Next Generation UAS Based Spectral Systems for Environmental Monitoring

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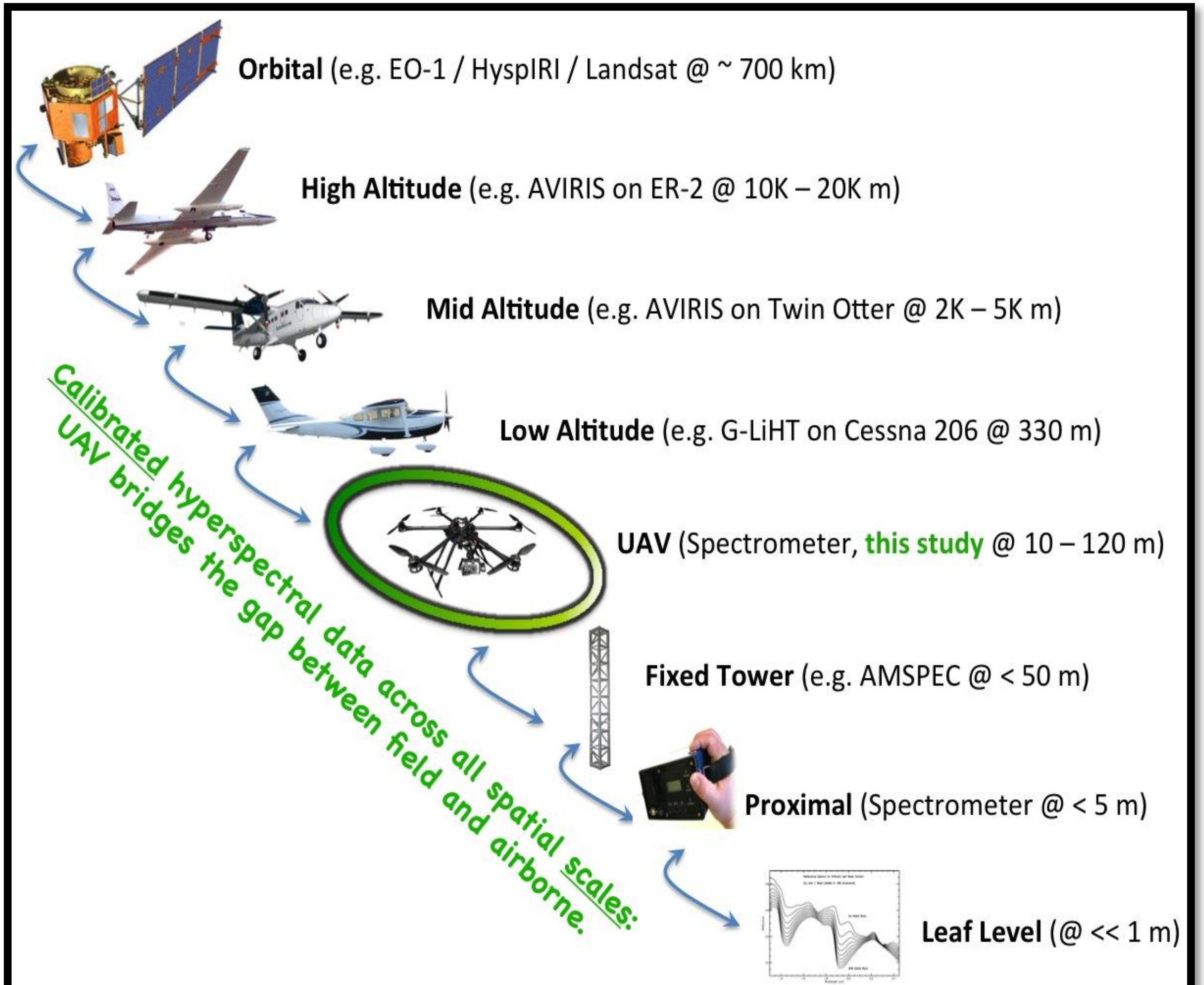
Scales at which remote sensing spectral measurements are currently made



***The** UAS sensors are bridging the gap between ground and higher altitude aircraft data.*

PROJECT GOALS

Our goal is to produce in 2 years (June 2015 – May 2017) science-quality spectral data from UASs suitable for scaling ground measurements and comparison against airborne or satellite sensors.

We will develop protocols and a workflow to ensure that VNIR measurements from UAS's are collected and processed in a fashion that allows ready integration or comparison to NASA satellite and airborne data and derived products (e.g. Landsat, AVIRIS EO-1 Hyperion and future HyspIRI).

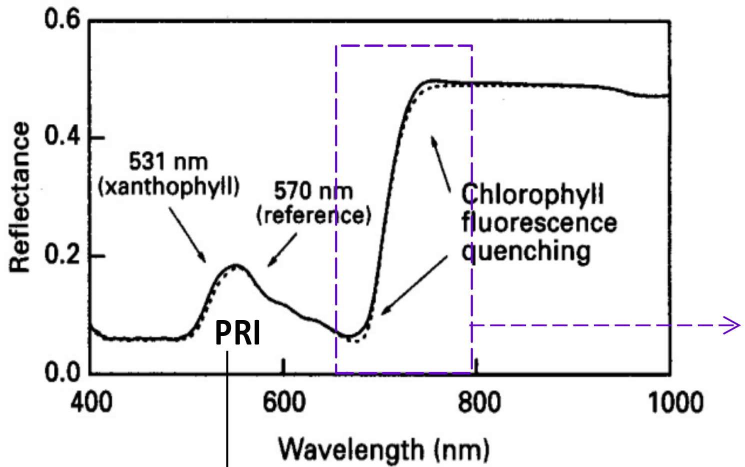
Objectives

Develop the UAS capability to:

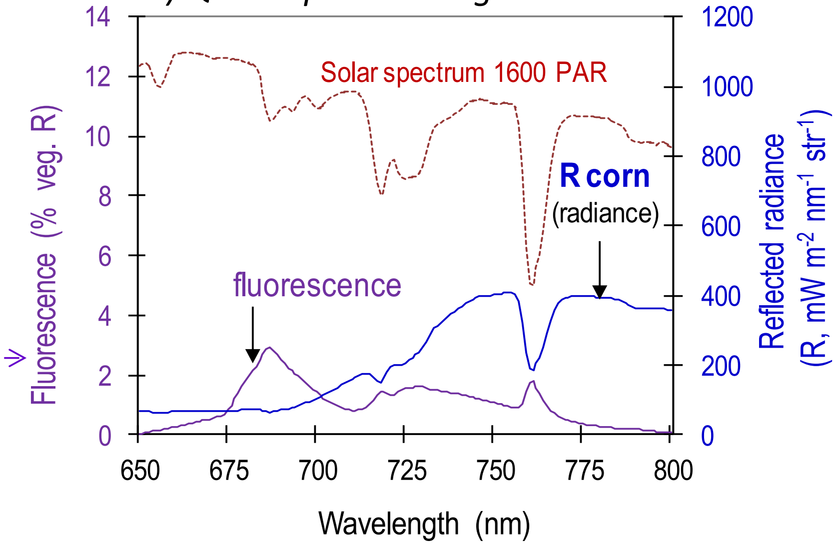
- retrieve biochemical and physiological traits
- depict diurnal and seasonal cycles in vegetation function,
- optimize UAS spectral data acquisition and workflows, to develop a small UAS hyperspectral sensor-web,
- produce science-quality spectral data and BPs, suitable for scaling ground measurements and comparison to from-orbit data products.

Technology/Measurements

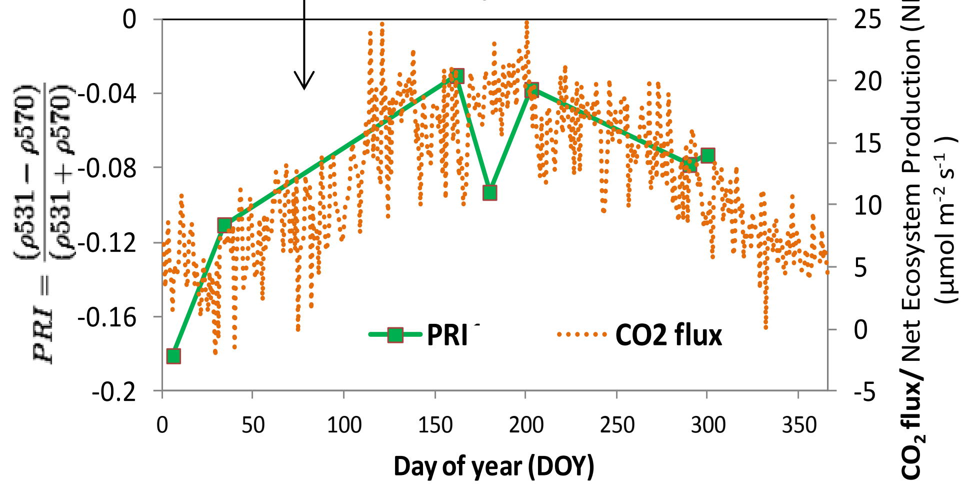
a) USB 2000 and Headwall spectral range



b) QEPro spectral range

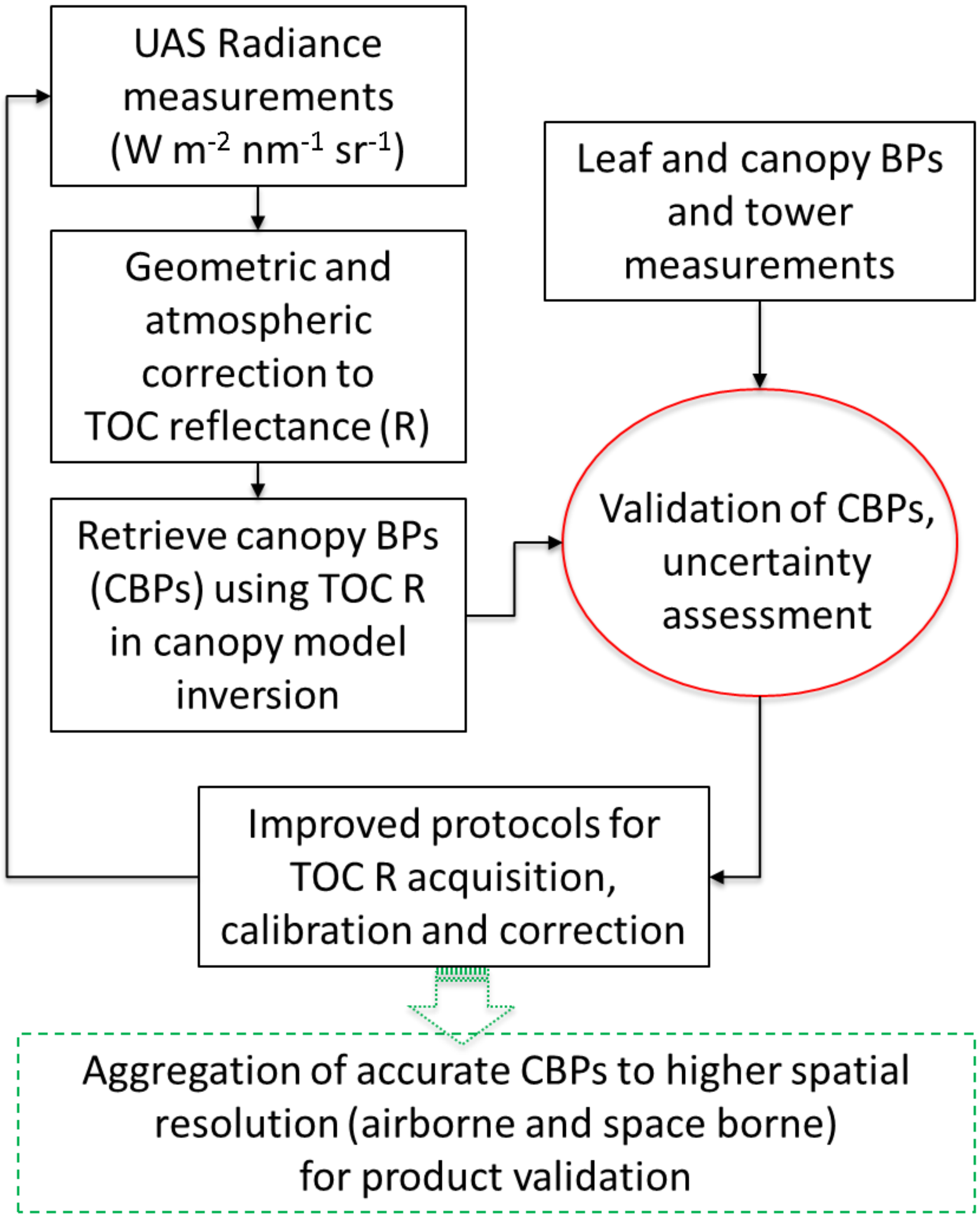


c) Photochemical Reflectance Index (PRI)



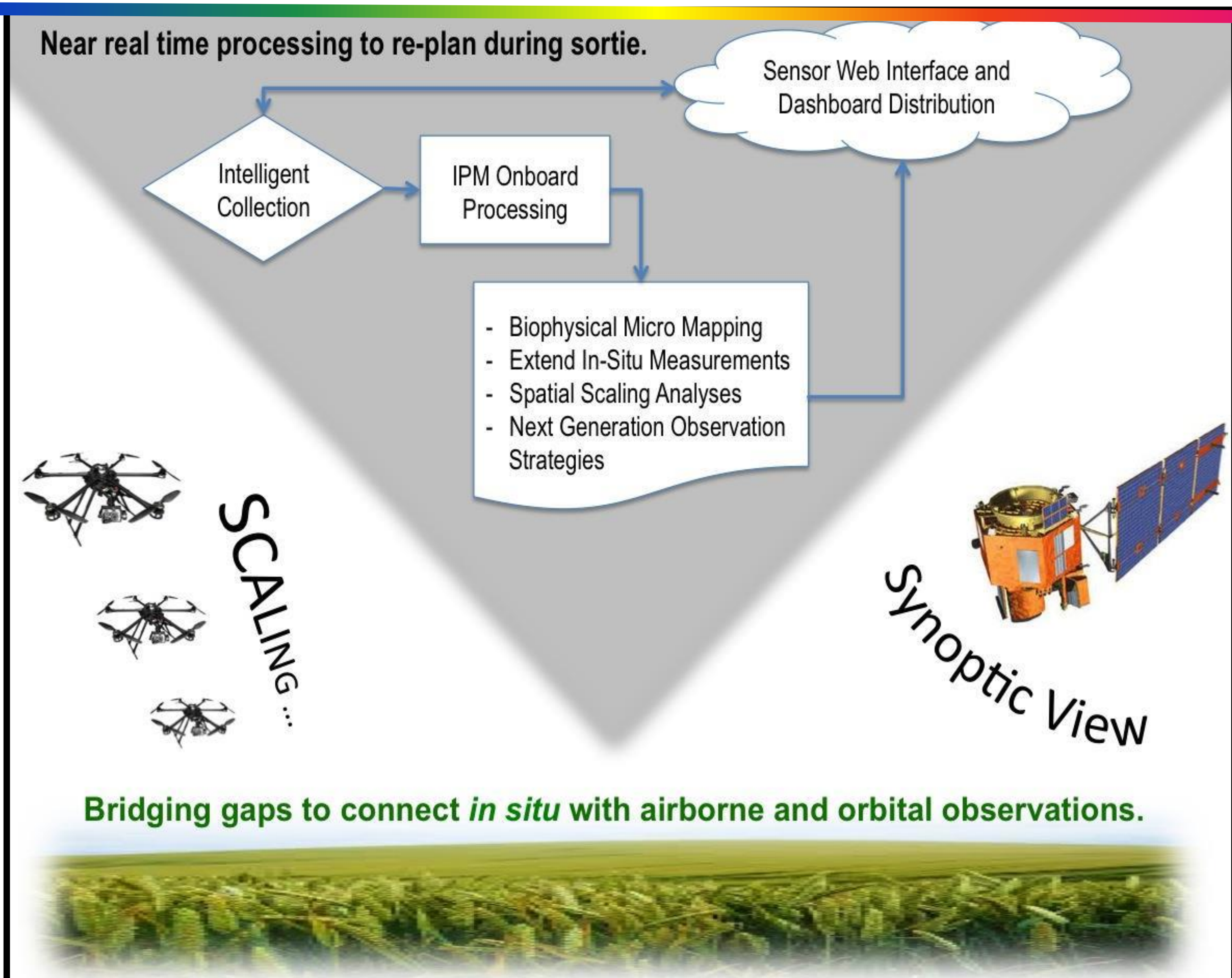
To characterize ecosystem biochemical and physiological parameters we will use: reflectance (a) and solar-induced fluorescence (b).

We will use high spectral resolution discrete measurements (Yr1) and imaging spectroscopy (Yr2).



Workflow for retrieval of Biophysical Parameters (BPs), validation and improvement (after Vuolo et al. 2012).

UASs SensorWeb capabilities



KEY MILESTONES and TECHNICAL APPROACH

- Integrate and test Ocean Optics spectrometer and *Piccolo Doppio* upwelling/downwelling foreoptic onto UAS, and establish calibration protocols
- Parameter retrieval and validation of measurements at well-characterized sites
- Develop Rapid Data Assimilation and delivery system, based on SensorWeb Intelligent Payload Module high speed onboard processing developed under AIST-11 and other cloud based data processing chain functionality (http://sensorweb.nasa.gov);
- Develop data gathering campaign strategy to optimize data yield;
- Leverage EcoSIS online spectral library
- Integration of Headwall imaging spectrometer, inter-calibration to *Piccolo Doppio*
- Validate real-time computing capacity
- Parameter retrieval maps and validation against field data
- Data Production Pipeline Demo

ANTICIPATED OUTCOME

This research effort will enable the acquisition of science-grade spectral measurements from UASs.

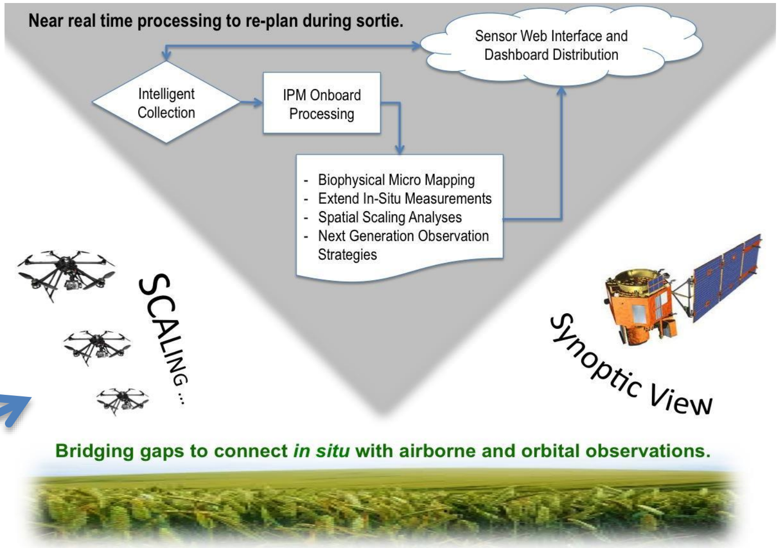
The UAS collections at 10-150m altitude would bridge the gap between ground/proximal and airborne measurements, typically acquired at 500m and higher, allowing better linkage of comparable measurements across the full range of scales from ground to satellites.

Next Generation UAV Spectral Systems for Environmental Modeling

PI: Petya Campbell, UMBC

Objective

- Develop capability to depict diurnal and seasonal cycles in vegetation function:
  - accurate measurements of vegetation reflectance at high spectral resolution
  - high temporal frequencies and stability
  - Spatial variability with high resolution
  - Optimize data acquisition and workflow
- Demonstrate the capability to produce science-quality spectral data from UAVs
  - suitable for scaling ground measurements
  - comparison to from-orbit data products
- Small UAV hyperspectral sensor-web, filling the gap between ground and satellite measurements



Approach:

- Integrate and test Ocean Optics spectrometer and Piccolo upwelling/downwelling foreoptic onto UAV.
  - Validate measurements at well-characterized sites.
- Develop Rapid Data Assimilation and delivery system.
- Develop data gathering campaign strategy to optimize data yield.
  - Leverage EcoSIS online spectral library.

CoIs: P. Townsend (lead), C. Kingdon and F. Navarro, UW; D. Mandl (lead) and V. Ly, GSFC; V. Ambrosia, CSUMB; P. Cappelaere, Vightel; L. Corp, Sigma Space; J. Nagol and R. Sohlberg, UMD; L. Ong, SSAI.

Key Milestones

• **Start Project**	**06/15**
• Spectrometer integration	07/15
• Calibration protocol, intercalibration (initial)	09/15
• Preliminary parameter retrievals and validation	11/15
• Integration of Headwall imaging spectrometer	02/16
• Validate computing capacity for real-time	12/16
• Parameter retrieval/validation against field data	12/16
• **Data Production Pipeline Demo (TRL 5)**	**05/17**

$TRL_{in} = 3$

Earth Science Technology Office