

Trent Regional Ammonia Monitoring using Passive Samplers (TRAMPS) Project

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Ammonia Measurements

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Objective and study design

- Determine the spatial and temporal variation of ambient NH_3 concentrations in regions of varying agricultural intensity across south-central Ontario
- NH_3 measured using Willems badge passive sampler. Project done as 4th year honours thesis



Study location



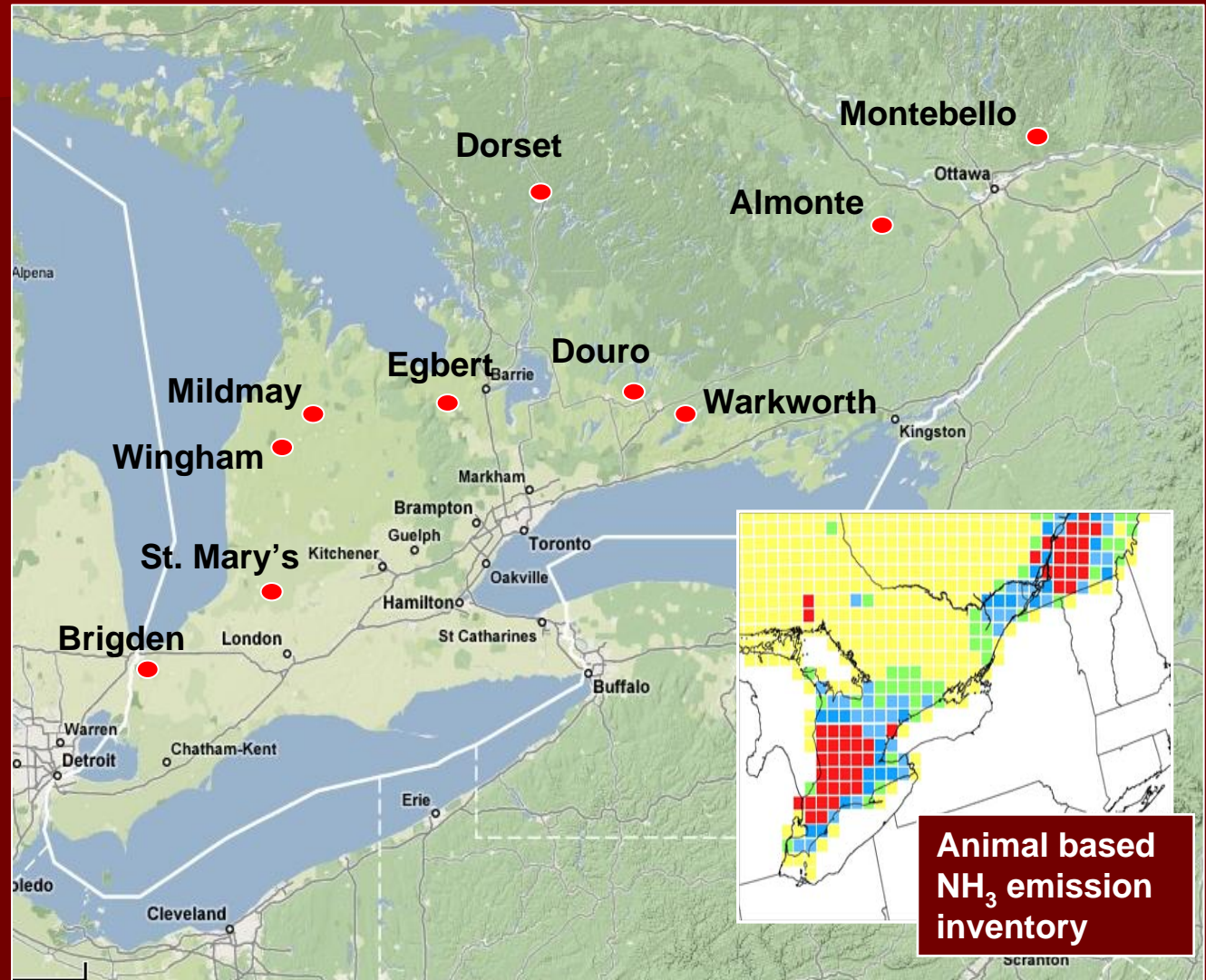
Site selection

10 sites selected

Open areas at least 1 km away from point source emissions

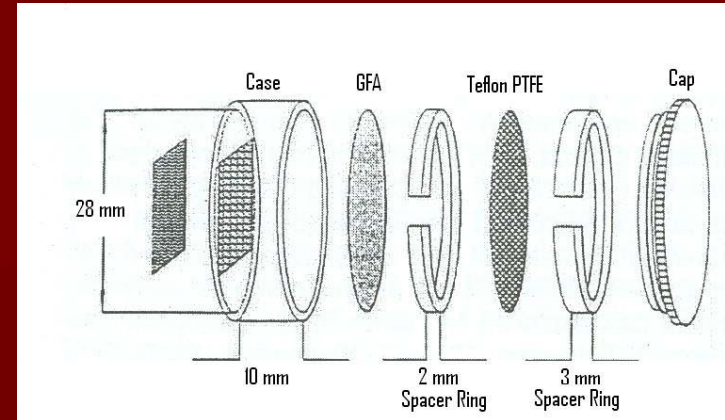
Egbert is EC CARE site, Dorset and Montebello provincial monitoring sites

Canada Census Data 2001 regarding agricultural practices in counties across Ontario



Willems badge

- Developed by Willems
 - Constructed, assembled and analyzed at Trent University.
- Teflon PTFE membrane
 - creates a stagnant air layer between itself and the glass fibre filter
- Absorbent layer
 - soaked in tartaric acid which absorbs NH_3 gas



Sample analysis

- Colourimetric method
 - UV/VIS Spectrometer at a wavelength of 655 nm.
- Atmospheric concentration, C , ($\mu\text{g m}^{-3}$) determined by...

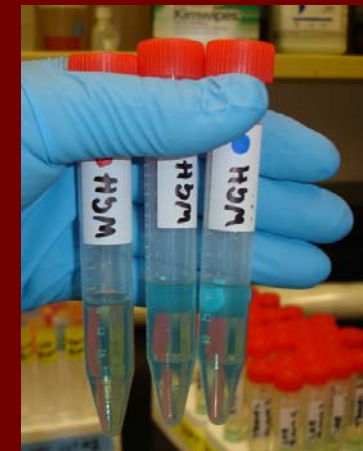
$$C = Q * R_t / A * t$$

Q = amount of NH_3 sampled (μg)

R_t = total resistance of transport (164 s m^{-1})

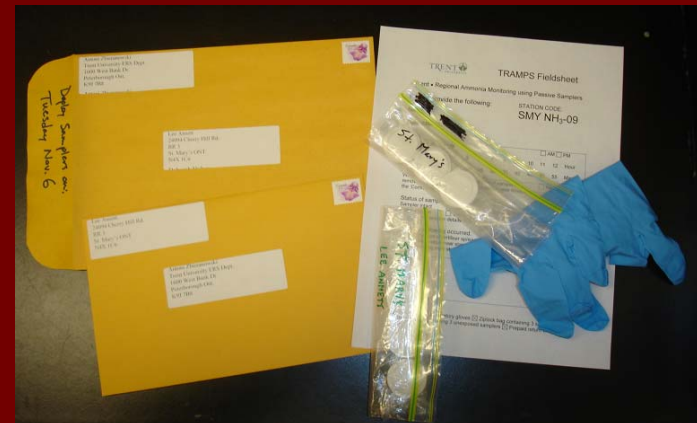
A = diffusion surface area (m^2)

t = exposure time (sec)



Experimental design

- At all study sites 2 m high stands were installed
- Biweekly sampling: 3 samplers exposed at each site (30 total) with 5 lab blanks for each sampling period
- Samplers mailed by Canada Post to site operators; exposed samplers sent back to Trent University
- Sampling: August 2007 – September 2008



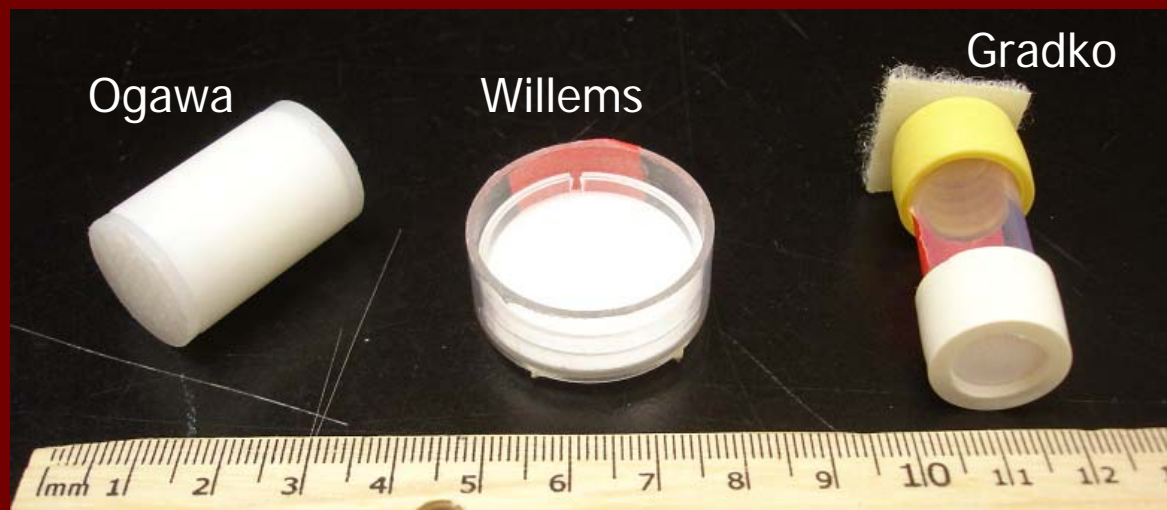
Study questions

- How does the Willems badge compare to other samplers?
- How do atmospheric concentrations relate to animal numbers?
- How do concentrations vary during the year?
- How do air concentrations relate to wet deposition estimates?

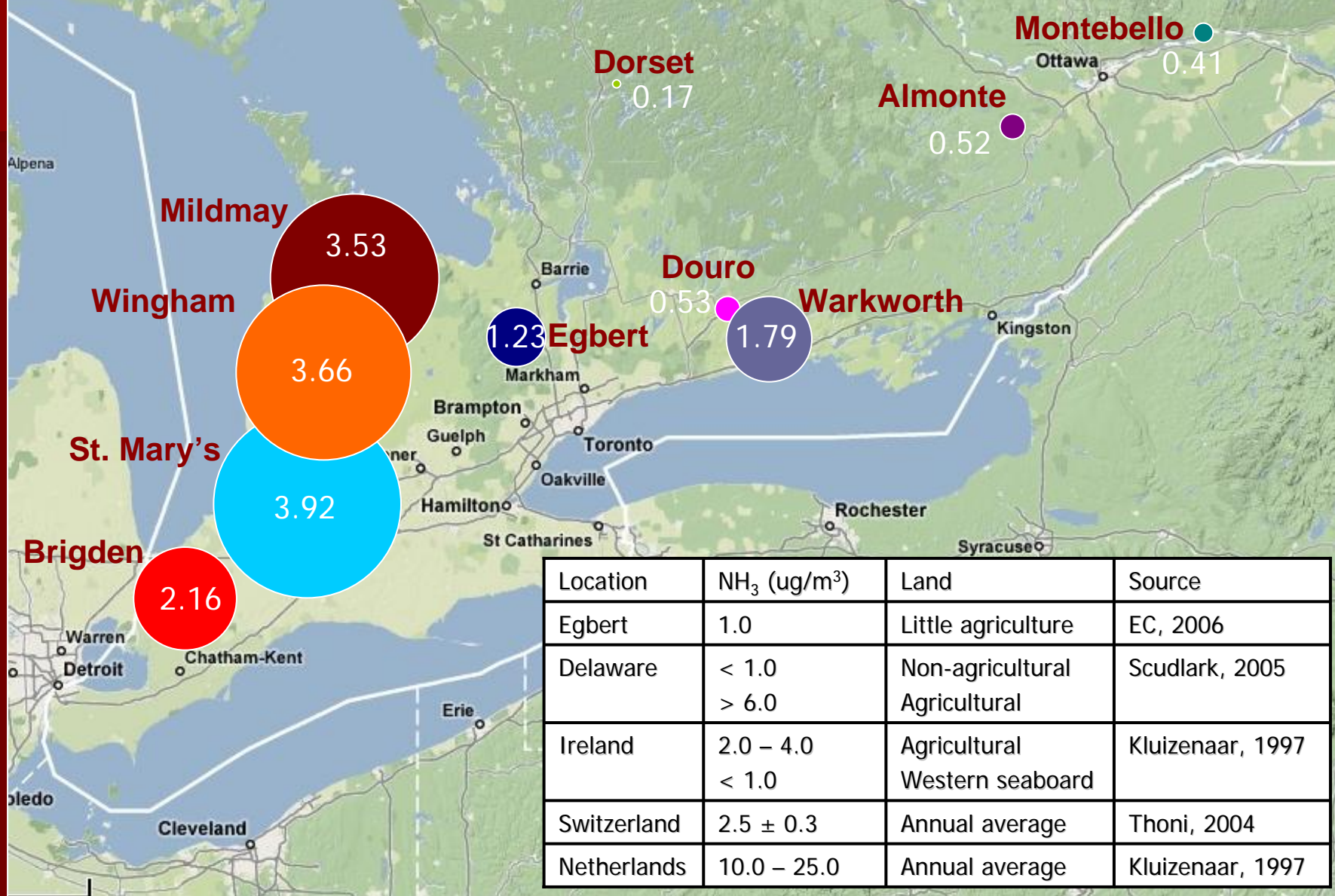


Comparison study

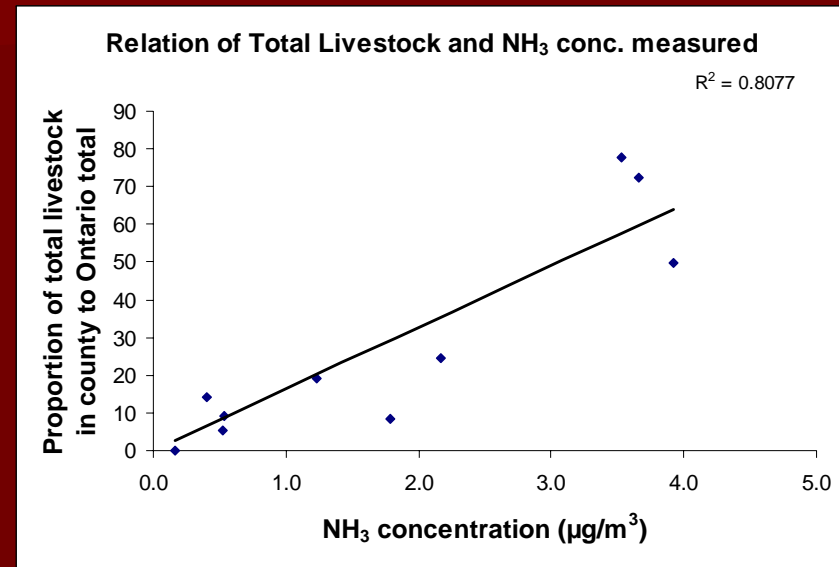
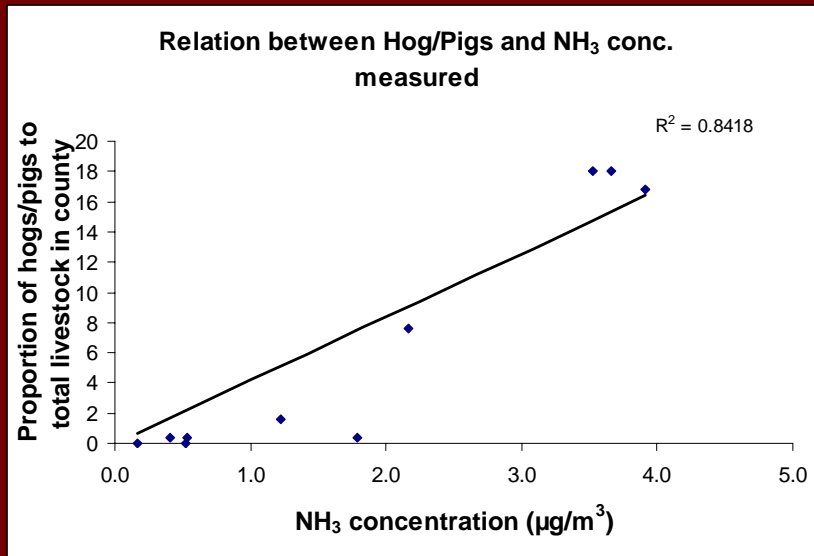
- Egbert: Centre for Atmospheric Research Experiments (CARE)
- Deployed Willems, Ogawa and Gradko passives
 - 1,2,3,4 week exposure periods during summer 2007 and 2008
 - 3 of each sampler exposed for each period
- Results: Willems had low CV



Ambient NH_3 concentrations increase as regional agricultural intensity increases from low intensity areas at $0.1 - 1.0 \mu\text{g}/\text{m}^3$, to medium at $1.0 - 3.0 \mu\text{g}/\text{m}^3$ to high at $3.0 - 4.0 \mu\text{g}/\text{m}^3$.

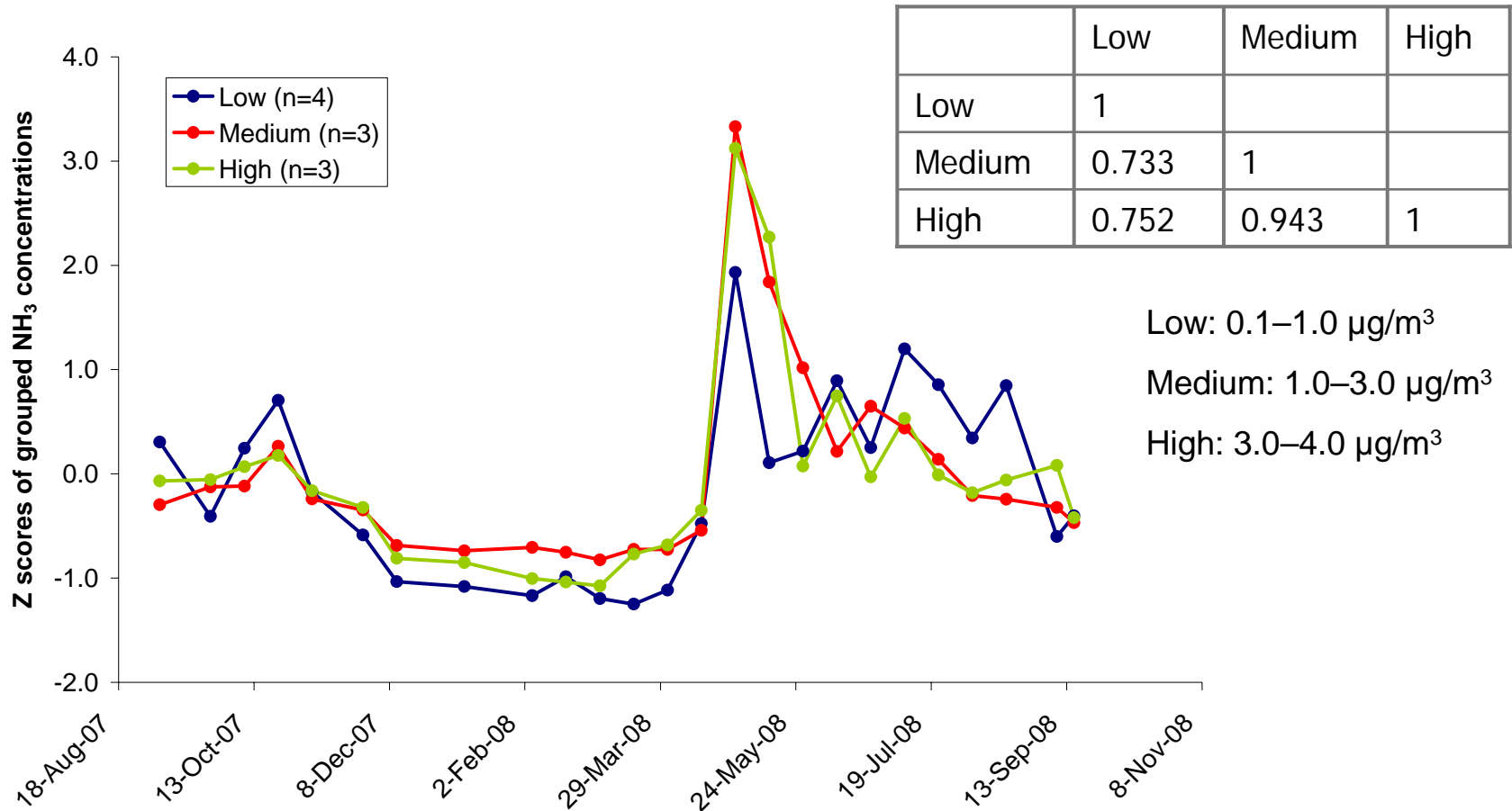


The moo and oink factor



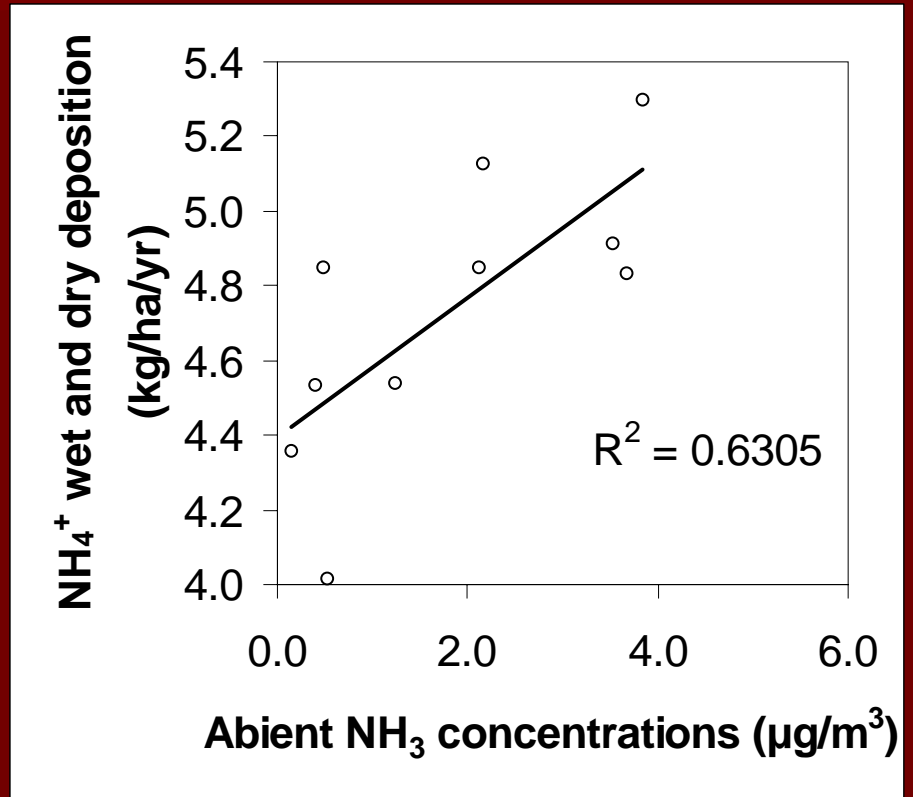
Cattle: $R^2 = 0.74$

Synchronicity: Temporal trends



Wet and dry deposition

- Wet and dry deposition taken from EC interpolated map
- Good correlation between ambient NH_3 concentrations and estimated deposition of NH_4^+



Conclusions

- Willems badge is a reliable passive sampling device giving comparable numbers to active denuders
- Spatial atmospheric NH_3 concentrations are related to regional agricultural intensity
- Temporal trends are larger in scale than regional patterns of agricultural intensity
- Wet and dry deposition of NH_4^+ is related to relative concentrations of atmospheric NH_3

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