A modified Jarvis model to improve the expressing of stomatal response in a beech forest

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Abstract

Jarvis-type model with a flexible parameterization of stress functions can improve the descriptions of physiological behaviour for specific vegetation species. However, it is criticized for the empirically formulated multiplicative equation that can deviate from the mutual impact of intercorrelated stress factors, e.g., vapor pressure deficit (VPD) and air temperature (T_a). This study proposed a modified Jarvis model by adding reduction factors in the stress functions of VPD and T_a to provide a better description of stomatal conductance. The sap flow data of transpiration rate in a beech forest in the mid-latitude of Centre Europe was used to inversely estimate the stomatal conductance, which facilitated the formulation of stress functions. Taking two recommended parameterization strategies for general deciduous broadleaf forest (DBF) led to severe overestimation of transpiration rate with a maximum value of ~2 mm/day in rainless days, which suggested that the beech forest had rather different stomatal response. With the parameterization using boundary analysis, the unmodified and modified Jarvis model provided the better simulation of transpiration with NSE values of 0.75 and 0.77. The results suggested that modelling transpiration can be improved through a more specific parameterization of stomatal conductance, especially for a vegetation species featuring its own stomatal behaviour that differed from its belonged general vegetation type. Particularly, the modified Jarvis model can further improve the description of stomatal conductance and modelling of transpiration in vegetated areas, especially under dry environment conditions with relatively high VPD.

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