Dear reviewer,

First of all, we would like to thank you for your feedback, it will help us to strengthen our manuscript. Second, we would like to give a more detailed reaction to some of your comments. The answers will be highlighted in bold, while your questions are contrasted in cursive.

While the authors suggest that the model could be applied to other basins (e.g., the Red Sea), it is not clear how the specific model configurations (A1, A2, B) would translate to different geochemical settings. Could the model be adapted to explore other evaporite-forming basins more explicitly?

The model can be adapted by changing the dimensional parameters (area, depth), forcing (net evaporation) and restriction to fit the basin in question. Since our study focusses on the Mediterranean Sea, we chose values for the dimensional parameters to reflect that. The influence of other parameters (net-evaporation, restriction, relative size of the boxes) is tested by applying a range of possible values. We did not test the influence of dimensional parameters on the results since it was not within the scope of this research. However, those parameters can easily be changed and adapted by anyone who is interested in this aspect.

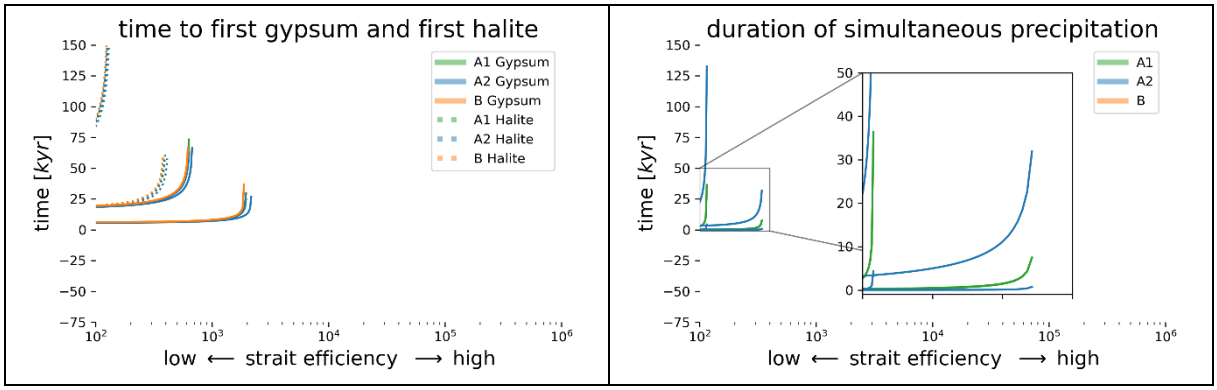
Regarding the title, you should mention the "Mediterranean Sea" because the MSC occurred in the Med Sea, and your study focused on the Med Sea.

We chose not to mention the Mediterranean Sea explicitly, since the title is already on the verge of being too bulky. We do not think adding this information would increase the information density of the title as the term 'Messinian Salinity Crisis' is indeed already strongly connected to the Mediterranean Sea,

The paper mentions that constant evaporation rates were used. How might a variable evaporation rate, could impact the model results? Could this change the timing or locations of gypsum and halite precipitation? Were there any sensitivity tests performed to explore this?

This is a very good point. As reaction to this and the other reviews we are going to expand our analysis by elaborating more on the time component.

To approach this, we add the times it would take to reach gypsum and halite precipitation respectively, as well as the time a model run stays within conditions that describe simultaneous but locally separated precipitation of Gypsum and Halite. The visualization of this dataset will be added to the set of plots in Figure 2 (see below).



We do not explore the influence of a variable evaporation rate because this would increase the amount of unknows in our study.

The manuscript does not provide sufficient discussion on the role of the Strait of Gibraltar in influencing Mediterranean circulation and salinity. A more detailed analysis of how restricted or variable water exchange through the Strait affects gypsum and halite precipitation patterns would add depth to the study.

We avoided labeling the connection to the Atlantic as Strait of Gibraltar, as the exact location of the connection between the Mediterranean Sea and the Atlantic is not entirely clear, with the Betic and Riffean corridor being two likely candidates.

We do however explore the influence of the efficiency of the connection independent of its location. This is expressed in the descriptor R_q as well as the strait efficiency. We will add a sentence to highlight this.

In connection with the analysis of the time component we will also add one more point to our conclusion. Since the process of restriction over time has a non-linear influence on the rate of change of the salinity in the different boxes, it is crucial to understand the closure of the connection better. Without having a better grasp on this process, the number of possible scenarios is unlimited. This however does not change the main conclusion of this study. Simultaneous precipitation of gypsum in the periphery and halite in the deep basin is only possible in a basin close to halite saturation.

Have you conducted sensitivity tests on key parameters such as evaporation rates, river water composition, or Strait of Gibraltar exchange? If not, how might these factors impact your results?

We do not label it as such, but we do explore the influence of the interplay of restriction and evaporation rates (discussed in 206- 237, 272-2076,), as well as the influence of other parameters (276 -281, 288 – 301, 303-308).

The analysis of the influence of river water composition on scenario B+ will be supported by a table for the exact values and a more in depth description on how those values relate to the results.

The abstract could benefit from a clearer articulation of the novelty of the study. It touches on known issues but doesn't strongly emphasize how the modeling results diverge from or contribute to existing theories.

We will strengthen the message by highlighting the time component and the need for a better understanding of the change in restriction.

The comparison with Simon & Meijer (2017) is helpful, but the contributions of the present study (e.g., density driven dynamic overturning) could be more explicitly emphasized early on. For instance, the detailed breakdown of different studies (e.g., Meilijson et al., 2019 vs. Manzi et al., 2018) could be summarized more concisely to avoid overloading the reader with too many specific comparisons at the outset.

Citations are included in parentheses, but in some cases, they interrupt the flow of the text. For better readability, consider rephrasing sentences to integrate citations more naturally. Example: Instead of "5.97 to 5.33 Ma, (Roveri et al., 2008)," you could say "According to Roveri et al. (2008), the event occurred between 5.97 and 5.33 Ma." This would make the text

smoother. Consistency in citation formatting is needed. For example, in some instances, authors' names are written in all caps, which should be corrected., e.g. (Decima & WEZEL, 1971; Decima & Wezel, 1973) .

The flow between ideas could be improved with clearer transitions between sections. For example, when moving from the discussion of modeling to the thermo-haline circulation section, adding transitional sentences can help guide the reader more smoothly from the background after the modeling approach.

Those are good ideas; we agree that this will increase readability.

The conversion from Atlantic water to more saline Mediterranean overflow water happens via an overturning cell in the Mediterranean Sea." Not clear, this sentence could be rephrased.

The process is elaborated on in the next sentence. We will rephrase the sentence to

'The conversion from Atlantic water to more saline and warmer Mediterranean overflow water (MOW) can be described via an overturning cell in the Mediterranean Sea.'

The abbreviation "MSC" for Messinian Salinity Crisis is introduced but not consistently used throughout the text. It would help to use the abbreviation after it's introduced to avoid repeating the full term, e.g. line 342.

We agree with this.

Method section

The overall structure and technical content are strong, but enhancing transitions will improve readability. While you define many variables, key terms could be better explained to ensure the reader fully understands. For example, explaining "net evaporation rate" in more detail would help if a reader is not familiar with the exact context. Similarly, more context around κ and why it's used differently from its traditional sense could be provided upfront to avoid confusion.

Some terms such as "anti-estuarine circulation," "driver flux," and "marginal basin" are used without sufficient context for non-expert readers. After describing each configuration (A1, A2, and B), it might be helpful to summarize their key differences in a table. This would help the reader quickly differentiate between them.

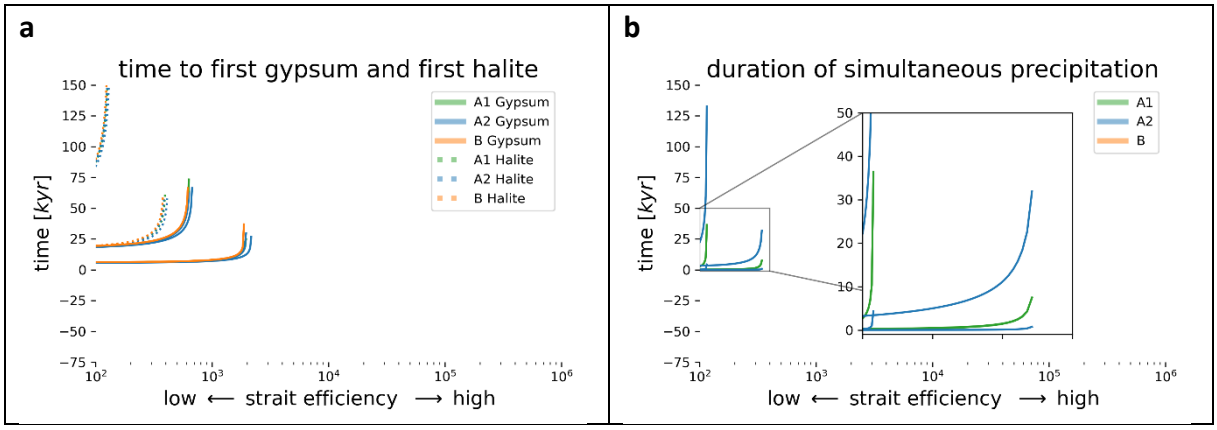
The concept of the driver flux will now also be introduced in the description of Figure.

Anti-estuarine circulation can be introduced with additional information 'i.e. outflow more saline than inflow' in line 62.

What is the temporal resolution of your model, and how does influence the results, particularly regarding the timing of halite and gypsum precipitation?

The model itself operates with dt = 0.5years, we also tested different timesteps up to 2 and saw no changes in the results.
To address the issue of timing we have now calculated the time the model takes to reach halite and gypsum, as well as the timespan the conditions for simultaneous precipitation are met. We plan to include the figures in the results section (Figure 2) and their implications in the discussion.

Figure a describes the time the model takes to reach gypsum (solid line) or halite concentration (dashed line). The vertical asymptote of each curve intersects the x axis at the restriction parameter that would just not yet lead to gypsum or halite. Figure b shows the timespan during which a model run would meet the conditions as defined in the manuscript. This time the vertical asymptote of each curve marks those runs that meet the conditions once they have reached stability. i.e. the duration goes to infinity. Left from this singularity, the model meets the conditions only for a short amount of time during the stabilizing phase.



Results section

The use of the strait restriction parameter (q) and its bulky unit [(m³/s)/(√kg/m³)] is well justified, but simplifying its interpretation would help make the section more accessible.

We are omitting the bulky unit later on to not overload the reader, but we can also add a brief explanation of the unit itself (i.e. relating water flux m³/s to the square root of salinity difference sqrt(kg/m³)).

The model uses generic assumptions about river water composition to assess gypsum precipitation in the extra box. How significant are variations in river chemistry (e.g., calcium and sulfate concentrations) for altering the results, and were sensitivity tests performed with different river compositions?

To make their influence clearer we will add a table showing the compositions we used.

This table will then be used to guide a more elaborate analysis of the results. The main message will be that net evaporation can be in compared to the river inflow before halite starts precipitating, the higher the calcium and sulphate concentrations are in comparison to natrium and chloride.

The section compares the model results with the Mediterranean and Red Seas, I think that the appearance of the part about the Black Sea is very abrupt, and there is very little information about the Black Sea in the paper.

Discussion section

The discussion is rich in technical detail but sometimes lacks a clear "so what?" moment that emphasizes why these results are significant in the context of the Messinian Salinity Crisis or other studies on evaporite formation. While the model's limitations are well discussed, it

would be helpful to suggest what future studies could address based on these results. How could the model be improved? What future work is needed to fill the gaps identified in your study?

Conclusion section

The conclusion, while summarizing the key findings, could be strengthened by tying the results more explicitly to potential future research directions or practical implications. It currently ends somewhat abruptly and could benefit from a more definitive closing statement on the significance of the study.

In connection with the more elaborate treatment of the time component we will highlight the necessity to describe the process of restriction over time to be able to describe the problem in more detail. We will also put more emphasis on our conclusion that simultaneous precipitation of halite and gypsum most likely only occurred towards the end of stage 1 of the consensus model and not sooner.

For example, what does this timeline and model tell us about the general understanding of evaporite formation in restricted basins? How might these findings inform future models or field studies in similar settings?

We will add that our timeline is an addition to the bullseye patten that is observed in deposits formed by a drying lake.

Legend of figures in bold?

Ensure that table legends appear at the top of the tables. This would align the manuscript with common publication standards.

In both instances I had misinterpreted the template. This will be fixed in the next version.

A few suggestions:

The comments listed under this header did not need clarification and will not be discussed here. They will be taken into account when revising the manuscript.