Human nitrogen fixation and greenhouse gas emissions: a global assessment

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Linkages between human N fixation and greenhouse gas emissions

1. Direct and Indirect N\textsubscript{2}O emissions

2. N-induced C sequestration

3 NO\textsubscript{x}-induced O\textsubscript{3} formation reducing C sequestration
Calculation of GHG response to N fixation

- $\text{N}_2\text{O}-\text{N}_{\text{exchange}} = \text{N}_{\text{input,ecosystem}} \times \text{N}_2\text{O}-\text{N}_{\text{response,ecosystem}}$

- $\text{CO}_2-\text{C}_{\text{exchange}} = \text{N}_{\text{input,ecosystem}} \times \text{C}-\text{N}_{\text{response,ecosystem}}$

- $\text{CO}_2-\text{C}_{\text{exchange}} = \text{O}_3_{\text{exposure,ecosystem}} \times \text{C}-\text{O}_3_{\text{response,ecosystem}}$

$\text{O}_3$ exposure = $fr \times \text{NO}_x$ emission

Ecosystem = agriculture, non-agriculture (forests/semi-natural vegetation) and marine systems
Example of C-N response of forests based on a meta-analysis

<table>
<thead>
<tr>
<th>Forest type</th>
<th>C–N response [kg C kg N⁻¹]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical</td>
<td>1.3 (1.3–3.9)</td>
</tr>
<tr>
<td>Temperate</td>
<td>12.7 (10.6–14.9)</td>
</tr>
<tr>
<td>Boreal</td>
<td>14.1 (10.6–17.5)</td>
</tr>
<tr>
<td>All</td>
<td>11.3 (8.7–13.9)</td>
</tr>
</tbody>
</table>
Estimated Impacts of human N fixation on net greenhouse gas emissions at global scale

The effect of human N fixation on global N\textsubscript{2}O emissions and CO\textsubscript{2} sequestration is an increase in emissions of **0.41 Pg CO\textsubscript{2}-C eq. yr\textsuperscript{-1}**.

De Vries et al. (2016; in press)