

Spring 2025 STEAC Meeting Report

Introduction

The STEAC met on March 31 and April 1, 2025 as a quorum of ten members total, with six members in-person (Henry Bart, Adrienne Sponberg, Jennifer Edmonds, Sydne Record, Daniel Rubenstein, and Samapriya Roy) and four attending virtually (Meghan Avolio, Shawn Serbin, Rich Fiorella, and Shannon LaDeau). Fourteen NEON-Battelle staff attended (Tanya Maslak, Kate Thibault, Darcy Gora, Paula Mabee, Chris McKay, Kim Nitschke, Christine Laney, Claire Lunch, Jeff Coleman, Chau Tran, Ed Ayres, Steve Jacobs, Chris Florian, Mike Kuhlman). Additionally, five members from Catalyst Consulting (Karen Peterman, Allison Black Maier, Veronica del Bianco, Maren Harris, Emily Ortiz Franco), an external evaluation team contracted by Battelle to assess NEON. The meeting was in-person and held at the CU SEEC Building, Boulder, Colorado. The following topics were discussed: NEON evaluation, evolving community feedback mechanisms, domain support facilities, upgrades and ensuring continuity of soil sensors, and sustainability of the Observatory. STEAC recommendations are highlighted in *italic text* at the end of each section.

Day One

Welcome and Stage Setting

The meeting began with introductions, reviewing and agreeing to abide by the NEON code of conduct, and assigning note takers for each section of the report. The minutes from the 3/19/25 virtual STEAC meeting were approved. There was acknowledgment that even with the growing use of AI, the STEAC will continue to take notes by hand. NEON Director Paula Mabee then set the stage for the remainder of the meeting by introducing the main aims: 1) to introduce the evaluators, 2) to review feedback mechanisms, 3) to consider how NEON can/should be connecting to Universities and other Domain Partners, and 4) to discuss opportunities to add value to data products.

NEON Evaluation - Introduction

The evaluation team from Catalyst Consulting was introduced to the STEAC by its lead, Karen Peterman, including Allison Black Maier, Veronica Del Bianco, Maren Harris, and Emily Ortiz Franco. This team will be working with NEON over the next two years to help implement the NEON Strategic Plan. Lead member Peterman introduced the CIPP Framework [Context, Input, Process, Product]. The team will use discussion and

interviews to understand what success should look like and develop implementation steps, benchmarks and specific indicators. They will help NEON identify priority actions to optimize database and data entry, and improve and grow NEON outreach and engagement mechanisms. STEAC members participated in online and in-person breakout discussions, and helped describe some current NEON users and partners. A lack of clarity in the intended meaning of User and Partner was identified. *The STEAC recommends that the assessment team should consider how to better define their terminology and also consider the temporal scale of their study.*

Evolving Community Feedback Mechanisms

Kate Thibault from NEON gave a presentation on current feedback mechanisms used by NEON, allowing the STEAC to evaluate the effectiveness of these mechanisms and explore improvements for increased interaction with scientists and data users. Current feedback mechanisms include Technical Working Groups (TWGs), a “contact us” form, user surveys, and NEON staff interactions with the community at conferences. TWGs were essential for addressing field sampling issues in the early days of the Observatory during protocol development, but now these advisory groups are needed much less regularly. It is challenging for NEON to manage so many TWGs. Furthermore, when feedback is needed, finding proper expertise is sometimes difficult. Several variations of the current TWG model were proposed, including reducing the number of TWGs, creating ad-hoc TWGs for one-off issues, encouraging TWG members to act as connection points to other experts, adding a login function to NEON data acquisition portal that identified expertise by users for ad-hoc advice, and clarifying with TWG members the expectations for participation prior to accepting the invitation. There was concern against disbanding the TWGs, as finding expertise with a moment’s notice is very difficult. A second feedback mechanism is the “Contact Us” form, which is underutilized. The STEAC recommended a ticketing system for better user experience and query tracking. Third, NEON also implements User Surveys, which have very poor response rates. It was suggested to add pop-up reminders, keep surveys open longer, send congratulatory emails to authors using NEON with a survey link, and offer small incentives (gift cards) to answer surveys. The final feedback mechanism discussed was NEON Staff Interactions at scientific conferences. It was noted that it is difficult to measure the long-term impact of this mechanism. The STEAC suggested that post-event contact and discussion forms be required for NEON staff to fill out, and notes that NEON is building infrastructure for tracking follow-up requests from conferences and outreach events.

The STEAC also discussed ambassadors and community builders. NEON currently has an ambassadors program that consists of seven postdoc ambassadors who are

required to complete capstone projects where they lead workshops to teach people NEON data usage skills (i.e., the train the trainers model that has been successful with groups like Software Carpentry). The STEAC discussed the potential expansion of this program to include undergraduate ambassadors and a badging/certificate system for recognition of “NextGen Stars”. The group discussed assigning digital object identifiers (DOIs) to tutorials that users generate and submit as a way to follow the ‘train the trainers’ work of the postdoc ambassadors. However, it was noted that currently very few tutorials have been stamped with a DOI.

The discussion ended with a forward looking view of potential new approaches and tools, including Chatbot/AI tools to be used by users for data discovery and real-time user support and new platforms. Such tools would notify users when data were ready for download, and produce documents in additional languages. There are AI tools that interact with pdf files of literature and create reviews of common methods and summarize literature. Providing a thumbs down/up response system along with these tools would be a start at user feedback. Community platforms (e.g., Slack were suggested, open forums) were discussed, but the STEAC had concerns about community uptake based on experiences with other groups (e.g., Long Term Ecological Research Network, Ecological Society of America, personal use). *The recommendation of the STEAC was to pursue the ChatBot option for enhancing community feedback, potentially increasing ease of use of the NEON data repository, while also generating analytics that would allow NEON to improve accessibility and interest in NEON products.*

Domain Support Facility - Status and Opportunities

Jeff Coleman, Field Support Lead and Chau Tran, Field Science Lead, spoke with STEAC about the siting of domain support facilities. Multiple considerations are taken into account when siting these facilities, including: proximity to core and gradient sites, security of assets, lab facilities, potential to collaborate with NEON users, and cost in including tenant improvement allowances. During the conversation with the STEAC, it was noted that there are a lot of benefits to co-locating these facilities with other academic or research organizations, but it is often challenging to do so due to costs or other bureaucratic barriers. The STEAC commends Battelle for the work they’ve done to negotiate the existing co-located sites and in pursuing other possible arrangements. *While the STEAC sees great potential in co-location due to the increased engagement of other researchers with NEON that it would facilitate, the STEAC acknowledges that this may not always be possible or financially feasible. The STEAC members are willing to provide local connections to Battelle for possible co-located facilities and request that*

Battelle query the group at a time that makes sense with lease renewals, so that we can provide current and relevant contacts in the geographic area.

Upgrades and ensuring data continuity: soil sensor intercomparison plan

NEON is planning a sensor transition for *in-situ* soil measurements, replacing fragile, outdated Sentek sensors with Stevens HydraProbes, which measure multiple parameters in a single probe at all but the most shallow depth (i.e., < 2 cm). NEON will continue to use Sentek sensors at the surface. Soil water measurements currently use Sentek EnviroSCAN TriSCAN sensor, but the measurements are not meeting data the validity target (i.e., 46% as opposed to the 73% target). Furthermore, the Sentek EnviroSCAN TriSCAN sensor is very fragile and is easily damaged during shipping and in field conditions. The manufacturer made these Sentek sensors obsolete in 2019. NEON had a stockpile following the discontinuation. However, supplies of the discontinued sensor are now low, so there is a need to transition to a new sensor.

Transitioning to an integrated sensor will streamline operations and reduce hardware, but could introduce comparability challenges. This transition has been discussed extensively with the broader scientific community, including TWGs. NEON plans to implement a one-year overlap in data collection between the two sensors, with contingency extensions if observed variability is particularly high at a site, suggesting "anomalous" behavior that would trigger extended overlap. The STEAC discussed the high spatial and temporal variability found naturally in soils, making direct 1:1 comparisons difficult. The STEAC suggested the possibility of doing both lab and field comparisons, as the field gives you realism, and the lab (even a "garbage can" test) helps isolate sensor behavior. The STEAC also suggested comparing site averages rather than one-to-one sensor matches to reduce noise from point variability.

NEON scientists discussed a need for documenting soil texture, salinity, and temperature. When sensors were initially installed, NEON collected soil blocks from a megapit and used gravimetric lab measurements to calibrate the Sentek probes. Therefore, the plan is to create a correction factor that will shift the offset between the new and old probes to overlay new data with old sensors, so that soil-specific analysis will not have to be repeated with the new sensor. The STEAC suggested ensuring that the rationale for linear vs. nonlinear adjustments is clearly laid out for long-term data users. It was also noted that soil-specific calibrations are burdensome and not widely adopted by other networks.

Another change in the field installation when moving from old to new soil sensors will be the depths of installation, which are being significantly altered to match depths used by

other soil monitoring networks. Matching new sensors to legacy depths and using national/international standard depths with the new sensors will help with interoperability. NEON is a leader in completing these sensor transitions and maintaining data integrity and should consider publishing or sharing a methods paper or technical note once the intercomparison is underway. *The STEAC fully supports this transition. The STEAC recommends adding a lab comparison to isolate inherent differences in the sensors themselves, considering linear and non-linear adjustments, and publishing this work once completed.*

Sustainability of NEON Part I: NEON Business Spin-Offs

NEON gathers, owns, and makes available to anyone for free many types of data. But three issues associated with NEON's data were discussed: 1) how useful is the data when in raw form or only moderately synthesized, analyzed or improved by NEON; 2) who actually is using it; and 3) should NEON be remunerated for making the data more user friendly, especially when some users will build upon NEON's improvements and generate large income streams by modifying it further.

With regards to data usefulness, examples were given showing that NEON often must organize the data into data products that require some basic analyses and the addition of metadata before it is understandable by users.

Regarding point two, to better understand who is using data, adding a required login was discussed. The benefits of doing so are: i) better tracking of who is using what types of data; ii) many repositories of NEON data already require logins to gain access, so for most users, no new barrier for access will be created; and iii) current procedures would continue to protect users' identity. The costs of adding a login feature could be: i) that it is off-putting to some users; ii) false information could be provided; and iii) increased staff time will be required to implement a tracking system and to mandate the use of a login to access data. In the end, the STEAC voted and approved a motion to recommend that NEON add a 'login' step for data downloads either via a personal ID or ORCID or Google and have a 2-month transition period during which potential users are notified of the new feature. The STEAC recommends a login only for data downloads, not for other information on the NEON website (e.g., tutorials, protocols, workshops). Potential users will be told that NEON has decided to add this feature because it will increase engagement, acknowledgements, provide feedback for NEON to increase user support, and will provide better reporting to NSF.

Third, the STEAC discussed the option of value added to data for free or for a fee. NEON adds value to raw data whenever it creates data products, which enables users

to do analyses or to add their own improvements. At times, it is perceived that these improvements may generate large income streams. After much discussion on user types, NEON data improvements and what other improvements partners or users add, it was decided to create a matrix of data types, what value NEON adds to each, and what value has been added by others as well. Armed with such a matrix, NEON will be able to decide on what data types and products could be provided for a fee.

This discussion of 'added value' led to further discussion on licensing the use of NEON data. Currently, NEON data is unrestricted [CC0], but some restrictions might be warranted. The simplest would require attribution of the data as NEON data [CCBY]. Both licenses might apply to non-profits without causing any concern. However, more restrictive controls might be placed on data used for commercial, and hence profitable, use [CCBYNC]. This discussion was a continuation of a licensing change discussion from a virtual meeting earlier this year where NEON considered a more restrictive license than CC0. *No consensus was made at this point, and the discussion was continued on Day Two (see Licensing section).*

Sustainability of NEON Part II: Industry Partnerships - NEON as a Research Enabler

NEON's Chris McKay led a conversation about the potential for expanding NEON Research Support Services (NRSS, formerly Assignable Assets), which makes available certain components of NEON's infrastructure to members of the community to support their own research or other activities. NEON serves as an accessible research platform for Principal Investigator-driven research and environmental studies. Research support includes access to NEON infrastructure, site coordination, and a labor pool of field ecologists, engineering, and science staff. The services are mainly cost-recoverable and dependent on the availability of resources. The NRSS webpages shows an impressive list of projects from 2023-2025. Chris showed us a history of NRSS projects (proposals only) broken out by NSF and other funders. He showed a slide that said NSF proposals dropped off in AY24. Also, funds generated by NRSS projects are not contributing much to NEON once NEON's costs are accounted for.

The STEAC discussed the use of NEON infrastructure outside of NRSS, providing opportunities for staff to engage in research activities and potentially attracting more international partners to use NEON infrastructure. Investigators are submitting proposals to NEON requesting NRSS projects. The STEAC noted the need to maintain a steady amount of NRSS projects and grow this type of support, specifically growing funding. NEON is currently partnering with the European Long-term Ecosystem Critical Zone; South Africa Environmental Observation Network, the Integrated Carbon Observing System (ICOS) and the Terrestrial Ecosystem Research Network (TERN) on a data harmonization project that also involves building a cyberinfrastructure. Other

international partners who are in the early stages of implementing research infrastructure, such as the National Institute of Ecology (Korea) are also currently engaged with NEON.

The STEAC noted that NEON should formulate costs of projects driven by outside investigators. If approved, NSF would make a subaward to Battelle to fund the work. Companies could pay NEON for validating/ certifying sensor data. However, the ability of NEON to turn a profit on NRSS activity has some caveats. Although the availability of NRSS funding adds value to investigator-driven projects, there are regional differences in costs across NEON sites. NEON has to calculate cost differences to ensure that funds are not being lost because of these cost differences. The STEAC discussed how NEON might hire consultants to figure out the real cost of services, explore ways to add value to services, and determine how to partner with companies. The STEAC also felt that it would be helpful for NEON to advertise to the commercial community or commercial arm of governmental agencies to attract more NRSS funding. Furthermore, it was noted that a question that must be answered is: what are NSF's expectations of the core responsibilities of NEON, and how open/supportive is NSF to commercialization?

There was also discussion of if NEON could offer services to foreign entities and governments or commercial entities to replicate NEON capabilities. It was recommended that NEON attend annual Joint Agency Commercial Imagery Evaluation (JACIE) workshops, a joint agency commercial satellite Imagery evaluation workshop held at USGS Headquarters in Reston, Virginia. Companies attending JACIE may be interested in the NEON AOP as many of them want to be involved in LandSat Science teams. Along those lines, there could be possible opportunities for NEON to partner with companies that provide downlinking stations for connecting satellites to data repositories. Such services are paid for by satellite owners. However, the STEAC expressed some concerns here that the current administration's goal is to privatize data, which would allow businesses to charge for it. This would not be in the spirit of open data that NEON is built upon.

Paula mentioned that NEON is planning to establish an innovation component in the near future. NEON is partnering with one of the Technology and Innovation Engines: CO-WY Climate Resilience engine, which is engaging small and large companies (Microsoft, Nvidia) as partners. NEON would benefit under a similar cost-recovery model. NEON can set its own costs for certain kinds of services. The STEAC noted that it would be a good idea to do this now, so that when big companies want to partner, NEON will be ready with reasonable costs and ready to repackage service offerings.

Small groups of NEON staff could develop a proposal to pursue such research opportunities. This sort of staff development aligns with Gordon Battelle's mission, "... using science to do the greatest good for humanity and making a positive impact for the planet and its people." The NEON community has built a lot of trust in the research community and at NSF. NEON Staff love NRSS and are accustomed to serving the research community in this way, but don't have a good model for doing this. There may be opportunity to further these efforts and provide important connections by networking

Battelle projects, which Battelle already does a good job of. For instance, the Vector-borne disease health collaboration that Battelle has (perhaps: <https://pmc.ncbi.nlm.nih.gov/articles/PMC7594249> ?) could be an opportunity to align NEON's monitoring with existing Battelle collaborations.

Finally, NEON posed the question of if it should change its marketing approach on its website to emphasize and connect with issues of societal concern more (e.g., disasters, national security, SEC dominance, human health, agriculture, pollinator declines). There may be opportunity in terms of funding in pivoting to other kinds of services. The STEAC also wanted to know if NEON data has been used to address/solve any major problems, or suggested useful pathways others could follow to solve major problems. This understanding would position NEON for major gifts from philanthropists. In addition to emphasizing NEON's ability to solve major problems of societal interests, the STEAC also suggested considering how to shift marketing to emphasize NEON's instrumentation and program management assets. *The STEAC encourages NEON to consider exploring new ways to raise revenue via industry partnerships in consultation with the NSF to ensure that open data expectations are maintained.*

Day Two

Reflections on Day One

On Day Two, there was a wide ranging discussion reflecting on the first meeting day. The following topics were among the items we reflected on at the start of Day 2 of the meeting. First the STEAC discussed NEON as an incubator for big science (e.g., warnings of climate change, agribusiness, mobile testing of PFAS in urban water supplies, biofuels and renewable energy). Second, there was discussion of how NEON might engage with state governments given the shifting governmental funding landscape, but Battelle staff noted that this has been challenging in the past. Following up on the end of Day One discussion, there was acknowledgment of a need for better marketing to promote the work of NEON (e.g., producing videos and public advertising campaigns).

In returning to the conversation about sustaining NEON long term. There was recognition about the lack of people in the NEON AOP footprints and if there needs to be more of a focus on more urban areas and communities through outreach with the users of the Observatory. There was recognition that it would also be helpful to meet with board members of corporations and business leaders to foster collaboration.

Catalyst urged the group to consider the following: What do we mean by outreach, education? Catalyst noted a need to know more about users, in terms of who they are and the positions they are speaking from. What will we do with TWGs, communications, user login? How will NEON prioritize these approaches to community engagement? *The STEAC recommends NEON focus on more than just identifying users, but also have a conversation with users about how cumbersome login is or not.*

Licensing

The STEAC discussion on licensing reflected a growing need for NEON to revisit how it shares data, especially as most repositories currently operate under CC0 or CC BY licenses, with the Marine Repository standing out as the only one using CC BY-NC-SA. It was noted that there is active discussion around shifting to a CC BY 4.0 International license by some groups to encourage attribution while maintaining openness. There were concerns about whether other repositories that house NEON data could technically support a new license type. The STEAC recommended a broader conversation with data providers and partners to align licensing strategies while emphasizing the need to clearly explain the rationale behind any change, particularly since many users do not attribute data under the current CC0 license. Some STEAC members and staff felt that moving toward a CC BY-NC license would allow NEON to better manage commercial use. It was acknowledged that there will be barriers no matter which license is chosen, so transparency and simplicity are key. Furthermore, having a single license would also ease implementation on NEON's side.

Additional ideas included exploring differentiated licenses based on data product type or user category. It was noted that NEON could manage usage based on level of dataset derivation (e.g., L3, L4). There was also discussion about whether different user types should trigger different restrictions and what NEON's philosophy is on this—particularly how restrictions should vary between individual researchers and commercial users. There was also discussion of whether any of NEON's analysis pipelines could be patentable, even if the raw data itself is not. The group also discussed how NEON's value-added data could generate returns on investment, especially when used commercially, with comparisons drawn to AmeriFlux who NEON should refer to in terms of how they are handling licensing and commercial engagement. Catalyst plans to reach out to partners, and the upcoming Research Data Alliance virtual meeting was flagged as a venue for further dialogue. *The STEAC supports continued exploration of licensing models that reflect NEON's leadership in open science while also considering sustainability, innovation, and recognition for the work being done.*

Sustainability of NEON Part III: Potential Philanthropic or Other Sources of Funding

The STEAC discussed several possible ideas for raising additional funding for NEON operations. There was no support for patenting NEON products. However, there was support for marketing the skill sets of NEON scientists and personnel and recognition that the outside scientific community does not appear to be well informed that they can pay NEON to help with analyses. The STEAC also suggested making NEON an

incubator for new products that might be sponsored by outside donors. Having it be the year of 'TYPE OF DATA' where a donor might fund collaborative grants between NEON and community scientists. For philanthropic donations, it was noted that building relationships with potential donors is a multi-year process with individuals and foundations, and that possible foundations include: Schmidt, Moore, and Allen (already has awards at NSF). The STEAC discussed the NEON's involvement with a lunar biorepository, as NEON is a great resource for collection of materials. Given the current attention given to AI, the STEAC thought NEON could maybe put out a course for using AI with NEON data. *Overall, the STEAC recommends considering how to market the skills and personnel of the Observatory and strategically building relationships with donors.*

STEAC Business and Report Planning

The STEAC made plans for generating the report for Battelle, NEON, and NSF from the meeting. The STEAC also spent some time agreeing on recommendations to provide for each topic discussed. Finally, the STEAC reflected on how this meeting was unlike any other meeting with respect for the discussion on NEON sustainability. *The STEAC expressed some discomfort in this regard and would like to ensure that NEON data remain true to the original mission of open data while at the same time recognizing current challenges.*