Response to referee comments

Referee comments are in black.
Responses are in blue. We indicate where in the text the changes can be found by L followed by a number that gives the line number.
Manuscript citations are in italic with changes in red.

1 A brief summary of the paper:
The paper by Bjordal, Smith, Cornec, and Storelvmo introduces NorESM2–DIAM, a coupled framework linking a state-of-the-art Earth System Model (NorESM2) with a high-resolution Integrated Assessment Model (DIAM). The objective is to study global and regional climate–economy interactions with a level of spatial and physical detail unavailable in conventional IAMs. The economic model covers about 19,000 regions worldwide, where agents optimize consumption, investment, and energy use given temperature-dependent productivity, while NorESM2 simulates the climate response to their emissions. The coupling is achieved through an iterative fixed-point procedure: DIAM generates emissions that feed into NorESM2, which in turn returns regional temperature and weather outcomes that affect productivity. A simplified statistical version of DIAM ensures tractability and internal consistency of expectations. The model reproduces global emission and temperature trajectories consistent with the NorESM2 climate response and produces credible spatial patterns of warming and economic change. Quantitatively, the global mean temperature is projected to rise by about 3.5◦C by 2100, leading to a decline of roughly 35% in global GDP per capita relative to trend. Around two-thirds of this decline stems from demographic shifts toward warmer, poorer regions, and about one-quarter reflects direct climate damages. Regional outcomes are highly heterogeneous: colder regions gain modestly from warming, while tropical and subtropical regions suffer substantial losses. The framework also shows that internal climate variability generates nontrivial fluctuations in GDP, highlighting the importance of weather variability for economic outcomes.

2 Assessment
This is an exciting and important methodological paper. To the best of my knowledge, it is the first study that succeeds in coupling a spatially highly resolved economic model with a fully fledged Earth System Model (ESM). The authors make a major step toward moving beyond externally imposed RCP or SSP scenarios, into a framework in which emissions are endogenously generated by economic agents. I applaud the authors for this ambitious and timely contribution. The paper is clearly written, conceptually transparent, and the authors provide an honest and thorough discussion of the methodological challenges and current limitations. It is in excellent shape and, in my view, fully merits publication.
I have only a few minor stylistic suggestions, none of which should delay publication.

Thank you for the nice summary of our paper, as well as for the encouraging overall assessment. We are grateful for the thorough reading of the paper and the helpful suggestions.

3 Minor Comments

1. It might be helpful for readers if the authors included a schematic diagram (e.g., in Section 2) illustrating the structure of the IAM in addition to its algebraic and textual description. Such a figure could clarify where exactly the coupling ("handshake") between NorESM2 and the economic model occurs.

A good suggestion. We have added such a schematic in section 2.

L101: *The two components of NorESM2–DIAM are coupled via a continuous, bidirectional flow of information as illustrated in Fig. 1.*

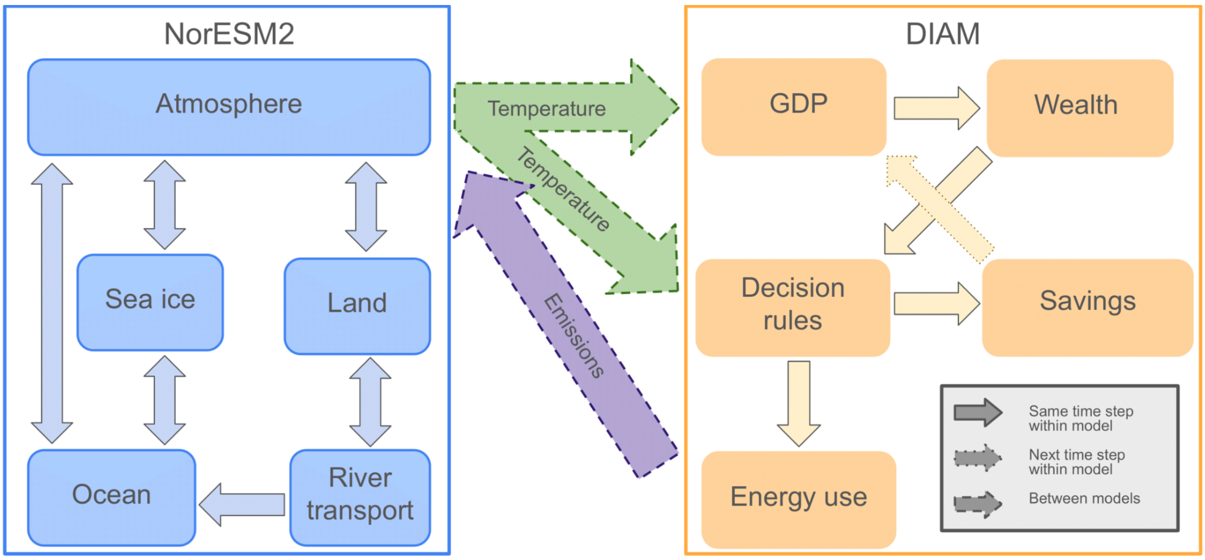

***Figure 1**. Schematic overview of the NorESM2–DIAM coupling and internal interactions. NorESM2 provides regional one-year-mean temperatures for the current model year to DIAM (dotted arrows indicate exchange between models). Regional temperature directly affects regional GDP, which in turn determines regional wealth (solid arrows indicate exchanges happening within one model for the current one-year time step of the coupled model). Based on regional temperature and wealth, each region then makes decisions about savings and energy use using pre-computed decision rules derived from the standalone version of DIAM. Within DIAM, savings affects GDP in the next model year (dotted arrows indicate exchanges happening within one model in the next time step of the coupled model). Energy use determines next year's emissions, which are provided to NorESM2. Finally, to complete the cycle, the different modules of NorESM2 interact to generate*

new regional temperatures. Note that the modules interact through a coupler, and the timing varies between modules, but they all exchange information at least once every 24 hours (Seland et al., 2020; Danabasoglu et al., 2020).

2. The quadratic functional form of temperature in Equation (1) is introduced on page 7, but its justification appears only later in Section 4.7. Since many readers may be more familiar with the linear specification, it could be useful either to move the discussion in Section 4.7 closer to the equation's introduction or to insert a brief forward reference to where the justification is provided.

We have changed the forward reference from Section 4 to Section 4.7 for easier navigation in the text, and also made it clearer that the explanation will be found in this section. (L207-208)

The justification for using a quadratic rather than linear functional form ~~and~~, along with details on how the parameters γi1 and γi2 are estimated from data, is provided ~~as described~~ in Sect.~~ion~~ 4.7.

3. Appendix A.6.2 explains how the numerical accuracy of the procedure can be assessed, but I could not find a summary table reporting the associated error statistics. Including such a table would help the reader gauge the quantitative reliability of the solution method.

A short section summarising the errors has been added. (L886-892)

A6.5 Euler equation errors: numerical values

To check the accuracy of the computed decision rules, both along the transition and in the steady state, we calculated Euler equations errors as described in Sect. A6.2 and A6.4. These errors are very close to zero. In particular, the average error relative to consumption (averaging across both regions and the values of the state variables) is less than 0.0024% (in absolute value) in every time period. In addition, the average of the absolute values of the errors is less than 0.021% in very time period. Finally, apart from a very small number of outliers (fewer than 10), the largest error—looking across all regions, time periods, and states— is smaller than 0.6% in absolute value.

4. On page 40, line 880, the text reads "as explained in Section ??". It seems that a LATEX cross-reference failed to compile correctly and should be fixed.

Thank you for catching this. We have removed this cross-reference, as it should not be there. (L917)

The function h^k_{it} is known only on a two-dimensional grid of points, so use bilinear interpolation to calculate it off the grid.~~, as explained in Section ??.~~