Proposal for a fluxnet synthesis action

A ‚quick-test' of all sites involved in the Fluxnet study concerning advectional losses during night-time

WERNER KUTSCH, MPI BGC, JENA

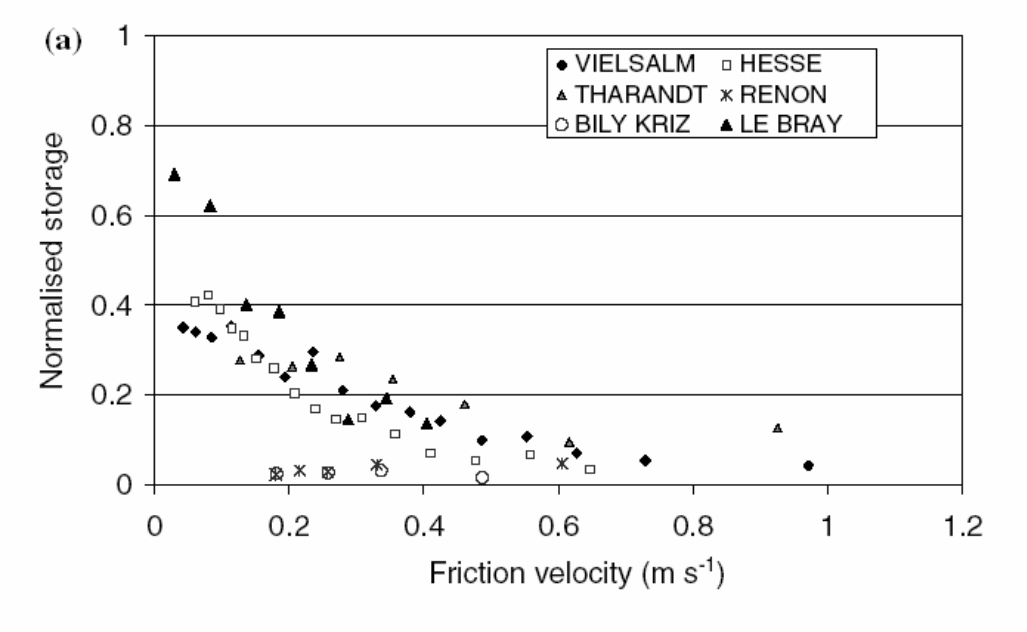
In two recent studies by Aubinet et al. (2005) and Kutsch et al. (i.p.) a data-oriented approach to detect advectional losses of respired CO_2 during night was developed. The idea is to compare the measured fluxes to an independent baseline and plot the measured turbulent fluxes and storage fluxes against u*. Usually, mean values of the normalized fluxes for u*-intervals are presented. Whereas Aubinet et al. (2005) used the soil respiration measured by means of chambers as an independent baseline, Kutsch et al. (i.p.) used a bottom-up model of total ecosystem respiration concerning process analyses of soil, stem and foliage respiration. From the two studies can be concluded that a certain pattern of the plots (see Fig. 1) is a strong indication of advectional losses during night time.

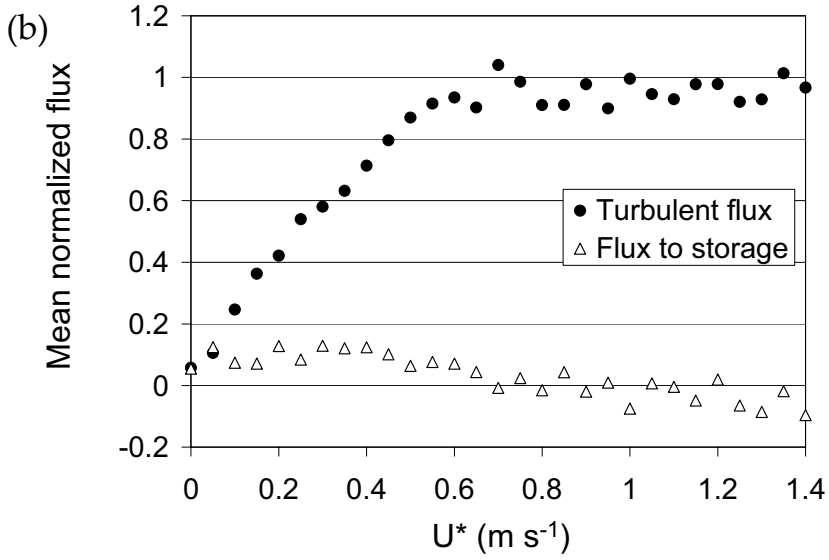
The challenge is now to develop a data-oriented test that allows to detect whether advection during night-time is probable or not and that is easily to apply at as much sites as possible. The problem arises from the fact that independent data are not available for all sites. The question is: can we use a model as baseline that is derived from the night time eddy-covariance data themselves? It would not be completely independent, but the biggest errors should be removed by the standard quality assessment and the application of a u*-threshold. If the 'high quality data' were used to calibrate an ecosystem respiration model the results could be used to normalize the measured values of lower quality and to calculate mean values of (1) normalized turbulent flux, (2) normalized flux to the storage, and (3) normalized deviation between measured fluxes and baseline. Even if the baseline model was biased by imperfect data, the procedure could reveal a tendency, a strong hint where the highest priorities for closer looks are. Fig. 2 shows that the basic pattern of an eddy derived model does not differ so much from the pattern of an independent model. Fig. 3 shows a flowchart of the procedure.

In addition I think it is possible to use the standard level 4 procedure of the CarboEurope database. At this level the data will be u* filtered and partitioned. Depending on the method of gap-filling (similar data from other days or modelled data) it should be possible to use these standard data as baseline.

The goal of the study is to identify the number of sites with a high probability of advection and derive the uncertainty that will origin in this problem for integrative studies. Therefore, I suggest to use the whole Fluxnet dataset for this study.

Fig.1: (a) shows the evolution of the normalised storage flux according to friction velocity (from Aubinet et al. 2005). Storage flux was normalized against soil respiration in this study. Some of the sites show the expected increase of storage flux when u* decreases, whereas two sites (Renon and Bily Kriz) show almost no storage flux even when friction velocity is close to zero. It is assumed that the CO_2 is transported by advection due to catabatic flow at these sites. (b) shows the normalised storage flux and the normalized turbulent flux plotted against u* for the Hainich forest. In this study the data were normalized against a bottom-up model. Also at the Hainich forest the storage flux does not balance the decrease of the turbulent flux and advection is probable. (c) shows the deviation between model and measurements (the 'missing source') plotted against u* for the Hainich forest.


(a)
VIELSALM
HESSE
THARANDT
RENON
BILY KRIZ
LE BRAY
Normalised storage
Friction velocity (m s-1)


(b)
Turbulent flux
Flux to storage
Mean normalized flux
U* (m s-1)

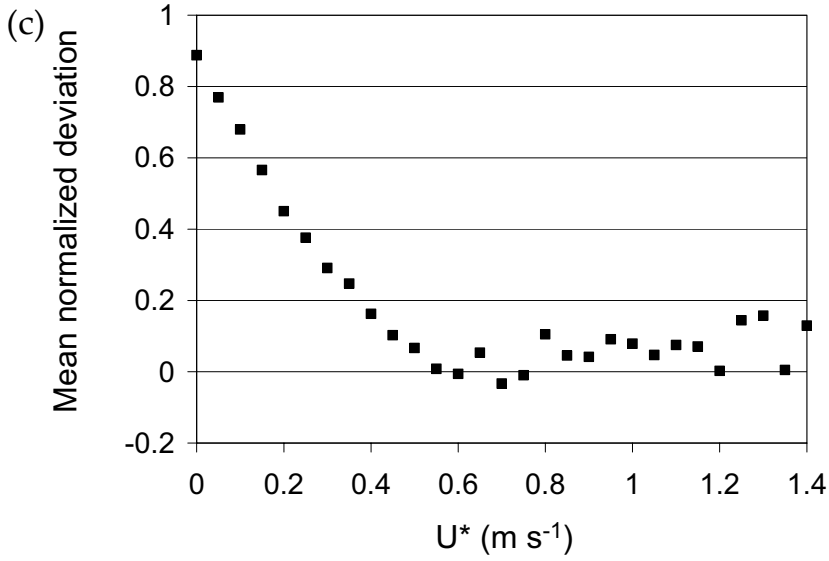

(c)
Mean normalized deviation
U* (m s-1)

Fig. 2: Deviation between modelled and measured fluxes (turbulent + storage). The Figure shows that bottom-up model and eddy-derived model result in the same pattern, even if the do not result exactly in the same numbers.

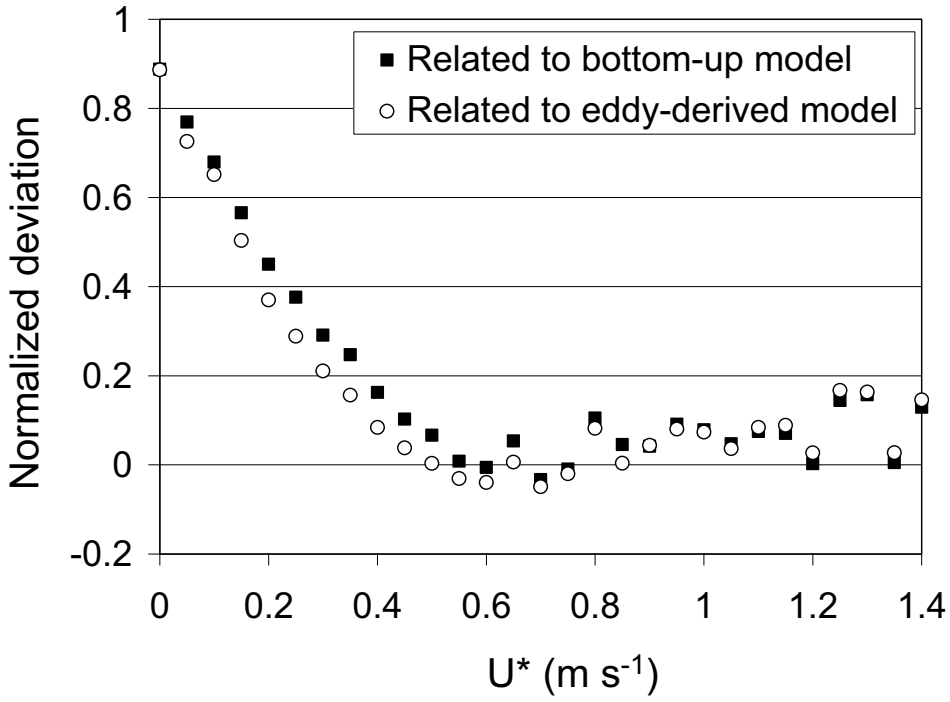
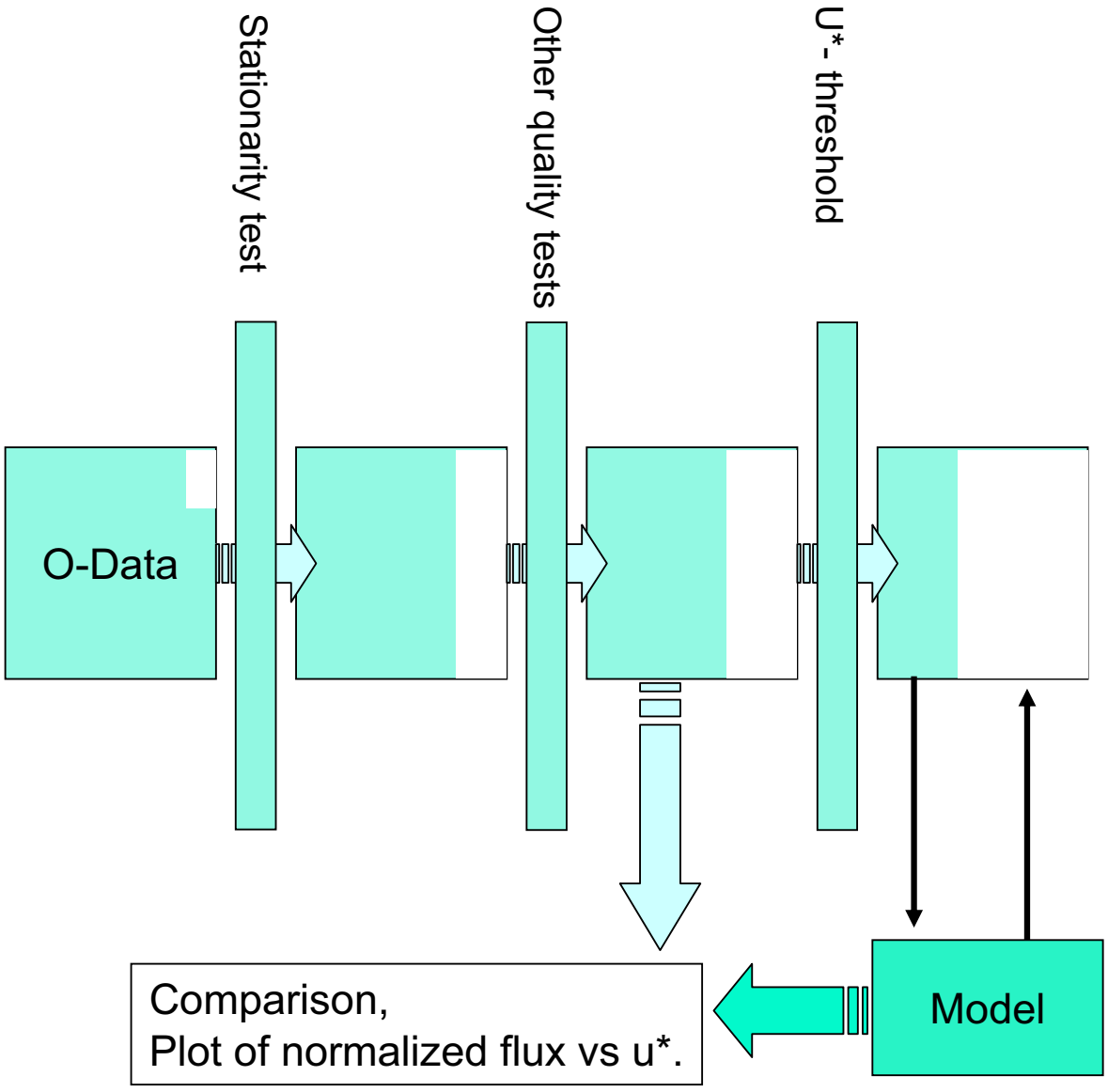


Fig. 3: Possible scheme for the proposed data evaluation procedure.



Disclaimer about co-authorship

From my personal point of view the organisation, planning, tower instrumentation, post-processing, quality checks, plausibility control etc. of an EC site are valuable intellectual work. Therefore, I offer one co-authorship per site finally used in the manuscript. In addition, I want to offer co-authorships for those people who have developed the different procedures for standard filtering and gap-filling that have been used to derive the level 4 data. The minimum requirement is that those people at least read the drafts and confirm that they want to be co-authors. People, who want to contribute more deeply in that study and will give additional intellectual input are welcome and will be ranked in the first places of the co-authors' list.

Cited papers:

Aubinet M., Berbigier P., Bernhofer C.H., Cescatti A., Feigenwinter C., Granier A., Grunwald T.H., Havrankova K., Heinesch B., Longdoz B., Marcolla B., Montagnani L. & Sedlak P. (2005) Comparing CO_2 storage and advection conditions at night at different carboeuroflux sites. *Boundary-Layer Meteorology*, 116, 63-94

Kutsch WL, Kolle O, Rebmann C, Knohl A, Ziegler W, Schulze ED (i.p.). Process modelling and direct measurements reveal uncertainties in flux measurements above a tall forest. Accepted by *Ecological Applications*.