Laboratory experiment to study solute transport in coastal environments

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Experimental Design

An experimental methodology has been developed to study the solute transport in coastal settings under tidal action using dye tracing in an illuminated laboratory model. The distribution of tracer concentration distribution was determined by establishing a quantitative relationship between concentration in a coloured solution and the Hue value in a photographic image.

It is possible through experiment to obtain images of solute transport at different times, a calibration curve must be developed to quantify the information of interest in an image, i.e. the relationship between image Hue value and dye concentration.

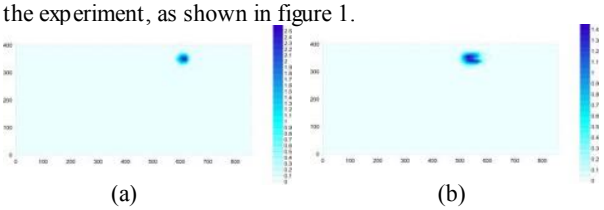
$$y = 67.741x + 176.31, \quad 0.07g/l < x < 0.2g/l; \quad (1)$$

$$y = 13.297x + 187.2, \quad 0.2g/l \leqslant x < 1.6g/l; \quad (2)$$

$$y = 5.9102x + 199.02, \quad 1.6g/l \leqslant x < 3.0g/l. \quad (3)$$

where y represents the Hue value (H) and x is the tracer concentration in solution (1)-(4), the units of x is g/L.

The relationship between the Hue value (H) and dye concentration in solution is used to process the image taken in the experiment, as shown in figure 1.



(a) (b)

Figure 2: Photographs of solute transport at (a) a quarter cycle, (b) a half cycle.

Discussion of Results

Previous studies [1-2] have shown that the groundwater level in coastal aquifers fluctuates regularly with the rise and fall of tides. Through the experiment we can get the conclusion that when the water level rises, the solute plume moves downward, and when the water level drops, the solute feather moves forward.

The light projection is non-destructive, has higher temporal resolution and spatial resolution, and is less costly than conventional methods [3].

[1]Boufadel et al. (2006) *J Env Eng* **132**, 616-623. [2]Xia et al. (2010) *Water Resour Res* **46**, W10528. [3]Yang et al. (2014) *Environ. Sci. Technol* **49**, 415-422.