Large Aperture Scintillometer measurements above a large green roof to assess the evapotranspiration flux

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INTRODUCTION
The promotion of Blue and Green Solutions (BGS) like green roofs to regulate urban microclimate, encourage the study of their thermal and physical behaviour. Different methods to characterize the ET flux during the summer were carried out on the Blue Green Wave (BGW), an extensive green roof located in Champs-Sur-Marne (France).

The objective of this research is to analyse the surface energy balance (SEB) method that deduces the latent heat, from the measurements of sensible heat flux by scintillation.

EVAPOTRANSPIRATION CHAMBER

\[ Q_e = 10^{-3} \lambda h \frac{\Delta v}{\Delta t} \]

\( Q_e \) from SEB was compared with a direct method of measurement: the absolute humidity by a dynamic evapotranspiration chamber.

RESULTS

• Cloudy conditions result in multiple abrupt peaks of \( Cn_z \) compared to sunny and clear days (Fig 1).
• In most cases, incoming energy \( (Rn) \) on the BGW is mainly transformed in \( Q_e \) (53%), followed by \( Q_h \) (43%) and \( Q_g \) (Fig 2).
• Low estimations of \( Q_g \) demonstrated poor heat conduction on the BGW soil.

SURFACE ENERGY BALANCE

\[ Q_e = Rn - Q_h - Q_g \]

Net radiation: Solar and longwave radiation

\( Rn \)

Sensible heat flux

\( Q_h \)

Soil heat flux

Fourier’s Law

\( Q_g \)

Latent heat flux

LAS Setting

Value

Path length \( L \) [m]

100

Effective height LAS [m]

2.229

Zero displacement height [m]

0

Surface roughness [m]

0.25

*LAS: Large Aperture Scintillometer

SENSITIVITY ANALYSIS

The influence of the BGW vegetation height (h), soil thermal conductivity (k) and meteorological variables (pressure P, wind velocity U, wind direction WD, relative humidity RH) on the iterative process calculus of \( Q/h \) was studied by a Latin Hypercube Sampling (LHS) method.

CONCLUSIONS AND PERSPECTIVES

In order to respect SEB, most of the energy on the BGW is translated to \( Q_e \) (demonstrated with the sensitivity analysis). However, the comparison with the ET chamber and scientific literature proved an over estimation of \( Q_e \) from SEB. This may be due to accumulated uncertainties involved in each energy flux component, like the under estimations of \( Q_h \) from the LAS and the low heat conduction rates on the soil.

To study the uncertainties of LAS measurements, a new LAS setting was implemented during a much longer period. Few test of spectral analysis suggest a possibility to determine the temporal and spatial multifractal variability of LAS measurements to better quantify the resulting uncertainties.

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