Nitrous Oxide emissions from Ag Soil Management and GHG Credits

Jason Warren

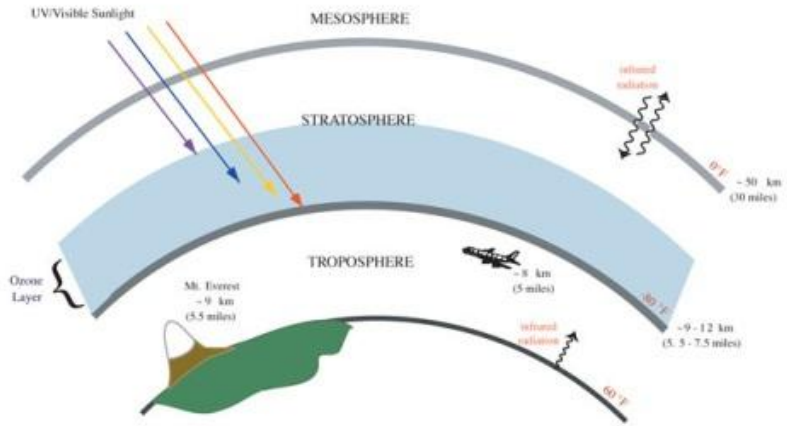
Oklahoma State University

Why are we Talking About N_2O

- It's a potent Greenhouse Gass
  - Its global warming potential is 300 times greater than CO_2
- EPA estimates that 68% of N_2O emissions come from Ag Soil Management
  - Inorganic N, manure N, and leguminous N
- Represents approximately 3% of total U.S. GHG emissions

Why are we Talking About N_2O

- It's an ozone depleting gas
- International treaties in the 1990's phased out CFC's
- Now N_2O is the #1 ozone depleting gas emitted by human activity



http://www.noaanews.noaa.gov/stories2009/20090827_ozone.html

Greenhouse Credit from Reductions in N_2O emissions

- Reducing its emission can produce a marketable GHG credit
- Similar to carbon credit
- N_2O credits are for <u>Avoidance</u>
  - Much more attractive to EPA and GHG credit buyers
- Carbon credits are for <u>Sequestration or removal</u>
  - Sequestration has a problem with permanency
  - No-till soils can be tilled, releasing CO_2

California's Effort to Reduce GHG Emissions

- In Oct. 2010 California voted to adopt cap and trade
- This provides a market for GHG credits
- Currently, many efforts are being made to develop protocols to generate GHG credits from N_2O emission reductions
  - Protocols outline the requirements for the generation of GHG credit.

Activities in Oklahoma

- OSU Extension and the OCC were asked to participated in a pilot project partially funded by the USDA.
    - National Wildlife Federation
    - Delta Institute
    - Conservation Technology Information Center
    - American Farmland Trust
    - DNDC Applications, Research and Training, LLC
    - EKO Asset Management Partners
    - American Carbon Registry

Activities in Oklahoma

- Project Goals:
  - Evaluate effectiveness of different BMPs in reducing N_2O emission, thereby creating a GHG credit
  - Contract with producers to sell GHG credits generated though adoption of BMP's
- OSU Extension
  - Provide technical expertise on Best Management Practices to reduce N_2O emissions

How is a GHG Credit Generated?

- A credit is generated when a practice is adopted that reduces N_2O emissions compared to business as usual.

Generating a N_2O credit

- Water quality concerns associated with N fertilizers are localized within a watershed.
  - Problems can be solved by simply reducing N fertilizer applications in watershed regardless of impact on crop production
- N_2O emissions is a global issue
  - Reducing crop production is not an option

Nature of Global Air Quality Issues

- Decreased production in a locality due to decreased N fertilizer application will be offset by production increases somewhere else
  - No change in net N_2O emissions
- We must decrease emissions without decreasing productivity

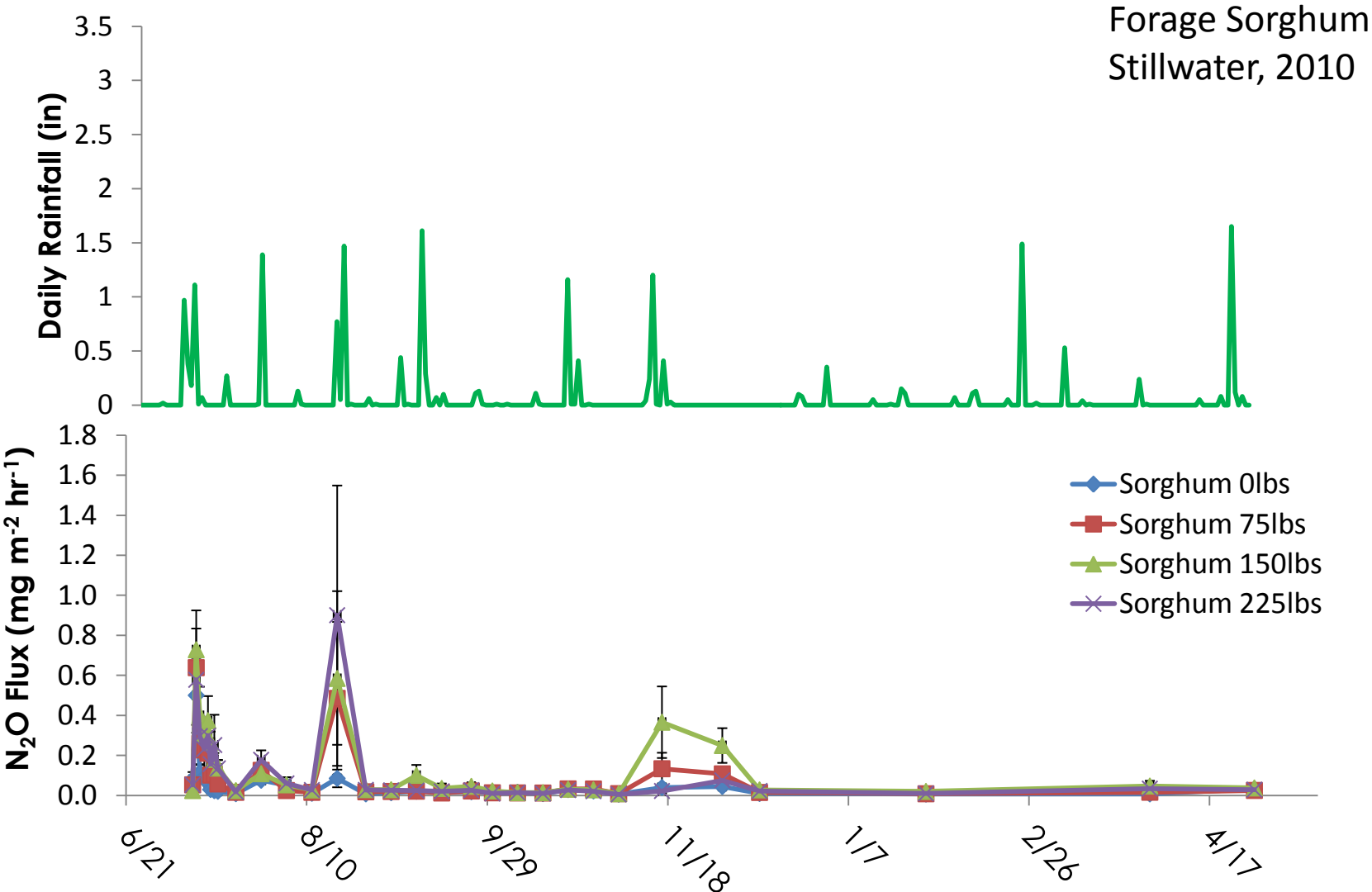
What Factors Influence N_2O Emissions

- N_2O is produced during denitrification and nitrification
  - Occurs in oxygen depleted conditions
- Emissions are influenced by soil moisture, organic matter, temperature and inorganic N concentrations
- Emissions are similar for Urea, NH_4, and NO_3 containing fertilizers

What Factors Influence N_2O Emissions

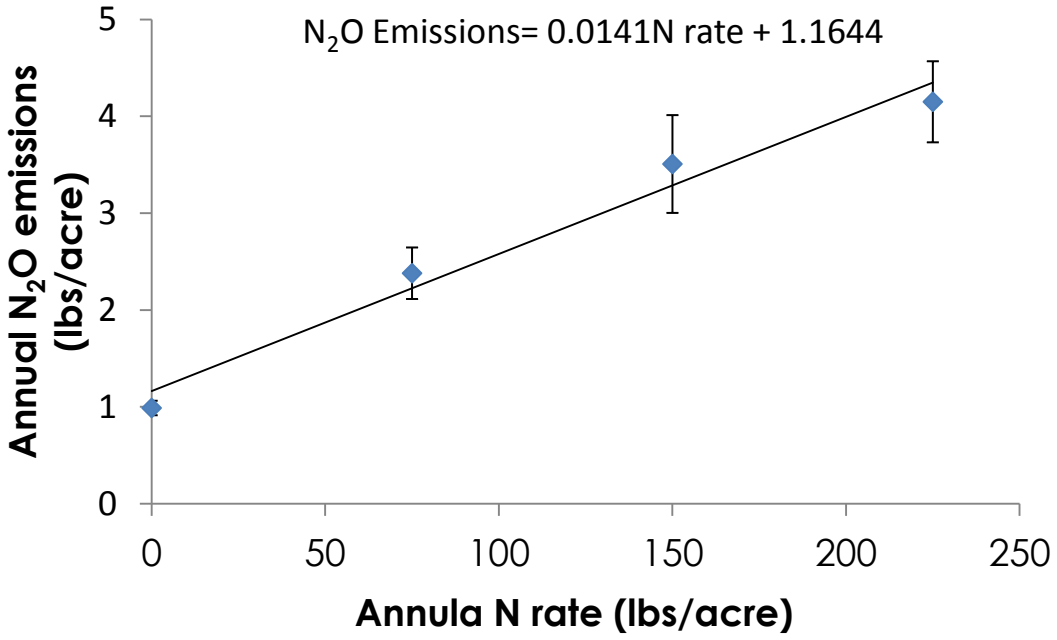
- Moisture:
  - Emission will occur at 60% water filled pore space
    - In a silt loam = 30% moisture by weight
  - Anoxic or oxygen depleted conditions

N_2O Emissions will Spike after Rainfall Event



Relationship between N_2O emissions and N Rate

- Rule of Thumb:
  - 0.01 lbs N_2O per lbs N fertilizer applied.
- Data from Stillwater in 2010-11 shows
  - 0.014 lbs per lbs



How can we decrease N_2O?

- Many environmental groups believe we can simply decrease N rates?
  - Some research from across the U.S. suggest this is correct.
- Enhanced N fertilizers have shown some promise but results are not consistent?
- Utilization of leguminous cover crops
- Split applications of N fertilizer

Decreasing N Rates?

- Assumes that producers over apply fertilizers
  - Sometimes they do
- How are N fertilizer rates determined?

Basis of N Recommendations

- Yield Goal!
  - Average yield
    - Can be calculated from historic yields
  - Maximum yield
    - Doesn't happen very often
  - Potential yield
    - Difficult to determine without some help
- If yield goal is somewhere between average yield and maximum we are more often than not over applying.

Our primary approach in Oklahoma

- Utilize sensor based technology to determine potential wheat yield and topdress N rate
  - Increases NUE?
  - Maintains or increased Yield?
  - Create GHG credits?

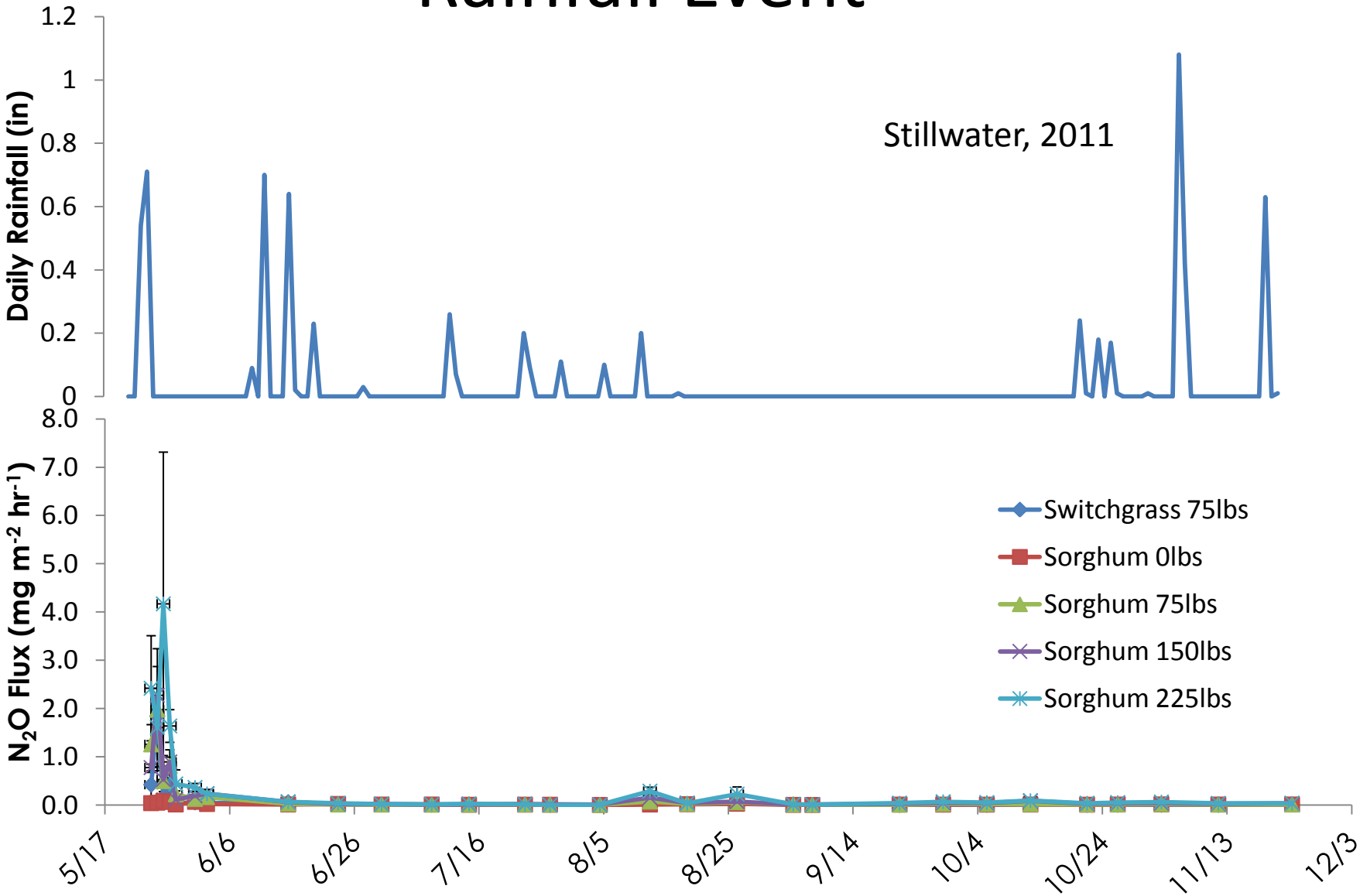
Our primary approach in Oklahoma

- Drawback to this approach is that it will not always decrease N_2O emissions per acre
  - SBNM can recommend N applications that are higher than business as usual (Farmer Practice)
  - Currently GHG credits are valued on a per acre basis
  - A GHG credit will not be generated every year?
- SBNM will decrease N_2O emissions per bushel
  - Perhaps this is how credits should be valued

There are other options.

- There is very little data for this region of the U.S.
- Application timing may be very important to reducing N_2O emission

Application of N Fertilizer prior to Rainfall Event



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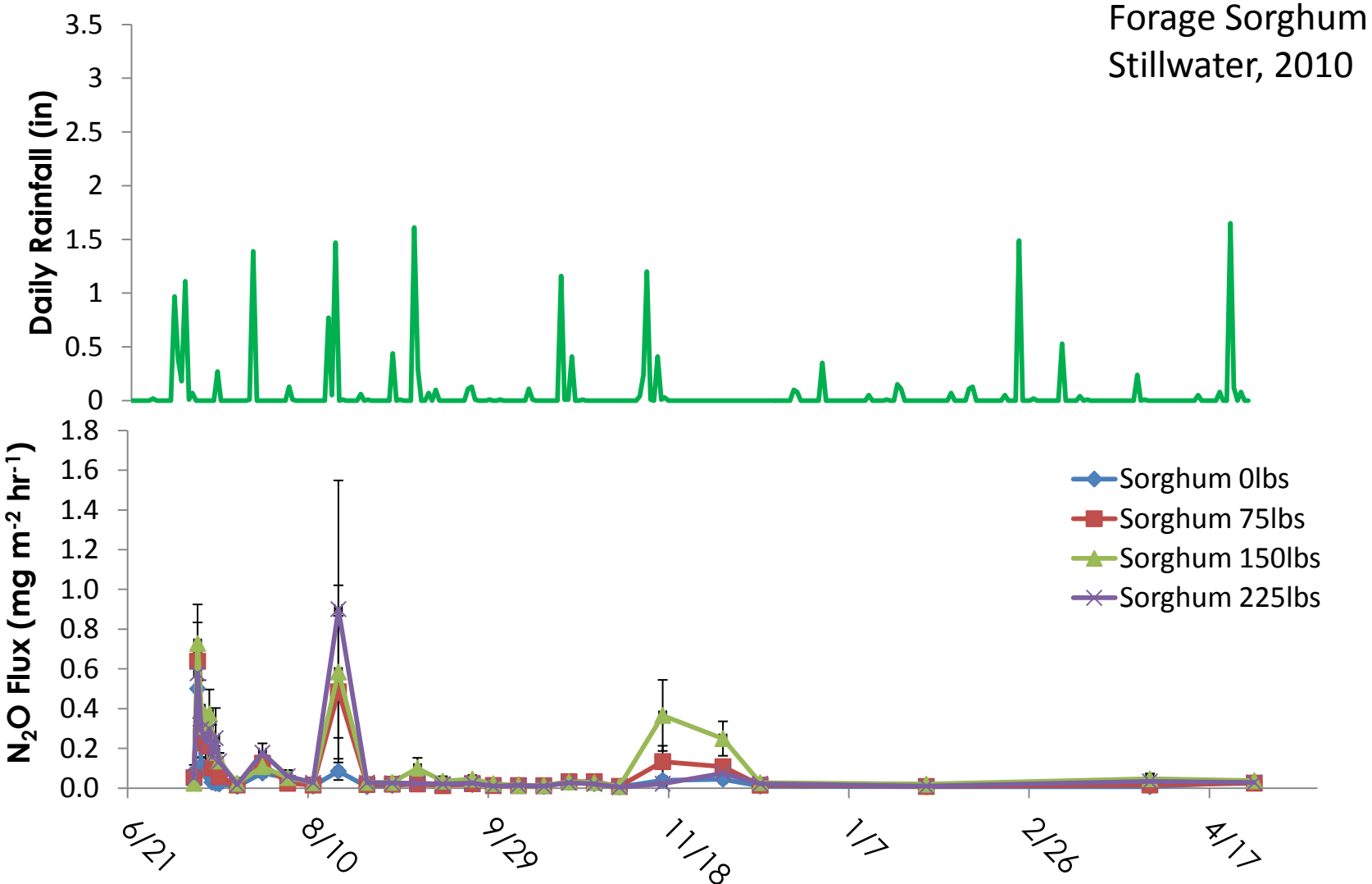


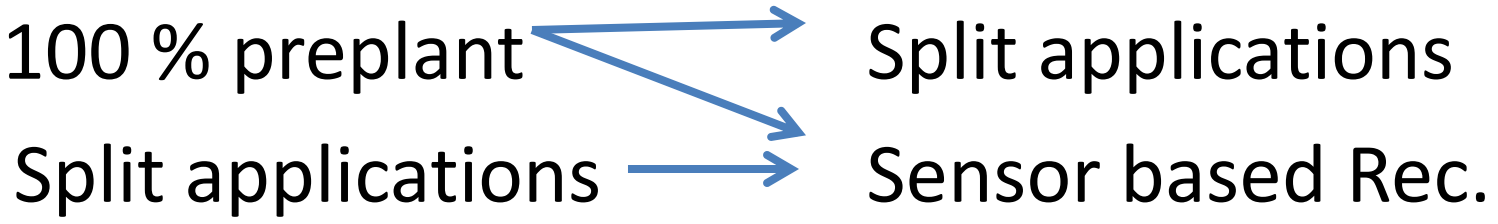
How will Split Applications impact N2O emissions

- For summer crops N_2O emissions may be increased sidedress?

- For Wheat and Canola we should get a significant decrease in N_2O emissions from split applying N
- Research is needed

Generating a GHG Credits

- A credit will be generated when a BMP is implemented that decreases N_2O emissions compared to business as usual.



Summary

- N_2O represents a small fraction of the total GHGs emitted into atmosphere annually
- There are many efforts underway to create protocals for the generation of GHG credits based on reductions in N2O emissions
- I believe they must result in increased NUE to be agronomic ally and environmentally sound

Questions

- Jason.warren@okstate.edu
- 405-744-1721