Operating the different remote sensing data to monitor wildfire by example Georgia's Borjomi fire in 2017

NATIONAL ENVIRONMENTAL AGENCY

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Why wildfires?

Wildfires present a number of critical issues

- *loss of human life*
- *loss of property*
- *air pollution*

Forest fires cause major damage to the environment and human health!

Variety of remote sensing data

Fires can be monitored and analyzed over large areas in a timely and cost-effective manner by using free satellite sensor imagery.

Suomi NPP/VIIRS
Suomi National Polar-orbiting Partnership Visible Infrared Imager Radiometer Suite
- *Complete coverage of Earth across the day*
- *resolution 375m*

Sentinel-1A and 1B
C-band synthetic-aperture radar instrument
- *12-day repeat cycle*
- *resolution 5m*

Sentinel-2A and 2B
Multi-spectral data
- *Revisiting every 5 days under the same viewing angles*
- *resolution 10, 20, 60 m*

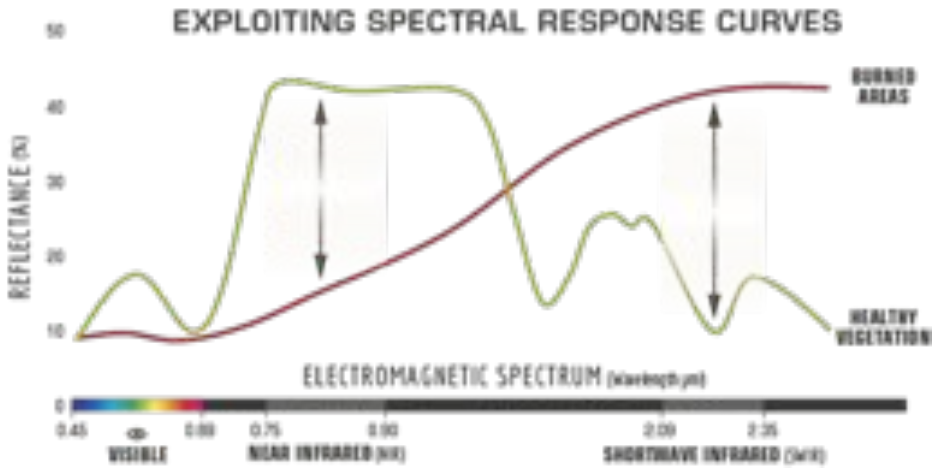
Sentinel-3
SLSTR (Sea and Land Surface Temperature Radiometer)
- *Complete coverage of Earth across the day*
- *resolution 500 m and 1 km in the thermal infrared channels*

Terra, Aqua/MODIS
Moderate Resolution Imaging Spectroradiometer
- *complete coverage of Earth across the day*
- *resolution 1000m*

Landsat 8
Operational Land Imager (OLI)
- *Revisiting every every 16 days in an 8-day offset from Landsat 7*
- *resolution 15, 30, 100 m*

Methods: Normalized Burn Ratio and Burn Severity

Burned areas have relatively low reflectance in the near-infrared and high reflectance in the shortwave infrared band.



$$NBR = \frac{NIR\text{-}SWIR}{NIR+SWIR}$$

A high NBR value generally indicates healthy vegetation while a low value indicates bare ground and recently burned areas

Source: http://gsp.humboldt.edu

To identify recently burned areas and differentiate them from bare soil and other non-vegetated areas the difference between pre-fire and post-fire NBR, the delta Normalized Burn Ratio (dNBR) is frequently used.

$$dNBR \text{ or } \Delta NBR = PrefireNBR - PostfireNBR$$

However, the dNBR is an absolute difference which can present problems in areas with low pre-fire vegetation cover, where the absolute change between pre-fire and post-fire NBR will be small.

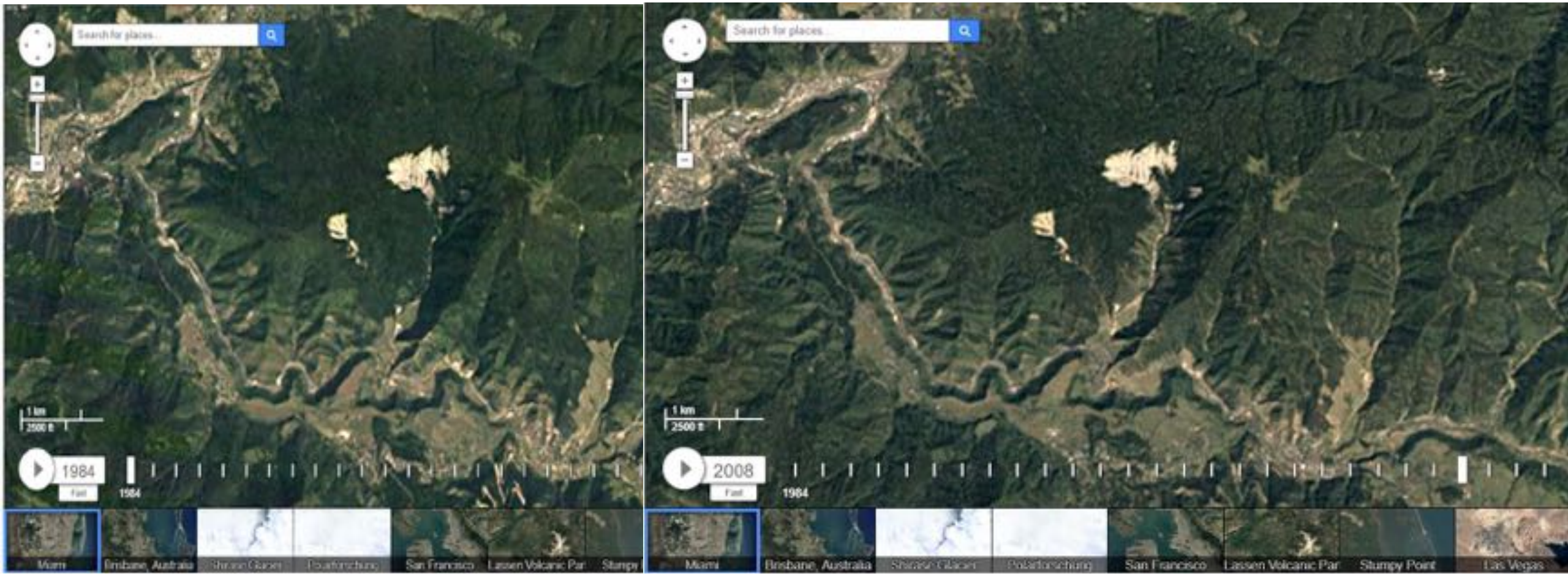
Relativized Burn Ratio:

$$RBR = \left(\frac{dNBR}{(NBR_{pre-fire} + 1.001)}\right) = \left(\frac{NBR_{pre-fire} - NBR_{post-fire}}{(NBR_{pre-fire} + 1.001)}\right)$$

Source: https://rus-copernicus.eu

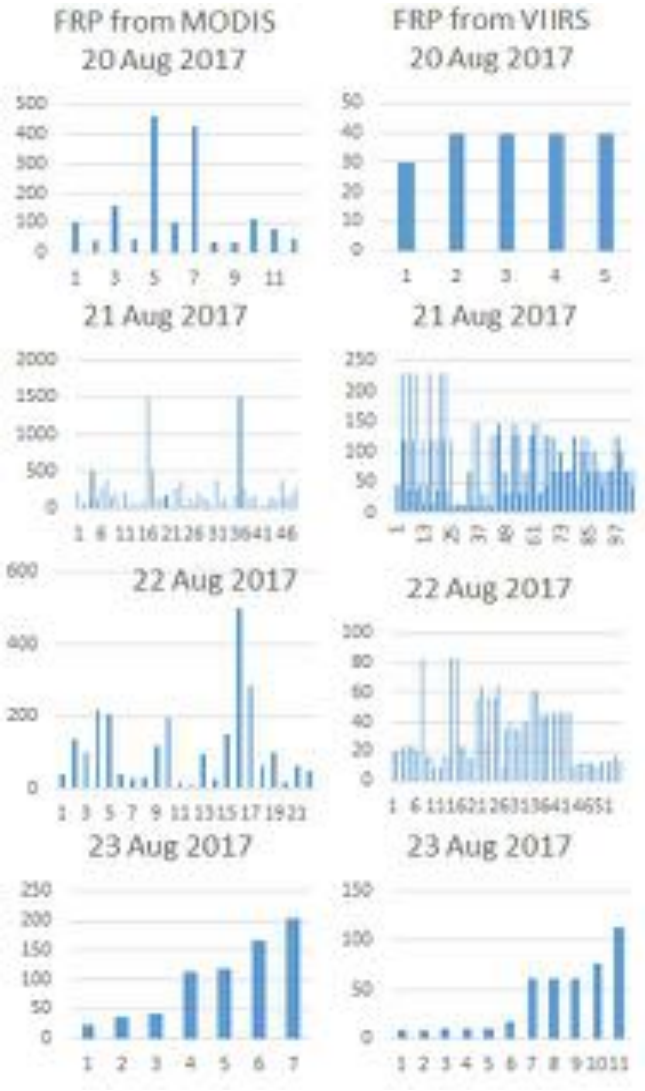
Borjomi wildfire (20-26 Aug 2017)

Pre-wildfires remote sensing data from Google Earth Engine



Borjomi wildfire (20-26 Aug 2017)

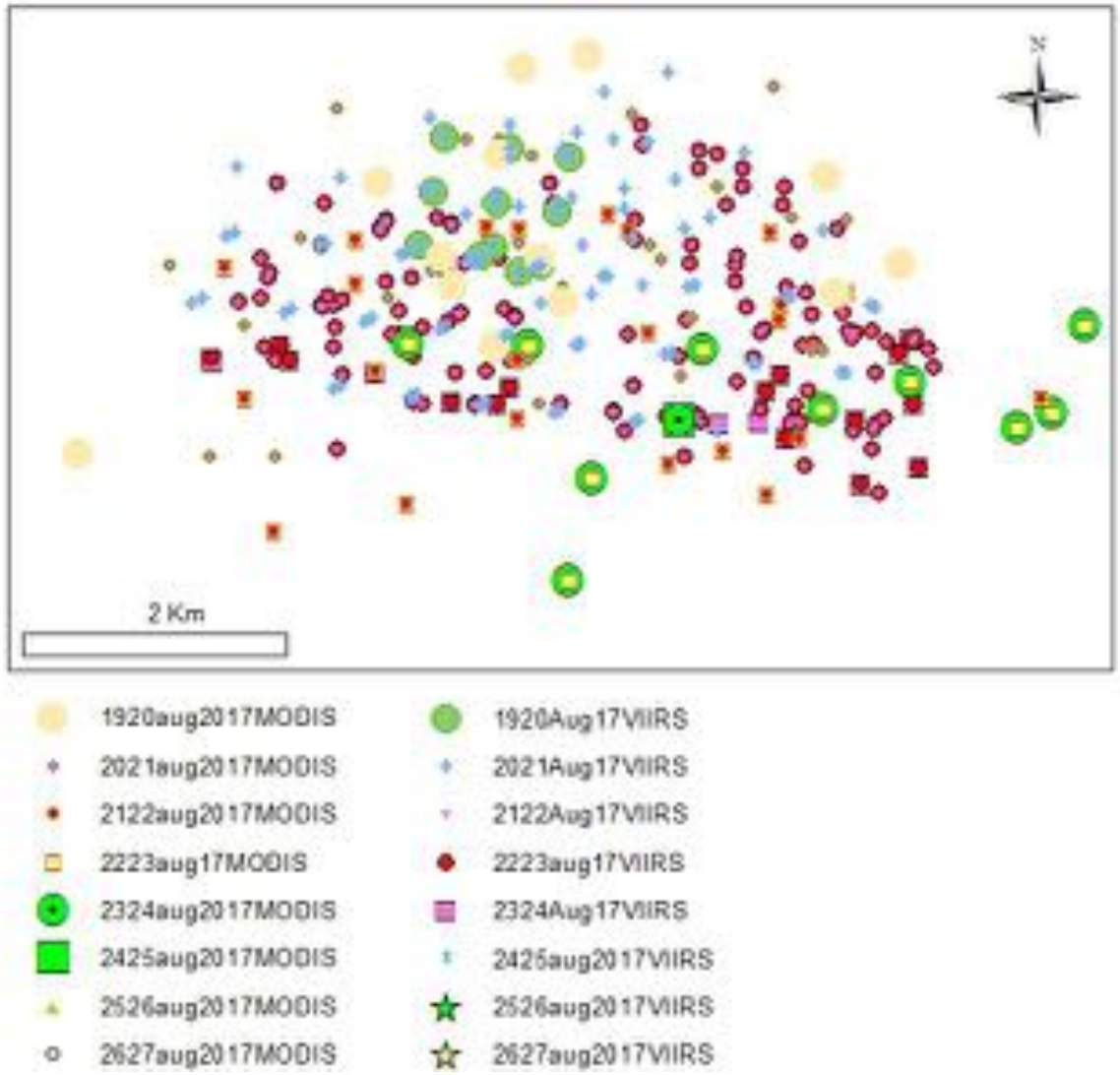
Active wildfires remote sensing data



Bar charts show the number of hot spot locations (x-axis) and Fire Radiative Power (y-axis) in MW (megawatts) from the MODIS (left column) and VIIRS (right column) satellites.

Borjomi wildfire (20-26 Aug 2017)

Active wildfires remote sensing data



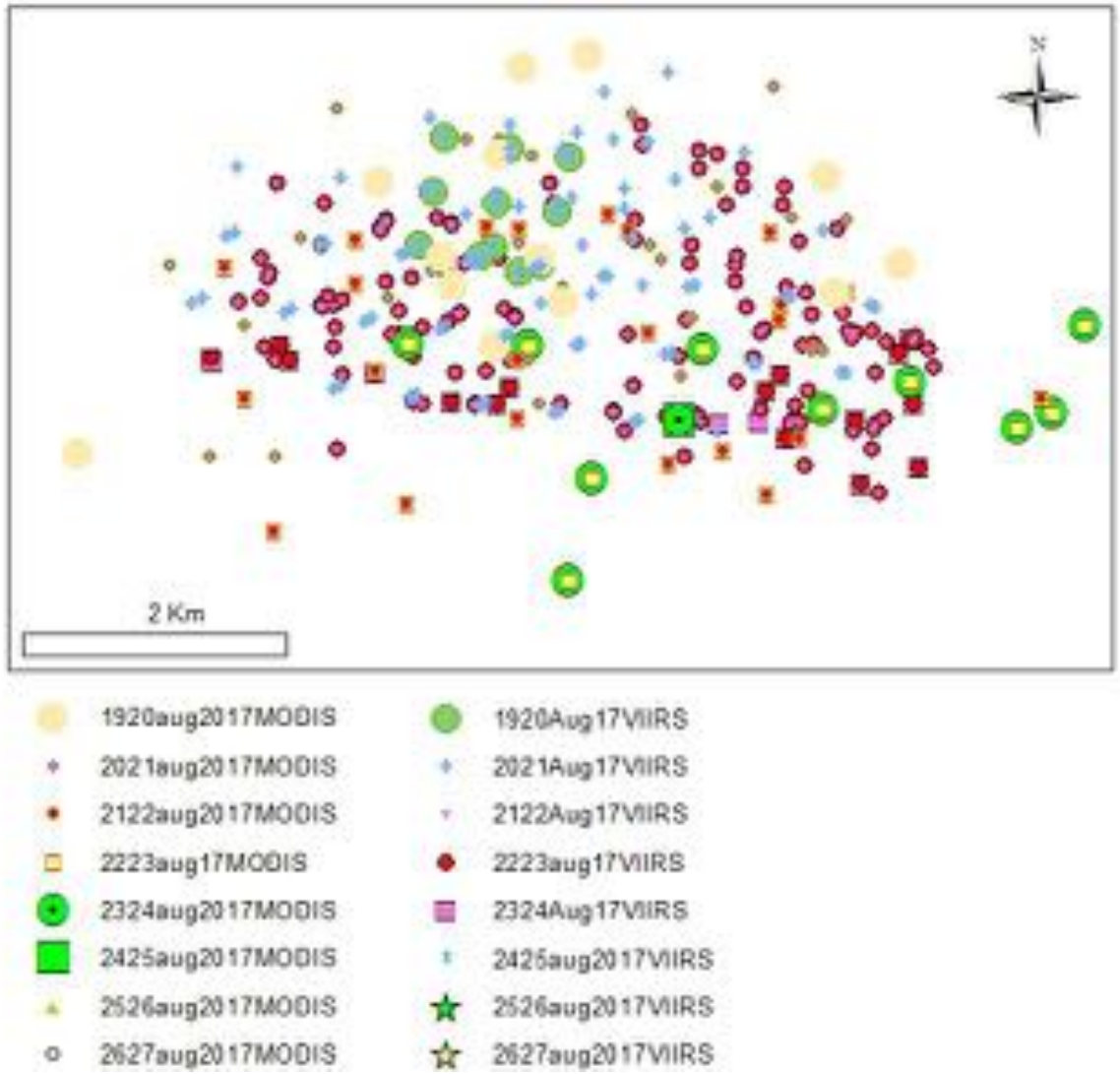
Borjomi wildfire (20-26 Aug 2017)

Active wildfires remote sensing data

Sentinel-3, 21.08.2017

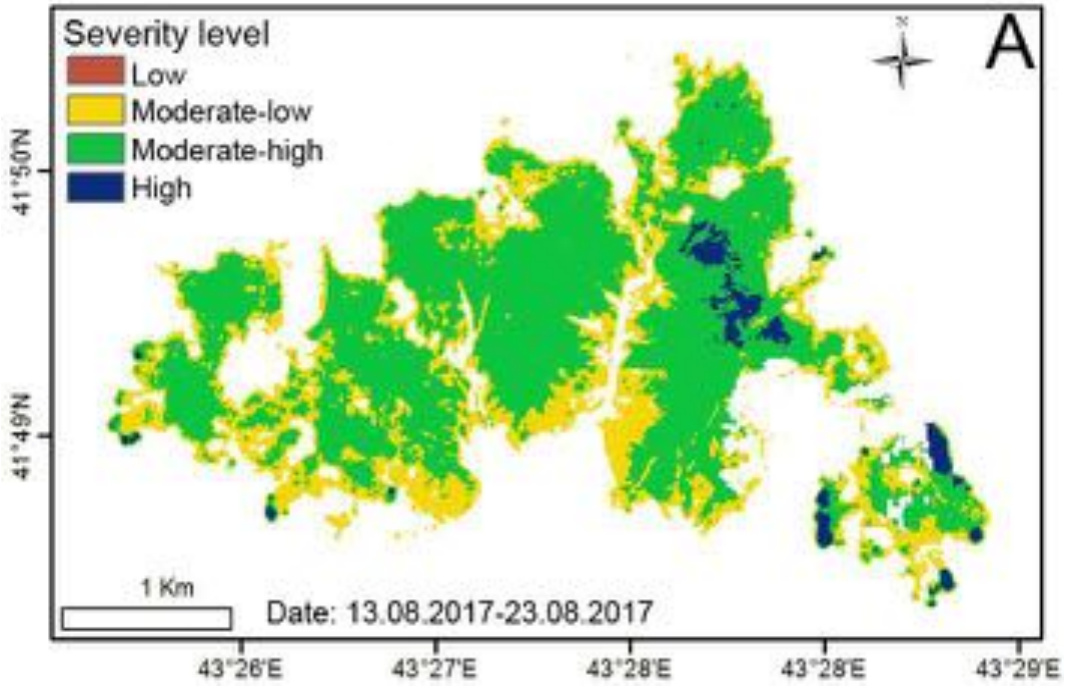
Sentinel-3, 22.08.2017

Sentinel-3, 23.08.2017



Borjomi wildfire (20-26 Aug 2017)

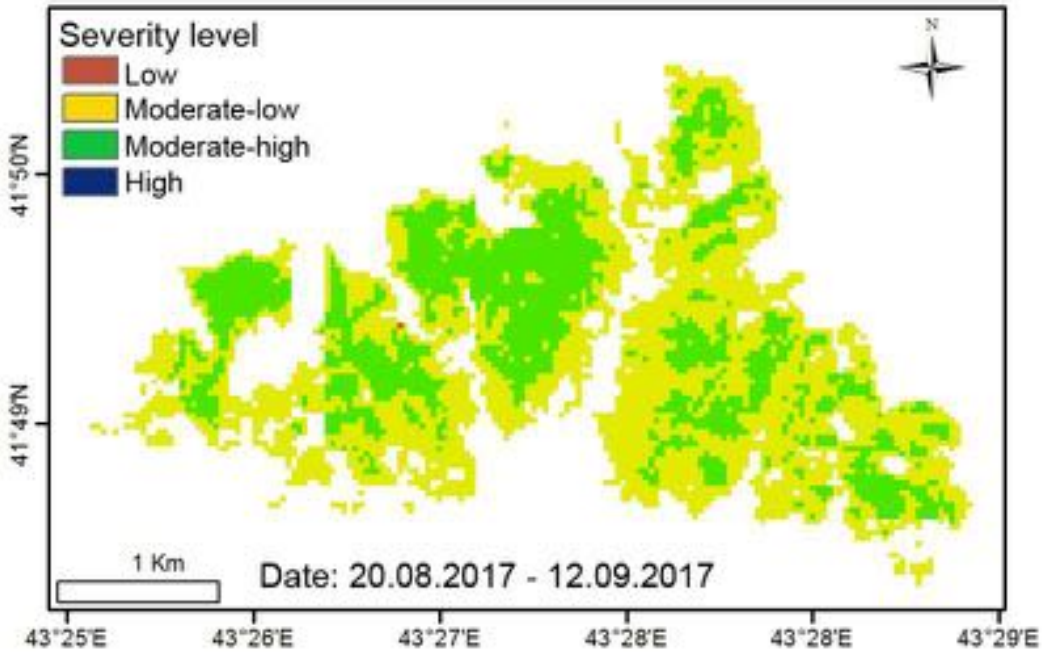
Active wildfires remote sensing data



Classification of the burned area from Sentinel-2 for different periods. The spatial resolution is 10 meters. Period: 13.08.2017-23.08.2017.

Borjomi wildfire (20-26 Aug 2017)

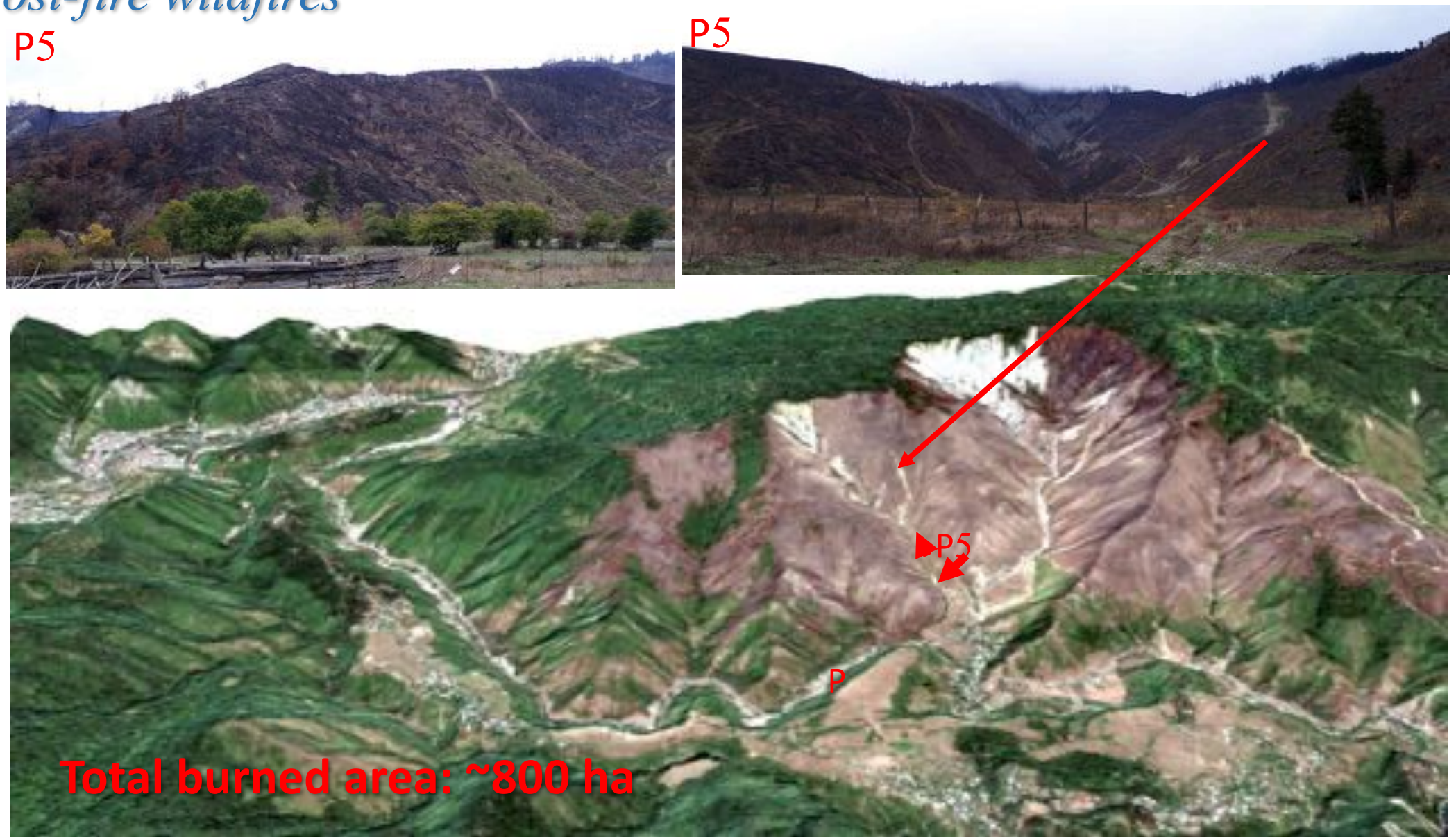
Post-fire wildfires remote sensing data
Map burn severity



Classification of the burned area from Landsat 8 for the period from 20.08.2017 to 12.09.2017. The spatial resolution is 30 meters.

Borjomi wildfire (20-26 Aug 2017)

Post-fire wildfires



Conclusion

- Use any remote sensing data which are available for the moment

  Collection of all pre-event available remote sensing data for the target area

  Collection of all available remote sensing data during event for the target area

  Collection of all post-event available remote sensing data for the target area

- Perform an analysis of remote sensing data

  -to exclude overestimation or underestimation of fire locations

  -to estimate of burnt area