

The paper presents an extreme power theory for the mixing of saline sea water and fresh river water in estuaries. By maximizing the power of energy dissipation with respect to the dispersion coefficient an additional differential equation is derived. This equation can be solved together with the advection-diffusion equation to determine the distribution of the dispersion coefficient and the salinity in an estuary.

There are more examples of extreme power theories, e.g. the minimum stream power theory in fluvial hydraulics. They are often controversial, but they also provide good results. This is also the case with the present theory. I have some doubts about the theory, which I will explain later. However, the derived equation appears to work well. The calculated salinity distribution in various estuaries agree better with observations than the results of previous models, even though an empirical relation needed in the previous models is replaced by the theoretically derived equation. Therefore, I would like to recommend the publication of the paper despite of my doubts about the theory.

First, I have a couple of questions on the theory:

1. Is it maximization or minimization of the power? In fact the used equation $\frac{\partial P}{\partial D} = 0$ is only saying that the power is extreme, thus maximum or minimum.
2. Why is the kinetic energy of the river water not taken into account? In fact the total energy dissipated in the estuary is the potential energy plus the kinetic energy of the river water flowing into the estuary. Upstream of the estuary, the potential energy is dissipated by bed friction while the kinetic energy remains more or less constant.

Further I have some concern about the step from equation (9) to equation (10). First this step is a bit difficult to follow. Therefore I would like to see an more extended description of the derivation by including the used equations e.g.

$$\frac{\partial A}{\partial D} = \frac{\partial A}{\partial x} \frac{\partial x}{\partial D} = \frac{A'}{D'} \quad (1)$$

$$\frac{\partial S}{\partial D} = \frac{S'}{D'} \quad (2)$$

These equations are essential in the derivation but they are not obvious as they cause some concerns of mine. I am not sure about their validity. I can give a simple example showing e.g. (2) is correct: both S and D are linear functions of x . However, I can also give an example showing that such way of doing the differentiation can be wrong. It is complicated how S and A depends on D . Therefore, let take an easier example. We know that the cross-sectional area A of an estuary is dependent on the location x and the water level h which also varies with x . We also know that

$$\frac{\partial A}{\partial \eta} = B(x, \eta) \quad (3)$$

In which B is the width of the estuary. However, if the similar rule is followed by doing

$$\frac{\partial A}{\partial \eta} = \frac{A'}{\eta'} \quad (4)$$

Then we will in general not end with the correct result as given in equation (3).

Finally I have the following detailed suggestions:

1. I think it is better to draw a sloping bed in Fig. 1. The figure is now showing an unrealistic extra depth at the upstream end of the estuary.
2. Please include some results of $D(x)$ as well together with $S(x)$. Please also show some results of the previous models.