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Interactive comment on "Flux measurements in the near surface layer over a non-uniform crop surface in China" *by* Z. Gao et al.

Anonymous Referee #1

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GENERAL COMMENTS

The manuscript contains a very interesting data set, which could have an impact on our understanding of how the soil energy balance should be measured and calculated, and the role of growing crops and rainfall events herein. However, the presentation and analysis could be improved to support the conclusions better. Some of the author's claims are not very clearly supported by the presented data and some of the results might be flawed due to the use of a constant heat capacity (same value for wet and dry soil). The alleged strength of the study, i.e. that it is performed over a "non-uniform crop surface" could be its weakness at the same time. By lumping together different crop types, their respective responses to climate can not be separated and information is lost in this way. Therefore the results are possibly unique to the particular site (its particular composition of rice, corn, bean and grass, and their arrangement in space

together with the prevalent wind direction). It is obvious what is lost by measuring over a mixed crop, but the authors did not make evident what is gained by this measurement setup. It would be helpful if the authors would show the arrangement of the different crops in relation to the measurement tower, the footprint of the measurements, and how the footprint changes in time (if it does). Addressing some of my points may require a major revision of the manuscript, but the potential outcomes are significant enough to make this undertaking worthwhile in my opinion. Once the points mentioned above and below are addressed adequately, I would strongly support the publication.

SPECIFIC COMMENTS

The presented study is an investigation of the energy- and CO2-fluxes over a mixed crop of rice, corn, bean and grass over a period of 40 days in which significant plant growth occurs.

The authors claim to have found that

1. “pattern of energy partition had no obvious variation during the season”

2. “daytime absorption of CO2 flux by the crop canopy suddenly increased after thunderstorm events”

3. “energy imbalance was most significant for the 1-3 days after rainy events”

4. “with crop growth, the pattern of energy partition and the magnitude of energy budget components remained fairly constant”

5. “Crop canopy absorbed more CO2 during daytime with the crop growth”

Points 1 and 4 suggest that crop height did not significantly influence the energy partitioning of the system. This is an important outcome, as one would intuitively expect that the Bowen ratio would decrease as Leaf area index (LAI) increases. However, it is difficult to confirm this finding from figure 8 alone, so it would be helpful to derive some meaningful energy balance ratios (like the Bowen ratio) from the data and plot them

HESSD

2, S280–S283, 2005

Interactive Comment

against LAI or time if LAI values are not available.

Points 2 and 5 are not obvious from the presented data. Fig. 4 shows a major increase in CO2 uptake between DOY 175 and 182, but after DOY 182 there does not seem to be a further increasing tendency in CO2 uptake. Between DOY 175 and 180 the most significant rainfall events occur, so that the increase could support statement 2, but statement 5 could only be confirmed if a significant upwards trend after DOY 182 was observed. However even the finding that CO2 uptake increases after rainfall events is an important outcome, as 60% of the area was covered by a rice field, which was flooded throughout the measurement. It would be interesting to find out whether the increase of CO2 uptake after rainfall could have been sustained by the non-flooded crops alone or if the rice field had to contribute to this increase as well. Therfore it would be important to know the footprints of the measurements and the location of the different crops within these footprints. In the fetch analysis (chapter 3.1), it is only mentioned that “approximately 90% of the measured flux at the measurement height was expected to come from within the nearest 600m of upwind area for neutral stability during the entire period”, and in chapter 2.1 the authors mention that “the predominant wind direction was south-east during the period of the experiment”. In the same chapter they also mention that “the site surface was non-uniform, and consisted of grass (10%), bean (15%), corn (15%), and rice (60%)”, but they do not comment on the spatial distribution of these crops relative to the footprint of the measurement, so that it can not necessarily be assumed that the above distribution reflects the distribution of crops contributing to the measurements. Furthermore, from the given information alone it can not be excluded that a short-term change of wind direction after rainfalls led to a different footprint and potentially different composition of crops contributing to the measurement, which would make the conclusion that CO2 uptake increases after rainfall unjustified.

Point 3 could be a very important finding, but needs further elaboration. The authors explain the energy imbalance with “warm or cold rainwater infiltrating into soil”. If heat

HESSD

2, S280–S283, 2005

transport due to rainfall falling on the soil is significant, the common formulation for the energy balance would have to be re-formulated to account for this effect. However, the authors mentioned that no measurements could be performed during rainfall, so the energy balance is calculated after the rainfall only, when infiltration has already happened. Thus the 'missing energy' can only be due to water fluxes within the soil, which are not accounted for by equation (4), or due to a change of the soil heat capacity. In fact, the authors assume a constant volumetric heat capacity of soil (2.42*106 J m-3 K-1). This will result in the largest error when soil moisture changes the most, e.g. just after rainfalls. The change of heat capacity due to a change in soil moisture could be easily accounted for, as the heat capacity of water is known, so the authors should try to remove this error and test whether the energy balance gets improved.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 1067, 2005.