

## ***Interactive comment on “Earth System Economics: a bio-physical approach to the human component of the Earth System” by Eric Galbraith***

### **Anonymous Referee #2**

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The paper “Earth System Economics: a bio-physical approach to the human component of the Earth System” is an interesting and thought-provoking article. However, even after reading the paper, I am not clear on why one needs to represent humans in this fundamental way in a coupled human-Earth system model. Why aren't traditional economic models or even agent-based models sufficient? Can you replicate reality with such a fundamental approach? It seems to me that it would be better to prove that such a framework works for representing human systems before you couple it to another complex system like the Earth system.

Line 32: “limited or no spatial resolution” is unclear and incorrect in some cases (e.g., IMAGE has a gridded land use module)

Line 42: I'd suggest noting the exceptions to this as there are a handful of examples of

steps taken in the citations you list here.

Line 60-62: What does “by the meat” mean?

Section 2.4: From this section, it seems that you are using the word “economics” outside of its common definition. I’d suggest clarifying that at the first use of the word in the introduction. Right now, the introduction doesn’t discuss economics other than to introduce the term ESE.

Section 2.5: How does this relate to agent-based modeling?

Line 240: I understand your quest for “real physical constraints”, but does constraining the metaconnectome impose meaningful constraints on variables of relevance to the Earth system? If not, then real physical constraints there have little value in a coupled human-Earth system model.

Section 3.1.2: Time allocation seems like a physical constraint more directly linked to the Earth system (e.g., a limit on the amount of time one can spend driving). However, even this constraint would only be loosely coupled with variables of relevance to the Earth system. One could theoretically consume a lot of electricity (and thus produce a lot of emissions) while sleeping. Also, in this section, it might be valuable to mention the existing literature on time allocation. There is an economic literature on labor-leisure trade-offs and the transport literature often factors in the value of one’s time when estimating modal shifts.

Line 276-278: I think this is a fundamental problem with this paper. It isn’t clear that this approach could capture any particular period in history. I think that needs to be demonstrated in order for the approach to be useful. Right now it just seems like a complex way of representing humans, but hasn’t been shown why this is needed or that it will work.

Section 4: Are there sources for the equations? How much does the precise functional form matter? For example, is equation 6 a standard way of representing the

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connectome?

Lines 435-440: A lot of food waste in the developed world today has nothing to do with consumption by other animals, bacteria, etc. The total amount of food produced vastly exceeds the amount needed for metabolic function in these countries. How is that accounted for in your model? Does this argue that metabolic function is not actually a binding constraint on food production?

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Interactive comment on Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2020-65>, 2020.

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