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FUSION OF GIS LAYERS AND SATELLITE DERIVED WATER STRESS FOR FOREST FIRE RISK EVALUATION

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ABSTRACT

Geographical information Systems (GIS) and Remote Sensing data are key factors in a suitable spatial description of the forest fire hazard. This paper shows the use of different static information layers on a GIS derived probability model of fire risk with the addition of dynamic information about water stress of forest, provided by satellite data. The use of different water stress indicators is analyzed over several test sites affected by fires in the Canary Islands during the period from 2004 to 2009.

INTRODUCTION AND METHODOLOGY

Human action is usually behind most of the forest fires that occur every year in our forests. This make really difficult to generate risk maps that alert quickly and effectively providing information about the areas that may eventually be affected by the flames. However, the use of Geographical information Systems tools has contributed to a better representation of the risk of fire, considering probability functions that take into account determinant factors such as terrain orography, type of fuel, the presence of infrastructures, vegetation cover, humidity conditions and other meteorogical variables, among others. The temporal variation of some of these variables are what accentuate or soften the aforementioned risk of wildfire. In addition, the use of remote sensing can help decisively in generating risk rates that reflect the state of water stress of vegetation and surface temperature, two key variables in such studies, both with a spatial and temporal resolution that could hardly been obtained with weather stations at the ground.

RESULTS

This study compares the use of several vegetation indexes: Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), Soil Adjusted Vegetation Index (SAVI), and Global Environmental Monitoring Index (GEMI); derived from Terra-MODIS sensor data, as indicators of water stress status of forests. They are use over the same GIS derived probabilistic model of static risk for Tenerife and la Palma Islands, in the Canary Islands (Spain). Multitemporal composite values of these vegetation indexes were considered for the areas finally affected by fires and other test areas selected as representative samples of the most important types of vegetation in the study area. Modulating the effect of water stress indexes with a static fire risk model previously developed for these islands (See fig. 1), the dynamic evolution of these models of risk has been analyzed during a seven-months period, previous to the most important fire events that took place in the Canary Islands from 2004 to 2009 (See fig.2). The consistency and degree of representativeness of each vegetation index in the composite value of risk is also assessed.

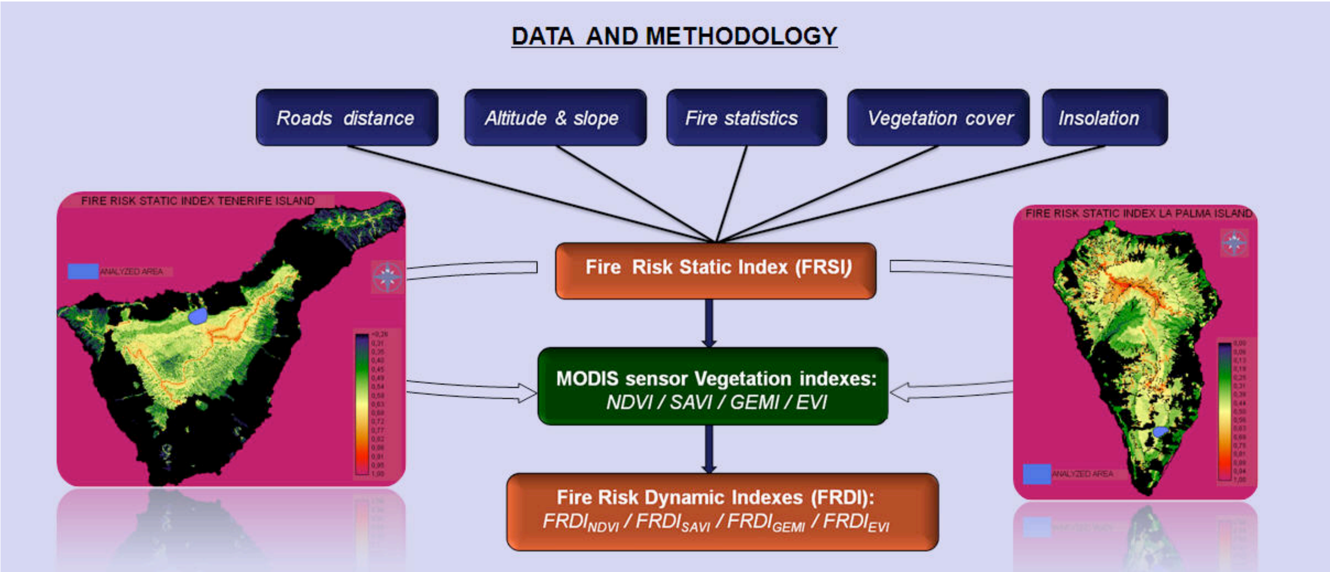

Figure 1: Data flow chart for the Fire Risk Dynamic indexes (FRDI) estimation. Layers of static risk and Maps of static Risk for la Palma and Tenerife Islands (Canary Islands-Spain) are also shown.

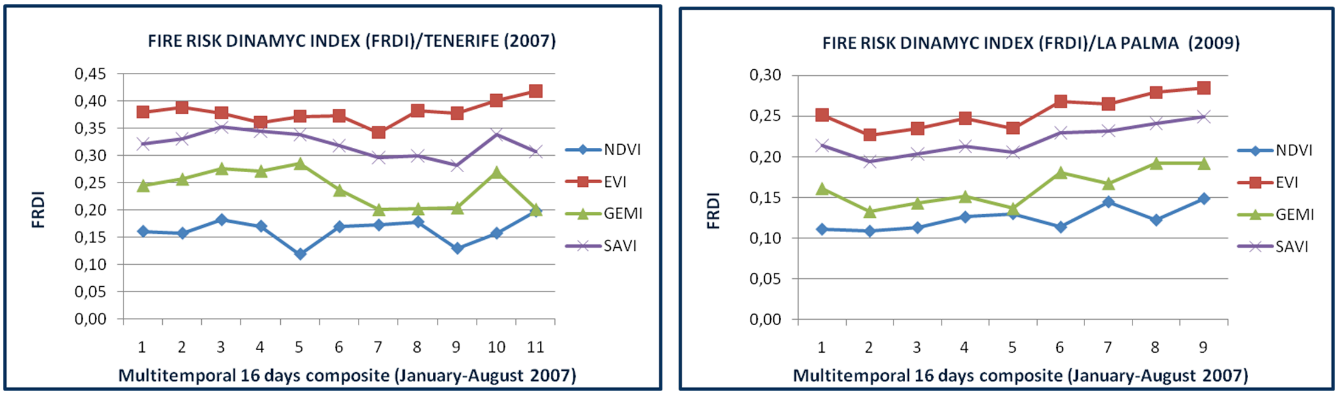

Figure 2: Graphic plots of mean Fire Risk Dynamic Indexes (FRDI) (derived from NDVI, EVI, GEMI and SAVI) for Tenerife (2007) and la Palma (2009) fires.

CONCLUSIONS

The analysis of the dynamic risk of fire derived from the different MODIS vegetation indexes over the static layers of risk, clearly remark the increase in some of these indicators in the composite dates prior to the fire events. However, depending on the particular conditions of the burnt area, some could be considered as unsuitable, since they are more representative of vegetation greenness than water stress of vegetation. The adaptation of these models of dynamic risk to the special climatic and orographic characteristics of an insular environment represents one of the innovative aspects of this work in a geographical location where this kind of products were not previously available. Furthermore, the operational use of them as an aid tool in both prevention and in the simulation of propagation of a fire is now being tested. The addition of low scale meteorological variables forecasting that will surely add more representativeness to the risk index, is also underway.

ACKNOWLEDGMENTS

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