STEAC FALL 2019 MEETING REPORT

Submitted 2019-09-24

The STEAC met in Boulder, CO on September 10-11, 2019 with eight members attending in person and three online. The committee appreciates the presentations on the progress of NEON, the time that key staff and domain managers took to interact with us, and the open discussion on current status and challenges.

In May 2019, NEON officially completed construction and is now in the Operations phase. At the dawn of this new and exciting phase, when data from all the domains are coming online daily, the STEAC recognizes that engagement impact is critical for the success of NEON. In this report to Battelle, we highlight key accomplishments and share our perspectives on NEON's 1) engagement strategy; 2) data availability and use; 3) relocatables plan and mobile deployment units; 4) postdoc and visiting scientists plan; 5) Hanta / Tick-borne disease change in scope and 6) staff morale.

I. Key accomplishments:

In general, we note that the project is on a good trajectory with good momentum especially with regard to:

a) Data availability and use. The STEAC is very impressed with the huge progress on data availability and use. We note that data availability metrics broken into completeness (technical availability), validity (scientific availability) and latency (time to publish on portal) have been established and that NEON is meeting the threshold of 90% for completeness and validity with a few exceptions.

b) Transitions to operations at domain level. We are also pleased to note that the transitions to operations are going well at the domain level. Previous reports identified training and recruiting researchers as a challenge. Currently, domain managers reported that seasonal technicians have been returning to sites, which increases the efficiency of data collection. Domain managers are facilitating the use of NEON data by working with local universities, schools and the public. Relationships with LTER sites is also occurring through collaborations with LTER students.

c) Flexibility in decision-making. We noted that the Science team has experienced a lot more flexibility to adapt to specific sampling conditions on the ground without sacrificing standardized data output. Many staff report job satisfaction has increased with this flexibility.

d) New data portal. We appreciated the vast improvements made on the NEON data portal resulting in an increase in data downloads and use of API data.

I. Engagement

Overall, the engagement activities are impressive in number and in the range of different audiences that are reached. We are glad to see the recent increased staffing in this area, which

reflects the understanding that engagement is essential for the success of the NEON project. The strategic plan for engagement is a positive step toward the organization of engagement efforts, and we are supportive of the theory of change framework that organizes the plan. However, there was concern that engagement activities may be spread too thin and that the current plan would benefit from clearer coordination. There is an obvious role for the incoming chief scientist/observatory director to work with NEON engagement staff to focus the engagement activities while continuing to engage the broad community of NEON stakeholders. Part of this cohesive effort should consider the scalability of engagement activities and could bring together current and new efforts from user communities such as those formed at the upcoming NEON Science Summit, or those facilitated by ESA and the NSF BIO Advisory Committee. It is important at the infancy of NEON operations to develop a unified strategy for engagement that not only reaches a diverse set of stakeholders, but which ultimately drives the science mission of NEON forward.

We encourage a data-driven approach to continue to identify and engage with key NEON stakeholders in academia and beyond. When engaging with different stakeholder groups, it would be helpful to recognize that different data cultures exist, and that due to scientific cultural differences, scientists may continue to use the data sources that they are familiar with, even if a better source exists. To make engagement efforts effective, staff should be proactive about using targeted messaging to these different stakeholder groups, in order to positively change perceptions about NEON data and increase use in scientific communities. Engagement should use assessment instruments and metrics that characterize the success and sustained impact of these activities, and changes in the perception of NEON in the broad scientific community, not just metrics of effort. These metrics may need to be more tied to the theory of change than simply counting social media reach. Success may be much more tied to perceptions in the community and how those are changed, and proof of those changes. These metrics should then be used to guide how engagement activities are prioritized (e.g. overall impact, impact per unit effort, and potential scalability)

The STEAC appreciates the efforts of the engagement team on the multiple opportunities that involve students, faculty and early career scientists. One of the challenges to broader engagement with NEON data may be the lack of general knowledge about coding, and about working with big datasets. This challenge is obviously too big for NEON to address entirely on its own. One approach to bringing in more users could be to target communities who already have these skills (e.g., quantitative ecologists, statisticians, computer and data scientists, engineers). NEON could ask the TWGs for help in identifying and contacting relevant researchers in these areas. Another would be through workshops such as those already being offered. Additionally, NEON could develop partnerships with organizations such as Data and Software Carpentries that train people in the basic programming skills that can be built upon to analyze NEON data.

The STEAC considers one key stakeholder group to actively engage more in NEON are government scientists, some of whom are involved in coordinated interagency scientific efforts

where NEON data could potentially provide essential datastreams or, through collaboration, information products for high-impact, real-time monitoring and risk assessment. One engagement approach to consider is small interagency workshops in DC with these relevant interagency stakeholders that would provide insight into how NEON data and products may be packaged to be most useful to decision-makers. NEON staff could also ask the STEAC and TWGs for help in identifying and contacting relevant stakeholders in this area.

II. Data accessibility & availability

Overall, the STEAC applauds the NEON team for the substantial progress made over the past two years to deliver data products to the community. It is encouraging that the completeness of many products has surpassed or is approaching the targets. The improvements (both implemented and proposed) to the data portal function and aesthetic experience were necessary, effective, and appreciated. The STEAC has some comments about data availability and use outlined in the following subsections, which we offer with the understanding that much of this work is still ongoing.

Data use tracking: The monthly counts of total data downloads, and the monthly counts of unique IP addresses accessing the NEON database, are increasing and seem to be of an encouraging magnitude[1]. However, usage statistics would be easier to interpret within the context of data use goals/expectations. More opportunities may exist to formulate expectations based on the experience of other networks. Data downloads, however, do not reveal how the data are being used (i.e. publications, education, training etc), nor do they reveal whether data end-users are using NEON data in ways that align with the broad science mission of NEON. Dataset digital object identifiers (DOIs) offer an opportunity for better tracking of published papers, code, and educational materials, but only if end-users cite the DOIs appropriately (and most likely do not yet). It would be to the benefit of the NEON project to provide dataset DOIs when users download data, and encourage DOI citation, or other approaches that make it easier to understand how its products are being used. This is a problem shared by other aggregators/networks, and conversations with those entities may be a source of new ideas. For example, AmeriFlux requires that users who access data from their website answer a short question about intended use of data before AmeriFlux data can be downloaded. Updating website docs on NEON data citation expectations is a needed first step, once DOIs are ready for roll-out.

Tracking user perceptions: The STEAC appreciates efforts already taken to better understand user experience with the data portal, for example in workshop settings and by asking the NSF AOR team for feedback. The STEAC sees value in efforts to collect feedback on a more regular

[1] e.g. in recent years the number of unique IP addresses downloading NEON data each year has exceeded the number of individuals attending the Ecological Society of America annual meeting

basis, for example by incorporating a very brief survey into the data portal. This is especially critical as front end improvements are made, to assure that users respond positively.

Data availability targets, and challenges to them: NEON has set ambitious targets for data completeness and latency for most of its products. While the STEAC applauds the ambition, concern was raised about whether these goals were realistic for all sites, all the time. For example, the goals could be adjusted to reflect the percentage of data loss that is truly unavoidable (i.e. due to power outages or unfavorable meteorological conditions). This recommendation was also made following the 2018 STEAC meeting in Boulder. On the other hand, the basis of the data completeness and availability targets for the Surface-Atmosphere Exchange struck the STEAC as less ambitious. A loss of 30% of theoretically-available data due to reasons that are not clearly linked to filtering for stable atmospheric conditions (e.g. so-called u^* filtering) is difficult to understand. The STEAC is happy to talk to members of the SAE team about this somewhat technical issue offline; in general, we encourage targets that are ambitious and achievable.

Data availability due to instrument malfunction: Automated instruments frequently fail in the field, and need to be switched out for repair. The STEAC perceived that a dearth of spare instruments is leading to long lag times between the time when a problem is detected, and the time when a spare instrument is available for redeployment. Now that systems have been operational in the field, it seems possible to estimate with some confidence how many spares of each instrument are required to minimize loss of data due to instrument malfunction. We recommend this analysis be performed, and additional spares purchased as necessary.

Developing a long-term plan for contending with instrument obsolescence: Instrument manufacturers are constantly developing new sensor models, and at the same time decommissioning older instruments. Newer models are not guaranteed to be compatible with pre-existing measurement systems (i.e. NEON systems), or at least may require substantial reconfiguration of hardware and data processing routines, as well as extensive cross-calibration in the lab and field. Instrument changes also have real and important impacts on data continuity, trend detection, and the ease that data can be analyzed by end users. All these factors argue for minimizing the number of instrument changes and making changes on a cohort (rather than individual) basis. We strongly urge NEON to develop a forward looking, strategic plan for contending with this challenge before it becomes a major operational problem. Such a plan could be informed by:

a) cost accounting, including tradeoffs between the purchase of a large number of spare, current-model instruments versus the costs incorporating newer models into the sampling design (which would require extensive testing of newer and older models co-located in the same environment)

b) conversations with instrument manufacturers about their expected timelines for new model development, and opportunities for extended windows of technical support for key instruments.
c) Conversations with other networks about how they have dealt with similar issues (i.e. sensor replacement in NOAA's meteorological station network).

III. Relocatables & MDP

First and foremost, the STEAC acknowledges that the financial and logistical costs of relocating the "relocatable" NEON sites appears to be considerably higher than originally envisioned. At the same time, the STEAC deeply values the importance of data continuity and long time-series for NEON to fulfill its mission. Therefore, the STEAC recommends that the bar for moving sites needs to be set appropriately high. With this comes the recalibration of expectations that the average "relocatable" may never be relocated over the duration of the observatory. Despite these challenges and changes in expectations, the STEAC does not recommend completely abandoning the concept of relocation.

When considering the development of a plan for the relocation of sites, the STEAC recommends that NEON consider two key cases, which may differ slightly in process: (1) the necessary relocation of a site due to changes in site status (e.g. expiration of land owner agreement); versus (2) the elective relocation of sites to optimize the observatory and tackle new, emerging science questions. For both these cases the STEAC recommends that the selection of new sites be driven by data and analysis, and that these analyses will require the inclusion of additional criteria that go beyond those used in the original site selections, including but not limited to: assessments of what we have learned from ongoing NEON observations (data usage, publications,etc), gap analyses that consider the larger constellation of environmental monitoring capacities, formal Observing System Simulation Experiments (OSSEs), and input from stakeholders about the new and emerging research and monitoring priorities of the community. The STEAC also acknowledges that it is impossible to know these things right now. Because of that, the STEAC recommends that the Relocatables plan not be overly prescriptive, at this point in time, about how to negotiate the trade-offs between these different design constraints. For the case of elective relocation, the STEAC recommends that the state of the observatory and the scientific needs of the community be reassessed periodically throughout the life of the observatory (e.g. every 7-10 years, so that the assessment is done 2-3 times over 30 years). For example NEON could form a Relocatables Technical Working Group in advance of that deadline (1-2 years out) that would make recommendations about the process that NEON staff would use to assess potential relocations, and then help assess the state-of-the-science and emerging frontiers. Overall, the STEAC feels it is not beneficial for the Relocatable plan to be overly prescriptive at this point in time.

When considering the usage of the Mobile Deployment Platform (MDP), the STEAC considers this a key asset of NEON for addressing emerging issues and filling in gaps in the network and its potential for reaching diverse communities e.g. those impacted by extreme

events. This role is even more important in light of the earlier discussion about setting a high bar on the movement of Relocatables. As such, the STEAC supports NEON's efforts to increase awareness and use of the MDP (e.g. journal articles, test deployments). Such efforts need to consider the difference in cost between PI-collected and MDP data, both in terms of communicating the full suite of services provided by the MDP (i.e. it involves renting the sensors as well as technical support and collection of biological specimen data) and in considering ways to reduce costs to a more competitive level. One new idea presented by the STEAC was to approach NSF about the possibility of running an RFP or DCL specifically focused on generating an initial MDP deployment (e.g. as part of the EAGER program). Similar to previous calls (Early NEON Macrosystems, NEON RCN, etc.) such a call would help to prime the pump within the community for generating a wider range of ideas about how the MDP could be deployed, while at the same time demonstrating the capacity of the MDP to the broader research community. A MDP focused call would also help reduce the 'sticker shock' that a number of researchers have experienced when scoping the inclusion of the MDP in other proposals, especially as terrestrial and freshwater ecologists do not have the same experience with (or history of) centralized equipment requests that has been successful in related fields (e.g. NCAR's assignable assets, oceanographic research vessels and submersibles).

IV. Postdoc and Visiting Scientist Plan

The STEAC strongly supports the idea of a postdoctoral fellowship program. We recommend that NEON move ahead with this plan, at least in its generic form. We support external mentors for the postdocs as this will benefit both the postdocs and NEON, and we encourage transparency in the process by which applications, and external mentors, are solicited. The proposed training for fellows in project and program management would likely be both a good selling point and beneficial to fellows in the long run.

While the STEAC sees benefits in NEON supporting a joint postdoc with NCAR, we believe that joint positions such as this should be treated differently from the fellows program and should be developed through a transparent process with clear priority given to their benefit to NEON and its mission. In this particular case, we believe that NCAR is the organization responsible for supporting CLM development; that's not NEON's job. NEON should carefully evaluate whether there is a strong enough value proposition before dedicating resources towards it. Also, in this case, we feel that the position should be discussed more broadly among the originating parties (e.g., with workshop leads and participants) before specifics are finalized. Most importantly, the benefit of the position to NEON needs to be clearly defined.

The STEAC would support NEON's exploring the idea of a graduate student-focused fellowship program similar to the postdoctoral fellowship plan. This could engage visiting graduate students in data collection at one or more NEON sites during the summer, and in data analyses at NEON headquarters in Boulder during an academic semester. This would help train students from the beginning of their development as scientists, and would be less expensive per person than the postdoctoral fellows, because the fellowships would be shorter.

While the STEAC also strongly supports the idea of a visiting scientist program for senior scientists, we suggest that its further development be delayed until the new Chief Scientist in place, so that they can help to shape it.

Like any organization, NEON / Battelle has developed its own culture, and this culture differs from that of an academic institution. Across all levels (graduate, postdoctoral, faculty) fellows coming to NEON from elsewhere may have different expectations regarding work hours, work locations, participation in group activities, and other factors from what is the norm for NEON staff. We think NEON staff should think carefully about what expectations for fellows should be, and how to establish a culture for that group. Establishing a cohort of fellows could benefit both NEON and the fellows, but for those benefits to be fully realized there must be sufficient interaction and overlap of interests. Clear policies in terms of expected time in residence at NEON, participation in activities, development of products, and work hours could be helpful (so long as they have some flexibility). For instance, many applicants may want to spend only a fraction of their time in Boulder (or at the NEON HQ building) during a longer term of fellowship. Will this be allowed?

V. Hanta / Tick-borne disease change in scope

NEON has developed a proposal to change the scope of pathogen testing with a switch from hantavirus testing to tick-borne pathogen testing. In general, the STEAC is supportive of this move. The discontinuation of hantavirus testing of rodent blood samples is a data loss; however, data collection is still in the very early stages and there are very few hantavirus positives because of low prevalence. The move to tick-borne disease allows ongoing tick data collection and pathogen testing to be directly linked to the tick-borne pathogen testing proposed here in small mammals. This, combined with the pressing ecological questions associated with tick-borne diseases, including pathogen/vector/host relationships, the continuing implications for human health, expansion of invasive tick species, and shifts in tick-borne disease distribution, suggest that this move would be beneficial and is a good fit for the NEON data collection network.

Overall, the STEAC thinks these could be valuable and unique data, but there is concern that while the shift from hantavirus to tick-borne pathogen testing makes sense, the proposal does not include any type of gap analysis e.g. are these in strong demand by the ecological community? This question may be something the the tick TWG could help answer. For this specific proposal, it would also be beneficial to build in an occasional, data-driven, reassessment of the pathogen testing protocol to determine if changes need to be made over time (e.g. an increase in sites where ear testing is done if shifts in Lyme disease prevalence are seen, etc.).

As a more general issue, the STEAC also discussed the process for reviewing future proposals for changes in scope. Unlike the TWGs, a key role of the STEAC is to look broadly at the full scope of NEON science, and to provide recommendations that consider the trade-offs between different parts of the Observatory. To better allow us to fulfill this role, where possible the STEAC would like to be informed about the broader suite of proposals in development rather than to consider proposals individually. Based on our experience with this case, we also feel that

future proposals could benefit from an in-depth rubric or gap analysis that identifies value added/gaps closed.

VI. Staff morale

STEAC met with Boulder staff from both the Observational Science Systems, the Instrument Systems, and Education/Engagement groups for informal discussions about staff needs and working conditions. STEAC also had a lunch meeting with a number of the Domain Managers via the web. We were pleased to see that overall there was a noticeable improvement in staff morale compared to our two previous visits. There is palpable excitement among the staff now that they are seeing the data come online and being used in research.

Now that NEON has moved into operations, the Domain Managers are also excited to be focused on collecting data. While there are still staffing issues in some domains, many of the domains now have a significant number of temporary staff return for a second or even third field season. The Domain Managers feel that this has reduced the amount of time needed for staff training and improved data quality. A number of the Domain Managers have also been active in local outreach. Much of this outreach is locally generated but they appear to be anxious to work more with HQ on engagement.

The HQ staff is still lean and under pressure to continue to make products available and to improve data delivery. The staff expressed some concern about getting everything done with the personnel available. Because of the work-load, staff has limited opportunities to engage in science. There are evidently some opportunities for staff to buy out time using funds from external grants or get internal research grants through Battelle. While a few staff members have taken advantage of these mechanisms, this also creates a challenge for the rest of the team since currently the other team members are left to pick up the slack if someone is working on a different project. Having staff members work with post-docs and outside scientists may help address this.

STEAC continues to be impressed with the quality and dedication of NEON staff. Finding ways to allow the staff to be more engaged with the science, encouraging professional development, and maintaining a reasonable work-load should be a top priority for the new Observatory Director.

STEAC Membership at Fall Meeting

In attendance

Michael Dietze (co-chair)
Rob Guralnick (co-chair)
Lil Alessa
Sarah Bevins
Anne Giblin
Jackie Matthes
Teresa Mourad
Kim Novick

Participating remotely

Jeff Dukes
Sparkle Malone
Peter Groffman