Reply to the Interactive comments by the anonymous referees on

J. Randers et al.

"A User-friendly Earth System Model of Low Complexity: The ESCIMO system dynamics model of global warming towards 2100"

We agree on many of the points made, and contest some of them. In the following, we have selected those of the referees' comments that need a follow up. We have placed the referees' comment in quotation marks before we make our own remarks.

Anonymous Referee #1, published 26 June 2016.

This is a very knowledgeable, insightful and useful review of the paper and model. We have numbered the comments for future reference.

1. "ESCIMO builds on the widely-used C-ROADS climate model developed by MIT and ClimateInteractive.org." ESCIMO does not build on C-ROADS: it was developed independently. But it is certainly useful to compare the two, as the reviewer does, since they are similar with regard to methodological platform and scope. *No changes are necessary to paper*.

2. "For example, ESCIMO includes explicit compartments for carbon in fossil fuel reserves, the atmosphere, biomass, permafrost, the surface ocean, and the deep ocean. It does not distinguish between C in biomass and soils, as C-ROADS does,.." ESCIMO does indeed distinguish between C in biomass and soils and has actually a rather detailed set of variables that represent various carbon reservoirs. *No changes are necessary to the paper*.

3. "The authors also compare the behavior of the model to the behavior of the CMIP5 model ensemble for RCP4.5. The fit is good. However, the authors should compare the behavior of ESCIMO to a much wider range of scenarios, including all the RCPs, to demonstrate that ESCIMO remains reasonable across a much broader set of assumptions for GHG emissions." We have used the central RCP4.5 in Figure 7 and then compared our emission scenario with four other RCPs in Figure 8. *No changes are necessary to the paper*.

4. "Curiously, in the "base" run showing model behavior through 2100 global GHG emissions peak around 2040 and fall nearly to zero by 2100….It is unusual to define a base run in such models that assumes such strong policy actions, actions that no nations have committed to make." Our base run emission scenario is based on the forecasts in the book by Randers, J.: 2052: A Global Forecast for the Next Forty Years, Chelsea Green Publishing, Vermont, 2012, as explained in ch. 3.4. The resulting base run is not very different from RCP2.6 and RCP4.5 in figure 7, and it does represent our current beliefs. *We will however include the main reasoning that explains the global GHG emissions scenarios that drives the base run through 2100. It is mainly determined by our forecast of population, GDP per person, and technological advance, and refer to the website www.2052.info for more detail.*

5. "Assessing model fit: I agree with the discussion on p. 22 that R^2 is not particularly useful as a measure of goodness of fit for the model, but the claim that it is sufficient to say that the fit is "or the order of 20%" is not appropriate. The authors should provide goodness of fit statistics in addition to the graphs in Figure 5 comparing simulated and actual behavior. Relevant goodness of fit statistics would include the Mean Absolute Error or Root Mean

Square Error (MAE/RMSE) and measures of bias (systematic differences between the data and model; there are some, for example, the model is consistently low compared to the data for arctic sea ice extent)." *Agreed. We will include MAE and RMSE for goodness of fit, and mean error for bias for the base run and history*.

The reviewer now turns to the documentation and the model.

6. "..the model does not fully conform to the documentation standards for dynamic models: the HTML documentation of the model shows that 64% of the equations/parameters in the model do not include explanatory comments or other documentation, and that 8% of the variables do not appear in any view of the Vensim model. The Vensim software returns 371 errors when the dimensional consistency check is run. These must be corrected. The model diagrams in Vensim are laid out poorly, making it more difficult to understand the structure of the model. The model should be divided into more views, each named appropriately, and the diagram showing the structure of each view should be laid out to be more readable. There should be a much better dashboard or cockpit with key parameters and policy levers available for sensitivity and policy testing, along with the graphs showing the key outputs." The Vensim software returns 371 errors when the dimensional consistency check is run because some of our units are too complicated for the documentation tool to parse correctly. It does not mean that the units are inconsistent. *We have corrected all unit 'errors' flagged by the documentation tool and will upload the corrected version shortly. We will also strip the diagram of all variables that are only there for experiments, and use different colors for different sub-types of variables, for example input data, lookup functions, etc.. This will provide for a much better overview and readability.*

Anonymous referee #2, published: 12 September 2016

7. "The results presented in the paper are encouraging, but need further testing and analysis before it can be made available for making policy decisions. A thorough comparison of the model results is needed, especially with all the RCP scenarios of CMIP5 is necessary to evaluate the model performance." *This has already been done as per §3 above. See also reply to §10 below.*

8. "The details about the base run, the forcings used for the base run and its performance is very much necessary." Here is an apparent misunderstanding: Carbon forcing is not an input to the model, but an output. *No changes are necessary to the paper*.

9. "The forcings are discussed as "The simple ESCIMO model structure, when parameterized with plausible parameter values obtained from the literature or common sense, and driven by actual man made emissions of greenhouse gases from 1850 to 2015. . .The future portion of these graphs is generated by ESCIMO with what we see as the most likely man made emissions from 2015 to 2100", is not justifiable. The global mean fields shown for the base run (Fig. 5) show a steady increase till 2070 and then a decrease in temperature and other fields. The base run also show GHG emissions sharply decrease after 2040, all these needs clarification." *We will justify this according to §4 above*.

10. "The model performance matrix depends on the base run characteristics, which need refinement before assessing the policy interventions for reducing global mean temperature." *The central idea behind making a simple model like ESCIMO is that any user with a PC can explore the model himself by entering his own beliefs about future carbon emissions. Our base run is based on our own beliefs, which are justified at very great length in the book by Randers, J.: 2052: A Global Forecast for the Next Forty Years, Chelsea Green Publishing, Vermont 2012 and on the website www.2052.info. No changes are necessary to the paper.*