Review: A modeling System for Identification of Maize Ideotypes, optimal sowing dates and nitrogen fertilization under climate change - PREPCLIM-v1 (gmd-2024-105)

General comments

In this manuscript, the authors describe a model system—including a graphical user interface (GUI)—that can be used to help decisionmakers understand what sort of crop planting practices will be optimal in the future. These practices include sowing date, fertilization level, and genotype selection. The latter is especially interesting, with the authors using a genetic algorithm in addition to a more deterministic method. The system is demonstrated for maize in Romania as a case study, but such tools are of much broader interest.

Unfortunately, the paper is hampered by poor organization, unclear use of language, and low-quality figures. An extensive rewrite is required to address everything from separating methods and results, to improving the way experiments are referenced, to more minor language and typo issues. I thus recommend this paper be reconsidered only after major revisions.

Major comments

- What are the genotype parameters that are getting modified? What do they represent in terms of processes?
    - This is only explained deep into the Results section (L516-519). This should be in the Methods instead.
    - If P4 was kept constant, why is it even mentioned?
- Treatment naming is very confusing, which results in figures that are hard to understand.
    - Looking at Table 1, what is the difference between Fertilization (3N) and Fertilization (1N)? How can, e.g., TR2 get both 60 and 23 kgN/ha? I think, from reading the rest of the paper, that this is not how they're distinguished. But it makes the table very confusing.
    - Instead of having to refer to, e.g., TR5 3N, it would be much clearer to name the treatment like "Apr1_60kgN."
    - Figures like Fig. 6 should have fully meaningful axes and labels. So instead of "treatment" on the X axis, have sowing date or fertilization level. And instead of "Fx#" in the titles, have actual numbers.
    - In figures like Fig. 7, treatments 1-4 are marked as Fx0, but according to Table 1, TR2 is Fx1 and TR3 is Fx2.
    - Why say things like "Fx1" when you could just say the actual amount of N applied?
- Agro-climate indicators and extremes
    - These should be introduced and explained in Methods, not Results.

    - What does the continentality index *mean* as far as maize is concerned?
    - Why are the scorching index results not in the Extremes section?
    - Why are the total precipitation results in the Extremes section?
    - It probably would be better to separate these into subsections for temperature and precipitation, rather than "indicators" and "extremes." Because aren't the extremes also measured using indicators?
- L 359-361: In contrast to what this text says, none of these actually had significant trends.
- Experiments and analyses should be explained and justified in the Methods, with the Results section focused on actual results and some interpretation.
- What is the purpose of the analysis in Sect. 3.b.3 ("Sensitivity to changes to nutrients")? How can farmers *choose* inherent characteristics of their soil? Because the paper is rather long, every analysis should be well-justified. This one seems like it could be removed, both because its usefulness is unclear and because it distracts from the actually-interesting bit of the paper (genotype identification).
- Sect. 3.c ("Optimal genotype identification") needs a complete rewrite. It is nearly impossible to understand due to the extensive use of abbreviations; I don't have the time needed to do the deciphering necessary for a review of its content.
    - L 611-2: "the slopes of Pi variation as a function of G-ranged index"??
- L662-70: How do the two methods compare in terms of computational time? It's not sufficient to just say how good the genetic method is after a certain number of iterations.
- According to GMD guidelines, code must be associated with a DOI, e.g. with Zenodo.

Miscellaneous comments / corrections

- L 142-6: L 142 says it's 3 models, but then there are five listed at L 145-6.
- Are the "cultivar related coefficients" at L 156-7 the same as the "six parameters defining the genotype" at L 153?
- L 169: "Schema from Annex1"?
- L 172: What does "static" mean here?
- L173: What is NUTS3?
- L 178-186: Per GMD guidelines, subplots in a single figure should have one combined caption, and the figure should be one single image. Either combine the captions and subplots or renumber 1a → 1 and 1b → 2. (Same for Fig. 3a/b.)
- Fig. 2 (L 200-230): Text not aligned with boxes.
- Table 1 (L 233): Suggest using e.g. "Apr. 1" instead of "1.04" for dates to avoid ambiguity and confusion.
- L 239 and following: Subsections should be labeled 3.1, 3.1.1, etc. according to GMD guidelines.
- Figs. 3a, 3b (L 270-306):
    - Fig. 3a: What is H32temp?

    - Fig. 3a: What is ENS? Why does the figure with that in the caption not have an associated date range?
    - Fig. 3b: Why do titles say "Martonne*1" and "Martonne_aridity*1"?
    - Fig. 3b caption says that both rows show deltas in the right two panels ("and changes relative to it"), but neither does.
    - Fig. 3b caption: What are IM and ID?
- L 313-4: "each of the three decades" conflicts with "both decades" and the fact that only two decades are shown in Fig. 4.
- Fig. 4 (L 322-55): Change subplot titles to something meaningful.
- L 371-377:
    - Text refers to "Control simulations" but Fig. 5 only shows "treatments."
    - Is it possible to say which of the treatments was closest to real practices?
- Fig. 5 (L 378-383):
    - Most colors are very hard to see against white.
    - Add Y-axis label and tick numbers.
    - Were the data first normalized to Z scores before correlation analysis?
- L 393-4: How does change in anthesis date affect growing season length? Wouldn't growing season length only be affected by sowing and maturity dates?
- Fig. 6 (L 398-414):
    - Do not use red and green on the same plot, as this is hard to distinguish for people with the most common color vision deficiency.
    - Why do plots only show some treatments?
    - This figure is impossible to understand without referring back to Table 1, but some thoughtful figure design would make that unnecessary.
    - Add Y axis labels.
- L 433: What is an H value?
- Fig. 7 (L 449-475): Add Y-axis labels.
- L 483-4: How exactly would richer soil lead to the model simulating slower maturity?
- L 522-3: Why increase the soil water content? This is insufficient explanation.
- Fig. 9 (L 577-89):
    - Far too small, especially considering the tiny plots inside plots.
    - What is "Hmax left"?
    - Add X axis tick marks for some points between 1 and 200.
- L 834-5: Why is the disclaimer about the US Government necessary? None of the authors have US government affiliations.
- All multi-plot figures: Add subplot labels (a, b, etc.) and refer to these in the text to help readers make the connection between what you write and what the figures show.
- Most figures are unnecessarily small; please enlarge them and make sure to use a high DPI (at least 300).

Significant work is needed on language cleanup. I've listed a number of examples here, but this list is not complete.

- L 30: Should "actual" be "current"?

- L 34: “in opposite” should be “on the other hand” or “in contrast”
- L 37-8: “but emphasizes… actual climate.” I’m not sure what this means.
- L 59: “9,1 milliards” should be “9.1 billion”.
- L 125-6: “mainly for isolated extremes, or broad parameters’ range”—?
- L 150: Delete last comma
- L 213 (Fig. 2): “Maxim” should be “Maximum”
- L 263-4: What is “([C]+10)”? Why the +10?
- L 285: “conventionality” should be “continentality”.
- L 311-13: Total precipitation is listed twice.
- L 316: “evolution” implies the long-term process of speciation. Presumably this should be “development”.
- L 350: “Ox axis” should be “X axis”.
- L 360: “turns in opposite” should be “flips” or “reverses”.
- L 382: “the S-Romania” should be “southern Romania”.
- L 389-391: This is not a complete sentence.
- L 395: “slowed grain feeling”?
- L 430: Should “Harvest” here be “yield”?
- L 434: “no more valid” should be “not true” or “no longer true”.
- L 481: “overestimate”?
- L 500: “astuciously,” while technically a word, is extremely obscure. Try instead: “smartly,” “astutely.”
- L 524: Should “known” be “no”?
- L 533: Should “intra-model” be “inter-model”?
- Throughout: “decade” should be changed to “dekad” when referring to a period of ten days, to avoid potential confusion with the much more common usage of “decade” to refer to a period of ten years.
- Throughout: When referring to figure axes, “Ox” and “Oy” should be “X” and “Y”.
- Throughout: Instead of H or Harvest, just say yield.

You might consider using an LLM with a prompt like “Please clean up this text from a scientific paper,” feeding it one or two paragraphs at a time. However, (a) make sure to check the output yourself to ensure it didn’t remove important ideas or introduce any spurious ones, and (b) make sure to have a native English speaker check the output for remaining inaccuracies.

As an example, I asked Google Gemini to clean up the text at L 310-320, and it gave me:

> Figure 4 presents the projected changes in extreme weather events for the Călăraşi target subregion under the RCP85 scenario compared to the historical period (Hist). The analysis focuses on three key variables during the critical maize sowing month of April: freezing days (FD), total precipitation (RR), and severe precipitation events (RR10, days with daily accumulated precipitation exceeding 10 mm).
>
> A decreasing trend in FD is observed for both decades under the RCP85 scenario. However, it's noteworthy that the third decade may still experience intervals with even higher FD counts compared to the historical period. This late-spring blizzard phenomenon, crucial for plant evolution, has been

> linked to the combined influence of Polar Jet instability and warmer Eastern Mediterranean sea surface temperatures (Caian and Andrei, 2019). As both factors are projected to intensify in a warming climate (Lelieveld et al., 2012; Shaw and Miyawaki, 2024), the region may experience a higher potential for severe spring blizzards, which could negatively impact crops and annual yields.

Although this is an improvement, there are still issues, including:

- "target subregion"—what is "target" saying here?
- "evolution" should be "development"
- Explanation of "decade" (ten-day period, not ten years) was removed.
- Gemini changed "main sowing month" to "critical sowing month," but I think "main" makes more sense. This isn't really a big issue, though, just a matter of taste.