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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Similarity analysis of turbulent transport and dissipation for momentum, temperature, moisture, and CO_2 during BLLAST" *by* João A. Hackerott et al.

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The authors would like to first of all thank the referee Thomas Foken for his valuable comment and recommendation. Bellow we provide a reply for each statement presented by the reviewer.

"Unfortunately, the theory is not new and is not only the subject of recent textbooks, but even of old ones from the 1960s and 1970s."
The Monin-Obukhov Similarity Theory and the Kolmogorov Power Law, used as a background for the work's discussions date back to the beginning and middle of last century as pointed by the reviewer, especially considering the analysis of

momentum and heat budget equations. However, as mentioned in lines 28-32 of the present discussion paper, there is still a need for investigations on these theories particularly for the chemical tracers such as CO_2. For example, after an intense bibliography search, we could only find the paper of Ohtaki (1985) and Sørensen and Larsen (2010) that discussed the aspects of the parameterization of CO_2 dissipation component as a function of stability, and it was done only for the convective regime. Iwata (2005) emphasizes that the inertial dissipation method has rarely been used to measure CO_2 fluxes. After searching in the literature, we also verified that this fact remains true nowadays, since only a few studies are available, among them we can mention Sahlée et al. (2008) and Norman et al. (2012). These recent studies emphasize the need for further investigations, especially for the tracer budget evolution.

"The presented results are within the usual error bars of the published similarity laws. "
As mentioned in the discussion paper, the turbulent characteristics of CO_2 are very important for climate studies about urban and marine boundary layers. In both applications a range of issues arise, for example platform motion (Prytherch et al., 2015) and horizontal inhomogeneities of cities. These issues decrease the data confidence and increase the error bar of theoretical relations that should be valid in both inland and offshore environments despite their peculiarities. Therefore, it was chosen the confident BLLAST data to perform the analysis. Although we did not provide a deep discussion about the error bars of presented results, we are confident about the accuracy of the presented methodology based on the results of Sørensen and Larsen (2010) as mentioned in Section 3. We are currently working to provide a better error analysis for both spectral and dissipation calculations in order to fill this lack of information.

"I have not seen any special link to the scientific idea of BLLAST (...) I propose that this be published in a paper describing the methodology. "
The initial idea of the presented work was to verify the described techniques using a well-established dataset in order to apply it on an upcoming air-sea interaction study. Although BLLAST was idealized mainly for the boundary layer afternoon transition, it fits perfectly for our analysis. Beyond the methodology, our paper supports the scientific hypothesis that the relationship between stability and the dissipation component of the variance budget equation of specific CO_2 content is similar to the water vapor and temperature variances. As mentioned before, this hypothesis has not been well described and proofed in the literature yet.

"I am sorry, but I see no necessity to publish results that are not new and that are already well known."
We decided to not only evaluate the CO_2 but also the momentum and heat fluxes because we would like to provide a better and complete inter-comparison study, following Hill (1989). Nonetheless, as mentioned by the reviewer, it is a nice and important exercise to also check a turbulence data set and confirm previous results. This additional evaluation allowed us to compare the power spectrum of different atmospheric tracers and highlight special features that are still not fully described in the literature, as an example the fact that, in some special conditions, the inertial subrange of different tracers collapse when normalized by the squared characteristic scale, described in Sections 3.1 and 4.3. Thus, our manuscript provides some new aspects on the complicated interactions between different physical and chemical processes which have not been elaborated too much so far.

"I am refraining from identifying other problems."
We understand that we may have possible skipped some important references that should be mentioned and make our results unpublishable. Thus we would appreciate if the reviewer could specify or introduce some references, particularly related to the

CO_2 dissipation, which may be helpful for the continuation and completing of this work.

Reply bibliography:

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