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# **An Adaptive Neuro-Fuzzy Inference System (ANFIS) applied to nutrient load calculations in watersheds under strong human impact**

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The validity of an Adaptive Neuro-Fuzzy Inference System (ANFIS) for estimating fluvial constituent loads in watersheds under strong human impact is tested. Historical nutrient loads (NT and PT) have been modelled in two watersheds of different size and human impact history, i.e. the Ter River (Spain) and the Mississippi River (USA). The ANFIS methodology and traditional estimates based on modified rating curves and ratio estimators have been applied in order to compare results.

The ANFIS methodology joins the ability of the Fuzzy Inference Systems to model non-linear dynamics and the parameterization power of neural-networks algorithms. We have applied the ANFIS in a Monte-Carlo framework to calculate the bias and precision of the results obtained.

The ANFIS approximation worked as well as a careful implementation of classical methods, i.e. splitting of the series to avoid time-varying concentration vs flow relationships, and the selection of a proper calculation method within each section. It is at this stage where the ANFIS uses the advantage of being model-free and its local mapping features. Neither splitting nor selecting a method for calculation are necessary using ANFIS, thus we could implement the same methodology throughout the data series. Moreover, the application of a single, local mapping methodology avoids the presence of 'steps' in the final load history.

In contrast to 'black-box' neural-network applications, the parameters fitted during the ANFIS modelling can be ecologically interpreted, and become a valuable tool to understand temporal changes in human impact on watersheds.