NEAR REAL TIME DETECTION OF BURNED SCAR AREA USING LANDSAT-8 IMAGERIES

Danang Surya Candra

Kustiyo

- Indonesian National Institute of Aeronautics and Space (LAPAN) -

LAPAN

Outline

INTRODUCTION:
Background, Problems, Purpose and Hypothesis

METHODOLOGY:
1. Near Real Time of
- **Firespot Detection**
- **Fire Burnt Area Detection**
- **Burned Scar Area Detection**

2. Assessment

RESULTS AND DISCUSSION

CONCLUSION

Introduction

- Burned areas are characterized by deposits of charcoal and ash, removal of vegetation, and alteration of vegetation structure (Roy et al. 1999)
- Fires of forest, plantation and peat in Indonesia's Riau province spiked to levels not seen since the previous Southeast Asian smoke haze pollution crisis of June 2013 (World Resources Institute)
- Nearly 50,000 are suffering respiratory ailments due to the smoke haze pollution, according to Indonesia's Disaster Management Agency (World Resources Institute)
- Needed a technology to monitor forest, plantation and peat fires
- Remote sensing technology is commonly used to monitor the information of forest, plantation and peatland fires

Introduction

- Existing systems for hotspot monitoring:
  - Indofire (Lapan – Australia) → using Modis data
  - JICA-JST SATERPS (Lapan – Japan) → using Modis data
  - Modis Catalog (Lapan – NOAA) → Using Modis data

- Problem :
  - Modis is low spatial resolution (250 m – 1000 m):

  → can not detect the small area of forest, plantation and peatland fires

  → only detect the big area of burned scar

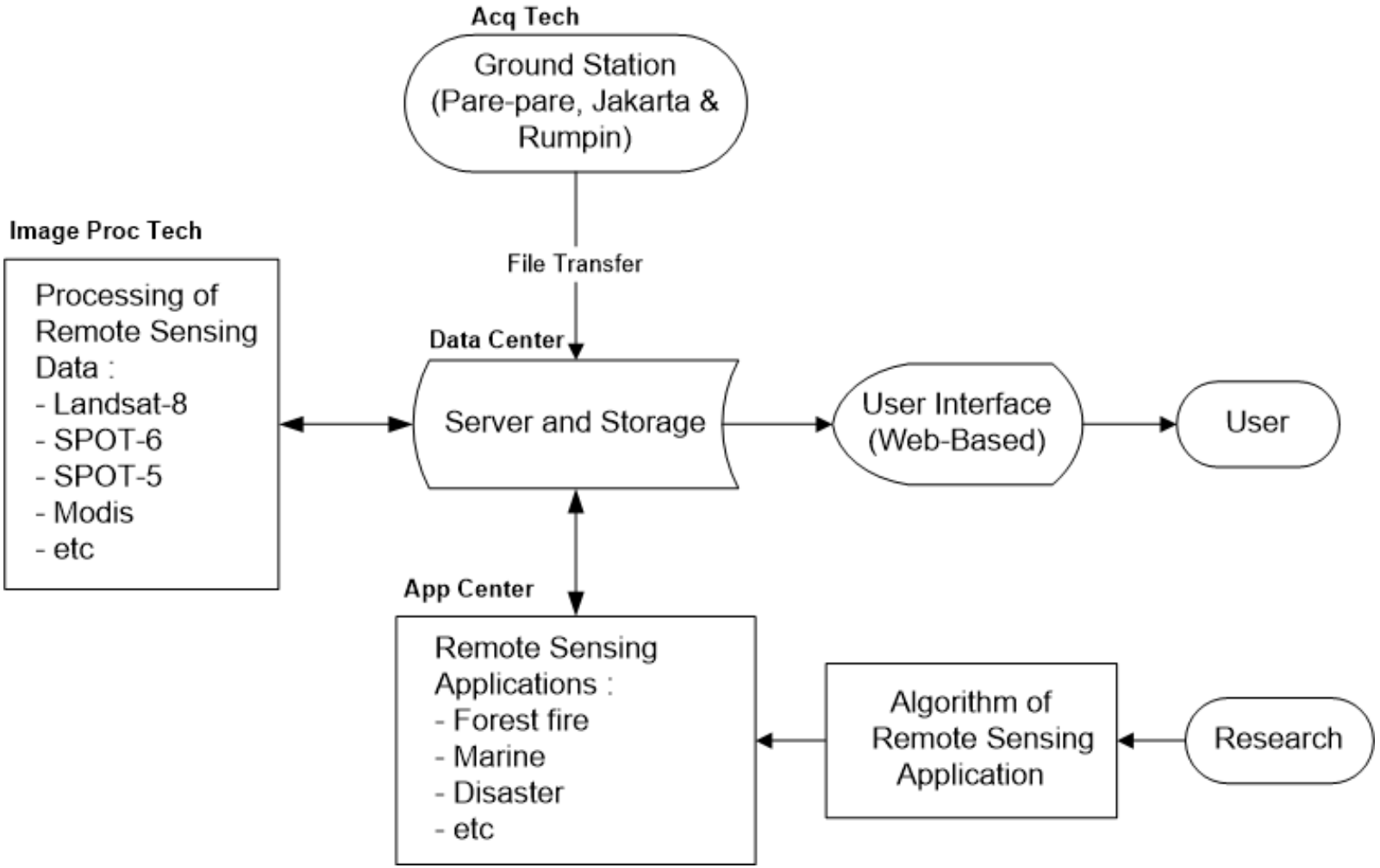
- Purpose → developing algorithms of :
  - Firespot Detection
  - Fire Burnt Area Detection
  - Burned Scar Area Detection

  to support system of near real time detection using Landsat-8 (30 m)

Introduction

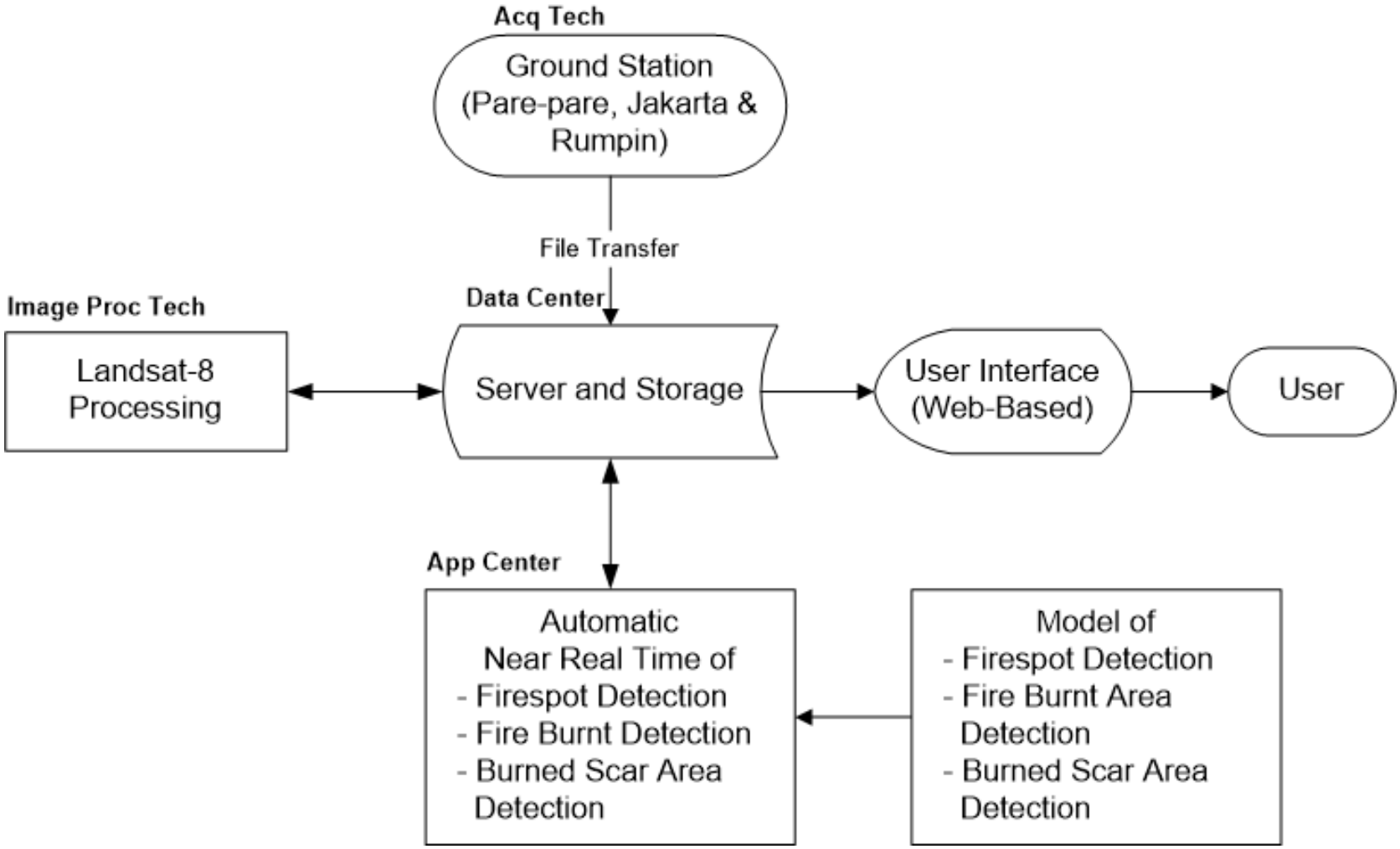
- Concern : Oil palm plantations
- Hypothesis:
  - Using Landsat-8 TIRS (brightness temp) can detect firespot
  - Using Landsat-8 OLI can detect burned scar area
  - Combine of Landsat-8 TIRS and OLI can detect fire burnt area
  - Using threshold can develop algorithms to support automatic system (for near real time detection)

Remote Sensing Systems (LAPAN) (Present and Future)

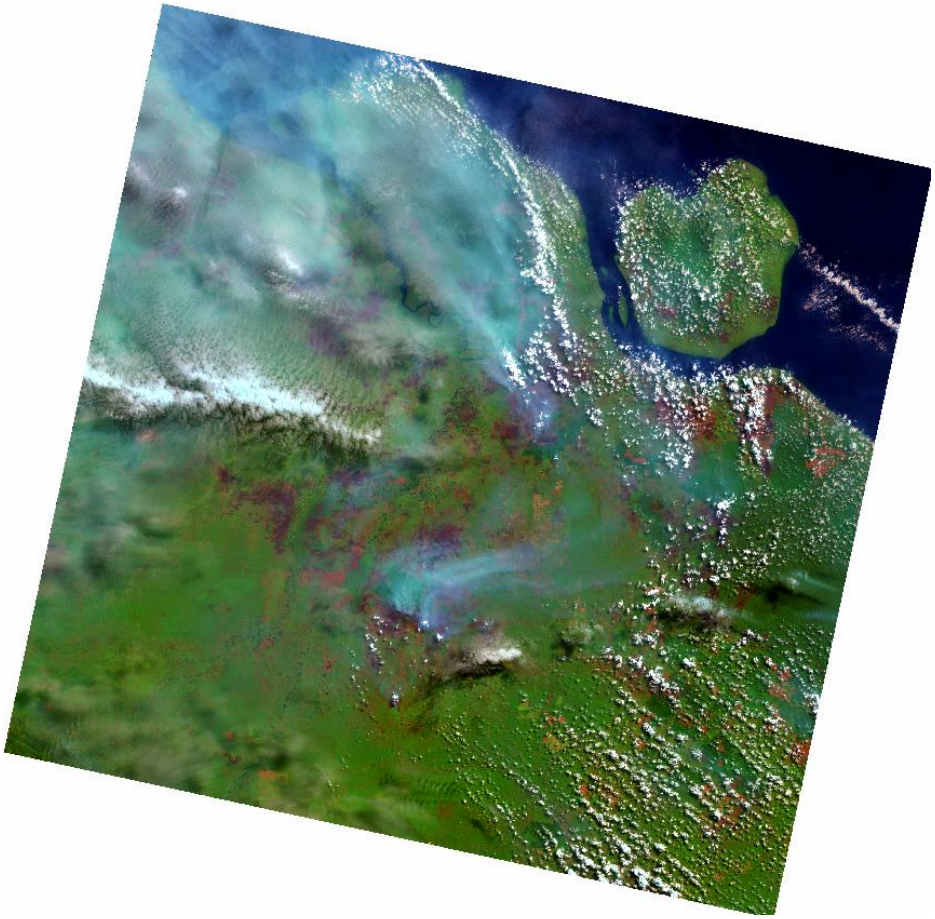


The image processing and RS applications are done in server automatically after the system detecting the data in storage from ground station → near real time process

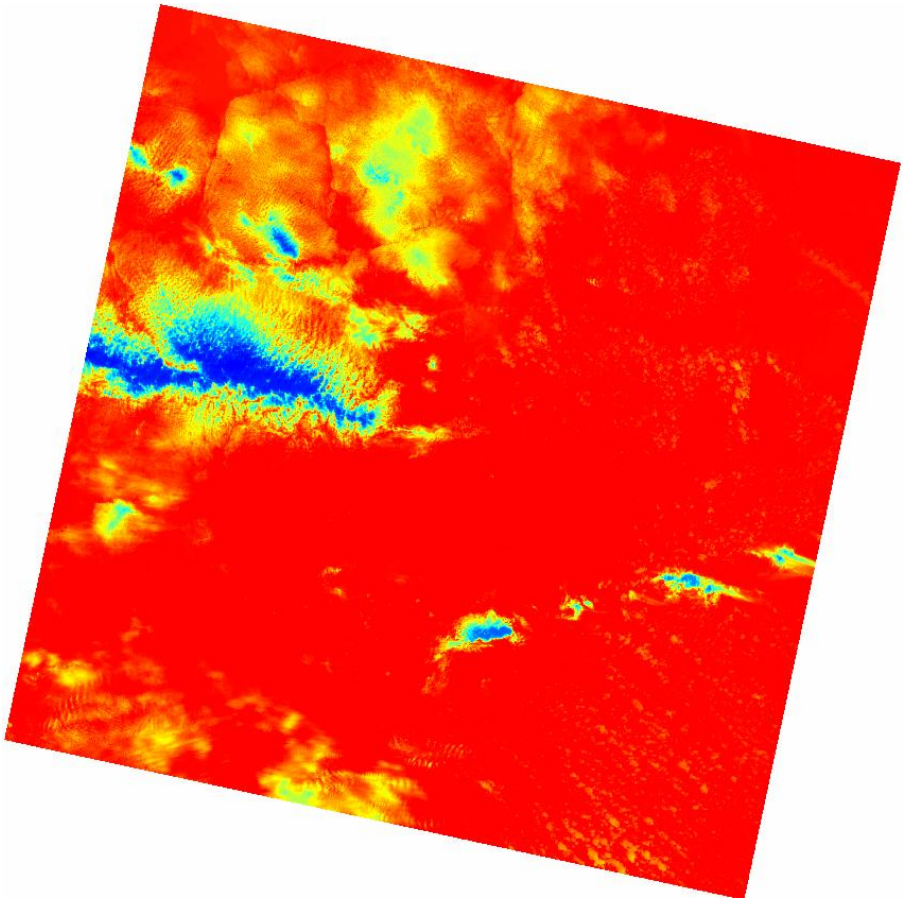
Near Real Time of Burned Area Detection (Present and Future)



Landsat-8 (OLI and TIRS), Riau Province (June 25, 2013, Path/Row 127/59)

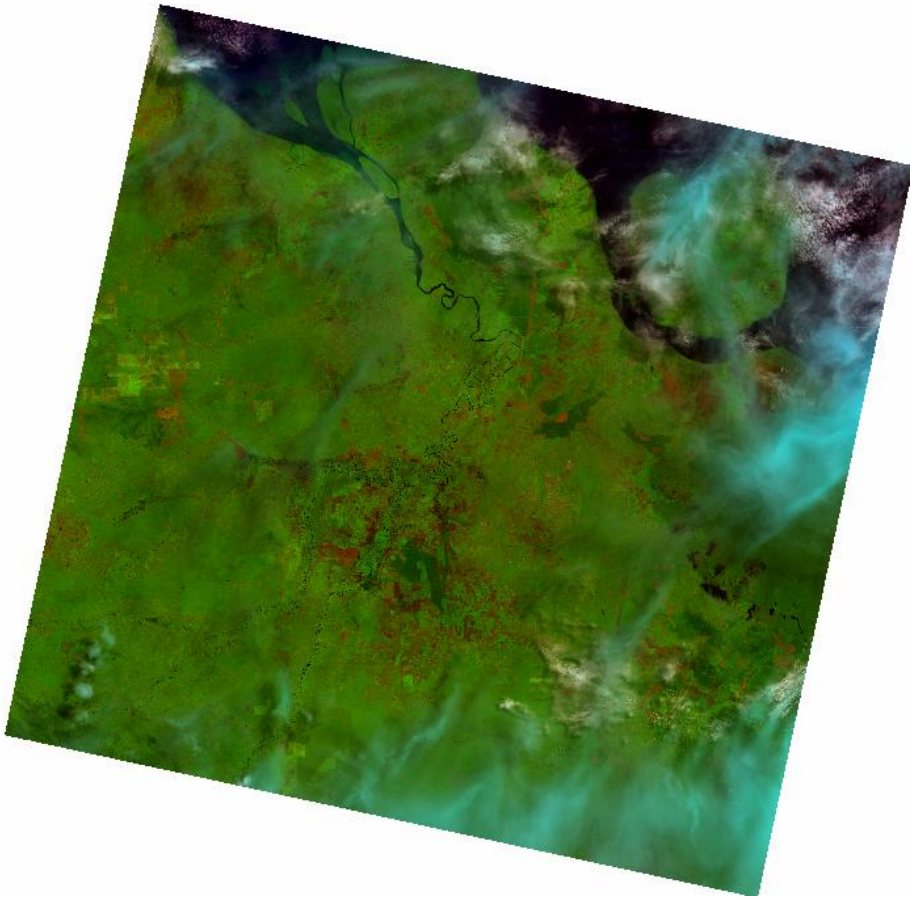


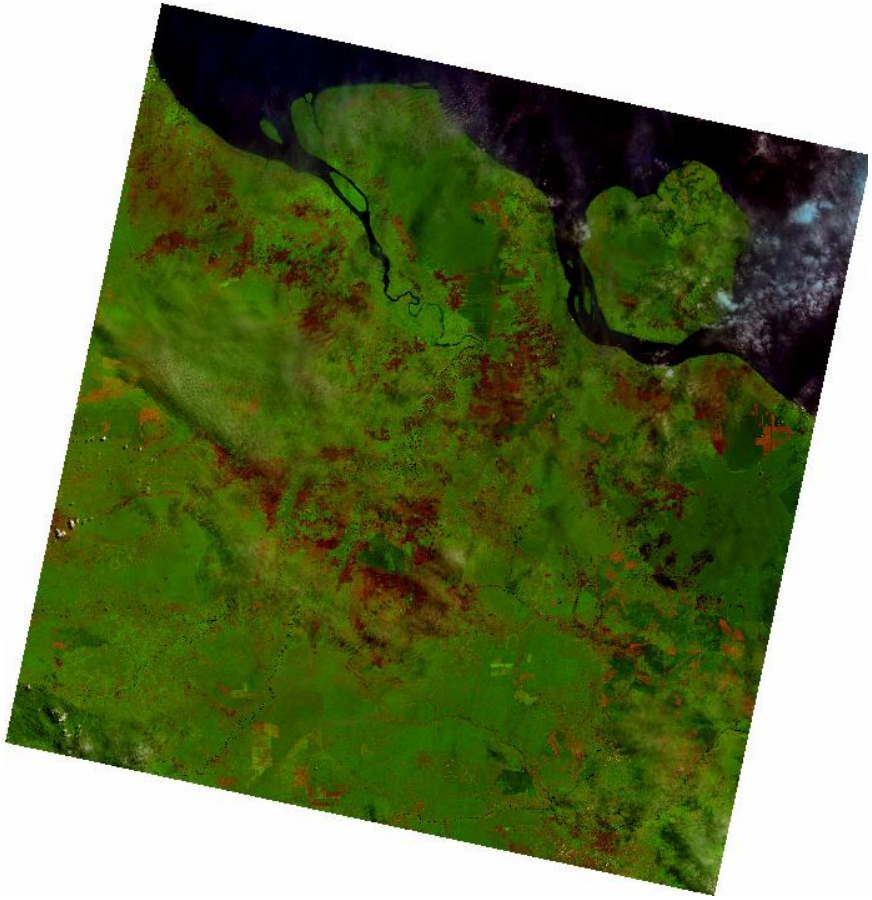
OLI (B6, B5, B3)



TIRS (B10 & B11)

L-8 OLI (Before and After Fire)





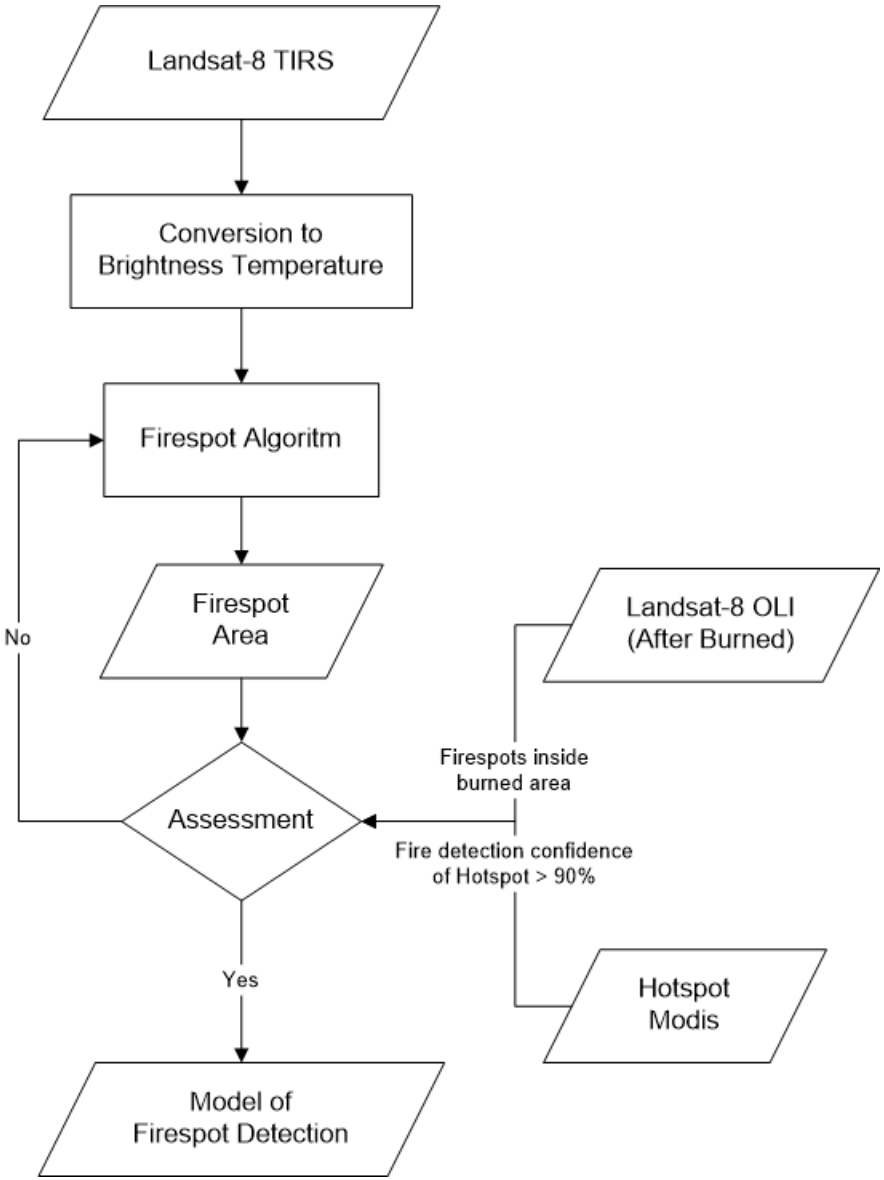
Before Fires : May 24, 2013

After Fires : August 12, 2013

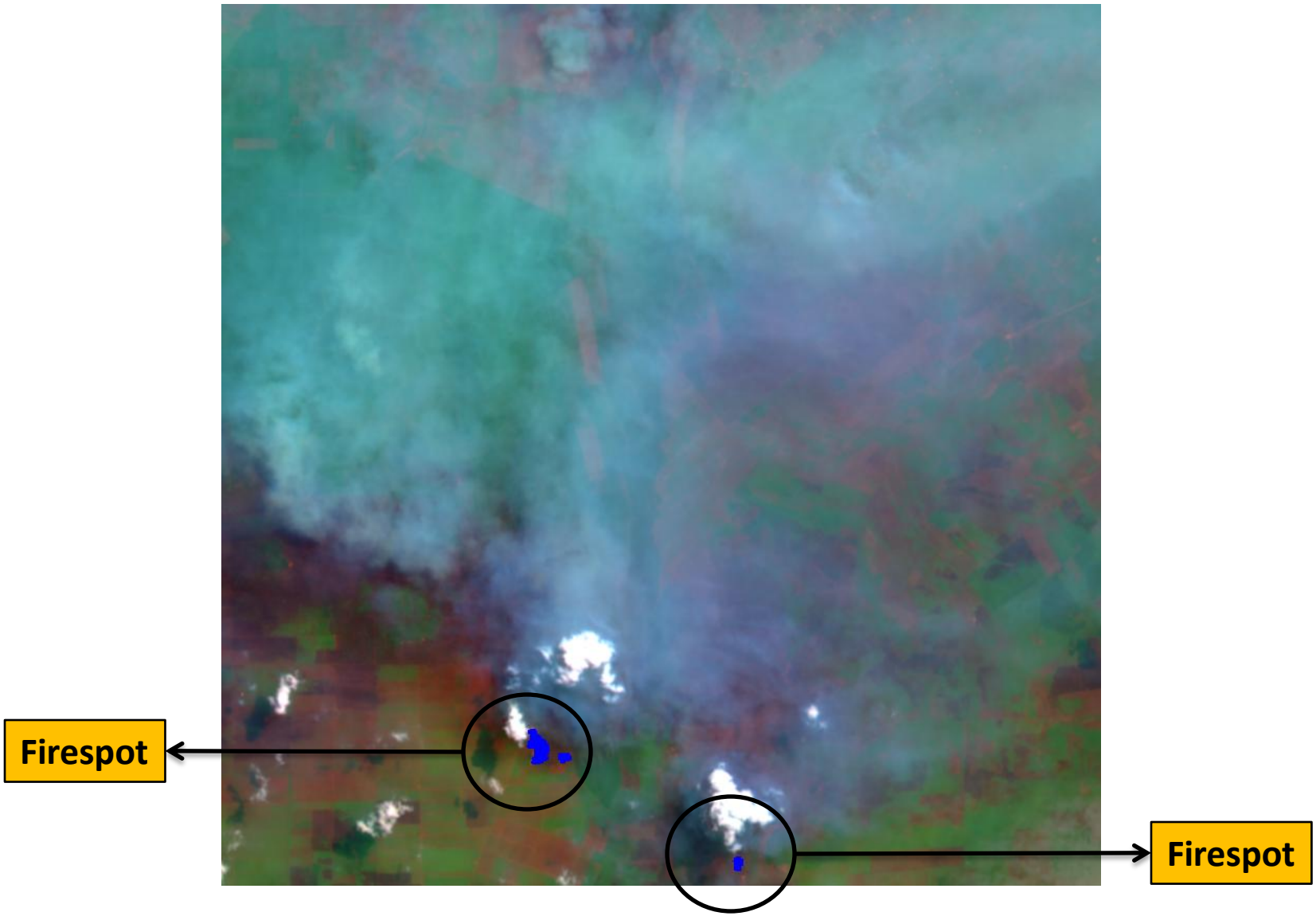
*** The data requirements → radiometric and geometric corrected**

FIRESPOT DETECTION

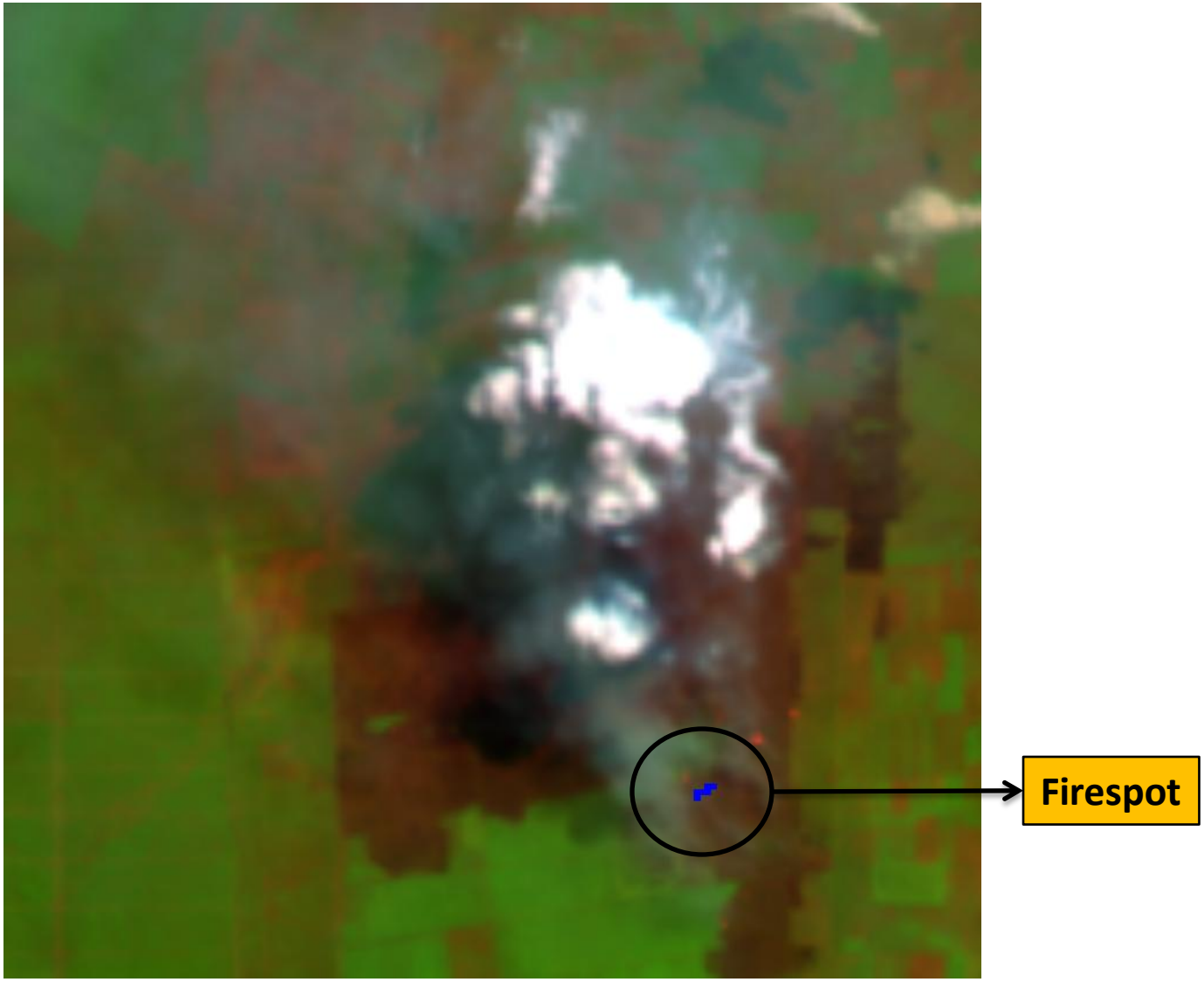
Firespot Detection



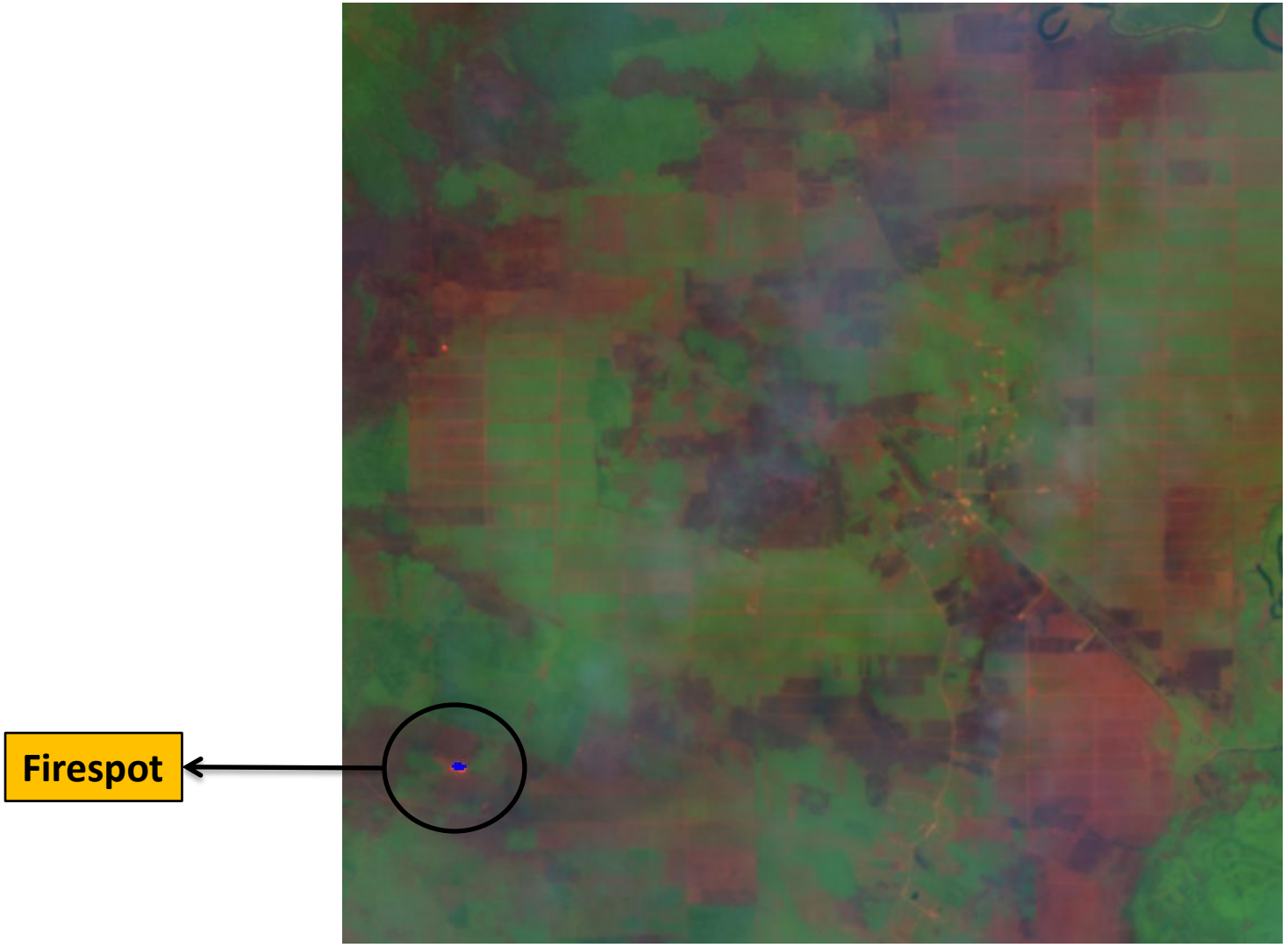
Results : Firespot using Brightness Temp



Results : Firespot using Brightness Temp

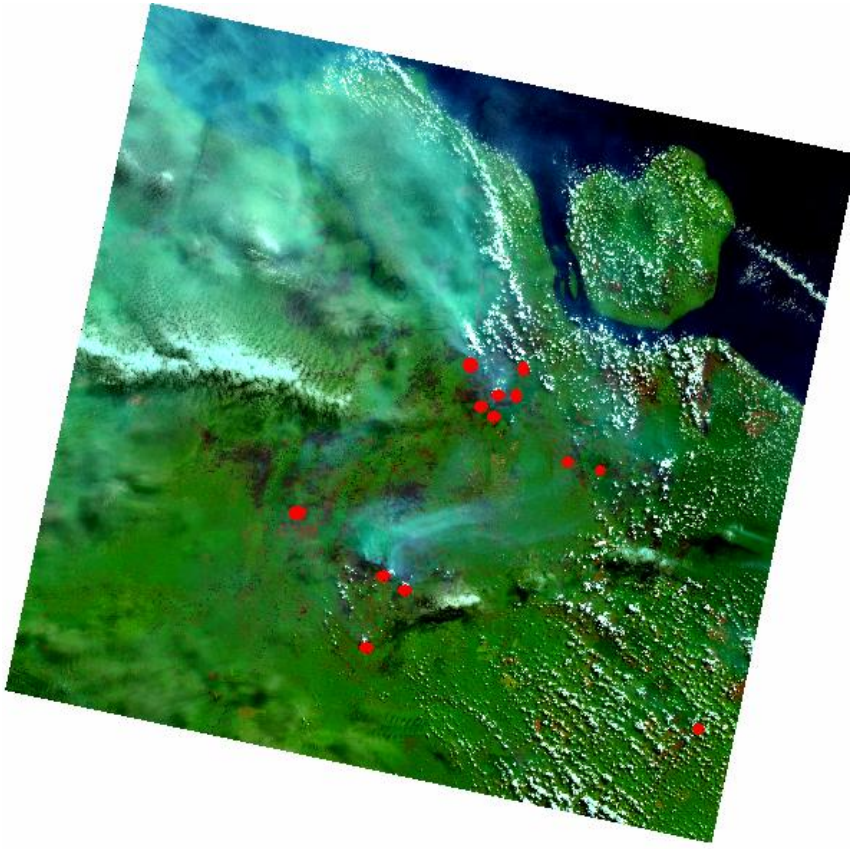


Results : Firespot using Brightness Temp

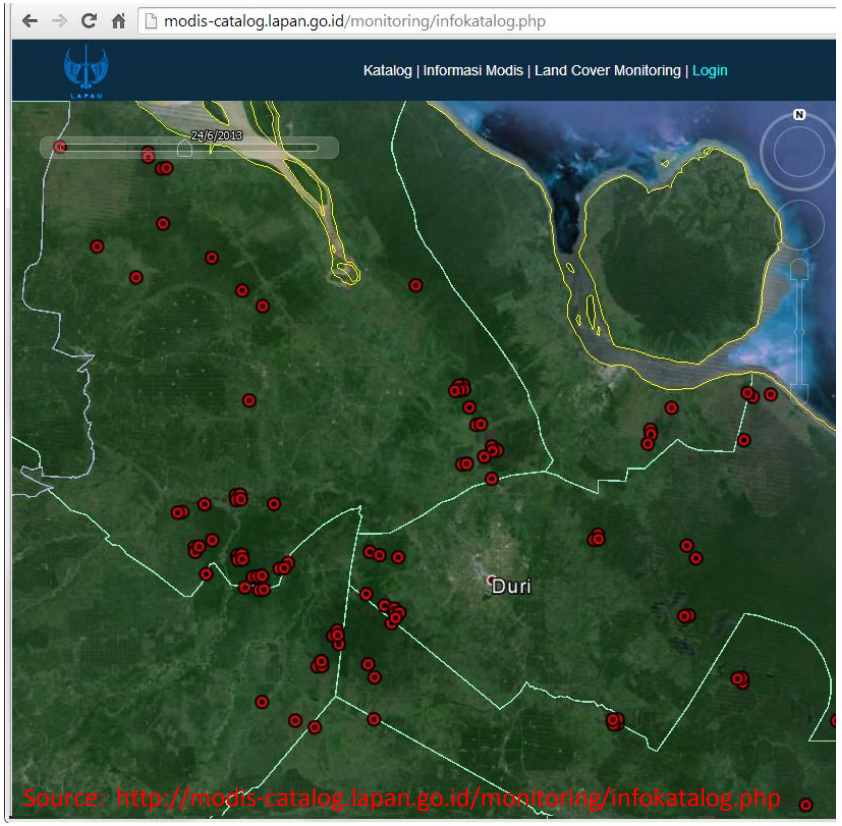


Assessment : Firespot-L8 & Hotspot-Modis

Firespot-L8 (25 Juni 2013, Time : about 10.00am)



Hotspot-Modis (24 Juni 2013, Time : 06.44am)

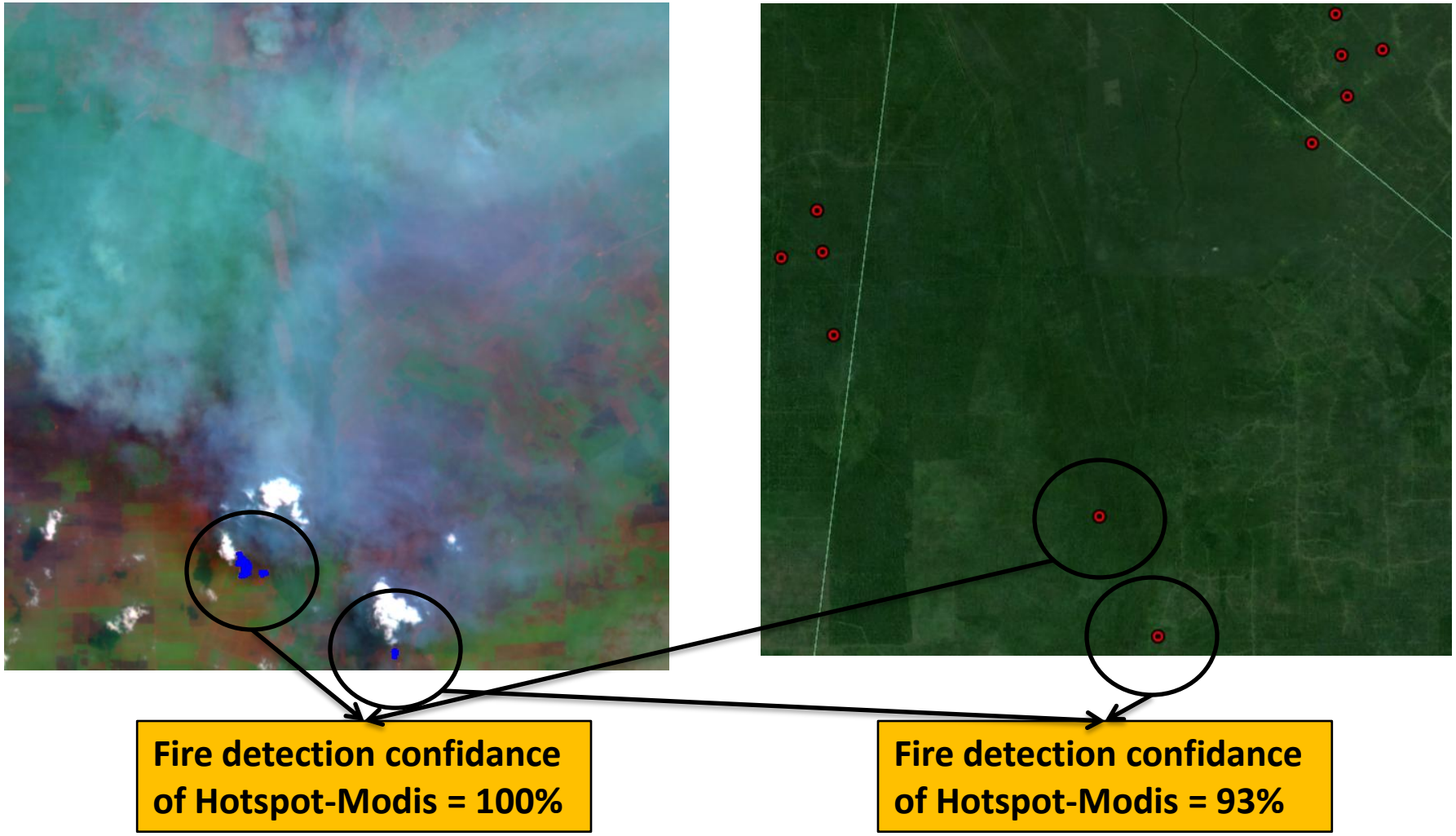


: Firespot-Landsat 8

: Hotspot-Modis

*** Fire detection confidance of Hotspot-Modis > 75%**

Assessment I : Firespot L-8 & Hotspot Modis

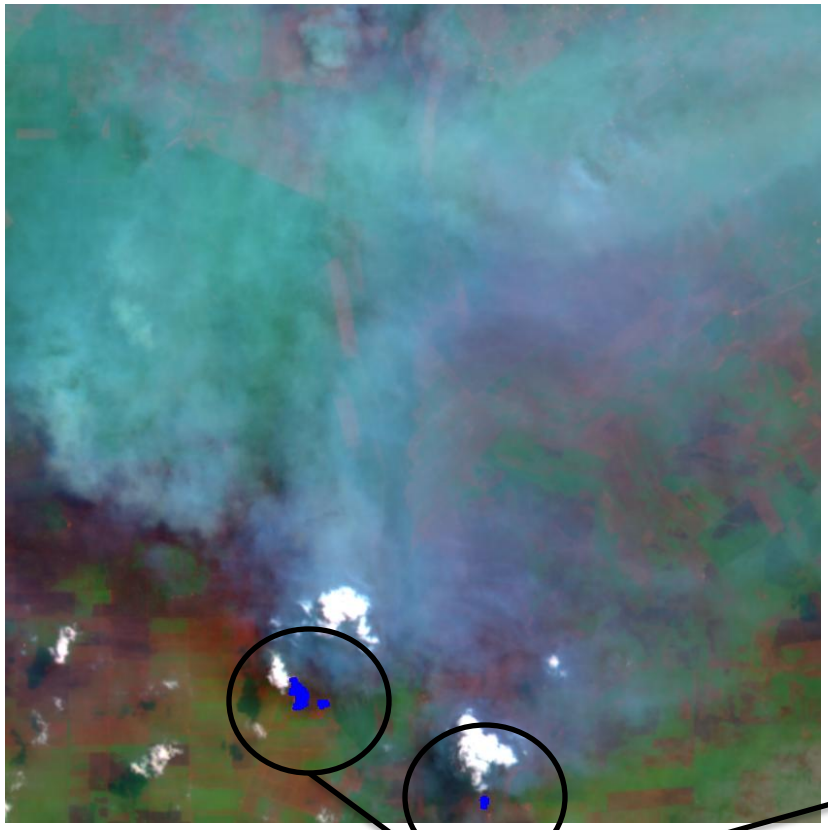


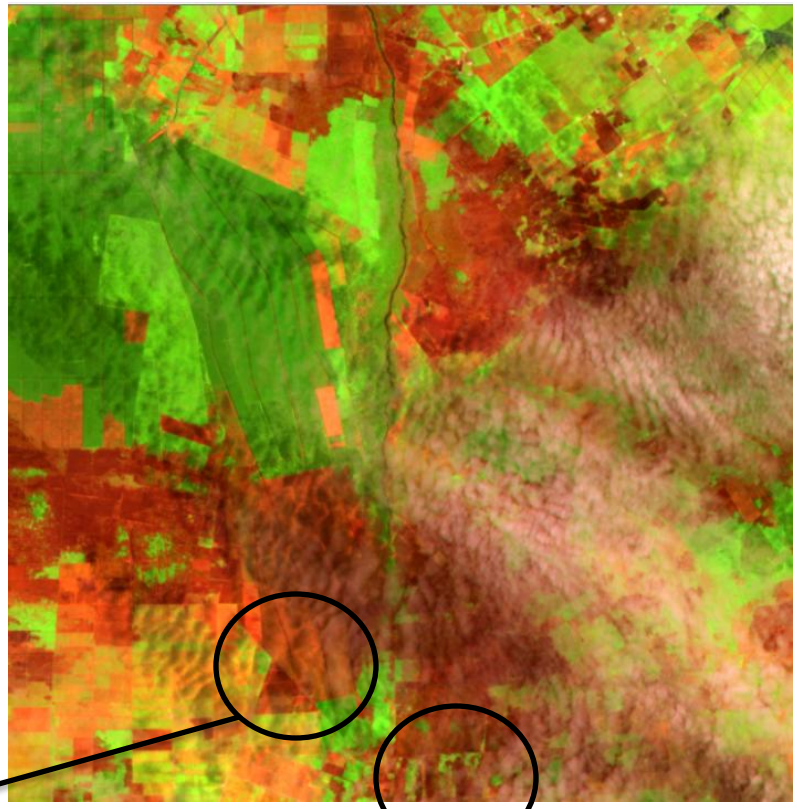
Fire detection confidance of Hotspot-Modis = 100%

Fire detection confidance of Hotspot-Modis = 93%

* Target of firespot = 90% until 100% of fire detection confidance
* The results are 93% and 100% of fire detection confidance → Good results

Assessment 2 : Firespot L-8 & Burned Area





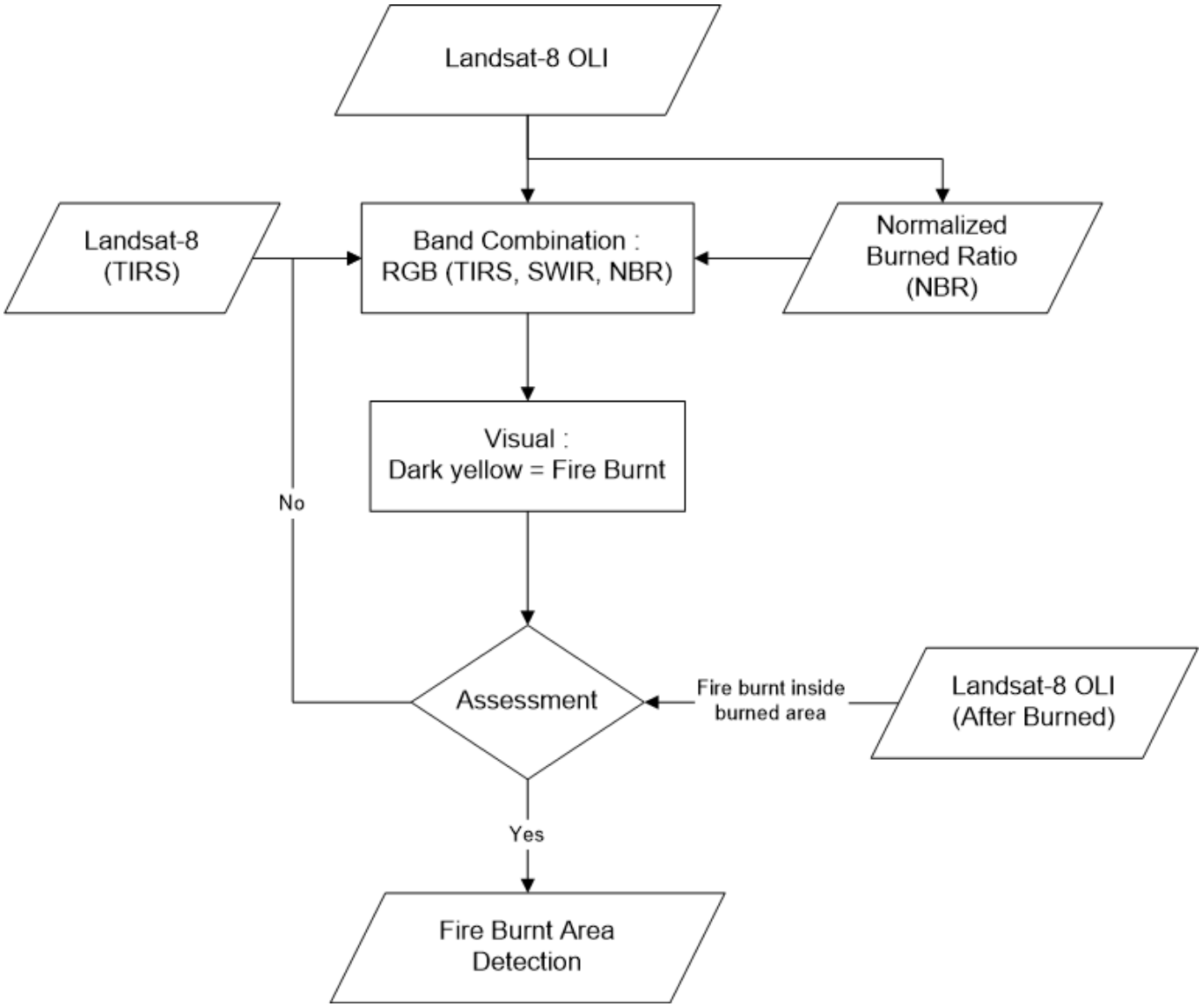
Firespot is inside burned area

Firespot is inside burned area

* The results are good → the algorithm can be used to detect firespot

FIRE BURNT AREA DETECTION

Fire Burnt Area Detection

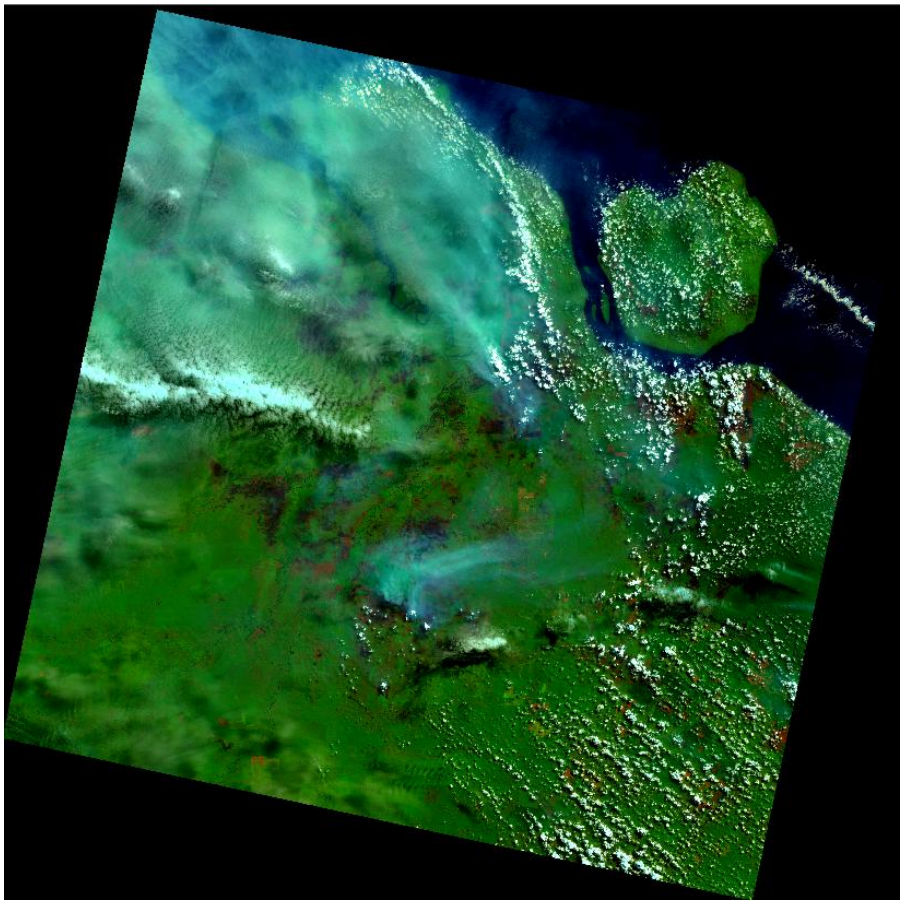


Fire Burnt Area Detection

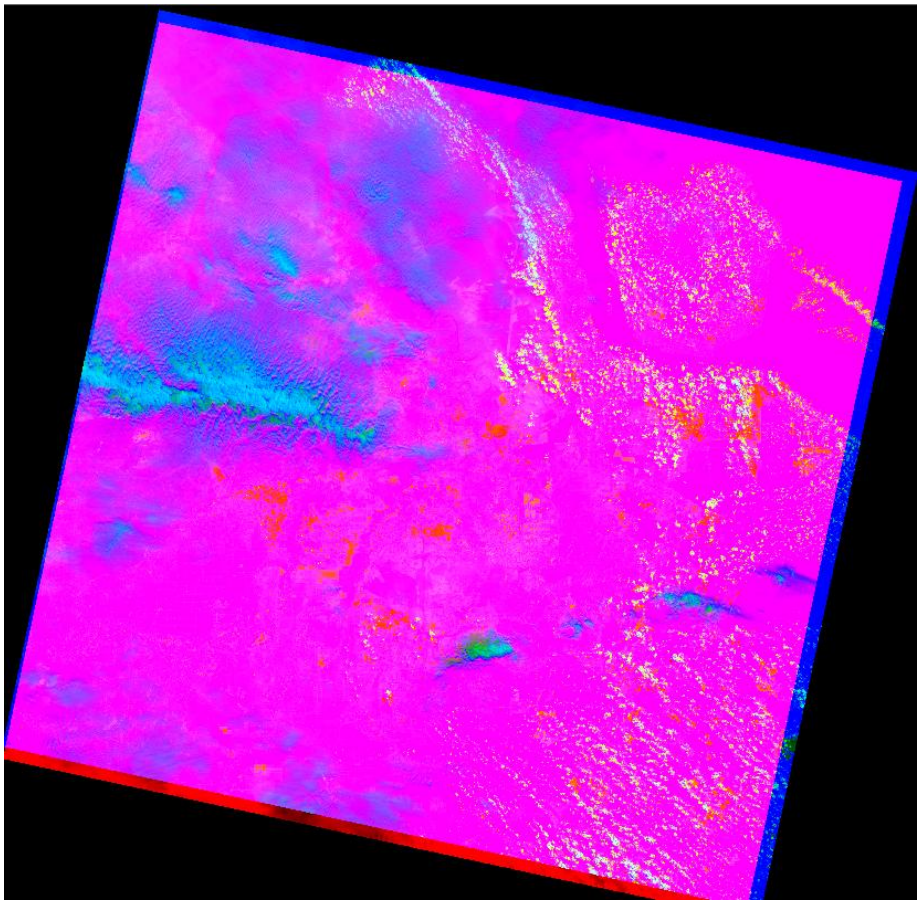
- Fire Burnt Area : RGB (TIRS, SWIR, NBR)
- TIRS can be used to detect fire → It will be high when fire burnt happened
- SWIR can be used to detect water stress in vegetation and burned vegetation → It will be high when fire burnt happened
- NBR can detect vegetation index → It will be low when fire burnt happened

* Red(high), Green(high) and Blue(low) → Dark yellow (when fire burnt happened)

Result : Fire Burnt Area Detection



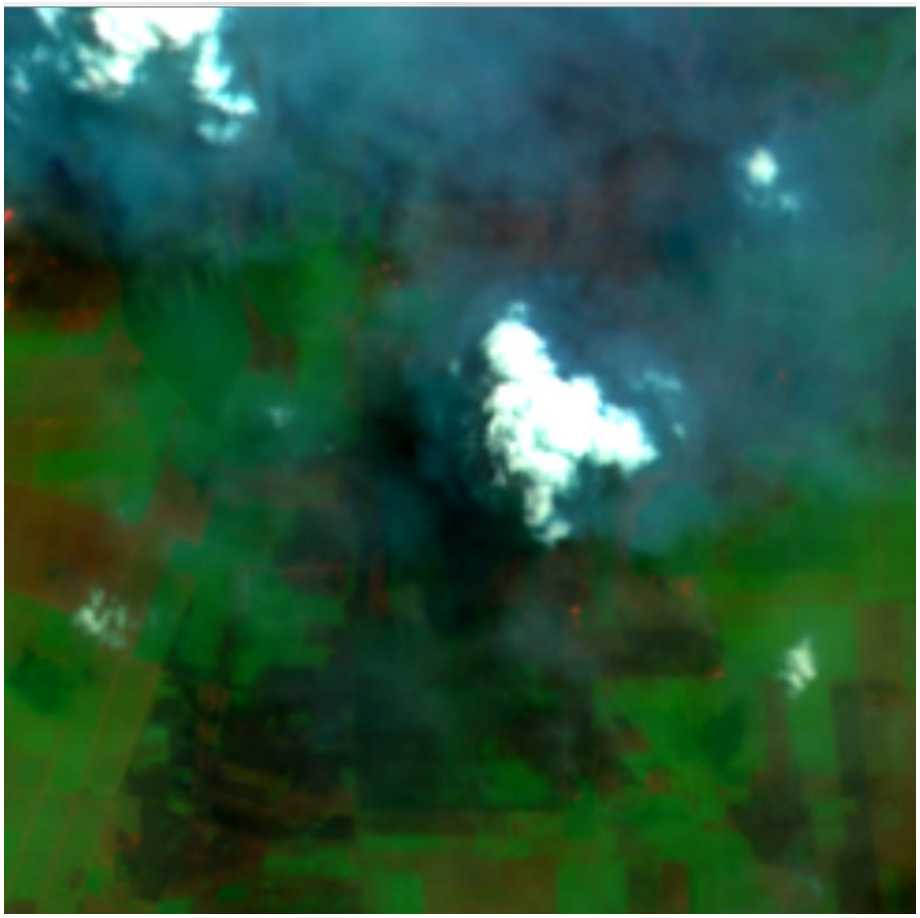
RGB (B6, B5, B3)

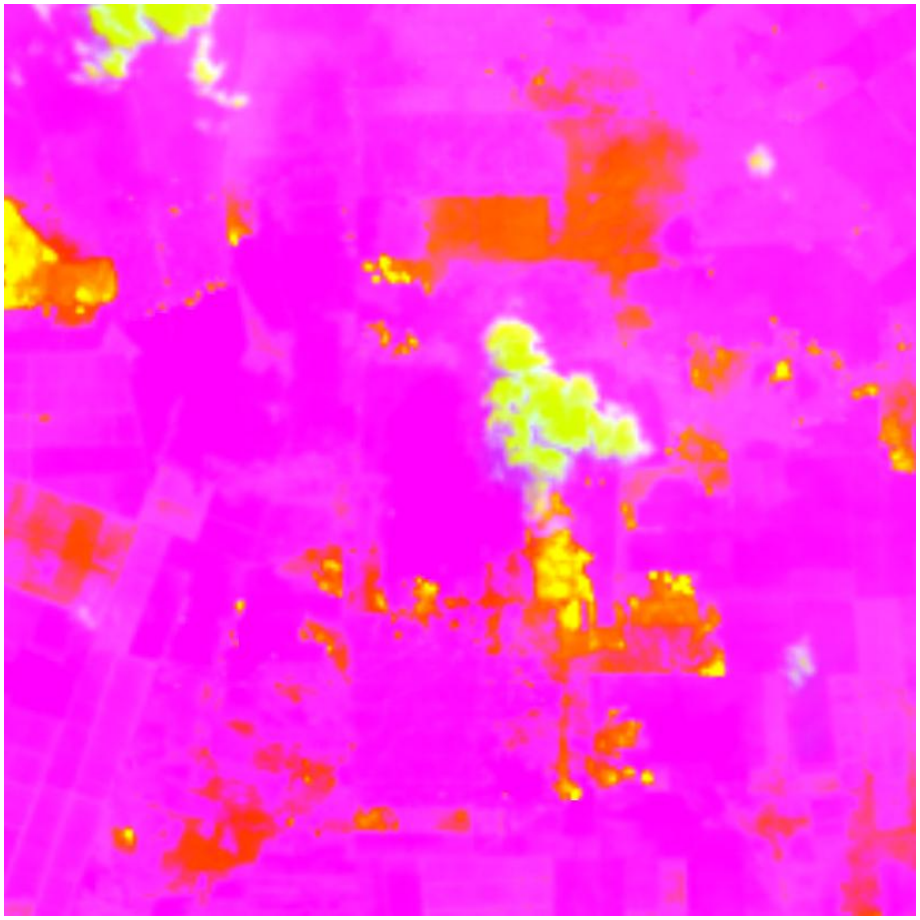


RGB (B10:TIRS, B7:SWIR, NBR)

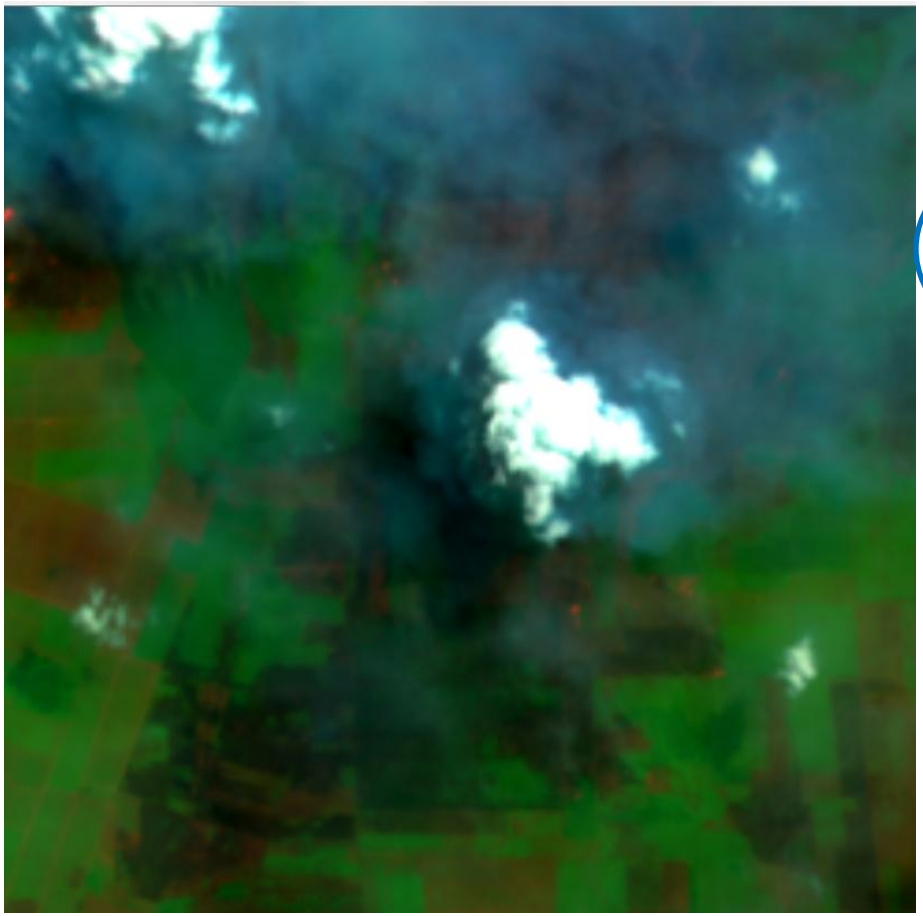
* To detect fire burnt area: RGB (B10, SWIR, NBR)

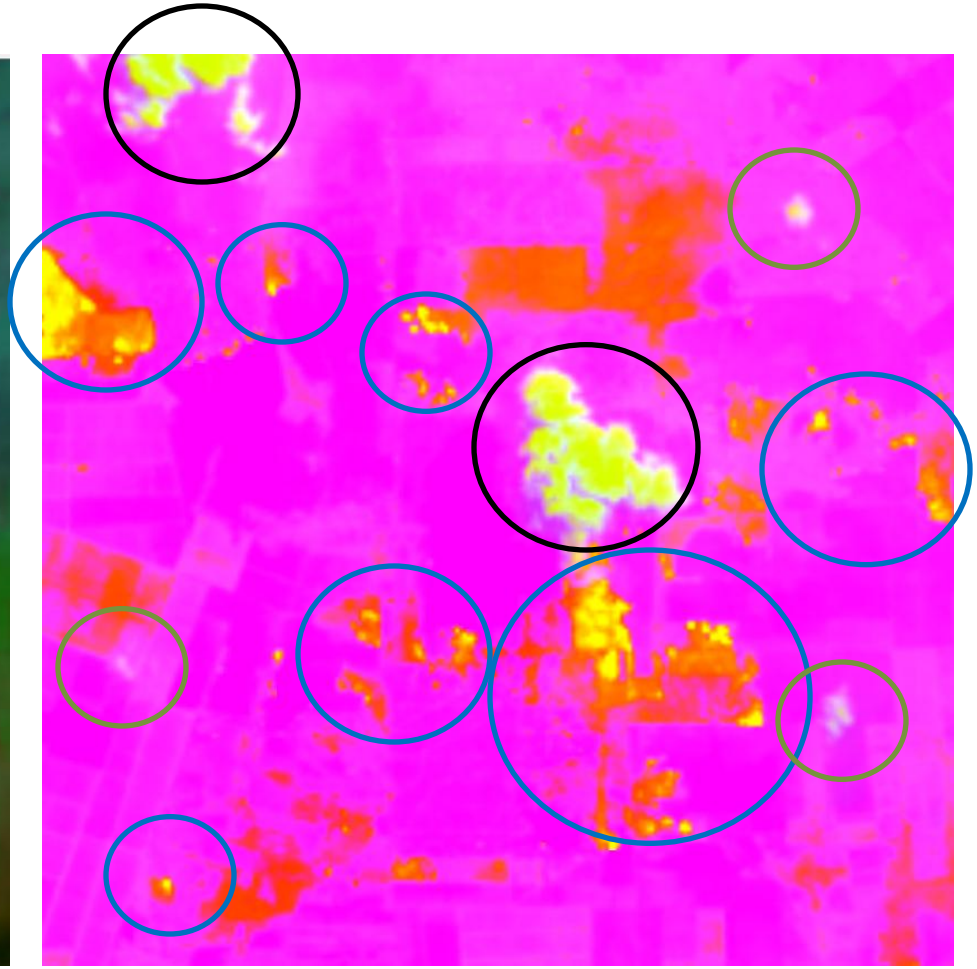
Fire Burnt Area Detection (Area 1)





Fire Burnt Area Detection (Area 1)





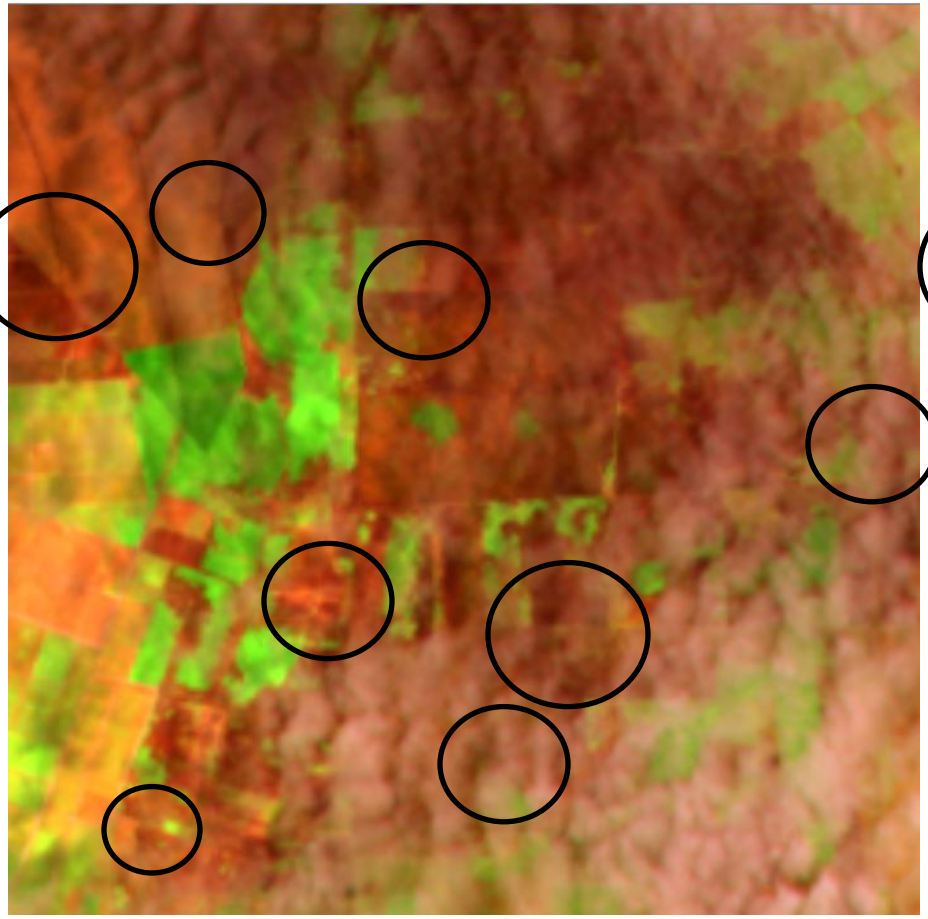
: Fire burnt (dark yellow)

: Thin cloud

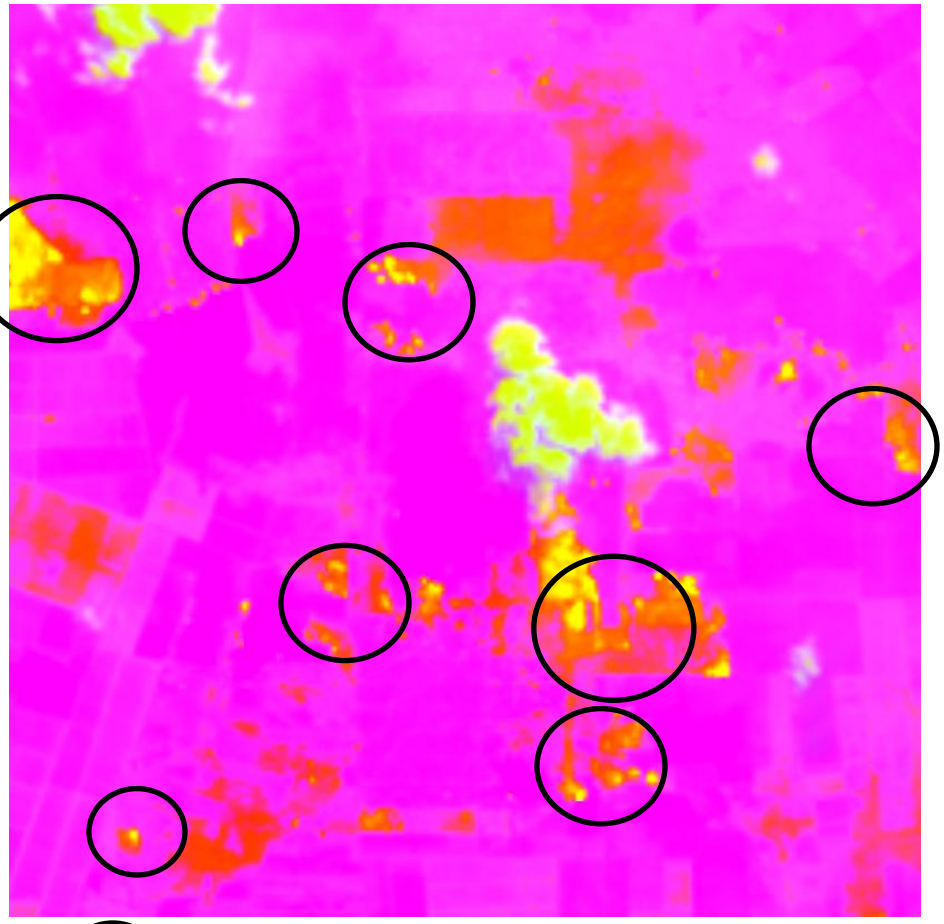
: Thick smoke/cloud (soft yellow)

Assessment: Fire Burnt Area Detection(Area 1)

After Burned



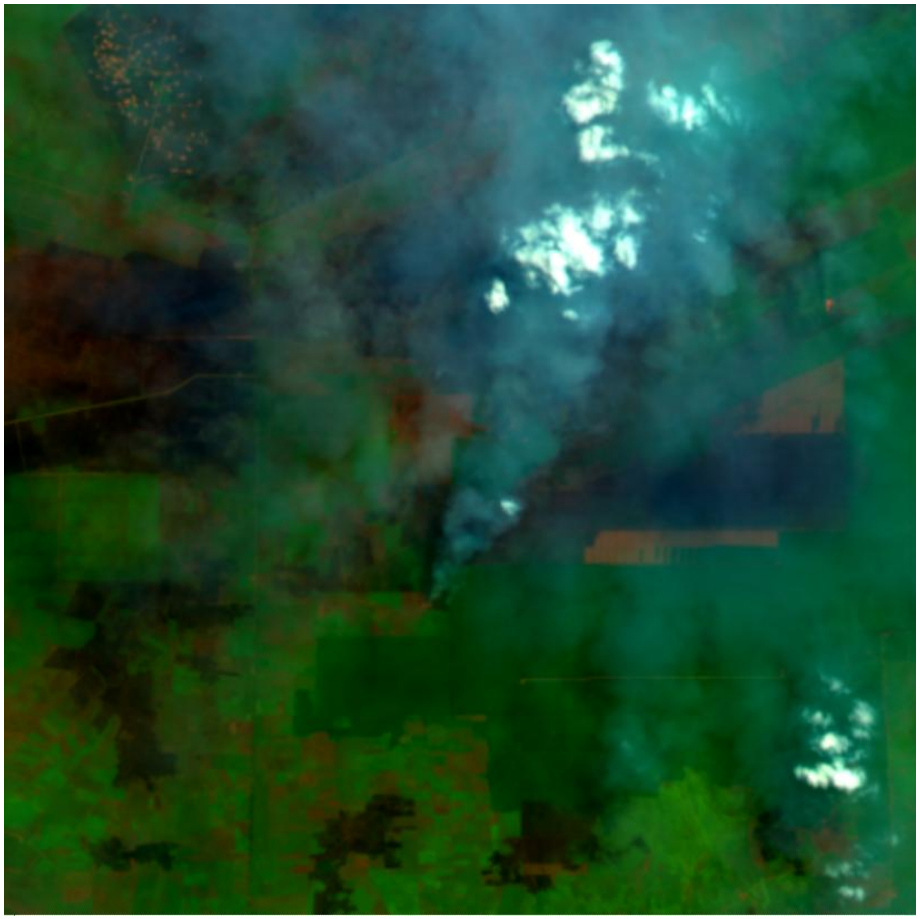
Fires burnt happened

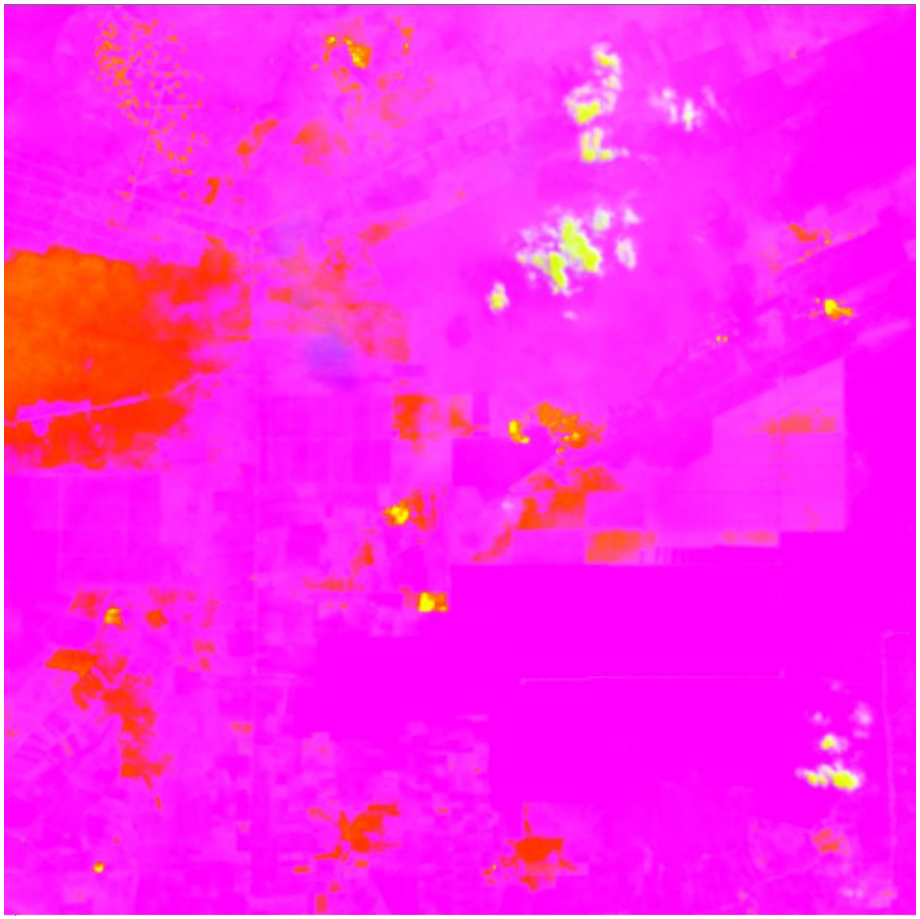


: Fire burnt inside burned area

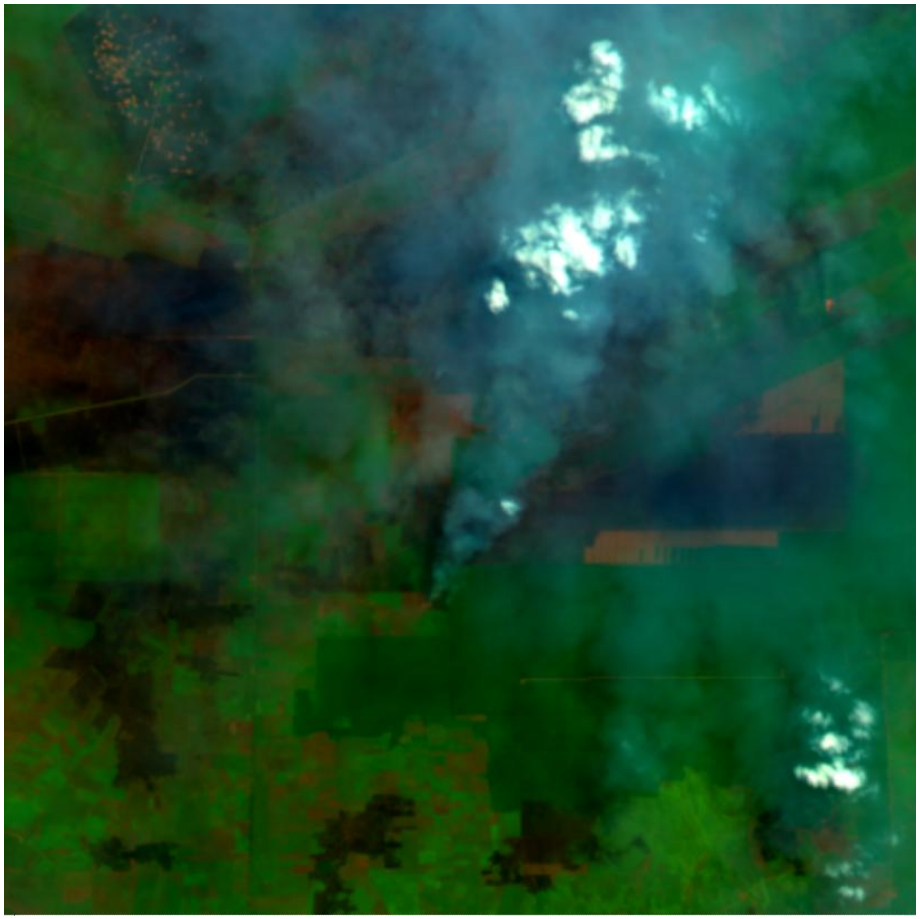
* All of the fires burnt are inside burned area → the result (area 1) is good

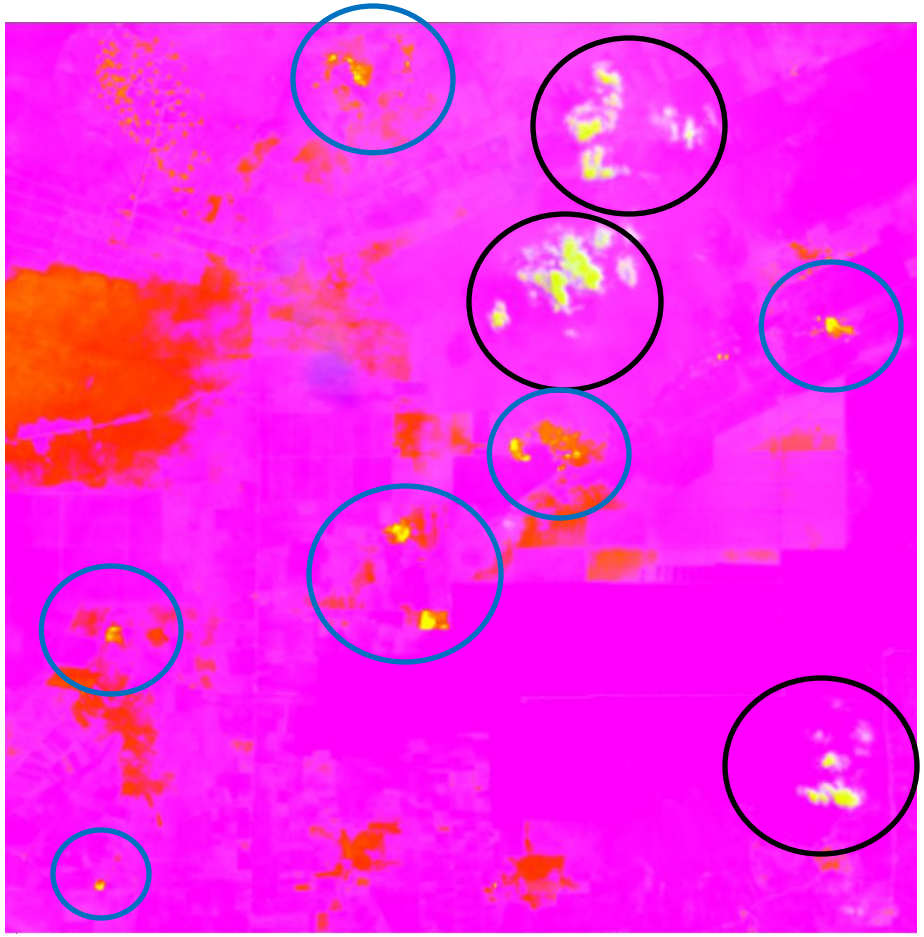
Fire Burnt Detection Area (Area 2)





Fire Burnt Area Detection (Area 2)



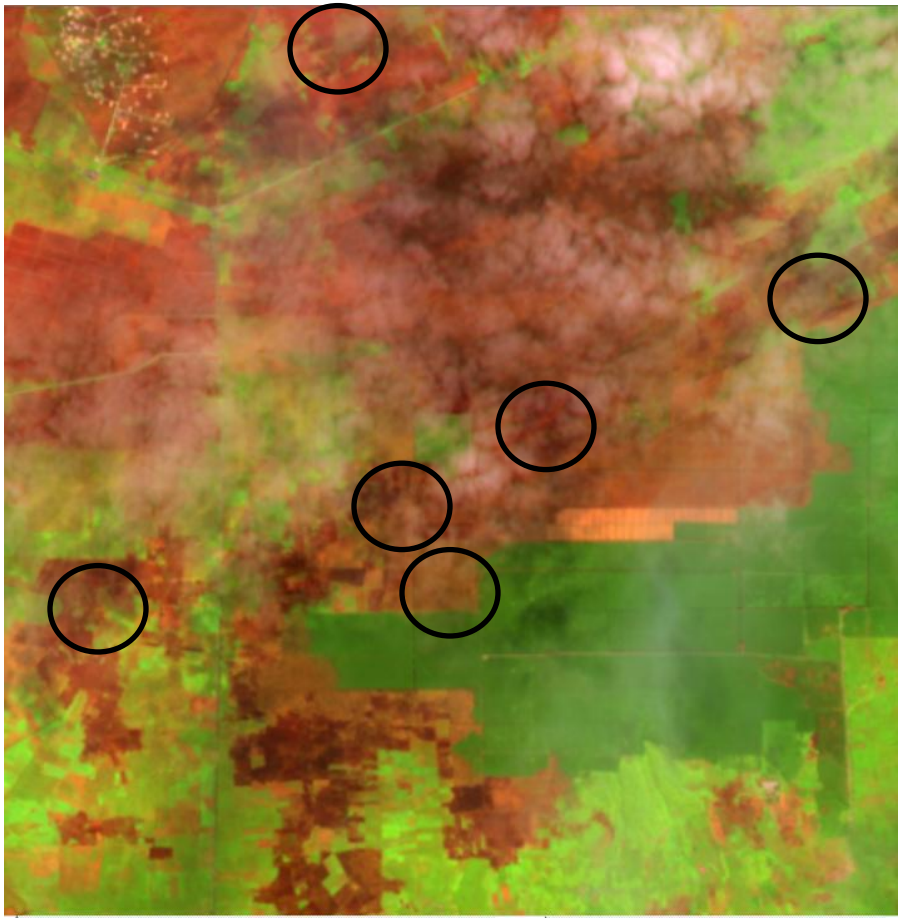


: Fire burnt (dark yellow)

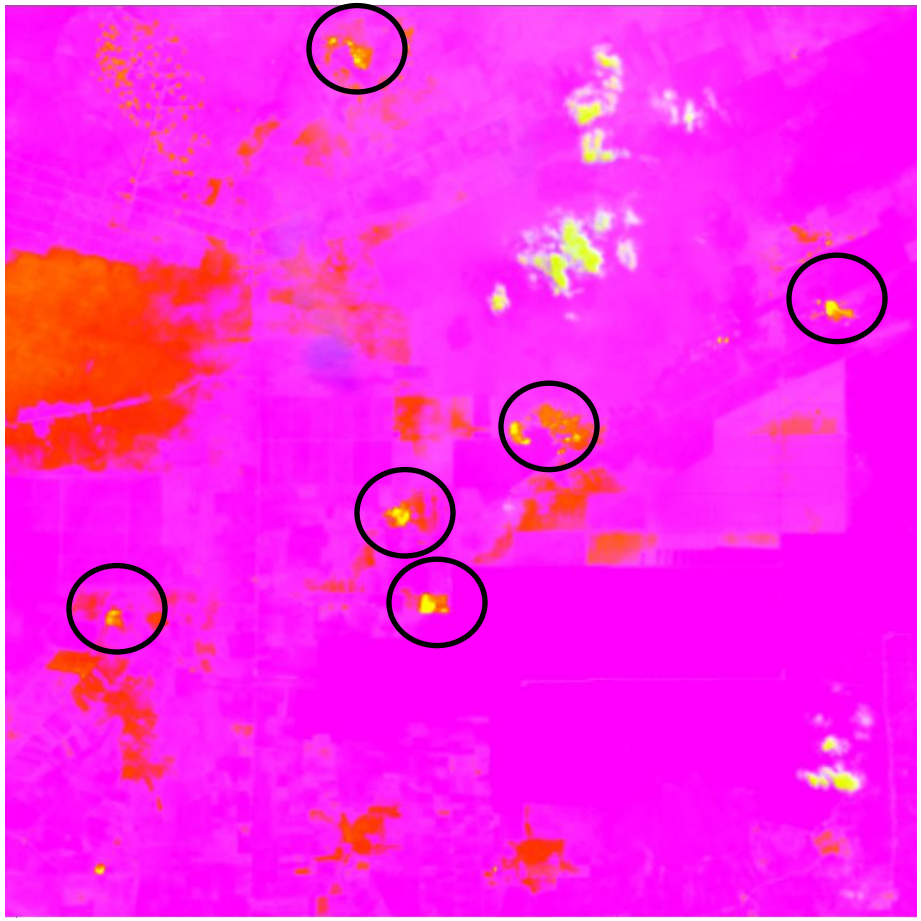
: Thick smoke/cloud (soft yellow)

Assessment: Fire Burnt Area Detection (Area 2)

After Burned



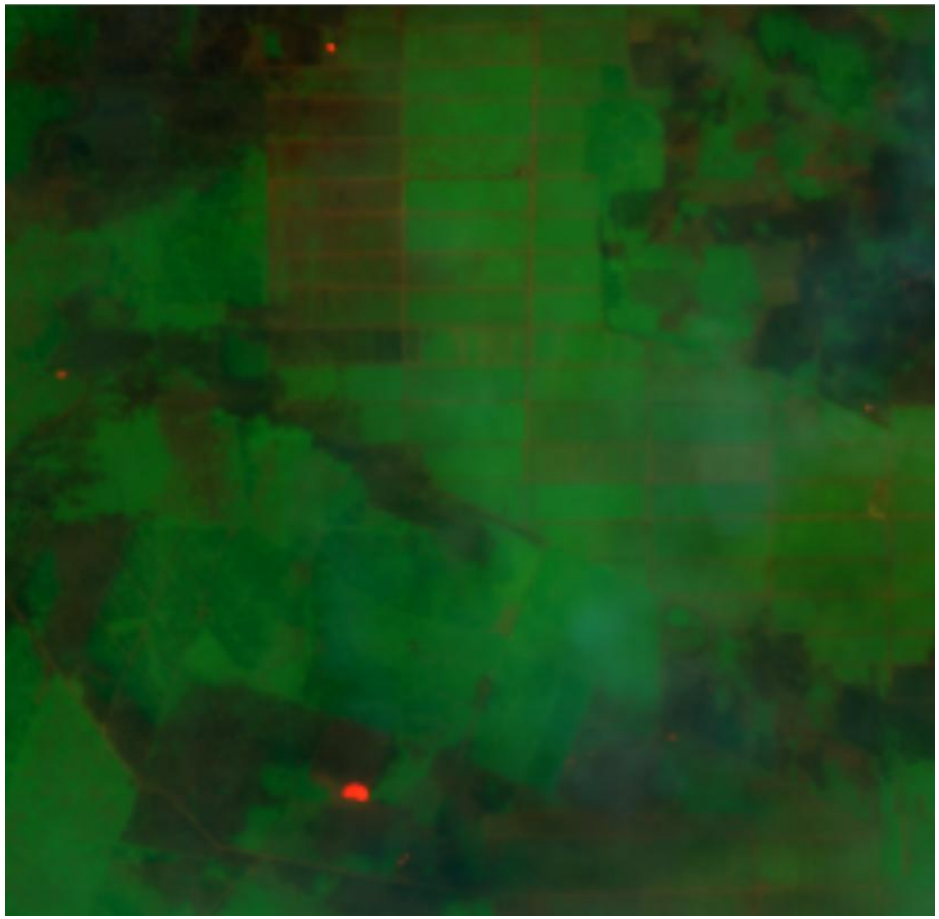
Fires happened

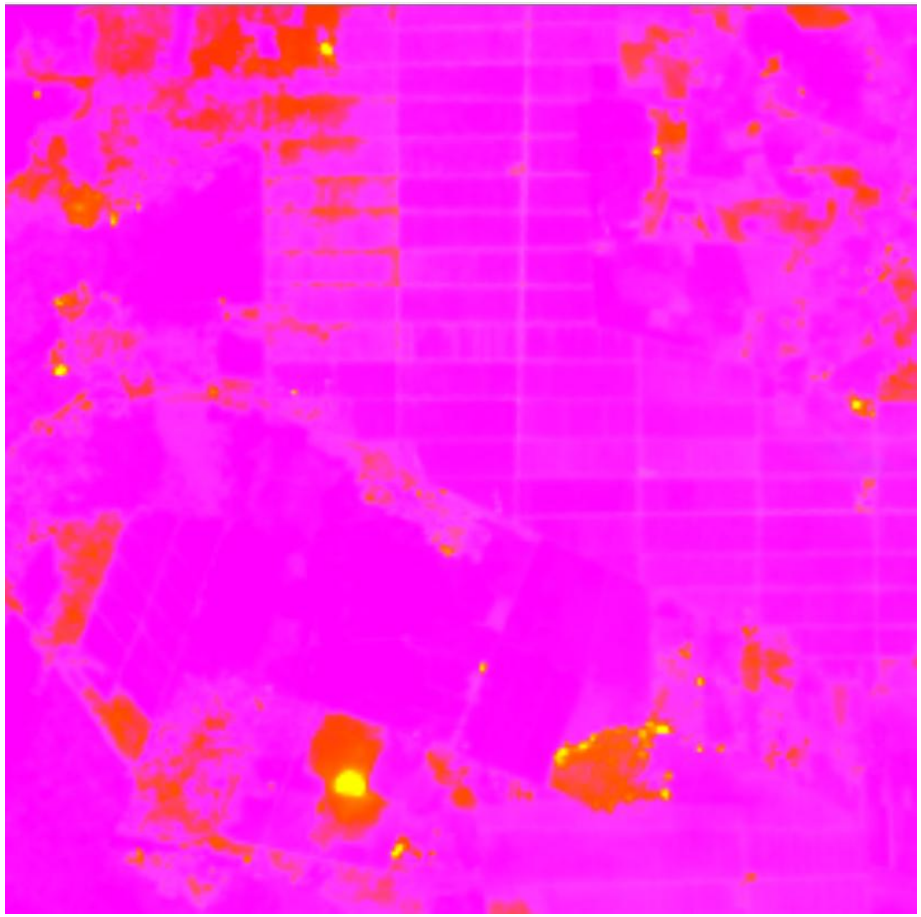


: Fire burnt inside burned area

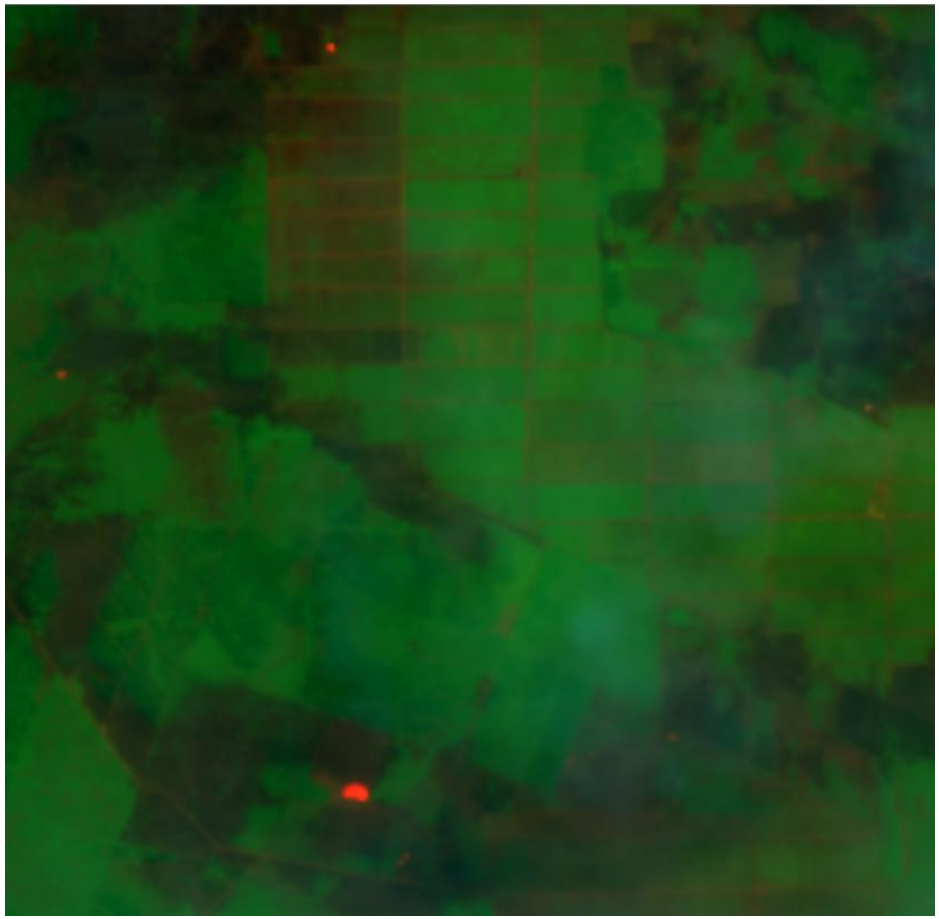
* All of the fires burnt are inside burned area → the result (area 2) is good

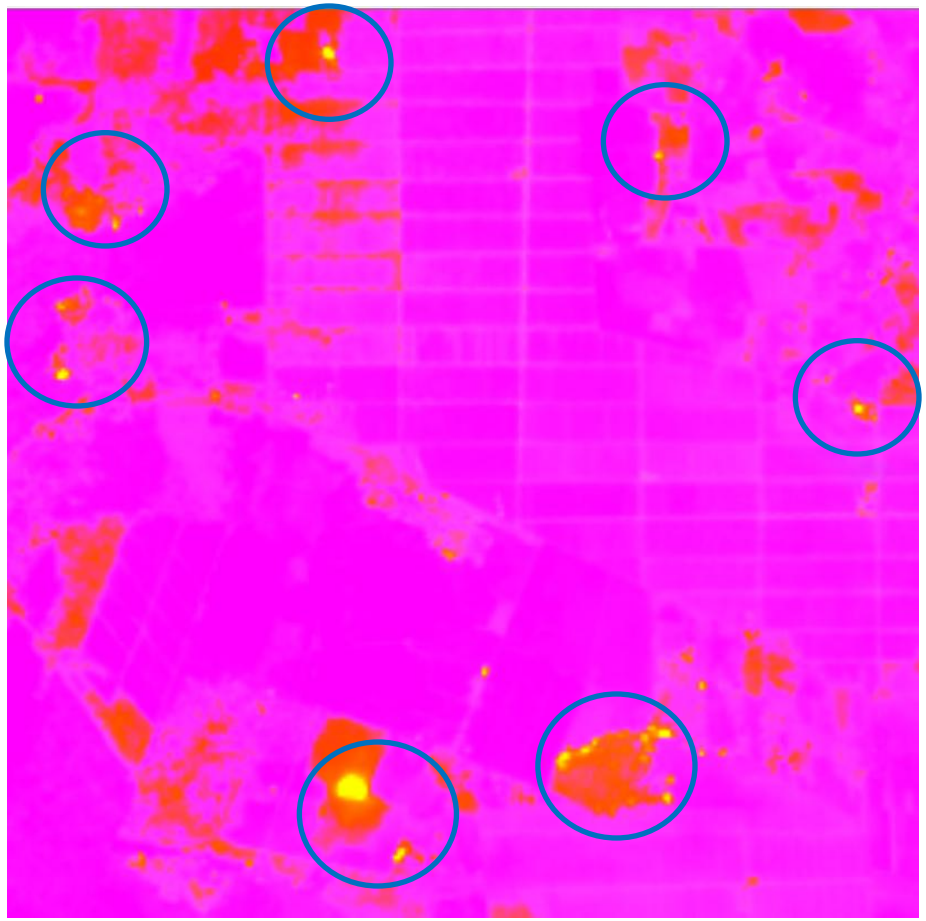
Fire Burned Area Mapping (Area 3)





Fire Burnt Area Detection (Area 3)



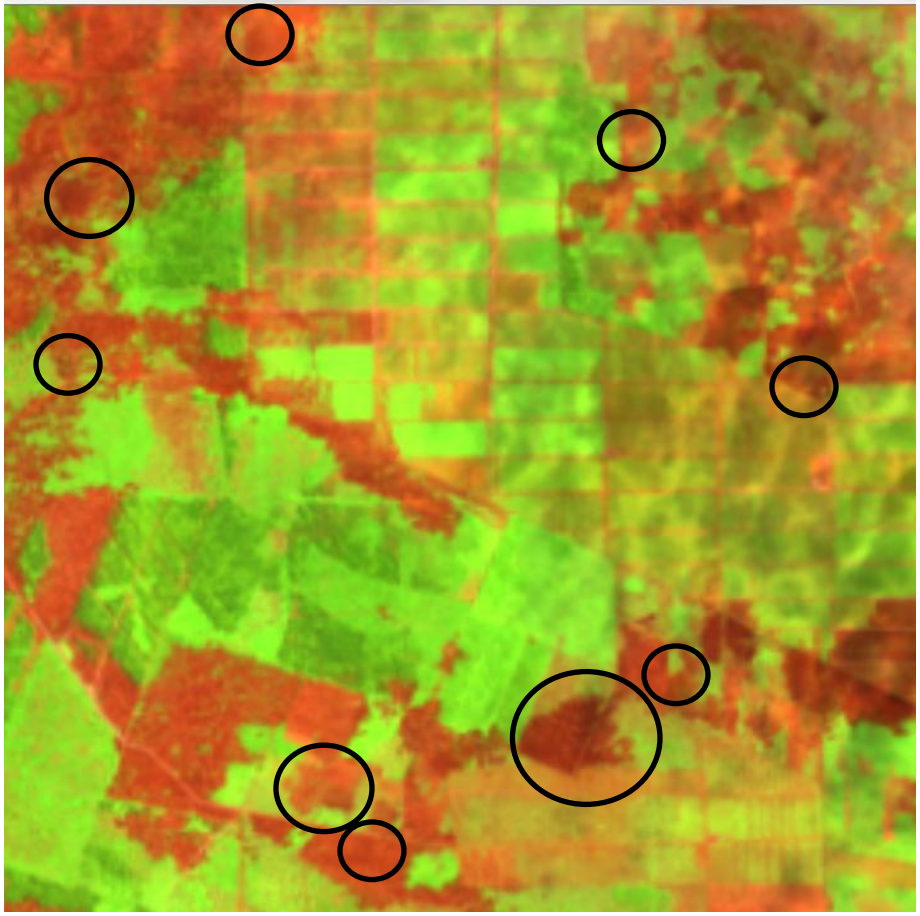


: Fire burnt (dark yellow)

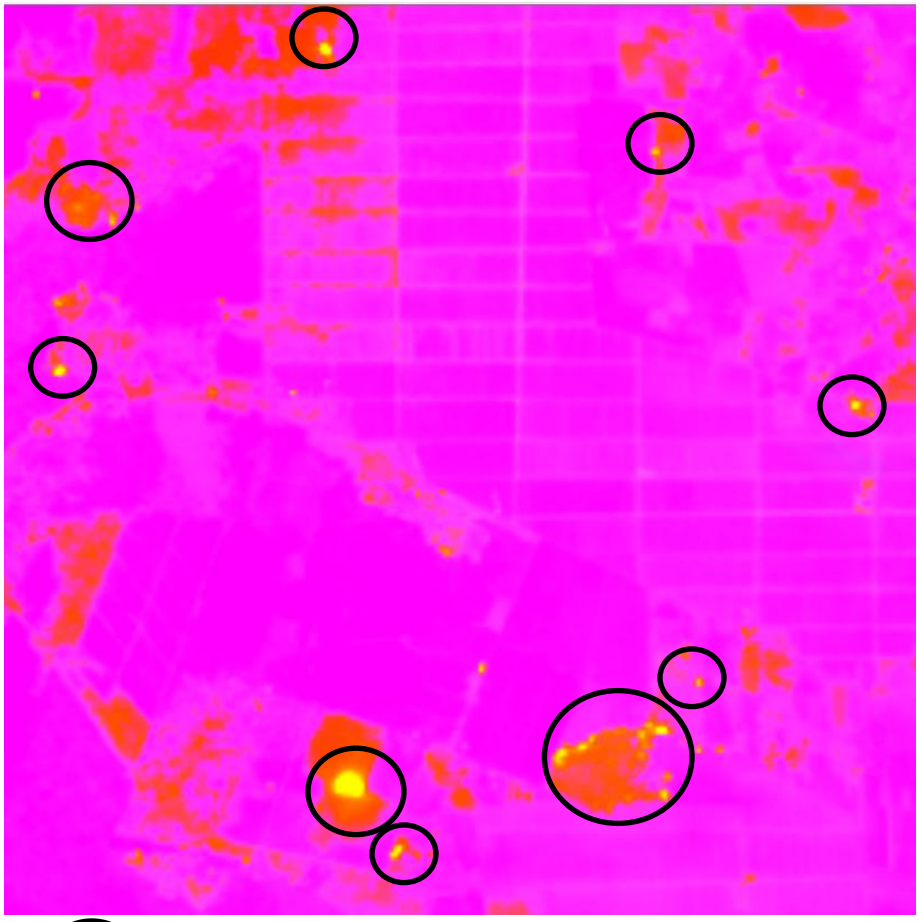
: Thick smoke/cloud (soft yellow)

Assessment: Fire Burnt Area Detection (Area 3)

After Burned



Fires happened



: Fire burnt inside burned area

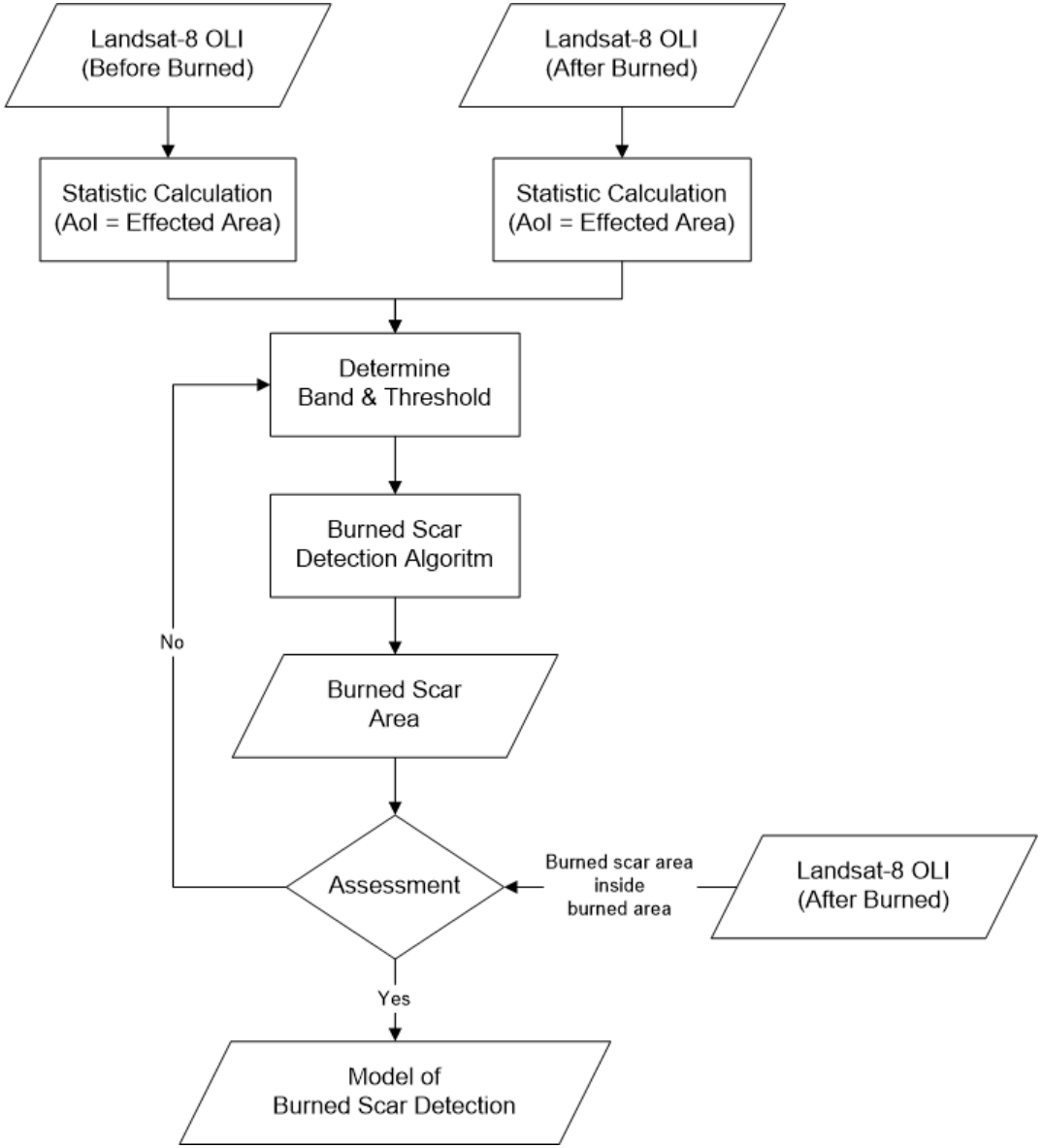
* All of the fires burnt are inside burned area → the result (area 3) is good

Assessment: Fire Burnt Area Detection

- **All of the results (area 1, area 2 and area 3) are good → the algorithm can be used to detect fire burnt area detection**

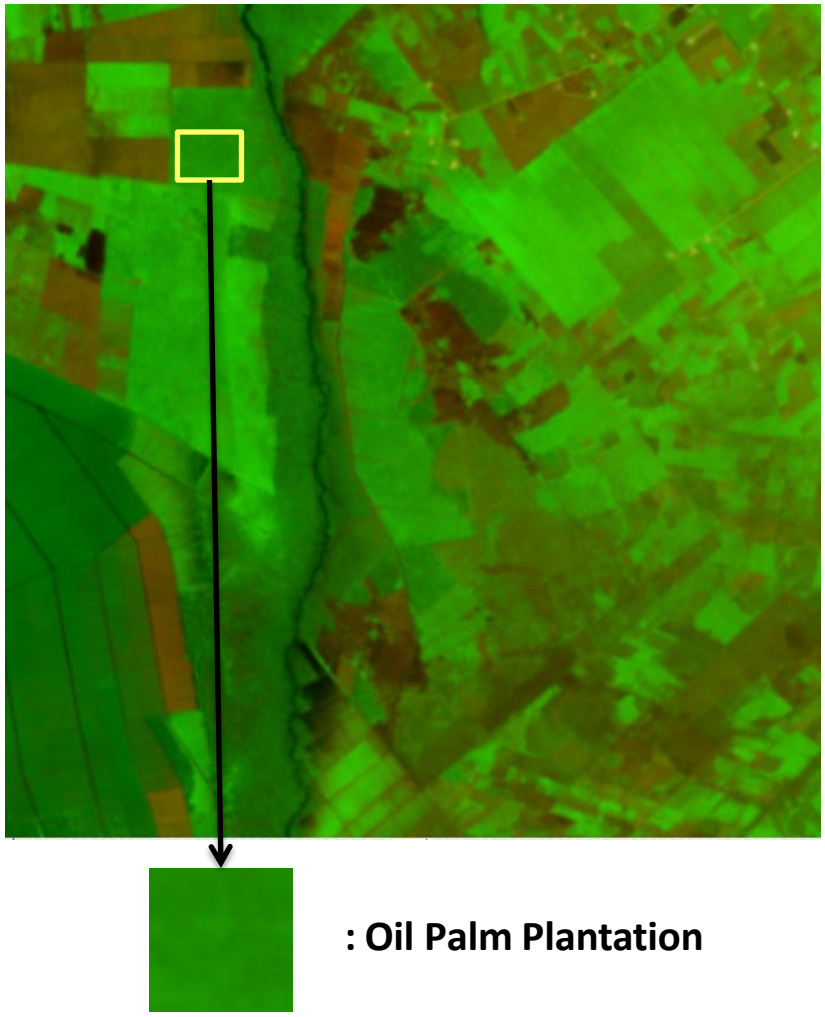
BURNED SCAR AREA DETECTION

Burned Scar Area Detection



Area of Interest (AoI) of Burned Area

Before Burned



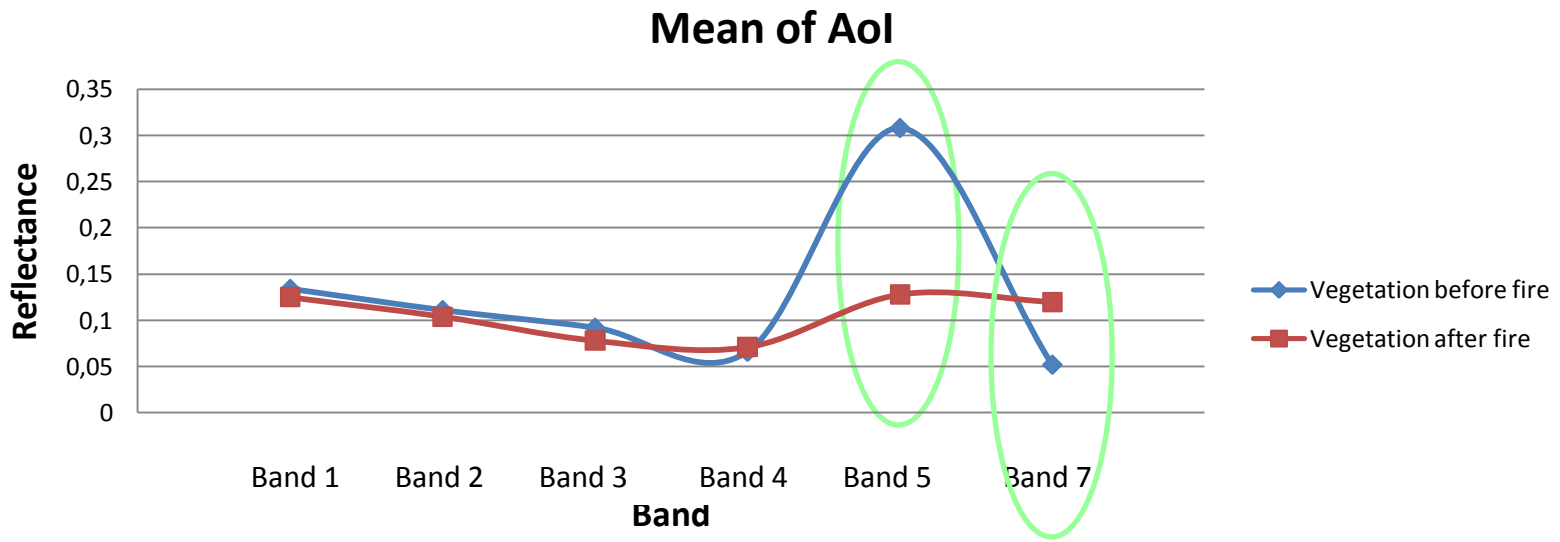
: Oil Palm Plantation

After Burned

: Burned Oil Palm Plantation

Statistic Overview of Burned Area

AoI	LANDSAT-8 SPECTRAL BAND					
	Band 1	Band 2	Band 3	Band 4	Band 5	Band 7
	0.43 - 0.45 µm	0.45 - 0.52 µm	0.53 -0.60 µm	0.63 -0.68 µm	0.85 - 0.89 µm	2.10 – 2.30 µm
Vegetation before fire	0,134	0,111	0,092	0,066	0,308	0,052
Vegetation after fire	0,125	0,104	0,078	0,071	0,128	0,12



* The difference value of mean at band 5 and band 7 are bigger than others.
  → band 5 and band 7 can be used to detect burned scar area on oil palm plantations
* NBR = (B5 – B7)/ (B5 + B7) → To enhance the spectral response of fires affected oil palm plantations

Normalized Burn Ratio (NBR)

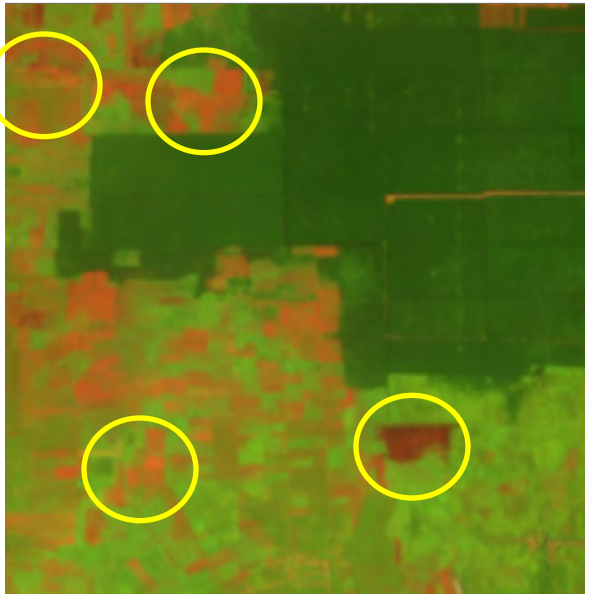
- Burned scar area detection:

  dNBR = NBR prefire – NBR postfire

- On burned scar area, NBR prefire value have higher value than NBR postfire → dNBR > 0 (choose a possitive number to be used for threshold)

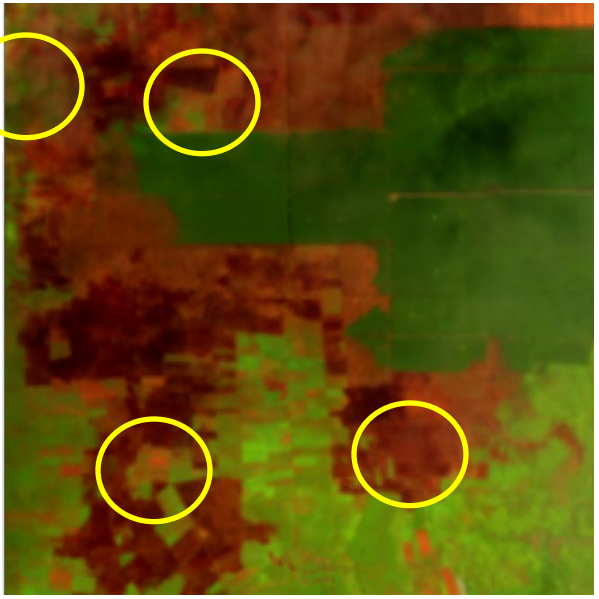
Burned Scar Area using dNBR

Before Burned



dNBR

After Burned



: dNBR is sensitive on oil palm plantations

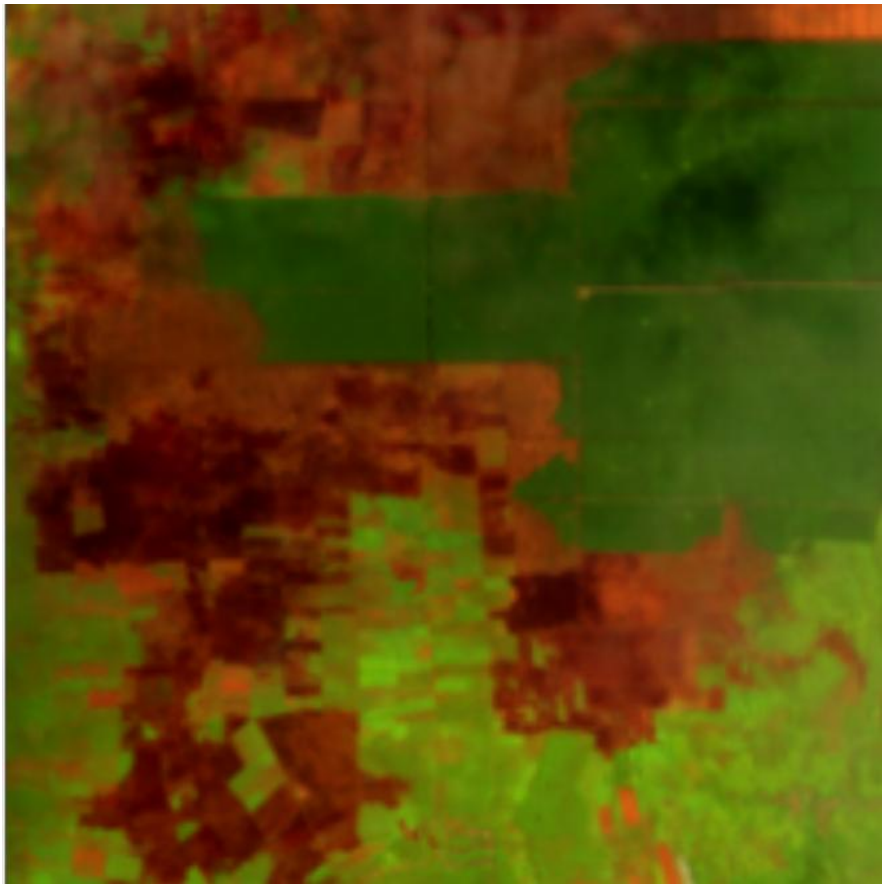
: dNBR is not sensitive on open land

* dNBR can be used to detect burned area especially on oil palm plantations

Assessment : Burned Scar Area using dNBR

Burned Scar Area

After Burned



* All of the burned scar area are inside burned area → the result is good
* The algorithm can be used to detect burned scar area

Conclusion

1. Brightness Temperature can be used to detect firespot

2. Band combination of RGB (TIRS, SWIR,NBR) can be used to detect fire burnt area (no need to classify (takes a long time) the remote sensing data to detect fire burnt area)

3. dNBR :

- Sensitive to burned oil palm plantations (vegetation)
- Not sensitive to burned open land/soil
- Can be used to detect burned area especially on oil palm plantations

Thank You

thedananx@yahoo.com