Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06122, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06122
EGU General Assembly 2008


# Frost risk mapping using neural networks and GIS decision models

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Frost can be a significant threat to farmers and gardeners because of its ability to damage plants. The way that frost phenomenon affects crops is complex and topography plays a major role. The goal of the present study is to model and analyze the spatial distribution of the mean number of frost days per month in Switzerland using neural networks and risk factors in GIS tools.

A neural network (multi layer perceptron) was chosen to determine the existing non-linear relationship between the target variable (frost days) and the predictors (location and elevation of the meteorological stations). The parameters of the model (number of neurons, activation function, optimal weights, scaling) were tuned with the help of a validation dataset to minimize the RMSE between predicted and measured values. After tuning the parameters, maps were produced over a digital elevation model (DEM) for different months. April and May were selected as the most vulnerable months for fruit cultures in the stage of blooming.

The resulting maps were one of the input components of a decision model in a GIS environment for assessing the risk to susceptible crops. In order to evaluate this risk during the vulnerable season, areas with land use labeled fruit and vineyards were chosen. Other topographical characteristics known to influence the frost phenomenon were included in the decision model. The parameters of this model (slope, number of frost days, solar exposition) and the thresholds that define the risk limits (e.g. number of frost days > 6) were then able to be selected.

Using the proposed methodology for frost mapping, a very high correlation between

measured and predicted values is found to validate the model. The quality of these predictions allows their use as a proper input for the decision model. The flexibility of the decision model gives experts in the fruit industry the option to choose the best parameters for risk assessment.