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Estimating critical phosphorus and nitrogen loading for good water quality in Finnish lakes with the model tool LLR

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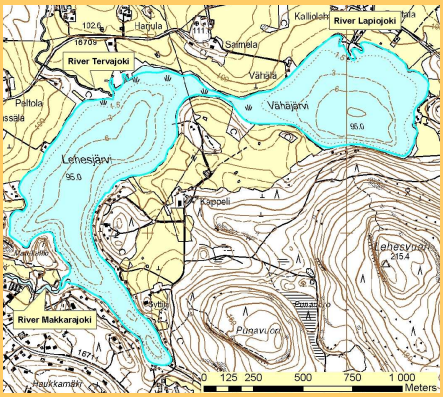
Introduction

Reducing phosphorus and nitrogen loading is one of the first priorities when treating eutrophic lakes. Models can be used to obtain estimates about the target loading for good lake water quality. Lake management usually must balance between costs and effectiveness, so it is very important to consider the reliability of estimated results. In LakeState (LS) model this is done by using Bayesian statistics with the Marcov chain Monte Carlo (MCMC) simulation method and hierarchical model structure.

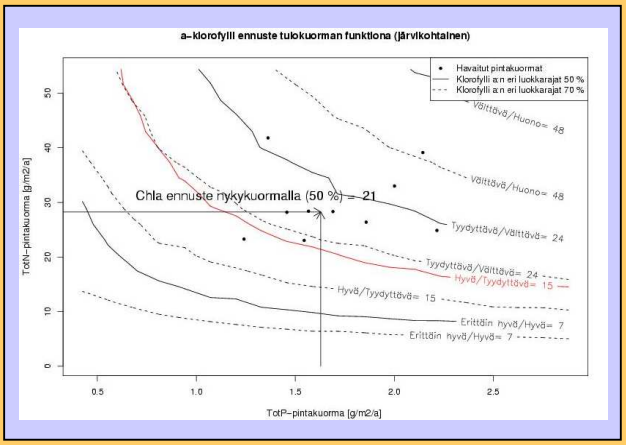


Model Tool LLR

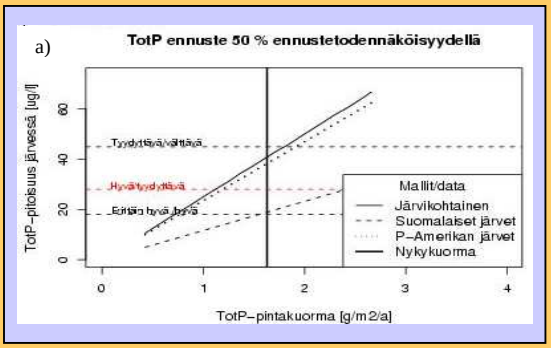
The model tool LLR (LakeLoadResponse) is developed to ease the use of the LS model. To run the model the user feeds data of in-lake nutrient concentrations, loading and water outflow. Some basic lake information and chlorophyll a concentrations are also needed. For most Finnish lakes those are found from the LLR database.

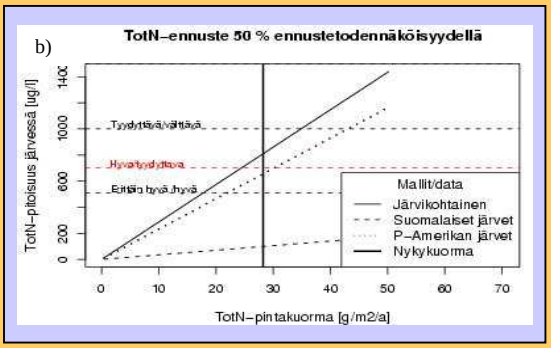
Lake Lehesjärvi Case

Lake Lehesjärvi is a small humic lake in Central-Finland. It suffers from poor water quality, mostly because of loading from agriculture. LLR was used to see by how much must the loading be reduced to achieve good water quality with 50 % probability. For phosphorus the reduction was 31 % and for nitrogen 14 %.



Estimate for chlorophyll a concentration in Lake Lehesjärvi as a function of phosphorus (X-axis) and nitrogen (Y-axis) loading (g/m²/a). The red curve shows the phosphorus - nitrogen loading combinations with which the chlorophyll a concentration will stay below good water quality limit with 50 % probability.





Estimate for a) phosphorus and b) nitrogen concentration (µg/l) in Lake Lehesjärvi as a function of loading (g/m²/a). Red horizontal dash line is the limit for good water quality according to WFD classification in Finland. The vertical indicates the present loading.

Further reading

Malve, O., 2007. Water quality prediction for river basin management. Doctoral dissertation, Helsinki University of Technology, Water Resources Laboratory.

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