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Interactive comment on "What can tracer observations in the continental boundary layer tell us about surface-atmosphere fluxes?" *by* C. Gerbig et al.

C. Gerbig et al.

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We very much appreciate the detailed and constructive comments provided by the reviewer. Our reply to the two general comments are given below.

1) Response to the suggestion that the discussion on the various parts of discretization issues should be brought together in the discussion: We have modified the discussion, and added the following statements at the beginning of the discussion section:

"In this experiment we have addressed the issue of aggregation errors, which occur when inhomogeneous sampling covaries with fluxes that cannot occur within the statistical model. The choice of inhomogeneous spatial grid with high resolution in the

near-field of the measurement for biosphere-atmosphere exchange largely avoids the aggregation error in its classical sense (Kaminski et al., 2001). A spatial aggregation error is reintroduced in the pseudo experiment when using a too large covariance length scale for the a priori error; this represents a reduction of the effective degrees of freedom. Further, temporal aggregation error is largely reduced by choosing a representation of biosphere fluxes in a very simple diagnostic model, with parameters that control response to light and temperature and thus allow for diurnally varying fluxes.

When applying such a model to the real world, however, it has to be noted that the a priori uncertainty $\mathbf{S}_{prior}$ as well as the measurement error $\mathbf{S}_{\varepsilon}$, did not include temporal correlation. The same basic principles apply for these temporal correlations as for the investigated spatial correlations, in that the interplay of averaging time scales, integrating time scales of the atmosphere, and the differences in true and assumed temporal correlations can cause biased results or loss of information. Also structural error due to inadequate model parameterization (e.g. changes of light sensitivity with water availability) has not been taken into account; so for real world applications the model either needs to be able to resolve resulting variations in fluxes, or it has to be allowed for in a corresponding uncertainty with the correct spatial and temporal covariances."

2) Response to the comment on the use of a single parameter for respiration (temperature dependence) in the biospheric flux model, without a base respiration term:

Given the short simulation period of one month during the summer season (August 2002) we argue that the relatively small variability in the surface temperatures (8°C variation (standard deviation) with an average temperature of 22°C) in the near field contributing most to the measured signals does not allow for independently estimating a base respiration term in addition to the temperature sensitivity. This is not the case, however, for simulation periods covering multiple seasons. Whether the temporally varying advection of a spatial structure in the base respiration contributes to a large fraction of the observed variability requires assessing this base respiration term at least in the a priory. Since the a priori parameters are based on eddy covariance data

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from a limited number of sites that have been lumped to forests and cropland, a base term could not be estimated. We feel that although a more sophisticated model will be able to address this issue, this would be beyond the scope of this paper.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 9249, 2005.