

Sensors, grapes, and disease: The GrapeSPEC Lab

Katie Gold

*Assistant Professor of Grape Pathology,
Cornell University*

NGRA New Scientist Series, Spring 2021

Katie Gold

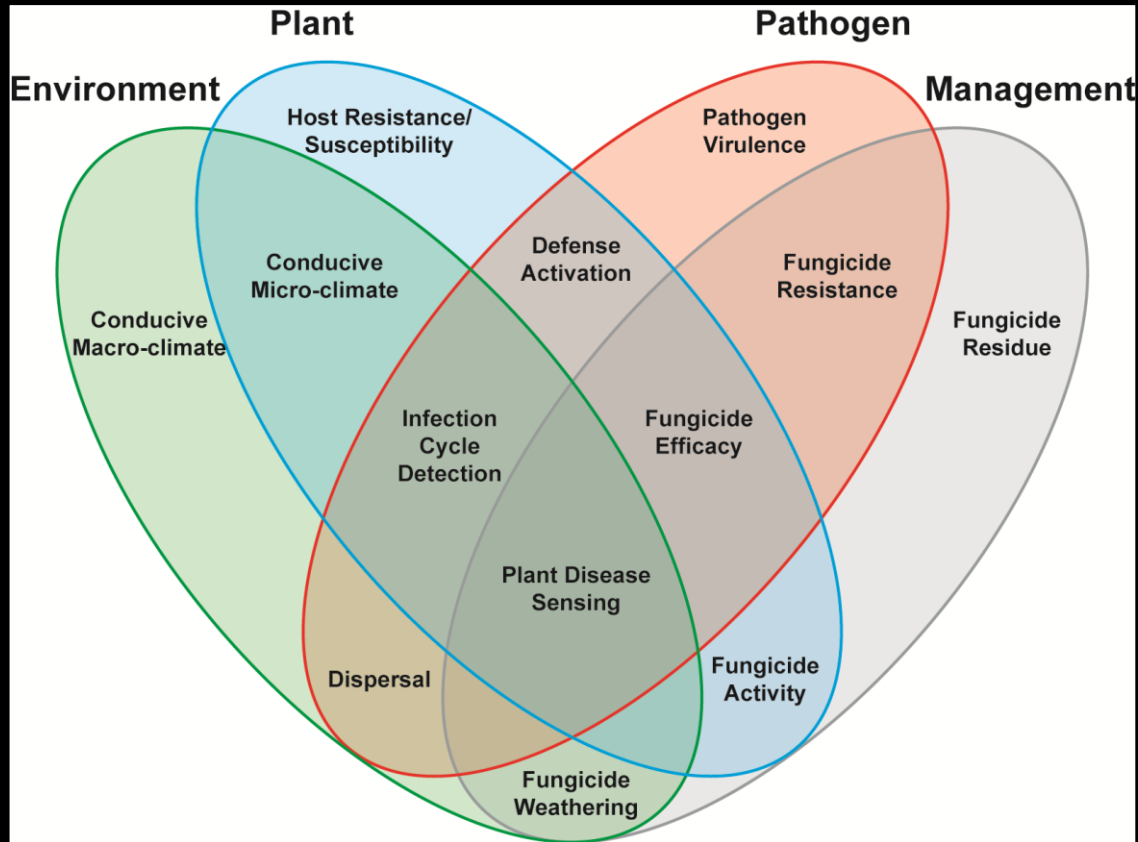
Asst. Professor of Grape Pathology, Cornell University



- B.S. (Plant & Ag Science) Rutgers University
- M.S. (Applied Statistics) & Ph.D. (Plant Pathology) University of Wisconsin-Madison
 - *In situ* and imaging spectroscopy for pre-symptomatic potato disease detection
 - Potato & vegetable pathology extension, oomycete biology and management, remote sensing
- NASA Jet Propulsion Lab, Cornell Faculty Fellow
 - Asymptomatic disease detection with NASA sensors
 - Applications team for Surface, Biology, & Geology hyperspectral satellite (~2025 launch)

Grape Sensing, Pathology, and Extension at Cornell University

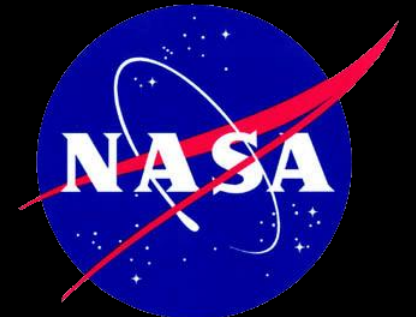
The GrapeSPEC Lab



We study the fundamental and applied science of **plant disease sensing** to improve early grape disease detection & management.



Jet Propulsion Laboratory
California Institute of Technology





Dave Combs
Field Specialist



Nikita Gambhir
Postdoc



Rocío Calderón Madrid
Postdoc



Fernando Romero
Galvan
PhD Student

GrapeSPEC

Members & Partners



and me!



Josh Evans
USDA Technician



Graham Trolley
Undergraduate



Somil Aggarwal
Undergraduate



Ryan Pavlick
NASA JPL



Yu Jiang
CAIR Lab

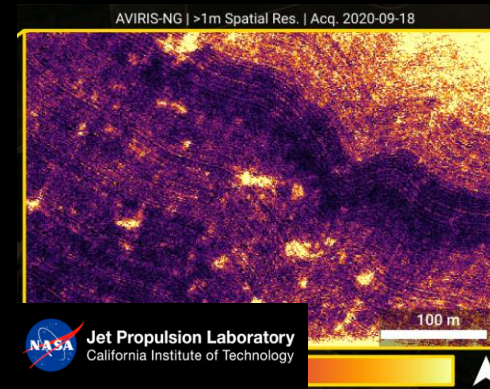


Lance Cadle-Davidson
USDA ARS

Grape Sensing, Pathology, and Extension at Cornell University

Ongoing Research Projects

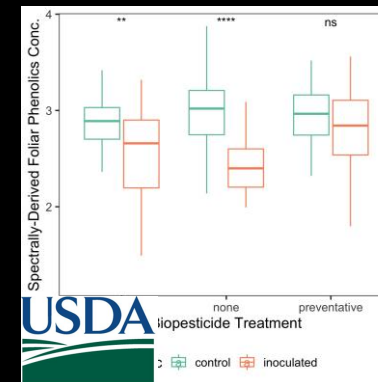
- Applied grape disease management
- Proximal & remote sensing for early grapevine downy mildew intervention
- Disease detection & surveillance with NASA imaging spectroscopy
- Plant protection sensing
- Atmospheric transport of soilborne plant pathogens



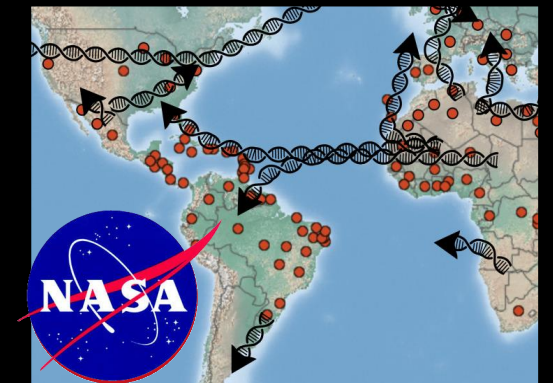
F. Romero Galvan



CAIR Lab, COE, & Cornell Viticulture



N. Gambhir

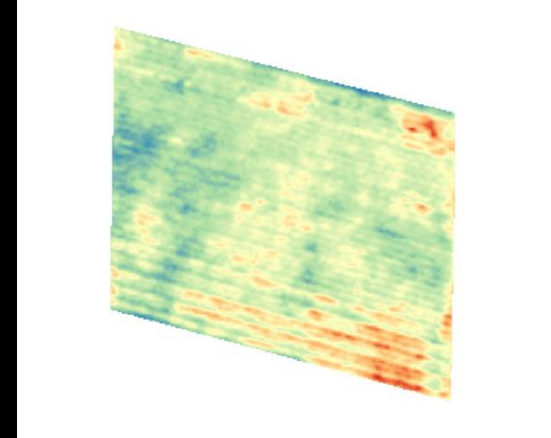


R. Calderon Madrid

Grape Sensing, Pathology, and Extension at Cornell University

Ongoing Extension Initiatives

- Applied grape disease management
 - Biopesticides
 - Sour rot management timing
- Reducing reliance on FRAC40 for DM management
 - Resistance survey
 - Outreach on managing w/out Frac40
- Integrated sensor management



Sensor:

A device that responds to a physical stimulus, such as heat, **light**, sound, pressure, or motion, and transmits a resulting impulse for measurement or action



What light can tell us

Drought Stress



Cornell Viticulture and Enology

Nutrient Stress



Pennsylvania State University

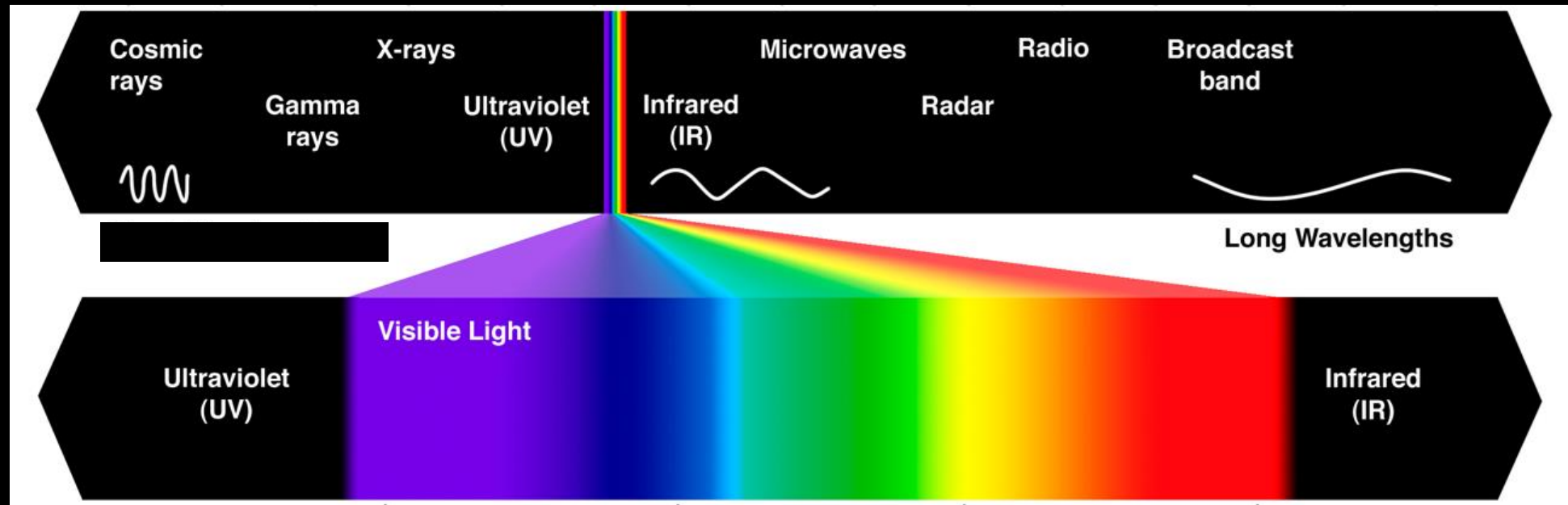
Disease



University of Wisconsin-Madison

These things will cause light to reflect differently long before we can see the impacts with our eyes

In situ and imaging spectroscopy



**Spectral
Resolution**

How many wavelengths?

**Spatial
Resolution**

How many pixels?

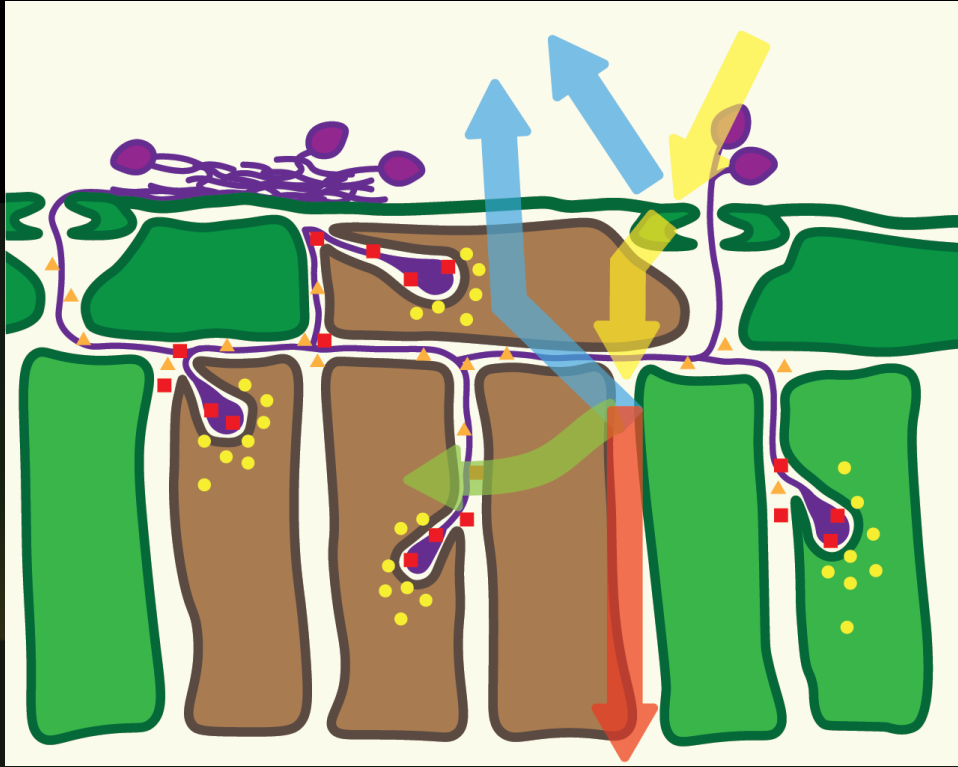
**Temporal
Resolution**

How frequent return?

Different pathosystems have different spectral, spatial, and temporal requirements.

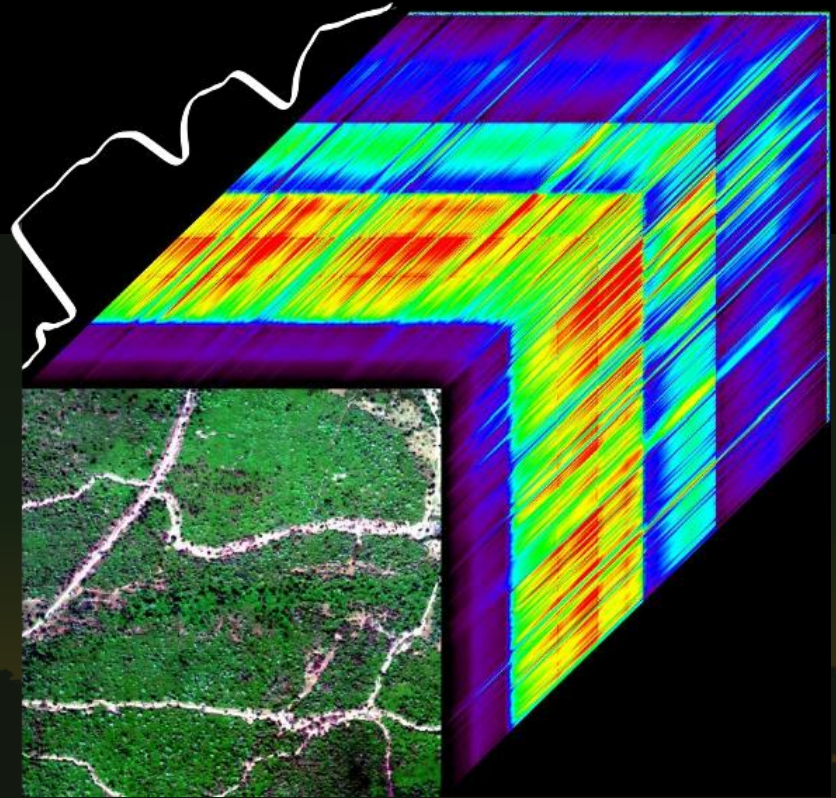
One size does NOT fit all!

Spectroscopy offers more information about plant-microbe interactions than our eyes alone can see



Art by Eric Larson

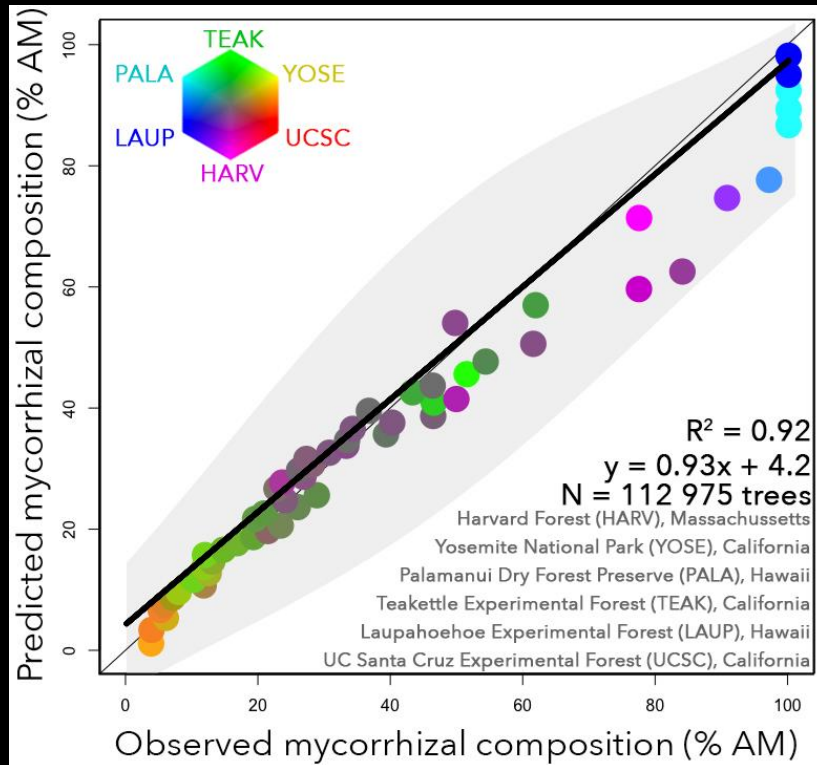
Plant pathogens physically and chemically change plant constitution



Imaging spectroscopy allows us to study how plant disease changes spectral reflectance at scale

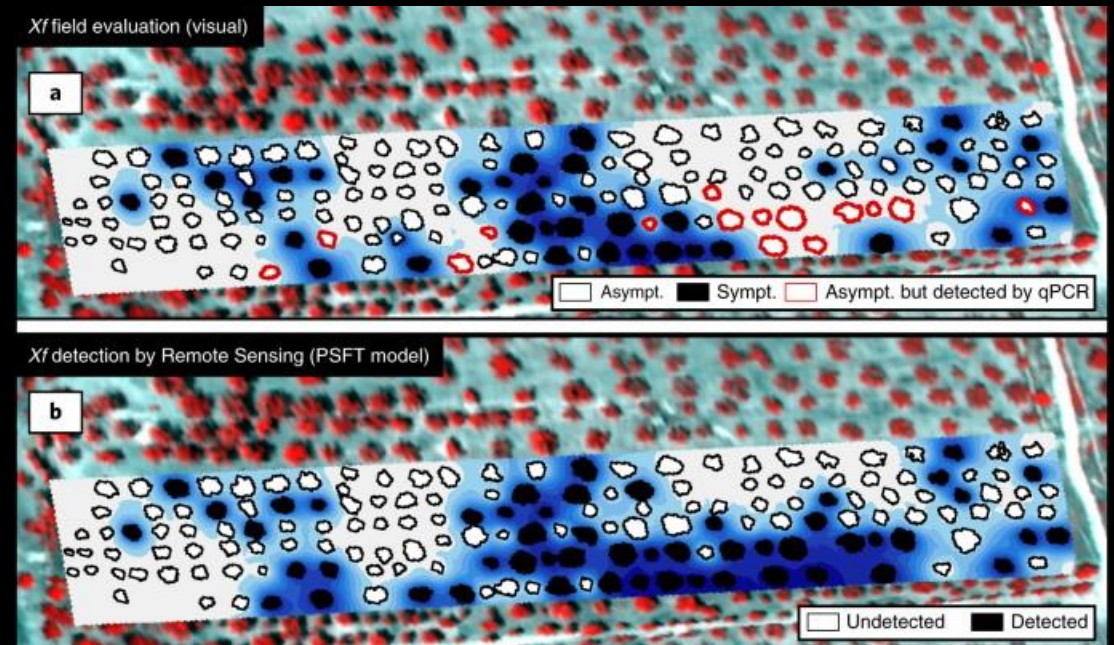
Detection with imaging spectroscopy is scalable

Beneficial




Sousa, Fisher, Romero Galvan, et al.
In review

Antagonistic



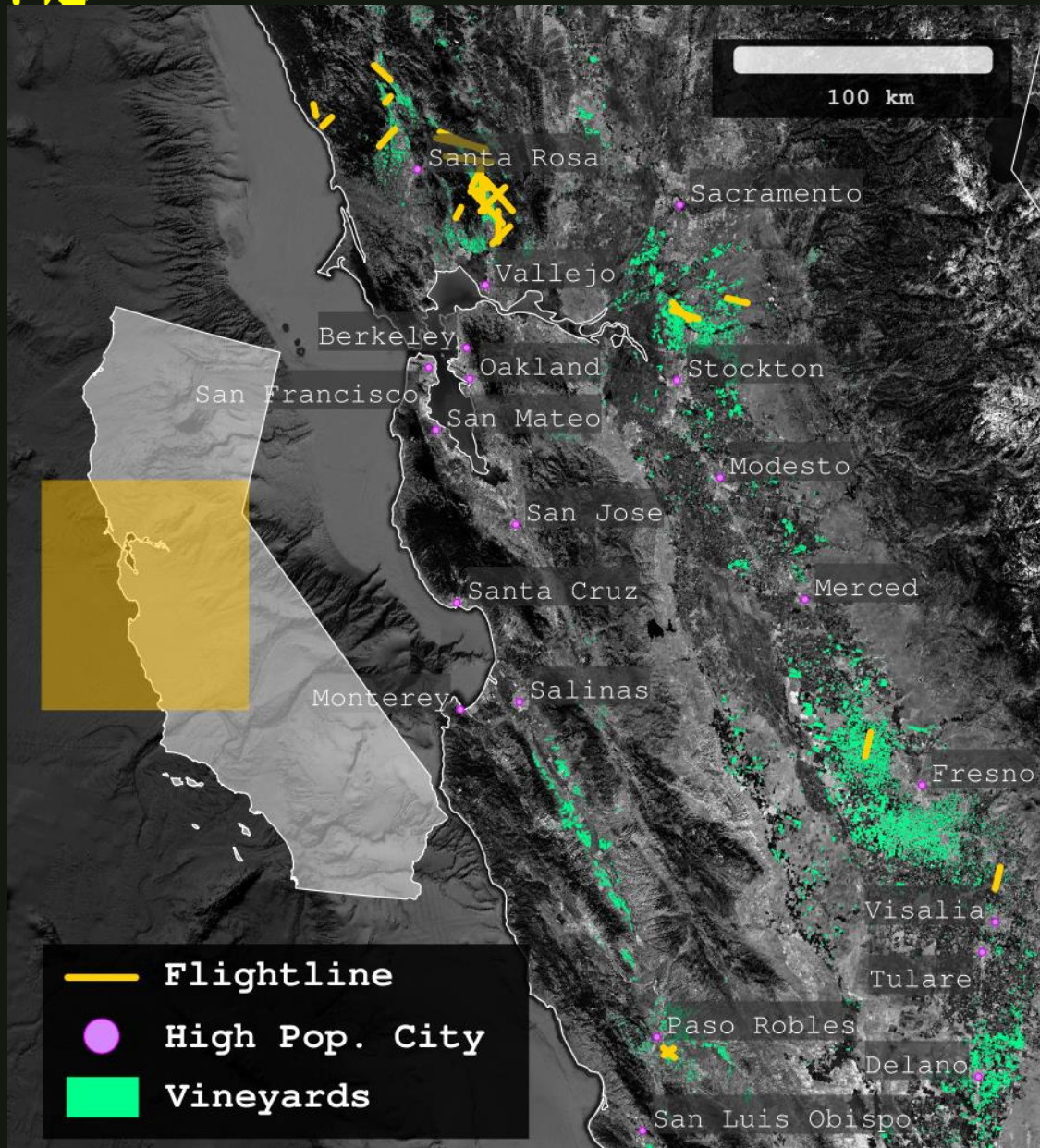
Zarco-Tejada et al. 2018
Nature Plants



The future of grape
disease management
is **early detection**



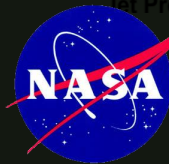
2020 AVIRIS-NG "Wine Tour"



Emergency allocation from NASA Biodiversity program office facilitated collections for not only our work, but also for heatwave, wildfire, and climate resiliency viticulture research in Sept. 2020.
Thank you Woody Turner!



*Not pictured but equally important:
Beth Forrestel (UC-Davis) & Charlie Starr (Viticultural Management)*





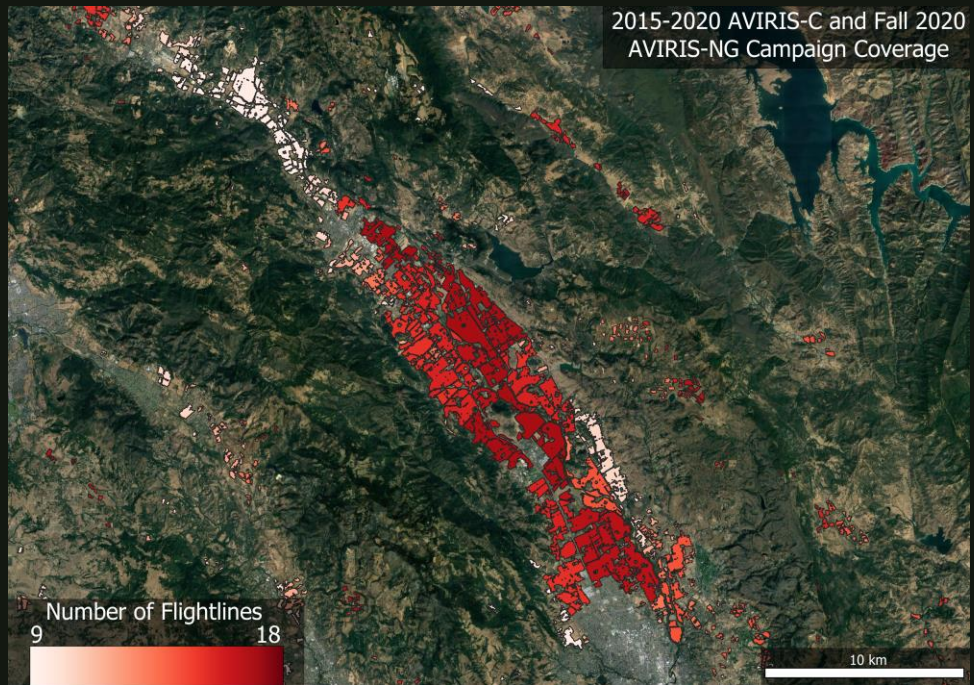
Mining historic AVIRIS vineyard acquisitions

Data Mining Historic Records

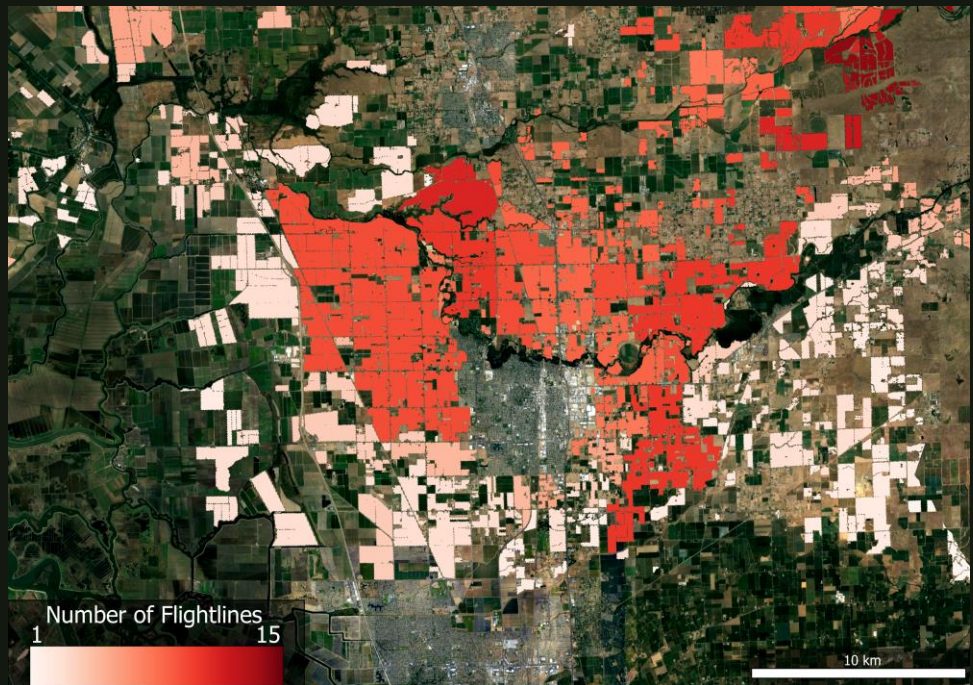
- Identified 888,000 acres of vineyards opportunistically captured by AVIRIS-NG & AVIRIS-C over the past 5 years!
- Crop variety has a strong impact on detection accuracy (Gold et al 2019). Building models for grape variety discrimination, preliminary test accuracy =77%.



Graham Trolley
Undergraduate



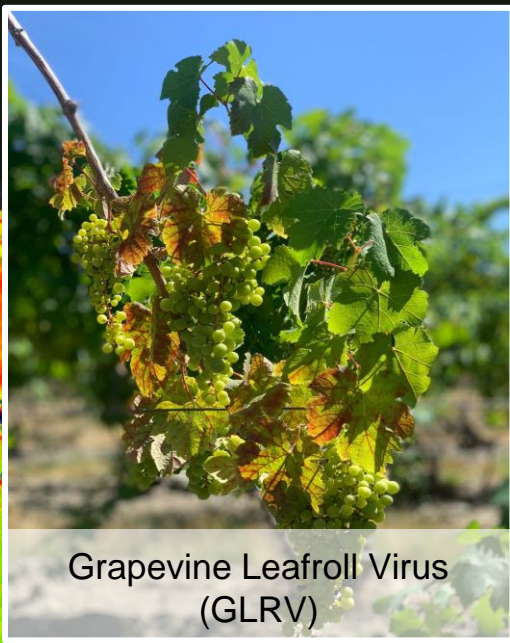
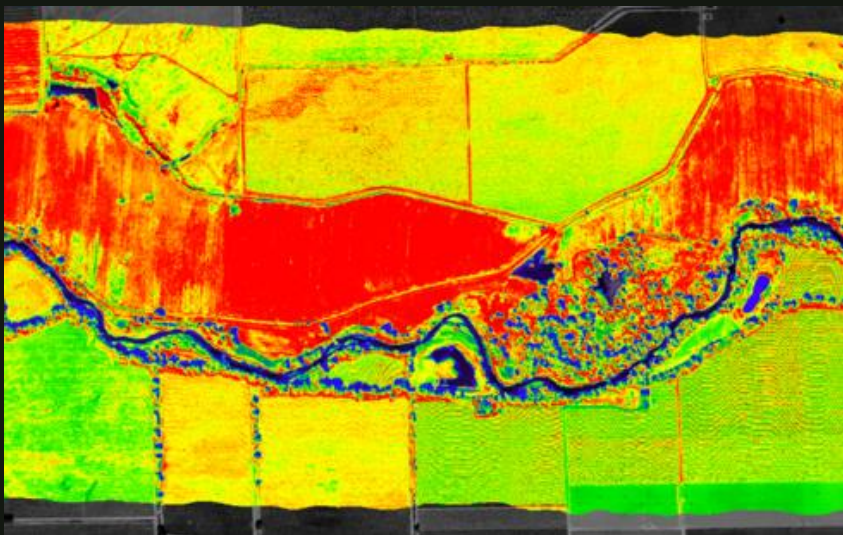
Napa Valley, CA Historic Coverage



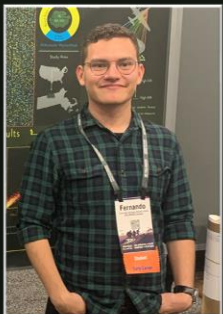
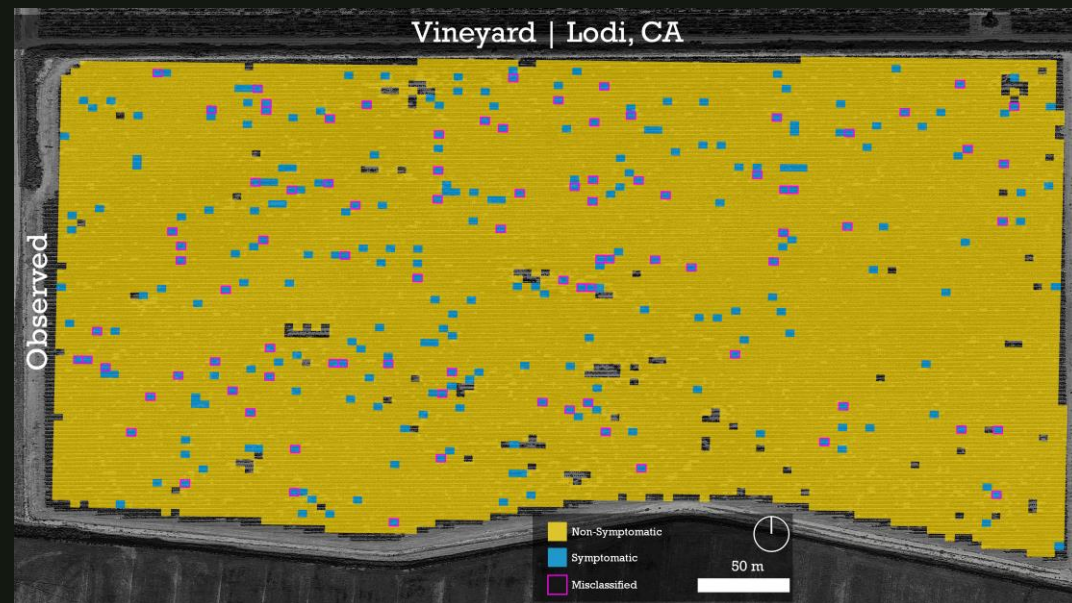
Lodi, CA Historic Coverage

How can sensing be used for disease management in the future?

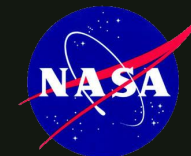
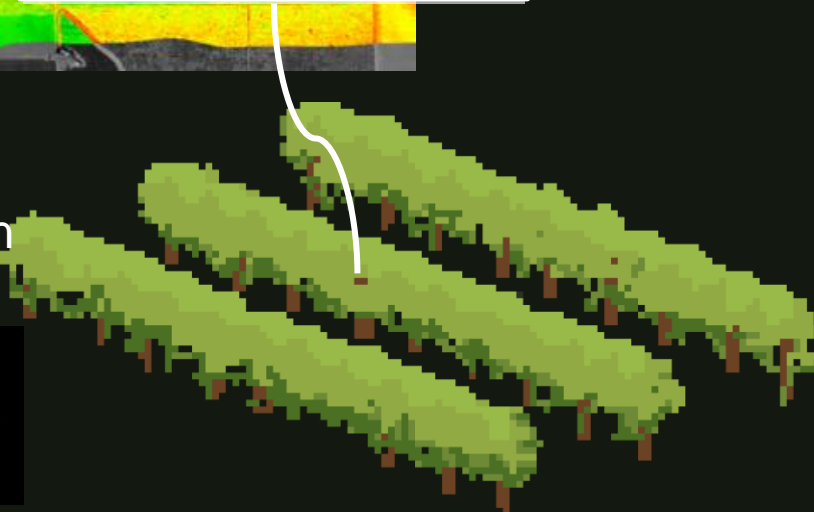
Grapevine virus detection with NASA hyperspectral aircraft and satellites



Grapevine Leafroll Virus (GLRV)



Fernando Romero Galvan
PhD Student



How can sensing be used for disease management in the future?

With autonomous vineyard robots



High accuracy ground-truthing at scale



Strategic and efficient deployment

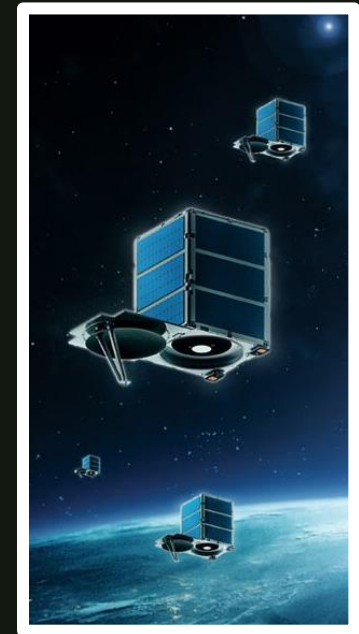
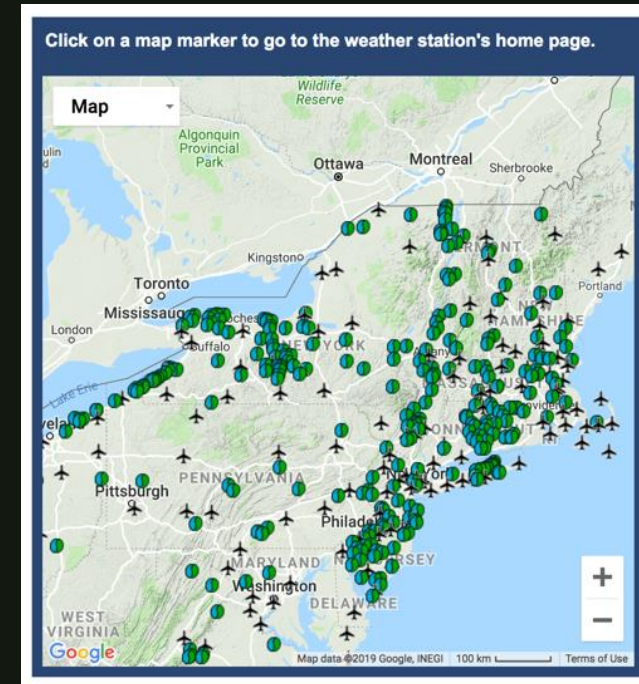
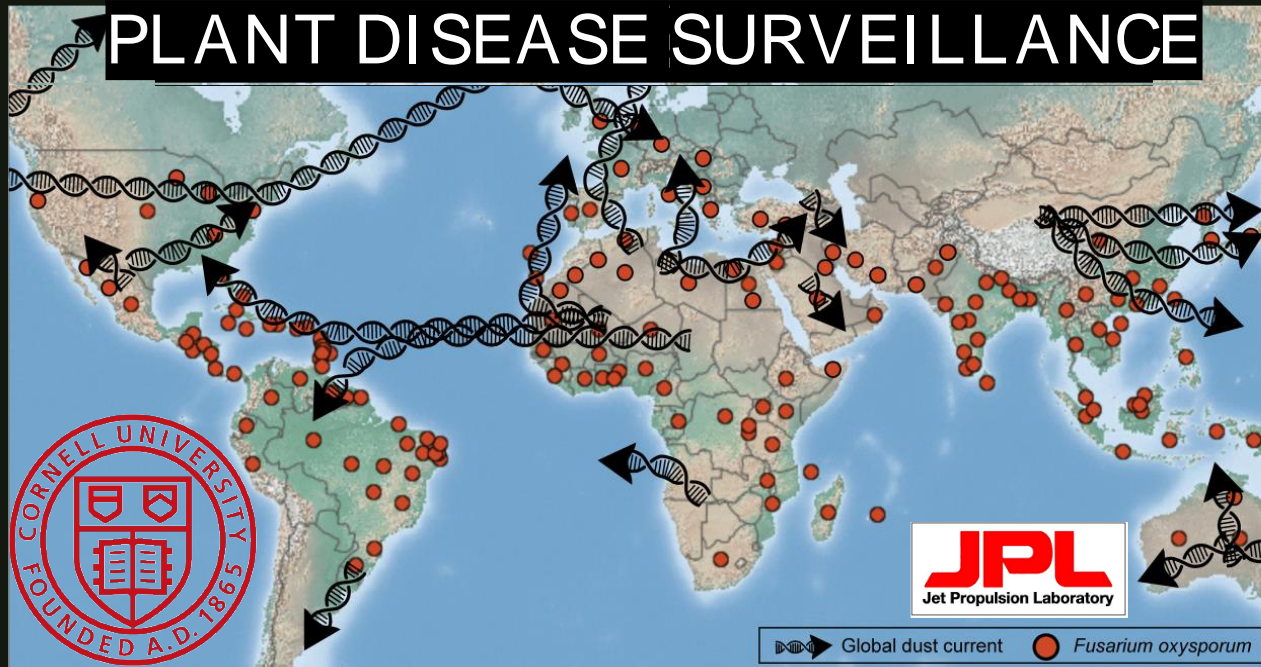


Yu Jiang, Assistant Professor



How can sensing be used for disease management in the future?

Remote sensing based global & regional warning systems for disease



Rocio Calderon Madrid
Postdoc



**NASA ROSES
Interdisciplinary
Sciences Grant**

80NSSC20K1533



Somil Aggarwal
Undergraduate





Questions?

kg557@cornell.edu



Jet Propulsion Laboratory
California Institute of Technology



cida

Cornell Institute
for Digital Agriculture

