

COUPLING FLUX STATIONS & NETWORKS WITH PROXIMAL & REMOTE SENSING DATA

NEW TOOLS TO COLLECT AND SHARE TIME-SYNCHRONIZED HOURLY FLUX DATA

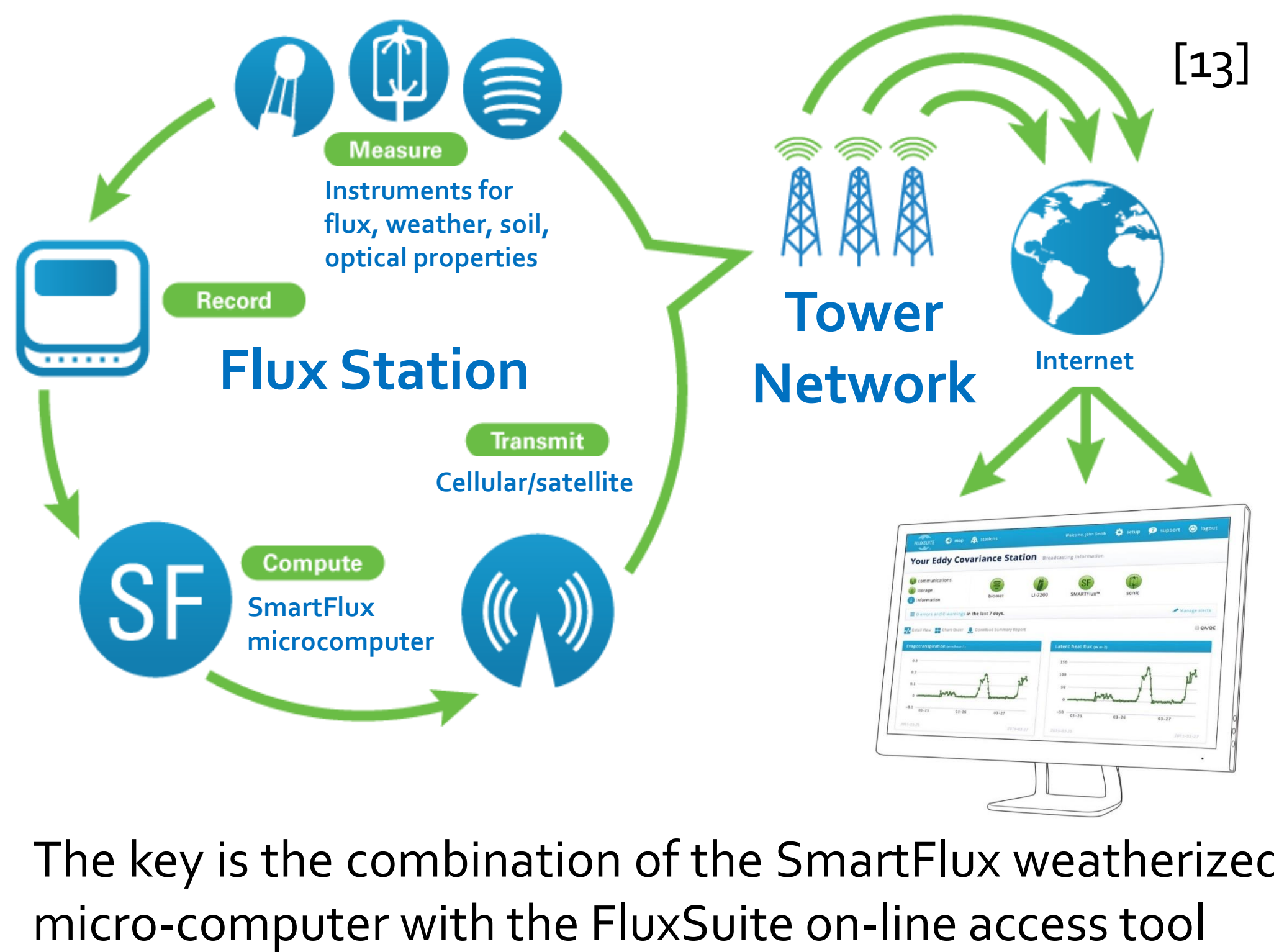
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INTRODUCTION

- Hundreds of flux stations presently operate standalone and as parts of flux networks [1,2,3]
- The value of coupling flux station data and remote sensing data has been outlined over the years in multiple publications [4,5,6,7,8,9]
- Yet, most of the stations do not allow straightforward coupling with remote sensing data, and very few have optical sensors for validation of products and upscaling from field levels [4-12]
- A new system to collect, process, and share flux data from multiple stations [13]; can substantially help in coupling flux, proximal & remote sensing data [14]

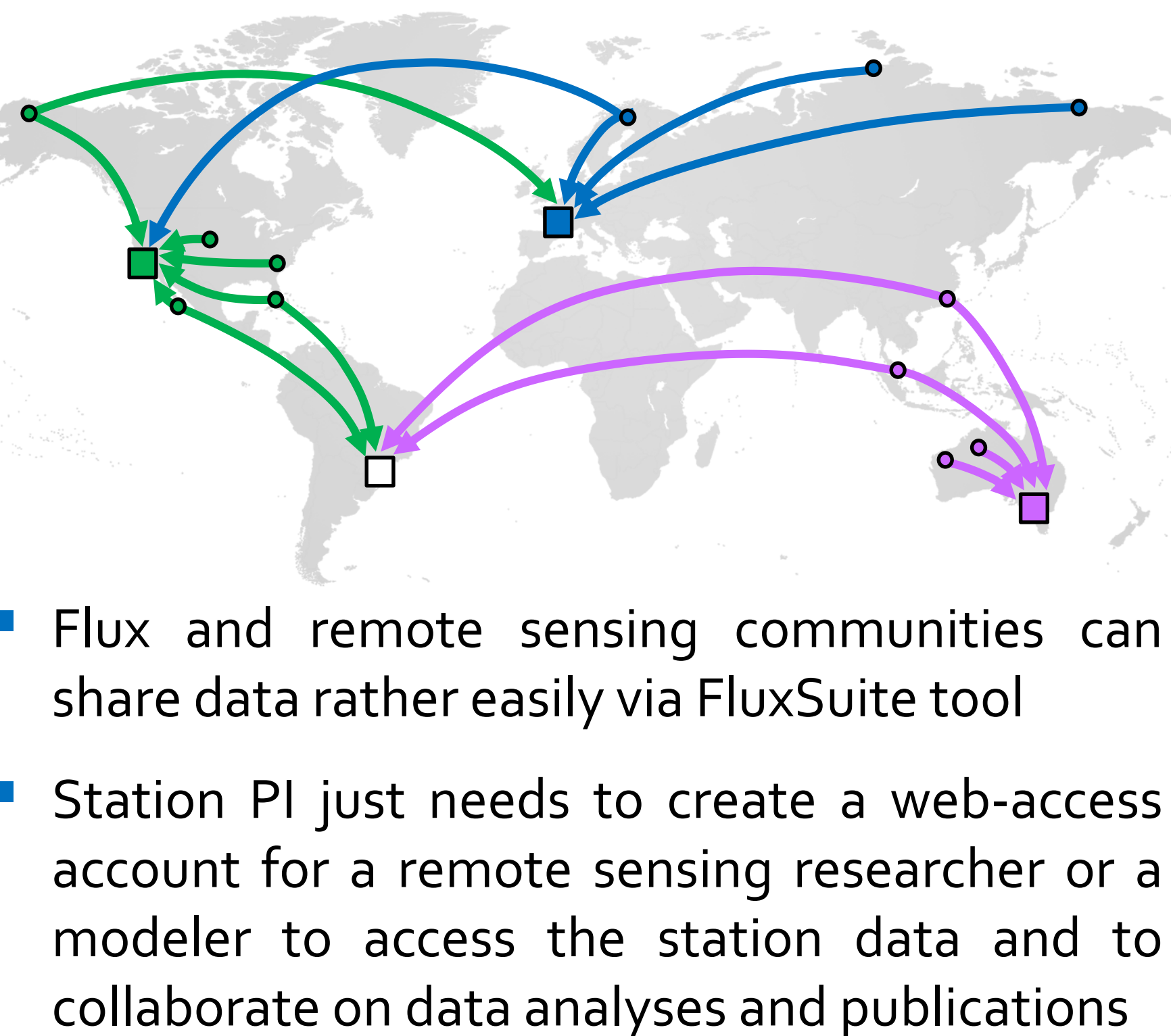
AUTOMATED FLUX SYSTEM



FEATURES FOR REMOTE SENSING

- Each flux station in this system outputs final fully-processed hourly fluxes of CO₂, CH₄, Evapotranspiration, Sensible Heat, Momentum, and auxiliary variables (radiation, weather, soil data, etc.)
- Actual flux footprint location and size is computed and reported by each station every 30-60 minutes
- Clocks within a station are synchronized with PTP, and clocks between multiple stations are synchronized using GPS to within fraction of a second
- Station time, coordinates, fluxes, auxiliary data, location and size of the flux footprint are stored in the form of hourly data and metadata files, and can be accessed remotely

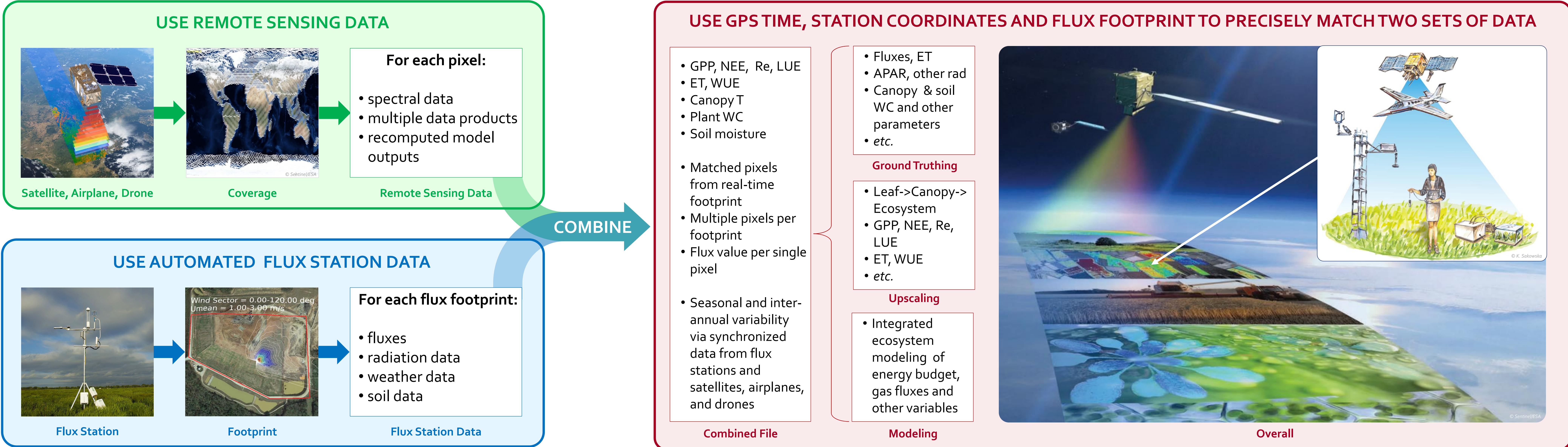
CONNECTING COMMUNITIES



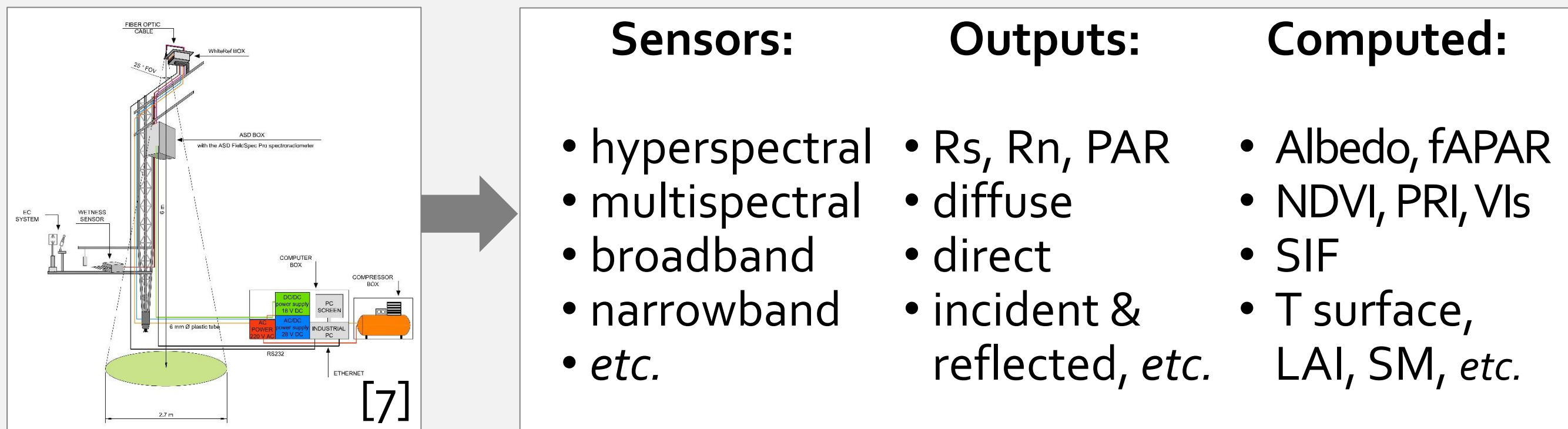
SUMMARY

- New technical tools can help connect remote sensing, modeling and flux communities to couple ground data (fluxes, proximal sensors, soil data, etc.) with the satellite, airplane and drone data:
- 1. GPS-driven PTP protocol synchronizes instrumentation within the flux station, different stations with each other, and all of them to satellite data to **precisely align remote sensing and flux data in time**
- 2. Footprint size and coordinates computed and stored with each 30-60 minute flux data file help correctly match footprints to satellite motion to **precisely align remote sensing and flux data in space**
- 3. Remote sensing researchers can collaborate with flux researchers to easily **access data from flux stations across the globe without having own stations**
- In addition, other key measurements can be utilized within flux station footprint:
- 4. Current flux stations can be augmented with ground-based optical sensors to deliver continuous products (e.g., SIF, PRI, NDVI, etc.)
- 5. Schedule can be developed to point ground optical sensor into the footprint, or to run leaf or soil chamber in the footprint, at the time of the satellite, airplane or UAV overpass
- 6. Full snapshot of the remote sensing pixel can then be constructed including leaf level, ground-based optical sensors, and fluxes from the same exact footprint
- Dozens of new stations already operate globally and can be readily adapted for the proposed workflow, and over 500 more active traditional stations can be upgraded to synchronize with remote sensing datasets

HOW TO COUPLE REMOTE SENSING & FLUX DATA: PHOTOSYNTHESIS, EVAPOTRANSPIRATION & GAS FLUXES



ADD PROXIMAL OPTICAL SENSORS TO FLUX STATION



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