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FOREST FIRE INFORMATION SYSTEM (FORIS)
(Forest fire early warning method)

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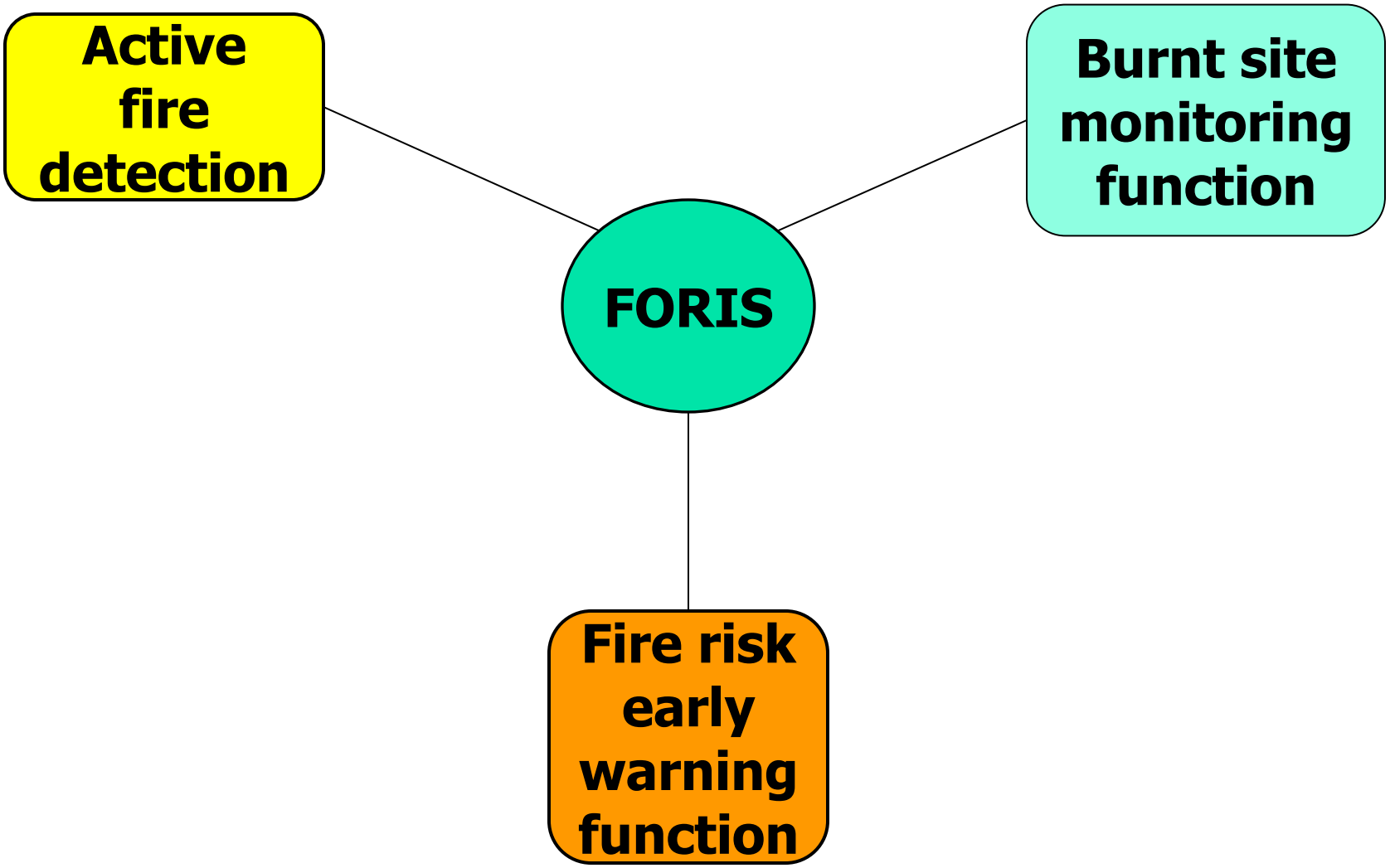
Problem addressing

- Vietnam spans an area of forest around 13.9 million ha.
  - 10.4 million ha of natural forests
  - 3.5 million ha of forest plantations
- From 1992 to 2008:
  - Around 1170 forest fire each year
  - Lost 6234 ha of forest each year
- Actual needs:
  - Forest fire monitoring
  - Forest fire early warning

Existing forest fire information system

- Firewatch:
  - Installed Forest Protection Department (**FDP**), Ministry of Agriculture and Rural Development of Vietnam (www.kiemlam.org.vn/FireWatchVN).
  - Hotspot detection: Hotspots derived from MODIS and NOAA sensors.
  - Forest fire risk warning:
    - Meteological variables are collected for analysis of a forest fire danger levels across the country using Nesterop algorithm.
    - The fire danger rating that is made available in rural areas.

Project objectives



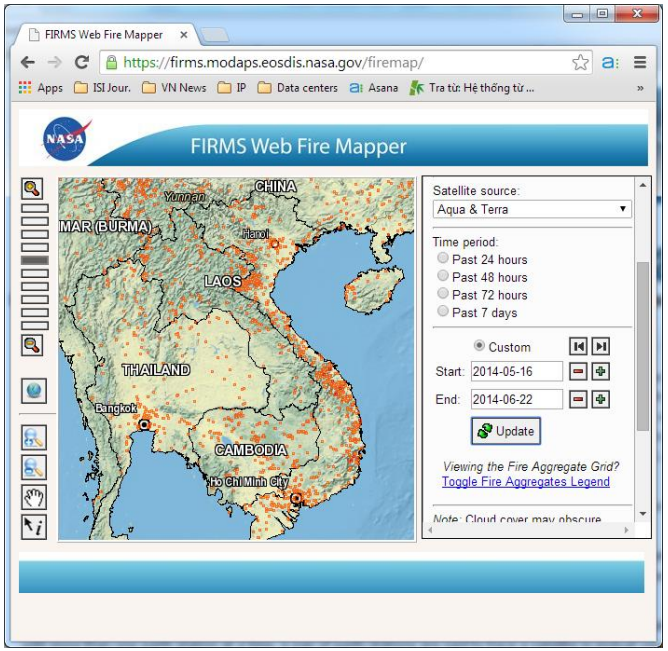
Fire detection

EOSDIS
NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM

FIRMS, Near real-time

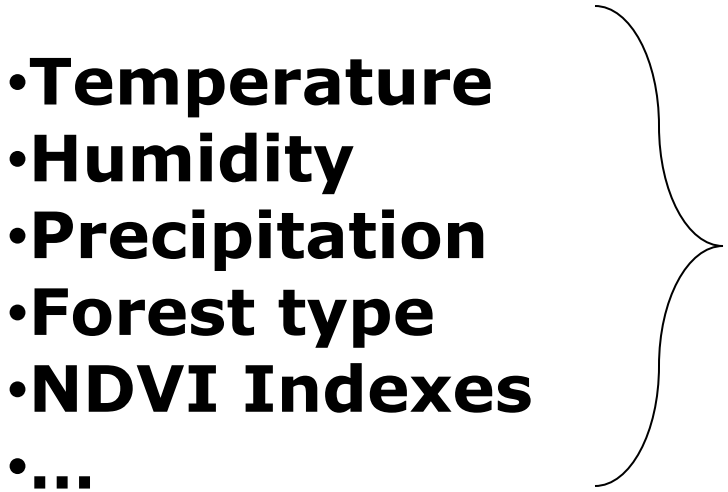
IPOPP, Real time

Active fire database



Fire risk early warning method

- To find the **mapping** from observed variables into danger levels at every spatial location of Vietnam regions.



Level 5	Dramatically danger of strong forest fire in large scale with quick spreading
Level 4	Very danger of forest fire
Level 3	Danger for forest fire
Level 2	
Level 1	

Steps for forest fire early warning method

1. Make complete meteological field data from ground-based point data and cloudy MODIS data

2. Find the correlations among:
- **Temperature field**
- **Humidity field**
- **Precipitation field**
- **NDVI**
- **Forest types**

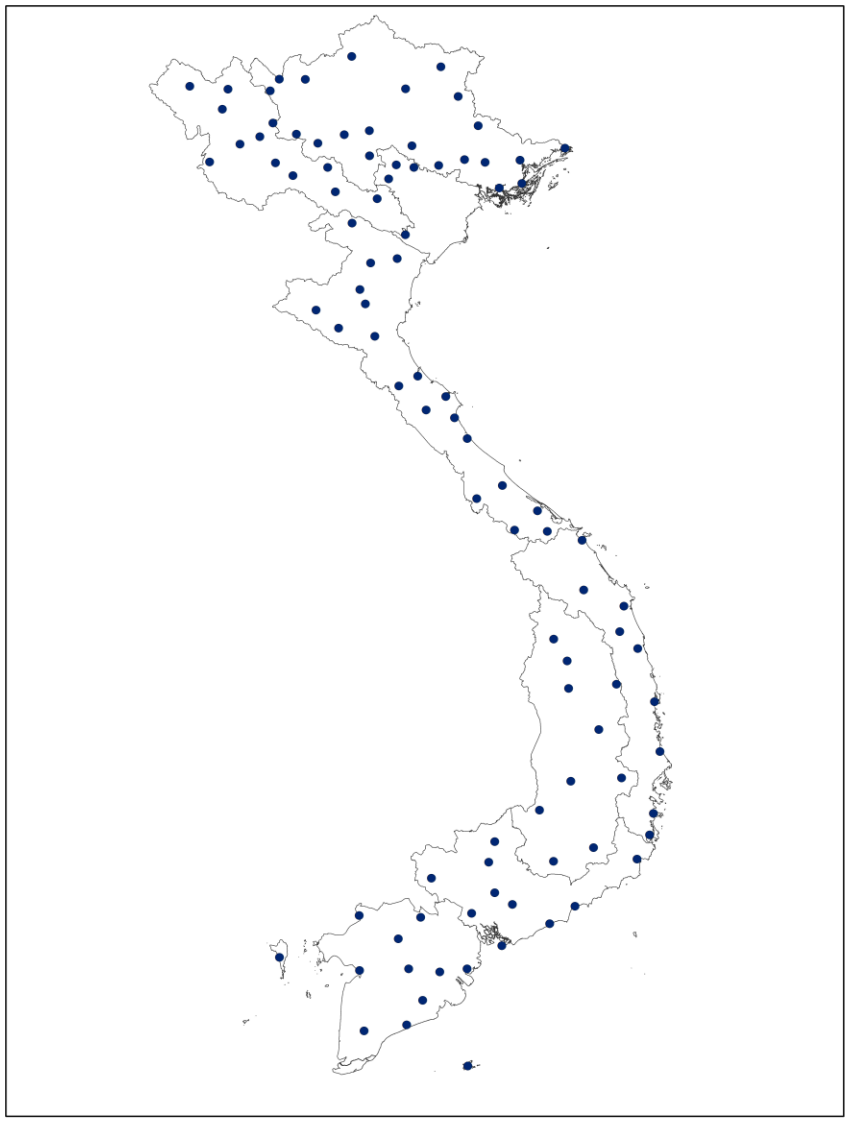
To Active Fire products

3. Based on the found correlations from previous steps, construct the mapping to levels of forest fire warning.

Fire early warning method - Data

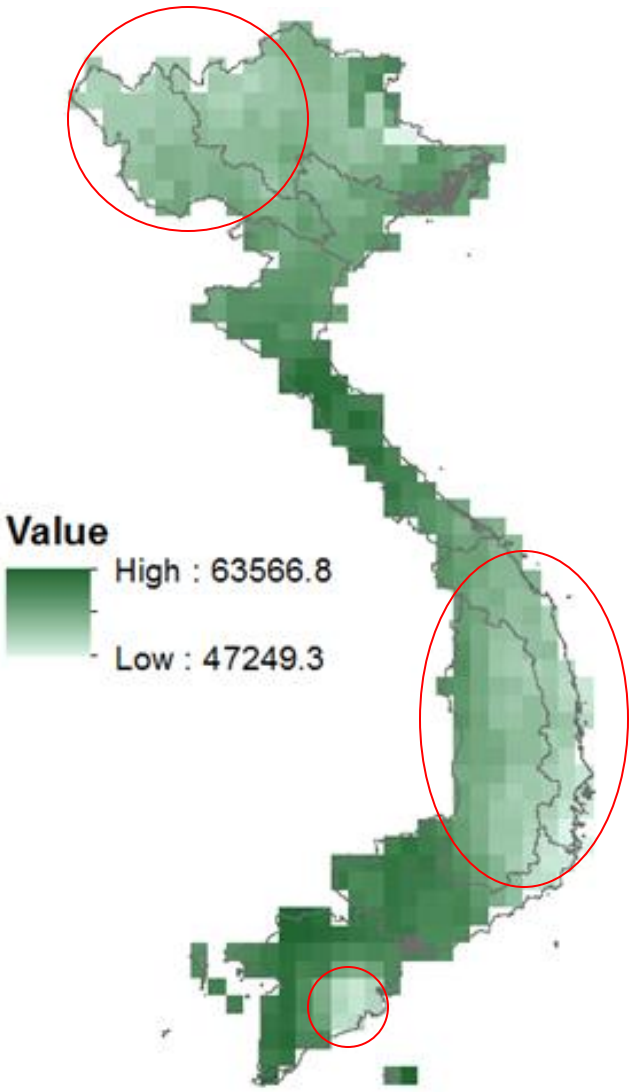
- Ground station meteology (Point data)
  - Temperature
  - Humidity
  - Precipitation
  - *From national centre for hydro – meteorological forecasting*
- Satellite meteology
  - MODIS - MOD07, MYD07: Field data with 90% missing data due to cloud.
  - Tropical Rainfall Measuring Mission (TRMM)
- NDVI map: MODIS – Mod13
- Forest type: Land use map
  - From Forest Protection Department

Ground based meteology point data



- Nearly 100 meteology stations:
  - Temperature (13:00PM)
  - Humidity (13:00PM)
  - Precipitation (1:00AM, 13:00PM)
- Daily update
- Data from 2000 to now

Precipitation (TRMM)



- Tropical Rainfall Measuring Mission (TRMM)
  - 3 hours update
  - 0.25° grid
- Two lowest rainfall rate regions are corresponding to peak burning regions Northwest and in Central Highlands

Forest types

- Nearly 20 types of forest:
  - Mixing salt-marsh forest
  - Timber bamboo mixing forest
  - Bamboo forest
  - Speciality reforest
  - (Half) exfoliation forest
  - Recover forest
  - Reforest
  - Average IIIA2 forest
  - Poor IIIA1 forest
  - Rich IIIA3 forest
  - Coniferous forest
  - Broad-leaf coniferous mixing forest
  - …

Forest fire statistics

Temperature variable verification

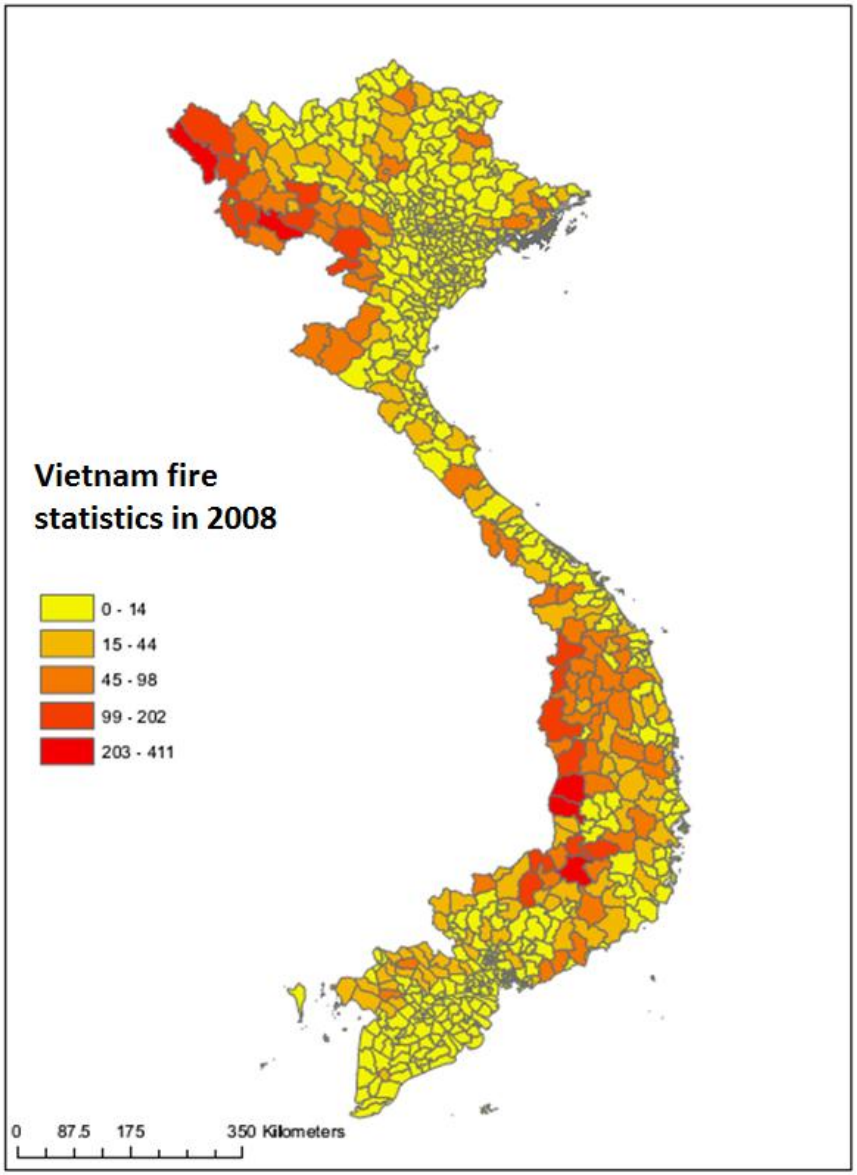
Temperature interpolation and assimilation

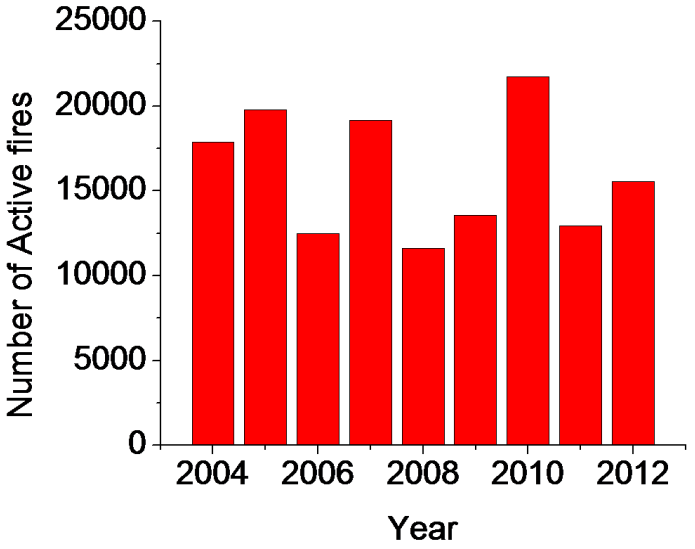
TRMM verification

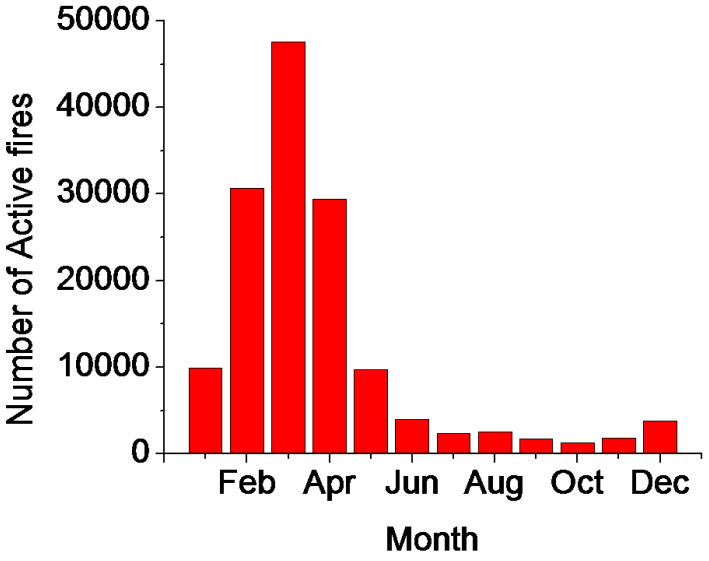
Correlation **TRMM**, **Forest type** to **Active Fires**

SOME RESULTS

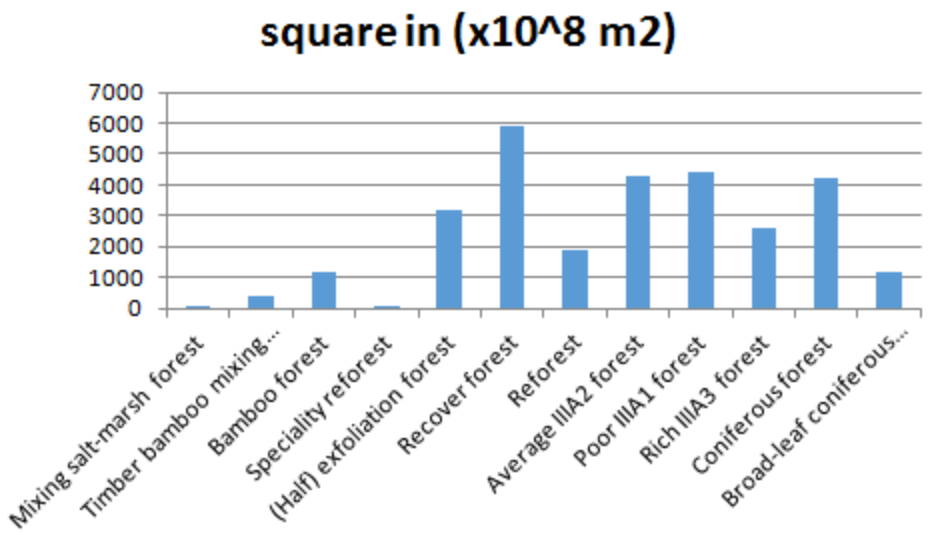
Vietnam forest fire statistics (spatial & temporal)

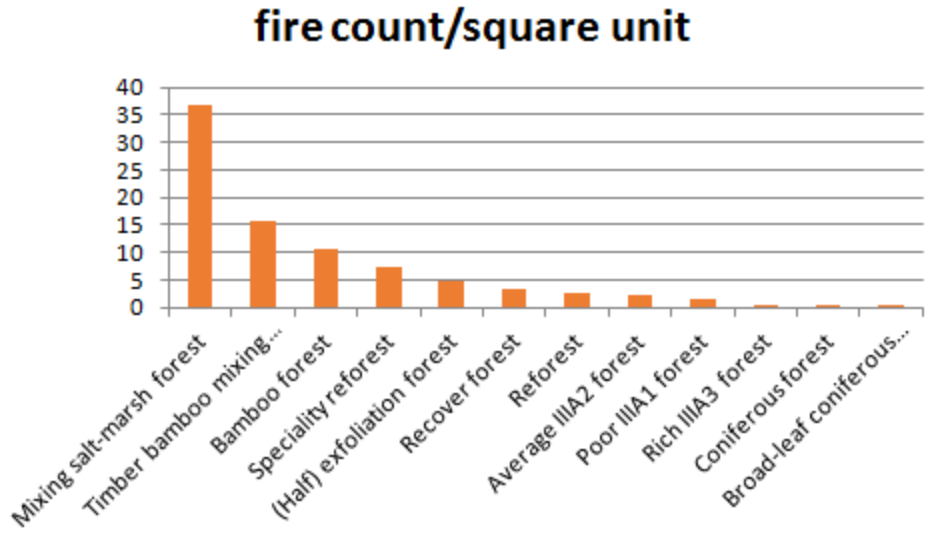






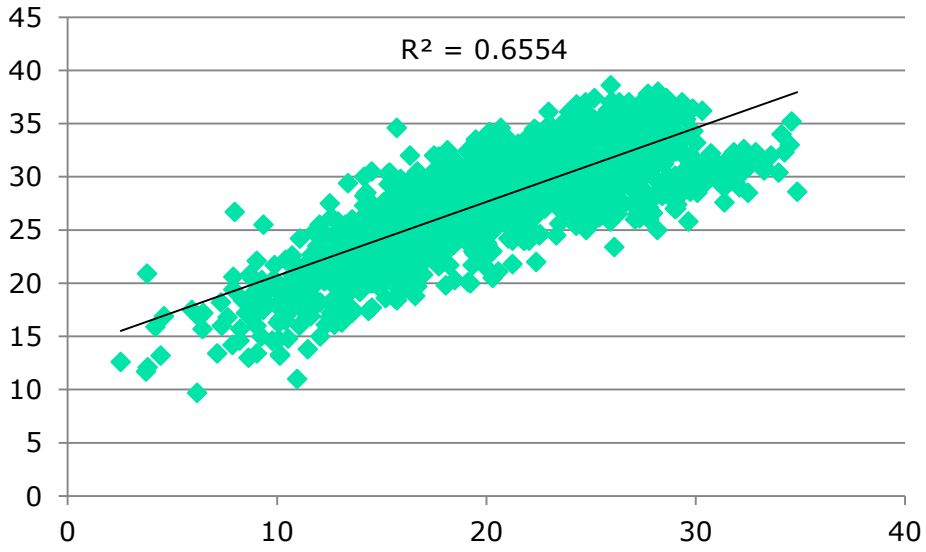
Vietnam forest fire statistics (Forest type)





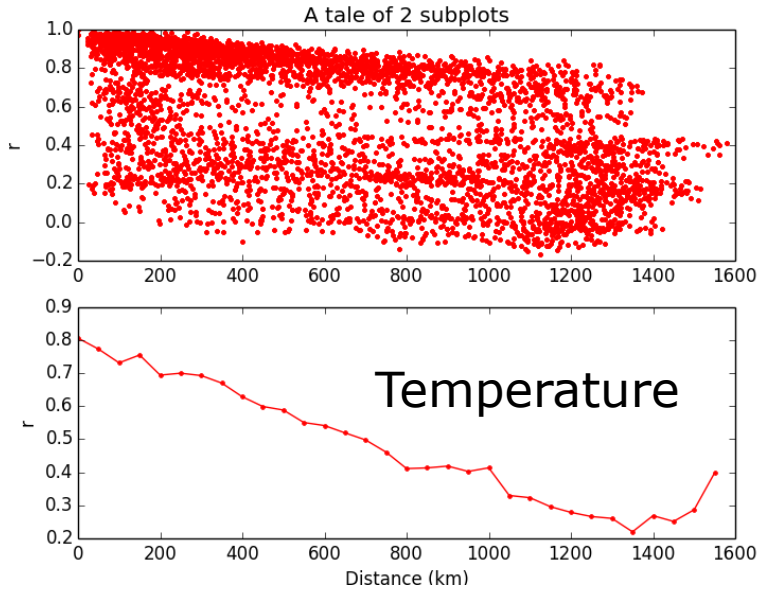
- The above graph shows the total land square covered by each forest types.
- The below graph shows number of fires occurs per square unit of each forest types. Forest type easily to catch fire:
  - Mixing salt-marsh forest
  - Timber bamboo mixing forest
  - Bamboo forest
  - Speciality reforest
  - (Half) exfoliation forest
  - Recover forest

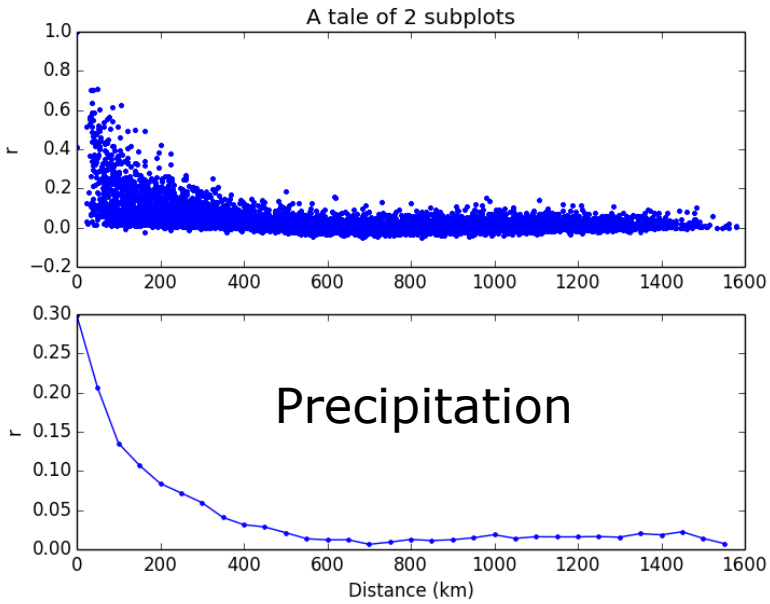
Temperature verification

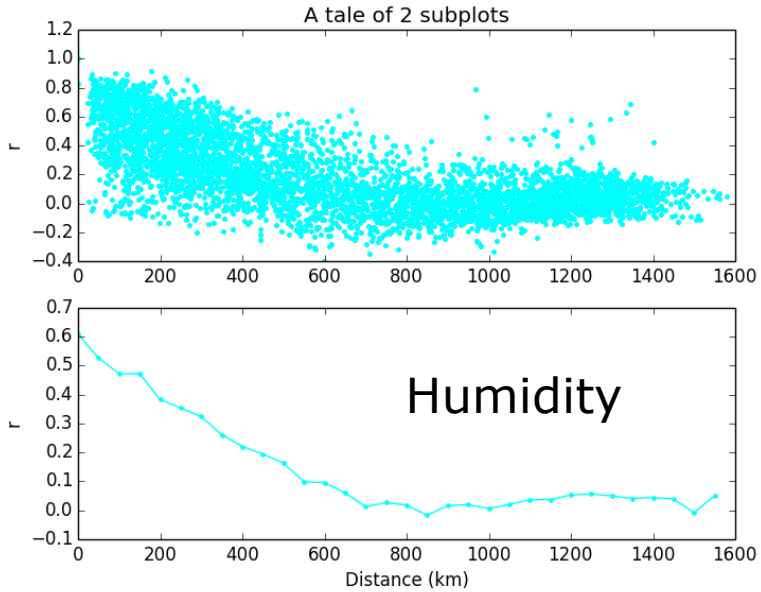


- We find the correlation between temperature ground-based point data with cloudy MOD07/MYD07 surface temperature.

Spatial correlation of ground-based meteological data

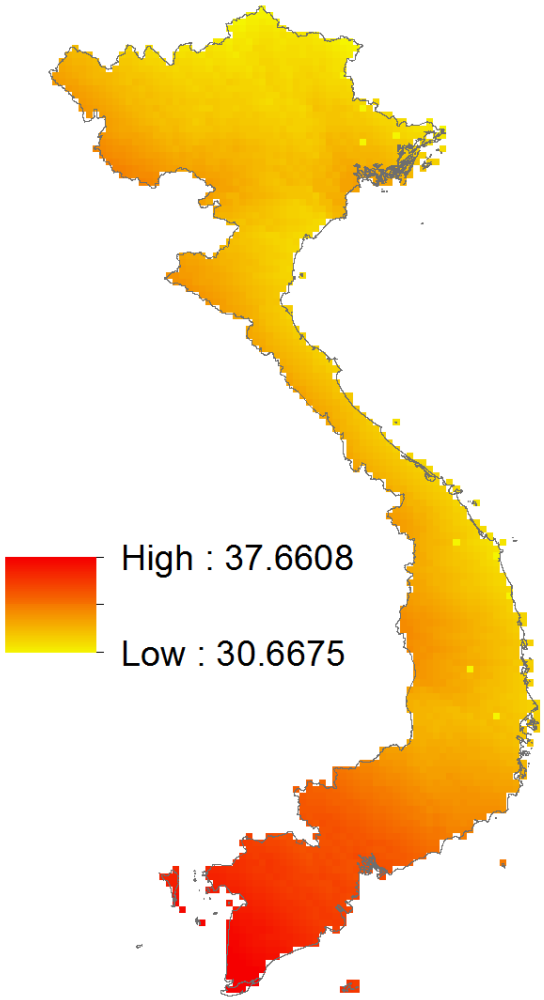


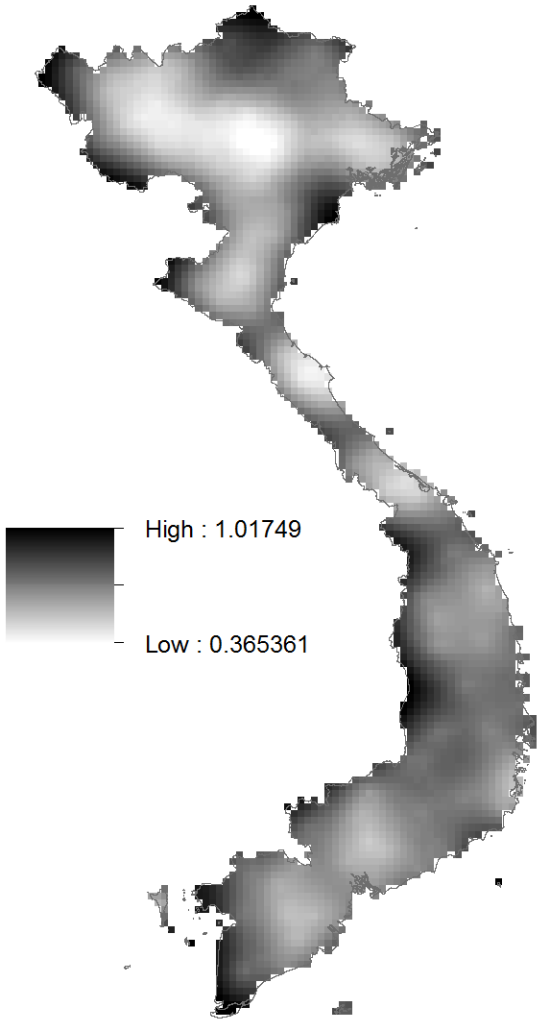




- **Temperature**: High correlate at long distance (800km).
- **Humidity:** Correlation reduce faster than Temperature
- **Precipitation:** Significantly drop when distance increase

Temperature interpolation and assimilation





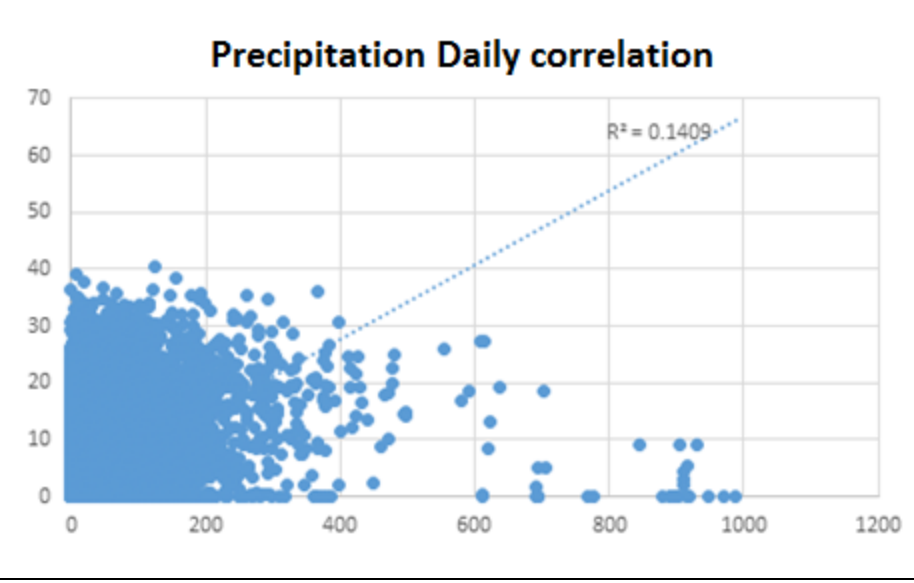
- **Temperature fields for Vietnam region** are generated with accuracy of ±3° celsius with 10-fold verification.
- **Surface_temperature** of MOD07/MYD07 product does not increase the accuracy of krigging interpolation.
- After carefully verification, we may release our temperature field at any spatial resolution for public usage.
- The same techniques will be done with **moisture**.

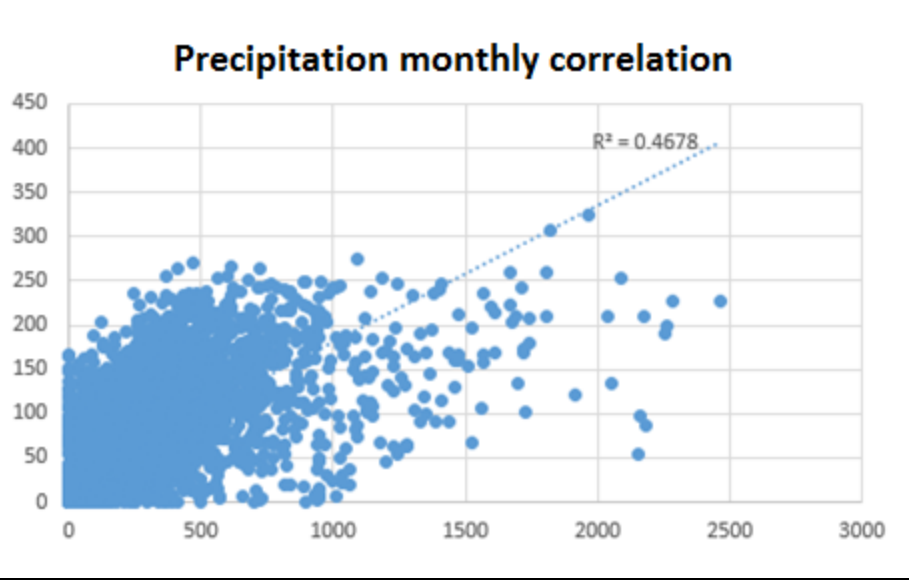
TRMM validation

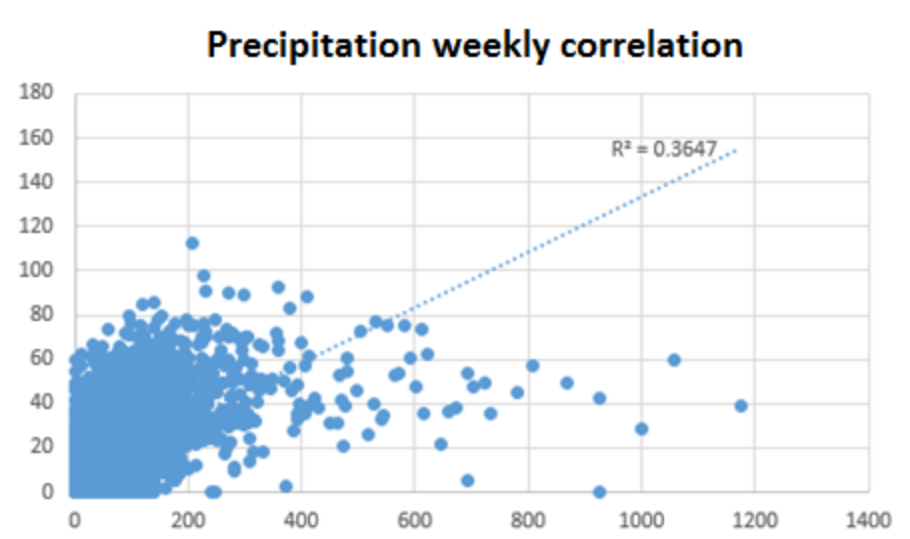
- Since the spatial correlation of ground-based precipitation variable is very low, TRMM is used.

- Validation of TRMM is done by calculating correlation with ground-based precipitation data:
  - **Daily** summation
  - **Weekly** summation
  - **Yearly** summation.

TRMM validation cont.

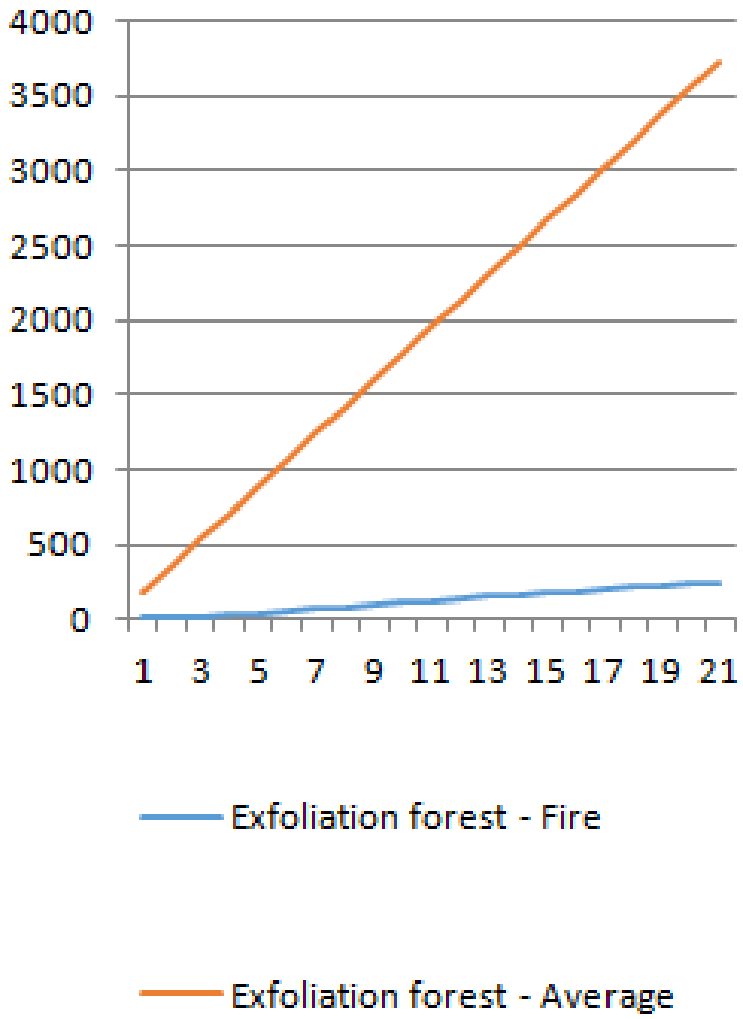






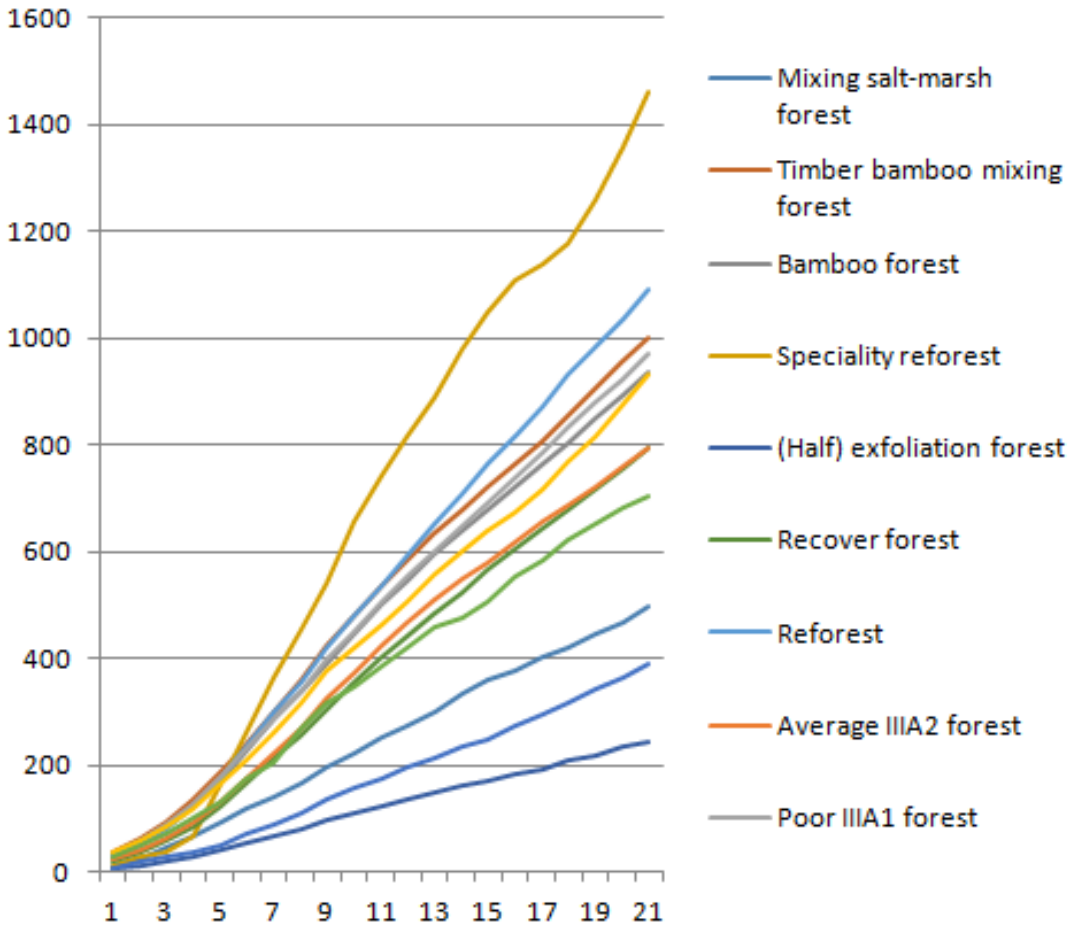
- There is correlation between TRMM and ground-based data at weekly and monthly summation.
- TRMM can be used for forest fire warning method.

Correlation TRMM, Forest type to Active Fires



- For each forest type, a history cummulative time series of TRMM variable is compared between fire and non-fire conditions.
- X-axis: number of consecutive days before the exmination day
- Y-axis: cummulative rainfall rate.
- Precipitation rate before fire is much lower than normal.
- It can be used as a fire danger predictor.

Correlation TRMM, Forest type to Active Fires (cont.)



- In concerning with rainfall rates:
  - Speciality reforest is easily to catch fire.
  - Exfoliation forest is harder to catch fire.
  - It may not lead to detemine exact rainfall thresholds for all forest types, but we can extract the order of how easily forest types catch fire.

Ongoing work

- Regarding forest fire risk warning method:
  - Complete the correlations among meteological variables, forest type and Active fires.
  - Find the danger mapping concerning with the found correlations
  - Do verification for this method

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THANK YOU