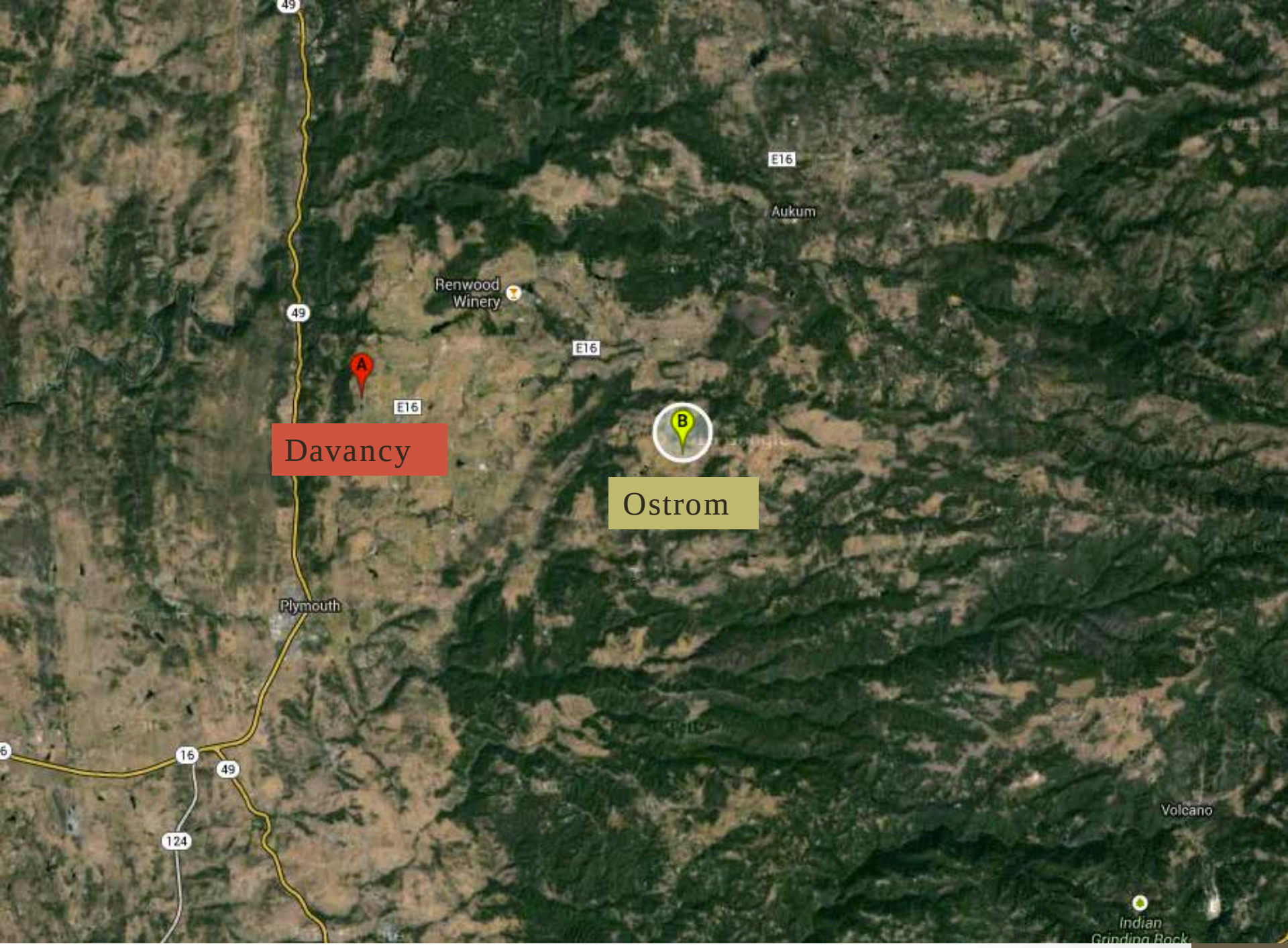
Evaluating "Virtual" Weather Stations to Predict Disease

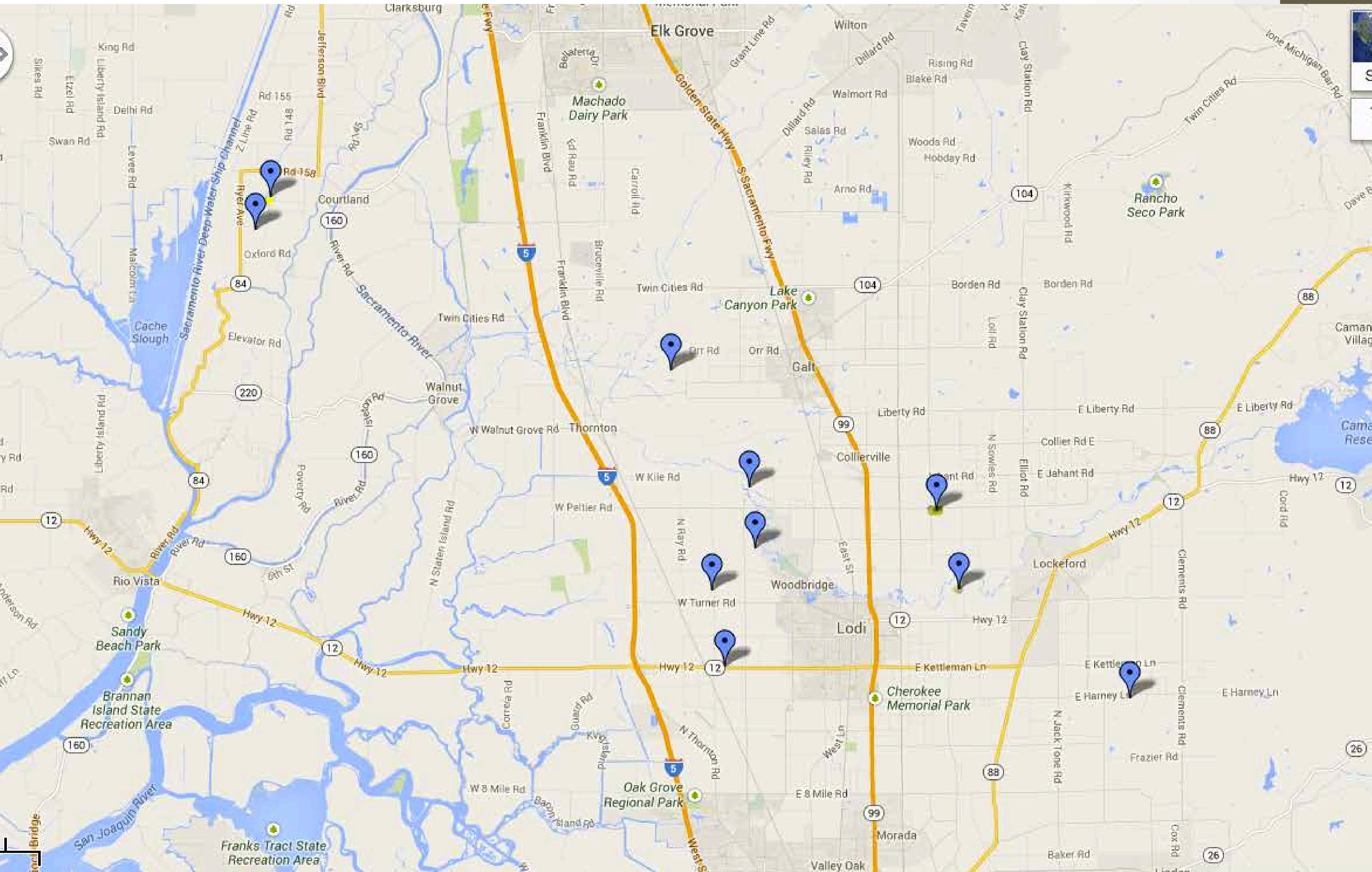
- Brianna McGuire
  - Member of Dr. Doug Gubler's lab, UC Davis

- Made possible through the collaboration of Carol Laubach, Dick Martella, Bill Naylor and Lynn Wunderlich

Where is this project happening?

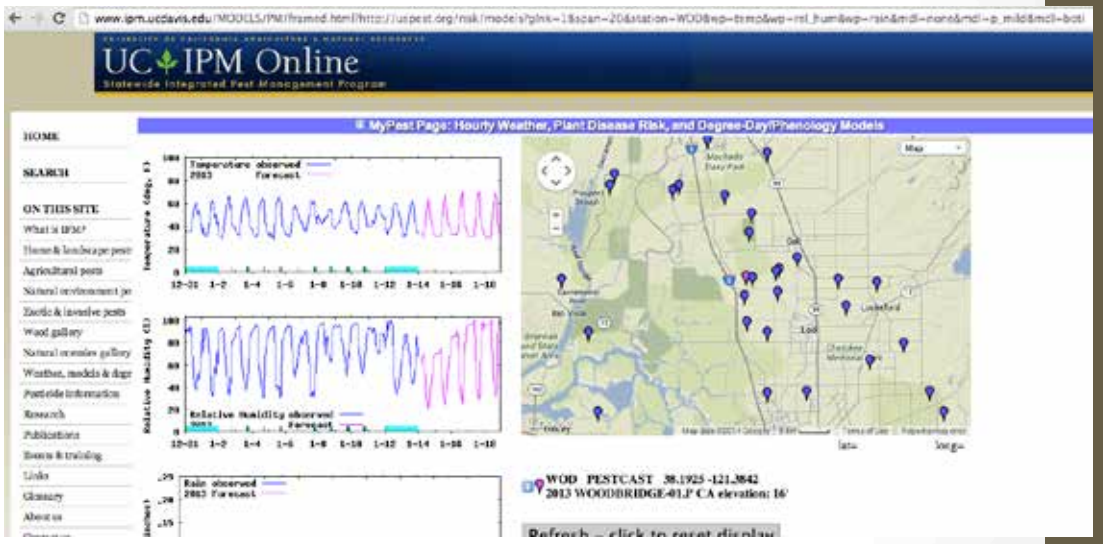
- Lodi
  - 10 sites
- Amador
  - 2 sites


Davancy
Ostrom
Aukum
Renwood Winery
Plymouth
Volcano
Indian Grinding Rock
E16
49
16
124
A
B

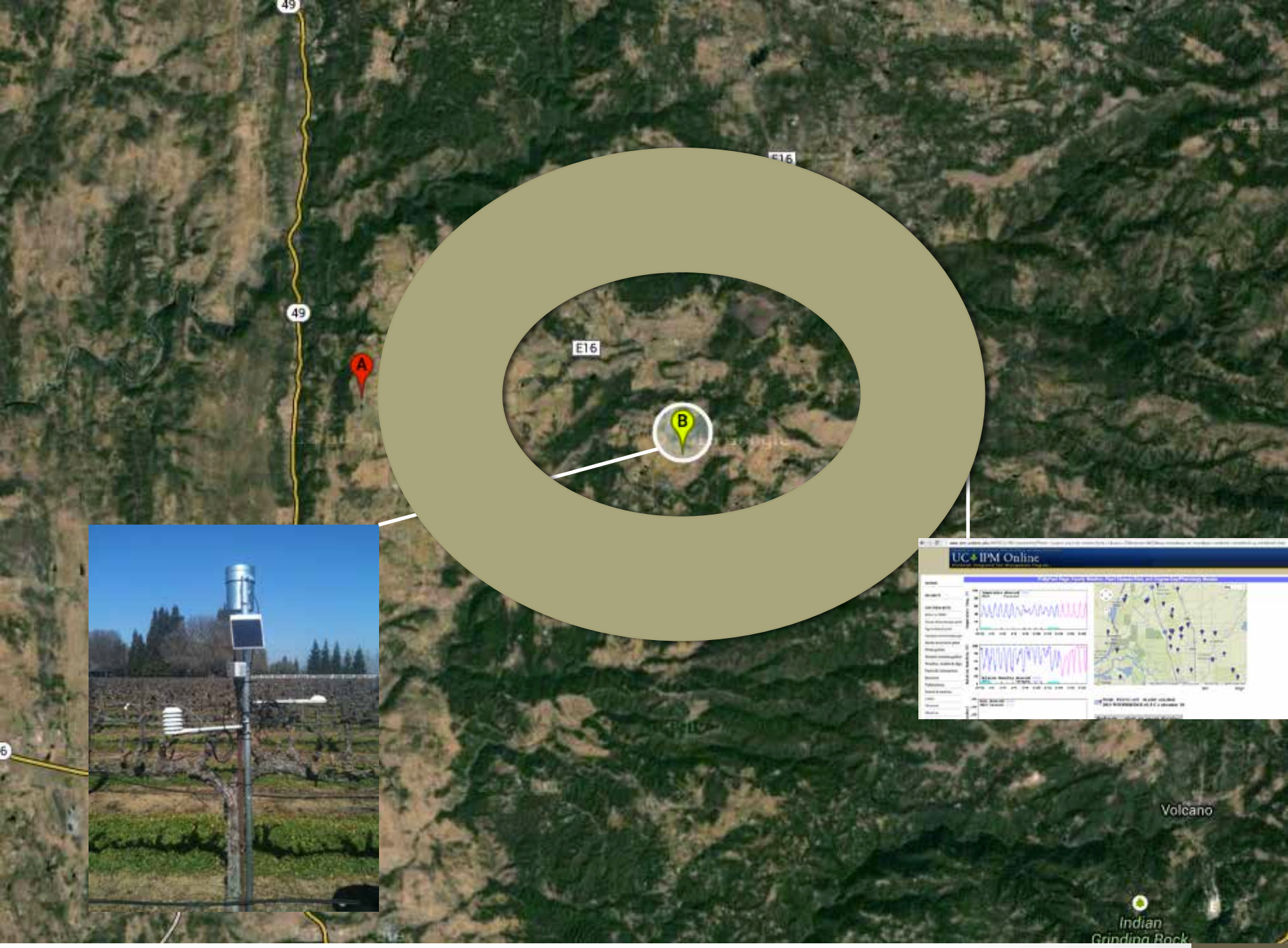

Clarksburg
Elk Grove
Wilton
Machado
Dairy Park
Rancho
Seco Park
Courtland
Lake
Canyon Park
Galt
Cache
Slough
Walnut
Grove
Thornton
Collierville
Woodbridge
Lockeford
Lodi
Rio Vista
Sandy
Beach Park
Brannan
Island State
Recreation Area
Cherokee
Memorial Park
Oak Grove
Regional Park
Franks Tract State
Recreation Area
Morada
Valley Oak
Linden
Camanche
Village
Sacramento River Deep Water Ship Channel
Sacramento River
San Joaquin River
Golden State Hwy
S Sacramento Fwy
Twin Cities Rd
Orr Rd
Liberty Rd
E Liberty Rd
W Kile Rd
W Peltier Rd
W Turner Rd
Hwy 12
E Kettleman Ln
E Harney Ln
W 8 Mile Rd
E 8 Mile Rd
Borden Rd
Collier Rd E
E Jahant Rd
Frazier Rd
Baker Rd
Clay Station Rd
Clements Rd
N Jack Tone Rd
Franklin Blvd
River Rd
Oxford Rd
Elevator Rd
King Rd
Delhi Rd
Swan Rd
5
99
88
104
12
160
84
220
26

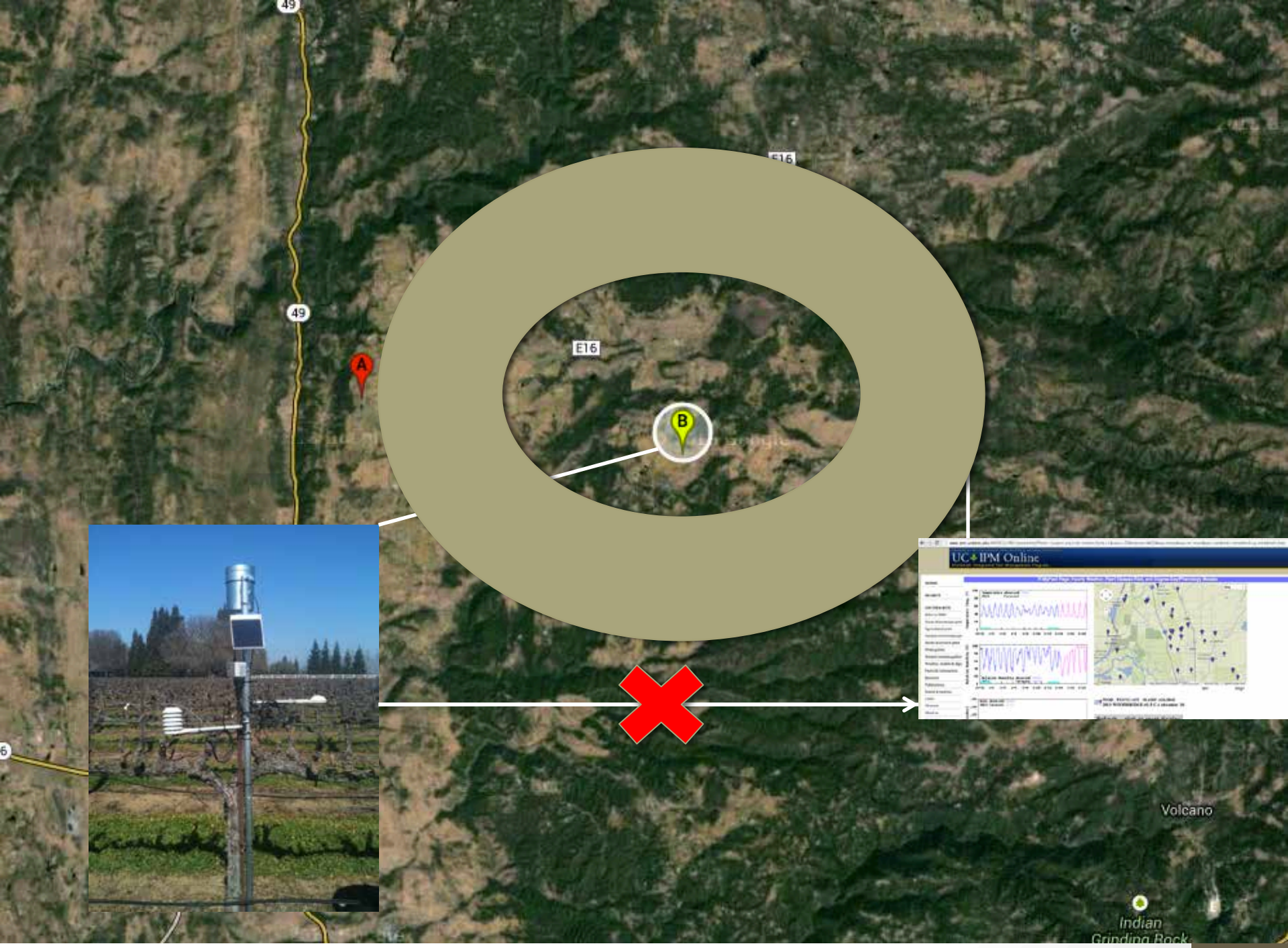
What is this project?

- Comparison of real and virtual weather networks




49
E16
Aukum
Renwood
Winery
49
E16
A
E16
B
Volcano
Indian
Grinding Rock


49
49
E16
E16
A
B
UC IPM Online
Volcano
Indian
Grinding Rock


49
49
E16
E16
A
B
UC IPM Online
Volcano
Indian
Grinding Rock

How did we accomplish this project?

- Randomized treatments within blocks
  - 2, 3 or 4 blocks at each site
- Four treatments
  - Grower standard (GS)
    - Whatever the grower does normally
  - Real weather station (RWS)
    - Spray according to in-vineyard station
  - Virtual weather station (VWS)
    - Spray according to interpolated local averages
  - Non-treated control (NTC)-leave unsprayed
    - Do not spray 5-10 vines per block

Experimental Procedures

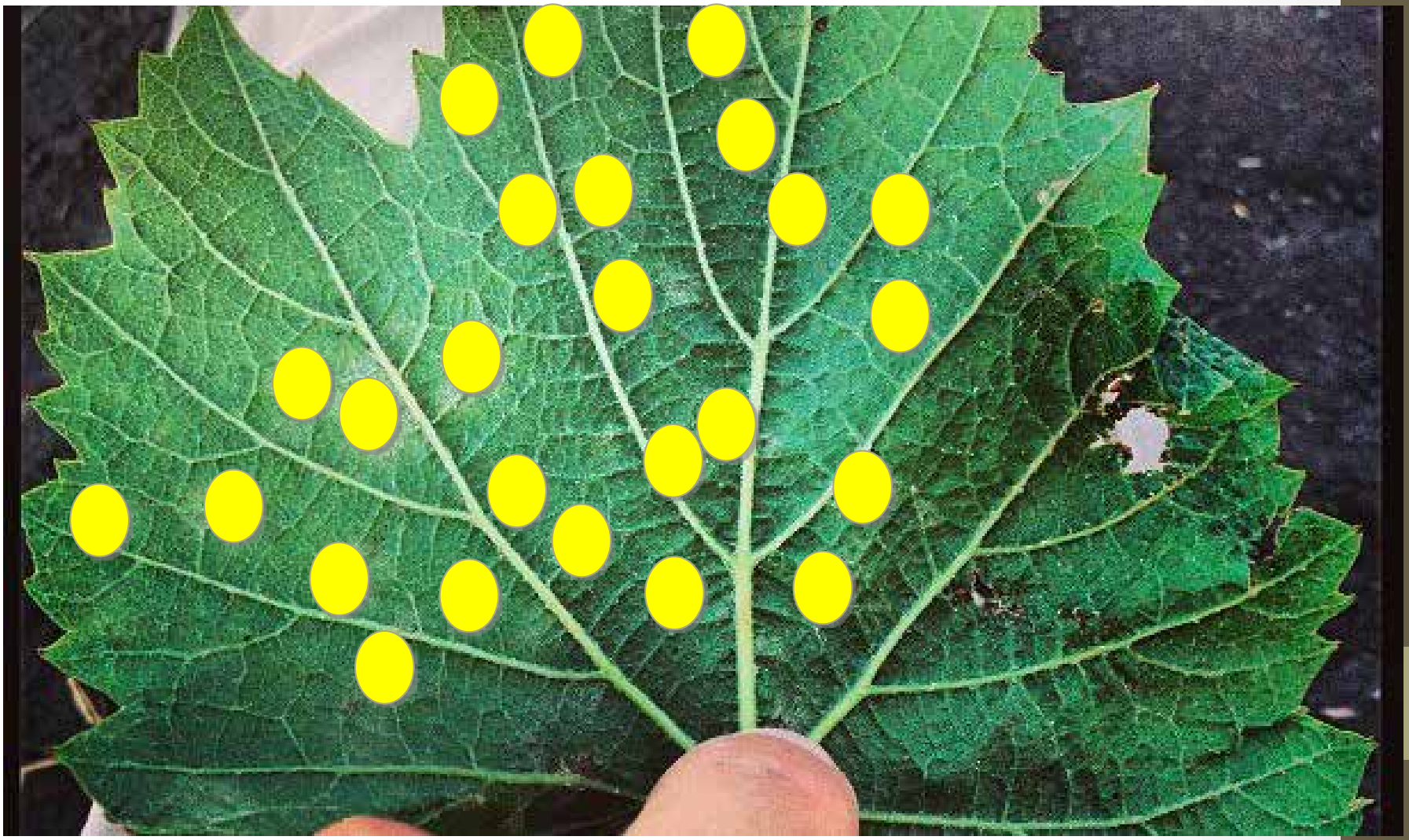
- Measure at each vineyard 5 times throughout the season
  - **Incidence of mildew**
  - **Severity of mildew**

- Each time, we examined 200 leaves or clusters per treatment per block=
  - 2 block design: 1,600 total evaluated leaves or clusters/week
  - 3 block design: 2,400 total evaluated leaves or clusters/week
  - 4 block design: 3,200 total evaluated leaves or clusters/week

- **How did we measure incidence and severity?**

Incidence = Is mildew present?

Severity = # lesions/leaf (25 lesions)



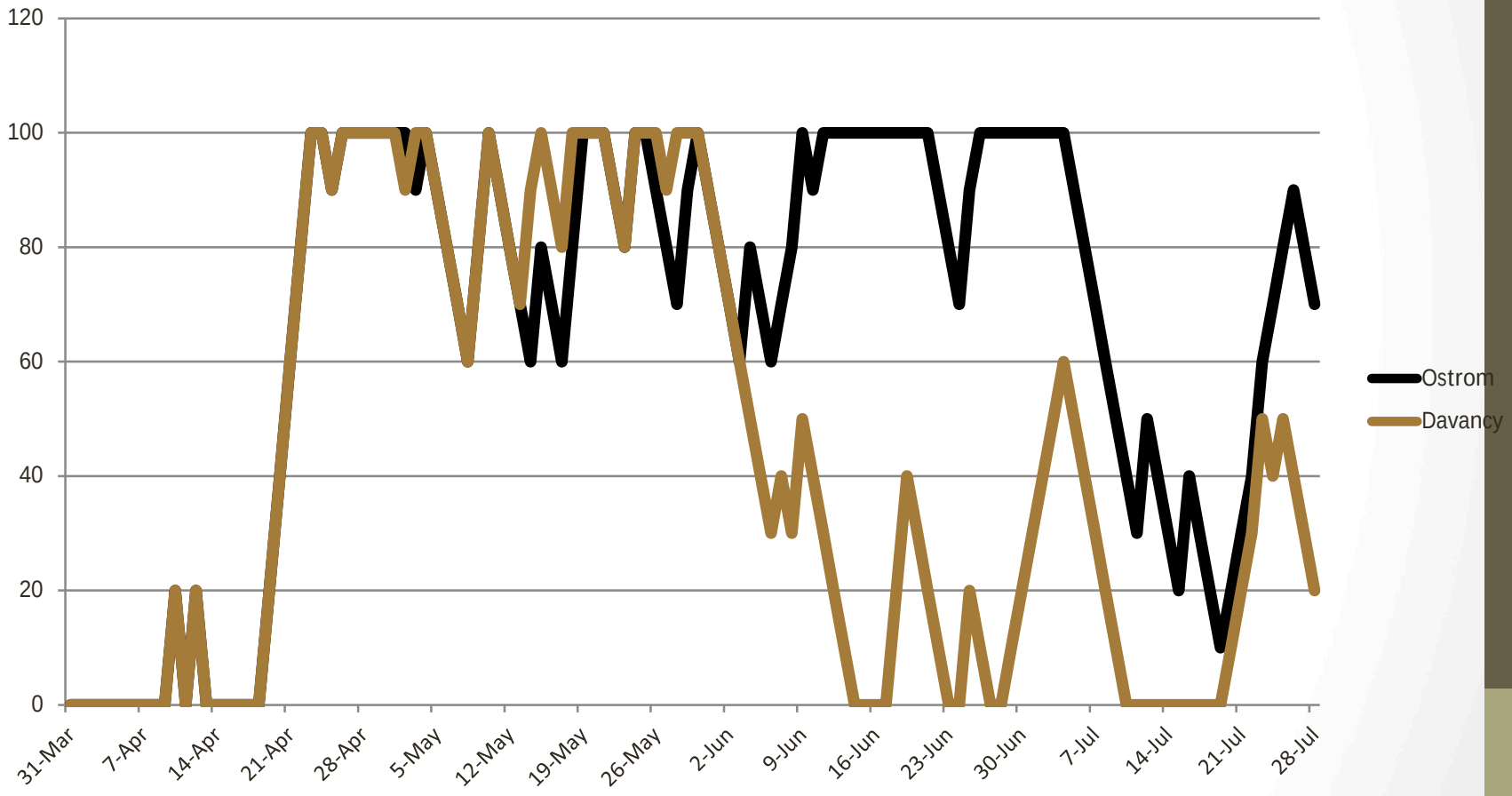
Incidence = Is mildew present?

Severity = Percent berries infected (100%)

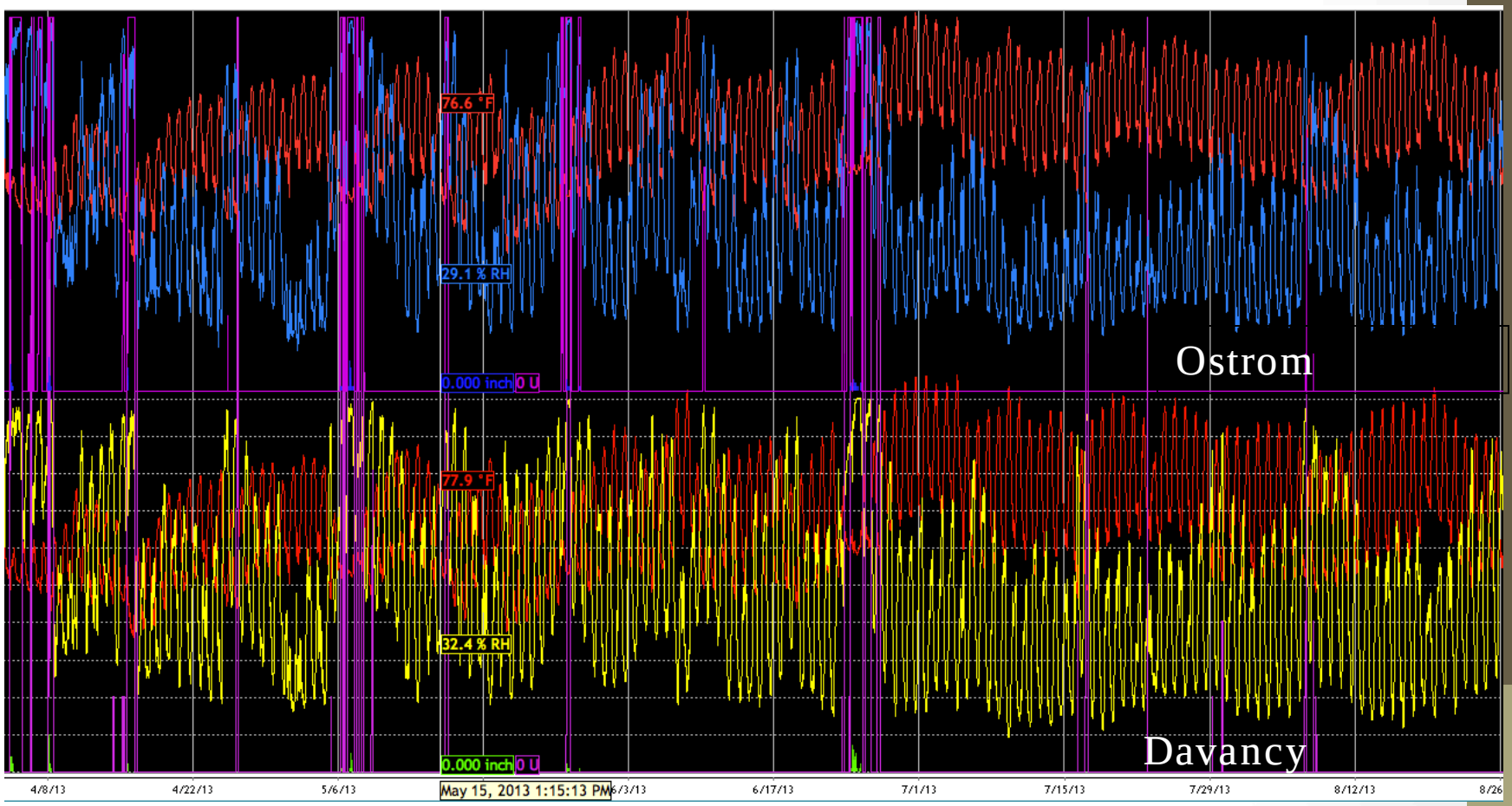
What did the project show?

- Weather and index results
- Mildew results

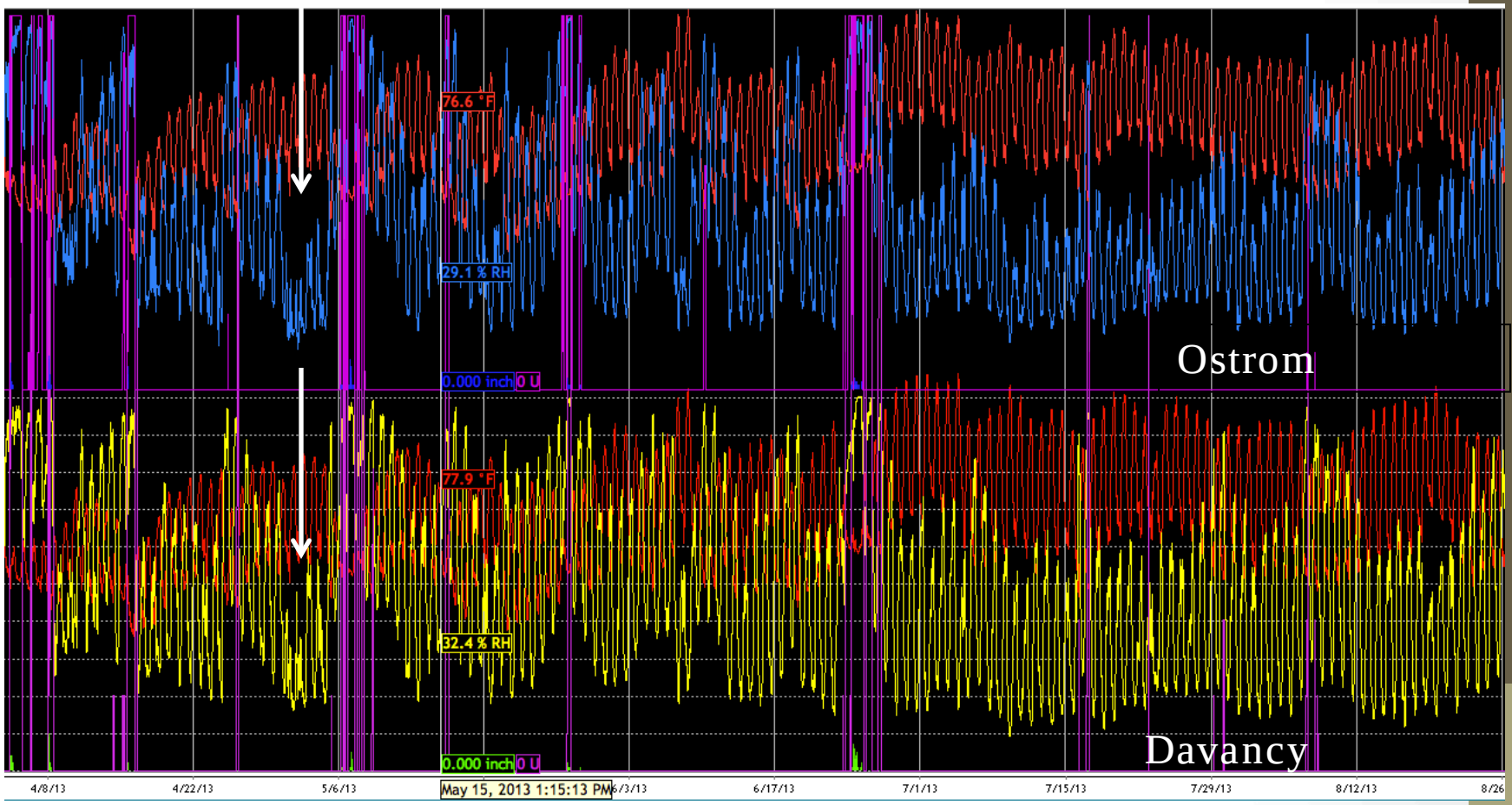
PM Indices for both Amador sites



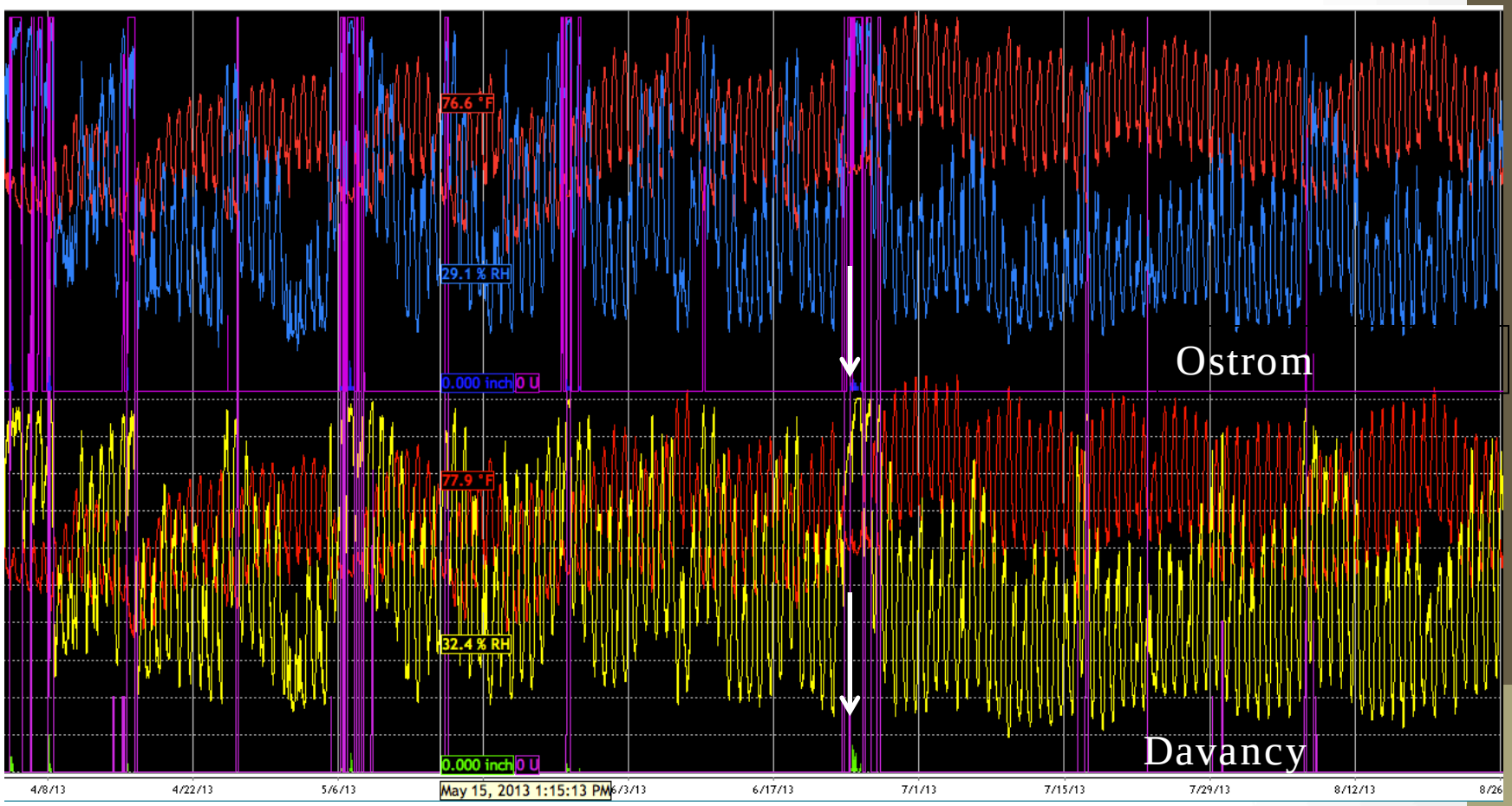
Difference in Site weather



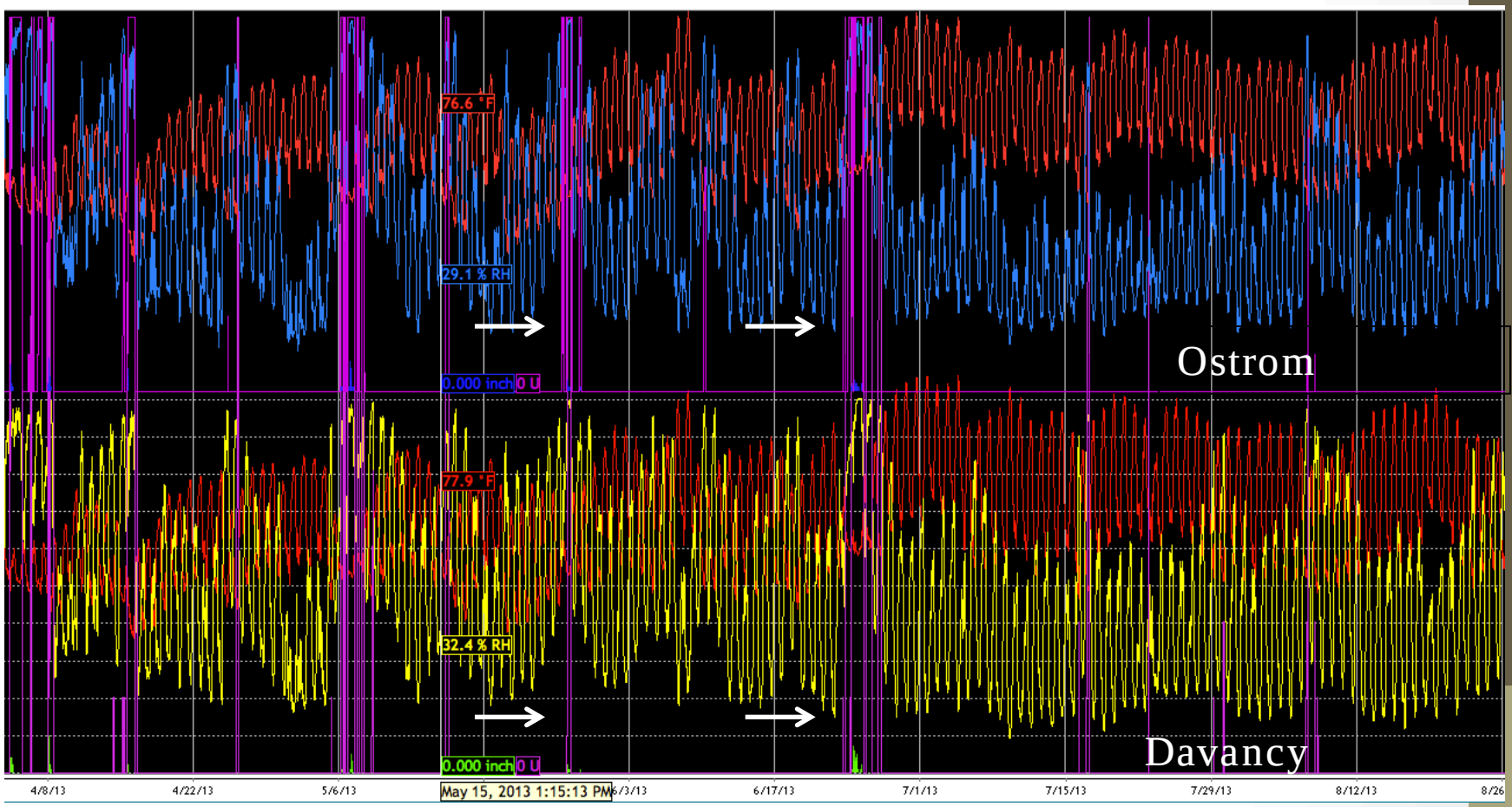
Difference in Site weather: Humidity



Difference in Site weather: Rain



Difference in Site weather: Leaf wetness



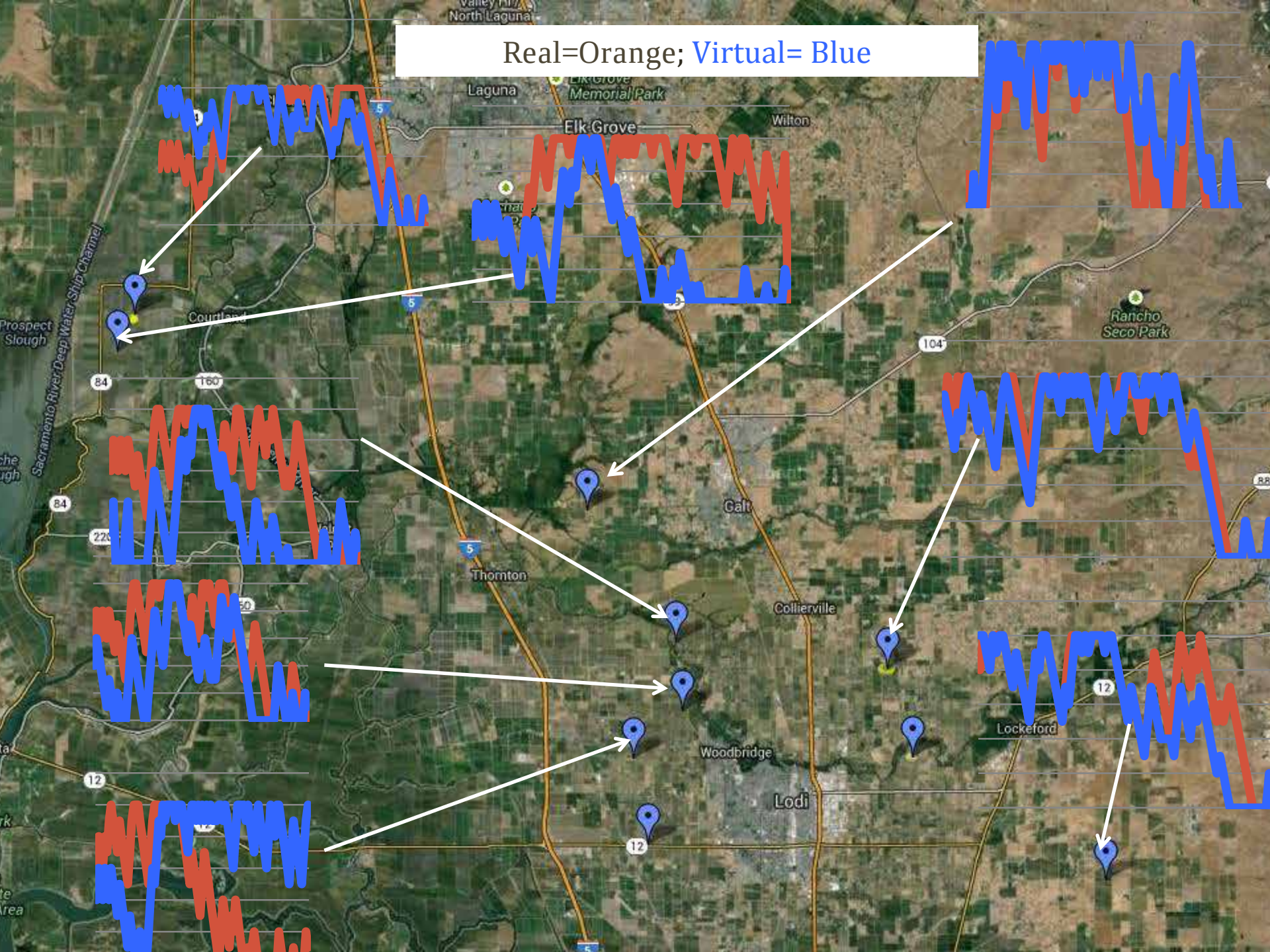
Incidences in vineyards

Davancy Leaf Lesions	Ostrom Leaf Lesions	Davancy Clusters	Ostrom Clusters
26/1800 = 1.2% incidence	21/1800 = 1.1% incidence	5/1800 = 0.2% incidence	14/1800 = 0.7% incidence

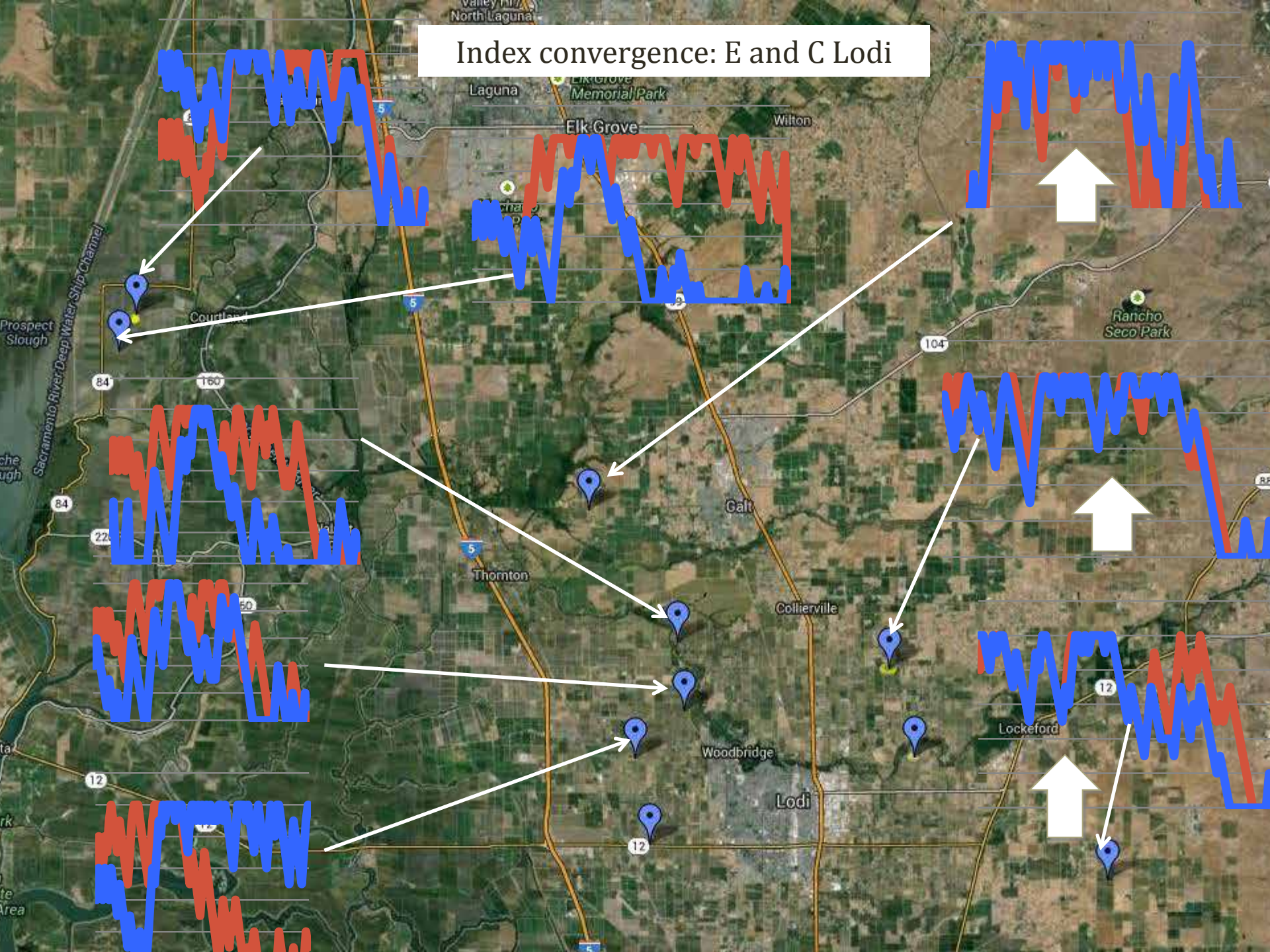
Davancy Cluster Severity	Ostrom Cluster Severity
7%, total ~ 0%	12%, total ~0%

What's the story?

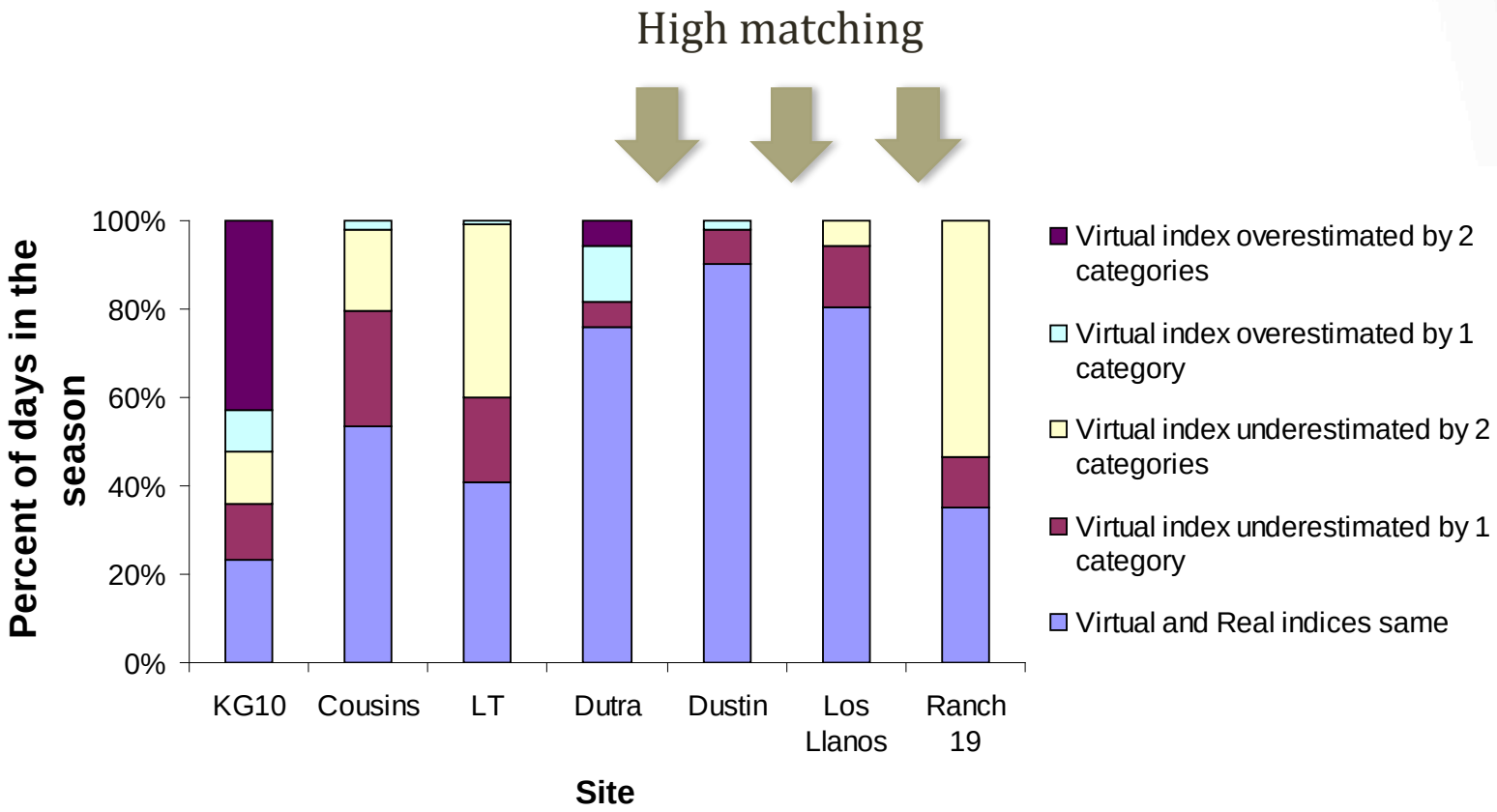
- Index divergence in Amador is likely caused by microclimates.
  - Lower nighttime temperature at Ostrom
  - Different swings in humidity relative to temperature
- Is virtual weather a possibility in Amador?
  - Yes! (with a few caveats)
- How did virtual weather work in Lodi?


Real=Orange; Virtual= Blue
Laguna
Elk Grove
Wilton
Courtland
Galt
Thornton
Collierville
Woodbridge
Lodi
Lockeford
Rancho Seco Park
Prospect Slough
Sacramento River Deep Water Ship Channel

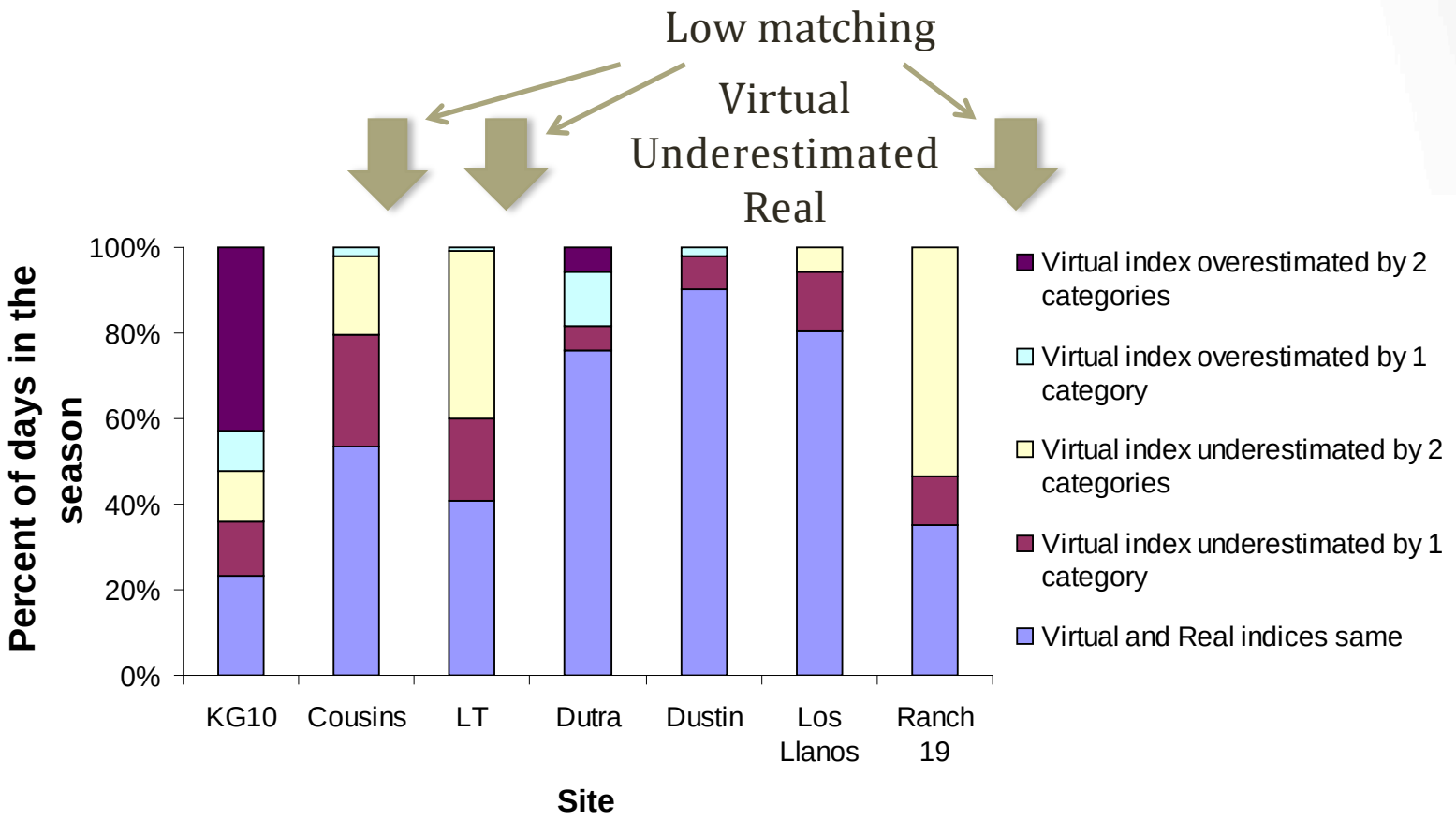
Index convergence: E and C Lodi



Magnitude of differences



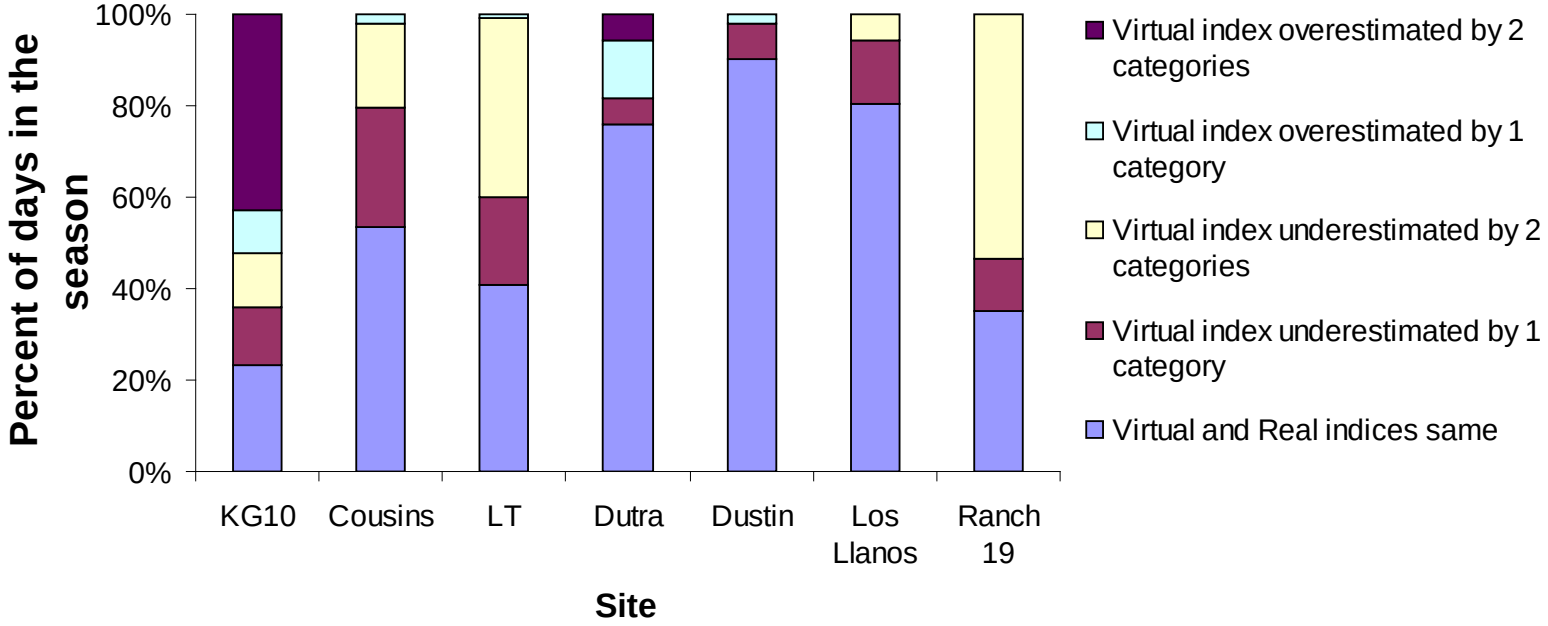
Magnitude of differences



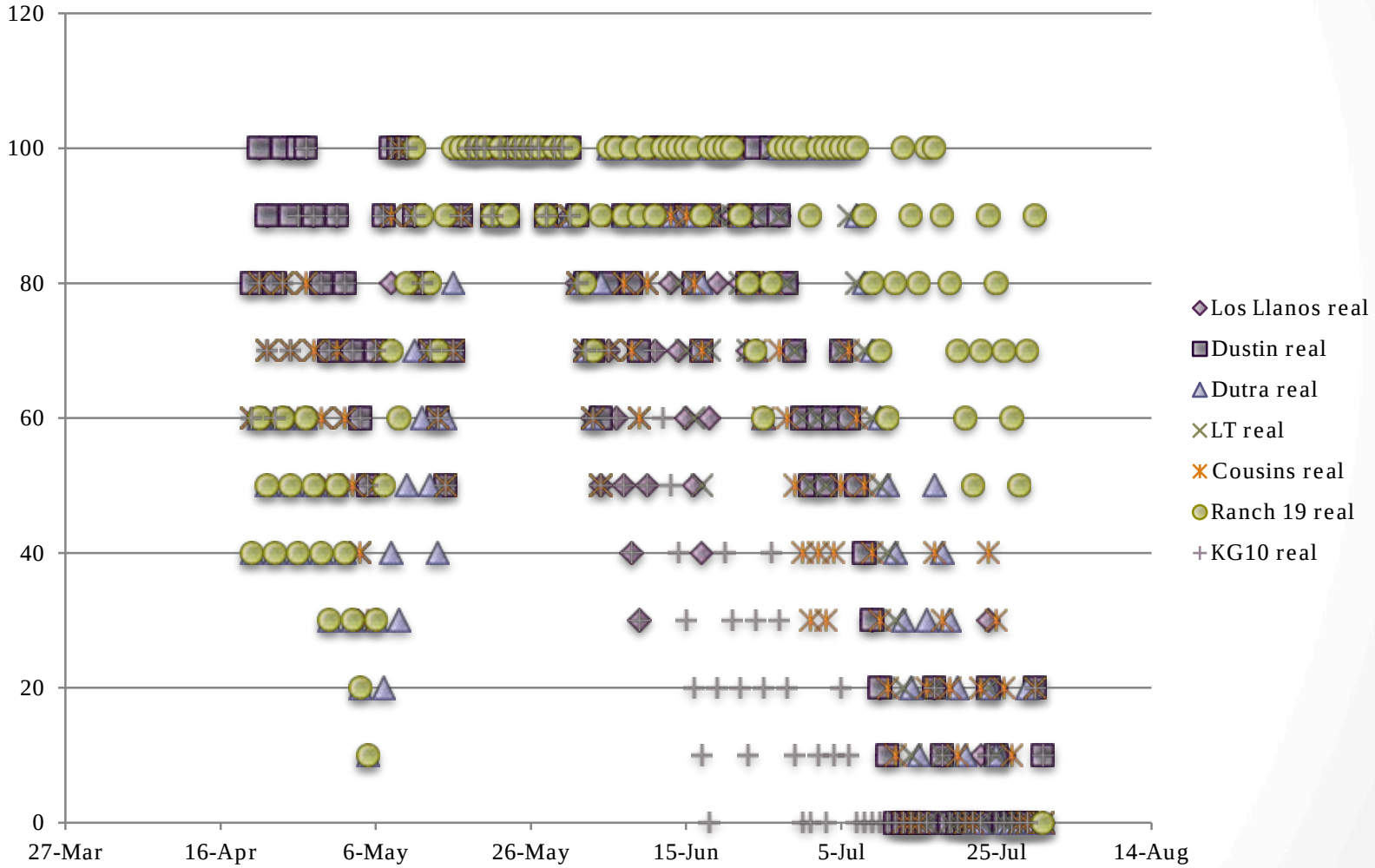
Magnitude of differences

Low matching

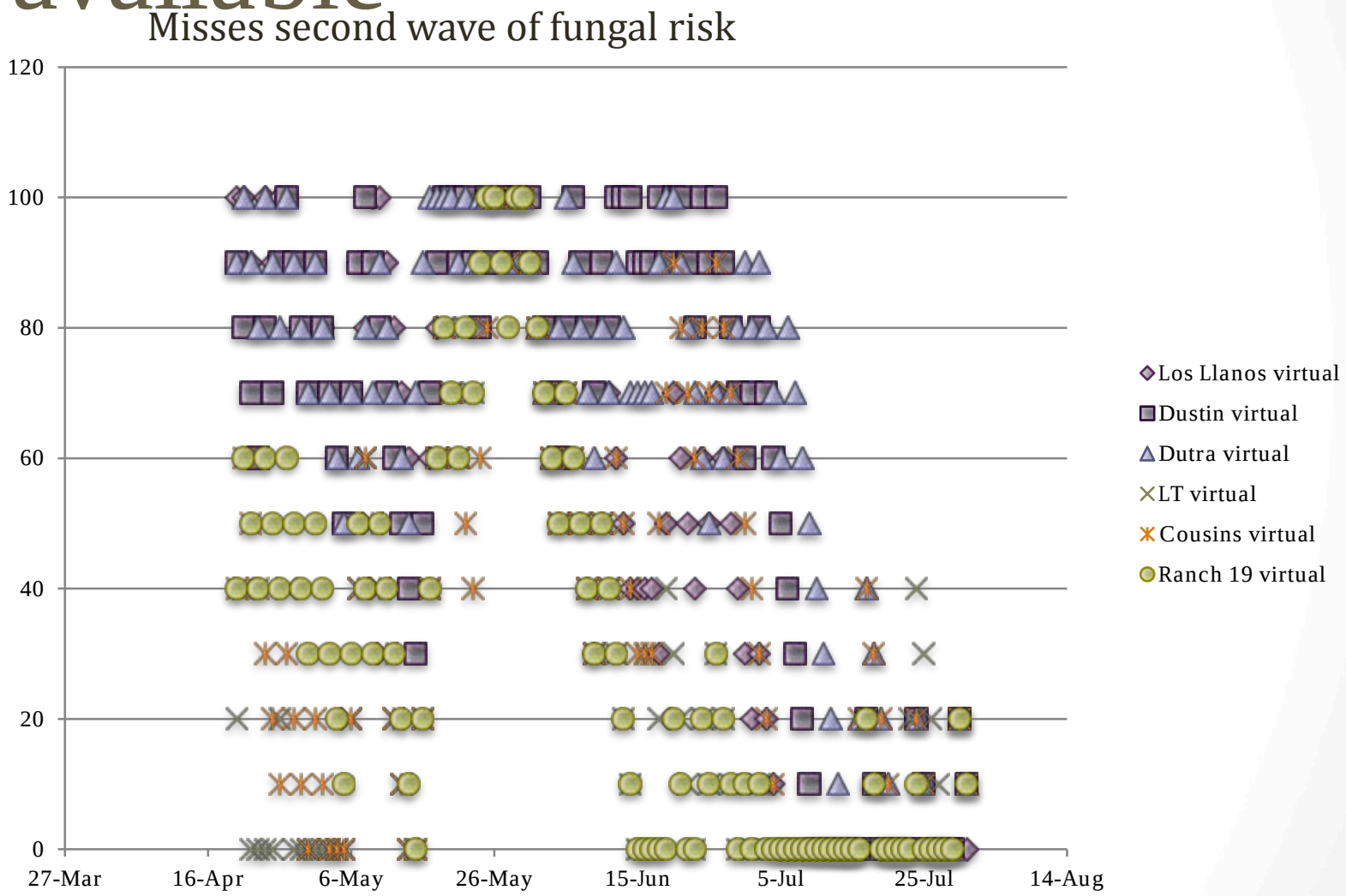
Virtual overestimated real



All real measurements available



All virtual measurements available

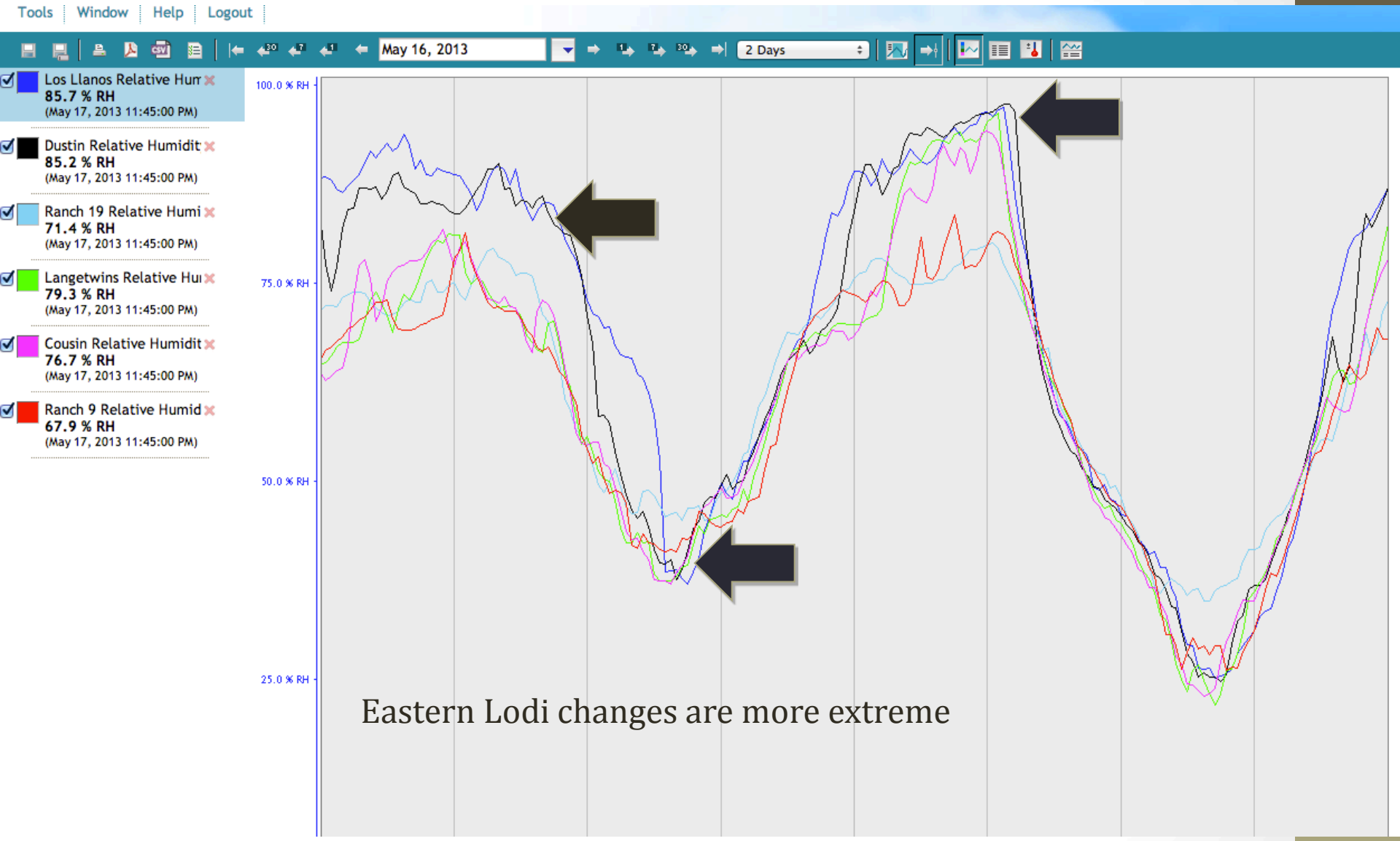


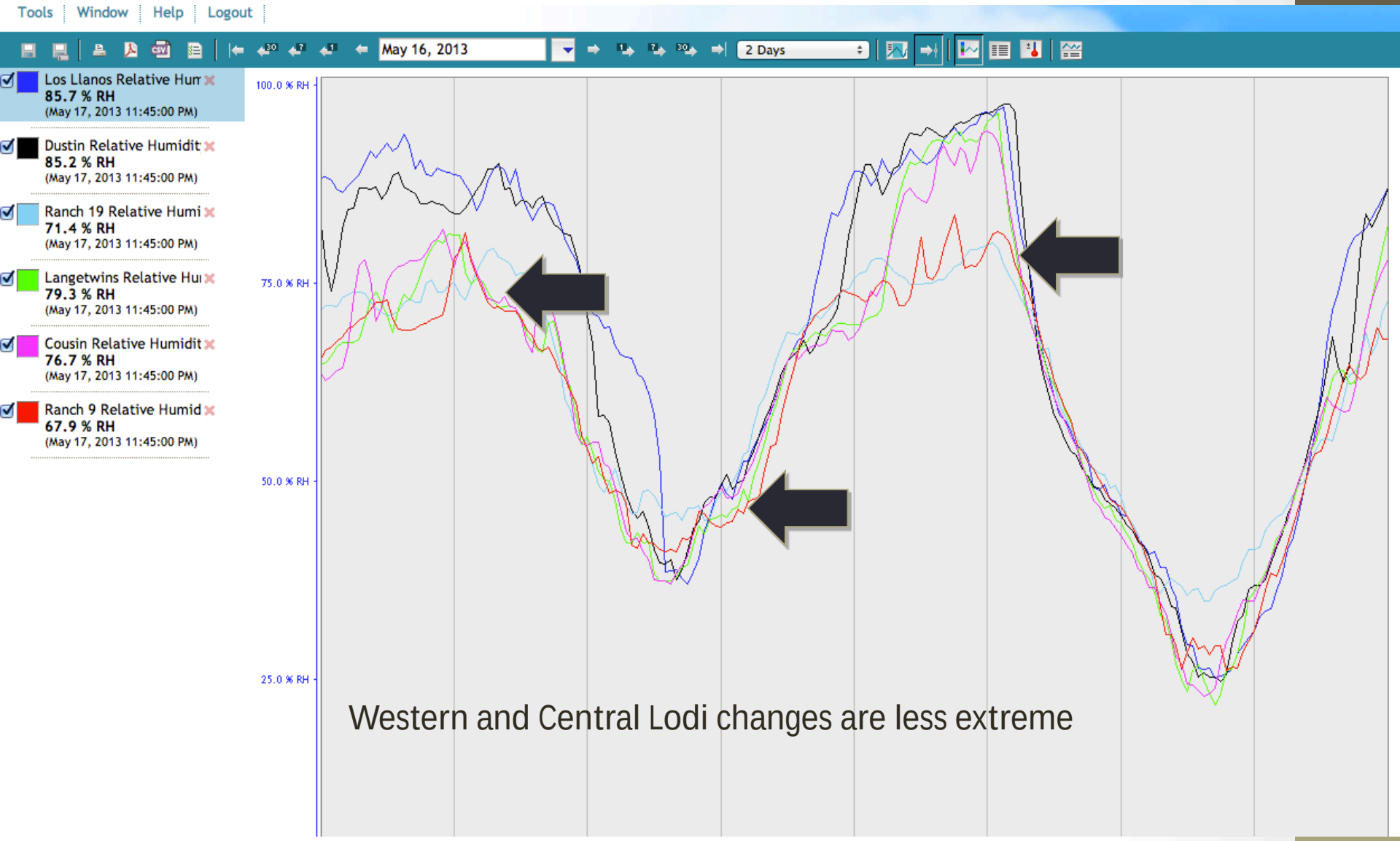
What's the story?

- Virtual network did not detect second temperature spike
- Generally gave lower risk predictions throughout season at many sites
- **How did this arise?**

Two (maybe more) reasons

- Virtual index algorithm error
- Humidity gradient


Tools
Window
Help
Logout
May 16, 2013
2 Days
Los Llanos Relative Hur
85.7 % RH
(May 17, 2013 11:45:00 PM)
Dustin Relative Humidit
85.2 % RH
(May 17, 2013 11:45:00 PM)
Ranch 19 Relative Humi
71.4 % RH
(May 17, 2013 11:45:00 PM)
Langetwins Relative Hu
79.3 % RH
(May 17, 2013 11:45:00 PM)
Cousin Relative Humidit
76.7 % RH
(May 17, 2013 11:45:00 PM)
Ranch 9 Relative Humid
67.9 % RH
(May 17, 2013 11:45:00 PM)
100.0 % RH
75.0 % RH
50.0 % RH
25.0 % RH
Eastern Lodi changes are more extreme


Tools
Window
Help
Logout
May 16, 2013
2 Days
Los Llanos Relative Hur
85.7 % RH
(May 17, 2013 11:45:00 PM)
Dustin Relative Humidit
85.2 % RH
(May 17, 2013 11:45:00 PM)
Ranch 19 Relative Humi
71.4 % RH
(May 17, 2013 11:45:00 PM)
Langetwins Relative Hu
79.3 % RH
(May 17, 2013 11:45:00 PM)
Cousin Relative Humidit
76.7 % RH
(May 17, 2013 11:45:00 PM)
Ranch 9 Relative Humid
67.9 % RH
(May 17, 2013 11:45:00 PM)
100.0 % RH
75.0 % RH
50.0 % RH
25.0 % RH
Western and Central Lodi changes are less extreme

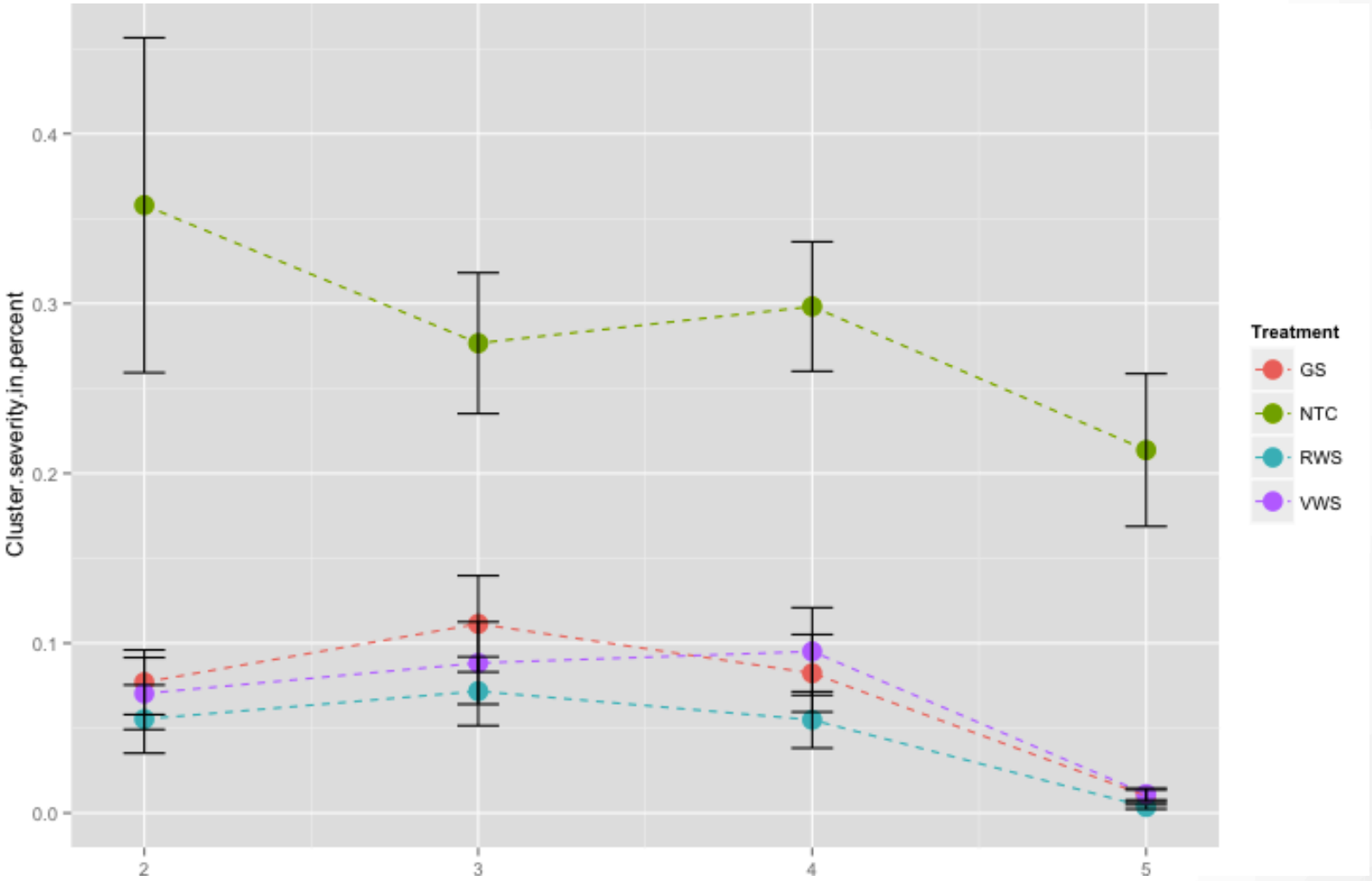
Preliminary conclusions of modeling data

- Eastern Lodi: Functional microclimate=large
- Western Lodi: Functional microclimate=small
  - Delta effects

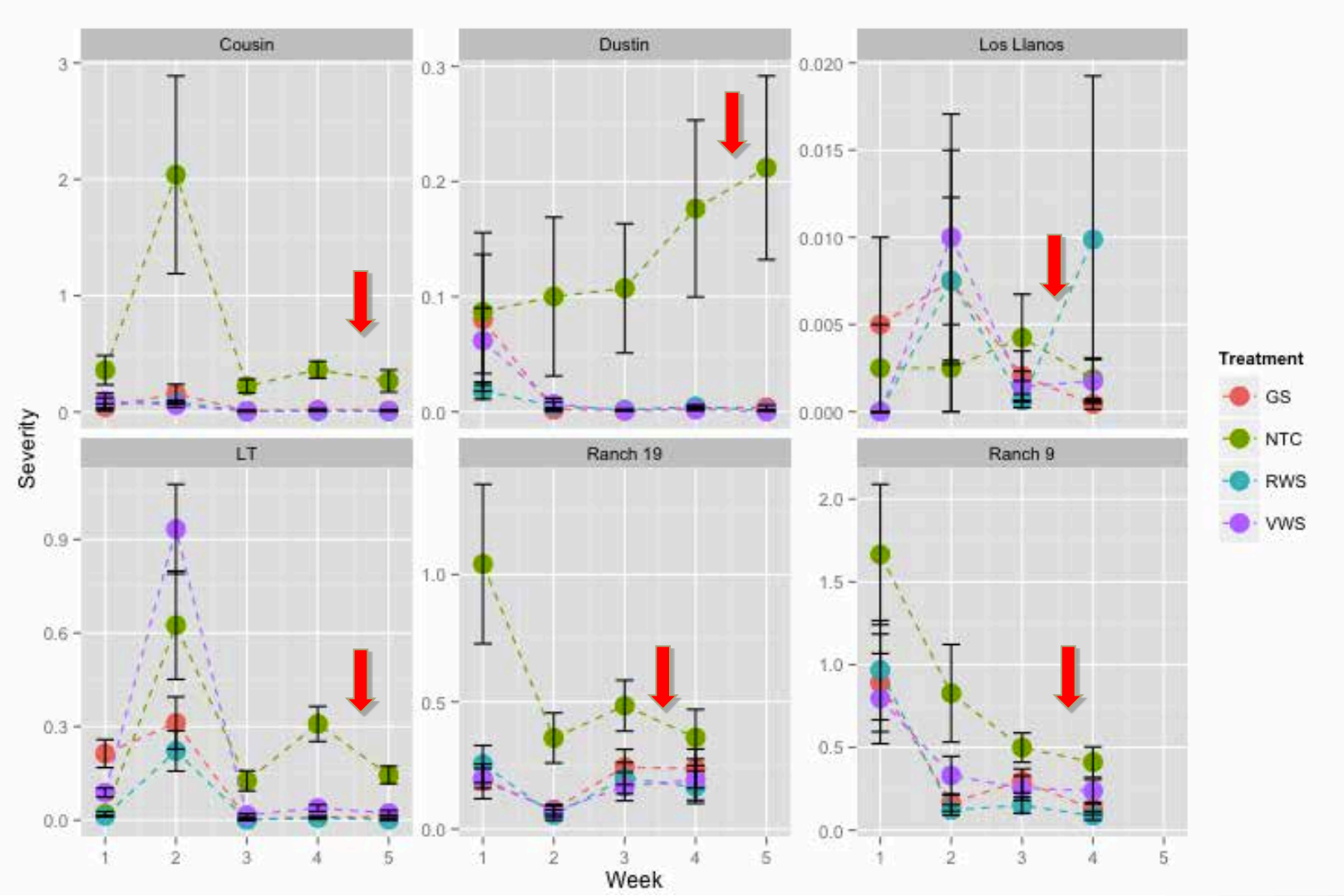
- Moving forward: Virtual calculation radius must consider microclimate type

- Work with model in off season to determine best size for virtual interpolation

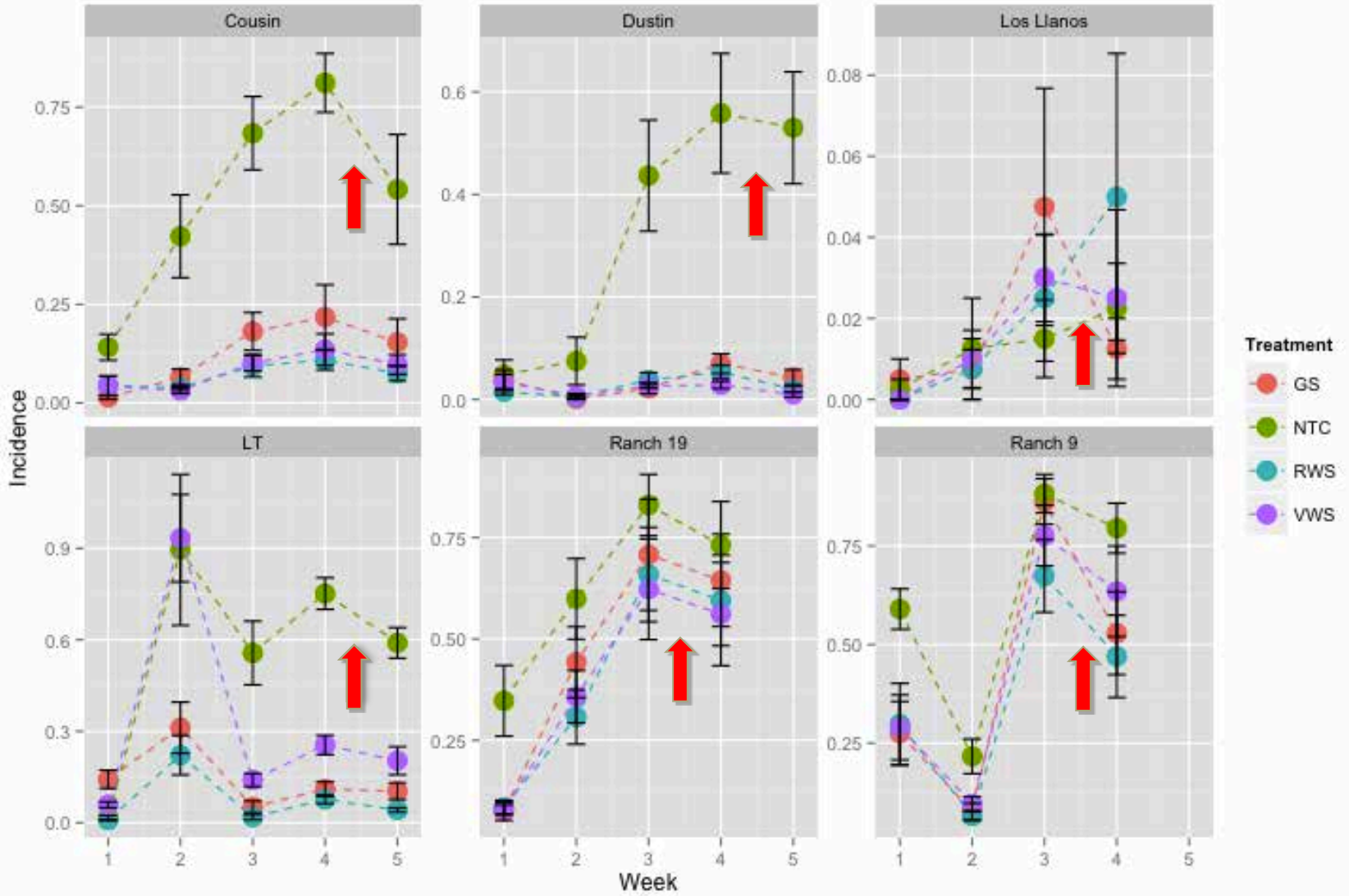
All site cluster severities



Severities over time



Incidences over time



Effect of heat wave

- Reduced mildew **incidence** by 10-30% and mildew severity by **<10%**
- More greatly affected spread (incidence) of mildew, did not totally destroy existing colonies (severity)

Preliminary conclusions

- Mildew = 10-25% less incident, 0-10% less severe following heat wave
  - Possibly selecting heat resistant mildew?

- Treatments ended up being similar-but were any sprays saved?

Prescribed vs. applied sprays: Real