

Review on “Modelling potential production of macroalgae farms in UK and Dutch coastal waters” by Johan van der Molen et al.

General comments

First, I would like to express that I am essentially very satisfied with the responses and changes made by the authors. They really put effort in addressing my comments on the original manuscript, which I appreciate.

Especially the inclusion of the macroalgae farm model equations and parameters I find very useful, as there are quite some differences to the work by Broch and Slagstad on which this studies bases, e.g., the inclusion of ammonium uptake. These differences are now outlined in a well understandable way.

Also, the rearrangement of the different methodology sections, from my perspective, really improved the readability and flow of the manuscript.

In principle, most of the comments I have on this revised manuscript are only of technical nature. However, I encountered a couple of inconsistencies in the new Tables 2-4 describing the farm implementation, which have to be resolved before publication. Also, I suggest to reorder some of the figures related to the sections' rearrangement.

Therefore, I recommend publication after minor revisions.

Specific comments

page 2, lines 17-19: The authors mention the potential of large-scale cultivation for carbon and nutrient removal/reduction. I would like to see a comment on this in the discussion – even if it is just saying that the applied setup does not allow conclusions on this. Though, for both, carbon and nutrient removal, the farm yield and C/N and C/P ratios allow for estimates which could be related, e.g., to reductions in river input in order to get an idea of their relative importance.

page 3, line 10: I would propose to remove the reference to Fig. 1 here and change the order of Figs 1-3, such that current Fig 3 comes first. This would better match with the sequence of the methods section. First: model description, second: farm sites. A reference to current Fig. 1 would be useful at the beginning of Sect. 2.2

page 5, line 33: “Table 2 to Table 4” and page 6, line 4: “see Table 5”. Currently, Table 1 is referenced last (on page 8, line 21). I would suggest adding a sentence referencing Table 1 in Sect. 1.2. Maybe after the reference to “Table 1 in Kerrington et al.”?

page 7, lines 22-24: “The nutrient data [...] substantially lower.” I would still propose to move this entire block to the results (Sect. 3.5). However, if the authors prefer to keep it here, it's fine.

page 10, lines 3-5: Would it make sense to also include relative differences for the absolute values of tidal amplitudes and currents, in order to provide a better insight into the model quality.

page 13, Sect. 3.5.3: From a “biofuel perspective”, would it be worthwhile to include a few notes on the numbers of carbon extraction in-text? Perhaps, this is not too relevant for the experimental farms, but for the large Norfolk farm this would be a nice confirmation of the suitability of this site. And it would explicitly support the paragraph about the Norfolk farm on page 15 in the Discussion.

page 14, lines 4-8: the “graph” labels referring to Fig. 14 used in-text are not correct, e.g., the Rhine plume farm is graph c not a. The order in the text description should follow the order of the figure panels.

Tables 2-4:

I have a couple of comments on the equations and parameters. Some are only typesetting issues, but I also think some units (and perhaps equations) are incorrect. So, please check the tables carefully. The equation numbering I apply relates to the order of the equations in Table 4 in the revised manuscript:

1. The type-setting of units should be consistent, e.g. “mgC” or “gC” with or without white space between “g” and “C”, analogous for “gChla” and “Chl”/“Chla”; “day-1” or “d-1”; unit of “W_L” (Table 2) is probably “mg Chl m⁻²” not “Mg ...”; “-“ instead of “(number)” for “n_pl” (Table 3)
2. The units of “W_S” [in mg C m⁻²] and “W_C” [in gC (g sw)⁻¹] seem to be inconsistent. Though, the denominator in the last term in the brace of Eq.1 requires this. Alternatively, some conversion factor is missing in the Eq. The same inconsistency affects Eq. 10 (e_C=...), in which the exponent needs to be dimensionless. A note on what “(g sw)⁻¹” means would be helpful, e.g., “relative to structural mass” as in Broch and Slagstad.
3. There is an inconsistency in the units of “A” (Eq. 2; non-dimensional) and “A0” [in m²]. This is not possible as “A/A0” is in the exponent in Eq. 3. If “W_S” was in “mg C” this would be fine – with “A” in m² – though, I think the issue with Eq. 1 would still remain.
4. The unit of the exponent in Eq. 6 (“f_CL(d) = ...”) must be non-dimensional which is not the case as both, W_L and q_LC have “mg Chl” in their numerators
5. In its current form, the unit of Eq. 9 (u_mn = ...) should be “mmol n (mg sw)⁻¹ d⁻¹” as W_C is in “gC (g sw)⁻¹”
6. Eq. 10 (e_C + ...): Even if W_C and W_S had the same unit, the exponent would not be dimensionless as y isn’t dimensionless (“g C g⁻¹”). In fact, I suspect, the units in the corresponding Eq. 15 in Broch & Slagstad are incorrect.
7. The unit of Eq. 11 (p_L = ...) is not gChl (gC)⁻¹. Perhaps the fraction should be “W_C/W_L”?
8. Eq. 12 (dW_N/dt = ...):
The dimensions don’t match. The last term (f_CT*W_n) is not per day, probably a specific growth rate is missing. Further, W_n is in mmol m⁻².

- Hence, there must be a factor with unit m^2 to get rid of m^{-2} or the entire equation has to be in " $mmol\ m^{-2}\ d^{-1}$ ". μ_m is not included in any table. Do you mean μ or μ_{Cm}/μ_{Sm} ?
9. Eqs. 13 & 14 (dW_C/dt and dW_L/dt): " r_C " is not defined, only " r_r " is (in Table 3). The unit of Eq. 14 must be " $mg\ Chl\ d^{-1}$ "

Technical corrections

page 3, line 2: "mixture **of** species"?

page 3, line 8: Should it be "**five** farms were simulated: **four** experimental farms"?

page 4, line 10: "species" instead of "biomass"?

page 4, line 24: please insert the type of vertical layers, before "layers" e.g., sigma or z layers?

page 5, lines 25/26: Would it be feasible to delete "as well as inclusion of and" for easier readability, without changing the meaning?

page 6, line 11: "°" is missing in geographical coordinates, while it is used in Sect. 2.1.1. It should be consistent throughout the manuscript.

page 6, lines 11-14: use either "Lough" or "lough" consistently

page 6, line 19: MLWS is only used here, so the abbreviation may be omitted

page 6, lines 20/21: already mentioned that the farm is "run by Queen's University" (on page 6, line 10)

page 7, line 26: "°" is missing in geographical coordinates

page 8, line 15: "allowing for" sounds favourable while "comparatively lower" implies the opposite. What about "resulting in lower"?

page 8, line 25: "°" is missing in geographical coordinates

page 8, line 28: use "°" instead of "degree"?

page 9, line 11: "were calculated for" instead of "were calculated of"?

page 9, line 26: Could you add a reference to current Fig. 1 for the Smartbuoy locations?

page 11pp.: Sect. 3.3 is empty. I suppose Sects. 3.4 to 3.5.4 should be subsections.

page 14, line 12: this should be “Figure **10f**”

page 14, line 14: Figure 14b does not show uptake rates. Do you mean Figure 10k,l?

page 15, line 24: “coarse” instead of “course”

page 15, lines 1 and 29: “Rhine **Plume**” vs. “Rhine **plume**”. Should be consistent throughout the manuscript.

page 15, line 33/34: Broch and Slagstad (**2012**); same for caption of Table 4

page 16, line 17: no comma after “we do not”

Table 3:

description of “ μ_{Cm} ”: unnecessary white space before “uncorrected”

descriptions of “ q_{lCS} ” to “ q_{LC} ”: would it make sense to use “ratio” instead of “quotum”? I think it’s more common but I leave it to the authors.

description of “ q_{LC} ”: white space missing in “perTotal”

description of “ K_e ”: typo in “whivh”

description of “ n_{pl} ”: “macrophyte”

Table 5:

The latitudinal information for the Norfolk farm is wrong. It must be “53-something” °N. The geographical information for the other farms slightly differs from the in-text information? Is this just the difference between the real farm locations and the centres of the model grid cells in which they are located? Maybe just use one of the two consistently to avoid confusion?

Figure 1: I accept the authors’ argumentation for showing the entire map, just sufficient quality/resolution of the figure should be ensured for the final publication. At the moment, it’s still rather pixelated.