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Geostatistical model to estimate in stream pollutant loads and concentrations.

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Models that estimate loads and concentrations of pollutants in streams can roughly be classified into two categories: physically-based and stochastic models. While the first ones tend to reproduce physical processes that occur in streams, the stochastic models consider loads and concentrations as random variables. This work is interesting in such models and particularly in geostatistical models, which provide an estimate of loads and concentrations and the joint measurement of uncertainty also: the estimation variance.

Along a stream network that can be modelled as a graph, most of usual geostatistical covariance or variogram models are not valid anymore. Based on recent models applied on tree graphs, we present a covariance or variogram construction combining one-dimensional Random Functions (RF) defined on each path between sources and the outlet. The model properties are examined, namely the consistency conditions at the confluences for different variables.

In practice, the scarcity of spatial data makes a precise inference of covariances difficult. Can then a phenomenological model be used to guide the geostatistical modelling? To answer this question the example of a portion of the Seine River (France) is examined, where both measurement data and the outputs of the physically-based model ProSe are used. The comparison between both data sets shows an excellent agreement for discharges and a consistent one for nitrate concentrations. Nevertheless, a detailed exploratory analysis brings to light the importance of the boundary conditions, which ones are not consistent with the downstream measurements. The agreement between data and modelled values can be improved thanks to a reconstruction of consistent boundary conditions by cokriging.

This is an example of the usefulness of using jointly physically-based models and geostatistics. The next step is a joint modelling of discharges, loads and concentrations along the stream network. This modelling should improve the precision of existing models and provide a quantification of uncertainty.