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Interactive comment on "LPJmL-Med – Modelling the dynamics of the land-sea nutrient transfer over the Mediterranean region–version 1: Model description and evaluation" *by* Mohamed Ayache et al.

Anonymous Referee #1

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LPJmL_med – Modelling the dynamiscs of the land-sea nutrient transfer over the Mediterranean region – version 1: Model description and evaluation.

This article aims to estimate the discharge as well as nitrate and phosphate export into the Mediterranean Sea with the LPJmL model at 1/12 degree spatial resolution.

General remarks

First of all I realize that the authors put a huge amount of work in the implementation and in writing this lengthy paper. This article tries to document the modeling con-

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cept,but this paper does not contain the quality needed for publication. There are a lot of reasons for this (see below). Beside that the structure of the paper could be improved. I had to go back and forth in this paper the whole time. It took me some time to make a review of this article. The formulas presented in this article are not new. The assumptions and the generation should be new. But on this part, I have a lot of questions or remarks. I stopped with remarks on typos and so on, because I believe this article needs a major revision before detailed feedback can be given.

Conceptional remarks

Where is the NH4 in the rivers? Why leave this part of the dissolved N out of this paper? This is needed here as well.

Soil and water temperature are needed in several equations. Where is their description?

Where is the description of the organic part of P and N in the soils?

I miss an overview of the inputs, the delivery to the rivers, the in-stream removal and the export to the sea.

Validation of discharge, NO3 and PO4 should be done on the same time scale. It is very confusing. Why only to the year 2000? That is still 20 years back from now!

Questions

Line 123-124: State variables: N and P contents has a fixed C:N and C:P ratios? Very strange. Why should this be?

Equation 2. Here MAN_x is used, but the description says it is organic matter. So I miss this components in the description of N and P. The organic P storage in the soil behaves totally different than the dissolved P storage. Then equation 4 shows a constant ratio C:P which I really doubt. The storage of P in the soils works different than the storage of C. . ...

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Equation 10: Which part of P fertilizer is available for uptake by plants? Why is the REMIN_PO4 multiplied by PO4. Should that not be organic_P?

Fertilizer only on crop fields. In Europe fertilizer is also used on grassland.

Equation 11: Why is growth of phytoplankton not dependent on NO3 and/or PO4? It turns out that in equation 30 this is not true. Why not moving equation 11 to 2.4.2? I need a lot of searching to find the explanation for some of the processes. Is there another structure of the description possible?

Line 207 – 211: Nice to include this remark, but assumption of N-fixers is not correct, and excluding atmospheric deposition (land and water) is a pitty. So both should be included!

Why is 50% NO3 and 50% NH4 of fertilizer? This is dependent of the type of fertilizer. It is a pitty when you consider NH4 and NO3 and just divide N into two. . .. Some type of fertilizer contains a lot of NH4, some don't. Please improve.

Line 253: What is cultivated land? Cropland and grassland?

Equation 15: Why area weighed distribution and not crop weighed. With LPJmL you have different crop types, so make better use of this information!

Equation 17: Values of Pman and Nman are not given. Why take a constant ratio? It is dependent on the type of animals that produce the manure. So it is country specific and time dependent. . ..

Line 251: Again the authors assume that 50% of sewage effluent is nitrate and 50% is NH4. Why? This is not a reasonable assumption!

Line 255. Where is the input from industry?

I am surprised by taking the waste water model of van Drecht et al. (2009). The problem is the assumptions of the GDPppp and GDPmer which is from US dollars of 1995. There exist almost no model which uses this specific GDPppp and GDPmer. So

the authors will run into problems when applying this model. Besides there are some updates of this model (Moree et al, 2013 and van Puijenbroek et al, 2018). Equations 21 – 24 are dependent on this GDP. . ..

Line 272: I don't think this ratio is the N:P ratio of municipal wastewater. This is the human intake. I miss for a lot of equations the units (for example equations 21 – 24). . .

The C_susp_water is calculated (equation 36). But this is only dependent on landuse. So the amount of suspend matter in the river is independent on the surface runoff or land erosion. Is this assumption valid?

Line 442: So maximal depth of soil is 3 metres. So there is no groundwater modelled here? Also in equations 45 – 49, I don't see any delay in nitrate going through the soil layers. Can you elaborate on this?

Line 512: missing ares?

Line 535: I read that legumes don't get any N and P fertilizer?? Strange.

Line 537: Is there a fertilizer application of grass or not?

Figure 3: typos in headers, What does c and d contain? Load in the main stream of the rivers? Where? At the mouth of the river? What is the unit? In the text it is always PO4-P and NO3-N. But here in the figures? Make clear. How is it possible that PO4 is twice as high as NO3 (c and d)? Why is y-axes of f three times lower than d? The sum of three rivers (c) is higher than sum of two regions. Why? Is a and b fertilizer on the soil? Is NO3 fertilizer in a half of total fertilizer?

Figure 4: I don't understand this figure. Manure is fully organic matter. So NO3 and PO4 are zero. I don't know what is presented here. . ..

Figure 5: I am completely lost. The unit here is in tonnes. Which means that WWT is very very very small compared to fertilizer or manure. Something is wrong. . .. . .

Line 550 – 556: GDP is not used. . ...

Line 566 – 567: “In general . . .. is poorer” Why is this statement here?

Figure 6: Why is the Nile here? There is no comparison with observations. Why upper figure average of 1963 – 2000? Figure caption claims 1920 – 1985, that is only for Ebro.

Line 576: Why limit the impact of damming and anthropogenic water use? This is one of the things your model can do, so I don’t understand this. Why mentioning “but not Nile”?

I think there is a misunderstanding in Figure 7. Here there is a comparison between modeled data and observed data. I miss the 1:1 line. What calibration data is used to calibrate the discharge of this model? At which location is this comparison? Why here 1920 – 1980 and not 1985?

Line 586: Why the word “may”? Do you mean that Lutz and/or Ludwig is claiming this or are you seeing this in the model data?

Line 590: the role of dams. Why figure 8? Is it a claim of this model also to reproduce the monthly discharge? Why not show the whole timeserie? I would not include this figure.

Line 613: the word “could”? Are you not sure?

Figure 9: There is something wrong with the model. The trend of observed NO3 is not reproduced by the model. This is a problem, because it is becoming worse when the time is closer to the current situation. The same holds for Figure 10 for PO4. Same questions for these two figures? Where in the rivers are these comparisons?

In conclusions the word “concentration” is used. I did not see any concentrations in this article.

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