The authors would like to thank Anonymous Referee # 2 for the detailed review. We adequately appreciate for carefully examining our paper and providing us a number of important comments. We would like to respond to the reviewer comments on several points.

1. General comments:

The main focus of this study were to compare empirical models using three years of observation data for determining the most suitable model for predicting salt intrusion length in the Sumjin River Estuary, and examine whether the model developed by Nguyen and Savenije (2006) for partially- and well-mixed estuaries was applicable to the stratified neap tide conditions. Six empirical models were applied to predict the salinity intrusion lengths using the same conditions for determining the suitable empirical model for this estuary. A fair comparison will be made based on the same data set (except Rigter, 1973; Van Os and Abraham, 1990) for spring and neap tides separately in the revised paper. As quantitative comparisons utilize statistical analyses to give quantitative measures of how good the model results fit the data, it will be represented for evaluating model performance instead of R^2. For examining the external driving forces of salinity intrusion, R^2 values will be used. Rigter (1973), Fischer (1974) and Van Os and Abraham (1990) use the Darcy-Weisbach's coefficient, which is solely a function of flow roughness, based on laboratory tests. Rigter (1973) and Van Os and Abraham (1990) use very similar equation, only different in numeric value that is 0.3. Fischer (1974) uses the same equation but the exponent differs much more compared to Rigter (1973) and Van Os and Abraham (1990). Conversely, Van den Burgh (1972) and Savenije (2005) use the Van den Burgh coefficient, *K*, which is a function of both tidal and freshwater flow characteristics, based on real estuary. Only the Savenije (2005) models have exponential geometry and it provided better result. We, therefore, stated that the exponential-geometry based model is preferable. We discussed these in the result briefly but it was mistaken in the method section. For the clarification of reader, theoretical background will be discussed in the method section elaborately in the revised paper. All the models were developed under the assumption of steady state.

2. Specific comments

Page 5 Line3-5: Only data for 2005 and 2006 are shown and it is not made clear how or whether the other data are used or whether there is only one sample per season per year.

We used three years of field observation data from 2004 to 2007. The longitudinal transects for salinity and temperature were taken during both spring and neap tides at high and low waters for each season from August 2004 to April 2007. In each season, we took 4 samples (spring high water, spring low water, neap high water, neap low water). As all upstream stations were not possible to survey at low water, data taken during these periods were not shown as they did not fulfill the measurement criteria of salinity =1. In the manuscript we only showed two years as a sample. For more clarification, we shall represent all year's data.

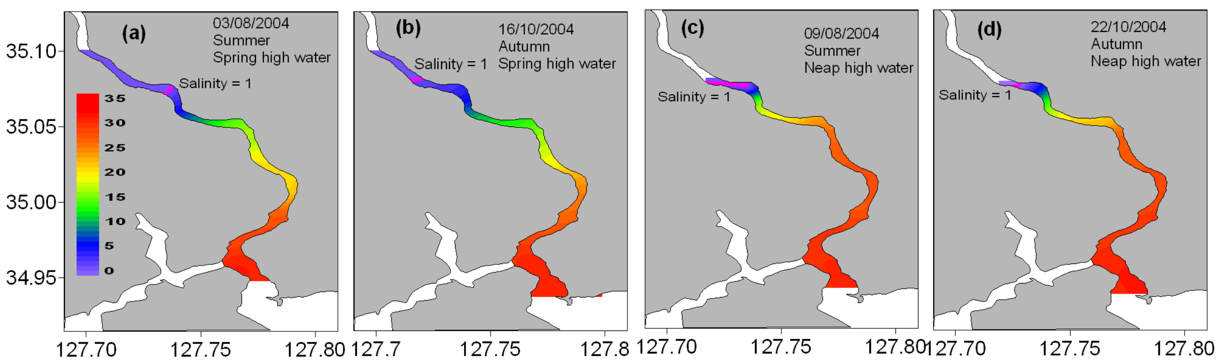

Fig. 1. Horizontal bottom salinity distribution at high water during spring (a, b) and neap (c, d) tide for summer and autumn 2004. The pink band indicates the limit of salinity =1.

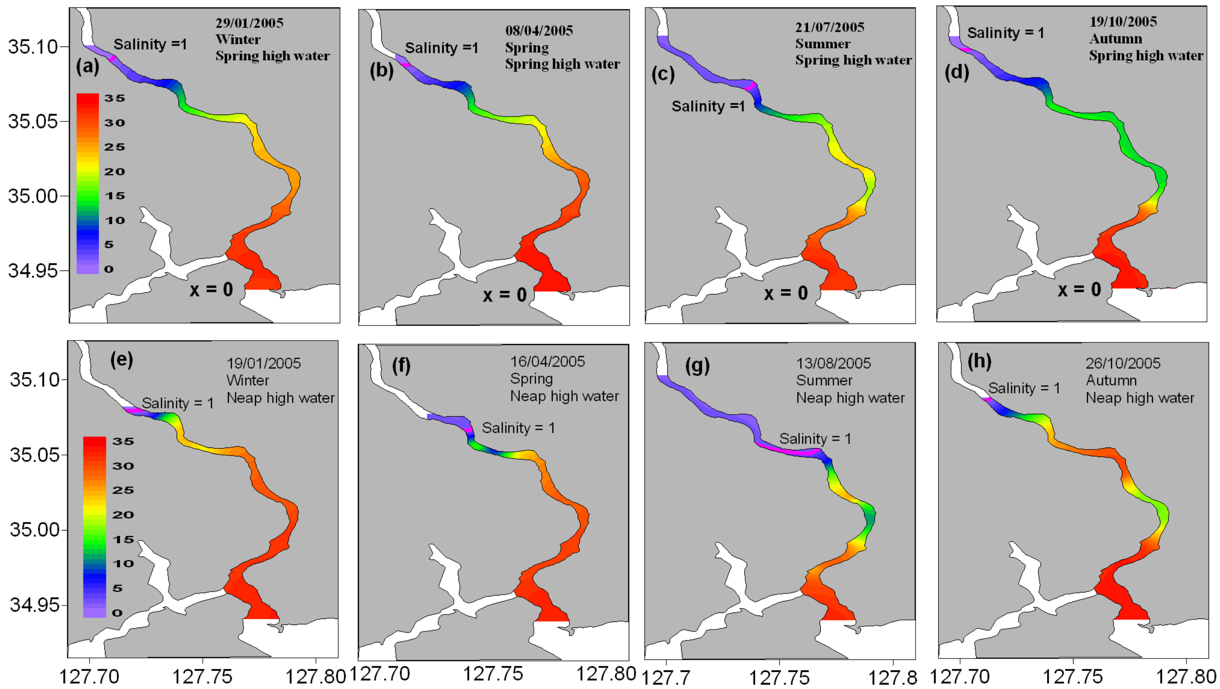

Fig. 2. Horizontal bottom salinity distribution at high water during spring (a, b, c, d) and neap (e, f, g, h) tide for each season during 2005. The pink band indicates the limit of salinity =1.

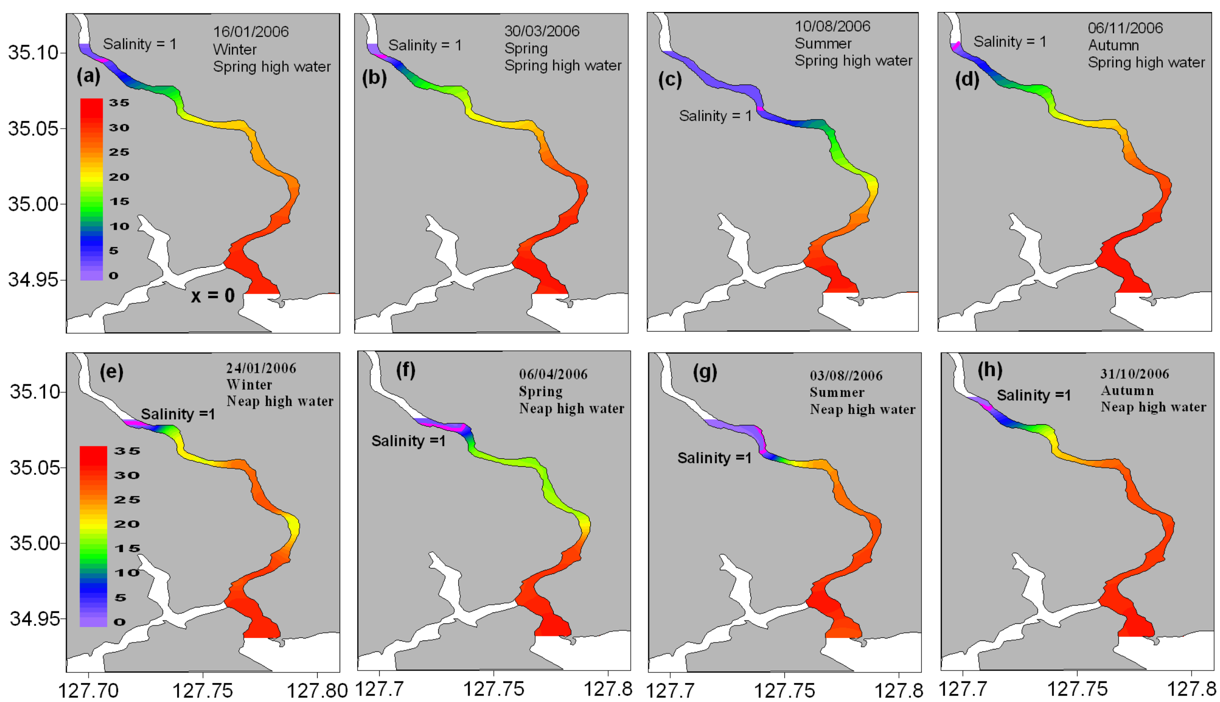

Fig. 3. Horizontal bottom salinity distribution at high water during spring (a, b, c, d) and neap (e, f, g, h) tide for each season during 2006. The pink band indicates the limit of salinity =1.

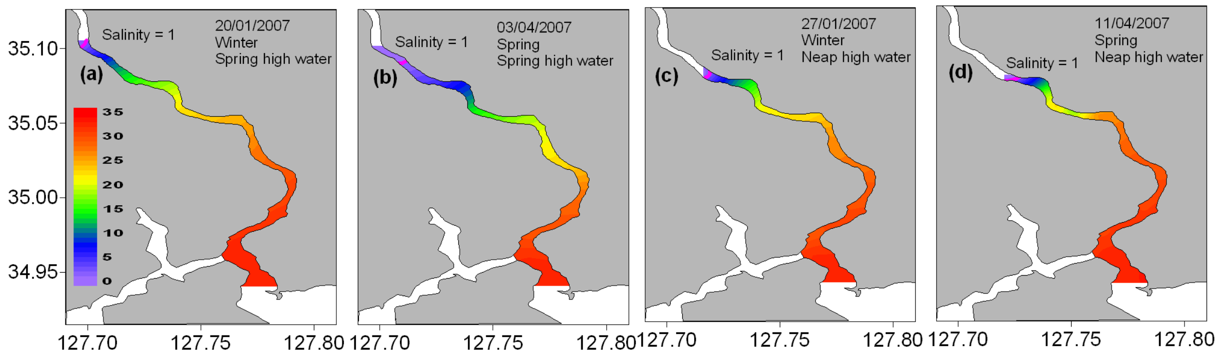

Fig. 4. Horizontal bottom salinity distribution at high water during spring (a, b) and neap (c, d) tide for winter and spring 2007. The pink band indicates the limit of salinity =1.

Page 5 Line7: It is usual to have a paragraph at the end of introduction assisting with full comprehension in reading the paper.

This paragraph will be added in the revised paper as the following. The rest of this paper is organized as follows. The data sources are briefly presented in section 2. Empirical models are described in the section 3. Observed and model salt intrusion length, and statistical analysis for model performance are presented in section 4. A discussion follows in section 5 and the conclusions are summarized in section 6.

Page 5 Line10: Is the east portion of the Gwangyang Bay part of the bay?

The Sumjin River Estuary enters the Gwangyang Bay located in the south coast of Korea. The bay is connected in the south to the coastal sea (South Sea) and in the east to Jinjoo Bay through the narrow Noryang channel.

Page 5 Line10-13: There are two entry points and why the one chosen is important?

The west channel of POSCO is not the entry points. The east channel of POSCO is the only entrance connecting to the Gwangyang Bay. The flow in the east channel of POSCO is northward during the flood tide and southward during the ebb tide. But this pattern is reversed in the west channel of POSCO. Therefore, the east channel is chosen as estuary mouth.

Page 6 Line 1: "on the day of" - one sample a day? One day a season?

On the date of field observation from July 2004 to June 2007.

Page 7 Line 2: Restate the goal of comparing these models and why do this?

The main motivation of this study were to compare empirical models using three years of observation data for determining the most suitable model for predicting salt intrusion in the Sumjin River Estuary.

Page 7 Line 2: Winds have been ignored without comment?

Page 10 Line 18: what about winds?

In a narrow estuary, the wind has minimum impact on the flow (Ji, Zhen-Gang, 2008, Hydrodynamics and water quality: Modeling rivers, lakes and estuaries, Page-28). As this estuary is narrow, we did not consider the wind effects. This will be addressed in the introduction for reader clarification in the revised paper.

Page 7 Line 2: The comparisons should be made based on the same data set for all models. Spring and neap data sets should compare for all models. The models are being compared for different data sets (not clear which are spring and which are neap).

As another objective of this study was to examine whether the model developed by Nguyen and Savenije (2006) for partially- and well-mixed estuaries was applicable to the stratified neap tide conditions, we compared the result of this model for both spring and neap tides and other models did not compare. In the revised paper, we will compare the model results for both spring and neap tides using the same data set (except the model result of Rigter (1973) and Van Os and Abraham (1990) due to not providing the same data set).

Page 7 Line 7: Why are the bottoms salinity used "instead of depth-averaged"?

To determine the maximum salt intrusion, the bottom salinity was used instead of depth-averaged salinity.

Page 7 Line 7: Use salinity units (psu) since when the authors later write "Salinity 1", this is unusual and not clear.

In the Practical Salinity Scale salinity is defined as a pure ratio, and has no dimensions or units. By decision of the Joint Panel of Oceanographic Tables and Standards it does not have any numerical symbol to indicate parts per thousand. Salinity should be reported as a number with no symbol such as psu, ppt or %, or indicator of proportion after it. It is not correct to add the letters PSU, implying Practical Salinity Units, after the number. We stated in the section “Data Sources” that salinity was measured using CTD (Conductivity-Temperature-Depth). Therefore, we did not use the units.

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Page 9 Line 16: What is the evidence of the complex vertical salinity distribution? Does this mean the estuary is not partially or well-mixed?

In the following, we shall show vertical section of salinity for 2004 and 2007 to clear about this. We are preparing another manuscript using 2005 and 2006 vertical section. Therefore, we do not publish here. Moreover, it will be clearer in the discussion of stratification parameter in the following.

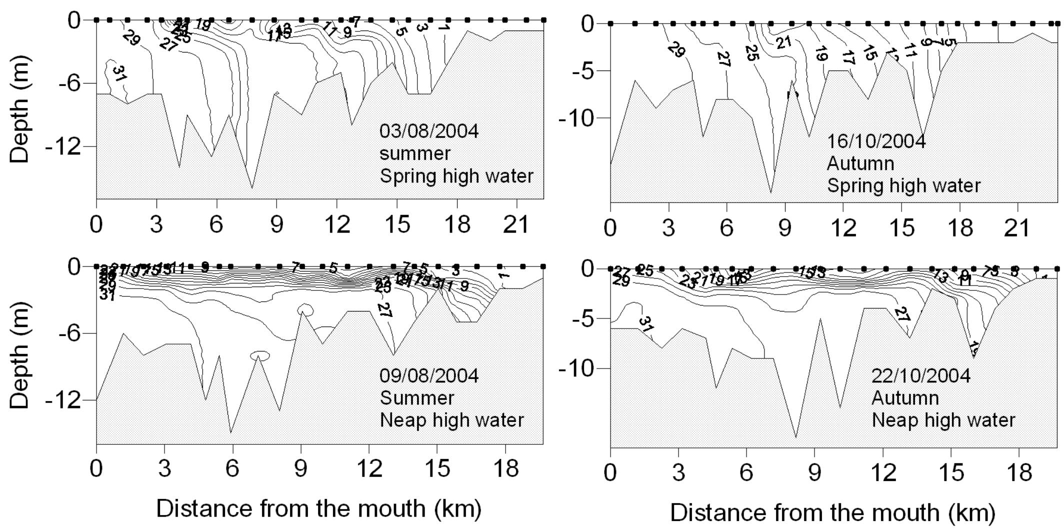

Fig. 5. Salinity distributions for longitudinal depth surveys of the Sumjin River Estuary at high waters during spring (upper panel) and neap (lower panel) tide for summer and autumn 2004. The black solid circles indicate the CTD stations.

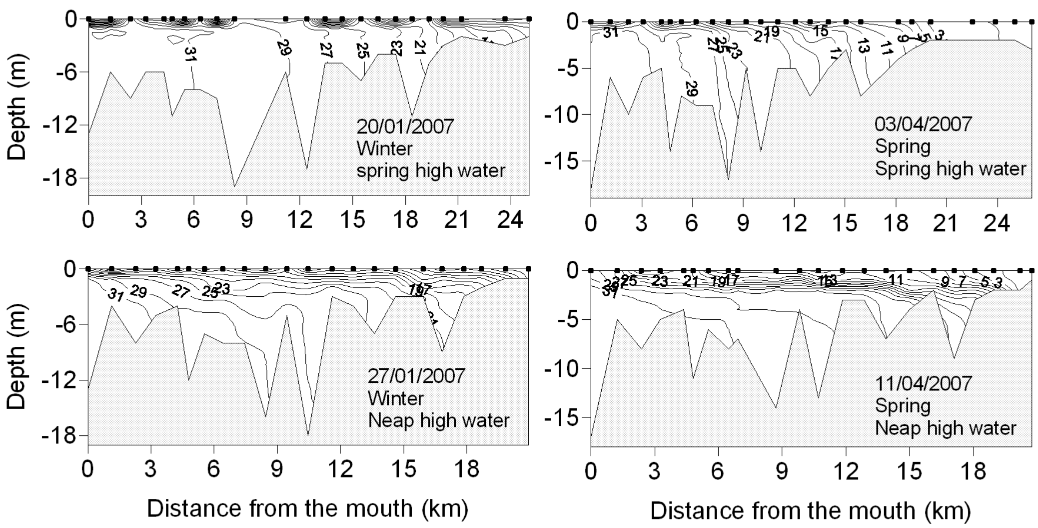

Fig. 6. Salinity distributions for longitudinal depth surveys of the Sumjin River Estuary at high waters during spring (upper panel) and neap (lower panel) tide for winter and spring 2007. The black solid circles indicate the CTD stations.

Page 9 Line 23: How is the "stratification parameter" determined?

Page 16 Line 2: The estuary can be either well-mixed or partially mixed but not both simultaneously?

Estuaries can be classified by their stratification and mixing patterns. Hansen and Rattray (1966) developed two dimensionless parameters to characterize estuaries. The first being a stratification parameter ($\delta S/\langle S\rangle$), defined as the ratio of the salinity difference between surface and bottom(δS) divided by the depth averaged salinity $\langle S\rangle$; the second being the circulation parameter (u_s/u_m), the ratio of the residual velocity at the surface (u_s) divided by the depth mean value (u_m). In contrast, the stratification number, $S_t = (0.85kU_0^3 L)/(\Delta\rho/\rho)gh^2u_m$, was defined by Prandle (1985). Where k is the friction coefficient (0.0025), L is the estuary length, U_0^3 is the amplitude of the tidal currents, h is the water depth and u_m is the depths mean current. Values of $S_t < 100$ indicate stratified conditions, $100 < S_t < 400$ partially mixed and $S_t > 400$ well-mixed conditions. Prandle (1985) showed by comparison with the data that ($\delta S/\langle S\rangle$) = $4S_t^{-0.55}$. This means that $\delta S/\langle S\rangle < 0.15$ is well mixed and $\delta S/\langle S\rangle > 0.32$ is stratified. In this study, the stratification parameter was calculated for all the stations surveyed during both the spring and neap tides for each season in the SRE. Maximum values of the stratification parameter, $\delta S/\langle S\rangle$, occurred during the neap tide, with minimum values during the spring tide. The estimated values of the stratification parameter varied between 0.06 and 1.25 during the observation periods. During the spring tide, the lowest values (<0.15) of the estimated $\delta S/\langle S\rangle$ generally occurred down the estuary up to about 5 km from the mouth, indicating the occurrence of well-mixed conditions, while at the same time, higher values between 0.15 and 0.32 occurred in the remaining upper portion, suggesting partially mixed conditions. The highly stratified conditions (>0.32) occurred throughout the estuary during the neap tide, with maximum values occurring in the halocline. The stratification parameter was also dependent on the trough of the estuary. Similar river discharges and tidal conditions produced different stratification parameters along the estuary, especially a higher stratification parameter in the trough stations due to trapping of a high salt wedge, which produced a higher salinity gradient and ultimately generated a higher stratification parameter. We are preparing another manuscript using the figure of this analysis. Therefore, we do not publish this figure here.

Page 10 Line 1: The estuary is either partially-mixed or well-mixed, not both at the same time?

The stratification parameter shows lower 5 km well-mixed and the remaining upstream partially-mixed at the same time. The vertical section also shows these characteristic.

Page 11 Line 10: For subsection 4.2, since the methods had not been adequately and clearly laid out in a preceding methods section, the results are difficult to evaluate and appreciate?

To overcome the difficulty in evaluating and appreciating the results, the methods will be adequately and clearly described in the revised paper.

Page 11 Line 10: The important output of the empirical models is the salt intrusion length?

This was cited from Savenije (1993). In the revised paper, we will add this reference to avoid confusion.

Page 11 Line 21 The authors need to improve their basis for model-model comparison considering other factors than R^2 value.

Page 16 Line 8 – "Reasonable prediction" - why? How is this demonstrated in the paper?

Based on the R^2 value, the above phrase was used. Previously the model was applied to the partially and well mixed estuary, but not applied to highly stratified estuary. This estuary shows highly stratified conditions during neap tide and partially- to well-mixed characteristics during spring tide. Therefore, we made correlation separately to examine the level of performance during spring and neap tide for the model of Nguyen and Savenije (2006). Statistical analyses will be presented for evaluating the model performance in the revised paper. Although numerous methods exist for analyzing model performance, mean absolute error (MAE), root-mean-square (RMS) error and relative error (RE) were used for model-data comparison in this study.

Table 1. Statistics of model-data comparison for salinity intrusion length in the Sumjin River Estuary.

Models	MAE (km)		RMS Error (km)		Relative Error (%)	
	Spring	Neap	Spring	Neap	Spring	Neap
Van den Burgh (1972)	3.99	4.6	5.81	6.01	17.86	24.70
Fischer (1974)	3.50	6.18	3.96	6.37	15.68	33.14
Nguyen and Savenije (2006)	0.90	0.96	1.16	1.11	4.04	5.20

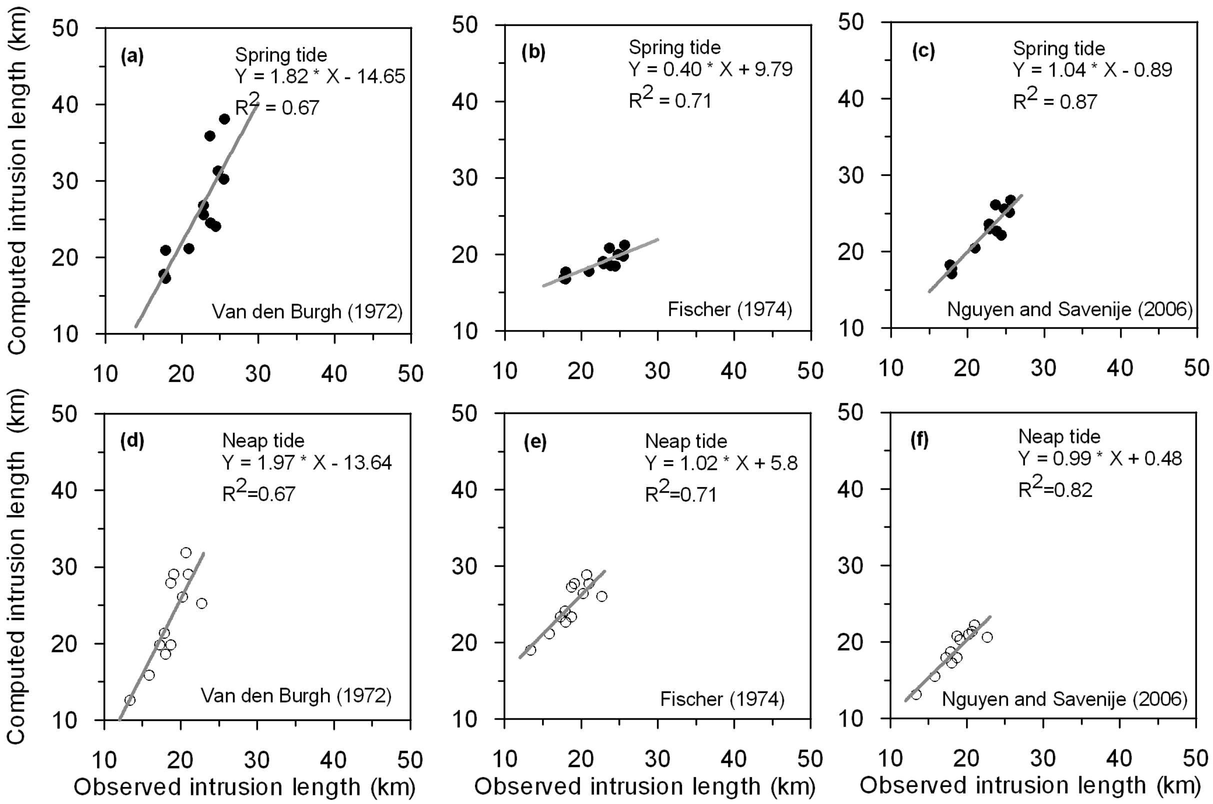

Fig. 7. Comparison of the results of various empirical models for the intrusion length measured at high water during both spring (upper panel) and neap (lower panel) tides.

Of all the models studied, the Nguyen and Savenije (2006) model yielded the least relative error of 4.04% and 5.20% for computing the salt intrusion length during spring and neap tides in the Sumjin River estuary, respectively. The R^2 value also shows the same result. We shall definitely address this result in the revised paper.

Page 12 line 7: which two models?

Van den Burgh (1972) and Savenije (2005)

Page 12 line: How the runoff and tidal variability is being used, needs to be detailed in a methods section.

The river discharge on the date of field observation was used in this study for predicting salt intrusion length using K=0.76, f=0.024, h = 6.1 m, A_0 = 7913 m^2, T = 44400 sec, v = 0.64 m s^{-1} (spring) and 0.34 m s^{-1} (neap).

Page 12 line16-17: Satisfactory results from the Van den Burgh (1972) compared to Savenije (1993) – satisfactory in respect to what?

According to the findings of Parsa (2007), the variation of cross-sectional areas of Bahmanshir can not be approximated by an exponential function. That is why, it can not predict properly. Conversely, Van den Burgh model (1972) does not contain exponential function and it provides satisfactory result.

Page 13 Line 12: "different estuarine conditions" – what conditions determine the difference?

Oey (1984) shows $\alpha \sim -1/5$ based on observed data in the Hudson River estuary for the highest flows. Monismith et al. (2002) obtains $\alpha \sim -1/7$ for their 21 years of observed salinity data for San Francisco Bay, and points out that the weaker dependence of salinity intrusion on flow is due to both the geometry of San Francisco Bay and the effects of stratification on vertical mixing.

3. Technical corrections:

In the revised manuscript, all technical corrections will be done.