Nitrate in Ground Water: Using a model to simulate the probability of nitrate contamination of shallow ground water in the conterminous United States

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Introduction

Nitrates come from nitrogen, an essential plant nutrient supplied to cultivated plants mostly in nitrogen fertilizers and animal manure. An altered level of nitrate in drinking water, however, poses possible health risks. Elevated nitrate levels in ground water and drinking water supplies can also indicate the presence of additional contaminants. Among moisture-distributed (at least 1 percent of the first 25 feet of soil) ground-water samples collected from domestic and public supplies, nitrate is by far the most commonly detected contaminant (Leggett, 1998). Nitrate contamination of shallow ground water can affect nitrate levels in surface water, especially during periods of low streamflow when ground-water discharge to surface water. Natural conditions—such as seasonal or low flows—can cause nitrate concentrations in surface water to vary widely. The potential for nitrate contamination of shallow ground water is greatest in areas with high nitrogen input and vulnerability. Many factors, including climate, surface-water chemistry, land use, and geology, either can accelerate or limit nitrate input to shallow ground water. The nitrate level observed for wells generally follows the probability of nitrate contamination in the area. The nitrate level observed for wells generally follows the probability of nitrate contamination in the area.

Model development

The risk of ground-water contamination by nitrate depends on many factors such as agricultural land use and aquifer susceptibility. The majority of land used for agriculture in the United States is devoted to the production of corn, soybeans, and wheat. The amount of nitrate in ground water is greatest in areas with high nitrogen input and vulnerability. Many factors, including climate, surface-water chemistry, land use, and geology, either can accelerate or limit nitrate input to shallow ground water. The nitrate level observed for wells generally follows the probability of nitrate contamination in the area.

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The map highlights general areas where nitrate likely occurs in shallow ground water and susceptibility to nitrate contamination increases:

• depth to seasonally high water table
• well-drained soils
• median predicted probability

The six variables were used as input to the logistic regression equation to predict probability of nitrate contamination of shallow ground water. The six variables were used as input to the logistic regression equation to predict probability of nitrate contamination of shallow ground water. The six variables were used as input to the logistic regression equation to predict probability of nitrate contamination of shallow ground water.

The nitrate level observed for wells generally follows the probability of nitrate contamination predicted for the area, and local conditions must be considered when analyzing water quality.

Comparison of median predicted probability with the observed proportion of wells with nitrate exceeding 4 mg/L (4 ppm) produced a robust set of model parameters. The coefficient of determination for the model was 0.67, or 67 percent, indicating that 67 percent of the variation in the outcome (nitrate exceeding 4 mg/L) could be explained by the logistic regression model. Maximum likelihood estimation was used to estimate the parameters of the logistic regression model. The six variables were highly significant, and the six variables were used in the logistic regression equation to predict the probability of nitrate contamination of shallow ground water. The six variables were used in the logistic regression equation to predict the probability of nitrate contamination of shallow ground water. The six variables were used in the logistic regression equation to predict the probability of nitrate contamination of shallow ground water.

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