

FORFAIT

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FOREST FIRE RISK: A HOLISTIC APPROACH

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May I explain you my point of view of what I consider a **holistic approach** to the problem of wildfires, so you have a close idea of the components we can arrange to design FORFAIT system.

Pre-fire

First we have to consider that natural environment, from a human point of view, is presented as a mosaic of **Land Uses** (cultivations, urban areas, woodlands, grasslands, water reservoirs, natural reservations etc), which have a direct link to the socio-economic development in a region. From the land uses a land value is derived in every region as result of its exploitation, whatever it is (industrial, recreation, protection etc.), value that can be obtained using existing procedures.

Land used have a close relation with **vegetation coverage**, in type and extension, which constitute the base of forest fuels. Changing composition of such vegetation modifies the forest fuel content in a region. Vegetation is the only hazard component that can be altered for our purposes, provided that **climate**, **wind** and **terrain** cannot be modified. We have participated in many studies in the planning and management of land uses in Spain and its relationship with vegetation. A simple model can be coupled with the socio-economic model to predict vegetation changes in time and space.

So the first ability that humans have to reduce fire hazard is **preventive silviculture** and planning and management of forest fuels, always taking into account socio-economic demands of sustainability together with ecological constraints such as biodiversity and preservation of habitats. Nevertheless, these preventive operations over the vegetation have some costs. We have done some studies about characterisation of forest fuel load reduction due to silviculture operations and their associated costs. This can be modelled also.

In the other hand, land uses derive into socio-economy development of a region and this into **potential risk** of human-caused forest fire risk, whether it is deliberately caused or initiated non-voluntarily as it happens in many occasions. There exists other risk component due to natural causes, such as lightning. All risks can be predicted using models and observations. We did a complete socio-economic risk model in FOMFIS that could be adjusted, improved and extended. Also we have developed a way to simulate climate and wind conditions change over time and have studied the typification of wind-climate events in case of forest fires. These two point could be considered in FORFAIT tool design.

Forest fire hazard has influence in three fire potential effects, the fire **ignitability**, the **fire spread** and the **energy release**, all of them depends largely on the vegetation coverage, but also in the other components of fire hazard. When fire risk and high combustibility (ignitability) match together in time and space, there you have real **fire outbreaks**. We have studied in FOMFIS an algorithm to predict fire outbreaks using probabilistic analysis, this can be modelled very effectively using historic data. There exists some methods to predict fire ignitability of forest fuels, including some that make use of remote sensing techniques (i.e. NOAA-AVHRR sensor images).

In-fire

Fire propagation is driven by the existing conditions of terrain, wind, climate and vegetation as well as their change over time. This is the main purpose of forest fire simulation. Although there exist ways to simulate crown fires, we have developed a fire spread engine that simulates forest fire, much the way as other models do. Nevertheless, FORFAIT should count on a holistic (including subject, space and time) forest fire simulation engine, rendering final numbers about average burned areas, number of developed fires etc. for a large (significant) period of time and space, making use of both probabilistic and deterministic initiation and development of wildfires.

The fire simulation gives you the **extension and shape of fires** over the terrain, so it is quite easy to estimate **direct losses**, due to wildfire. We have developed a primary algorithm for the estimation of losses due to forest fires, which is a computerisation of the algorithm used by our Central Fire Service of forest fire defence in Spain. In the direct losses we must consider natural resources, infrastructures and human fatalities, all of them directly linked to some kind of insurance. Banks and insurance companies take its role here when goods and services are at risk in a forest fire contingency.

In the fire propagation there are other (external, or non-natural) factors affecting the final extension and shape of the burned area, like the **fire fighting**, suppression and control operations. These operations do represent costs that must be accounted as well. We have studied also a dispatching and fire fighting simulation engine that has the ability to calculate fire resources requirements and operations effects on fire suppression, together with associated costs, according to a fire theatre where several fires can occur at a time.

Fire fighting efficiency is heavily based on the existing **infrastructure** to carry out the operations. This includes road network, number and position of bases, airports, water points, lookouts and radio antennas. Construction and maintenance of the infrastructure has associated costs. We have studied also some methods to estimate fire fighting efficiency according to the existing infrastructure and calculated the total cost.

Post-fire

Burned areas are subject to a number of **post-fire effects**, including erosion processes and landslides due to vegetation change coverage. Other impacts can be also estimated, such as the effect on the wildlife, fauna, flora, and socio-economic changes and land value change and potential, just as suggested in FORFAIT proposal. As you can see, wildfires draw a completely different scenario after fire contingency, and this occurs just in some hours. This aspect, as I mentioned in Florence meeting, has special relevance in open, large wildlands (think about Siberia) in which forest fires are part of a natural cycle (as we discussed) and that are typically detected by satellite or airborne surveillance. Effects on such lands cannot be evaluated in the same way as they are for smaller wildlands and wildland-urban interface areas present in most places in the Mediterranean basin.

Adaptation of the socio-economy and ecology to the new conditions under the same climate and terrain is a slow process that ends in changes in land uses, thus closing the circle in this dynamic analysis.

One idea could be to develop a computer-based, GIS-based and RS-supported system to characterise several generations of wildfire theatres, taking into account all the components and actors present in the process, and evaluating risk evolution over time, instead of yielding instant or average results (as current systems do). This will lead to make holistic planning in terms of priorities, space and time, plans that must be respected regardless political or socio-economic changes, in order to ensure sustainable development of a region. Obviously, the application of this system in a demonstration case study will end in the elaboration of a Plan General for the sustainable defence against forest fires of a selected region, made using the system.

Below I enclose a simplified scheme of holistic risk components, under my point of view:

FIRE RISKS AND LAND USE CYCLES FROM A HOLISTIC POINT OF VIEW

