

## ***Interactive comment on “Estimations of tidal characteristics and aquifer parameters via tide-induced head changes in coastal observation wells” by Y.-J. Chen et al.***

### **Anonymous Referee #2**

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The manuscript presents an approach for estimating tidal characteristics and aquifer parameters using the analytical solution of Jeng et al. (2005) and inverse modeling. The manuscript is well written and is appropriate for publication in Hydrology and Earth System Sciences Discussions. However, I have several comments that if addressed should improve the manuscript.

General Comments:

1. The authors make suggest that the method presented in the manuscript may provide a better estimation of aquifer parameters than the approach used in Nielsen (1990) for

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real world applications. Could application of the method of Nielsen (1990) and the simulated annealing optimization technique to the synthetic scenarios (1, 2, and/or 3) be used to demonstrate that method presented is clearly better? Obviously, the approach of Nielsen (1990) ignores the  $A_2$ ,  $\omega_2$ , and  $\delta_2$  components but it may be instructive to demonstrate that the solution of the inverse problem, using synthetic data generated using the analytical solution of Jeng et al. (2005), is sensitive to the  $A_2$ ,  $\omega_2$ , and  $\delta_2$  components.

2. Scenario 4 was configured to use a shallow water parameter ( $\varepsilon$ ) of 1.772. Could the authors discuss why values converge to such different values? For example, is the maximum number of iterations exceeded in some cases but not others? Does the simulated annealing optimization approach fail for large  $\varepsilon$  values with different initial parameter values (i.e., is the solution sensitive to initial parameter values)?

3. A relatively simple tidal forcing function composed of two harmonic constituents (bichromatic) has been used. In reality, the tide at Barrenjoey beach is more slightly more complicated (Figure 1). For example, using the harmonic constituents reported in the manuscript (9162 Lines 11-13) and equation 2 generally captures the rising and falling limbs of the tide but over- or under-predicts minimum and maximum tide levels.

Although additional harmonic constituents cannot be accounted for in the method of Jeng et al. (2005), can the authors discuss how additional harmonic constituents might affect the ability to simulate observed groundwater levels at Barrenjoey beach?

4. The analytical solution of Jeng et al. (2005) assumes the aquifer is homogeneous and incompressible. It is likely that the aquifer is heterogeneous and that this heterogeneity is contributing to the difference between aquifer parameters estimated using the optimization approach (simulated annealing) applied in this study. Can the authors comment on the role that heterogeneity may play in the ability to fit the observed data and under what conditions a method that can account for spatial heterogeneity would need to be applied to tidally-induced head problems (i.e., a numerical solution with a

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highly-parameterized inversion technique).

Specific Comments:

1. 9158 Lines 16-20: It should be clearly stated that the solution of Jeng et al. (2005) neglects the effect that a seepage face would have on groundwater levels. Lines 18-19 indicate that the water table height at the boundary equals the tidal oscillation but readers may not be fully aware of the assumptions of Jeng et al. (2005).
2. 9159 Line 9: Suggest “effective porosity” rather than “soil porosity”
3. 9161 Line 6: Suggest modifying “. . .1% for representing the accuracy of. . .” to “. . .1% and represents the accuracy of. . .”
4. 9171 Figure 2: It is difficult to read the figure legends and distinguish what each line represents on the printed version of the manuscript. Suggest the authors increase the size of the subplots, subplot text, and possibly use color.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 9155, 2010.

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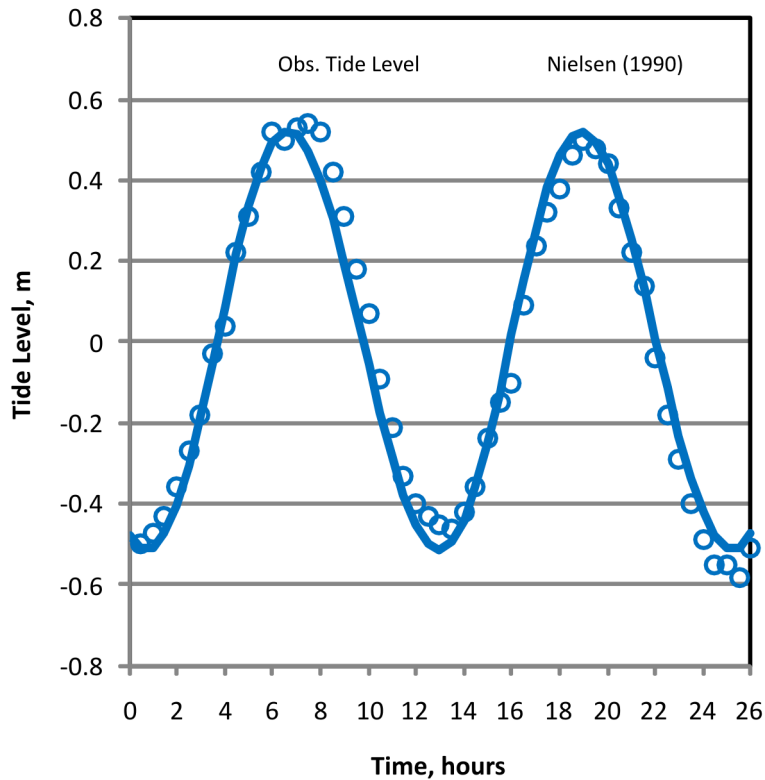
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**Fig. 1.** Observed tidal levels from Nielsen (1990) and estimated tide using tidal constituents reported in the manuscript and equation 2.

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