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Biogeosciences Discussions

Interactive comment on "Advection of NH_3 over a pasture field, and its effect on gradient flux measurements" *by* B. Loubet et al.

Anonymous Referee #2

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Review of the manuscript, "Advection of NH3 over a pasture field, and its effect on gradient flux measurements", by B. Loubet, et al. (MS-NR: bgd-2008-0176). This paper describes a study which considers how local advection can lead to errors in estimates of surface deposition near a large emission source. This topic is important and interesting, because of environmental concerns regarding high N-fertilisation rates to the landscape downwind of large ammonia sources.

The paper is reasonably well-written, and I have no important disagreements with the "big-picture" conclusions reached by the authors. For example, messages of a "bias towards emission" or "bias toward deposition" are very welcome. For this reason this work is worth publication. My criticism of this paper is its complexity. The value of this work is best seen as conceptual, i.e., why micrometeorological measurements of

deposition near-downwind of strong sources can be in error. As a conceptual work it suffers from being applied to the imperfect experimental framework of GRAMINAE.

GENERAL COMMENTS

Real World Complexity.

The GRAMINAE experimental situation examined in this paper is probably a poor choice for illustrating the basic problem of micrometeorological deposition measurements. It's simply too complex a setting: 1) experimental geometry is not suitable for reduction to a two-dimension problem; 2) terrain is very inhomogeneous which will lead to errors in a homogeneous dispersion model treatment; 3) there may well be more NH3 sources/sinks than assumed here; and 4) there is a need to consider non-ideal measurements. All of these factors are a distraction for the reader trying to follow the basic concepts.

In my opinion it would have been better to look at a simple 2-D simulation of an idealized farm. I think with realistic choices of emission rates, compensation points, etc., one could look at the problem more confidence and less confusion. And I think some realistic results would follow (I think the FIDES-2D model would very well). A useful calculation for this simple situation would be a graph of the error of a deposition inference with distance from the idealized farm.

I don't expect the authors to forgo the GRAMINAE experimental data in this paper at this stage. I simply want to document my confusion, and the source of that confusion in reading the paper.

2-D Treatment of Experiment

The main scientific criticism of this work is the reliance on two-dimensional model simulations. I do not believe that the geometry of the GRAMINAE problem allows a good 2-D treatment. The farm is only about 300 m in cross-wind extent, so sensors 500 m or more downwind of the farm clearly "see" the edge of farm (i.e., sensors are influenced

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by the lateral dispersion of "fresh" air north and south of the farm). The 3-D geometry creates important consequences for the authors, beginning with the addition of another term to the true conservation equation (Eqn. 1) – the lateral flux divergence, dFy/dy.

More importantly, what is the consequence of interpreting the 3-D pattern of downwind concentration through the results of a 2-D dispersion model? In the real 3-D world, crosswind dispersion acts to reduce the concentration downwind of a finite source (i.e., dispersion mixes fresh air laterally). How will a 2-D model, which cannot account for this extra "dilution" account for the more rapid decline in the downwind concentration of real data? One possibility is to attribute the reduction to another factor, such as surface deposition. The possibility of these simulation errors is worrisome when the model is used to estimate deposition rates, or infer the level of errors in the source inferences were.

This is a substantial weakness of the paper. While I don't expect the authors to develop a truly 3-D model, I think that there is the need to acknowledge the problem.

SPECIFIC COMMMENTS

The experimental map is complex with many labels displayed. Some are mentioned correctly, some are mentioned incorrectly (e.g., there is no labeled Field I), and many labels are not explained or used. I would like to see only the pertinent information displayed.

Eqn. (3) is a potentially useful quantity when thinking about advection errors. Later in the paper the authors examine the reasonableness of the assumption of a height invariant u*dC/dx? Perhaps it might be good to move these ideas forward to accompany Eqn. (3)?

Figure 4. Hard to distinguish pre-cut and post-fertilisation lines. At what x distance is the farm located in this figure?

Interactive comment on Biogeosciences Discuss., 6, 163, 2009.