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Groundwater Vulnerability Assessment: influence of using two subsets of wells, respectively with nitrate concentrations above and below an established threshold, as training points in the Weight of Evidence (WofE) model

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Using the WofE, a data-driven Bayesian-probabilistic modeling technique, a groundwater vulnerability assessment to nitrate (NO_3^-) contamination has been performed in the aquifer of the Province of Milan (northern Italy). The occurrence of elevated nitrate concentration in the study area is constantly monitored by a net of about 200 wells.

The WofE calculates the weighted relationship between hydrogeological-anthropogenic factors (explanatory variables) that influence the aquifer vulnerability and groundwater nitrate concentration in the wells used as training points (response variable) to run the model.

The use of this model requires to express the response variable as binary with the necessity to establish a threshold value of concentration which separates the data set in two subsets. The conventional approach is to use only the subsets containing wells with concentration higher than the threshold value as training points in the analysis. In fact in groundwater vulnerability problems this subset represents the number and location of the events (where groundwater has been strongly impacted from contamination). One obvious limit of this approach is that an entire subsets, the one indi-

viduating areas where groundwater has been slightly impacted from contamination, is completely neglected. In this study the threshold value of concentration has been calculated by simple statistical analysis and both the subsets of data served as training points to run two different WofE models. This was done to avoid losing important information on experimental data and to better describe the aquifer vulnerability by directly considering the importance of factors which are related not only to high values of groundwater contamination but also to low values.

The influence in the final outputs due to the use of the two different training point sets has been evaluated comparing the spatial distribution of the resulting vulnerability classes. For both models the obtained weighted relationships between the explanatory variables and response variable have also been investigated highlighting the main difference in the results.