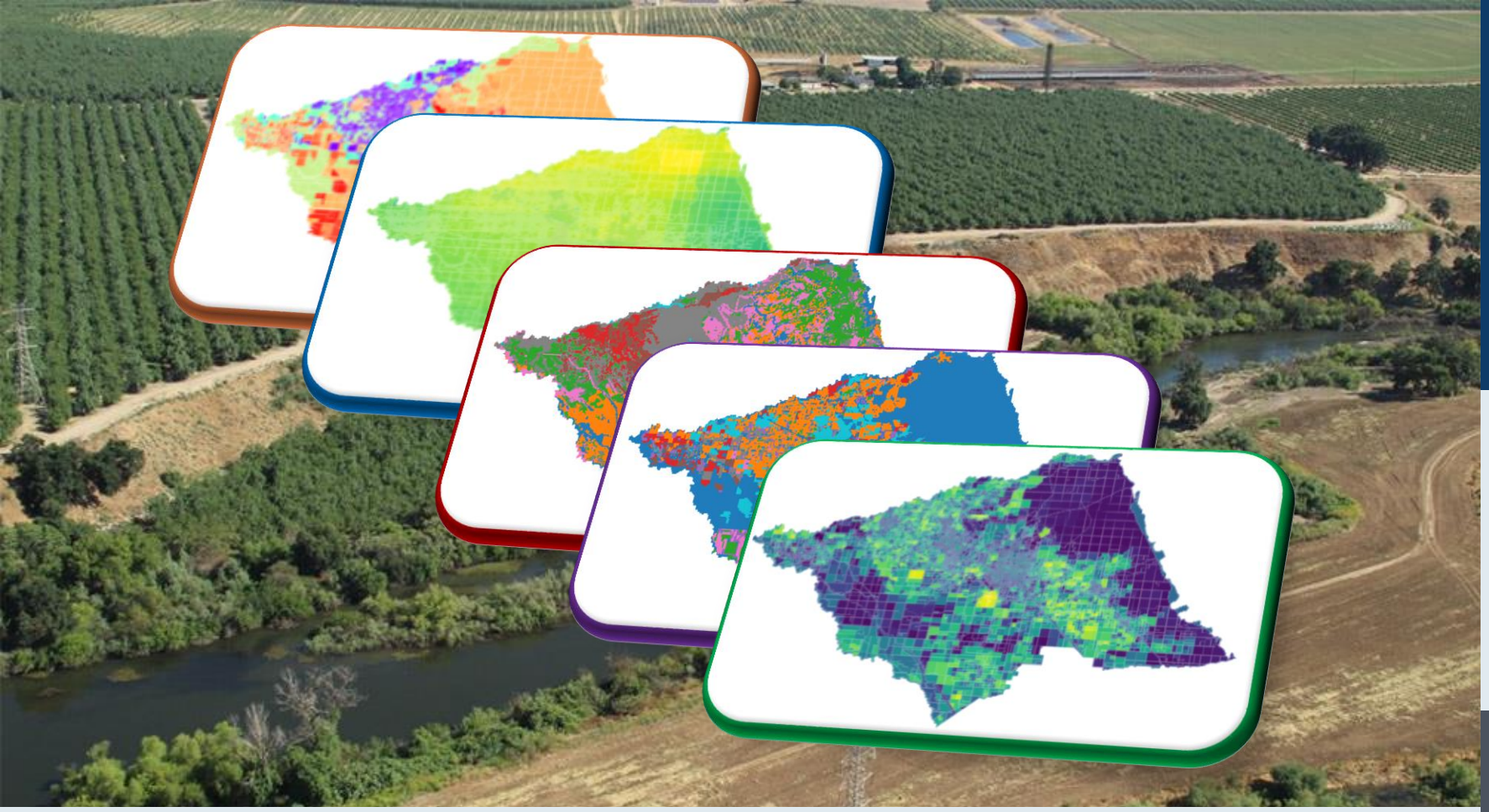


Woodard & Curran

CWEMF 2023

Pulling it all Together

High Resolution Demand Modeling

Dominick Amador

In collaboration with:

Jack Baer, Jim Blanke & Ali Taghavi

Merced Subbasin Remote Metering Tool

Project Goal: Develop a framework to integrate remote sensing data with state and local models to estimate both net- and gross-groundwater production.

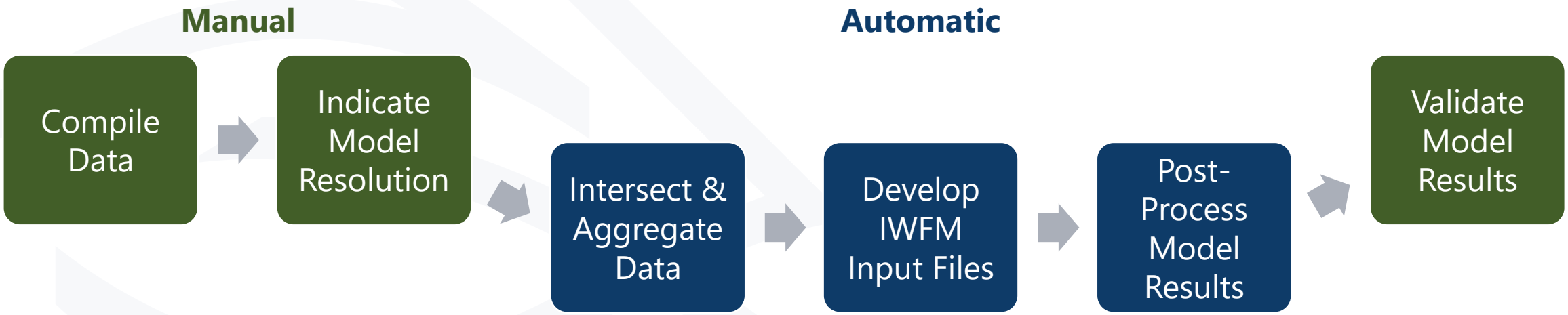
→ Estimate Net-Groundwater Use
- Evapotranspiration
- Effective Precipitation
- Surface Water Supplies

→ Estimate Groundwater Pumping
- Irrigation Methodology
- Water Supply Source
- Soil Characteristics

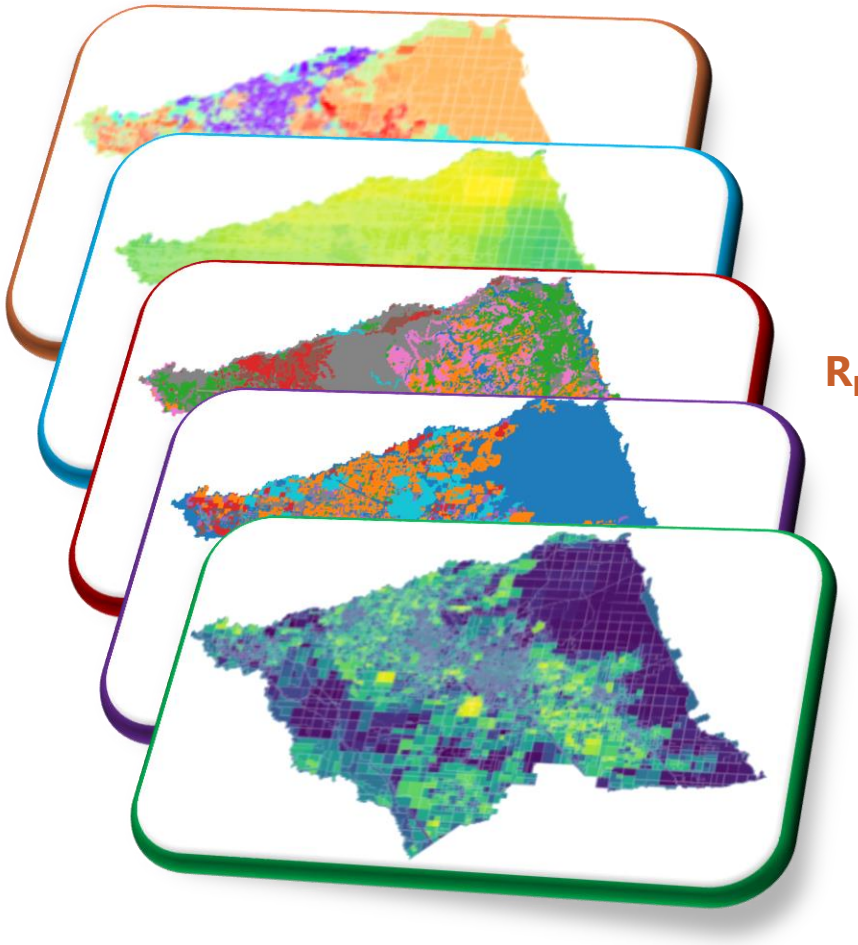
Workflow Diagram

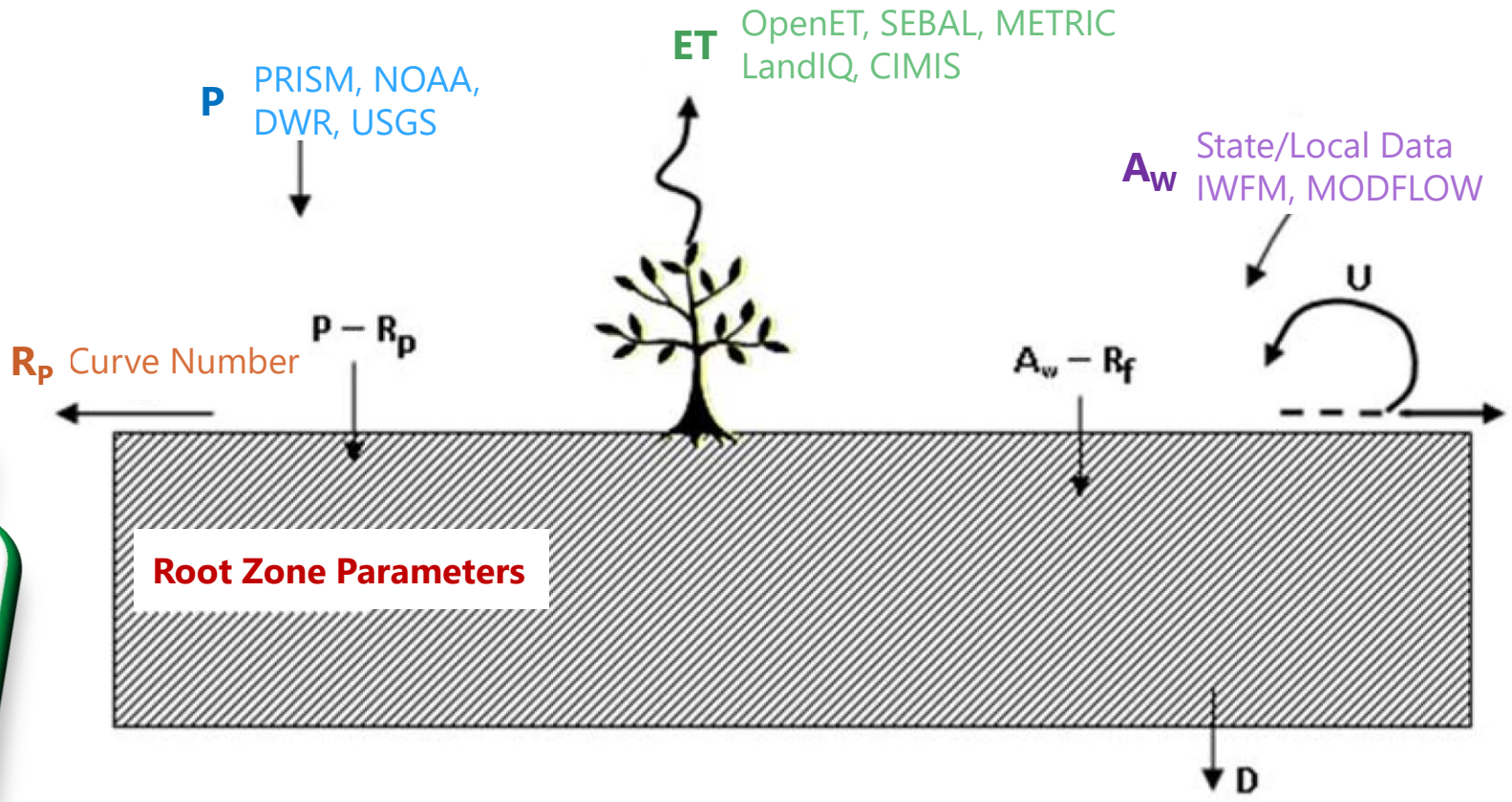
Project Approach

- Establish and integrate a high-resolution IDC model to support refinement of new and existing groundwater models.
- Create an integrated software package to compile available data and streamline development of IWFM-based modeling efforts in order to:



Data Compilation





Model Resolution

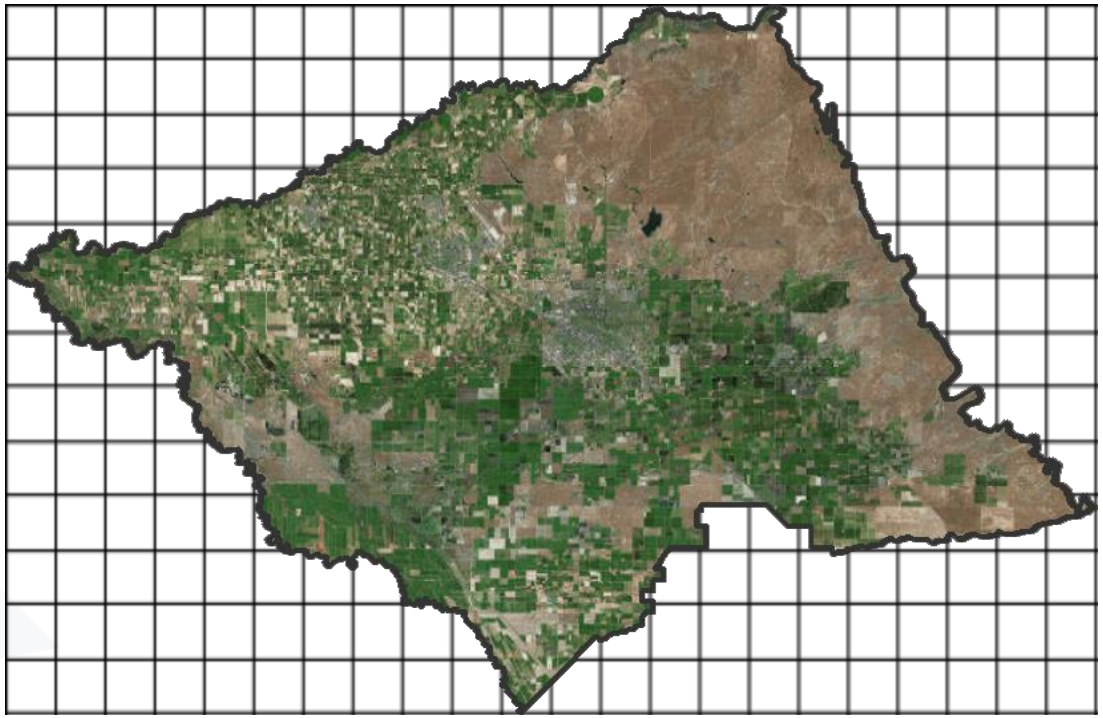
Resolution

→ Time-Step:
- Monthly Simulation
- Daily Simulation

→ Spatial Format:
- Management Areas
- Parcel or Field-level
- Finite Grid

→ Constraints:
- Data Availability
- Simulation Run Time
- File Size / Drive Space

Element Resolution: 2,000 acres
Number of Elements: 250



Model Resolution

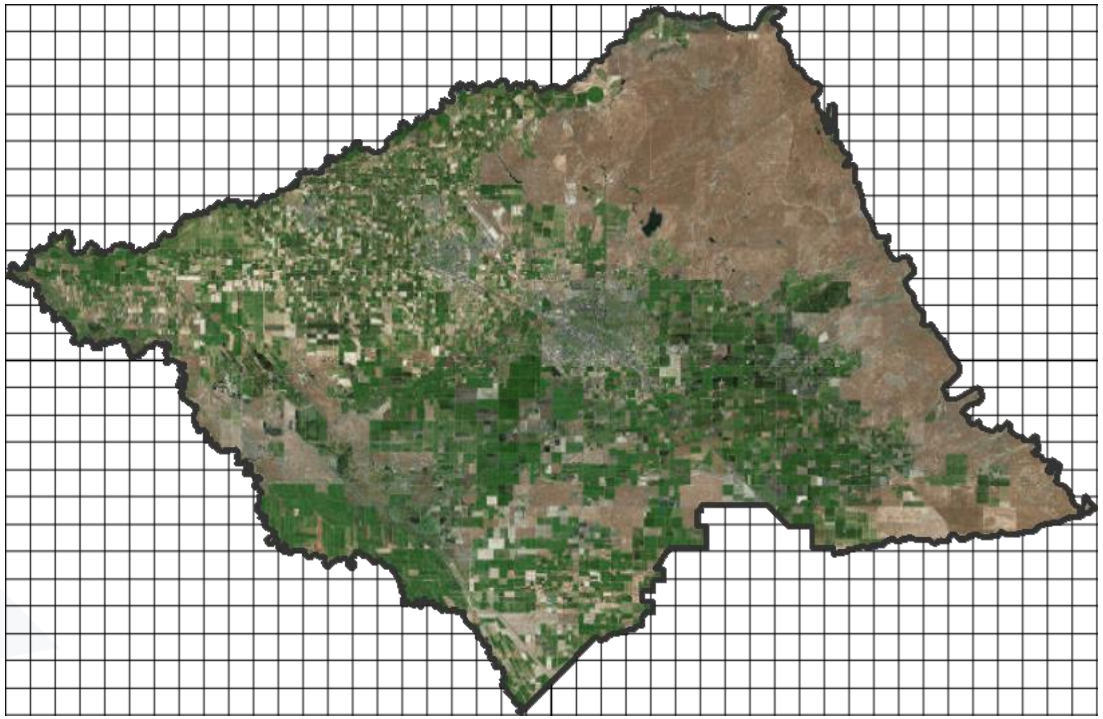
Resolution

→ Time-Step:
- Monthly Simulation
- Daily Simulation

→ Spatial Format:
- Management Areas
- Parcel or Field-level
- Finite Grid

→ Constraints:
- Data Availability
- Simulation Run Time
- File Size / Drive Space

Element Resolution: 500 acres
Number of Elements: 1,000

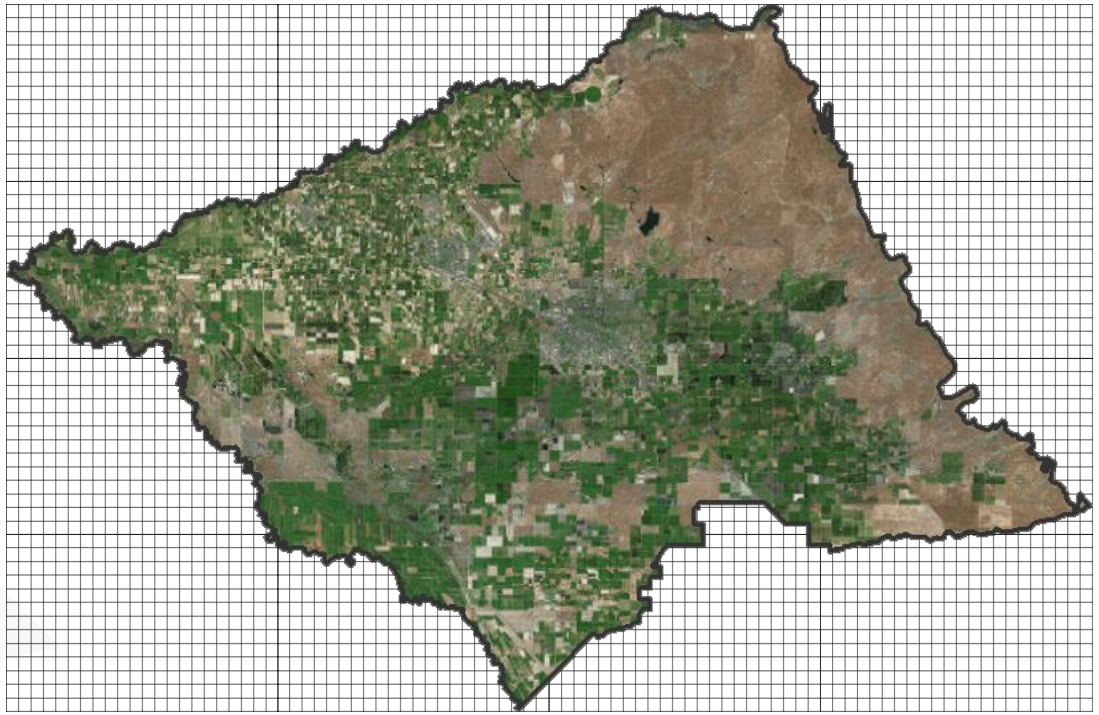


Model Resolution

Resolution

- Time-Step:
  - Monthly Simulation
  - Daily Simulation
- Spatial Format:
  - Management Areas
  - Parcel or Field-level
  - Finite Grid
- Constraints:
  - Data Availability
  - Simulation Run Time
  - File Size / Drive Space

Element Resolution: 200 acres
Number of Elements: 2,500

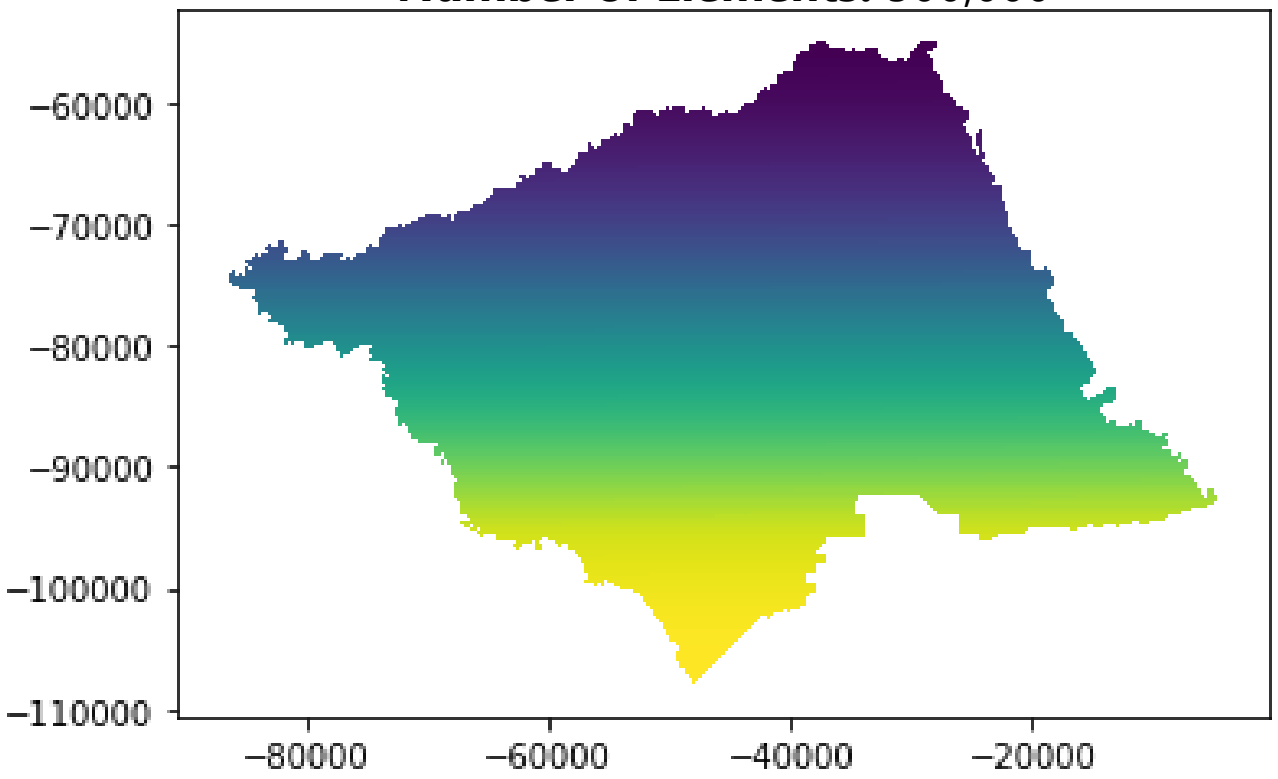


Model Resolution

Resolution

- → Time-Step:
  - Monthly Simulation
  - Daily Simulation
- → Spatial Format:
  - Management Areas
  - Parcel or Field-level
  - Finite Grid
- → Constraints:
  - Data Availability
  - Simulation Run Time
  - File Size / Drive Space

Element Resolution: 1 acre
Number of Elements: 500,000



Soil Parameters: Texture Based Modeling

Approach:

→SSURGO soil texture

→12 soil classifications

→4 hydrologic soil groups

Benefits:

→Stakeholder Understanding

→One-time calibration

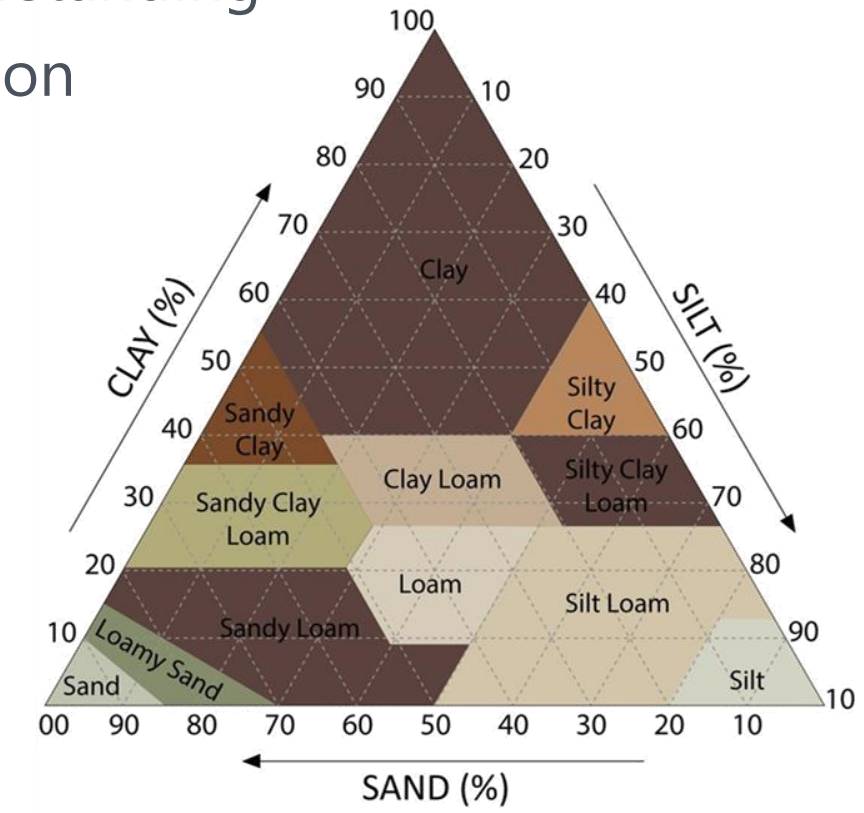
Parameters: Rawls et al. 1982

→Field Capacity & Wilting Point

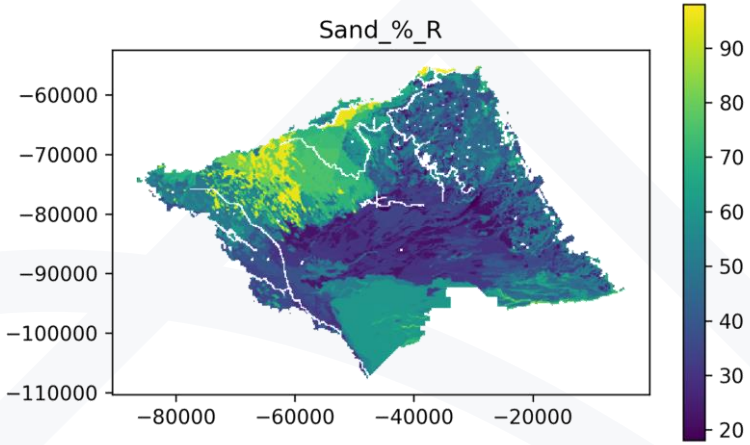
→Pore Size Distribution Index

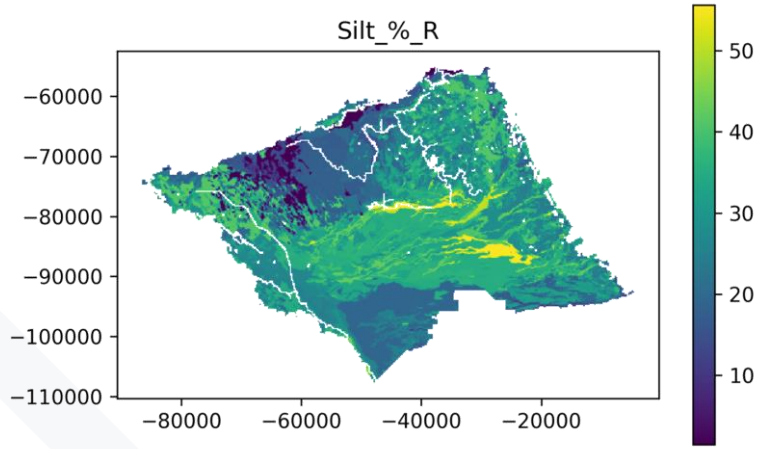
→Hydraulic Conductivity

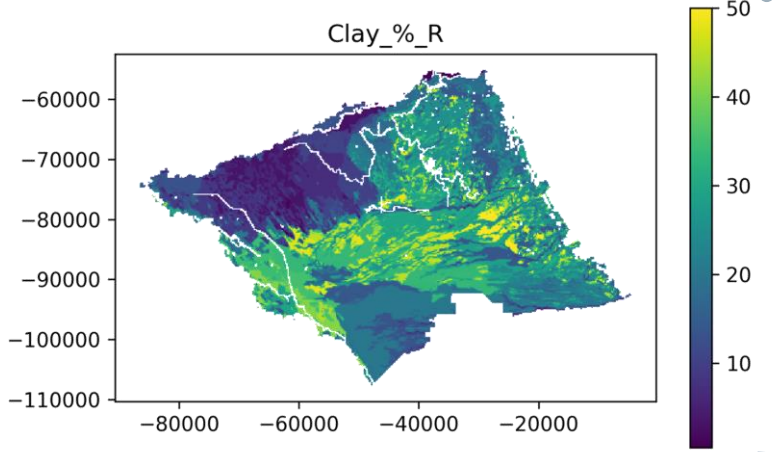
→Soil Porosity

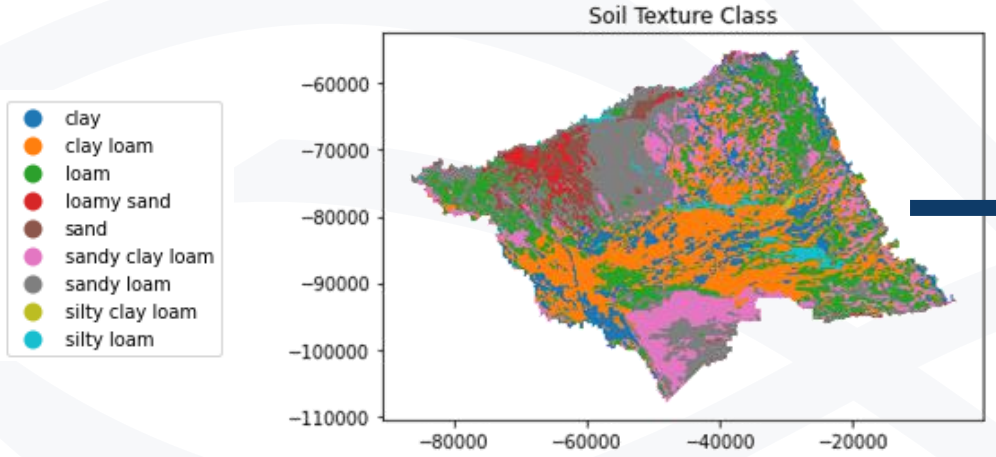


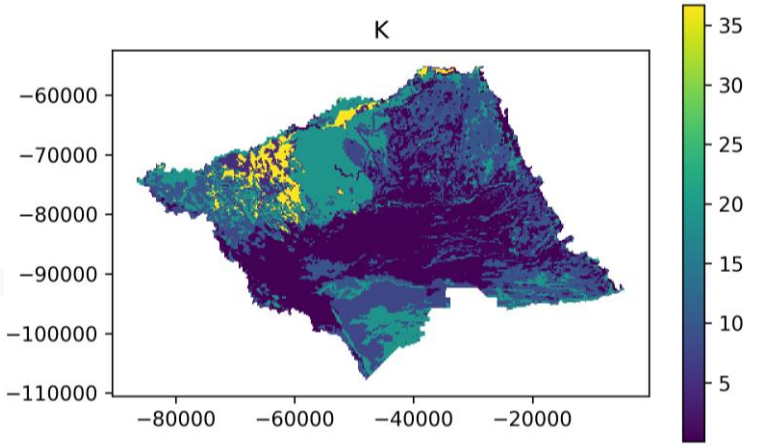
Soil Parameters: Merced Subbasin



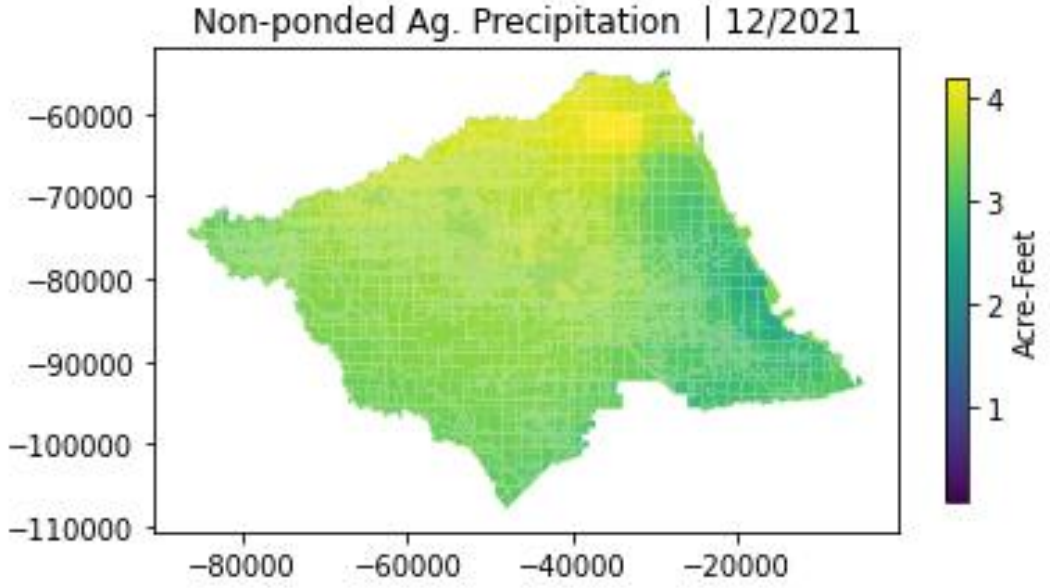








Hydrology: Precipitation & Evapotranspiration



Precipitation (PRISM)

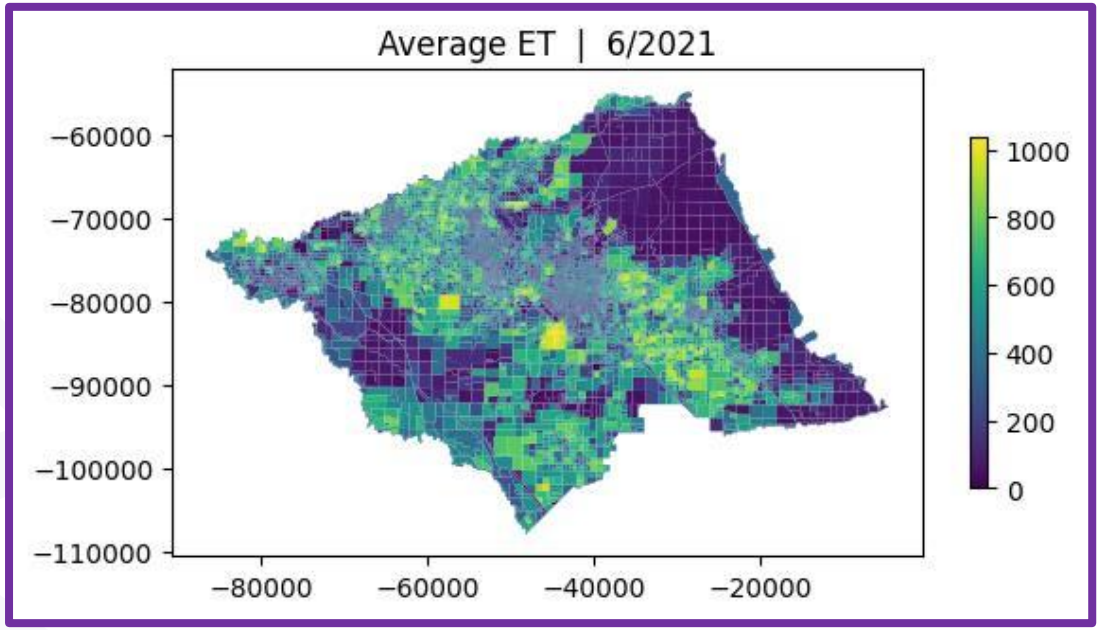
→ Daily data estimated on an 800m grid

→ Infiltration estimated per CN method

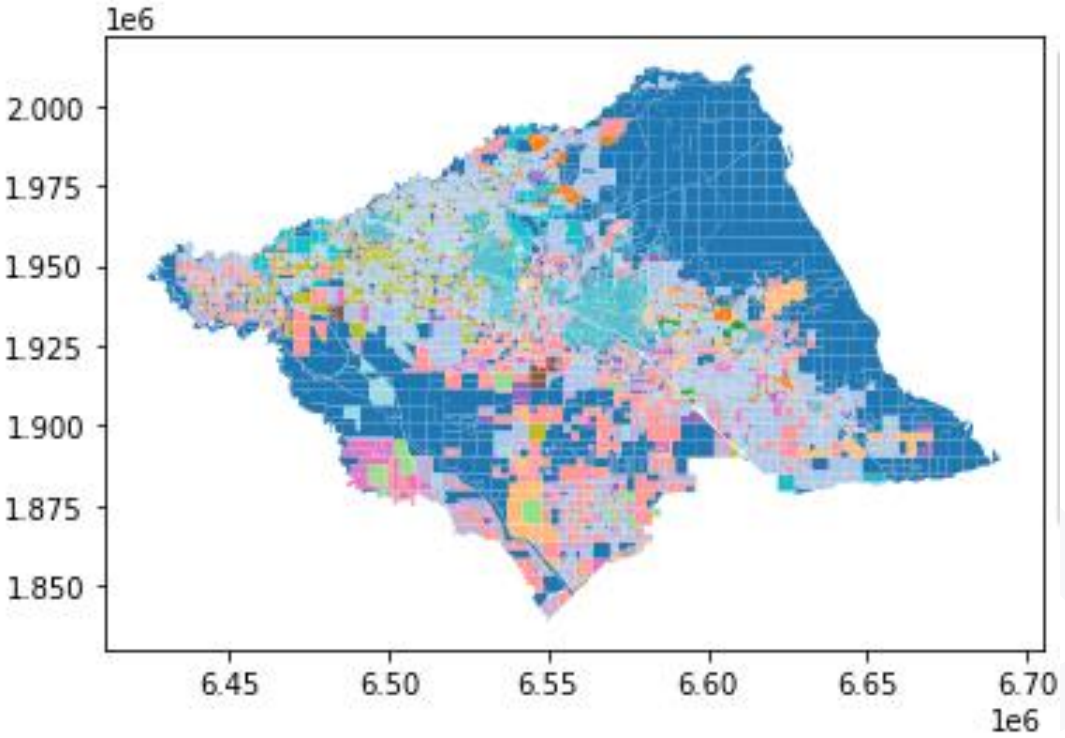
Evapotranspiration (OpenET/CIMIS)

→ Monthly ET_A estimated on a 30m grid

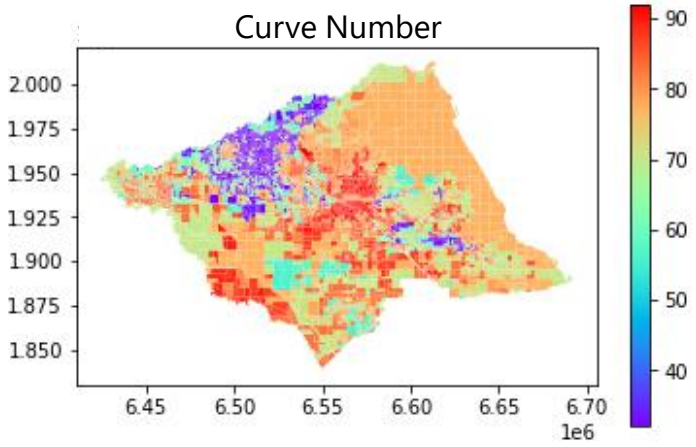
→ Daily ET_A correlation via CIMIS data



Land Use Dependent Variables



- Operational dependent variables allow us to refine and validate model performance
  - Curve Number (NRCS TR-55)
  - Surface Water Supply
  - Target Soil Moisture



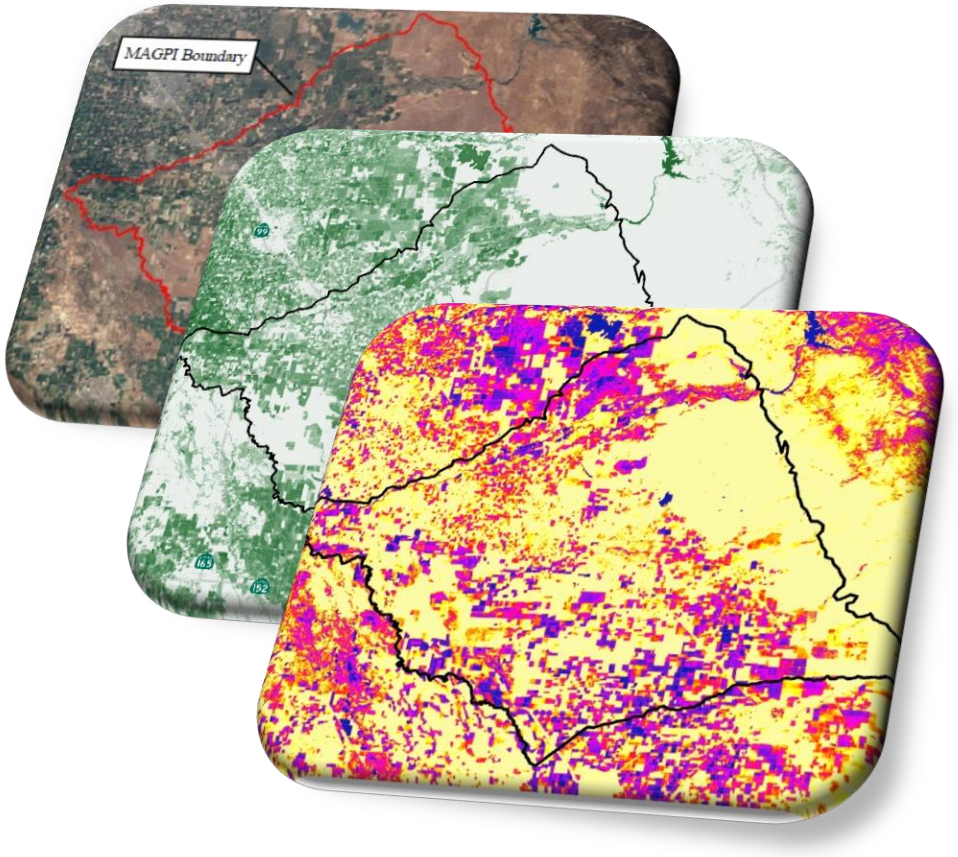
Irrigation Management: Calibration

→ Base Calibration:

- Representative of flood irrigation (TSM=1.0)
- Adjust soil parameters within published range
- Consumptive use factor (CUF) between 0.55 and 0.75 based on soil conditions and water supply

→ Advanced Calibration:

- Representative target soil moisture (TSM) developed to account for increased efficiency from varying crop and irrigation management
  - » Drip, sprinkler, surface, subsurface irrigation
  - » Deficit irrigation, recharge events, reuse, return flow



Model Validation: Project Dashboard

Select parcel number and desired year of analysis

Full time-series, and calculations can be exported to .csv upon request

Output graphics can be queried on specific years or full time series

Input Data:
Parcel Number: _____ Summary Year: _____

Output Data:
Land Use: _____ Total Acreage: _____
ET $_{Actual}$: _____(af/y) ET $_{Applied\ Water}$: _____(af/y)
Precipitation: _____(af/y) Surface Water: _____(af/y)
Runoff: _____(af/y) Net-Groundwater: _____(af/y)
Return Flow: _____(af/y) Pumping: _____(af/y)

See Detailed Breakdown