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Interactive comment on “Advances in understanding, models and parameterisations of biosphere-atmosphere ammonia exchange” by C. R. Flechard et al.

Anonymous Referee #1

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This paper gives an impressive overview, which e.g. can be very useful for a Ph.D. student who is starting up in this field. The paper does what the title says and focuses mainly on models and parameterizations and is generally of good quality.

At the end (section 4.1) a list of suggestions for improvement for current models are presented, which in itself is nice. The authors notice that the more mechanistic models require more input which is not always available. I do not disagree with the list of recommendations, but would like to add a few. Before doing that I just would like to make some remarks.

Environmental authorities require data on the NH₃ exchange over periods of at least

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one year. When scientists who do field studies of fluxes and gamma-values apply for money, they apply usually for money to get into more detail than was previously done, as then there is a larger chance for “scientific harvest” (enough stuff for a Ph.D. Thesis and additional articles.). As field work is usually labour-intensive it is often restricted to some periods, usually periods where interesting phenomena occur (e.g. just after spreading of manure, during senescence when higher emission rates occur) are investigated.. This is very logical. Moreover, it is also more difficult to do measurements when concentrations are low. This means that large periods of the year are underrepresented. The reality is that even in Western-Europe there are sometimes no gamma-values available at all for important crops (and these can be cereals too). If you are lucky then there is just one value available. You often become unhappy when there are more values available, at least when they are an order of magnitude different and the question is then: which one should one take? This occurs often. Then again, there are maybe only gamma-values available measured during the interesting periods. A year is longer than a the few weeks needed for a field campaign. Then there is the question if the gamma-value measured for one species in one region (with a certain climate and not at least a certain agricultural practise) can be used in other regions with a different climate and agricultural practise (these regions can even occur within a smaller country). What I see as an important problem is that it does not seem possible to harvest scientific prestige by obtaining information on e.g. fluxes and gamma-values in different regions and for long periods and, moreover, that it can be very expensive. For that reason there is a tendency to develop scientifically sound models for which the input data not are available and will not become available in the near future.

So I would propose that under 4.2. also the fact is addressed that gamma-values for different regions/agricultural practises should be obtained.

A few other remarks:

As far as I know long-range atmospheric transport models do not a good job in addressing local dry deposition of NH₃. This is logical, as they focus on the larger scale, but I

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fear that they could have some systematic error, which leads to an underestimation of the local dry deposition and therefore maybe an overestimation of the long-range transport. The first long-range transport models had only one layer and all emissions were instantaneously distributed over this layer, leading to a larger underestimation of the local dry deposition, as in reality the low-level plume is not diluted instantaneously. To overcome the error made correction factors were introduced by which a fraction of the emission was assumed to be dry deposited in the grid cell where the emission occurred (Janssen and Asman, 1988). Nowadays multi-layer models are used. In these models the emission is instantaneously diluted over the lowest layer (maybe up to 50 m), making the error somewhat smaller. Moreover, a vertical concentration profile is calculated, which results in somewhat higher concentrations near the surface and hence somewhat higher dry deposition, but the effect of that the dilution of the emission does not proceed instantaneously near the source is not taken into account and for that reason I fear that the dry deposition near the source is systematically underestimated.

So maybe a point could be added: Improvement the description of the local dry deposition in long-range atmospheric transport models.

Gamma-values can be determined in different ways, e.g. from chamber measurements and from measurement of the NH_4^+ and H^+ concentration in the apoplast. There are only a few publications where both methods were used and differences were found (e.g. Massad et al., 2009). This should be addressed and information should be given on which method should be preferred.

p. 5395. Is it possible to give reliable values for K_h and K_a ? This would be better for the reader who now only gets confused.

Reference: Janssen, A.J., Asman, W.A.H. (1988) Effective removal parameters in long-range air pollution models. *Atmospheric Environment* 22, 359-367.

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