Perturbative corrections for the scaling of heat transport in a Hele-Shaw geometry and its application to geological vertical fractures

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In this work, we investigate numerically the perturbative effects of cell aperture in heat transport and thermal dissipation rate for a vertical Hele-Shaw geometry, which is used as an analogue representation of a planar vertical fracture at the laboratory scale. To model the problem, we derive a two-dimensional set of equations valid for this geometry. For Hele-Shaw cells heated from below and above, with periodic boundary conditions in the horizontal direction, the model gives new nonlinear scalings for both the time-Averaged Nusselt number and dimensionless mean thermal dissipation rate in the high-Rayleigh regime. We demonstrate that and depend upon the cell anisotropy ratio , which measures the ratio between the cell gap and height. We show that values in the high-Rayleigh regime decrease when grows, supporting the field observations at the fracture scale. When , our results are in agreement with the scalings found using the Darcy model. The nume