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Hydrology and Earth System Sciences Discussions

Interactive comment on "Buffering of the salinity intrusion in estuaries by channel convergence" *by* P. S. Gay and J. O'Donnell

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General Comments

This manuscript presents a theoretical argument for how salinity intrusion in estuaries is affected by channel convergence. The premise of the argument is that the salinity intrusion in estuaries with along-channel variations in cross-sectional area is less sensitive to changes in river flow because the movement of the isohaline position up- or down-estuary is buffered by the fact that the flow occupies a different cross-sectional area. A steady-state advection-diffusion model is assumed, and the authors seek to explain salinity intrusion and longitudinal disperison as a function of river flow that accounts for the buffering via convergence. To facilitate their argument, a linear change in cross-sectional area is assumed, with a spatially constant axial salinity gradient and

longitudinal dispersion coefficient.

A buffering factor, B = -dx_s/dR (where x_s is the salinity intrusion and R is the river flow), is defined to represent the decreased response of the salinity intrusion to runoff changes. However, both the presentation and discussion of this parameter are short and somewhat confusing. Since this concept is the focus of the paper, it might be useful if the results were perhaps cast in terms of this parameter, or if the relationship between B and gamma were explored more thoroughly. The model is only explored in terms of dispersion that either varies as a function of flow to the 2/3 or is independent of river flow, which I think hinders its application to real estuaries.

This is a complex problem and, while some of the assumptions taken to reach a tractable solution could be challeneged, the authors deem the simplifications necessary in order to examine the sensitivity of intrusion to changes in convergence. The parameter space of this sensitivity is somewhat poorly explored, however. Additionally, the comparison to real data in Figs. 5-7 does not address specifically how the instrusion is affected by convergence. These results may be more striking if the estuary lengths and instrusion lengths are normalized and compared against one another [e.g. CB (a = 1.0, p 6020 line 5) has less convergence than DB (a = 2, p 6020 line 28), but the dependence of x_s on rho appears to be diminished, contrary to the underlying premise?] A table of the convergence rates, lengths, and fitting results would be helpful for comparing these results, too.

Specific comments 0. Rho should be defined somewhere other than in the caption of Fig. 4 1. The reference for Prandle 1981 is missing, page 6017, line 26. 2. Why do the authors not consider the model valid near rho=1? 3. Why is gamma evaluated at rho=0.3 on page 6020, line 6? 4. The discussion of how how Van den Burgh's factor is unclear to me, because (capital) K has been assumed spatially constant. Also, is the (lowercase) k on line 27, page 6017 different than the lowercase k on line 12?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 6007, 2009.