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Earth System Dynamics
Discussions

Interactive comment on "A simple model of the anthropogenically forced CO_2 cycle" *by* W. Weber et al.

W. Weber et al.

moluedecke@t-online.de

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The comment of J. Halpern (hereafter JH) repeats the comments of Joos and Köhler et al. Therefore, we refer to our corresponding answers.

Additionally, we note the following two corrections to the JH comment:

Pulse decrease: For the first ∼30 years our calculation results in (we do not "conclude" this) a SLOWER pulse decrease than other carbon cycle models do. Only after that does our model give a decrease faster than the other models, because a Revelle effect is not included.

Second correction: Our model parameters are not fitted (to the annual Mauna Loa record) but calculated with the CDIAC data of time series for the ocean sink, the sink

into the biosphere and the Mauna Loa record (Eqs. 8, 9 in our paper). As a test in paragraph 4 under "An alternative method of parameter optimization" we use the nonlinear SIMPLEX method to evaluate the parameters. This is a fit. The parameter values of both methods agree confirming that the fitting method does NOT lead to more precise parameter values.

Further general remarks:

JH remarks that complex carbon models break the system down into ever finer details - which means microscopic modeling. In contrast, we use phenomenological modeling, the two parameters in the Eq.(7) being derived from measurements. Two linear equations which represent the well-known law of mass action in chemistry are sufficient to describe correctly the CDIAC measurements and the Mauna Loa data. We agree that the model may not be sufficient to describe finer details beyond the CDIAC measurements. However, such data at present do not exist for the entire globe. More detailed calculations cannot be tested by measurements and must therefore, presently, remain hypothetical.

We note that until present no publications of complex models exist which reproduce consistently the CDIAC data. As Eby [1] and also Joos [2] show, considerable variation larger than the uncertainty of the CDIAC data exist between the results of the more complex models. A critique of this simple model would only be justified if it were shown that more complex models yield better agreement with measurements. We are not aware of models with better agreement.

Our linear model reproduces the CDIAC data for over ∼160 years. As a consequence, one can expect that linearity will be a good approximation for the next decades. At which CO2 concentration more complex models, which include nonlinearity or a Revelle effect, will be needed to describe measurements is beyond present knowledge.

After the three comments it seems to us helpful to emphasise in the final version of the paper that the simple model is sufficient for a correct description of presently avail-

able measurements. Without including further details our model may of course not be sufficient to decribe possible future more precise measurements.

[1] Eby et al: Historical and idealized climate model experiments: an intercomparison of Earth system models of intermediate complexity, Climate of the Past, 9, 1111–1140, doi:10.5194/cp-9-1111-2013, 2013.

[2] Joos et al.: Carbon dioxide and climate impulse response functions for the computation of greenhouse gas metrics: a multi model ananlysis, Atmos. Chem. Phys. 13, 2793-2825, 2013

Interactive comment on Earth Syst. Dynam. Discuss., 6, 2043, 2015.