Update of chapter 3D

Calculation of NH_3 emissions from crop residues

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NH_3 emissions from crop residues

- Emissions occur under the following conditions:
  - plants/plant parts die or are killed and there is decomposition of protein to ammonium
  - the plant material is exposed to the atmosphere
  - the nitrogen concentration in the residue is above a threshold value
- Emissions are small (<1–3 kg ha^{-1} $year^{-1}$), but given the large areas of crops, the total is likely to be significant at the national scale

Calculation of NH_3 emissions from crop residues

- De Ruijter and Huijsmans (2019) developed a robust methodology
  - now incorporated into The Netherlands emission inventory
- Emissions are calculated from non-senesced crop residues which remain on the soil surface
- In the majority of cases these will be residues from the crop grown in that field

Calculation of NH_3 emissions from crop residues

- Residues may also be left on or added to the soil surface after other management actions such as:
  - cutting grass for silage or hay
  - trimming pasture to stimulate fresh growth
  - killing volunteer crops by the use of herbicides
  - desiccating potato haulms
  - to control erosion, act as a mulch or as a source of nutrients
- Green manures that die after frost are also to be included in the calculation

Calculation of NH_3 emissions from crop residues

- The methodology does not apply to situations where N is applied as synthetic fertilizer or manure to crop residues present on the soil surface at the time of fertilizer or manure application
- In these situations, NH_3 emissions will be deemed to have originated from the N fertilizer or manure

Calculation of NH_3 emissions from crop residues

- To calculate emissions from crop residues we need
  - the amount of residues left or added to the field
    - minus residues incorporated within 3 days
  - the N content of those residues
- $NH_{3\_cropresidues} = (17/14) * \Sigma (A_T * N\_Load_T * F_T) * EF_{\_cropresidues}$
  - N_LoadT can be calculated using the part of Equation 11.6 of IPCC (2019) that estimates above-ground residues, since only those are considered to emit NH_3
  - FT is the fraction of the crop residues from the Tth crop that produce NH_3 emissions, i.e. the fraction that remains on the soil surface for longer than 3 days after harvesting

Activity data

- Most of the data should already be available
  - See IPCC (2006 or 2019), Equation 11.6 N input in crop residues
- Additional information required
  - amounts of residues remaining on soil surface after 3 days
    - 0 = incorporation within 3 days after harvest and hence no contribution to emissions
    - 0.5 = half of the residues is covered or mixed with soil at harvest.
    - 1 = no covering by soil during harvest or incorporation.

Calculation of NH_3 emissions from green manures and cover crops – data needed

- Frost sensitivity (F) needs to be known to calculate NH_3 from residues of green manure and cover crops
- De Ruijter and Huijsmans divided green manures into two groups according to their degree of frost sensitivity
  - half of the frost-sensitive green manure crops grown in The Netherlands are estimated to be incorporated into the soil before senescence and hence that fraction of the crop will not leave residues on the surface and emit NH_3
  - 10 and 25% of frost tolerant crops are estimated to be killed by herbicide application, with the remainder being incorporated
  - de Ruijter and Huijsmans (2019) used 19% as the average proportion of frost-tolerant green manure crops killed by herbicide

Calculation of NH_3 emissions from crop residues

- The $EF_{\_cropresidues}$ depends on the N concentration in crop residues (NAG(T); kg N (kg DM)$^{-1}$):

- If the NAG(T) $\leq$ 0.0132 kg N (kg DM)$^{-1}$
  - EF = 0

- Otherwise
  - EF = (410 * NAG(T) - 5.42)/100

Calculation of NH_3 emissions from crop residues

- The IPCC method only provides data on the N content of a limited number of residues hence we include the greater range cited by de Ruijter and Huijsmans in an annex