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Effects of Daily Temperature Changes on Transient Heat and Moisture Transport in Unsaturated Soils

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Abstract : This research contains the formulation of a two-dimensional analytical solution to transient heat, and moisture flow in a semi-infinite unsaturated soil environment under the influence of daily temperature changes. For this purpose, coupled energy conservation and mass fluid continuity equations governing hydrothermal behavior of unsaturated soil media are presented in terms of temperature and volumetric moisture content. In consideration of the soil environment as an infinite half-space and by linearization of the governing equations, Laplace–Fourier transformation is conducted to convert differential equations with partial derivatives (PDEs) to ordinary differential equations (ODEs). The obtained ODEs are solved, and the inverse transformations are calculated to determine the solution to the system of equations. Results indicate that heat variation induces moisture transport in both horizontal and vertical directions.

Keywords : analytical solution, heat conduction, hydrothermal analysis, laplace–fourier transformation, two-dimensional
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