



Greenhouse gases: Monitoring and approaches to mitigation



**Transitioning Cereal Systems
to Adapt to Climate Change**

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What are the principal gaps and opportunities for linking efforts in this area to the others covered in the breakout sessions?

- What are the knowledge gaps and priorities for moving forward?
 - Lack of N₂O flux data, generally
 - For mitigation
 - » need info on perennial biofuel feedstocks, how to transition between annual/perennial phases, and better performance measures—longer term concurrent measurements
 - Lack of data for other crop types in other areas
 - What is the process in the spring thaw pulse?
 - Can you manage systems to consume N₂O?
 - What is the best intensity measure for N₂O (normalized by yield)?
 - Need more model development and testing
 - » Initialization of soil carbon is critical
 - » Analysis of synergistic adaptation and mitigation strategies using models
 - How can we identify environmentally optimal crop production
 - How well is agriculture represented in GHG inventory in areas throughout the world?



What sorts of short and long-term activities could promote the needed collaboration and integration?

- What are the next steps?
 - Must address denitrification and relationship to nitrogen use efficiency
 - Need to understand relative importance of nitrification and denitrification processes
 - More work on understanding wetting events, frequency of events, and resulting emissions
 - Need to understand spring thaw pulse
 - Need integrated approach to understanding emission/mitigation options
 - Looking ahead to drought and/or more extreme rainfall events --how will this affect N₂O emissions
 - Comparison of EFs across regions, by soil texture, by precip, etc
 - Better low cost N₂O sensors
 - Improved spatial agronomic management to reduce N₂O emissions
 - Improved N fert technology and practice
 - Need new microbial probes to understand process level dynamics
 - Need to take advantage of new isotopic instrumentation



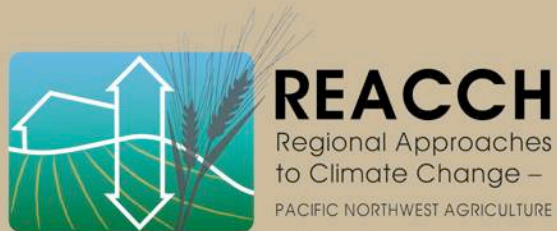


Thank you!

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United States Department of Agriculture
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Monsanto

GHG Monitoring and Mitigation

Key Questions

- What do we know about net fluxes of GHG?
- What do we know about the management of GHG fluxes?
- How well can we model GHG fluxes?

Notes on presentations and discussion

- Mark Liebig: GHG in US Great Plains
 - 42% SOC loss due to cropping (from native grasses)
 - Now, no til, annual $\sim +0.13$ MgC/ha/yr SOC
 - Lack of N₂O data
 - 2 to 5 g N/ha/day (can only release 1 to 3 for GHG neutrality)
 - Projected changes—more denitrification in Northern Plains and SOC reduction in Southern Plains
 - Switchgrass—large SOC accural due to large root biomass—low to moderate N₂O fluxes
 - Gaps
 - Mitigation—info on perennial feedstocks, transition between annual/perennial phases, better performance measures—longer term concurrent measurements

Notes, cont.

- Reynald Lemke GHG emitted from Canadian semiarid prairies
 - Rough equilibrium, slight increase in SOC over time
 - N₂O, highly variable 10 to 350 ugN/m²/hr (spring thaw pulse, after N applied in June—first soil wet-up)
 - Simple EF model using P/PE with modifiers: tillage, slope position, irrigation, soil texture
 - What is the impact of crop rotation?—oilseed-cereal or oilseed-cereal-pulse, etc.
 - 3 yr cum
 - canola-wheat = 2120 g N/ha
 - Pea-wheat and others 990 to 1440 g N/ha
 - Pea-wheat is best on a C harvested scaled basis
 - Canola-wheat is worst on a C harvested scaled basis
 - Including oilseed 'costs' on a per area or scaled basis

Notes, cont.

- Louise Barton—Australia GHG
 - Highly weathered soils
 - N₂O rates 0 to 0.13 kg N/ha/yr w/w/o fert N
 - 0.2% EF factor from fert N—very low
 - Grain legumes do not increase N₂O emissions
 - Increased SOC (incorporated chaff) increases N₂O emissions by 10x over 2.5 yrs
 - Annual rates still low
 - Mitigation—focus on summer rainfall events
 - Liming—increase pH—see slight decrease during an event (cum 0.09 vs 0.13 kg N/ha without liming)
 - Liming increases carbon footprint due to CO₂ release
 - N inhibitors

Notes, cont.

- Peter Grace—adaptation and mitigation
 - GHG emissions are indicators of sustainability
 - Process level understanding of GHG emissions is missing across diverse agroecosystems
 - Need measurements
 - Increase daily sampling frequency improves annual estimate
 - Automated chamber network in Australia
 - 2 to 15 kg N/ha/hr from wheat to dairy to sugarcane sites
 - Model tests —working reasonably well for yield, not quite as good for N₂O