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Discussions

Interactive comment on "Technical Note: Alternative in-stream denitrification equation for the INCA-N model" *by* J. R. Etheridge et al.

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This note deals with the difficult question of in-stream denitrification modelling at meso- and macro-scales. The aim of the paper is to assess two different equations inside a semi distributed catchment model. It is well written, clear and concise. Basically, the two equations are in the same form of proportionality to NO3 abundance in the streamwater. The difference is that, in the first case, the whole NO3 amount in a given reach is considered (concentration x volume of water in the reach), and the rate coefficient is calibrated (and temperature dependent), while in the second case, the concentration only is considered, and the rate coefficient depends in part on the interface area (i.e., the streambed area, considering that denitrification takes place in the sediment only). The authors should have stated this difference more clearly. It could have helped them to justify why this alternative formula might be more realistic, and more efficient in

low flow conditions: if the denitrification rate depends on the total amount of nitrate in the reach, for a given temperature and a given concentrations, it will be higher in high flow conditions than in low flow conditions, whereas usually it is observed that the lower are the discharge and the height of the water column, the higher will be the denitrification rate. The fact that the mass transfer equation seems to "work" at lower concentrations than the theory is not really a problem: in detail, the variations for the very low concentrations do not seem very well simulated, what is relatively well simulated is the "bottom line" at low flow, and this is due to what happens previously, at concentrations higher than 1 mg/L. The authors also stated in the conclusion that introducing a new input (the streambed area A) in the model might be a drawback. However, even if this feature cannot be precisely quantify, the most important is that it almost always varies in a consistent way with respect to in-stream denitrification: the longer and the larger the reach, the higher will be the denitrification, in general. In practice, the errors on A could be compensated when calibrating the mass transfer coefficient. And one should remember that the "V" (reach volume) variable in INCA is also dependent of relatively poorly defined parameters: a simple comparative sensitivity analysis would have been welcome! The comparison of the two formulae against observed values is definitively not a convincing demonstration: the poor fit of the model in one particular point of the river network can be due to many other parts of the model structure or to the calibration of many other parameters (and there are quite a few in INCA!) for this particular application. At least, a good test should include two contrasted catchments and data from a consecutive reaches within each catchment. Indeed, a definitive demonstration should include some sort of measured data for the process modeled itself (isotope data, retention experiments. . .). The figure is not very explicit, should separate concentration and discharge and include observed and simulated discharge. To conclude, this technical note raises interesting issues about in-stream process modeling. I encourage the authors to focus their paper on the significance of the equations rather than on the goodness of fit.