Use of Operational Airborne and Satellite Remote Sensing to Forest Fire Mapping in Catalonia: lessons learned

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Abstract

Institut Cartogràfic i Geològic de Catalunya (ICGC) participates in a Forest Fire Mapping Program with *Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Natural (DARPAM),* both belonging to *Generalitat de Catalunya* (Autonomous Community Government). In the frame of this program ICGC produces the cartography at 1:50.000 scale of wildfires occurring annually in Catalonia since 1986. DARPAM provides localization of the fires, ICGC maps the boundaries and calculates the burned topographic surface using Remote Sensing techniques. The surface threshold for a fire to be mapped, established by DARPAM, has changed from 50 ha at the period 1986-2001, to 20 ha between 2002-2004, and 10 ha since 2005 up to now. Currently ICGC is analyzing both the annual fires as those historical fires under threshold but bigger than 10 ha.

Common ICGC surface estimation approach

Common ICGC surface estimation approach is based, since 1986, on using Landsat TM images (USGS service) acquired before and after the forest fire, analyzing NDVI indexes, principal components or just an image in order to classify the multitemporal data, followed by a final photo-interpretation analysis.

DARPAM Information

Generalitat de Catalunya
Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Natural

Incendis forestals superiors a 10 hectàrees forestals

Data Incendi	Municipi	Comarca	Paratge	Ha Arbrades	Ha No Arbrades	Ha Forestals	Ha No Forestals	X	Y
19/04/13	PRADELL DE LA TEIXETA	PRIORAT	LES SERRES	28.7	25.6	**54.3**	**0.5**	322971	4559734
28/07/13	VALLIRANA	BAIX LLOBREGAT	CAN BOGUNYÀ	56.14	21.66	**77.8**	**2.21**	411276	4580289
29/07/13	MIRAVET	RIBERA D'EBRE	LES VALLS	17.92	11.49	**29.41**	**0**	295750	4549238
14/08/13	AIGUAMÚRCIA	ALT CAMP	LES POBLES	8.64	58.61	**67.25**	**0.63**	367612	4582489
26/08/13	RIBA-ROJA D'EBRE	RIBERA D'EBRE	BERRÚS	7.12	9.06	**16.18**	**0.9**	281630	4567288
19/09/13	TIVISSA	RIBERA D'EBRE	PLANES DEL MONTBAIX	68.35	37.67	**106.2**	**34.73**	306839	4549045
05/11/13	LA GRANJA D'ESCARP	EL SEGRIÀ	PARTIDA PURROIG	0	12.5	**12.5**	**1.3**	279692	4589164
11/11/13	VILOPRIU	BAIX EMPORDÀ	LES COMES	430.38	84.23	**514.61**	**209.6**	498842	4663061

ICGC Quick-response approach

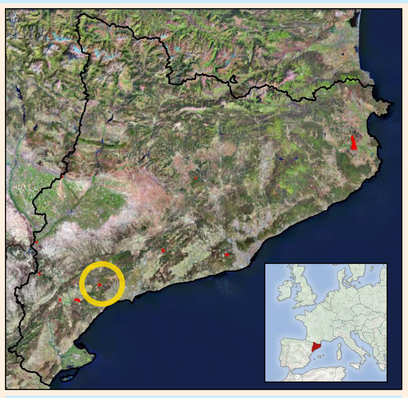
Quick-response approach consists in capturing images of the burned area with sensors on board ICGC airplanes as soon as meteorological conditions allow it. Sensors may be:

- DMC photogrammetric camera
- CASI-550 hyperspectral sensor
- AisaEAGLE II hyperspectral sensor

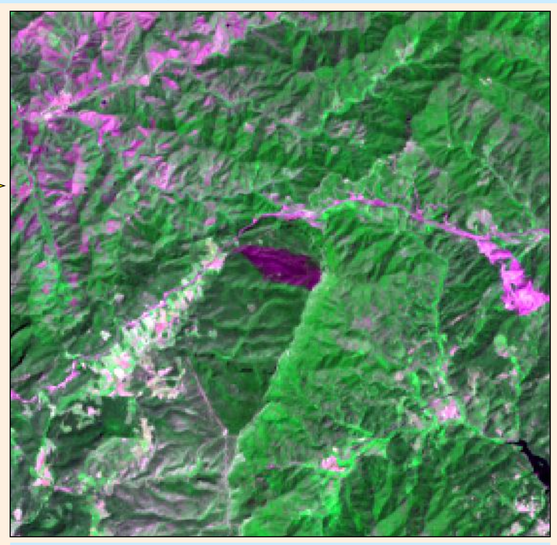
A fast delivering requires a classification approach.

Common procedure

Pradell case (2013), Landsat image classification solution & photointerpretation

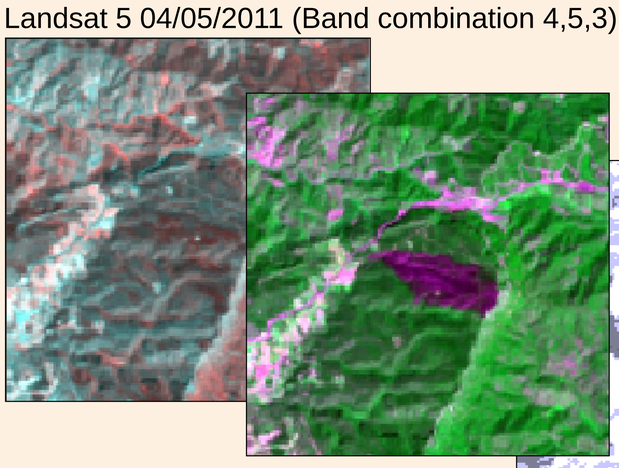


2013 Forest Fires distribution in Catalonia (421 ha)

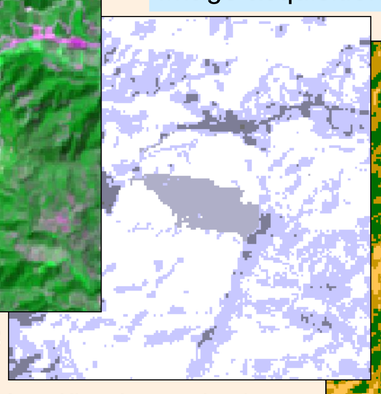


Pradell de la Teixeta **53.6 ha**
Fire: 19/04/2013
Image acquisition: 23/04/2013

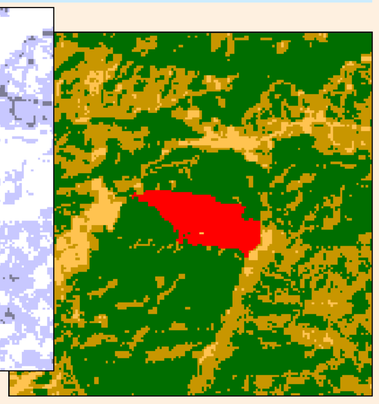
Landsat 5 04/05/2011 (Band combination 4,5,3)



Landsat 8 23/04/2013



Classification 23/04/2013

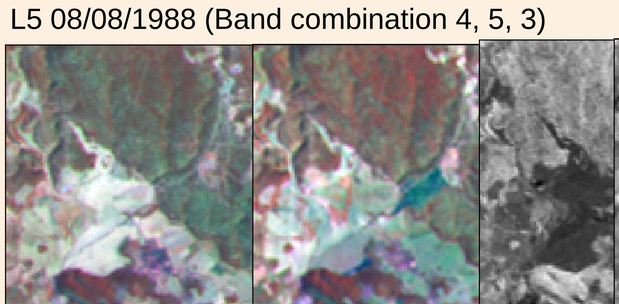


Result, burned area in red

Historical case

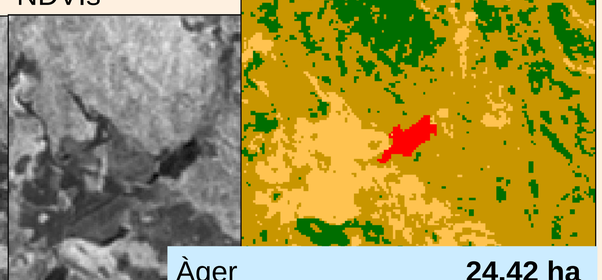
Àger case (1990), multitemporal NDVI classification solution , solved in 2014 thanks to free USGS images (with photointerpretation control)

L5 08/08/1988 (Band combination 4, 5, 3)



L4 06/08/1990

NDVIs



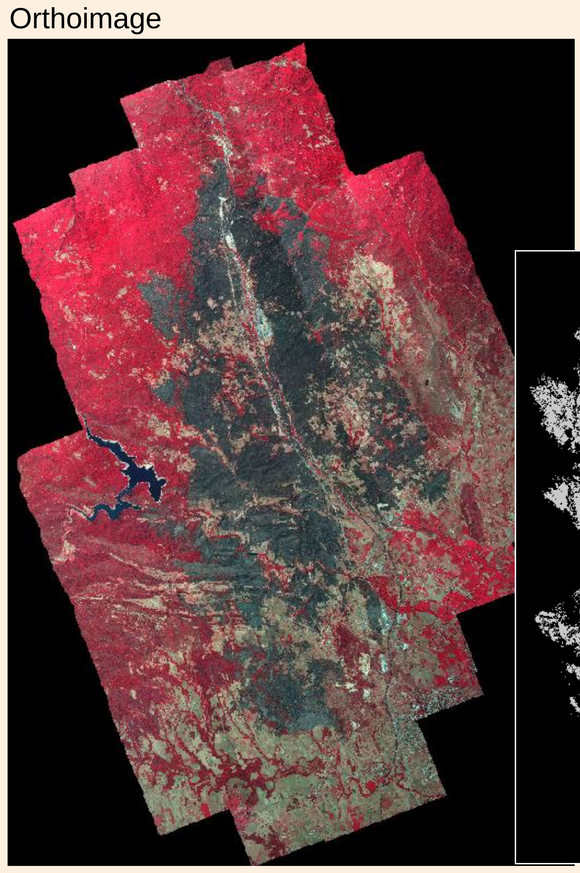
Result, burned area in red

Àger **24.42 ha**
Fire: 05/08/1990
Image acquisition : 06/08/1990

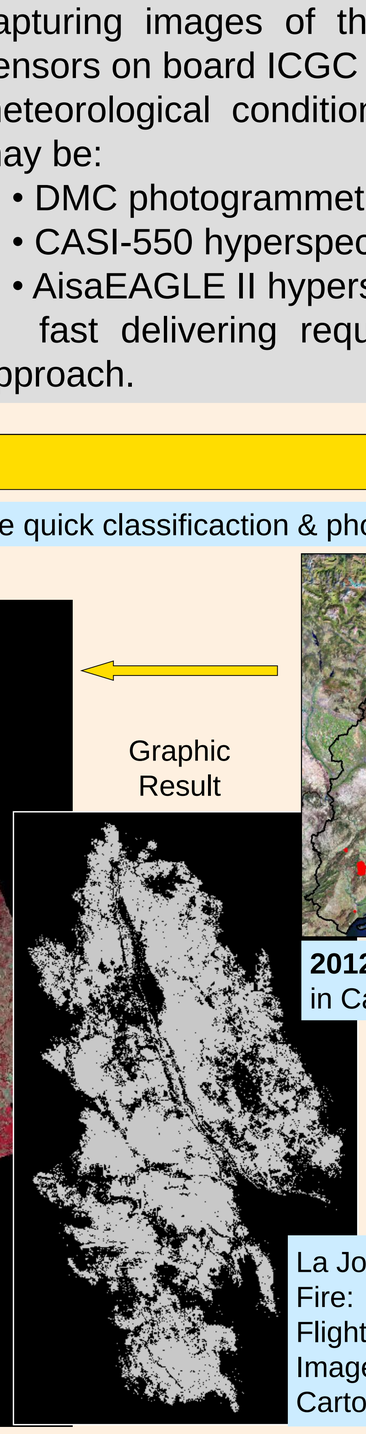
Quick procedure

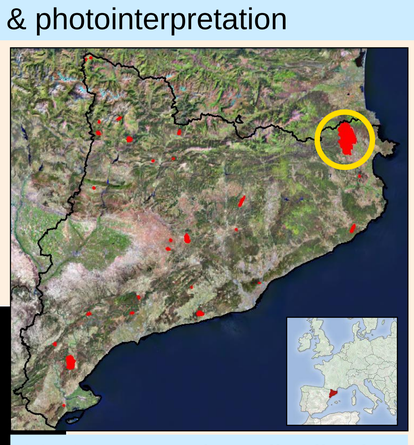
La Jonquera case (2012), DMC image quick classificaction & photointerpretation

Orthoimage



Graphic Result



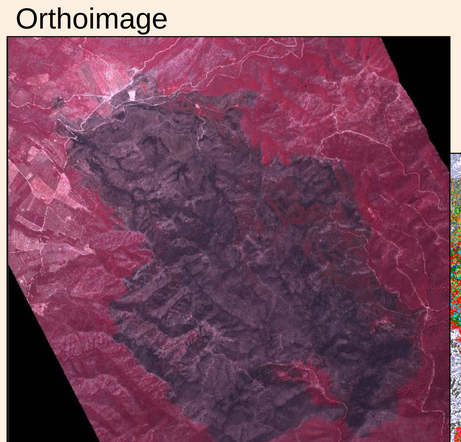


2012 Forest Fires distribution in Catalonia (17959 ha)

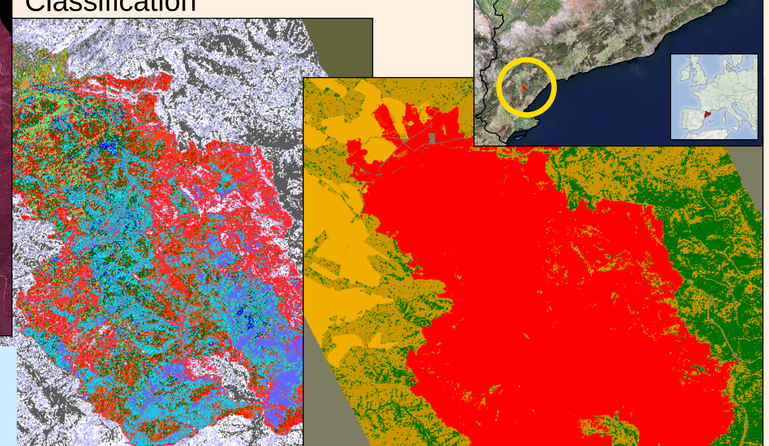
La Jonquera **10826 ha**
Fire: 25/07/2012
Flight: 26/07/2012
Image process: 27/07/2012
Cartography: 27/07/2012

Tivissa case (2014), DMC image quick classificaction & photointerpretation solution

Orthoimage



Classification



Tivissa **941.5 ha**
Fire: 15/06/2014
Flight: 28/06/2014
Image processing: 03/07/2014
Cartography: 09/07/2014

Result, burned area in red

Considerations

ICGC has built a Fire Data Base for the Catalan territory since 1986 up to now, that is 28 years delimiting burned areas with more than 470 forest fires analyzed. We have been studying the annual burned territory by either a 'Common approach' or by a 'Quick-response approach' depending on the emergency degree. Satellite image availability difficulties, due to the Landsat revisit time and cloud coverage makes the Pradell case, where the image was acquired only 4 days after the fire, an exception, so a 'quick-response approach' is often mandatory. A 'Quick-response approach' provides the affected surface in a few days after the fire, even for a large case as La Jonquera in 2012, although the image acquisition using ICGC sensors makes it much more expensive.