

# Tier 3 ammonia emissions from field-applied slurry - the ALFAMI project

An introduction for the TFEIP Expert Panel on Agriculture and Nature

Sasha D. Hafner and the ALFAMI consortium

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# ALFAMI project introduction

**ALFAMI** stands for

*Ammonia Losses from Field-Applied Slurry: a Model-Based Approach for Emissions Inventories*

Or, an application of the **ALFAM2** model for **Inventory** calculations.

It is a 2 year (2022-2023) project **aimed at developing a Tier 3 methodology for ammonia loss from field-applied animal slurry.**

We will develop a **method and a software tool** which we hope will become popular for inventory calculations.

Project funding is from the Thünen Institute (Braunschweig, Germany), a research institute under the Ministry of Food and Agriculture.

## Thünen Institute

- Andreas Pacholski, emission processes and measurement
- Roland Fuß, inventory compiler / stakeholder
- Gokul Prasad Mathivanan, PhD student, pH & acidification effects

# ALFAMI consortium

## Principal investigator

- Sasha D. Hafner at Hafner Consulting LLC (Virginia, USA)

## Advisers/contributors

- Sven G. Sommer, Aarhus University (Denmark), emission data
- Nick Hutchings, Aarhus University, international inventory groups
- Barbara Amon, ATB, international inventory groups
- Sebastian Wulf, KTBL (Darmstadt, Germany), inventories

# Presentation objectives

Today we want to:

- 1 Introduce you to the project
- 2 Invite you to provide feedback at a later meeting

# Presentation topics

- 1 The problem
- 2 The ALFAMI vision
- 3 Software package components
- 4 Future stakeholder meeting

# The problem

Methods and tools for calculating ammonia emission from field-applied slurry for inventories vary widely across countries.

- Tier 1 or Tier 2 methods are commonly used
- Effects of abatement measures are difficult or impossible to include with Tier 1 or 2 approaches
- More flexible and accurate Tier 3 methods accommodate abatement, but are complex (and expensive)

# The ALFAMI vision

Through the ALFAMI project, we want to develop a **complete method for inventory calculations** of ammonia loss from field-applied slurry. The project includes:

- 1 **Evaluation, refinement, validation, and demonstration of the ALFAM2 model** based on the best available emission measurements
- 2 **Tier 3 method** for estimation of ammonia emissions from field-applied liquid manure applicable to any location in Europe
- 3 **Free, open-source software package** implementing the new Tier 3 method, meant to simplify consistent, accurate, and reproducible calculation of emissions or emission factors
- 4 **Application of the new method to Germany** as a demonstration and test
- 5 **Free method documentation**



# Software package components

We plan to develop an R package that streamlines and (partially) automates calculation of emissions.

Some components are briefly discussed here.

# The ALFAM2 model for emission calculations

The existing ALFAM2 model will be the “calculation core” of the new software tool. It is a semi-empirical (semi-mechanistic!) model, presently available as an R package or a simpler spreadsheet file.

The new software package will add a layer on top of ALFAM2, preparing input data, making the calls to the ALFAM2 model, and processing output.

# The ALFAM2 model

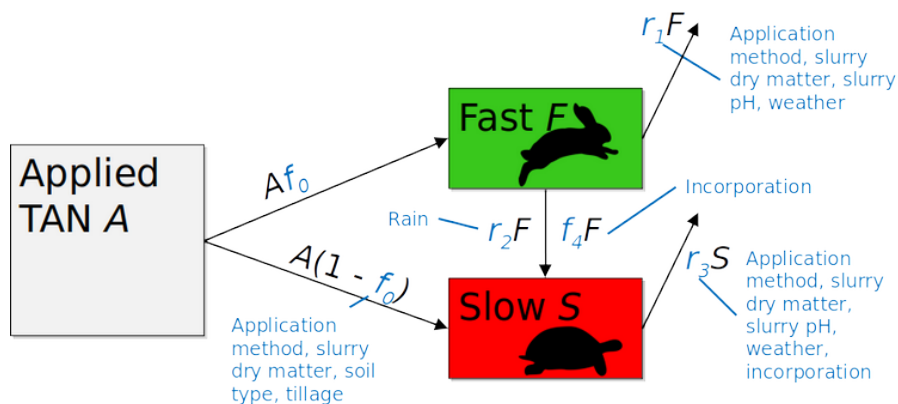


Figure 1: *ALFAM2 model structure.*

Application method bc bsth os ts

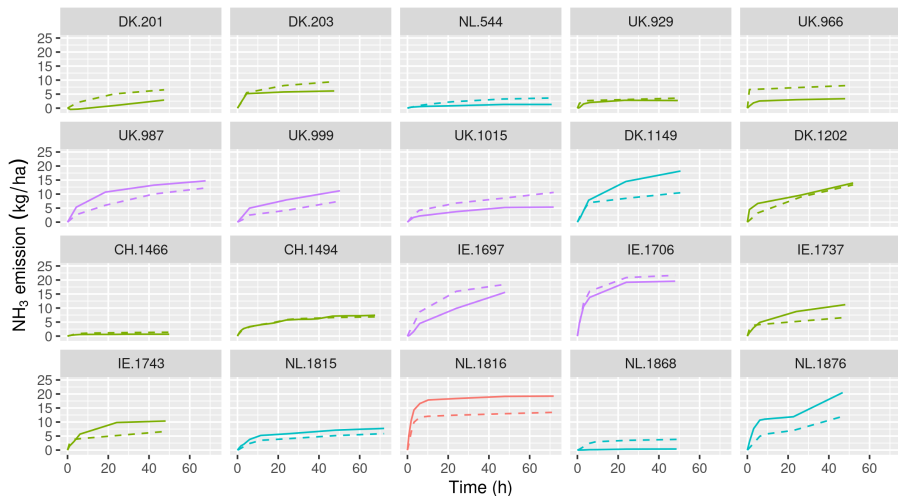


Figure 2: Comparison between measured and calculated (dashed, ALFAM2 model) ammonia emission from 20 random plots from data used for parameter estimation.

# Input data

The ALFAM2 model needs at least:

- Weather or climate
- Slurry (manure) properties
- Application methods

We want to make sure the software tool can easily handle common types and formats of input data. Determining the best approach for data organization and option selection will take some effort. We want a cross-platform approach that is easy to use.

## Activity data

For inventory calculations, “activity” data are also needed.

Variable	Examples
Location	Denmark, Schleswig-Holstein, grid cell 57
Quantity	550 t, 30 t/ha
Application method	Broadcast, trailing hose & acidification, open slot injection
Timing	April, 2021, April 2021, 9.00 15 April 2021

The software package should be completely flexible with respect to the resolution or level of aggregation: from entire country to individual farm.

## Uncertainty in emissions

The new package should be able to estimate uncertainty in emissions. The approach used and the required inputs must be determined. For example, input requirements might be relative error in each category of inputs and correlation between errors, and overall uncertainty estimates could be made using a Monte Carlo approach. Estimates should include uncertainty from ALFAM2 predictions.

## Future stakeholder meeting

We are interested in your feedback and advice, and invite you to join a future stakeholder meeting. If you would like to participate, please send a message to [sasha@hafnerconsulting.com](mailto:sasha@hafnerconsulting.com).



Thank you for your attention!