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New Tools for a Comprehensive Time- and Space-Synchronized Flux, Weather, Soil and Optical Sensor Network

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Many hundreds of flux stations are presently operational as standalone projects and as parts of regional networks. Many have weather and soil data to help clean, analyze and interpret the flux data. However, the vast majority do not have optical proximal sensor measurements, do not allow straightforward coupling with remote sensing (drone, aircraft, satellite, etc.) data, and cannot be easily used for validation of remotely sensed products, ecosystem modeling, or upscaling from the field to regional and global levels.

In 2016-2018, new tools to collect, process, analyze and share time-synchronized flux data from multiple flux stations were developed and deployed globally. Originally designed to automate site and data management and streamline flux data analysis, these tools allow relatively easy matching of tower data with remote sensing data:

1. GPS-driven PTP protocol synchronizes instrumentation within the station, different stations with each other, and all of these to remote sensing data to precisely align remote sensing and flux data in time

2. Footprint size and coordinates computed and stored with flux data help correctly align tower flux footprints and drone, aircraft or satellite motion to precisely align optical and flux data in space

3. Sophisticated interactive data analysis software allows to clean, gap fill and analyze the flux and all the supporting data in a fast and efficient manner

4. Full snapshot of the remote sensing pixel can then be constructed, including leaf-level, ground-based optical sensor, and flux tower measurements from the same footprint area, closely coupled with the remote sensing measurements to help interpret remote sensing data, validate models, and improve upscaling

Additionally, current flux stations can be augmented with advanced ground-based optical sensors and can use standard routines to deliver continuous products (e.g. SIF, PRI, NDVI, etc.) based on automated field spectrometers (e.g., FloX and RoX, etc.) and other optical systems.

Over 100 of new flux stations already operational globally can be readily used for the proposed workflow. Over 500 active traditional flux stations can be updated to synchronize their data with remote sensing measurements.

This presentation will show how the new tools are used by major networks, and describe how this approach can be utilized for matching remote sensing and tower data to aid in ground truthing, improve scientific interactions, and promote joint grant writing and other forms of collaboration between the flux and remote sensing communities.