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Hydrology and Earth System Sciences Discussions

Interactive comment on "Model based on dimensional analysis for prediction of nitrogen and phosphorus concentration in the River Laborec" *by* M. Zeleňáková et al.

Anonymous Referee #1

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This manuscript presents the the interesting approach of using dimensional analysis to predict nutrient loads in the river Laborec in Slovakia. Catchment parameters of river flow, catchment area, velocity of water in the stream, water temperature, and air temperature, are used to form dimensionless groups which are, in turn, calibrated to observations of solute concentrations from the catchment.

Whilst the principal of using dimensional analysis for water quality modelling, the approach documented here is fatally flawed.

The manuscript itself states "the most important part for the model development is

selection of appropriate variables. For determination of pollutant concentration in the water stream using dimensional analysis it is essential to state the parameters which characterise the water stream, and which may be measured..." (lines 16 to 19 on page 5616). However, the formulated model is based on very few parameters which cannot capture the cause and effect required for a predictive water quality model. The fatal flaw is that all identified catchment parameters are response variables: there are no fundamental driving variables considered. Therefore, the model represents a simple correlation of solute flux to river flow, catchment area and mean flow velocity.

It is particularly noteworthy that the identified dimensionless groups do not convey a particular physical meaning: for example the Reynolds number is a dimensionless result from the proportionate relationship between inertial and viscous forces. Equation 6 (page 5617) suggests two ratios are important: that between air temperature and water temperature; and, the dimensionless group comprising river discharge divided by the product of catchment area, mean river flow velocity and pollutant concentration. The former is merely a non-linear characteristic of the specific heat capacity of water, and the latter does not convey any particular physical meaning.

There is no justification to use only a handful of variables to define the basic model, and it is puzzling as to why none of the variables selected actually characterise the potential source terms within the studied catchment. It is undoubtedly the case that dimentional analysis may be a tool in water quality modelling, but the approach would need to be much more thorough than that presented in this discussion paper. It is scientifically unjustified to propose a water quality modelling framework for the purposes of prediction, that does not include any mechanism to represent the source term that dries a particular response. Furthermore, in order for a particular model to be broadly applicable, it must not be based on correlation with, or calibration to, a specific catchment or specific dataset from a particular river.

It is with some disappointment that I recommend this manuscript not be published. While the fundamental premise is perhaps sound, the methodology is very poorly de-

veloped with only a cursory consideration of how it may be applied to water quality modelling. For this reason, I do not see this as bringing any tangible benefit to water quality modelers.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 5611, 2012.