

# Online Time Series Analysis of Land Products over Asia Monsoon Region via Giovanni

Suhung Shen<sup>1,2</sup>, Gregory G. Leptoukh<sup>1</sup>, Irina Gerasimov<sup>1,3</sup>

<sup>1</sup> NASA Goddard Earth Sciences (GES) Data & Information Services Center (DISC), Code 610.2, NASA/GSFC, Maryland 20771, USA, <sup>2</sup>George Mason University, <sup>3</sup>ADNET

LCLUC Science Team Meeting  
November 5-11, 2011, Hanoi, Vietnam

Suhung.Shen@nasa.gov  
http://disc.gsfc.nasa.gov/mairs

## Abstract

Time series analysis is critical to the study of land cover/land use changes and climate. Time series studies at local-to-regional scales require higher spatial resolution, such as 1km or less, data. MODIS land products of 250m to 1km resolution enable such studies. However, such MODIS land data files are distributed in 10°x10° tiles, due to large data volumes. Conducting a time series study requires downloading all tiles that include the study area for the time period of interest, and mosaicking the tiles spatially. This can be an extremely time-consuming process. In support of the Monsoon Asia Integrated Regional Study (MAIRS) program, NASA GES DISC (Goddard Earth Sciences Data and Information Services Center) has processed MODIS land products at 1 km resolution over the Asia monsoon region (0°-60°N, 60°-150°E) with a common data structure and format. The processed data have been integrated into the Giovanni system (Goddard Interactive Online Visualization ANd aNalysis Infrastructure) that enables users to explore, analyze, and download data over an area and time period of interest easily. Currently, the following regional MODIS land products are available in Giovanni: 8-day 1km land surface temperature and active fire, monthly 1km vegetation index, and yearly 0.05°, 500m land cover types. More data will be added in the near future. By combining atmospheric and oceanic data products in the Giovanni system, it is possible to do further analyses of environmental and climate changes associated with the land, ocean, and atmosphere. This presentation demonstrates exploring land products in the Giovanni system with sample case scenarios.

## Data Processing

Standard MODIS Level 3 land products of 1km or higher spatial resolution are distributed in tiles as shown on the image in sinusoidal projection. For each product, tiles over the Monsoon Asia region (red boxes in the image) were downloaded from NASA LP DAAC by using the automated data archive system at GES DISC. The data processing procedures include: a) mosaic all tiles, and b) project data to Equirectangular projection with nearest point resampling method. The data quality are the same as the input data (no quality filtering performed). The integrated data are then integrated into the Giovanni system.

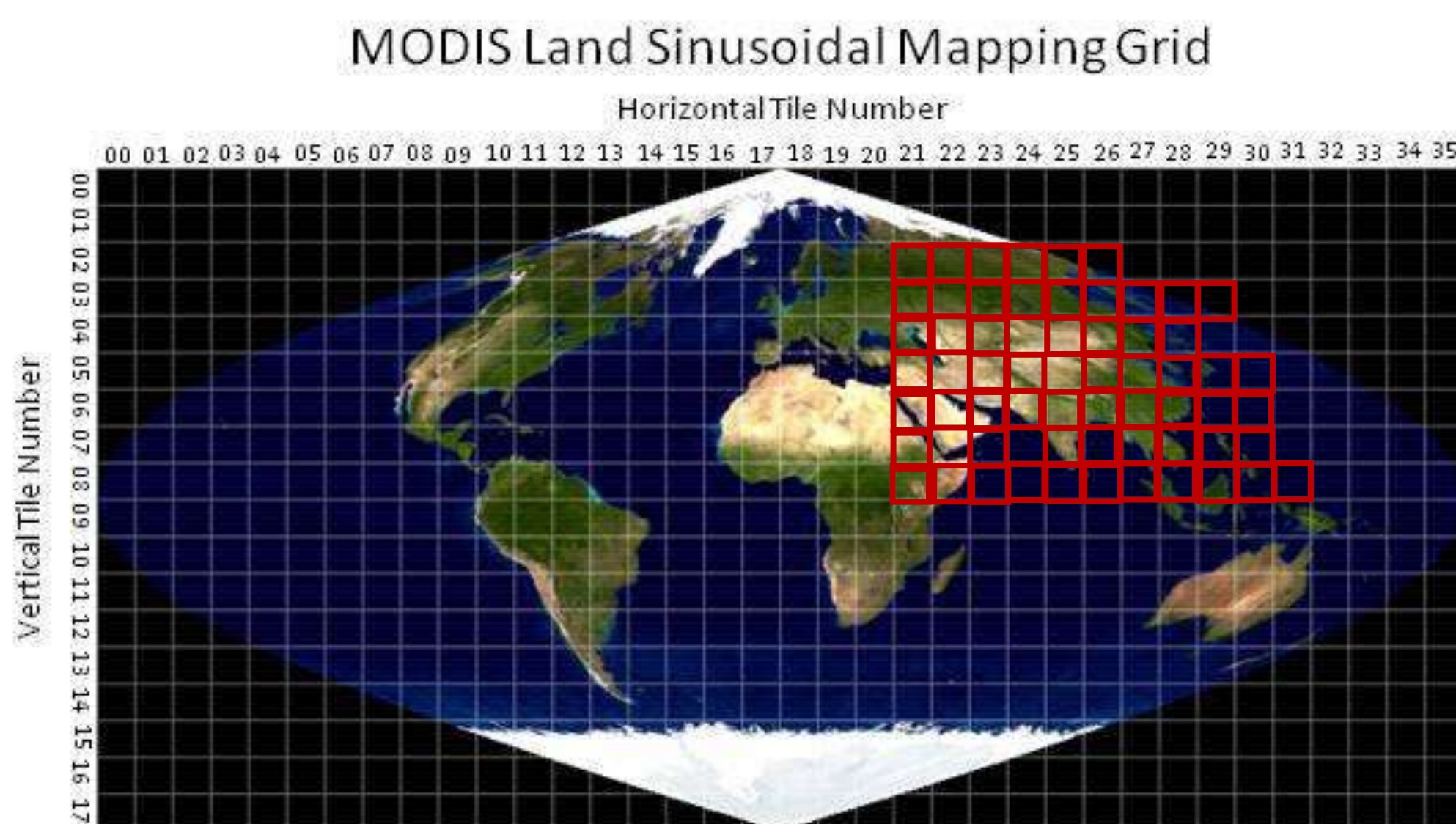


Figure 1: Tiles illustration image, from MRT user manual ([https://lpdaac.usgs.gov/tools/modis\\_reprojection\\_tool](https://lpdaac.usgs.gov/tools/modis_reprojection_tool))

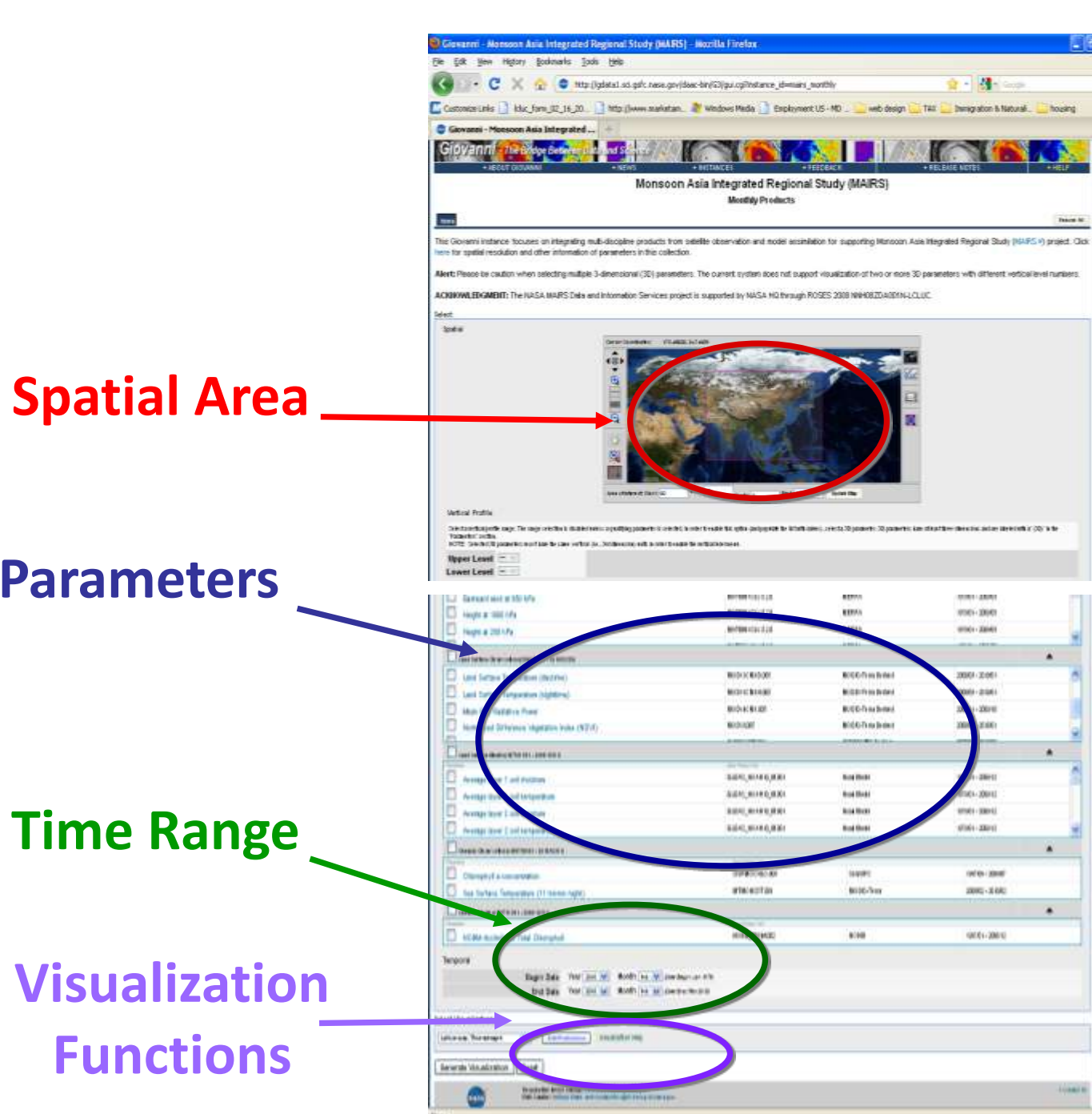
### Key Parameters for Re-projection:

```
RESAMPLING_TYPE = NN (Nearest Point)
OUTPUT_PROJECTION_TYPE = ER (Equirectangular)
OUTPUT_PROJECTION_PARAMETERS = (
  6371007.181 0.0 0.0 0.0 0.0 0.0 0.0 0.0
  0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0)

```

## Giovanni System

<http://disc.gsfc.nasa.gov/giovanni>



- Customizable portals
- No need to install software; no need to download and process data
- Provides visualization and basic statistical analysis functions, such as map, time series, scatter plots, correlation coefficients, difference of map, difference of time series, etc.)
- Able to download images (PNG, KMZ) and data in different formats (ASCII, netCDF, HDF)

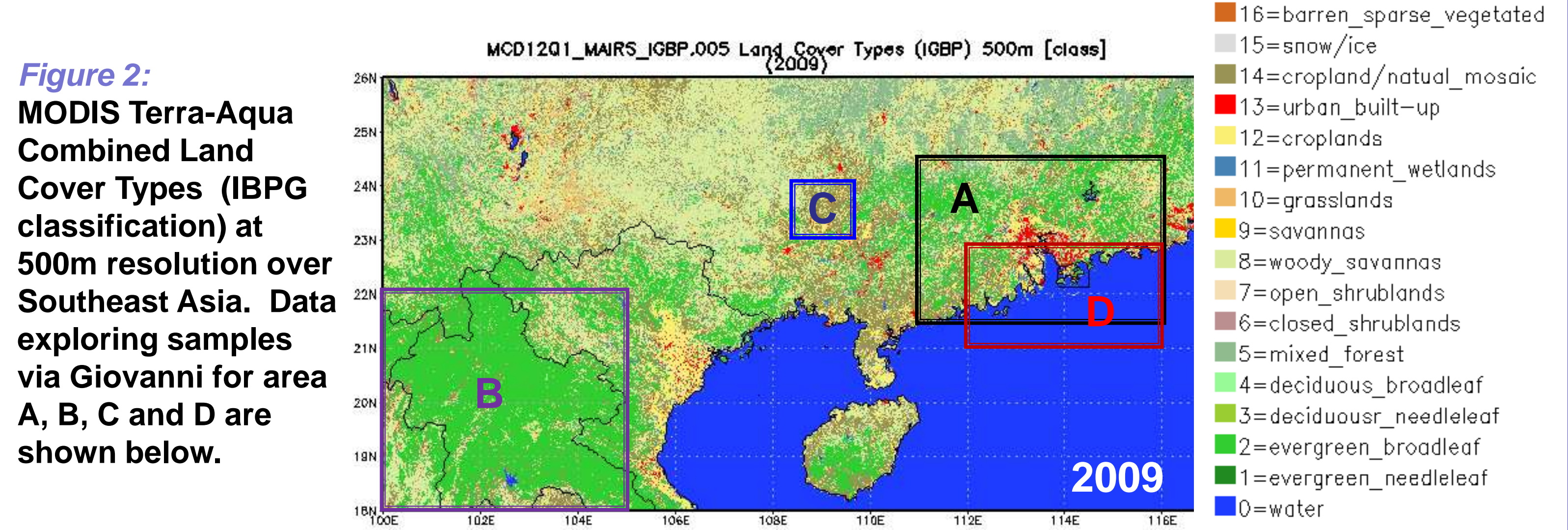
## Land Products in Giovanni

Operation, In test, Proposed

Parameter Name	Sensor/Model	Available Since	Spatial Resolution
Vegetation Indices	MODIS-Terra MODIS-Aqua	2000.03 2002.07	Monthly, 1.0° Monthly, 1 km
Land Surface Temperature	MODIS-Terra MODIS-Aqua	2000.03 2002.07	Monthly, 1.0° 8-day, 1 km
Thermal anomalies/Fire	MODIS-Terra MODIS-Aqua	2000.03	Monthly, 1.0° 8-day, 1 km
Land Cover Types	MODIS Terra+Aqua	2001	Yearly, 5.6km Yearly, 500m
Land Cover Dynamics	MODIS Terra+Aqua	2001	Yearly, 500m
Leaf Area Index	MODIS Terra+Aqua	2002.07	8-day, 1km
Total Evapotranspiration, Snow Water Equivalent, Surface Runoff, Soil Moisture	GLDAS	1979.01	Monthly, 1.0°

## MODIS Land Cover Types (IGBP 500m)

Figure 2: MODIS Terra-Aqua Combined Land Cover Types (IGBP classification) at 500m resolution over Southeast Asia. Data exploring samples via Giovanni for area A, B, C and D are shown below.



## A: Observing Urban Heat Island effects from MODIS LST

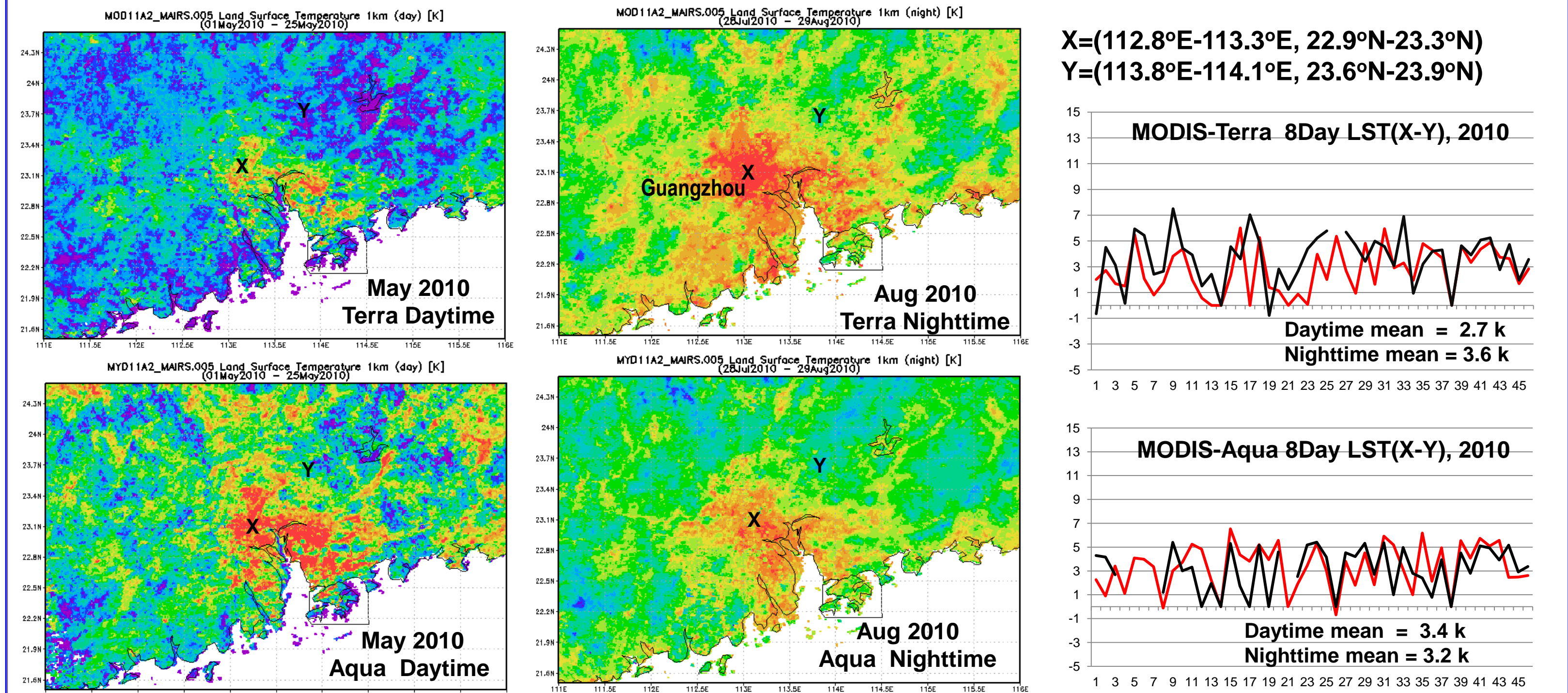


Figure 3: Images are MODIS monthly 1km land surface temperature (LST) over Box A in Figure 2, indicating LST over urban (Pearl River Delta, China) is significantly higher than over rural areas for both daytime and nighttime. The satellite crossing local time is about 11am (day) or 11pm (night) for Terra and 2pm (day) or 2am (night) for Aqua. Due to the diurnal cycle effect, LST from Terra and Aqua are different. Time series are LST difference of point X and Y for day (red) and night (black), respectively.

## B: Interannual Variations of Forest Fires

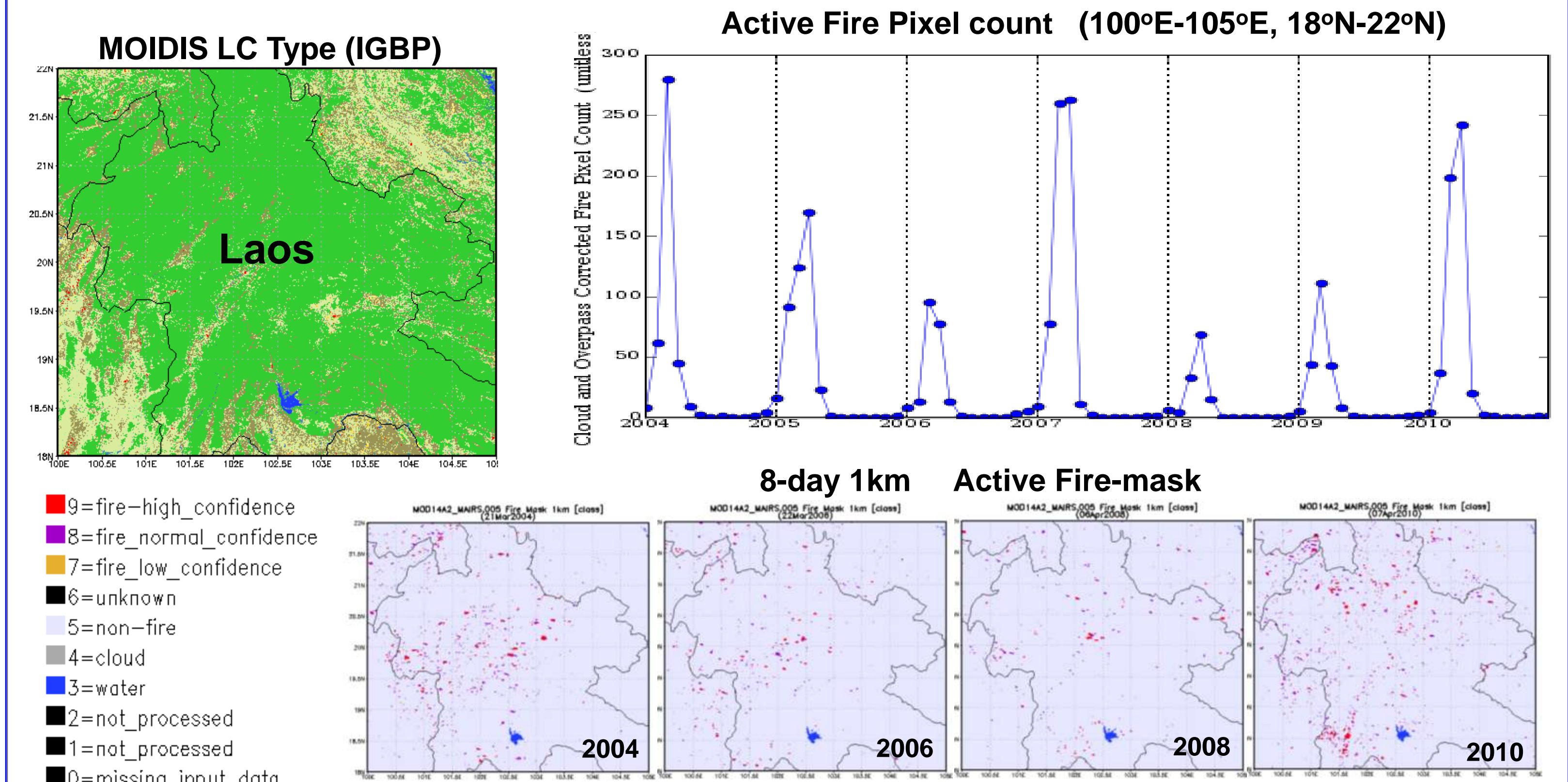


Figure 4: MODIS monthly active fire pixel count time series and 8-day fire-mask images over Laos (Box B in Figure 2). Most fires occur during March and April. The number of fires and locations vary each year.

## C: Land Cover Changes & Annual Cycle of Vegetation Index

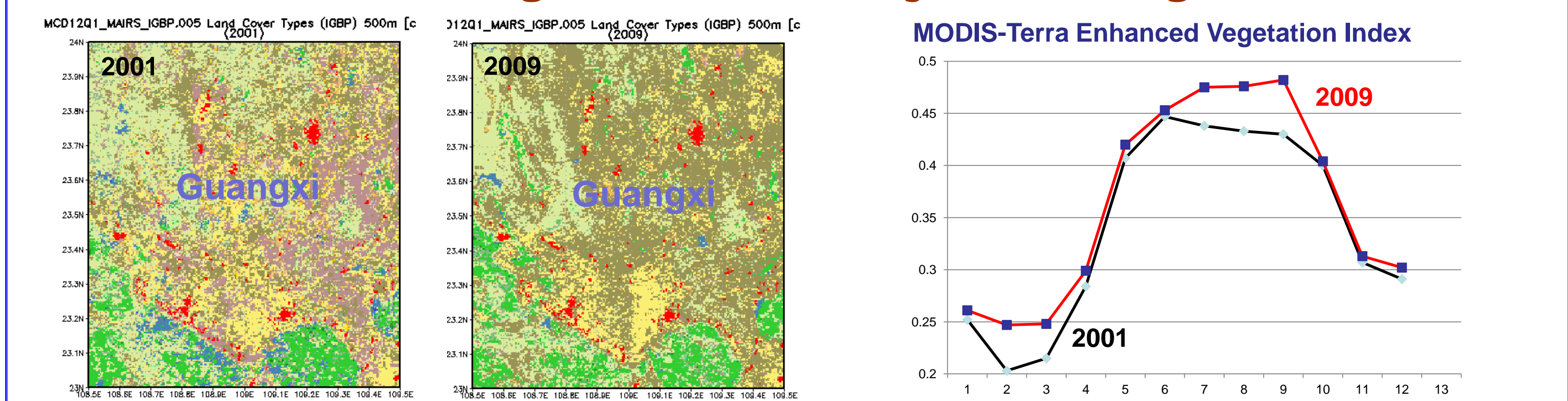


Figure 5: Observed different seasonal cycles of EVI between 2001 and 2009 are likely associated with the land cover changes over this area (Box C in Figure 2).

## D: From Land to Ocean

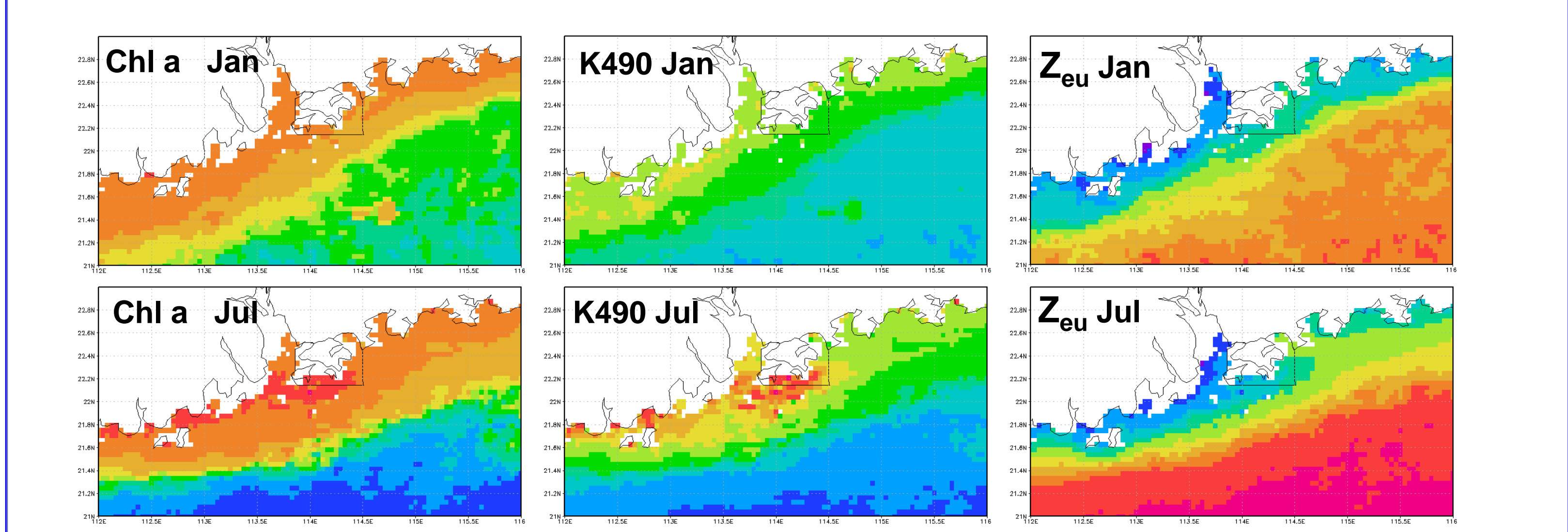


Figure 6: Sample images for monthly 4km climatology of coastal data over Pearl River Delta coastal region (Box D in Figure 2) from MODIS-Aqua for chlorophyll a concentration (Chl a), diffuse attenuation coefficient at 490 nm (K490), and euphotic depth (Zeu). Land use changes may change nutrient amount/type of the river water that could influence the coastal water quality. Monthly and 8-day ocean color data from SeaWiFS and MODIS are available in Giovanni through Water Quality for Coastal and Inland Waters project at GES DISC.

## Acknowledgments:

The project is supported by NASA through ROSES 2008 (NNH082DA001N-LCLUC). The authors wish to express great appreciation for the technical support of the Giovanni, Mirador and S4PA working groups at GES DISC.