Monitoring Vineyard Water Use and Vine Stress for Improved and Sustainable Water Management

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The Problem

250,000 ha

Wine Grape Production (13,000 ha/yr)

$3B

Water Resources (groundwater storage)  (snowpack)

*Faunt, C.C. et al., Water Availability and land subsidence in the Central Valley, California (2016)
Importance / Why it Matters

Vineyards/Orchards are replacing annual crops and pastures, effectively “hardening demand” for water use.

Economics are creating a “Race to the Bottom”. Growers with sufficient financial resources are able to drill deeper wells to sustain production, forcing out other farmers that cannot afford the added expense.

Must Improve Water Management

Potential Solution at Field to Regional Scale

Provide a range of products based on satellite-derived maps of Evapotranspiration (ET)

ALEXI / DisALEXI / Fusion Model
- Physically-based
- Daily / 30-m ET estimates
- Does not require ground-based inputs or Calibration
- Well tested over multiple surfaces

Shown to be a critical part of improving management of water resources by providing quantifiable values of water use and stress.

Why?

Model used to estimate ET
Incorporating UAV High Resolution Imagery

UAV imagery = Sensors-Landsat fusion / subfield characterization

Potential Solution at canopy scale

GOES/MODIS
Landsat
UAV/Aircraft

Overpass frequency

Optimal frequency for submeter information
Combining ground biophysical, remote sensing, biometeorological and high resolution aerial imagery with satellite obs. and models
Deliverable Products to Stakeholders

Spatial and temporal monitoring of ET and stress at either field or landscape and regional scales
Deliverable Products to Stakeholders-weekly water use and irrigation amounts

- Compare to “Business-as-usual” (BAU) methods applied to a Variable Rate Drip Irrigation (VRDI) system.
- 2018 Case study: using 30 m VRDI grid with ET from BAU and Fusion Method to prescribe weekly irrigation for 4 zones with 2 crop ET management factors
Deliverable Products to Stakeholders - Weekly Irrigation Amounts

Zones 1 & 2: Using $ET_{\text{Fusion}}$ with deficit irrigation management factor
Zone 3: Using $ET_{\text{BAU}}$ with best management factor
Zone 4: Using $ET_{\text{Fusion}}$ with best management factor

- Applied on a 30m scale (same as VRDI)
- Each cell can be changed
  - Grape type, time of year, amount of stress (management factor) the manager would like to impose.
Impacts

- Close communication and collaboration with stakeholders (irrigation managers)
- Determine regions experiencing stress in near real time
- Prevent over-irrigation in regions already well watered
- Combine routine satellite-based ET with periodic UAV for plant level management
Anticipated Impacts

A better understanding between grape yield and ET/LAI/Irrigation

* Maintain grape yield and quality while decreasing water consumption.
Anticipated Impacts

Deployment of Satellite/UAV-Based applications

• Desktop and mobile based – information delivered to growers real time via mobile applications

• Use of ‘Landsat web services’ and cloud computing systems via:
  • Amazon S3
  • Google Earth Engine

• Custom mobile applications for:
  • Viewing
  • Editing
  • Collection

• 24-HOUR DELIVERY