GLY 5828, Assignment 5

1. Starting from Mass In – Mass Out = Change in Stored Mass, derive the 1-D CDE.

2. Derive an explicit finite difference expression for the 1-D CDE.

3. Compute the grain scale Reynolds number for the experimental column using the images I provided via email. The grain diameter is a very good estimate of the order of magnitude of the pore size for a uniform sand.

4. Compute different estimates for the dispersion coefficient expected in the column experiment conducted in class. Use the Peclet number correlation chart from Assignment 4 and the 0.1 rule-of-thumb or the scale-based chart.

5. Process the data file for the column salt breakthrough to obtain time in seconds and normalized concentration for

   - 1) The breakthrough curve represented by the pulse of solute (which we applied to the column in class and you have all of the pertinent data) and,

   - 2) The next breakthrough curve in the file representing the displacement of salt water by fresh water (the step change in concentration—time zero if you like—came at 1:37 pm). Because of the significant density difference between the two solutions and its strong effect on the transport process, we don't expect this one to fit the standard CDE as well and we'll revisit it later.

Note that the voltages should all be normalized to the same maximum and minimum (since they reflect the electrical conductivities of the water we used). Note also that the maximum and minimum will ideally be reflective of the 'average' maximum and minimum rather than any extreme noise values.

6. Analyze both curves as follows:

   - Use an Excel spreadsheet solution of the explicit finite difference expression and approximately fit the simulation to the data by varying the dispersion coefficient and the velocity

   - Download StAnMod and use it to fit the dispersion coefficient to the observations. Since the capacity of StAnMod/CXTFIT is limited, you might want to use one out of every 50 or 100 data points. Use the velocity and dispersion coefficient as fitting parameters. Compare the results from both models to the observations by plotting the model results (concentration as a function of time) as a solid line over the observations plotted as open symbols

7. For the first BTC only, compare and contrast your pre- and post-experiment estimates of the dispersion coefficient, dispersivity, porosity, and velocity. Propose a new estimated porosity and dispersivity based on the experimental results