

## ***Interactive comment on “Thermodynamics, maximum power, and the dynamics of preferential river flow structures on continents” by A. Kleidon et al.***

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Received and published: 14 July 2012

I read this paper with a great interest. This manuscript is very well written and provides in-depth background information on how thermodynamics principles can be applied for land surface processes. I think that the insights delivered by this paper are worth reading by HESS readers. Below I list some minor points where the authors may wish to consider for improving the manuscript even further.

Notations: There are notations which may not be familiar with HESS readers. For example, we are familiar with  $Q$  for water flux (volumetric). This paper uses mass flux

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of water and expressed it as  $J$ . Further, authors use notations such as  $J^p$ ,  $J^{pe}$ , and  $J^{ke}$ . These  $J$  series have different physical dimensions (mass flux, energy, etc.) which can confuse readers. In particular, the superscripts of  $p$ ,  $pe$ , and  $ke$  look like exponents. These notations make readers to spend additional effort to read the paper. Authors also use  $\tau_s$  for the time scale. Actually  $\tau$  has been very widely used notation for the shear stress, and so this could be also confusing (especially because the authors are dealing with sediment transport in the context). I would suggest the authors reconsidering the choice of notations.

Title: I assume the title ending with ‘continents’ could be better suited for the context if it ends with ‘continental scale’.

P7319, Line 8: It would be good to add another reference of Paik and Kumar (2010) next to Phillips (2010).

P7320, Line 9: Not clear what ‘these proposed principles’ mean in this sentence. I suggest revising this as ‘these maximization principles’, ‘these minimization principles’, or ‘these maximization/minimization principles’.

P7335, Line 1: The expression for the root should start with  $\Delta\phi^{1/2}$  (which should be consistent with expressions on the line 5 of the same page).

P7335, Line 4: Authors may wish to check whether they want to say  $F_{w,d} \gg 2J_{w,in}\Delta\phi^{1/2}$  instead of  $F_{w,d} \gg 0$ .

P7335, Line 5: Please revise the expression here because it is not clear whether  $N_d$  and  $\Delta\phi$  are denominators.

P7336, Lines 17-18: I am not sure whether the authors can call  $L/\tau_s$  as the ‘settling velocity’. There have been previous studies that scaled the settling velocity. Authors may want to check them and if necessary, it may be better to call the quantity  $L/\tau_s$  as a different name.

P7337, Line 12: I recommend insert ‘kinetic energy’ between ‘exported’ and ‘by’ for

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clarity.

P7339, Line 19: In eq. (38),  $D_{w,o}$  on LHS also appears on RHS. How does this eq. work?

P7340: Lines 16-22: The monotonic decrease of optimal channel number along with increasing rainfall suggested by eq. (44) may need to be stated cautiously because it has been studied that the 'drainage density' is not following monotonic function of precipitation. For example, check Gregory (1976). Authors may need to cite relevant references.

Section 4.3: There are many references that deal with the steady-state condition. Some of the key references are summarized in Paik (2011) (pages 686-687) and so authors can check them easily. In particular, the authors' model 3 is similar with the model of Ahnert (1970) (full reference given in Paik (2011)), and so they may wish to check the reference. I suggest authors citing appropriate references about the steady-state condition.

Figure 1: This figure contains fundamental assumptions on tectonic mechanisms which may bring arguments. I would be more careful in stating the four steps. I wonder whether we really need Figure 1 for this paper. If this figure is not critically necessary, authors may consider removing this figure. Figure 1a: I don't think  $\Delta Z_e$  is defined in the paper. Figure 2: What does  $M$  stand for here? Figure 4, 5, 6: Please show the units on the y-axis. Figure 4, 6: Are these figures drawn from an example? Then please describe.

#### References

Gregory, K. J. (1976) Drainage networks and climate, in *Geomorphology and Climate*, edited by E. Derbyshire, pp. 289–315, John Wiley, New York.

Paik, K. and P. Kumar (2010) Optimality approaches to describe characteristic fluvial patterns on landscapes. *Philosophical Transactions of the Royal Society B-Biological*

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*Sciences*, Vol.365, No.1545, pp.1387-1395, doi:10.1098/rstb.2009.0303.

Paik, K. (2011) Optimization approach for 4-D natural landscape evolution. *IEEE Transactions on Evolutionary Computation*, Vol.15, No.5, pp.684-691, doi:10.1109/TEVC.2010.2087027.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 7317, 2012.

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