Hydrol. Earth Syst. Sci. Discuss., 10, C8156–C8171, 2014
www.hydrol-earth-syst-sci-discuss.net/10/C8156/2014/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Forchheimer flow to a well considering time-dependent critical radius" *by* Q. Wang et al.

Q. Wang et al.

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General Comments: 1. The paper presents a new concept of describing the critical radius between Darcian and Non-Darcian Flow in a time dependent way. The work is well embedded into previous work on the issue of Forchheimer flow near wells. It contains a comparison with previous solutions dealing with Forchheimer flow near wells and clearly describes difference and extensions. The derivation of the time-dependent critical radius uses established methods and is sufficiently complete. The paper contains an appropriate discussion of results. The authors examined the impact of several important quantities/parameters on the behavior of the newly derived solution for the time-dependent critical radius. The presentation of results is of mixed quality. The pa-

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per is well structured and presents a sufficient number of figures and tables. Reply: Thanks!

2. It should be considered to reduce the draft to a technical note. Reply: We have changed the manuscript as Technical Note.

Specific Comments: 1. p 14097, line 15:"some researcher": clarify who Reply: We have changed "some researcher" into "George and Hansen (1992)" (see P6 Lines 3-4).

2. p14098, line 14/15/16: content of the sentence is unclear Reply: We have revised it (see P7 Lines 6-9).

3. p14099, line 6: clarify under which conditions the analytical solutions of Sen (1988) and Wen et al. (2008) are valid Reply: We have clarified it. The analytical solutions of Sen (1988) and Wen et al. (2008) were valid for the groundwater flow in the quasi-steady state (see P8 Lines 7-9).

4. p14099, line 11: why referring to Sen (1988) and Wen et al. (2008) in the context of quasi-steady state flow (with respect to the sentence in line 6)? Reply: We have revised it (see P8 Lines 7-9).

5. p14101: line 2: give literature reference of this formula Reply: We have added the literature reference of this formula (see P10 Line 18).

6. p14102: line 5: Where does this sentence refer to? Is that assumtion taken for the following statement? Then "We assume..." or "Under the assumption of ..." Reply: We have revised it (see P12 Lines 5-7).

7. p14103: line 1-4: account for the fact that hydraulic conductivity is assumed to be constant (homogeneous aquifer), this is an important assumption when dealing with well flow problems Reply: We have revised it (see P11 Lines 13-15).

8. p14107: line 13/14: please specify the sets of aquifer parameters Reply: We have

HESSD

10, C8156–C8171, 2014

revised it (see P18 Lines 4-6).

9. p14108/14109: Why it is necessary to introduce the solution of Sen (1988) in detail in equations (33)-(36)? And if the solution is introduced, why are not those of Papadopoulos & Cooper (1967) and Mathias et al. (2008), as stated in line18? Recommendation: remove Eq (33) - (36). Reply: We have deleted Eqs. (33) - (36).

10. p14109: line 10: specify what figures 4a and b show: a comparison of the distance drawdown curves for all 4 models/solutions Reply: We have revised it (see P19 Lines 17-20).

11. p14111: line 26: How can that be explained by using Eq.(37)? Reply: We have revised it (see P22 Lines 9-11).

12. p14113: line 2: Why r_D=0.1, when explaining figure 8 which refers to r_D=1? Reply: We corrected it, and rD=0.02 (see P23 Lines 14-15).

13. p14113: line 9: "The convergence of this iteration method has been verified.“ How? (Where was that done in the previous sections?) Reply: We have revised it (see P24 Lines 1-3).

Figures: 1. figure 2a: dotted lines are very difficult to distinguish Reply: We have revised it (see Fig. 2a).

2. figure 2b: lines in legend difficult to refer to lines in the plot Reply: We have revised it (see Fig. 2b).

3. figure 4a,4b: either in the legend or in the caption should be assigned which flow model (Darcian, fully non-Darcian,...) refers to which model/solution (Mathias et al. (2008)...) dotted lines are very difficult to distinguish (4a), recommendation of using the same linestyle in both plots Reply: We have revised it (see Figs. 4a-4b; P31 Lines 7-12).

4. figure 5: specify the caption: the plot shows the time-dependent critical radius

HESSD

10, C8156–C8171, 2014

R_CD(t) for different values of the inertial force coefficient beta Reply: We have revised it (see P31 Line 13).

5. figure 6: specify the caption: the plot shows the time-dependent critical radius R_CD(t) for different values of the critical specific discharge Reply: We have revised it (see P31 Line 14).

6. figure 7/8: Why using different scales at the y-axis? Recommendation of using log-log-plots for both figures Reply: We have revised them and plotted two figures in the log-log coordinate system (see Figs. 7 and 8).

7. figure 5,7,8: recommendation of using the same linestyle in all plots (same lines for the same values in beta) and keeping the order in the legend constant dimensions are missing at labels (Figs. 2, 4-8) Reply: We have revised them (see Figs. 2, 4-8).

8. In general: plots should be made more fashionable (strong recommendation) Reply: We have revised all figures according to the reviewer's comments (see Figs. 2, 4-8).

Technical corrections 1. p14097, line 2: in respect of/with respect to Reply: We have revised it as "with respect to" (see P5 Line 11).

2. p14097, line 28: what ist dolostone? Reply: We have revised it (see P6 Lines 13-15).

3. p14098, line 2/3: greater than Reply: We have corrected it (see P6 Line 17).

4. p14100: line 4: simplify Reply: We have revised it (see P9 Line 15).

5. p14100: line 20: set to Reply: We have corrected it (see P10 Line 9; P17 Line 13; P18 Line 12,).

6. p14100: line 21: is in linear relation to Reply: We have revised it (see P10 Line 11).

6. p14100: line 23: space character after calculate is missing Reply: We have added a space there (see P10 Lines 13-14).

HESSD

10, C8156–C8171, 2014

7. p14101: line 3: in case of Reply: We thought it should be “in the case of”, and have revised it (see P10 Line 20).

7. p14103: line 7: compose (without of), probably change the sentence construction Reply: We have revised this sentence (see P13 Lines 13-14).

8. p14115: line 10: "Wasserbewegung durch den Boden“ Reply: We have revised it, and “Wasserbewegung durch den Boden” should be changed into “Wasserbewegung durch Boden” (see P26 Line 19).

9. p14110: line 13: "Therefore, the new solution agrees...“ (skip the "it is not suprise to see that“) Reply: We have deleted “it is not surprise to see that” (see P20 Lines 19-20).

10. p14110: line 15: "Another fact that can be seen in Fig. 4b is that the new solution...“ Reply: We have revised it (see P20 Line 20; P21 Lines 1-2).

11. p14111: line 8: skip the "that“ Reply: We have deleted “that” (see P21 Lines 14-15).

12. p14111: line 13: "Therefore, R_CD does not depend on beta under quasi-steady state flow conditions, it only depends reciprocally...“ Reply: We have revised it (see P21 Lines 19-20).

13. p14111: line 23: "show“ instead of "represents“ Reply: We have changed “represents” into “show” (see P22 Line 9).

14. p14112: line 17/18: "...deflection point in the curve , that becomes larger in time with increasing beta_D.“ Reply: We have revised it (see P23 Line 6-8).

15. p14114: line 5: "larger“ instead of "longer“ Reply: We have changed “longer” into “larger” (see P25 Line 1).

16. Very often space characters are missing (in particular in front of brackets) Reply: We have checked the whole manuscript, and added the space character if necessary.

HESSD

10, C8156–C8171, 2014

17. In general expression in English should be improved Reply: We invited a native English speaker to check the grammars of the article, and revised them accordingly.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/10/C8156/2014/hessd-10-C8156-2014-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 14095, 2013.

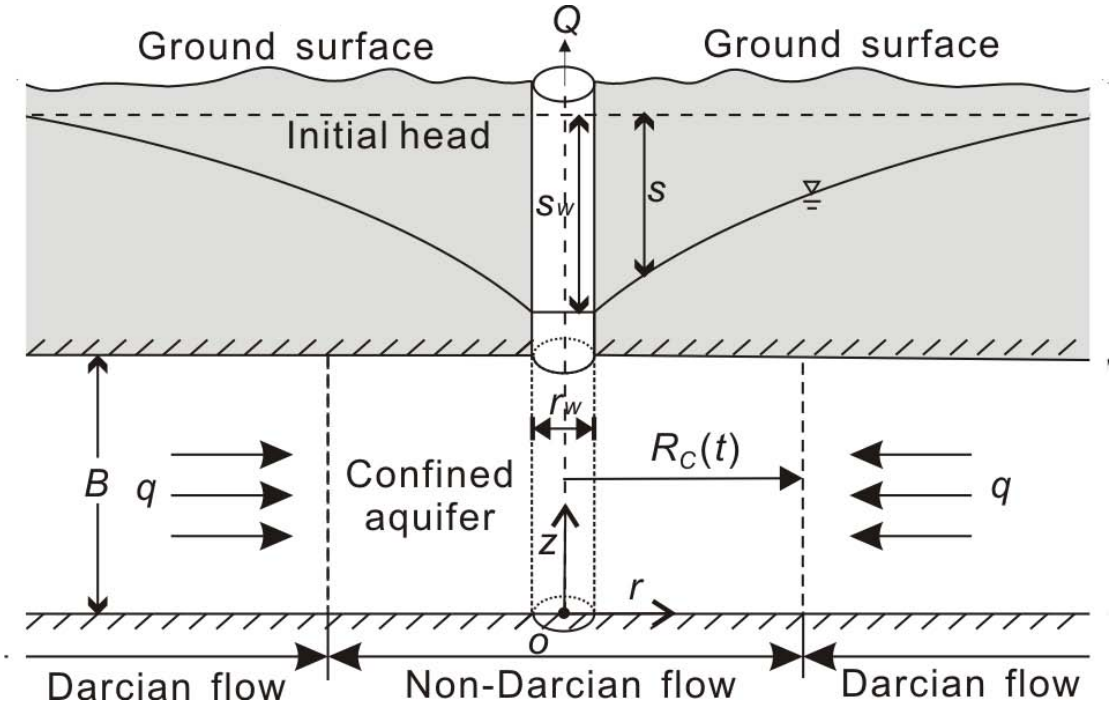

Fig. 1. Fig. 1. The schematic diagram of the non-Darcian flow into a fully penetrating pumping well considering the time-dependent critical radius.

HESSD
10, C8156–C8171, 2014

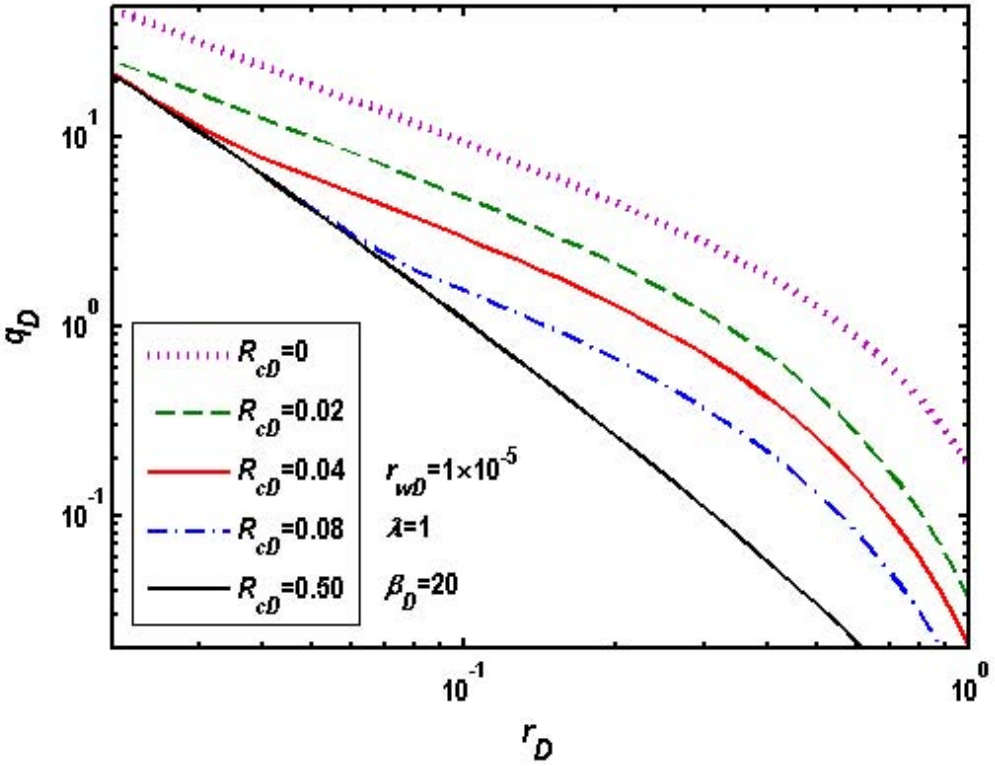

Fig. 2. Fig. 2a. Specific discharge distributions with different critical radius RCD.

HESSD
10, C8156–C8171, 2014

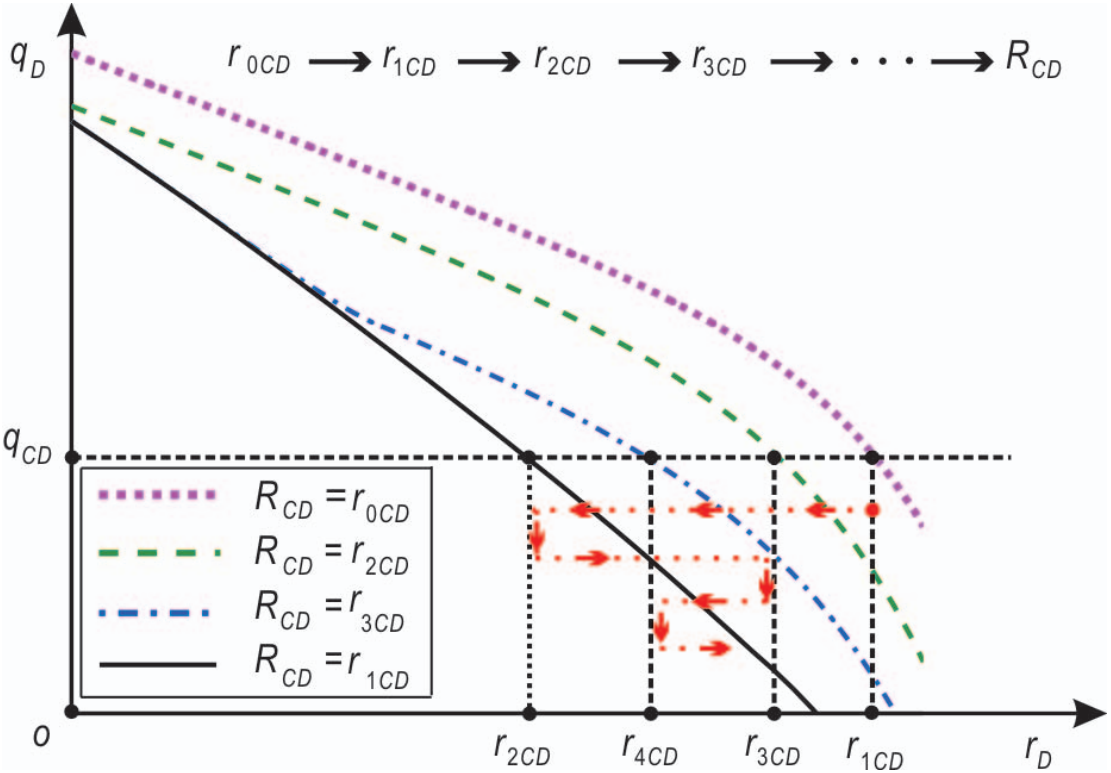

Fig. 3. Fig. 2b. The schematic diagram showing the iterative process of seeking RCD.

HESSD
10, C8156–C8171, 2014

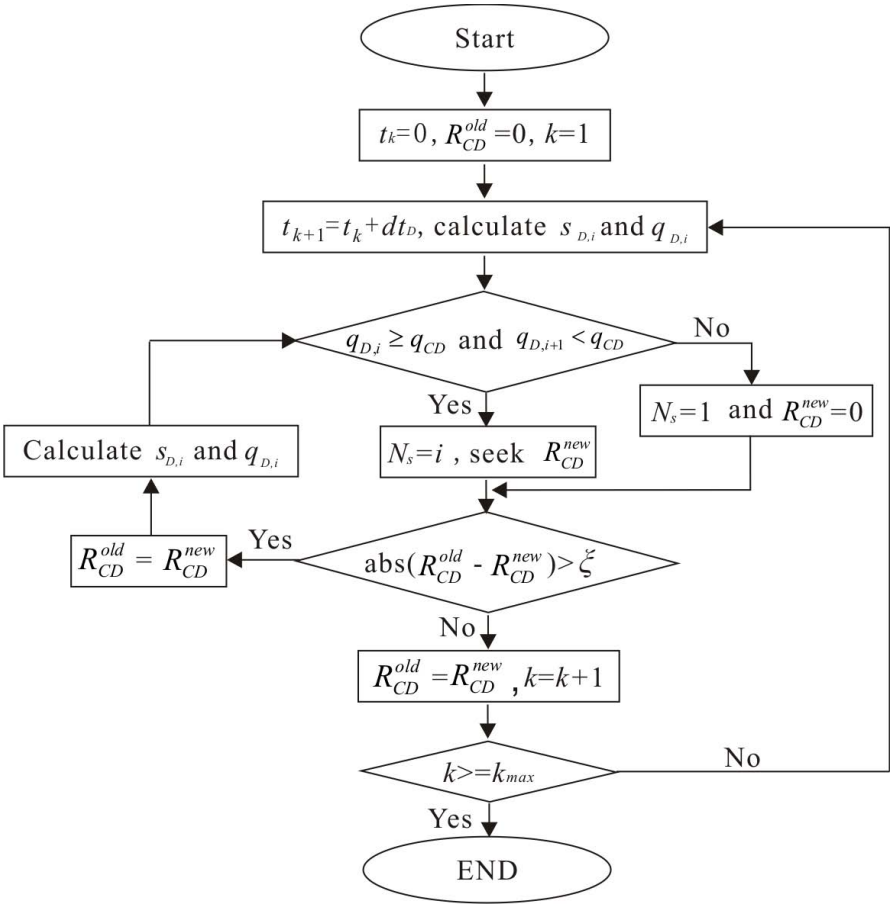

Fig. 4. Fig. 3. Flow chat of the MTRM algorithm.

HESSD
10, C8156–C8171, 2014

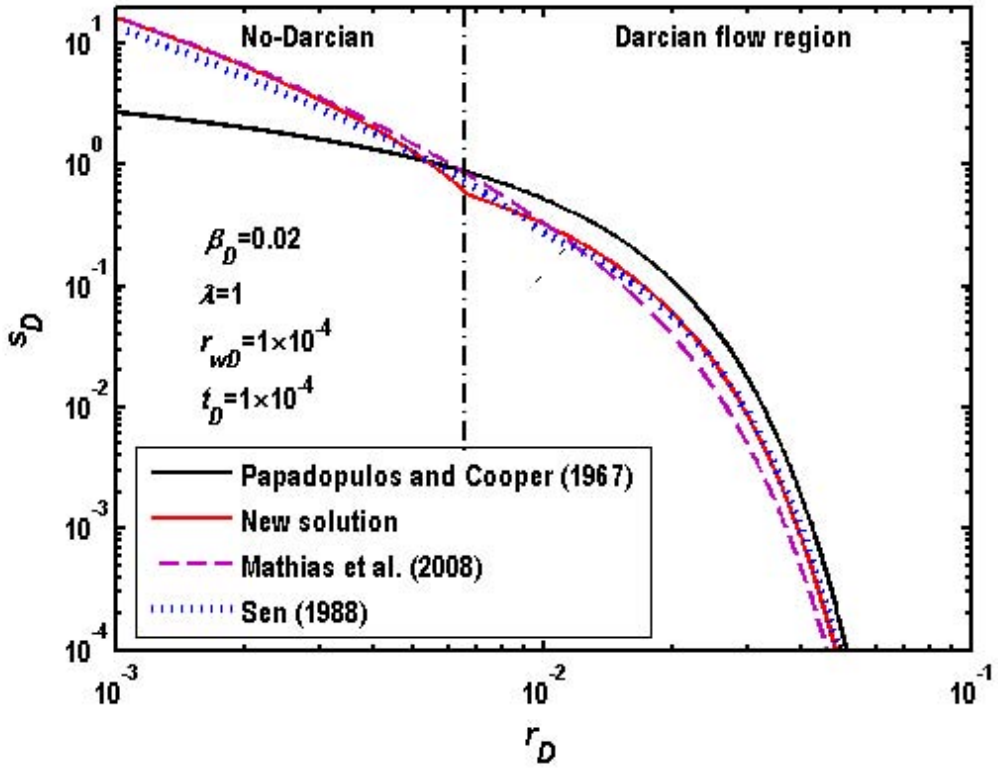

Fig. 5. Fig. 4a. Comparison of the distance-drawdowns by the fully Darcian flow model (Papadopoulos and Cooper, 1967), the fully non-Darcian flow model (Mathias et al., 2008), the two-region flow model (Sen,

HESSD
10, C8156–C8171, 2014

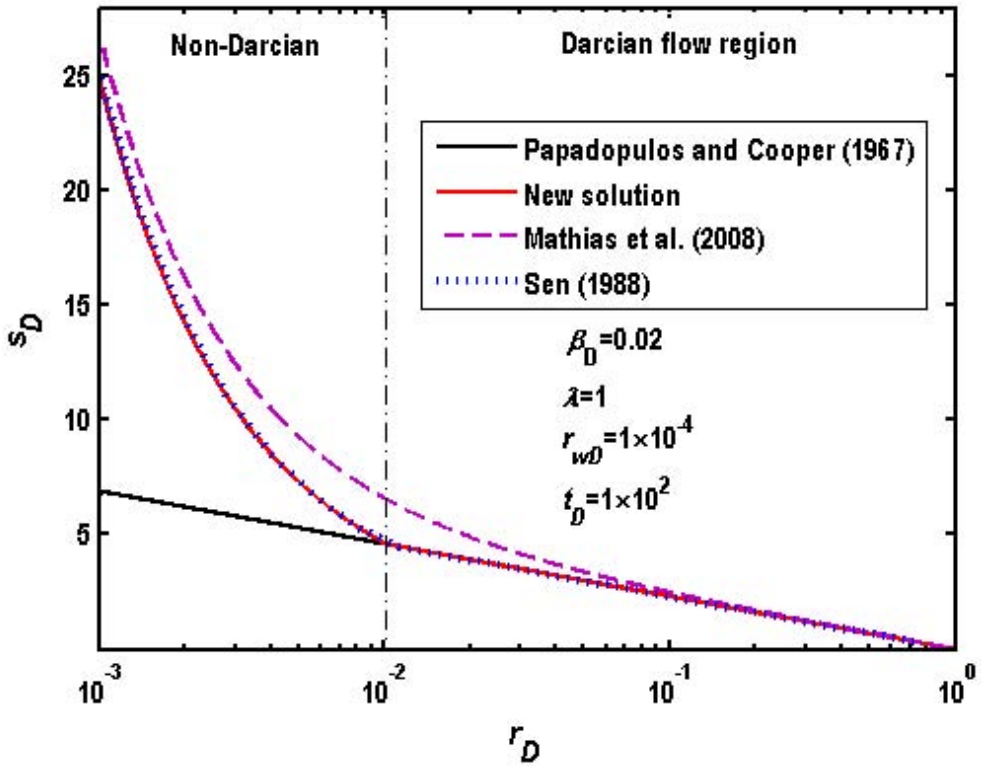

Fig. 6. Fig. 4b. Comparison of the distance-drawdowns by the fully Darcian flow model (Papadopoulos and Cooper, 1967), the fully non-Darcian flow model (Mathias et al., 2008), the two-region flow model (Sen,

HESSD
10, C8156–C8171, 2014

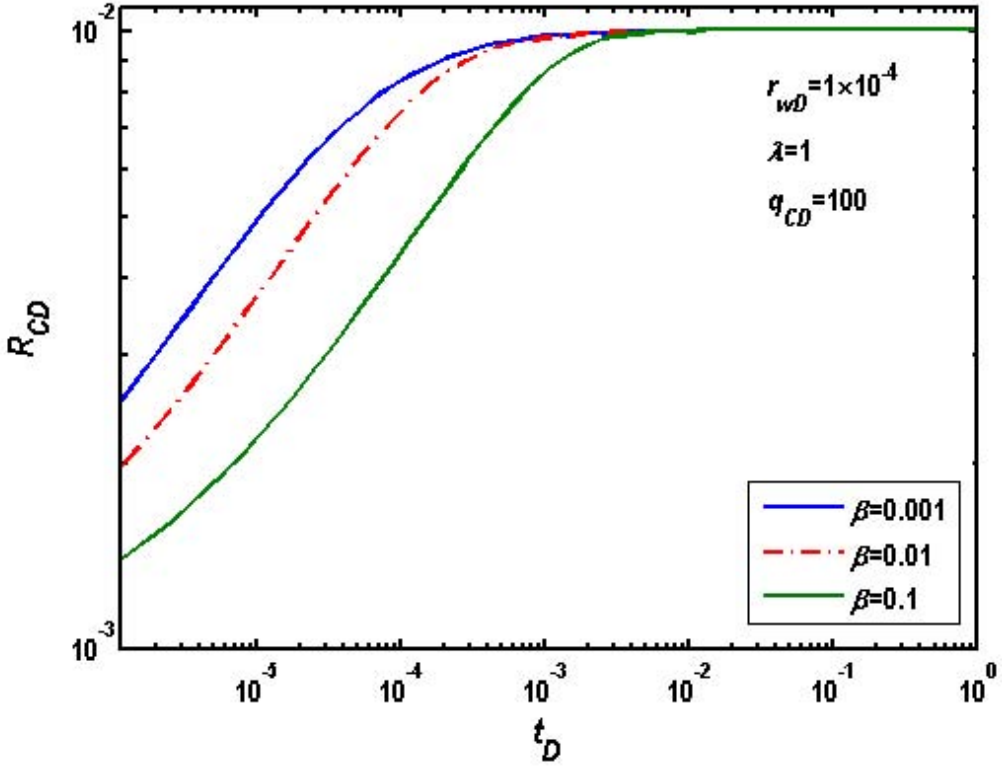

Fig. 7. Fig. 5. Time-dependent critical radius (RCD) for different inertial force coefficients.

HESSD
10, C8156–C8171, 2014

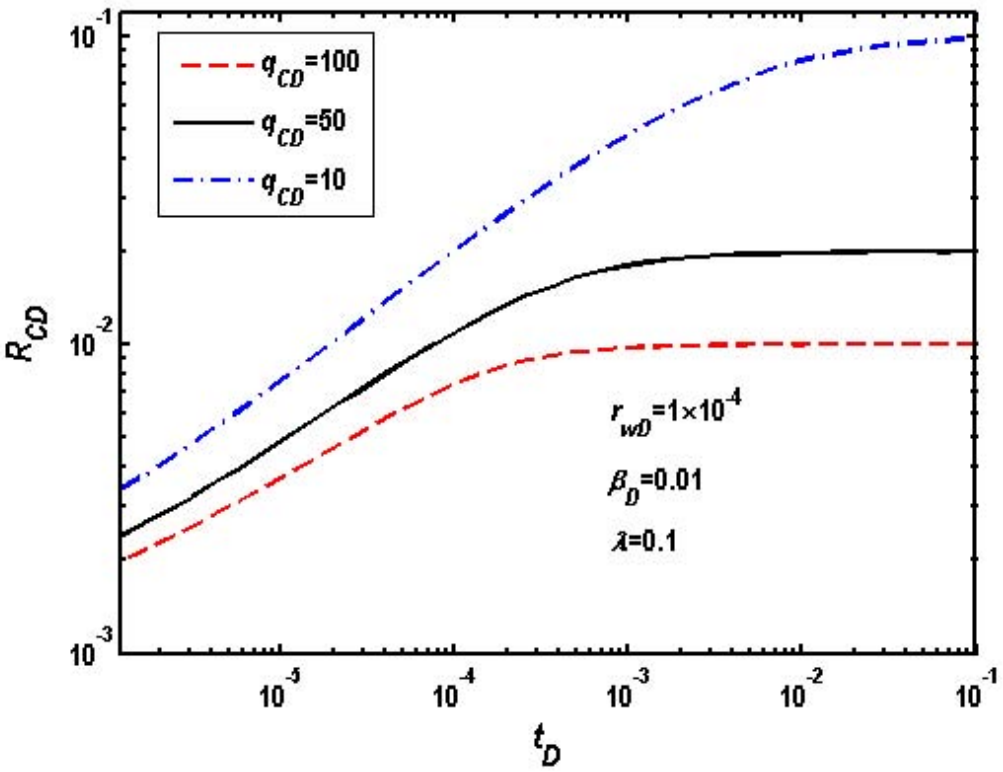

Fig. 8. Fig. 6. Time-dependent critical radius (RCD) for different critical specific discharges.

HESSD
10, C8156–C8171, 2014

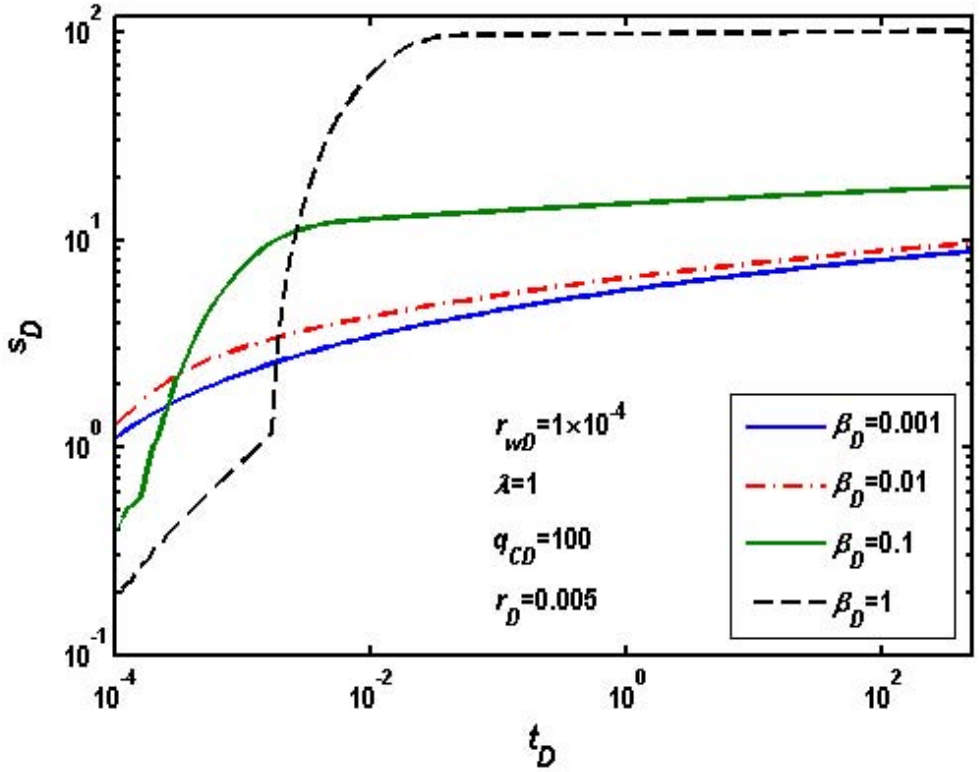

Fig. 9. Fig. 7. Time-drawdown at rD=0.005 for different inertial force coefficients in a log-log scale.

HESSD
10, C8156–C8171, 2014

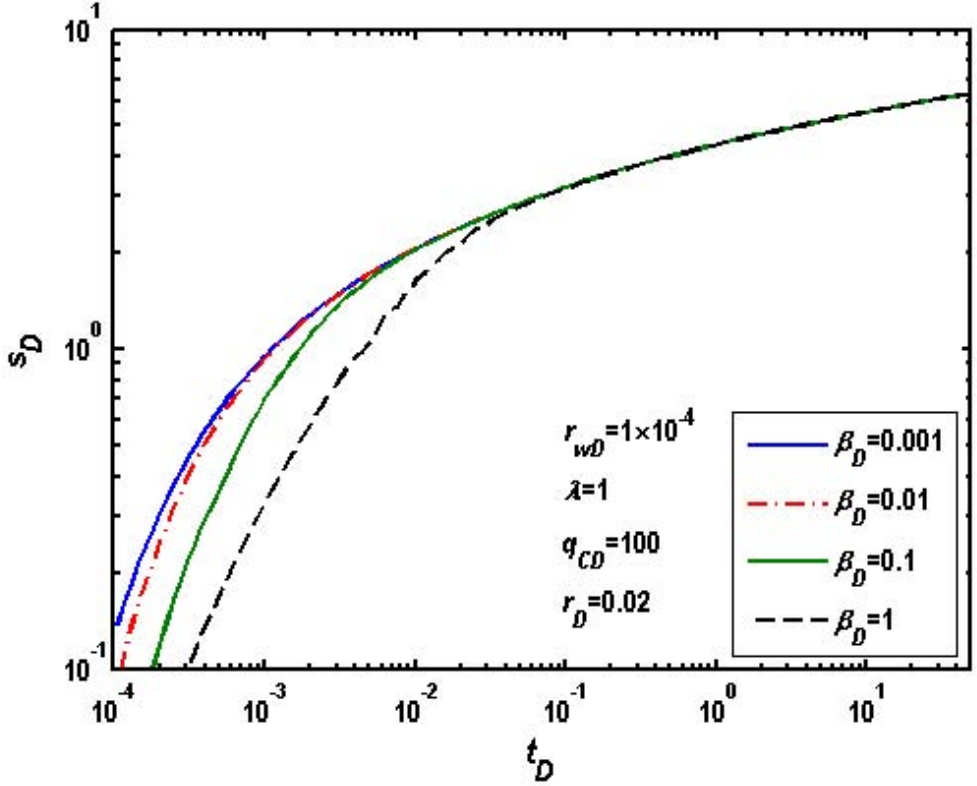

Fig. 10. Fig. 8. Time-drawdown at rD=0.02 for different inertial force coefficients in a log-log scale.

HESSD
10, C8156–C8171, 2014