NEON Technical Working Groups

2020 Third Quarter Report

1685 38th St., Suite 100 | Boulder, CO 80301 | 720.746.4844 | www.neonscience.org

National Ecological Observatory Network (NEON) is a project sponsored by the National Science Foundation and proudly operated by Battelle.

Table of Contents

The National Ecological Observatory Network (NEON) is a major facility fully funded by the National Science Foundation and operated by Battelle.

Introduction

Since its inception, NEON has relied on expertise within the science, education, and engineering communities to advise on key areas impacting the design, construction, and maintenance of the observatory with the goal to optimize its operation. Currently, two types of external advisory bodies support staff and leadership in making key decisions that guide all of NEON's activities: the Science, Technology & Education Advisory Committee (STEAC) and Technical Working Groups (TWGs). Both bodies are comprised of experts nominated to serve in these roles who are selected by NEON staff following a rigorous selection process.

NEON currently relies upon input from 22 TWGs. These groups play an important role by providing input to NEON's data collection and processing methods and ensuring that NEON infrastructure, data, and programs are a valuable community resource. Working groups are participatory and advisory; they are often tasked with providing input on issues that have scientific, educational, engineering or operational implications. This document includes a summary of activities, recommendations, and NEON's response to those recommendations for each TWG during the third quarter of the 2020 funding year (May 2020-July 2020).

Airborne Remote Sensing Data Quality TWG

The Airborne Remote Sensing Data Quality Technical Working Group provides expert input and advice regarding NEON's airborne sampling design, data collection requirements and constraints, campaign scheduling, data products and algorithms, and reported quality metrics.

Summary of Activities

Meeting held on 6/29/20 with 16 TWG members present. Provided updates on the AOP flight season, finalized the NSF letter on AOP data products, discussed potential AOP test flights to be held during 2020 down-time due to COVID-19, provided a brief update on plans to host AOP data in Google Earth Engine, presented on and further discussed the possibility of adopting CEOS standards for stages of data production, and continued the previous meeting's discussion on relaxing acceptable solar elevations for AOP collections.

TWG Recommendations

The TWG recommended that AOP make it a priority to adopt a BRDF-correction algorithm in generation of surface reflectance products, and in the meantime ensure that the NEON website be very clear on how to use non-BRDF corrected data properly. TWG suggested that if test flights were conducted, NEON should reach out to external researchers who could benefit from the data. TWG members were excited by the prospect of having access to AOP data in Google Earth Engine, and consensus was that both orthorectified flight line radiances and reflectances, as well as site mosaics be included, at least until BRDF corrected data were available. The TWG agreed that NEON should evaluate the CEOS standard to see if they are appropriate. Finally, the group recommended that 35-degree solar angles be considered for sites where topography was not too extreme.

NEON Response

AOP will follow up with NSF regarding BRDF correction, and work with TWG members to adopt and implement the appropriate algorithm once inclusion of BRDF-corrected products is approved. AOP will also make NSF aware of TWG recommendations to add data to Google Earth Engine, and will approach the Science WG to evaluate the appropriateness of CEOS standards in rating data product maturity. AOP will also develop a list of sites where relaxed solar angles are appropriate for the 2021 flight campaign.

Aquatic TWG

The Aquatic Technical Working Group provides expert knowledge across the fields of Aquatic Ecology, Biogeochemistry, and Ecohydrology. This group is broadly geared toward aquatic observational sampling and instrumentation along with associated data products, design and maintenance documents, protocols, and algorithms.

Summary of Activities

Meeting held 5/18/20 with 7 external members present, 2 FSCI, and 2 AOS/AIS science. Discussed and assigned AOS protocol reviews, algal taxonomy QAQC issues, presented sensor data comparisons, and under-ice temp chains.

TWG Recommendations

Some recommendations on what groups to target for algal taxonomy QC survey. Continue looking at sensor/lab data comparisons, especially with pH, make sure labs are using appropriate standards. Under ice temperature is important and glad to see we are doing this.

NEON Response

Starting a separate Algal Taxonomy TWG to address those issues. Need to continue to monitor sensor and external lab data quality. AIS to continue with installing under-ice temperature chains in lakes.

Additional Notes:

Moving forward with reconfiguring multisondes to report chlorophyll in RFU, which was previous recommendation of the TWG.

Atmospheric Stable Isotope TWG

This group provides guidance regarding sensor designs and assemblies, data products, and field and lab procedures and protocols to measure atmospheric stable isotopes of ^{13}C in CO^2 and ^{18}O and 2H in water vapor and precipitation water.

Summary of Activities

Discussed whether or not to continue archiving Picarro raw data files. These files contain the raw spectrum data before it is processed by the instrument software.

TWG Recommendations

The TWG recommended that we continue to archive the files, although there was discussion regarding storage cost vs benefit to the science community. TWG members advised that that the technology for laser absorption spectroscopy is evolving and preserving raw data files will ensure that we retain the ability to assess whether long term trends are real or the product of changing algorithms. It was suggested that these files would not often be needed, so it is not necessary to stream the files back to NEON HQ, and that storage of files could be re-assessed every 5 years as algorithms stabilize.

NEON Response

NEON will continue to archive the Picarro files but will examine cost-saving data transfer strategies. Data storage costs will accumulate over time, we will revisit this discussion and potentially examine other storage options according to the suggestion that these files will not be frequently accessed.

Biorepository TWG

The Biorepository Technical Working Group is comprised of curation, archival and museum collections experts as well as ecologists and others who would make use of the NEON Biorepository. The group advises NEON on curation best practices; and discoverability of and ready access to biological samples and specimens for future scientific research. A particular focus is to broaden the availability and use of museum assets for regional to continental-scale ecological research.

Summary of Activities

Discussed Biorepository construction schedule, annual projected archive sample numbers and types, and quality plan. TWG members collated documentation of curatorial best practices for sample types NEON will be archiving. Discussed need for publicizing NEON samples housed at ASU and other facilities on the NEON website and other aggregators (e.g., GBIF, iDigBio); discussed mechanisms for publicizing sample use.

TWG Recommendations

Suggested best practices for the NEON Biorepository in line with other institutions with regards to curation and loans.

NEON Response

NEON Biorepository will highlight sample use on its portal; sample specimens will be cross listed on aggregator websites.

Breeding Landbird TWG

The Breeding Landbird Technical Working Group provides expert input and advice regarding the science design and protocols related to NEON breeding landbirds sampling.

Summary of Activities

The TWG discussed sampling regimes for the automated recording unit (ARU) proposal to be submitted to the NSF. Among the considerations were how to reduce data storage costs while still preserving the ability to look at seasonal phenology and spatial heterogeneity.

TWG Recommendations

The TWG recommended that the ARU proposal include three different levels of sampling effort corresponding to three different budget levels, and that this be accomplished by staggering deployments (e.g., some or all individual ARUs only record every 4th day but staggered such that ¼ of ARUs are recording every day).

NEON Response

NEON staff revised the ARU proposal according to TWG recommendations.

Community Engagement TWG

The Community Engagement Technical Working Group (TWG) provides guidance on the ways in which NEON engages with its existing and potential user community. This includes scientists, educators, and students as well as organizations, agencies, institutions, and companies whose activities align with the mission and goals of the NEON program. Members serve as liaisons to the NEON user community while providing input on the program's strategic engagement plan and the activities and outcomes identified in that plan.

Summary of Activities

The TWG has divided into two subgroups: one focused on broadening awareness and the other on building data science skills. During this quarter, each subgroup met twice. The broadening awareness subgroup has been participating in working sessions to support development of a NEON Ambassadors Program. A spreadsheet was created to collect information on existing programs, including expectations, duration of the program, incentives offered, training requirements, and resources made available to participants. The group is identifying existing program features that could be adopted by a new NEON program. The data science subgroup had working sessions centered on identifying opportunities to leverage other programs to teach data science skills using NEON data. Members have been listing opportunities and relevant URLs and will be prioritizing these opportunities in upcoming meetings.

TWG Recommendations

NEON has been reviewing tools for contact management and metrics tracking and reporting. The broadening awareness subgroup provided ideas on tools for NEON to consider.

NEON Response

NEON included the recommendations in the list of tools being considered for adoption by the program.

Data Standards TWG

The Data Standards Technical Working Group is tasked with making recommendations about effective ways to provide NEON's data products to the broader scientific, educational, and policy communities. Topics may include 1) principles, standards, and policies for open data and software, 2) data discovery, exploration, and delivery mechanisms, 3) improvement of data products to increase utility, and 4) monitoring impact of NEON data use on research.

Summary of Activities

The TWG met once, in June, and discussed progress toward data portal and neonscience.org rebuild goals. We also discussed the new data formats and conventions webpage.

TWG Recommendations

The primary recommendation from the TWG is that we be especially careful to include information about missing values and how users will and should interact with them.

NEON Response

We will include this recommendation into the data formats and conventions webpage.

Ecological Forecasting TWG

The Ecological Forecasting TWG provides recommendations to NEON on how to best support ecological forecasting. This may include facilitating community discussions around forecasting needs, providing guidance for data product development, and identifying opportunities for NEON to engage with the forecasting community though workshops, educational materials, and code/data product development.

Summary of Activities

This TWG did not meet during Q3 though many of us participated in the Ecological Forecasting Initiative Research Coordination Network (EFI-NEON RCN) meeting in May and follow-up meetings.

TWG Recommendations

N/A

NEON Response

N/A

Fish TWG

The Fish Technical Working Group provides expert knowledge and support for the development of field-based protocols and strategies for standardization of sampling across NEON aquatic sites.

Summary of Activities

NEON staff worked with a TWG member over email with expertise in crustacean by-catch requirements (Dr. Thilina Surasinghe).

TWG Recommendations

The TWG member recommended we collect and identify by-catch to the lowest common taxonomic level or weigh all crayfish.

NEON Response

That those sites that can, ID to lowest taxonomic level.

Foliar Sampling TWG

The Foliar Sampling Technical Working Group provides expert input and advice related to sampling sunlit plant foliage, with a key goal of linking field measurements to remotely sensed observations of vegetation chemical and physical properties.

Summary of Activities

The TWG did not meet this quarter, nor did we correspond over email.

TWG Recommendations

N/A

NEON Response

N/A

Ground Beetle TWG

NEON collects ground beetle observations and archival samples at all terrestrial field sites to capture how ground beetles (*Carabidae*) communities change in different habitats and ecosystems over time. This TWG determines targets for sampling that generate data that can reveal significant changes in beetle abundance, diversity, and community composition.

Summary of Activities

Discussed current status of ground beetle data product, data quality targets, and circulated current sampling protocol to the TWG for comment.

TWG Recommendations

TWG made recommendations about sample archiving and handling of specimens with less than complete metadata.

NEON Response

NEON staff are incorporating input from TWG on the data quality analyses; specimens with incomplete (but generally sufficient) metadata will be advertised in the NEON Biorepository and Data Portal with appropriate context.

LiDAR TWG

The LiDAR Technical Working Group assesses and recommends strategies for developing and implementing techniques for instrument calibration and data validation, operational instrument testing, and product data formatting for vegetation remote sensing.

Summary of Activities

No activity for Q3.

TWG Recommendations

N/A

NEON Response

N/A

Additional Notes

Plan to request one more round of feedback on AOP LiDAR products.

Microbial TWG

The Microbial Ecology Sampling Program encompasses measurements of soil and aquatic microbial diversity, composition, and abundances that are deemed critical for understanding long-term changes in biodiversity and ecosystem function. The tools used for measuring microbial diversity in the environment develop and change rapidly. NEON relies on input and guidance from the Microbial Technical Working Group to advise on questions related to methods and analyses, as well as best practices for ensuring data quality, accessibility, and usability.

Summary of Activities

Reviewed and approved a proposal to change the data processing methods for microbial community composition data products; formed a microbial biomass QC working group; discussed ideas for NEON in developing useful tutorials for NEON microbial sequencing datasets.

TWG Recommendations

N/A

NEON Response

N/A

Mosquito TWG

The Mosquito Technical Working Group is comprised of researchers focused on topics including: mosquito surveillance, public health, disease ecology, and phenology. The group advises NEON on sampling approaches that will generate data that reveal significant changes in mosquito abundance, diversity and community composition. A focus of this group is to ensure compatibility of the mosquito dataset with other surveillance infrastructure used to monitor arboviruses in mosquito populations.

Summary of Activities

Reviewed current mosquito pathogen sampling program and targets.

TWG Recommendations

The TWG recommended that disease sampling be retargeted to better enhance ability to detect pathogens.

NEON Response

NEON staff are preparing a redesign of the pathogen testing program for review by the TWG and NEON internal science committees.

Small Mammals TWG

The Small Mammal Technical Working Group provides expert input and advice regarding the science design and protocols related to NEON small mammal abundance, diversity and pathogen sampling.

Summary of Activities

Discussed data-driven ideas for optimizing sampling efforts. We reviewed impacts of reduced bouts, nights-per-bout, sample grids, and traps per grid on Capture-Recapture analyses completed by TWG members Dr. Roland Kays and Dr. Arielle Parons, as well as diversity estimates.

TWG Recommendations

The most cost-effective strategy with the least impact on diversity and abundance estimates is likely to be reducing the total number of bouts at a site (either by making Core = Relocatable = 4, or dropping one early season bout per site). The other strategy with low data impacts was reducing the number of traps per grid, but this might make continuity of models more challenging and realize less cost savings.

NEON Response

We are currently completing analyses of the DNA barcoding product and plan one additional meeting prior to recommending changes to the small mammal sampling protocol.

Soil Sensor TWG

The Soil Sensor Technical Working Group (TWG), provides feedback on all aspects of sensor measurements made in the TIS soil plots, including soil temperature, soil moisture and salinity, soil CO_2 concentration, soil heat flux, throughfall, soil surface photosynthetically active radiation (PAR), net longwave radiation, and soil surface/litter/vegetation infrared temperature measurements. In addition, the Soil Sensor TWG provides recommendations on approving or disapproving requests for large amounts of soil from the NEON Megapit Soil Archive.

Summary of Activities

TWG reviewed a request for soil samples from the Megapit Soil Archive that exceeded 20 g/sample (the threshold requiring TWG review). TWG members requested additional justification for various aspects of the request, in particular in relation to the quantity of soil. Comments were sent to the requester and an updated request was received. TWG recommended approving updated request.

A question raised in the 2020 TWG kick-off meeting was "Which soil sensor data products are most popular?", with the hope that this could be used to guide which data products the TWG should focus on. These data were not available at the time; however partial data based on API downloads became available this quarter and were sent to the TWG.

TWG Recommendations

Recommended approval of updated Megapit Soil Archive request.

NEON Response

Megapit Soil Archive request was approved, and sample preparation is ongoing.

Surface Atmosphere Exchange TWG

NEON measures the surface-atmosphere exchange of momentum, heat, and several climate-relevant trace gases. This Technical Working Group advises on the operation of NEON's surface-atmosphere exchange assets, development of novel, scale-aware data products, adaptive algorithms, and usability tools, and active contribution to network science. The Technical Working Group accomplishes these tasks by working closely with NEON's Surface-Atmosphere Exchange Group. This includes prioritizing quarterly developments, pre-reviewing new resources, and bringing forward community input.

Summary of Activities

NEON communicated current SAE-related work priorities to the TWG for feedback.

TWG Recommendations

There we no recommendations from the TWG during this quarter.

NEON Response

SAE work was scheduled according to previously determined TWG priorities.

Terrestrial Biogeochemistry TWG

The Terrestrial Biogeochemistry Technical Working Group provides expert input and advice regarding the science design and protocols related to measurements of plant and soil biogeochemistry within the NEON Observational System (e.g., not sensors).

Summary of Activities

Communicated observatory status in the face of COVID-19, then discussed a variety of topics including NEON linkages with other data repositories, user tutorials related to biogeochemistry data, method options for KCl inorganic N analyses, and different ways to pool litter samples for biogeochemical analyses.

TWG Recommendations

TWG was glad to hear about data sharing between NEON and other repositories, recommended we look into COSORE, FRED and TRY to expand our reach. Dr. Steven Hall shared his positive experience using second-derivative spectroscopy for KCl nitrate analyses and suggested this may be something for NEON to look into. The TWG was positive on the idea of our prototype to pool litter samples across plots for chemical analyses. In their experience, mass varies more across space compared to chemistry (within litter type), so pooling is a fair tradeoff to get more temporal coverage and more functional groups analyzed.

NEON Response

NEON reached out to the leads of FRED to discussing adding our root observations to FRED v 4. They are excited about this idea and it will likely proceed sometime in the next year. NEON is waiting to see if the use of an ultra-pure type of KCl powder solves previous issues with nitrite contamination. If it does not, we absolutely will explore the second derivative method and are glad to know about this option. NEON is continuing to run the litter prototype at 2 sites and will ask the TWG to review data once available and weigh in on whether the Observatory should switch methods.

Terrestrial Instrument Data QA/QC TWG

The Terrestrial Instrument Data QA/QC Technical Working Group represents a diverse set of NEON data users and experts, in the relevant disciplines of biometeorology, soil science, ecology, and data science. The overarching goal of the TWG is to ensure that NEON delivers the highest quality data possible with the available resources and that quality information is adequately communicated to data users. The TWG broadly covers terrestrial instrument measurements, data processing, data monitoring, and data publication as they relate to quality.

Summary of Activities

Presented results of the 2020 TIS quality review. The TWG provided feedback and advice on the priority of quality improvements and techniques to achieve them.

TWG Recommendations

The TWG agreed with NEON's prioritization of quality issues and recommended a specific technique to address spurious trace precipitation in the primary precipitation data product.

NEON Response

NEON will follow up with the TWG to implement the technique to improve the primary precipitation data product.

Terrestrial Plant Diversity and Phenology TWG

Membership of the Terrestrial Plant Diversity and Phenology Technical Working Group includes researchers and practitioners from universities, federal and regional government agencies, and coordinated research networks. This group represents the community of plant diversity and phenology data users that NEON aims to serve; members provide expert input and advice regarding the science design, protocols, and data quality issues related to NEON plant diversity and phenology sampling.

Summary of Activities

Two email discussions took place:

1. Requested feedback on proposed updates to the falling leaves phenophase definition to resolve some ambiguity and suggested dropping the phenophase altogether for drought deciduous broadleaf growth form.

2. A reduction in the number of Tower Plots at which herbaceous plant productivity was sampled, required a decision for plant diversity sampling: should plant diversity which occurs at just three Tower Plots moved to ensure collocation with herbaceous productivity or remain at existing plots to maintain temporal consistency?

TWG Recommendations

The TWG made the following recommendations:

1. General support for the proposed definition changes but some disagreement about whether to drop the falling leaves phenophase from drought deciduous broadleaf species.
2. Given the mismatch in scale (herbaceous productivity sampled from a 0.2 x 2 m clip strip within a 20 x 20 m plant diversity plot) the TWG suggested that herbaceous biomass and productivity - and subsequent comparisons to plant diversity - are most appropriate at the scale of the site or the part of the site (e.g., the tower airshed or a NLCD cover class) as opposed to the plot scale. Therefore, maintaining the existing plot locations for plant diversity is preferable.

NEON Response

1. We are updating the phenophase definition but will keep falling leaves phenophase for all growth forms where it has historically been observed. Field Science affirms that the updated definition resolves their sampling difficulties.
2. Plant diversity sampling continued at existing Tower Plots.

Terrestrial Plant Productivity and Biomass TWG

The Terrestrial Plant Productivity Technical Working Group advises which methods, protocols, and equipment are employed to cr eate robust ground-based estimates of live and dead woody biomass, woody and herbaceous productivity, coarse downed wood volume and density, fine and coarse litterfall, belowground plant biomass, and leaf area index across a suite of different vegetation types. The TWG also considers optimal spatial and temporal integration of ground-based measurements with remote-sensing hyperspectral and LiDAR datasets (i.e., the NEON AOP system), and with data streams generated by the NEON Terrestrial Instrument System. Finally, the TWG is also deeply invested in determining how NEON Plant Biomass and Productivity data products can be optimized to enhance usability and value for the NEON end-user community.

Summary of Activities

In the third quarter of AY2020, the Plant Productivity TWG continued working on a proposal to create a higher-level NEON plant above-ground biomass data product. Discussions focused on uncertainty estimation and biomass estimation for smaller shrub growth forms. The NEON lead is currently responsible for working with the TWG Chair to incorporate the shrub biomass estimation strategy and finalize the memo for delivery to NSF.

TWG Recommendations

The TWG recommended completing a proposal to create a NEON above-ground biomass data product for delivery to NSF.

NEON Response

Using the outline created by the NEON lead in Q2, the TWG identified members to add specific content to the memo.

Tick Sampling TWG

The Tick Technical Working Group provides expert input and advice regarding the science design and protocols related to NEON tick abundance, diversity and pathogen sampling.

Summary of Activities

We discussed the most time-effective ways to process large numbers of larvae as well as changes to sampling windows and testing for tick-borne diseases in small mammal blood.

TWG Recommendations

The consensus was the using weak painter's tape on denim cloth is the easiest way to reduce the cotton fibers and processing time for tick larvae samples. If this method does not work on our cotton cloths, preserving a subset of 50-100 ticks seems reasonable for population genetics, although it may limit the pathogen testing possibilities. A sampling period during November/December might increase the number of adult ticks collected, although it presents logistical challenges for field staffing. Testing the small mammal blood for the same pathogens as the ticks (especially with respect to *Borrelia burgdorferi sensu stricto* vs. *sensu lato*) will enhance compatibility of the 2 datasets and should be a priority.

NEON Response

We are piloting the use of weak painters' tape in some of our high-larvae domains (D02 and D06) to determine if it will solve the problem of the cotton fibers obscuring samples. If not, we will move forward with subsampling the larvae to reduce overall processing time for field and lab teams. We are looking into feasibility of a variety of options for increasing the capture rate of nymph and adult ticks. We will consider comparability of pathogen datasets when selecting the laboratory that will do the testing of rodent blood and ear samples for tick-borne pathogens.