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On the measurement of solute concentrations in 2-D flow tank experiments

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Abstract. In this study we describe and compare photometric and resistivity measurement methodologies to determine solute concentrations in porous media flow tank experiments. The first method is the photometric method, which directly relates digitally measured intensities of a tracer dye to solute concentrations, without first converting the intensities to optical densities. This enables an effective processing of a large number of images in order to compute concentration time series at various points of the flow tank and concentration contour lines. This paper investigates perturbations of the measurements; it was found both lens flare effects and image resolution were a major source of error. Attaching a mask minimizes the lens flare. The second method for in situ measurement of salt concentrations in porous media experiments is the resistivity method. The resistivity measurement system uses two different input voltages at gilded electrode sticks to enable the measurement of salt concentrations from 0 to 300 g/l. The method is highly precise and the major perturbations are caused by temperature changes, which can be controlled in the laboratory. The two measurement approaches are compared with regard to their usefulness in providing data for benchmark experiments aimed at improving process understanding and testing numerical codes. Due to the unknown measurement volume of the electrodes, we consider the image analysis method more appropriate for intermediate scale 2D laboratory benchmark experiments for the purpose of evaluating numerical codes.

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