



NEON Technical Working Groups

2020 Fourth 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

Introduction.....	3
Airborne Remote Sensing Data Quality TWG	4
Aquatic TWG	5
Atmospheric Stable Isotope TWG	6
Biorepository TWG	7
Breeding Landbird TWG	8
Community Engagement TWG	9
Data Standards TWG.....	10
Ecological Forecasting TWG.....	11
Fish TWG	13
Foliar Sampling TWG.....	14
Ground Beetle TWG	15
LiDAR TWG.....	16
Microbial TWG.....	17
Mosquito TWG.....	18
Small Mammals TWG	19
Soil Sensor TWG	20
Surface Atmosphere Exchange TWG	21
Terrestrial Biogeochemistry TWG	22
Terrestrial Instrument Data QA/QC TWG.....	23
Terrestrial Plant Diversity and Phenology TWG	24
Terrestrial Plant Productivity and Biomass TWG.....	25
Tick Sampling TWG.....	26

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 fourth quarter of the 2020 funding year (August 2020-October 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

No meeting was held during Q4. The next TWG meeting is scheduled for early December. Three new members have been recruited, replacing two long-time members who have decided to withdraw for 2021. Meeting agenda includes the following items:

- New TWG member introductions
- 2021 flight campaign update
- 2020 test flights review
- Update on AOP data in Google Earth Engine
- Maintaining legacy data products
- Utility of tower cam metadata to external users
- Point density versus complete waveforms

TWG Recommendations

N/A

NEON Response

N/A

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

TWG has advised on the following topics:

- Chla sensors in small streams
- Shallow lakes sonde profiling
- Changes to NEON data product names

Next TWG meeting scheduled for Dec 15.

Adding four new members, plus NEON's visiting scientist Jeff Wesner.

TWG Recommendations

- Remove chla sensors from water quality multisondes at all small stream sites where chla is effectively non-detectable
- Allow water quality multisondes to not profile at shallow lake sites where prolonged stratification does not occur (D03, D09)
- Agree to changing discharge data product names

NEON Response

Aquatics is planning to move forward with recommendations.

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

No activity for Q4.

TWG Recommendations

N/A

NEON Response

Work is ongoing to address previously raised data quality concerns and recommendations.

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

No activity for Q4.

TWG Recommendations

N/A

NEON Response

Work is ongoing to address previously raised recommendations.

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

- 1) TWG discussed the newly revised bird survey sampling windows, which are narrower and, in most cases, later in the season.
- 2) TWG discussed current QA/QC procedures and future tweaks
- 3) TWG discussed full acoustic ARU (automated recording unit) proposal to NSF.

TWG Recommendations

- 1) TWG approved the Bird Conservancy of the Rockies (BCR) recommended survey sampling windows.
- 2) Continue looking at additional ways to QA/QC data as close to the time of sample collection as possible.

NEON Response

- 1) Bird Conservancy of the Rockies will use the newly approved survey sampling windows starting in 2021 field season
- 2) Sam Simkin (NEON) to continue discussion with Chris White (BCR) about additional QA/QC measures.

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

NEON staff presented on the annual community engagement report at the August meeting. During the September meeting, NEON staff presented and requested feedback on current activities and programs to facilitate diversity, equity, and inclusion within the NEON user community. Opportunities to improve DEI was further discussed at the October meeting. Five new members to the TWG were selected to replace five outgoing members.

TWG Recommendations

The TWG co-chairs will be drafting formal recommendations for review and approval by all TWG members during the December meeting.

NEON Response

N/A

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

At the August 2020 meeting, the TWG discussed the upcoming plans for a data release and reviewed progress made toward previous recommendations. There was a brief discussion about a possibility of generating annual releases for the Darwin core records from the Biorepository, but more discussion would be warranted.

TWG Recommendations

Generally, the TWG agreed with the overall plans for data releases. The primary recommendation was to be very clear about the provisional data, in particular, to help users understand that these data may improve over time (as is typical with many datasets that are thoroughly QA/QC'd).

NEON Response

The internal data release working group is proceeding with developing the workflow and outputs of the first data release, and we are being very careful to consider the user perspective by implementing documentation about provisional vs. released data from the data portal webpages, within the data packages (readme and manifest files), and in the API responses.

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 through workshops, educational materials, and code/data product development.

Summary of Activities

A primary goal of this TWG is to liaise with the Ecological Forecasting Initiative Research Coordination Network (EFI-RCN). The EFI-RCN is coordinating a NEON Ecological Forecast Challenge that will run its first round January-December 2021, with the goal of the Challenge occurring multiple times in future years. Teams from around the world with varying levels of expertise in using NEON data will forecast ecological variables derived from NEON datasets for the Challenge. Currently, there are five themes: Aquatics (focused on forecasting water temperature and dissolved oxygen monthly at Lake Barco and the Flint River), Terrestrial fluxes (focused on forecasting net ecosystem exchange, latent heat, and soil moisture at four flux tower sites), Beetle communities (focused on forecasting beetle community abundance and species richness at all terrestrial NEON sites), Tick populations (focused on *Amblyomma americanum* and *Ixodes scapularis* nymphal tick abundance at seven NEON sites), and Plant phenology (forecasts of plant greenness at seven deciduous broadleaf forest NEON sites, as measured by Phenocams)..

TWG Recommendations

Recommendation 1: Expedite instrumented data access for selected NEON data products

To best support the ecological forecasts that will be developed as part of the EFI-RCN Challenge, we propose expedited data access for specific NEON data products that are needed to make near-term forecasts on the daily and weekly scale. The current month-long data latency of NEON data products prevents the generation of forecasts of future ecological conditions, so the 2021 Forecast Challenge is focused on hindcasts (forecasts of historical conditions). To support future Forecast Challenges as well as the NEON forecasting community as a whole, having access to specific level 0' data products on the day to week scale would enable members of the ecological community to be able to generate actual forecasts of future conditions, as well as update models on a much more rapid time scale. These data products would be for a limited number of sensor variables that the Challenge teams need for forecast development, model drivers, and forecast validation.

Recommendation 2: Expedite processing of eddy-covariance data at selected NEON sites

To best support the ecological forecasts that will be developed as part of the EFI-RCN Challenge, we propose expedited processing of eddy-covariance data at selected NEON sites. These sites would be prioritized for processing so the monthly eddy-covariance bundle (Bundled data products - eddy covariance) is available through the API within 2 weeks at the end of the month or sooner. The EFI-RCN Challenge would greatly benefit from more predictable availability of the eddy-covariance data for designing the timing of the Challenge submissions.

Recommendation 3: NEON Staff Support for NEON Forecasting Challenge

To best support this actively growing community of forecasters using NEON data, we propose appointing a NEON staff person (or persons) to be available to field questions specific to NEON data for each of the five Challenge focal themes (Aquatics, Beetle communities, Terrestrial fluxes, Tick populations, and Plant Phenology). Specifically, we request having an individual NEON employee identified and available as a direct contact person for questions from both the design teams and participant teams that will submit forecasts to the Challenge. While resources exist online from NEON and community members for downloading and cleaning data, there will undoubtedly be usability challenges for team members unfamiliar with the new data products they are working with. As the EFI-RCN's NEON Ecological Forecast Challenge is a catalyst for increasing the number of NEON users within the research community, having a designated NEON staff member (or members) available for troubleshooting lowers the barrier of entry for team members new to using NEON data.

Recommendation 4: NEON should endorse CyVerse and the EFI-RCN Cyberinfrastructure Working Group's efforts in automating the collection of NOAA GEFS forecasts for NEON sites

Many ecological forecasts at NEON sites require forecasts of future meteorological conditions specific for a site. The NOAA Global Ensemble Forecasting System (GEFS) produces weather forecasts 4 times per day, up to 35 days in the future. Similarly, the NOAA Climate Forecasting System (CFS) produces weather forecasts 4 times per day up to 9 months in the future. However, the NOAA GEFS and CFS output are globally gridded products that require extraction for each individual NEON site. The extraction of these meteorological forecasts requires continual downloading and processing, which is extremely computationally intensive and may be challenging for the average ecologist to manage on their individual computers. Consequently, we propose endorsing the development of a partnership with CyVerse (via the EFI-RCN) to provide the computational resources needed for both 1) extracting NOAA forecasts at all NEON sites and 2) providing storage for saving these forecasts for use in subsequent ecological forecasting analyses.

Recommendation 5: NEON should provide an FAQ for common questions from the Ecological Forecasting Community

Working with data specifically for the purpose of ecological forecasting is a different endeavor than using similar data in typical ecological research. To date, the ecological forecasting community has asked questions about topics such as which data products are best suited for forecasting, expected data latency, best practices for programmatically and frequently pulling data to incorporate into scheduled code runs, and best practices for archiving workflows and their outputs. A section of the existing FAQ that is specifically dedicated to ecological forecasting questions would assist forecasters new to working with NEON data and reduce the redundancy of questions submitted through NEON's service portal. The TWG will explore FAQ forum options during fall 2020.

NEON Response

Recommendations are still being considered at this time.

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

No activity for Q4.

TWG Recommendations

N/A

NEON Response

N/A

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 asked for input regarding poor execution of a foliar sampling bout at YELL.

TWG Recommendations

TWG notes that data collected outside of protocol specifications (late in the season, not aligned with AOP) must be clearly flagged. Additionally, the site should be resampled as soon as possible (not wait 5 years).

NEON Response

TWG lead took these recommendations to the OS and Ops IPTs. Leadership supportive of re-sampling YELL as soon as AOP can return to the site, but the next scheduled bout is actually 2023 (not 2025). Decision was that if we can resample in 2021, we will, otherwise we will likely wait until 2023 and then continue with the every-five-years schedule. TWG lead is working with data products team to add a new flag to the foliar data product for 'samples not coincident with AOP.'

Additional Notes

There is a plan to conduct an extensive root cause analysis and follow up with domain manager and staff to understand why this happened. Plans are in place to prevent reoccurrence, including protocol updates and revised strategies for D12 manager to keep tabs on field staff.

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

No activity for Q4.

TWG Recommendations

N/A

NEON Response

Work is ongoing to address previously raised recommendations.

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 Q4.

TWG Recommendations

N/A

NEON Response

N/A

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

In October, emailed with the group requesting feedback about 1) whether NEON should sample immature biocrusts as part of soil microbial sampling; 2) whether NEON should document the presence of biocrusts in soil samples.

TWG Recommendations

About half of the TWG responded. From the respondents, recommendation was made to 1) exclude immature biocrusts from soil samples, as they are not part of the soil matrix, and 2) to document the presence of biocrust in soil samples.

NEON Response

This is a relatively large change to the protocol and resulting data, and also would leave a data gap for the Observatory for measuring 'vegetative' biomass in arid environments. As such, a decision hasn't been made with reference to item 1, and the TWG lead is waiting to get feedback from the Biogeochemistry TWG as to whether they concur with the microbial TWG recommendation. As for item 2, decision was made to add the ability to document the presence of biocrusts in soil samples as a field data entry value.

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

Discussed how to retain historical identification when taxon IDs change. We also continued the discussion of which vectors to select for pathogen testing.

TWG Recommendations

The TWG recommended changing the taxonID in the data to the new/updated ID while also marking the record and retaining the original identification in some way. The TWG also recommended a medium-broad testing strategy for vectors that are well-represented in the literature, even when they have not yielded positive tests in the current NEON dataset. Mosquitoes that are not commonly considered vectors in the literature, particularly those with extensive testing and no positives in our dataset can be cut from the testing pools. Additionally, more urbanized vectors such as *Aedes albopictus* and *Aedes aegypti* that are not commonly caught at NEON sites and unlikely to test positive for human pathogens in those areas were also cut from the testing pools.

NEON Response

A new identificationHistory table was created for the mosquitoes data product to help retain identifications that have changed for certain records over time. Approval was received to cut the species of mosquitoes that will be sent for testing in the 2020 field season to include only those that are widely regarded as vectors of human pathogens in the literature.

Small Mammals TWG

The Small Mammals 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 final biorepository storage of small mammal blood samples that will be pathogen tested, further considered optimization efforts to reduce small mammal sampling efforts, and considered the utility of the DNA barcoding data.

TWG Recommendations

A popular recommendation was to split blood samples in half so that the same sample could be stored as both whole blood and DNA extracts to allow for a broader variety of uses including serology and DNA analyses; however there may be logistical hurdles to this recommendation. We also determined that the best sampling reduction strategies with minimal impact to data quality for small mammals are either reducing the total number of bouts or reducing the size of trapping grids. More analyses on the effects for life history estimates need to be examined before making a final decision. Finally, the DNA barcoding data were deemed to be quite useful and popular and it was recommended that a longer discussion about improving its use as a quality assessment tool be continued next year.

NEON Response

Discussion of optimal blood sample handling and use of DNA barcoding will continue into 2021. Additional optimization analyses are also being performed to assess how sampling changes would impact life history estimates in the data. Resolution of these topics are expected in 2021.

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 CO₂ 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

No activity for Q4.

TWG Recommendations

N/A

NEON Response

N/A

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

Discussed data availability gains and data quality tradeoffs that would result from potentially adding wicks to the CSAT3 sonic anemometers. Wicks can improve data availability at wet sites but can also influence wind measurements by contributing to flow distortion.

TWG Recommendations

The TWG recommendation was to ensure consistency across sites while maximizing data availability. Although only a few sites have frequent wet conditions, if wicks are installed at those sites they should be installed across the observatory. There was some discussion about to what extent does a little bit of improvement warrant a large observatory-scale change. With a break in data continuity such as this, it was suggested to look further into the literature or do a site-by-site comparison.

NEON Response

NEON plans to address the question of adding wicks to sonic anemometers as part of the sensor intercomparison effort between the currently used CSAT3 and the new CSAT3B model. We have evaluated sources of data loss from the sonic anemometers and found that data loss in wet conditions is a small percentage of overall data loss. Because of this, we plan to address higher return on investment items first. A detailed analysis as part of sensor intercomparison will allow us to get actual numbers for data availability gain and flow distortion impact.

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

No activity for Q4.

TWG Recommendations

N/A

NEON Response

N/A

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

No activity for Q4

TWG Recommendations

N/A

NEON Response

N/A

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

No activity for Q4

TWG Recommendations

N/A

NEON Response

N/A

Terrestrial Plant Productivity and Biomass TWG

The Terrestrial Plant Productivity Technical Working Group advises which methods, protocols, and equipment are employed to create 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

NEON POC Meier reached out to TWG to obtain guidance for measuring large Ohi'a trees in Domain 20 that have prop roots that join the main bole far above current measurement height limits of 200 cm. Additionally, TWG Chair and Meier have continued to develop a memo to propose development of a derived Plant Biomass data product.

TWG Recommendations

Domain 20 Ohi'a question: TWG recommended use of ladders, which is standard practice in CTFS plots and described by Condit.

NEON Response

Domain 20 Ohi'a question: D20 manager and staff do not want to implement the ladder recommendation made by the TWG due to safety concerns; NEON POC (Meier) currently working with D20 staff to determine whether alternate methods with an extension pole are acceptable.

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

There were few agenda items, so we swapped the Q4 meeting for an email. We discussed what to do about the fact that the DSNY site rarely gets ticks in drags, but they are observed off the tick plots regularly. The recommendation was to keep plots the same to maintain long-term sampling continuity. We also discussed making some data analyses a part of 2021 TWG activities, and there was a lot of interest.

TWG Recommendations

It was determined that the current location of the tick plots at DSNY should stay where they are.

NEON Response

We are keeping DSNY plots where they are and will continue to evaluate ways to improve the tick sampling to ensure that we are collecting a robust and representative sample at plots. There was also a lot of interest in a TWG data analysis activity to look at phenology to help inform sampling, so we have begun making plans for that at the 2021 kickoff meeting which was held 11/12/20.