

# Monitoring N<sub>2</sub>O Emissions from Agriculture Using Micrometeorological Methods Paired with Chambers

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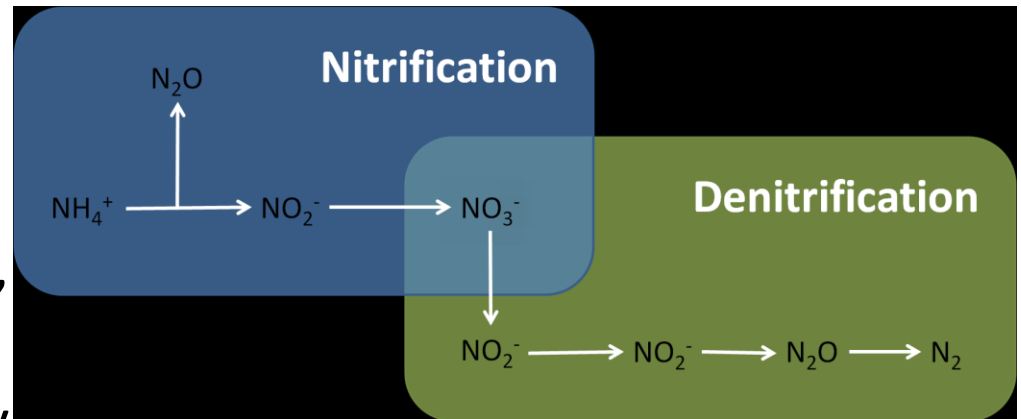
# Nitrous Oxide (N<sub>2</sub>O): No Laughing Matter

- 310x the warming potential of CO<sub>2</sub> per molecule
- Lifetime of ~100 yrs
  - same as CO<sub>2</sub>
  - 4x longer than CH<sub>4</sub>
- Makes it to stratosphere, destroys “good” ozone
- Different chemical family than NO<sub>x</sub> (NO and NO<sub>2</sub>)
- Produced as a byproduct of nitrification and denitrification



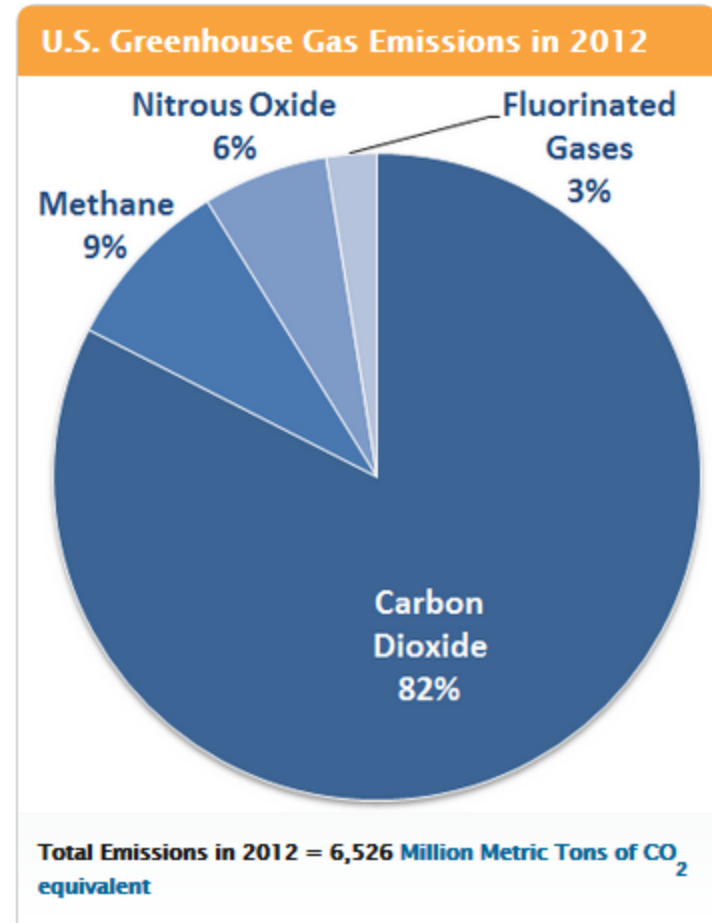
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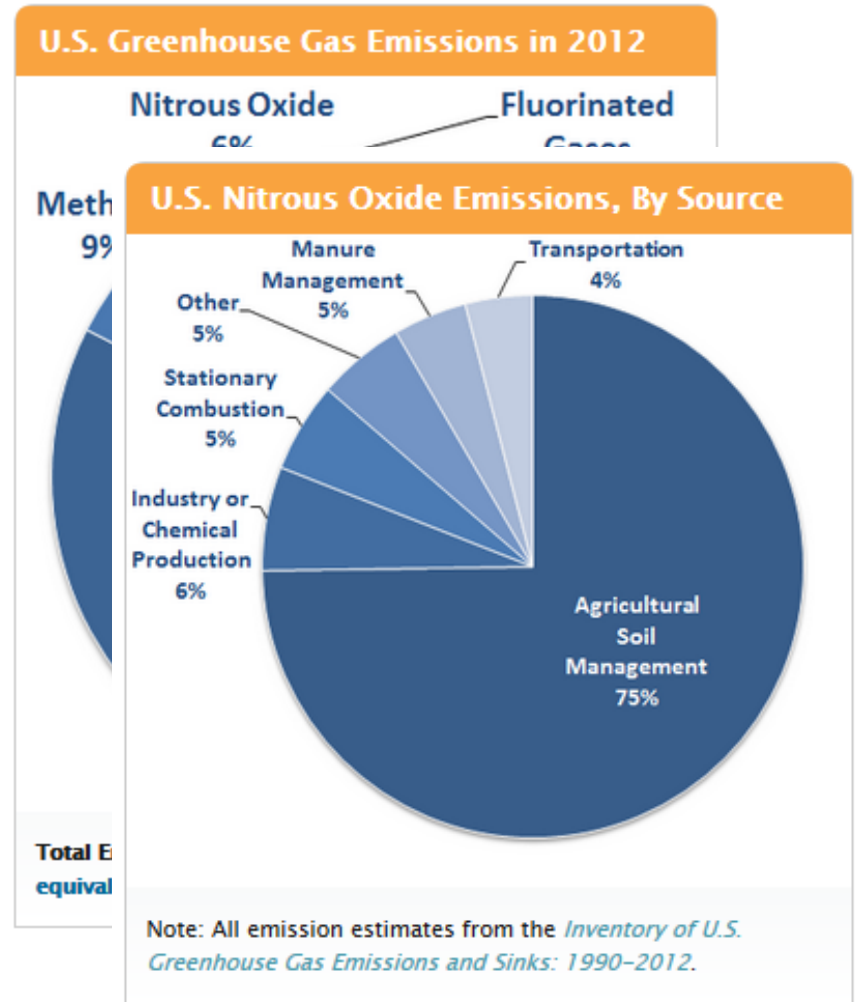
# Agriculture and N<sub>2</sub>O

- 6% of radiative forcing
- 58% from agricultural soils globally
- 70-75% from ag in US



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# Nitrogen Cycling in Ag

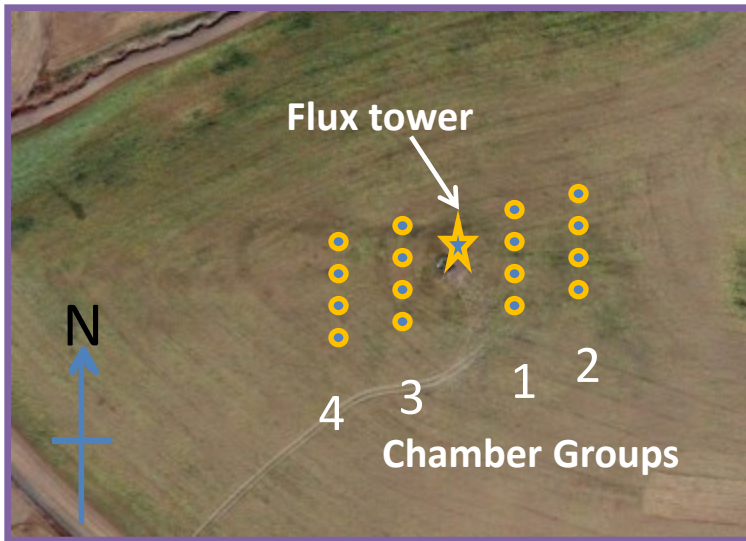
- In iPNW, ~150-200 kg N/ha applied
- Approx. half of that is used by the crop
- Few percent lost as  $N_2O$
- IPCC estimate: 1% of fertilizer N



# Challenges in Measuring N<sub>2</sub>O

- Temporal variability
  - “hot moments”
    - soil disturbance
    - precipitation
    - freeze-thaw cycles
- Spatial variability
  - “hot spots”
    - soil temperature and moisture
    - microbial community
- Detection limit
  - absorption spectra – water vapor interferes more with N<sub>2</sub>O than with CO<sub>2</sub>
  - Precision of N<sub>2</sub>O instrument is 0.05 ppb

# Our setup (4<sup>th</sup> version):

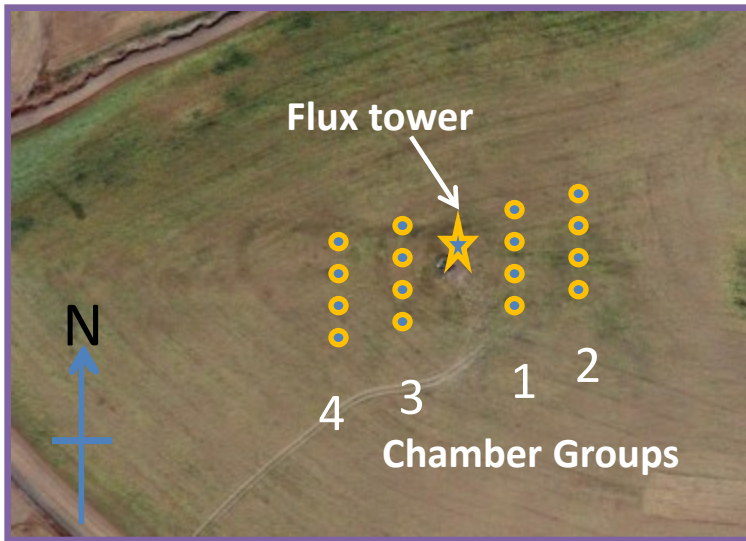


- Paired sites at Cook Farm: no-tillage and conventional tillage
  - co-located with flux towers measuring CO<sub>2</sub>, H<sub>2</sub>O fluxes
- sixteen chambers
  - can monitor small background fluxes
  - continuous temporal coverage





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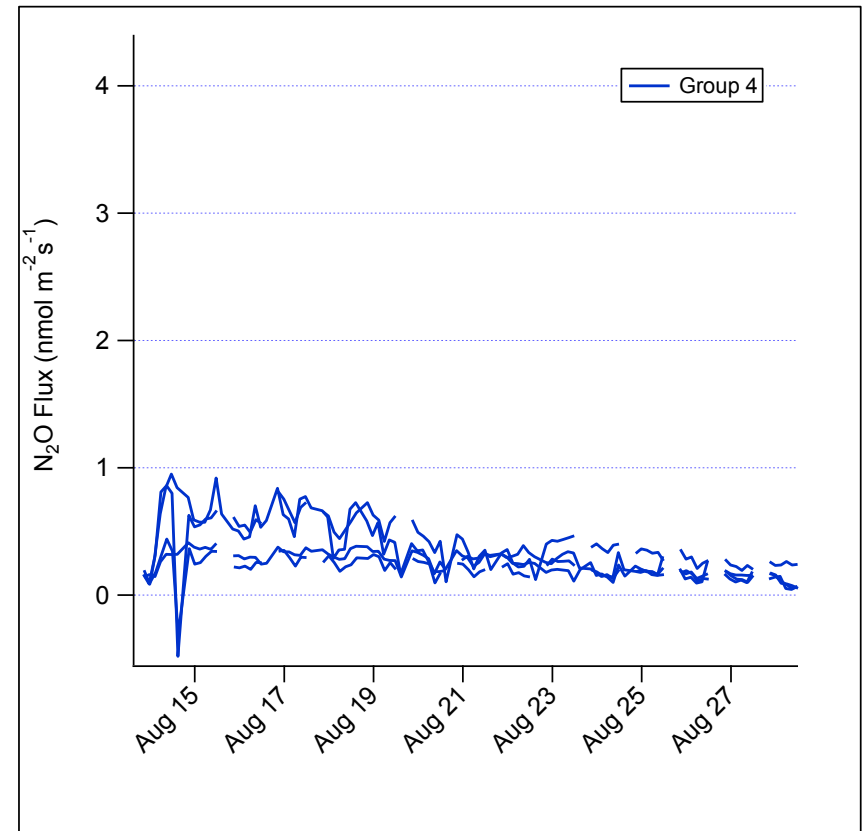


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  - co-located with flux towers measuring CO<sub>2</sub>, H<sub>2</sub>O fluxes
- sixteen chambers
  - can monitor small background fluxes
  - continuous temporal coverage
- flux tower (gradient method)
  - field-scale measurement
  - minimal soil disturbance



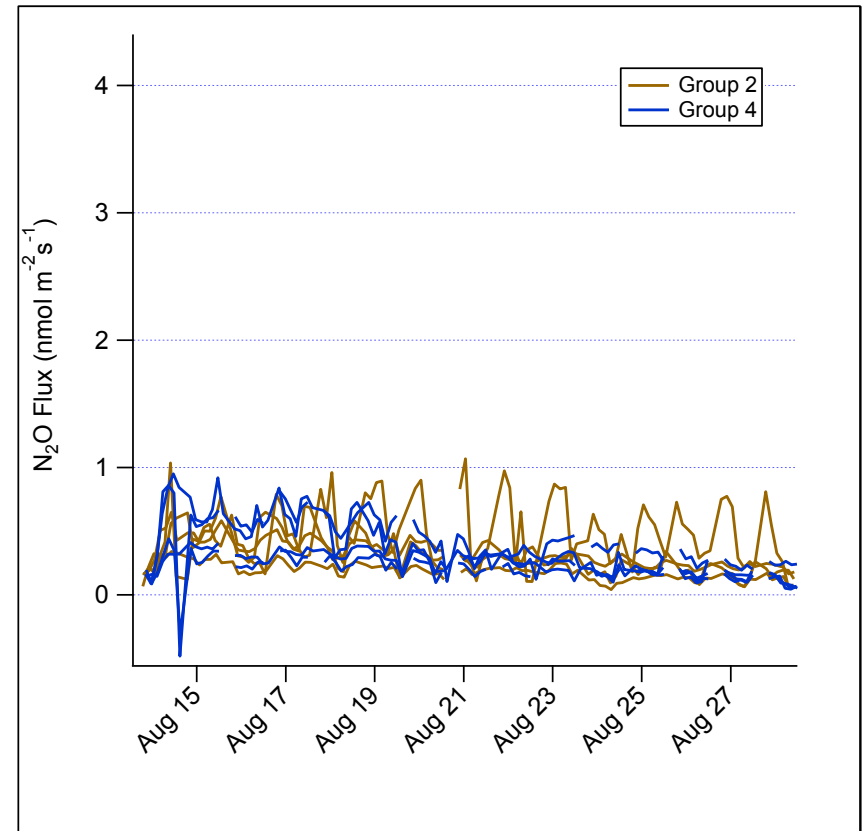
# Example Chamber Results from NT

- Group 4; furthest downhill
  - diurnal pattern (higher emissions during the day, lower at night)
  - avg emissions decrease over time
- Group 2; furthest uphill
  - avg emissions steady
- Group 1; just uphill of tower
- Group 3; just downhill of tower
  - outlier chamber?



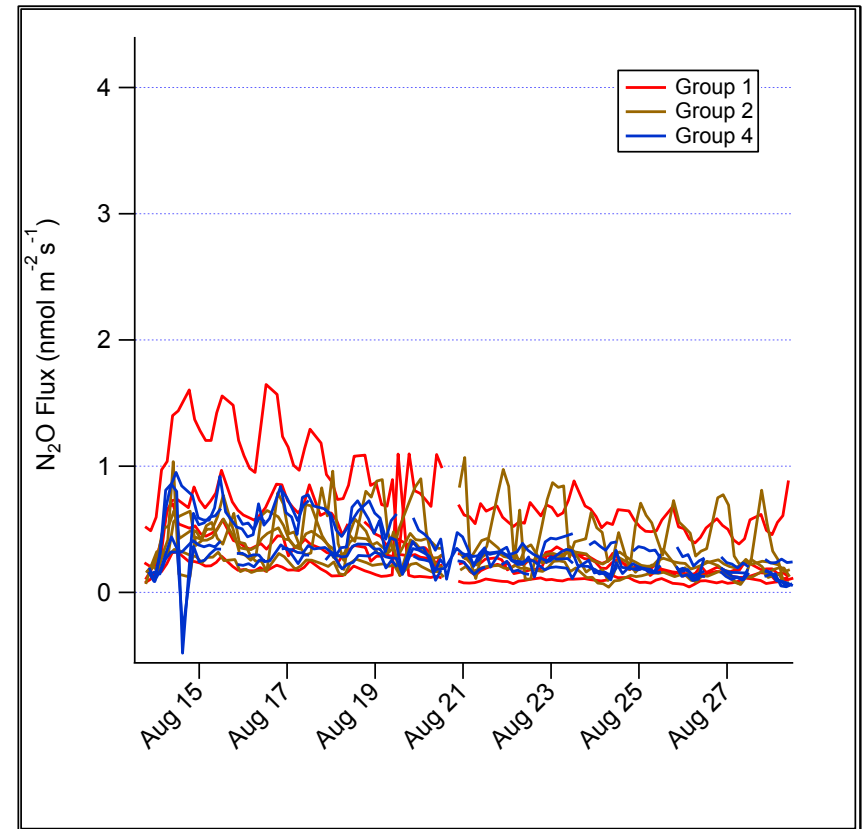
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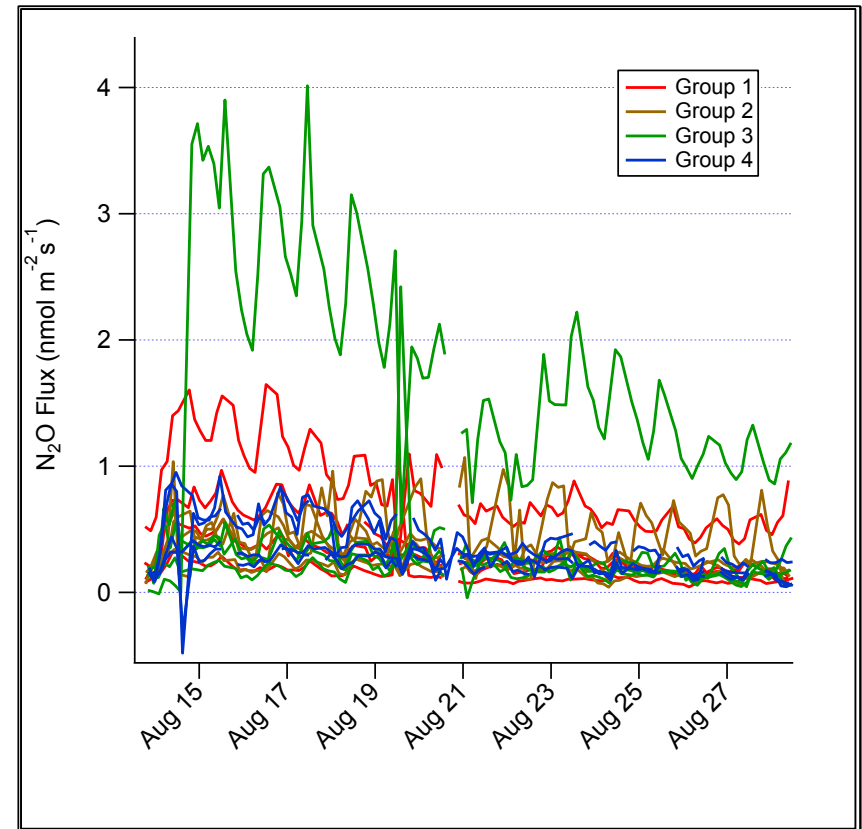
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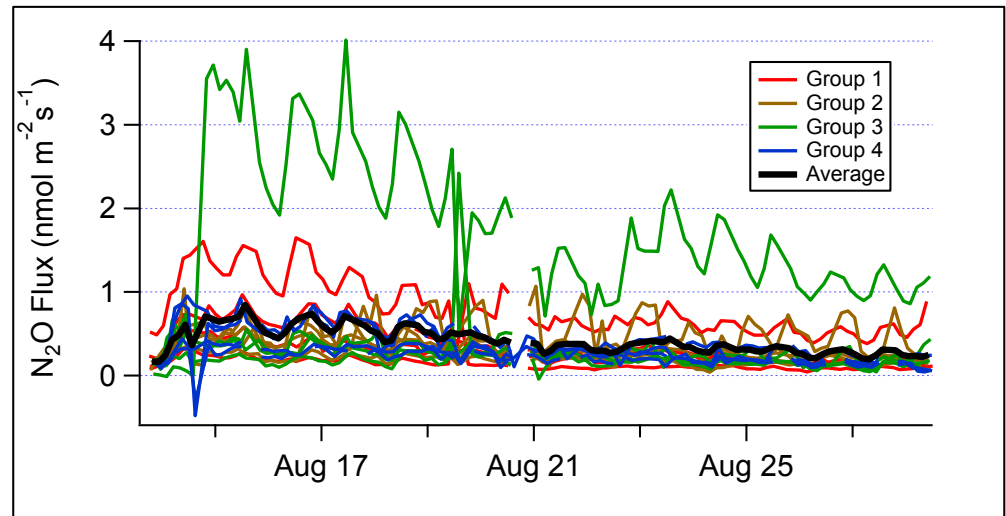
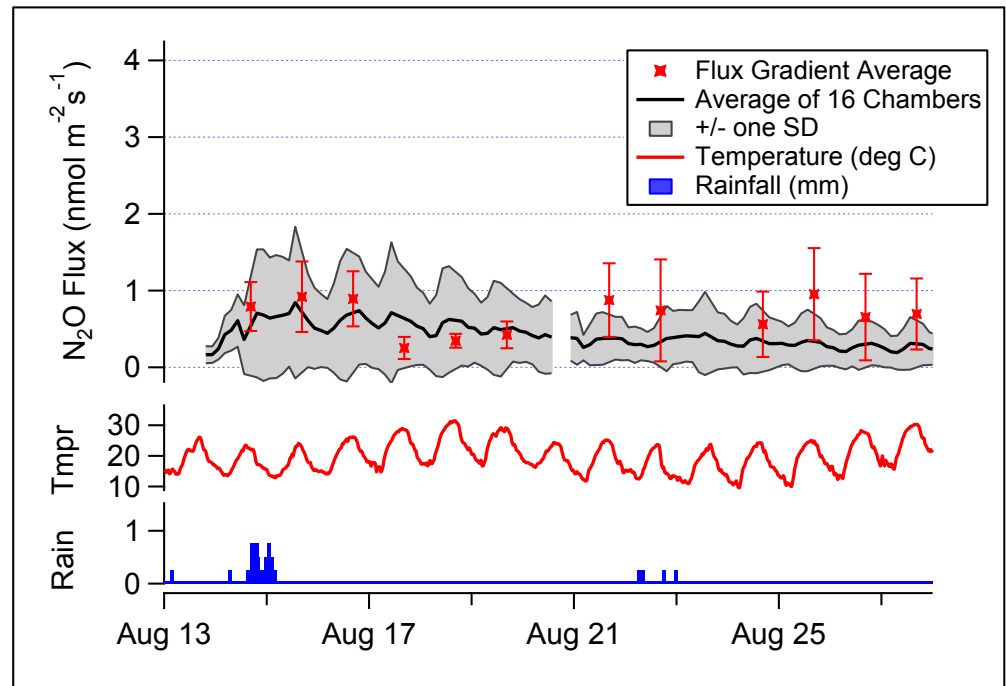


## Chambers compared to FG

Top plot shows:

- chamber average (black line)
- chamber standard deviation (grey area)
- FG average & stdev (red markers with whiskers)
- Air temperature
- Rainfall

FG results suggest that “outlier” chamber is representative of the field



# Future/Ongoing Work

- First continuous, long term, multi-site measurements
- Total N<sub>2</sub>O losses per annum
- Characterize N<sub>2</sub>O emission behavior
- Compare sites

