Comment 1: 'Unified' may not be an appropriate term for the title. This reviewer agrees in general with the assumptions and corrections included in the proposed methodology, but not all researchers may do it. Some debate exists on how to post process turbulent fluxes

Reply and Changes: We have changed unified to ' An open source code'. We also agree that there is some debate how many post processing steps are needed to arrive at accurate data. Especially small corrections that are prone to large uncertainties might not always be well constrained. We now include a thorough cospectral analysis and perform high frequency corrections as suggested by reviewer 1 (see reply and changes regarding comment #4 by reviewer 1).

Comment 2: A flowchart will help to visualize the order of the steps for post processing disjunct fluxes.

Reply and Changes: The revised manuscript now includes a flowchart that outlines individual work steps for processing EC data in Chapter S1 and Figure S1.

Comment 3 : The introduction should explain the need for measuring fluxes by eddy covariance over urban surfaces, particularly of speciated VOCs. Velasco et al. (2005, doi:10.1029/2005GL023356) deployed by first time a PTR-MS for measuring turbulent fluxes over an urban surface using the disjunct eddy covariance method. Some of the corrections and assumptions discussed here were also discussed by them.

Reply and Changes: We incorporated more discussion on the need to perform EC and also added new references as suggested.

Comment 4: "...and disjunct eddy covariance flux data."

Reply: OK Gibt's im manuscript nun in Sachen DEC eine reference zu Valescos Arbeit – ich finds nicht

Comment 5: Define acronyms every time they are used by first time. Please check this through-out the whole text. Many acronyms were used without being properly defined.

Reply: Ok we doublechecked and corrected acronyms throughout the text.

Comment 6: What about the met data necessary to compute turbulent fluxes?

Reply: Thank you for pointing out this omission. We included it in the abstract. The sentence now reads "We demonstrate the capabilities of the code based on a large urban dataset collected in Innsbruck, Austria, where three dimensional winds and ambient concentrations of NMVOC and auxiliary trace gases were sampled with high temporal resolution above an urban canopy."

Comment 7: Replace "surface fluxes" by "turbulent fluxes".

Reply: ok this was changed. Now the sentence reads: "Eddy covariance (EC) is the method of choice for most micrometeorological studies of turbulent fluxes (e.g. Dabberdt et al., 1993; Aubinet et al., 2012)."

Comment 8: Use italic fonts for referring to variables. Check this throughout the whole text.

Reply: Ok we corrected this.

Comment 9: in the horizontal dimension?

Reply: We rewrote this paragraph (in the new manuscript on P2L3+) completely according to suggestions from reviewer 1 (see also reply and changes regarding comment #3 by reviewer 1).

Comment 10: fast and highly accurate sensors

Reply: We changed this accordingly and the sentence now reads: "In the past EC has been largely restricted to a limited number of species (e.g. H2O, CO2, CH4) due to the requirement of fast and highly accurate sensors (ideally sampling frequencies > 10Hz)."

Comment 11: Consider that the atmospheric reactivity of some species limits the application of the eddy covariance method for measuring turbulent fluxes. Some species react faster than the time taken by the air sample to reach the height of the instrumented tower. This is a particular constraint in polluted urban atmospheres.

Reply: We acknowledge the reviewer's comment on this issue. For typical heights measured in Innsbruck (approx. 40m above street level) we note that in our case it is only the interconversion between NO, NO2 and O3, that would warrant a significant consideration of reactivity. One of the fastest reacting VOC (e.g. Isoprene) has typical lifetimes of 30 minutes. The turbulent exchange time at our site is on the order of 200s. Thus a significant chemical

loss can be excluded for NMVOC reported in this manuscript. It is true though that this issue could become more important for measurements on tall towers where the vertical exchange time scale is much longer.

Changes We added a discussion on the issue of reactivity in the introduction.

Comment 12: Why is the co-spectral analysis important? What does it show?

Reply: We performed a thorough cospectral analysis based on Foken et al (2012a) and Lee et al. (2004) in response to this comment and comment #4 by reviewer 1. Such an analysis is important because it may allow for corrections of fluxes that are underestimated due to cospectral attenuation. In our example for toluene it shows that high frequency loss due to sensor separation, sonic path averaging, sensor averaging and tube attenuation is on average 2%.

Changes: We conducted a thorough analysis of the cospectral behavior of the VOC EC system described here based on Foken et al. (2012a) and Lee et al. (2004). The added Chapter S4 in the supplement now guides the reader how to derive a model cospectrum from quality checked individual half-hour cospectra (example in Figure S3). It shows how to determine transfer functions describing high frequency losses due to sensor separation, sonic path averaging, sensor path averaging (PTR-MS response) and tube attenuation, and how these attenuations cause loss of cospectral density at high frequencies, thus underestimating the flux (Figure 7). The new Chapter 3.5 in the main text points out the cospectral information calculated and stored by innFLUX, mentions both the experimental approach and the theoretical approach for the correction of high frequency losses, gives the user guidance which approach might be more appropriate, and details the procedure (reference to Chapter S4 and Figure S3) and results (Figure 7 and Figure S4) of the cospectral analysis.

Comment 13: The averaging time period depends also on the roughness elements' height. For flux measurements over smooth surfaces such as lakes and grasslands, for example, averaging time periods of 10-15 min are used, while for measurements over tall canopies in forested and urban environments, averaging periods of 30 min are common.

Reply and Changes: We agree and have added the clarification in the manuscript. Now the text reads: "For flux measurements over smooth surfaces such as lakes or short grasslands, averaging time periods as low as 15 min can be used. For measurements over tall canopies in forested and urban environments, it has been shown that 30 min averaging intervals are quite suitable for surface layer measurements, and that averaging periods up to 1 h can be feasible. Longer averaging periods often suffer from non-stationary conditions (Foken et al., 2010). "

Comment 14: Define inertial subrange

Reply and Changes: In context of turbulent kinetic energy (TKE), the inertial subrange is defined as the part of the co-spectrum where the energy density drops exponentially. The revised sentence reads: "A slow sensor will act as a low pass filter, where for example eddies in the inertial subrange (i.e. the co-spectral region where the energy density of the turbulent kinetic energy drops exponentially) cannot be fully resolved anymore."

Comment 15: Explain how you reached this figure.

Reply: With reference to the particular line, we assume the question is related to Figure 2. It shows the increasing scatter due to random (white) noise, when only one half hour period compared to a cumulated dataset is used for lag time determination. Assuming the lag time does not change between the cumulated half hour intervals and each of the individual half hour intervals, the analysis of lag time becomes more accurate due to a reduction in random noise.

Comment 16: You could save the reader of searching in a second article to learn about the eddy covariance flux system used here as a test case. Provide at least the local climate zone, land cover, measurement height, mean roughness elements height and zero-plane displacement height.

Reply: we have added the requested information to section 2.1 to make the manuscript more readable.

Comment 17: How many VOC species and of which groups (i.e. olefins, aromatics, etc.)?

Reply and Changes: We included a more detailed description of the calibration in Chapter S3 as well as Table S1 with the VOC species in the supplementary information.

compound	protonated parent ion	m/z
Methanol	(CH4O)H+	33.03350
Acetonitrile	(C2H3N)H+	42.03382
Acetaldehyde	(C2H4O)H+	45.03350
Acetone	(C3H6O)H+	59.04914
DMS	(C2H6S)H+	63.02629
Methyl-Ethyl-Ketone	(C4H8O)H+	73.06480
Benzene	(C6H6)H+	79.05422
2-Methyl-3-buten-2-ol	(C5H10O)H+	87.08045
Toluene	(C7H8)H+	93.06988
m-Xylene	(C8H10)H+	107.08553
1,3,5-Trimethylbenzene	(C9H12)H+	121.10118

1,2,4,5-Tetramethylbenzene	(C10H14)H+	135.11683
α-Pinene	(C10H16)H+	137.13248

Comment 18: What about data from a low frequency met sensor for flux corrections. The sonic/virtual temperature is not the absolute temperature. In most urban environments moisture in the air is inherent

Reply: Currently we apply corrections to the fast data stream. The sonic temperature is directly corrected by the instantaneous 10Hz H2O data (see Foken et al 2012a, eq. 4.1). In the case when no fast H2O data are available the code will not apply any corrections, and the user would need to apply an estimate of the Bowen ratio in the post-processing analysis.

Comment 19: But a co-spectra analysis is not feasible for DEC as explained above .....

Reply: In principle co-spectral analysis is always possible up to the Nyquist frequency. The ability to extract information for high frequency damping depends on whether the inertial subrange can be captured given a chosen DEC interval. This is location dependent (e.g. peak of the co-spectrum) and dependent on the DEC interval. In principle it should always be possible to perform co-spectral analysis in the low frequency domain.

References

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