Task Force on Reactive Nitrogen (TFRN)

First meeting of

Expert Panel on Mitigation of Agricultural Nitrogen

(EPMAN-1)

Milan, IT

12 November 2008

Expert Panel on Mitigation of Agricultural Nitrogen emissions (EPMAN)

Approach

- Chairs: Martin Dedina (CZ) and Shabtai Bittman (Canada)
- Workshop to support GP revision (Nov. 12, 2008)

Key issues

- Links to emissions of other Nr forms
- Seasonality of NH_3 emissions (particulate matter impacts)
- Possible farm NH_3 emission cap for application of BAT

From Sutton and Oenema report to WGSR-42

LRTAP
Long-range Transboundary Air Pollution

Expert Panel on Mitigation of Agricultural Nitrogen Emissions (EPMAN)

Objectives

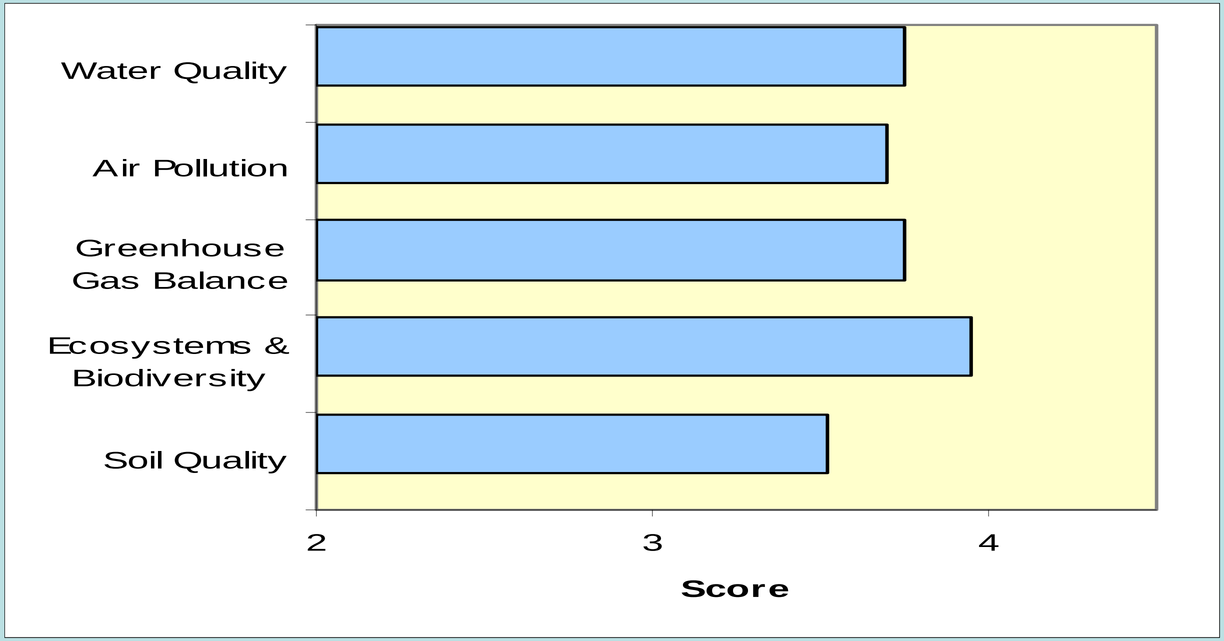
- To develop options for a more integrated approach to mitigate Nr emissions from agriculture;
- To continue work of the former Ammonia Expert Group;
- To contribute Gothenburg Protocol revision;
  - Code of Good Agricultural Practice, Annex IX, Guidance Document

From Sutton and Oenema report to WGSR-42

Nr & Society
The NitroNet Poll

In collaboration with
The Green Room, BBC News.

If one molecule of reactive nitrogen has multiple effects in the environment, what priority would you give to minimizing the following threats? (Score each 1-5)



From Sutton and Oenema report to WGSR-42

Role of EPMAN

- Traditional- Expert group on NH_3 abatement
  - Ongoing reassessment of abatement data-
    - Are they still valid?
  - New abatement technology
- NEW- Task Force on Reactive N
  - Improve on synergisms and interactions NH_3 abatement with other N compounds and
  - Improve costing
  - Seasonal emission factors
  - other environmental factors (pathogens, P, etc)

Discussion Points

New technology & market development has potential to reduce costs

From Sutton Oenema report to WGSR-42

Emission estimate

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Table 2

(a) Category 1 abatement techniques for slurry application to land*

Abatement measure	Type of manure	Land use	Emission Reduction (%)	Applicability[a/]	Costs (OPEX)[b/] (Euro per m^3)
Trailing hose	Slurry	Grassland, arable land	30 Emission reduction may be less if applied on grass <10 cm.	Slope (<15% for tankers; <25% for umbilical systems); not for slurry that is viscous or has a large straw content, size and shape of field should be considered.	2.67 [c/]
Trailing shoe	Slurry	Mainly grassland	60**	Slope (<15% for tankers; <25% for umbilical systems); not viscous slurry, size and shape of the field, grass height should be > 8 cm.	2.45 [c/]
Shallow injection (open slot)	Slurry	Grassland	70**	Slope < 10%, greater limitations for soil type and conditions, not viscous slurry.	3.43 [c/]
Deep injection (closed slot)	Slurry	Mainly grassland, arable land	80	Slope < 10%, greater limitations for soil type and conditions, not viscous slurry.	2.89 [c/]

EPMAN –budget approach

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uly 2007

Table 2

(a) Category 1 abatement techniques for slurry application to land*

Abatement measure	Type of manure	Land use	Emission Reduction (%)	Applicability[a]	Costs (OPEX)[b] (Euro per m^3)	N recovery
Trailing hose	Slurry	Grassland, arable land	30 Emission reduction may be less if applied on grass <10 cm.	Slope (<15% for tankers; <25% for umbilical systems); not for slurry that is viscous or has a large straw content, size and shape of field should be considered.	2.67 [c]	20%
Trailing shoe	Slurry	Mainly grassland	60**	Slope (<15% for tankers; <25% for umbilical systems); not viscous slurry, size and shape of the field, grass height should be > 8 cm.	2.45 [c]	40
Shallow injection (open slot)	Slurry	Grassland	70**	Slope < 10%, greater limitations for soil type and conditions, not viscous slurry.	3.43 [c]	-10 to 0
Deep injection (closed slot)	Slurry	Mainly grassland, arable land	80	Slope < 10%, greater limitations for soil type and conditions, not viscous slurry.	2.89 [c]	

Unintended consequences

grazing

Grazing

106. Urine excreted by grazing animals often infiltrates into the soil before substantial NH_3 emissions can occur. Therefore, NH_3 emissions per animal are less for grazing animals than for those housed where the excreta is collected, stored and applied to land. The emission reduction achieved by increasing the proportion of the year spent grazing will depend, inter alia, on the baseline (emission of ungrazed animals), the time the animals are grazed, and the N fertilizer level of the pasture. The potential for increasing grazing is often limited by soil type, topography, farm size and structure (distances), climatic conditions, etc. It should be noted that additional grazing of animals may increase other forms of N emission (e.g. N_2O, NO_3). However, given the clear and well quantified effect on NH_3 emissions, this can be classed as a category 1 technique (in relation to modification of the periods when animals are housed or grazed for 24 hours a day). The abatement efficiency may be considered as the relative total NH_3 emissions from grazing versus housed systems. The actual abatement potential will depend on the base situation of each animal sector in each country.

Unintended consequences

grazing

- Urine N is not volatilized- what happens to it?
- Grazing increased leaching in the DeMarke Model Farm, NL
- Lost N needs to be replaced with fertilizer
- Fate of urine (urea) in compacted areas of congregation (shade, water, etc) ?

Feed N-- Grazing

- Springtime herbage (esp. with legumes) can be over 20 or 25%
- Dairy requirement ~16%, beef cows ~12%
- What becomes of excreted N?

Feed N-- Confinement

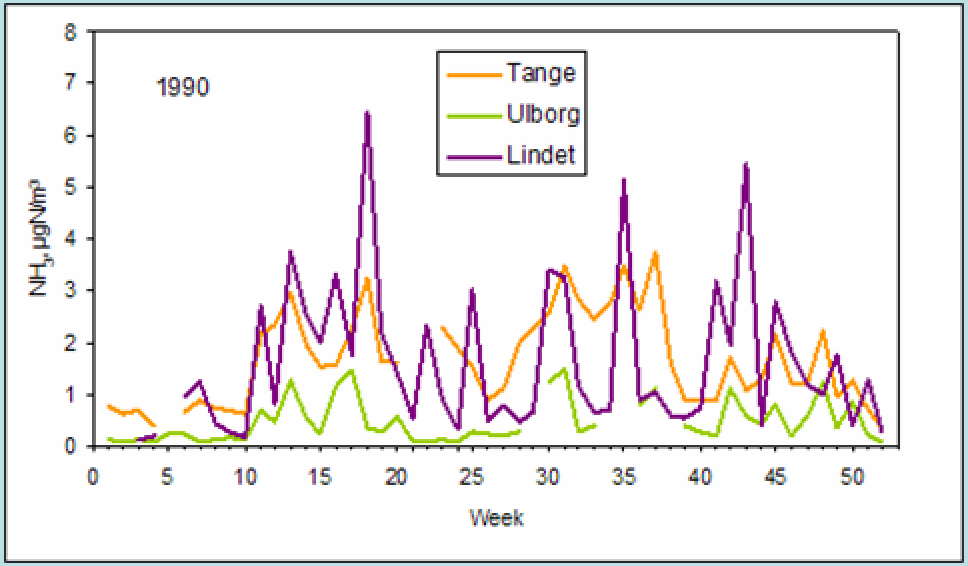
- Goal to reduce surplus N, but
  - Ruminant nutrition very complex (ruminant dynamics requires synchrony of energy, digestible fiber and degradable and bypass protein
  - Homegrown feed variable (weather storage) and not usually tested
  - Is purchased feed over formulated?

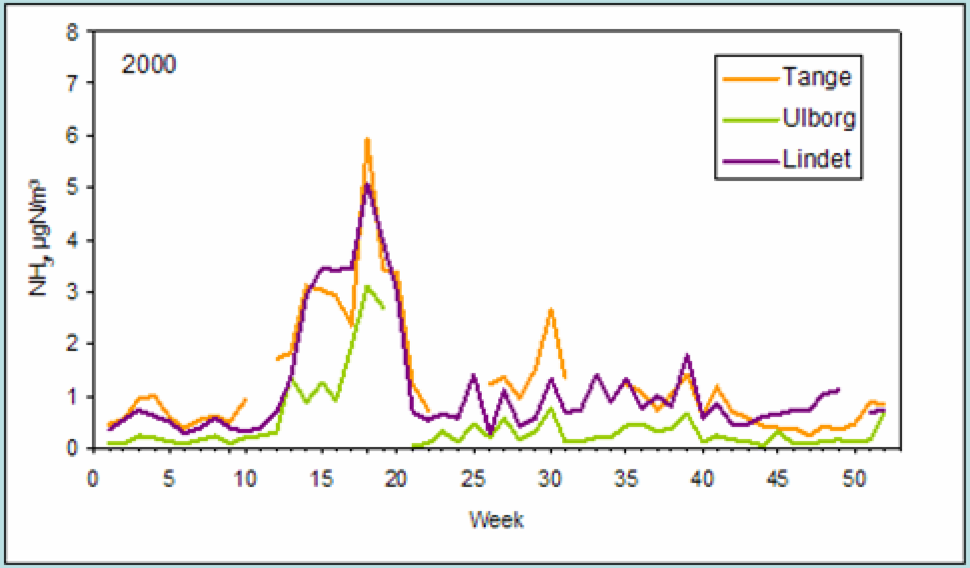
Calculation issue

- Because emissions are based on animal numbers, there is benefit for reducing animal numbers – improving milk/ egg production (and meat animal growth rate to reduce emission times).
- Note: These goals often require relatively high feed-N and excretion per animal, in contrast to feeding strategy in items 94, 103 etc.

Effect of time

Effect of Danish nitrogen mitigation policy on ammonia levels





- Implemented measures reducing ammonia and nitrate.
- Ammonia measures reduced overall concentrations.
- Nitrate measures provided new spring peak in ammonia.

Question: What is the environmental impact of this new peak?

From Sutton and Oenema report to WGSR-42

Effect of time

- Need to consider time of application to assess

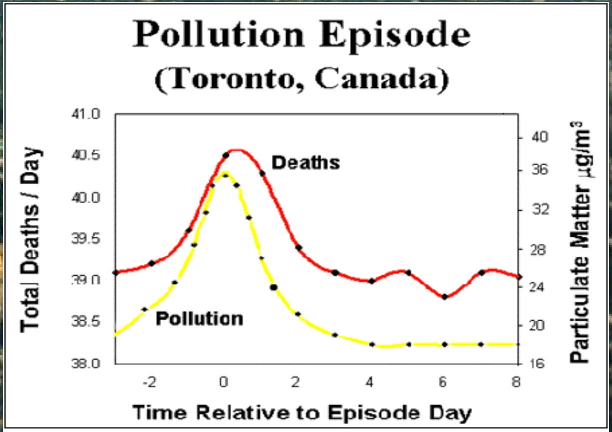
    a/ baseline losses

    b/ efficacy of abatement

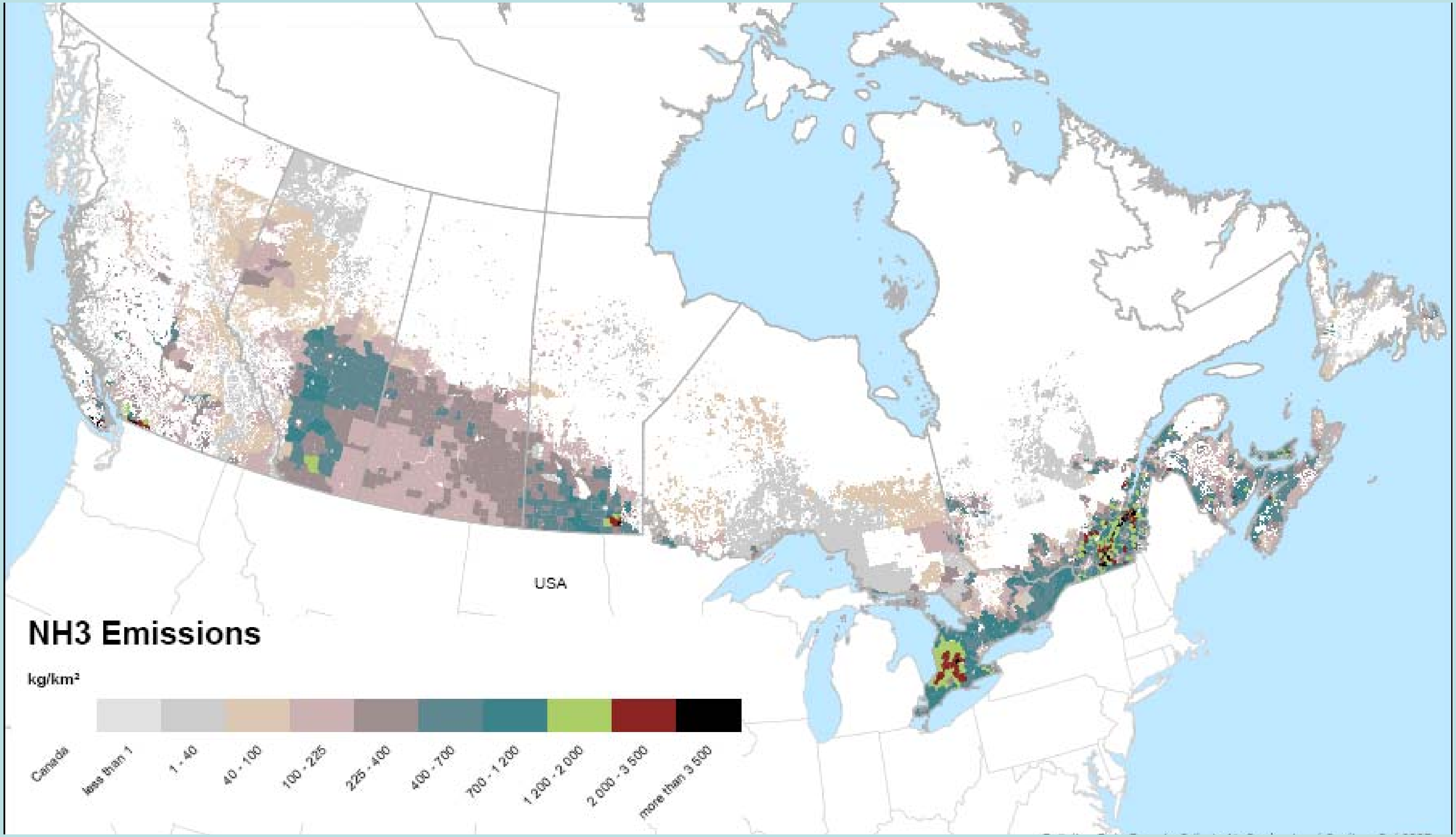
- E.g. under cool springtime conditions with low baseline emissions, what is benefit of low-emission spreading techniques?

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

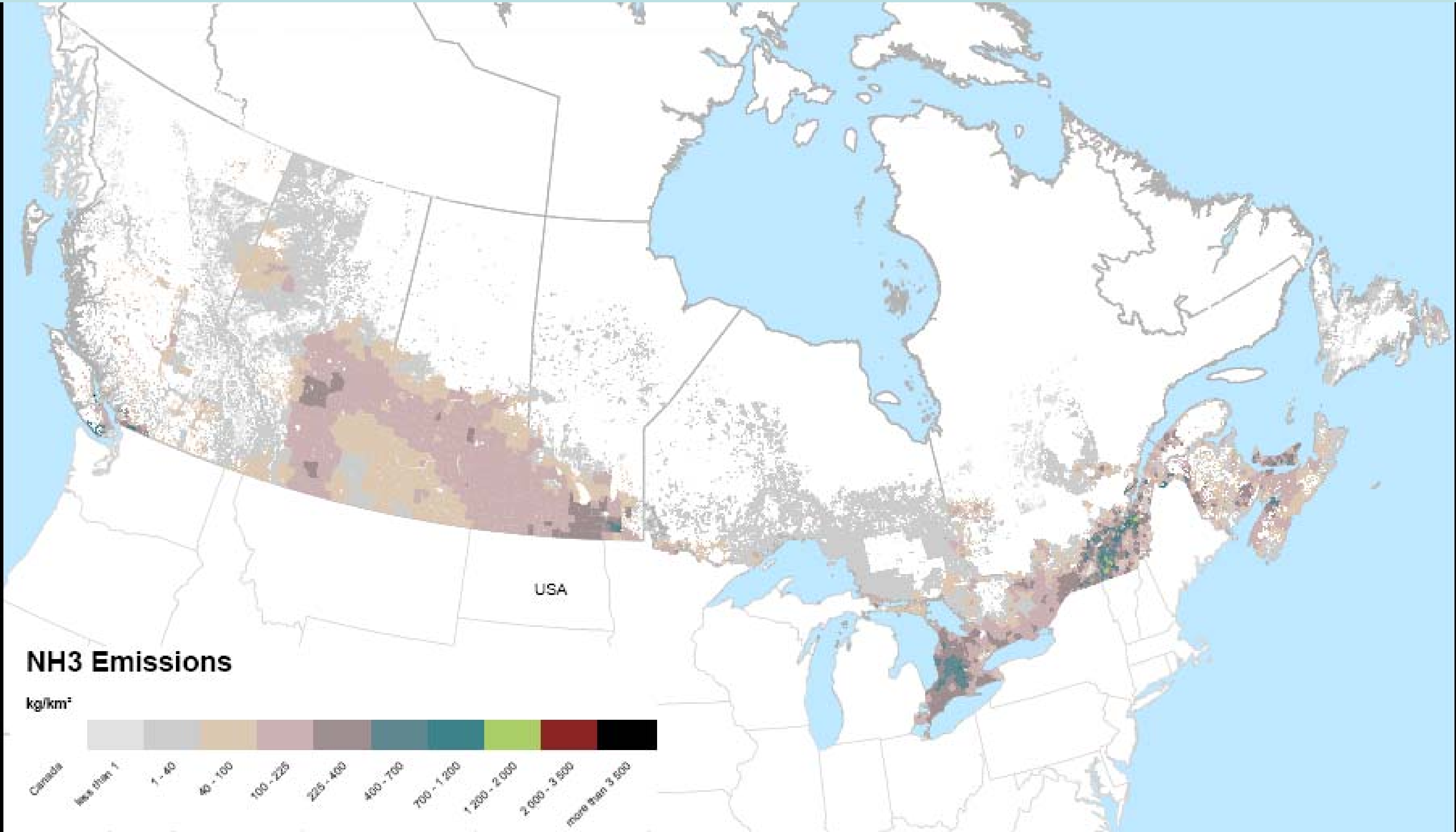
J. Clin. Invest., Oct 2007; 117: 2952 - 2961. Gökhan M. Mutlu, David Green, Amy Bellmeyer, Christina M. Baker, Zach Burgess, Nalini Rajamannan, John W. Christman, Nancy Foiles, David W. Kamp, Andrew J. Ghio, Navdeep S. Chandel, David A. Dean, Jacob I. Sznajder, and G.R. Scott Budinger



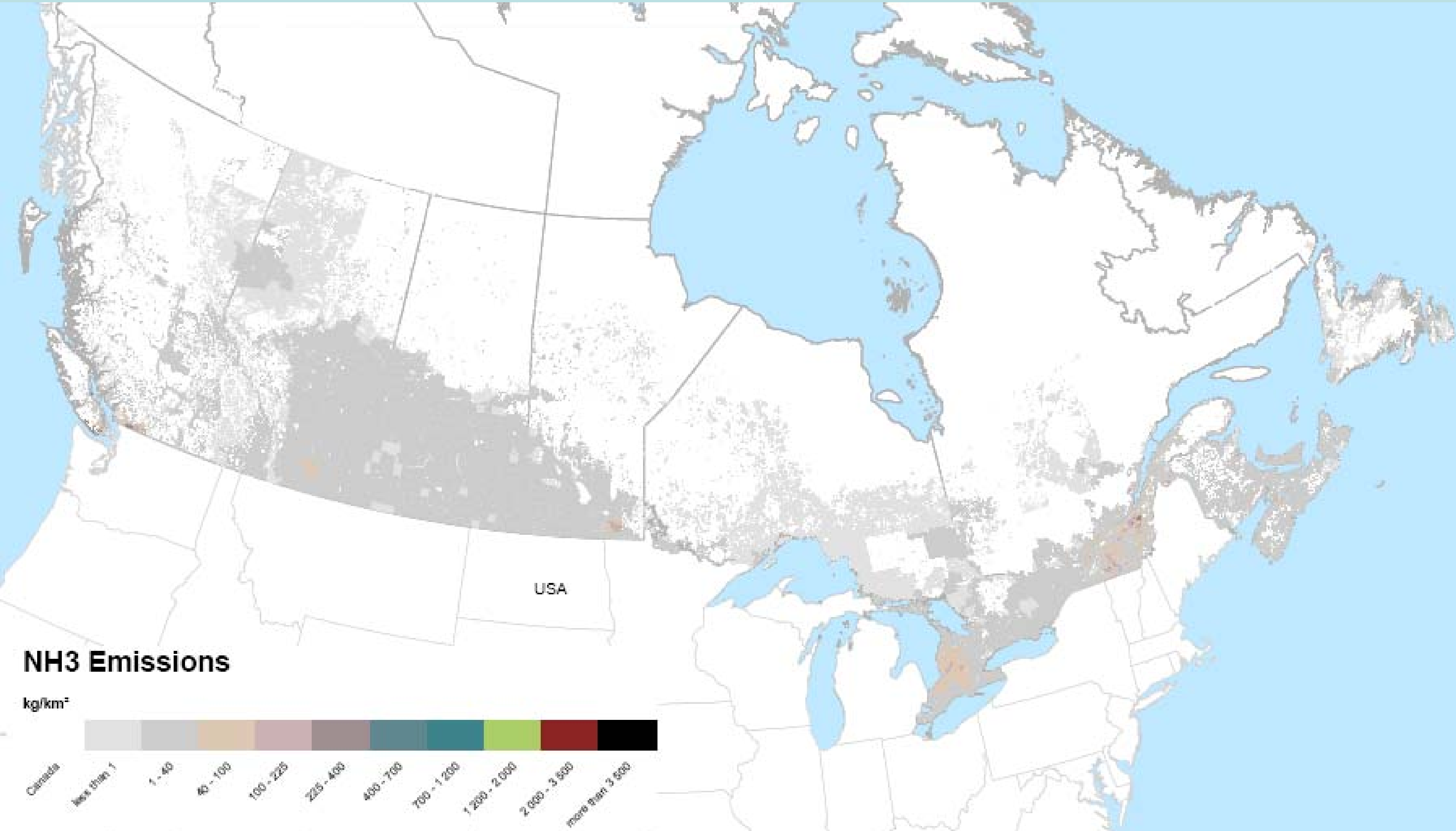
Annual NH3 emissions 2002



NH3 emissions May 2002



NH3 emissions Jan. 2002



New technologies not covered

- Manure injection into standing corn, reduces leaching risk and ammonia loss (need long fields)- being done in Ontario and Quebec on sandy soils where leaching into tile drainage is a huge concern for pathogens

New technologies

- Controlled release urea fertilizer (polymer coated)

- Evidence of usefulness for fall application of fertilizer for winter crops-
- Reduces N2O emissions and
- May increase yield (match to crop growth)

Conflicting Interests

- Cultivation of manure for NH3 reduction
- vs minimum-tillage for soil and fuel conservation

Non –N synergies

Scrubbers to reduce PM emissions may help reduce ammonia

EPMAN Activities

EPMAN Objective:

Revise 3 N-Abatement Documents

LRTAP
Long-range Transboundary Air Pollution

Possible contributions of TFRN to the revision of Gothenborg Protocol (1)

To provide technical information related to:

- New insights and information related to NH_3 abatement measures, including possible synergies and trade offs;
- Integrated measures for decreasing NO_X, NH_3 and N_2O emissions to air and NO_3-leaching to water;
- Highlight interactions between the measures in Gothenburg Protocol and Climate Change Policy;

From Sutton report to WGSR-42

LRTAP
Long-range Transboundary Air Pollution

Possible contributions of TFRN to the revision of Gothenborg Protocol (2)

To provide technical information related to:

- the roles of managerial measures and structural measures on NH_3 emissions;
- integrative indicators for N use efficiency in agriculture;
- economic instruments for effective implementation of policies aimed at decreasing N emissions;

Tasks

- Annex IX on NH_3, Code of Good Practice, Guidance Doc.

From Sutton report to WGSR-42

Outlook

- Recommendations of EPMAN have to be adopted by the TFRN (meeting in Garmisch, Germany, April 2009).
- Recommendations of TFRN have to be adopted by WGSR and the Executive Body (meetings Geneve, September 2009).
- Revision of the Protocol……

Annex IX

MEASURES FOR THE CONTROL OF EMISSIONS OF AMMONIA FROM AGRICULTURAL SOURCES

1. The Parties that are subject to obligations in article 3, paragraph 8 (a), shall take the measures set out in this annex.

2. Each Party shall take due account of the need to reduce losses from the whole nitrogen cycle.

A. Advisory code of good agricultural practice

3. Within one year from the date of entry into force of the present Protocol for it, a Party shall establish, publish and disseminate an advisory code of good agricultural practice to control ammonia emissions. The code shall take into account the specific conditions within the territory of the Party and shall include provisions on:

- Nitrogen management, taking account of the whole nitrogen cycle;
- Livestock feeding strategies;
- Low-emission manure spreading techniques;
- Low-emission manure storage systems;
- Low-emission animal housing systems; and
- Possibilities for limiting ammonia emissions from the use of mineral fertilizers.

Parties should give a title to the code with a view to avoiding confusion with other codes of guidance.

B. Urea and ammonium carbonate fertilizers

4. Within one year from the date of entry into force of the present Protocol for it, a Party shall take such steps as are feasible to limit ammonia emissions from the use of solid fertilizers based on urea.

5. Within one year from the date of entry into force of the present Protocol for it, a Party shall prohibit the use of ammonium carbonate fertilizers.

C. Manure application

6. Each Party shall ensure that low-emission slurry application techniques (as listed in guidance

Gothenburg Protocol (Annex IX)
MEASURES FOR THE CONTROL OF EMISSIONS OF AMMONIA FROM AGRICULTURAL

SOURCES

1. **The Parties that are subject to obligations in article 3, paragraph 8 (a), shall take the measures set out in this annex.**
2. **Each Party shall take due account of the need to reduce losses from the whole nitrogen cycle.**
   - A. Advisory code of good agricultural practice
   - B. Urea and ammonium carbonate fertilizers
   - C. Manure application
   - D. Manure storage
   - E. Animal housing

From Sutton report to WGSR-42

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EXECUTIVE BODY FOR THE CONVENTION ON
LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Working Group on Strategies and Review

Fortieth session
Geneva, 17–20 September 2007
Item 3 of the provisional agenda

**GUIDANCE DOCUMENT ON CONTROL TECHNIQUES
FOR PREVENTING AND ABATING EMISSIONS OF AMMONIA**

Submitted by the Chairman of the Expert Group on Ammonia Abatement

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17 July 2001

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EXECUTIVE BODY FOR THE CONVENTION ON
LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Working Group on Strategies and Review
(Thirty-third session, Geneva, 24 - 27 September 2001)
Item 4 of the provisional agenda

UNECE FRAMEWORK CODE FOR GOOD AGRICULTURAL PRACTICE FOR REDUCING AMMONIA */

Prepared by the Expert Group on Ammonia Abatement

Suggestions from the co-chairs of TFRN

- Review & revise the three documents where needed:
  - How to invite & encourage farmers to mitigate N emissions;
  - Greater considerations of interactions and synergies of measures as regards the various N species emissions
  - More emphasis on animal feeding, especially (dairy) cattle (using milk urea as indicator?)
  - Using N balances as N use efficiency indicators?

Enhanced Economic Assessment

Current RAINS/GAINS model (Approx)

- Equipment capital and usage costs
- vs gains in N fertilizer value

Additional valuation for consideration under EPMAN

+ Uniform field application (essential for fertilizer replacement)
+ Consistent results
+ More application time
+ No concern about wind
+ Spread closer to field edge (less risk of drifting)
+ Reduced odour

- (Soil compaction and slippage)
- (Slower application /miss application window)

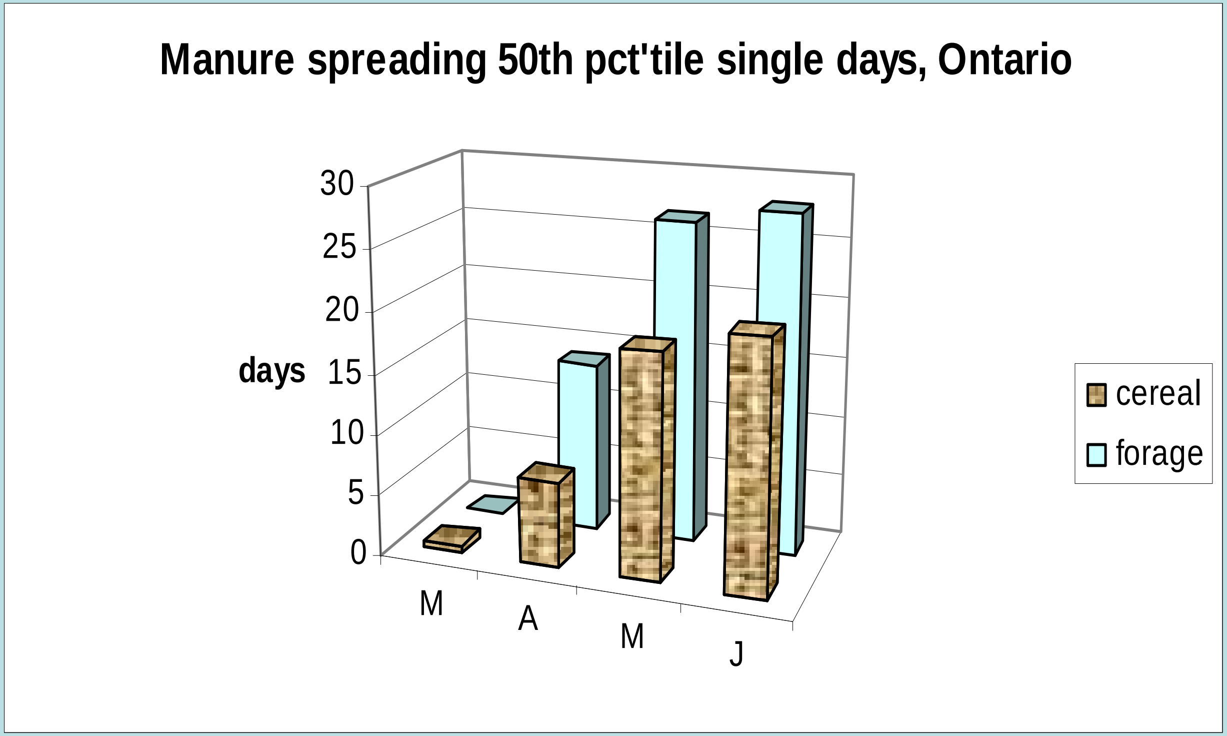
New technology & market development has potential to reduce costs

Enhanced Economics

- (Slower application /miss application window)

Actual manure application days

Ontario, Canada



Ideas for holistic management of N on farms: ‘involving the farmers’

1. Ceilings on total N applied (Denmark and Switzerland)- incentive for efficient N use
2. Indicator based on N use efficiency as the MINAS system; milk urea-N indicator (Oenema)
3. Farm sustainability indicator (Quebec) multi- environmental factors (voluntary self-evaluation) relative to other farmers (G.Allard, U Laval)
4. Real time manure management and regulations (Stakeholder groups) using guidelines and real time tools, (eg TSUM-200, ALFAM, real time weather and forecasts, soil N models)
5. Licensed industry for manure application (as pesticide) with responsibility for records and accountability (paid service to gov.)

Example of daily 'Dashboard' outputs from soil N model for real time N management