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Erratum

Erratum to "The effects of combined horizontal and vertical heterogeneity on the onset of convection in a porous medium" [Int. J. Heat Mass Transfer 50 (2007) 1909–1915]

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The authors regret that the following errors occurred in the above article:

Eq. (41c) should read

$$E_H = (4/3\pi)\varepsilon_H. \tag{41c}$$

In Eqs. (42) and (43) the subscripts H and V should be swapped.

Eqs. (46) and (47) and the remainder of Section 3 should read:

$$S = -\frac{1}{63}\left[7(4\Delta_H - 5E_H)^2 + 3(2\Delta_V - 5E_V)^2\right], \tag{46}$$

$$Ra = 4\pi^2\left\{1 - \frac{64}{567\pi^2}\left[7(4\delta_H - 2.5\varepsilon_H)^2 + 3(2\delta_V - 5\varepsilon_V)^2\right]\right\}$$
$$\approx 40\{1 - 1.281(\delta_H - 0.625\varepsilon_H)^2 - 0.137(\delta_V - 2.5\varepsilon_V)^2\}. \tag{47}$$

A number of conclusions can be drawn. The effects of weak horizontal heterogeneity and vertical heterogeneity are each of second order in the property deviations. Their combined contribution is of the order of the variances of the distributions for permeability and conductivity (which are here equal to $\delta_H^2 + \delta_V^2$ and $\varepsilon_H^2 + \varepsilon_V^2$, respectively.) The effect of vertical heterogeneity is somewhat less than that of horizontal heterogeneity. Further, they act independently at this order of approximation. (Product terms like $\delta_H\delta_V$ are absent in the last expression.) Since the expression in square brackets in Eq. (46) is positive definite, the heterogeneities lead to a reduction in the critical value of Ra for all combinations of horizontal and vertical heterogeneities and all combinations of permeability and conductivity heterogeneities. (The reduction is zero for the very special case where $\delta_H = 0.625\varepsilon_H$ and $\delta_V = 2.5\varepsilon_V$.) The effects of the horizontal permeability heterogeneity and the horizontal conductivity heterogeneity are at the first combination step subtractive (and similarly with horizontal replaced by vertical), as one might expect since the permeability appears in the numerator in the definition of Ra whereas the conductivity appears in the denominator.

Eqs. (54) and (55) and the following paragraph should read:

$$S = \frac{1}{15}\left[5(2\Delta_H - E_H)^2 + (16\Delta_V - E_V)(\Delta_V - E_V)\right]. \tag{54}$$

$$Ra = 4\pi^2 A^2\left\{1 + \frac{16}{135\pi^2}\left[5(4\delta_H - \varepsilon_H)^2 + 4(16\delta_V - \varepsilon_V)(\delta_V - \varepsilon_V)\right]\right\}$$
$$\approx 40A^2\{1 + 0.060(4\delta_H - \varepsilon_H)^2 + 0.192(16\delta_V - \varepsilon_V)(\delta_V - \varepsilon_V)\}. \tag{55}$$

Comparison with Eq. (47) shows that the homogeneous case value of Ra is increased by the factor A^2, while the effect of heterogeneity is no longer monotonic. The horizontal heterogeneity leads to an increase in Ra and the vertical heterogeneity produces either an increase or decrease depending on the value of δ_V/ε_V.

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