



# China Air Quality

Monitoring of Aerosol Changes over Eastern China, Using NASA Earth Observations



# China Air Quality

## Community Concerns

- Beijing, Shanghai, and Linfen among most polluted cities
- China-origin aerosols affect other countries
- Severe health impacts in China and abroad

## Decision Making Process & Partner Needs

- Assessment of air quality methods from perspective of end-user
- Case study in Beijing of 2008 Olympics



A coal-fired power plant in Linfen, China last December. (NY Times)

Science Advisor

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Langley Research Center



# China Air Quality – Overview

## Project Objectives

- User perspective on methods for studying air quality
- Examine aerosols over Eastern China before 2008 Olympics

## Study Area & Period

- Eastern China with emphasis on Beijing, Shanghai, Linfen, and Changsha
- 2000 to 2010 – focus on seasonality (spring, summer, fall, and winter)

## Benefits to Partners

- Methodology to measure aerosols over Eastern China for future air quality monitoring





# China Air Quality – Methods

## Satellites

- MODIS - AQUA – Level 2 Version 5.1 AOD
- CALIOP - CALIPSO – Level 1 Version 3.01 Aerosol Profile

## Models

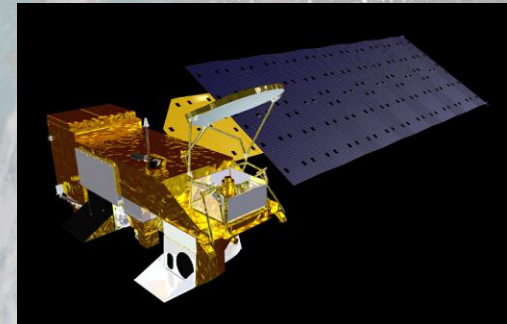
- NOAA HYSPLIT Trajectory

## Data Acquisition

- NASA DAAC WIST
- NASA GIOVANNI
- US Embassy in Beijing Website

## Data Processing & Analysis

- No processing required for MODIS AOD or CALIOP level 1 products
- MODIS images were visualized using Google Earth



MODIS AQUA Satellite



HYSPLIT Trajectory Model

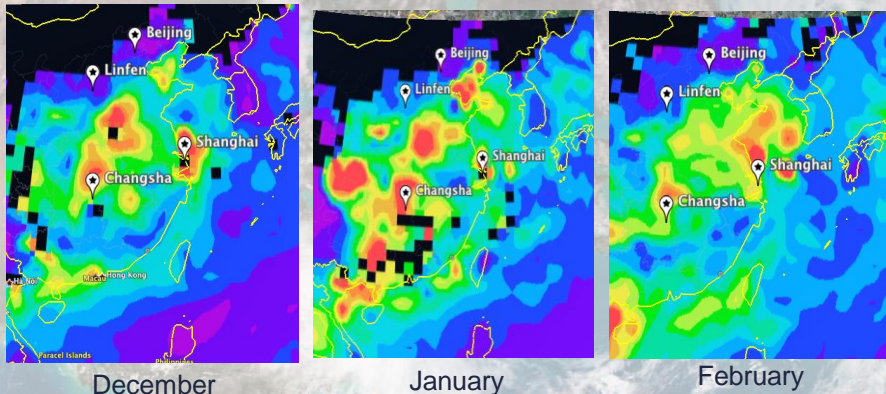


CALIPSO Satellite

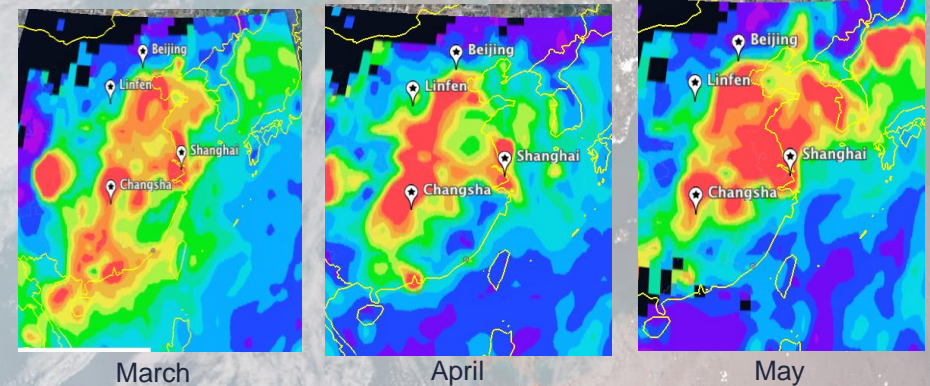


# China Air Quality – MODIS AOD

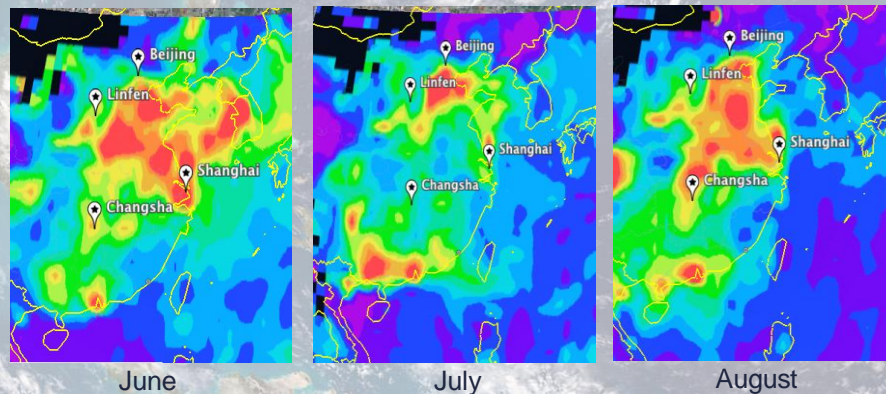
## Winter 2005



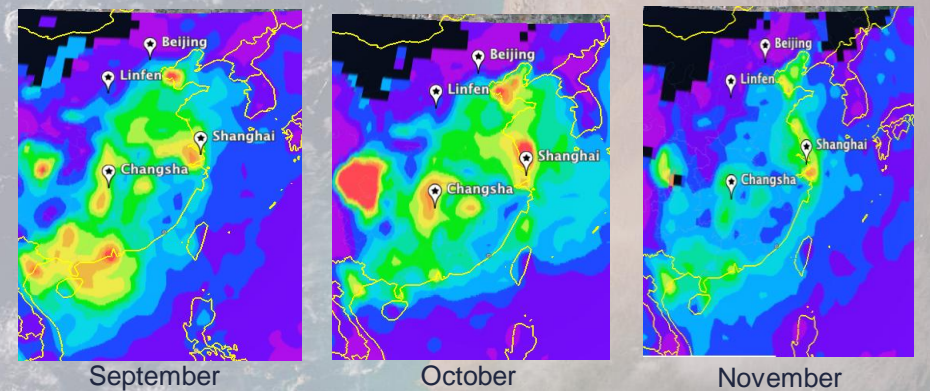
## Spring 2005



## Summer 2005

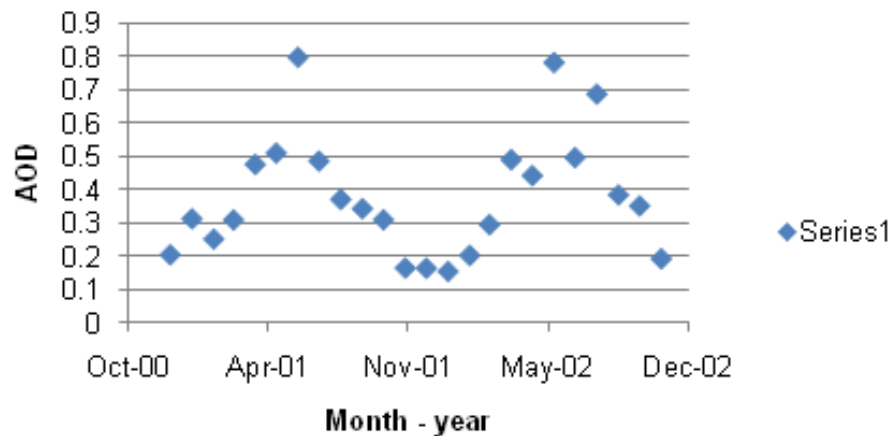


## Fall 2005

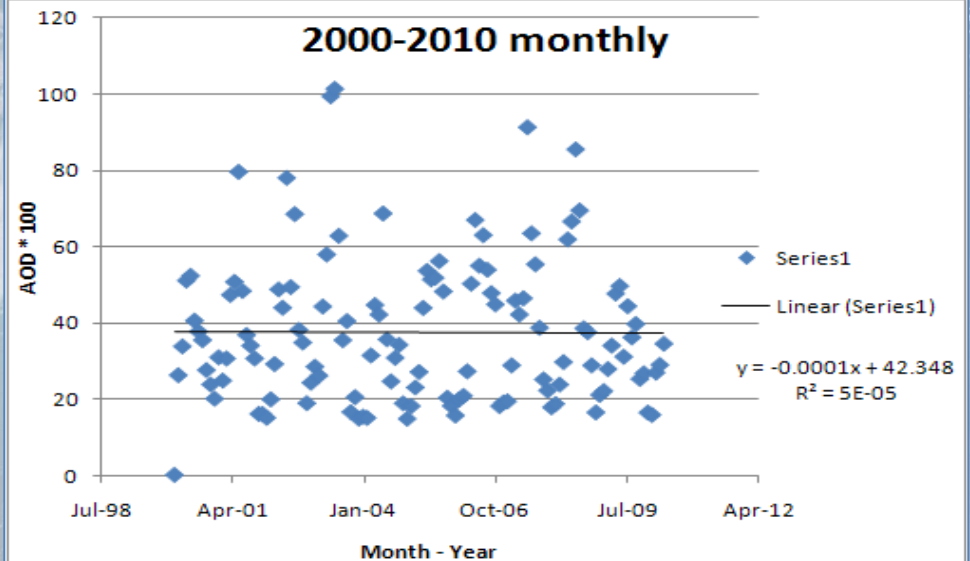


# China Air Quality – MODIS AOD Results

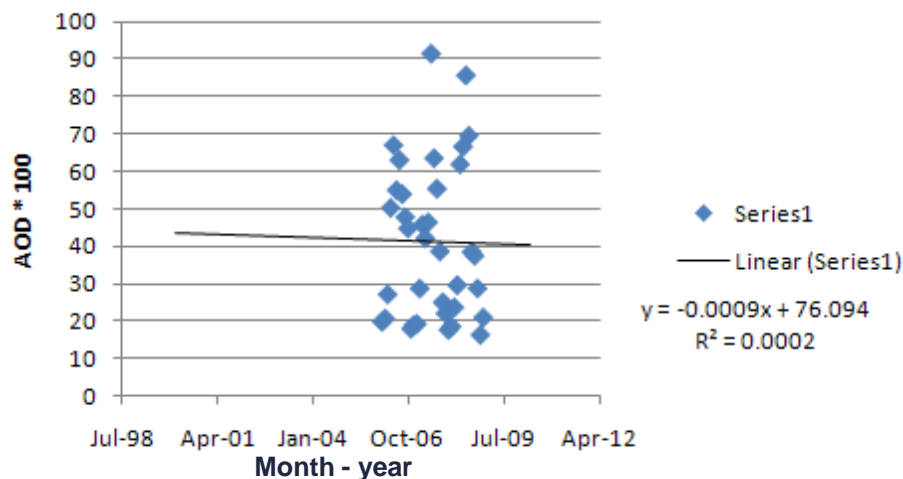
## Two year monthly



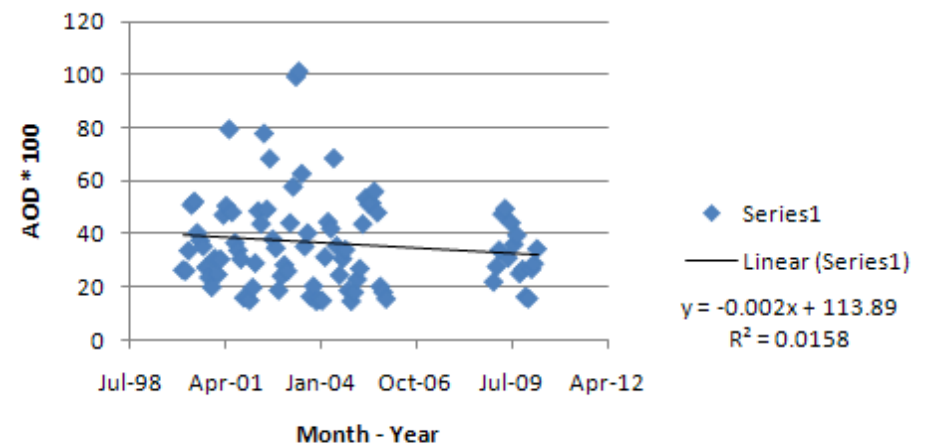
## 2000-2010 monthly



## 2006-2008 Monthly

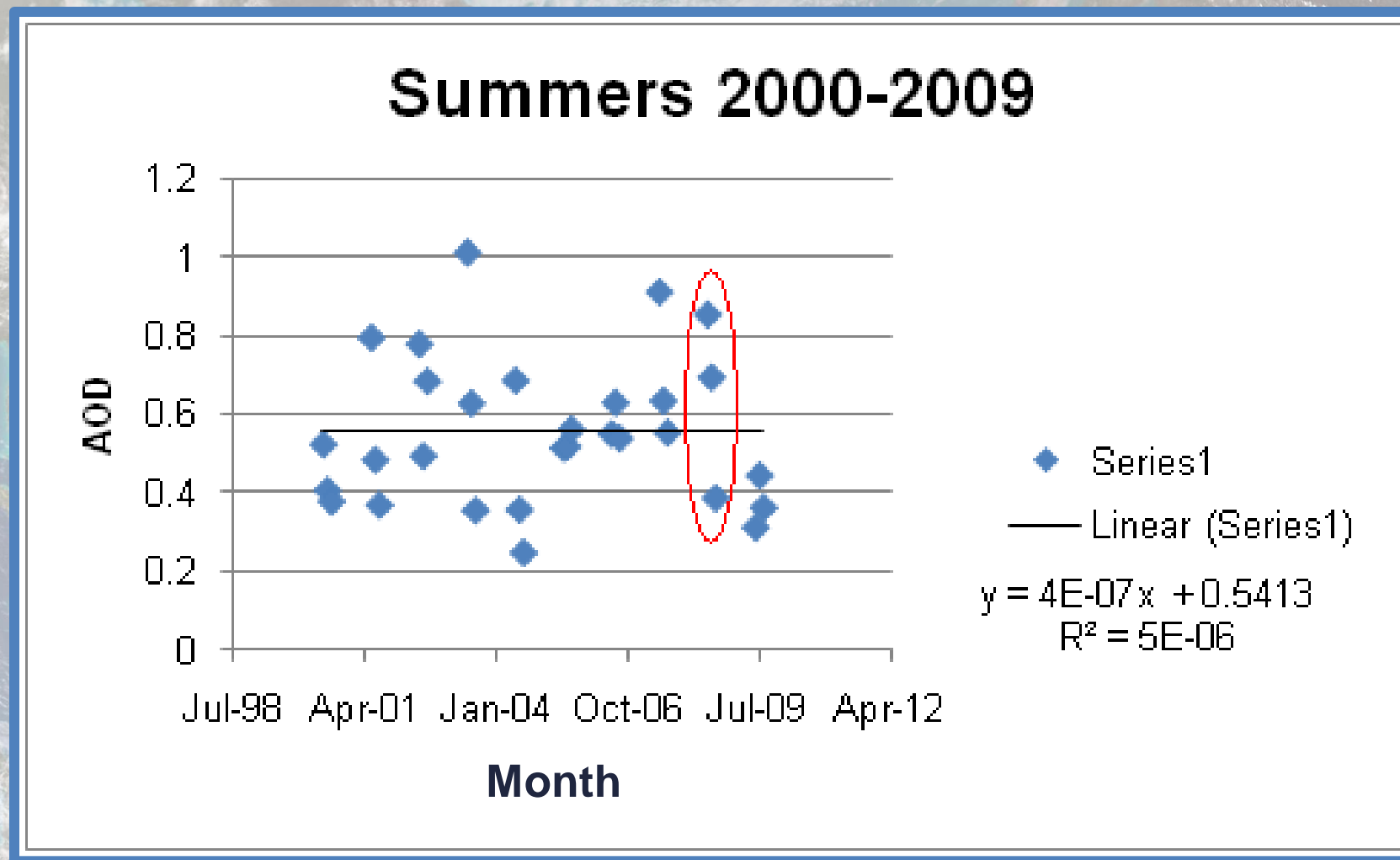


## Excluding 06-08



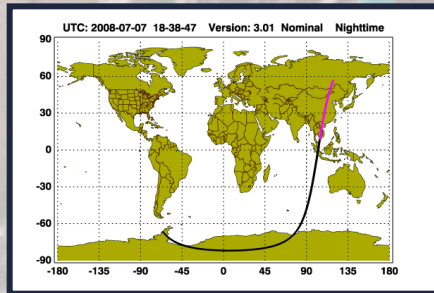


# China Air Quality – MODIS AOD Results

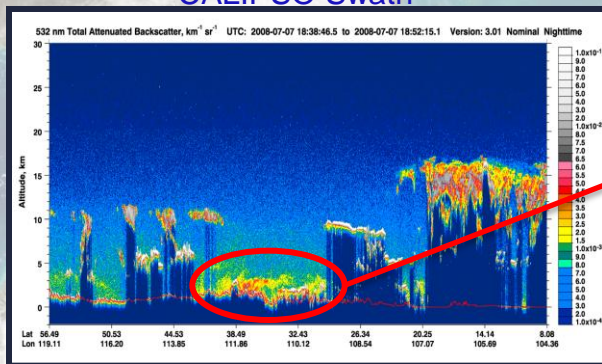


# China Air Quality – CALIPSO Aerosol Profile

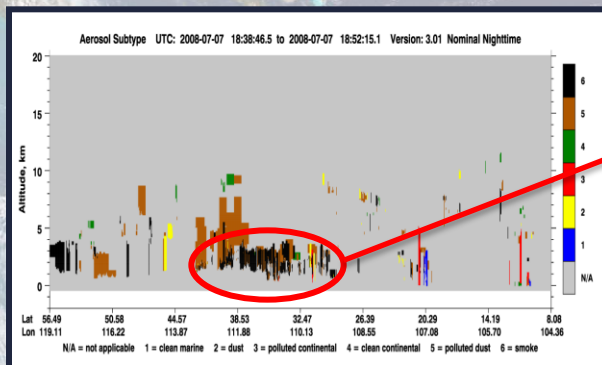
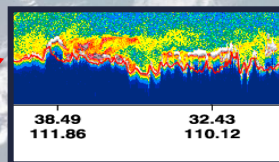
July 7, 2008



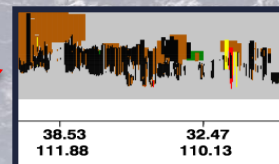
CALIPSO Swath



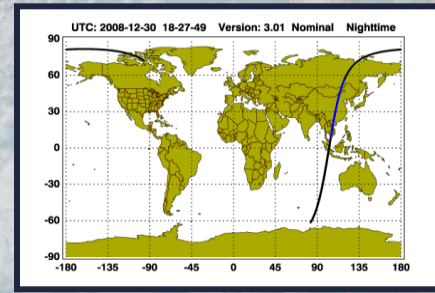
Total Attenuated Backscatter



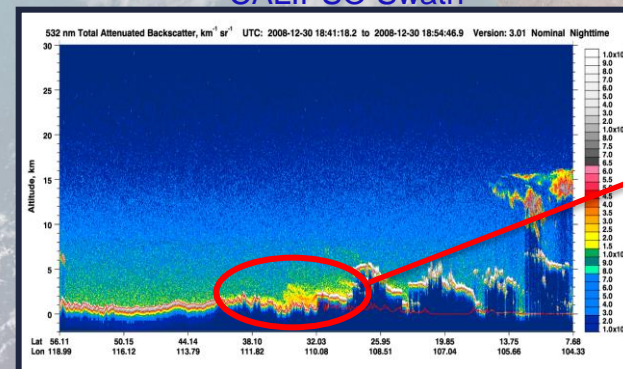
Aerosol Subtype



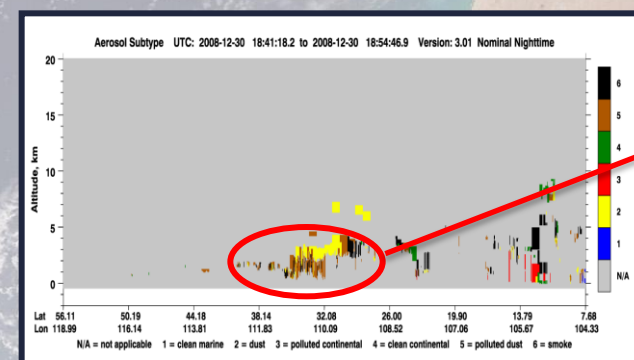
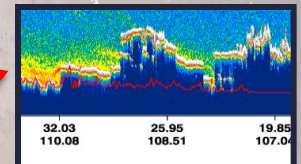
December 30, 2008



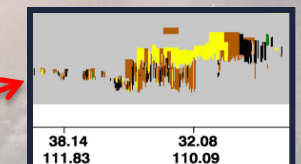
CALIPSO Swath



Total Attenuated Backscatter

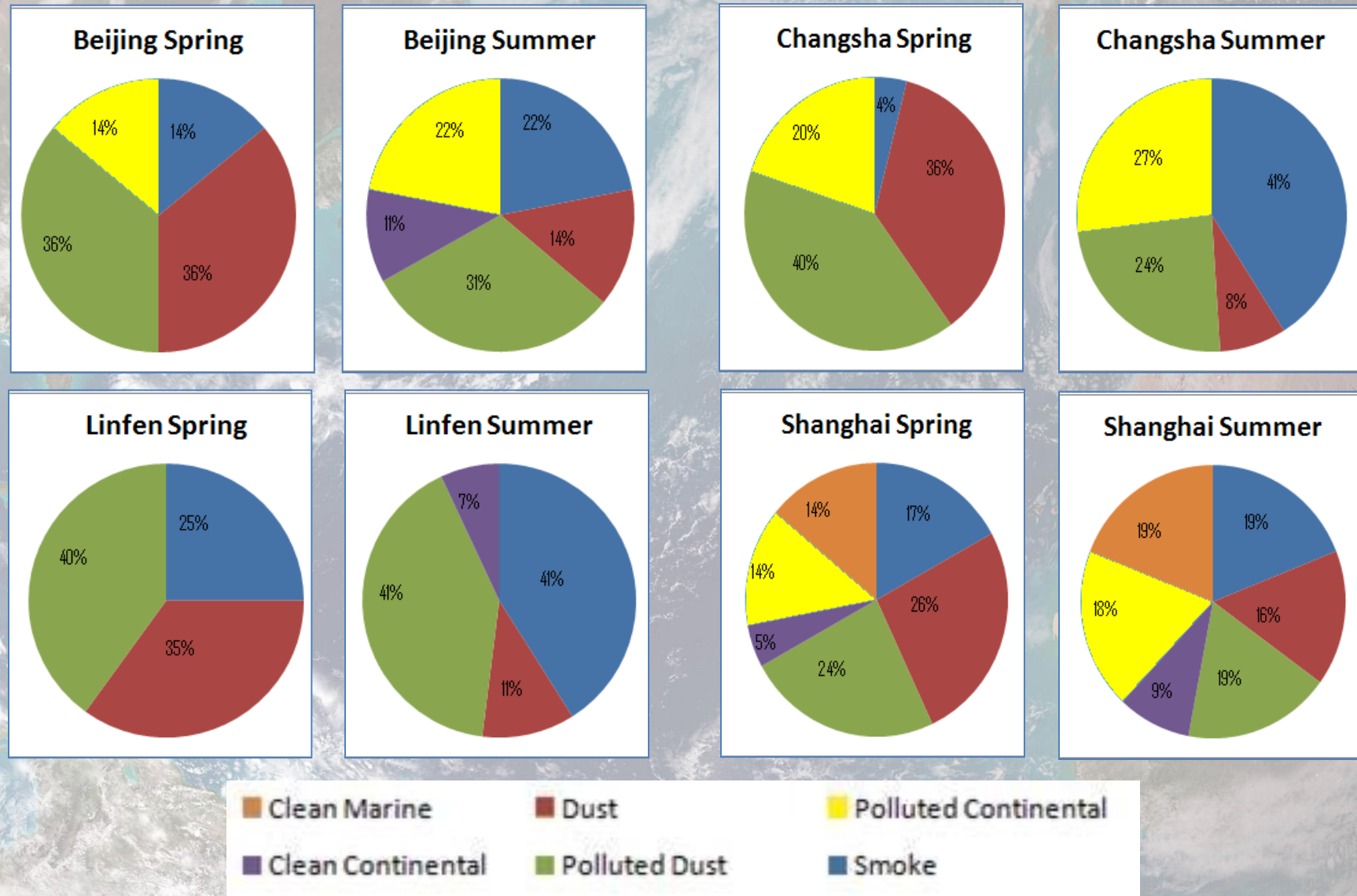


Aerosol Subtype





# China Air Quality – CALIPSO Data Analysis





# China Air Quality – CALIPSO Results

## Results of Qualitative Analysis of Aerosol Subtype

### Overall

- Dust, polluted dust, and smoke present all years in all cities

### 2006

- Less dust compared to 2006-2010

### 2007

- Generally bad air quality in all four cities

### 2008

- Generally improved air quality in all four cities, particularly Beijing

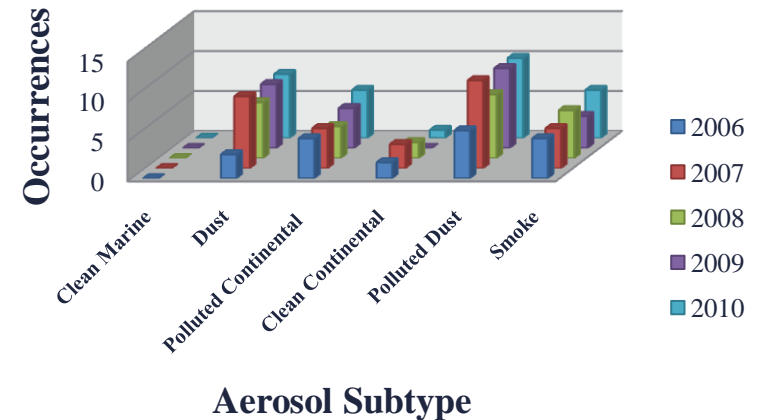
### 2009

- Air quality similar to 2008

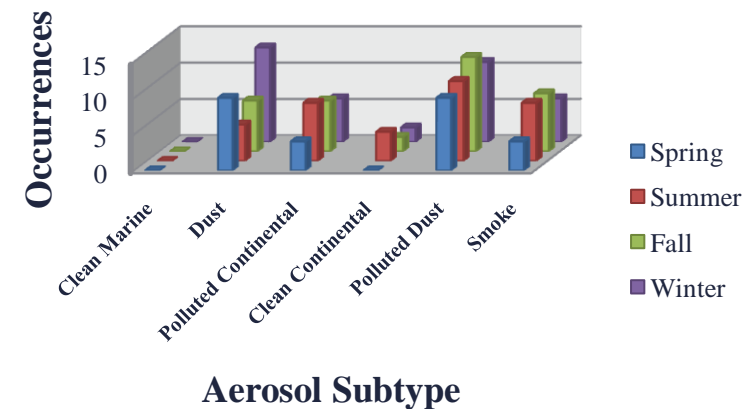
### 2010

- Improved air quality overall in all cities

Beijing, by year



Beijing, by season





# China Air Quality – HYSPLIT Trajectories

## Beijing

### Seasonally Direction

Winter	SE
Spring	NE
Summer	S
Fall	E

Overall HYSPLIT  
Direction SE

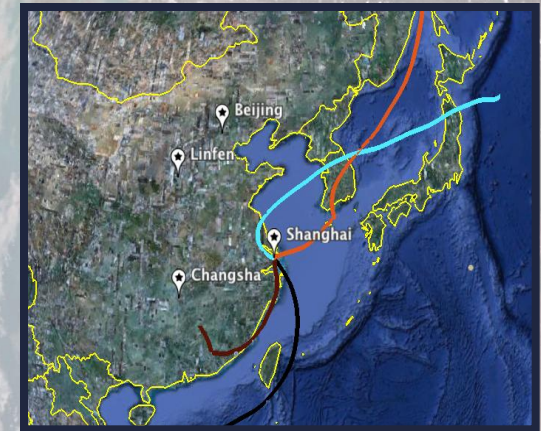


## Shanghai

### Seasonally Direction

Winter	SW
Spring	NE
Summer	NE
Fall	SE

Overall HYSPLIT  
Direction NE

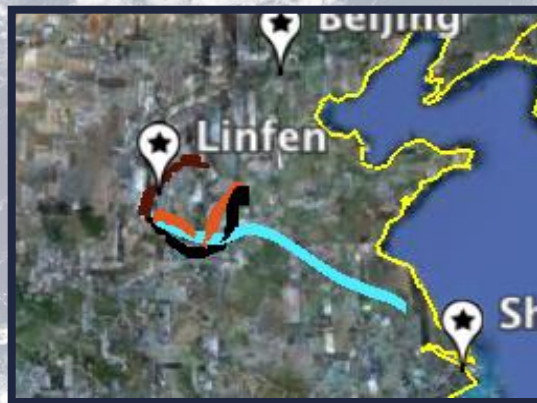


## Linfen

### Seasonally Direction

Winter	NE
Spring	SE
Summer	NE
Fall	NE

Overall HYSPLIT  
Direction NE



## Changsha

### Seasonally Direction

Winter	SW
Spring	SW
Summer	NE
Fall	SW

Overall HYSPLIT  
Direction SW



### Legend:

Winter - Black    Spring - Light Blue    Summer - Orange    Fall - Brown



# China Air Quality – Conclusion



Beijing air quality on a good and bad day (Asia Society Center on US-China Relations).

- ❖ MODIS AOD and CALIPSO with HYSPLIT provide satisfactory macro-scale assessment of aerosols
- ❖ Any improvement in air quality prior to the 2008 Olympics cannot be statistically identified



