EMISSIONS INVENTORIES FROM FOREST FIRES AND CROP RESIDUE BURNING IN THAILAND

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OUTLINE

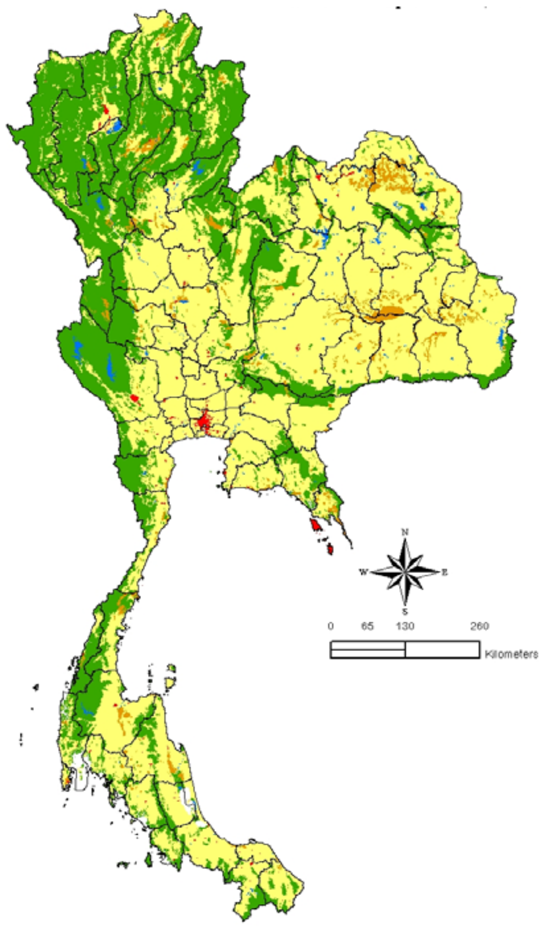
- Background & Objective
- Methodology
- Results and discussion
- Recommendation

BACKGROUND

Thailand

Total Land **514,310 km^2 (5 regions)**

- **Forestland** **183,899 km^2**
- **Cropland** **305,642 km^2**
- **Urban Area** **2,957 km^2**
- **Grassland** **17,742 km^2**
- **Irrigation Area** **4,070 km^2**



BACKGROUND

There are three majors open biomass burning activities in Thailand

- Garbage/Junkyard Burning
  - Only in Rural area/city without garbage collection system
- Crop Residue Burning
- Forest Fire

BACKGROUND

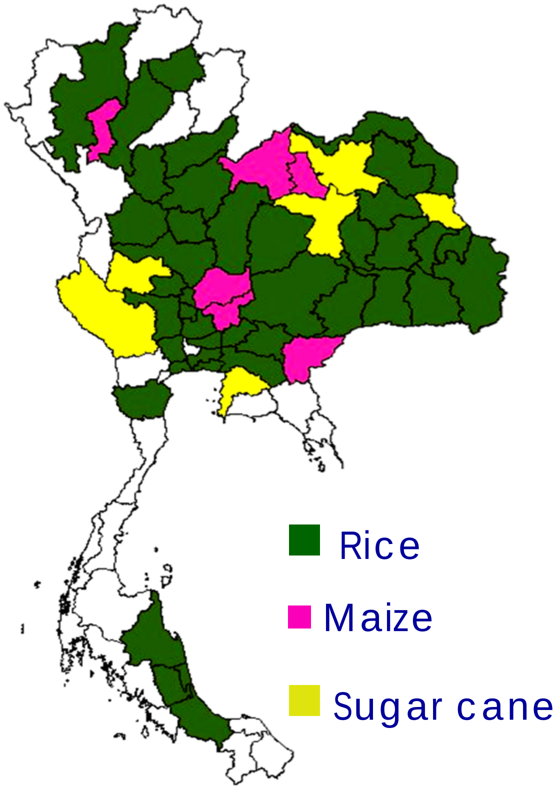
Impacts

Visibility at Chiang Mai airport when PM_{10} conc = 20 and 149 µg/m^3

Credit: Dr.Supat Wangwongwattana, Director General, Pollution Control Department, Ministry of Natural Resources and Environment

BACKGROUND

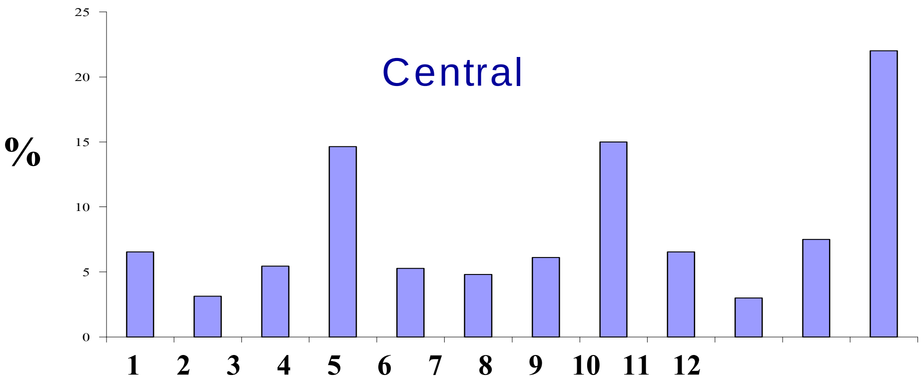
Crop Residue Burning

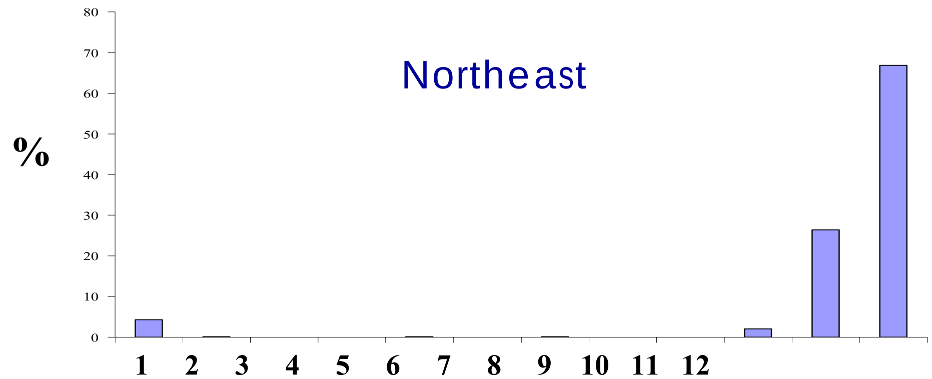


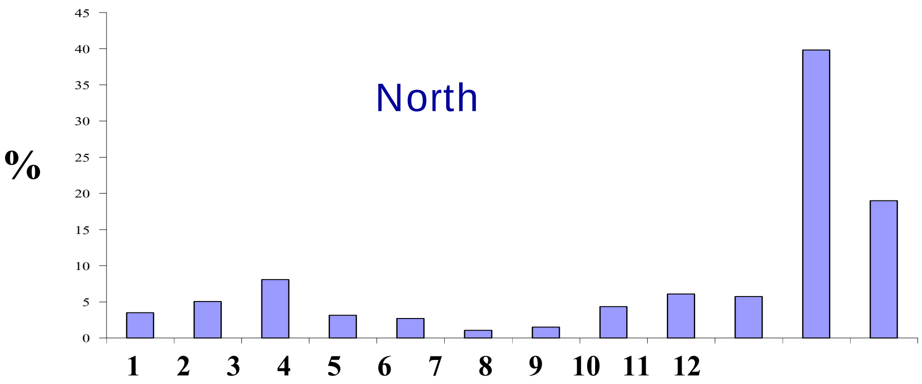
- Thailand is a major rice exporter in the world.
- The more rice production -> more crop residue -> more burning crop residue -> increase of carbon dioxide, gaseous pollutants, aerosols to our atmosphere.

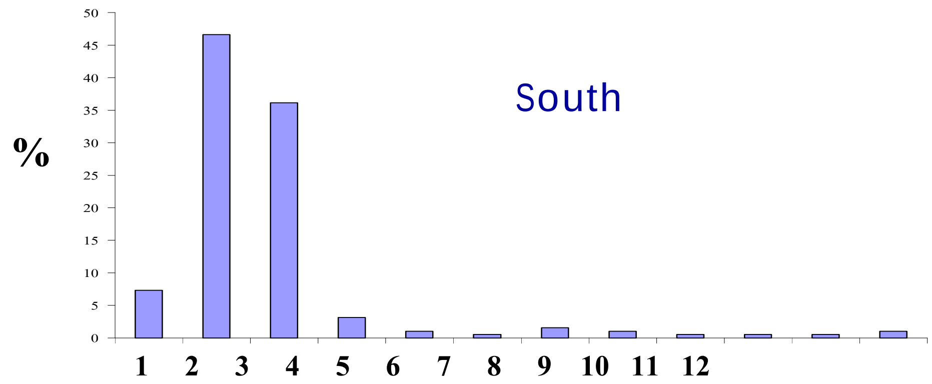
BACKGROUND

Rice: Harvesting Months



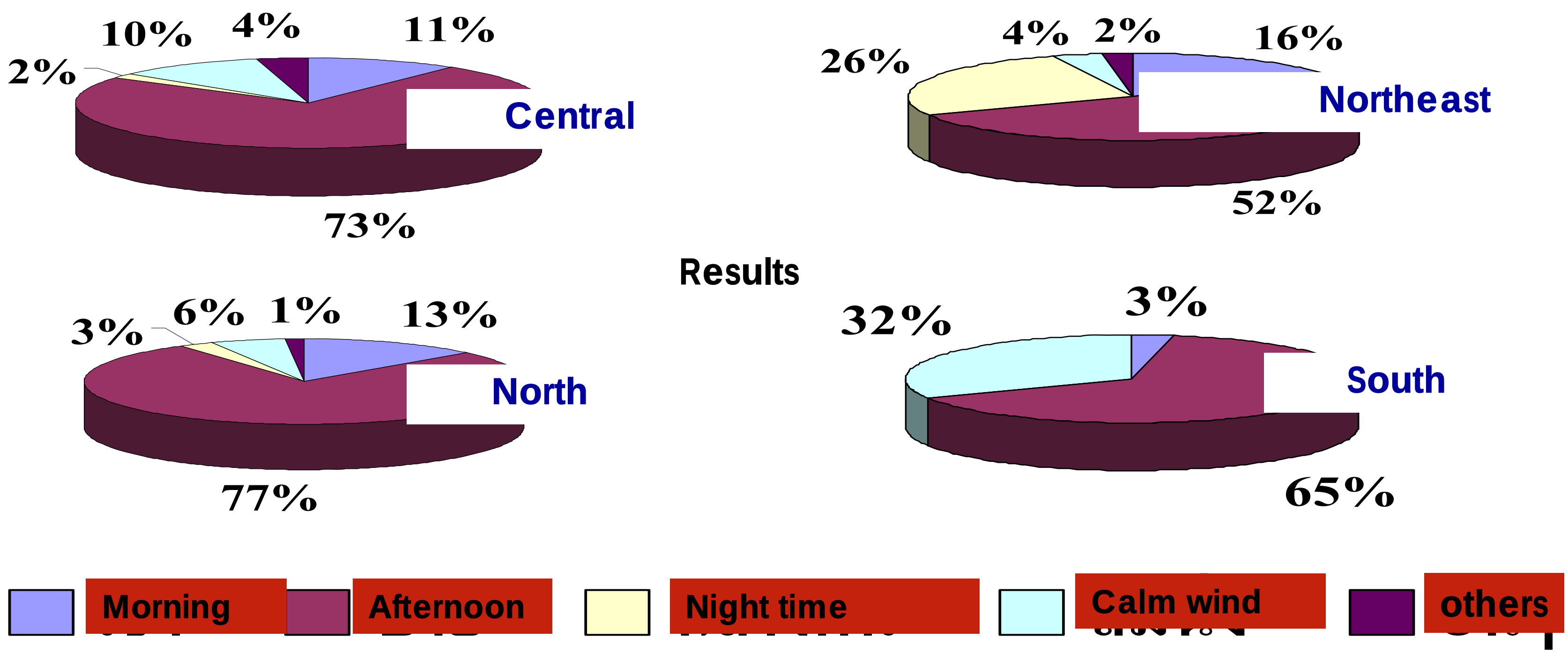






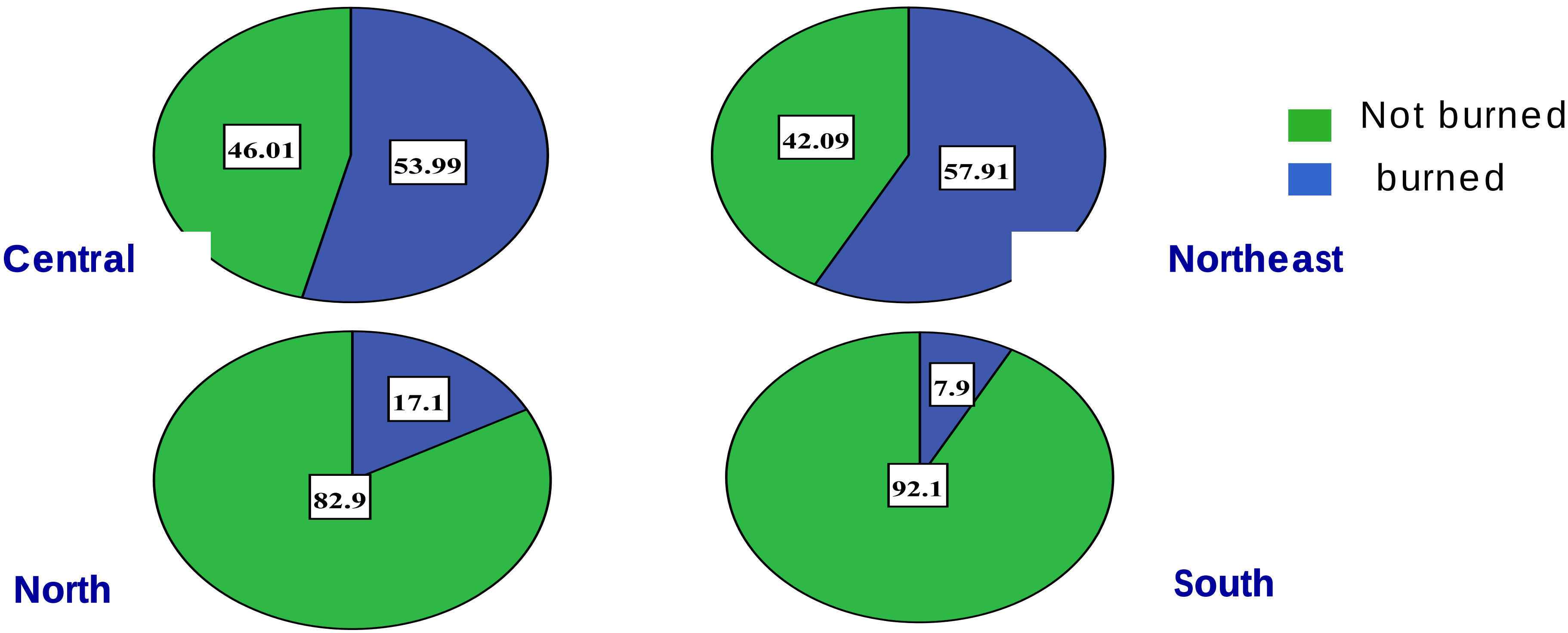
BACKGROUND

Rice: Timing for crop residue burning



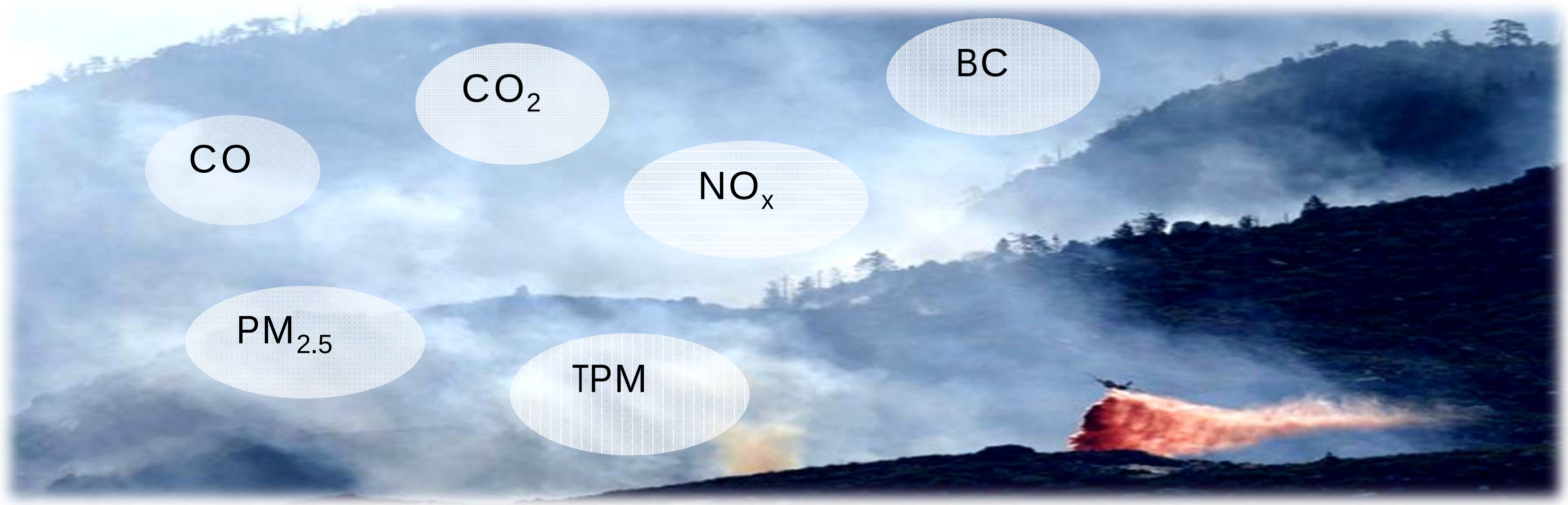
BACKGROUND

Rice: fraction of burning crop residue in field



OBJECTIVES

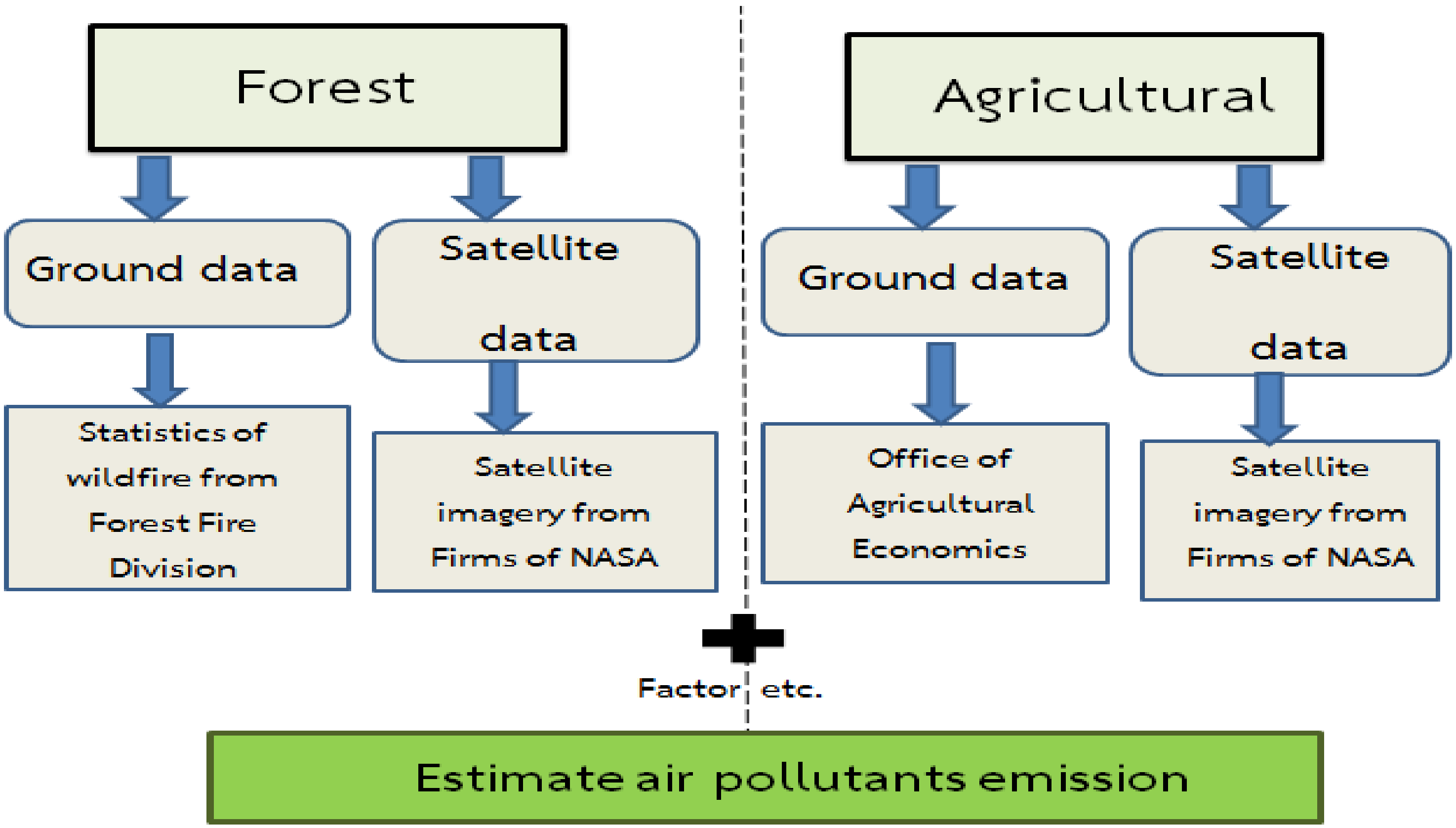
Estimate air pollutants emission from biomass open burning in agricultural area and forest fire by using the Satellite based and ground report fire data for year 2013.



METHODOLOGY

- Emissions Factor is a technique for air emission estimation.
- Two types of biomass open burning included in this calculation, i.e., forest fires and crop residue burning.
- Two sources of fire data were calculated and compared, i.e., Satellite based data, and ground based data
- Data Sources
  - Daily hotspots from Fire Information for Resource Management System (FIRMS)
  - Daily Fire information(location, started time and length of fire occurrence, type of burned forest) from ground report from Forest Fire Control Division, National Park, Wildlife and Plant Conservation Department

METHODOLOGY



METHODOLGY

Emissions Estimation

Step 1

- Estimated Biomass Burned

a) Equation for area based data

$$M = A * BL * BE$$

b) Equation for Production rate data

$$M = CP * RCR * DMF * FB * BE$$

While M = Burned Area BL = Biomass Load BE = Burning Efficiency CP=Annual Crop Production DMF=Dry Matter Fraction FB= Fraction Burned in Field

METHODOLGY

Emissions Estimation

Step 2

- Emissions Estimation

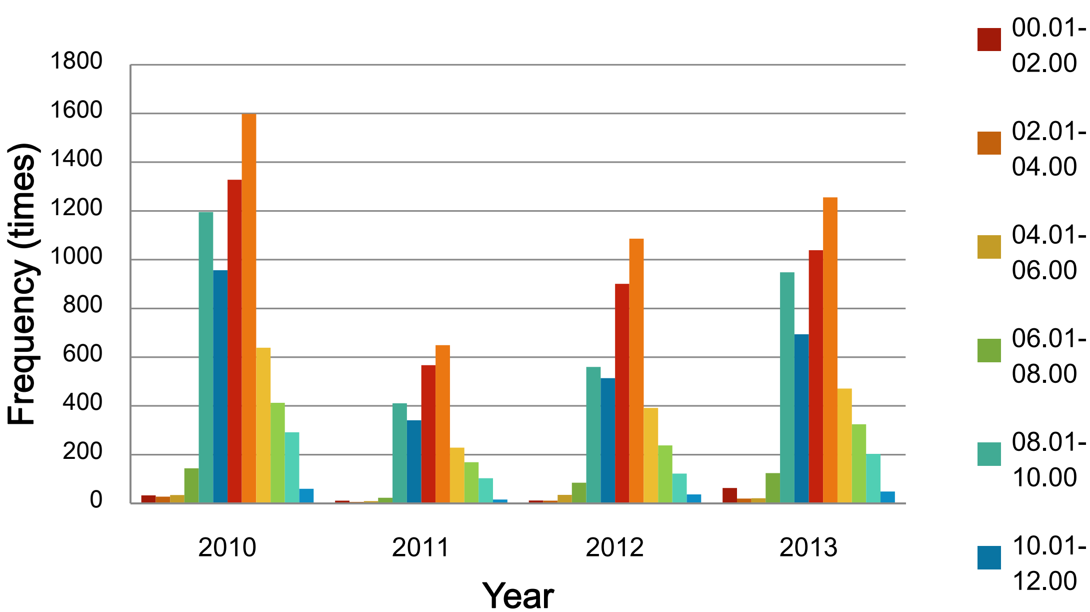
$$E_i = M * EF_i$$

While E_i = Emission of air pollutant species I M = Burned Area EF_i = Emission factor

RESULTS AND DISCUSSION

- Forest Fires statistics from ground report from 2001-2003

  Hourly Statistics



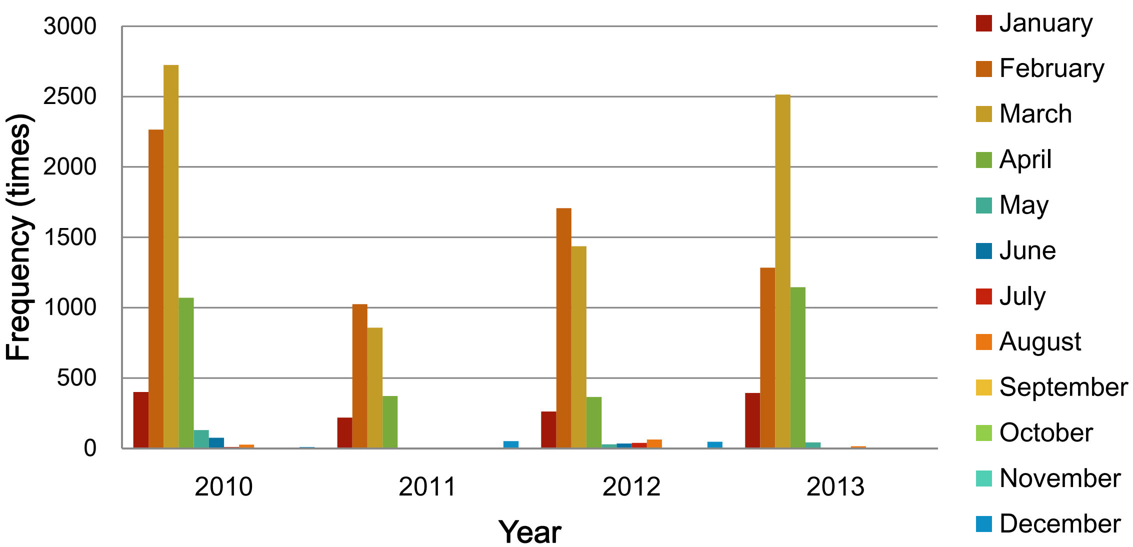
Fires usually occurs around noon time and afternoon. The peak time for fires was from 14:01-16:00, followed by 12:01-14:00 and 08:01-10:00, respectively

AQUA & TERRA overpass is about 10:30 and 14:30

RESULTS AND DISCUSSION

- Forest Fires statistics from ground report from 2001-2003

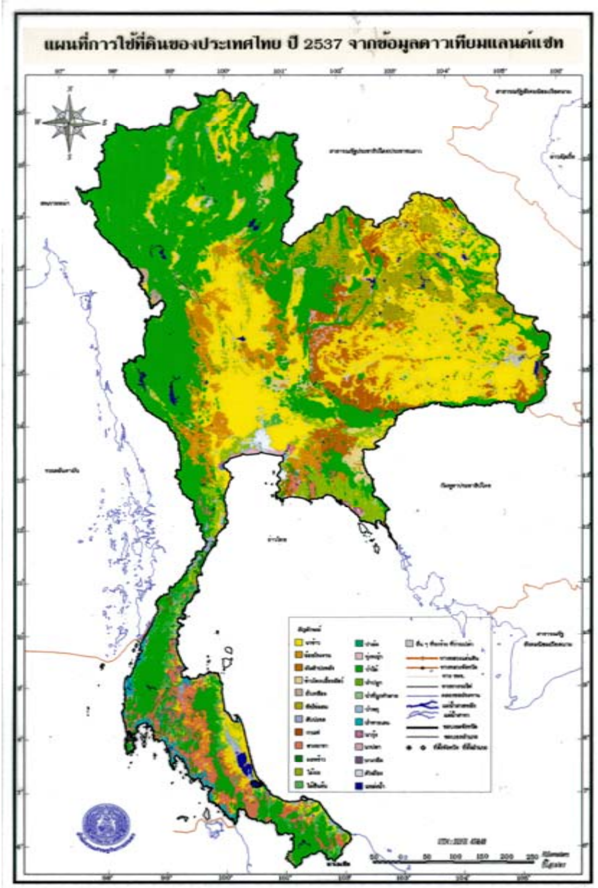
  Monthly Statistics

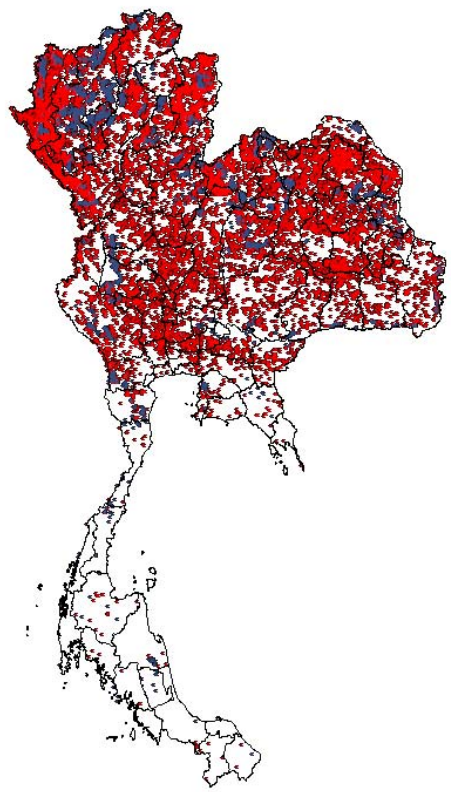


Fires were frequent detected started from late winter to summer season. March was the month of highest frequency, followed by February, and April, respectively.

RESULTS AND DISCUSSION

Comparison between Fire data from Satellite and ground based data in 2013





Red: Satellited Based Fires
Blue: Ground Based Fires

Important Notice!
Ground report could notified fires only in accessible area
Satellite based could detect hotspot in agricultural area and Inaccessible area

RESULTS AND DISCUSSION

Comparison between Fire data from Satellite and ground based data in 2013

Satellite Based

- detected 18,528 times(confident level > 66 %)
- 8686 sq km^2 in forest area(4.8% of forest area in Thailand) and 6920 km^2 in agricultural area

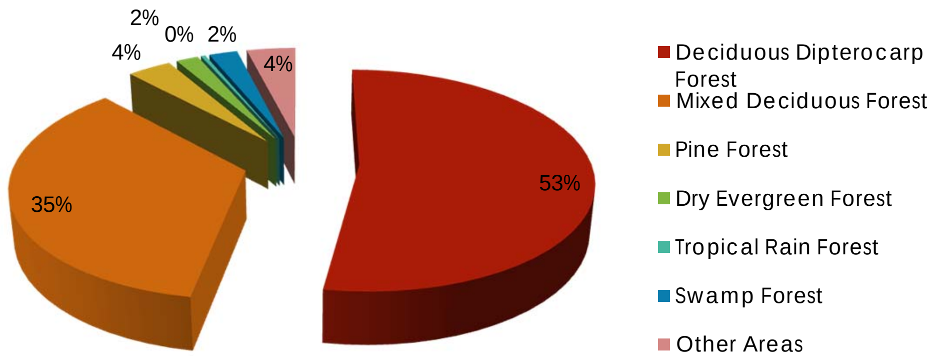
Ground Report(Forest Fire only)

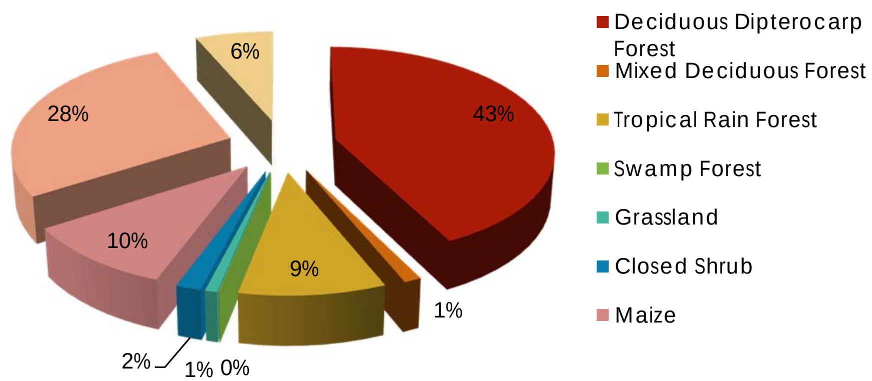
- detected 4,604 times , total burned area 90.72 sq km^2(0.05 % forest area in Thailand)
- **Important Notice!** Average of burned area for forest fire was 0.02 sq km^2 which is about 5 times less than 1 km^2(rough estimated for burned area from hotspot)

RESULTS AND DISCUSSION

Comparison between Fire data from Satellite and ground based data in 2013

Frequency classified by Landuse Type





Ground Based Fires

Satellited Based Fires

RESULTS AND DISCUSSION

Comparison between Fire data from Satellite and ground based data in 2013

Statistics by region **Northern > Northeastern > Central > Eastern > South**

Regions	Ground Data (times)		Satellite Imagery (times)	
	Forest Fire	Agriculture	Forest Fire	Agriculture
North	3,236	-	6,447	2,869
Northeast	900	-	1,433	2,999
Central	385	-	727	856
East	48	-	65	195
South	35	-	14	1
Total	4,604	-	8,686	6,920

RESULTS AND DISCUSSION

- **Estimated Air Emissions from Forest Fire**

Species of Pollutants	Emissions (tons/year)	
	Satellite Imagery	Ground Data
Carbon Monoxide (CO)	36,324,809	49,278
Carbon Dioxide (CO_2)	61,596,875	723,199
Nitrogen Oxides (NO_x)	2,417,585	2,111
$PM_{2.5}$	283,918	6,646
Black Carbon (BC)	-	-

*Important Notice: Emissions from Satellite based >> Ground Based due to very high estimated burned area and double number of fires count

RESULTS AND DISCUSSION

- **Estimated Air Emissions from Crop Residue Burning**

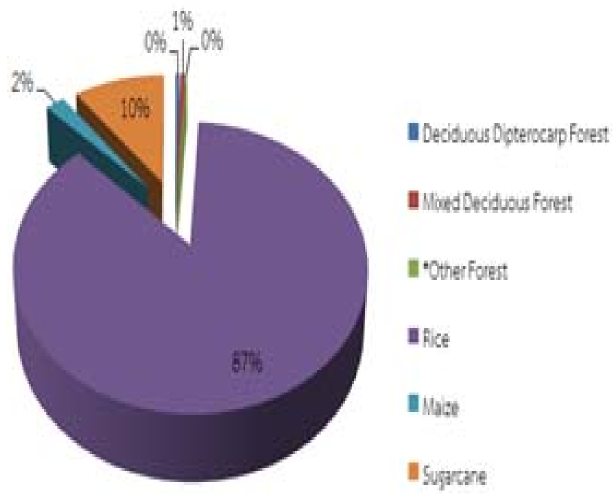
Species of Pollutants	Emissions(tons/year)	
	Satellite Imagery	Ground Data
Carbon Monoxide (CO)	1,003,672	6,950,000
Carbon Dioxide (CO_2)	10,405,734	61,700,000
$PM_{2.5}$	196,402	1,630,000
Black Carbon (BC)	6,200	35,500

For Comparison: CO Emissions from crop residue burning in 2004 from National GHG emissions inventory = 4,383,000 tons/year

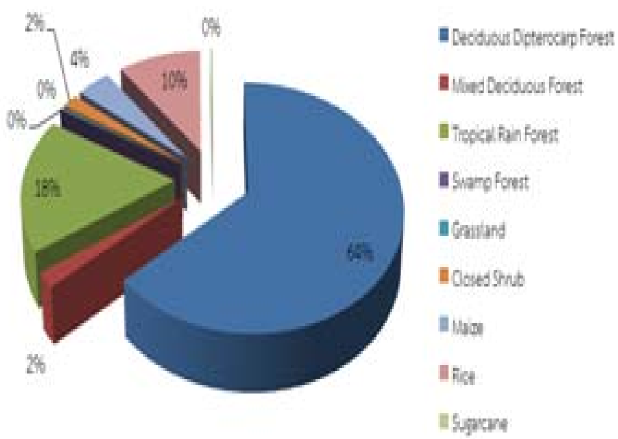
RESULTS AND DISCUSSION

- **Major sources of Air Pollutants: CO_2**

  •Rice straw Burning was a major sources from ground based estimation While Satellite based indicated that Deciduous Dipterocarp forest was the highest Released sources, followed, and Tropical Rain Forest,and Rice Straw Burning.



Ground Based Fires



Satellite Based Fires

RESULTS AND DISCUSSION

- **Major sources of Air Pollutants: $PM_{2.5}$**

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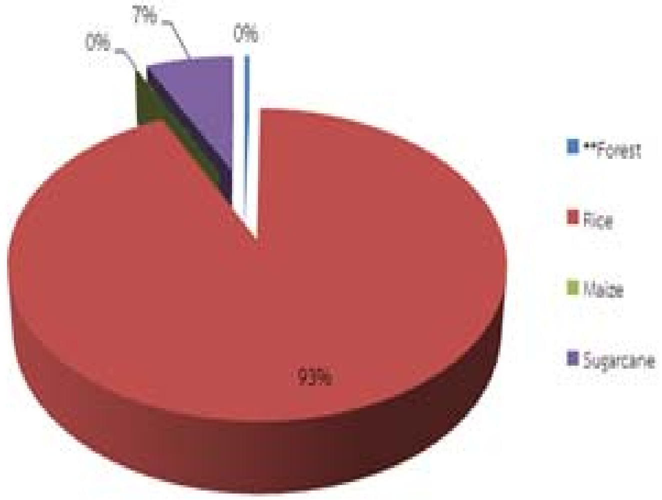
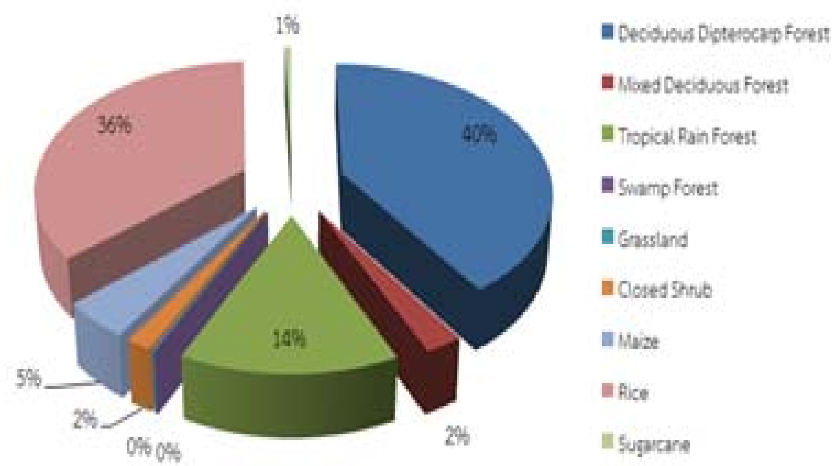


Ground Based Fires



Satellite Based Fires

FUTURE WORK

- **Special Thanks for Gwangju Institute of Science & Technology, S.Korea for funding.**
- **Future work:**
  - **Prepare daily gridded emission for evaluation with chemical transport model**
  - **Recalculated burned area from MODIS burned scar and compare with these calculation**