Structure and Function of Ecosystems Mission

Randolph H. Wynne[1], K. Jon Ranson[2], Valerie A. Thomas[1], Petya K. Campbell[3], Jeannine Cavender-Bares[4], Philip W. Dabney[2], John A. Gamon[5], David J. Harding[2], K. Fred Huemmrich[3], Joel T. McCorkel[2], Elizabeth M. Middleton[2], Geoffrey G. Parker[6], Victor M. Torres[2], Philip A. Townsend[7]

[1]Virginia Tech, [2]NASA GSFC, [3]University of Maryland-Baltimore County, [4]University of Minnesota, [5]University of Nebraska, [6]Smithsonian Institution, [7]University of Wisconsin-Madison

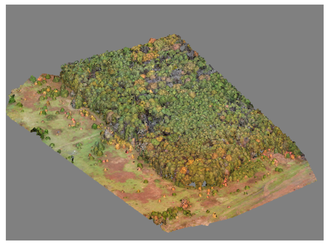
Vegetation structure and function are connected. Canopy structure controls the light environment within a canopy. That light environment is an important factor in determining how vegetation functions and responds to stress.

SAFE (Structure and Function of Ecosystems) smallsats are designed to provide both structure and function measurements. Flying along with hyperspectral missions such as Surface Biology and Geology (SBG) enhances the science for both missions with the following objectives:

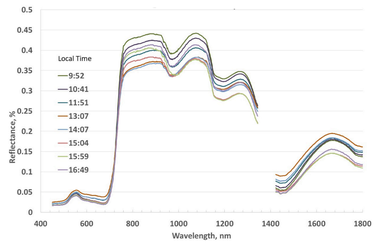
- Quantify vegetation structure that determines the sunlit and shaded components of canopies. Understanding the light environment is also critical for understanding photosynthesis and photoprotection processes.
- Measure diurnal changes in vegetation productivity and biochemical responses to environmental conditions through frequent spectral observations that describe changes in plant pigments, water content, and plant productivity.
- Improve light use efficiency and gross primary productivity estimates.

NRC Decadal Survey Definitions

Structure is the spatial distribution of plants and their components on land, and of aquatic biomass.
Function is the physiology and underpinning of biophysical and biogeochemical properties of terrestrial vegetation and shallow aquatic vegetation.

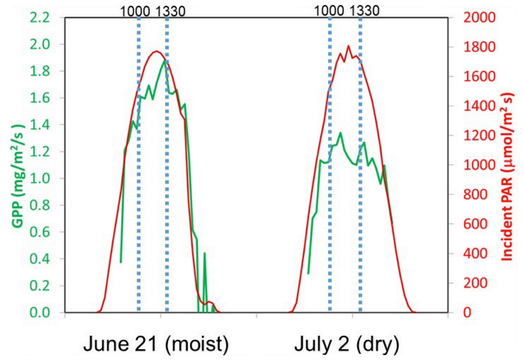


Photogrammetrically-derived canopy surface of forest near Beltsville, MD.



Spectral signatures of green vegetation over a day. Note diurnal effects (stresses, shadow fraction).

Diurnal productivity dynamics without and with stress.



Mission:

Three SAFE smallsat buses for diurnal sampling of vegetation structure and function, 3 hour on-orbit temporal separation of smallsats

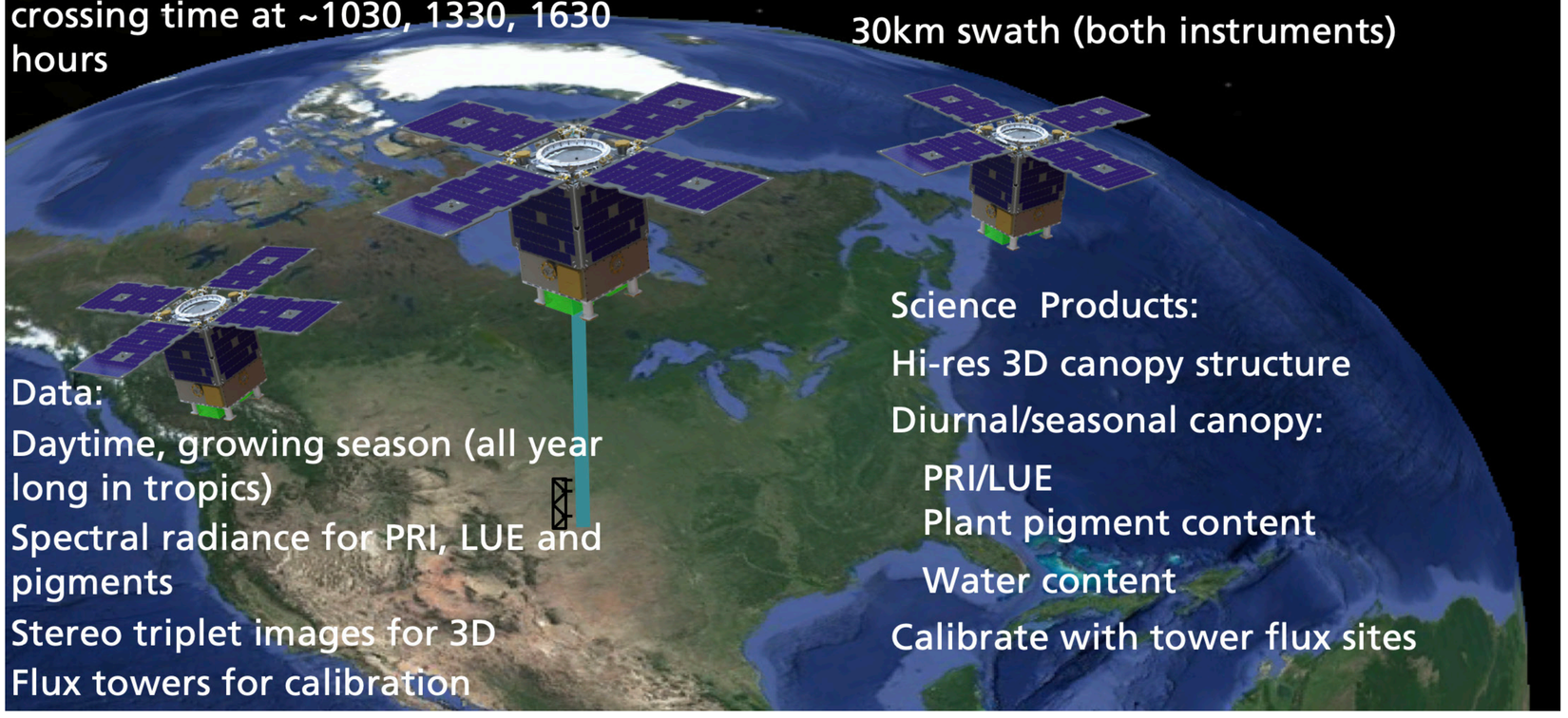
Orbit: ~700 km, sun sync, equator crossing time at ~1030, 1330, 1630 hours

Instruments:

Stereo camera (visible pan) for structure (1-2m resolution)

VSWIR (400-1700nm, 20 bands) for vegetation functioning (10-20nm bandwidth, 30m resolution)

30km swath (both instruments)



Data:

Daytime, growing season (all year long in tropics)

Spectral radiance for PRI, LUE and pigments

Stereo triplet images for 3D

Flux towers for calibration

Science Products:

Hi-res 3D canopy structure

Diurnal/seasonal canopy:

PRI/LUE

Plant pigment content

Water content

Calibrate with tower flux sites

The photochemical reflectance index and the light use efficiencies derived therefrom are sensitive to illumination.