

Interactive comment on “The significance of nitrous oxide emission from biofuel crops on arable land: a Swedish perspective” by Å. Kasimir Klemedtsson and K. A. Smith

Anonymous Referee #2

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The paper addresses the importance of nitrous oxide emissions from cereal production in Sweden for the fossil fuel GHG reduction from substituting fossil fuels with bioethanol produced from cereal grains produced in Southern Sweden. The paper makes the point that nitrous oxide emissions from the production process largely determines whether the substitution can meet the requirements of the EU RE Directive. The paper also addresses the uncertainties associated with the N₂O emission estimates and how this will affect results. The paper is well written and clear in its argumentation, and the paper also addresses an important and pertinent issue.

The study uses measurement data from published studies in Europe and data from

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measurements at two sites in Sweden. However, the details on the methodology used for the measurements in Sweden are not given in the paper. Also there should be a description on how the measurements (presumably chamber measurements) were upscaled to obtain an annual estimate.

The text on “Estimation by use of process-based models” in the materials and methods should be removed, since these modelling procedures are not applied in the paper. Instead some of this text may go into the discussion for a qualitative assessment of other modelling procedures. However, I do not believe that the conclusion “Process-based models can be a help in achieving this objective in the future” can be made. No proper assessment of whether process-based models would actually help has been made, and therefore such a conclusion is unwarranted. In many cases development and testing of process-based models are hampered by the availability of high-quality datasets against which to do this, so I would suggest also to consider this aspect in the discussion.

Figures 3 and 4 should be omitted since these details of seasonal variation in emissions are not essential for the discussion and conclusions made. In fact none of these detailed results are used in the discussion.

The paper only very briefly touched upon the issue of attribution, i.e. how much of the nitrous oxide emissions (direct and indirect) can be attributed to growing the cereal crop for biofuel production. The paper simply assumes that all of the emissions can be attributed to the biofuel production. However, even native ecosystems (e.g., forests or permanent non-fertilised grasslands) would have N₂O emissions, and I suggest that the authors at least give a range for such emissions in Sweden.

There is another issue, which is not mentioned in the paper, i.e. that bioethanol production from cereal grain in modern biorefineries will result in a residual protein product that can be used for feeding livestock, and which will substitute protein feed production. This will thus reduce nitrous oxide emissions elsewhere, which is an aspect typically

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included in LCA. This aspect should be considered.

Based on these considerations I recommend that the paper is accepted after major revision.

Specific comments

Page 6744, line 5 Change "strong" to "potent".

Page 6744, line 14 Change "procedure" to "approach".

Page 6745, line 2 Change "rules" to "standards".

Page 6746, line 4 Change "know" to "assess".

Page 6746, line 6 Change "from" to "from arable".

Page 6746, line 13 Change "regions" to "regions in Sweden".

Page 6749, line 6 It is not clear what the values 117 and 128 refer to.

Page 6750, line 21 Change "soils" to "soils may".

Page 6751, lines 18-20 Is this soil DRY weight?

Page 6753, line 14 Change "newly" to "emitted from newly".

Page 6753, lines 18-20 I do not understand this sentence, and would suggest to remove it. Also I suggest to remove figures 3 and 4 and replace them with a short description in the text.

Page 6754, line 18 Change "emissions" to "variation in emissions".

Page 6754, line 20 Change "tons" to "several tons".

Page 6755, line 19 Change "was predicted" to "were predicted".

Page 6757, line 3 Change "harvest size" to "crop productivity".

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Page 6757, line 26 Change "needs agricultural production" to "means that agricultural production needs".

Page 6758, line 22 Davidson (2009) is missing in the references.

Page 6759, line 26 Change "an increased" to "a higher".

Page 6759, line 28 Change "this" to "these".

Page 6760, line 6 Change "soil type" to "soil type that".

Page 6761, lines 3-7 This text on process-based models is pure speculation and wishful thinking. It should be removed or rewritten with references to document these claims.

Table 1 The heading should state that this is for spring wheat.

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