



ESA - MOST Dragon 2 Programme

2011 DRAGON 2 SYMPOSIUM

中国科技部-欧洲空间局合作“龙计划”二期

“龙计划”二期2011年学术研讨会

BURNT SCAR AND FOREST FIRE DAMAGE ANALYSIS BY MEANS OF DEIMOS-1 IMAGES

20 - 24 June 2011 | Prague | Czech Republic

捷克 布拉格 2011年6月20-24日

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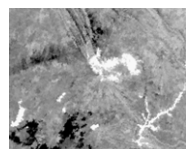
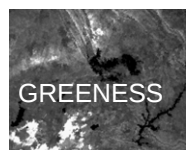
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Prof. Huide Cai
Forest Resources Monitoring Center, Forestry Survey and Design Institute, GuangXi, China

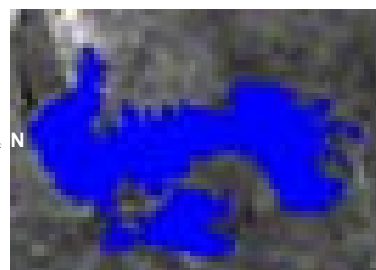
Dr. Zhenchun Huang
Department of Computer Science, Tsinghua University, China

DRAGON 1

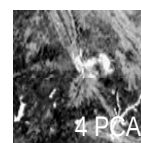
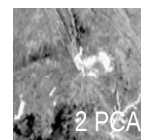
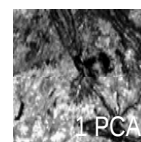
MONITORING OF FOREST FIRES IN CHINA THROUGH THE ENVISAT-AATSR SENSOR: BURNT AREA CARTOGRAPHY



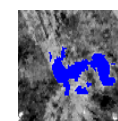
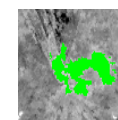
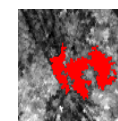
TASSELED CAP APPLIED TO MERIS IMAGES



PRINCIPAL COMPONENTS APPLIED TO MERIS IMAGES

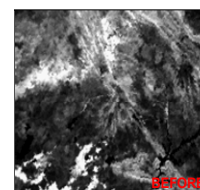
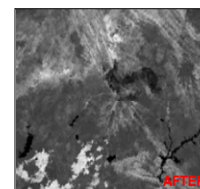


VISUAL
INTERPRETATION

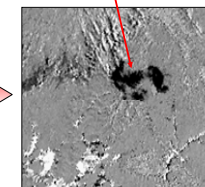
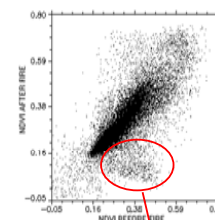


■ 3 Confidence level
■ 2 Confidence level
■ 1 Confidence level

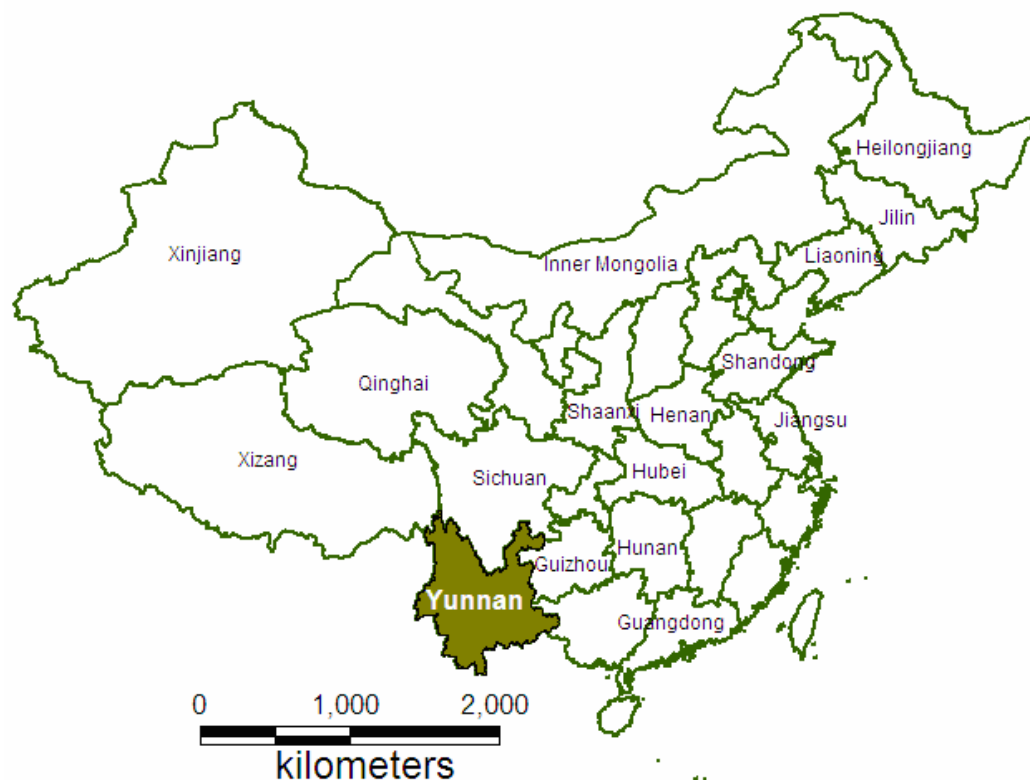
CONTEXTUAL ANALYSIS BY USING NDVI ON MERIS IMAGES

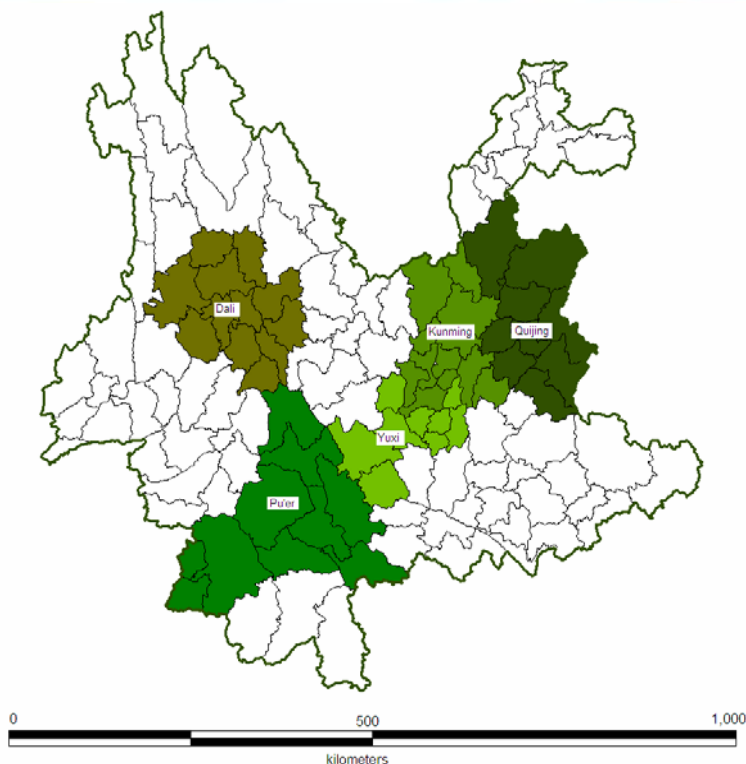


$NDVI_{AFTER} - NDVI_{BEFORE}$



On 13th October 2009, the Chinese Insurance Regulatory Authority (CIRC) and State Forestry Administration (SFA) jointly notified an intention to develop forestry insurance on China. Since then, forestry insurance programmes with subsidised premiums have been launched.





YUNNAN

24,300,000 ha
62 % - 9 % China

Pu'er District 3,044,867 ha

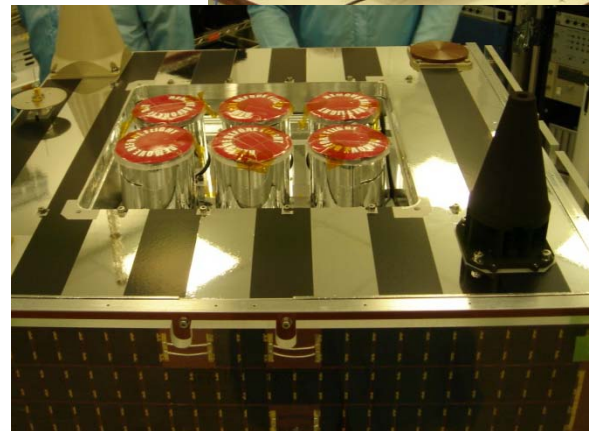
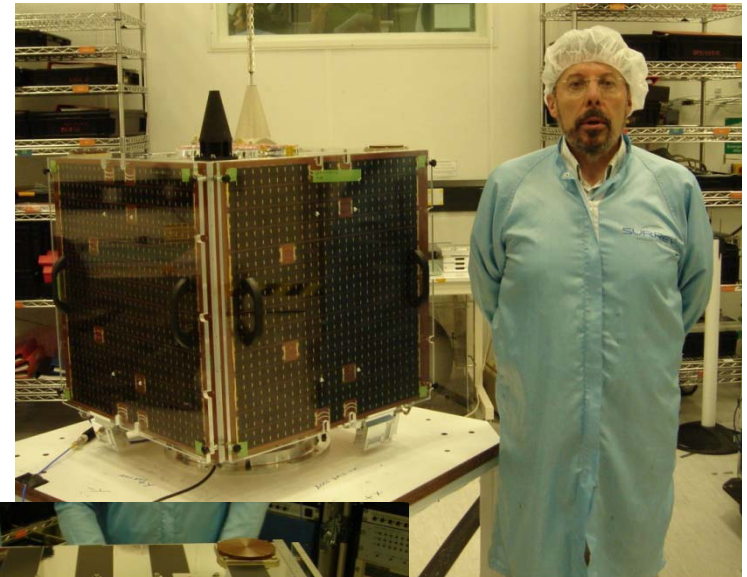
Average number of fires 2001-2010: 68 fires/year
Average area damaged " : 1262 ha/year

Average area damaged by fire: 18'6 ha/fire

Source: China Statistical Yearbook & others
Area Damaged is the area with more than 30% loss.

DEIMOS-1

- Multi-spectral Satellite
- Green, Red and Near Infrared Bands; Landsat equivalents
- High 659 km
- Spatial resolution (GSD=22m)
- Wide Swath (620 km for 8 bits or 500 km for 10 bits)
- High temporal resolution
- Third Party Mission ESA 2009-2010
- GMES Contributing Mission



TROPFOREST-ESA

ESA / Joint Research Centre
(JRC)

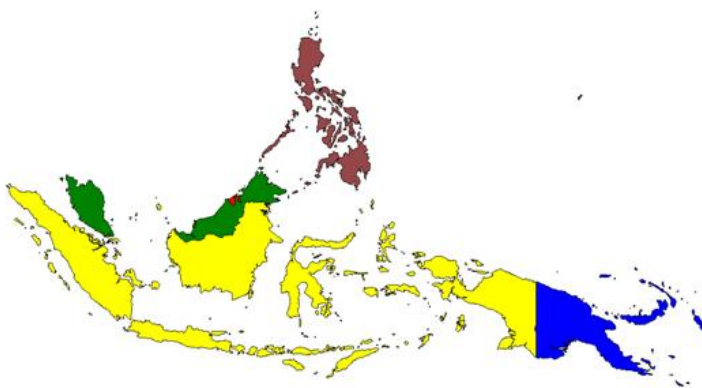
The tropical forest biomes in
Latin America, Africa and
Southeast Asia are the focus of
this work

South-East Asia:
7 countries, 3.0 Mkm²

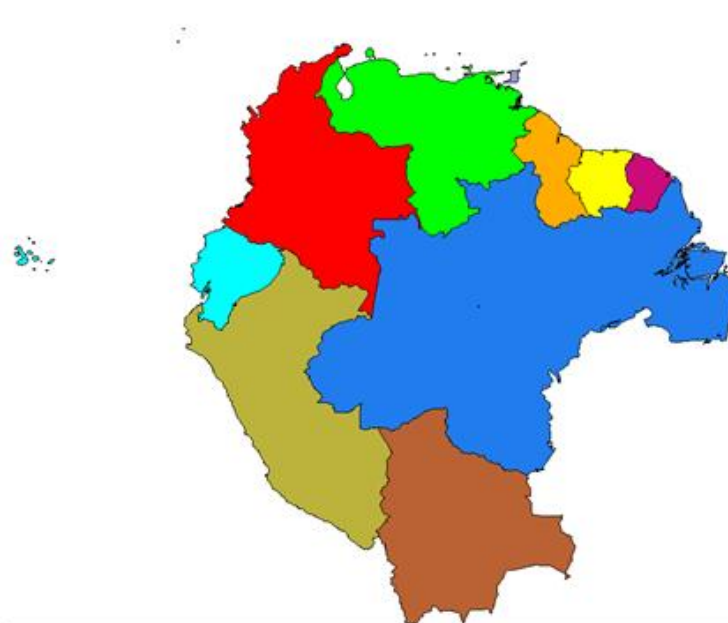
South America:
10 countries, 8.3 Mkm²

FAO, JRC, UN-NPOC, DUE...

<http://due.esrin.esa.int/prjs/prjs134.php>



- Singapore
- Papua New Guinea
- Malaysia
- Indonesia
- Guam
- Philippines
- Brunei



- Brazil
- Bolivia
- Colombia
- Ecuador
- Guyana
- French Guiana
- Peru
- Suriname
- Trinidad and Tobago
- Venezuela

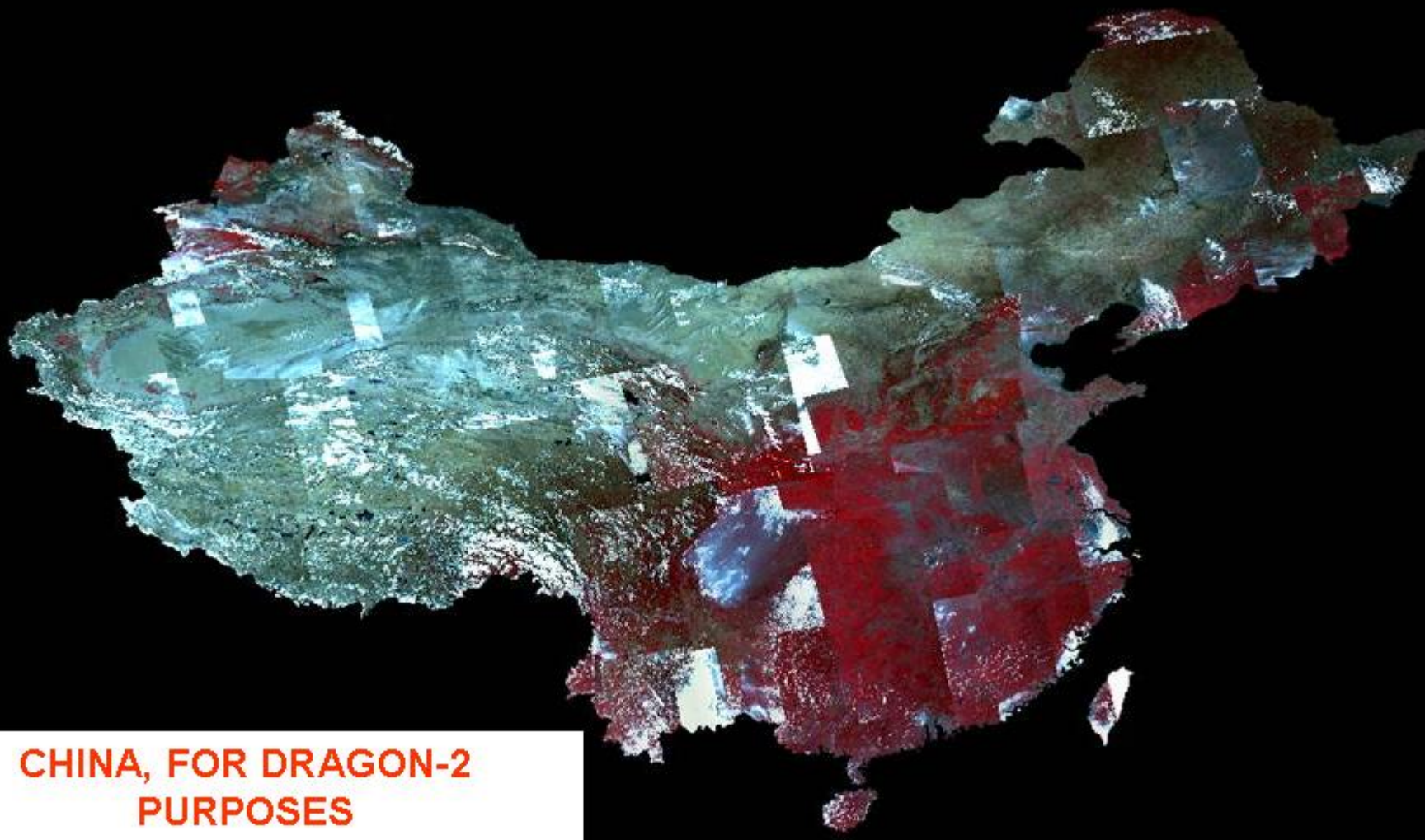
ESA: EUROPE



ESA: AFRICA

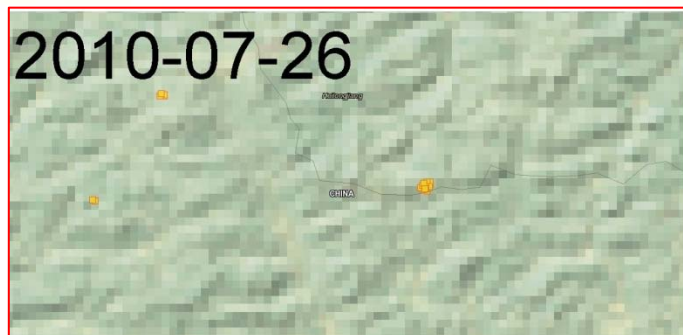
USDA: USA



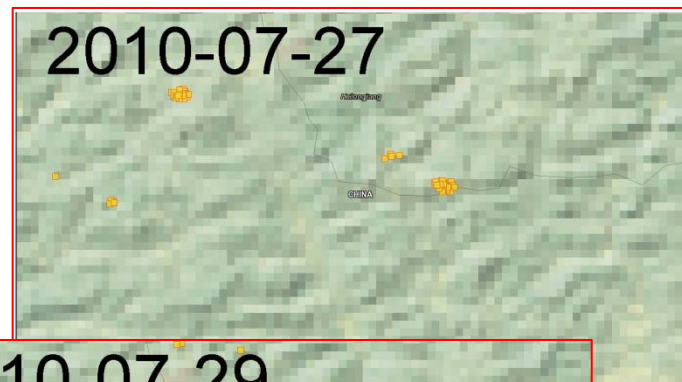


CHINA, FOR DRAGON-2 PURPOSES

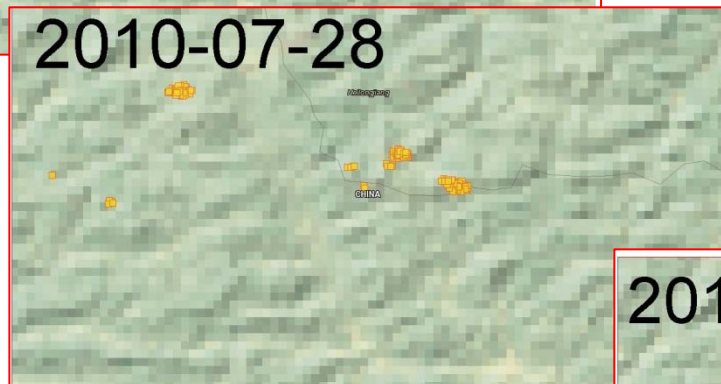
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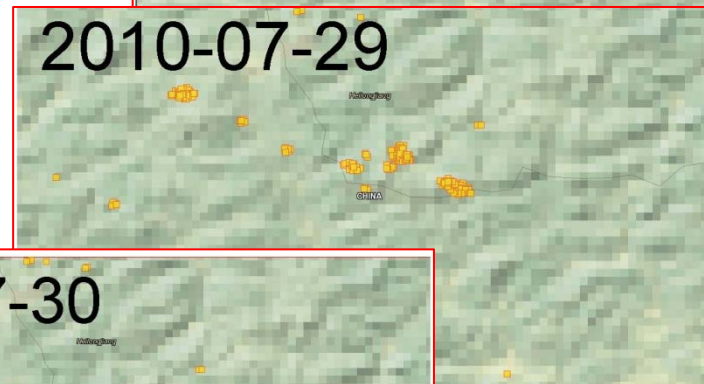
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2010-07-28



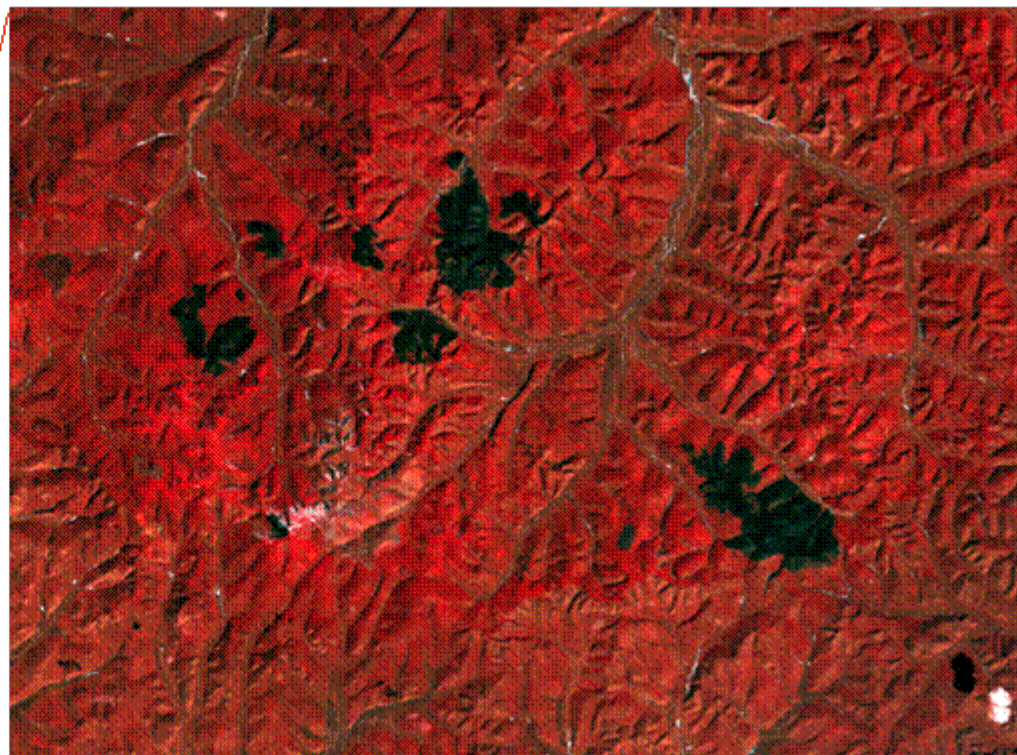
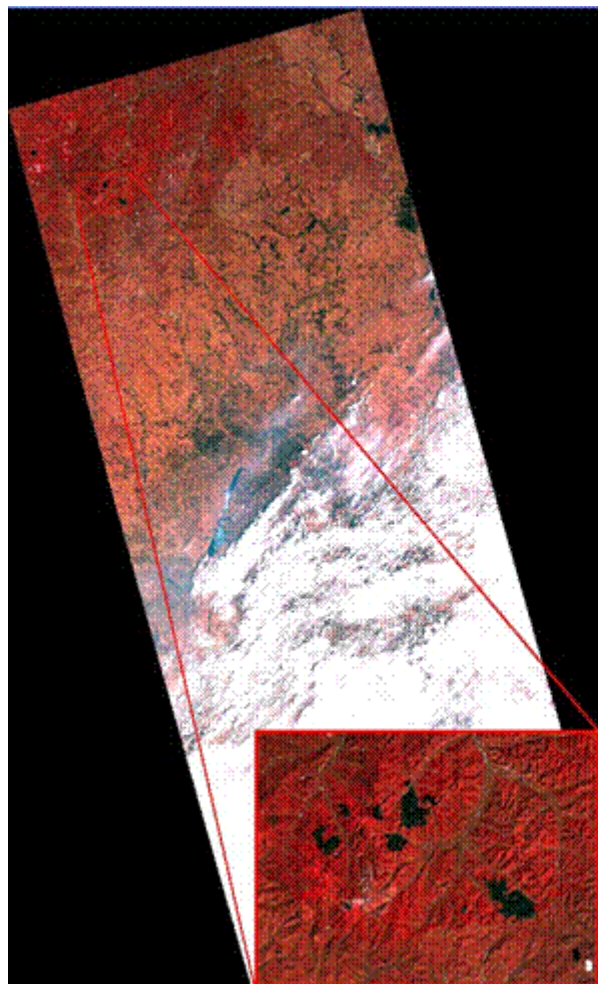
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2010-07-30

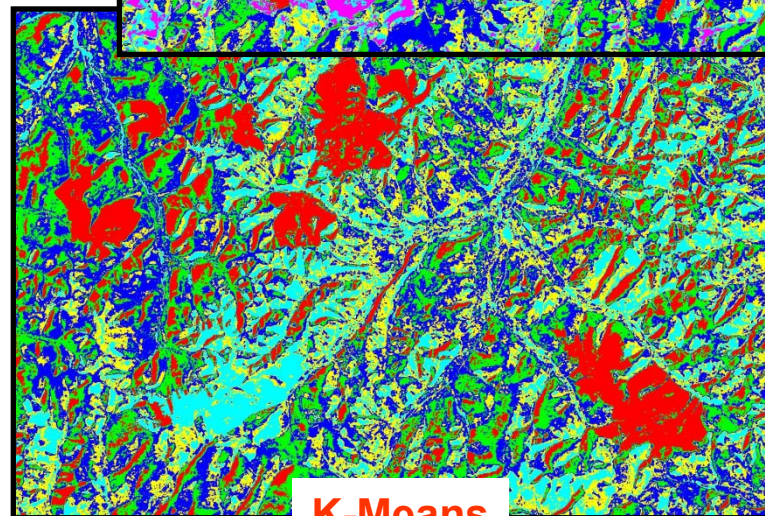
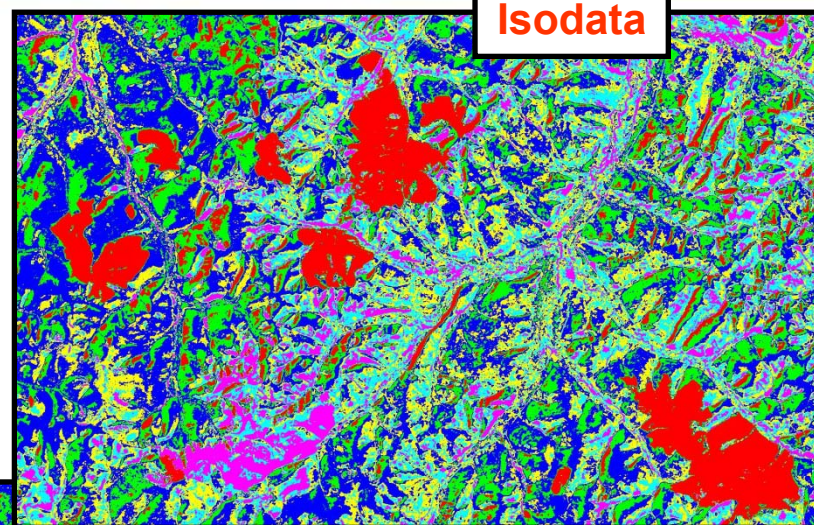
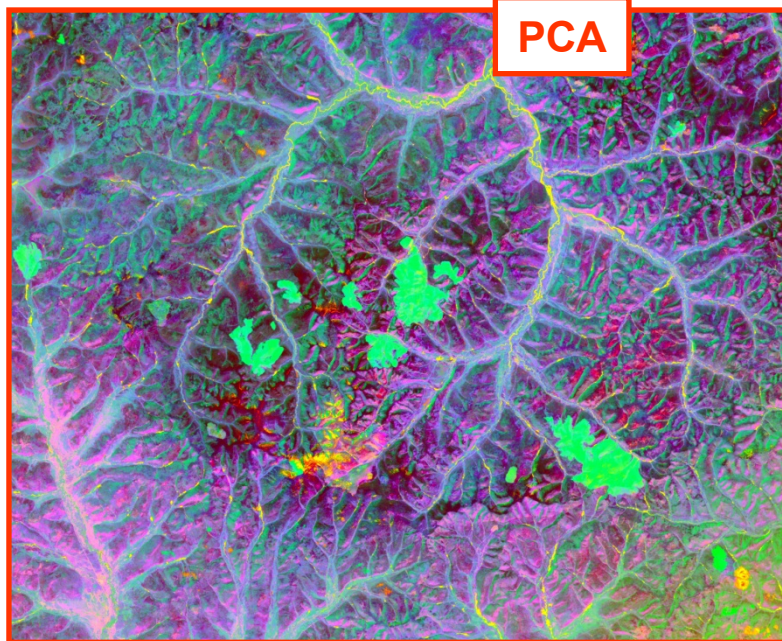


FIRMS-MODIS
Fire Information for Resource
Management System
NASA



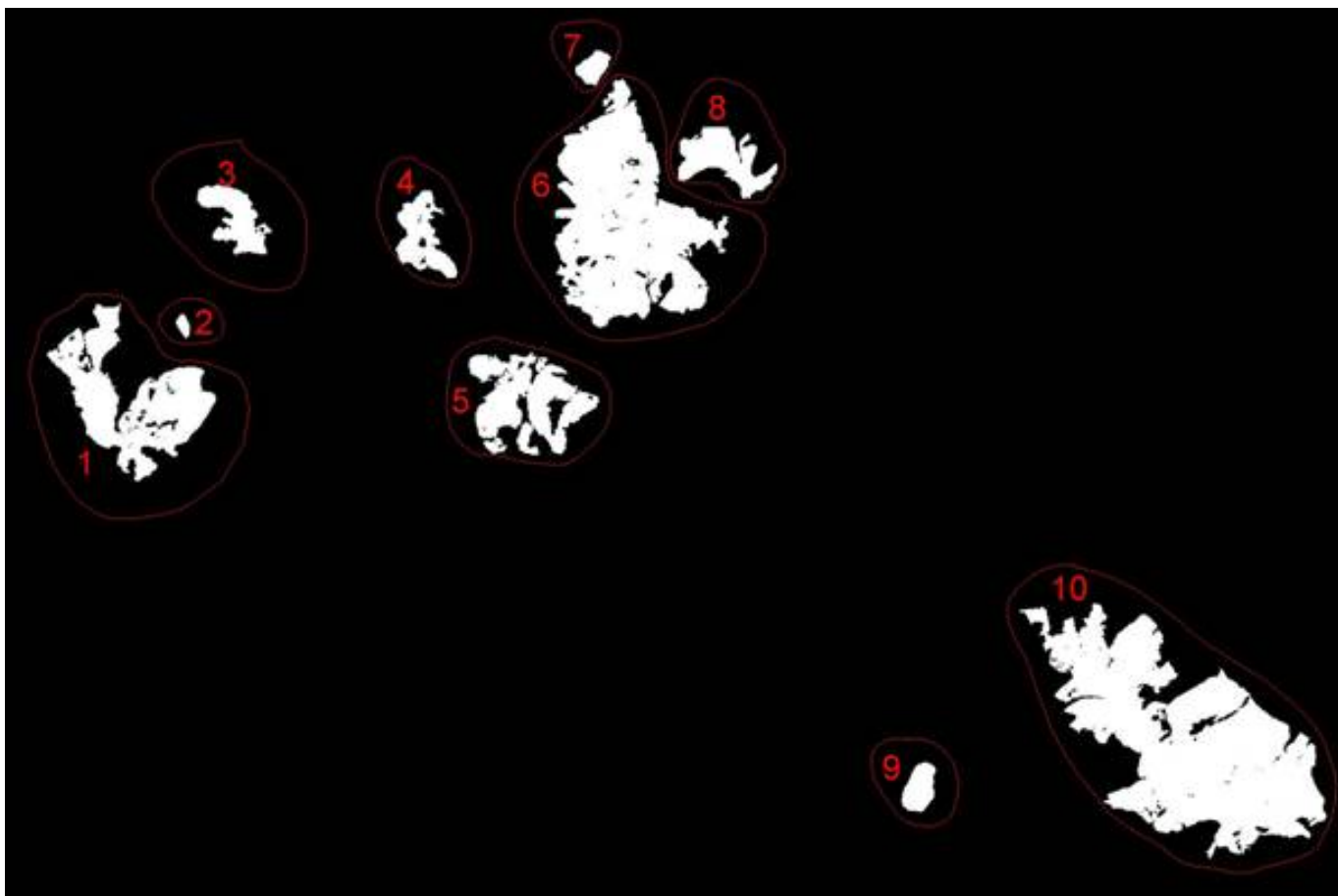
FOREST FIRE 29- 07- 2010
IMAGE 2011 - 04 - 04

FOREST FIRE

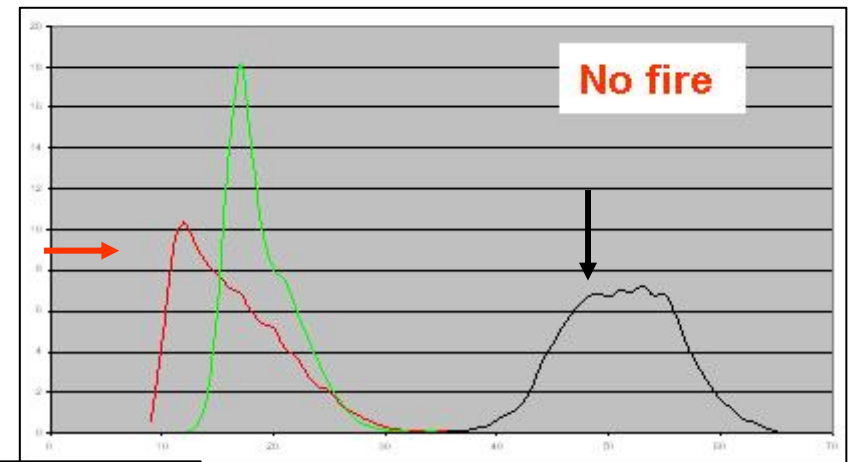
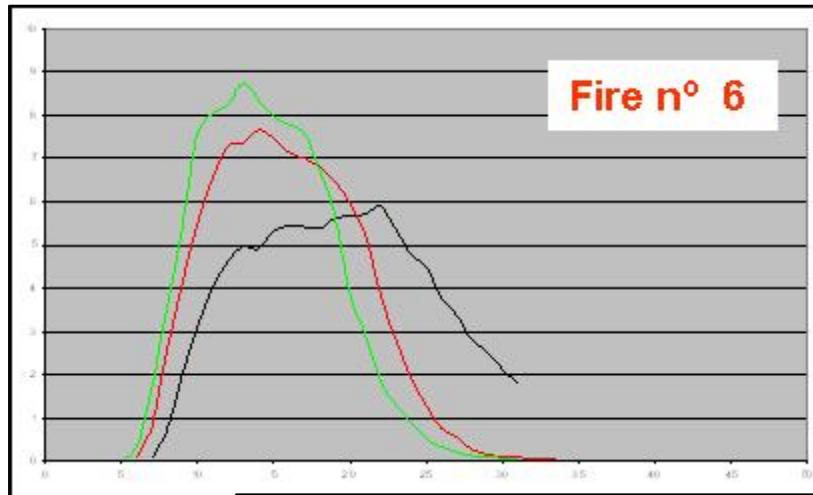


Methods useful for large fires using MERIS images, are inappropriate for small fires

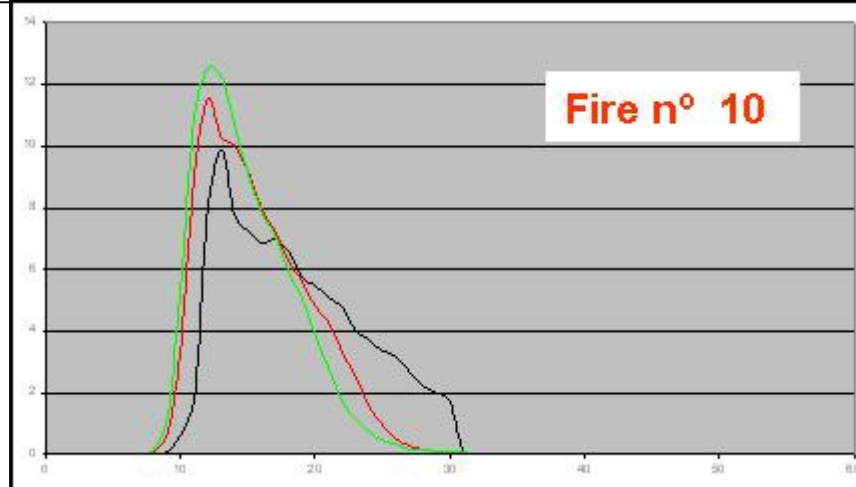
1st Step: Visual analysis of possible fire



2nd Step: To analyze the bands's histogram inside/outside the fire



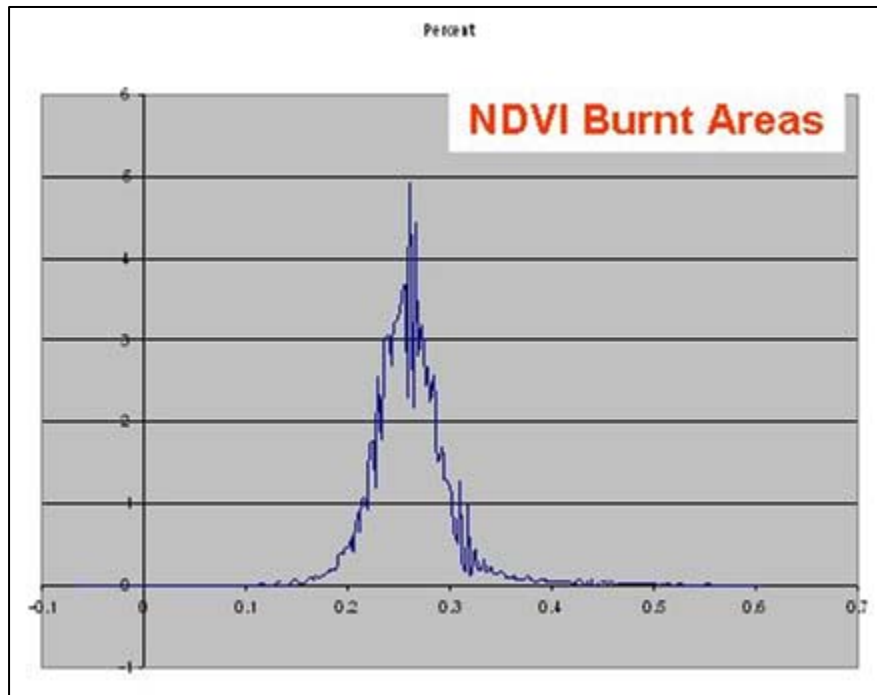
Red
Green
NIR



Fire Indicators

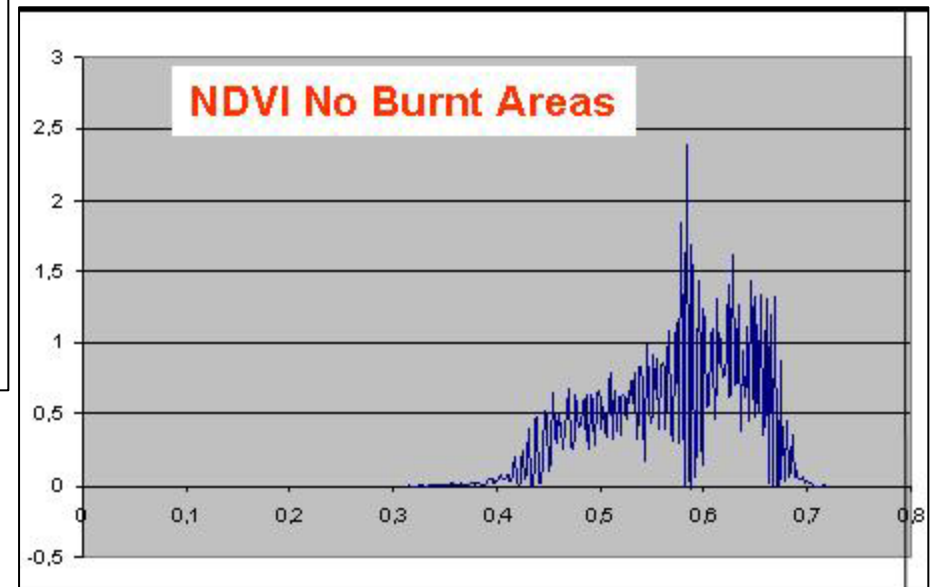
NIR DN (Rad/Ref)
RED Intensity Dif.
GREEN Variation

3rd Step/1: To analyze the NDVI histogram inside/outside the fire

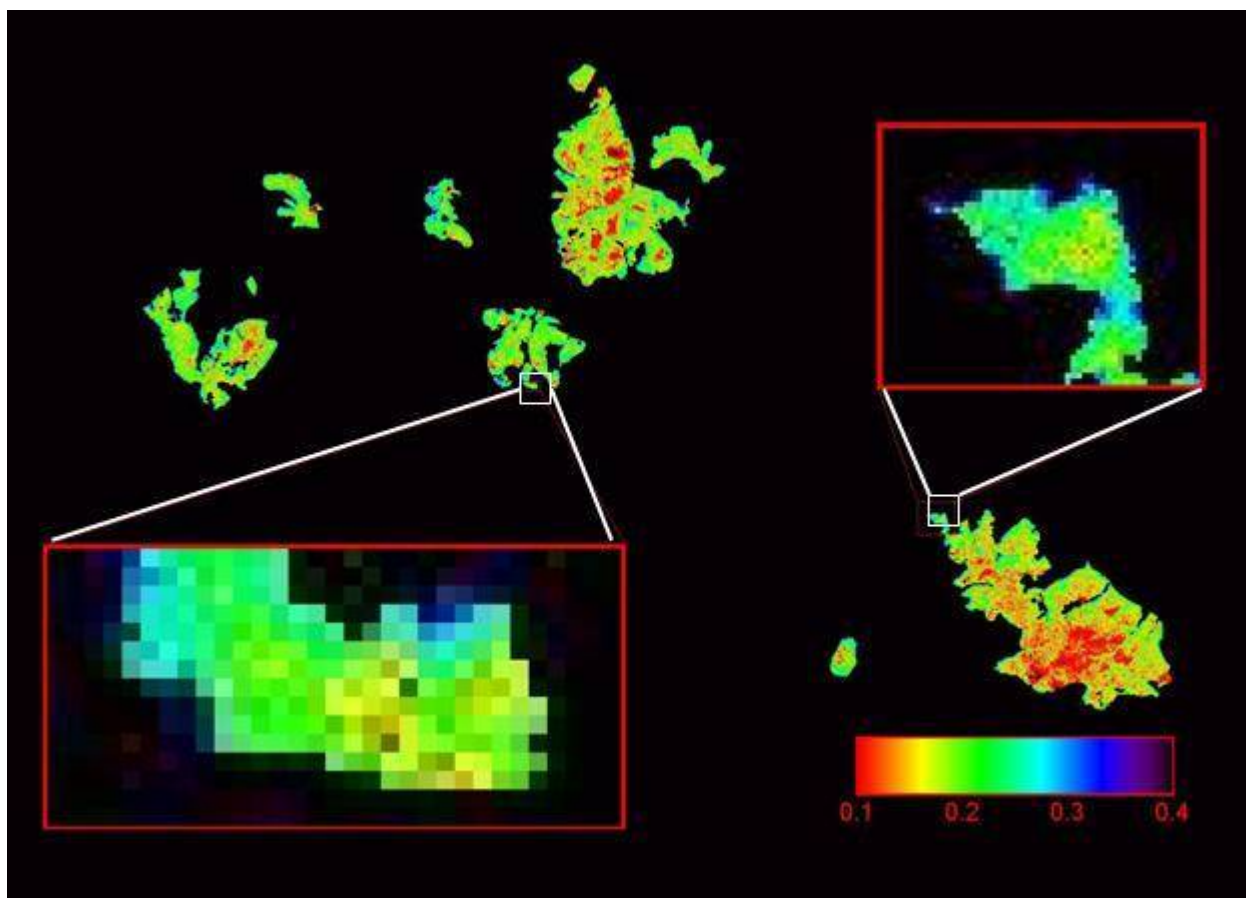


Fire Indicator:

**Distance between NDVI's
NDVI range**



3rd Step/2: To analyze the NDVI inside/outside the fire



ALGORITHM_{Burnt Forest Surface} = f (ΔRed, ΔGreen, ΔNIR, (Δ-δ)NDVI)

Ref (NIR)_{burnt} < 50 %Ref(NIR)_{no-burnt}

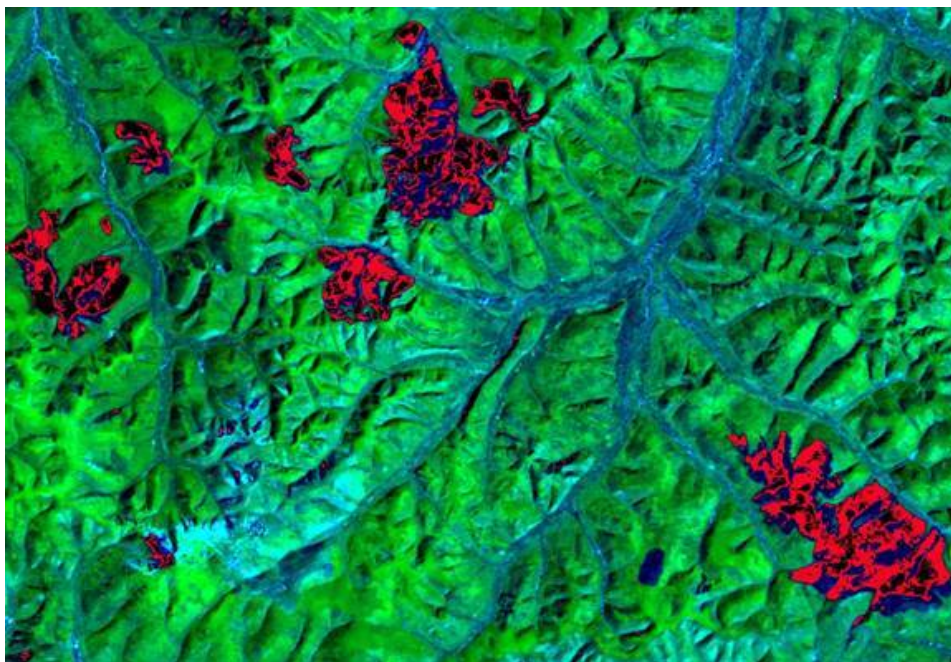
Ref (RED)_{burnt} < 40 %Ref(RED)_{no-burnt}

Ref (GREEN)_{burnt} < 30 %Ref(GREEN)_{no-burnt}

Contextual analysis 3x3: (R, G, NIR) average reflectances ± 1.σ

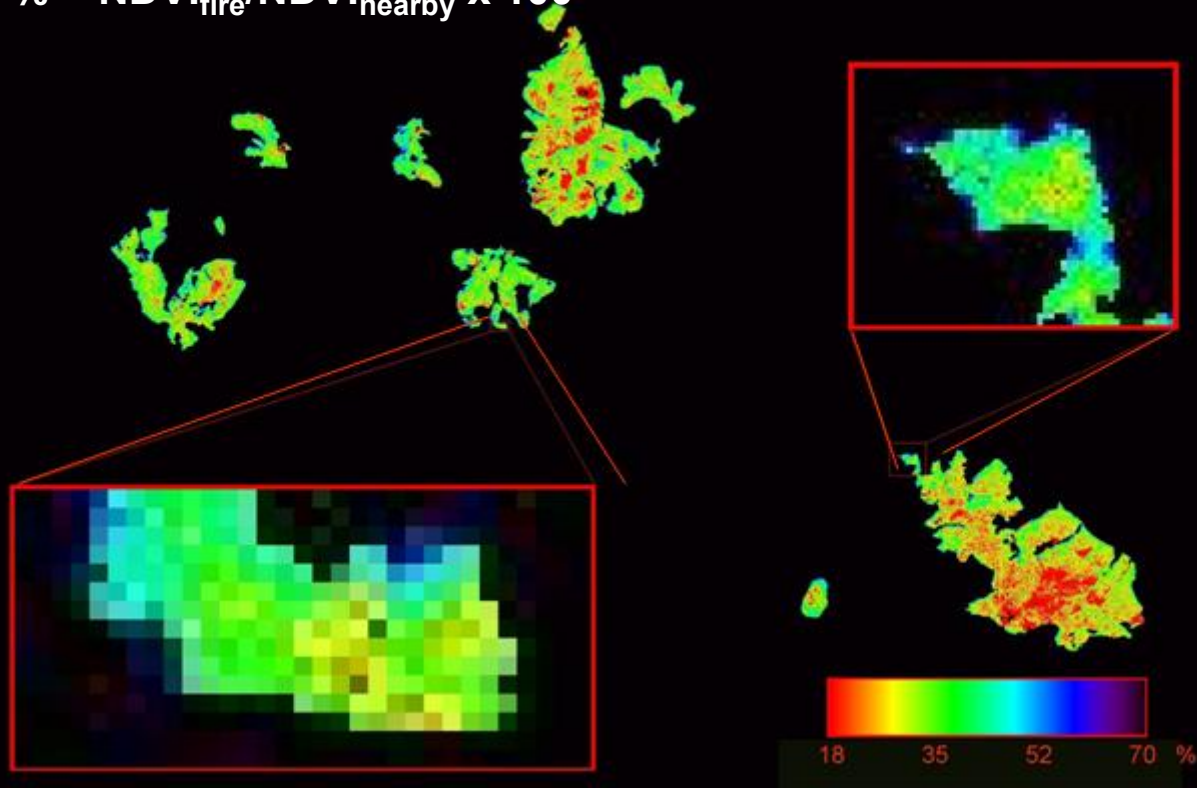
Min (NDVI_{no burnt}) ≥ 0,9 Max (NDVI_{burnt})

R: burnt area cartography; G: NIR; B: Green



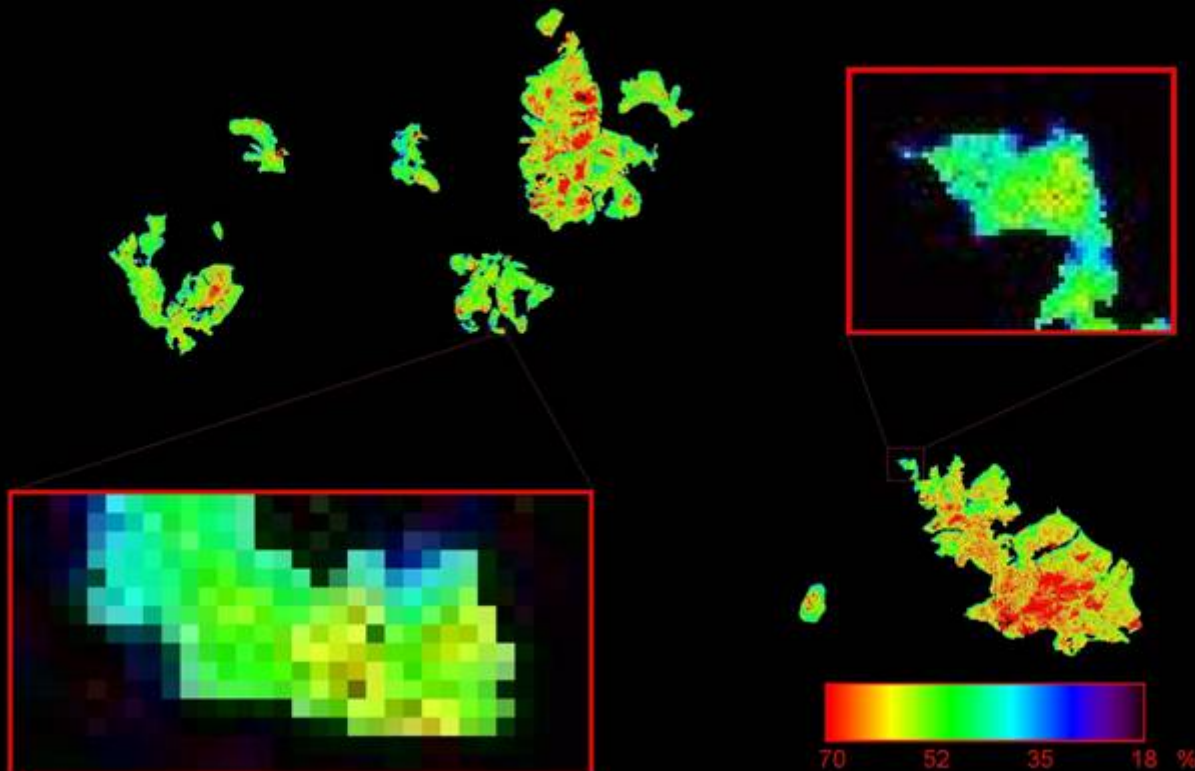
Percentage of recovery NDVI one year after the fire

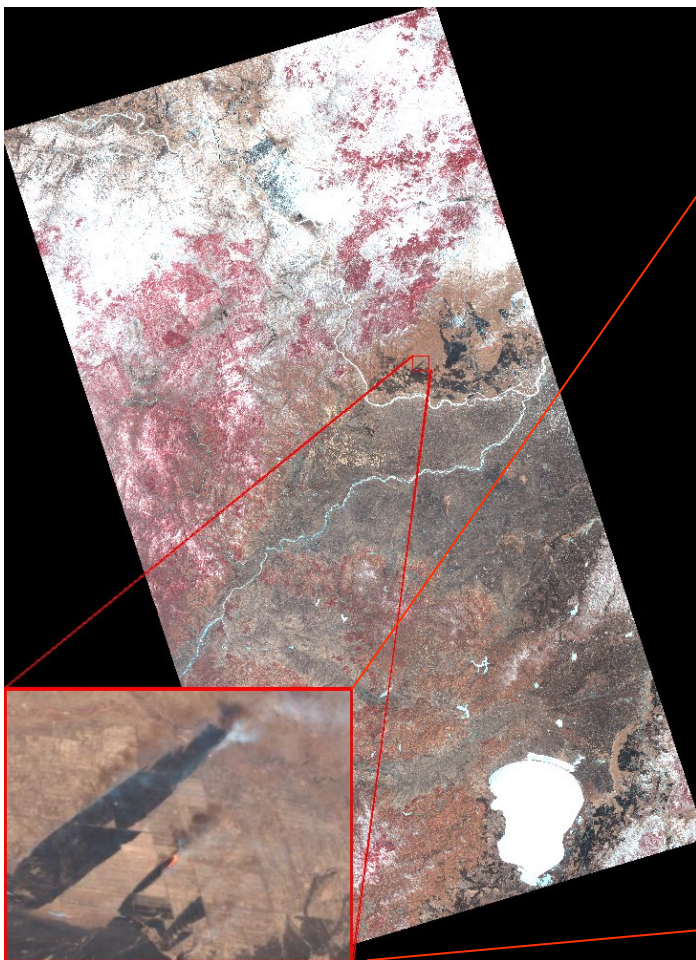
$$\% = \text{NDVI}_{\text{fire}} / \text{NDVI}_{\text{nearby}} \times 100$$



Percentage of NDVI lost after the fire

$$\% = (1 - \text{NDVI}_{\text{fire}} / \text{NDVI}_{\text{nearby}}) \times 100$$



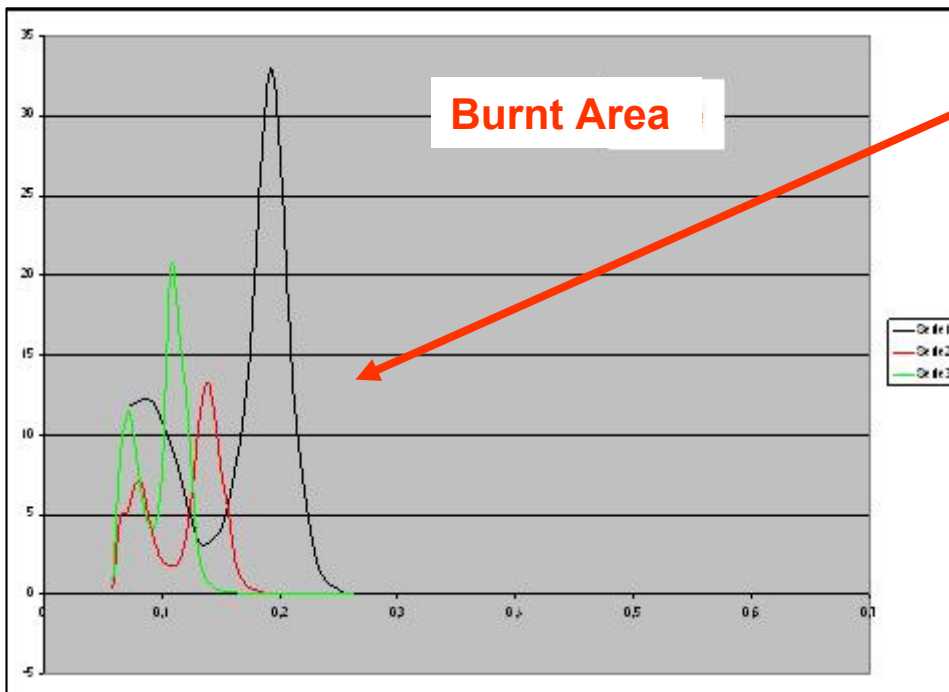


AGRICULTURAL FIRE 13-05-2011
Image was taken on the same date

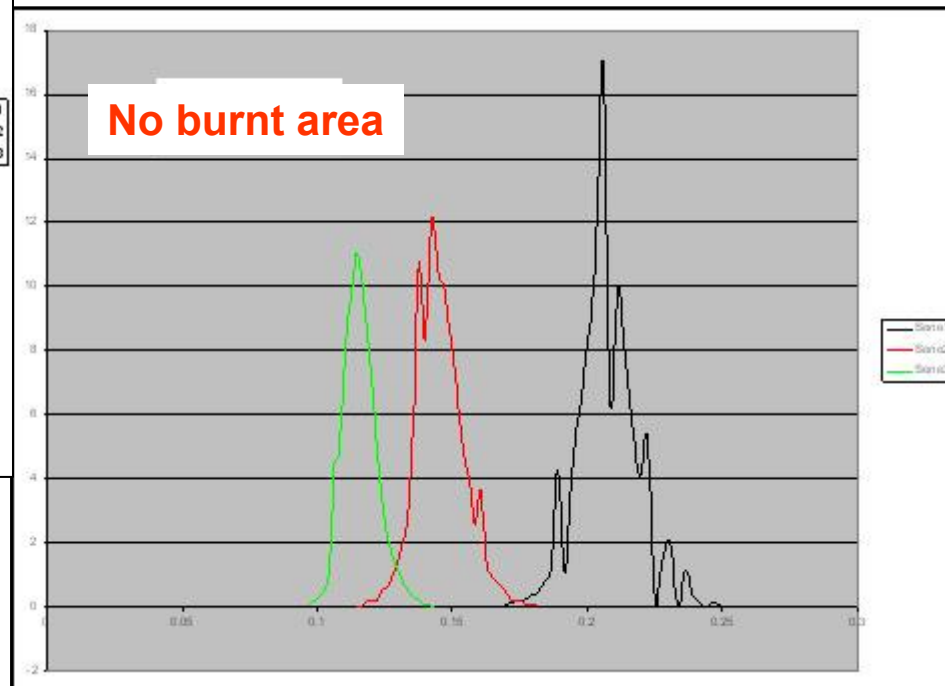
1st Step: Visual analysis of possible fire



2nd Step: To analyze the bands's histogram inside/outside the fire

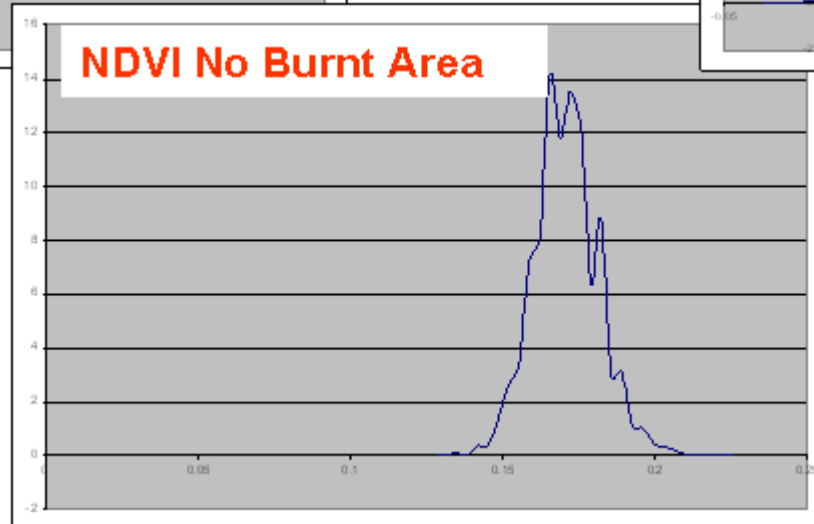
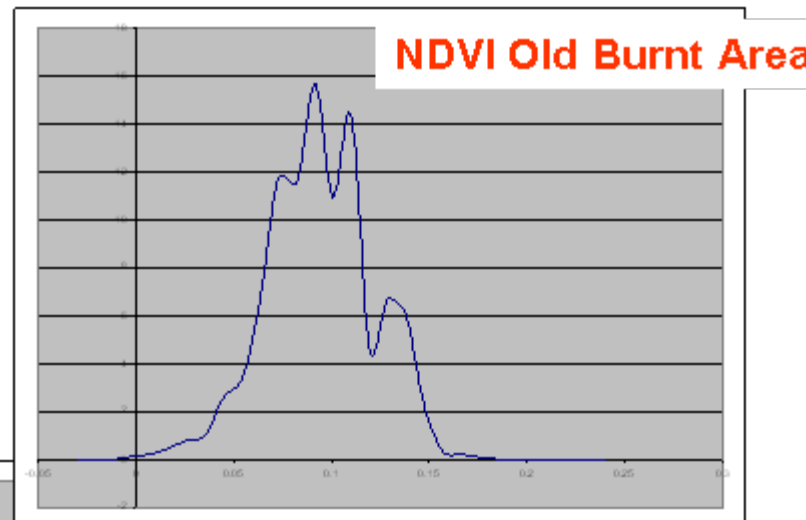
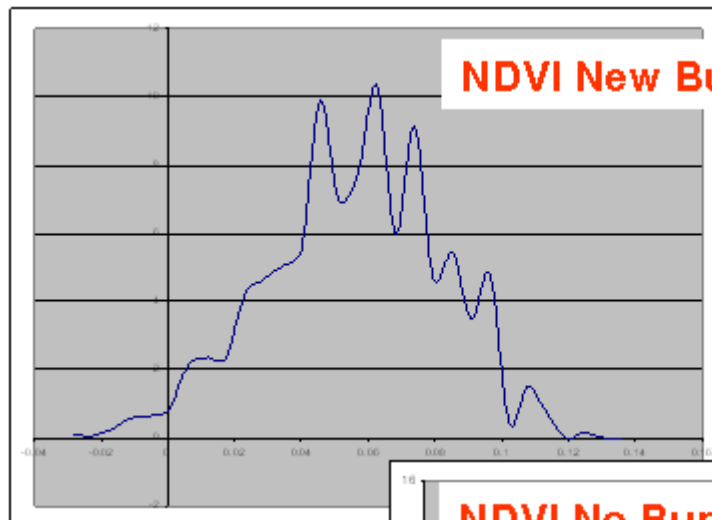


Double Maxima means TWO different fires!

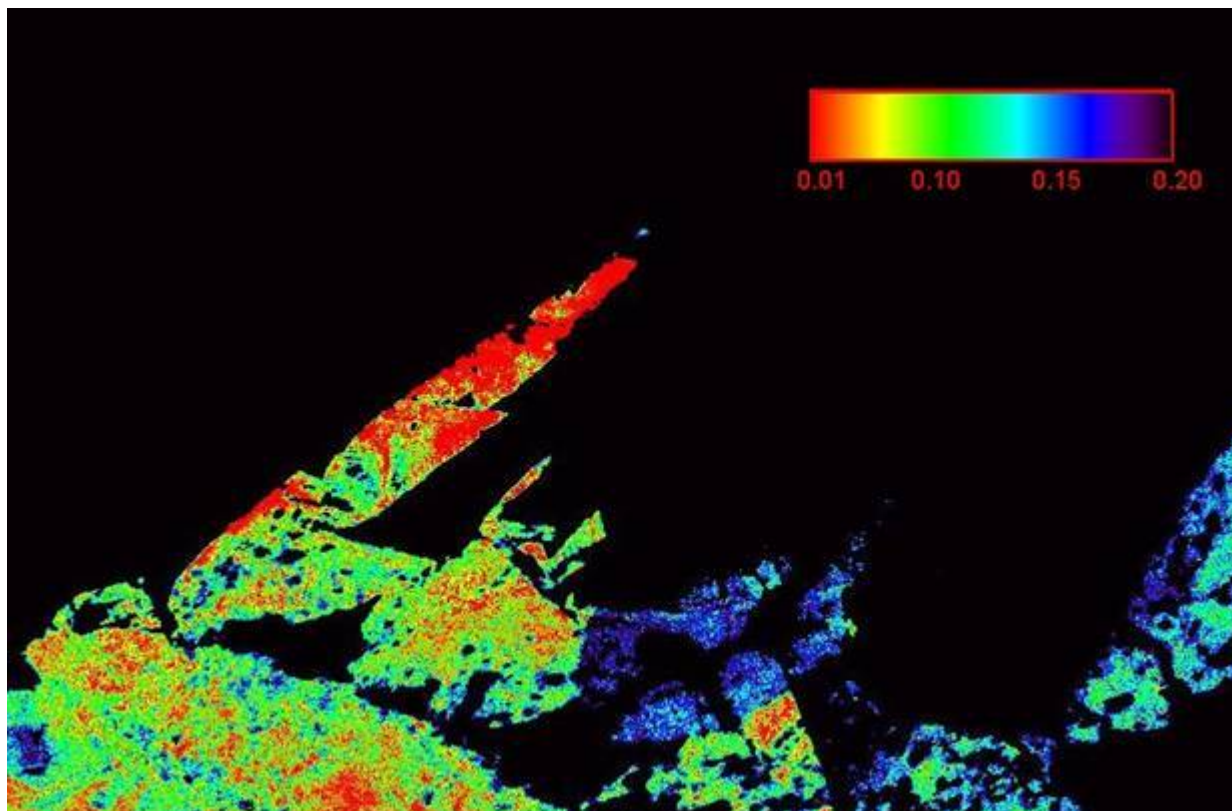


Red
Green
NIR

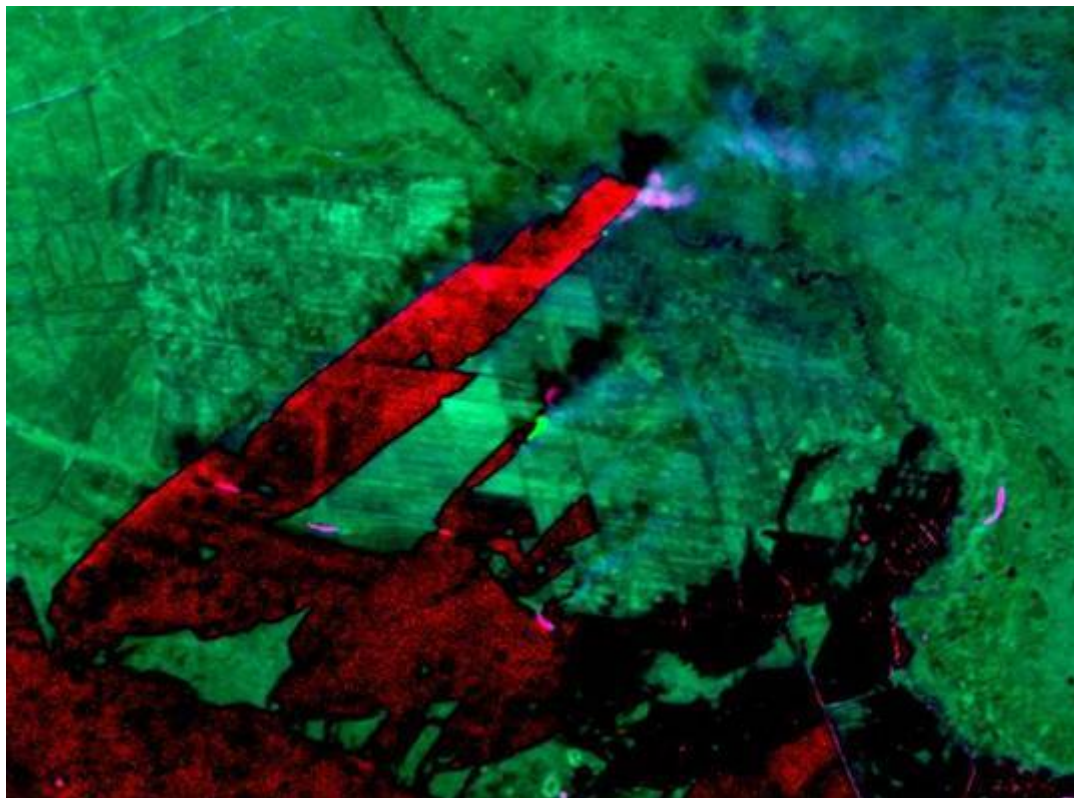
3rd Step: To analyze the NDVI histogram inside/outside the fire



3rd Step: To analyze the NDVI inside/outside the fire

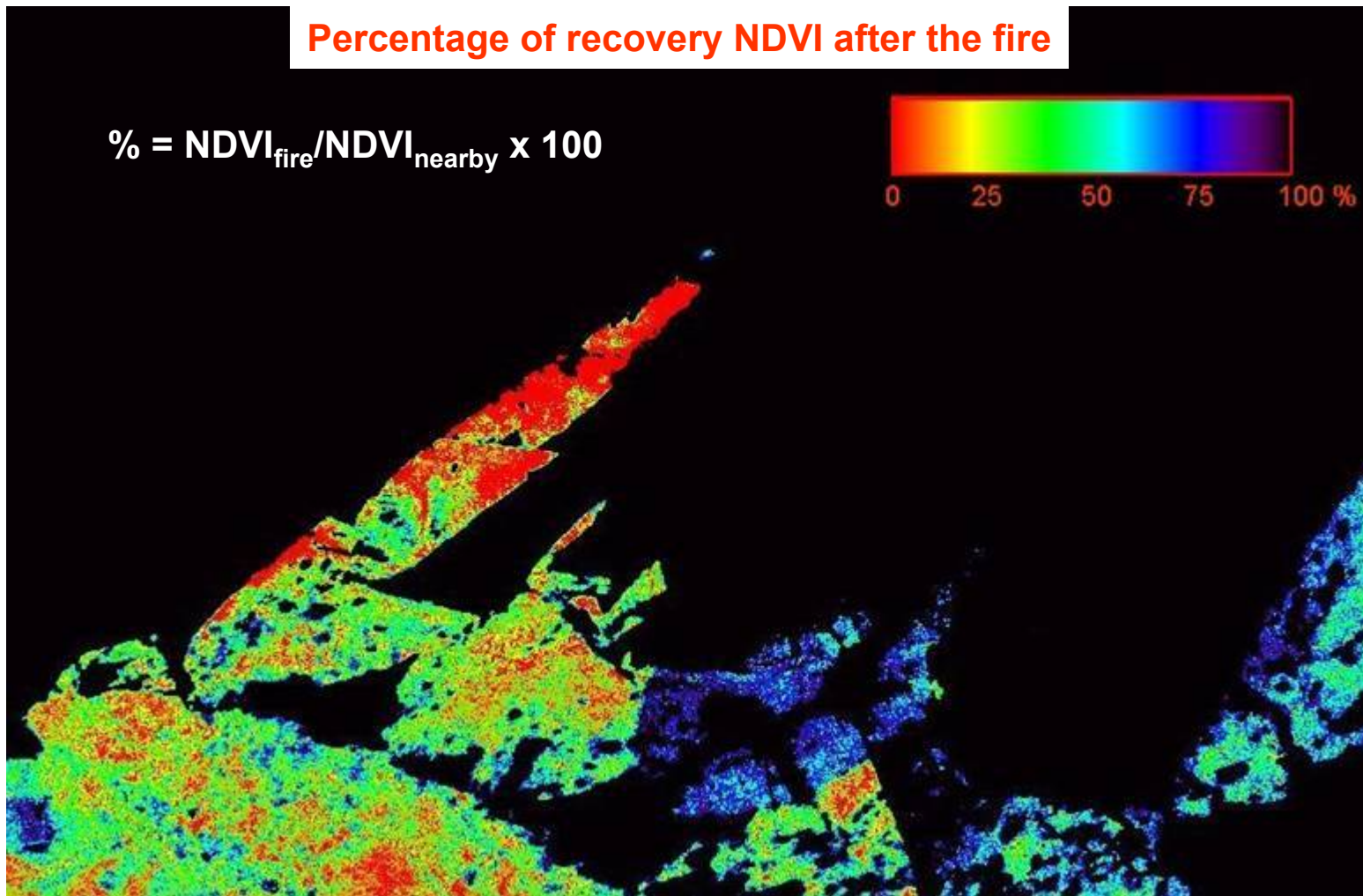


R: (1-NDVI); G: NIR; B: Red



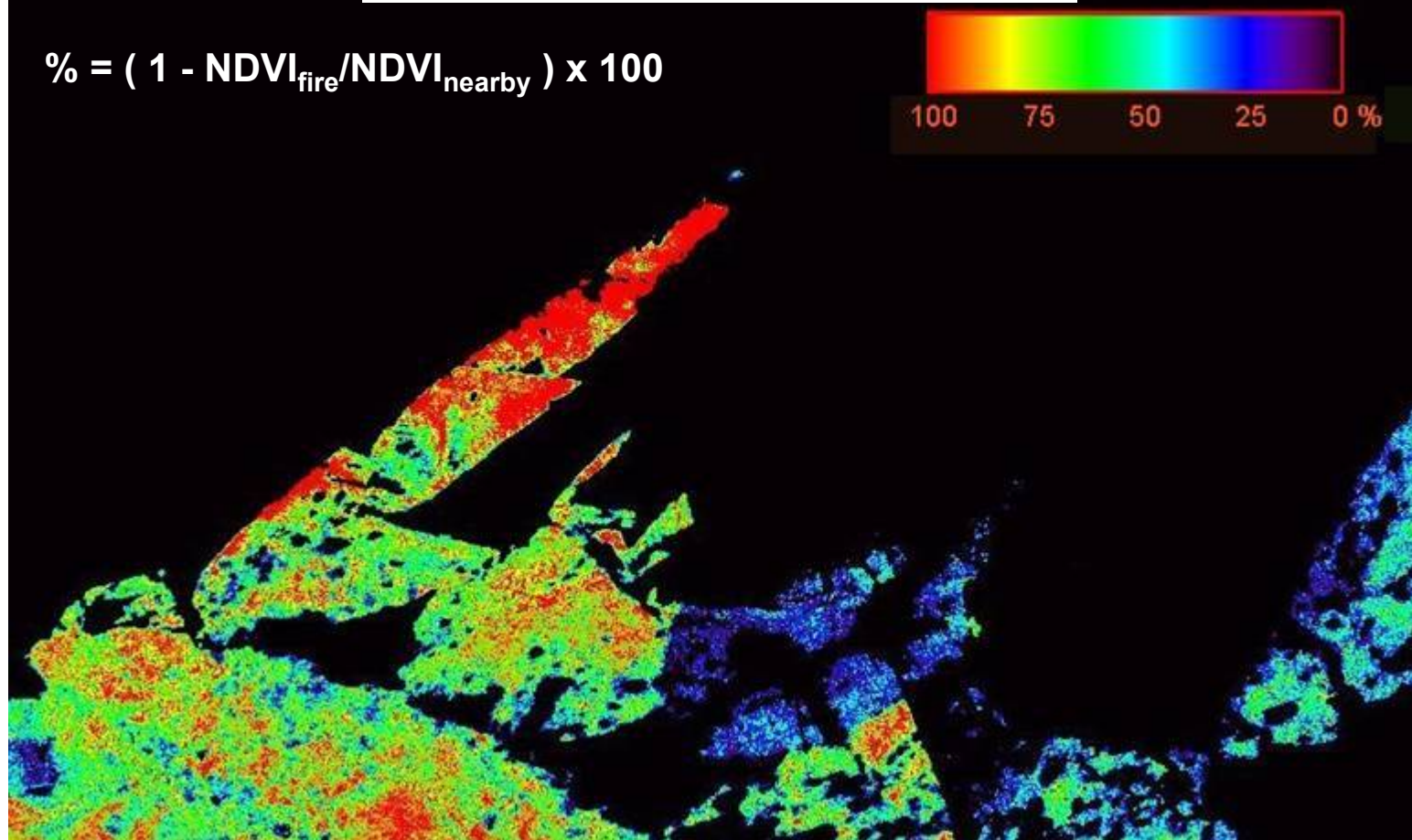
Percentage of recovery NDVI after the fire

$$\% = \text{NDVI}_{\text{fire}} / \text{NDVI}_{\text{nearby}} \times 100$$



Percentage of NDVI lost after the fire

$$\% = (1 - \text{NDVI}_{\text{fire}} / \text{NDVI}_{\text{nearby}}) \times 100$$



CONCLUSIONS

- 1.- Small fires of few ha, could be detected by means of Deimos-1 images by using a suitable algorithm based on R, G and NIR changes and NDVI values.
- 2.- Just after the fire is possible to estimate the loss by means of the comparison between the current NDVI and the NDVI of the nearby areas.
- 3.- Time after the fire, the recovery NDVI could be measured by comparison with unburnt areas of the nearby areas.
- 4.- Field campaigns to measure real damage are necessary in order to improved the developped algorithm and to stablisch a relationship between the real damage and the satellite data.