Peer review report

Peer review report 1 On "Measuring H2O and CO2 Fluxes at Field scales with Scintillometry: Part I - Introduction and Validation of four methods"

1. Original Submission

1.1. Recommendation

Minor Revision

2. Comments to Author:

2.1. General comments:

The authors describe the use of scintillometry to first calculate spatially-averaged fluxes of heat and momentum over paths of hundreds of meters and then to combine these values (notably the spatially-averaged $_*$ and u*) with those derived from eddy covariance measurements of the fluxes of scalars such as water vapour and CO2 (q* and qCO2*).

These combined fluxes are then compared with those calculated by four point measured fluxes and the sensitivity of the former to the variables that enter the flux calculations are analysed. The comparison is with four point measurement techniques: a flux- variance method, a Bowen-variance method, a structure-parameter method and an energy-balance method.

I am not expert in scintillometry, but I have had experience with the methodologies for point measurement with which the authors compare their scintillometry results. To me, the paper seems to present a nice way of extending from point- to areal-scale flux measurement and I recommend its acceptance after some consideration of the points I raise below.

Specific comments

1. Although the authors say that scintillometers spatially average fluxes from field to kilometre scales, the path length of the scintillation measurements in the work described here was only 120 m. Perhaps the authors could comment on the effect of path length on the generality of their results

2. A related point is that only one eddy covariance installation was used. One could guess that because of surface variability more than 1 eddy covariance station would be needed for kilometre scales. Further, the lateral dimensions of the site should be given

3. It is a pity that the exercise did not include a comparison with the backward Lagrangian stochastic dispersion technique described for instance by Flesch et al. (J. Appl. Meteorol. 43: 487-502, 2004). The technique uses open-path measurements of gas concentration over similar path lengths to those used in scintillometry and combines them with turbulence statistics obtained from a 3-D anemometer to infer gas fluxes, but the concentration of each gas is measured over the same path as used to calculate $_*$ and u* in scintillometry. Another point of difference is that only mean concentrations are required for flux calculation. Perhaps the authors could comment

4. P.2, line 23 and in a number of places throughout the paper: "negligible" for "neglectable"

5. P.5, lines 80-82: suggest give units

6. P.5, line 93: suggest reword to read ".....the eddy covariance method has limited application"

7. P.6, line 99: Is 670 nm the wave length

8. P.6, line 115: suggest comma after 0

9. P.8, line 159: It is not clear which MOST function fxx represents

10. P.11, line 226: suggest comma after MOST

11. P.13, line 268; using d = 2/3 crop height seems rather empirical after all the mathematical derivations elsewhere in the MS

12. P.14, lines 274-277: The authors note in later discussion that just one soil heat flux plate at 0.01 m is not adequate for accounting for spatial variability or neglect of the change in heat storage above the plate, but their justification (on the ground that G was only small) is acceptable to me

13. P.14, line 288: What is the Schotanus correction?

14. P.14, line 291: What are the SLS corrections?

15. P.14, lines 294-295: suggest reword to read ".....errors in the SLS measurements, for which we applied corrections."

16. P.14, line 298 suggest "by" for "with"

17. P.16, line 338 suggest "set" for "taken"

18. P.16, lines 339-340: suggest reword to read "..... they impact the flux. A relative perturbation of 20% was set for all other variables, so that we can see....."

19. P.16, line 349: suggest semi-colon for comma after "scattered"

20. P.17, lines 371-372: clarify "but with 8%"

21. P.18, line 402 twice & p.19, line 419: "linearly" for "linear"

22. P.18, line 406: suggest "to" for "as"

23. P.19, line 424: Does the fact that H is small compared to Qnet (and LE is correspondingly large by a factor of about 4) signify that conditions were not very unstable in the study and conclusions might not carry over to highly unstable conditions

24. P.19, line 430: suggest "than" for "as"

25. P.19, line 431: suggest "to" for "with"

26. P.20, line 441: suggest "section" for "chapter"

27. p.21, line 473: suggest reword to read "....when compared with examples from the literature"
28. p.21, lines 483-485: clarify
29. p. 22, line 493: suggest "very much" for "way"
30. p.22, line 501: "caused" for "cause"
31. p.23, line 513: suggest reword to read "those of the flux-variance method, they compare well with those in the literature"
32. p.23, lines 522 and 527: "subsequently" for "consequently"
33. p.23, line 532: "holds" for "hold"
34. p.23, line 534: ".....is not an influence"
35. p.24, line 557: delete comma
36. p.25, line 569: suggest insert "those in the" after "to"
37. p.25, line 570: "by" for "with"
38. p.26: suggest reword to read ".... is that getting a spatially reliable..."
39. p.26, line 588: "negligible" for "neglectable"
40. p.26, line 607: suggest reord to read "...turbulence variables varies strongly during"
41. p.27, line 628: suggest reword to read ".... fluxes was improved by shortening...."
42. Fig. 6: Units needed

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