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New Software for Flux Data Analysis: from Gap Filling to Flux and Footprint Partitioning

George Burba (1), Israel Begashaw (2), Antonio Forgione (2), Nick Franken (2), Frank Griessbaum (2), Peter Isaac (3), Dave Johnson (2), James Kathilankal (2), Adam McQuistan (2), April Parkinson (2), Mong-Kuen Sun (2), Adam Templeton (2), Lynn Woodford (2), and Gerardo Fratini (2)

(1) LI-COR Biosciences, Daugherty Water for Food Institute, University of Nebraska, Lincoln, United States (george.burba@licor.com), (2) LI-COR Biosciences, Lincoln, United States, (3) TERN-OzFlux, Melbourne, Australia

Over 500 flux towers are presently operational as a part of several dozen continental and national flux networks under the umbrella of the FluxNet global network [1]. In addition, multiple dozens of flux towers operate as smaller dedicated networks and standalone projects.

In 2016-2018, new tools to collect, process, and share time-synchronized flux data from multiple towers were developed and deployed globally [2]. These new tools can be effective in fostering scientific interactions and collaborations among the multiple research communities:

• The fully automated FluxSuite system combines hardware, software and web services, and does not require an expert to run it.
• The system can be incorporated into a new flux station or added to a present station, using a weatherized remotely-accessible microcomputer, SmartFlux3.
• It utilizes EddyPro software to calculate fully-processed fluxes in near-real-time, alongside radiation, weather and soil data.
• All data are merged into a single quality-controlled file timed using PTP time protocol.
• Multiple stations can be linked into the time-synchronized network with automated real-time reports and email alerts.
• Flux researchers can cross-share station access to specific stations and data with each other.
• Remote sensing researchers and modelers without actual physical stations can form “virtual networks” of actual stations by collaborating with tower PIs from different physical networks.

The latest 2018-2019 development in this overall approach is the flux data analysis software, Tovi. Driven and guided by the research community, and developed, implemented and supported by LI-COR Biosciences, it is designed to seamlessly ingest the data from the flux stations and to allow a non-micrometeorologist to quality control and analyze the data:

• Shareable, traceable, and reproducible parallel workflows use methods available from the research community, and greatly enhance standardization and comparability among sites and users, making results defensible.
• The present set of tools allows rapid execution of the QC/QA and data analysis steps which have been quite time-consuming and complicated in the past, and other data analysis steps virtually not doable in the past, all using interactive and intuitive GUI.
• Examples include an automated search of 14000+ weather stations data for gap-filling; site-specific u* thresholds; advanced footprint calculations and flux apportioning; NEE and ET flux partitioning; automated generation of reproducible workflows and specific lists of references for each workflow; etc.

This presentation will show how this latest tool can be used for a sophisticated QC/QA and data analysis, and will describe how the overall approach can be utilized for facilitating collaborations across research domains to improve scientific interactions and promote joint project developments, grant writing, and other forms of collaboration, between the flux, remote sensing and modeling communities.

References:

[1] Baldocchi et al, 2001. FLUXNET: A new tool to study the temporal and spatial variability of ecosystem-scale carbon dioxide, water vapor, and energy flux densities. Bulletin of the AMS, 82(11): 2415-2434
[2] Burba et al, 2018. Time- and Space-Synchronized Flux, Weather, Soil and Optical Sensor Networks. 3d International GHG Flux Workshop “From Leaf, Soil and Canopy to Remote Sensing and Modelling”, Nanjing University of Information Science & Technology, China, October 22-25