

Earth Syst. Dynam. Discuss., author comment AC4
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Additional Reply on RC1

Mikhail Verbitsky and Michael Mann

Author comment on "ESD Ideas: A Global Warming Scaling Law" by Mikhail Verbitsky and Michael Mann, Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2021-87-AC4>, 2021

Dear Referee 1,

We would like to share with you an additional thought that has been motivated by your comment.

We do not think we "attempt to reinvent the wheel" but instead we hope we are closing the gap.

Since 1969, the Budyko's model (e.g., our equation (8) and similar) became a most popular simple tool of climate studies. The next level of sophistication, as you quite rightly noted, was "shallow atmosphere + ocean mixed-layer reservoir coupled to a deep ocean (Hansen et al. 1985)", followed by intermediate complexity models and 3D models.

But Budyko's model doesn't have a property of incomplete similarity and the next-level atmosphere-mixed-layer model is already too complex for incomplete similarity to be easily recognized (it would require a specially designed studies that, to our knowledge, nobody did). Thus, a possibility of the incomplete-similarity regime remained unnoticed. Our dimensional analysis, in fact, closes this gap. It is more general than zero-dimensional EBM but obviously simple enough to reveal a possibility of incomplete similarity.

Mikhail Verbitsky and Michael E. Mann