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Atmospheric Measurement Techniques Discussions

Interactive comment on "Note on the application of planar-fit rotation for non-omnidirectional sonic anemometers" *by* M. Li et al.

M. Li et al.

wolfgang.babel@uni-bayreuth.de

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We thank anonymous referee #2 for his review, which helps us to further improve our manuscript.

General comments

This manuscript describes a comparison of different applications of the planar fit method for non-omnidirectional sonic anemometers. The application of the planar fit method for "undisturbed" sectors leads to increased friction velocities. This may be an improvement but as there is no reference measure available to state this reliably, an increase does not necessarily mean an improvement. Irregular values of momentum

fluxes may occur due to flow distortion by the probe itself but also by obstacles in the surrounding and flux values should be removed in both of these cases. The manuscript should be improved by comparisons with other (omni-directional) anemometers or at least by a comparison with 2D-rotated wind fields as the experiment was not performed with an additional omnidirectional anemometer. Obviously there is an urgent need for publications on this topic with thorough experiments and data analysis. This should be added in the discussion and outlook.

We agree with referee #2 that irregular values of momentum fluxes may also be caused by obstacles in the surrounding and should be removed. The landscape at BJ site, however, is very flat (we will describe this in more detail in the revised manuscript), thus we can eliminate this as a source of error except for the influence of the tower. But the tower has no influence on the flow in the undisturbed sectors for both instruments. Consequently, other reasons for these irregular momentum fluxes, measured by eddy-covariance, exist as well. The large scatter typically found for momentum flux can be attributed to the spectral gap between the spectrum of the horizontal and the vertical wind velocity (Foken, 2008, pp. 57 and 221). Also, Högström (1996) stated that the accuracy of the universal function of momentum is much lower than for scalar fluxes. Hence, a difficulty of our work is the occurrence of unrealistic friction velocities in all wind sectors and we can only show, whether this number of irregular values increases or decreases.

Although there is no real reference measurement for momentum available, the application of the planar-fit (PF) method only in the undisturbed sector has the potential to be the reference in this study: As mentioned before, the terrain can be ruled out as a contributing factor. The sectorwise PF clearly reduces a potential source of error compared to the PF over all wind directions, as it is less affected by sensor specific flow distortion. This leads us to the statement, that the differences observed constitute an improvement. Furthermore, the double rotation (DR) cannot serve as a reference, because it achieves a zero tilt on the expense of potential overrotation, information loss

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and deterioration of data quality (Lee et al., 2004; Foken et al., 2004; Rebmann et al., 2012, see also answer to referee #1). Nevertheless, the DR can be used for comparison. Therefore we will include the comparison with DR in the revised manuscript.

We agree with referee #2, that there is a need for more experiments and analysis on this topic and will incorporate this aspect into the conclusions.

Specific comments

P 7324, l 16: the double rotation is still in use, especially for short vegetation

The PF method is preferred in the community today, please see our discussion of the advantages and disadvantages in the answer to the general comments of referee #1. We agree, that our statement was too extreme, we change it accordingly.

P 7325, l 12f: The first sentence has to be re-written to make it clear. The next sentence is not fully correct as effects on routine measurements are not discussed in the paper.

The first sentence says, that flux calculation is based on a wrong coordinate system, when using the PF method for the whole wind sector, because the determination of the regression coefficients (and therefore rotation angles) is influenced by the disturbed flow due to sensor structure. The word "routinely" is misleading in this case. In the following paper we discuss amongst others the difference of a sectorwise PF to a planar fit for the whole wind sector. The latter is the standard procedure in flux calculations. Therefore, we approach the issue, what effect this has on routine measurements. We will revise the passage to avoid misunderstandings.

P 7326, l 11f: The difference in orientation means that there is no overlap for the undisturbed sectors of the two sonic anemometers. For a comparison of the results this would have been helpful.

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No, as the CSAT3 has an open sector (including the front sector) of 300°, we have overlap for the full size of the DAT 600 open sector (223° to 303°). Nevertheless, we see now, that direct sensor comparison in the undisturbed sector should not be contaminated by the use of data from the CSAT3 front sector, where it is not clear, whether the data can be treated as undisturbed, even if they are rotated separately (see also answer to referee #1). Therefore we will exclude the front sector of the CSAT3 for comparison. in this case there is an undisturbed sector of 243° to 303° for both instruments. We will clarify it in the Material and methods section.

P 7326, l 14: a topographical map should be added to show the need for the planar fit rotation

The landscape is very flat, gentle hills occur in NNW - NE of the measurement location, the shortest distance to the hill slope is 900m in NNE. Other hills and mountains in sectors E,S and W are at least 10 km away from the EC setup. Therefore, the site should in general be suitable also for double rotation. But our intention was to test the influence of sensor structure on the planar fit rotation and subsequent flux calculation as the terrain enables us to neglect the influence of landscape heterogeneity here. We will point this out in the revised manuscript and add landscape information of the site.

P 7326, l 25f: there is no overlapping of the undisturbed wind sectors, which would have been necessary for a comparison

There is overlap, see previous answer.

P 7327, l 9f: A comparison with 2D rotation should be added.

We agree, see the answer to the general comment as well as the reply to referee #1. We will include the information in the revised manuscript.

P 7328, l 4f: This can hardly be seen, the remaining number of negative values should

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be pointed out and be related to table 1 (20% compared to 34%?). Table 1 should then be complemented by dataset B.

Thank you for the suggestion, we will do so.

Further technical comments

We thank referee #2 for his technical comments and will incorporate them in the revised manuscript.

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