Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04642, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04642
EGU General Assembly 2008

Predicting nitrogen leaching in European forests using linear and non-linear statistical methods

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Dissolved inorganic nitrogen (DIN) leaching from forest soils causes surface water acidification and eutrophication. Several empirical models based on linear relationships between DIN leaching and hypothesised environmental drivers have been derived for forest ecosystems. The use of non-linear methods is less common and a non-linear approach may be more appropriate for modelling threshold responses between DIN leaching and environmental variables. Nitrogen inputs and outputs from over 200 European forests together with ecosystem data (site, deposition, vegetation and soil parameters) were used to develop linear and non-linear models of controls on DIN leaching. Stepwise multiple linear regression (SMLR) identified throughfall N deposition, soil C:N ratio and mean annual temperature as predictors of DIN leaching. SMLR was able to predict DIN leaching from forests at early to intermediate stages of nitrogen saturation, but not from the nitrogen saturated forest sites. The Classification and Regression Tree (CART) approach was used as the non-linear method. Using the same database, CART identified throughfall N deposition, acid deposition, hydrology, the carbon content of the organic soil horizon, soil type, and cumulative historic N deposition as the main controls on DIN leaching. CART performed much better than SMLR at predicting DIN leaching. The CART approach allows the complex interactions between predictor variables to be identified and modelled. Non-linear partition tree approaches show promise for improving forest management strategies and potentially refining pollution abatement policies.