



Cartography of risk in interfaces – Evolutionary cartography of vegetation sensibility

GP4 : cartography of fire risk

Workshop in Léon, 20-24 february 2012



**EUROPEAN REGIONAL
DEVELOPMENT FUND**

In France, the cartography of risk and hazard is used in many contexts and with many goals. In the frame of this workshop, we chose to focus on two recent and innovative practices that come out a few of our habits and potentially interest other partners :

- cartography of risk in the interfaces**
- evolutive cartography of vegetation sensitivity**

- **General facts on french cartography of risk**
 - Static risk
 - Daily risk
- **Cartography of risk in the interfaces**
- **Evolute cartography of vegetation sensibility**



Static risk, or intrinsic risk

This risk relates to the physical characteristics of where it is described.

It is dependent on many characteristics which the main are vegetation and topography.

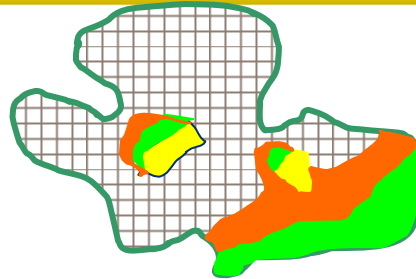
It may use notions of climate, but which will be determined



Fire intensity

Occurence

Suffered hazard

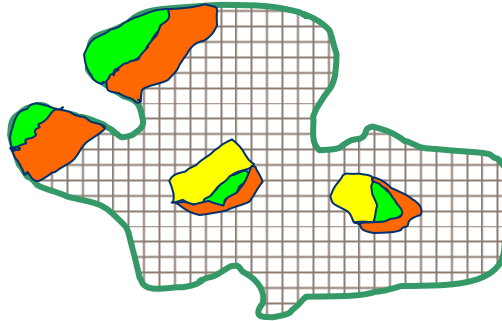


Hazard

Eclosion probability

Surface threatened

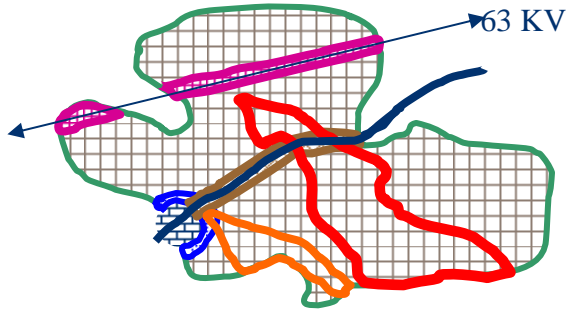
Induced hazard



Risk

		hazard		
		low	medium	strong
issues	high importance	3	4	5
	medium	2	3	4
	low importance	1	2	3

Issues

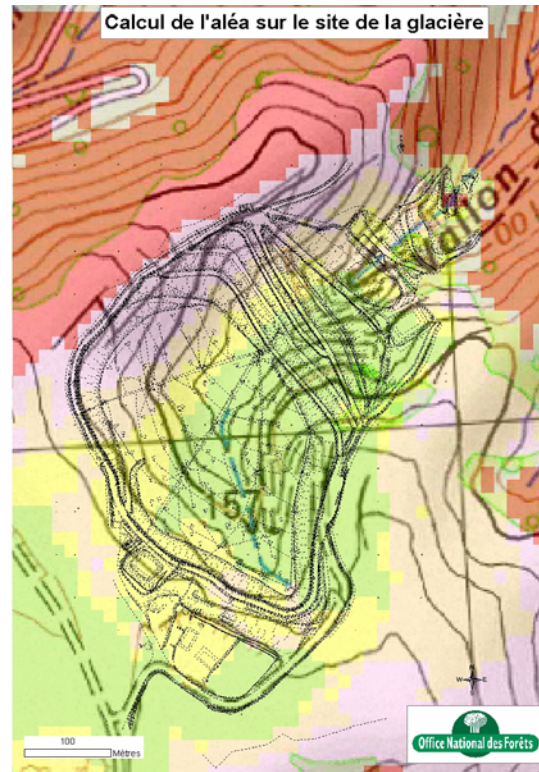




This risk is usually assessed by foresters (ONF or state services) or private consulting firms, because of their familiarity with the vegetation which is one of the overriding factors.

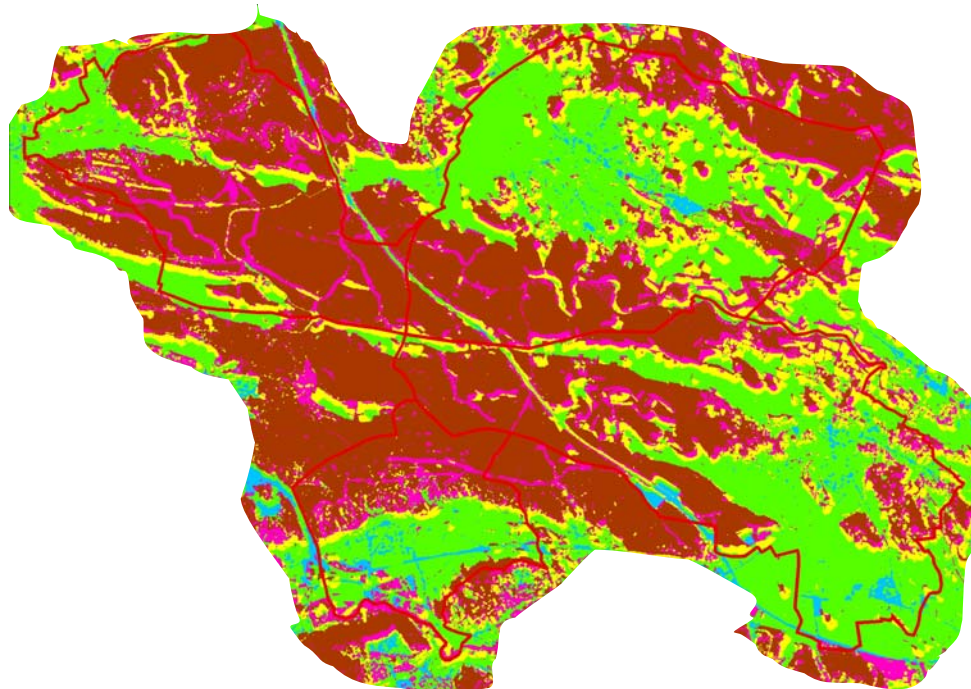
This risk can be assessed at different scales for different purposes :

- On the scale of a punctual issue (residential district, public building, industrial establishment, specific patrimonial issue ...) to identify specific protection measures based on risk assessment



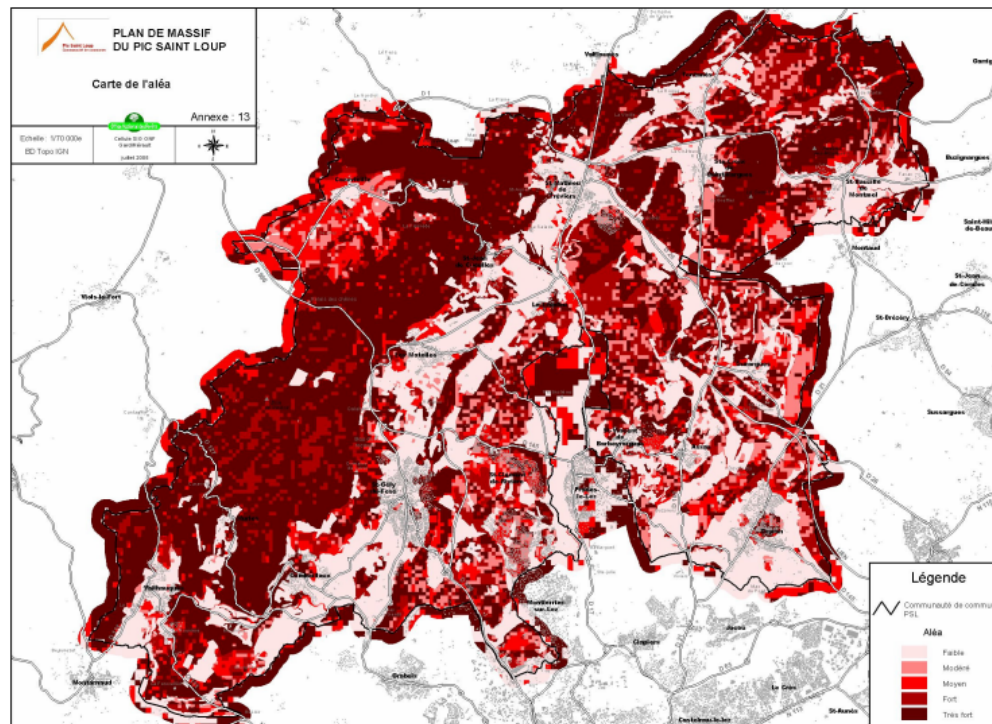


- at the scale of a municipality or a small massif, to take measures to regulate urbanization (definitions of areas unsuitable for building, of measures to new buildings, equipment for the protection of wildland-urban interfaces ...)

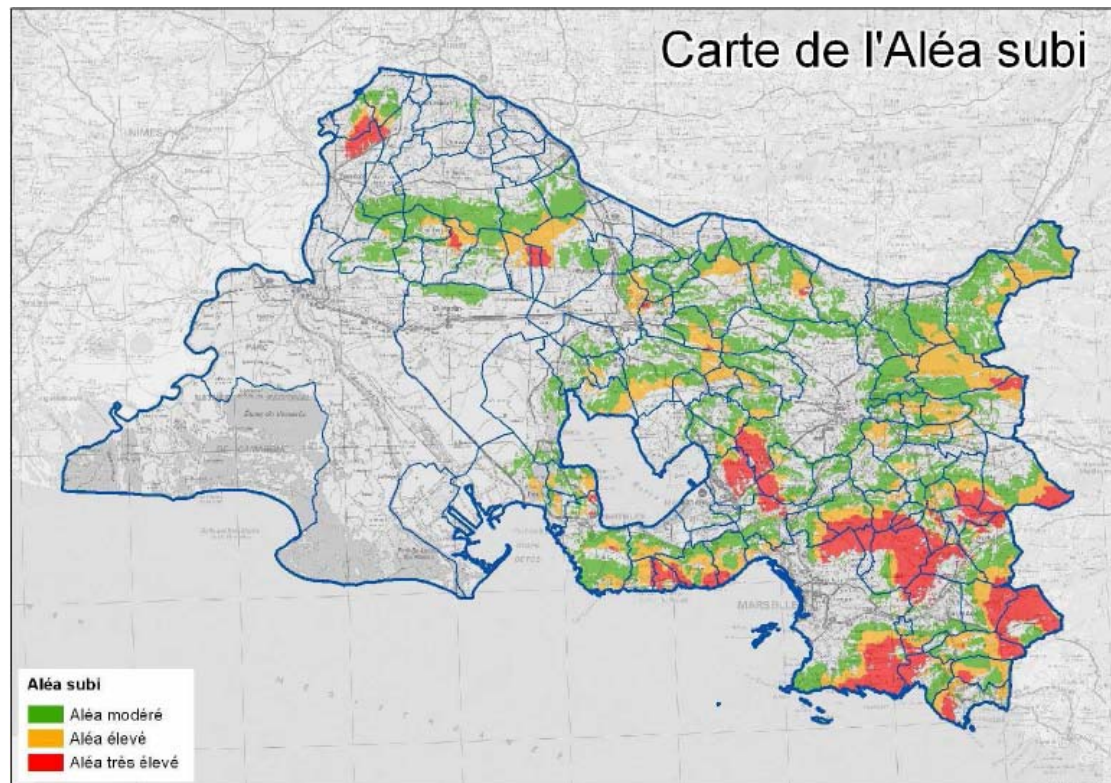




- On the scale of a massif, to define strategies for the protection of this massif (prevention, surveillance, control, reduction of risk areas ...) and / or set of equipment plans of this massif (tracks, water points, fuelbreaks ...).

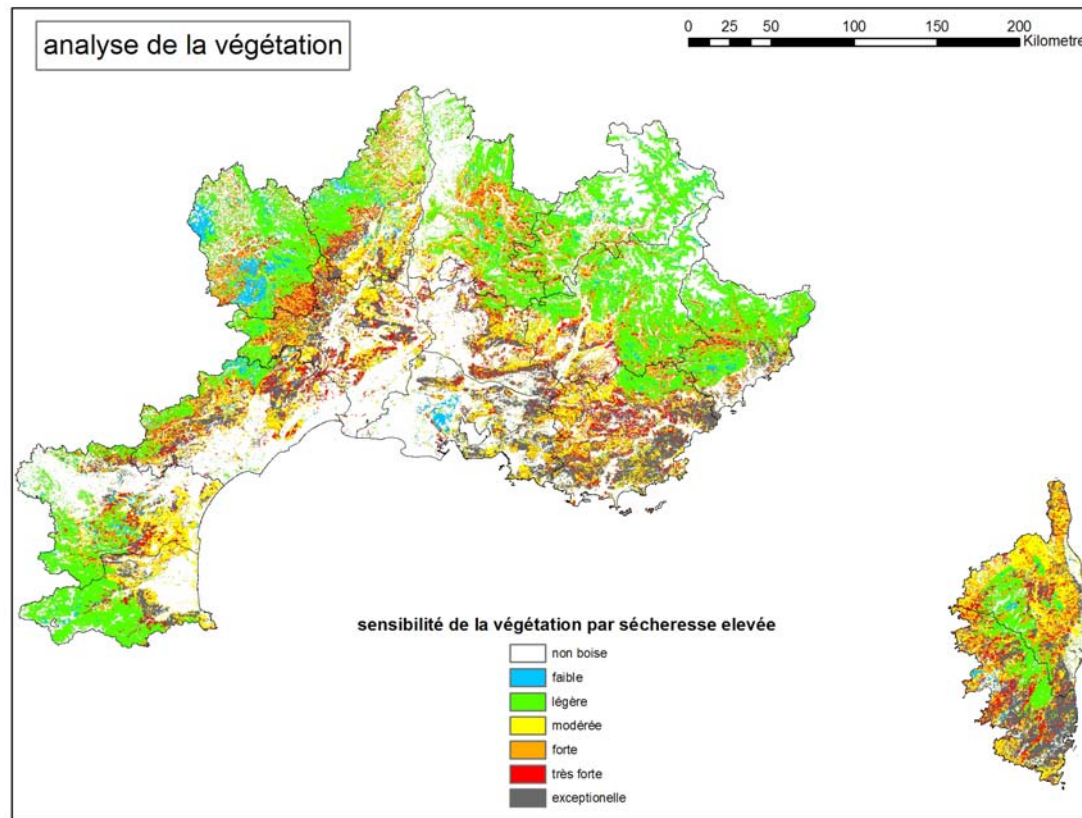


- On the scale of a department, to define departmental strategies for prevention (specific measures, surveillance network, specific plans ...) and firefighting, and prioritize municipalities and massifs.

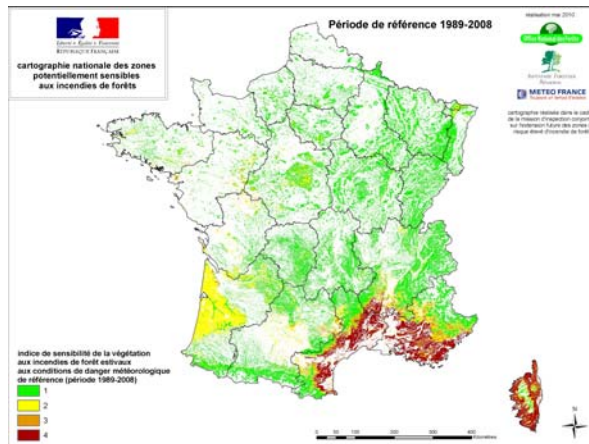




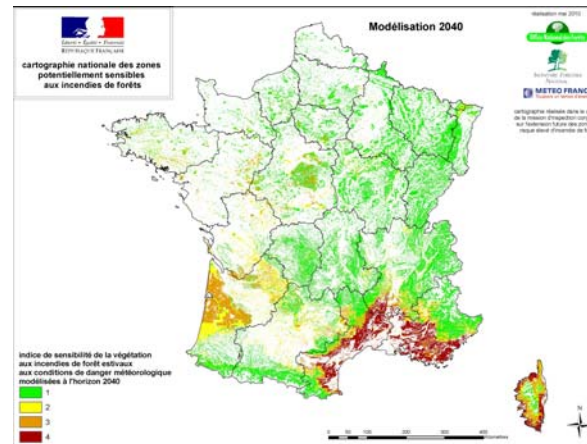
- At the interregional level, in order to define the general policy of prevention (balancing state means, including financial) and for firefighting to help the choice of allocation of state resources.



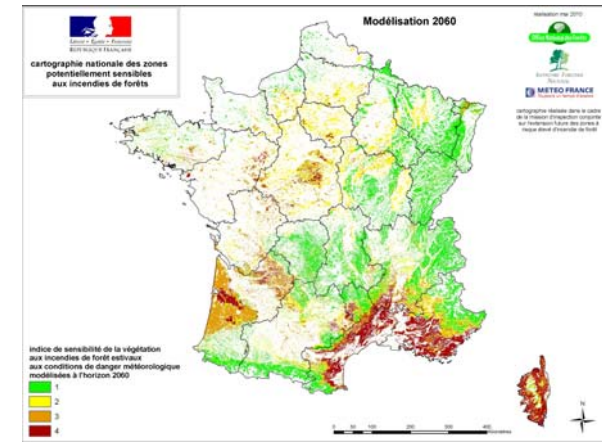
- Nationally, with simulated summer weather conditions in 2040 or 2060, in the context of an interministerial mission in charge of anticipating the effects of climate change on national policy for prevention and fighting against fire



Reference period (1989-2008)



Modeling 2040



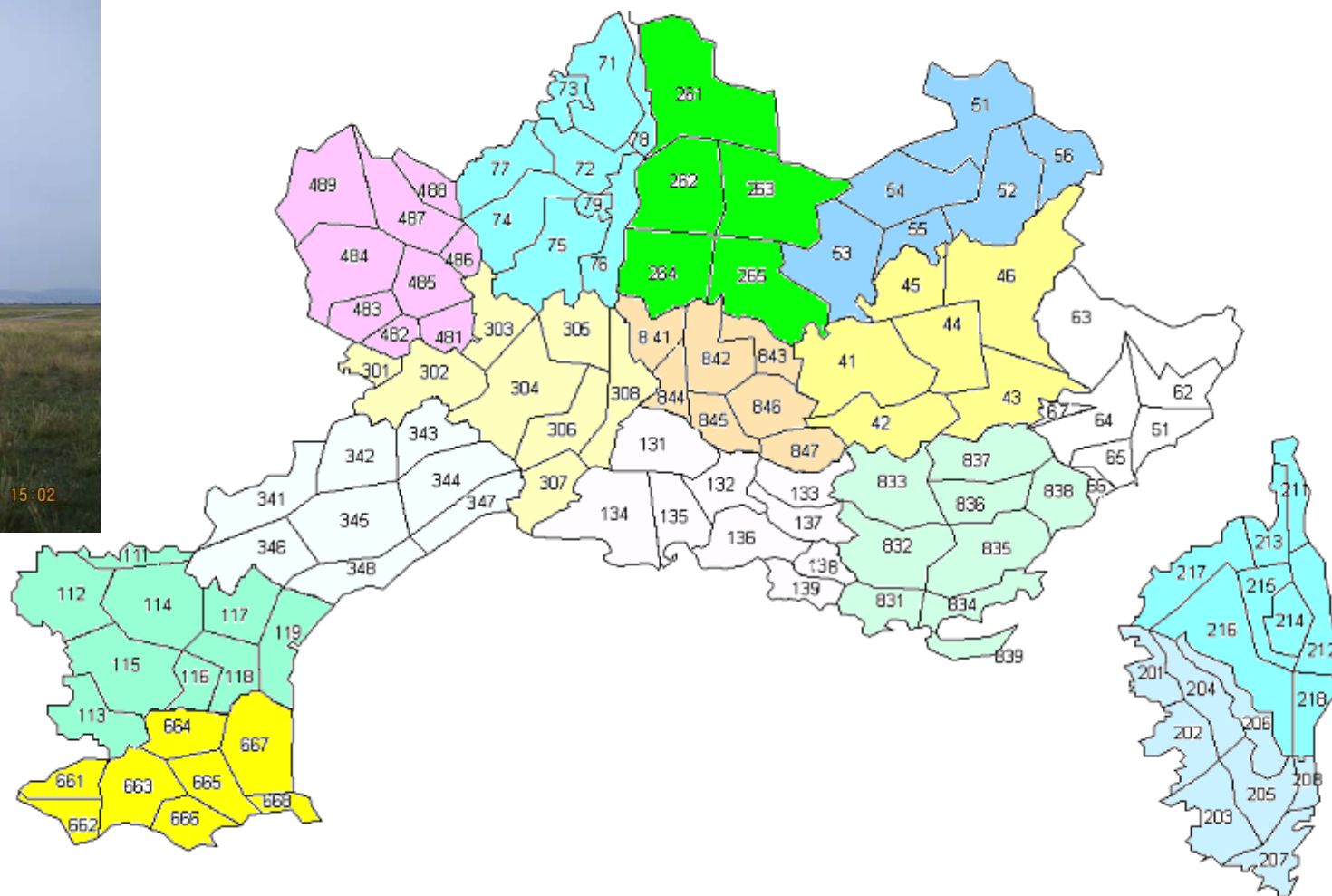
Modeling 2060



Daily risk or evolving risk

Also often called "**weather risk**" or "**weather danger**" because it takes into account mainly the meteorological component which unlike other factors is changing quite rapidly.

During the summer season in South-eastern France (Mediterranean area), this risk is rated 2 times per day by Météo-France that calculate several indices (derived from the method of the Canadian Fire Weather Index - FWI) and bring expertise to define six levels of danger. Appraised levels of danger are published across 112 "weather zones" (5-9 per department).
In winter, only some indices continue to be calculated but no expertise is achieved.



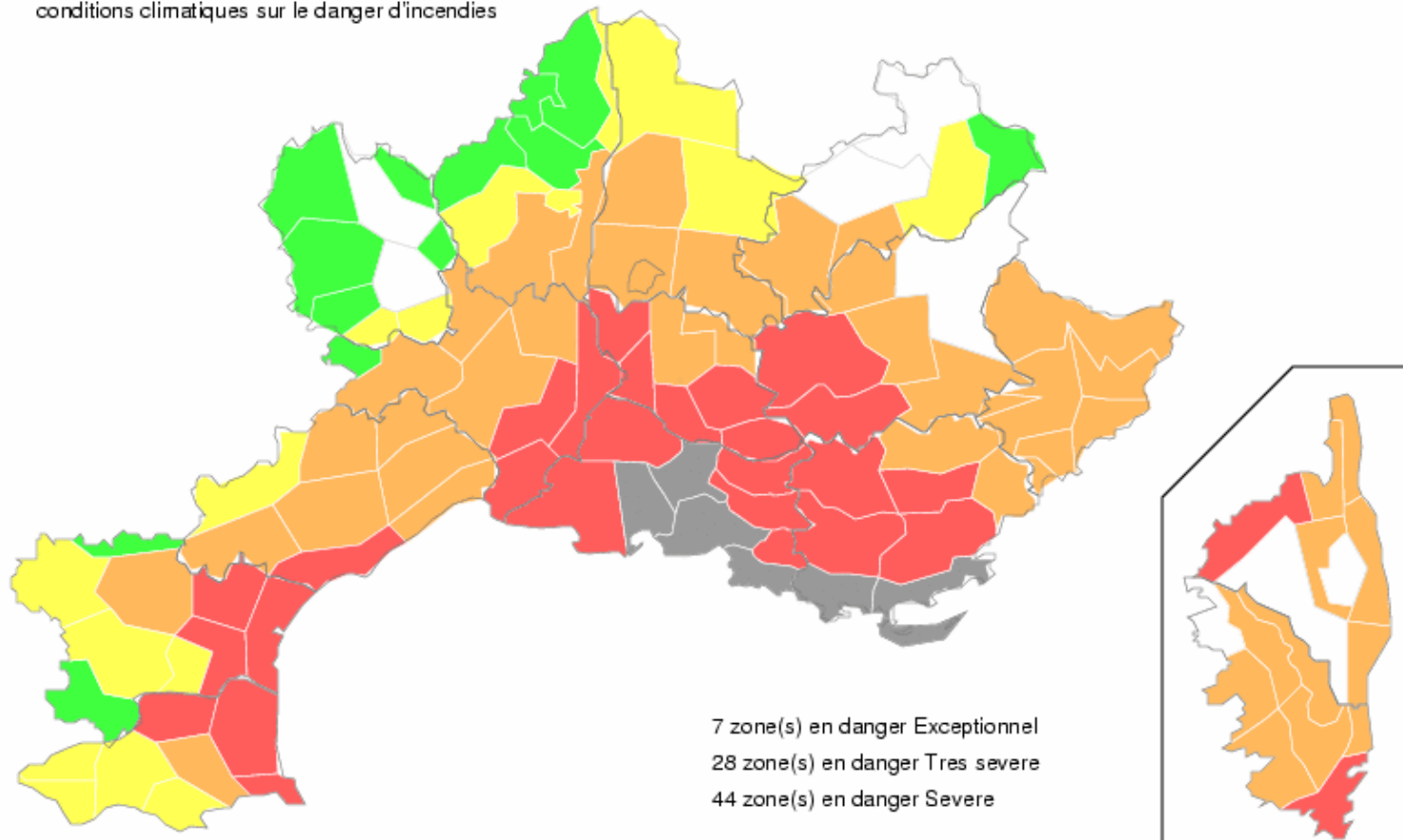


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PREVISION DE DANGER METEOROLOGIQUE D'INCENDIE POUR LE 30/07/2007 (PREVISIONS DE LA VEILLE)



NB : ces elements sont realises a partir des previsions meteorologiques de Meteo-France. Ils prennent en compte uniquement l'impact des conditions climatiques sur le danger d'incendies





Cartography of risk in the interfaces

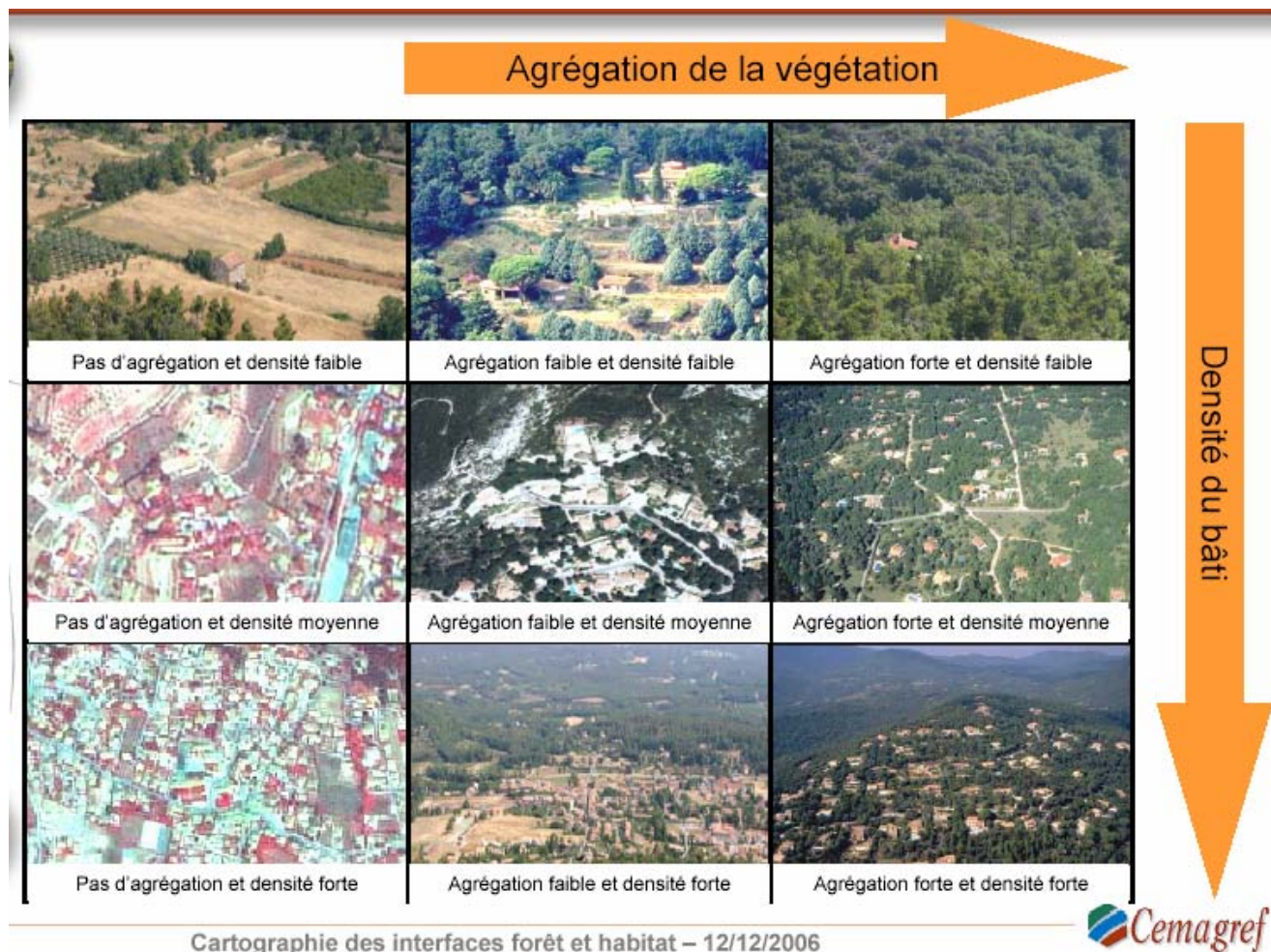
In the static cartography of risk at the scale of a municipality, of a massif or of a department, the most important areas to consider are the wildland-urban interfaces, because that's where are concentrated the highest issues (natural issues passing always in the background behind the protection of persons and goods).



To better define the risk levels and to adapt the measures, it appeared necessary to characterize these interfaces. A first work was done in 2006-2010 in the European research project **FIREPARADOX** by French research institute CEMAGREF (now IRSTEA) crossing **habitat grouping types** with **aggregation of vegetation types**.

A second study was conducted in 2010-2011 within the framework of European cooperation project **PYROSUDOE** in which ONF participated. This project has made progress in defining **habitat grouping types** and in defining **areas of influence of these types**, which seemed perfectible points in the previous work. The first results and their uses are the subject of this form of good practice

Results from CEMAGREF work :



Results from PYROSUDOE work :

The four habitat types :

Isolated habitat : groups from 1 to 3 buildings separated by more than 100m from other buildings

Diffuse habitat : groups from 1 to 3 buildings separated by less than 100m and more than 50m from other buildings

Grouped habitat : groups of 6 or more buildings spaced at intervals of less than 50m and more than 15m, or groups from 1 to 5 buildings spaced at intervals of less than 50m and 50m apart within a group of urban habitat, or groups from 6 to 9 buildings spaced at intervals of less than 15m.

Urban or dense habitat : groups of 10 or more buildings spaced at intervals of less than 15m



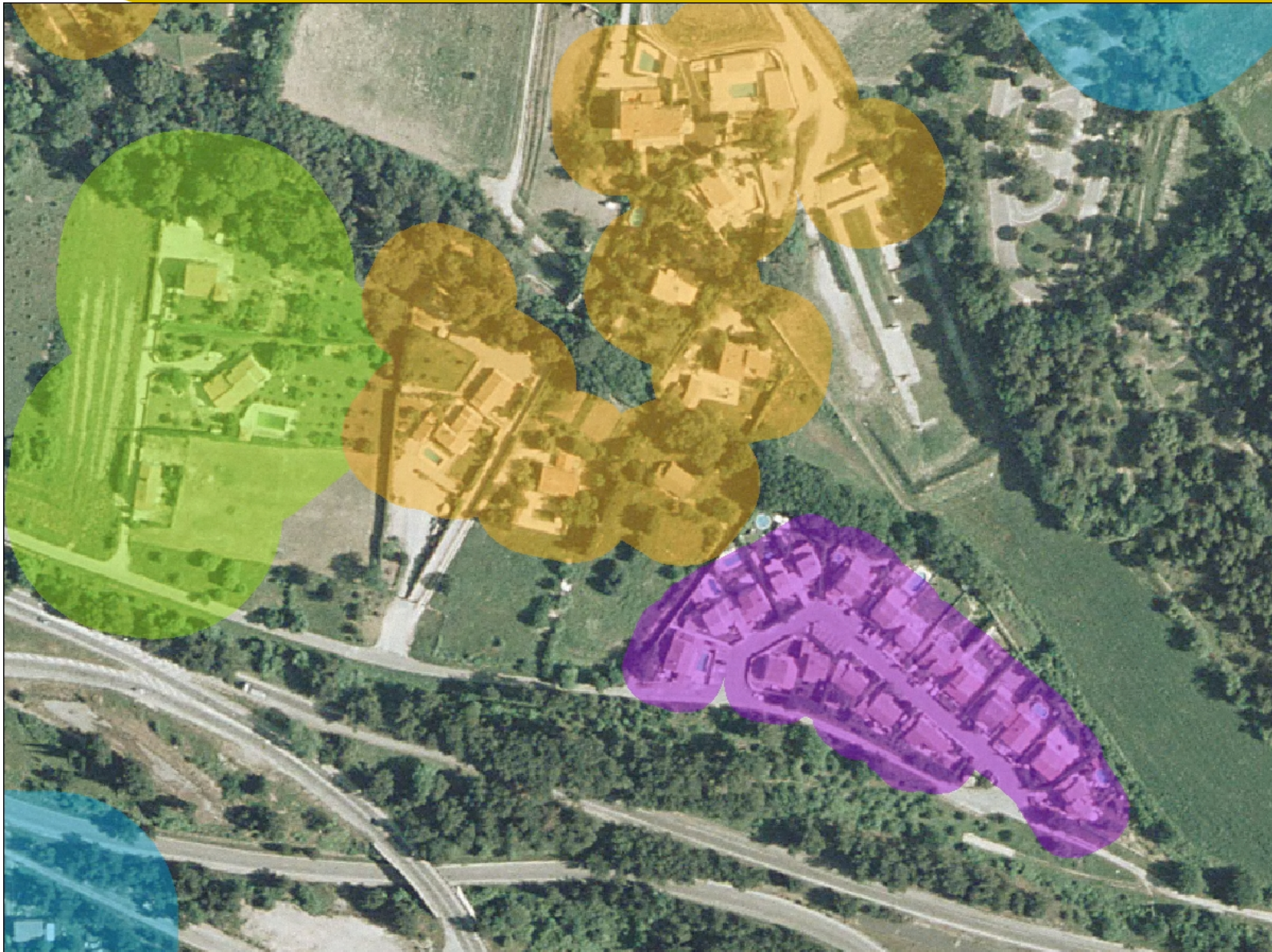


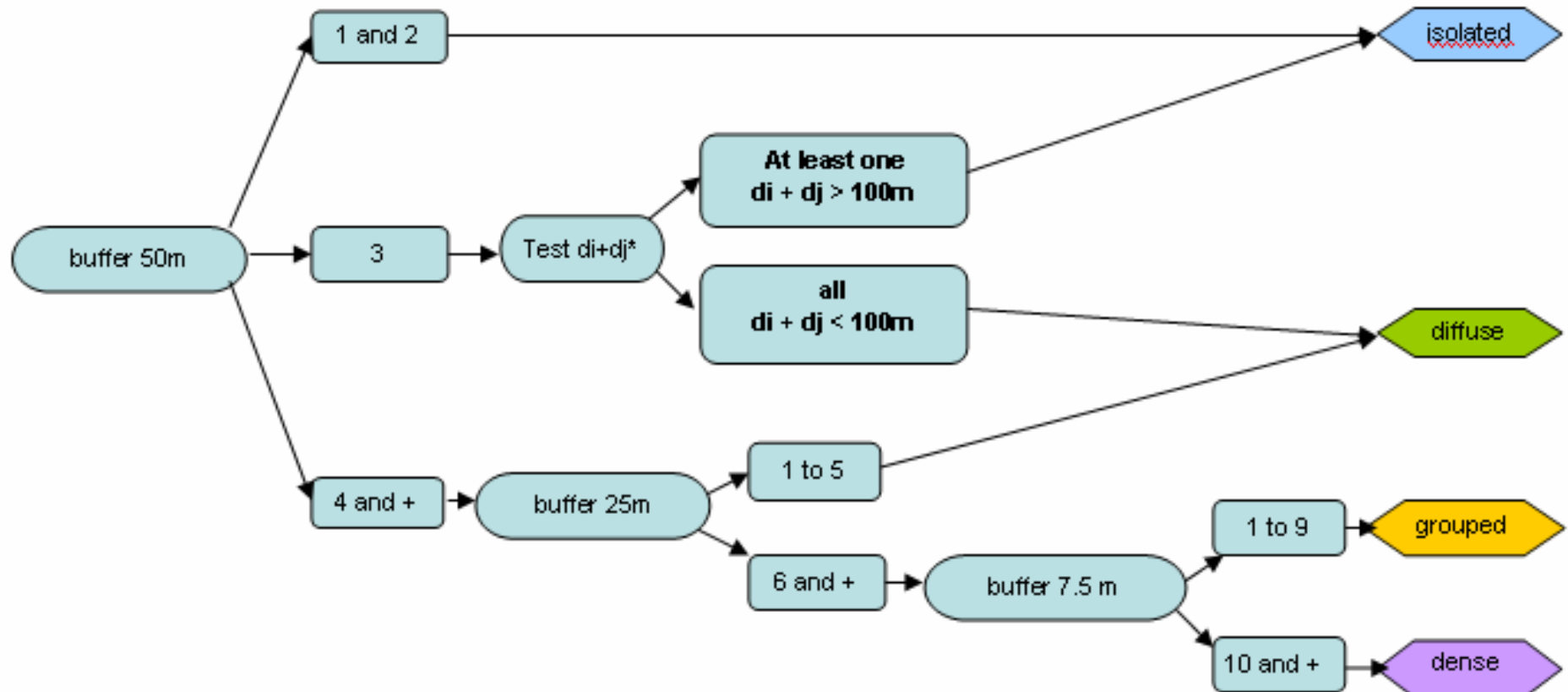
Once the buildings classified, they are grouped into **habitat areas** that are defined by buffers whose width depends on the type of habitat (50m for isolated habitat and diffuse habitat, 25m for grouped habitat, and 15m for dense habitat).

"Holes" with a surface lower than 1ha within a habitat area are integrated in this habitat area.



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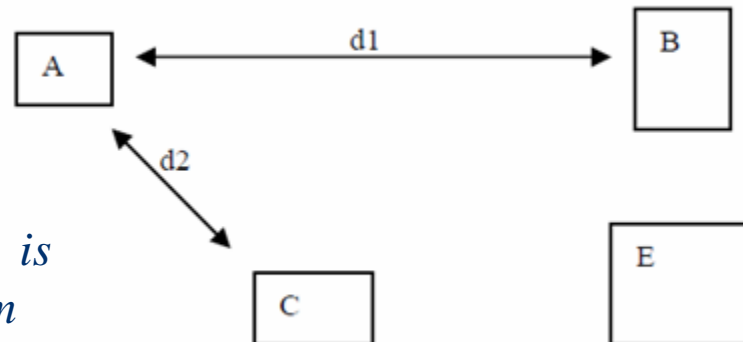
*distances between buildings additionned 2 by 2

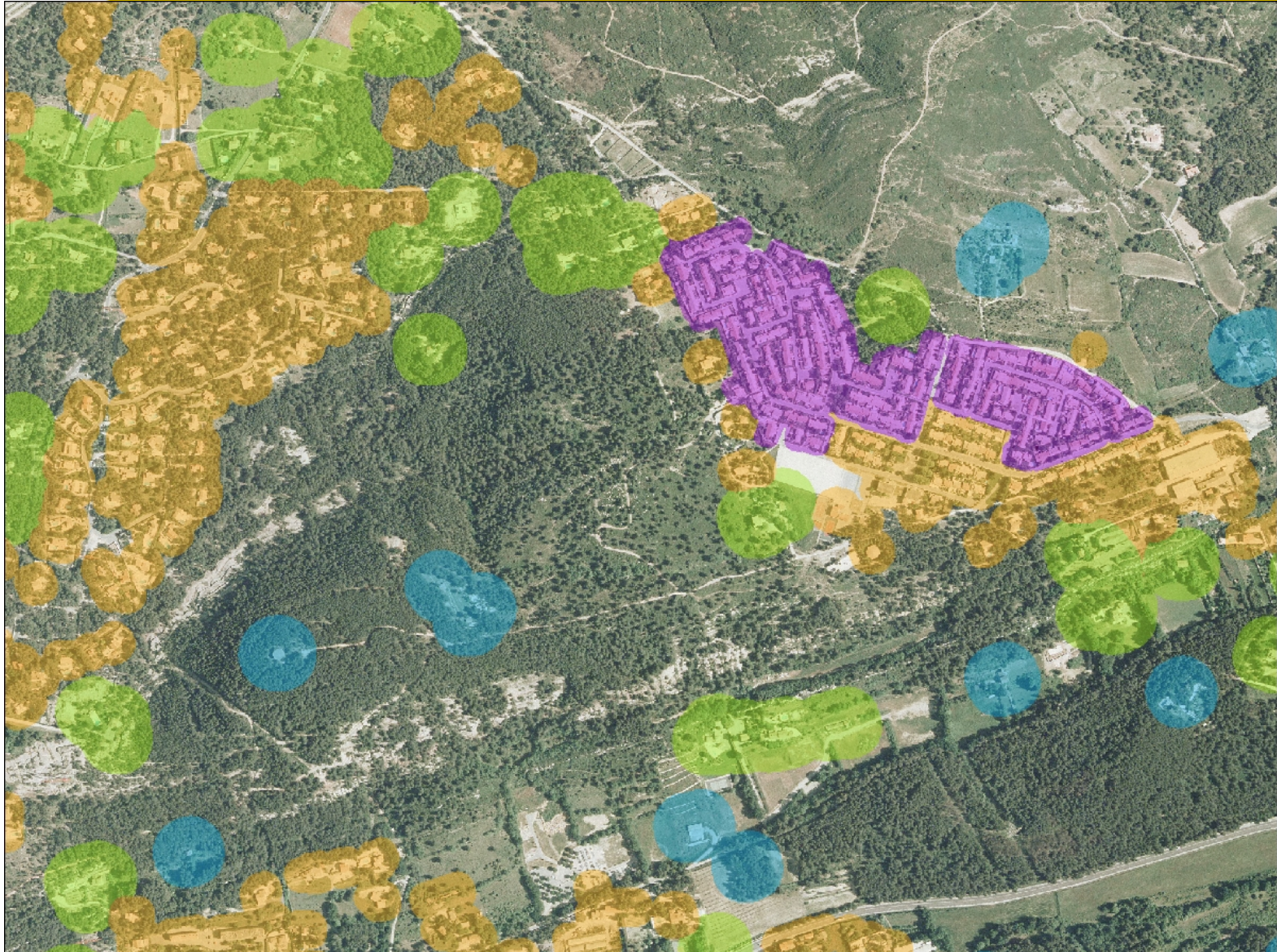


The test on groups of 3 buildings is used to identify isolated habitat in the sense of the following definition: "a building is not isolated if the sum of the distances separating it from two other buildings is less than 100m."

This definition is often used in France in the urban development measures to prohibit the construction of isolated buildings in high fire risk areas.

On this exemple, building A is not isolated if $d1 + d2 < 100m$



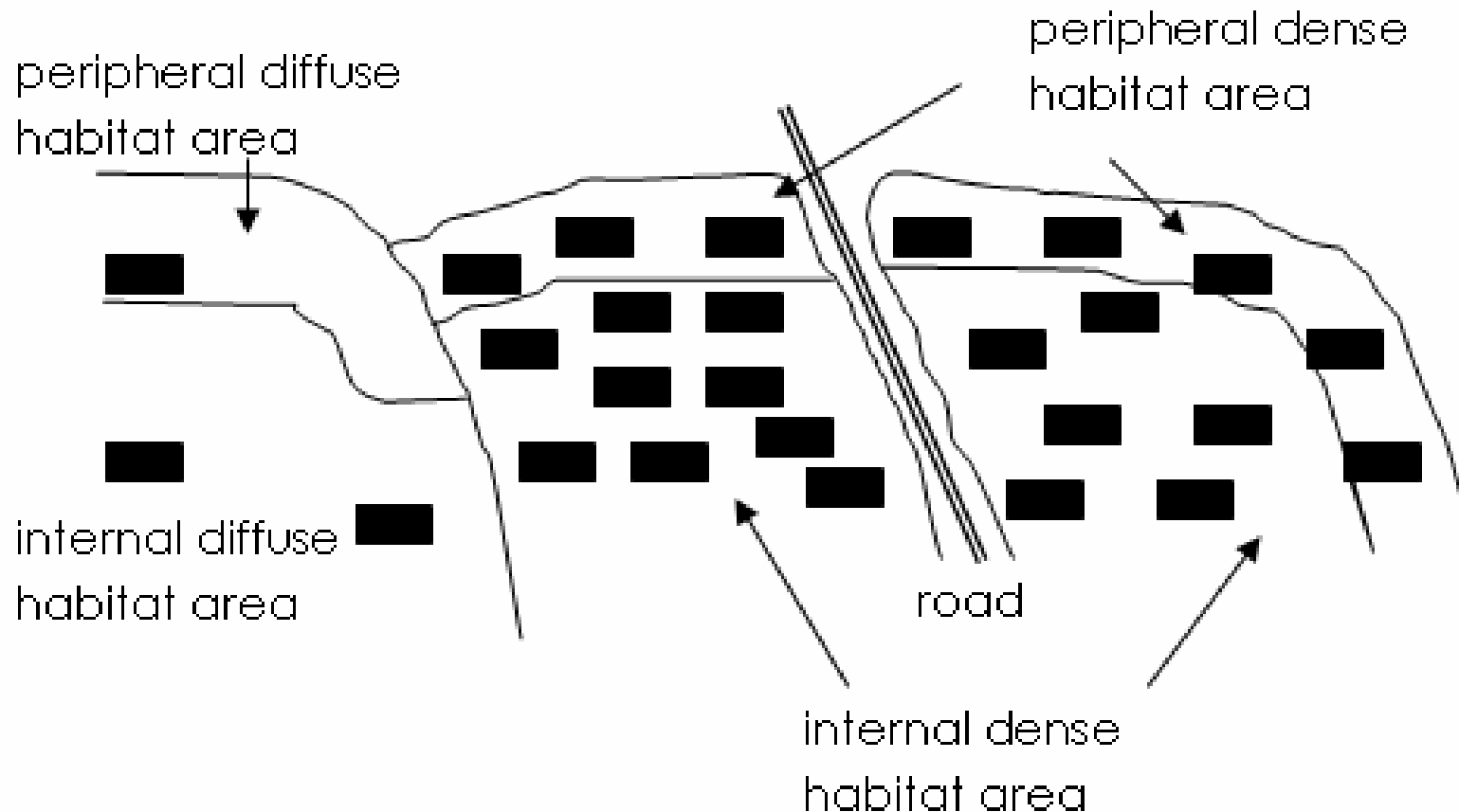




We then defined in these habitat areas **peripheral areas and internal areas**.

The peripheral areas are formed by the first row of houses facing the wildland. Considering that most houses do not exceed 20 meters in length, the peripheral areas therefore include the buffer surrounding the area (50, 25 or 15 m) with the addition of a buffer of 20 meters inland.

The parts in contact with other habitat areas or areas anthropized (infrastructure, activity zones ...) are not mapped as peripheral areas.





Several uses are made of this mapping :

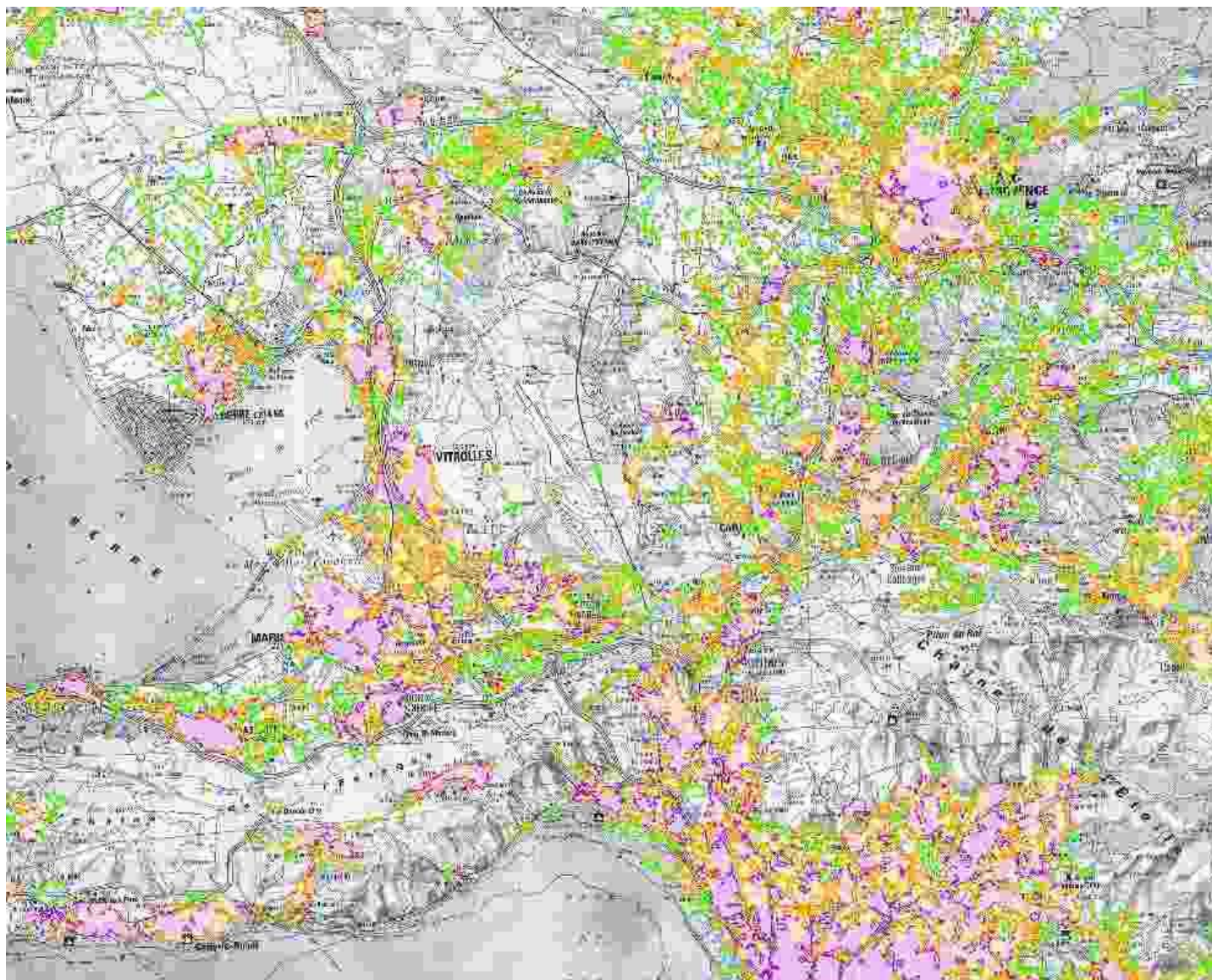
- It allows to **refine the cartography of vegetation** in these interface zones.

Field observations of fire behavior during summer fires allowed to set rules for correcting raw maps of vegetation, such as :

- classification of every types in the internal dense habitat area as incombustible,
- subordination of certain highly combustible types located in peripheral dense habitat or internal grouped habitat areas into less combustible types, considering the high probability of clearing or irrigation in these areas.



- At the departmental level, it has been used to make analysis to determine the policy of control of Legally Required Brushing in municipalities where there are the sectors most at risk which are diffuse habitat areas and peripheral areas
- At the scale of a massif, it helps better define the issues to protect and better orientate strategies and choice of equipment



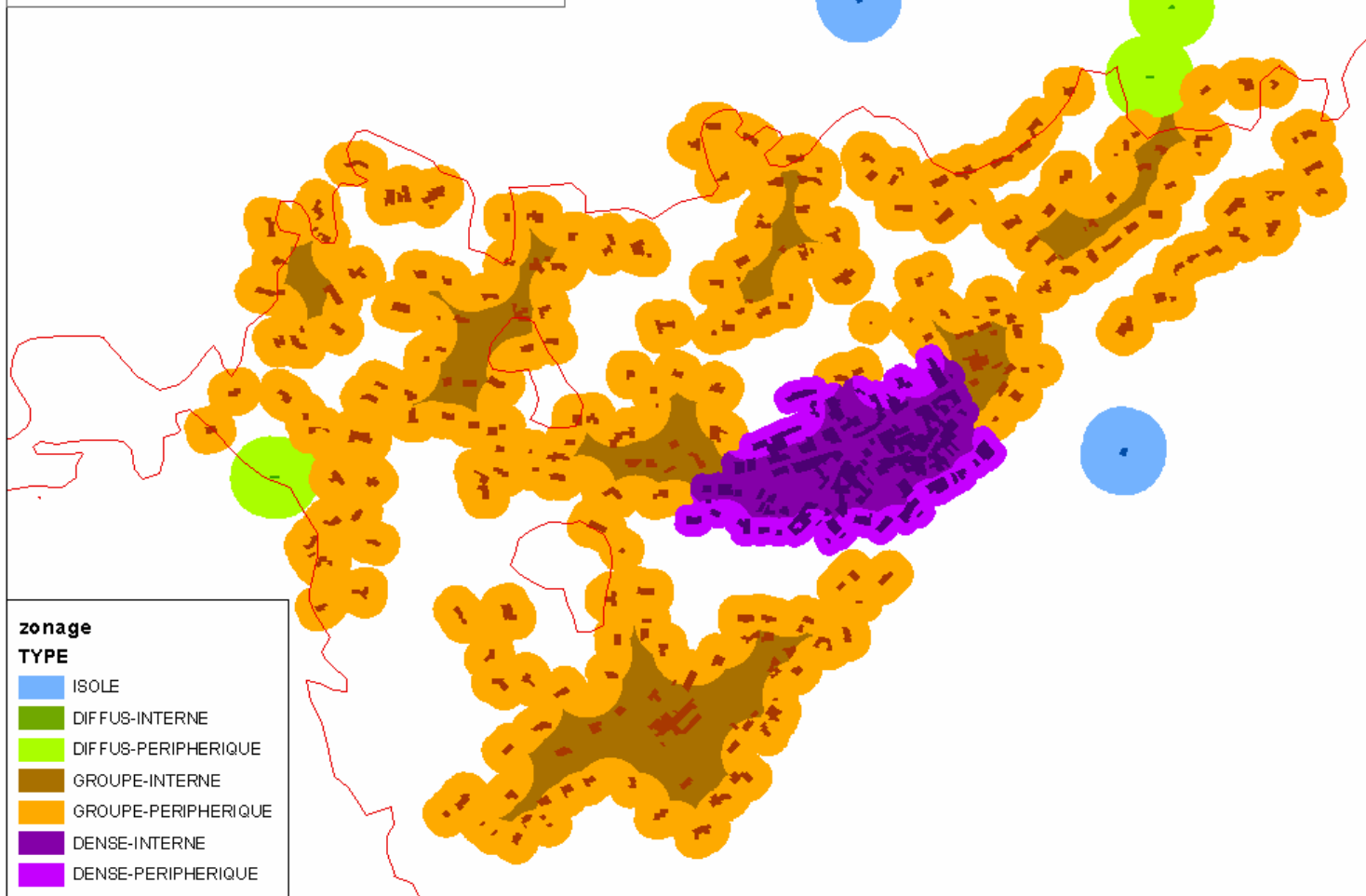


- On the scale a town, this characterization of the issues is used to define different levels of equipment and urban planning rules for the different habitat areas that do not have the same vulnerability to fire risk, but also to guide the urban planning policy of the municipality.

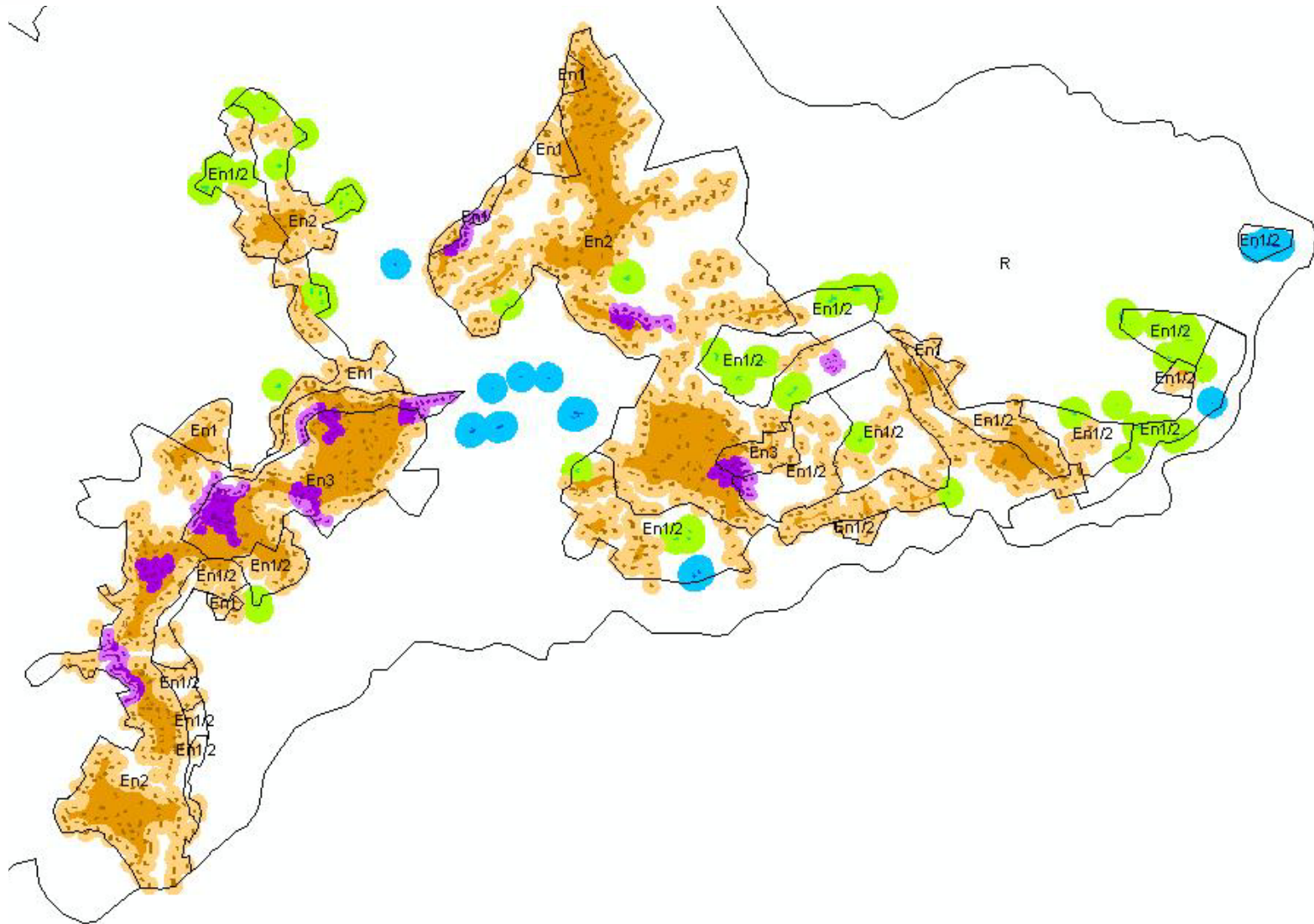


Feedback after a fire showing the difference of vulnerability :

feu de Fontanès (31/08/2010)



Zonage of different urbanization rules for different habitat types:

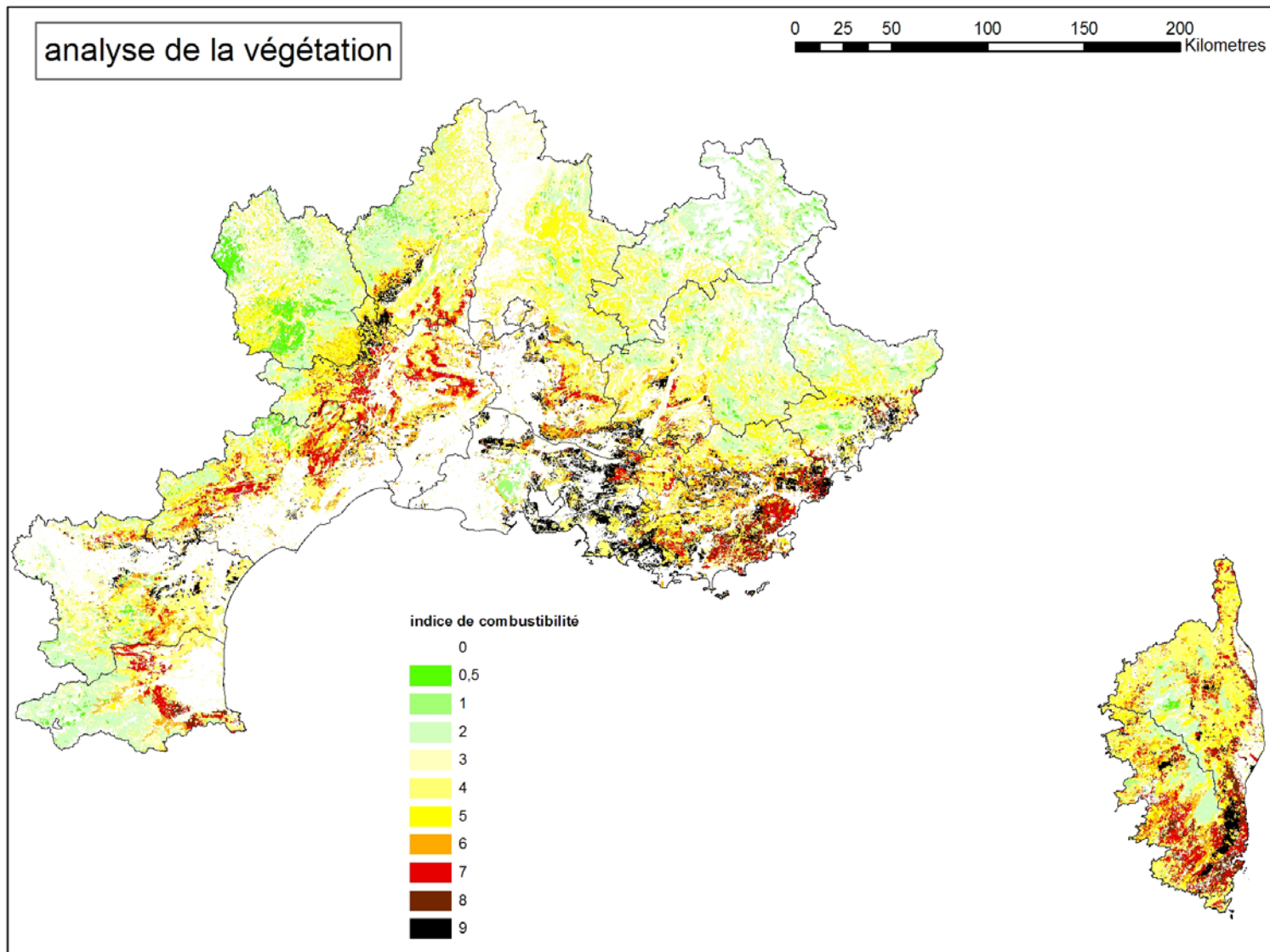




Evolutionary cartography of vegetation sensitivity

To respond to a need of the Interministerial **General Staff of Defence Zone South** (Mediterranean region), which coordinates the activities of all extra-departmental resources (national resources and reinforcements from other departments or other zones), ONF in 2009 produced a map of sensitivity of the vegetation.

This map is based on **maps of stands** made by the National Forest Inventory grouped into 31 types. **Other factors** such as biogeographic zones, altitude, sunshine, slopes, major soil types, are used to assign to these different types of combustibility indices, then translated into sensitivity levels taking the **hypothesis extreme summer conditions** (strong drought homogeneous throughout the zone).



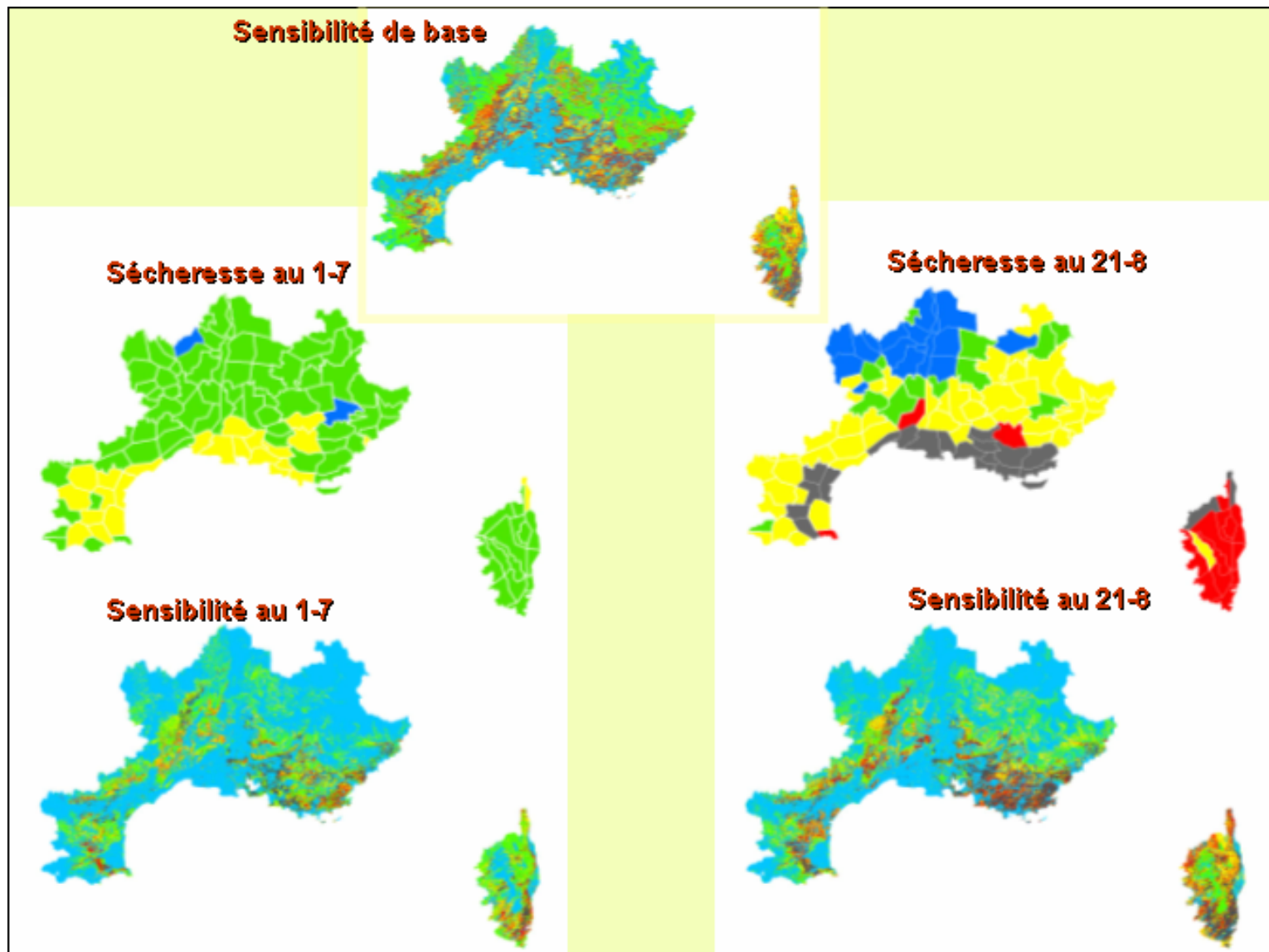


During the seasons 2010 and 2011, ONF has developed a methodology which allows to **modulate the sensitivity of vegetation according to the drought** calculated by Météo-France.

Drought is an index into 5 levels calculated from the indices IH (humus index) and IS (soil index) of the Canadian method, themselves evaluated from the cumulative rainfall and evapotranspiration.

This index is calculated **daily and spatialized** (1km pixels), but changes very little rapidly in the absence of rainfall.

The **modulated sensitivity map is generated 2 times a week** plus intermediate production in case of heavy rainfall.





The first version of the modulation tested in 2010 consisted of **increasing the combustibility index of 1 point** in case of drought "very strong" and the **decrease of 1, 2 or 3 point** in case of drought "medium", "low" or "very low".

Feedback has shown some flaws to this method (overestimation of risk for "medium" and "high" drought, and poor evaluation in the hinterland) that has therefore evolved in 2011 :



Rather than a systematic offset of index, modulation is done by **cross tables**, which can take into account different behaviors, depending on stand type, biogeographic zones, slopes and sunshine.

A different modulation was also introduced for the **start of the season** (called "spring modulation ", versus "summer modulation ").



SUMMER MODULATION

Mediterranean area +
Part of mountains and
hills with steep slopes
and high sunshine

mountains and hills

high mountains

non boisé	0	0	0	0	0
formation naturelle non combustible	1	1	1	1	1
pelouse de montagne	1	1	1	1	1
pelouse sèche	2	2	1	1	1
hêtraie	2	2	1	1	1
lande de montagne	2	2	1	1	1
pin à crochets	2	2	1	1	1
sapin - épicéa - douglas - mélèze	4	3	2	1	1
inculte ou friche	4	3	2	1	1
lande	4	3	2	1	1
feuillus divers	4	3	2	2	1
autre boisement	4	3	2	2	1
chêne pubescent	4	3	2	2	1
boisé bâti	4	3	2	2	1
cedre	5	4	3	2	2
garrigue boisée de feuillus	5	4	3	2	2
châtaignier	5	4	3	2	2
mélange feuillus-résineux	5	4	3	2	2
garrigue	5	4	3	2	2
pin laricio - noir - sylvestre	5	4	3	2	2
résineux divers	5	4	3	2	2
pins divers	6	4	3	2	2
garrigue boisée de chêne vert	6	4	3	2	2
maquis	6	5	4	3	2
eucalyptus	6	5	4	3	2
maquis boisé de feuillus	6	5	4	3	2
maquis boisé de chêne liège	6	5	4	3	2
chêne vert	6	5	4	3	2
chêne liège	6	5	4	3	2
pin d'alep - pin maritime	6	5	4	3	2
garrigue ou maquis boisé de résineux	6	5	4	3	2

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SPRING MODULATION

Mediterranean area +
Part of mountains and
hills with steep slopes
and high sunshine

mountains and hills

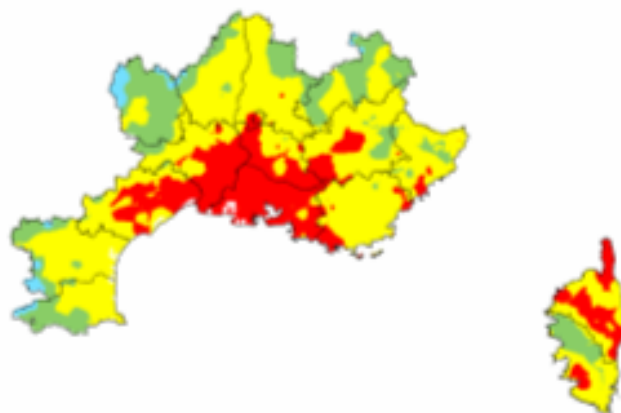
high mountains

non boisé	0	0	0	0	0
formation naturelle non combustible	1	1	1	1	1
pelouse de montagne	1	1	1	1	1
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sapin - épicéa - douglas - mélèze	3	2	2	1	1
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cédré	5	4	3	2	1
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chêne liège	5	4	3	2	1

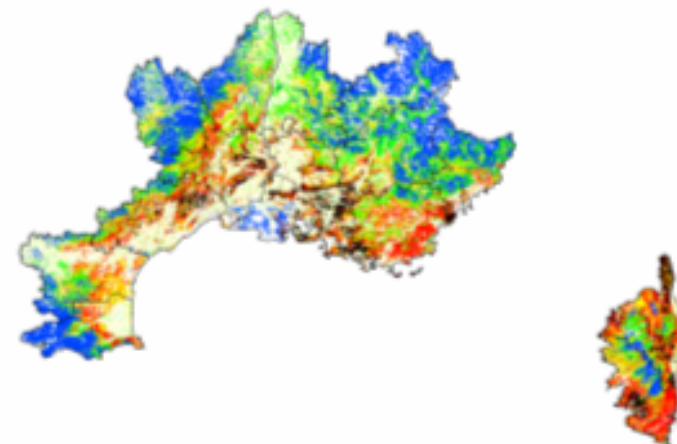
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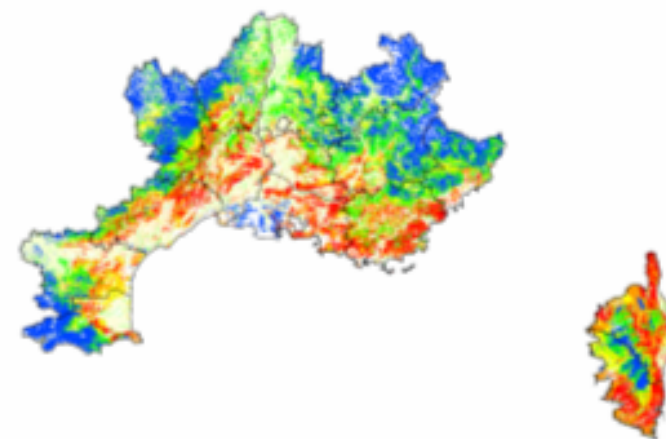
drought 27 july 2010



Modulation « 2010 »

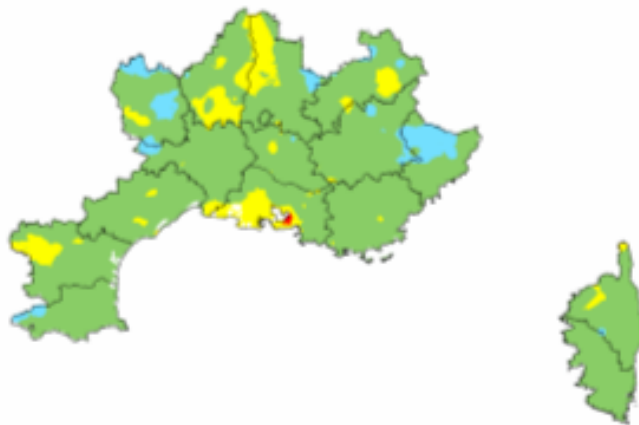


Modulation « spring 2011 »

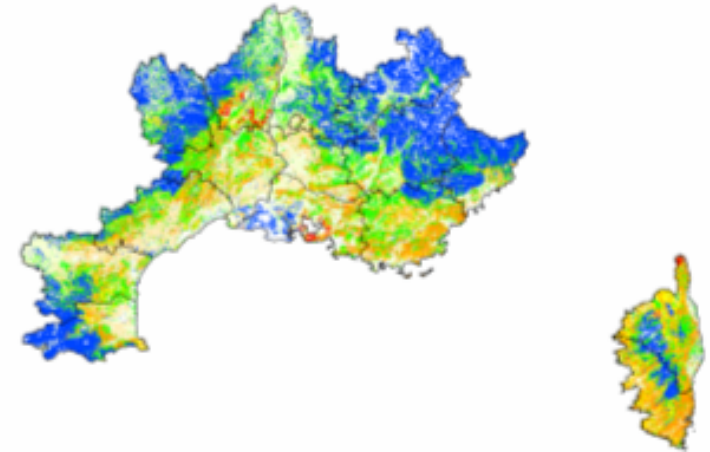




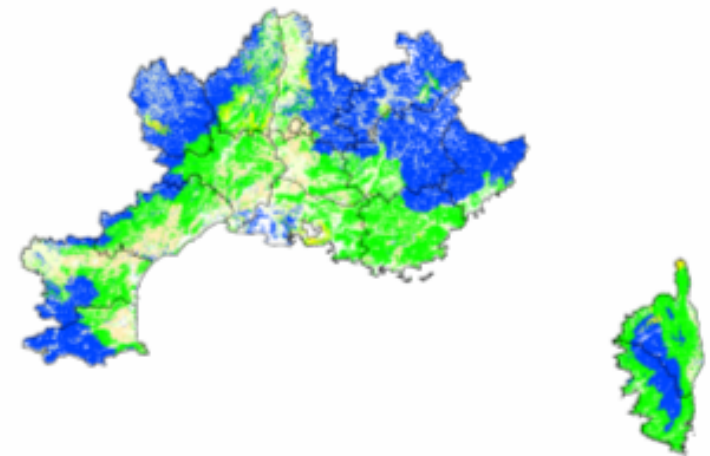
Drought 23 may 2011



Modulation « 2010 »



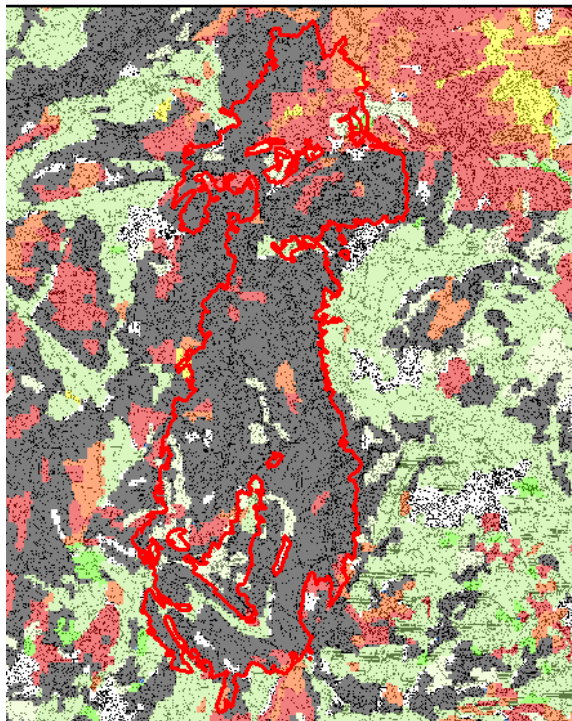
Modulation « spring 2011 »



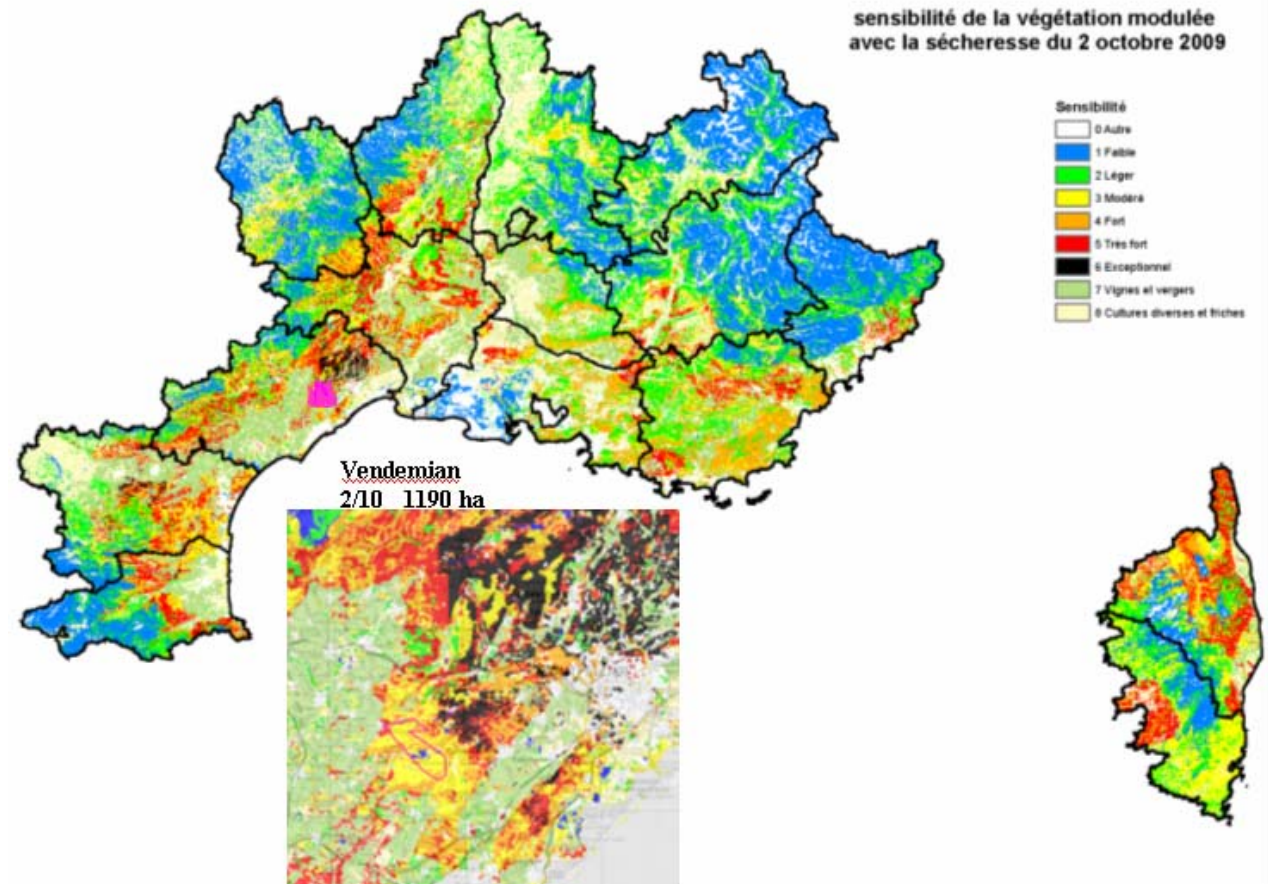


Exemples de feedback

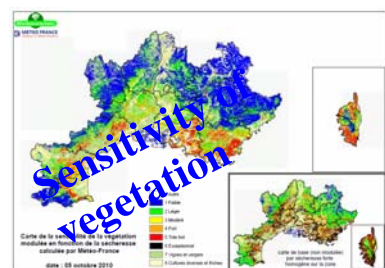
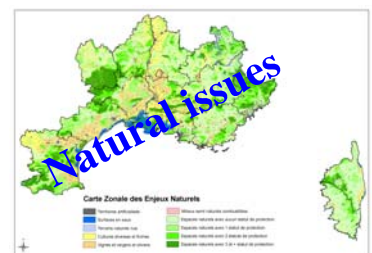
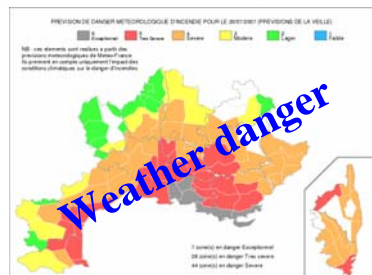
Département de l'Hérault
Contour du feu de FONTANES 30/08/2010 (2544 ha)
Carte de sensibilité de la végétation modulée
avec la sécheresse du 31/08/2010



sensibilité de la végétation modulée
avec la sécheresse du 2 octobre 2009



Use of this tool combined to others to help on decision making



THANK YOU FOR YOUR ATTENTION !!!