

Biogeosciences Discuss., referee comment RC2
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Comment on bg-2021-135

Axel Kleidon (Referee)

Referee comment on "Comment on K. Michaelian and A. Simeonov (2015) "Fundamental molecules of life are pigments which arose and co-evolved as a response to the thermodynamic imperative of dissipating the prevailing solar spectrum"" by Lars Olof Björn, Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-135-RC2>, 2021

This comment criticises the paper by Michaelian and Simeonov (M&S), which was published in 2015 in Biogeosciences. The commentary is motivated by the claims in M&S that "The driving force behind the origin and evolution of life has been the thermodynamic imperative of increasing the entropy production of the biosphere through increasing the global solar photon dissipation rate". While I sympathise with this critical attitude towards this claim and believe that M&S could well be a subject to a scientific debate, I not think that the comment in its current form provides a substantial contribution. I therefore recommend rejection in its present form.

Specifically, the comment questions the statement that "Living systems reduce the albedo of Earth" and elaborates whether this statement is correct. The manuscript uses the example of the Moon and compares it to the Earth, and provides some anecdotal evidence where life is not darker than its surroundings. Yet, this comparison is flawed, because what we would need to compare is an Earth without life to an Earth with life, not with another planetary body (Simulations of such conditions have been made, e.g., Kleidon et al. (2000) "A green planet versus a desert world", *Clim Change*, 44: 471-493.). Furthermore, it is textbook knowledge that the surface albedo of forests is in most cases darker than bare ground, even though there may be some isolated exceptions.

Hence, I find the arguments brought forward quite shallow and not strong enough to challenge M&S. As an example of a much more specific criticism that in my view reflects a substantial contribution to a scientific debate, I may refer to the paper of Volk and Pauluis (2010), "It is not the entropy you produce, rather, how you produce it", *Phil Trans B*, 365: 1317-1322.