Geophysical Research Abstracts
Vol. 17, EGU2015-1451, 2015
EGU General Assembly 2015

Calibration of a one-dimensional water flow model for the evaluation of the reclamation success of saline soil substrates

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Highly saline-sodic soils restrict plant establishment. Salt affected soils may be reclaimed by leaching salts from a potential root zone. Soil amendments can be used as a reclamation technique to improve the soil pore system and hydraulic functions, which allows the downward transport of water under certain precipitation conditions. The objective of this study was to investigate salt movement within saline-sodic soil at a small scale in soil columns and assess the success of amendment strategies for reclamation of the soil. For the purpose of predicting the effect of typical rainfall scenarios on the reclamation of saline-sodic soils, a one-dimensional numerical water flow model (HYDRUS-1D) was tested and calibrated. The model was calibrated using data from laboratory column experiments. A saline-sodic soil was packed into 30 cm long columns (diameter 7cm) from a depth of 10 to 30 cm and then covered with the same soil, however amended with 40% (wt/wt) fine sand and 20% (wt/wt) wood chips, respectively. A column filled with the saline-sodic soil only to a depth of 30 cm was used as a control. The experiments were carried out by establishing an initial pressure head of -60 cm at the soil surface. Based on climate data from a location in south-west Queensland, rainfall scenarios with 50% and 1% probability of annual exceedance for this location were calculated and applied to the soil columns. The hydrological response in the columns was monitored by measuring the water potential using tensiometers installed in three depths (3, 11 and 25 cm) and knowledge of inflow and outflow of the columns. The simulation captured the observed trends in the results for the investigated columns and measured depths under heavy rainfall events as well as surface substrates exposed to small rainfall events, where the simulated and measured results were in very good agreement, with R^2 values generally ranging between 0.92 and 0.98. The simulated results also provided a good description of the observed results for the subsoils (25 cm) of the columns subjected to the land reclamation strategies under small rainfall events (R^2 ranged between 0.82 and 0.86). This study identified that the model can be applied to simulate water flow in the soil profile subjected to rehabilitation techniques as influenced by intensive water application/rainfall patterns.

Key words: HYDRUS-1D, Model calibration, Rainfall event, Water flow