MODELING AGRICHEMICAL TRANSPORT IN MIDWEST RIVERS USING GEOGRAPHIC INFORMATION SYSTEMS

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A method is proposed for regionalizing watershed scale water quality estimates. Elementary watersheds are delineated using digital elevation data and linked to form a river basin scale watershed network. Elementary watersheds are combined into stream gauge zones for which the only streamflows into and out of a zone are those measured at the zone boundary by stream gauges. Time series of monthly streamflow are obtained by an interpolation procedure in which monthly precipitation over each elementary watershed is converted to streamflow by a runoff coefficient, and then adjusted so that the accumulated streamflow over the gauge zone is equal to the measured outflow. Concentrations of water quality constituents are found from regression equations in which the mean annual concentration is estimated as a function of watershed, chemical application and climatic characteristics, and a ratio of expected monthly to annual concentration is applied. Parameters of these equations were found for two constituents: nitrate plus nitrite as nitrogen, and atrazine, using data sampled by the US Geological Survey at 151 sites in the Missouri, Upper Mississippi and Ohio River basins. Nitrate plus nitrite concentrations show a fairly uniform seasonal pattern and some dependence on spatial factors; atrazine concentrations show a strong seasonal pattern with high values in May and June, and little dependence on spatial factors. Both constituents appear to increase in concentration with discharge to the 0.3 power approximately. An example application of the method is made to the 32,000 km^2 Iowa-Cedar River basin using elementary watersheds of average area approximately 30 km^2. In this basin, constituent loading estimates determined using discharge-dependent concentrations appear to be too large when compared with independent loading estimates, which suggests that the sampled water quality database may be somewhat biased towards processes occurring during high runoff rather than baseflow periods. Loading estimates found from discharge-independent concentrations are more reasonable.