A statistical procedure for fire risk mapping in Italy

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FONDAZIONE CIMA CIMA RESEARCH FOUNDATION

CENTRO INTERNAZIONALE IN MONITORAGGIO AMBIENTALE
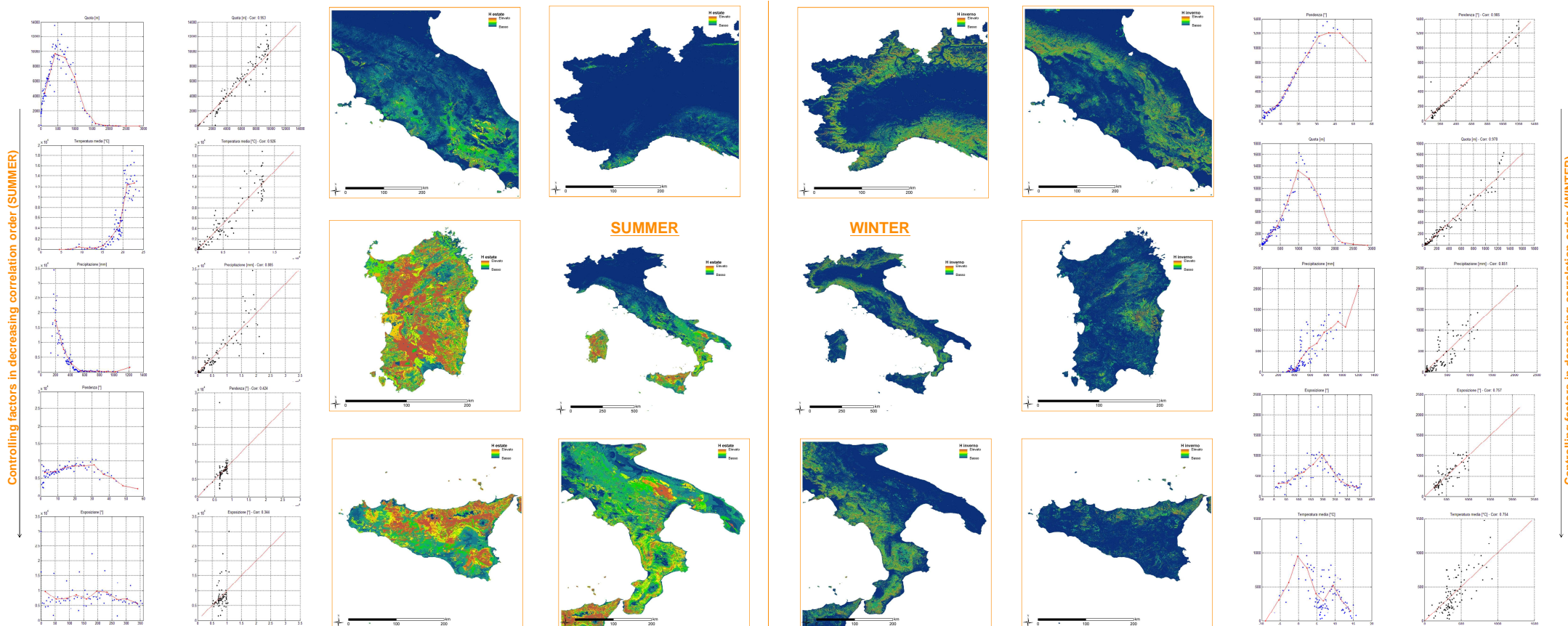INTERNATIONAL CENTRE ON ENVIRONMENTAL MONITORING

Introduction

The high topographic and vegetation heterogeneity makes Italy vulnerable to forest fires both in the summer and in winter. In particular, northern regions are predominantly characterized by a winter fire regime, mainly due to frequent extremely dry winds from the north, while southern and central regions and the large islands are characterized by a severe summer fire regime, because of the higher temperatures and prolonged lack of precipitation. The threat of wildfires in Italy is not confined to wooded areas as they extend to agricultural areas and urban-forest interface areas. In view of the limited availability of fire risk management resources, most of which are used in the management of national and regional air services, it is necessary to precisely identify the areas most vulnerable to fire risk. The few resources available can thus be used on a yearly basis to mitigate problems in the areas at highest risk by defining a program of forest management interventions, which is expected to make a significant contribution to the problem in a few years' time. Given the availability of fire perimeters mapped over a period spanning from 5 to 10 years, depending by the region, a statistical procedure was defined in order to assess areas at risk based on objective criteria by observing past fire events. The availability of fire perimeters combined with a detailed knowledge of topography and land cover allowed to understand which are the main features involved in forest fire occurrences and their behavior. The seasonality of the fire regime was also considered, partitioning the analysis in two macro season (November-April and May-October). In addition, the total precipitation obtained from the interpolation of 30 years-long time series from 460 raingauges and the average air temperature obtained downscaling 30 years ERA-INTERIM data series were considered. The analysis consists on the subdivision of the territory in classes based on the named information layers (elevation, slope, rainfall height, temperature, etc.) with a recursive algorithm that ensures the equal numerosity of each class. The number of fires occurred in each class is then assessed basing on time series in the last decade, in order to have an estimation of the fire hazard with a constant statistical confidence. The analysis was carried out at a spatial resolution of 500 m on the whole Italian territory by using a dataset of fires occurrences that spans from 2007 to 2013.

Controlling factors in decreasing correlation order (SUMMER)

Controlling factors in decreasing correlation order (WINTER)

SUMMER

WINTER

Results

Artificial surfaces, wetlands, water bodies permanently irrigated lands and rice fields: Burned areas occurred in this class can be considered as a misrepresentation of actual vegetation cover. The spatial resolution of CORINE does not match with the very high resolution of burned areas. Anyway most of the burned areas in this class corresponds to Urban Fabric and can be considered as fires in WUI. The results show that this areas are prone to fires in summer in those areas where the total precipitation in summer is under 400 mm with air average temperature over 20°C. Topography is almost completely uncorrelated.

Agricultural areas, open space with little vegetation and grassland: Areas covered by herbaceous vegetation are the most representative vegetation at national level and it is the most frequently spread both in summer and in winter. In summer fire danger increase with the elevation since 1000 m and decrease at higher quote becoming negligible over 1500 m. Areas characterized by summer average air temperature over 15°C and precipitation lower 400 m are the most prone to fires. In winter, fire danger increase with slope and the most prone areas to fire are between 750 and 1800 m. Climatic variable are poorly uncorrelated.

Forest not prone to fire (climax): In summer most dangerous areas are under 1500 m exposed to SW with a total precipitation uder 400 mm. In winter most dangerous areas are above 1500 m exposed to South with high scope. Climatic variable are completely uncorrelated.

Conifer forest prone to fire: This kind of forests shows the minimum value of correlation both for geomorfological and climatic aspects, in both Seasons. It proves the high vulnerably of the Mediterranean conifer species to forest fires. In summer a poorly correlation with air temperature and total precipitation has been identified.

Broadleaves forest prone to fire: In summer high danger areas are characterized almost completely by climatic factors. Danger increase exponentially with the air temperature between 15 and 24°C. The most dangerous areas are characterized by total precipitation under 500 mm. In winter high danger areas are characterized almost completely by the geomorphologic aspects.

Shrubs: In summer high danger areas are characterized almost completely by climatic factors in the areas under 1000-1500 m. Danger increase exponentially with the air temperature between 15 and 24°C. The most dangerous areas are characterized by total precipitation under 200 mm. In winter high danger areas are characterized almost completely by the geomorphologic aspects.