

Hydrol. Earth Syst. Sci. Discuss., author comment AC2  
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## Reply on RC2

Amilcare Porporato

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Author comment on "Hydrology without dimensions" by Amilcare Porporato, Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-442-AC2>, 2021

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Thank for the friendly comments and useful suggestions. I am glad the reviewer appreciated the attempt to provide a different approach to dimensional analysis, in particular regarding how the Buckingham Pi theorem be used in an era where data generation is overwhelming the ability of data interpretation.

With regard to the suggestions and comments, I agree with the reviewer that there are too many instances where geophysical problems, when tackled in their most general form, lead to a large number of Pi groups. In these cases, the Pi theorem becomes useless when  $n-k \gg 1$ . This is why it is extremely important to emphasize the crucial step of building suitable physical laws. We have further emphasized this point – also in relation to the fermi reasoning, starting from earlier on in the manuscript. Thank you.

I also proceeded to rearrange in part Sec 3.3, as recommended by the reviewer. In particular, I improved and extended the derivation of the the erosion term and the specific contributing area, 'a'. This is also inline with the recommendations of Ref. 4. Indeed the erosion term is too complicated to derive from first principle, but in the revised version we have better linked it to the water balance equation, which also leads to the equations for 'a'. We have also provided in an appendix a more direct explanation of the mathematical analogy between the turbulent velocity profile and the landscape elevation profile.

Unfortunately, while a very interesting suggestion, we are not aware of a derivation of these equations using scaling and dimensional analysis concepts. This valuable suggestion will be kept in mind for future contributions and is actually mentioned in the revised paper as an open direction for research.