Measuring ammonia emission from livestock on grassland

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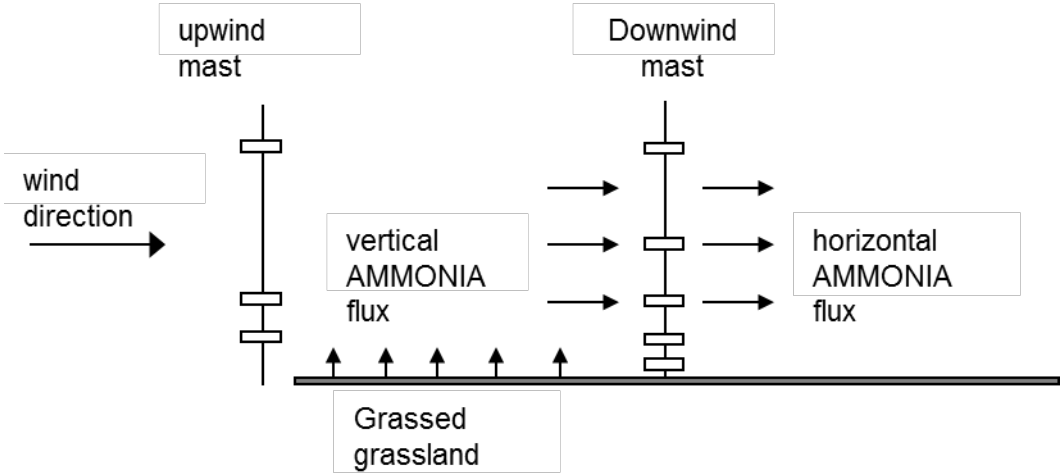
Ammonia emission from sows and piglets

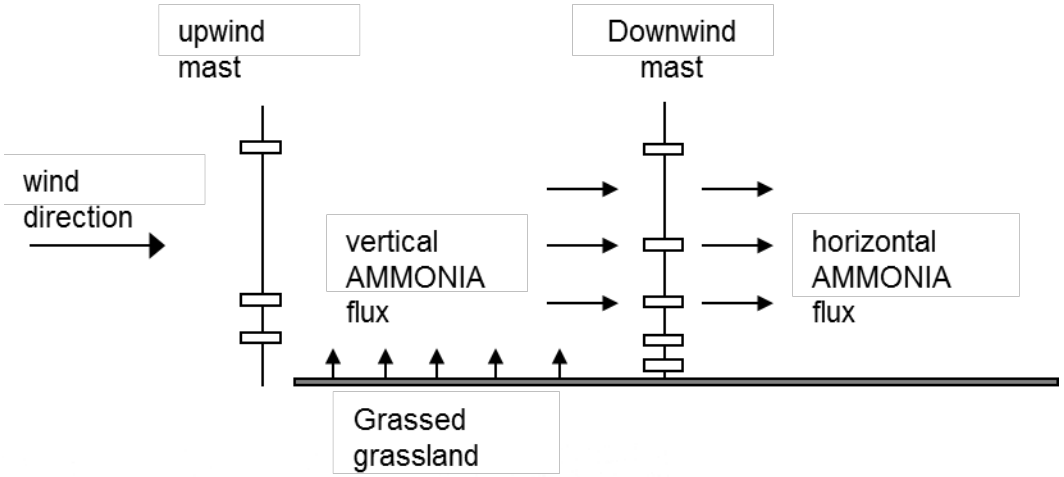
(Eriksen et al. 2002)

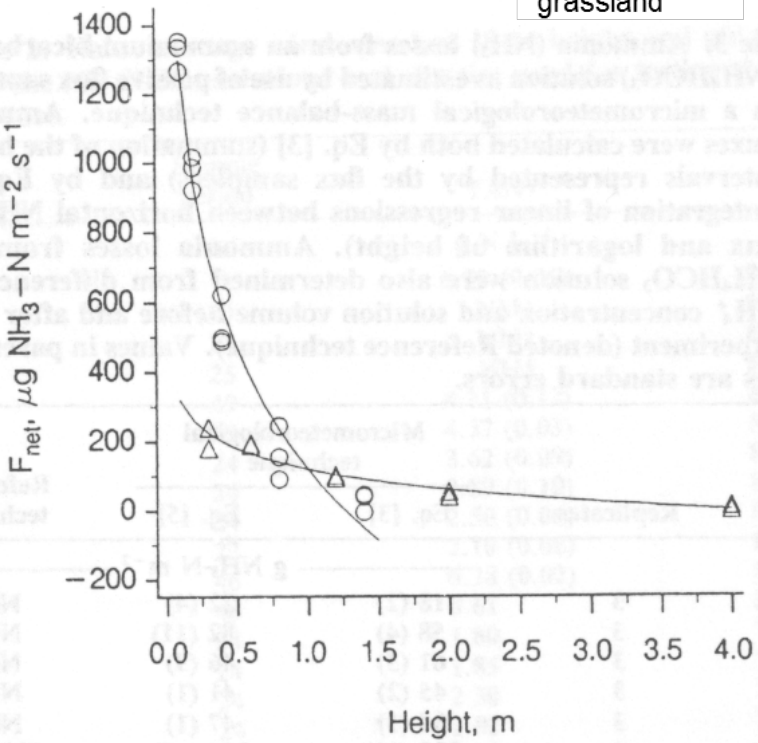
	Kg N ha^{-1}	% of N in feed
Input: Feed	880	
Output: Piglets		44
Nitrate leaching	141-308	16-35
Ammonia volatilization	114	13
Denitrification	69	8
		81-100

Ammonia emission was measured using a micrometeorological mass balance method (Integrated Horizontal Flux method – IHF)



Micrometeorological mass balance technique



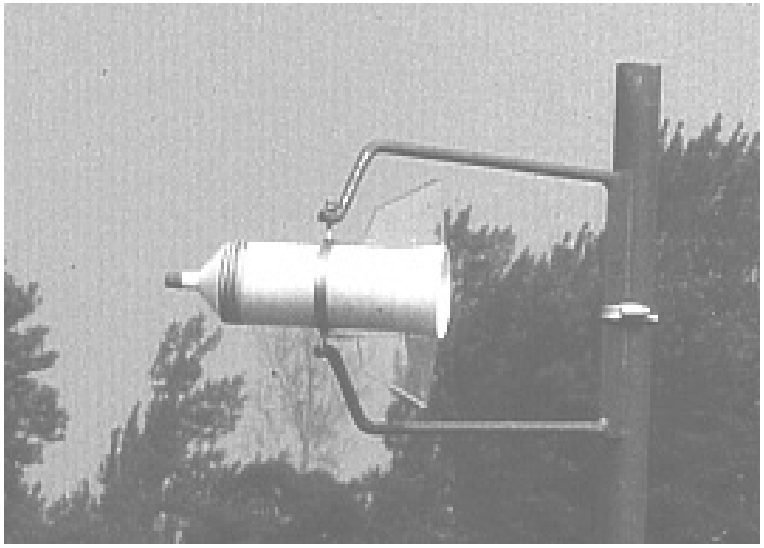


$$netF_x = \overline{u}\,\overline{C}_{dw} - \overline{u}\,\overline{C}_{uw}$$

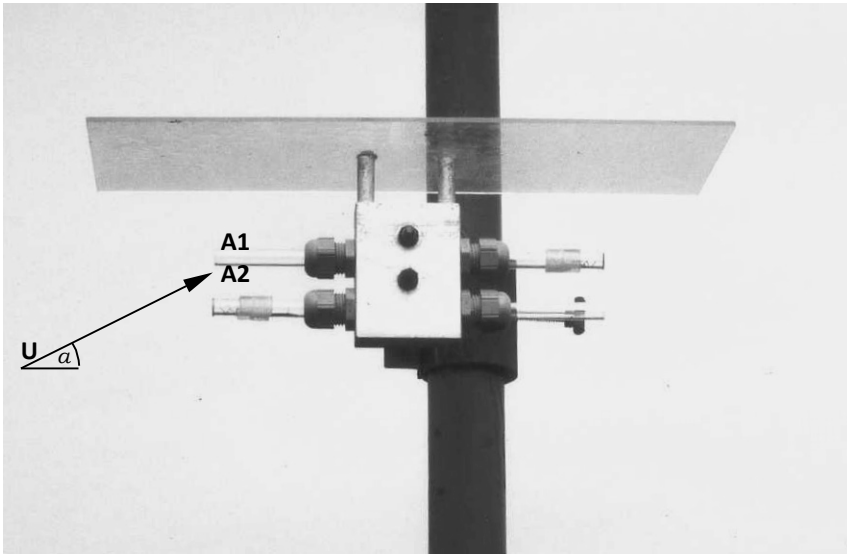
$$Q = \frac{1}{X}\int_{z_0}^{z_p} F_x dz$$

Tom Misselbrook
IGER

Passive ammonia horizontal flux samplers

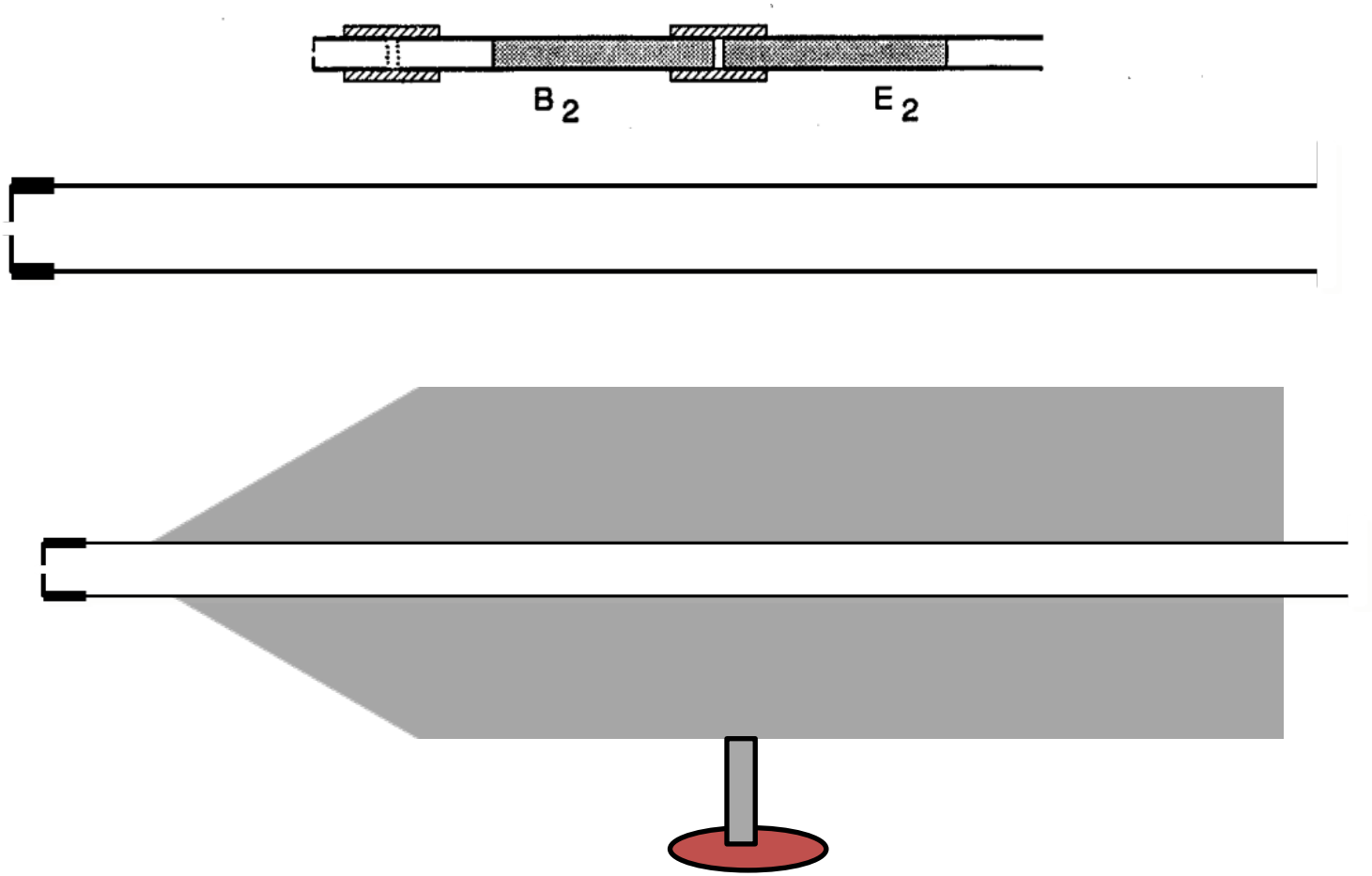


Space shuttle –
Leuning sampler

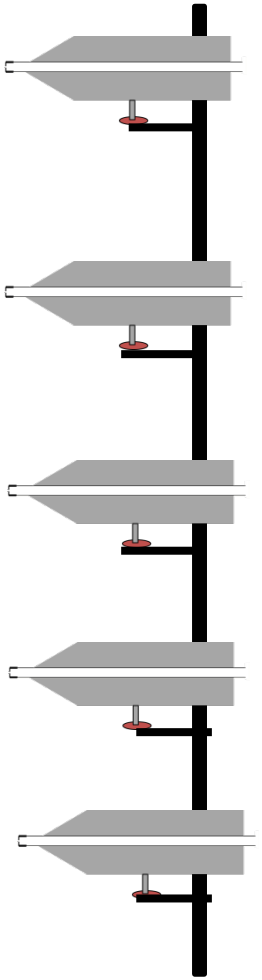


Passive denuder
Ferm sampler

Passive denuders, on a wind vane with bearings

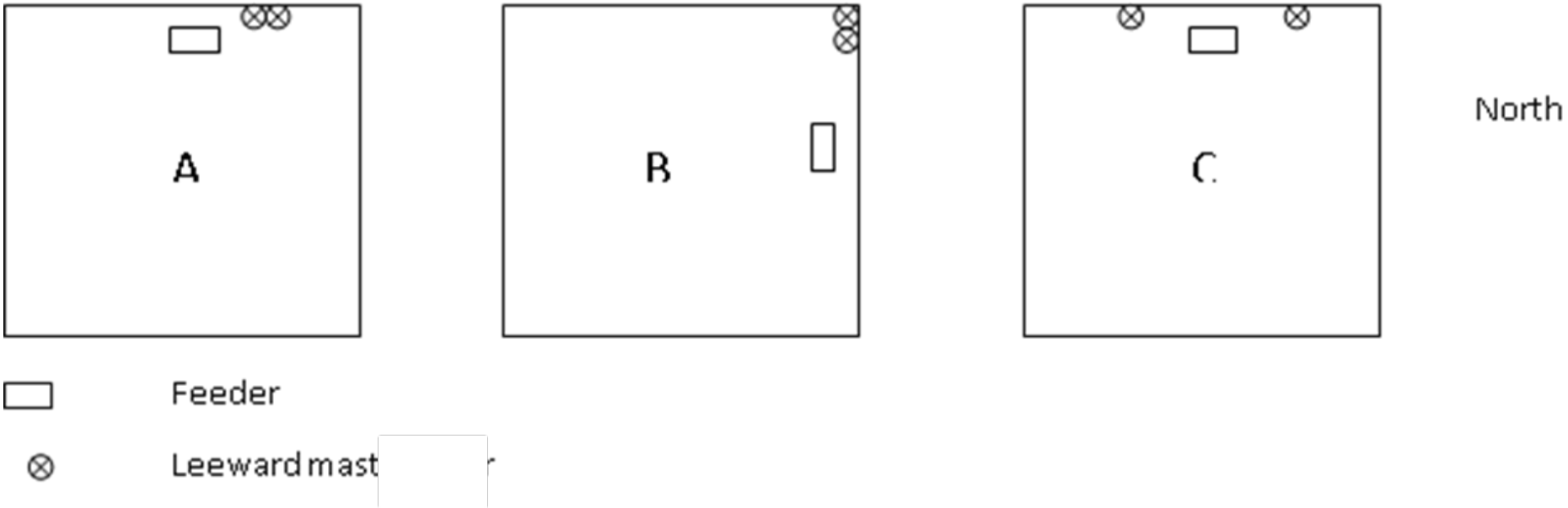


Mount these on a mast



Mast where placed upwind the field with grazing sows

Dimensions of field was known
Wind direction was measured

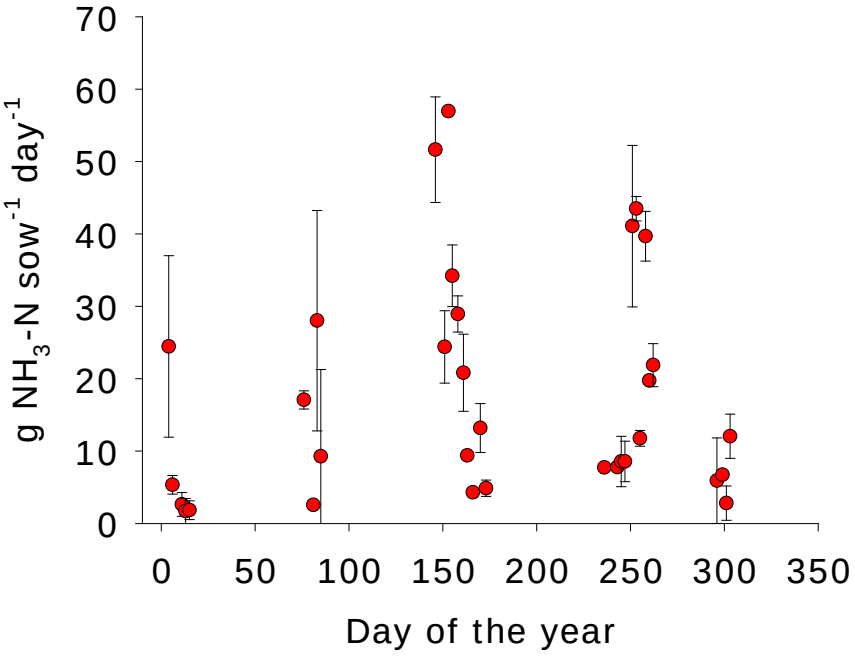


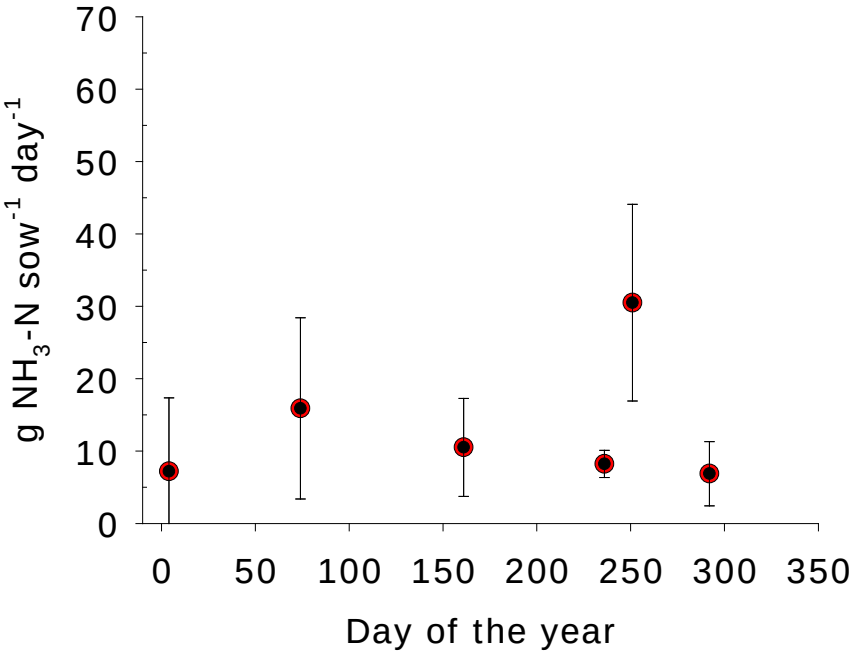
Micrometeorological mass balance method

	% of measurements Rejected
Wind did not pass over the pasture before reaching passive denuder	10
Background NH_3 conc. high – no enrichment measured	12

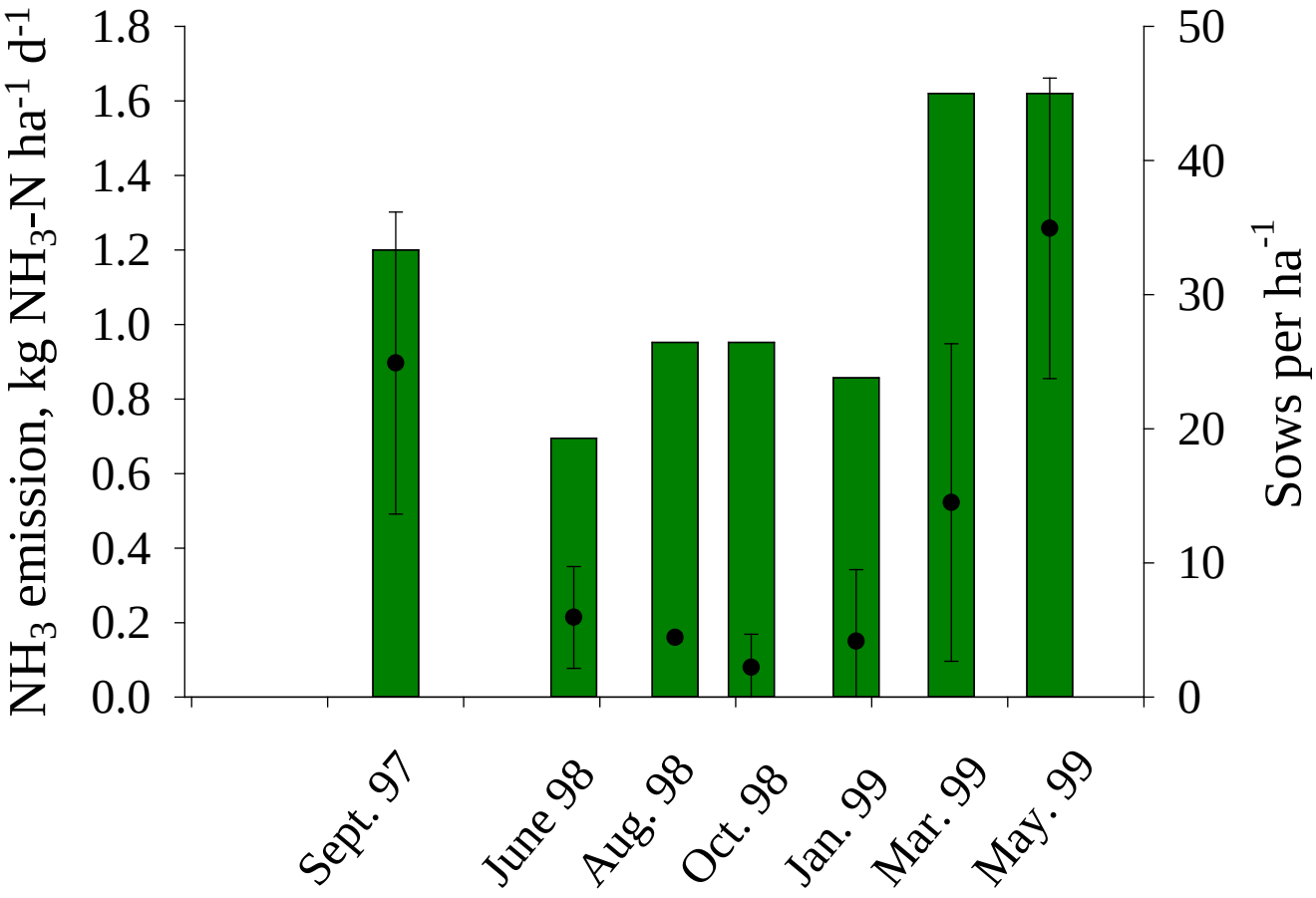
Ammonia emission

3 years of study presented

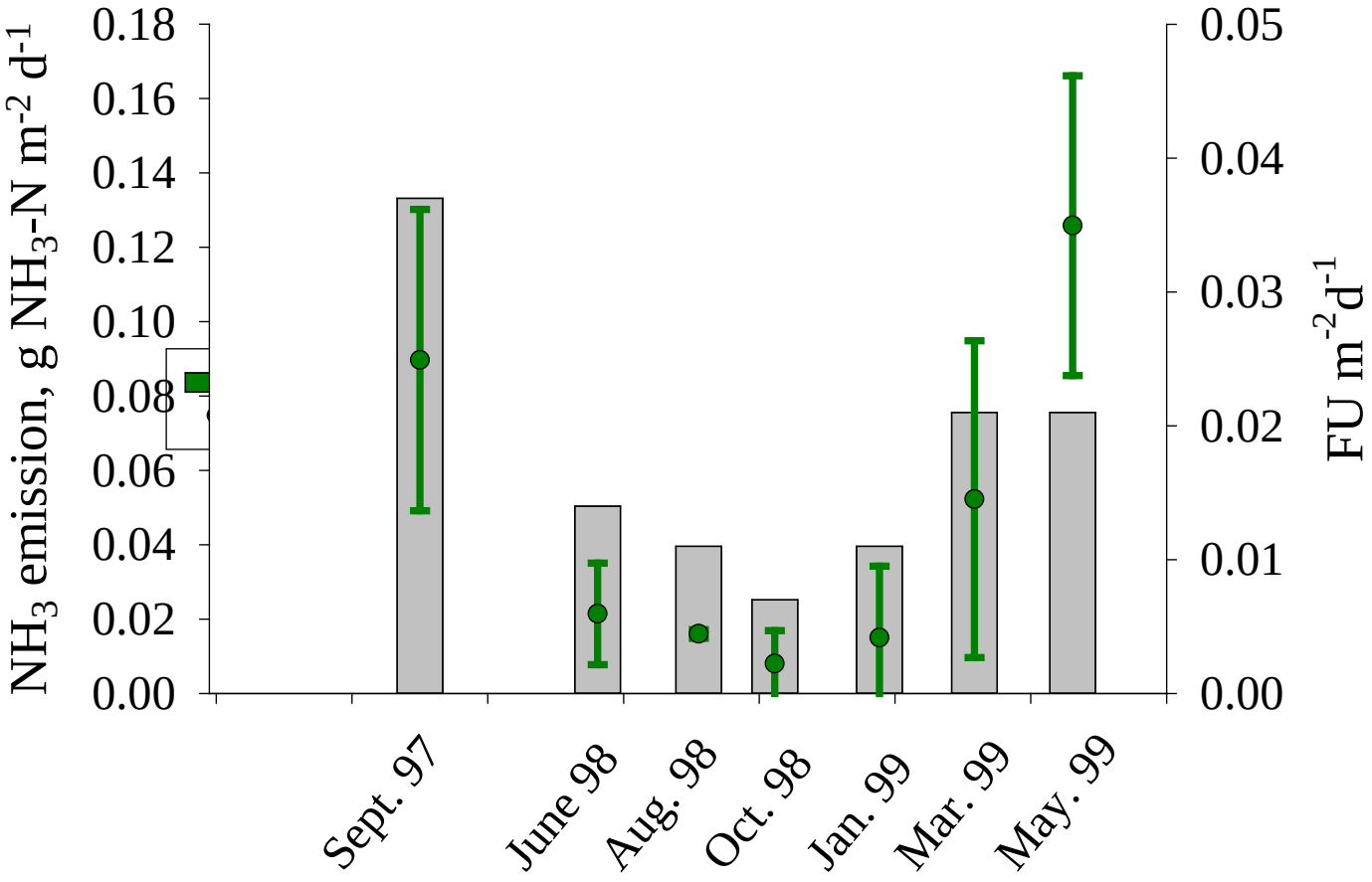




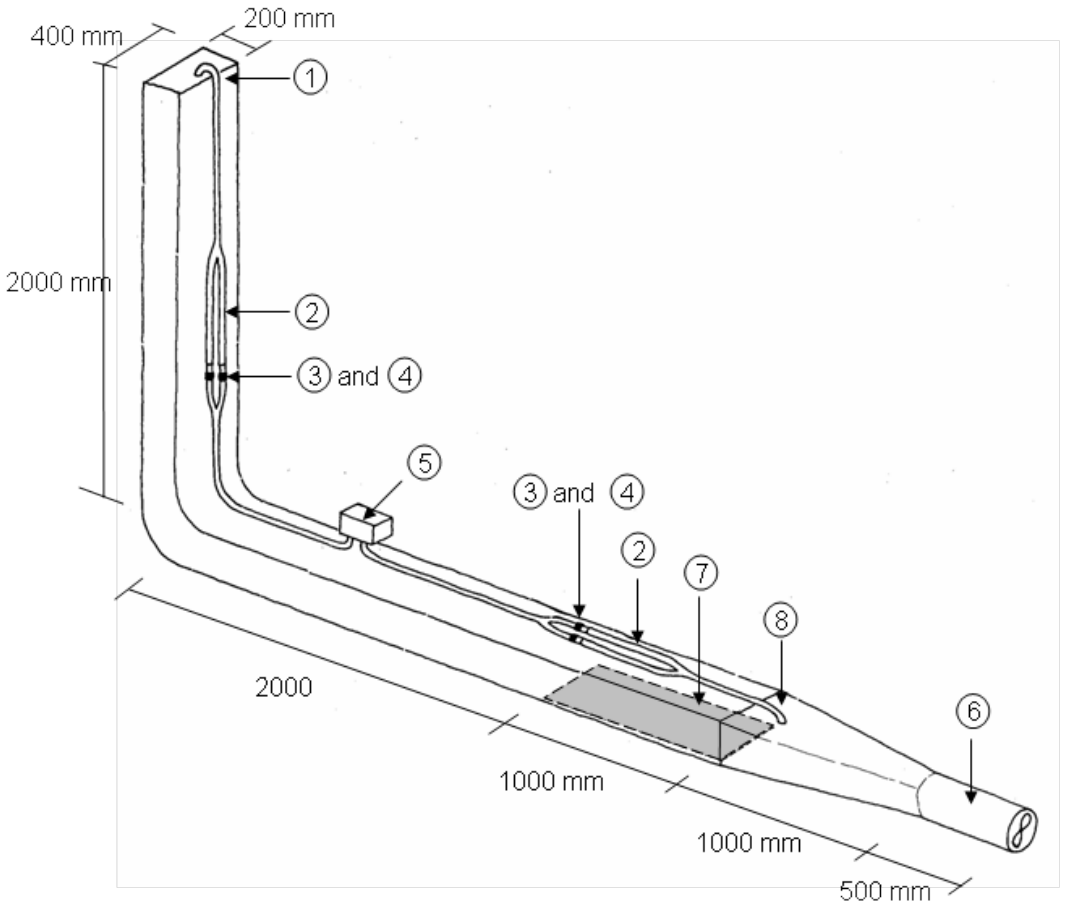
Emission related to sows per ha



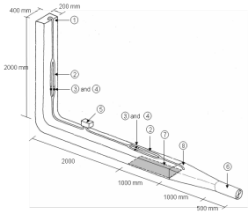
Emission related to nitrogen in feed per ha

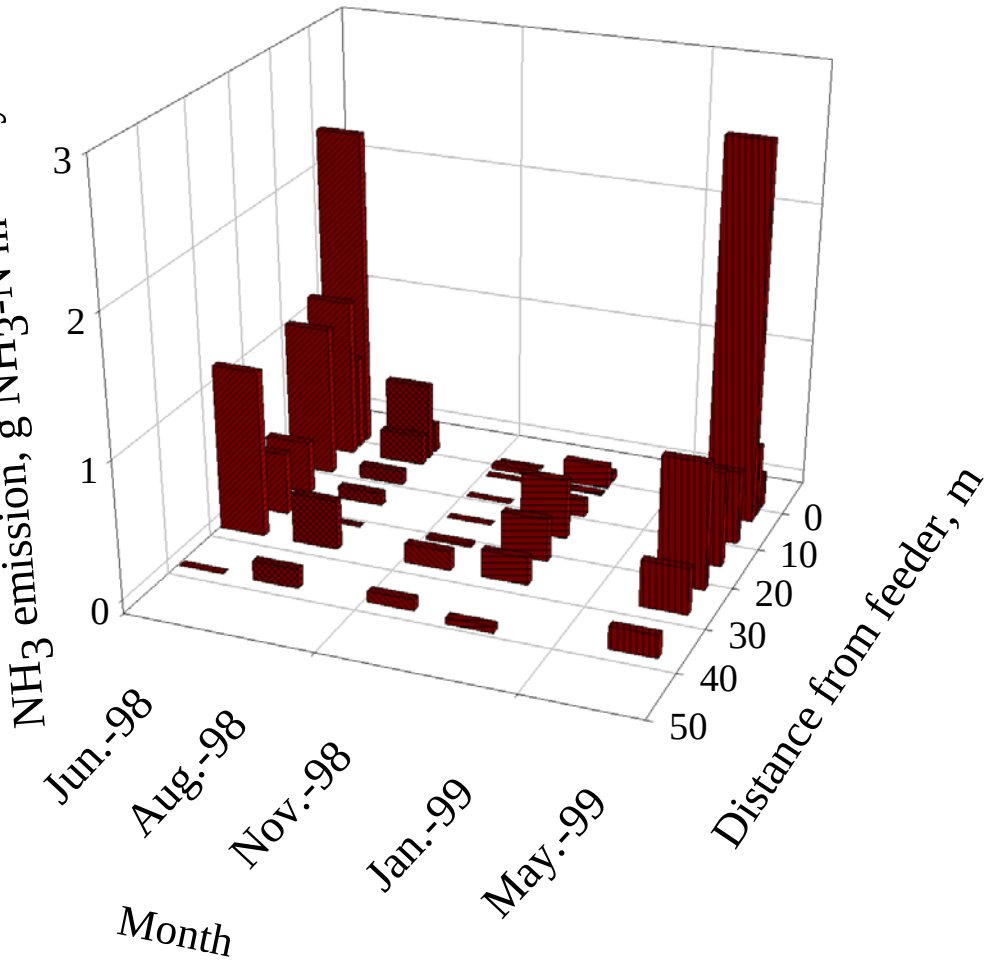


Wind-tunnel designed to measure spatial variation in emission

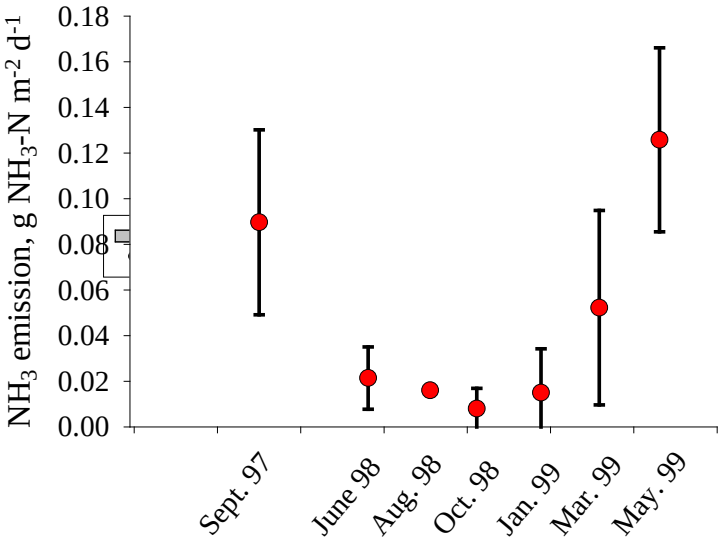


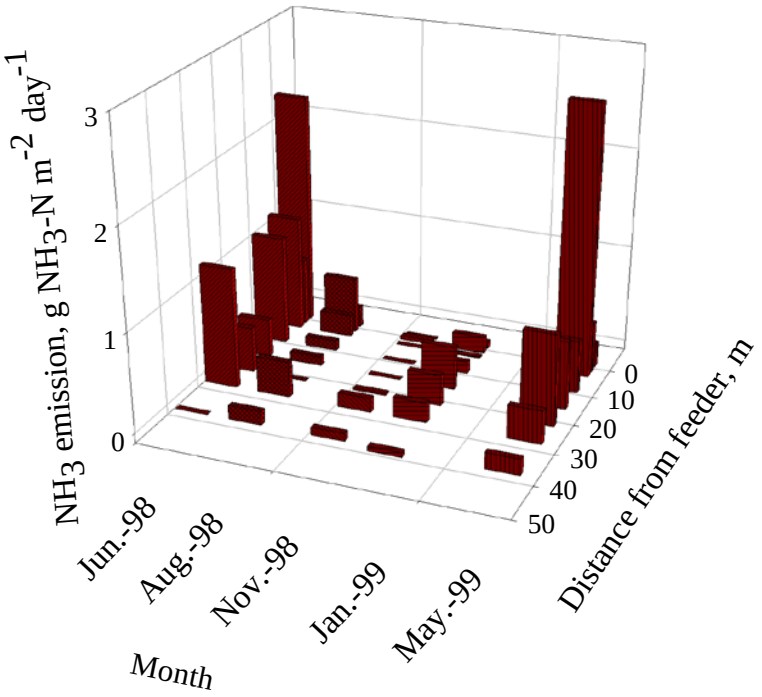
Emissions measured with wind tunnel





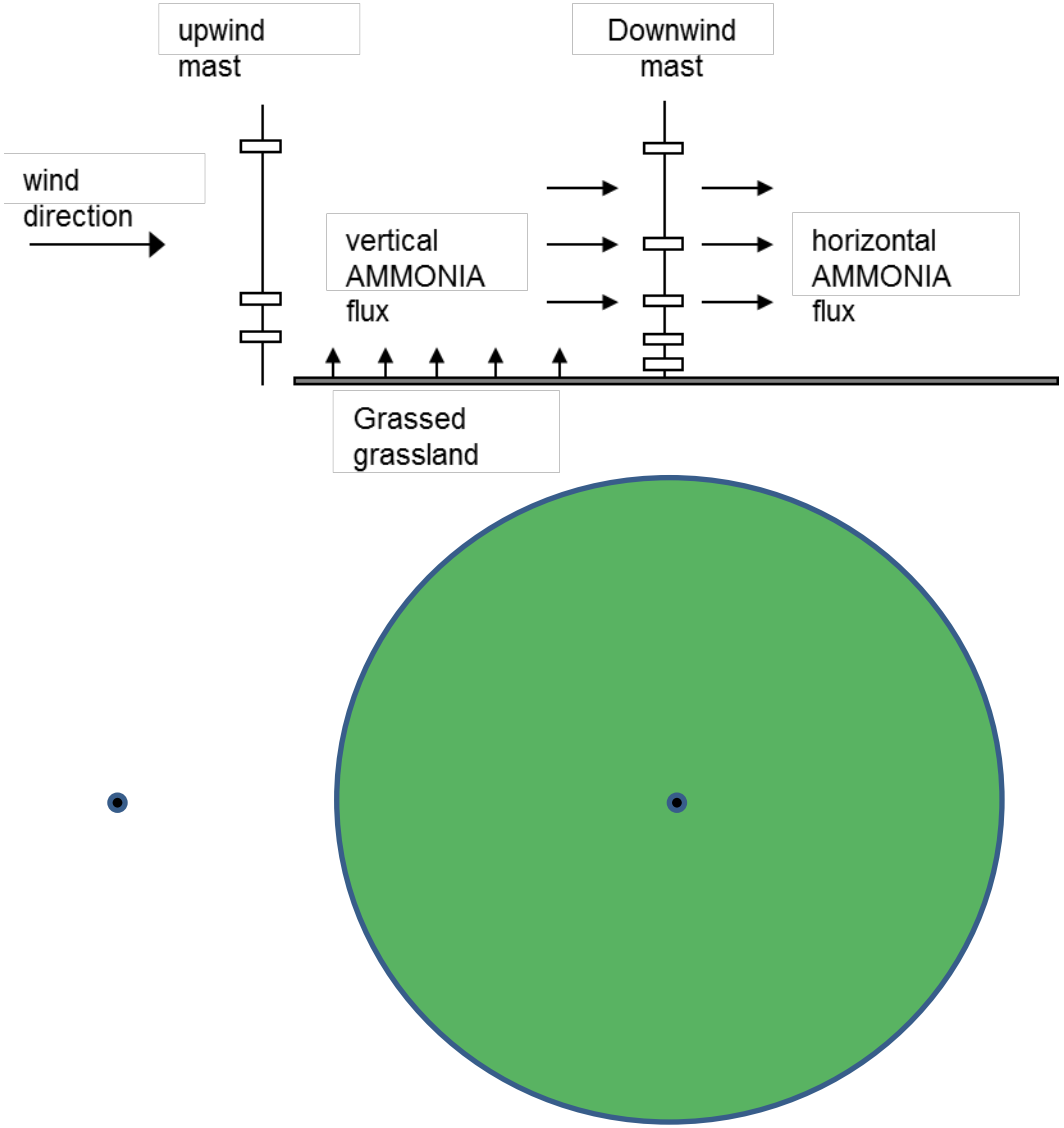
Ammonia emission





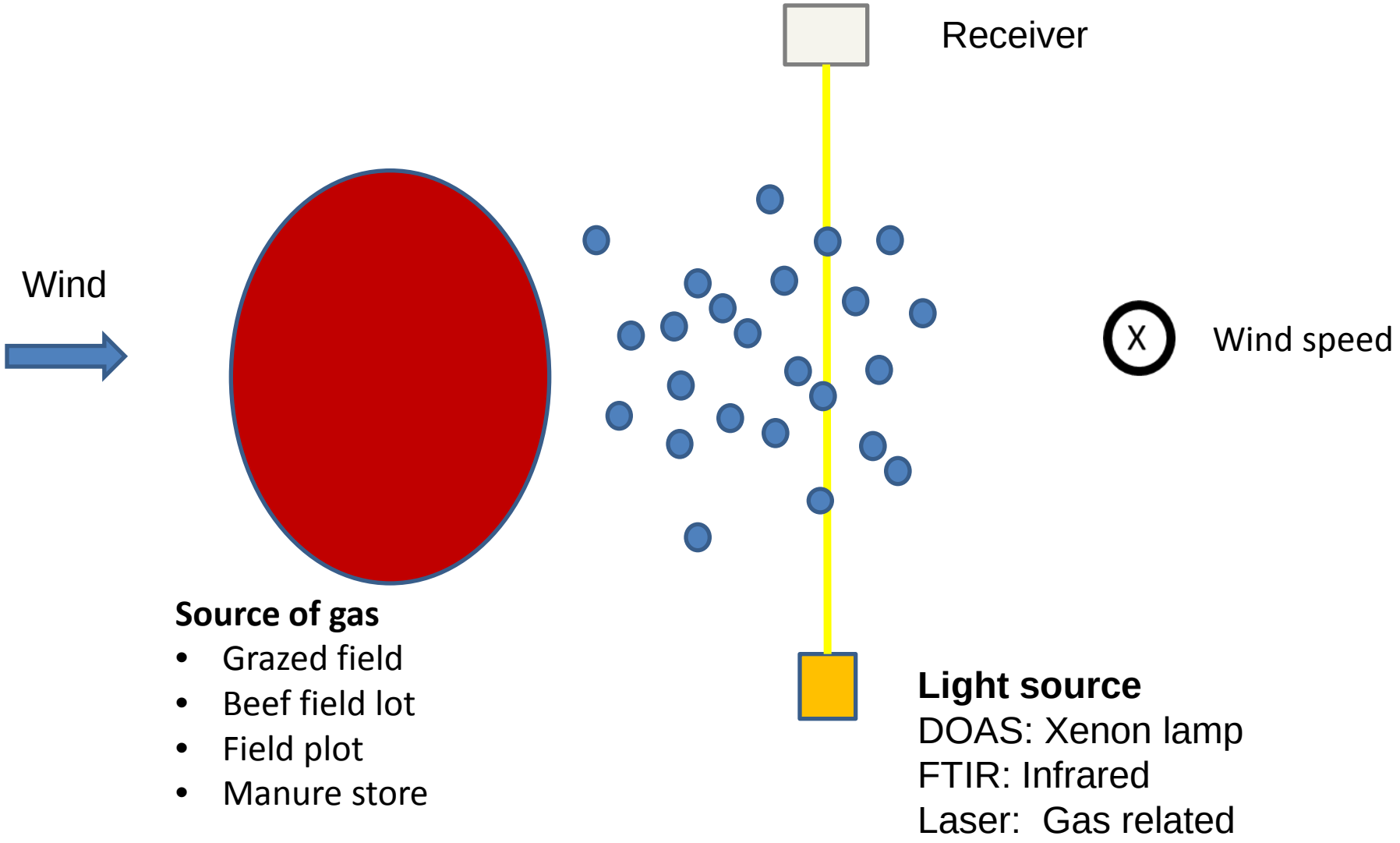
Micrometeorological mass balance technique g NH_3 m^{-2} d^{-1}		Wind tunnel g NH_3 m^{-2} d^{-1}
0.01	Min	0.01
0.14	Max	2.5

The ‘measuring mast’ in the centre of a circular field with grassing livestock

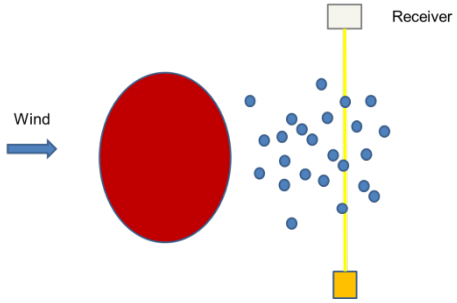


Jarvis, SC., Hatch, DJ., Orr, RJ., Reynolds SE 1991. Micrometeorological studies of ammonia emission from sheep grazed swards. Journal of Agricultural Science,: 117,101-109

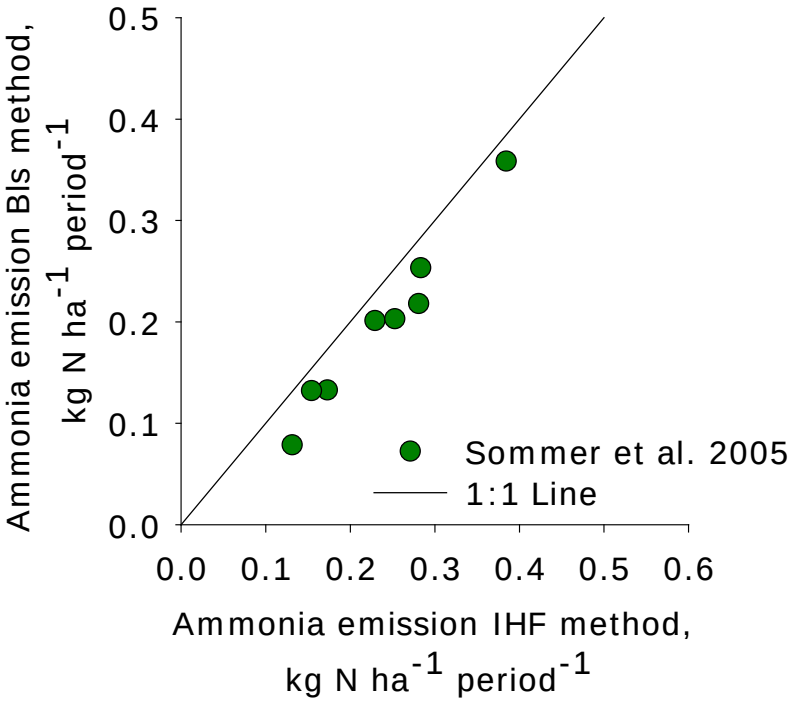
Open path measurements combined with backward Lagrangian Stochastic (bLS) dispersion technique

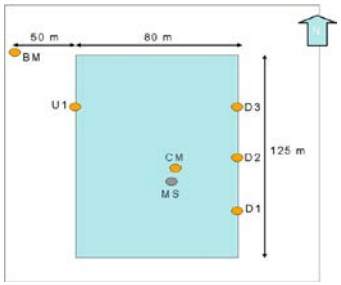


The mast is downwind a source of ammonia
bLS technique

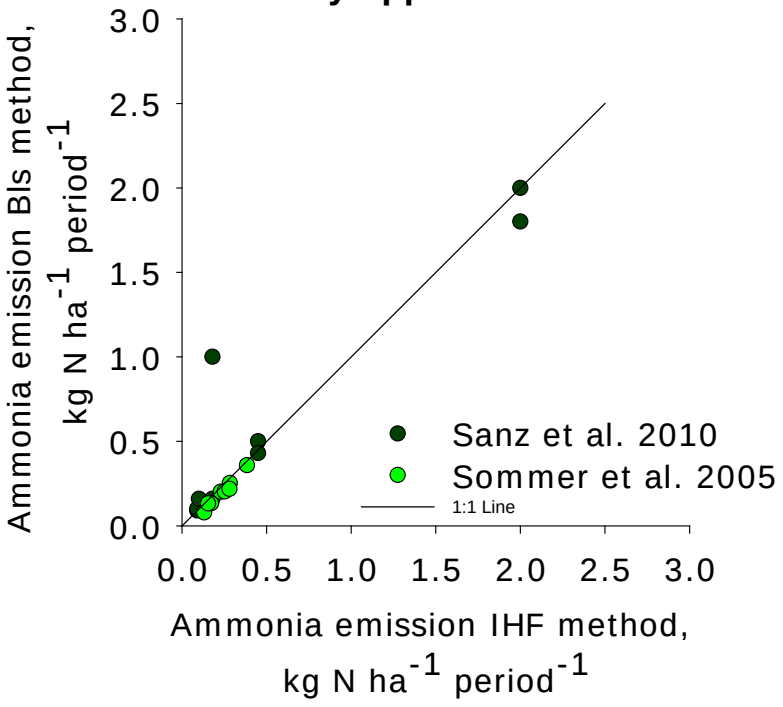


Compost heap





Slurry applied to field



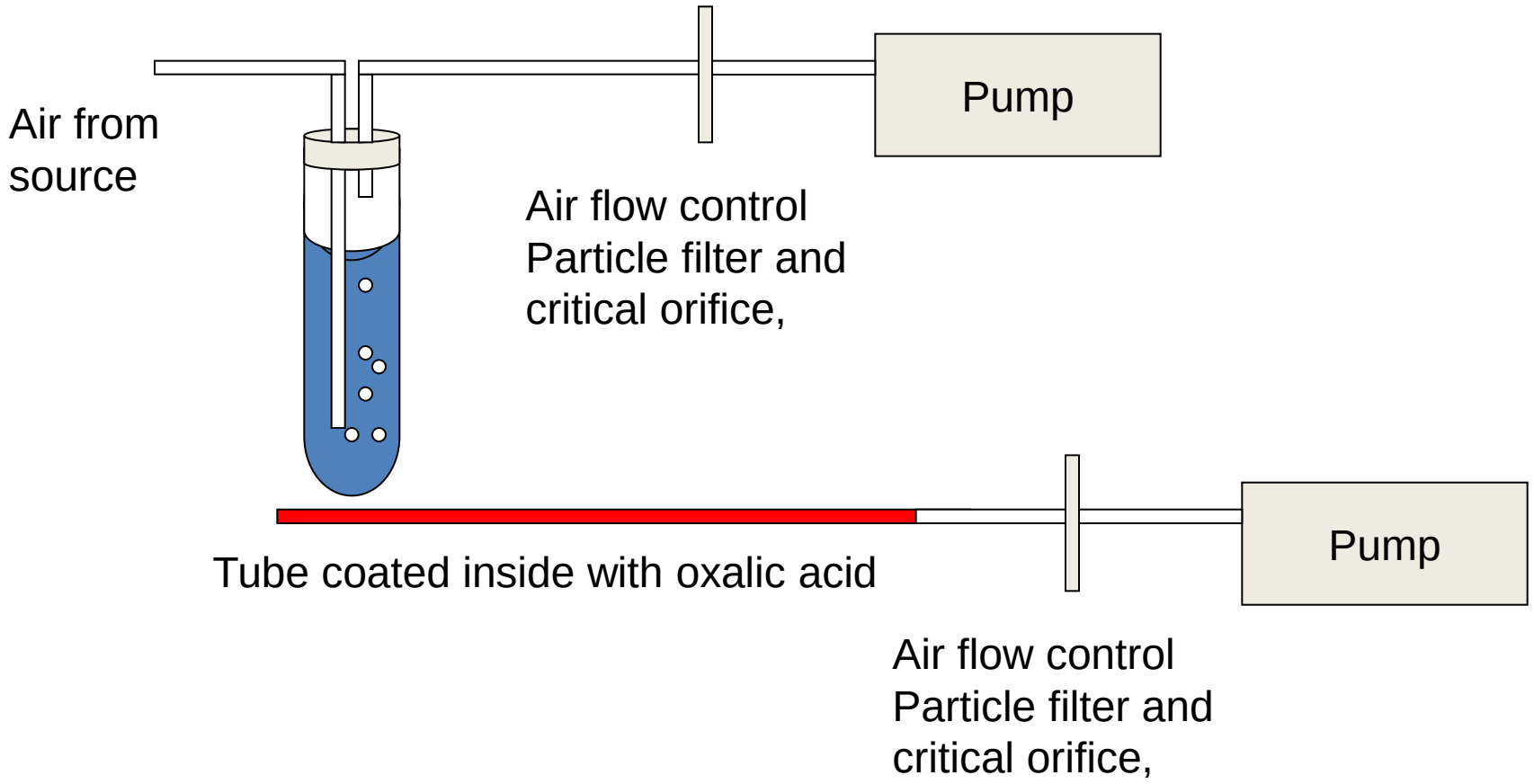
Quantitative measurements of ammonia and methane loss from animals. Chapter for CABI (McQuinn S. 2012).

Category	bLS vs. other techniques	Reference
Cattle grassing	Under estimated CH_4 emissions 7% relative to the SF_6 tracer technique	McGinn et al. (2009)
Cattle grassing	Good fit of CH_4 emissions from confined cattle to the IHF technique	Laubach and Kelliher (2008)
Stockpile of manure	Good fit to the IHF techniques for NH_3 emissions from stocked beef cattle manure	Sommer et al., (2004)

Conclusion

- Gas emission from grassing livestock can be measured with IHF and bLS techniques
- The techniques have been tested under a variety of conditions and proven reliable
- Measurements may be rejected due to weather conditions

Gas measuring technique



We used bLS to measure CO2 and CH4 emission from a composting deep litter heap