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Earth System Dynamics Discussions

Interactive comment on "A User-friendly Earth System Model of Low Complexity: The ESCIMO system dynamics model of global warming towards 2100" *by* J. Randers et al.

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We thank you for a very knowledgeable, insightful and useful review of the paper and model. We agree on many of the points made, and contest some of them. In the following, we have selected those of the referee's comments that need a follow up, and enclosed them in quotation marks before we make our own remarks. "ESCIMO builds on the widely-used C-ROADS climate model developed by MIT and ClimateInteractive.org." ESCIMO does not build on C-ROADS but was developed independently, and it is certainly useful to compare the two, as the reviewer does, since they are similar with regard to methodological platform and scope. "For example, ESCIMO includes explicit compartments for carbon in fossil fuel reserves, the atmosphere, biomass, per-

mafrost, 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. "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 the four RCPs in Figure 8. We felt that a more elaborate investigation of the CMIP5 model ensemble would require too much space, but we are open on this point. "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, Club of Rome, Chelsea Green 5 Publishing 2012, as explained in ch. 3.4. It is not very different from RCP26 and RCP45 in figure 7, and it does represent our current beliefs. "Assessing model fit: I agree with the discussion on p. 22 that R2 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. "..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 the sectors. This will provide for a much better overview and readability.

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