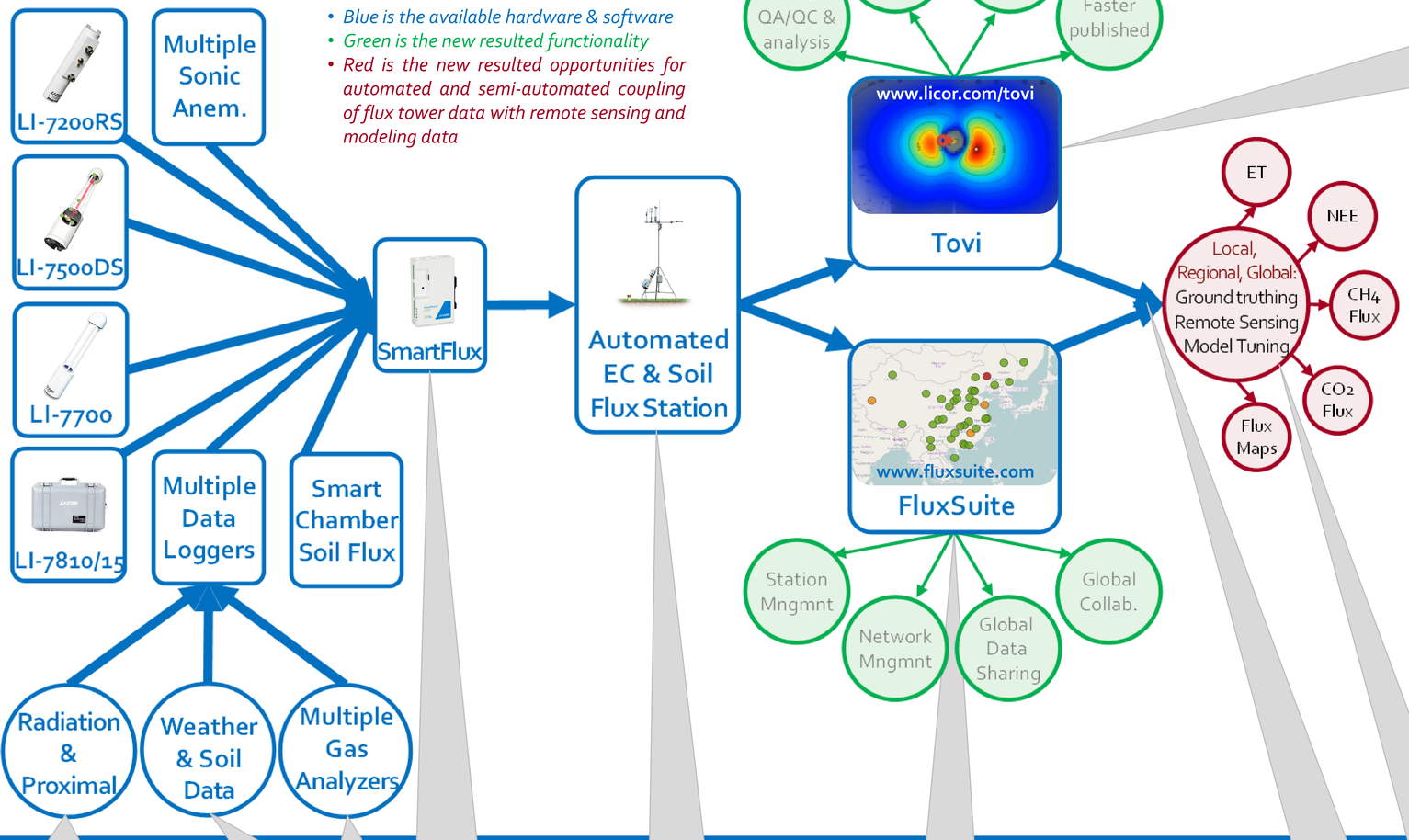
EDDY COVARIANCE FLUX DATA: SITTING ON A GOLDEN EGG

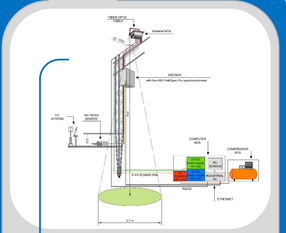
Fratini G[1], Begashaw I[1], Burkart A[2], Gamon J[3,4], Guan K[5], Johnson D[1], Julitta T[2], Neale C[6], Pastorello G[7], Sakowska K[8], Sun M[9] Woodford L[1], and Burba G*[,1,7,10]

[1]LI-COR Biosciences, Lincoln, Nebraska, USA; [2]JB Hyperspectral Devices UG, Düsseldorf, Germany; [3]Center for Advanced Land Management Information Technologies, SNR, University of Nebraska, Lincoln, Nebraska, USA; [4]Departments of Earth & Atmospheric Sciences and Biological Sciences, University of Alberta, Edmonton, Alberta, Canada; [5]Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA; [6]Robert B. Daugherty Water for Food Global Institute, Lincoln, Nebraska, USA; [7]AmeriFlux Management Project, Computational Research Division, Lawrence Berkeley National Laboratory, Berkeley, California, USA; [8]National Research Council, CNR Institute of BioEconomy, San Michele all'Adige (TN), Italy; [9]Traction Tools, Lincoln, Nebraska, USA; [10]Bio-Atmospheric Interactions, SNR, University of Nebraska, Lincoln, Nebraska, USA; *Corresponding author: george.burba@licor.com

LATEST SCIENTIFIC TOOLS

- *Blue is the available hardware & software*
- *Green is the new resulted functionality*
- *Red is the new resulted opportunities for automated and semi-automated coupling of flux tower data with remote sensing and modeling data*



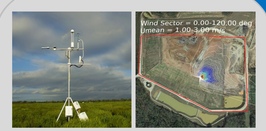


Sensors → Outputs → Products

- hyperspectral
- multispectral
- broadband
- narrowband
- *etc.*

- Rs, Rn, PAR
- diffuse
- direct
- incident & reflected, *etc.*

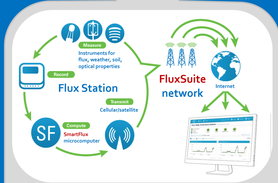
- Albedo, fAPAR
- NDVI, PRI, VIs
- pigment indices
- SIF
- Tsurface, LAI, SM, *etc.*



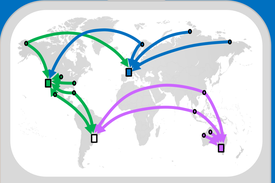
Flux Station — Footprint

Field-level Data

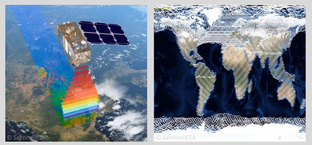
- **SmartFlux** is a field microcomputer for a fast logging and a complete on-site real time flux processing
- Each 30-60 mins file has exact GPS time, station coordinates, flux footprint size and location
- CO_2, CH_4, Heat fluxes, ET rates, Soil Flux, *etc.*
- Radiation and proximal optical data
- Weather and soil data, *etc.*



- The key is combining **SmartFlux** micro-computer with the **FluxSuite** on-line access tool
- GPS time-keeping, PTP clocks, patented time alignment across multiple sites and networks
- Multiple anemometer models and logger models to automatically merge virtually any auxiliary weather, soil & optical data



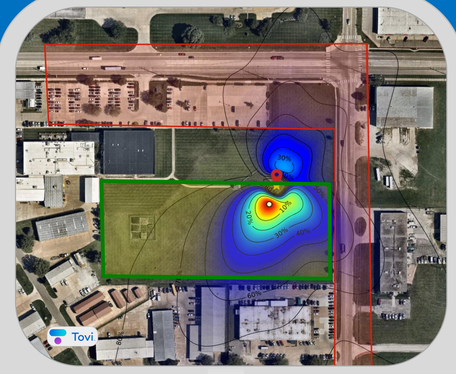
- **FluxSuite** is a new on-line system to remotely manage a station or a network of stations, and to collaborate with other groups
- All stations and networks are time-synchronized with GPS-driven Precision Tine Protocol and managed remotely
- Flux, remote sensing, and modeling communities can share data rather easily



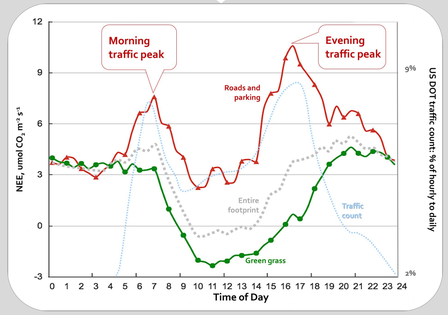
Satellite, Airplane, Drone → Global Coverage

Remote Sensing Data

- Each single pixel
- Universal time
- Exact coordinates
- Spectral data
- Multiple data products
- Recomputed model outputs

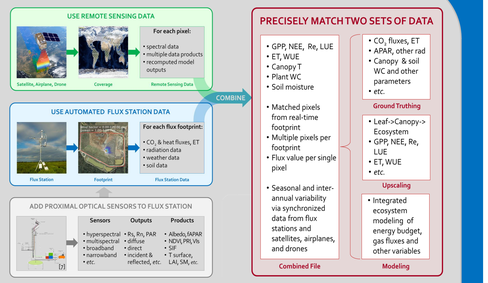


Identify source area of measured fluxes, sort out different dynamics in mixed ecosystems, collaborate with remote sensing/modelling communities



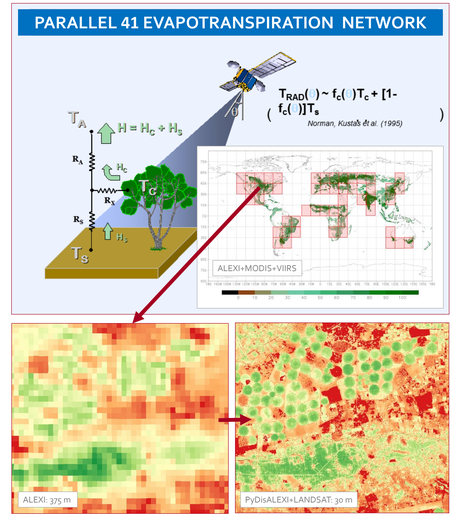
Tovi is a new environmental data analysis platform:

- Driven and guided by the Research Community; integrated, implemented & supported by LI-COR
- Scientifically sound and programmatically robust software allows seamless data retrieval, quality control, analysis, and workflow documentation
- Shareable, traceable, and reproducible workflow uses methods available from the research community
- Greatly enhances standardization and comparability among sites and users, and makes results defensible
- Automates multiple time-intensive procedures and handles large datasets
- Automated search of 14000+ weather stations for gap-filling, advanced qc, flux partitioning, reproducible workflows and lists of references, easy use of analytical tools for better cross-domain collaborations



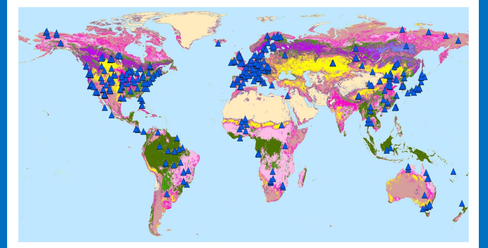
- Use GPS time, station coordinates and flux footprint
- Precisely match two sets of data: tower and remote sensing

LATEST EXAMPLES

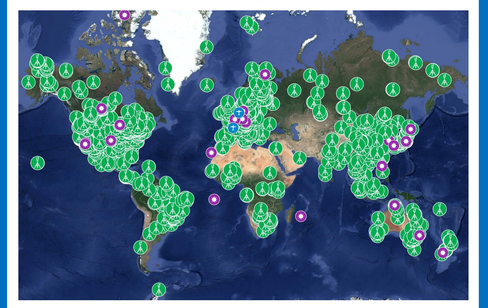


NEW OPPORTUNITIES

- 500+ SmartFlux equipped stations can readily be used for remote sensing and modelling applications right now
- Another 500+ traditional stations can be adapted to synchronize with remote sensing datasets, many of them - easily



- Data from over 2100 past and present EC locations can be reanalyzed for remote sensing and modelling



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