Yale-NUIST Center on Atmospheric Environment

Interannual variation of MODIS NDVI in Lake Taihu and its relation to climate in submerged macrophyte region

ZhangZhen

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Outline

- Introduction
- Data acquisition
- Preprocessing
- Preliminary analysis
- Results

Introduction

- It is difficult to track the spatio-temporal variability of vegetation distribution in lakes because of the technological limitations associated with mapping using traditional field surveys as well as the lack of a unified field survey protocol. (zhao et al. 2013)
- The Moderate-resolution Imaging Spectroradiometer (MODIS) is a payload scientific instrument launched into Earth orbit by NASA in 1999 on board the Terra (EOS AM) Satellite, and in 2002 on board the Aqua (EOS PM) satellite.
- The instruments capture data in 36 spectral bands ranging in wave length from 0.4 μm to 14.4 μm and at varying spatial resolutions (2 bands at 250 m, 5 bands at 500 m and 29 bands at 1 km).
- Use NDVI to describe the macrophyte condition in Lake Taihu

Data acquisition

Data	Time Span	resolution	range
NDVI	Feb 18 2000-Jun 25 2015	16 day; 250m	Taihu
Surface Reflectance	DOY 217 2013	8 day; 250m	Taihu
Meteorological data	Jan 1 2000-Feb 28 2015	daily	DongShan station
Radiation data	Jun 26 2010-Jun 25 2015	Half-hourly	Meilangwan station

- Normalized Difference Vegetation Index and surface reflectance data is acquired from MODIS Terra product data: MOD13Q1(351 scenes) and MOD09Q1(1 scene)
- MODIS Data access address: *https://lpdaac.usgs.gov/data_access/data_pool*
- Surface reflectance data is used to remove land pixels .
- Meteorological data is downloaded from China Meteorological Data Sharing Service System.

Preprocessing

- ENVI 4.7

Projection transformation

Irregular cutting

Band math to wipe off abnormal value

- Matlab

Remove land pixel signal

Select NDVI value in a range of zero to one

Preliminary analysis

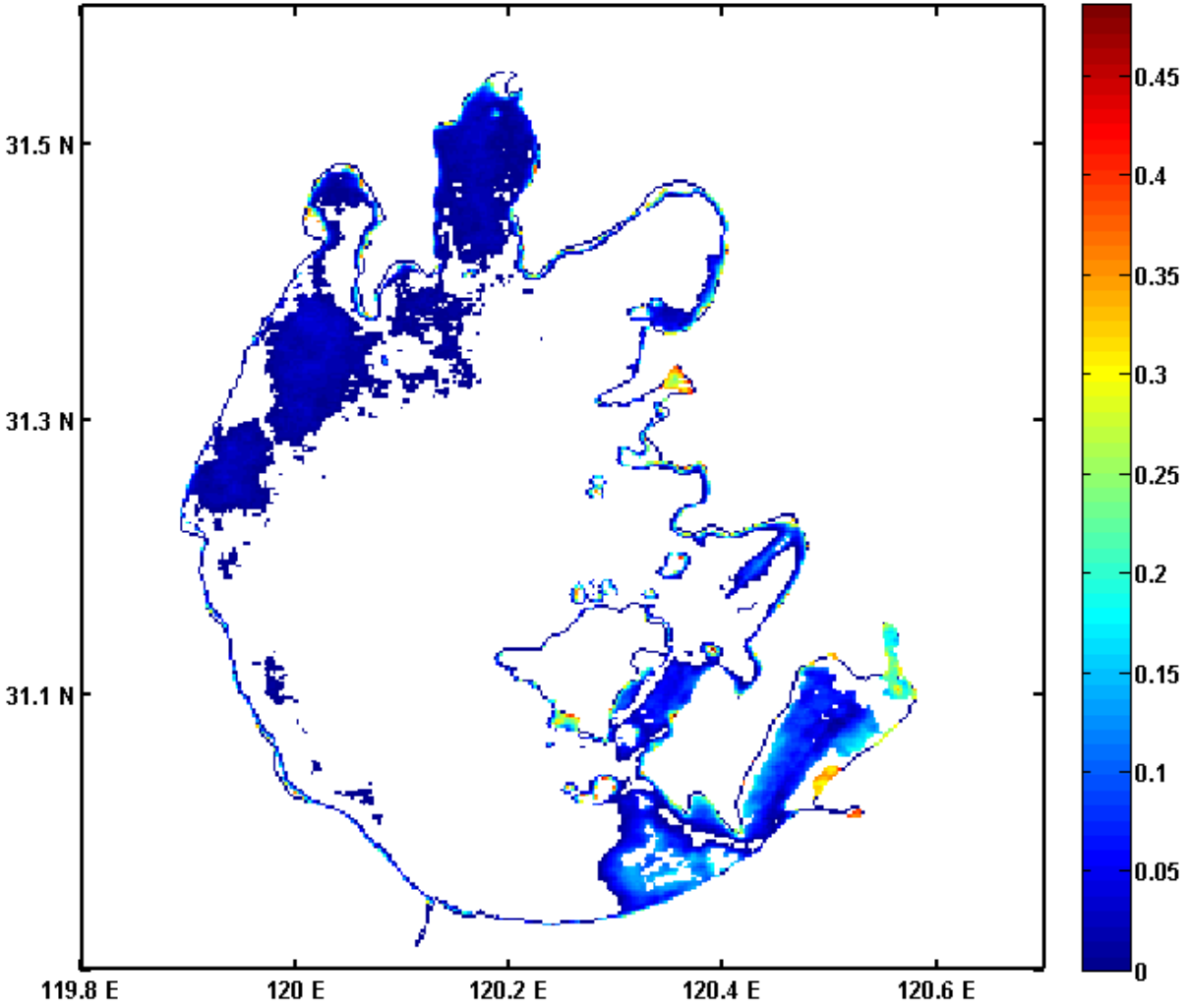


Figure 1 Spatial distribution of average NDVI in Lake Taihu from DOY 81 (21 March) in 2000 to DOY 176(25 June) in 2015

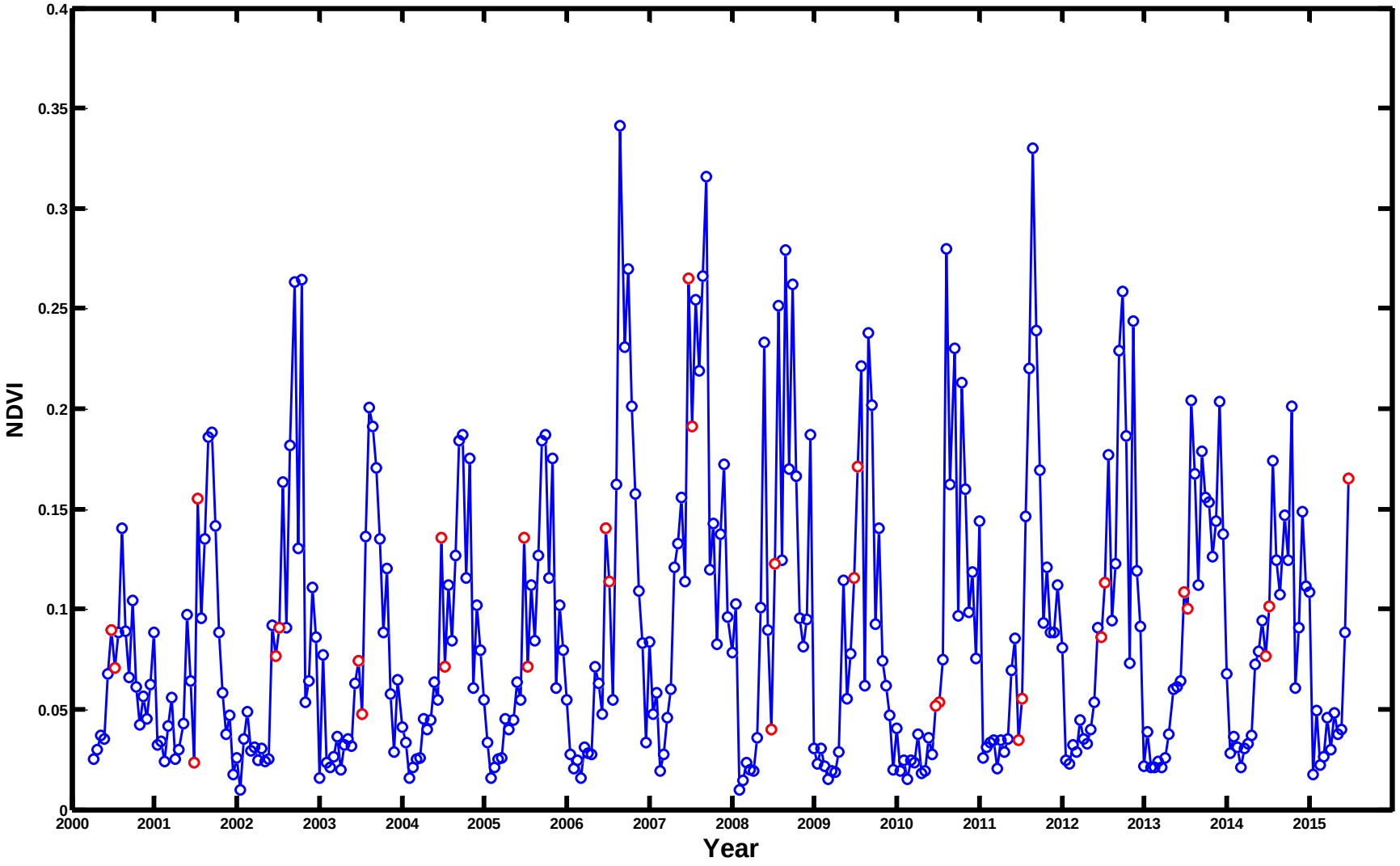


Figure 2 Time series of mean NDVI of the whole Lake Taihu from 2000 to 2015

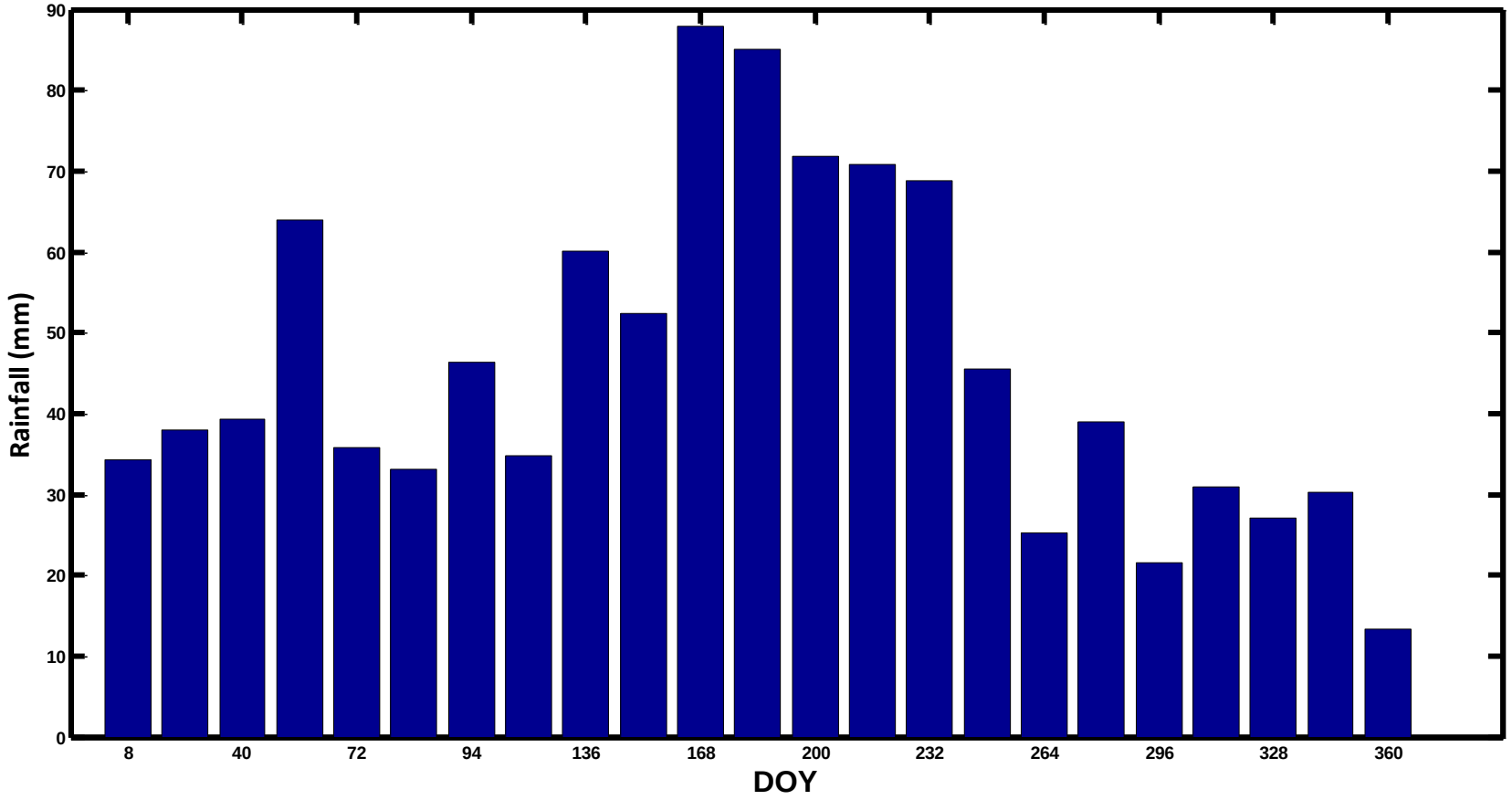


Figure 3 annual variation of multi-yearly average rainfall in Lake Taihu from 2000 to 2015

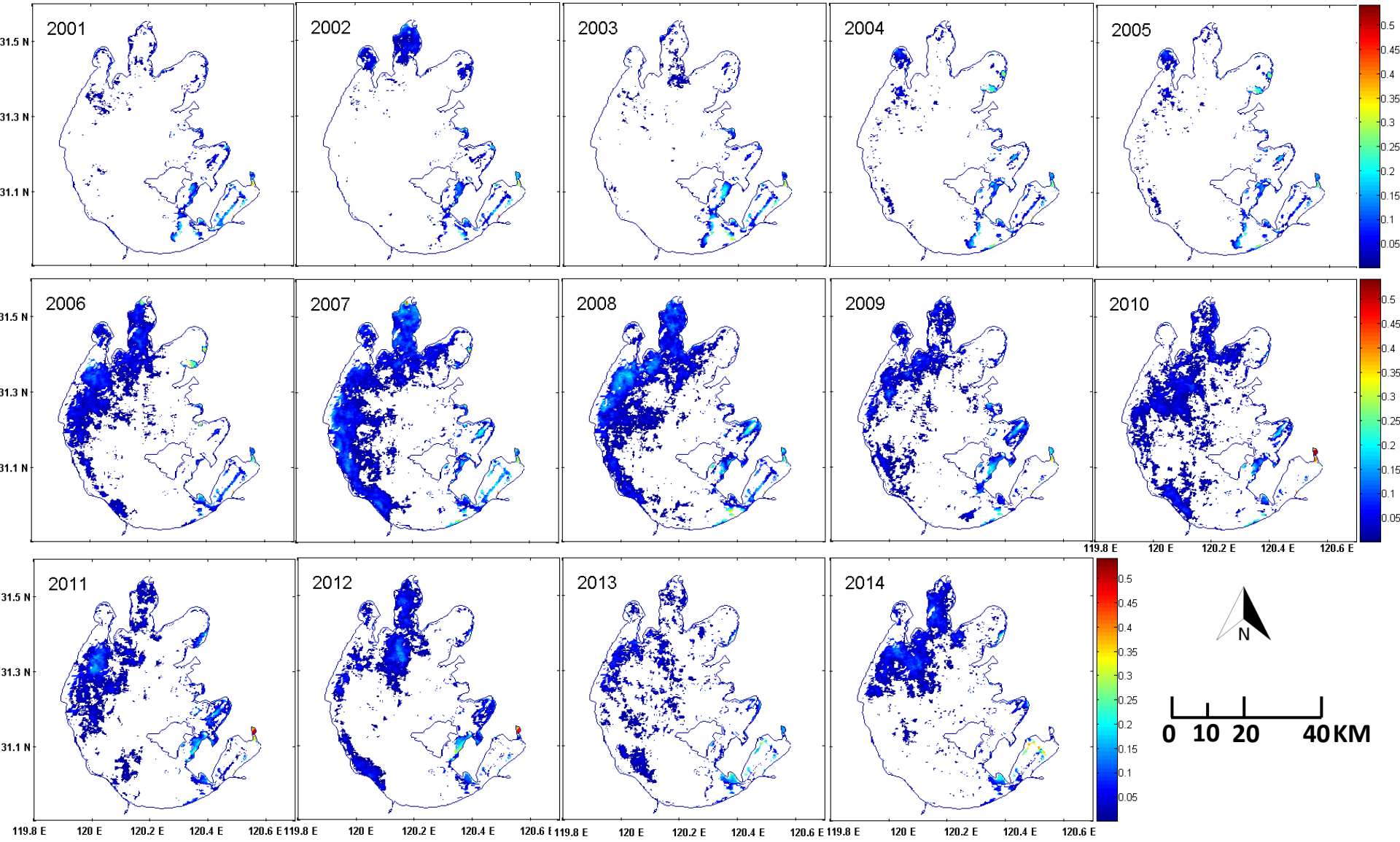


Figure 4 interannual NDVI spatial distribution of Lake Taihu from 2001 to 2014

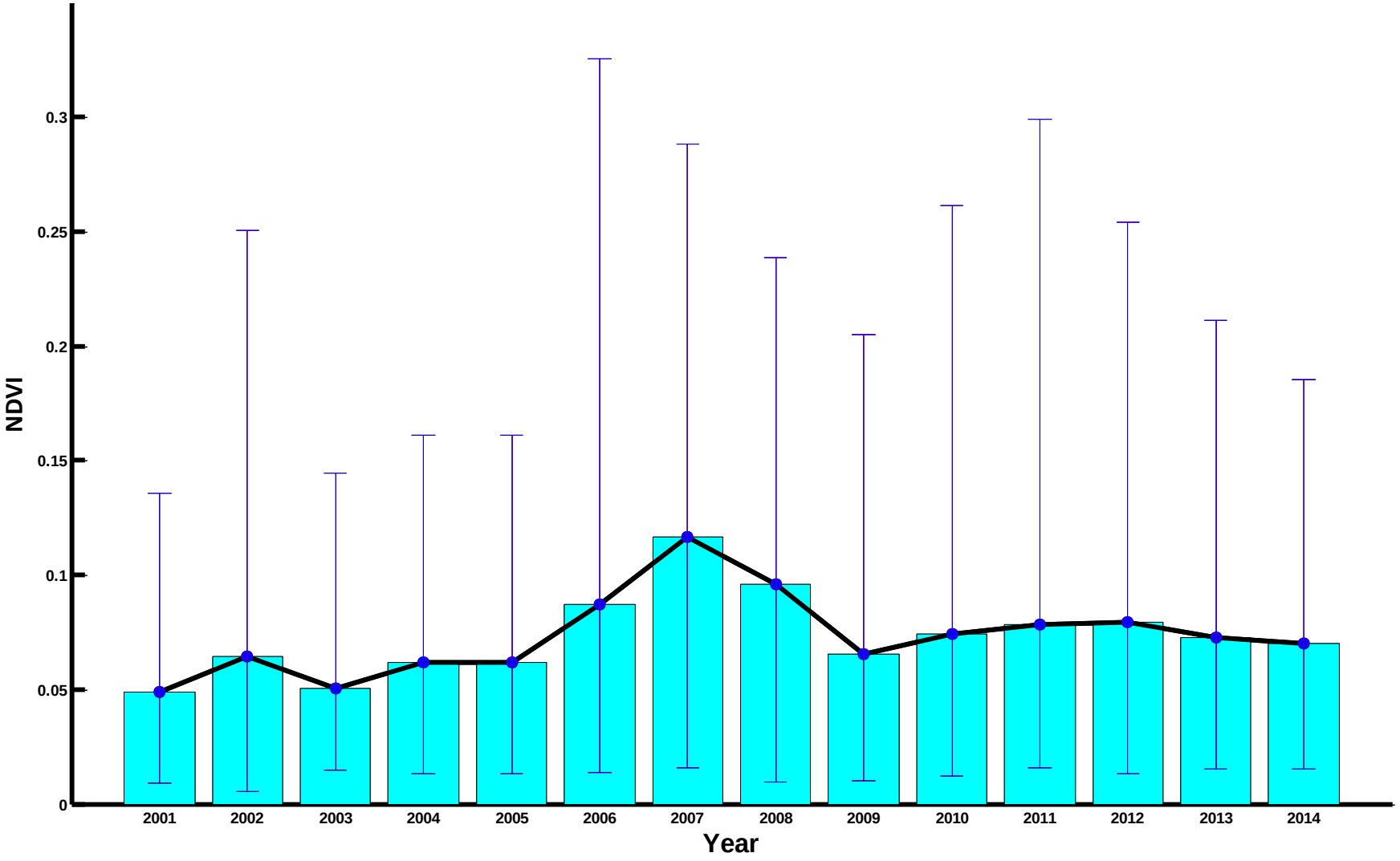


Figure 5 interannual mean NDVI variation of Lake Taihu from 2001 to 2014

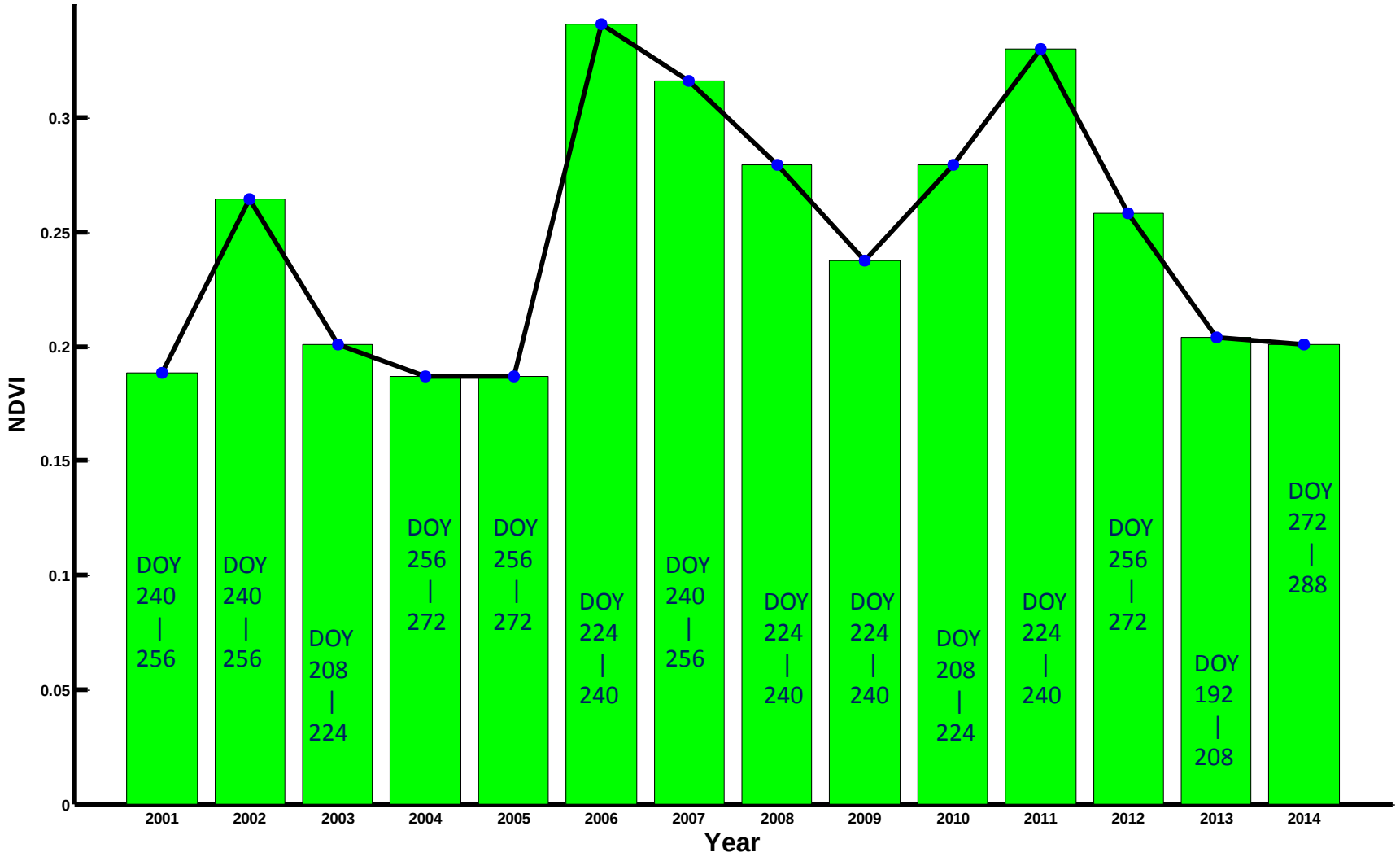


Figure 6 interannual max NDVI variation of Lake Taihu from 2001 to 2014

July: DOY 182-212
Aug: DOY 213-243
Sep: DOY 244-273
Oct: DOY 274-304

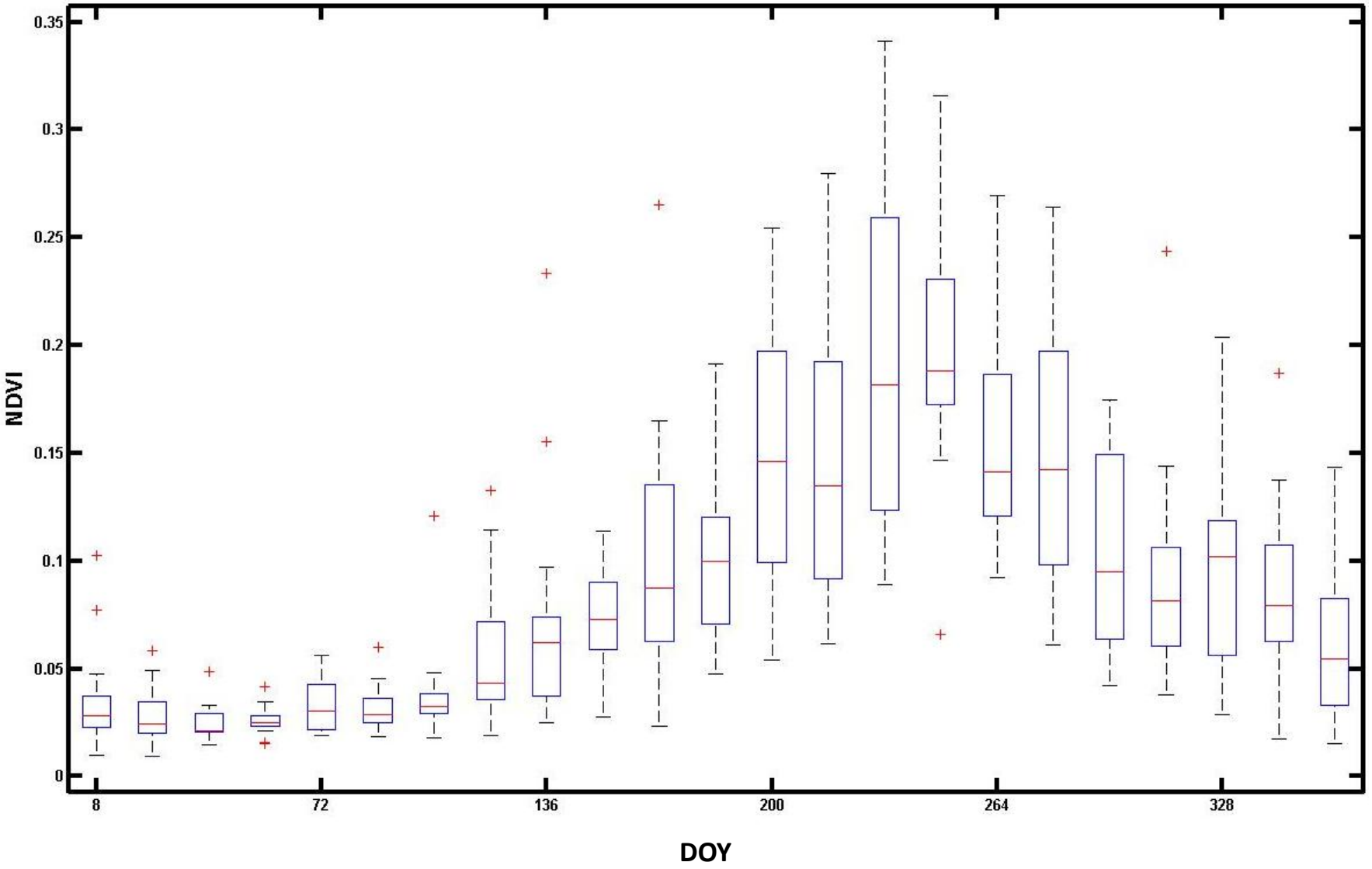


Figure 7 Boxplot of multi-year NDVI seasonal variation in Lake Taihu from 2000 to 2015

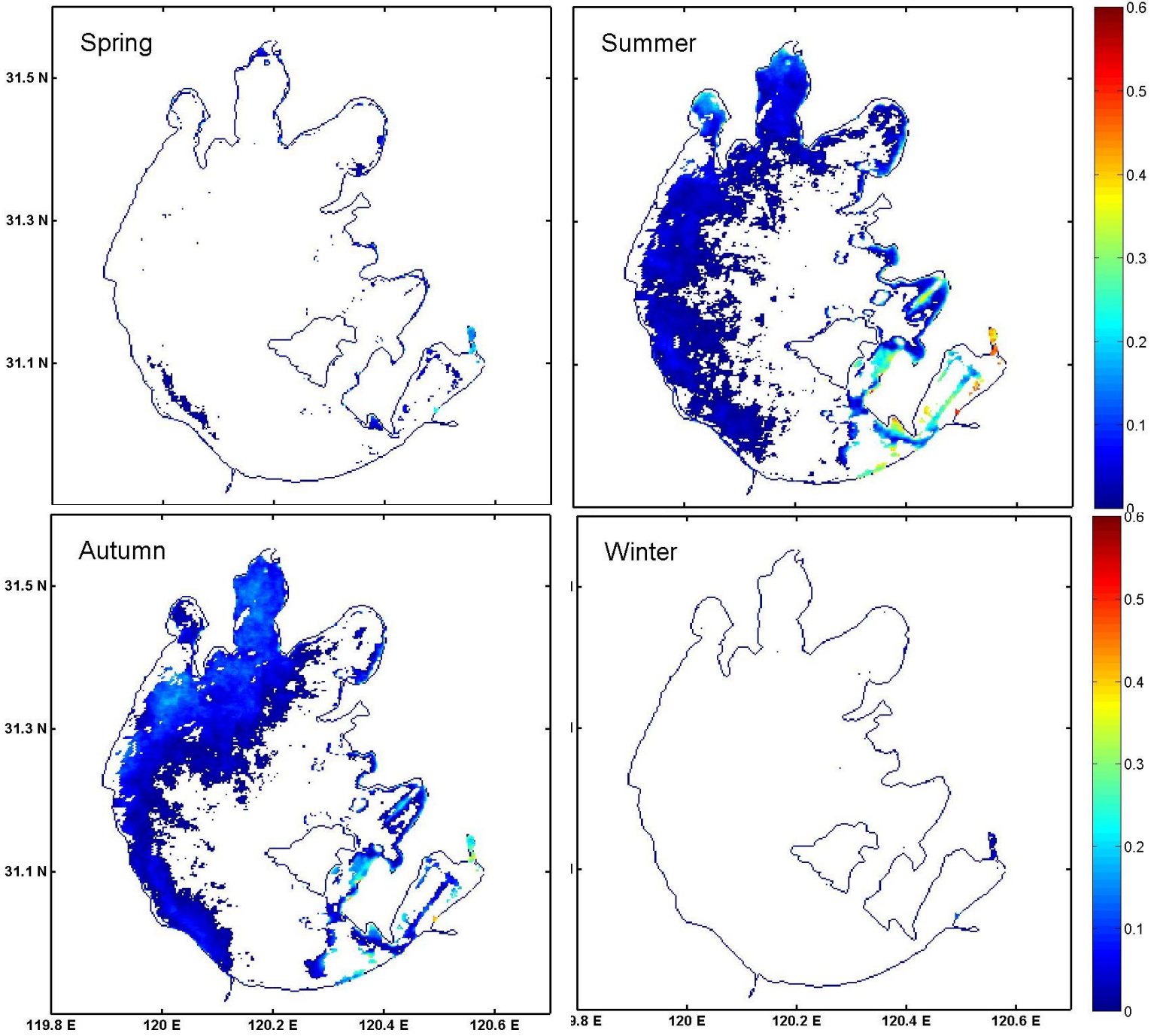
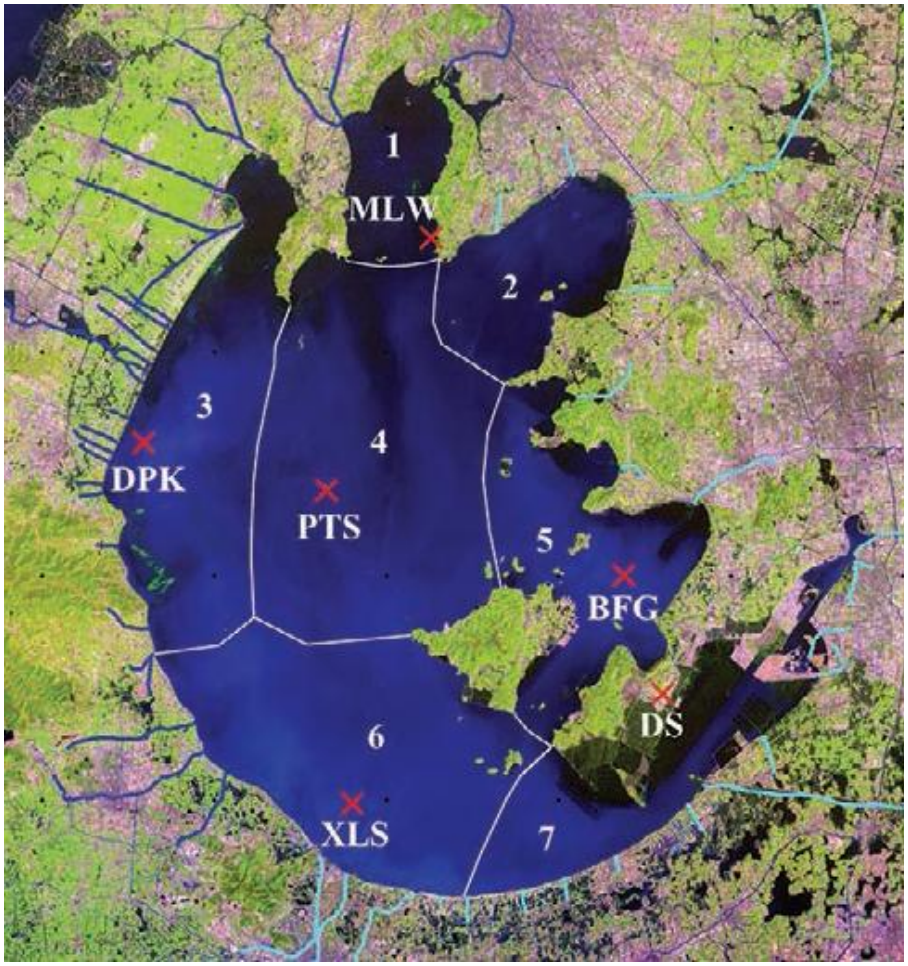


Figure 8 Spatial distribution of seasonal average NDVI in Lake Taihu from 2000 to 2015



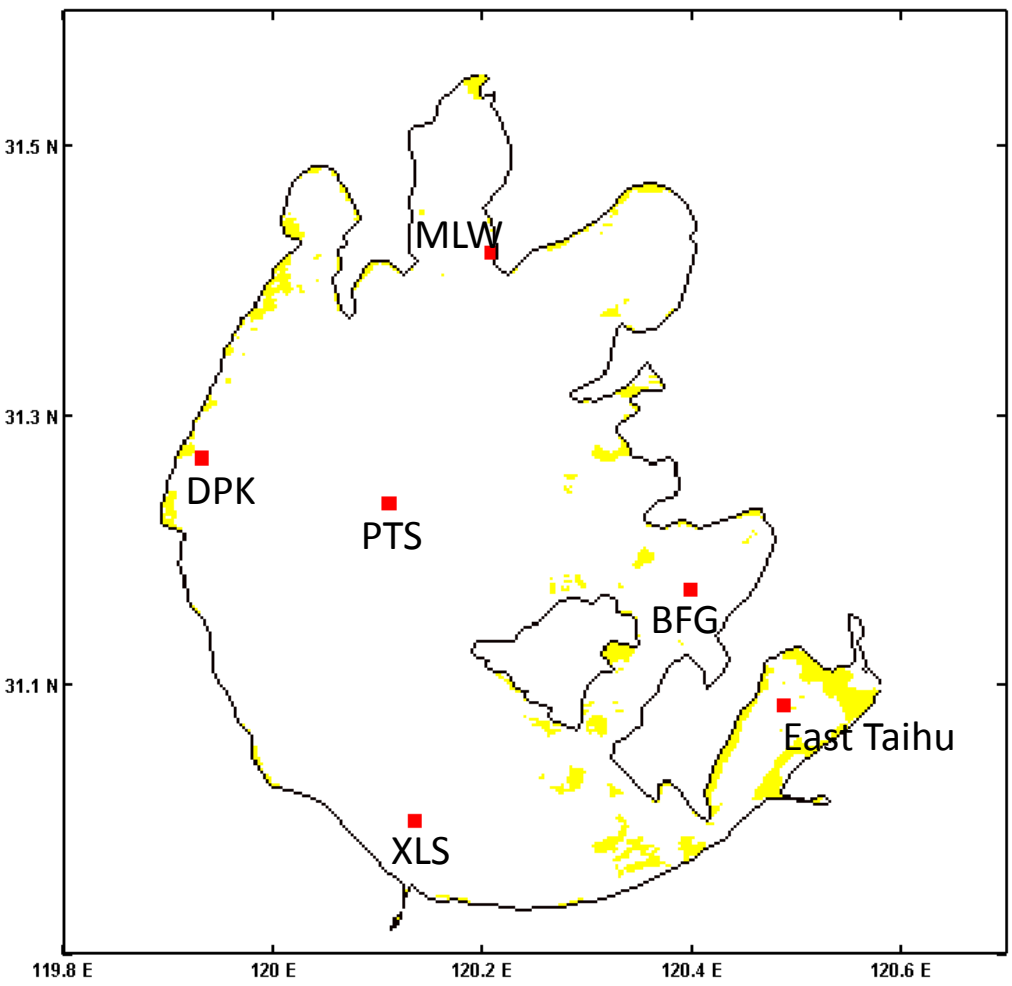


Figure 9 Landsat 8 image of Lake Taihu(Lee et al. 2014) and Sample station in Lake Taihu (each red block covers 1.5 km^2 and yellow region represents land pixels)

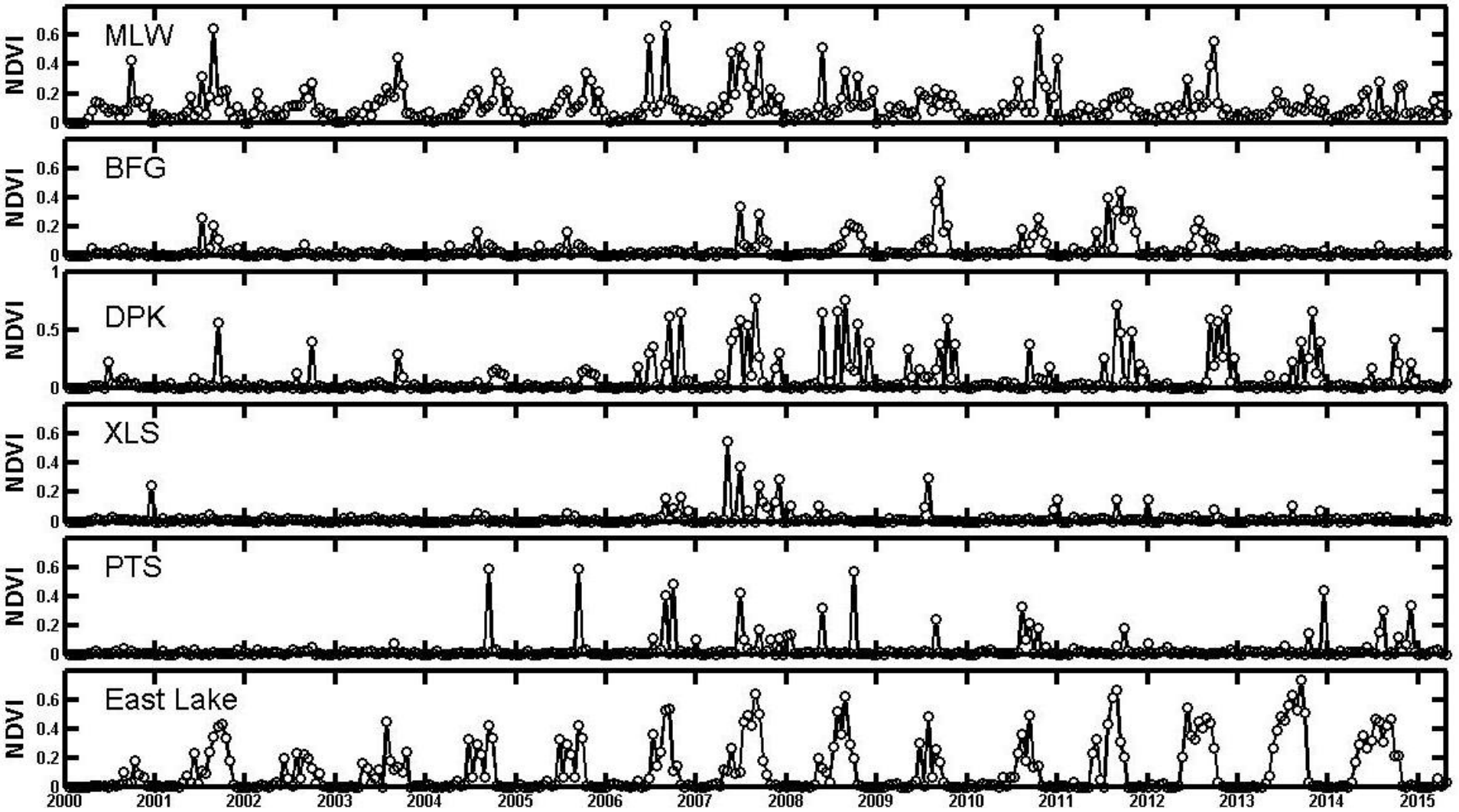


Figure 10 Comparison of average NDVI in Region MLW, BFG, DPK, XLS, PTS and East Taihu

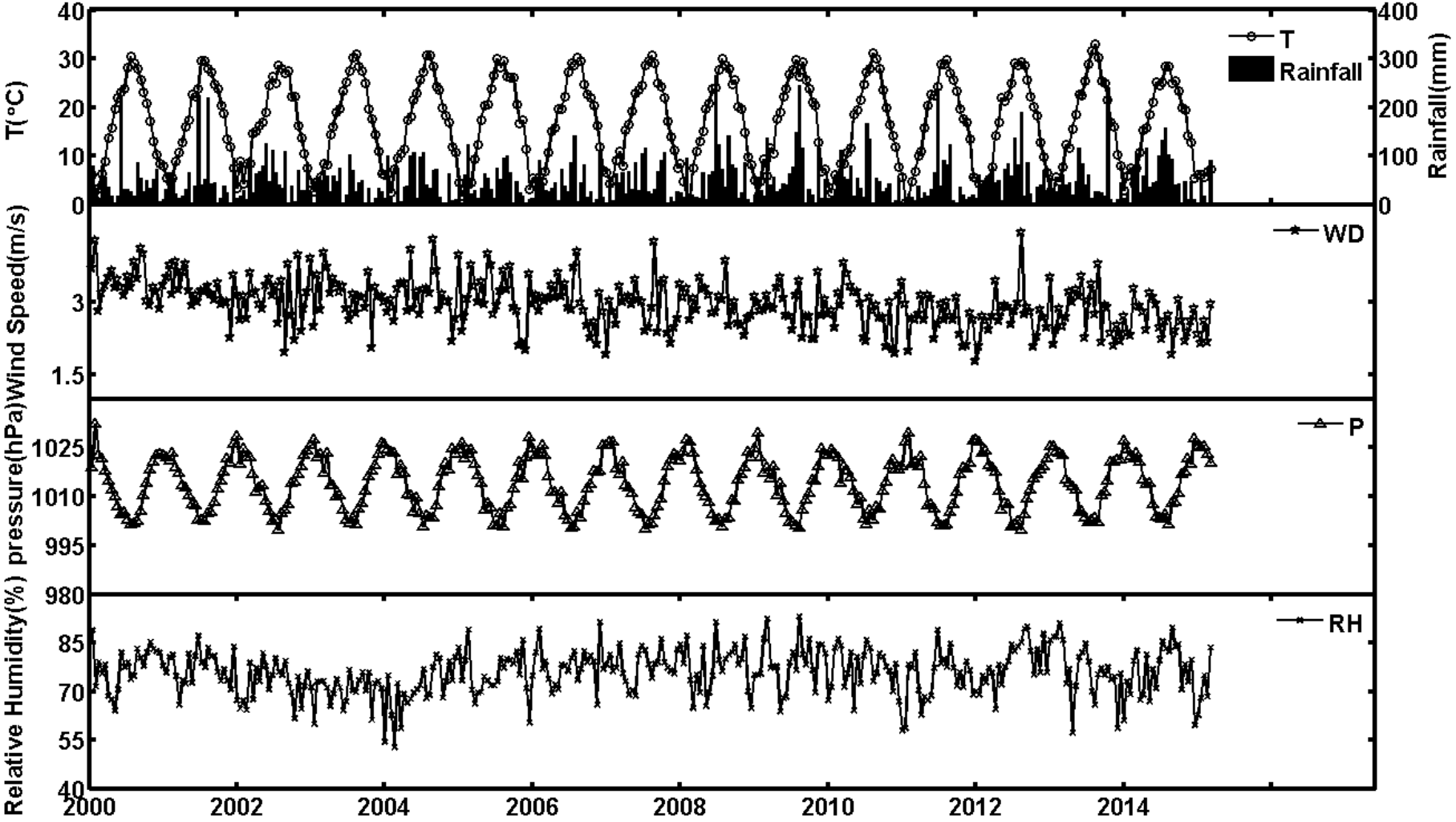


Figure 11 Time series of meteorological factors(Air Temperature, Rainfall, Wind speed, Air Pressure, Relative Humidity) in Dongshan Station

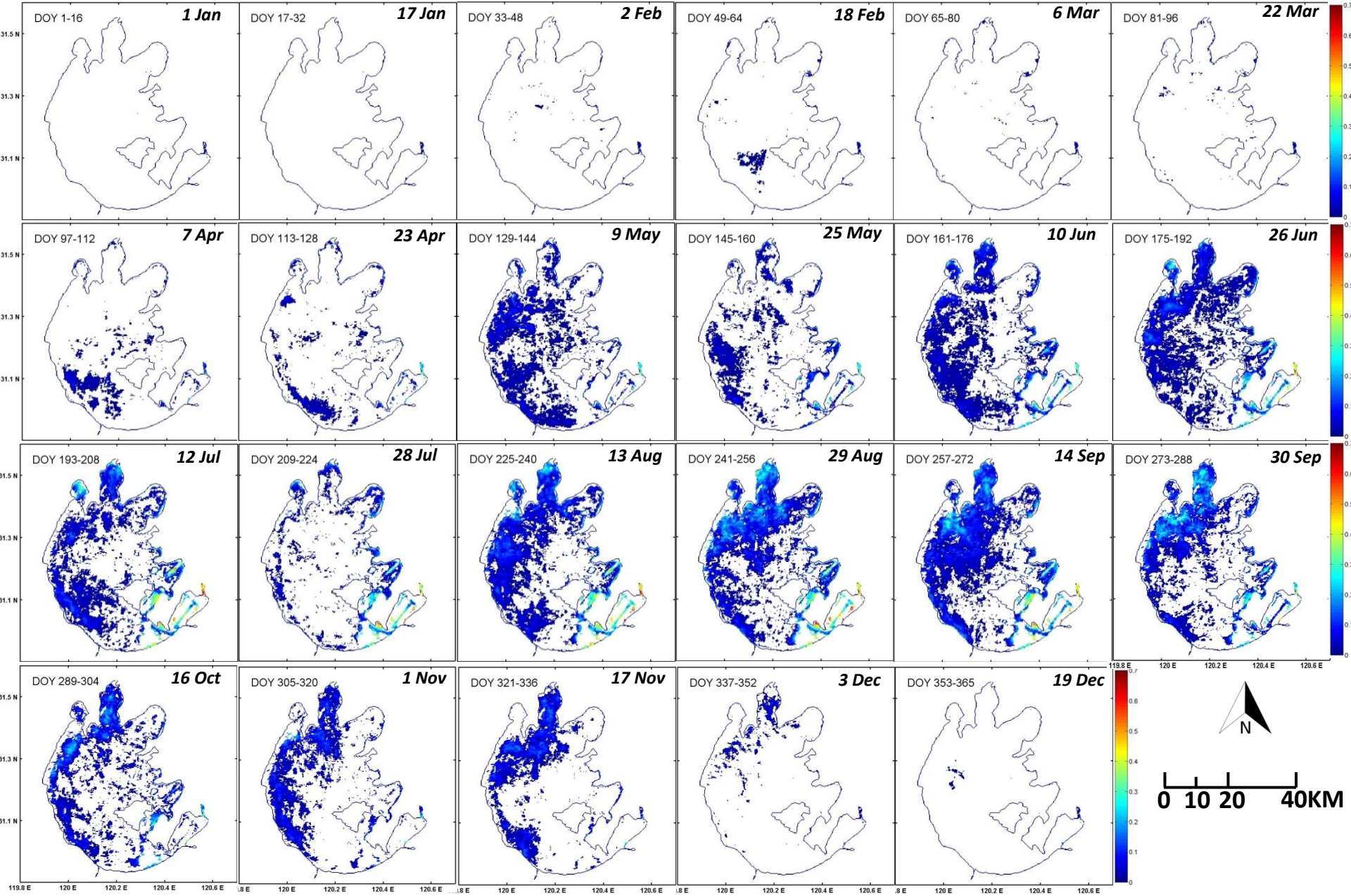


Figure 12 Spatial distribution of seasonal average NDVI in Lake Taihu from 2000 to 2015

assumption

- Temperature and Radiation are main factors to control the growth of vegetation.
- Consider multi-year average meteorological factor value which matching MODIS data's time scale.
- Exclude the NDVI value in January, February, March and December which is not growing season of aquatic vegetation.

BFG

East Taihu

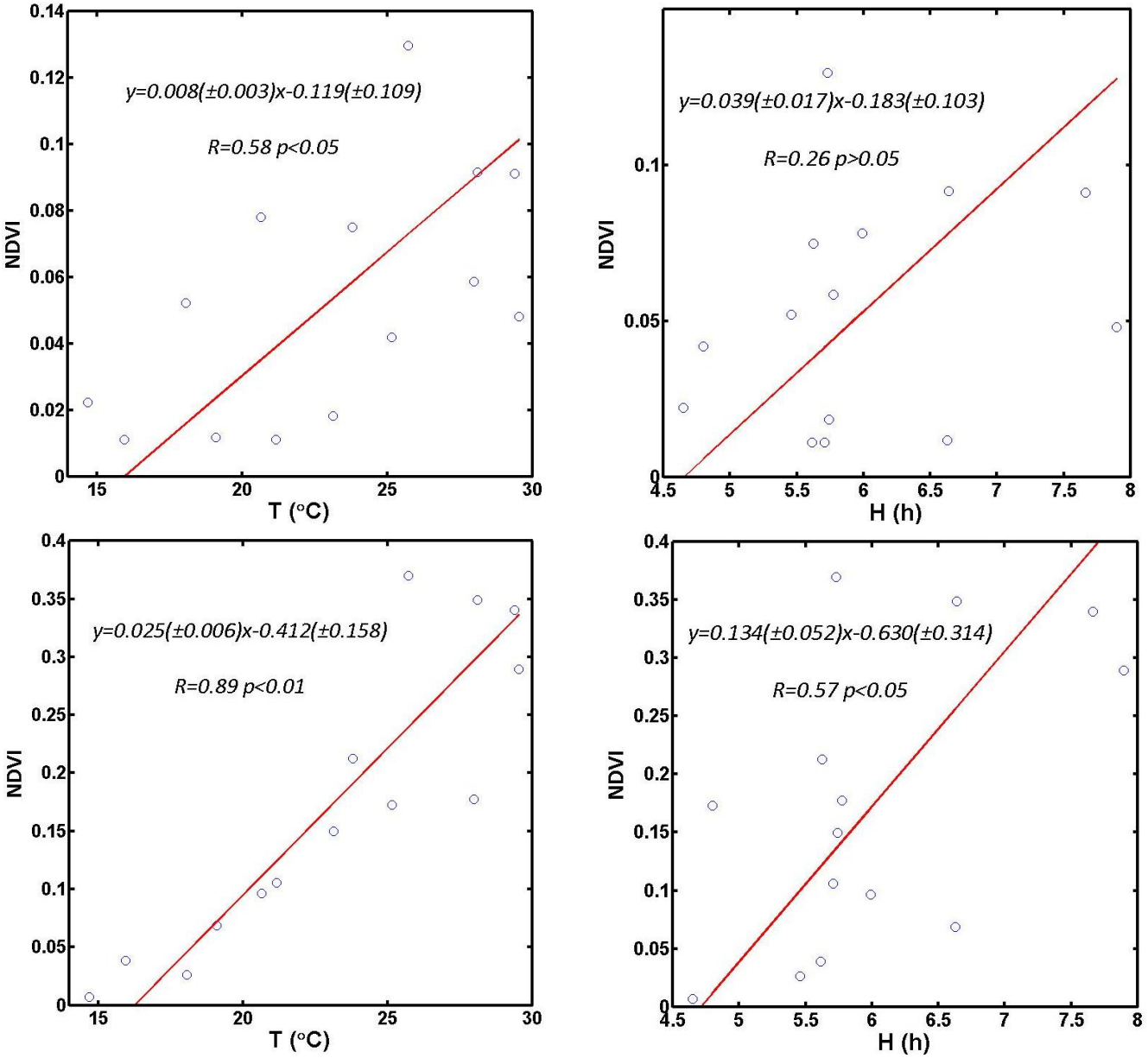


Figure 13 Relationship of average NDVI and meteorological factor(air temperature and sunshine duration) in Region BFG and East Taihu

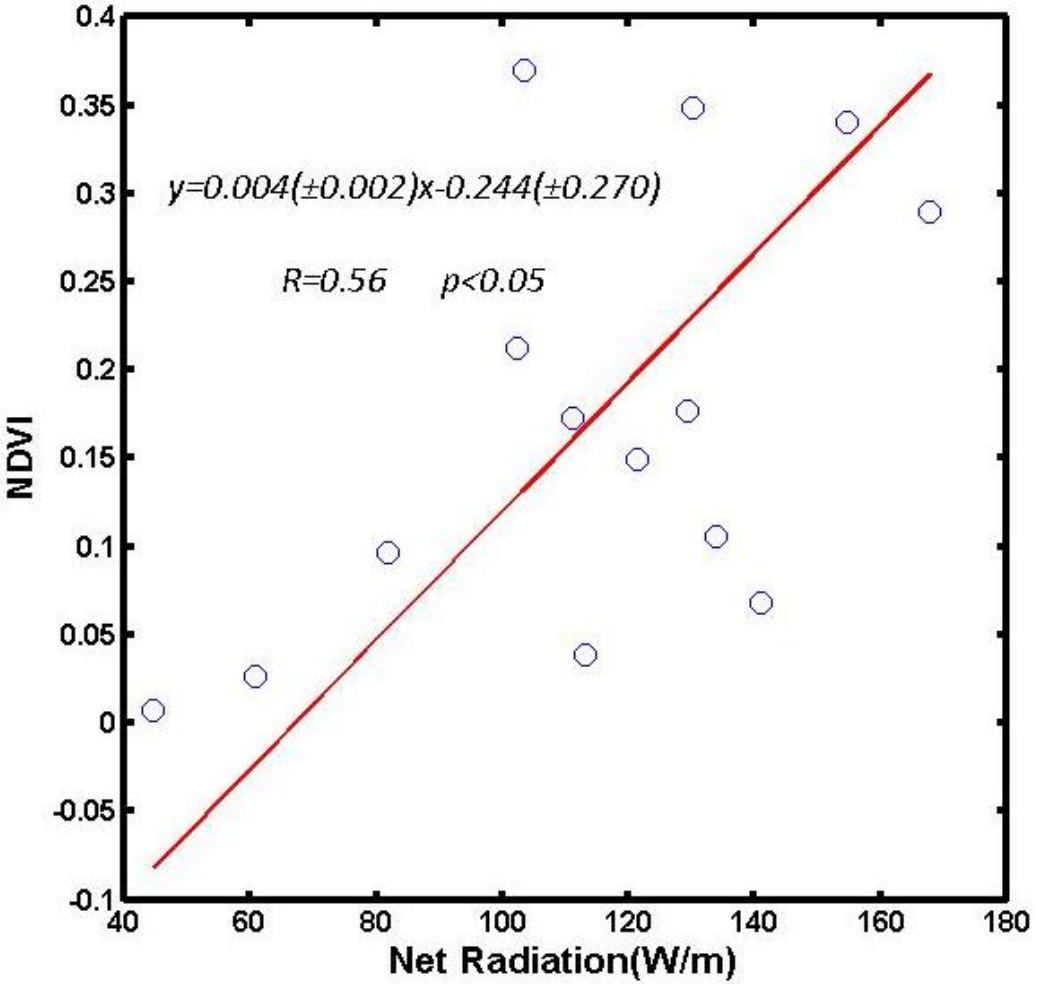


Figure 13 Relationship of average NDVI and net Radiation in East Taihu

April 20 in BFG

May 13 in BFG

July 09 in BFG

Results

- NDVI in Lake Taihu has obvious seasonal variation. The minimum happens in winter and the maximum values are clustered between summer and autumn, which mostly occcurs in August and September.
- The growing season of macrophyte vegetation is from April to November .
- Interannual trend of NDVI exists difference to some extend.
- NDVI in macrophyte region (East Taihu and near BFG) has better linear relation with meteorological factor than other regions, which characteristic of vegetation type is close to Landecosystem.

Thank you