NEON Surface Atmosphere Exchange Technical Working Group

2020 Annual Report

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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 the Surface Atmosphere Exchange TWG during the 2020 funding year (November 2019-October 2020).

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.

Q1 – November 2019-January 2020

Summary of Activities

Q1 2020 TWG activity has focused on discussion of data quality impacts resulting from a problem with LI7200 infrared gas analyzer (IRGA) pressure data stream mapping. Flux data median error resulting from this issue is between 1 and 5 percent, and proportional to site elevation. We asked the TWG to advise about the seriousness of this issue for data quality, and what they suggest regarding whether to reprocess data, and if so, how to prioritize reprocessing. We also inquired about determining thresholds for what constitutes a minor vs. major data quality concern.

TWG Recommendations

The TWG recommendations for this issue were varied, with most of the group recommending that reprocessing data should have a medium priority and should be done prior to the 2020 version release. Two members felt that reprocessing for any known error should be a top priority for any known data quality issue, no matter how small. This began a broader discussion about how communicate known issues with end users, additionally considering that NEON flux data are also served via the AmeriFlux data portal. The TWG recommended including a 'known issues' section on the download page, rather than reporting issues in the data portal news. There was also concern of not being able to notify users

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who had already downloaded the data and would be less likely to re-visit the website and read the warning message. This also brought up the question of whether NEON should continue submission of data with known issues to AmeriFlux.

NEON Response

For prioritizing data reprocessing, we decided to primarily go with the majority opinion which was to reprocess data prior to the release of the 2021~~0~~ version. Discussions of reprocessing with our cyberinfrastructure team led to the optimization of hardware to be able to be more responsive to these types of requests in the future. This new hardware is currently in testing and we hope to be able to respond to the more conservative members of the TWG by reprocessing the data well-ahead of the 2021~~0~~ version release. In response to messaging users, the data portal team updated the 'change log' on the data download page to say 'issue log' and we have added an entry to communicate this error. We asked AmeriFlux management to advise whether we should continue submission of these data, they confirmed that we should continue as planned. AmeriFlux keeps track of who downloads each dataset, and we plan to develop a strategy to directly notify those users.

Q2 – February 2020-April 2020

Summary of Activities

We requested input regarding how to raise quality flags for storage flux values calculated with less than a full set of tower measurement levels. Currently, pump or valve failure frequently leads to 'gaps' in the sampling profile. During these times, we still calculate a flux value but flag it as invalid. We identified this as a significant source of data loss and our work with the TWG focused on a scientifically defensible quality flagging strategy that would relax the requirement of having data from all tower measurement levels.

TWG Recommendations

The key recommendation that seems unanimous among responding TWG members is that a storage calculated with missing profile values is better than being left with a gap to fill.

As for the best strategy and quality flagging:

- Consensus that a ‘leave out’ error analysis will be a good approach, and this has been demonstrated by Nicolini et al. (2018)~~. This~~ and would be particularly useful during periods when the storage term is large (~10%). It will also be important to keep in mind that profile levels within the canopy will be most important, particularly levels very close to the ground.
- Ideally if a profile level is missing at one end of the half-hour but not the other, this level would not be used in the storage calculation.
- One alternate idea to consider as a quality indicator is to provide the number of profile levels used in each half hourly storage (or a fraction of total levels).

There was also a rich discussion around the storage flux approach in general.

There was some concern that intermittent or short-term advection essentially amounts to a storage term for the ecosystem that should be somehow accounted for in the profile sampling scheme. However, more of the group feels that doing so is not advisable or necessary, and potentially would

even amount to double-counting a portion of the flux. A more detailed summary of this discussion may be useful but is outside the current scope of request.

NEON Response

We plan to conduct a “leave out” study similar to Nicolini et al. (2018) across a representative subset of NEON sites, and if supported by this leave out analysis, relax our flagging criteria according to the feedback that ‘storage calculated with missing profile values is better than being left with a gap to fill’, add a quality indicator as recommended by the TWG~~, relating~~ that refects ~~to~~ the number of profile levels used in each half-hourly storage flux calculation, report results back to SAE TWG, and schedule a meeting with the SAE TWG to discuss results as needed.

Q3 – May 2020-July 2020

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.

Q4 – August 2020-October 2020

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.