POSTER 71

산림생태계에서의 엔트로피의 교환: 열역학적 패러다임의 재고

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Entropy Exchange in Forest Ecosystem: Revisiting the Thermodynamic Paradigm

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In the past decades, a new ecology has been emerging from the systems perspective, proposing several theories and propositions. The principles of thermodynamics and especially the entropy principle offer a framework for a theory that underlies and implies important features of ecosystem growth and development processes. For example, a theory of ecological succession such as "the strategy of ecosystem development (SED)" (proposed by Odum) provides insightful conceptual paradigms on energy flows in ecosystem. SED suggests that the energy usage at the macroscopic level not only shapes the structure and function of ecosystem, but also controls how an ecosystem will succeed and evolve (i.e., dissipative paradigm). The more entropy/energy efficient systems are those that survive and prosper in the limiting conditions encountered in nature. From the thermodynamic point of view, forest ecosystem is an open system which exchanges energy, matter, and information with the surrounding environment. For the application of the thermodynamic framework, quantification of entropy exchange in forest ecosystem is essential. An accurate assessment of the energy balance in forest ecosystem is a prerequisite to entropy accounting, which is dealt with *Lee et al.*, this issue. The balance of the thermodynamic entropy in forest ecosystem can be written as:

$\frac{dS}{dt}(Wm^{-2}) = \sigma + J = (\sigma_{Rsnet} + \sigma_{Rl\downarrow}) + (J_{Rsnet} + J_{Rl\downarrow} - J_{Rl\uparrow} + J_H + J_L + J_G + J_B + J_M)$, where

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$\frac{dS}{dt}$ is the rate of change of the total entropy (in $J \cdot m^{-2} \cdot s^{-1} \cdot K^{-1}$), σ is the entropy production within the system, and J is the entropy transfer between the ecosystem and environment. The subscripts $Rsnet$, $Rl\downarrow$, $Rl\uparrow$, H, L, G, B, and M represent the entropy terms associated with the net short-wave radiation, the incoming long-wave radiation, the outgoing long-wave radiation, the sensible heat flux, the latent heat flux, the soil heat flux, the biomass heat storage, and the metabolic (or biochemical) energy storage, respectively. In this presentation, using the KoFlux data of the Gwangneung deciduous forest site (GDK) from 2006 to 2018, we show the examples of the typical magnitudes and trends in entropy production and transfer along with their implications on the growth and development of the conserved GDK forest ecosystem.

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