On the temperature function in Jarvis scheme of Noah land surface model

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Jarvis scheme is one of the two key schemes in Noah Land Surface Model for transpiration simulation. The scheme estimates canopy conductance from the maximum value under the optimal condition reduced by a set of conceptually independent scaling functions. Each scaling function is dependent on an individual environmental factor (Eq.1).

$$g_c = g_x f(D) f(T) f(R) f(\psi) \quad (1)$$

where g_x is the maximum canopy conductance, D vapour pressure deficit, T air temperature, R solar radiation, and ψ soil water potential. f denotes the empirical function representing the stress from the corresponding environmental variable; conceptually it has a value between zero and unity.

For each stress factor, multiple functions have been introduced in literature. We performed a rigorous function selection and parameterisation based on an advanced optimisation algorithm (DREAM), and found that *f(T)* has to be larger than unity in order to optimize the model performance (Fig 1). We demonstrate that this apparent conceptual inconsistence with the definition of stress functions (i.e., not larger than unity) in Jarvis scheme stems from the inappropriate assumption of independence between the stress function (Fig 2). Clearly, *f(T)* and *f(D)* are highly interdependent simply because *D* is temperature-dependent. Without considering this interdependence, a forced smaller-than-one *f(T)* may lead to incorrect parameterisation of other functions and reduce model performance.

The finding reported here is based on two species from different bioclimatic zones. Further examination of this issue on other species and bioclimatic zones are recommended.

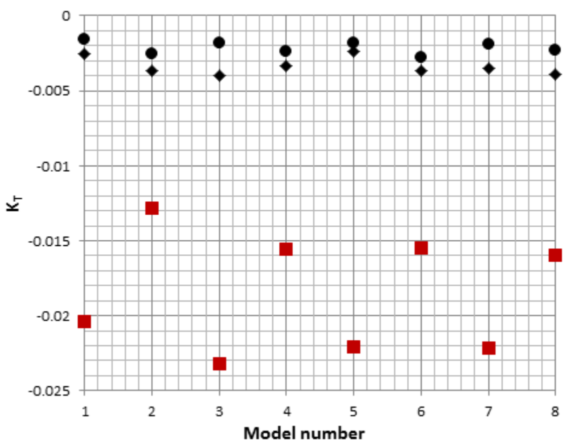

Fig. 1 An optimisation solver calculated K_T in $f(T) = 1 - K_T (T - T_0)^2$ of eight Jarvis-Stewart models of different combination of stress functions for *Osmanthus fragrans* (black circles and diamonds) in subtropical monsoon climate and *Allocasuarina verticillata* (red squares) in Mediterranean climate, consistently showing negative values (i.e., *f(T)*>1).

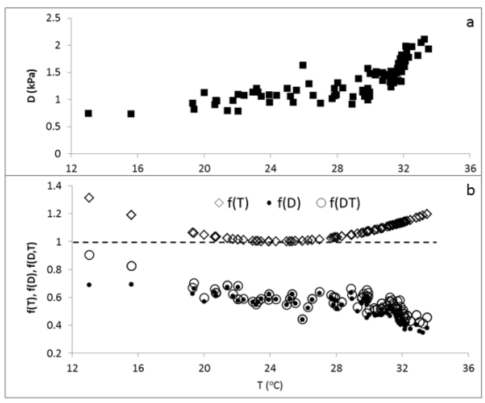

Fig. 2 DREAM optimized two stress functions (f(D) and f(T) and the combination of them as a function of temperature, as well as the relationship between vapour pressure deficit and air temperature, for *Osmanthus fragrans* in a subtropical humid environment.

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