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Importance of unsaturated zone parameters for chemical transport

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In the northern hemisphere the use of deicing chemicals on airplanes, runways and taxiways is necessary in order to secure aircraft traffic during wintertime. The main airport of Norway, OSL, is located on top of a glaciofluvial ice contact delta, which comprises Norway's largest rain fed unconfined aquifer. This implies that OSL acts upon strict regulations to prevent contamination of groundwater and surface waters and disturbance of the ground water balance of the aquifer. In order to handle melt water containing de-icing chemicals, the airport authorities rely on the unsaturated zone as a filter for degradation of the deicing chemicals before reaching the ground water level. This is especially a challenge during the snow melt in the spring, as a large volume of melt water containing deicing chemicals which has accumulated during the winter infiltrates the soil profile.

For proper aquifer management it is important to predict flow rate and contaminant transport through the unsaturated zone. Computer modeling is a valuable tool for assessing the flow and transport of solutes through the soil profile. There are two major challenges associated with sound predictions of flow and transport in the unsaturated zone, describing the correct unsaturated zone properties and determining the infiltration rates.

Construction and management procedures at the airport implied extensive construction work affecting the soil physical properties. To assess the effect of natural and anthropogenic induced subsurface variability, variation of soil physical parameters and different infiltration rates, transport of solutes through the unsaturated soil profile was simulated with SUTRA 2.1 (Saturated-Unsaturated-TRAnsport finite element code). Parameters and variables describing soil physical properties were estimated based on soil samples and infiltration rates from meteorological data and local snow measurements. Sensitivity analyses of the parameters was performed in order to estimate the relative importance of the different soil physical parameters and infiltration rates when simulating flow and transport through the soil profile. The computer simulations were compared with infiltration experiments conducted during spring 2009 for validation of the results.