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Biogeosciences Discussions

Interactive comment on "Ideas and perspectives: Biogeochemistry – Its Future Role in Interdisciplinary Frontiers" *by* Thomas S. Bianchi et al.

Thomas S. Bianchi et al.

tbianchi@ufl.edu

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Response to:Reviewer comment: I have a fear that the statements about rapid evolution (page 3, line 79ff) are at odds with the recognized inefficiency of eugenics.

Apart from our surprise with respect to the link to eugenetics that the referee makes, we feel that this comment strengthens us in the fact that we touch upon a novel perspective that needs to be highlighted in order to push the further development of the field of biogeochemistry. There is now ample evidence for so-called "rapid" evolution or, "rapid" here meaning: contemporary evolution or evolution in ecological time. Multiple review papers on this topic have emerged (Fussmann et al 2007 Functional Ecol-

ogy; Schoener 2011 Science,. . .), as well as a first monograph (Hendry, 2017, "Eco-evolutionary Dynamics", Princeton University Press). In brief, from micro-organisms over plankton and insects to plants, fish and birds, there are now hundreds of studies showing significant evolutionary changes in trait values over short time spans – just a few or a few tens of generations, leading to trait change during the course of a few weeks, a few months, or a few years. These evolutionary changes are rapidly gaining attention because they can influence ecological responses to, amongst others, global change. This implies that in our analyses of ecological responses and their biogeochemical implications, we should not assume that trait values of species are fixed in time. Depending on the taxon and the selection pressure, traits can significantly change, and these changes have been shown to influence ecosystem processes such as consumption, production, respiration and nutrient cycles. Given the importance of microbial organisms for biogeochemical cycles, this notion becomes even more important, because microbial organisms because of their short generation times can evolve significant different trait values in a matter of a few days or weeks. Just to illustrate with one example: Lawrence et al (2012) showed that bacterial strains that were competing with each other and had difficulties to grow together, when forced to grow together changed their physiology so much that they started to be partially dependent on each other, and thus reach higher densities when grown in the present of the other species. There are many ramifications through which eco-evolutionary dynamics can influence biogochemical cycles and recommendations, yet few people in the field are aware of that. So we view this as one of the next frontiers on which biogeochemistry can and should become even more integrative than in the past. We acknowledge that perhaps we were not clear enough on this point, so we edited the text in the revision we made.

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