We sincerely thank the reviewer for the time he or she spent editing the manuscript. In editing the manuscript, we have invested more in the language. Among other things, several co-authors proofread the text, particularly with regard to readability. The reviewer's comments provided us with a solid foundation for this. We believe this has significantly improved the readability of the manuscript.

Our answers are integrated into the review below.

Review #2

“This manuscript describes ICON XPP, a new Earth system model configuration that substitutes the previous MPI Earth system model, as part of the ICON framework. ICON XPP is tailored for climate predictions and projections at two available model resolutions, and aims to be used in the CMIP7 suite of models, after further tuning.

General review:

The manuscript provides a valuable contribution to the climate modelling community. The manuscript comprehensively documents and evaluates the ICON XPP model components, configuration and its tuning on decadal and seasonal simulation scales, at both model resolutions. Key drivers of climate prediction and projection are presented and assessed, comparing against other well-established models and ERA5 observational datasets. Assessment and comparison of the models’ ability to simulate key measures of climate state, such as climate sensitivity and also key dynamical processes clearly demonstrates where the model performs well and where further improvement could be beneficial. Overall, the manuscript is generally well-written, and the authors effectively present the evaluation of this new Earth system model using key metrics.

I therefore find this paper suitable for publication in GMD, after the author’s response/ corrections to a few minor revisions below:

General:

- **Overall, the manuscript is well-written, however I believe the manuscript could be condensed as there are a number of lengthy sentences/ paragraphs throughout, that should be more concise for clarity and understanding.**
  We agree. As suggested by the reviewer, we will revise shorten the abstract and restructure the introduction. See individual comments below. We also will check the entire text for clarity.

- **There are also a number of spelling and grammatical mistakes throughout, I have highlighted some of these below, but I recommend a thorough read through to correct these.**
  We will read the text thoroughly with a focus on spell-check and grammatical mistakes. In particular, several co-authors will have a cross-check with regard to the readability of the manuscript.

General Abstract:

- **The abstract is too long, in my opinion. Ideally the abstract could be condensed into a more concise version, with only key results and information presented. There is some information I believe could be removed/ sentences condensed to reduce the size.**

Agreed. The abstract will be reduced by a couple of sentences and subordinate clauses. For example, we have identified the role of the model initiative from which ICON XPP is results, and some very specific text passages about the basic assessment, ENSO and the stratospheric dynamics as clear candidates for cut off.

Introduction general:

- **While the introduction provides a good presentation of background information required for understanding and guiding the reader through the manuscript, I find the could be structured improved. There is some repetition in some paragraphs, or others seem to continue discussing a point made in previous paragraphs throughout all paragraphs. I would recommend some minor restructuring of the introduction, so it easily flows and provides a succinct background to the great main body of the manuscript.**

  e.g Line 82: ***"Here, we present ICON XPP, from the design of the configurations to a first evaluation of the Earth System state based on the CMIP DECK (Diagnostic, Evaluation and Characterization of Klima) experimentation framework (Eyring et al., 2016)."***
  This reads as if it should be placed at the end of the introduction? But this could be a personal opinion.
  Yes, we agree. We will sharpen the individual paragraphs by shuffling a couple of sentences. For example, the sentence including "…new modeling initiative…" will better be placed in the 2nd paragraph, where the model structure is described. Also, the CMIP DECK experiment is better placed in the paragraph about climate projections. The climate projection paragraph will be shifted upward, right after the predictions, and fits much clearer the textual order (prediction, projections, research).

  In addition, some subordinate clauses will be deleted. On example is – as already mentioned by the reviewer – the relative complex last sentence in the first paragraph, which will be rephrased to: "Special attention is given to monitoring certain aspects of the tropical and extra-tropical mean climate, including key modes of variability. "

Minor corrections:

- **Line 47: "*At regional scale*". Should this read: "At a regional scale"?**
  Will be changed accordingly.

- **Figure 1 and Figure 8: The colours used for each model resolution is switched in these figures, ensuring all figures have a consistent colour scheme would improve clarity.**
  Yes, sorry! The colors in figure 8 will be synchronized with figure 1.

- **Lines 76-78:** ***"Since 2020, a new modelling initiative integrating numerical weather forecast, climate predictions and climate projections based on the ICON framework (Müller et al., 2025)."*** **This sentence seems unfinished?**
  This sentence will be rephrased and shifted to the next paragraph. It will read: "Since 2020, a new modeling initiative integrates numerical weather forecast, climate predictions and climate projections based on the ICON framework into a single model system (Müller et al., 2025)."

- **Line 79: '-,' - The comma isn't needed.**
  Agreed**.**

- **Line 80:** ***"ICON XPP will be the baseline for next generation climate predictions …"*****Should be: "ICON XPP will be the baseline for the next generation of climate predictions…?**
  Will be changed accordingly.

- **Lines 84-87:** ***"Special attention is given to monitoring certain aspects of the tropical and extra-tropical mean climate, and the stratosphere, including key modes of variability and their predictability, such as the El Niño/Southern Oscillation (ENSO), or the North Atlantic Oscillation (NAO)."*** **- This sentence is slightly verbose and clunky.**
  The sentence will be changed to: **"**Special attention is given to monitoring certain aspects of the tropical and extra-tropical mean climate, and key modes of variability."

- **Line 88:** ***"for the individual components"*** **- Leaves the reader wondering what the individual components are. Could point to a table or list of the components, or leave the "individual components" part out?**
  This sentence will be changed to:" ICON XPP builds upon accomplishments of previous ICON initiatives with regard to the climate sub-components."

- **Line 107: Needs to be clearer**
  The part "continental-scale temperature and precipitation patterns" will be deleted.

- **Lines 107-108:** ***"and it is recently for machine learning methodologies to assess…"*** **- Should read, "and it has recently been used for machine learning methodologies to assess…"? If not, this sentence should be re-phrased.**
  The subordinate clause about machine learning will be deleted.

- **Line 109:** ***"MPI-ESM has been also used for decadal climate"*** **- Should read, "MPI-ESM has also been used for decadal climate".**
  Will be changed accordingly.

- **Line 172: "TERRA" isn't defined? A definition or acronym description here would be useful.**
  Thanks! TERRA was adopted from the Latin for "earth". This note will be added to the sentence where TERRA first appears.

  For clarity we will also explain the role of TERRA in ICON Land, which has not been stated yet:" ICON Land includes the JSBACH land-surface model developed for predecessors of ICON XPP such as MPI-ESM (Reick et al., 2013, 2021), and other land-surface model such as TERRA (from the Latin for "earth"), which is implemented into the operational configuration of ICON NWP"

- **Line 264:** ***"2 metre"*** **- Should it read "2 meters"?**
  Will be changed accordingly.

- **Lines 262-265:** ***"The targets mainly consider the thermodynamic state of the atmosphere - depicted by the top-of-atmosphere radiation balance and global-mean temperature at 2 metre - and the ocean-cryosphere - by the strength of the Atlantic meridional overturning circulation (AMOC) and sea-ice properties"*** **- A long sentence, could split into 2? The whole first paragraph of the 2.3 Tuning section could be re-worded for flow and clarity.**

The sentence will be rephrased: “The targets mainly consider the top-of-atmosphere (TOA) radiation balance and global-mean temperature at 2 meters (GMT) - and the strength of the Atlantic meridional overturning circulation (AMOC) and sea-ice properties. “

- **Line 276: “@26° N” – is this the correct symbol?**
  Will be changed to “at 26° N”

- **Line 277: “*a small trend remains for the AMOC at the end of the simulation.”* - Should this read ‘by the end of simulation”, instead of “at the end of simulation”? This would provide more clarity for me, implying a trend still remains by the end of the simulation? The authors could also elaborate on this trend more? A negative trend/ the AMOC weakens?**
  Thanks! The sentence will be changed to: In 160/40 a small negative trend of the AMOC at the end of the simulation. **“**

- **Line 284: “sediment,.” – should be “sediment.”? No need for extra comma.**
  Will be changed accordingly.

- **Table 1: Could the sea ice parameters have units? i.e Sea ice melting 0.25, is this millionkm^2? Or is there a reason no units are provided? Some more information could be provided on the tuning process for the reader to understand how each value was reached.**
  The sea-ice parameters are dimensionless. We will add a statement of the units and whether they are dimensionless in the figure caption.

  In addition, to get the optimized values we performed a series of tailored experiment targeting the climate benchmarks. We will include a statement accordingly in the main text to make this a bit clearer:

  ” A series of tailored pre-industrial control experiments are employed to find the optimal parameterization values. First, a wider range of convection, microphysics and cloud cover parameters are examined to estimate their impacts on the TOA radiation balance and GMT. Then, with the resulting subset of atmospheric and oceanic parameters the ocean-circulation and sea-ice distributions are adjusted. With the optimized parameters a new spin-up is started. The values of the optimized parameter values are shown in Table 1.”

- **Line 307: “*The climate sensitivity is estimated by 1%...”,* should read “The climate sensitivity is estimated by a 1%...”?**
  Will be changed accordingly.

- **Line 324: Again, I may have missed it but “AMIP-type”, could be defined or the acronym breakdown provided.**
  Will replace “AMIP-type” by “atmosphere only”

- **Line 328: “…for 160/40 and ~1.7 °C 80/20,…”, missing a ‘for’? should read “…for 160/40 and ~1.7 °C for 80/20,…”**
  Thanks. Will be changed accordingly.

- **Line 330: "*The sea-ice reveal reasonable…”,* missing ‘simulations’? Should read: “The sea-ice simulations reveal”?**
  Thanks. Will be changed accordingly.

- **Line 330: "peak season"/ "minimum season" could be defined? As the terms "peak season"/ "winter season/ growth season" etc are used interchangeably. Could be useful to provide the months referred to in brackets.**
  We will replace "peak" by "winter" and "minimum" by "summer". "Winter" and "summer" are defined in the figure caption.

- **Line 344: *"peak magnitudes of ~15-20 Sv at 26° N at 1000m depth,…",* should it read "and 1000m depth…"? In addition, should the peak magnitude be a range, or a single number?**
  Yes, thanks. We will change this sentence to: **"**For the last 500 years of simulation, the overturning circulations in the Atlantic at 26° N and 1000 m depth show values between 14-17 Sv for 80/20 and 16-19 Sv for 160/40,…"

- **Table 3: misaligned data in the observations column/ Denmark Strait row?**
  Will be changed accordingly.

- **Line 423: "a *small ensemble of three…"* – I would be interested to know why three were generated? Was this a computational constraint, or something else? An explanation in-text could be useful?**
  No, unfortunately not. The number is simply a guess to see whether the experiments roughly do similar by changing the initial conditions. Since this is based more on "modeler's experience" rather than "computational constraints" we would like to avoid a discussion in the text.

- **Line 437: "*The causes are currently unclear, and further investigations are in progress.*" Is there any literature available yet? Is it possible to cite these further investigations?**
  We modified this sentence and provide references to support the text, the new lines are: "Although the causes of the double-ITCZ are currently unclear, some models have modified the clouds microphysics, vertical entrainment rates, convection schemes or the atmospheric energy balance to reduce this feature (e.g., Ma et al., 2023; Ren and Zhou, 2024); however, no generalized modification can be applied to all models"

  Ma, X., S. Zhao, H. Zhang, and W. Wang, 2023. The double-ITCZ problem in CMIP6 and the influences of deep convection and model resolution. International Journal of Climatology, 43, 2369-2390, doi: 10.1002/joc.7980.
  Ren, Z., and T. Zhou, 2024. Understanding the alleviation of "double-ITCZ" bias in CMIP6 models from the perspective of atmospheric energy balance. *Climate Dynamics*, 62, 6819-6839, doi: 10.1007/s00382-024-07238-7.

- **Line 448: "*Smaller errors"* – could be made clearer? "Smaller margin of error"?**
  We will change this sentence to: "Smaller root mean squared errors (RMSE) are found for many dynamical and thermodynamical quantities by increasing the resolution from the 160/40 to the 80/20 configuration."

- **Table 4: It would be nice to see Table 4 placed nearer to where comparison to observations is mentioned, if possible.**
  Will be changed accordingly.

- **Line 577: Could define the *"cold tongue bias"* better, this sentence could also benefit from some citation.**
  Thanks, we will add the following: " The cold tongue bias refers to the excessive cooling along the equatorial Pacific, a common systematic error in climate models (Li & Xie, 2014)."
  Li, G., & Xie, S.-P. (2014). Tropical biases in CMIP5 multimodel ensemble: The excessive equatorial Pacific cold tongue and double ITCZ problems.

- **Line 588: *"Nino3.4-related"*, could you introduce this? A definition or explanation would be useful here.**
  Thanks, this sentence now starts with: "A regression of SST anomalies to the Nino3.4 index" to make the Nino3.4 region more explicit. Further the Nino3.4 index will be defined in the figure caption.

- **Line 590: "*As many coupled models…"* – should read "As in many coupled models…"?**
  Will be changed accordingly.

- **Line 691: "*Among other*…" – should read "Among others…"?**
  Will be changed accordingly.

- **Line 698: "*… and meanwhile…"*, do you need both?**
  In fact, not both are needed. The sentence will be changed to: "…and seasonal and decadal prediction skill of the NAO is established …"

- **Line 716: Full stop missing after citation (Müller et al., 2018)**
  Will be changed accordingly.

- **Line 737: *"well-behaviour*", is this the appropriate word? Are you referring to good performance?**
  Thanks. Will be changed to "good performance"

- **Line 786: Brackets are needed around the citation (Niemeier et al., 2024), or sentence needs re-phrasing if not.**
  Will be changed accordingly.

- **Line 795: "*However, several factors – among others volcanic eruptions…*", grammatical errors here/ more punctuation needed.**
  We will remove the two sections on the polar vortex and SSWs (including Figure 18), as it would require more effort to elaborate on the SSWs in the necessary depth. In response to the first reviewer, it would be necessary to consider several decades to quantify the necessary variability of the SSWs, as well as a more in-depth analysis beyond the presentation of the time series. Both would require currently considerable effort, especially an in-depth analysis of the SSWs of both configurations would increase the scope of this chapter.

- **Line 806: The sentence would read better if it were *"winter northern hemisphere"* not "hemispheric"? Punctuation is also missing from this sentence: *"shows, for example, …".***
  Please see comment above.

- **Line 812:** ***"exhibits comparable variations as in observations",*** **this sentence could be much shorter e.g "comparable to observations".**
  Please see comment above.