



Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada



Atmospheric Ammonia from Agriculture in Canada- A case study

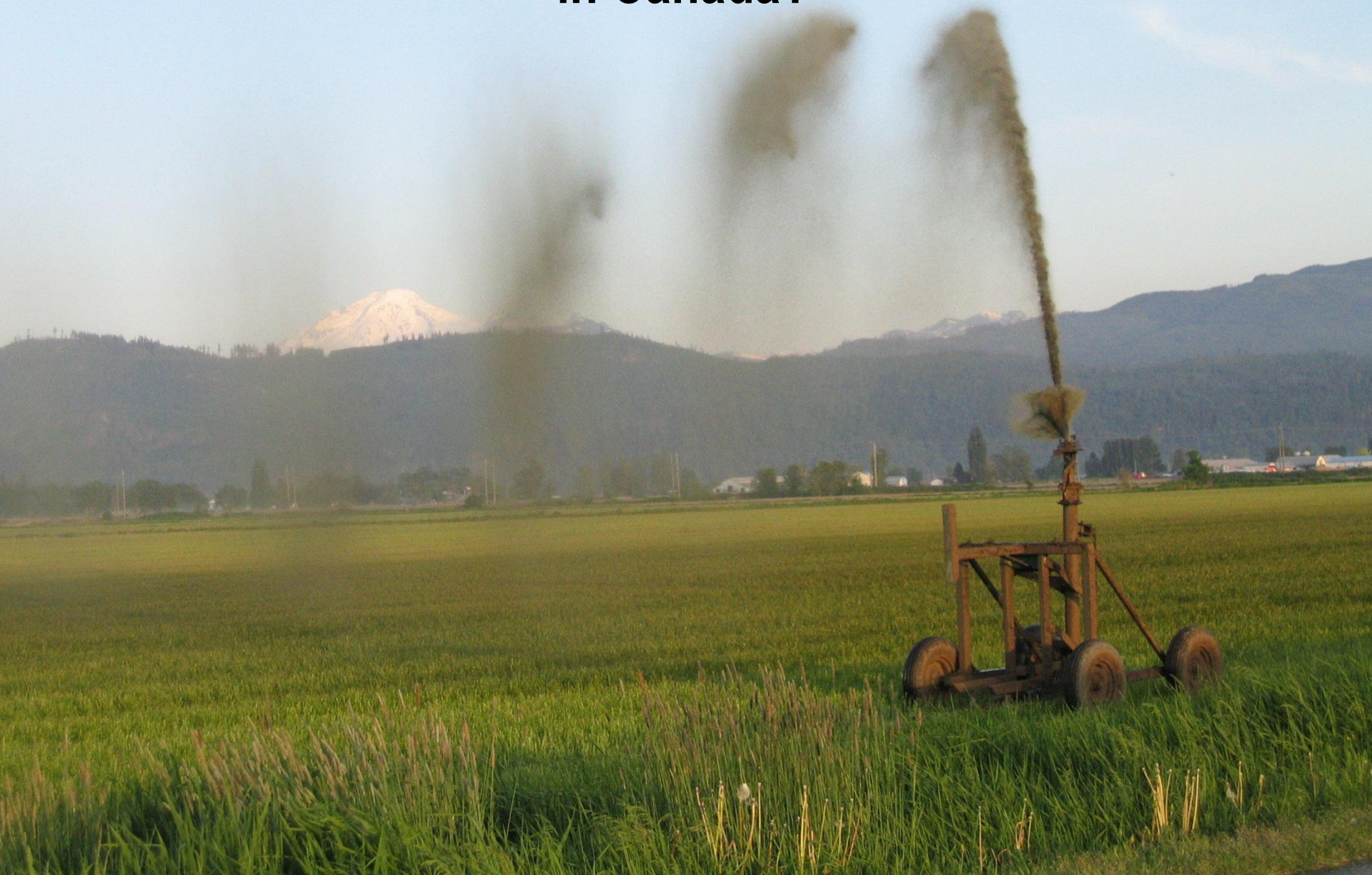
Ammonia Mitigation Workshop

Feb 29, 2012 St. Petersburg, Russia

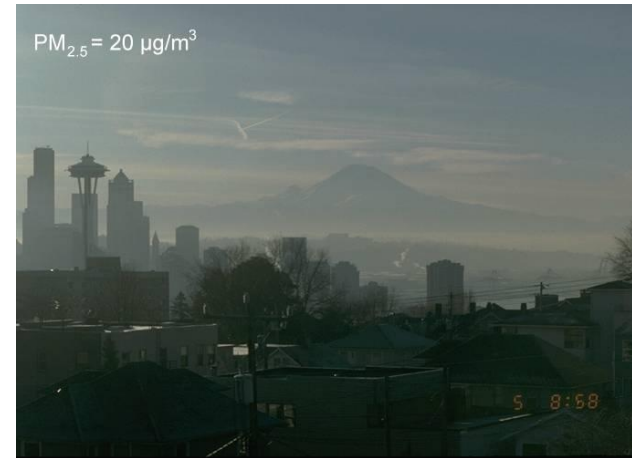
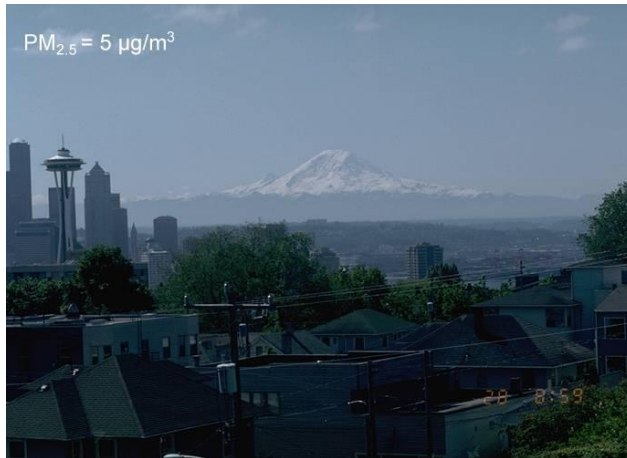
Shabtai Bittman and Keith Jones
Agriculture and Agri-Food Canada, Agassiz, BC
Environment Canada Vancouver, BC

Canada

What is driving interest in atmospheric ammonia in Canada?



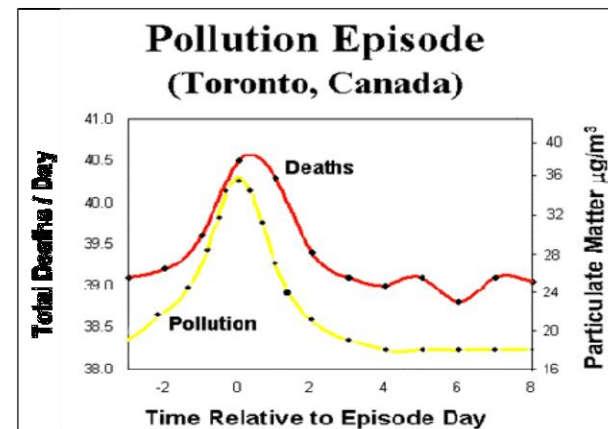
Effect of PM_{2.5}



Photos courtesy of C. Di Cenzo Environment Canada

Ambient particulate matter accelerates coagulation via an IL-6–dependent pathway

J. Clin. Invest., Oct 2007; 117: 2952 - 2961. Gökhan M. Mutlu, David Green, Amy Bellmeyer, Christina M. Baker, Zach Burgess, Nalini Rajamannan, John W. Christman, Nancy Foiles, David W. Kamp, Andrew J. Ghio, Navdeep S. Chandel, David A. Dean, Jacob I. Sznajder, and G.R. Scott Budinger



The View Ahead - Managing Visibility in BC

Tuesday, June 19th, 2007 • 8:30 to 4:30pm • Segal Graduate School of Business



Did You Know?

A single poor visibility day could result in a loss of almost \$9 million in future tourist revenues for the Lower Mainland and Fraser Valley. ⁽¹⁾

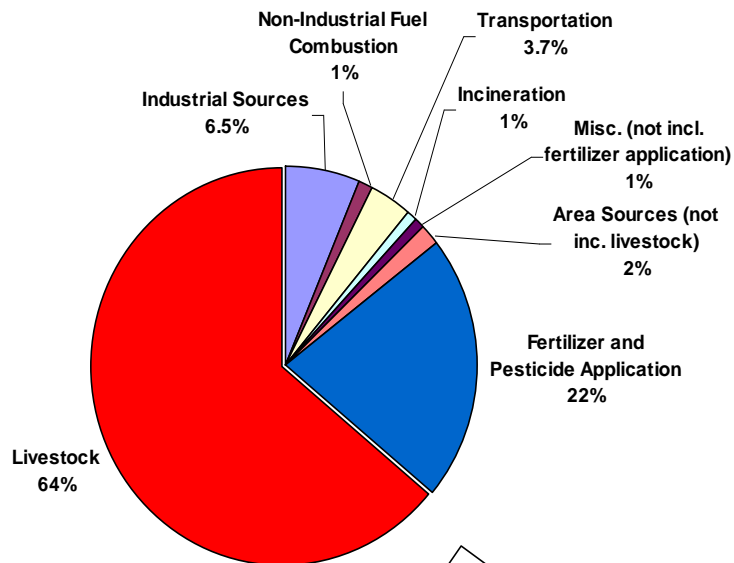
Why is Visibility Important to You?

(1) July 2000 Environment Canada report, *The Impact of Visual air Quality on Tourism Revenues in Greater Vancouver and the Lower Fraser Valley*

An aerial photograph of the Fraser Valley, showing a dense residential area in the foreground and middle ground, surrounded by green hills and mountains in the background. A white haze is visible over the eastern part of the valley, obscuring some of the details of the landscape and the distant mountains. The sky is a clear, pale blue.

White Haze in Eastern part of Lower Fraser Valley

- **Fine Particles ($\text{PM}_{2.5}$)**
- **Light Scattering**

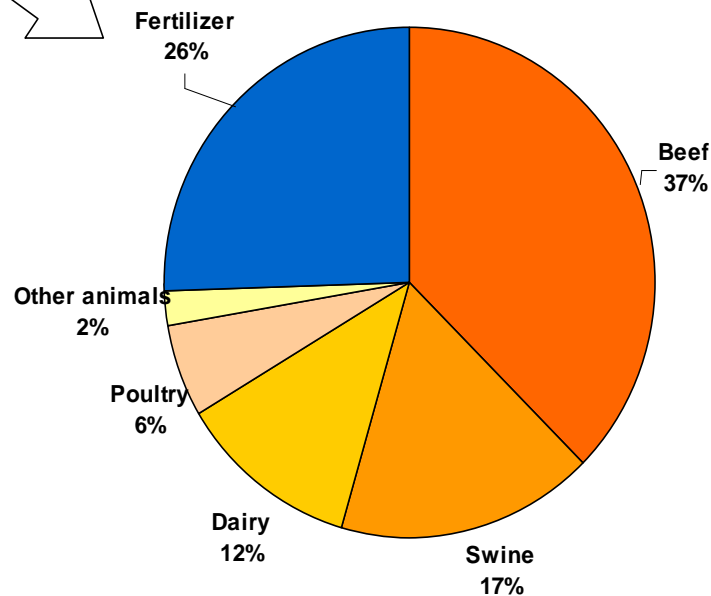


Total 2002 NH₃ Emission:
504.7 ktonnes

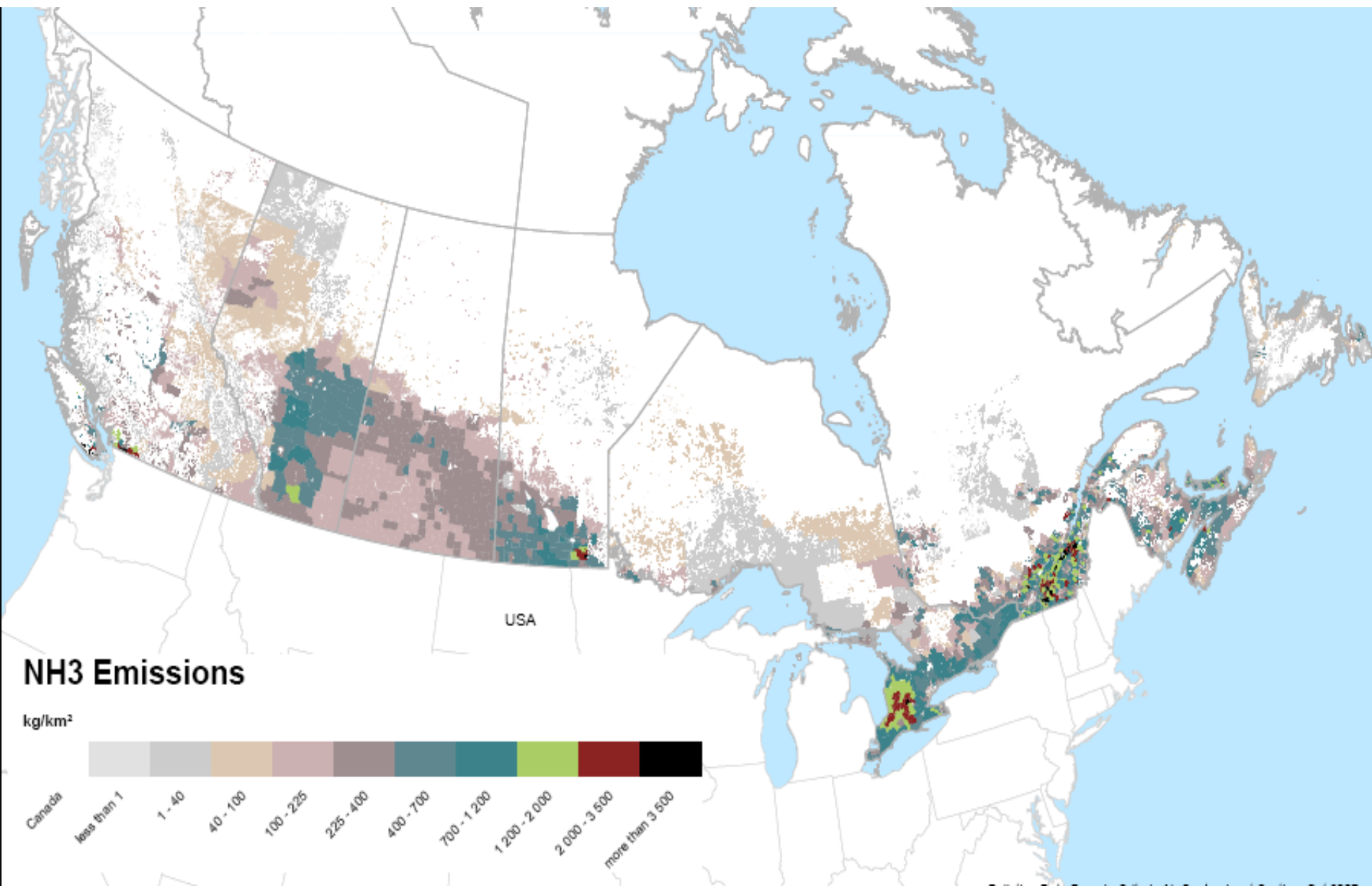
Total 2002 Agricultural NH₃ Emissions:
432 ktonnes

Total Livestock NH₃ Emissions:
322 ktonnes

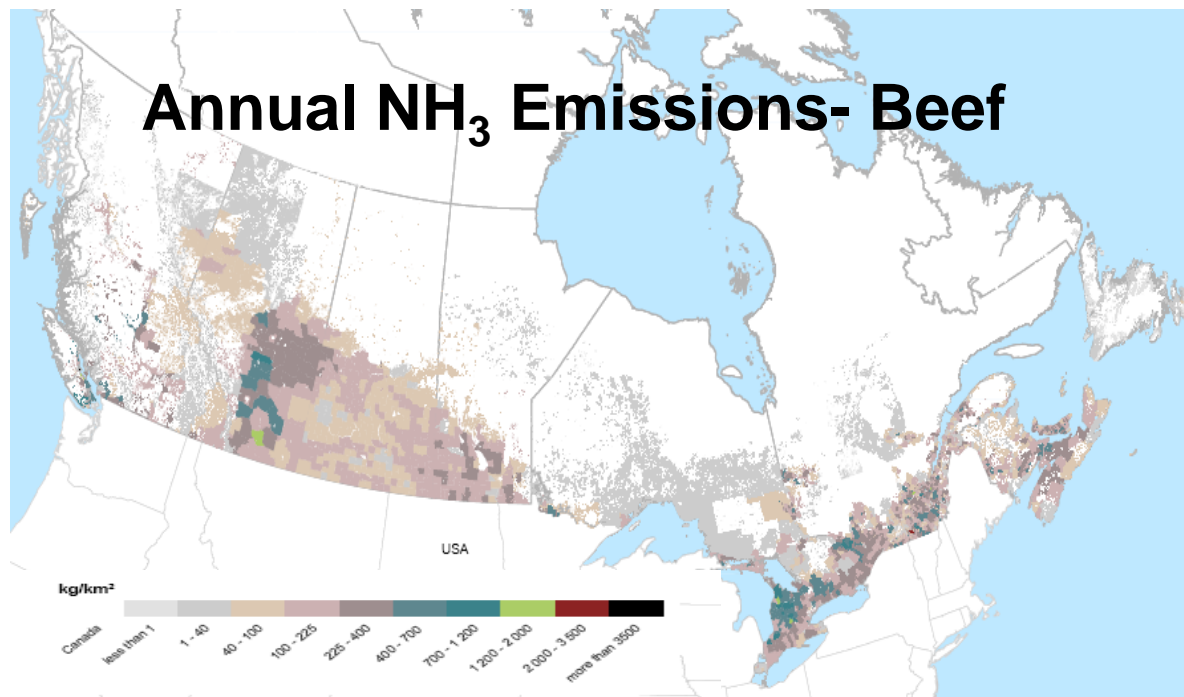
Total Fertilizer Application NH₃ Emissions:
110 ktonnes



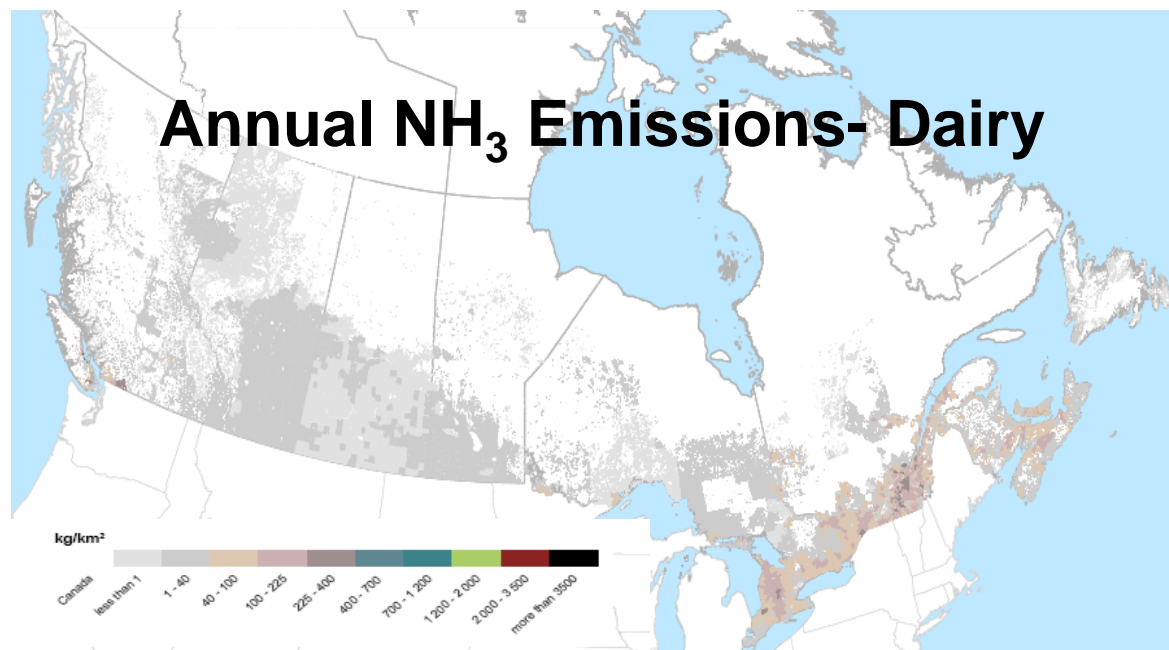
Annual NH_3 emissions all sources



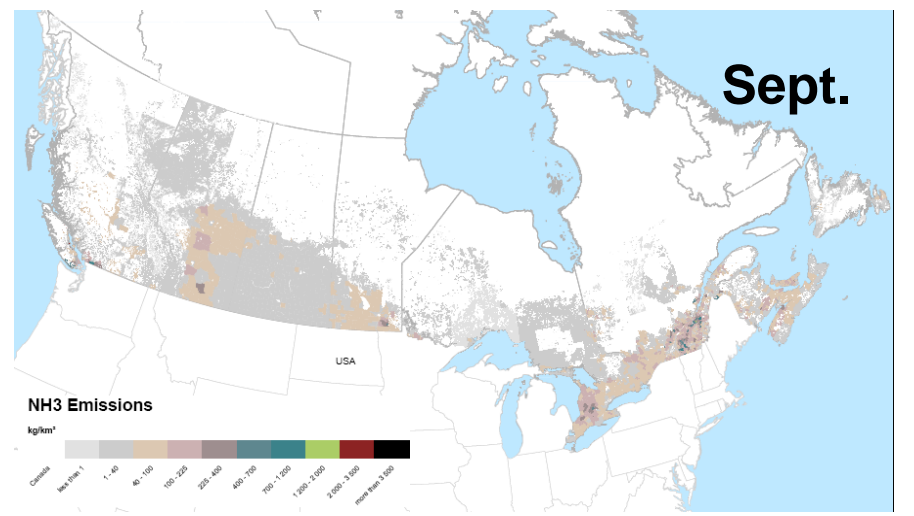
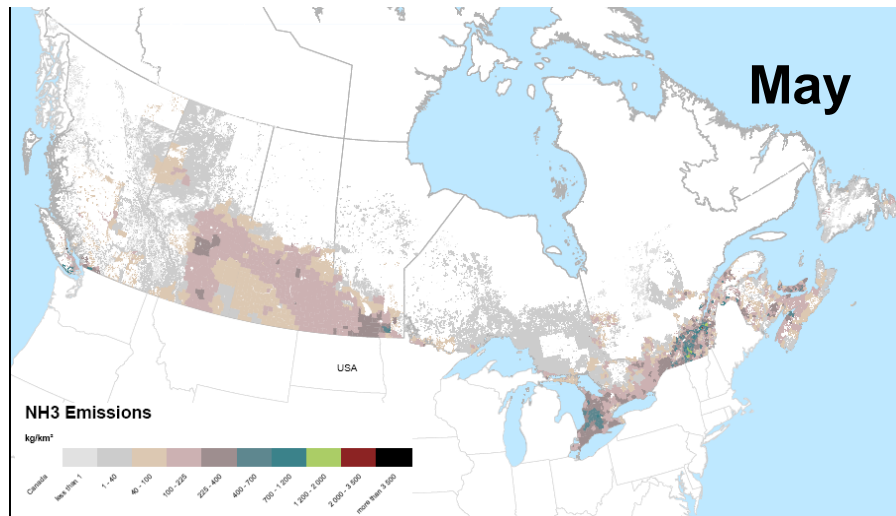
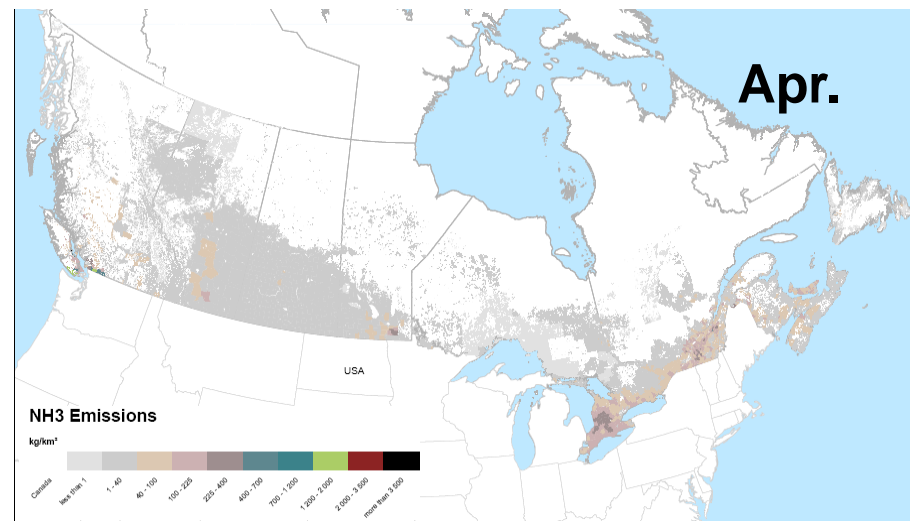
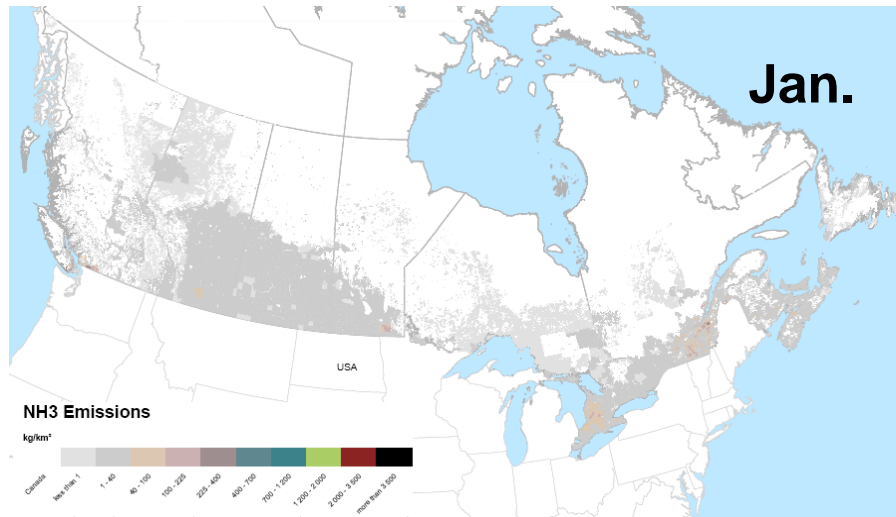
Annual NH₃ Emissions- Beef



Annual NH₃ Emissions- Dairy



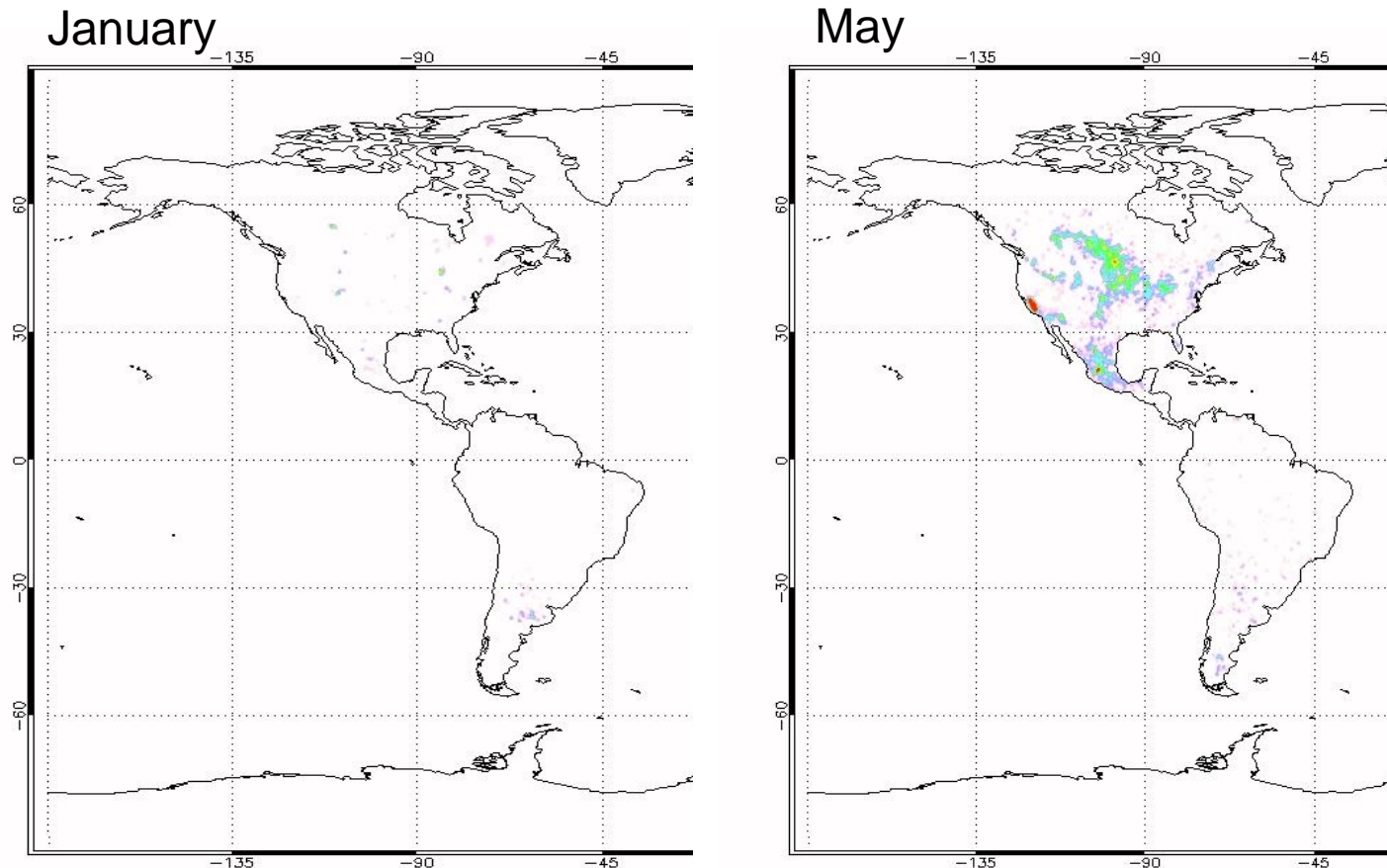
Monthly NH_3 emissions from all agricultural sources



Ammonia satellite retrieval

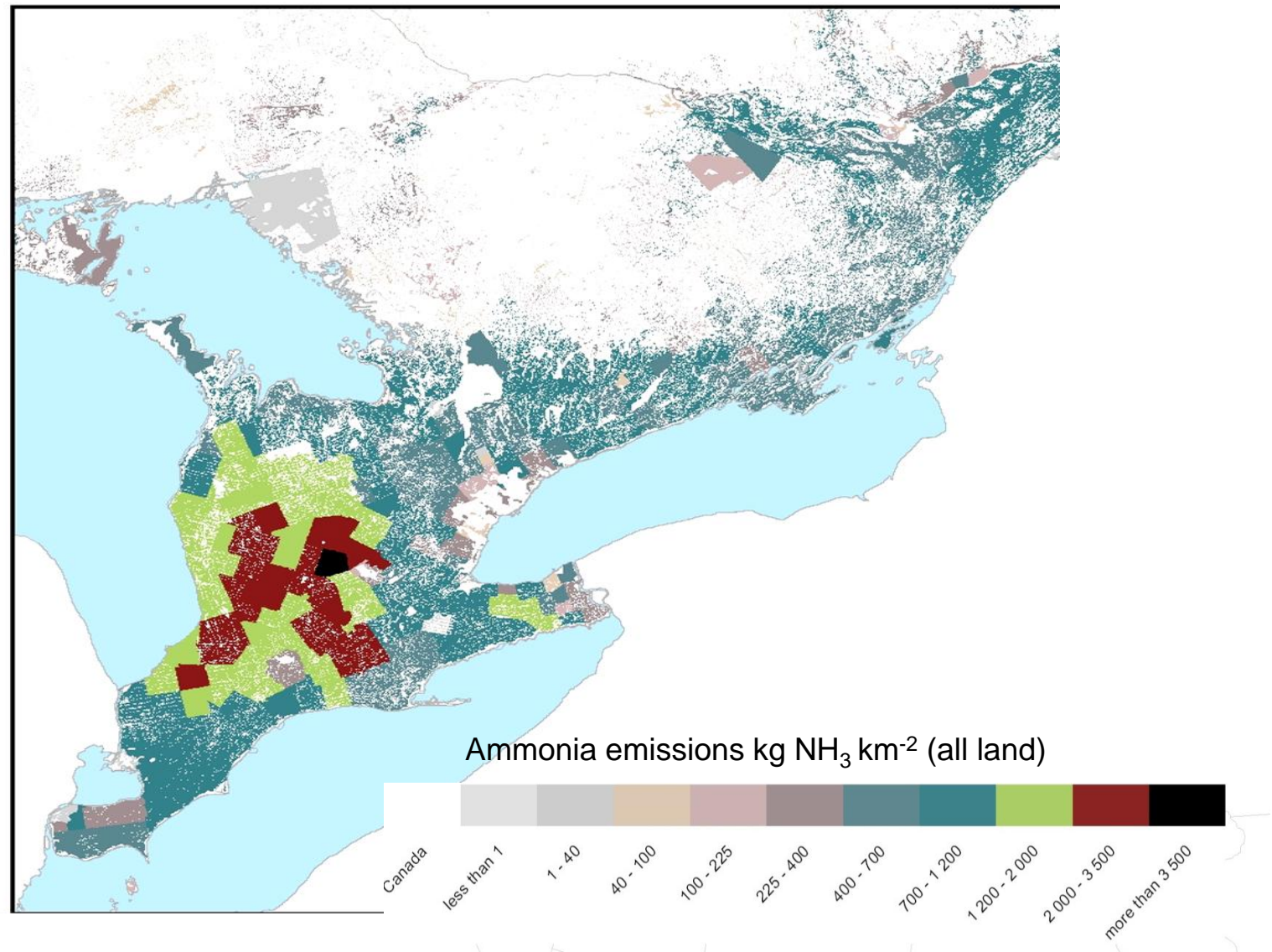
Lieven Clarisse

University Libre, Brussels, Belgium

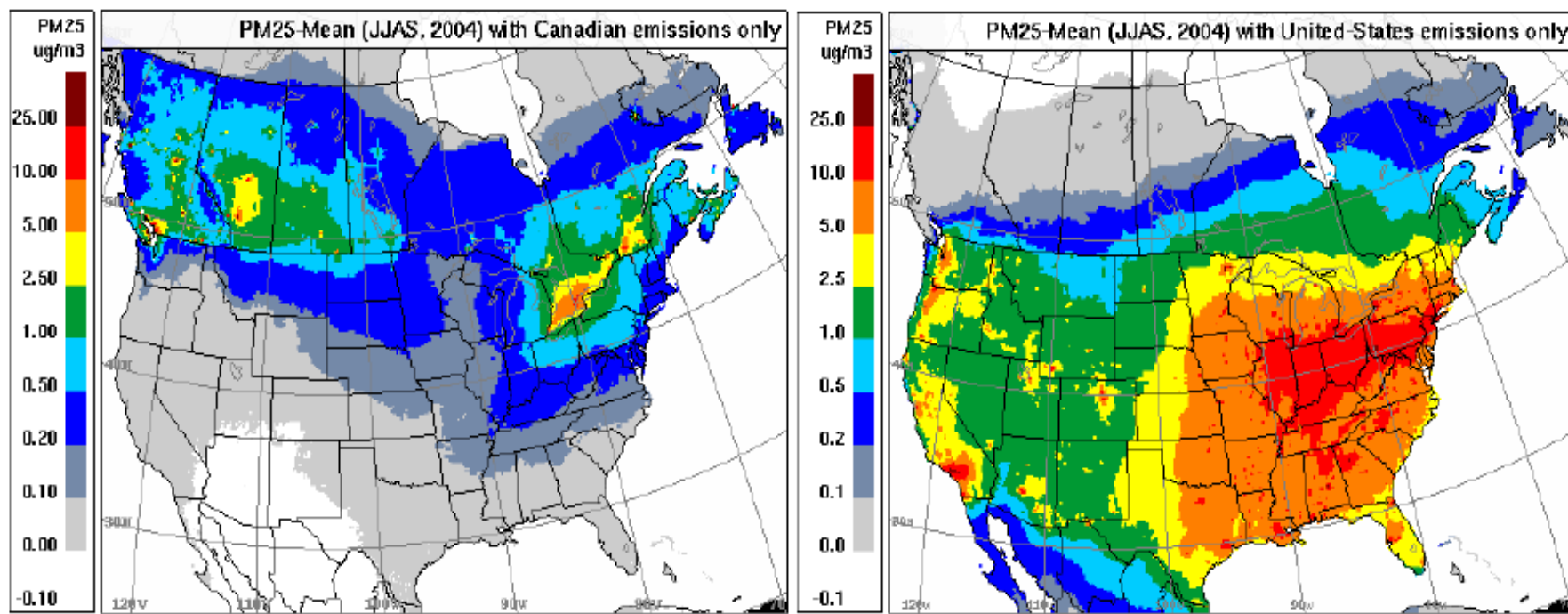


Annual NH_3 Emission -All Agricultural Sources

spatial resolution depends on size of census district (based on human population)



Predicted Transboundary Contributions to Mean Ambient $PM_{2.5}$ Concentration ($\mu g/m^3$) in Summer 2004 from (left) Canadian emissions; (right) U.S. emissions (from *2008 Cdn Smog Assessment*)



DRAFT - Page 24 - October 3, 2009

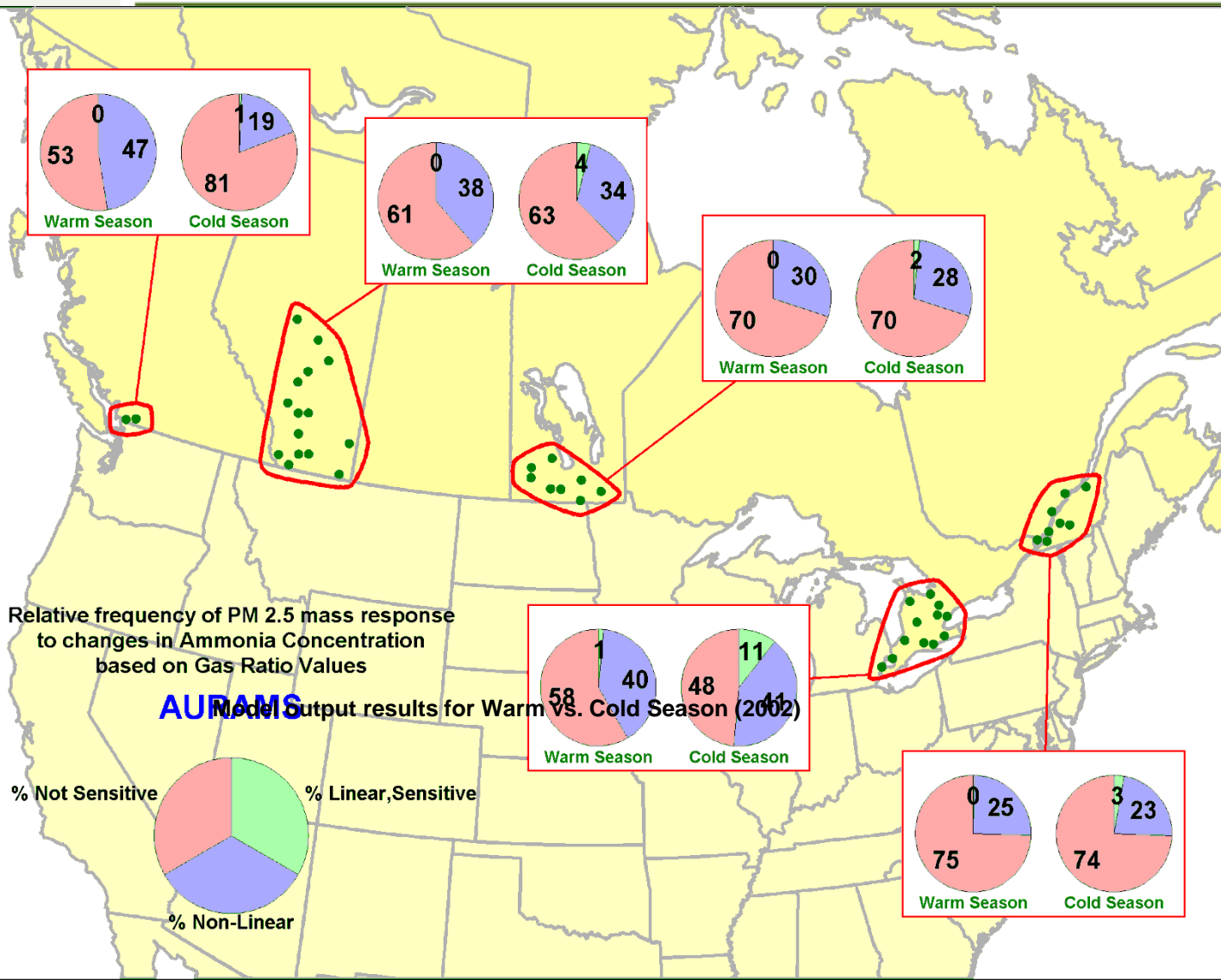


Environment
Canada

Environnement
Canada

Canada

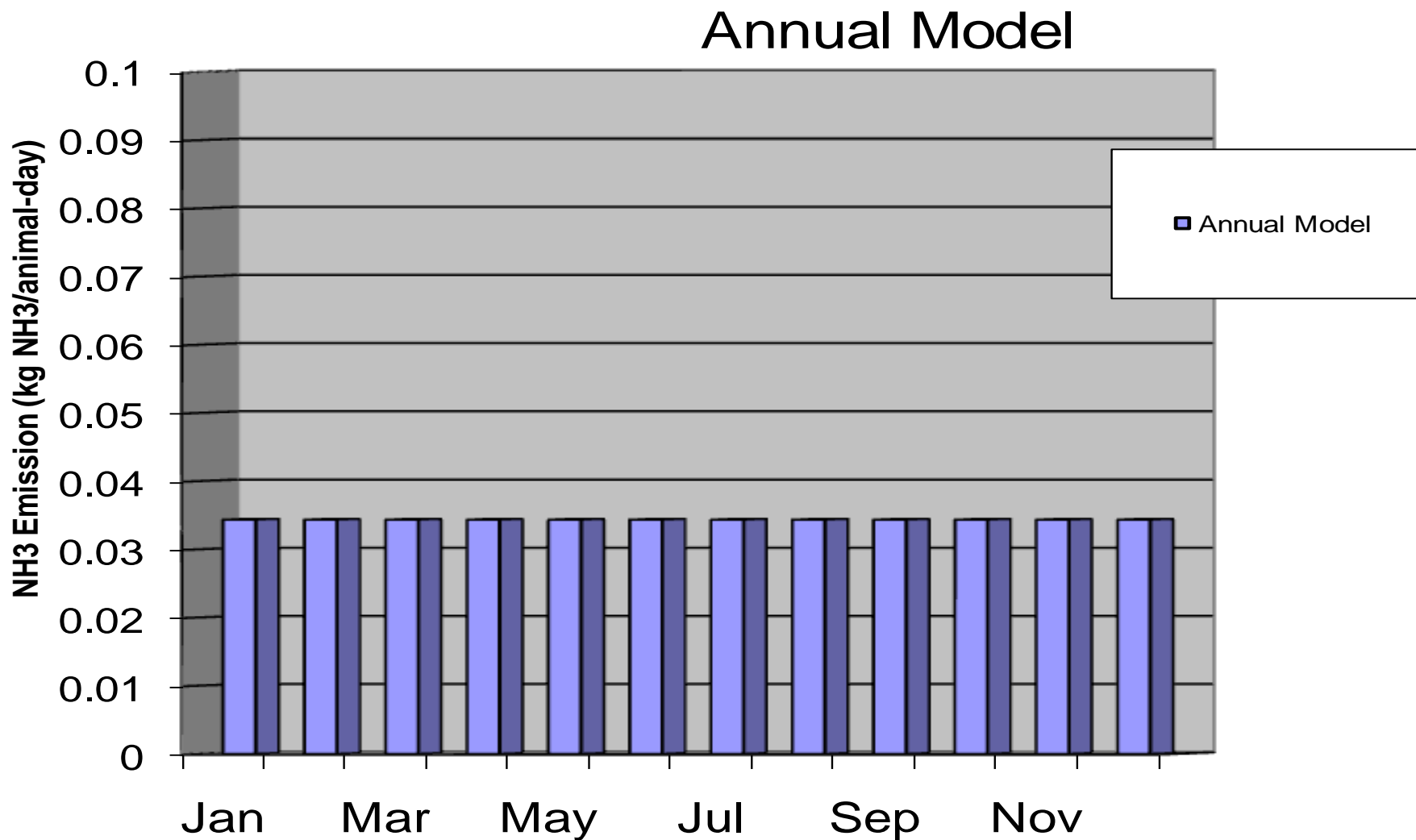
Sensitivity of particulate matter to perturbations in NH_3



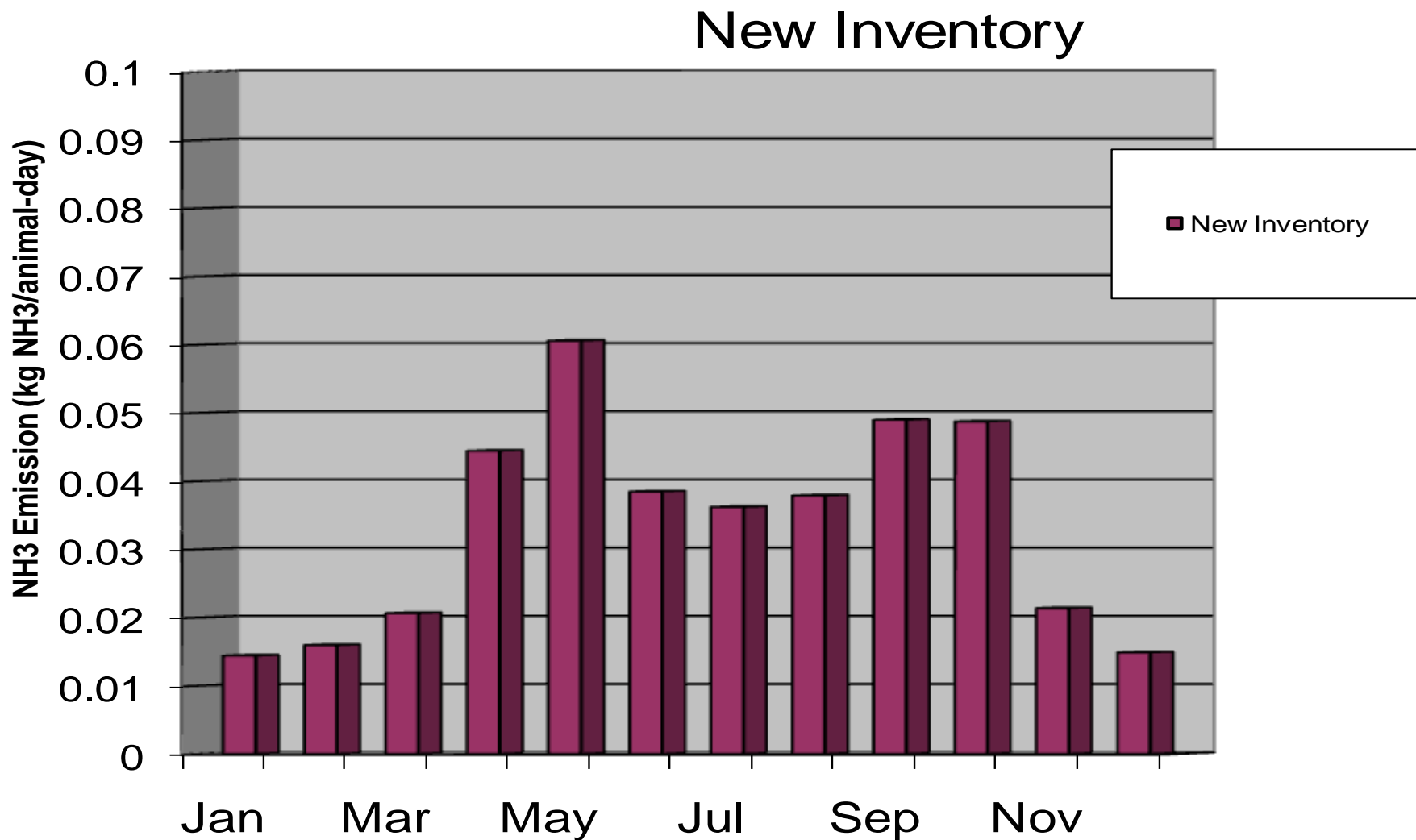
Several methodologies used to determine the sensitivity of PM to changes in NH_3

A weight-of-evidence approach allowed the categorization of L-M-H sensitivity for six agricultural areas

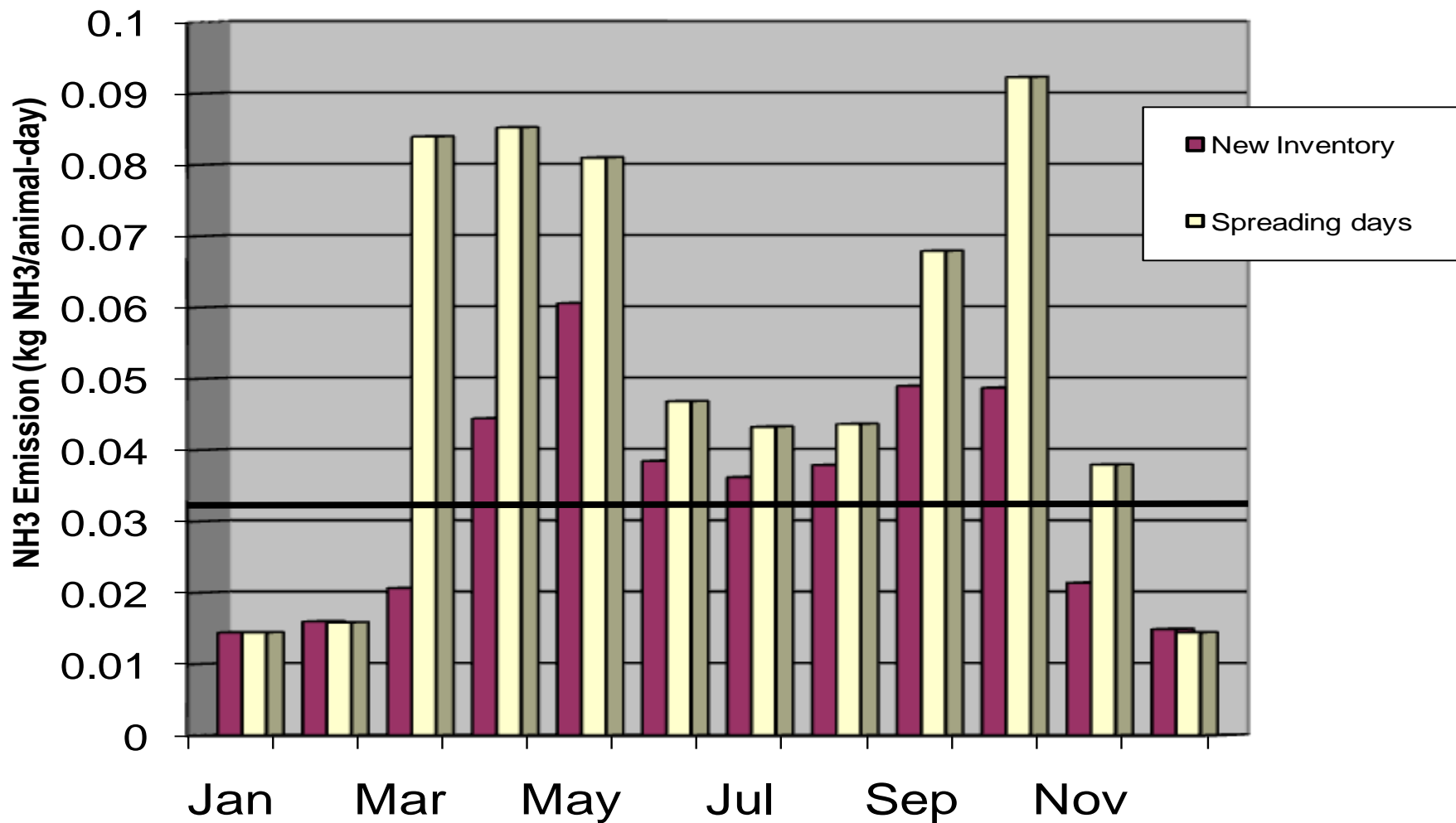
Daily ammonia emissions from dairy cattle using different models



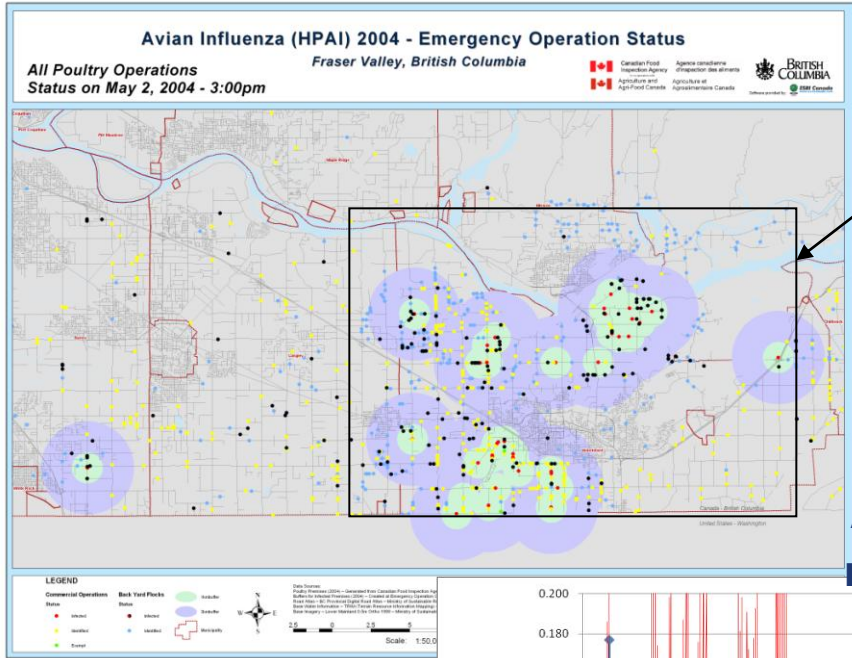
Daily ammonia emissions from dairy cattle using different models



Daily ammonia emissions from dairy cattle using different models

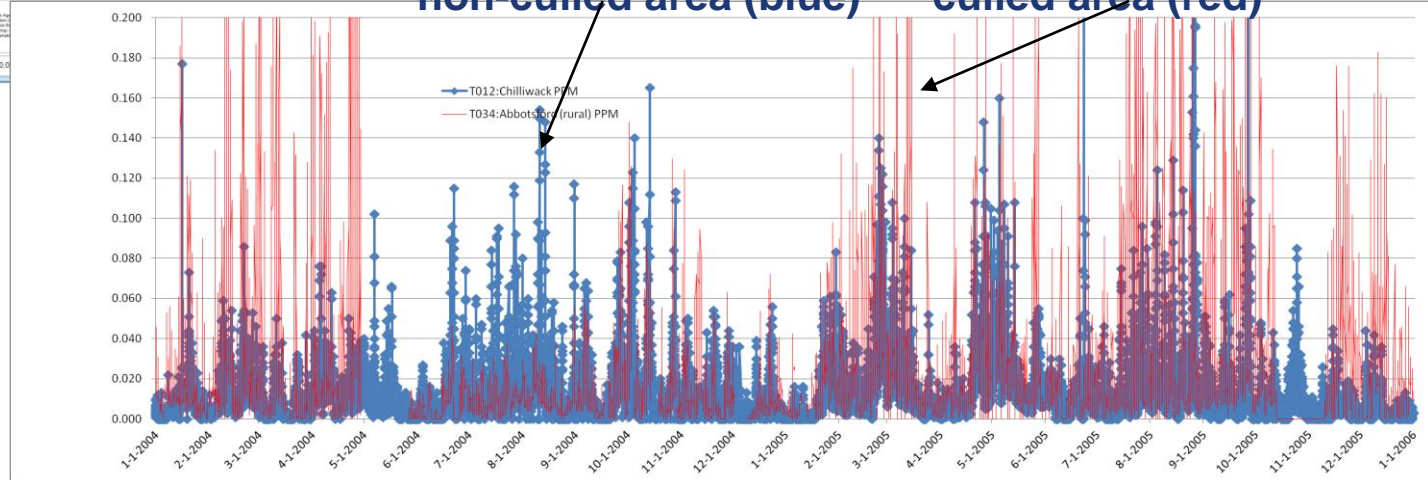


Evidence of link between poultry barns and atmospheric ammonia during the poultry cull

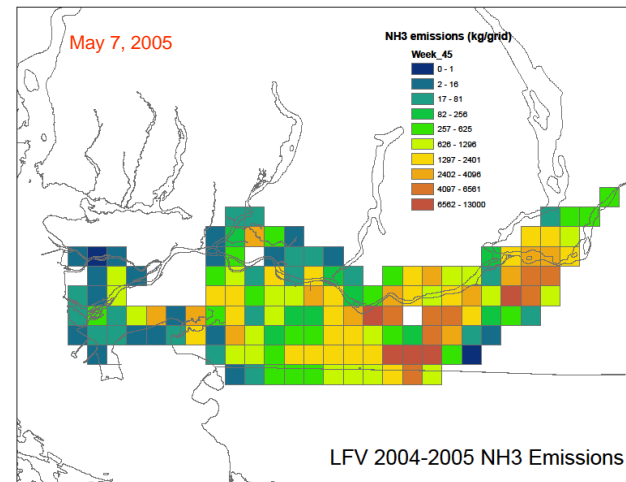
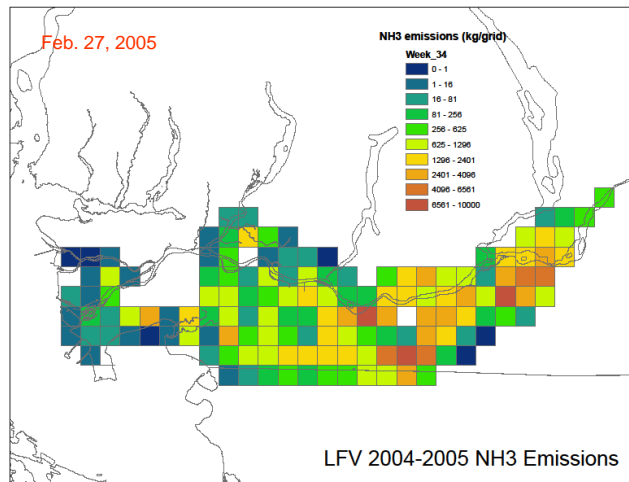
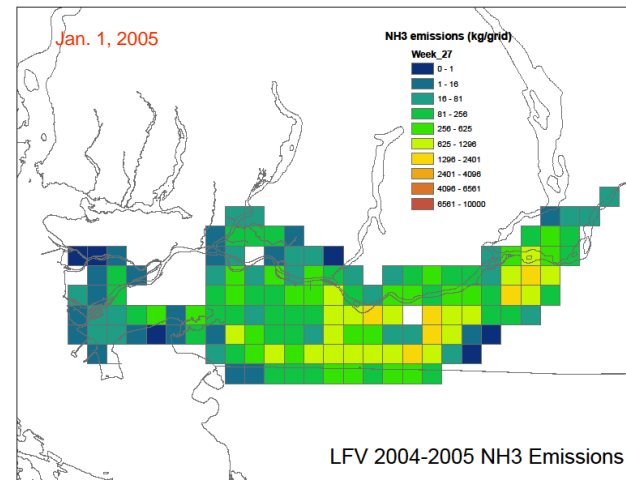
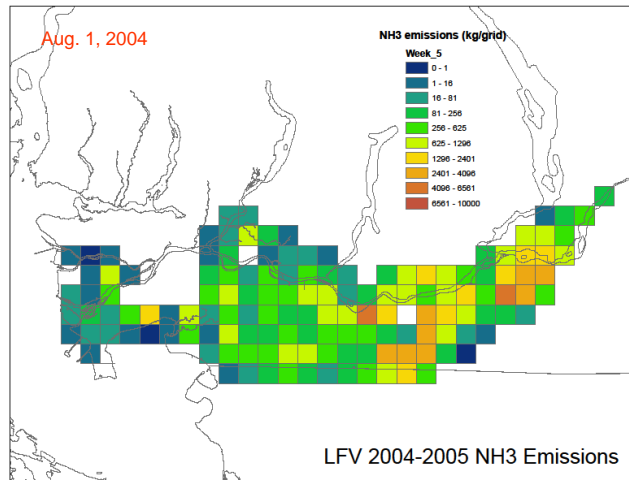


Poultry
cull area

Atmospheric ammonia concentration

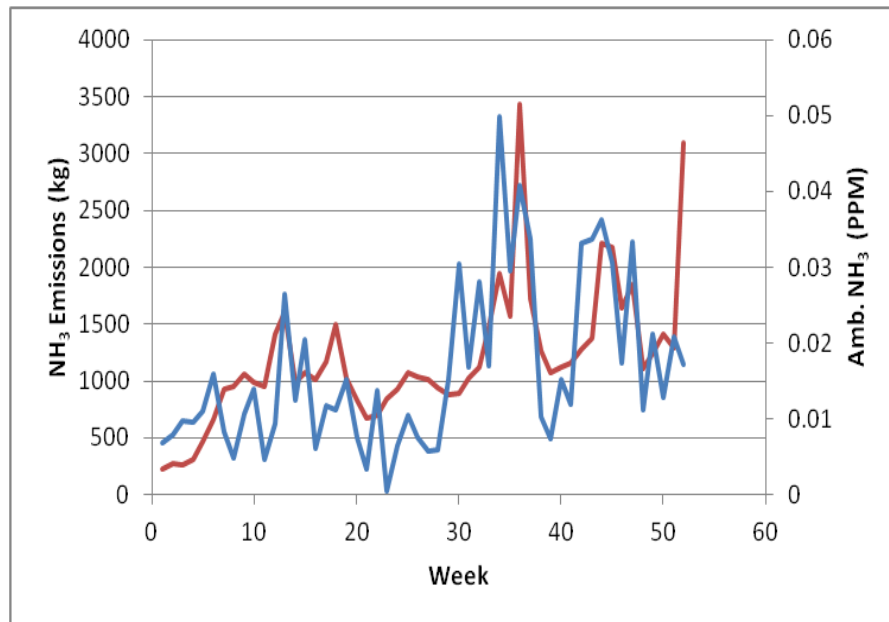


Emission of NH_3 (kg grid^{-1}) from 4 km grids in 1-wk showing spatial and temporal variation

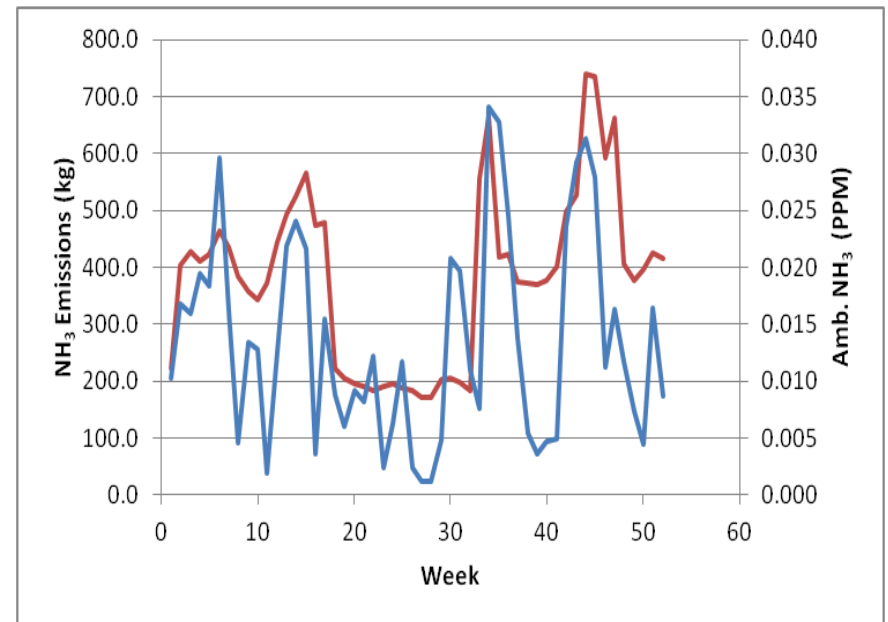


Weekly average ambient ammonia concentration (ppm) and weekly emission (kg) in poultry cull and non-cull areas over 52 weeks in lower Fraser Valley of BC, Canada

Cull area



Non-cull area



Blue= emission; red = ambient

Correlation coefficient between weekly ammonia emissions (from inventory) and weekly average ambient NH₃ concentrations over 12 months in 2004-05

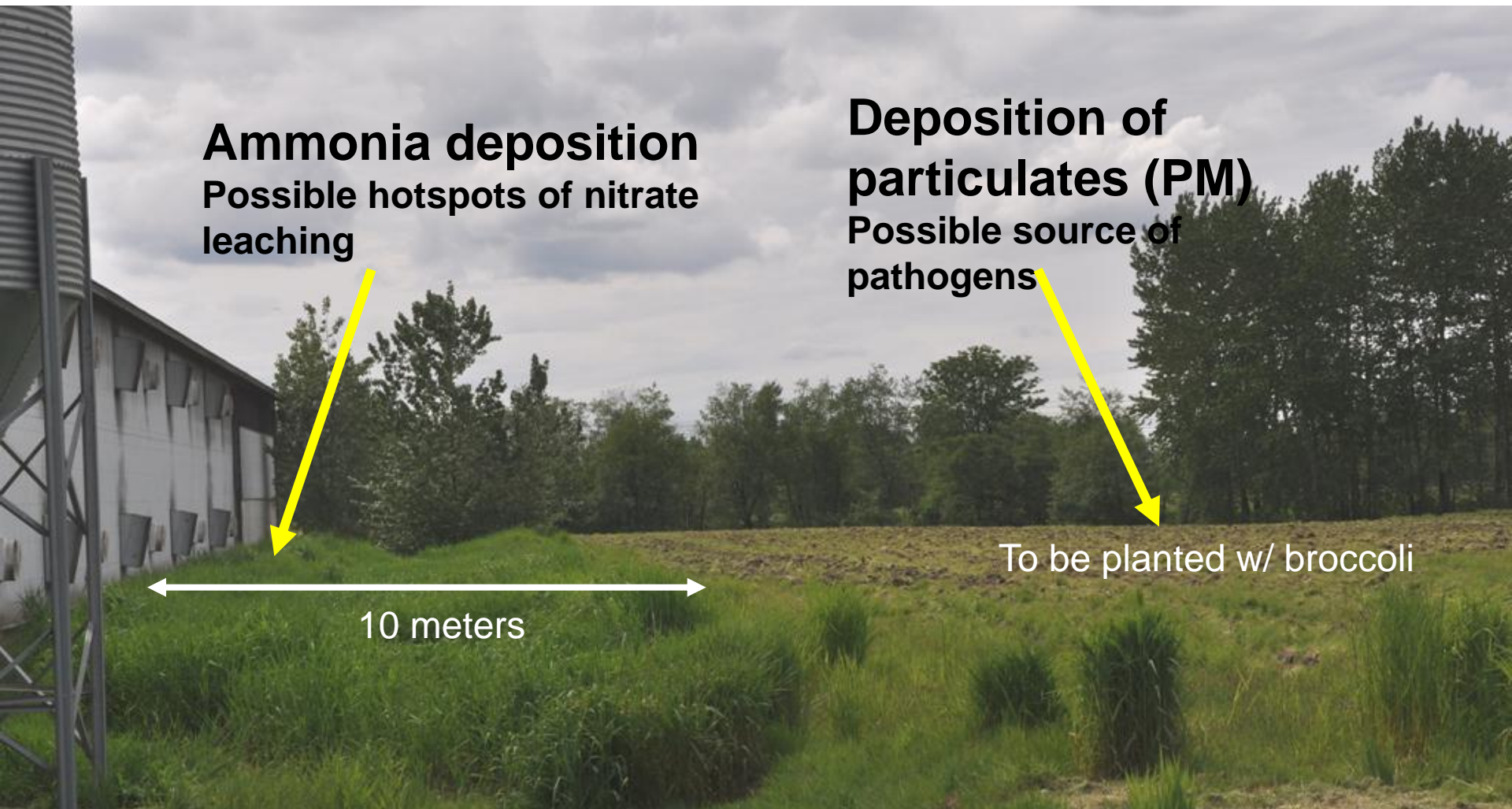
Poultry cull area during cull and restock

| Grid | R ² |
|------|----------------|
| 457 | 0.40 |
| 499 | 0.36 |

Non-cull area

| Grid | R ² |
|------|----------------|
| 344 | 0.35 |
| 385 | 0.33 |

Other concerns about emissions from poultry barns



Ammonia Emissions reduce N surplus on soil

| | tonne N/ cull area |
|---|--------------------|
| Total N in Feed input | 6,862 |
| Home-grown feed | 768 |
| Imported feed | 6,094 |
| Fertilizer N Applied | 526 |
| | - |
| N in milk/meat Product | 3,290 |
| N loss as NH ₃ (incl. fert losses) | 1,074 |
| Manure N Exported from Grids | 685 |
| NET N SURPLUS REMAINING IN GRID | 1,571 |

- Ammonia N emission (1,074t)= ~15% of imported N from all commercial sources
- How is the 1,571 tonnes surplus distributed across grids?

Calculating NH₃ emissions?

Integrate
with GHG?

Farm activity data

Farm activity
survey
-Feed quality

X

Emission factor or model

X

No. of animals or amt. fertilizer use

Key Ammonia Abatement Measures

- Phase feeding (cost saving)
- Deep Injection and shallow injection (odour)
- Manure incorporation (tilage systems)
- Fertilizer injection (cost saving)
- Grazing (cow-calf)
- Increased legumes (rotations)- reduce fertilizer

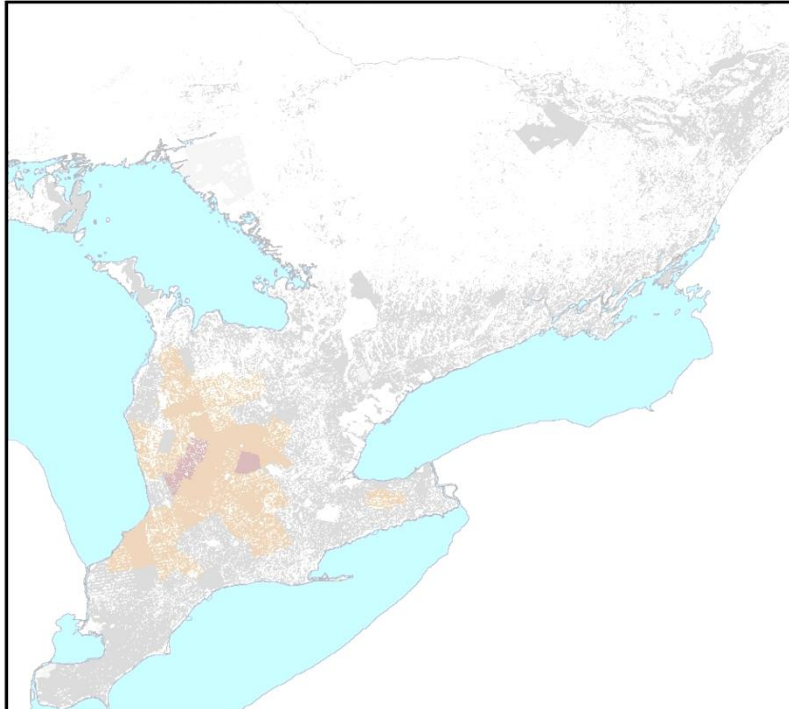
But

- Increase use of urea fertilizer
- Increased no-till and perennial crops
- Dry Distillers Grains
- More loose housing

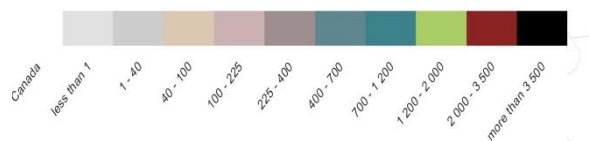
Thank you



Ammonia Emissions in January



Ammonia emissions kg km⁻² (all land)



Ammonia Emissions in May

