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Interactive Comment

Interactive comment on "Hydroperiod and hydraulic loading for treatment potential in urban tidal wetlands" *by* T. T. Eaton and C. Yi

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Review of 'Hydroperiod and hydraulic loading for treatment potential in urban tidal wetlands' by Eaton and Yi

The paper presents a method to determine estimates for hydroperiod and hydraulic loading for a schematised tidal wetland, with the objective of using these parameters in the calculation of natural treatment potential. This subject is interesting for a hydrological journal, since it provides a link between the approaches ecologists use to calculate the treatment potential of wetlands and the approaches used by hydrologists and hydraulic engineers. In principle this is an interesting inter-disciplinary subject, but the paper still suffers from severe shortcomings and mathematical deficiencies.

On definitions: It is not at all clear what the two main state variables used in the methodology (hydroperiod and hydraulic loading) exactly mean and for what purpose they have been defined and derived. From my own perception (judging from the way these state variables are used) I conclude that the hydroperiod (indicated as Ω)is the average inundation level times the period of flooding, since it is obtained as the integral of the inundation level over the time of inundation. Hence it is the product of the average flood level and the period of flooding with dimension [LT]. What is not clear is what the purpose of this variable is in wetland analysis and in which equations it is used. In this paper it is merely used to compute the average inundation level (by dividing Ω by the period of inundation). As a result it does not seem to have a wider purpose than purely to compute the average inundation level, which could have been calculated directly. Maybe for ecologists this is standard textbook knowledge, but for a hydrologist it is vague. It is not a flooding period, it is not an average inundation level, but its product. Similarly, I deduce that the hydraulic loading (q) is the water discharge into the flooded area per unit area, with the dimension [L/T]. This variable is used in the pollution balance equation to determine the amount of pollution entering and leaving the area. I recommend that these conventions are explained to the readers, as well as the purpose for which they are used.

On the computation of the hydroperiod.

The computation of the hydroperiod is done in equations (3) and (5). In these formulas the limits of integration are used to prevent the build-up of a negative hydroperiod. This is unnecessarily complex and could be easily dealt with by using the operator MAX(f(t),0) instead of f(t) in the integration.

On the computation of the hydraulic loading

Now we come to the more serious problem with this paper. The hydraulics of the model is flawed. The authors use a steady state and uniform flow equation (a Manning type equation) for the flow. This cannot be done in tidal hydraulics where acceleration terms are dominant. Not only is equation (6) flawed (it uses the wrong exponents: in a

Manning equation c=0.5 and the exponent b is in the order of 2), it is not at all applicable in tidal hydraulics because there is no relation between flow and average slope, which on average is zero as the authors indeed mention. The only way to find the flow is by using the water balance equation which (with disregard of rainfall and evaporation) reads: dh/dt=q. During the upcoming tide with duration T_flood, the average hydraulic loading q=Δh/T_flood; during the ebbing tide, the average hydraulic loading q=-Δh/T_ebb. That's all. The value for instantaneous values of q(t) can be found by differentiating h(t) with respect to time. Very simple.

Because Manning's equation is not appropriate, equations (7), (8), (10) and (11) are flawed, and as a result, so are the values in Table 2, Table 4 and Figure 4.b.

On the computation of the treatment capacity.

The authors cite the equation for the removal rate (equation (16)) and the equation for the contamination reduction (equation (17)). These have apparently been taken from Kadlec and Knight. The first equations looks obvious, but the second is not. I tried to derive it from the water and solute balance equations and noticed that quite some assumptions had to be made to arrive at this equation. Unlike what the authors write the assumption is not that there is steady state, because a tidal wetland is never in steady state. The assumptions required to obtain eq.(17), from my rapid review, are: that rainfall and evaporation are neglected, that q is constant over the integration period and that the difference of the incoming and outgoing concentration divided by the average concentration is small (by the way these are acceptable assumptions, I guess). I am sure hydrologists would like to see how it is derived since the assumptions made may be relevant for the hydrology of the area.

Summary.

I compliment the authors for bringing two disciplines together which are not enough confronted with each other. The method presented is simple and the wetland is schematized in a logical and acceptable way. It aims at deriving simple relationships

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that can be used for the computation of wetland purification capacity. In the present form, however, the paper is not acceptable. The paper needs to be adjusted on a number of points: 1. better define hydroperiod and hydraulic loading 2. the hydraulic loading should be computed on the basis of the water balance and not on the basis of Manning's equation 3. derivation needs to be given of the pollution reduction equation 4. all the results need to be reworked and recalculated.

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