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Hydrological and thermal regime of green roof test beds simulated with S1D model

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Recently, hydrological and thermal regime of extensive green roofs has attracted great attention of the scientists and engineers dealing with climate change impacts, green infrastructure, and design and/or building construction. Two green roof test beds with distinct soil substrates – locally prepared fine-grained Technosol and coarse more permeable commercial substrate – were installed at the University Centre for Energy Efficient Buildings of the Czech Technical University in Prague. The test beds are equipped with a temperature probe; intensity of outflow is registered via a tipping bucket flowmeter. For complete hydrometeorological characterization, data from the nearby meteorological mast are available.
The hydrological and thermal regime of the test beds were simulated using the S1D model - a numerical model of coupled soil water and heat transport in variably saturated soil profile. The soil hydraulic properties were described using van Genuchten-Mualem approach. The methodology proposed by Cote and Konrad was used to approximate the soil thermal conductivity function. Selected model parameters were optimized using the PEST code based on a Levenberg-Marquardt algorithm. Measured temperature and outflow from the experimental green roof test beds were used in objective function for the inverse modeling.
A good agreement between the measurement and modeled outputs was achieved, especially for the test bed with the more permeable substrate. The model results indicate a significant reduction of the prescribed potential evapotranspiration (more than four times). The optimized parameter values are physically meaningful; however, their applicability for other seasons was not verified yet. Generally, the S1D model was recognized as a suitable tool for assessing hydrothermal regime of such artificial soil systems.
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