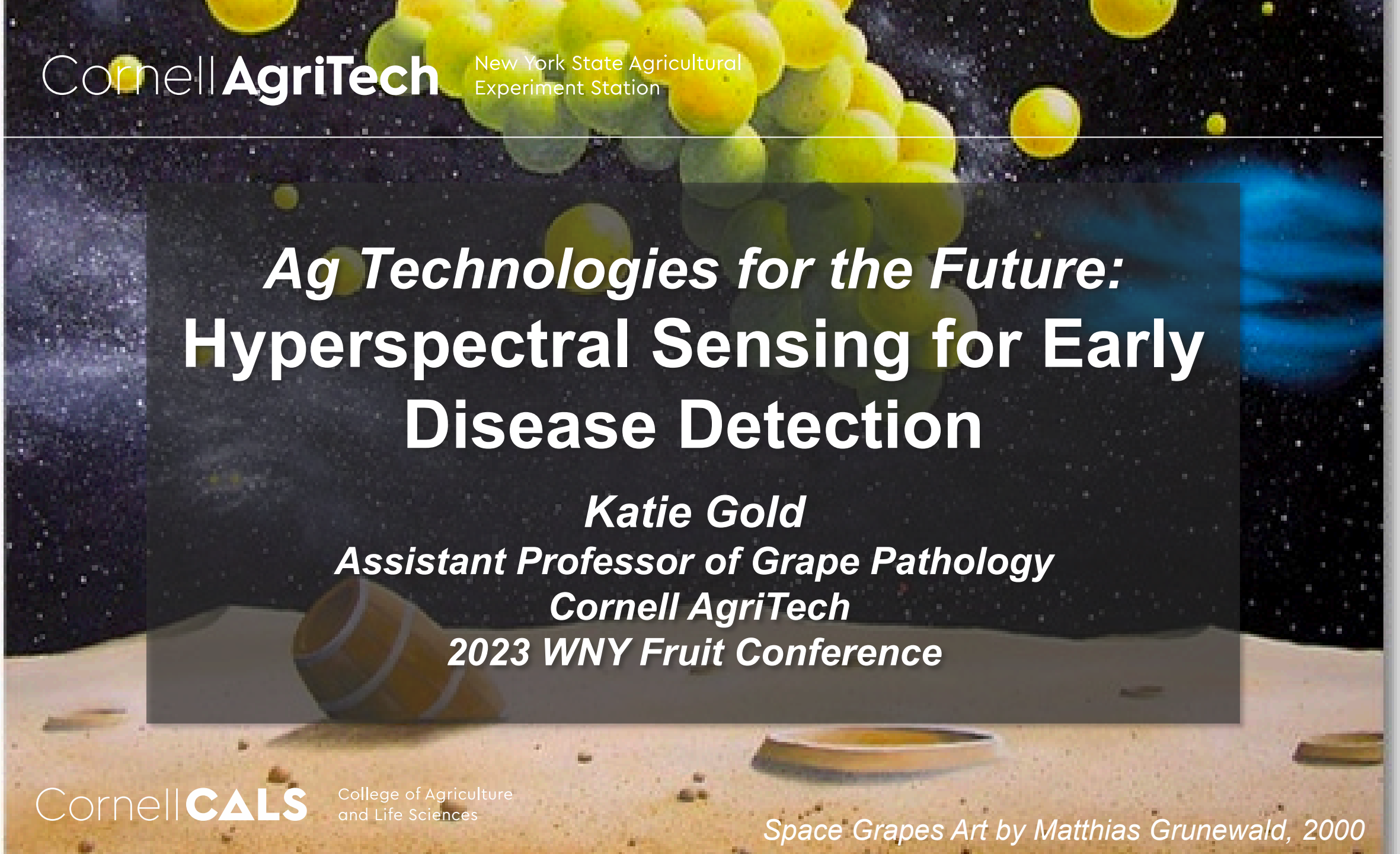


Cornell AgriTech
New York State Agricultural Experiment Station

Ag Technologies for the Future: Hyperspectral Sensing for Early Disease Detection

Katie Gold
Assistant Professor of Grape Pathology
Cornell AgriTech

2023 WNY Fruit Conference

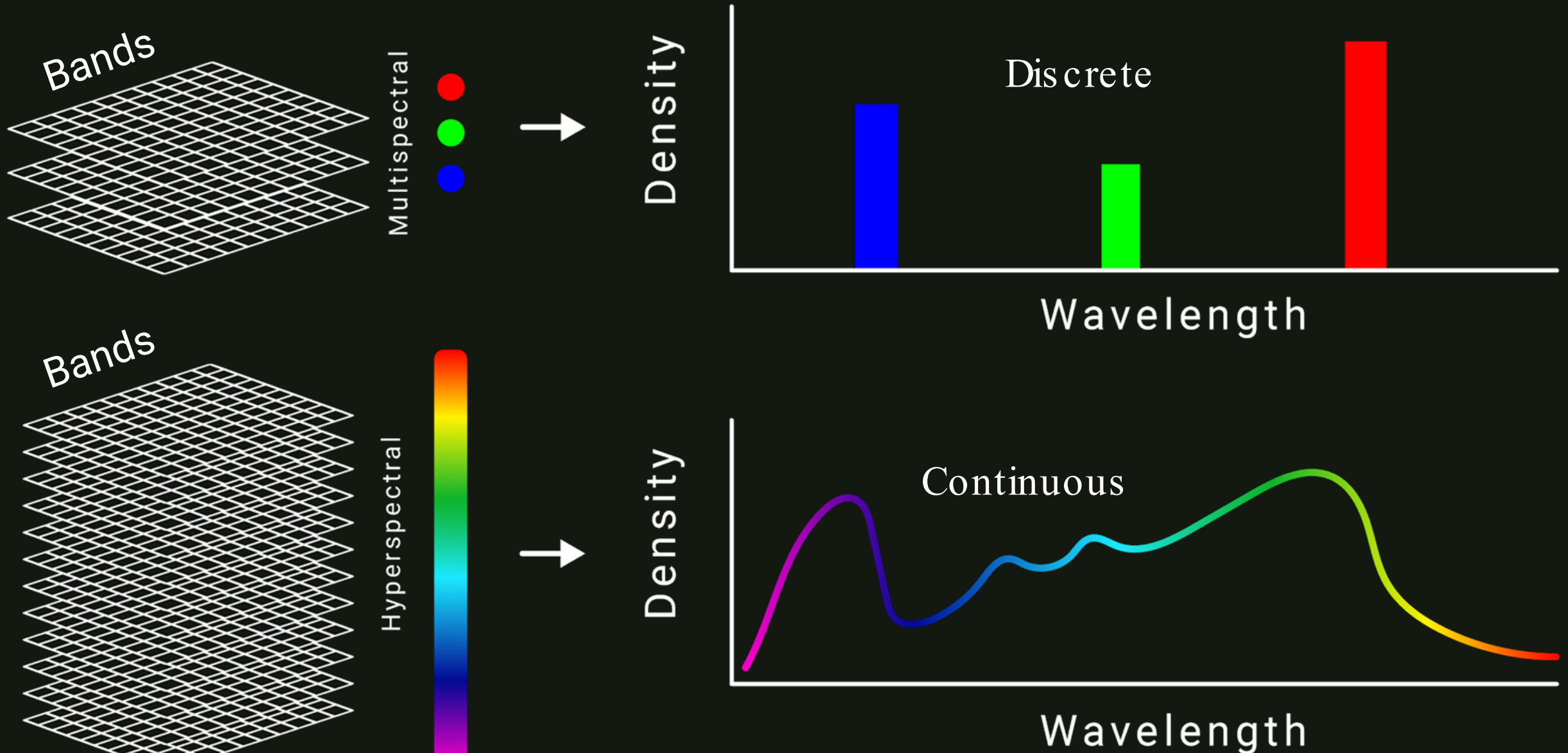
Cornell CALS
College of Agriculture and Life Sciences

Space Grapes Art by Matthias Grunewald, 2000

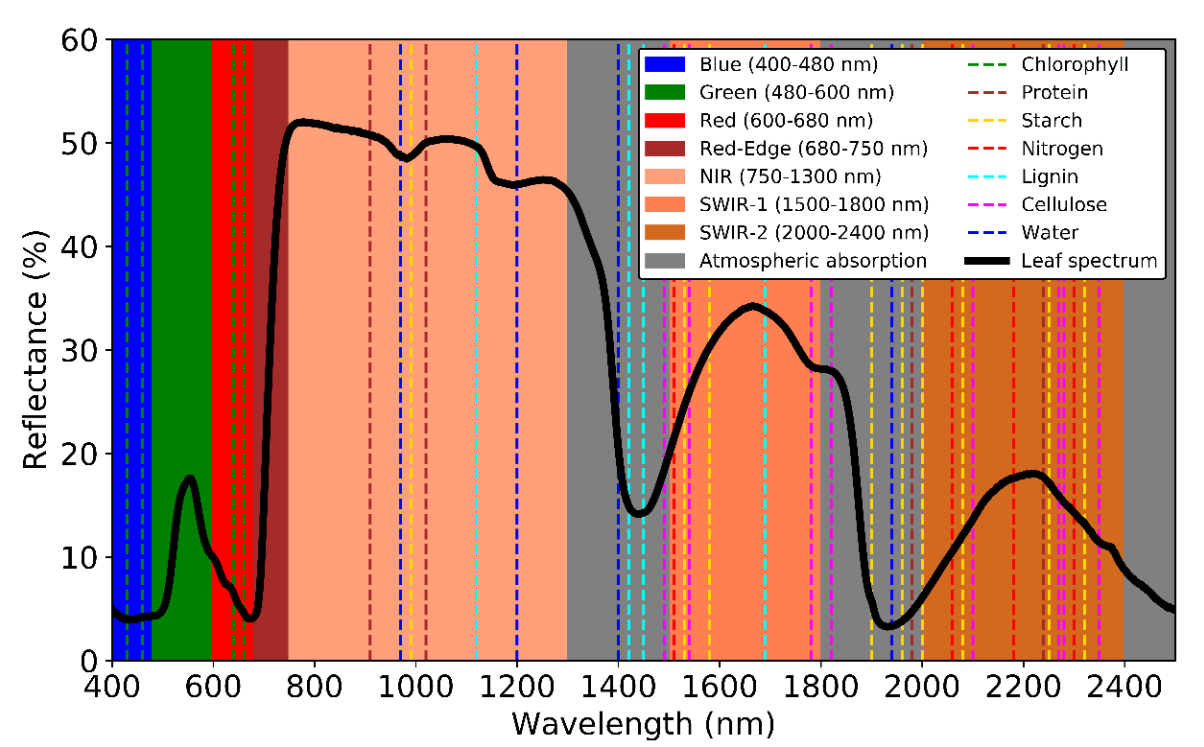
Grape Sensing, Pathology, and Extension at Cornell AgriTech

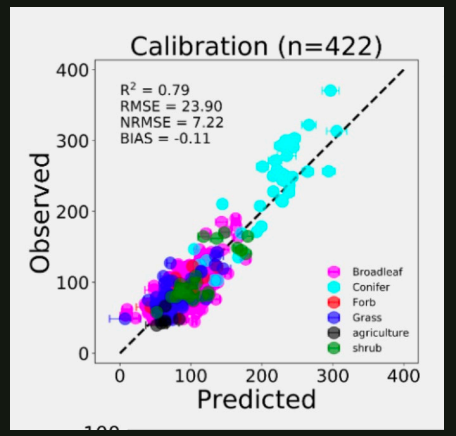
The Gold Lab

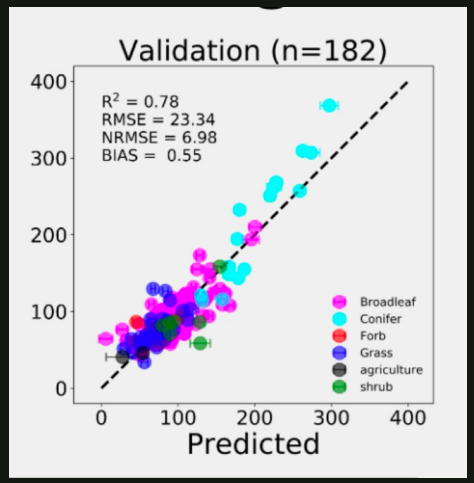
Hyperspectral sensors measure light reflectance more precisely than ever before



Plant chemistry changes light reflectance







Photosynthesis

CO_2 → carbohydrates

Nitrogen

Leaf Mass per Area (LMA)

Sugars and Starches

Chlorophyll, Pigments

Water

P, K, Ca, Mg

Decomposition

Structural Compounds

Lignin

Cellulose

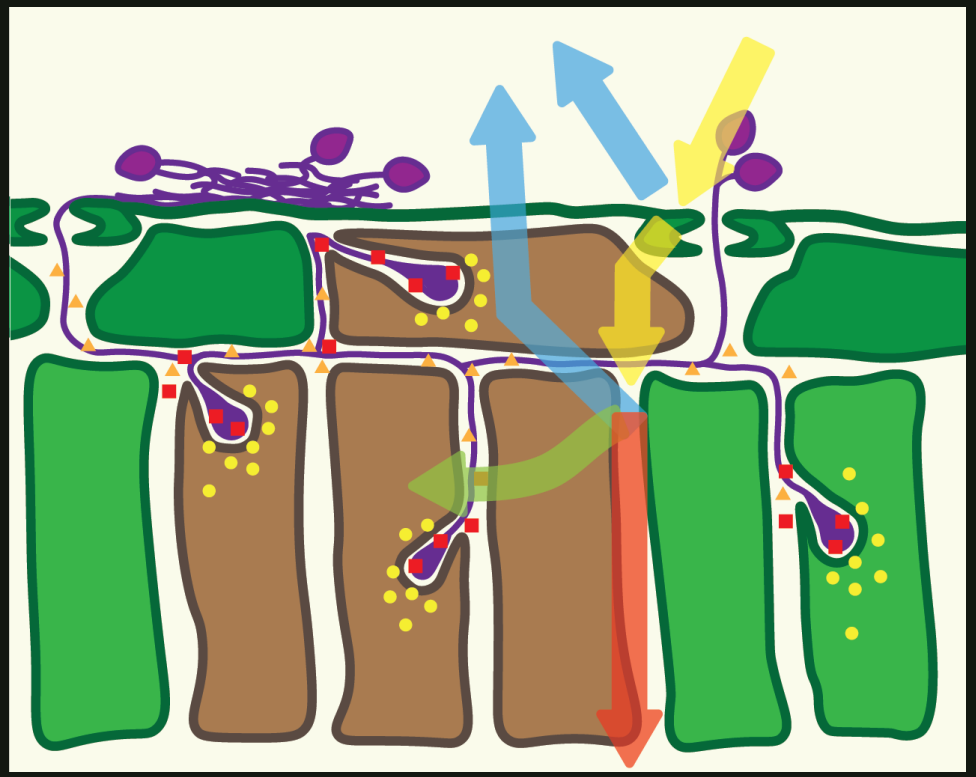
Defense

Tannins

Phenolics

Slide content from Townsend Lab, UW-Madison

Spectroscopy tells us more about plant pathogen interactions than our eyes can see



Art by Eric Larson

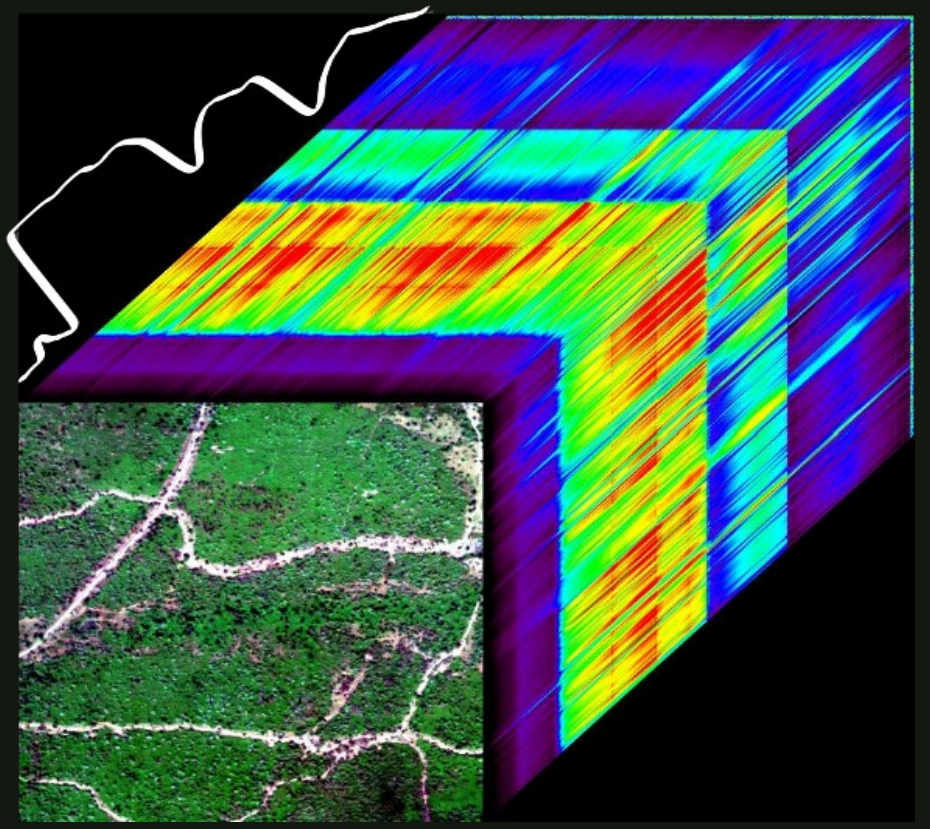
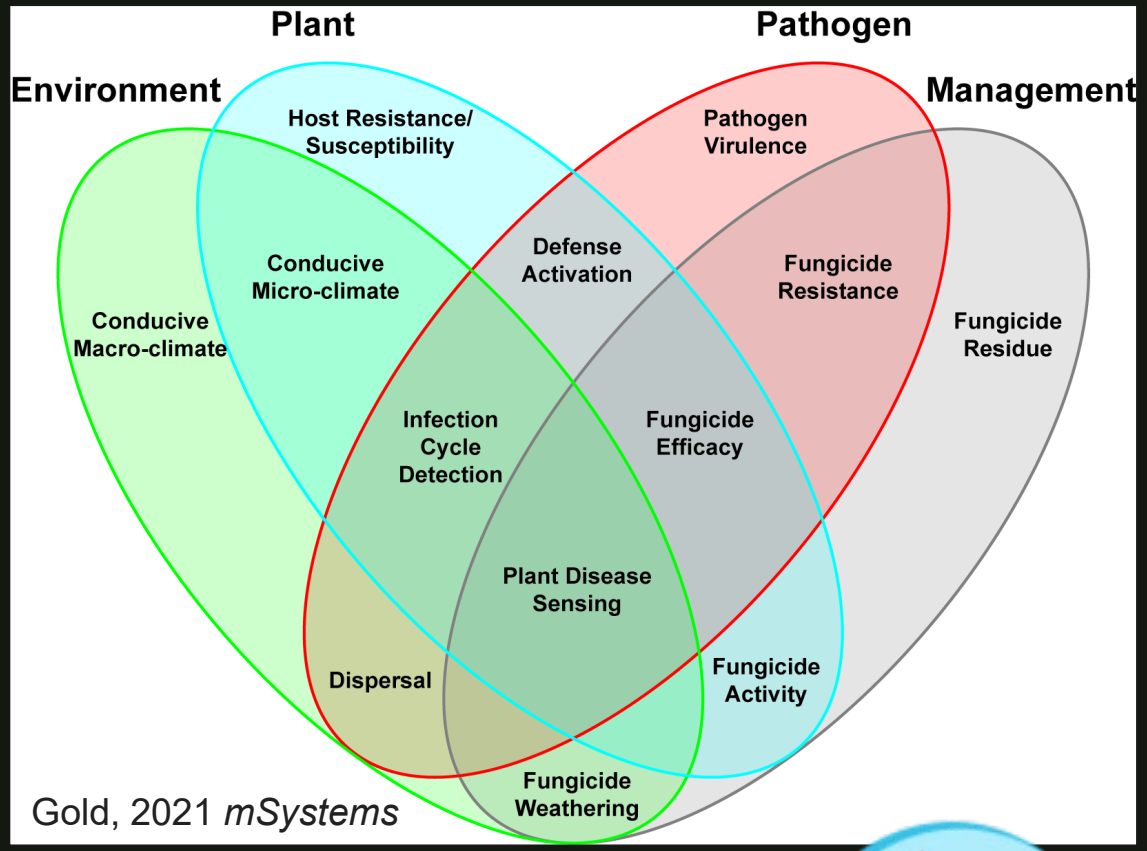


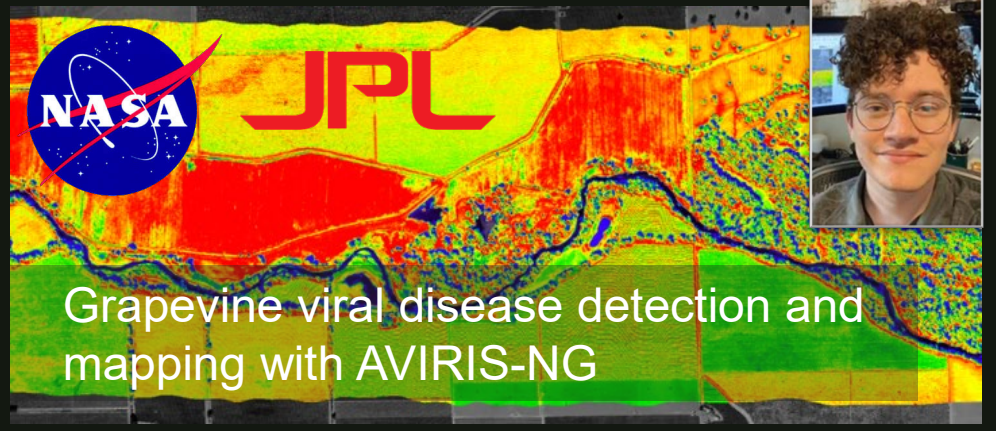
Figure courtesy Townsend Lab UW-Madison

The Gold Lab studies the fundamental and applied science of **plant disease sensing** to improve early detection & intervention.



Gold, 2021 *mSystems*

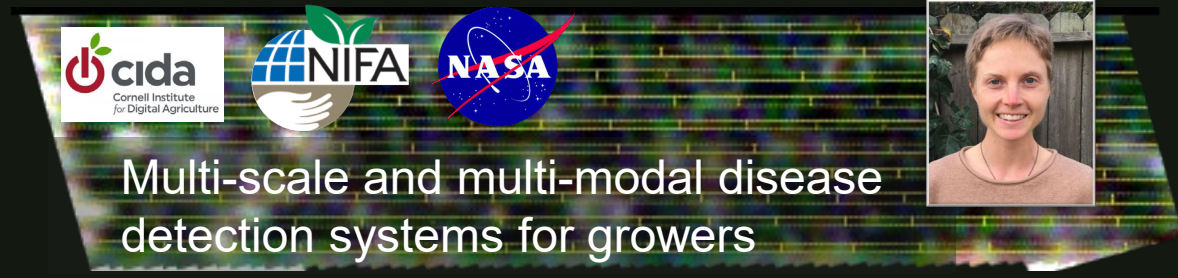
Soilborne plant pathogen dispersal on transatlantic dust currents



Grapevine viral disease detection and mapping with AVIRIS-NG

May 24, 2021
RELEASE 21-070

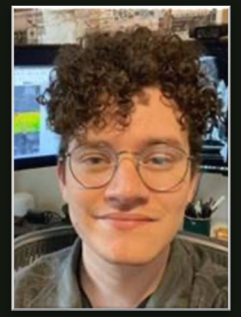
New NASA Earth System Observatory to Help Address, Mitigate Climate Change



Multi-scale and multi-modal disease detection systems for growers

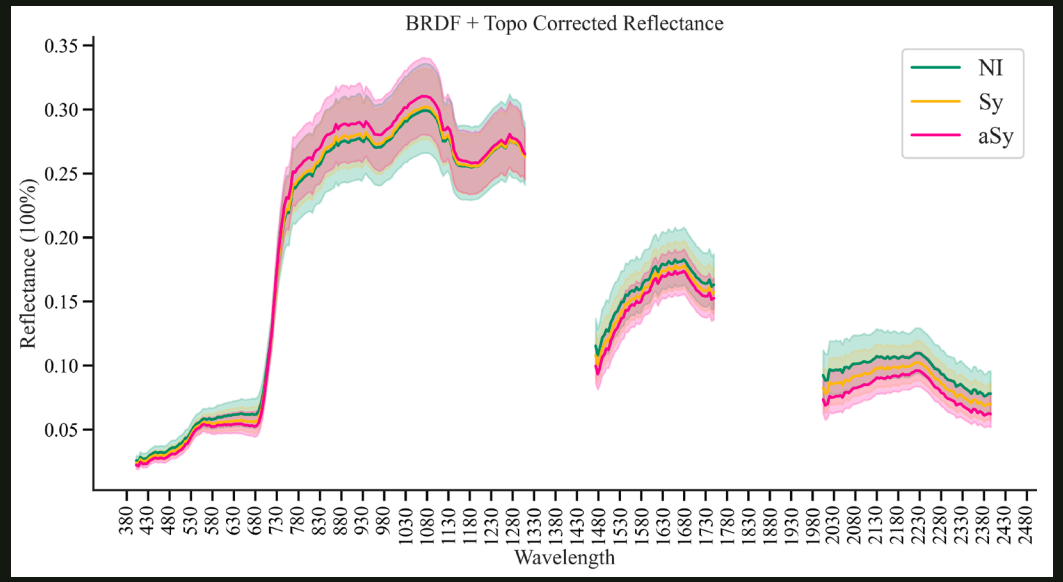
Grapevine virus detection with NASA AVIRIS-NG

Romero Galvan et al. *accepted*



Fernando Romero Galvan

Ryan Pavlick JPL



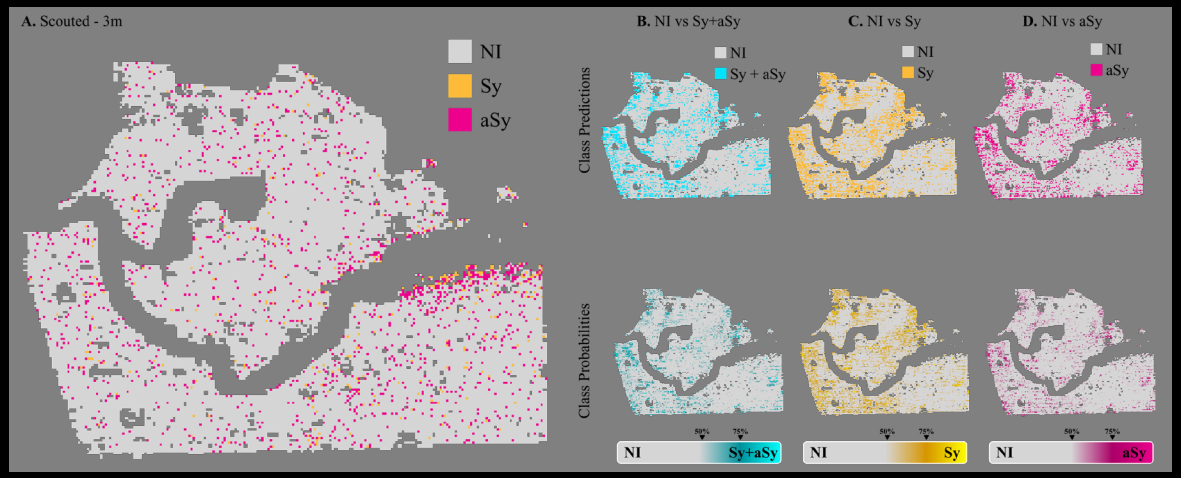
Resolution	Classification	Random Forest + SMOTE + Smoothing + Unmixing	
		Test Accuracy	Test Kappa
3m	H vs (Sy + aSy)	**85%**	**0.71**
	H vs Sy	81%	0.62
	H vs Sy vs aSy	67%	0.51
	H vs aSy	**87%**	**0.73**

- Airborne imaging spectroscopy facilitates scalable early detection of GLRV – **symptomatic and asymptomatic.**
- Random forest models accurate from 1m to 5m but perform best at 3m resolution.
- Imaging spectroscopy can supplement ground methods by more strategically deploying mitigation efforts.

LODI WINE GROWERS

E&J. Gallo Winery

NASA ACRES



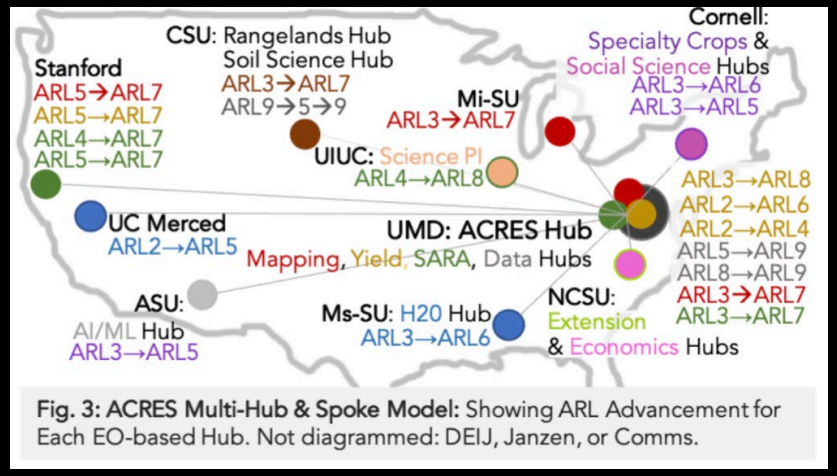
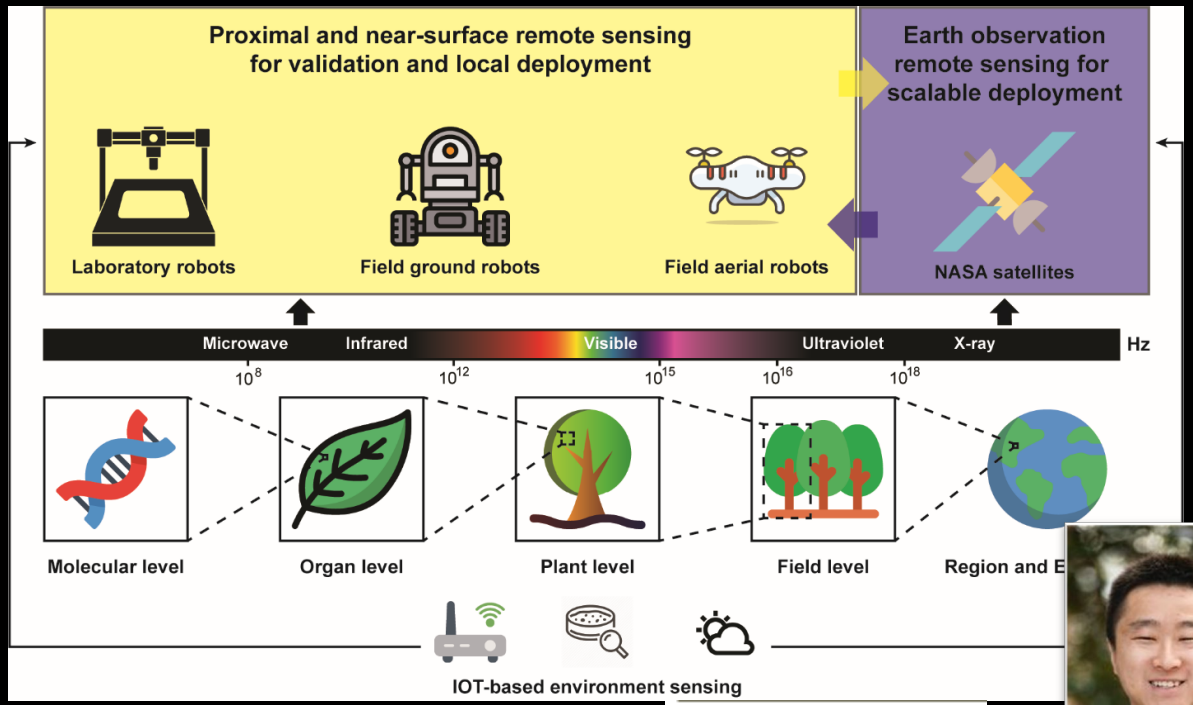


Fig. 3: ACRES Multi-Hub & Spoke Model: Showing ARL Advancement for Each EO-based Hub. Not diagrammed: DEIJ, Janzen, or Comms.

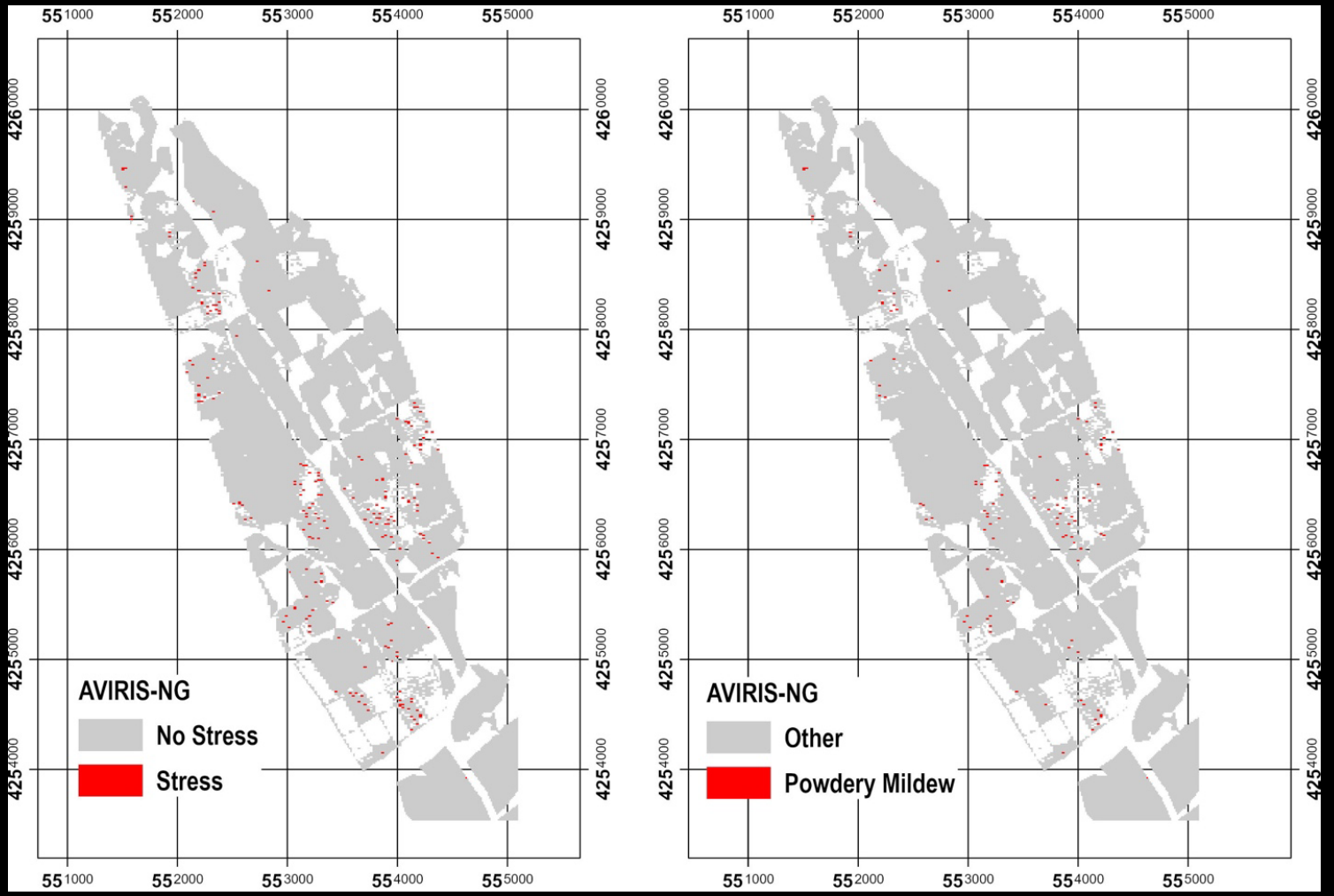
Alyssa Whitcraft
Project Director



CAIR

J. Eller

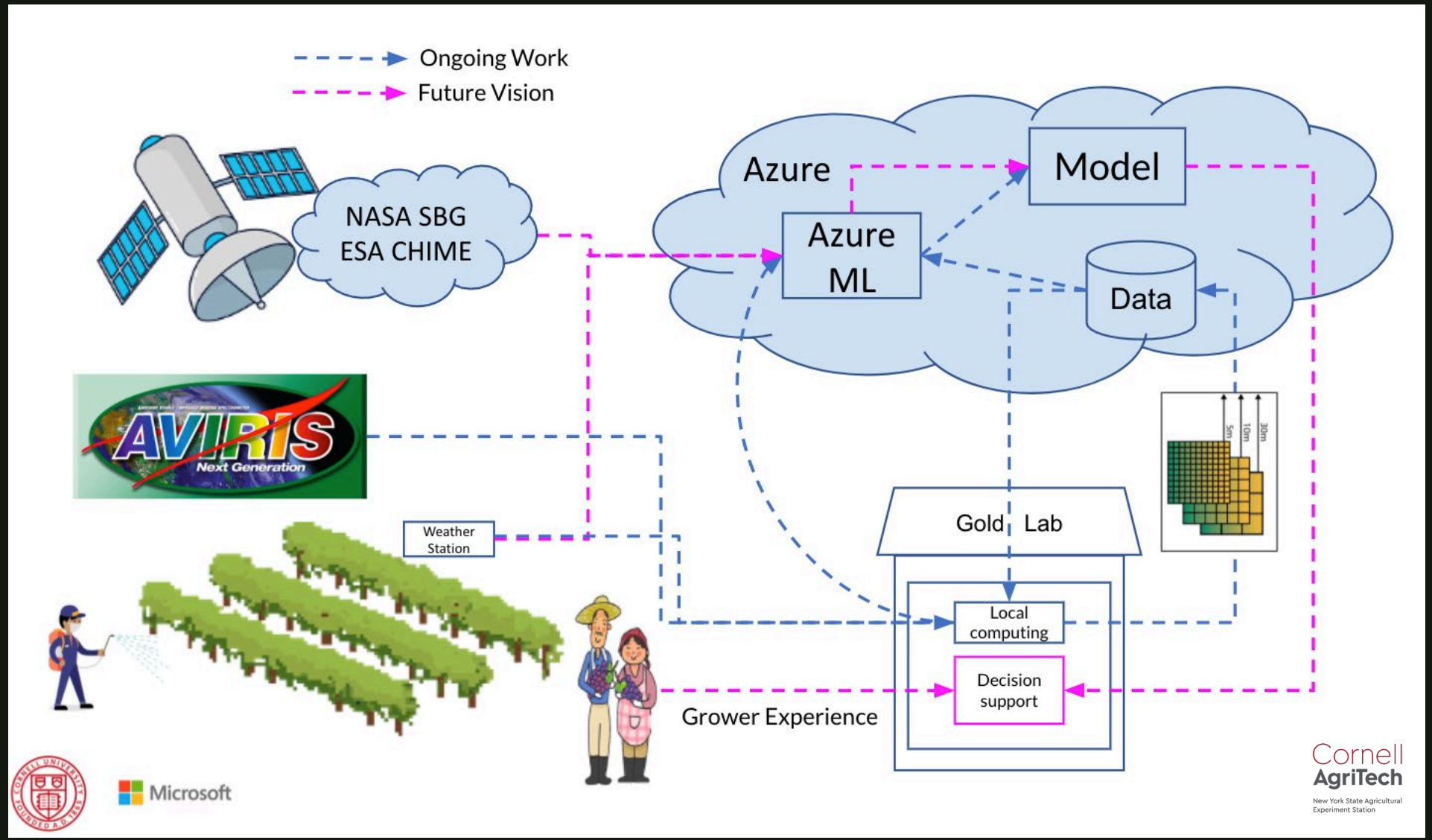
Combining AVIRIS-NG with epidemiological modeling to predict and map powdery mildew epidemics

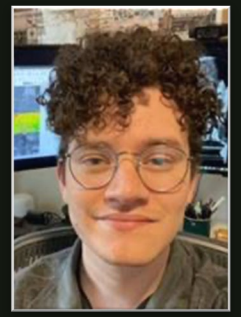


Eller MS Thesis, CSUN
Using Hyperspectral Remote Sensing Techniques to Identify *Vitis vinifera* Powdery Mildew in Napa Valley, California

Cloud-Native, Machine Learning Based Detection

Rubambiza & Romero Galvan et al. *accepted*





Fernando

Gloire Rubambiza

Hakim Weatherspoon

Cornell AgriTech

New York State Agricultural Experiment Station

Questions?

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NASA NIFA JPL Boldly. NY. NEW YORK WINE & GRAPE FOUNDATION cida Cornell Institute for Digital Agriculture CW CanandaiguaWine NY farm viability INSTITUTE