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Interactive comment on "Spectral approach to seawater intrusion in heterogeneous coastal aquifers" *by* C.-M. Chang and H.-D. Yeh

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Review of HESSD paper on Âń Spectral approach to seawtaer intrusion" by C.M.Chang & H-D.Yeh

Reviewer comments:

This paper analyzes the stochastic interface between seawater and freshwater, based on as spectral perturbation and transformation method, previously developed by Albitar & Ababou (2005).

In fact, the paper relies to a large extent on the analytical technique developed by these authors (Albitar & Ababou 2005), and they are indeed cited in the paper (as should be), although a few other references should be added (see reference list below).

However, in the Introduction (last paragraph of section 1), it should be added more clearly that the "closed form expressions developed" in this paper "have never been presented before"...except in the case of zero recharge, where they correspond directly to the results of Albitar & Ababou (2005), which have been validated numerically.

The major contribution of this paper is that it offers a generalization to the previous study of Albitar & Ababou (2005), as follows:

==> Analyzis of the interface Z(x) for the case of variable or "stochastic" recharge W

==> Analyzis of the variances of specific discharge (qx,qy)

However, note that the analyses are focused here on the effect of recharge and boundary conditions, rather that on the effects of heterogeneity: indeed, all the figures show results for the same weak heterogeneity (Var(LnK)=0.1). It is worth noting that the numerical validations by Albitar & Ababou (2005) were conducted for stronger heterogeneity (Var(LnK)=1.6) and higher (Albitar 2007). It would be worthwhile to also display the sensitivity of the interface with respect to Var(LnK) and in particular, including also the wedge tip position.

There are also some issues which need to be addressed, as follows.

The paper does not include any validation of the analytical calculations. It would be useful to emphasize the necessity and usefulness of future numerical simulations to confirm or complete the analyses presented in this paper. In fact, the authors explicitly base their arguments on the numerical confirmations by Albitar & Ababou (2005), but this can only confirm a part of their analyses (zero recharge).

Another issue needs to be addressed concerning the position (Xtip) of the "wedge tip". From Fig.3, it seems that the authors assume that Xtip is a deterministic constant. But this is not concurrent with the simulation results by Albitar & Ababou (2005). The latter show in particular that the mean of Xtip increases significantly with heterogeneity. Therefore the position Xtip should be left random, rather than fixed. This, in itself,

shows the need for comparing (possibly combining) analytical calculations with numerical simulations. In addition, there seems to be a mistake in eq.2 and eq.8 (confusion between XL and XG?). . .

Other remarks: ==========

Quoting the authors:

«This implies that the assumption of negligible perturbation-boundary effects is applicable, at least far enough from the sea and the salt-wedge tip».

This sentence should be replaced by:

. . ... only far enough. . ..

References : ==========

Given the above remarks, in addition to the quoted reference:

==> AL-BITAR A., R. ABABOU, 2005: "Random Field Approach to Seawater Intrusion in Heterogeneous Coastal Aquifers : Unconditional Simulations and Statistical Analysis". In : GeoENV : Geostatistics for Environmental Applications, Renard P., Demougeot-Renard H., Froidevaux R. (eds.), ISBN:3-540-26533-3. Springer 2005.

the additional references should be included for completeness:

==> ABABOU R., A. AL-BITAR, 2004 : Salt Water Intrusion with Heterogeneity and Uncertainty : Mathematical Modeling and Analyses. Proceedings CMWR'04, Comput. Meth. in Water Resources, Special Session on Coastal Aquifers, 13-17 June 2004, Chapel Hill, N.Carolina, 12 pp. <—[for an earlier account of both numerics and stochastic analyses]

==> Al-Bitar A., 2007 : Modélisation des écoulements en milieu poreux hétérogènes 2D/3D, avec couplages surface / souterrain et densitaires. Ph.D. thesis. IMFT Institut National Polytechnique de Toulouse, Juin 2007. <—[for complete details of all

stochastic and numerical analyses of the seawater intrusion problem: Chapter 4 & Appendices].

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 621, 2010.