Regional assessment of Phosphorus and trace metal accumulation in Swiss agricultural top soils due to manure application

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Delimitating areas with high risks of phosphorus (P) and trace metal accumulation is an important task for the limitation of their export from intensively used agricultural land into surface waters. Avoiding excessive P application on agricultural land also is an important step towards a sustainable management of the very limited resources of this important nutrient. In Swiss agro-ecosystems, major inputs of P and trace metals into soils result from the application of manure. Thus, the spatial pattern of these inputs is driven by farm management decisions. Here, we describe a regional approach to account for farmers' fertilizer application strategies in a model designed to identify areas with high risks of P and trace metal accumulation in topsoils. The approach, which is based on newly available georeferenced farm census data, is used to estimate the P and trace metal fluxes associated with manure application in two Swiss cantons (Thurgau, 991 km^2 and Fribourg, 1671 km^2) over the last three decades. The available data base includes data on land management (crops, areas) and livestock (animal type and quantity) for each farm in the target region. In addition, the coordinates of each farm are available. For spatial referencing, we used Swiss areal statistics, which is available on a hectare raster. In a first step, each hectare cell that corresponds to agricultural land is attributed to a farm, and the distinction between arable and grassland is made on the basis of distance and topography (slope). In a second step, the amount of manure applied to each hectare cell is estimated, taking into account the P need of the crop, the livestock composition of the farm and boundary conditions such as legal restrictions in manure application due to groundwater protection. Using data on P and trace element concentrations of the manure, the model then predicts georeferenced element fluxes into soils. Together with soil and climate data, this information will be used as input into the EPIC model to simulate the temporal evolution of soil P and trace metal concentrations. The EPIC model is being adapted and calibrated for this purpose in a parallel project (see abstract of R. Della Peruta et al.), using data collected over the last three decades on reference sites of the Swiss Soil Monitoring Network. Using the calibrated EPIC model, we will analyze dynamic scenarios of P and trace metal pools in soils linked to changing economic and environmental boundary conditions.

EPIC model: http://www.brc.tamus.edu/simulation-models/epic-and-apex.aspx