The use of chemical drone sensor technology in assessing emission rates and deposition from area sources

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Introduction

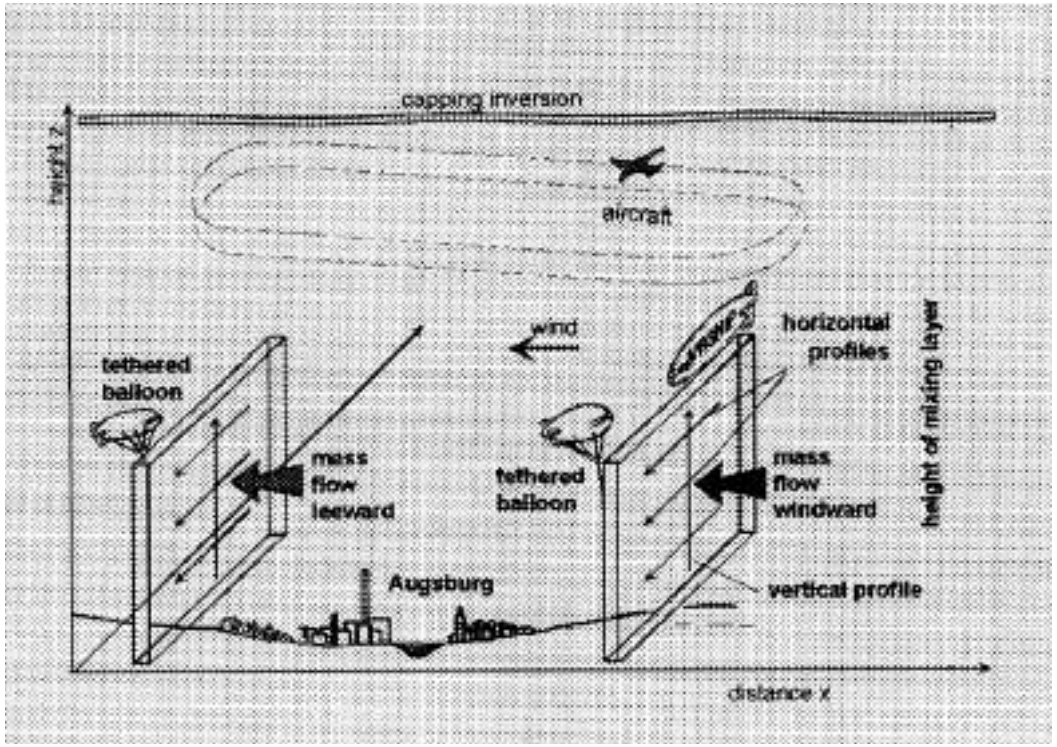
- Objective
  - Quantifying emission impact on the environment from area sources

Introduction

- Challenge 1 – quantifying emission concentrations
  - Fractionated sampling i.e. hood sampling
  - Exhaustive technique for complete mapping

Introduction

- Challenge 2 – determining emission rates
  - Vertical & horizontal profiling -> fluxwindow
  - Requires flexible airborn technique -> drones
  - On site meteorological assessment



Methodology

- Experimental design
  - N-impact determination of sludge buffer tank
  - Meteorological assessment via on site meteorological station (10 m)

Methodology

- Experimental design
  - Construction of imaginary fluxwindows

Methodology

- Experimental design
  - NH_3-concentration mapping through OLFASCAN Flying Lab attached to DJI Matrice600 Pro RTK drone

Methodology

- Data processing
  - Averaging NH_3-measurements over both windows
    - Difference between windows = NH_3-fluxconcentration
  - Translation of NH_3-fluxconcentration via flux rate to NH_3-emission rate
  - Modelling NH_3-emission rate through Flemish model IMPACT to determine N-deposition on VEN-area

Results

- NH_3-concentrations fluxwindows

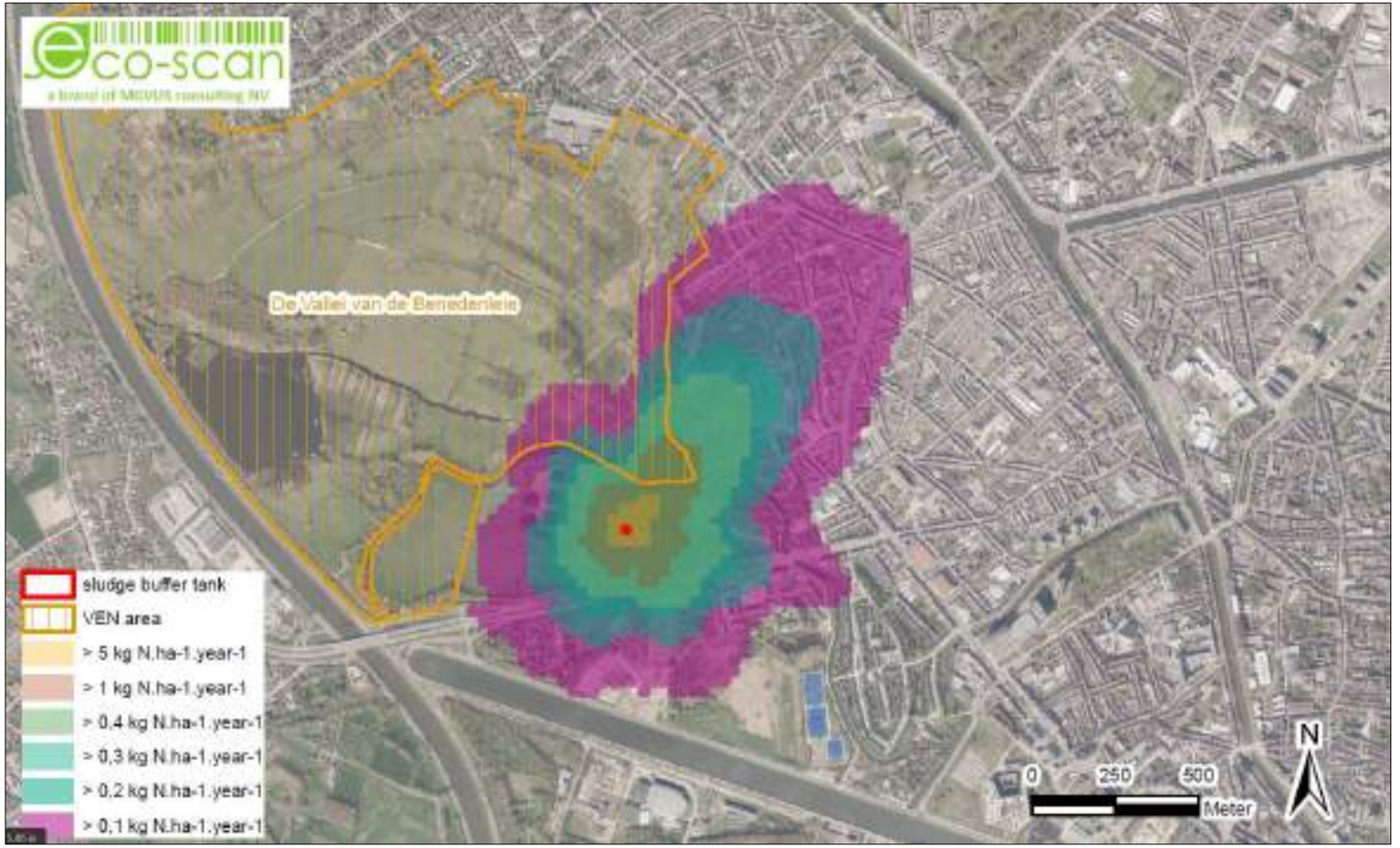
Average NH_3-concentrations ± SD (ppb) fluxwindows

Height/ width	0 m		1.5 m		3 m	
0.15 m	4 423 ± 520	2 414 ± 42	2 951 ± 178	2 311 ± 104	2 442 ± 444	1 133 ± 222
1 m	2 177 ± 520	3 615 ± 93	3 202 ± 605	2 215 ± 39	1 581 ± 165	927 ± 121
2 m	2 063 ± 1 034	2 628 ± 559	2 347 ± 427	1 893 ± 89	1 257 ± 21	1 584 ± 85
3 m	1 865 ± 87	2 271 ± 29	1 815 ± 165	1 811 ± 107	1 286 ± 104	2 392 ± 42
4 m	725 ± 6	2 504 ± 20	876 ± 89	2 333 ± 56	1 139 ± 5	1 987 ± 21
5 m	207 ± 7	2 475 ± 119	462 ± 38	2 007 ± 69	717 ± 113	1 806 ± 145
6 m	128 ± 17	3 328 ± 156	439 ± 25	2 018 ± 22	751 ± 24	1 585 ± 295

Averaged NH_3-concentrations (ppb) windward fluxwindow grid
Averaged NH_3-concentrations (ppb) leeward fluxwindow grid

Results

- N-deposition impact on VEN area



Discussion

- Reliability of calculated NH_3-concentrations

Discussion

- Reliability of calculated NH_3-emission rate

Future perspective

- Increase execution time fluxwindow measurements to reduce variations in measured emission concentrations
- Investigate feasibility of fluxwindow method to determine emission impact from large area sources such as pools

Conclusion

- Drone & chemical sensor technology presented here as the OLFASCAN Flying Lab is a usefull step in determining the emission impact of area sources, as emissions can easily and accurately be measured in both vertical and horizontal profiles

Special thanks to our partner Drone Division

Questions?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