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Earth System Dynamics
Discussions

Interactive comment on "Maximum power of saline and fresh water mixing in estuaries" *by* Zhilin Zhang and Hubert Savenije

Anonymous Referee #1

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This papers presents an elegant, analytical model to describe salt intrusion in estuarine systems. Symbols / abbreviations are consistently used while accounting for the correct units. In its compactness, the paper tends to be a bit brief on providing background information / references on distinct aspects and explaining the rationale behind certain choices. For instance: âĂć The fundamental principle underlying the new model ('freely evolving systems perform work and dissipate energy at maximum power, close to the Carnot limit') is only briefly introduced; a more extensive description of this concept, preferably illustrated with one or two examples would be helpful. âĂć The estuarine geometry used in the model (Eq. 16, 17, 21). Why these expressions? Do we know from earlier studies that these fit well with estuary geometries across the world? Reference? âĂć The geometric inflection point of an estuary (Section 3). How

is this defined? Reference to literature?

On the set-up of the model: âĂć Based on the description of gravitational circulation and the definition sketch in Fig. 1, I would expect the horizontal length scale of the circulation to relate to the length of the salt wedge (= distance L in Fig. 1) rather than the tidal excursion E (which is the distance the salt wedge travels up and down the estuary between high tide and low tide). Please clarify. If so, does it affect the model formulations? âĂć The model does not cater for a bed slope along the estuary. How would inclusion of such bed slope, even if minor, affect the gravitational circulation (order of magnitude analysis)? If of secondary importance, please state.

On the model outcomes / presentation of results: The presented figures clear show the model potential to represent the salinity dispersion across the majority of estuaries considered. Nevertheless some questions remain: âĂć From the presented results, it is not clear which estuary corresponds to the numbers listed in Figures 4 and 5 âĂć Why does the MP method calculate an (erroneous) strong decrease of salinity values seaward of the inflection point? If not realistic, isn't it better to leave this part of the model output out? âĂć How much parameter fittings is needed to achieve the results presented here? Is it only the C3 value, or are other parameters modified as well? Were the geometry parameters varied as part of the calibration? âĂć The estuaries labelled in red show larger deviations than the other ones. This becomes clear from Fig. 5 (not from Fig 4 yet – though indicated there as 'less reliable datasets'). What can be the physical explanation for this? In what sense are the red estuaries different from the other ones? Please clarify further on the explanation of model devations. âĂć Calibrated and predicted values of DgO differ on a log-log scale. What is the implication of this in terms of deviations in calculated salinity profile? In other words, how sensitive is the model to offsets in C3. After having gone through this paper, the reader may wonder about the added value of this new model – as the existing Van der Burgh method generally gives better results (especially seaward of the infliction point). It would be good to clearly stipulate the benefits and added value of the new model in

the paper, to avoid any possible confusion at this point.

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