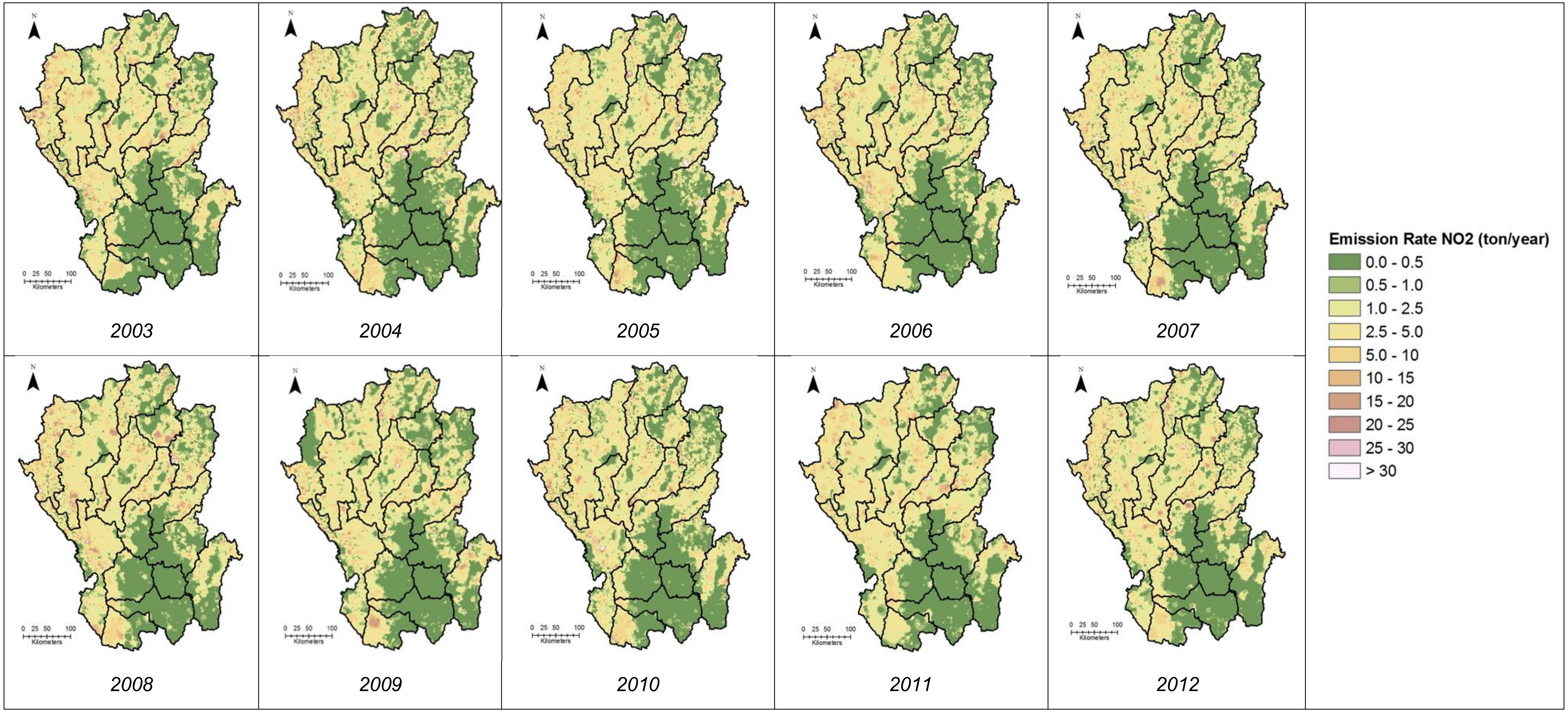

Figure 22: Maps of NO_2 emission rate in year 2003-2012

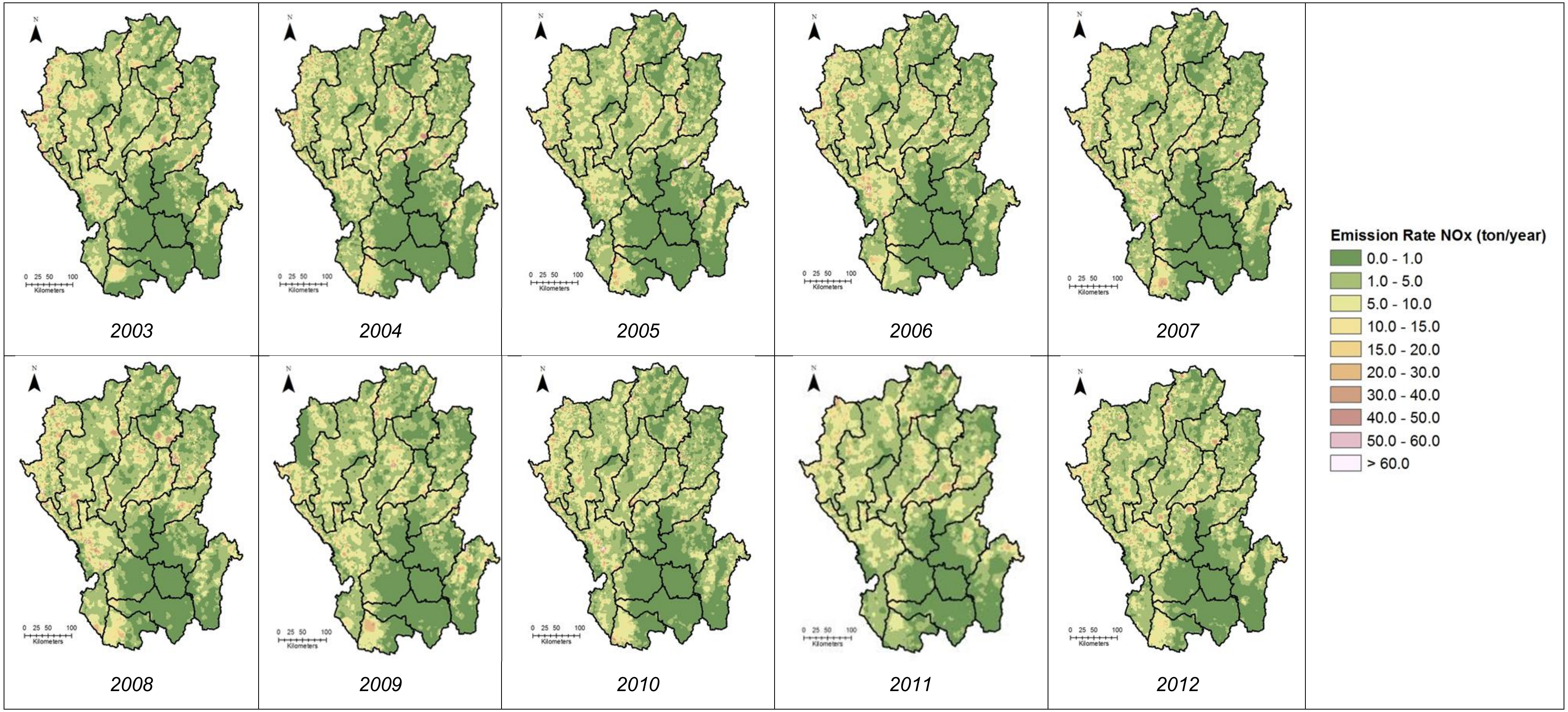

Figure 23: Maps of NOx emission rate in year 2003-2012

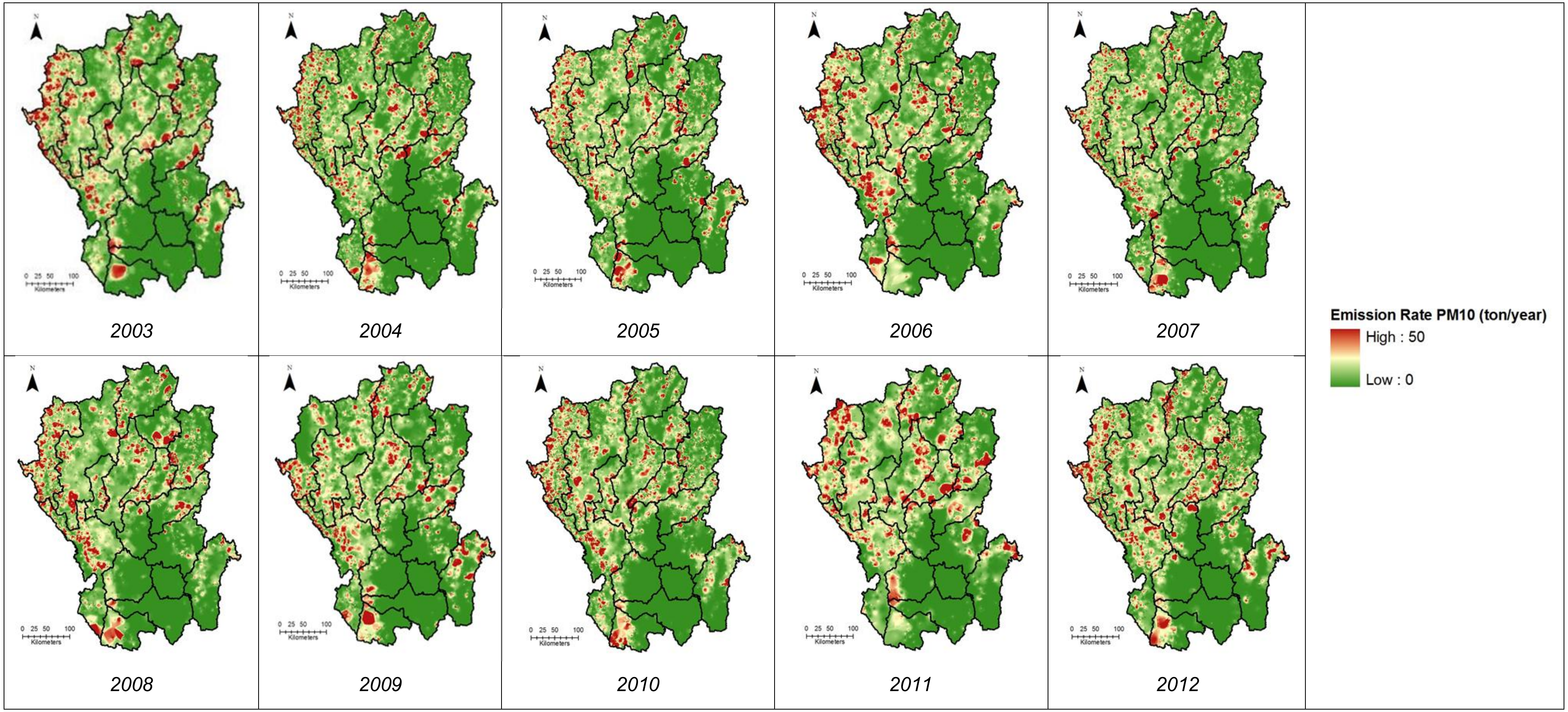

Figure 24 : Maps of PM10 emission rate in year 2003-2012

4. Develoment Geodatabase

From the results, there are many maps and attribute data need to stored and management such as hotspots fire location, burned area, fuel load, combustion factors, emission factor and maps of pollutants emission rate during 2003-2012. The geodatabase in ArcGIS format work across a range of database management system (DBMS) architectures and can work with geographic information management as well as in numerous GIS file formats. it's native data structure used for editing and data management so that's why it's be used this database type in this study.

Three geodatabase were design for stored 3 groups of datas such as Base Maps, Fire Data and Emission Data show in Figure 25.

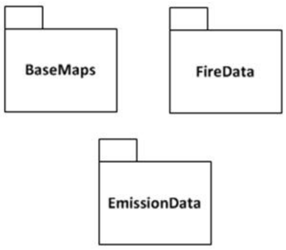

Figure 25 : three geodatabase design for 3 groups of similar data

The spatial references data such as Administrative Boundary, Landuse in year 2010 and transportation data were stored in the "personal geodatabase" file name *"BaseMaps.mdb".*

Hotspots and burned area data can store in same database because it's represented the location of burning. The geodatabase file name *"FireDatas.mdb"* was created to store the original hotspots during 2003-2012 in points shape. Burned area was generate from hotspot were added to this database and split from hotspots by Dataset name *"BurnedArea"* while hotspots stored in *"Hotspots"* dataset.

Difference in the emission data included both spatial data such as the maps of emission rate of pollutants and attribute data.of emission parameter such as fuel load value, combustion factor, emission factor and table of landuse reclassification from Land development department to landuse group to calculate and transform for the emission parameter in this study. However, the emission rate in 10 years was larger size more than 2GB can stored in personal geodatabase. The difference fire format call "file geodatabase" has been used and create the geodatabase name *"EmissionDatas.gdb"* to store the emission rate maps.(figure 26 and 27).

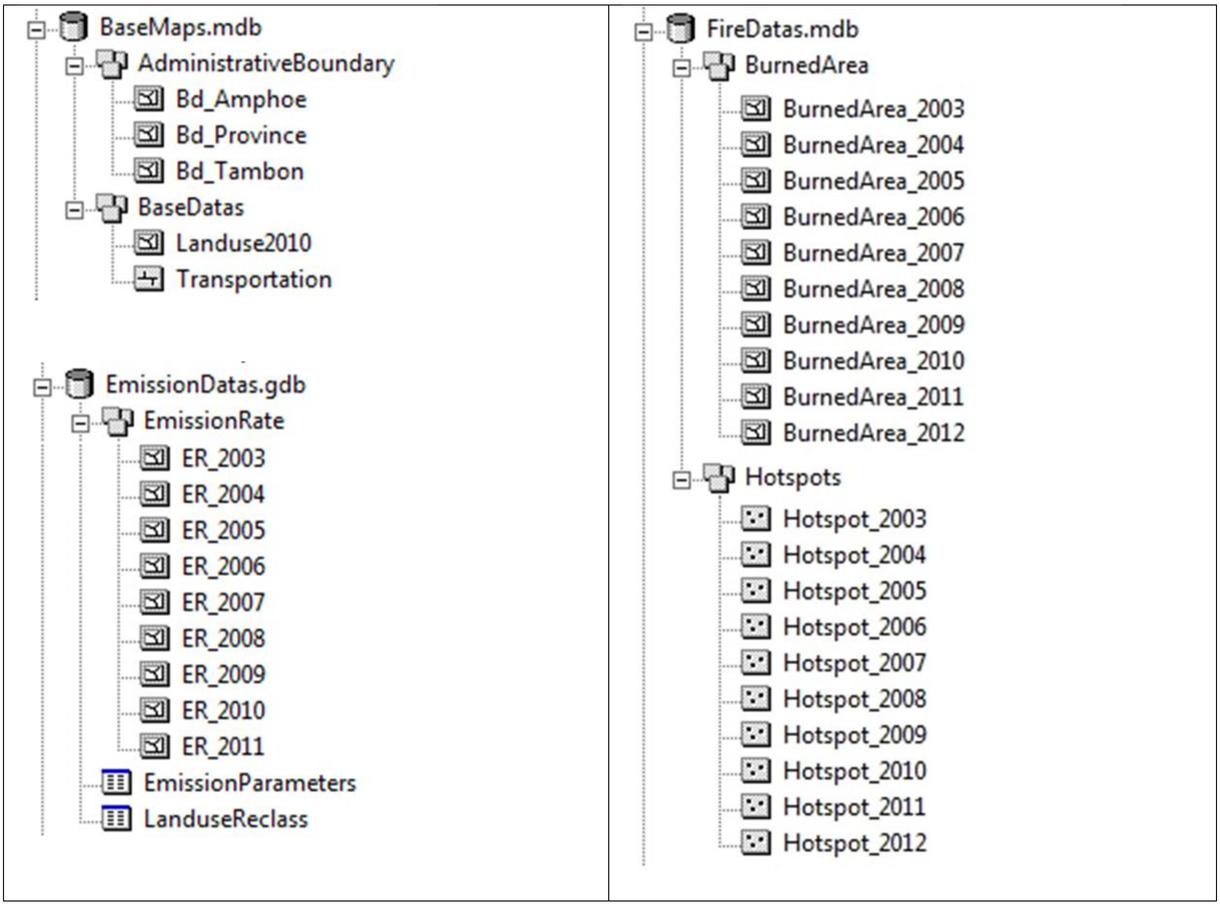

Figure 26: Show list of spatial data and attribute data includes in three geodatabases

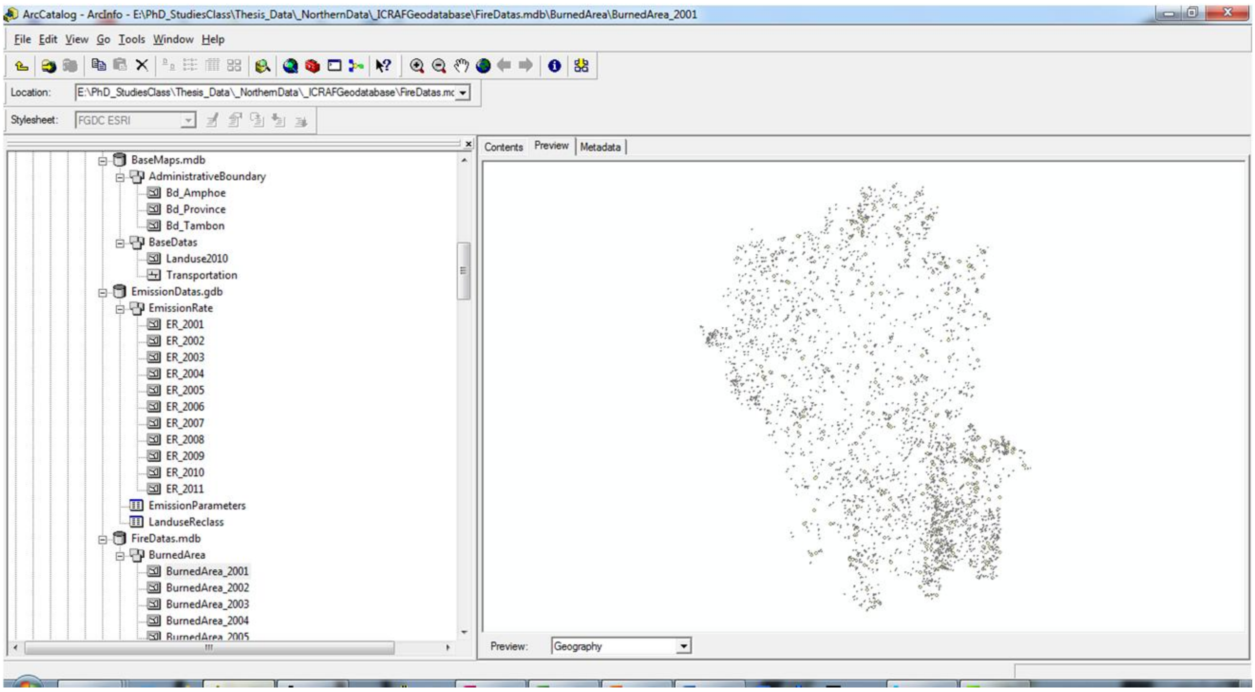

Figure 27: Show sample map of BurningArea 2001contain under BurnedArea dataset in FireDatas.mdb

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Appendix

Using some part of this study in

"Graduate Seminar in Environmental Science"

at Meeting Room 7120, 7^{th} Environmenal Science Program, Faculty of Science, Chiang Mai University, Thailand

January 11, 2013

Graduate Seminar in Environmental Science
213791-792 (2/2555)

Title : Characterization of Spatial and Temporal Distribution of Biomass Burning in Northern Thailand During 2005-2010

เรื่อง : ลักษณะการกระจายตัวเชิงพื้นที่และเวลาของการเผาไหม้ชีวมวลในภาคเหนือของประเทศไทยระหว่างปี พ.ศ.2548-2553

Speaker: Ms.Praphatsorn Punsompong (น.ส.ประภัสสร พันธ์สมพงษ์) Student code: 530551022

Date: 11/01/2013 **Time**: 13:30 – 15:00 p.m. **Place**: ScB1720

Abstract

Northern Thailand (NT) is covered by 57.8% forest and 37.4% agricultural fields which are approximately 95% of total land cover (172,061 sq.km.). About 69% of the forest area in the NT is in the upper Northern Thailand (UNT). Dipterocarp forest covers about 77.7% of total forest area, while evergreen forest covers about 17.6%. The major part of the agricultural area (64.4%)is in the lower Northern Thailand (LNT). Agricultural field consists of paddy field (48.7%), field crop (31.2%) and fallow/swidden cultivation (12.5%). Air pollution usually occurs in dry season and biomass burning has been known as a major source of smoke and pollutants in this area. Thus, In this study focuses on the aspect of distribution of spatial and temporal of biomass burning during 2005-2010. The maps were produced by adaptive hybrid method using active fire detection obtained from Moderate Resolution Imaging Spectroradiometer (MODIS), while the post-fire scars detection using Normalized Difference Vegetation Index (NDVI) function was calculated by high resolution satellite data (30 m resolution Landsat TM imagery). The results showed that this method reduced about 33.2% of overestimation of hotspot number from MODIS. The analysis of burning area distribution in 6-year period (2005-2010) revealed that the highest burned area was in 2007. The annual average of burned area accounted for 60.6% in forest and 37.0% in agricultural fields. Forest fire often occurs in February and March in UNT in mixed-deciduous and dry-depterocarp forests. Open burning in swidden cultivation and field crop areas was found to be the highest in March. In case of paddy field, the field was burnt after harvesting for second crop planting. In the LNT, the burning starts in December and reaches its peak in January and February, while in the UNT the highest number of hotspots was found in December. In conclusion, open burning pattern in NT was analyzed in terms of spatial and temporal variation and found that its pattern seems to be related with local and regional air pollution.

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……………………………………..…… ……………...............................…….

(Ms.Praphatsorn Punsompong) (Asst. Prof. Dr. Somporn Chantara)

Speaker Advisor

Characterization of Spatial and Temporal distribution of biomass burning in Northern Thailand during 2005 – 2010

ลักษณะการกระจายตัวเชิงพื้นที่และเวลาของการเผาไหม้ชีวมวล พื้นที่ภาคเหนือระหว่างปี 2548-2553

Ms.Praphatsorn Punsompong

PhD.Student of Environmental Science Program , Faculty of Science, Chiang Mai University

Asst.Prof.Dr.Somporn Chantara

Environmental Science Program , Faculty of Science, Chiang Mai University

Dr.Arisara Charoenpanyanet

Department of Geography , Faculty of Social Science, Chiang Mai University

1

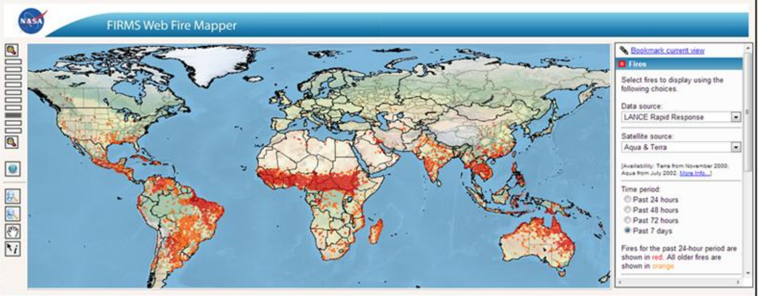
Outline

- **Introduction**
  - The problems
  - Objective
- **Materials & Methods**
  - Mapping , processing and analysis burned area
- **Results & Discussions**
  - Maps/Attribute data of total biomass burning
- **Other**
  - Conclusion
  - Future Work
  - References
  - Acknowledgement

2

Introduction

- Fire is widely used in the tropical countries
  - *Deforestation , slash and burn*
  - *Removal of excess crop residue from agricultural fields (land clearing/weed controls)*



http://firms.modaps.eosdis.nasa.gov/firemap/ : Date 15 Dec 2012

3

Introduction

- Fire is widely used in the tropical countries
  - *Deforestation , slash and burn*
  - *Removal of excess crop residue from agricultural fields (land clearing/weed controls)*

Biomass burning are *important sources of atmospheric trace gases and particulate matter*

CO_2, CO, CH_4, NO_x, NH_3, SO_2, VOCs, PM

(Dennis et al. 2002; Garivait et al, 2004; He et al,2011; Mieville et al, 2010)

Affecting in local, regional and global air quality/human health

(Chang and Song, 2009; Heil and Godammer, 2001; Ito and Penner, 2004)

4

Introduction

The gaseous emitted from open biomass burning has been widely used a standard formula

(develop by Seiler and Crutzen, 1980)

$$E(i) = A \times FL \times CC \times EF(i)$$

fire emissions (E) for a specific gas species (i)

burned area (A)

fuel load (FL), combustion completeness (CC) and specific emission factors (EF)

The total amount of burning area usually assessed by using Satellite Images data.

In all estimations - > the large uncertainties associated with inherent in burned areas

(Zhang et al,2008; Mieville et al,2010; Streets et al, 2003; Garivati et al, 2004; Vognmahadlek et al,2009)

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Introduction

In Northern Thailand

- A few measurements have been made to determine the burned area in terms of spatial and temporal distributions in local scale
- Does not have report about air pollutant estimates from open burning separately from types of vegetation land cover

Therefore

An accurate estimation of characteristics of burned areas and up-to-date information in local scale are urgently needed and remain to develop

6

Introduction

Objective

To characterize the spatial and temporal distribution and variability of biomass burning in 17 Provinces in Northern Thailand from 2005 to 2010

7

Material & Method

Development of a burned area mapping algorithm

To reduces the area that overestimate from Sattellite data and fix the burning boundary

Analysis the spatial and temporal characteristic

- Geographic Information System (GIS) was adopted for allocation & analysis
- The pattern of land cover burned area
- Seasonal variations of burning

8

Material & Method

Development of a burned area mapping algorithm

Adaptive hybrid method from 2 data sources

Hotspots time series

- Obtained from Moderate Resolution Imaging Spectroradiometer (MODIS)
- provide *GIS shapefiles* of the centroid *location of actively burning* in 1 sq.km .
- real-time active fire data

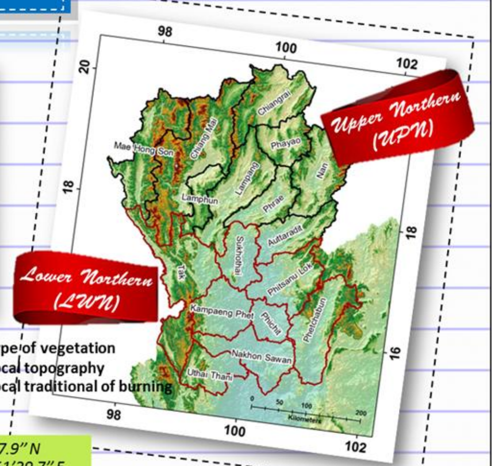
Post-Burned area boundary

- using High resolution satellite data (30 m Landsat ETM+ images)
- calculate the Normalized difference vegetation index (NDVI)
- But , Burned areas are becoming available for longer time periods

9

Material & Method

Study Domain



17 Provinces in Northern Thailand

Type of vegetation
Local topography
Local traditional of burning

latitudes 14◦51'50.1'' N and 20◦30'37.9'' N
longitudes of 97◦14'1.3'' E and 101◦51'29.7'' E

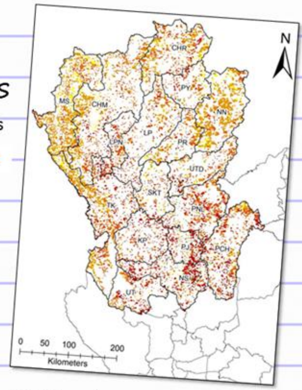
10

Material & Method

Hotspot from MODIS

Time series over 2005-2010 periods

➢ Analysis the spatial and temporal characteristic



Landsat ETM+ images

➢ path 129-132 ,row 46-50 (17 images)
➢ Year 2005-2010 were received from GISTDA*

*Geo-Informatics and Space Technology Development Agency : Northern Thailand , Faculty of Social Science, Chiang Mai University

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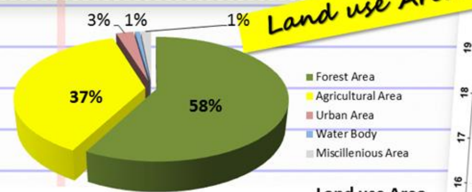
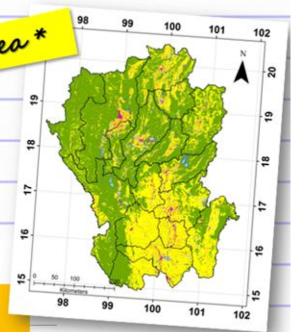
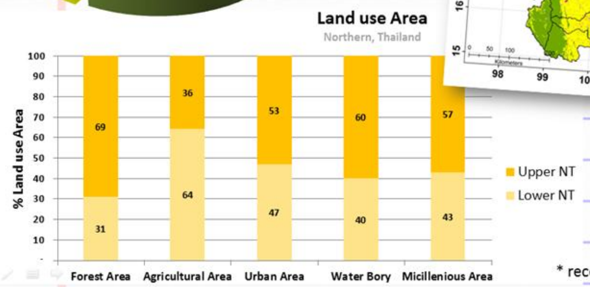
Results and Discussions

Land use Area *

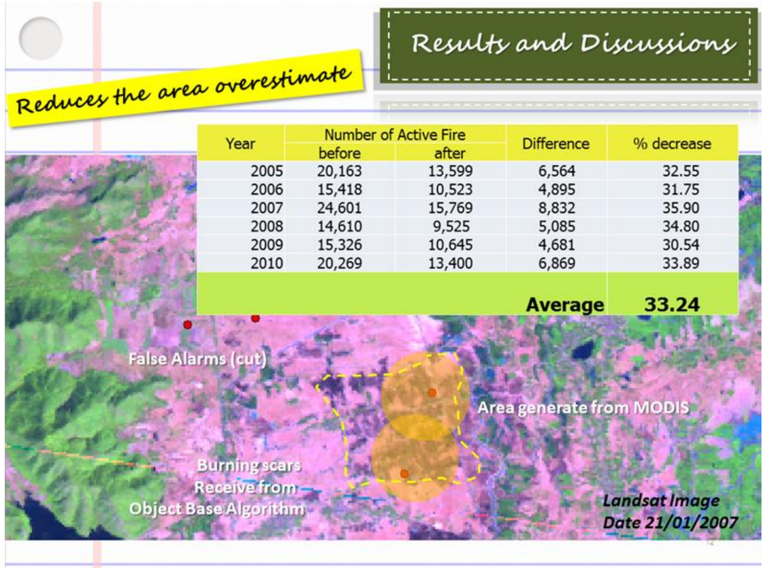






* received from GISTDA

12



Results and Discussions

Reduces the area overestimate

Year	Number of Active Fire		Difference	% decrease
	before	after		
2005	20,163	13,599	6,564	32.55
2006	15,418	10,523	4,895	31.75
2007	24,601	15,769	8,832	35.90
2008	14,610	9,525	5,085	34.80
2009	15,326	10,645	4,681	30.54
2010	20,269	13,400	6,869	33.89
			Average	**33.24**

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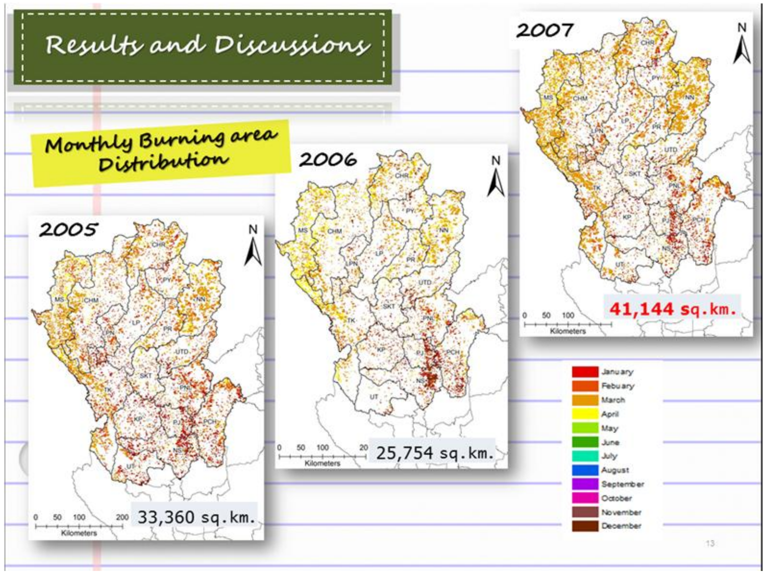

Results and Discussions

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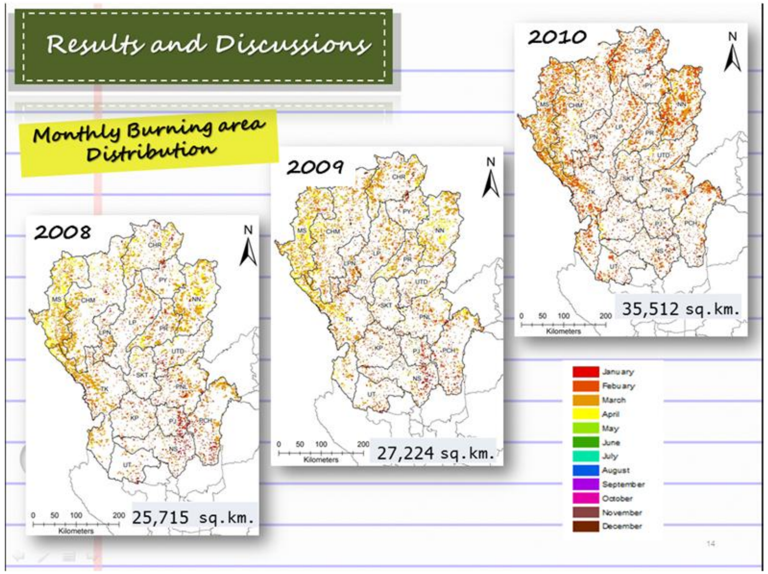

Results and Discussions

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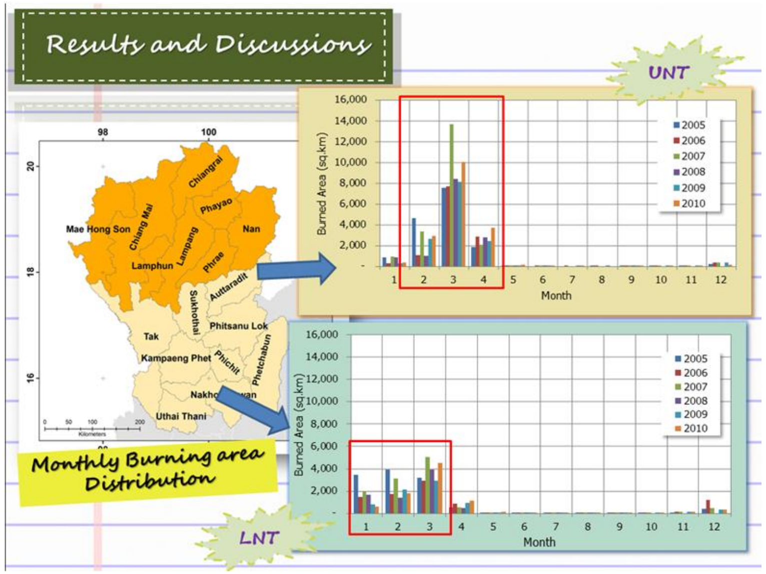

Results and Discussions

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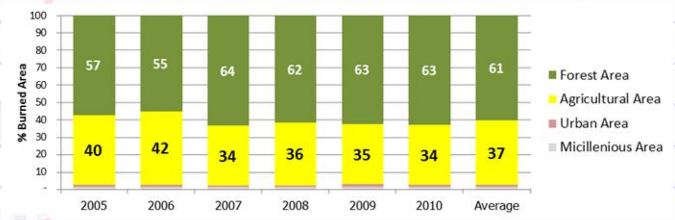
Results and Discussions

Analysis of Burning area Distribution

Year	Burned Area (sq.km)				Total
	Forest Area	Agricultural Area	Urban Area	Micillenious Area	
2005	18,006	12,593	394	361	33,360
2006	13,116	10,032	318	281	25,754
2007	24,857	13,445	428	407	41,144
2008	14,646	8,544	270	247	25,715
2009	15,778	8,766	377	294	27,224
2010	21,154	11,487	464	396	35,512



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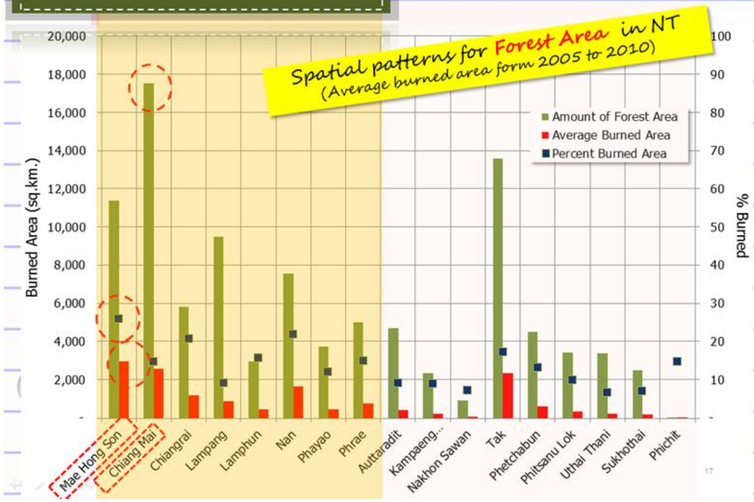
Results and Discussions



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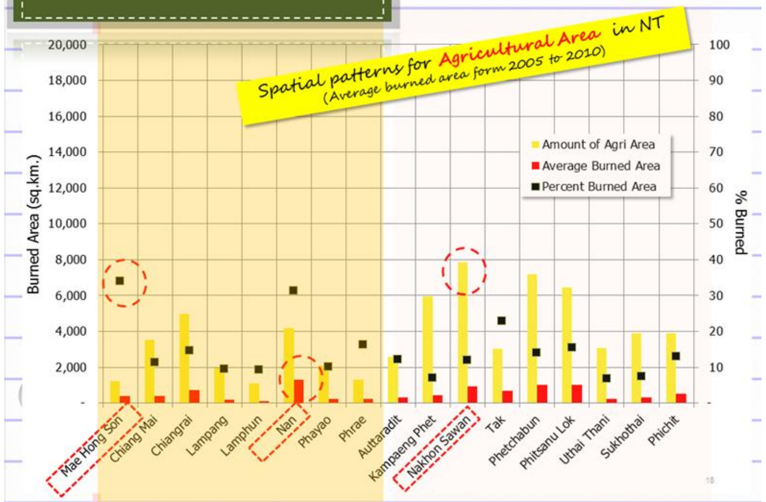
Results and Discussions



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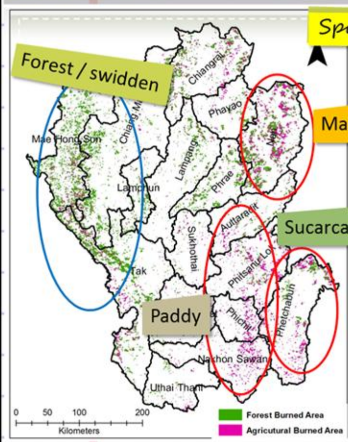
Results and Discussions

Spatial Burned Area-Overlap in NT



Annually Burned Area
F = 26.92 sq.km. (Mae Hong Son, 7.08 sq.km)
A = 11.54 sq.km. (Nan, 3.17 sq.km)

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Conclusions

Open burning pattern in NT was analyzed in terms of spatial and temporal variation

- The most important sources of burned area is Forest area.
- UNT -> Swidden cultivation was highest agricultural burned area.
- LNT -> Field crop was highest agricultural burned area.
- The peak of burning season usually occurs from December to April over the area and highest in March

related with local and regional air quality in NT

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Acknowledgement

ETM
The center for Environmental Health, Toxicology and Management of Chemical

ICRAF
World Agroforesty Center
Faculty of Social Science, Chiang Mai University

GISTDA
Geo-Informatics and Space Technology Development Agency : Northern Thailand
Faculty of Social Science, Chiang Mai University

ECRL
Environmental Chemical Research Laboratory
Faculty of Science, Chiang Mai University

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