Temporal-spatial variations of visibility in Jiangsu and underlying mechanisms

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Outline

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Introduction

- Visual range, sometimes taken to be synonymous with visibility, is defined as the distance at which the contrast of a target equals the contrast threshold of the human eye.

- In atmospheric environment, visibility is an good indicator of air quality, especially for ambient levels of PM2.5.

- Over past several decades, the visibility deterioration continues in China.

- Jiangsu, located in Yangtze River delta, a highly urbanized and industrialized region, suffers from deteriorating visibility.

- It is critical to understand the underlying mechanism of the visibility deterioration.

Objectives

- To investigate the spatial and temporal distribution of visibility in Jiangsu.

- To identify the driving factors of visibility changes in Jiangsu.

Data

- Hourly visibility data during 2012 (measured by forward scattering visibility meter CJY-2B).

- Surface meteorological observations: relative humidity, temperature, wind and pressure.

- Satellite measurement: MODIS AOD data from NASA (10KM$\times$10KM).

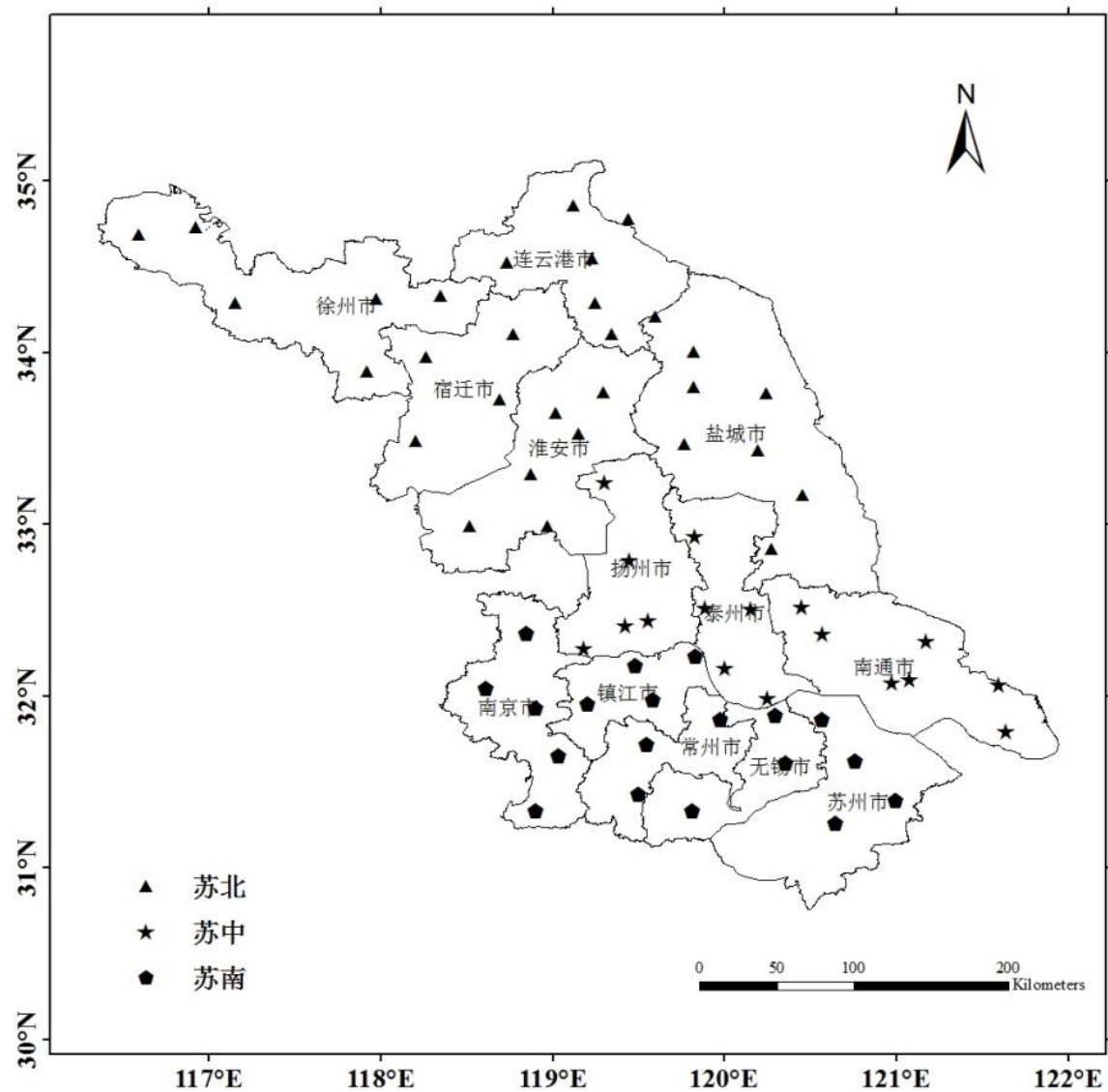- Daily Air Pollution Index (API) issued by Ministry of Environmental Protection (MEP), China.

Fig.1 Location of the observe sites in Jiangsu

Method

- Principal component analysis (PCA) is a useful statistical tool, which is based on the assumption that the observed values of the variables can be expressed as linear combinations of a series of mutually independent factors.

- PCA is often used in data reduction to determine fewer factors that explain most of the variance observed in much more of manifest variables.

Results and discussion

Table1. Summary of visibility and relevant factors over Jiangsu during 2012

	Max.	Min.	Mean	SD
VH（m）	28235	15	6858	5569
VD（m）	26125	524	5790	3419
RH（%）	99	19	64	17
Wind（m/s）	12.1	0.5	2.6	1.0
Temp.（℃）	38.6	-6.2	3.2	4.0
Pressure（hpa）	1037	1001	1023	6

VH: hourly visibility, VD: daily averaged visibility.
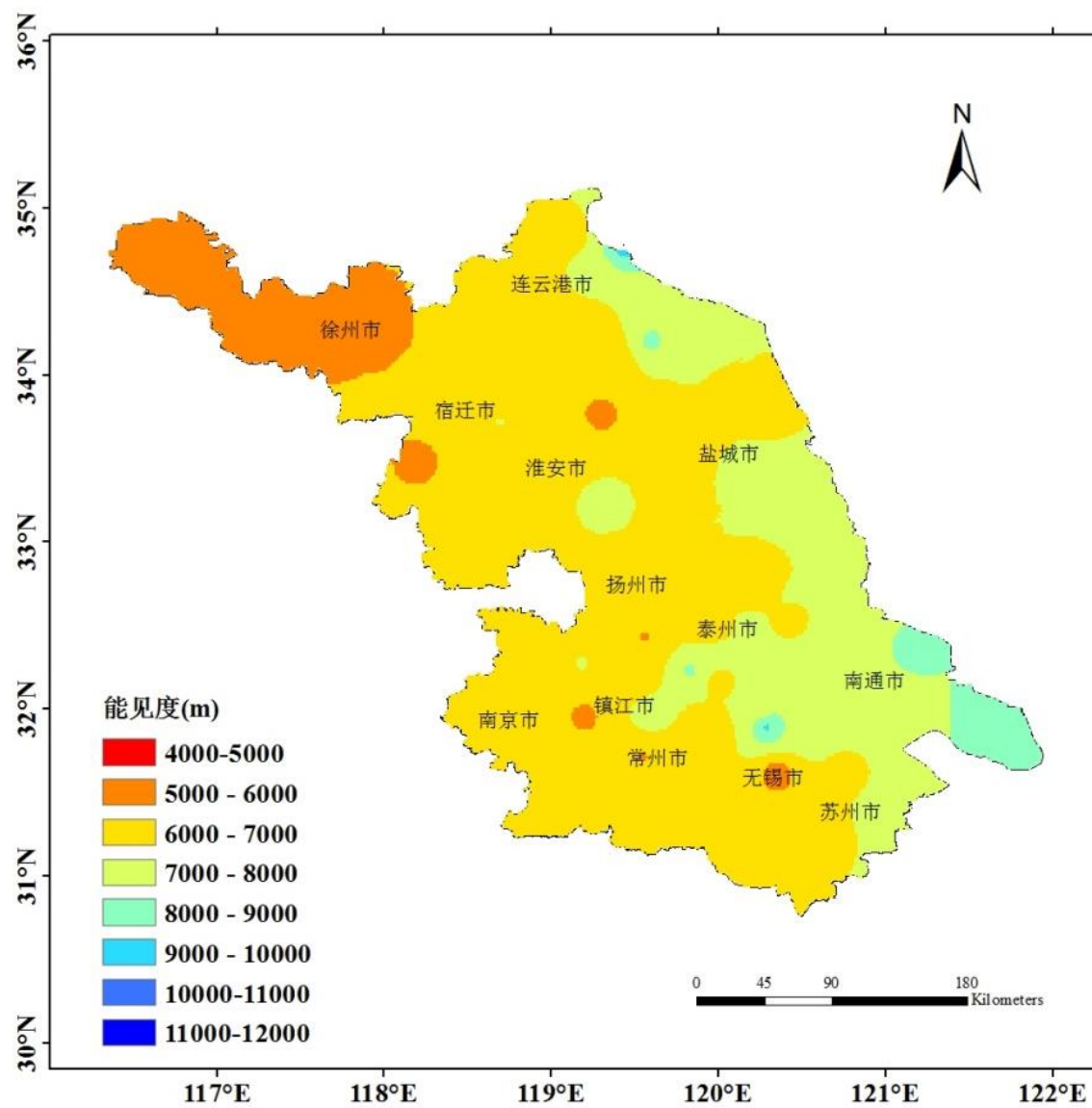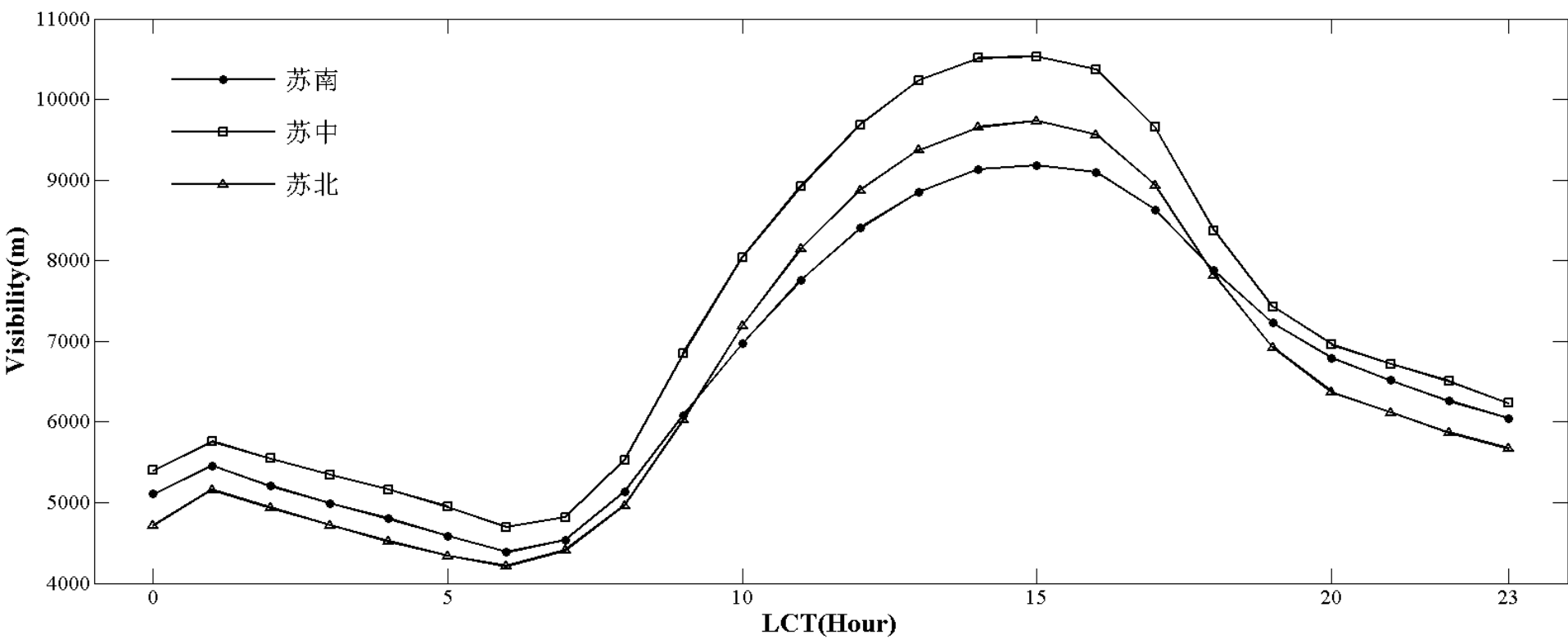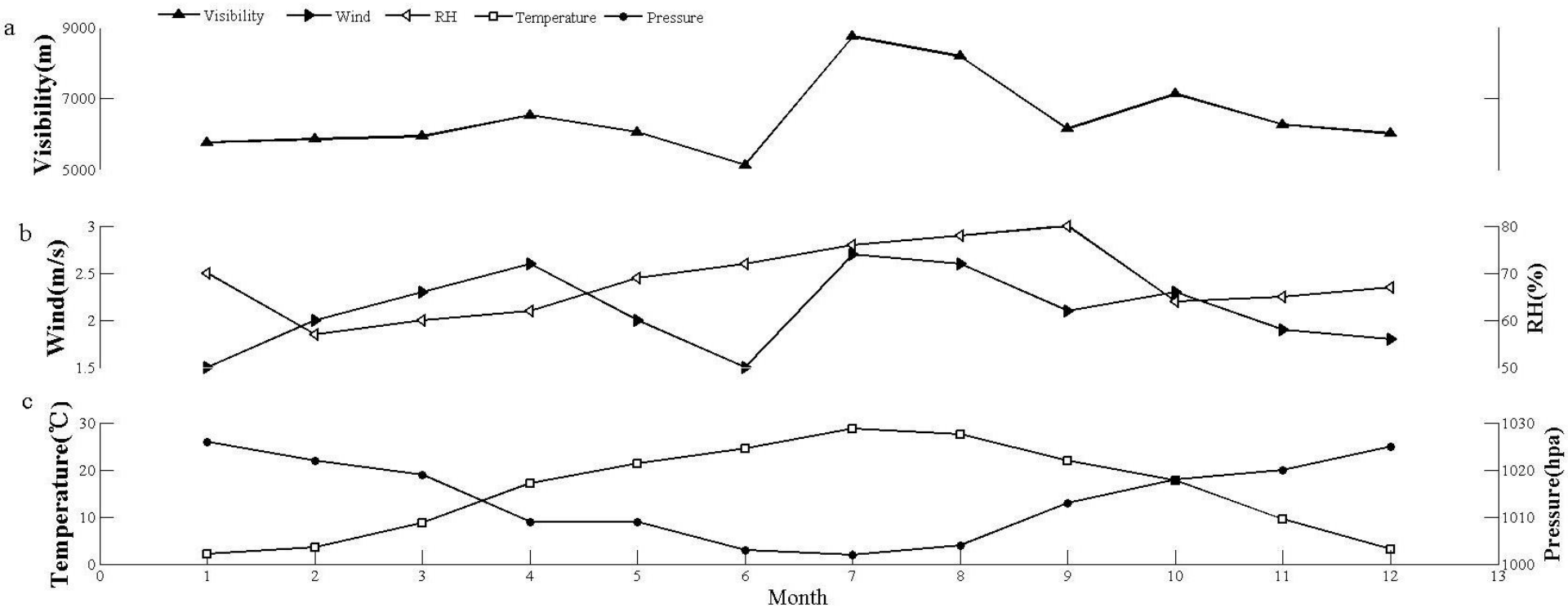
Fig.2 Spatial variations of annual averaged visibility in Jiangsu

Fig.3 Diurnal variations of annual visibility in Jiangsu

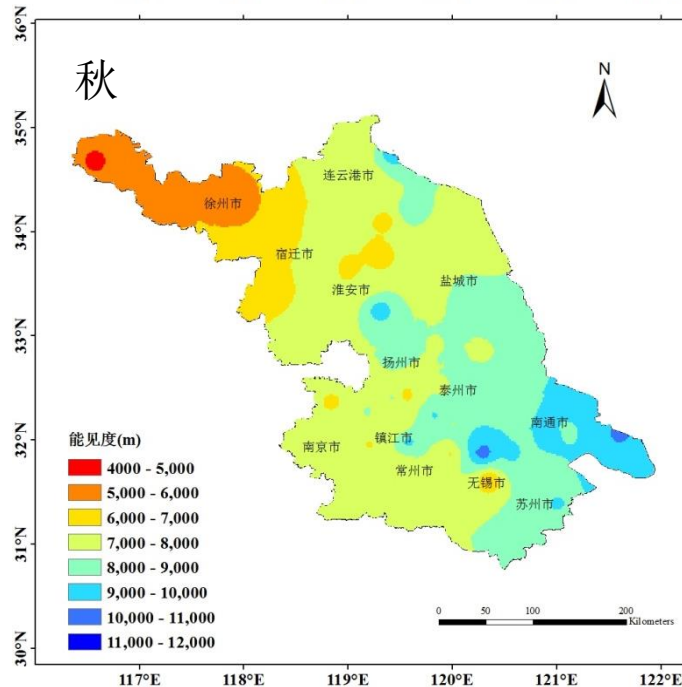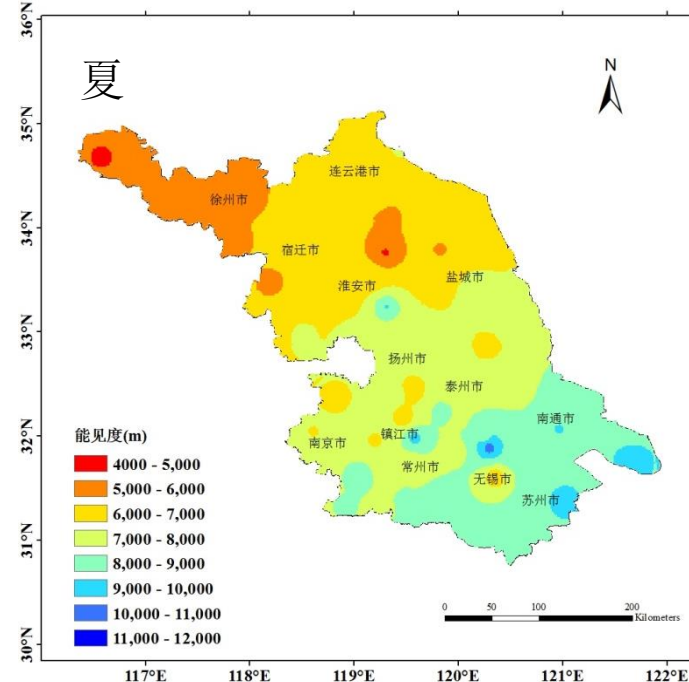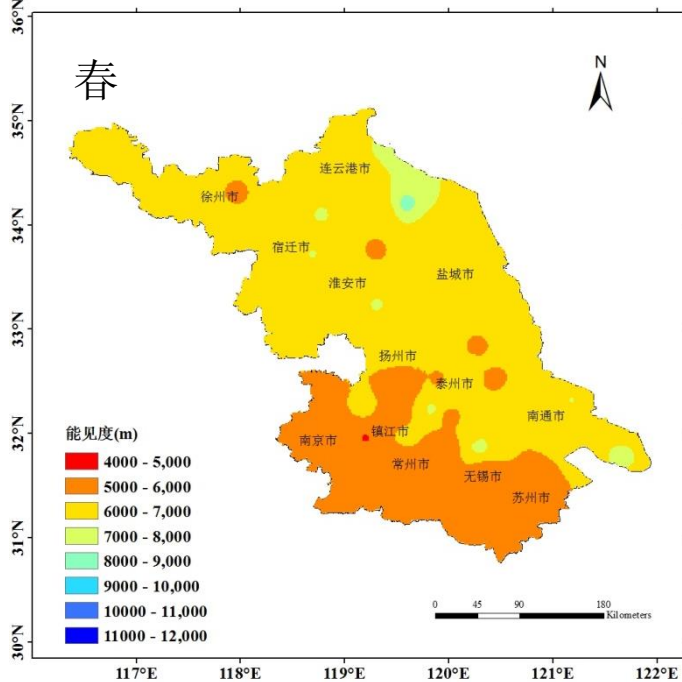Fig.4 Seasonal changes of visibility and meteorological variables in Jiangsu
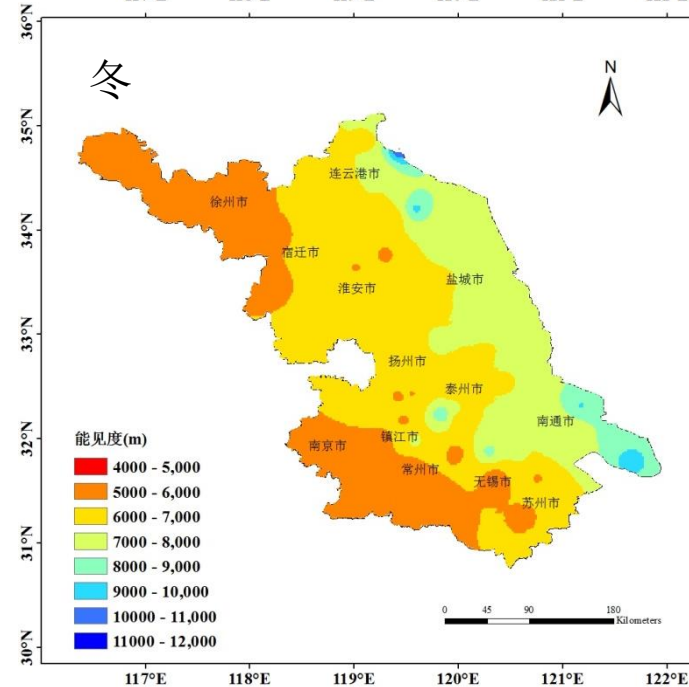
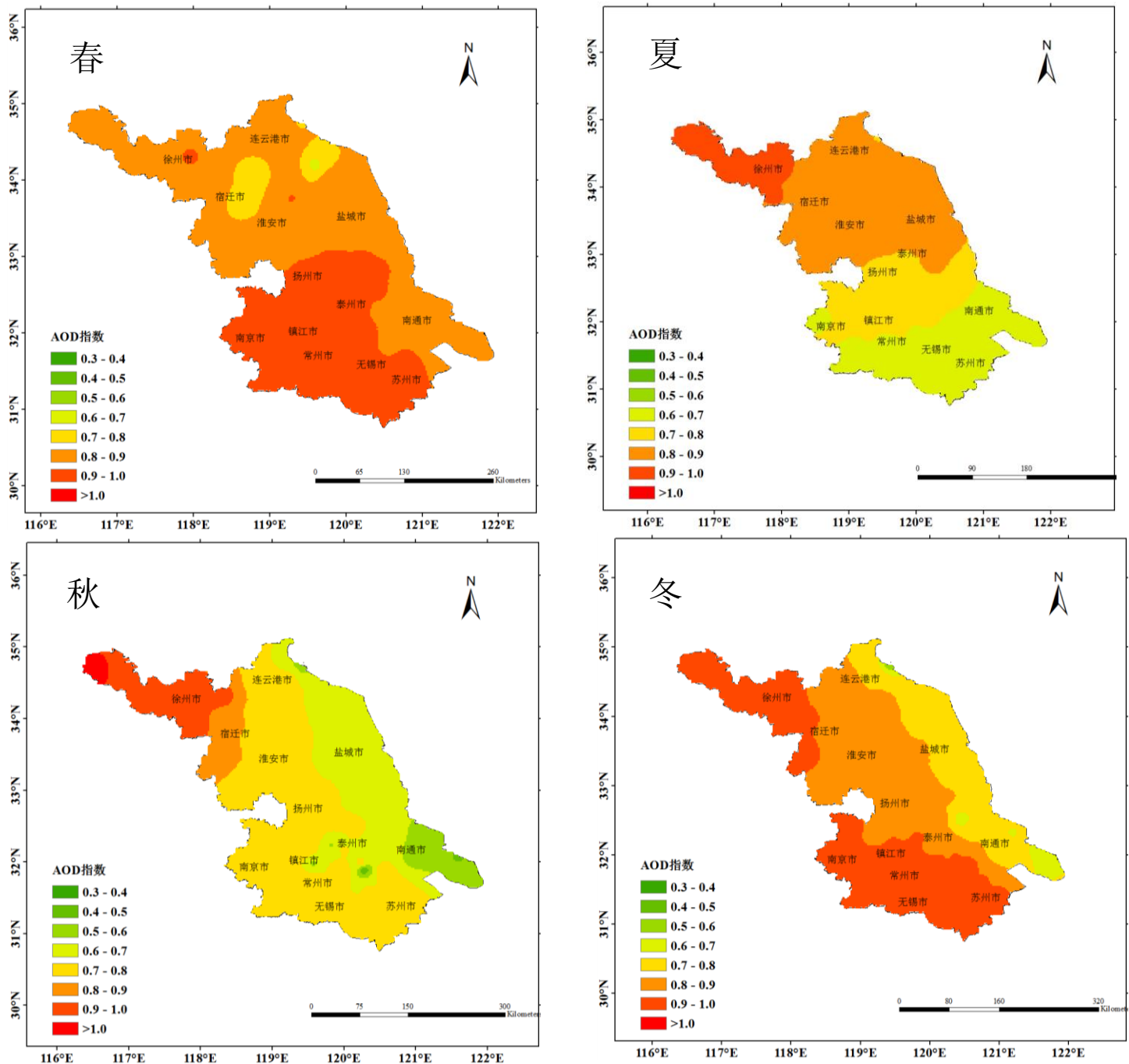Fig.5 Spatial variations of seasonal averaged visibility in Jiangsu
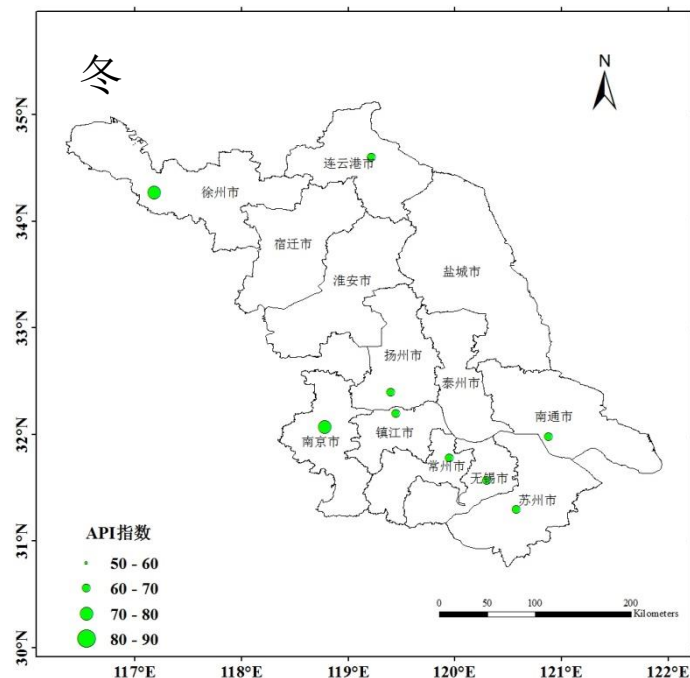
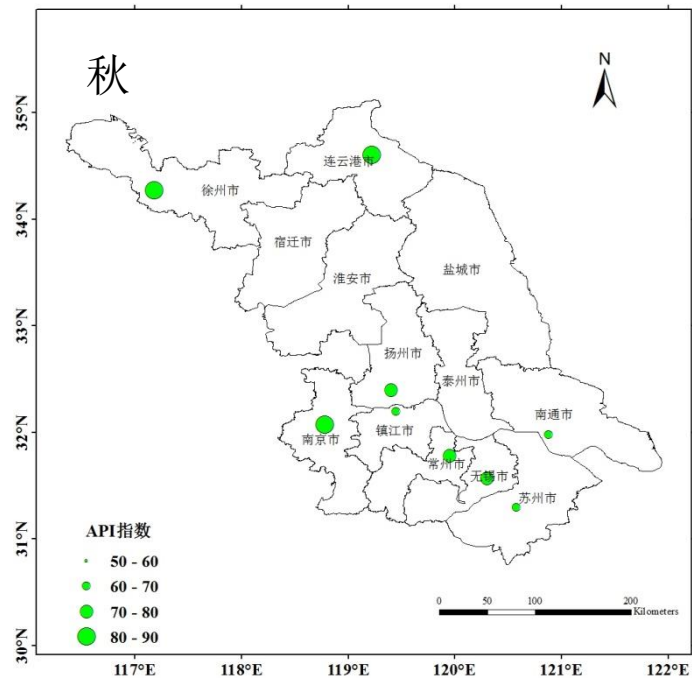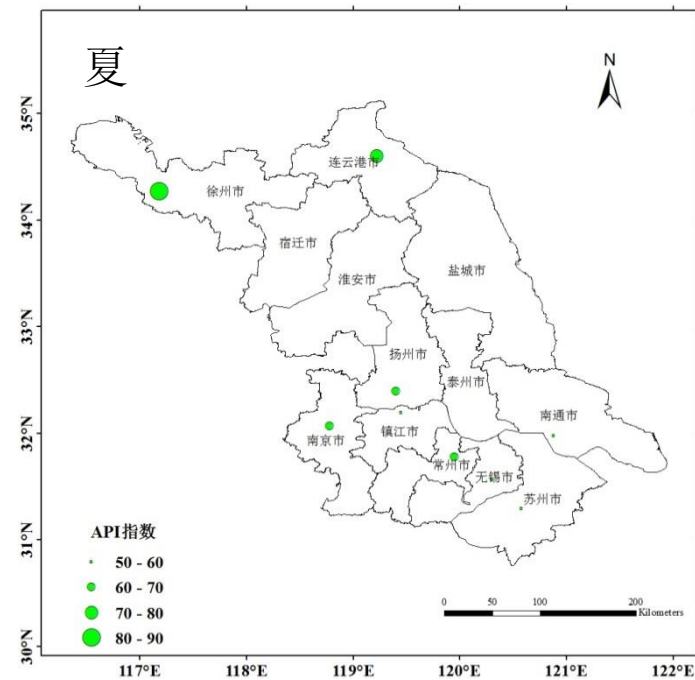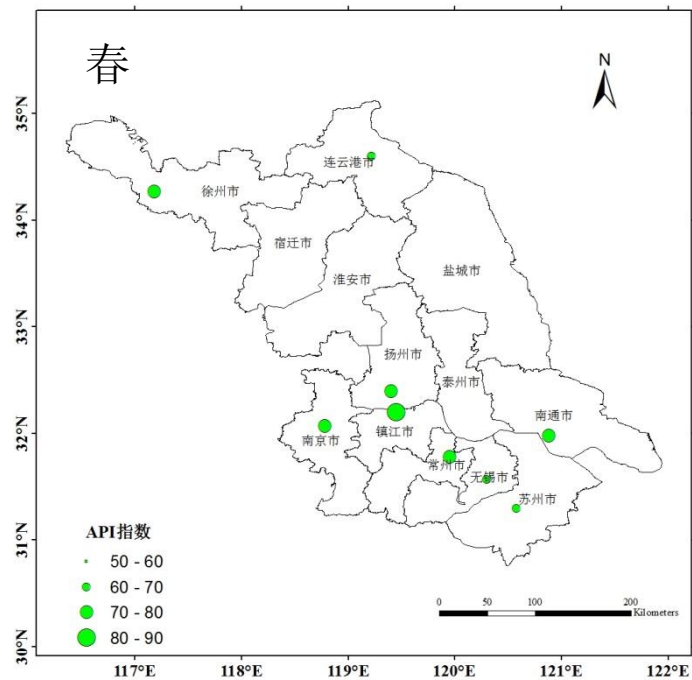Fig.6 Spatial variations of seasonal averaged AOD in Jiangsu

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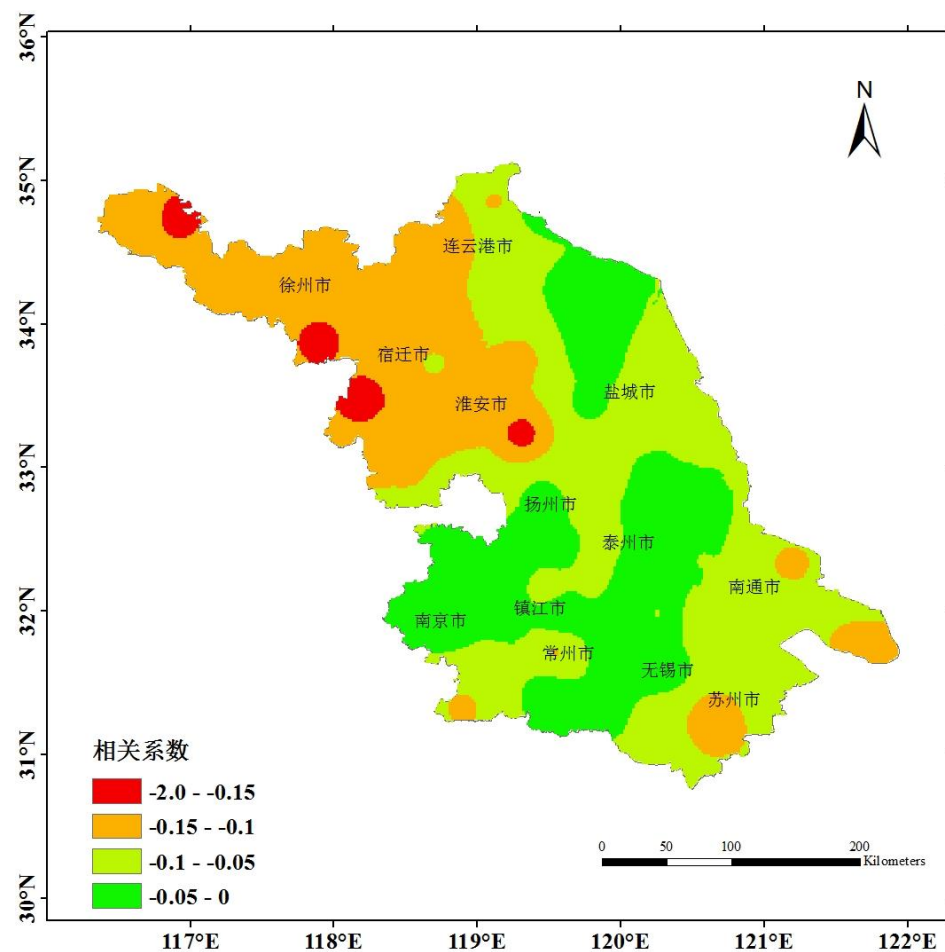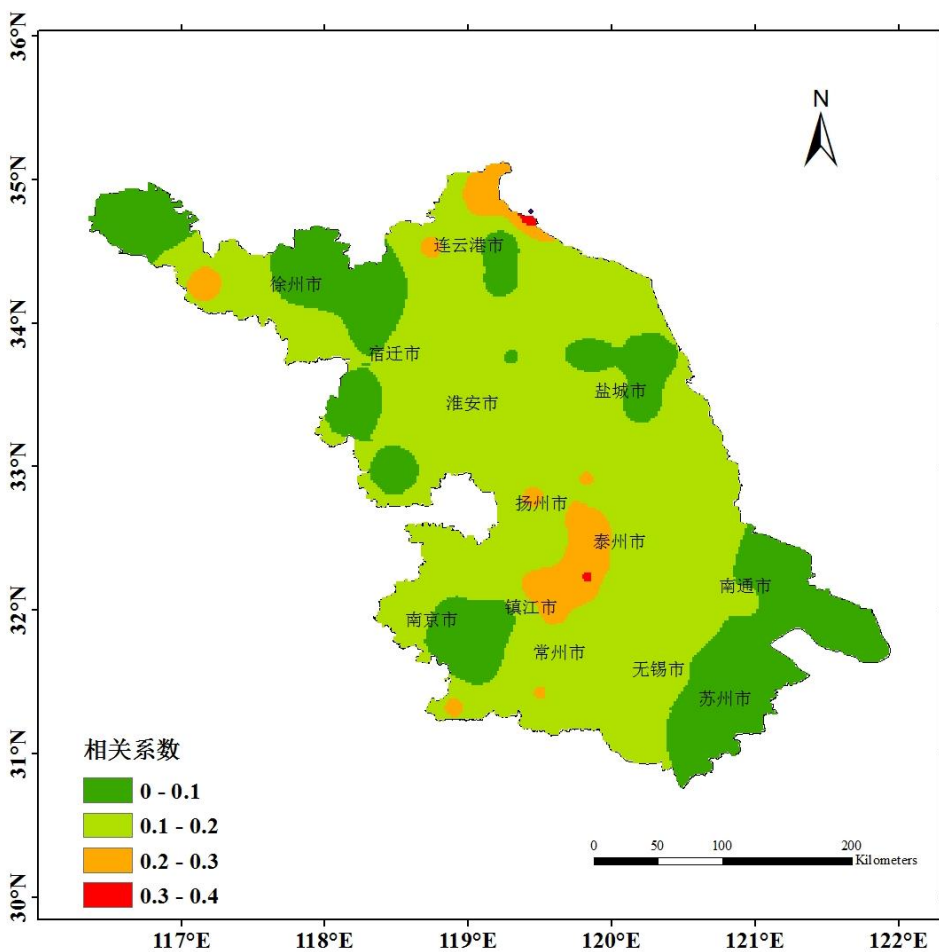Fig.7 Spatial variations of seasonal averaged API in Jiangsu

Fig.8 Correlation coefficient between visibility and wind(left),RH(right) in Jiangsu

Table2. Factors loadings from principal component analysis for the data in Jiangsu during 2012 (total explained variance 82.05%).

	Factor 1	Factor 2	Factor 3
AOD	**-0.835**	**-0.835**	**-0.764**
RH	0.042	0.032	**-0.643**
Wind	0.032	**0.743**	0.048
Temperature	**0.822**	0.032	0.035
Pressure	**-0.764**	0.041	0.044
Variance	31.2%	28.75%	22.10%

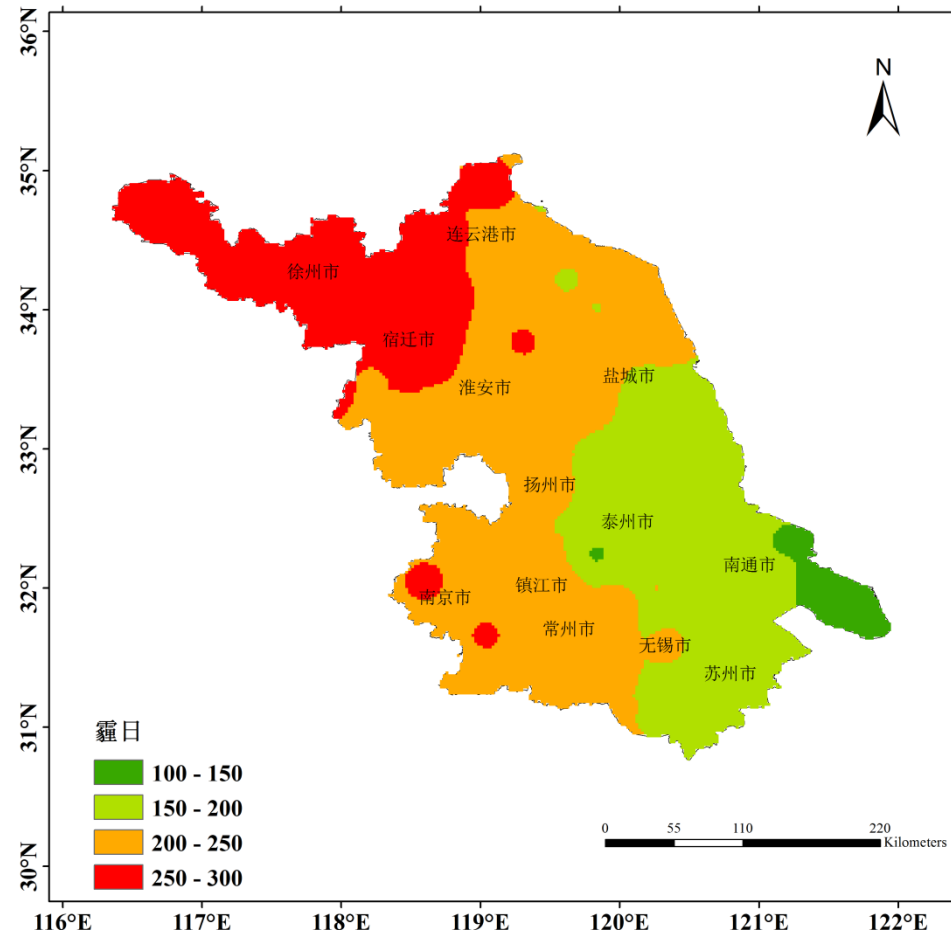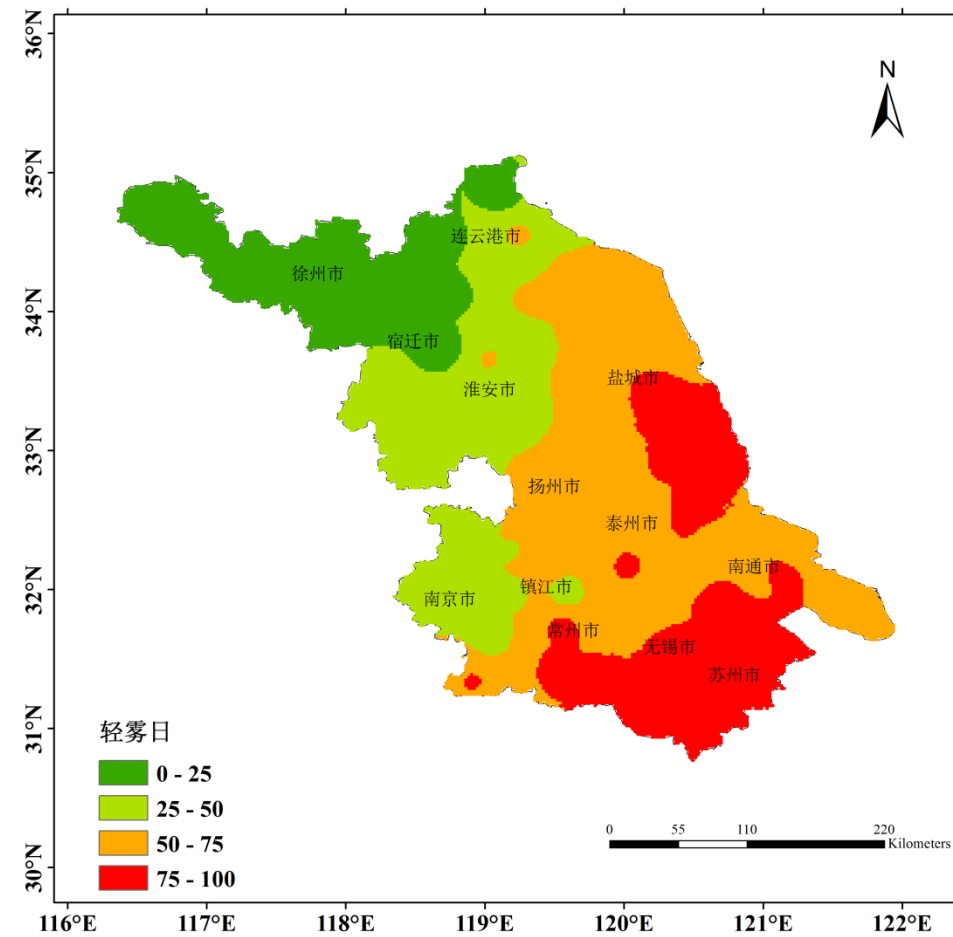Values in bold indicate loading factors larger than 0.5.

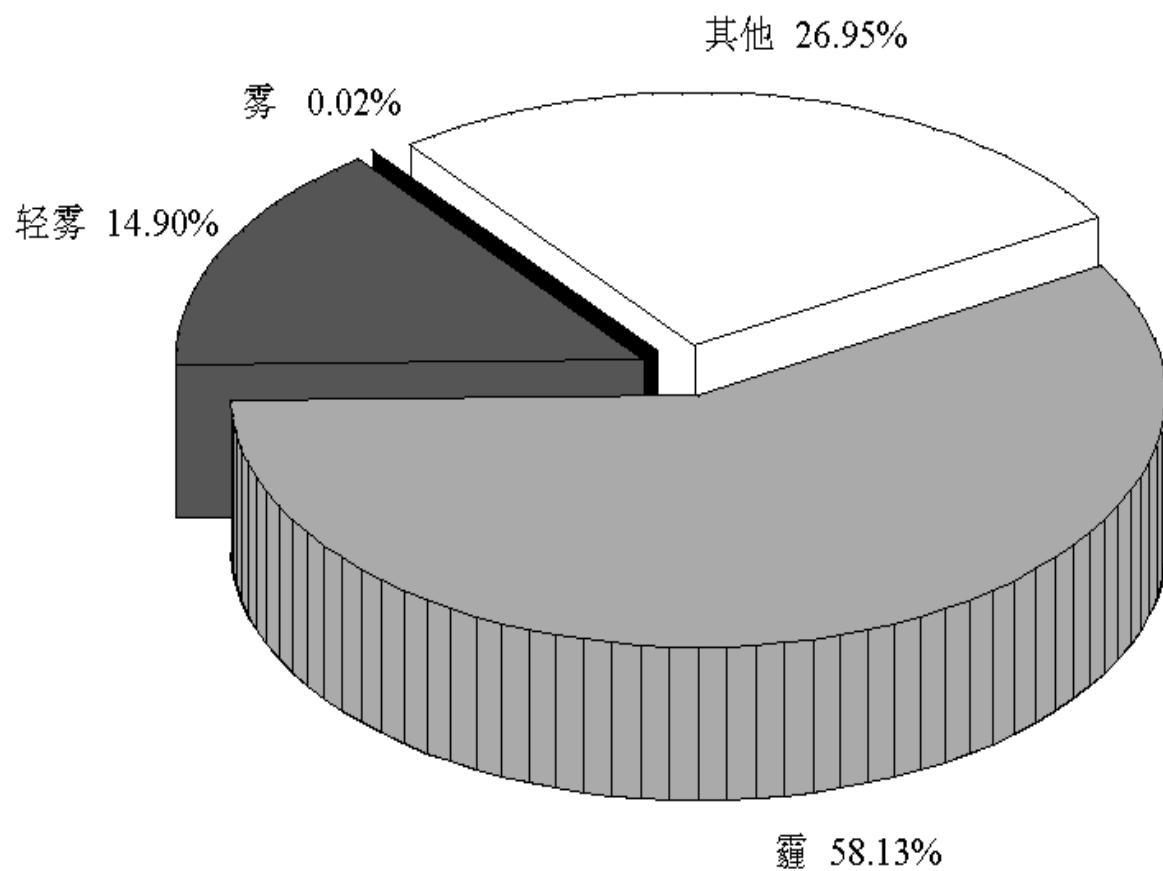Fig.9 Days of fog(left) and haze(right) in Jiangsu during 2012

Fig.10 Percent of days that fog and haze happened in Jiangsu during 2012

Summary

- During Spring visibility in Jiangsu presents that the north part is higher than the south part, but in Summer the situation is opposite, and in both Autumn and Winter the east part is lower than the west part.

- Visibility in most cities in Jiangsu has a negative relationship with RH and AOD, but a positive relationship with wind.

- Air pollution is the most important factor for visibility variations in Jiangsu.

- As compared to fog, haze has more effects to visibility variations in Jiangsu.

On-going work

- To find and investigate some cases of low visibility during 2012.

- To know the relationship between PM and visibility in Jiangsu.

Thank you!