

THE USE OF NEW SPATIAL TECHNOLOGIES IN FOREST FIRE FIGHTING IN ANDALUSIA

Carmen Navarro Mezquita, José Manuel Moreira Madueño and
Francisco Rodríguez y Silva.

Consejería de Medio Ambiente (Junta de Andalucía)
Avda. de Las Acacias S/N. 41092-Sevilla. Spain
Tel: 34 5-44480200 Fax: 34 5-4480222

Forest fires are one of the major sources of environmental damage in Andalusia. Due to the long drought that is affecting the region since late 1991, the problem of forest fires has become more and more critical, so that the regional budget for forest fire fighting has increased considerably in the last years. Because of the environmental damages and high costs in fire fighting, systems for fire alert, fire detection and fire evaluation should be more accurately improved.

The above mentioned needs lead to the problem of acquiring feasible information at a local and regional scales as input in the calculation of fire risk, damage evaluation and regeneration assessment. That is why new source of information such as satellite imagery, spatial databases and ground position systems are systematically being used by the Fire Prevention and Natural Resources Evaluation Departments of the Consejería de Medio Ambiente of the Junta de Andalucía in a common program that aims to study fire impact on the region. The following paragraphs will describe this overall program, which covers three main aspects of forest fire evaluation:

Forest Fire Prevention: Fire Behaviour And Fire Danger Prediction

Both departments of the Consejería de Medio Ambiente are actually working in the formulation of a daily meteorological forest fire risk index with the help of NOAA-AVHRR images and the regional meteorological stations network. In order to achieve the best results in a daily-scale forest fire danger prediction, different methodologies are actually being evaluated so that the influence of different variables on fire risk can be assessed. On the other hand, a good knowledge of forest fuel distribution and behaviour at local scale is one of the main demands for fire suppression activities.

That is why we have established three different scales when mapping forest fuel type: 1:10,000, 1:50,000, and 1:100,000. Related to a regional forest fuel map, two different working lines are actually being followed:

- NOAA-AVHRR pixel fuel forest map: there was a first attempt to produce a regional forest fuel map at NOAA scale by combination of variables by means of different classification algorithms. The variables were selected based on their influence on forest fuel location and accumulation. They were the regional 1981 Land Use map, two NDVI maximum-value composites from spring and summer 1994 and slope and aspect in the region.

- due to the intrinsic problems of finding suitable landuse-forest fuel training areas at NOAA scale, another project on regional forest fuel map is now being carried out. The 1991 Landuse map can now be displayed in vector format and it is better adapted to forest monitoring requests as it includes different structure and density related forest and shrub stands. That is why direct fuel type assignment to landuse is more accurate than the 1987 Landuse map. At present, field evaluation of direct assignment is being made in some areas of Andalusia.

Up to now we have been evaluating the possibility of formulating a mixed ignition-propagation probability index as a result of different factors: fuel type and slope, relative humidity, relative greenness and stress degree.

Relative greenness and stress degree day will be calculated with NOAA-AVHRR Normalized Vegetation Index and thermal bands respectively. Both of them have been proved to be related to plant vigour and plant water content. Stress degree is a relative measure of evapotranspiration, as it does not account for all the parameters which are necessary to calculate the energy balance equation. That is why

accumulated calculation $T_s - T_a$ (surface and air temperature) seems reasonable for regional areas at a daily scale. Surface temperature is obtained by a "split-window" formula which uses the thermal NOAA-AVHRR bands, and correcting coefficients for water vapour and emissivity. Some surface temperature maps have already been produced for the whole region, which are now being validated with data of meteorological stations.

Evaluation Of Forest Fire Damage

Since 1991 the Consejería is evaluating the major forest fires that take place during fire season. Landsat-TM images and information coming from the SinambA, the Andalusian Environmental System, are used to evaluate fire damage and fire erosion risk. For each forest fire area, the following information is provided: description of the forest fire, place, date and duration and statistical tables; false colour composite showing the scorched area; fire damage levels and calculated hectares; Land Use and Vegetation; map; slope and aspect maps and municipalities affected.

This document is a useful tool when planning the post-fire management and reforestation practices, as it provides information on type of vegetation, affected area and site aspect and slope. It can also be used in other related studies such as post-fire erosion risk and regeneration evaluation.

For summer 1995 a pilot project will intend to establish some relationships between forest damage evaluation by satellite and some biophysical parameters that describe forest fire damage such as degree of carbonization or leaf structure after the fire.

With the collected information, the Consejería de Medio Ambiente is now working on a regional vector map which shows the major forest fires that have been evaluated since 1991. This will be a great help when assessing the performance of the different forest fire risk indexes.

Regeneration Monitoring

Related to the pilot program on forest fire evaluation, fire regeneration monitoring by satellite will also be evaluated. Some of the major forest fires which have been evaluated since 1991 will be surveyed by field work by measurement of different plant parameters and satellite-derived cartography. The outcoming results will then be correlated to Landsat or Spot data for modelling plant regeneration and evaluation of possible erosion risk.

Cita bibliográfica:

NAVARRO, C.; MOREIRA, J.M. y RODRÍGUEZ, F. 1995. The use of new spatial technologies in forest fire fighting in Andalusia. EARSel. Workshop on Remote Sensing and GIS applications to Forest Fire Management. University of Alcalá de Henares. Spain. 7-9 de Septiembre de 1995.