Water Use Efficiency as a Means of Up Scaling Carbon Flux from Leaf to Stand

Linderson, Maj-Lena; Mikkelsen, Teis Nørgaard; Ibrom, Andreas; Lindroth, Anders; Pilegaard, Kim

Published in:
Geophysical Research Abstracts

Publication date:
2008

Document Version
Publisher's PDF, also known as Version of record

Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09322, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09322
EGU General Assembly 2008

Water Use Efficiency as a Means of Up Scaling Carbon Flux from Leaf to Stand.

M-L. Linderson (1,2), T. N. Mikkelsen (1), A. Ibrom (1), A. Lindroth (2), K. Pilegaard (1)

(1) Biosystems Department, Risoe National Laboratory Technical University of Denmark - DTU, Roskilde, Denmark, (2) Department of Physical Geography and Ecosystems Analysis, Geobiosphere Science Centre, Lund University, Sweden.

The aim of this study is to assess the possibility to use instantaneous water use efficiency (WUE) as a means for up scaling leaf carbon uptake to forest stand scale. WUE is considered to be a conservative species property mainly dependent on VPD, and thus not reliant on light exposure. Here, we test if this holds for beech forest leaves at different heights of the trees, and thus different exposure to light. The leaf flux measurements originates from a Danish 80-years old beech (Fagus sylvatica L) forest with an average tree height of 25 m and stand density of 430 stems/ha. The measurements were made at different heights (24, 22, 18 and 12 m) on four trees around a scaffold tower, once a week during the growing seasons of 1999 and 2000, comprising more than 3500 observations. An LCA-3 infrared gas analyzer (ADC) with a Parkinson leaf chamber was used, where PAR and transpiration were registered simultaneously as photosynthesis. Preliminary results show that, for PAR>250mmol m-2 s-1:

1) WUE becomes independent from incoming PAR, although the variability is large. 2) Comparisons between the height levels indicate that WUE is slightly higher for sunlit leaves but the result is not statistically significant due to large variability.

3) WUE is shown to decrease exponentially with VPD.

Further analyses includes statistical evaluation of average WUE, including assessment of environmental controls on the WUE variability, using meteorological measurements and eddy-flux measurements from the forest site as well as modeling of the

separate carbon and water leaf fluxes.

The available results support the initial hypothesis that WUE is a conservative property among leaves from different canopy layers and within a certain error also across different scales, i.e. the leaf and the canopy scale.