

## ***Interactive comment on “Biogeochemical cycles and biodiversity as key drivers of ecosystem services provided by soils” by P. Smith et al.***

### **Anonymous Referee #1**

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Biogeochemical cycles and biodiversity as key drivers of ecosystem services provided by soils Smith et al.

General comments: The group of authors presents a review on soil functions, i.e. carbon cycling and storage, nutrient cycling and supply (with focus on N and P), water storage and filtration, as well as soil as a habitat for organisms. Background information on these aspects, which especially addresses human impacts on these functions, is combined with an overview on existing knowledge gaps and recommendations for management activities. The topics researched from about 170 references are backed by five tables summarizing major aspects of some of the soil functions and management effects thereon. Additionally three figures are presented. This is a well-written and concise manuscript, suited for publication in SOIL. It nicely summarizes the state-

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of-knowledge on several general aspects in soil functioning and will be of special interest for a readership from adjacent disciplines being interested in soil science. Yet some critical comments might be given. Due to the wide range of topics discussed, the synoptic information is in some cases rather superficial.

Specific comments - 540/2: It is rather the diversity than the richness (the latter being the number of different species). - 540-541: There are also other soil services defined, i.e. soil as source of raw materials such as sand or clay, soil as a surface for building infrastructure, soil as an archive for landscape development and history of human soil use (see for example Blum W.E.H., 2002, in: Land degradation - Contributions to the International Workshop “Land degradation” 5-6 December 2002, Ispra, Italy; Jones R.J.A. & Montanarella L.; Eds.). Similarly, also Fig. 1 is incomplete. It might be discussed whether soil formation is a service that soils provide to the ecosystem (see also 549/16). - 545/6: This sentence is misleading. I guess the authors intended to say that aerobic soils exist where all transformation of SOM leads to CO<sub>2</sub> . . . . Actually the information reads like “all SOM is mineralized” so that no SOM would remain in soil. - 545/10: What is meant with the information “an element of the climate regulation service”? - 545/12-14: A reference is missing for the methane formation and oxidation. - 545/18-19: Change the sentence to “A decrease in soil C storage has been observed initially after fire, but . . .”. What kind of fire is this? The effect of fire very much depends on the occurring temperatures, which are largely different for example between a forest fire and burning of a stubble field. - 548/27: There are many other soils rich in pedogenic oxides. It is unfitting to reduce this statement to rice paddies alone. - 550/26: Soils also provide the species of N and P suited as nutrients. Delete “when they are needed”; this is an euphemism. - 550/27: What is meant by “buffering in soil organic matter”? Is it the fact that SOM amounts react rather slowly to changed conditions or is it the chemical buffering function of organic molecules’ functional groups? - 552/2-3: This statement is too general and oversimplifying. Numerous examples could be given showing the opposite. - 553, Section 4: This section very much repeats textbook knowledge. References are missing in most parts of this section. - 553/26: “cultural

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services such as landscapes and water bodies". These are not truly soil ecosystem services. Soils are parts of landscapes, while surface water bodies belong to the part of the hydrosphere not overlapping with pedosphere. - 555/3: I agree that macropores very much control the "transmission of water through the soil". However, why would macropores define the water holding capacity of soil? - 555/23: The term "excessive precipitation" is inadequate. A positive water balance is found in many regions of the Earth and does not necessarily lead to waterlogging in soil. Vice versa, waterlogged soils are also found in regions (lowlands) without "excessive precipitation". - 560/23: Nitrogen fertilizers produced by the Haber-Bosch process are synthetic fertilizers. If other (mined) fertilizers are also meant, then the authors should write "mineral fertilizers". - Table 2: Regular organic fertilizers such as manure or compost are not mentioned (in contrast to biochar). - Table 4: Land use change should have more than aesthetic implications. - Table 5: The "production of (precursors to) industrial and pharmaceutical products" is mentioned as a provisioning service impact from all management actions. Yet, this use of soil biota is rare and thus, assumed consequences on this function are rather speculative.

Technical comments - 540/3: Correct to "functionality". - 542/22: Change to "waterlogged soils, e.g. peats (Smith et al., 2010)". - 5542/26: Correct to "components". - 543/1: The way the sentence is written, it might be misinterpreted that the maximum depth of peat soils is 8 m. - 543/5: Correct to "bicarbonate". - 544/27: Add a bracket to "(Thevenot ...)". - 545/9: Here and elsewhere: Change "PgC" to "Pg C". - 546/16: Correct to "provide". - 548/21: Why is this in contrast? Skip this term. - 548/25-26: Suggested to skip the comparative by changing to "occurrence is very much geographically restricted". - 549/19: Correct to "soils continue". - 550/8: Change to "production and (future)". - 551/22: Correct to "Generally". - 552/8: Correct to "through". - 552/20: Correct to "of P and N". - 554/6: The authors should add a reference to the end of this sentence. - 559/24: Correct to "synthesis is" or "syntheses are". - 563/2: Correct to "achieving". - 564/15-16: Incomplete sentence, rewrite. - 564/19-20: "but we know enough to start to make a difference now". This euphemism is very imprecise and

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could mean all or nothing. Delete. - Tables and figures: Often it is referred to the tables and figures at the end of the respective section, making them an appendage that is only marginally mentioned in the text.

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