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Earth System
Dynamics
Discussions

Interactive comment on "Assessing life's effects on the interior dynamics of planet Earth using non-equilibrium thermodynamics" *by* J. G. Dyke et al.

Anonymous Referee #1

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This manuscript provides some very interesting and thought provoking models of the interaction between Earth's interior and surface, between biotic and geologic activities. The simple models are very interesting and I believe the work presented in this manuscript deserves being published. Still I have so major comments concerning the presentation. Indeed, the equations are simple but the assumptions used and the notations are very often simply not explained. It is very cumbersome to try to guess what the authors have assumed, what is the meaning of the symbols and then try to get the same equation. Quite often, some assumptions are given at the end of the problem (example line 4 page 213) not at the beginning. The schematic figures (Fig.4, 7 and 9) are not helpful at all to understand the equations and should be redrawn with

model notations/equations in mind. Finally, I have some big concerns with the third model (which may be linked to a lack of explanations?) and the assumption of isostatic dis-equilibrium. Overall, the manuscript is not acceptable for publication in its present form. I therefore ask for rejection or major revisions.

Comments:

- Introduction (also line 9 page197): it is often said that the Earth heat production is linked to 2 sources: fossil heat and radiogenic heat. This is oversimplistic and wrong (see eg. line 10 page 206) since phase transition (freezing) or other processes may have an important contribution.

- the presentation of MEP is a bit lengthy and probably not necessary. In particular (lines 10-15 page 205) the example is not appropriate: if J = Jc+Jv is assumed fixed, then the maximum of equation (8) is easily computed and (for deltaT small compared to T) we find Jv = Jc (equipartition of fluxes). I am not sure this very specific example is a good illustration of MEP. Besides, it is a bit strange to write a simple equation without solving it (equation 8)... But may be the text "we assume a fixed heat flux J" (line 11) was not what the authors meant?

- line 6 page 206: Figure 5 instead of Figure 4.

- line 20 page 207: "fossil and latent heat input will decrease". I don't understand why this should not be the case also for radiogenic heat....

- equation (12). The choice of boundary condition is very strange: r=0 is the center of the Earth, not the core boundary. Tcore is not known, why not use Tsurface ? This model makes a lot of implicit assumptions that are not even mentionned (km, cm, Phi ... are uniform in the Earth, do not depend on temperature, ...) but may contradict some later statement (line 4 page 209: "rates of convection will vary with temperature")

- equation (15): now Ts is given (in contrast to equ. 8). Why not giving the analytical formula for entropy production (this integral is a priori easy to compute from equ. 8... a

priori with arctanh()). ? This is a pity when we have a nice, simple model, not to give the answer !

- line 25 page 210: Figure 7 instead of Figure 6.

- page 211: what are Toa, Tmc, Tca... Notations should be introduced and explained. And assumptions written (eg. Tmc = Tmo...)

- line 14 page 211: "heat diffusivity ... is the ratio of its density and heat capacity". This is wrong (dimensionaly impossible).

- this model 2 is very difficult to understand since assumptions are not clear. Why using a time varying equation (equ. 19) for a steady state problem? Time should be replaced from the beginning by space (t = x/v0), otherwise it is very difficult to understand the model. This part should be reformulated completely (with a figure explaining the different terms). This is a 2D advective diffusive steady state problem and it should be explained as such. As a result, I cannot understand the use of gamma (equation 29) as the control parameter of this model. Again, please explain the hypothesis, what is fixed, what is variable, ...

- model 3 line 16-18: "not at isostatic equilibrium... isostatic imbalance". I have a big concern with this third model... Mountains have roots which makes them at isostatic equilibrium. Besides, the isostatic time scales (thousands of years) are much faster that the erosion time scaes (millions of years). So I do not understand how geopotential energy can enter into this model. Again, a simple schematic figure would help to explain Zca, Zmc deltaZc, deltaZs, what is the zero line deltaZc1 and deltaZc2 ? Though I tried quite hard, I do not understand this model. This obviously cannot be published...

Interactive comment on Earth Syst. Dynam. Discuss., 1, 191, 2010.