Research Bits

INCORPORATION OF AUXILIARY INFORMATION IN THE GEOSTATISTICAL SIMULATION OF SOIL NITRATE-NITROGEN

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In north-central Florida the potential risk for movement of nitrate into the aquifer is high due to the large extent of well-drained marine-derived quartz sand overlying porous limestone material coupled with high precipitation rates. Our objective was to estimate spatio-seasonal distributions of soil NO_3-N across the Santa Fe River Watershed in north-central Florida. We conducted spatially-distributed synoptic and seasonal sampling (September 2003 – wet summer/fall season; January 2004 – dry winter season; May 2004 – dry spring season) of soil NO_3-N. A summary of the soil NO_3-N observations is given in Table 1. Prior distributions of probability for NO_3-N were inferred at each location across the watershed using ordered logistic regression. Explanatory variables included environmental spatial datasets such as land use, drainage class, and the Floridian aquifer DRASTIC index. These prior probabilities were then updated using indicator kriging, and multiple realizations of the spatial distribution of soil NO_3-N were generated by sequential indicator simulation. Cross-validation indicated that smaller prediction errors are obtained when secondary information is incorporated in the analysis and when indicator kriging is used instead of ordinary kriging to analyze these datasets (Table 2). The NO_3-N values were lowest in September 2003 (Fig. 1) due to excessive leaching caused by large intense tropical storms. Overall the NO_3-N values in January 2004 were high and could be attributed to fertilization of crops and pastures, low plant uptake as well as low microbial transformation during the winter period. Despite seasonal trends reflected by the values of observed and estimated NO_3-N we found areas that showed consistently high soil NO_3-N throughout all seasons. Those areas are prime targets to implement best management practices.

Table 1. Statistical properties of profile averaged soil NO_3-N ($\mu g\ g^{-1}$) for different seasons.

Statistics	Sept. 2003	Jan. 2004	May 2004
Number of observations	101	123	128
Mean	0.70	4.09	1.17
Standard error of the mean	0.13	1.45	0.24
95 % Confidence of mean – Lower	0.45	1.22	0.69
– Upper	0.97	6.96	1.64
Median	0.23	0.11	0.29
Max.	6.54	103.71	19.92
Standard deviation	1.31	16.09	2.74
Skewness	2.77	4.91	4.37
Kurtosis	7.59	25.36	22.30
Detection limit (DL)	0.01	0.06	0.105
% data below DL	29.7	41.5	11.7

Table 2. Cross-validation results: Root mean square error (RMSE) of predictions ($\mu g\ g^{-1}$) between observed nitrate-N concentrations and estimates obtained using alternate methods for the different time periods.

Estimator	Sept. 2003	Jan 2004	May 2004
Soft indicator kriging	1.101	15.04	2.127
Univariate indicator kriging	1.272	15.87	2.670
Lognormal kriging	1.274	15.90	2.687

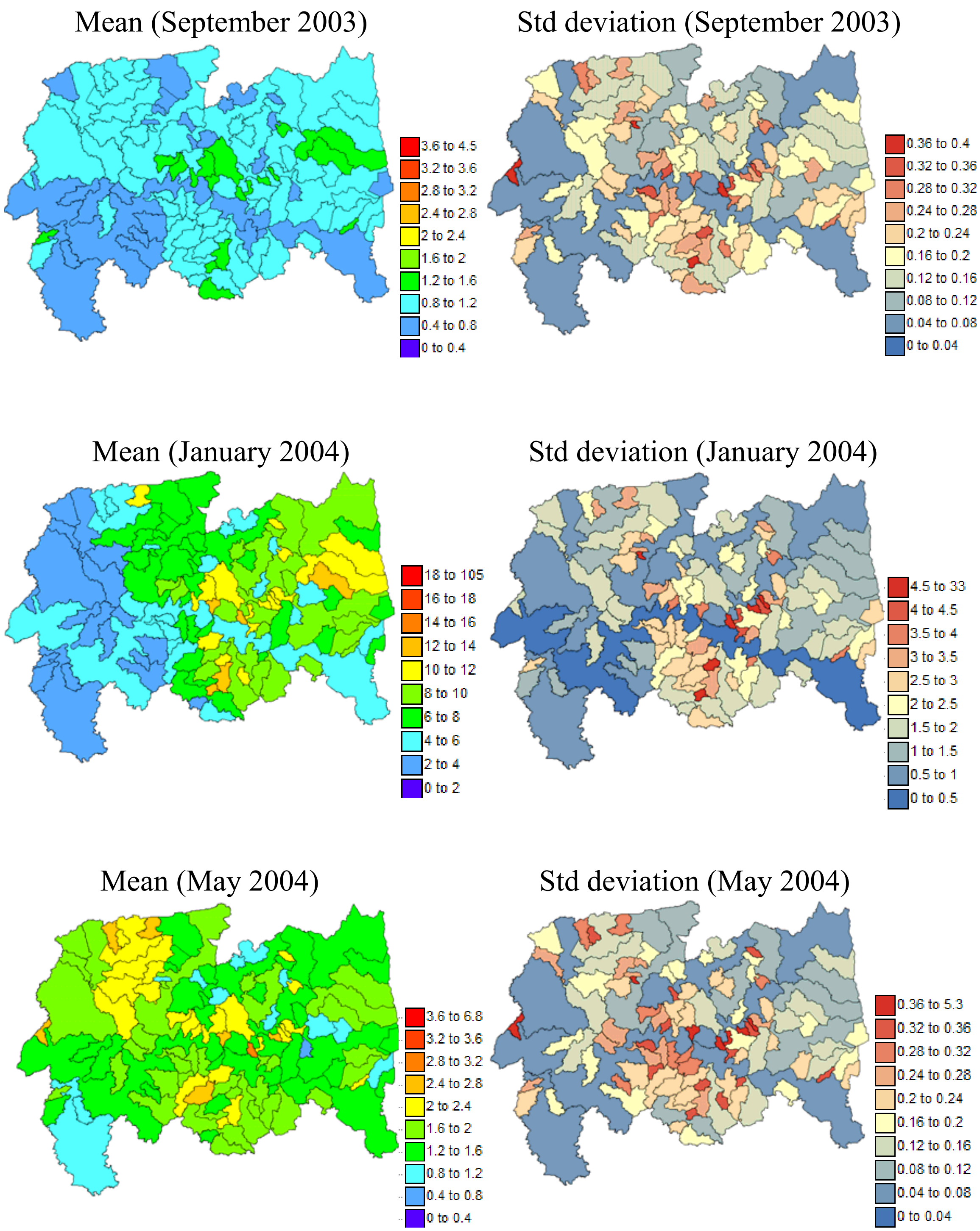

Fig. 1. Mean and standard deviation of the distribution of 100 realizations of NO_3-N concentrations generated using sequential indicator simulation and aggregated within each sub-basin (units: μg g^{-1}).

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