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Monitoring fire activity in a Mediterranean ecosystem using SEVIRI geostationary imagery: a case study

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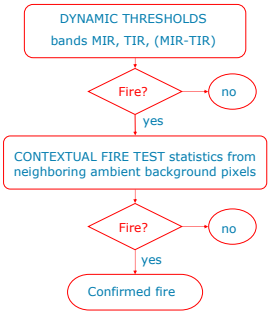
Abstract – Fire is a frequent phenomenon in the Mediterranean region mostly caused by human activities. It affects ecosystems and has a relevant impact on local air pollution releasing significant amount of gases and particulates. The magnitude of such emissions is known to be considerable, but high uncertainties are still attached to current estimates. This is mostly due to the parameters used by current models. Among others burned biomass is the most difficult factor to determine. In this study we present the first results from an application with MSG-SEVIRI imagery. Active fires are monitored and characterized in a case study in Italy. Fire Radiative Power is derived from the satellite images in order to retrieve the amount of burned biomass (Wooster et al., 2005). Moreover results from the application are compared to ground truth data collected during a field campaign.

Fire detection algorithm

The concept for the fire detection methodology is based on a multi-channel contextual approach already used for MODIS imagery (Flasse and Ceccato, 1995; Roberts et al., 2005). A set of thresholds has been defined using the brightness temperature of MIR and TIR channels. The thresholds change according to the time of image acquisition since the variability of ambient background temperature is different on daytime and night-time images. In the figure below fire detection approach is summarized in a scheme.



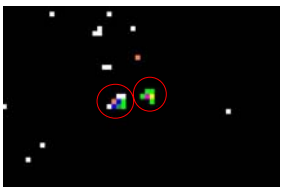
Comparison of Fire Detection applying different conditions

The images show the total fire frequency on each pixel.

Total number of scenes: 480 -5 days-

without condition on BRF (band 0.6µm)

with condition on BRF (band 0.6µm)



Fire frequency over the same pixel

0	Black
1	White
2 to 6	Coral
6 to 16	Green
17 to 25	Blue
26 to 34	Yellow
35 to 43	Cyan
44 to 52	Magenta
53 to 61	Maroon
62 to 70	Sea Green

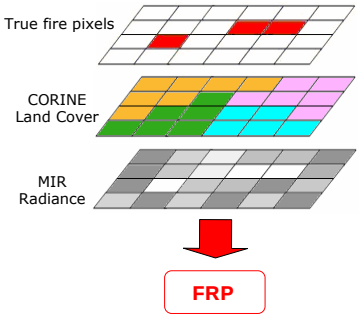
The number of false alarms is significantly reduced with the condition on reflectance.

Fire Radiative Power

It is defined as below:

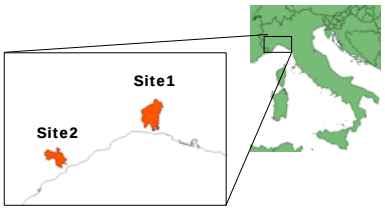
$$\frac{A_{sample}\ \sigma}{a}\ (L_{f,MIR} - L_{bg,MIR})$$

Lf,MIR and Lbg,MIR are the MIR radiance on the active fire and the mean MIR radiance in the ambient background;
Asampl is the pixel sampling area;
σ is the Stefan-Bolzmann's constant (5.67 x 10-8 J s-1 m-2 K-4);
a is a constant sensor-dependent (3.06 · 10-9 for SEVIRI sensor).



Comparison with field data

Fire events: 14-18th of February 2005



Vegetation type affected: *Pinus pinaster*, the understorey being mainly constituted by *Erica arborea* and *Arbutus unedo*.

Site1: Pegli

Burned area: 1600ha

Site2: Savona

Burned area: 950 ha

Tree diameters and heights have been measured in the field campaign. These data have been used to quantify pre and post-fire biomass. The burned biomass has been derived as the difference between pre and post-fire biomass.

	Burned biomass measured in the field (tons)	Burned biomass derived from FRE (tons)
Site1: Pegli	13561	13427
Site2: Savona	8051	9582

Conclusions

The analysis of SEVIRI data has produced active fire maps which show little number of false alarms when the condition on BRF is used. The Fire Radiative Power derived from each scene has been integrated in time to obtain Fire Radiative Energy which is used to quantify burned biomass.
The comparison between burned biomass derived from the RS application and the ground truth show high agreement which makes such methodology very promising.

References

Flasse and Ceccato, 1995. A contextual Algorithm for AVHRR Fire Detection. Remote Sensing Letters;
Roberts, G., Wooster, M. J., Perry, G. L. W., Drake, N., Rebelo,, L. M., Dipotso, F., 2005. Retrieval of biomass combustion rates and totals from fire radiative power observations: Application to southern Africa using geostationary SEVIRI imagery, J. Geophys. Res., 110;
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