Earth System
Dynamics

Discussions

EGU

Interactive comment on "Analytically tractable climate-carbon cycle feedbacks under 21st century anthropogenic forcing" *by* Steven J. Lade et al.

Steven J. Lade et al.

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Heitzig wrote: "I like this model a lot. You may improve its exposition marginally and make it less time-dependent by introducing a fifth state variable, cd = deep ocean carbon stock, and rewrite eq. (8) as two ODEs, one for cd (containing the two integrals) and one for ca. This way the model's remaining time dependency is only on the two "control" variables $E(t)$ and $LUC(t)$ and it may thus be analysed more easily using tools from bifurcation analysis or topology of sustainable management (see this special issue)."

We thank the commenter for the constructive proposal to improve the readability of the

model and its potential for analysis. In the revised version of the manuscript, we will implement a slightly modified version of the commenter's proposal. We would prefer not to introduce a state variable that corresponds to a quantity (deep ocean carbon) that is outside the boundaries of our system of analysis (which is upper ocean, atmosphere and marine carbon). Instead, we will introduce a new state variable that counts the total amount of carbon over our three carbon stocks. The rate of increase of this quantity will be a differential equation given by the rate of carbon emissions minus the rates of the solubility and biological pumps (Eq. 9 in the revised manuscript). Conservation of carbon within the three internal stocks will then give a simple algebraic equation (Eq. 8 in the revised manuscript) to replace the former Eq. 8.