

## ***Interactive comment on “A call for international soil experiment networks for studying, predicting, and managing global change impacts” by M. S. Torn et al.***

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We thank the reviewer for his comments and good suggestions about partnering with other networks. We are glad that the main thrust of our argument—“for whole-soil manipulations and networks of such experiments”—had some resonance. We address the comments in the order they were presented.

1. Narrow focus on soils. It is correct that in this effort we are focusing on the effects of climate change on soil ecosystem services, with an emphasis on soil biogeochemistry. However, while SOM cycling and nutrient provision are two critical ecosystem services

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that depend on climate, there are many others and we hope that our mention of soil ecosystem services conjures up a broader list for the reader. We agree that a strong case could be made for networks for other purposes, and hope that the SOIL Forum hosts a lively exchange of such cases.

2. Relationship to existing networks. We agree that existing networks offer valuable resources and potential partnerships for a network of experiments. The experimental network would not be redundant, because most soil, critical zone, and ecosystem networks are observational, rather than experimental (with respect to climate change experiments), such as CZO and NEON. The ISCN is not a network of sites, but rather is a carbon-focused database. Nevertheless, we are glad it was mentioned because it is also a good resource: in fact, the iSEN proposes to build upon ISCN data templates to accommodate manipulative treatments. Due to word limits, we had to reduce mention of non-experimental networks like CZO. However, CZO sites could be good locations for manipulative experiments; the kinds of research and observations conducted at CZOs are highly synergistic. We have now added mention of critical zone observatories and the example of nesting manipulations within a CZO network (citing Banwart et al.).

We included a table of soil manipulative experiment networks (mostly international). We welcome further suggestions via the interactive discussion about (1) networks of global-change soil-manipulation experiments, or (2) observational networks like CZO that could potentially host experiments.

3. References. Thanks for the recommendations of good papers. We have added citation to Paustian (1995) as an early proponent of this idea, and cite Banwart (2012) for developing the concept of using CZOs (see Banwart (2012) for an example of nesting manipulations within a CZO network). There are many other excellent papers about soil monitoring networks as well, but given our word limit will thought these were especially relevant.

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4. Limitations of Manipulative experiments. We agree that manipulative experiments have limitations, and that we should augment this in the paper. Typical artifacts include a step change in conditions (e.g, a step change of 4oC); relatively short duration; small islands of manipulation; manipulation of only some system components. We have added a citation to Hanson et al. 2008 on this point.

5. Relationship between experiments and gradients. We agree and intended to promote the view that a combination of approaches is best. The integration of manipulations and natural gradients could be particularly powerful. We had to cut some of the original text on the relationship among gradients, experiments, and laboratory studies because of space limitations.

6. Were we trying to guide others' research on nutrient dynamics? The comment on page 7 about nutrient dynamics was specifically in reference to the fact that some iSEN participants are prioritizing nutrient dynamics at their sites. No greater implication was intended.

7. "Engaging the community through larger networks and meetings of scientific unions for example AGU and EGU (for example) is a must and piggybacking off developed networks will be important to access the relevant communities and have their engagement." We are glad to hear that this call for action resonates and that the reviewer thinks it is mature enough to now engage other networks and communities. Earlier meetings at AGU and EGU were used to develop the basic scientific principles, and it is good to have the encouragement to expand the community at this time. That was one goal of the Forum article!

8. "The critical zone Observatory has a focus that is synergistic with this proposed network and provides a larger framework. The most value to be gained by a soil experimental network will be gained by linking disciplines as part of a larger picture [for example the CZOs]."

We agree there is large potential synergy. It would be wonderful if a group would like

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to develop manipulative experiments in partnership with the CZOs. At the same time, other PIs are partnering with some of the other networks and field stations mentioned by the reviewer, and others with, for example, agricultural research networks

9. Create a system of intensive manipulative sites with observational sites. It is an excellent suggestion to consider a hierarchical approach, where some manipulation experiments are performed at a number of key intensive sites, and coordinated with simpler observations that are made at more sites across a wider range of conditions. This is a nice expansion on the idea that it would be effective to nest manipulations within gradients or matrices of, for example, different soil types, climate, and vegetation zones.

10. Consider opportunities posed by AmeriFlux and FLUXNET. Although we did not have space in the Forum to spell out connections with observational networks, the writing team includes the lead of the AmeriFlux Management Project, a founding member of the ISCN, the director of two large European networks, and other strong network connections.

We agree that there are benefits to nesting experiments in sites for which ecosystem fluxes are being measured (there is a soil warming experiment in the footprint of Harvard Forest AmeriFlux site, for example). However, if the goal were to use eddy flux to measure the treatment response, a soil warming treatment that matched the footprint of a flux tower would require each manipulated plot to be >104 m<sup>2</sup>, and even if smaller than that, a large manipulative experiment could be a large perturbation to other studies in the tower footprint.

More generally, we imagine that there are many more opportunities for good sites (and good network partners) than we could find or describe. We encourage other suggestions and contributions through this discussion forum. We also leave it to scientists who would like to develop a participating experiment to find the site or sites that meet their research interests, logistics needs, and funding opportunities. In parallel, it is worth

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developing a set/map of potential sites (or site criteria) in hopes of achieving a distribution of experiments that covers a useful combination of environmental conditions. This would be a worthwhile scoping project, and could take into account information from many of the networks mentioned in this review, models, and other sources.

11. In response to this theme of the review (i.e., “a discussion on the consideration of linking with larger scale networks.”), we agree that collaborating with existing networks and specific network sites has great benefit. At the same time, it does not seem wise to choose only certain networks for partnership, nor warranted to require self-funded, international PIs to locate where we dictate. To the extent that an existing network is interested in expanding their scope to include experiments, however, this would be a great opportunity.

12. Title suggests management of global change. The title is meant to say that this is research for managing “global change impacts,” rather than managing global change. Does that help? It is a rather long title, but one of the research goals is development of approaches to managing impacts, for example in agricultural contexts.

13. Important to engage modelers. Excellent point. Using information from modeling studies and having buy-in from modelers is important. Indeed, modeling studies and data-requests from modelers directly shaped the SPRUCE, California, and Puerto Rico projects, and the SPRUCE and California experiments employ full time modelers as part of those studies. We will make sure that the point is stated in the article.

14. Figure 2 relevance. The reviewer wonders if this is relevant enough for inclusion. We thought an illustration of a deep soil warming experiment would be useful, and leave it to the editor to advise us. We could remove the upper-left and upper-right panels to simplify the graphic or remove.

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Interactive comment on SOIL Discuss., 2, 133, 2015.