Steering Committee report for Reynolds Creek CZO
site visit and PI meeting

Sept. 18-21, 2016

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**Background and context:**

The 2016 Critical Zone Observatory site visit and PI meeting was held at the Reynolds Creek CZO (RC-CZO). Kent Keller and Gordon Grant represented the Steering Committee at the 3.5 day meeting. The meeting began with an informal Sunday afternoon science discussion at which PIs representing all 9 CZO sites were represented as was the CZO National Office and the Steering Committee (Keller). Monday was an all-day indoor session that focused on network-scale issues, including planning for the November network review, data management questions, National Office education, outreach, and coordination activities, and cross-site research and working groups. Late Monday, site-level science activities and themes from the RC-CZO were introduced, both orally and as an evening poster session. Tuesday was spent on an all-day field trip to the RC-CZO. Wednesday was devoted to feedback from NSF and the Steering Committee and more strategic planning for the November review.

**Network-level comments**

Over the 9 years that the CZO has been developing as a network of sites, the role of the site visits has similarly evolved. Originally the site visit was an opportunity for the PIs at the few sites (first 3 then 6) to meet with each other, learn what each site is doing, and visit the research program at the host site. Now the number of sites and plethora of CZO-based activities at multiple scales precludes a

comprehensive reporting. Instead, the multi-site discussion now focuses on the broad suite of network science, data management, coordination, education, outreach, and communication, activities, as well as future directions for the network as a whole. The host site activities are still featured, but specific research activities at other sites are less emphasized. This is an inevitable consequence of the network's maturation, and highlights the importance of the All-Scientists Meeting (ASM) as the appropriate venue for a deeper and broader exposition of the full range of site research; an ASM is being planned for the first week of June 2017 in Arlington, VA.

The Sunday science discussion was an extremely energetic and positive forum for discussing, debating, and honing network-level scientific themes and narratives. It is, perhaps, a bit surprising that more of this has not occurred in the past, but nonetheless the fact that it is happening with increasing frequency and with strongly positive reviews – first at the deep CZO salon, followed by the February 2016 strategic planning meeting, and now here, is a very encouraging development that we hope continues.

It is particularly encouraging that these discussions are articulating common themes, story lines, hypotheses, and ideas that highlight the new insights that are emerging as a direct consequence of the establishment of the CZO network. This is golden; for years the Steering Committee has been encouraging the PIs to be working towards common frameworks with complementary and competing hypotheses for understanding the structure and development of the critical zone. It's clearly happening now and needs to continue, as these frameworks will be one of the most enduring legacies of the CZO network and inform CZ science and direction into the future.

In general, the frank, sometimes blunt, yet always mutually respectful discussions among the PIs that occurred at this meeting are both

laudable and essential to pushing ahead. It seems clear that this happens at face-to-face meetings of this kind, and it is worth considering what else feeds into this success. At any rate an approach discussed by the PIs is to consistently allocate time for discussion of network science at site meetings, and to do this ahead of the field trip that seems so valuable for the on-the-ground learning that stimulates more granular cross-site conversation.

It goes without saying (but we'll say it here) that these emerging themes, narratives, and hypotheses need to provide the foundation for what gets presented in the November review. The transformative potential of the CZO network is more than just aspirational – it is being realized and the world needs to hear about it.

We were deeply impressed by the depth, breadth, and impact of the remarkable suite of education, outreach, and communication efforts that Tim White and the National Office have undertaken. From developing K-12 programs, teaching materials, and even CZ comic books, to promoting STEM and CZ activities to a much wider and diverse student and underserved communities, to developing a website and social media presence, to participating in both science and educational forums, the list of new, impactful activities goes on and on. Along with Tim and Lou, we would like to recognize the critically important efforts of Justin Richardson who has spearheaded much of this work. Our only suggestions here are to encourage the NO to make sure that the broader CZO community and PIs are aware of the NO's efforts and their impact, and also to review the portfolio of NO activities regularly to ensure that it represents a good mix and that key elements are not falling off the screen.

We are also encouraged by the progress being made in advancing network-level data management. This has been a challenging arena in the past, but by forming a data management committee, identifying

logical and capable allies (i.e., CUAHSI) to get the most tractable and available data into extant and functional data management frameworks, and not trying to do it all at once, we see the opportunity for real progress to be made swiftly.

One of the most important discussions among the PIs was an open and free-wheeling consideration of what the Critical zone science program of the future should look like. All are aware that the deeper motivation for the November meeting is to develop a blueprint for CZ science moving beyond 2018, and the CZO PIs have a "critical" role to play in defining this direction. What should be the most scientifically fruitful mix of long-term hub and satellite observatories, rapid response and short-term mobile stations and infrastructure, where should these be located, and how should these be funded at the appropriate time scales? These questions were raised as part of the strategic planning exercise, and they need to be followed through on and developed. This has to be someone's responsibility and cannot be allowed to fall through the cracks.

We are pleased to recognize the development, over the past year, of effective lines of communication between NSF and the network including the NO. We appreciate that this took a lot of work on all sides.

**Reflections on Reynolds Creek CZO**

In a short time, the Reynolds Creek CZO has achieved a striking level of productive enthusiasm that sets the stage for novel critical zone science. The PIs evidently respect and enjoy each other, and this rubs off on the students. The students themselves are bright both in their prospects as scientists and in their eagerness to show and share their research among themselves and with others. This "vibe" set the stage for a successful field trip that introduced the broader group to a

potpourri of interesting and coupled investigations, stimulating useful cross-CZO reflections and conversations.

Reynolds Creek CZO is exemplary for leveraging the scientific and infrastructural capacities of its site host/collaborator, the ARS Experimental Watershed (RCEW). Scientifically the RCEW brings invaluable hydrologic, land-management and other long (50+ year) time series and insights to the table, while the CZO brings new ecological questions and methods to extend and invigorate longstanding ARS investigations. Logistically, RCEW provides facilities and staff that freely support students and their experimental work at all levels from sleeping quarters to field vehicles to help with data acquisition. We strongly commend these collaborations and recognize them as a significant accomplishment that are a cornerstone for future CZ-science productivity over the long term at Reynolds Creek. More broadly, we wonder whether this relationship might serve as an examplar for supporting CZ science at other locales in terms of facility or observatory logistics and funding.

The new studies of carbon -- its occurrence, fate, and its cycling interactions with other nutrients and with water – are promising in and of themselves and for their tie-ins to cross-CZO questions. We're impressed with how well the biogeochemists are talking with the ecologists and hydrologists and vice versa. The ambitious goal of describing the carbon budget for a topographically complex landscape has been advanced by development of empirical and statistical models that seem plausible and sound. We do think that future progress will increasingly require linking the statistical findings to process-based models that help explain the interactions between weathering, carbon processing, and fluxes of water and $CO_2$. In other words as these studies move forward, we advocate that active consideration be given to how the findings relate to broader CZ science.

Along these lines, we think a very fruitful direction involves placing the RC-CZO findings within longer-term contexts of geologic and landscape development. The geological narrative encoded in the RC-CZO is rich: a mixed-lithology accreted terrane just at the edge of a long-lived hot spot that has experienced major episodes of drainage network re-organization and (more recently) intense periglacial processes. How does this context drive the stories unfolding about the modern landscape? What is the consequence of Reynolds Creek being isolated from regional base level by geological controls, or of the vastly different energies available for erosion between the wet upper basin and the dry alluvial valleys downstream? What have been the relative importance of fluvial, aeolian, and relict periglacial processes in shaping the modern landscape and its dynamics? Addressing questions like these would complement the rich tapestry of soil, carbon, snow, and vegetation work that is being woven.

**A comment on the Steering Committee**

The relatively modest number of SC members who were able to participate in this site visit has prompted us to reflect on how to make the Committee more effective. We think that the Steering Committee can continue to provide useful guidance and informal review, and facilitate effective communication between the PIs and NSF. Moreover we are encouraged that both the PIs and NSF continue to support this role. To continue to be an effective part of the CZO enterprise, we need to address some key issues in the near future, including revisiting our charter, the need for a modest travel budget to support meetings beyond the AGU beer hall, and re-energizing and expanding the membership as indicated in the charter. Within the next few months we will move forward with these actions as a means of refreshing our mandate and improving our overall effectiveness and utility to the CZO community.