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Coupling of Bayesian Networks with GIS for wildfire risk assessment on natural and agricultural areas of the Mediterranean

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Wildfires cause severe damages to ecosystems, socio-economic assets, and human lives in the Mediterranean. To facilitate coping with wildfire risks, an understanding of the factors influencing wildfire occurrence and behavior (e.g. human activity, weather conditions, topography, fuel loads) and their interaction is of importance, as is the implementation of this knowledge in improved wildfire hazard and risk prediction systems.

In this project, a probabilistic wildfire risk prediction model is developed, with integrated fire occurrence and fire propagation probability and potential impact prediction on natural and cultivated areas. Bayesian Networks (BNs) are used to facilitate the probabilistic modeling. The final BN model is a spatial-temporal prediction system at the meso scale (1 km^2 spatial and 1 day temporal resolution). The modeled consequences account for potential restoration costs and production losses referred to forests, agriculture, and (semi-) natural areas. BNs and a geographic information system (GIS) are coupled within this project to support a semi-automated BN model parameter learning and the spatial-temporal risk prediction. The coupling also enables the visualization of prediction results by means of daily maps.

The BN parameters are learnt for Cyprus with data from 2006-2009. Data from 2010 is used as validation data set. A special focus is put on the performance evaluation of the BN for fire occurrence, which is modeled as binary classifier and thus, could be validated by means of Receiver Operator Characteristic (ROC) curves. With the final best models, AUC values of more than 70% for validation could be achieved, which indicates potential for reliable prediction performance via BN. Maps of selected days in 2010 are shown to illustrate final prediction results.

The resulting system can be easily expanded to predict additional expected damages in the mesoscale (e.g. building and infrastructure damages). The system can support planning of preventive measures (e.g. state resources allocation for wildfire prevention and preparedness) and assist recuperation plans of damaged areas.