Geophysical Research Abstracts,
Vol. 10, EGU2008-A-11805, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-11805
EGU General Assembly 2008

A thermodynamic analysis of the evapotranspiration phenomenon

A. I. Ciobanas (1) and A. N. Rousseau (1)

(1) INRS-ETE, 490, rue de la Couronne, Quebec (Qc), G1K 9A9, CANADA
(aciobanas@yahoo.com)

In this study we investigated the evapotranspiration phenomena from the point of view of the thermodynamic constructal theory, theory which states that, given external constraints, flow systems adapt their configuration in order to minimize the internal irreversibilities associated with the inner energy flows. Given the thermal and light constraints we rigorously obtained the parameters defining the optimal thermodynamic state of plants under potential conditions. The results are similar with the ones obtained by Eagleson for the optimal habitats viewed from a Darwinian perspective. To validate the central conclusion obtained in this study - given potential conditions, plants adapt their stomatal resistance such that the entropy generation at the leaves surface is minimized - we modeled the thermal behavior of the vegetation cover. For 32 FLUXNET sites around the globe, we investigated the variation of the vegetation thermal state with respect to the stomatal resistance r_s. We showed that plants can significantly thermoregulate their temperature by means of the stomatal resistance and that there is a critical stomatal resistance, r_s^{min}, corresponding to a minimum entropy generation rate. We showed that, for sites characterized with highly evolved plants, the optimal thermodynamic state defined by r_s^{min} is indeed selected by plants when potential conditions are met. In this light, r_s^{min} becomes an important parameter defining the potential state of plants, easily computable for any sites around the world.