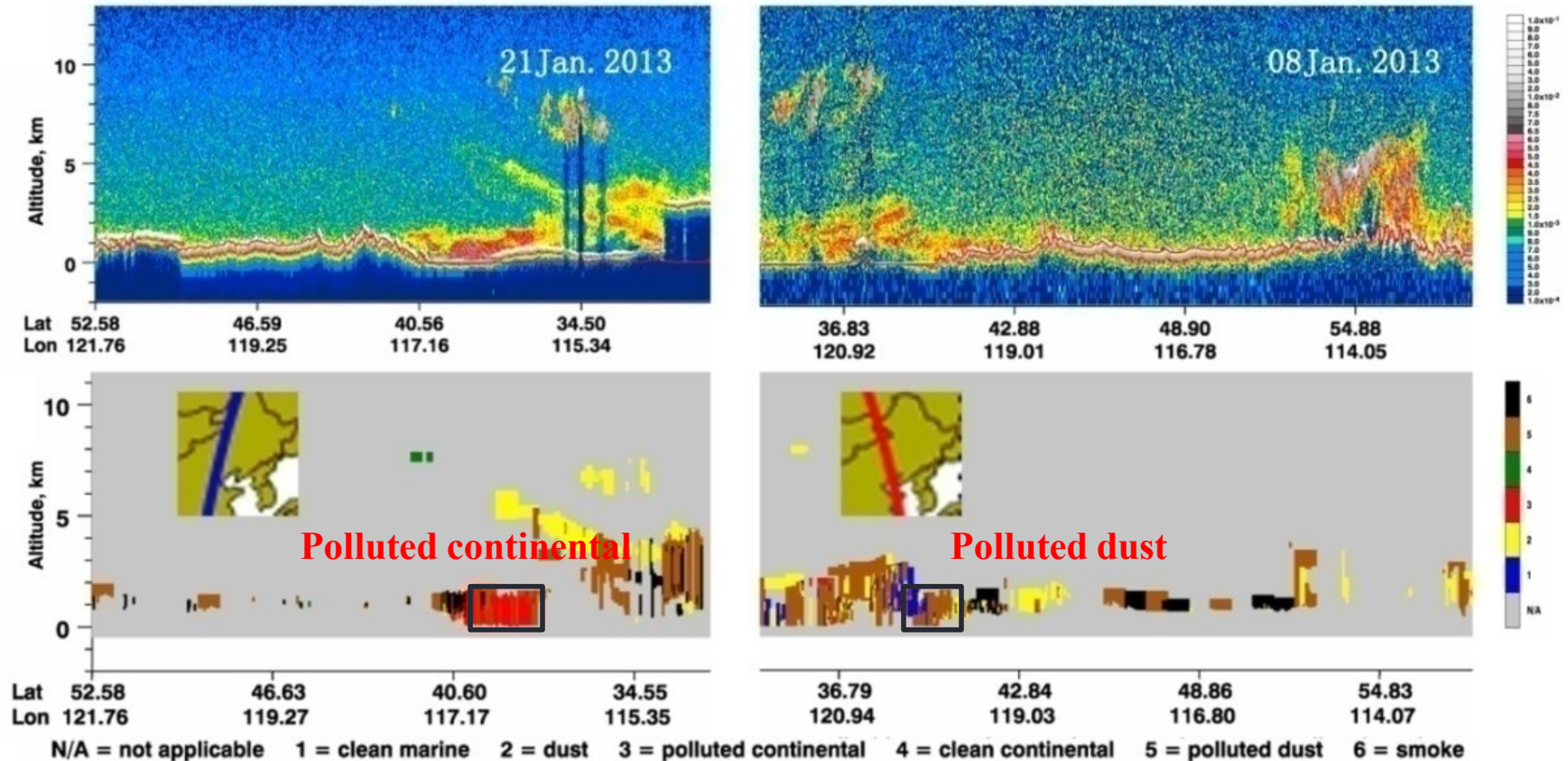
Haze effect on Environment/Human

1/3



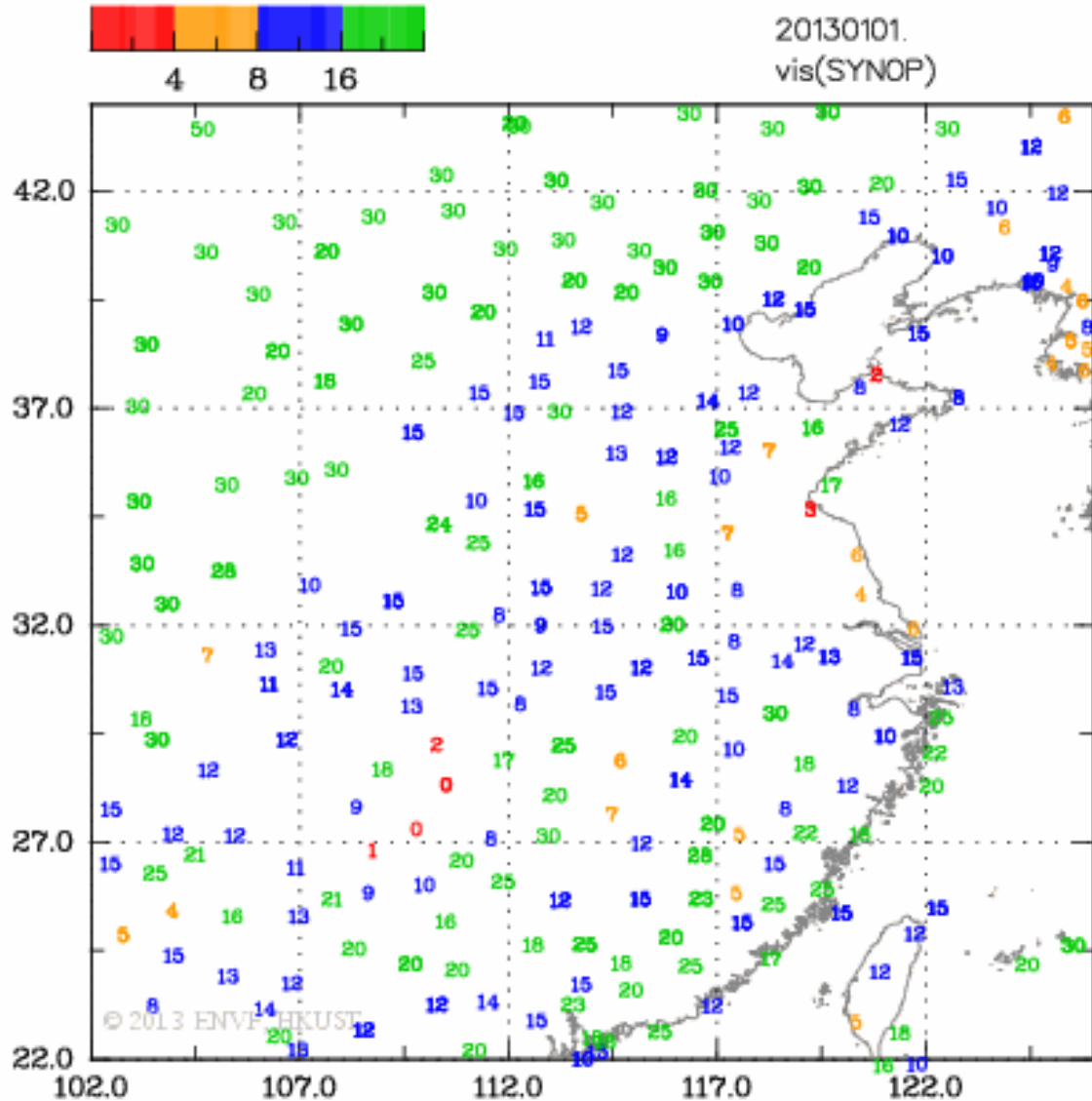
AOD and PM_{2.5} time series from ground-based measurement

Haze effect on Environment/Human

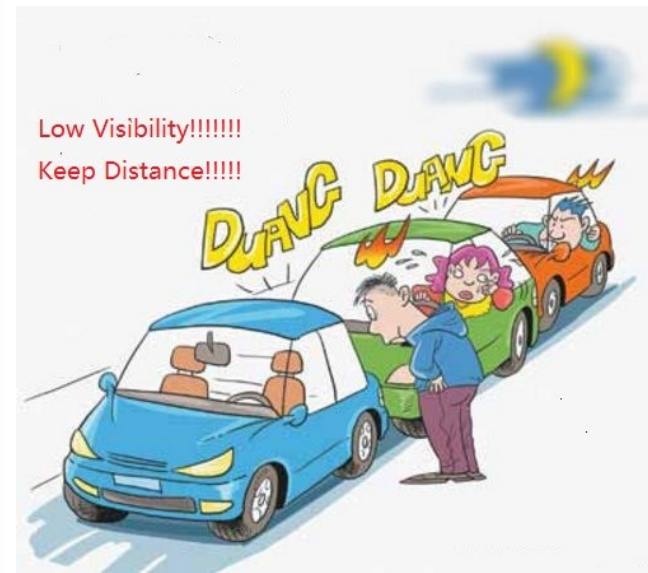


CALIPSO Total Backscatter at 532nm and Aerosol Subtype on 8 and 21 Jan. 2013. The blue and red line in the map represents the orbit track

Formation of the 2013 Beijing haze

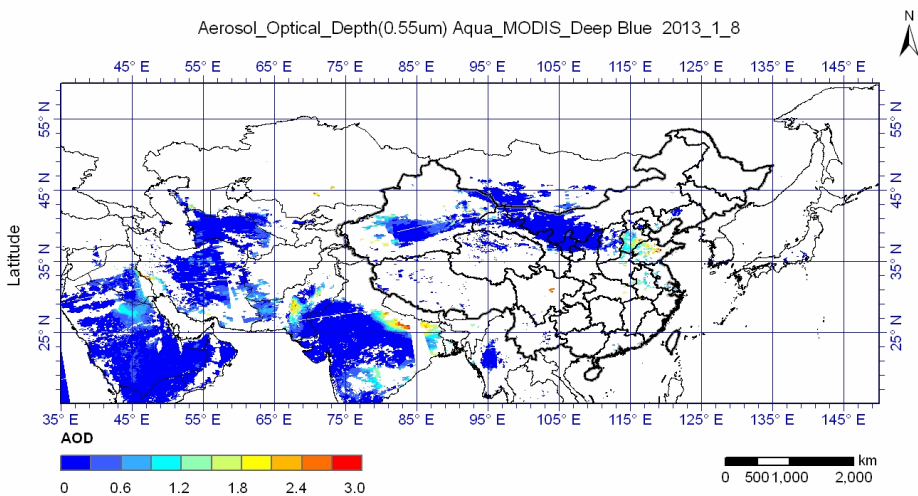


Red and Yellow
means low visibility

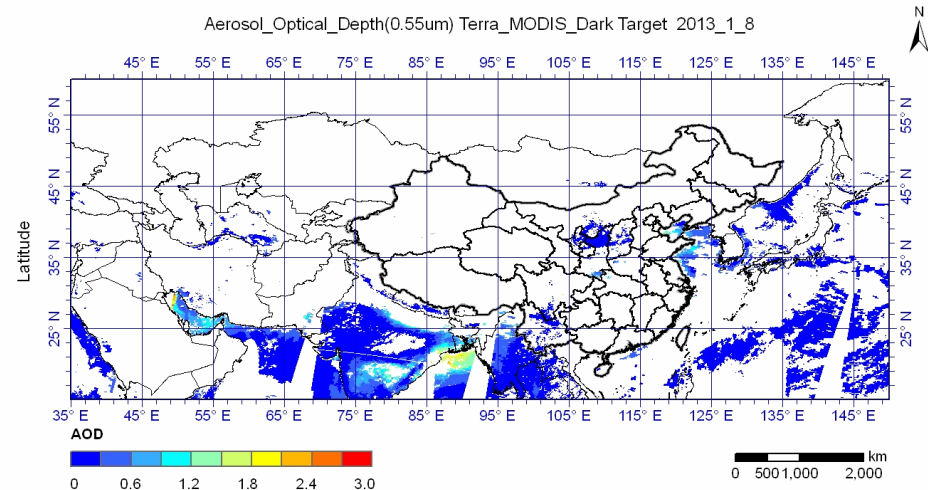


AOD Products

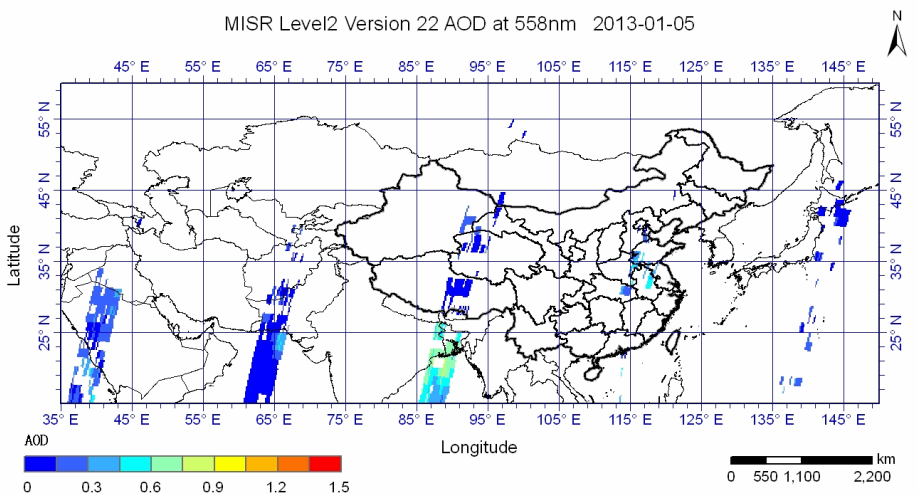
Aerosol_Optical_Depth(0.55um) Aqua_MODIS_Deep Blue 2013_1_8



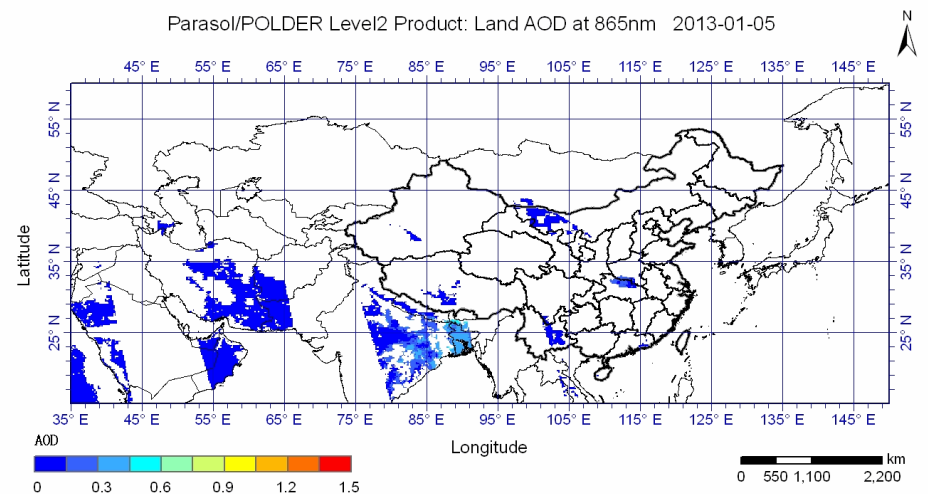
Aerosol_Optical_Depth(0.55um) Terra_MODIS_Dark Target 2013_1_8



MISR Level2 Version 22 AOD at 558nm 2013-01-05



Parasol/POLDER Level2 Product: Land AOD at 865nm 2013-01-05

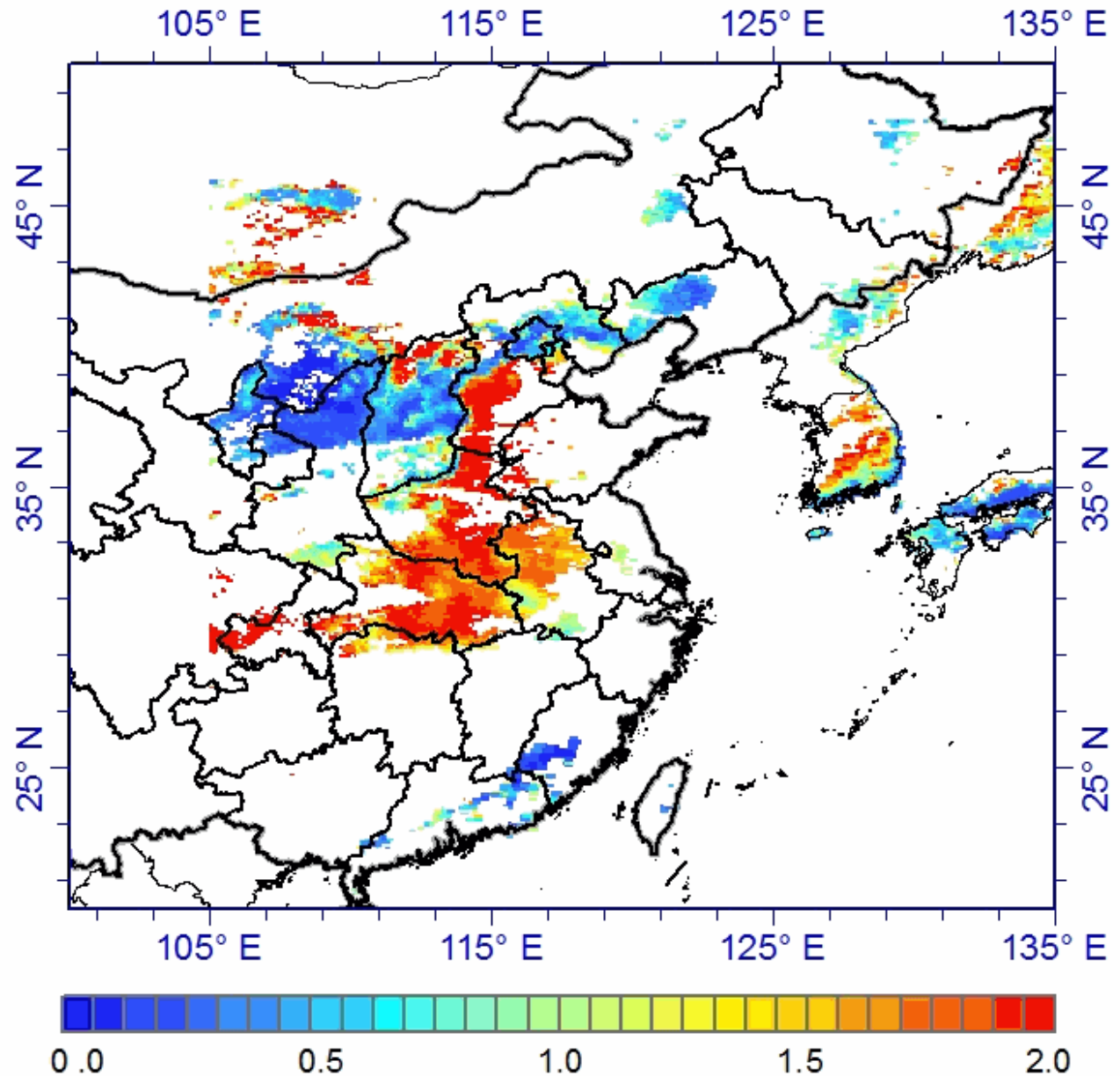


**AOD –
China Collection 2.0**

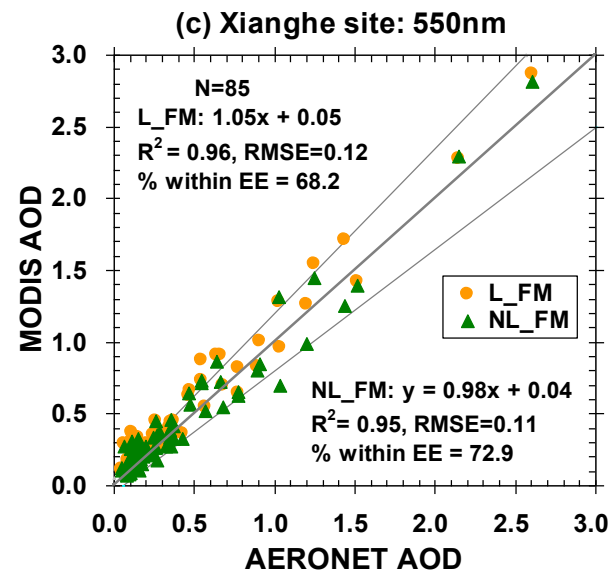
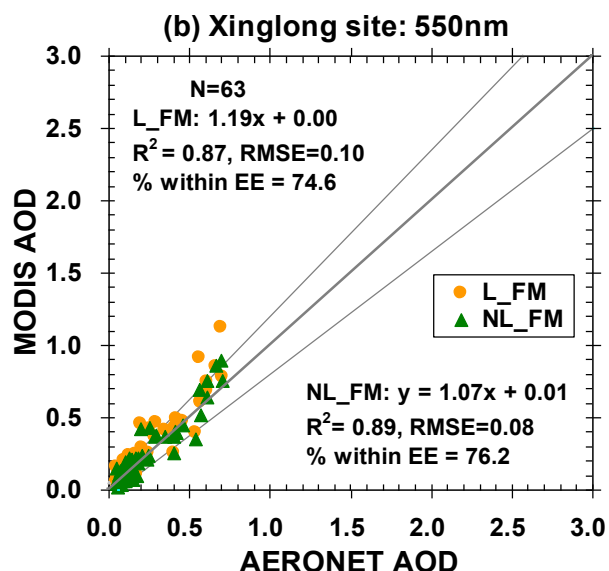
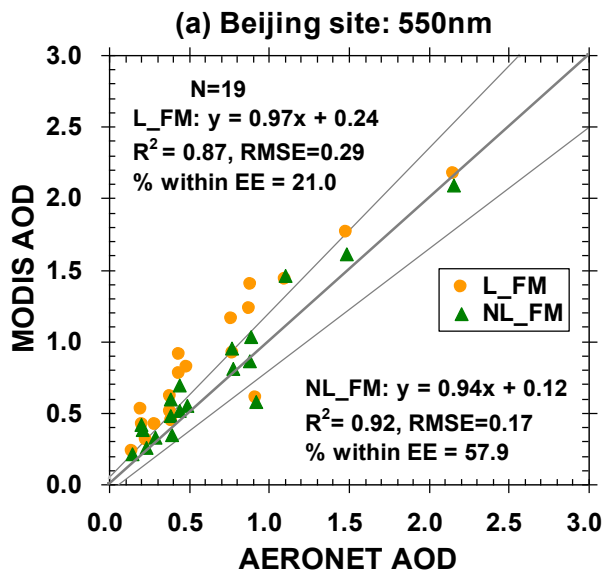
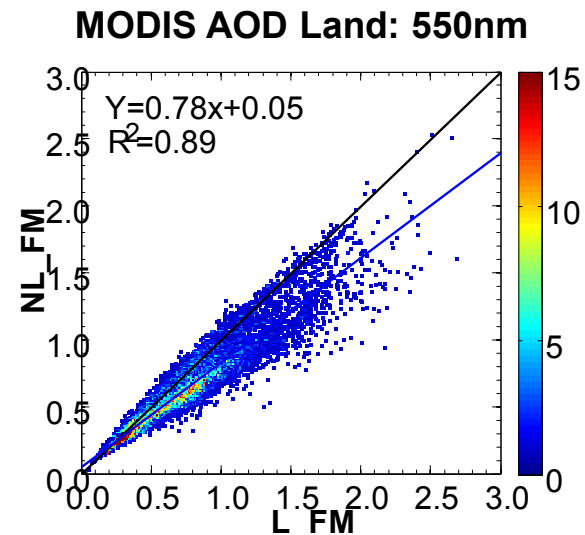
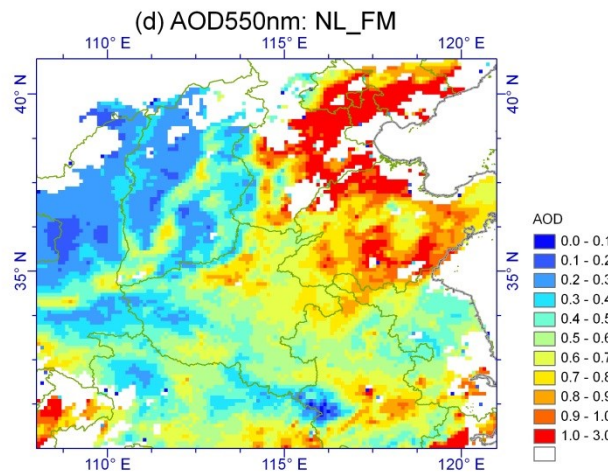
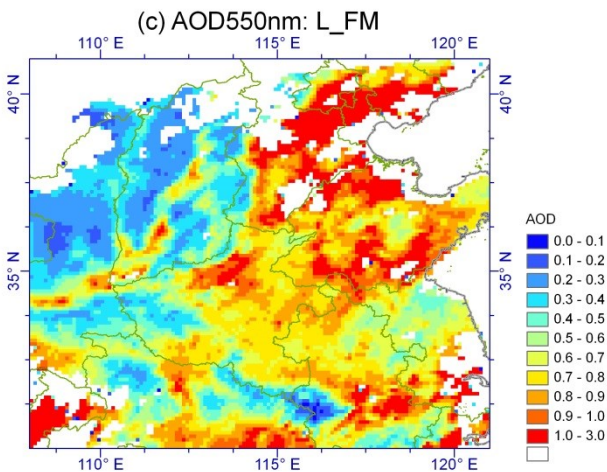
**NASA Cloud Mask:
p0.47>0.4 or std>0.0025
or p1.35>0.01 or
std>0.025**

**New Cloud Mask:
p0.47>0.3 or p1.35>0.01
or std>0.025**

TERRA_MODIS AOD at 0.55um 2013-01-08

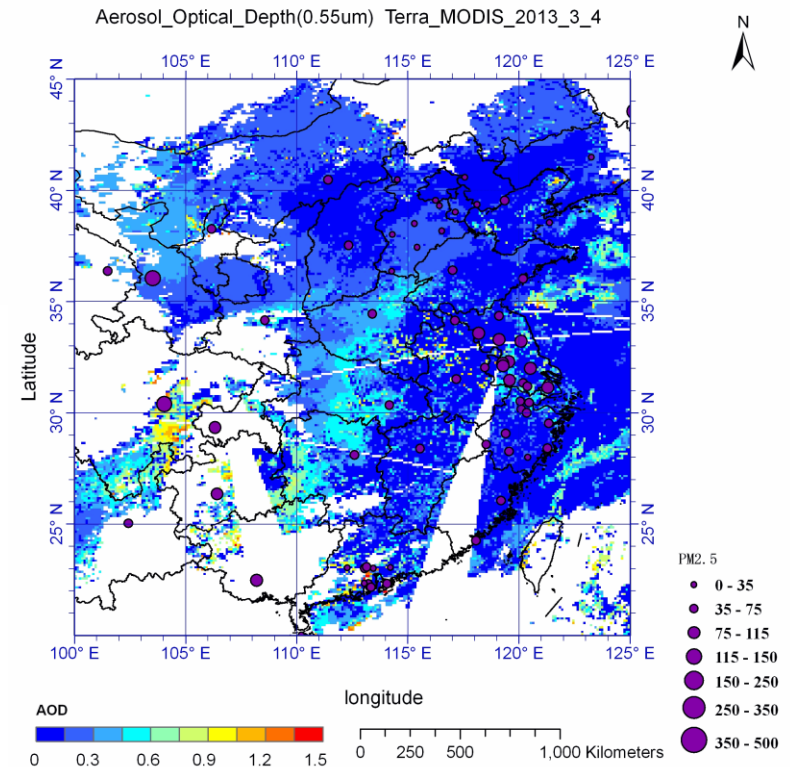
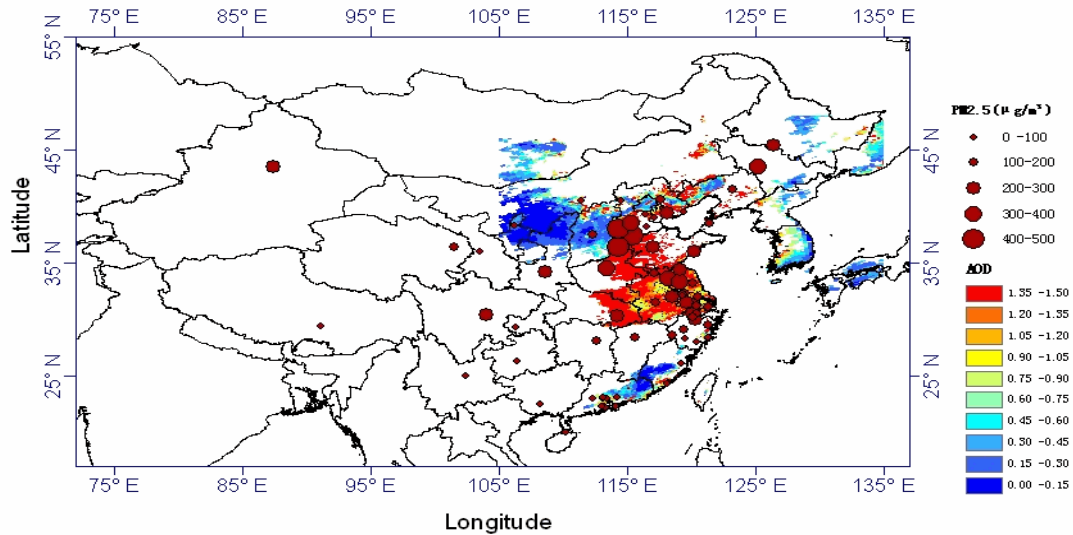


AOD Retrieval from MODIS with Non-Lambertian Ground Model



AOD – China Collection 2.0

AQUA_MODIS_AOD_550_and_PM2.5 2013_1_8

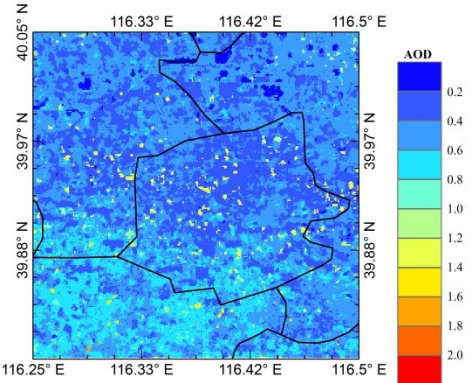


Recent Haze cases in Beijing

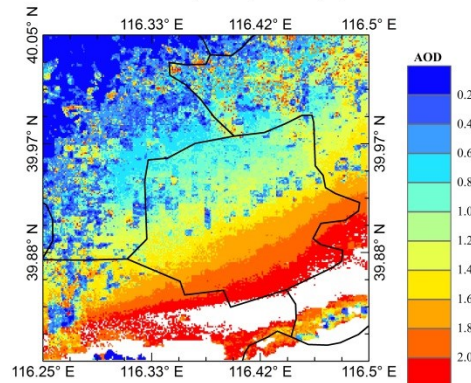
AOD at 100 m resolution from HJ-1 A/B CCD

2013 January 08 → 10 → 12 → 14

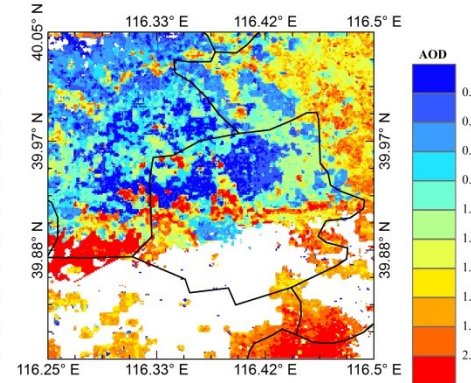
HJ-1 100m AOD (550nm) over Beijing 01/08/2013



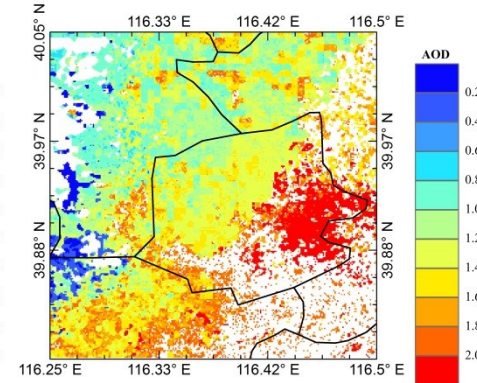
HJ-1 100m AOD (550nm) over Beijing 01/10/2013



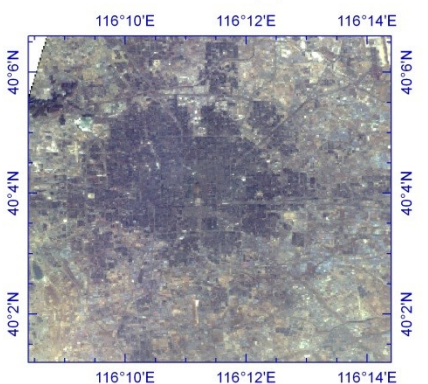
HJ-1 100m AOD (550nm) over Beijing 01/12/2013



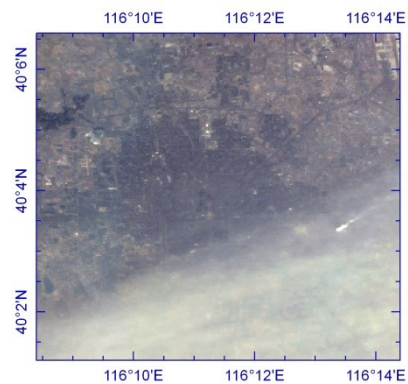
HJ-1 100m AOD (550nm) over Beijing 01/14/2013



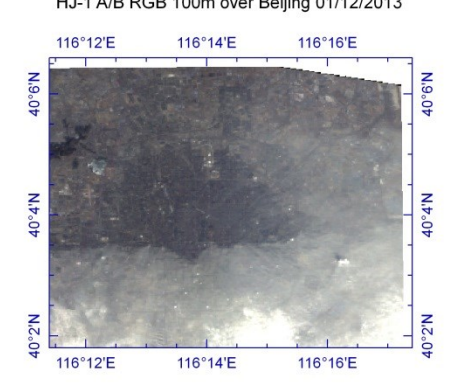
HJ-1 A/B RGB 100m over Beijing 01/08/2013



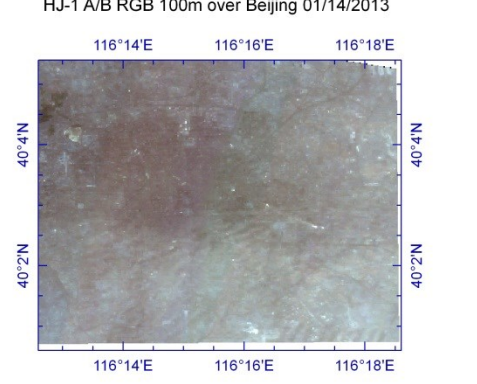
HJ-1 A/B RGB 100m over Beijing 01/10/2013



HJ-1 A/B RGB 100m over Beijing 01/12/2013

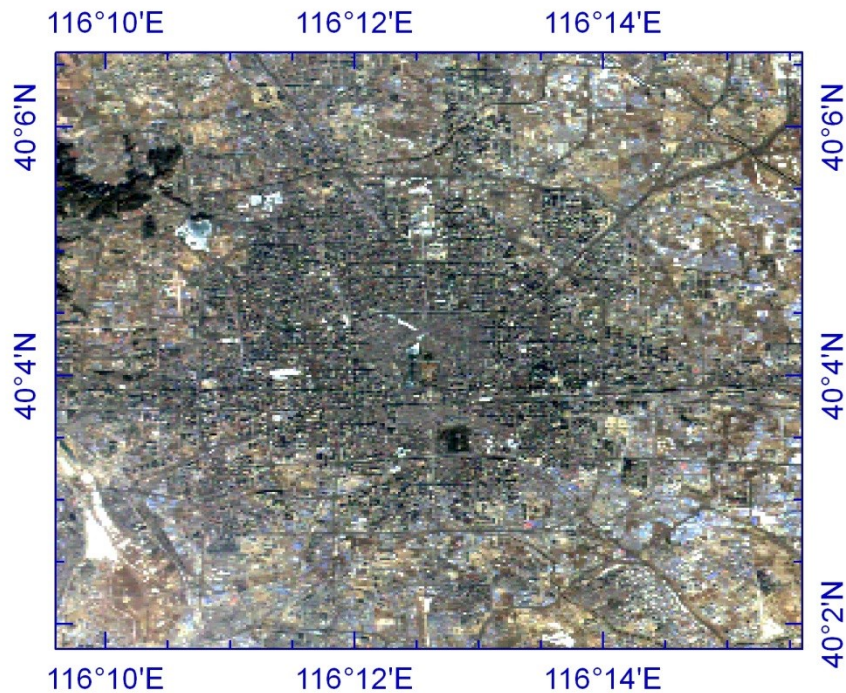


HJ-1 A/B RGB 100m over Beijing 01/14/2013

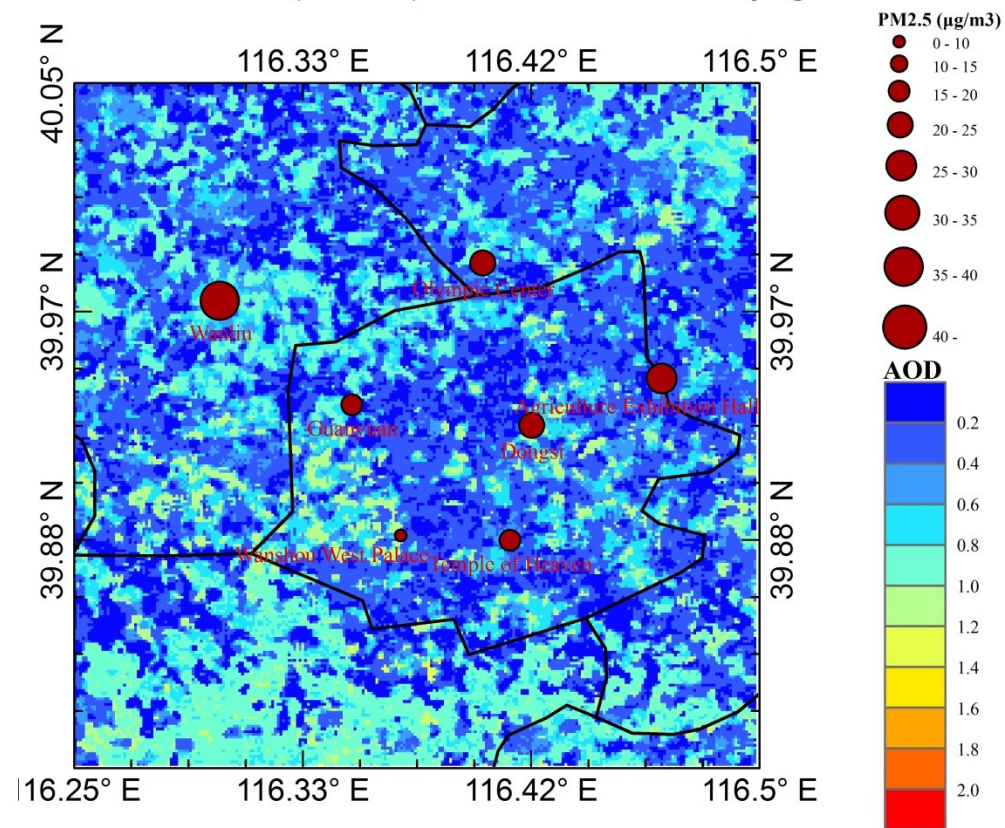


AOD and PM2.5 at 100m Resolution from HJ-1 Data

HJ-1 A/B RGB 100m over Beijing 01/17/2013

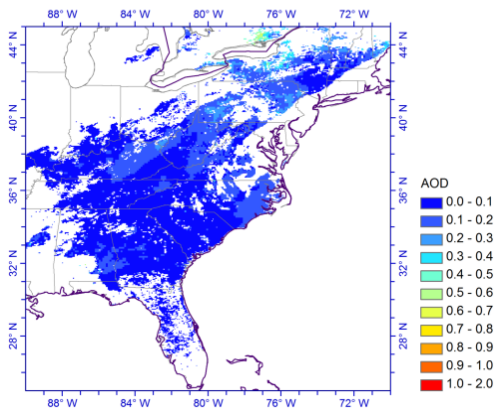


HJ-1 100m AOD (550nm) and PM 2.5 over Beijing 01/17/2013

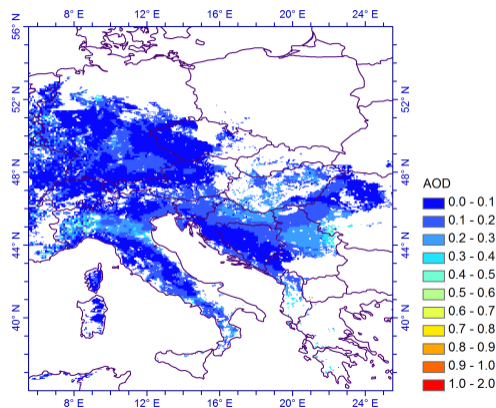


AOD Retrieval from AVHRR Data

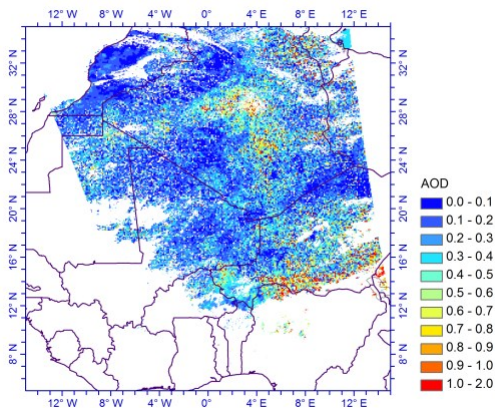
NOAA-16 AVHRR AOD at 0.63 μm over AME on 10/03/2001



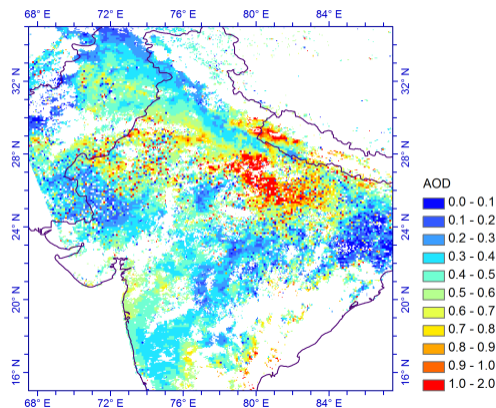
NOAA-15 AVHRR AOD at 0.63 μm over EUR on 08/15/2001



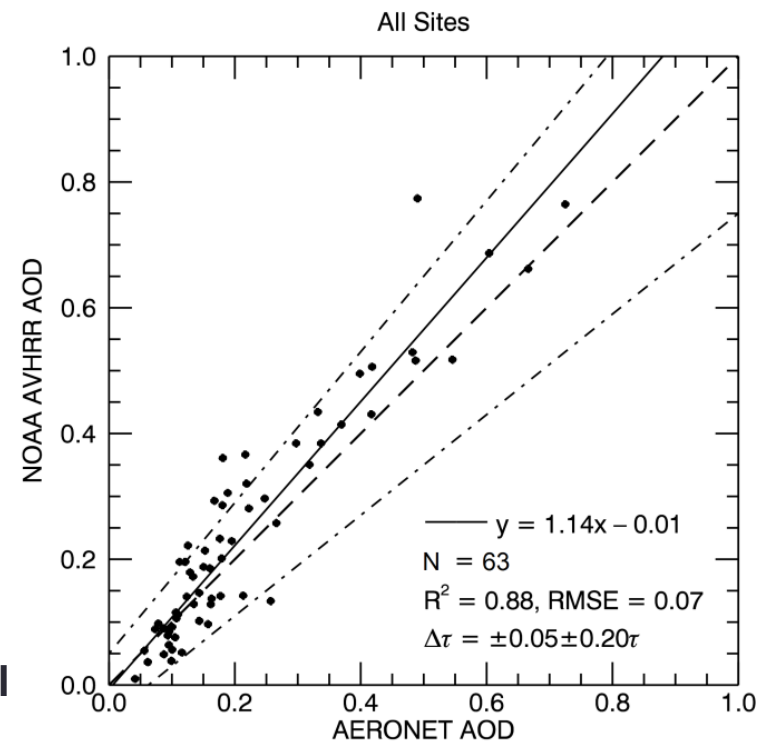
NOAA-18 AVHRR AOD at 0.63 μm over SAH on 04/29/2006



NOAA-18 AVHRR AOD at 0.63 μm over IND on 04/29/2008



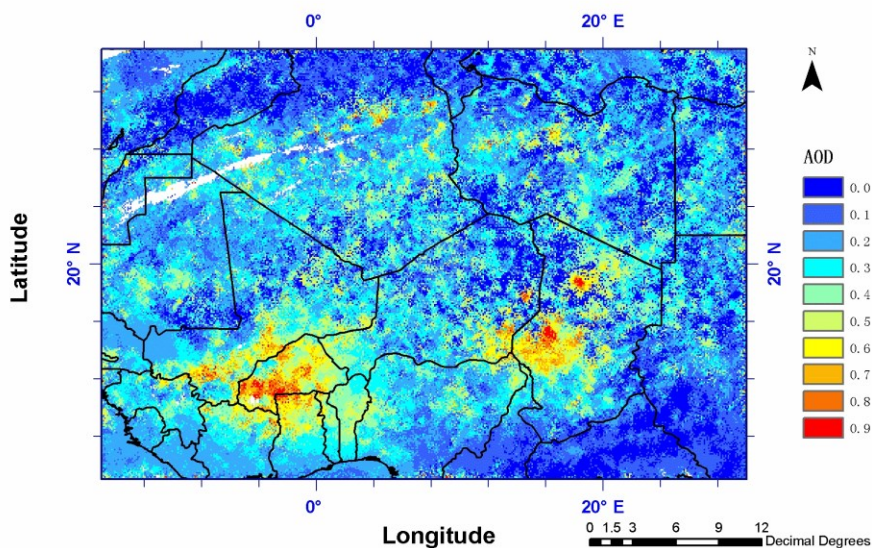
ROI	SSA	ASYM
AME	0.9748	0.5906
EUR	0.9011	0.6650
SAH	0.9241	0.6795
IND	0.8621	0.6315



Yingjie Li, Yong Xue, Gerrit, de Leeuw, Chi Li, Leiku Yang, Tingting Hou, Farhi Marir, Retrieval of Aerosol Optical Depth and Surface Reflectance over Land from NOAA AVHRR Data. *Remote Sensing of Environment*, 133, 1-20, 2013.

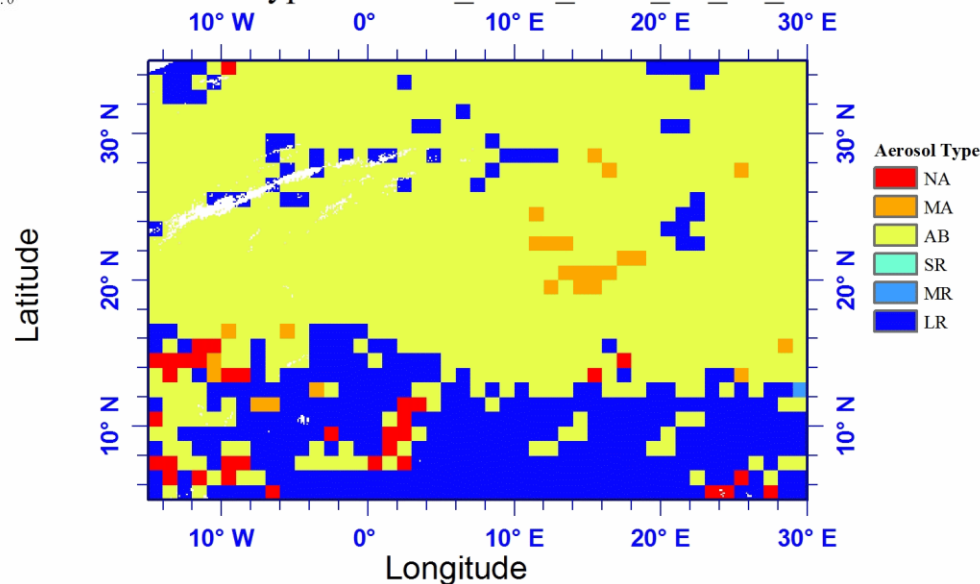
Hourly AOD from Geostationary Satellite Data

AOD_10KM_TS(0.8 μ m) SEVIRI_MSG_2010_04_14_08:45



NA: Spherical Non Absorbing
MA: Spherical Moderately Absorbing
AB: Spherical Absorbing
SR: Non Spherical Small
MR: Non Spherical Medium
LR: Non Spherical Large

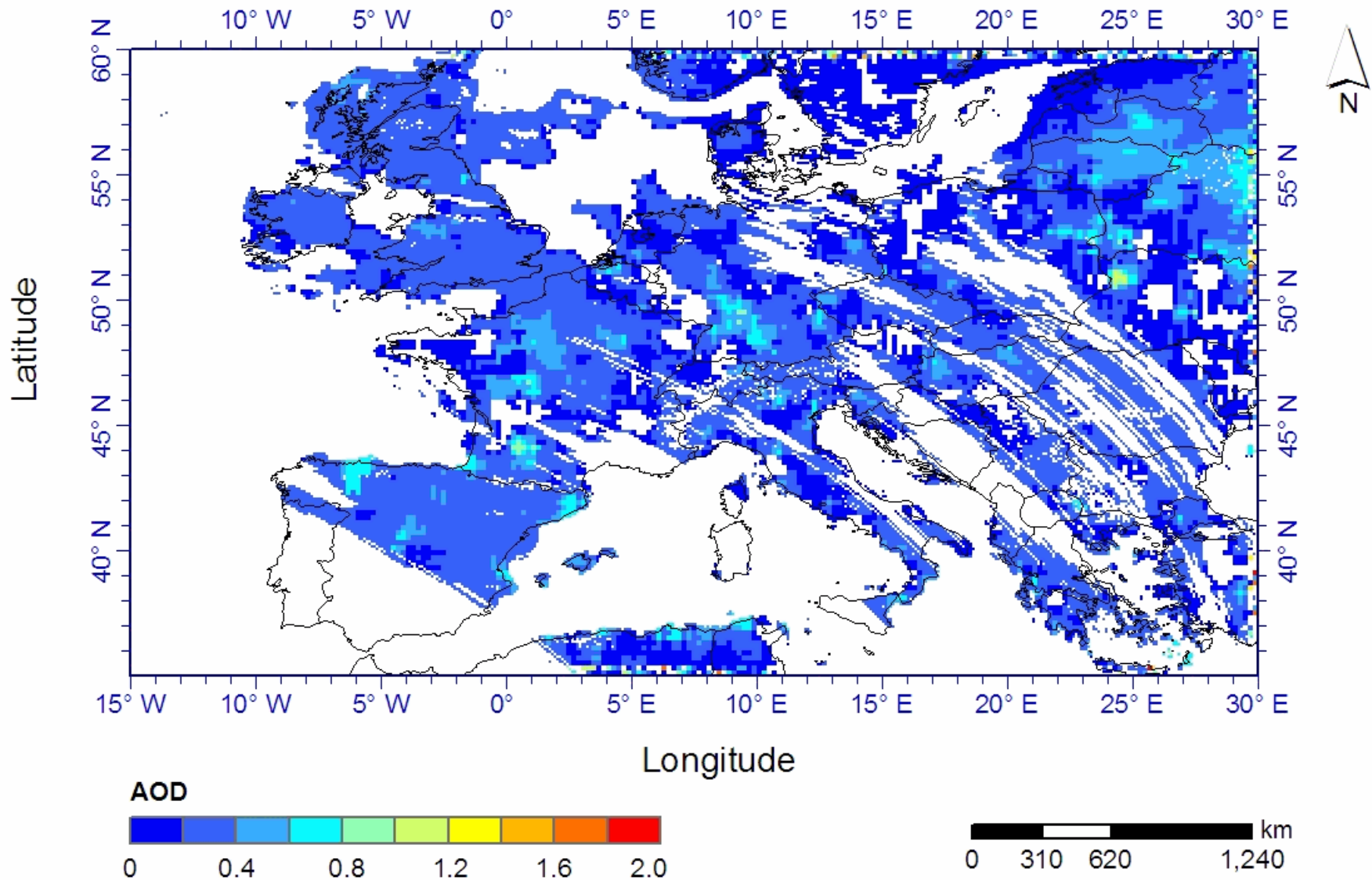
Aerosol Type SEVIRI_MSG_2010_04_14_08:45



Mei, L., Xue, Y., et al.: Retrieval of aerosol optical depth over land based on a time series technique using MSG/SEVIRI data, Atmos. Chem. Phys., 12, pp9167-9185, 2012. (impact factor: 5.520)

Aerosol Optical Depth at 0.6 μm from MSG SEVIRI

2010-04-14 08:00 UTC



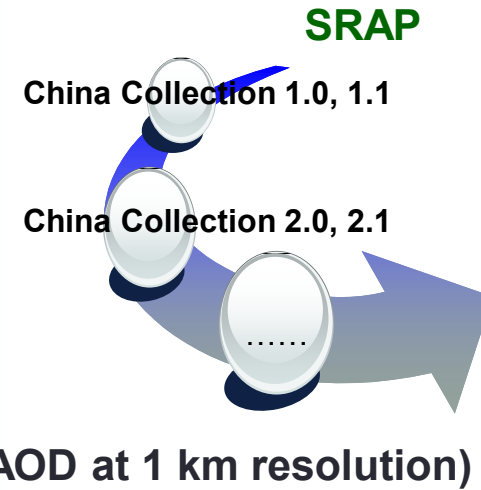
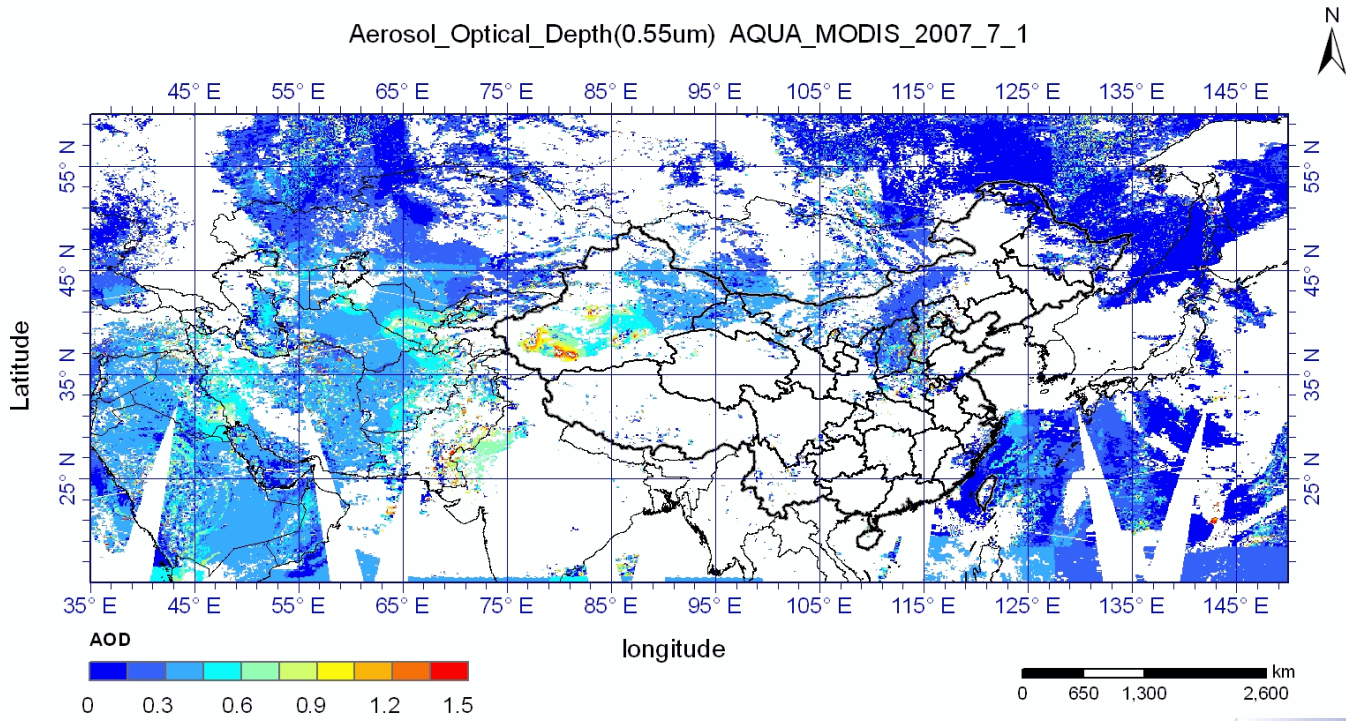
Conclusion

- The current cloud mask algorithm blocks the AOD retrieval for most haze area;
- High resolution satellite data can show more details of air pollution, especially for urban regions;
- Geostationary satellite could be useful for monitor those air pollution events;
- AVHRR (MetOp) could provide long-term (over 30 years) AOD data?
- Dust particles from NCP play a very important role at the beginning of the haze (8 January 2013) and local emission dominate the haze event latter.

AOD data collection over Mainland China

China Collection 1.0 & 1.1

Spatial Resolution: 10km, 1km, 100m (regions)
Temporal Scale: from August 2002



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Remote Sensing Information Service Grid Node

数据服务 网格工作流 论文发表 科研成果 科研队伍

数据源	卫星	传感器	波段	产品	时间	下载数据
TIF	TERRA	MODIS	1	AOD	2010-12-01	下载
TIF	TERRA	MODIS	1	AOD	2010-12-02	下载
TIF	TERRA	MODIS	1	AOD	2010-12-03	下载
TIF	TERRA	MODIS	1	AOD	2010-12-04	下载
TIF	TERRA	MODIS	1	AOD	2010-12-05	下载
TIF	TERRA	MODIS	1	AOD	2010-12-06	下载
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TIF	TERRA	MODIS	1	AOD	2010-12-08	下载
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