# ACCOUNTING FOR FARMYARD MANURE AND COMPOSTS IN AMMONIA VOLATILIZATION MODELS: THE CASE OF VOLTâAIR

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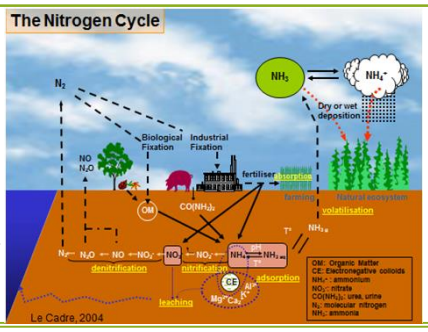
## Context

**The use of various residual organic products** as fertilizer results in ammonia volatilization, which lessens the fertilizing value of the organic product, and leads to environmental impacts (eutrophication, PM formation).




**Various models can help predict the potential magnitude of emissions** of a given product and thus can help in any measures taken to lessen NH3 emissions. But there is currently a lack of process based models accounting for a large range of products.

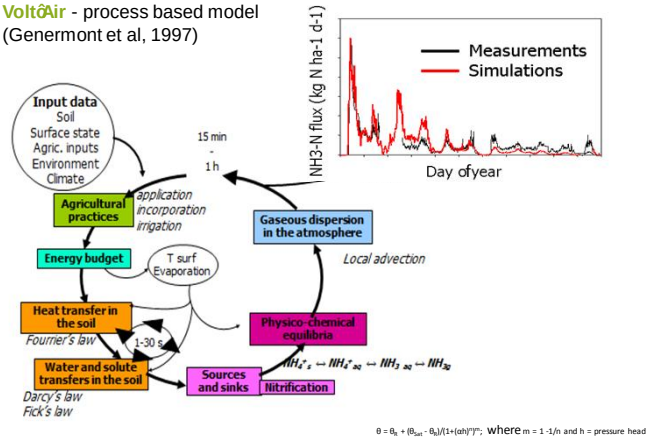
**Volt'Air, a process-based model**, has recently been improved for slurry application. A more realistic representation of the slurry was obtained by adding a specifically parameterized slurry layer above the soil profile (Garcia et al, 2012).

## Objectives

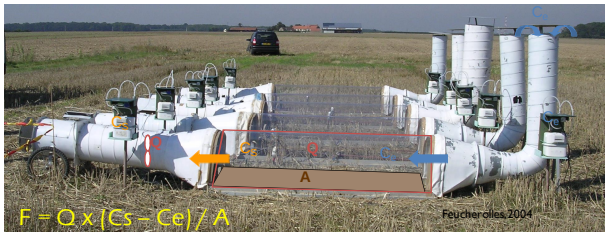
**Evaluate the capability of the current modification** to adapt to organic products characterized by high dry matter content, and thus susceptible to form a fiber matrix at the soil surface, with properties differing from those of the soil.

## Materials and methods

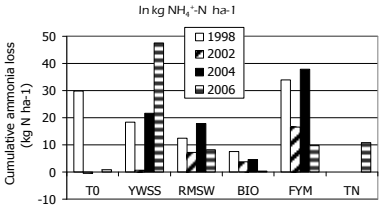
VoltâAir - process based model (Genermont et al, 1997)




**Qualiagro:** source of data sets used with VoltâAir (Genermont et al 2007; Genermont et al 2011)




During this project, wind tunnels used to measure $NH_3$ emissions from various exogenous organic matter.



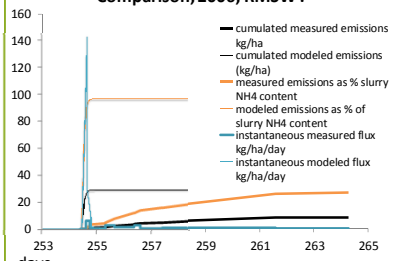

RMSW ï Residual organic matter taken from the household waste fraction
BIO ï the fermentable fraction of household waste, composted with green waste
YWSS ï sewage sludge, mixed with green waste and composted.
FYM ï dairy cattle manure solids
**TN (Nitrogen Solution)** ï 25% ammonia, 25% nitrate and 50% urea (standard).

## Results: NH3 Flux Simulations

The initial fluxes were very high.

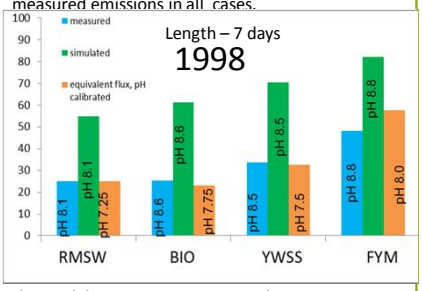
The magnitude of error varied by year and product

**Comparison, 2006, RMSW .**

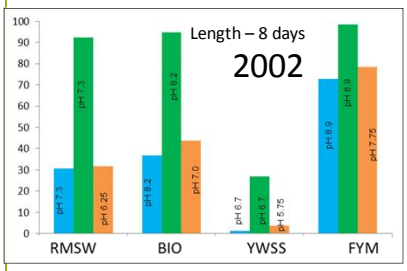


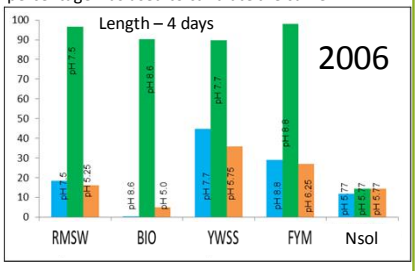

This graph shows an example of the very high instantaneous flux that was characteristic of the simulations.

The modeled emissions greatly exceeded the measured emissions in all cases.



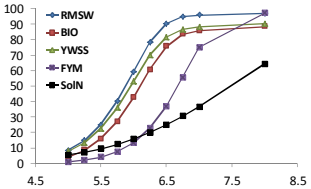

The model is very sensitive to product pH. To perform the rest of the analyses the pH corresponding to the measured emissions percentage was used to calibrate the curve.



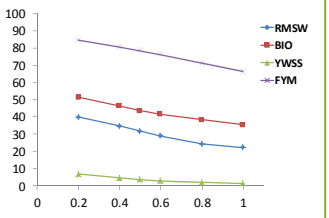




## Sensitivity Analyses

**Effect on emissions as % of EOM $NH_4$ content**

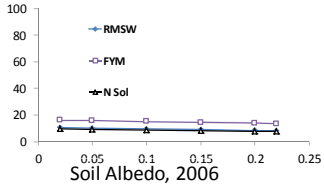


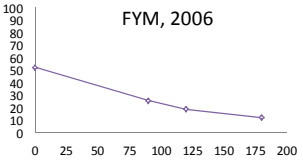

**Cultivation Techniques:**



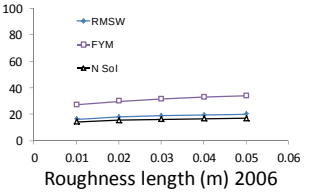

Fraction of EOM incorporated, 2002

**Surface Properties (modified by addition of EOM):**

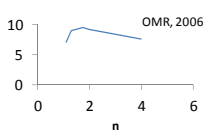


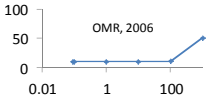

Critical application rate for uniform application ($m^3/h$) :




**Van Genuchten parameters:**




Parameter n can vary from 1 to around 10 (Naasz et al) (Garcia et al)




Parameter α can vary from 0.01 to around 50 (Naasz et al) (Garcia et al)

Van Genuchten parameters: n varied unexpectedly, in a non linear fashion. Alpha had almost no sensitivity for values that were found in literature. There was no reaction to the Ksat parameter. There were problems when attempting to change θsat and θres and so they should probably be changed together and not separately.

## Conclusions and perspectives

**Biggest issue**: overestimation of emissions
Possibly due to:
- high dry matter content – no longer approaches ideal solution;
- adsorption not well represented (lack of an analytical solution to the equilibria equations)

**Perspectives:**
Experiments in controlled conditions (laboratory) : to build a statistical model of chemical equilibrium/ adsorption instead of complex analytical solutions.
Improve VanGenuchten parameter simulations.

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