Geophysical Research Abstracts, Vol. 9, 11211, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-11211

Prediction of Weekly Fluctuations of Nitrate-N in a Small Agricultural Watershed in Illinois

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Various hydrologic, meteorological, water quality and many other types of data are available for water scientists and practitioners. Those datasets could be analyzed using sophisticated and complex modeling techniques that might require powerful computers to handle the computation. Various data mining tools help us better understand the data and methods, better interpret the results, and more accurately predict the future values of hydrologic variables, and thus make better water planning and management decisions. This research presents a set of data mining tools including back-propagation artificial neural networks coupled by genetic algorithm, minimum resource allocation neural networks, and Naïve Bayes' analysis. These tools were developed and/or applied at the Illinois State Water Survey (ISWS) and the National Center for Supercomputing Applications (NCSA) for water resources research and applications. The tools were applied to predict weekly fluctuations in nitrate-N concentration in the Upper Sangamon River watershed in central Illinois. The results point to various benefits of exploiting the above techniques that can be used in watershed planning and management, such as forecast accuracy, forecast confidence limits, and rankings of explanatory variables. Based on three modeling techniques, the accuracy of weekly nitrate-N forecasting is approximately 0.4-0.5 of its standard deviation. In categorical forecasting, the Naïve Bayes' model produced a 70% success rate for three categories (low, medium and high) and about 51% success rate for four categories (low, medium-low, medium-high and high).