Impacts of soil/grazing management on GHG emissions

Laura Cardenas
Background
Background

\[ \text{CH}_4 \rightarrow \text{GWP} \times 25 \text{ CO}_2 \]

\[ \text{N}_2\text{O} \rightarrow \text{GWP} 298 \times \text{CO}_2 \]

\[ \text{CO}_2 \rightarrow \text{GWP} 1 \]
Ncycle-agriculture

Inorganic-N

Atmospheric deposition

Crop residues

Denitrification

Water course

Leached-N

Crop uptake

OM-N

Mineralisation

Immobilisation

Nitrification

NO₃⁻-N

NH₄⁺-N

Excreted-N

N Fixation

Runoff-N
Factors affecting emissions of $\text{N}_2\text{O}$

- Carbon
- Nitrogen
- Oxygen content

Wrage et al. 2001
Processes

Nitrification

\[ \text{NH}_4^+ \rightarrow \text{NH}_2\text{OH} \rightarrow \text{NO}_2^- \rightarrow \text{N}_2 \text{O} \rightarrow \text{N}_2 \]

Denitrification

\[ \text{NO}_2^- \rightarrow \text{NO} \rightarrow \text{N}_2\text{O} \rightarrow \text{N}_2 \]
Spatial variability of N$_2$O emissions
Aims

- Technological development successfully implemented on farm as well as areas where this has worked less well.

- Explore the barriers to the uptake of technology, why they exist and how to overcome them.

- Unexpected consequences of technological development and methods to mitigate these
Methodologies: static chambers
Methodologies: dynamic automated chambers
Rothamsted Research-North Wyke
Research Platforms: the North Wyke Farm Platform

- Permanent grassland
- Clover-grass leys
- Breeding for new high-performance biodiverse pasture mixtures
Chamber deployment
Chamber-Data

N₂O flux Photoacoustic  —  kgN/ha/d  —  Soil temperature


Mean soil temperature (°C)
Farm Platform – next 5 years

SI: farm/research

Plant exudates

Soil/microbes/compaction

N, C exchange

N, C exchange

N,C,P Water

C

N

P
Mitigation

- Nitrification inhibitors
- Urea vs. AN
- AN applied in smaller doses
- Replacing fertiliser with N\textsubscript{2} fixing grasses
- Recycling manure
Mitigation-data

<table>
<thead>
<tr>
<th>Site</th>
<th>Clay content (%)</th>
<th>Soil pH</th>
<th>Average annual rainfall (mm)*</th>
<th>Average annual air temp. (°C)*</th>
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<tbody>
<tr>
<td>Crichton</td>
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<td>5.6</td>
<td>1244</td>
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<td>Hillsborough</td>
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<td>5.0</td>
<td>1140</td>
<td>8.2</td>
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<td>Pwllperian</td>
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<td>1869</td>
<td>10.4</td>
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<tr>
<td>Drayton</td>
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<td>7.6</td>
<td>756</td>
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<td>North Wyke</td>
<td>37</td>
<td>5.7</td>
<td>1253</td>
<td>9.7</td>
</tr>
</tbody>
</table>

*Annual rainfall and air temperature of the experimental periods
Mitigation-data

$N_2O$, g N ha$^{-1}$ d$^{-1}$

- April 12
- May 12
- June 12
- July 12
- August 12

- C
- NU
- NU+DCD
Inventory of GHG

TOTAL EMISSIONS 2014: 518.2 MT CO₂ EQUIVALENT

- Energy 80%
- Waste 4%
- Industrial processes and product use 6%
- Agriculture 8%
- LULUCF -2%
Thank you