

# ***Interactive comment on “Technical Note: Approximate solution of transient drawdown for constant-flux pumping at a partially penetrating well in a radial two-zone confined aquifer” by C.-S. Huang et al.***

## **Anonymous Referee #2**

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## **General comments**

C.-S. Huang, S.-Y. Yang and H.-D. Yeh present in the technical note a new approximate solution for the drawdown induced by a constant rate pumping test in a radial two-zone confined aquifer. By considering partial penetration of the pumping well, their approximate solution for the transient drawdown is new and interesting to the hydrologic community. The publication is well-written. A more detailed description of the mathematical model and results in the discussion section could improve readability and

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understanding, as described later. Tables and figures are clear and comprehensible, minor improvements are suggested for captions.

## Specific comments

### *Abstract*

Please clarify under which assumptions your solution is valid: 2D or 3D aquifer, heterogeneous or homogeneous media?

### *Introduction*

The introduction might concentrate on studies directly related to the presented work, i.e. solutions which consider partial penetration or two-zone aquifers, respectively. A comprehensive overview on available solutions for constant rate pumping tests is already given in table 1.

What are potential applications for the presented solution?

### *Mathematical model*

Please state the aim of the section at the beginning and explain model configurations and assumptions (2D or 3D, homogeneous or heterogeneous media, boundary conditions).

Figure 1 shows the observation well to be screened over the entire aquifer. Is this a prerequisite for your solution or is it also valid for partially penetrating observation wells?

Refer to the meaning of  $\alpha$  in the text.

$\alpha$  includes the vertical hydraulic conductivity,  $K_z$ . Are you assuming the aquifer and the skin zone to be anisotropic? Please elaborate this in more detail.

### *Approximate transient solution*

Please elaborate in more detail on the procedure how equation 18 was found to allow

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for reproducibility. What was the range of tested parameters. How is the accuracy of equation 18 for early, intermediate and late pumping times?

Why is the coefficient different to the one obtained by Yang et al. (2014)?

### *Accuracy of approximate transient solution*

Please specify "the approximate solution" in line 10, p 2750 by giving the equations you refer to.

Presented results generally assume that  $\alpha_1 = \alpha_2$ . What does this assumption imply?

Figures 2a and 2b show examples of the solution at specific values of dimensionless time and distance. Were these values chosen randomly or by some criterion? Did you test other choices?

I assume that by "discrepancy" in line 20, p 2750, you mean the deviation of your solution from Chiu et al. (2007) during early pumping times. As I understand, equation 18 should compensate for neglecting the temporal derivative in equations (2) and (3). Might the deviation between the two solutions possibly come from the definition of  $\bar{R}(\bar{t})$  in equation 18? This could be answered by a more detailed description on the trail and error procedure regarding  $\bar{R}(\bar{t})$  in section 2.3.

The phrase "except at early time during which the radius of influence arrives" (line 2, p 2751) is somehow unclear to me.

### *Vertical flow*

What does the assumption  $\alpha_1 = \alpha_2$  imply? Did you test for  $\alpha_1 \neq \alpha_2$ ?

How/why did you choose the set of parameters ( $\bar{r}$ ,  $\bar{z}$ ,...)? Did you test for other choices?

In line 10, p 2751, "vertical flow vanishes": I guess the *effect* of vertical flow on the drawdown at an observation vanishes, but vertical flow itself does continue.

You state a criterion for the presented model by which vertical flow can be neglected.

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Do comparable criteria exist for other models (e.g. models mentioned in the introduction)? If so, please relate to those. Such criteria could also be mentioned in the introduction.

### *Concluding remarks*

Line 23, p 2751: The meaning of the phrase "during which the time-dependent radius of influence just touches" is somehow unclear to me. Please consider revising.

### *Figures*

Figure 1: Specify abbreviations.

Figure 2: Specify the approximate solution by referring to equations.

Figure 3: List chosen parameters ( $r$ ,  $z$ , ...) in the caption, as done for figure 2.

### **Technical corrections**

Figure 1: Is CFT a typo? If so, please change to CFP.

Please consider revising the language by a native speaker.

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