

## ***Interactive comment on “A method for calculating the duration and intensity of salt intrusions: the Yangtze River estuary” by M. Webber et al.***

### **Anonymous Referee #1**

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To overcome the problem that observations of both discharge and salt intrusion are limited, the paper presents a statistical model representing the relationship between salinity and discharge and subsequently uses Monte Carlo simulations to reconstruct the probability of different intensities and durations as a function of discharge. This statistical method (Eq.(2)), which is essentially a combination of a non-linear auto-correlation of salinity and discharge, is used to predict the salinity at a time  $t$  as a function of preceding salinities and river flows. I wonder why this rather concocted equation was used instead of the physics based equation between salinity and river discharge that exists and has proven its value, as published in Zhang et al. (2011), which the authors cite. Surely that equation would have provided a better functional basis for the predictions.

It is a bit hard to see the innovation of this paper. The application of a complex autoregressive function is not really the innovation, when a more physics-based, and even simple, model exists. If there is an innovation, then it is the observation that: "Unlike previous studies of intrusions of salt water into the estuary of the Yangtze River, this paper has sought to identify the conditions under which intense intrusions of long duration occur". So the innovation lies in the combination of a salinity-discharge relation with a Monte Carlo simulation method to construct high intrusion periods, and to analyse which of these have a critical duration.

Because the authors have used an auto-regressive function that lacks physical foundation, the risk is that this model works well for the calibration period, but fails during the critical periods the method has been designed for. On top of this, the authors mention that: "All of these modifications (physical interventions) will affect the probability of salt intrusions in the estuary and it is important to calculate their effects". Only a physics-based model will be capable of simulating the effects of these interventions (dredging, sea level rise, changing seasonality, etc.), whereas the statistical method cannot. Therefore I suggest the authors use the physics-based model and combine that with an auto-regressive model for the discharge only, and base their analysis of critical periods on a more reliable method for salt intrusion.

Finally, as an aside, the main problems of salinity near the intakes for Shanghai, are the result of relatively saline water from the North Branch spilling into the South Branch during low flows. This effect is impossible to take into account in this statistical model, while it is this phenomenon that is most probably critical for the water supply of Shanghai.

So in conclusion, I am not impressed by this paper. I would welcome a revised paper that is more physics-based, but that would probably involve substantial additional work and rewriting of the paper.

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