Comment on "Modeling of Scale-Dependent Dispersion in Hydrogeologic Systems" by J. F. Pickens and G. E. Grisak

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Pickens and Grisak [1981] present an interesting analysis of modeling of scale-dependent dispersion in hydrologic systems. They conclude that for systems that exhibit a constant dispersivity at large times or large mean travel distances, the importance of scale-dependent dispersion at early times or short travel distances is minimal in long-term predictions of solute transport. The purpose of this comment is to point out that this conclusion may not be appropriate.

The effect of scale-dependent dispersivity on spreading of the contaminant plume is self-evident. A graph (Figure 1) of spatial concentration variances of contaminant plumes resulting from a constant dispersivity and a scale-dependent dispersivity versus mean travel distance or time illustrates the effect. The spatial concentration variance of a contaminant plume is a measure of spreading of the plume. Thus the value $\Delta\sigma_x^2$ in Figure 1 represents the difference between the sizes of the plumes resulting from a constant dispersivity and a scale-dependent dispersivity. This value depends on the mean displacement distance, the development distance or time of the asymptotic dispersivity, and the magnitude of the dispersion coefficient ($D = aU$) or the asymptotic macrodispersivity a if the velocity, U is constant. This figure shows that asymptotic macrodispersivities with large values of development time will produce much smaller variances (curve 1) at large values of distance than the constant dispersivity (curve 2). Also, the difference in the spatial concentration variances increases with the magnitude of the asymptotic dispersivity ($\Delta\sigma_x^{2*} > \Delta\sigma_x^2$).

However, at this moment there is no adequate information to quantify the relationship between spatial variances and mean travel distances and the magnitude of asymptotic macrodispersivity. It is premature to conclude that the scale-dependent dispersion at early times or short travel distances has little effect in long-term predictions of solute transport, although the relative error in such predictions may diminish with distances. It should also be pointed out that a well-defined scale-dependent dispersivity function does not warrant the use of the classical diffusion equation in the prediction of large-scale dispersion processes [*Dagan*, 1982].
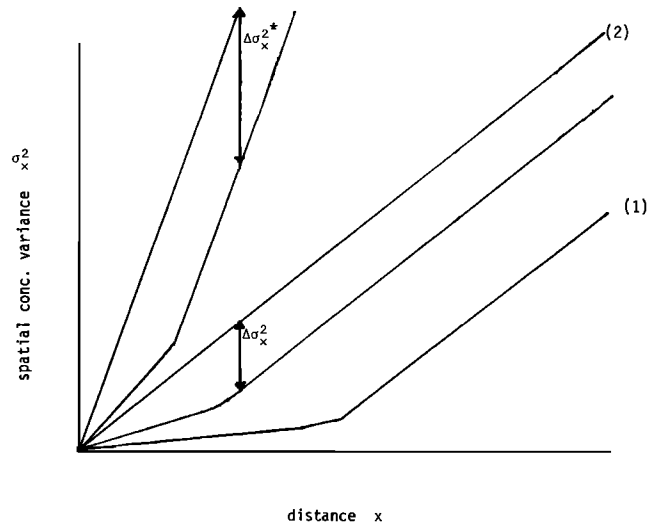

Fig. 1. Spatial concentration variance versus distance.

Unless experimental data from various geological environments are available, the effect of scale-dependent dispersivity remains at large.

REFERENCES

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