Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS21-06 Room:301A Time:May 22 17:30-17:45

Consideration of latent heat transport processes in the Penman-Monteith equation

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It is considered that there are two processes in the latent heat transport, which are turbulent diffusion and molecular diffusion, but when we estimate the latent heat flux from the place whose spatial scale is as large as the plant community (tens to thousands meters), the expression is often used taking into account only the turbulent diffusion process and the molecular diffusion process is rarely considered.

However, Furuya et al. (2011, JpGU meeting) suggested that molecular diffusion process, compared to turbulent diffusion process, contributes to the sensible heat transport near land surface, and if we estimate the sensible heat flux, we should use the estimation formula considering molecular diffusion process because the formula expresses the real physical mechanism. This can be said about the latent heat transport.

Therefore, we calculated Penman ? Monteith equation (Monteith, 1968) which is often used to estimate the latent heat flux assuming turbulent diffusion or molecular diffusion and compared the estimations with the observed interception loss which is reported by Furuya et al.(2012, JpGU meeting).

In result, whether the estimated values fit the observed value depended on the day, but the estimations with two different theories were similar.

We used values by Rutter et al. (1971) to calculate the estimation assuming turbulent diffusion but the values are not in accordance with the physical law and they are decided in order to fit with observations, while the calculation with molecular diffusion has no arbitrary constant. Considering this point, this result showed that the method assuming molecular diffusion to estimate latent heat flux can explain the real mechanism.

Keywords: latent heat, heat transport, land surface process, atmospheric boundary layer, vegetation