Modeling in Time and Space (MTS)

(A regional nitrogen model implemented with ARC VIEW and VENSIM)

by

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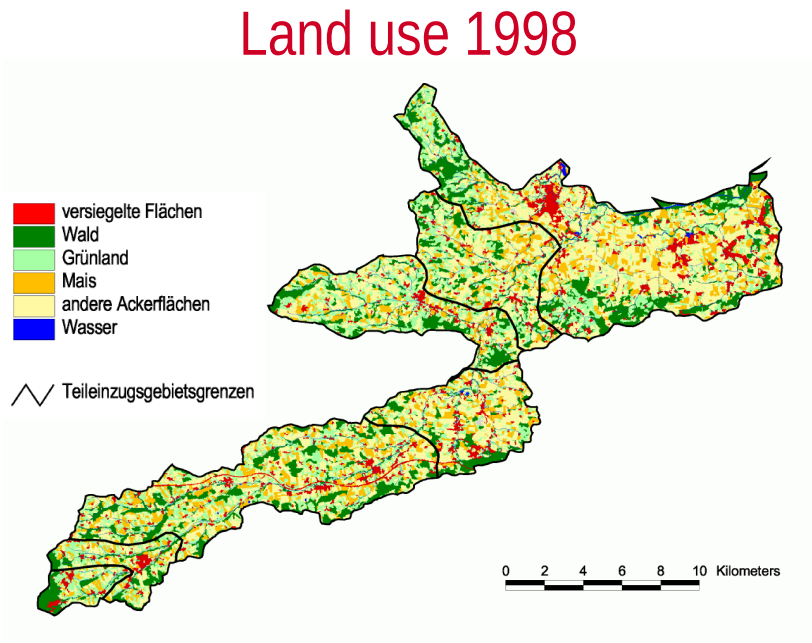
Abstract:
During the last few years a continuously increasing amount of geographic information has become available. A basic requirement for predictive models is data of high quality and sufficient quantity. Accordingly, the aim of our study was to use available spatially explicit data within a dynamical modeling software. Data processed by Arc View, a Geographic Information System Software (GIS), was used as input for a model built in Vensim, a system dynamic modeling software. Finally, the results from the simulation are returned to Arc View for further processing and visualization. Because of this combination it is possible to simulate the development of a given region in both space and time. The suggested method was evaluated for the simulation of a nitrogen balance in a region in upper Austria. The following figure shows an example of the input data from Arc View (land use of 1998).

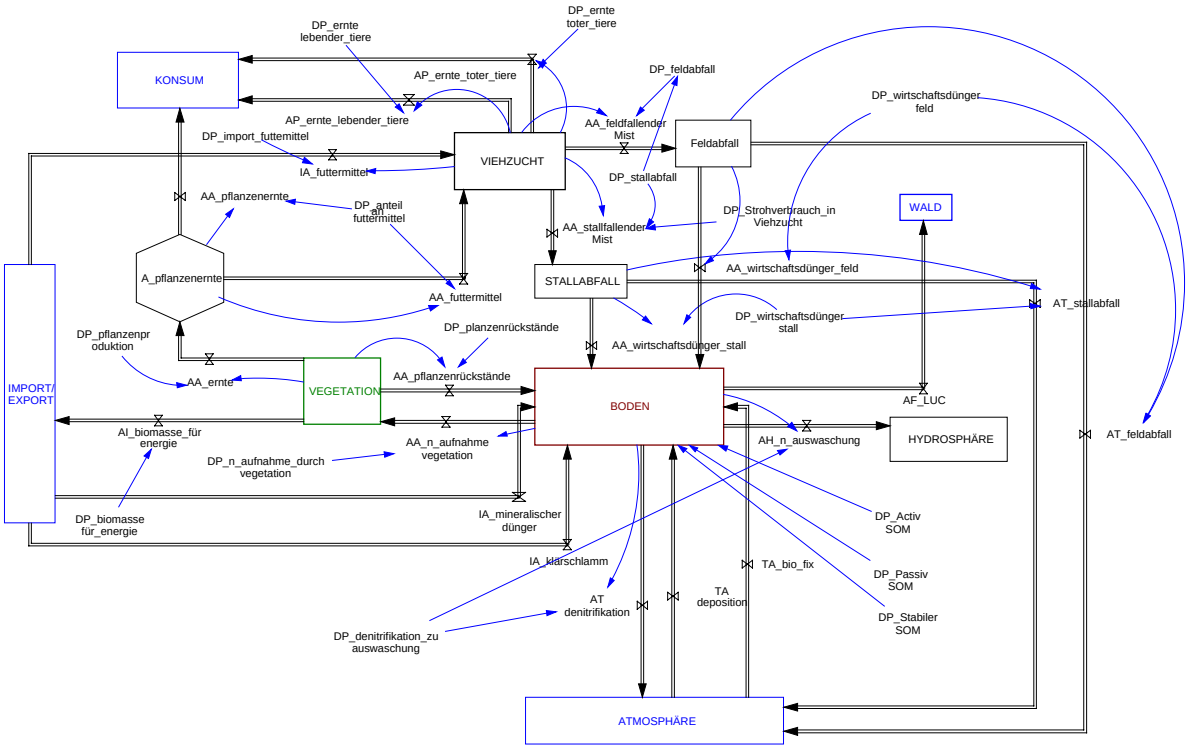
Figure 1: Spatial input data for a regional nitrogen cycle model.



This input, together with information on prevailing soil types, the amount of annual rainfall, fertilizer application (and other parameters) are essential data for the derivation of a regional nitrogen balance. To analyze the dynamics of the nitrogen

cycle and the effect of agriculture on ground water quality a consideration of the regional conditions is necessary.
In natural systems uncertainties are very high, thus scenarios for the future development can help to prepare to different situations. Arc View alone is not flexible enough to deal with these uncertainties, whereas Vensim can handle such figures quite easily.
Figure 2 shows the model scheme built in Vensim.

Figure 2: Model scheme of a regional nitrogen cycle.



Vensim allows a better understanding of the nitrogen cycle's structure and provides a suite of methods to analyze the model behavior (e.g. sensitivity analysis).
The developed method can be used for other simulations in space and time, it combines the benefits of two different tools therefore new possibilities for the understanding and visualization of dynamic systems behavior are presented.