

Interactive comment on “Atmospheric turbulence triggers pronounced diel pattern in karst carbonate geochemistry” by M. Roland et al.

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The authors are very pleased with the insightful comments and suggestions of referee #3, which are addressed one-by-one below.

-Comment (1): Referee #3 suggests displaying results from direct comparison of eddy covariance measurements with the modeling approach as a major improvement of the manuscript.

-Response to comment (1): We fully agree that the direct comparison of measured and modeled fluxes is ultimately the best way to validate the model and confirm our hypothesis. Consequently, our initial aim was to adjust the ventilation model until the modeled CO₂ fluxes from ventilation and weathering would satisfactorily reproduce the observed

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eddy covariance fluxes during periods without biological activity. However, (1) the main focus of this manuscript is on the importance of ventilation (which is only a transport process) in altering carbonate weathering (which actually constitutes a source or sink for CO₂) and (2) we rapidly learned that local ventilation processes are very difficult to generalize and have drivers that are not yet fully understood. Nevertheless, the model was able to capture the days when ventilation occurred and predicted peaks that were of comparable magnitude to the observed ones. Discussion Figure 2 (Fig. D2) shows the comparison of the modeled and eddy covariance fluxes for 2 sets of data: a week with moderate ventilation in 2005 and a week with high peaks of ventilation in 2009. The main discrepancies were the modeled ventilation occurring a few hours earlier and lasting shorter than the observed ventilation.). A possible explanation could be that the soil parameters (e.g. soil water content) should be measured deeper in the soil, where diurnal changes are a bit lagged compared to the surface where our sensors were deployed.

-Comment (2): Referee #3 requests a more elaborate description of the parameters prescribing the CO₂ efflux due to ventilation in equation (Eq. 2).

-Response to comment (2): Note: this response is adapted from the response to comment (4) of referee #1, who raised a similar concern.

It is true that the ventilation equation is an important element of this manuscript. As shown above, it works acceptably well for the training set, because it was structured and parameterized to fit the observations. The site specific parameters, such as the maximum water content and the minimum friction velocity for enabling ventilation were derived empirically; these values are displayed in the manuscript. However, as is clearly stated in the manuscript, it was not within our scope to develop a model that is generally applicable. This would require detailed insight in the three-dimensional structure of the Karst system to estimate macropore-interconnectivity and the presence of caves and cracks that serve as preferential CO₂ outflows. Furthermore, not all the drivers of ventilation are well-understood yet. Rather than attempting to model these

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ventilation events, one alternative could have been to simply extract (in the WITCH model) a given amount of CO₂ from the topsoil and see how this affects weathering rates. However, in this case, we would have completely uncoupled the WITCH model results from the eddy flux observations at the site. Using this equation we do capture days when ventilation occurs, although we are often a few hours early. We therefore opted to use the modeled ventilation flux provided that the associated uncertainties are clearly stated, and focus on its impact on carbonate weathering rather than its magnitude and drivers. We hope the referee can accept this approach.

-Comment (3): The referee proposes the implementation of part of the supporting material in the main text, more specific, the description of the eddy covariance measurements.

-Response to comment (3): We fully agree that this suggestion enhances the flow of the manuscript, and effectuated these changes in the final revised manuscript.

-Response to technical comments: We thank the referee for pointing out the minor but significant errors, which are all corrected in the revised manuscript.

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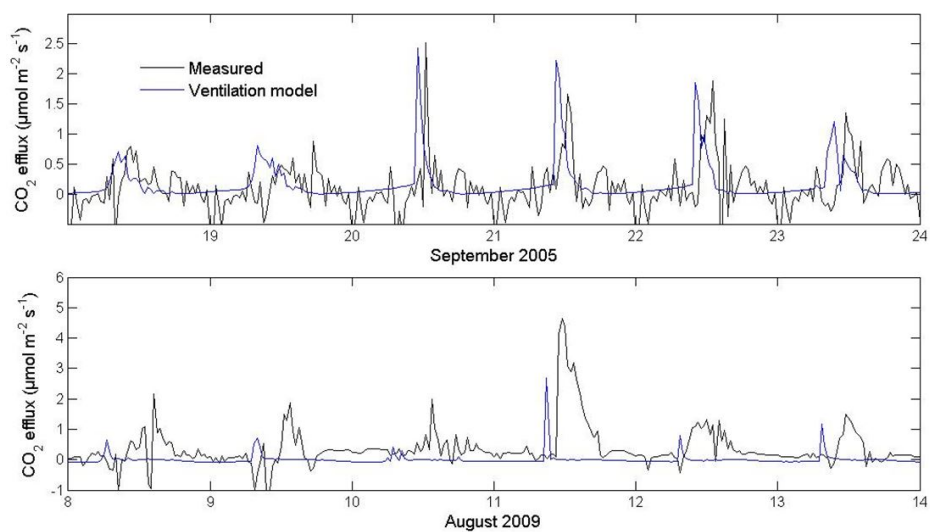


Fig. D2

Fig. 1. Fig D2

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