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Interactive comment on "The soil N cycle: new insights and key challenges" *by* J. W. van Groenigen et al.

Anonymous Referee #3

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doi:10.5194/soild-1-623-2014 [van Groenigen et al.]

This MS is intended as a review of the principal key insights which have been gained in relation to soil N cycling over the past decade or so (i.e. 2003-), and to posit some key challenges as perceived by the authors for future research in the area. It is stated that it is not intended to be a comprehensive literature review of N cycling phenomena, nor to deal with coupling of the N cycle to other elements to any extent.

As such, there is a qualified personal perspective to the topics and challenges, and this is admissible given this has been openly declared. However, there needs to be some guarding against this becoming – or being intended or used – as a manifesto for any form of prioritisation – these are after all the opinions of the authors per se and have

not been through a large scale ratification process (some online debate via the SOIL portal notwithstanding). Thus I think some more explicit caveat statement in relation to this is needed.

Taking it on these terms, (and thus that it should not include my personal opinions !), the MS is I think successful, very well written, and generally engaging. Areas I am familiar with are accurate, and I felt informed about topics less well known to me. I note a few topic gaps which struck me, but as stated above, this is not my paper, thus I note them merely for the authors to consider:

Section 2.1 : A notable omission with respect to "F-BNF" in this section is that there is no consideration of N-fixation via soil surface biological assemblages, notably cyptogamic crusts. Amounts of N input via this route, on an ecological scale in natural systems are significant and ought to be considered. Also missing is any mention of free-living fixation in agri-systems, e.g. associative rhizosphere fixation – what are current perspectives on this, and knowledge/opportunity gaps ?

Section 2.4 : No mention of denitrification rates, extent or patchiness, in pastures and especially GRAZED pastures, which is also a notable omission given their global significance and the challenges arising with these more complex and heterogeneous systems.

Section 3.2 : No mention of 'priming effects' here, which is a highly pertinent concept here – it does not just apply to C.

Section 3.3 : Common mycorrhizal networks not mentioned, and a phenomenon the significance of which still not really sorted out, especially for N.

The abstract contains details of content but no summary of the key recommendations. These are also then not summarised in the concluding section either, so remain dispersed throughout the text. Thus at least there needs to be synthetic section at the end which summarises the key points.

There are too many repetitive and platitudinous closing sentences for each section apropos ‘more work is need on this or that which will lead to news insights into such and such.’ This has likely arisen as a result of each section being dealt with more or less independently, so some smoothing and polishing would make the paper more connected and coherent.

Otherwise I mainly have minor points of clarity / editorial type issues to note:

P624-L7 : ‘mitigation’ is not an appropriate word in this context. ’mitigation’ means "The action of reducing the severity, seriousness, or painfulness of something", and these surely do not apply to the N cycling processes in a general sense, only to some specific aspects, and then it is a question of perspective.

P625-L7 : ‘maintain’ not ‘upkeep’

P625-L19 : ‘regimes’ not ‘regime’

P626-L8 : carry out «apparently» ever more complex

P626-L12 : define what is meant by ‘missing’

P628-L8 : defined as «via» the infection

P628-L19 : ‘loses’ not ‘looses’

P629-L8 : ‘relatively large’ not ‘high’

P631-L14 : ‘selectivity’ not ‘selectiveness’

P634-L8: What do you mean by ‘modular’ – the term is used again later, and it’s also unclear there.

P633-L15: define DNRA on first use

P634-L14 : ‘Gram’ not ‘gram’ (Gram was a microbiologist.....)

Page 634-L20 : There is certainly a vast body of literature on denitrification (‘soil and

dentific*’ returns some 6,500 hits on Web of Science...), and much current research effort. So it is apparently ironic if this is indeed ‘the most poorly understood process in the N cycle’.... or actually, is it ? Can you qualify this assertion ?

P636 : Links here to Section 2.2 ?

P636-L26 : NO, denitrification hotspots and hotmoments have been known to occur, actually especially in field crops, for a very long time !

P637-L24 : Does pH really control leaching ? such that it should be first in this list ?

P640-L1 : Why does the furhter work have to be ‘molecular’ in nature ?

Section 3.2 : No mention of ‘priming effects’ here, which is a highly pertinent concept here – it does not just apply to C.

P644-L8 : ‘nutrient’ not ‘nutrients’ – and what do you mean by ‘organic nutrient cycles’ – unclear or illogical at least.

P644-L25 : What do you mean by ‘mine’ ?

P645-L8 : Benefit for what / to whom ?

P648-L14 : What do you mean by ‘phylogentic signals’ ? How were they ‘corrected’ for ?

Section 4 is relatively curt, especially in terms of conclusions or future vision. And, then in Figure 1 there is indeed only 1 ‘challenge’. Really the only thing now outstanding in this respect ?

Figure 1 : Manuscript is accurate at this stage – remember to change to ‘paper’ when at proof stage !

Figure 3 : What is meant by ‘fertiliser denitrification ? And especially as a counterpart to ‘nitrifier-coupled denitrification’ ? I think I can infer, but it took time, so worth explaining.

Figure 4 : In caption, put numbers at start of associated terms, not at end.

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