There was an error in the reply to the following comment.

Referee #5:

General comments:

The authors acknowledge (but not completely clearly) a major shortcoming of the Earth System Models (ESMs) and Integrated Assessment Models (IAMs).

Even though the Human System has become the dominant driver of most components of the Earth System since about 1750, and especially since about 1950, IAMs use independent, exogenous projections of the Human System (HS) variables in order to drive ESMs to create future projections. Not including essential bidirectional feedbacks between ES and HS can lead to missing important dynamics that is critical to the sustainably of our planet and people. This problem is discussed in detail in the "Modeling Sustainability" paper by Motesharrei et al. [2016]:

Motesharrei, Safa, Jorge Rivas, Eugenia Kalnay, Ghassem R. Asrar, Antonio J. Busalacchi, Robert F. Cahalan, Mark A. Cane, et al. "Modeling Sustainability: Population, Inequality, Consumption, and Bidirectional Coupling of the Earth and Human Systems." National Science Review 3, no. 4 (December 11, 2016): 470–494. https://doi.org/10.1093/nsr/nww081.

Reply: Many thanks for giving us the opportunity to expand this point in the paper. Also, thanks for the reference, which reinforce our point. We have used it to expand the issue in the revised version of the manuscript.

We extended the third paragraph of the introduction section to explain the point in details. The text now reads:

> *One of the fields most in need of development is the inclusion ~~in global models~~ of co-evolutionary dynamical interactions of the socioeconomic dimension into global models with other Earth system components (Nobre et al., 2010; Robinson et al., 2017; Sarofim and Reilly, 2011). Human activity was a major driver of change in the Earth System in the recent past (Alter et al., 2017; Barnett et al., 2008; Crutzen, 2002), and it now dominates the natural system (Ruth, et al. 2011). However, most global models use basic socioeconomic assumptions about the behavior of societies and are only unidirectionally linked to the biogeophysical part of the Earth system (Müller-Hansen et al., 2017; Smith et al., 2014). The standard way of introducing anthropogenic climate change into ESMs is through Representative Concentration Pathways (RCPs). These are consistent sets of projections involving only radiative forcing components (van Vuuren et al., 2011), but which represent a step forward from the scenario approach of the last decade (Moss et al., 2010; van Vuuren et al., 2014; van Vuuren and Carter, 2014). However, RCPs are not fully-integrated socioeconomic parameterizations but rather estimates for describing plausible trajectories of human climate change drivers (Moss et al., 2010; Vuuren et al., 2012). They provide simplified accounts*

of human activities and processes from one-way coupled Integrated Assessment Models (IAMs, Müller-Hansen et al., 2017).

The use of RCPs is advantageous because they provide a set of pathways that serve to initialize climate models. However, two major problems remain within this approach. Firstly, human activities are not intrinsically embedded into the ESM, impeding sensitivity studies. Secondly, because of the weak coupling of IAMs, they cannot capture the sometimes counterintuitive bidirectional feedback and nonlinearity between the socioeconomic and natural subsystems (Motesharrei et al. 2016; Ruth et al. 2011). Good examples that illustrate the importance of including such bidirectional feedbacks feature in the HANDY model (Motesharrei et al. 2014) which has been used to analyze the key mechanisms behind societal collapses using the predator-prey model.

The RCP approach has been used in climate models because of its low computational cost. However, advances in computational resources now allow to parameterize human-Earth processes in a more detailed way, including the inclusion of population dynamics into the modeling, as in the POPEM (POpulation Parameterization for Earth Models) module (Navarro et al., 2017).