TODAY'S ACTION

Consider receiving an update on the Salinas Valley Groundwater Basin Investigation

Salinas Valley Groundwater Basin Investigation - Project Team

Project Management

Howard Franklin, P.G., Senior WRA Hydrologist

Amy Woodrow, P.G., WRA Hydrologist

Model Development

Wesley Henson, PhD., Research Hydrologist

Data Analysis and Final Report

Derrik Williams, P.G., C.Hg., Principal Hydrogeologist

Monterey County Basin Investigation :
Salinas Valley Model Suite Report

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Food and Water Security Research Partnership

CAWSC

WMA

Reclamation

MCWRA

Monterey County

Tool Development

- Wesley Henson
- Scott Boyce
- Ian Ferguson – Reclamation
- Donald Martin
- Randy Hanson

Hydrologic Modeling

- Marisa Earll
- Deidre Herbert

Municipal/Private Partners

- Howard Franklin-MCWRA
- Matt Baillie, Les Chau (Wood)
- Derrik Williams (Montgomery)
- USC
- TUD

Mentoring Collaborations

- Technical University of Munich – Germany
- Daniel Bittner – TUM
- Jake Hasslau – U of IL
- Anav Mittal – UC Berkeley
- Lauren Finkelstein – SFSU

General Terminology Overview

California Pesticide Use Reporting Database (CalPUR)- A comprehensive database of pesticide application and crop data collected since 1974.

MODFLOW One Water Hydrologic Model (OWHM) – A modular groundwater/surface water/agricultural/operations model based upon the MODFLOW groundwater modeling software.

MODFLOW Farm Process (FMP)- An implementation of agricultural operations and the United Nations Food and Agricultural Organization Crop Model.

Water Balance Subregion (WBS)- A water accounting subregion used to estimate and simulate agricultural supply and demand and quantify hydrologic budgets.

Surface Water Operations module (SWO)- A rigorous and flexible module to simulate complex reservoir operations, enforce simulated river flow thresholds and limits, and provide linkages between water balance subregions and reservoirs.

Nash Sutcliffe Coefficient of Model Efficiency (NS)- A metric used to quantify model performance (how well a model reproduces data).

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Salinas Valley Model Suite

Basin Characteristics Model (BCM) - A 1-D climate, rainfall, and runoff model used to prepare precipitation and potential evapotranspiration input for models.

Salinas Valley Geological Model (SVGM)- A 3-D Geologic model of Salinas Valley with discrete representation of geologic structures, aquifers, confining units and textural properties of geologic materials.

Salinas Valley Watershed Model (SVWM)– A historical rainfall and runoff watershed model of the entire area that contributes flow to the Salinas river and tributaries. The SVWM is calibrated from 09/30/1948 to 12/31/2014 and updated though water year 2018.

Salinas Valley Integrated Hydrologic Model (SVIHM)- A historical integrated hydrologic model that uses estimated and measured data to simulate historical rainfall, runoff, recharge, storage, water levels, streamflow, water supply and demand for native and cultivated lands to develop comprehensive water budgets. The SVIHM is calibrated from 10/1/1967 to 12/31/2014 and updated though water year 2018.

Salinas Valley Operational Model (SVOM)– An operational baseline model that inherits, the geologic structure, hydrologic properties, and climate from the SVIHM. The SVOM assumes that current reservoir operations and 2014 land use were constant for the entire simulation from 10/1/1967 to 12/31/2014. The SVOM is used as a baseline for evaluation of potential water supply projects and to quantify project benefits.

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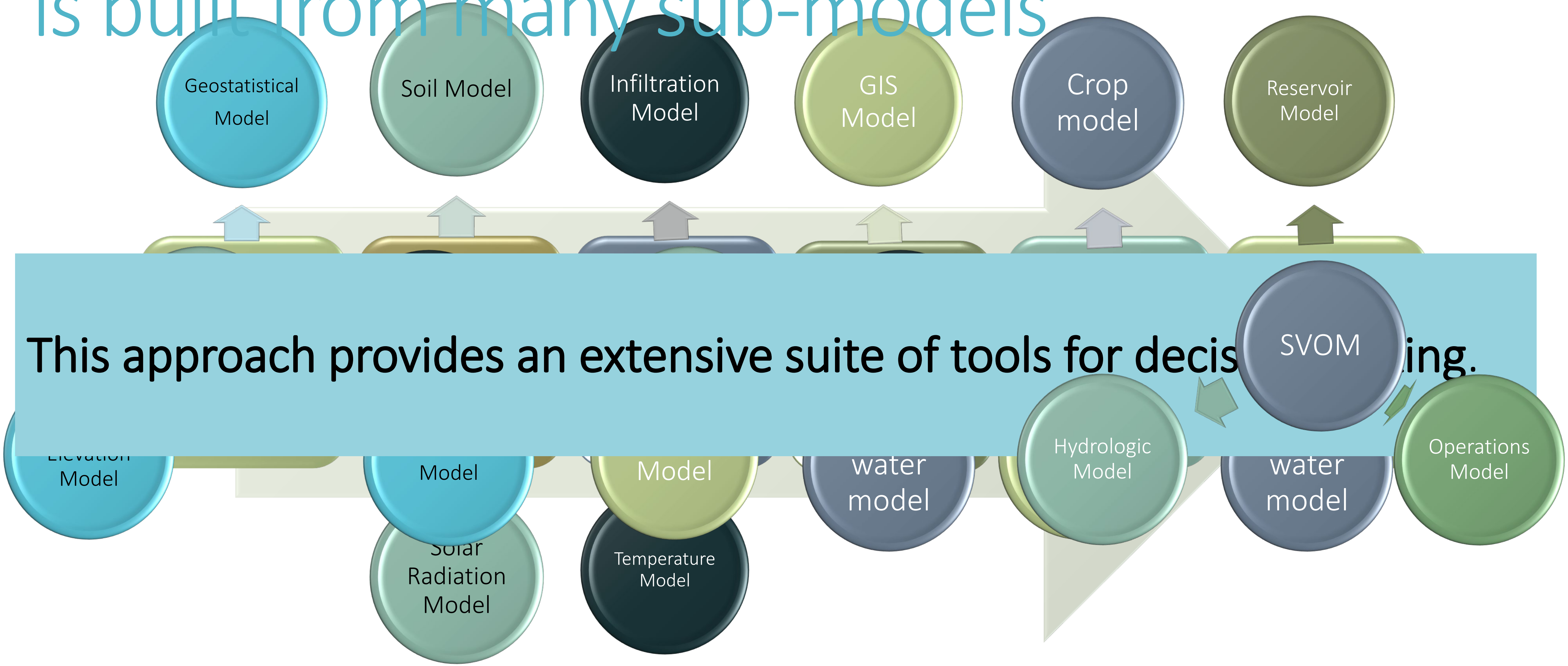
Salinas Valley Integrated Hydrologic Model is built from many sub-models



This approach provides an extensive suite of tools for decis ing.

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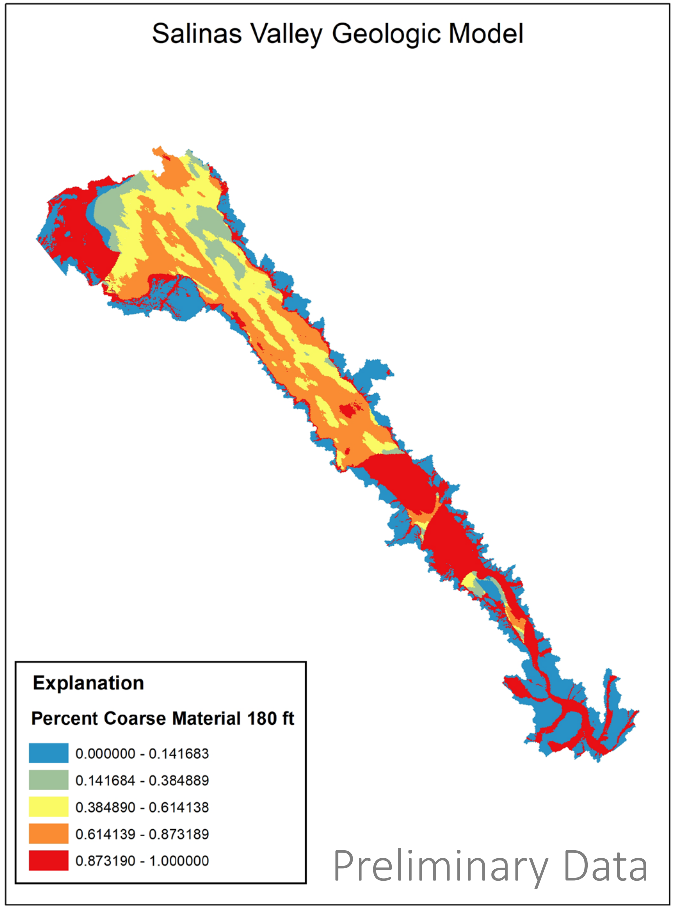
Salinas Valley Geologic Model (SVGM)



Salinas Valley Geologic Model showing percentage of coarse material distribution for the 180-ft aquifer in the Salinas Valley Integrated Hydrologic Model.

- Provides a robust hydrogeologic framework and conceptual flow model
- 3-D Geologic texture model of entire Salinas Valley and watersheds
- Downscaled from regional scale model
- Developed subregional geologic facies
- Lithology database from Monterey County

Model Framework – 9 Layers with 529 ft. by 529 ft. grid cells

Layer 1 → Salinas Shallow/Recent Aquifer
Layer 2 → Salinas Valley Aquitard
Layer 3 → 180-Ft Aquifer
Layer 4 → Middle Aquitard
Layer 5 → 400-Ft Aquifer
Layer 6 → Deep Aquitard
Layer 7 → Paso Robles Formation
Layer 8 → Purisima/Santa Margarita Formation
Layer 9 → Composite Bedrock Aquifer

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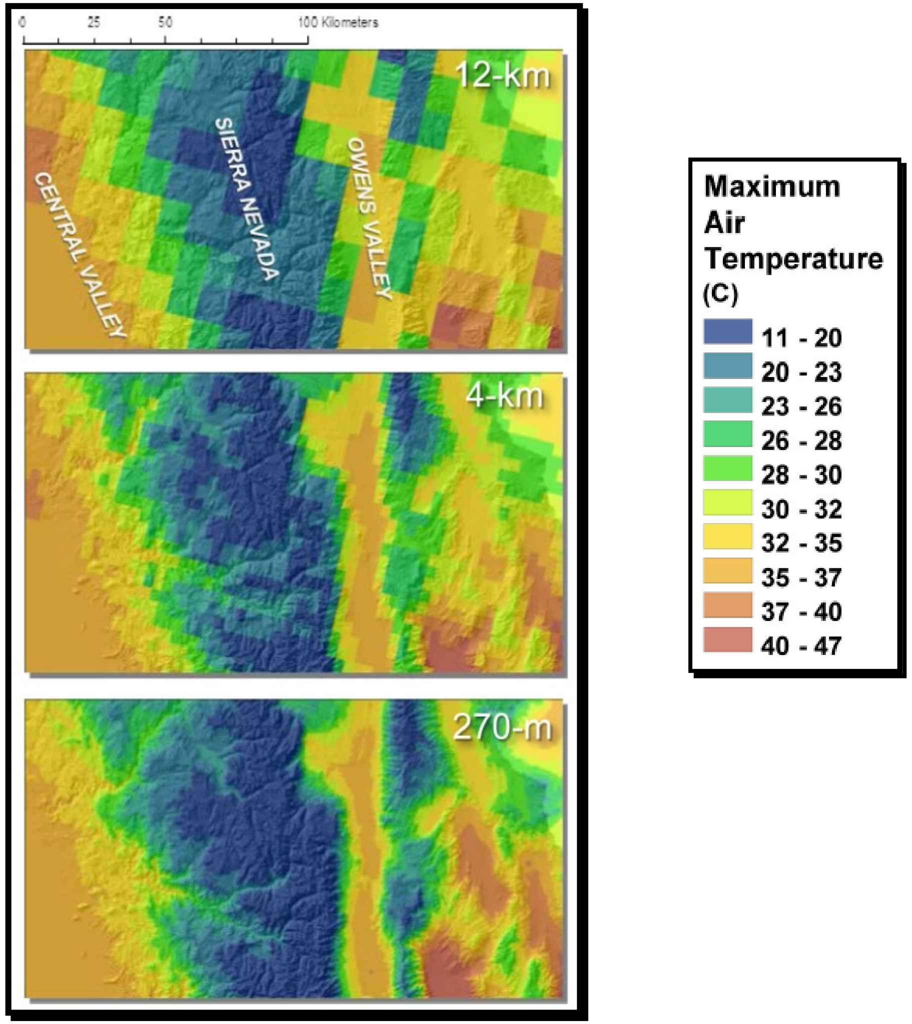
Basin Characteristics Model

Basin Characteristics Model (BCM) tools are used to prepare spatially distributed climate input for hydrologic models



- Climate data is downscaled to 270m
  - maximum temperature (Tmax)
  - minimum temperature (Tmin)
  - Precipitation
- Potential evapotranspiration (PET) is estimated
  - Priestly Taylor
  - Bias correction to California Irrigation Management Information System (CIMIS) station data.
  - With solar radiation model that incorporates slope, aspect, and topographic shading (to define the percentage of sky seen for every grid cell) (Flint and Childs 1987).
- Downscaled using Gradient Inverse Distance Squared (GIDS) approach (Nalder and Wein, 1998)

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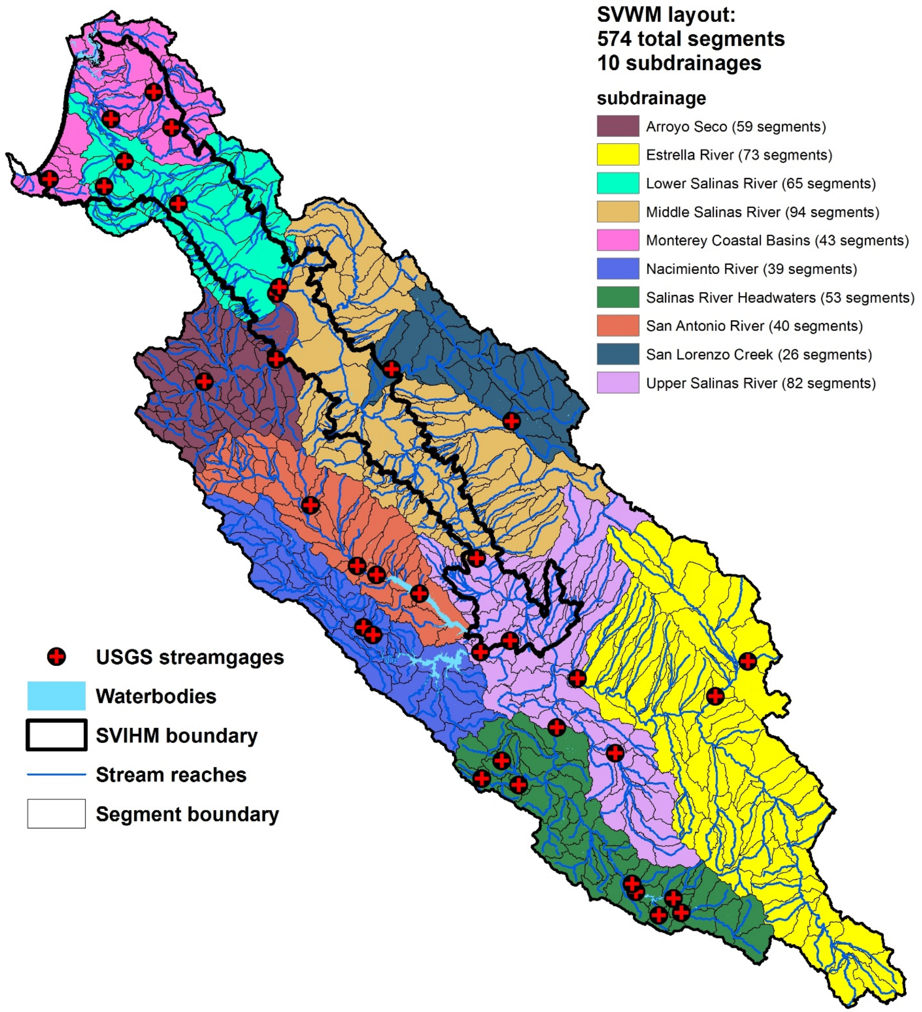
Salinas Valley Watershed Model (SVWM)



Salinas Valley Watershed Model (SVWM) and Salinas Valley Integrated Hydrologic Model (SVIHM) showing boundaries, stream networks, stream gages, and subdrainages.

- Simulates watershed processes for the entire Salinas River Valley from Paso Robles to the coast
- Regionally downscaled climate from Basin Characteristics Model
- Provides surface inflows to integrated models from hillslopes to valley floors.
- Sediment and Contaminant transport capable

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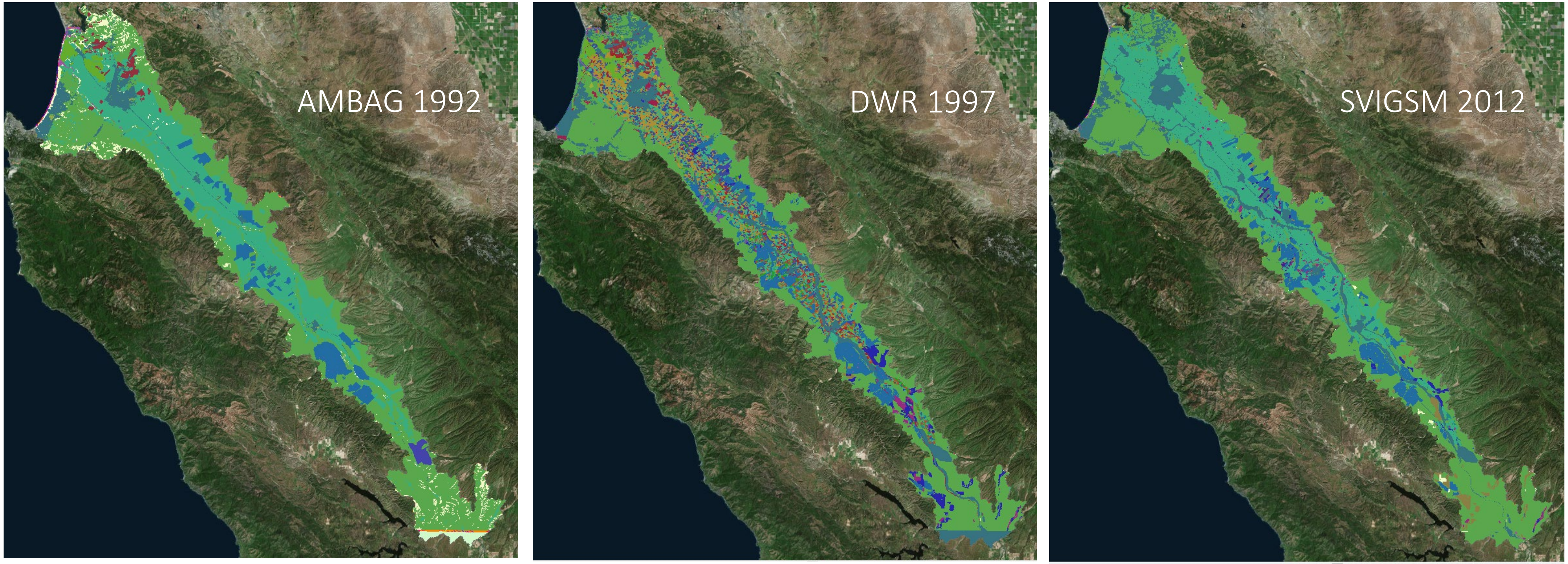
Available land use data was limited to multi-year snapshots with variable detail



A new land use model was developed to improve representation of semi-annual variability, multi-cropping, and crop diversity.

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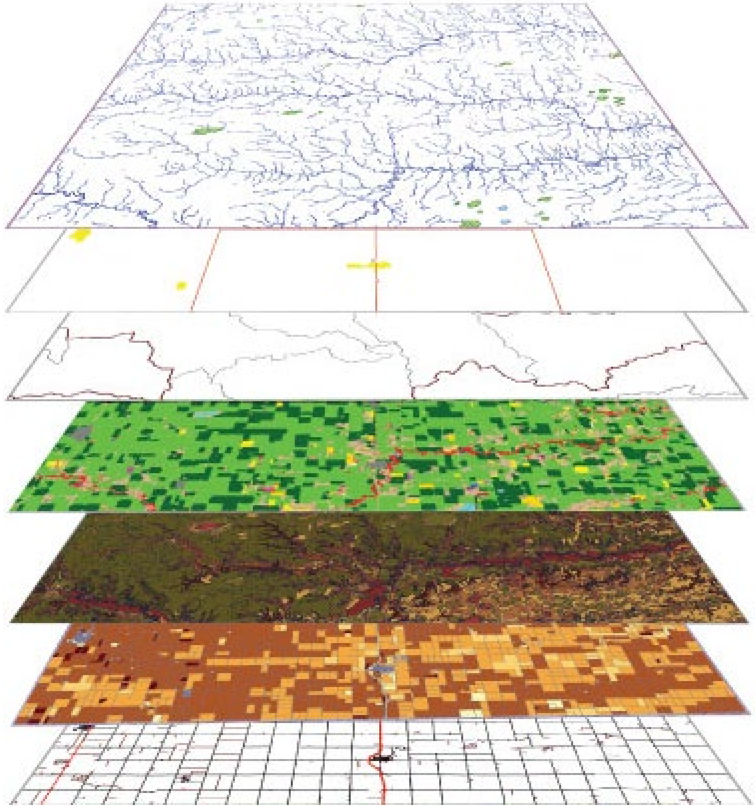
We use a tiled approach of available land use data to represent the landscape

Native and Urban areas represented by National Land Cover Database (NCLD) datasets

Riparian areas defined using aerial photography and the National Hydrography Database (NHD)

Representing agricultural development and distribution of crops and cropping patterns rely on

- Land use snapshots
- Aerial photography
- Agricultural commission data
- Stakeholder outreach activities



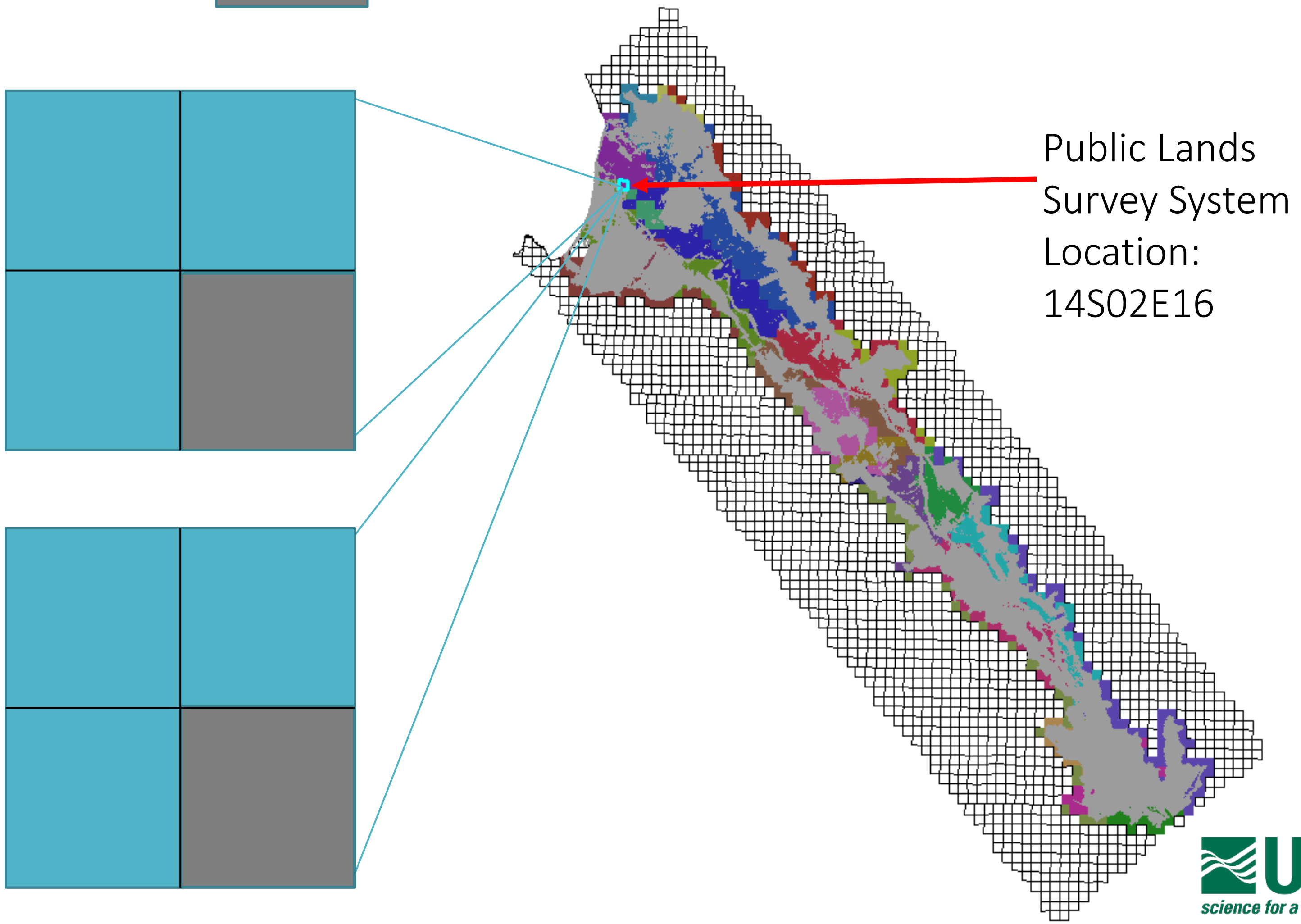
CalPUR data provides comprehensive crop data that can vary in time.

Land use data is updated with area weighted crop types from CalPUR

Land use data preserves stable land use types (native, vineyard)

March Crop Distribution:
Crucifers 27%
Lettuce 72%

August Crop Distribution :
Rotational 30 Day 5%
Crucifers 1%
Lettuce 94%



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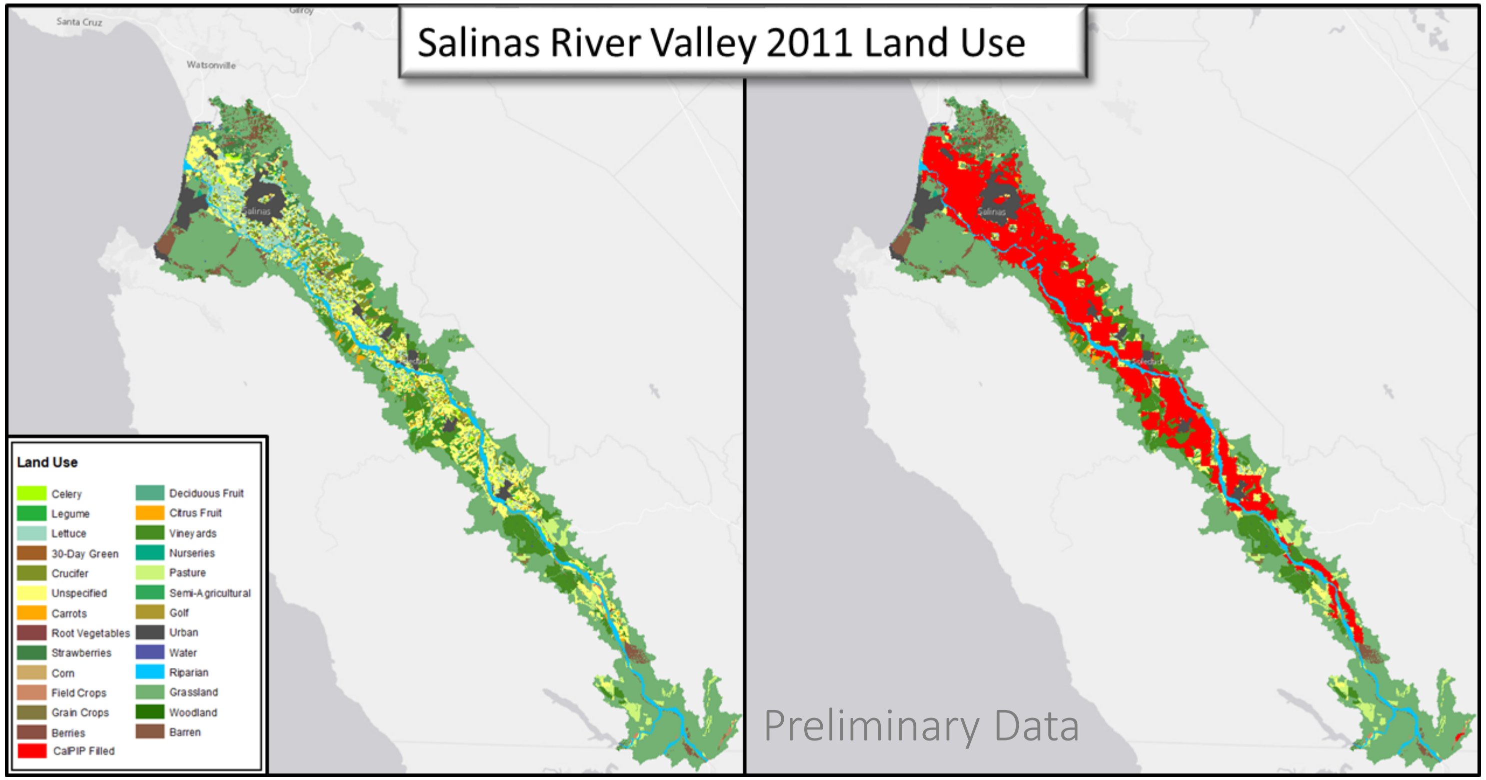
Cropped land use estimation is improved using pesticide data



Available multi-year land use data is combined with CalPUR pesticide data to generate semi-annual land use for each model cell (~6 Acres)

This approach better represents:

- Crop Type
- Multi-Cropping
- Crop variations

Red area shows vague crop categorization that is enhanced with additional information from pesticide database

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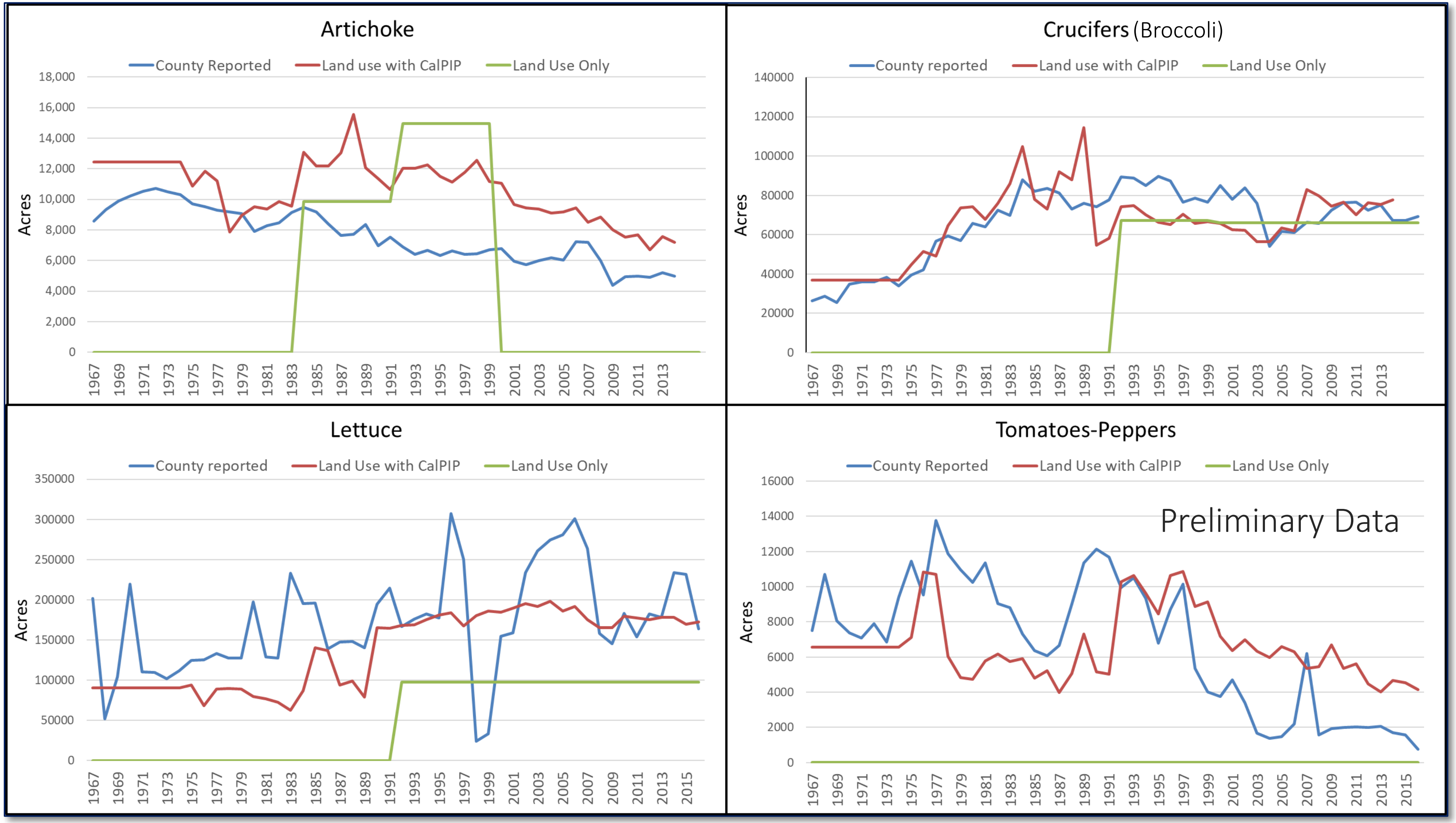
Reproduces magnitude and variation in cropped acreage



Comparison between cropped acreage reported by Monterey County Agricultural Commissioner annual crop reports, estimated acreage with CalPUR data, and estimated acreage from land use alone.

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SVIHM received substantial input from stakeholders and technical advisors

- 8 Technical Advisory Committee meetings over 2 years

Monterey One Water

Monterey Peninsula Water Management District

US Army Corps of Engineers

The Nature Conservancy

California Water Service

PV Water

Monterey County Water Resources Agency 1947

Grower-Shipper Association of Central California Since 1930

The Open Monterey Project

LandWatch Monterey County

California American Water

Salinas Valley Water Coalition

Seaside Basin Watermaster

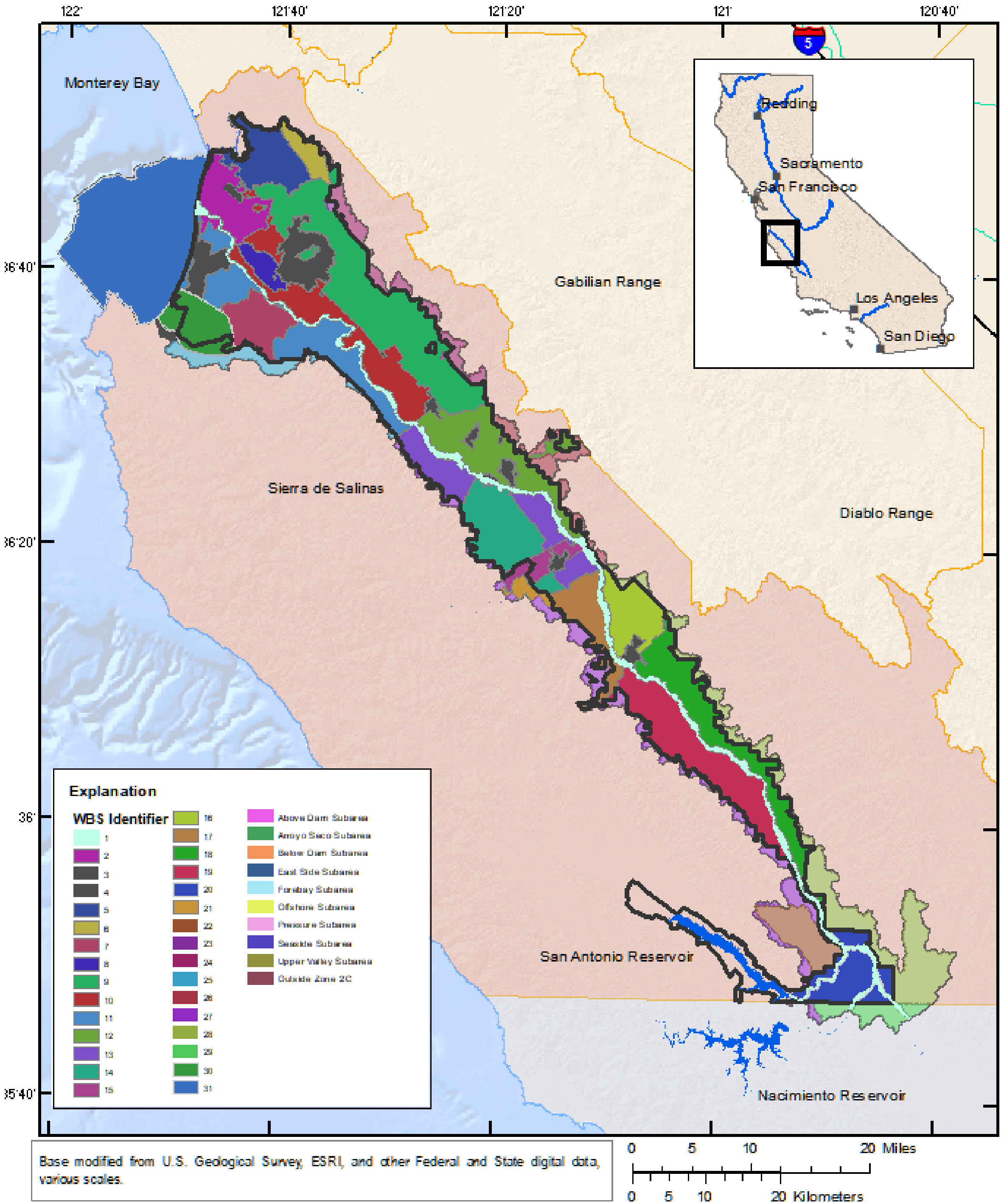
Farm Bureau Monterey

- Stakeholder surveys and 11 meetings
- Consultations with local and national agricultural experts
- Discussions with Groundwater Sustainability Agencies

SVIHM Calibrated using almost 104,000 Observations and reported data

- Stream flows (annual, monthly)
- Streamflow differences between stream gages (annual, monthly)
- Water Levels and drawdowns (annual, quarterly, monthly)
- Head differences (annual, quarterly, monthly)
- Reported groundwater pumpage (annual, quarterly, monthly)
- Reported diversions (annual, quarterly, monthly)

10 Subareas were split into 30 Water Balance Regions



- Aggregated water budget accounting areas
- Based on Zone 2C and Bulletin 118 Subareas
- Related efforts using model may have different definitions of subareas (e.g., SGMA)

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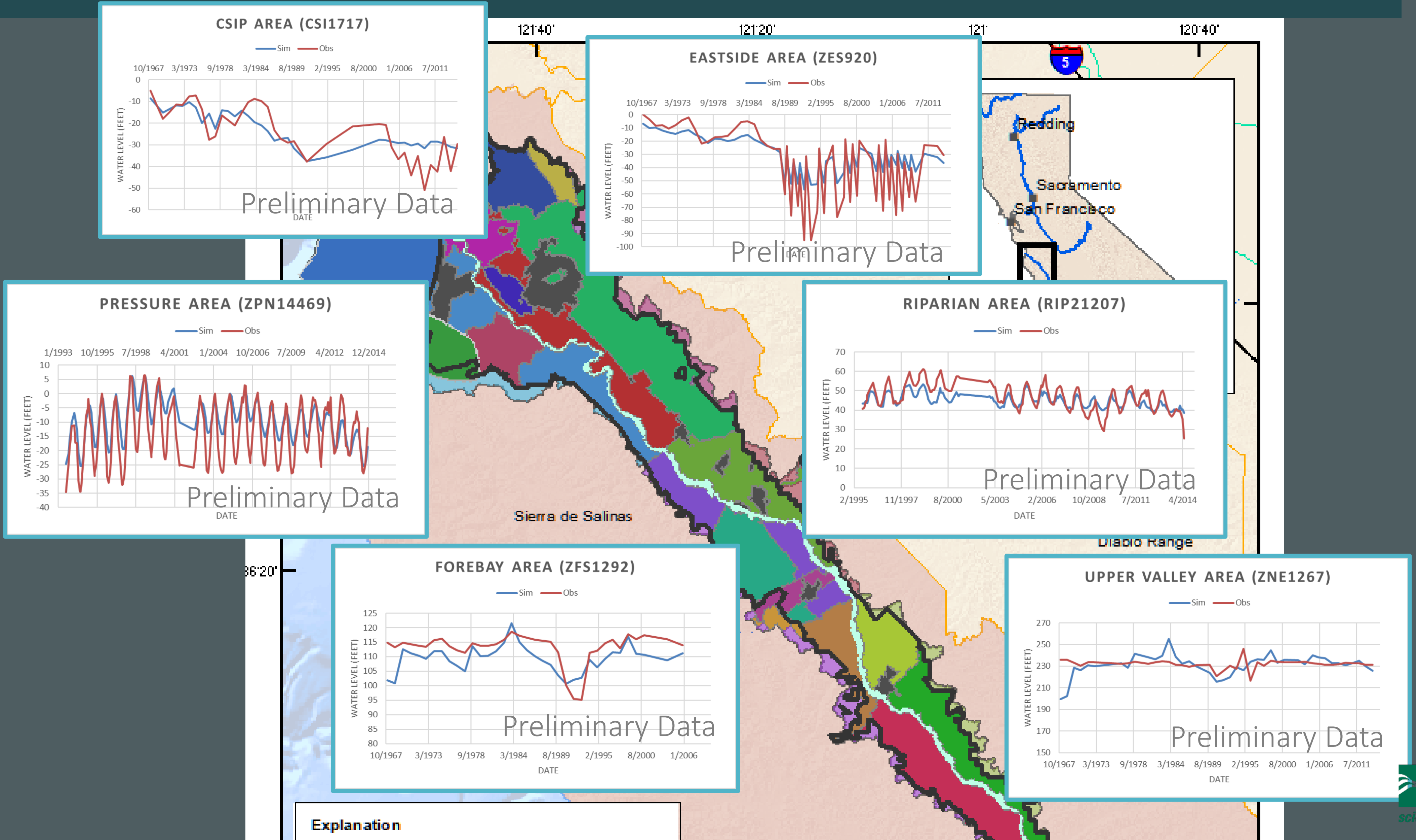
Groundwater Levels



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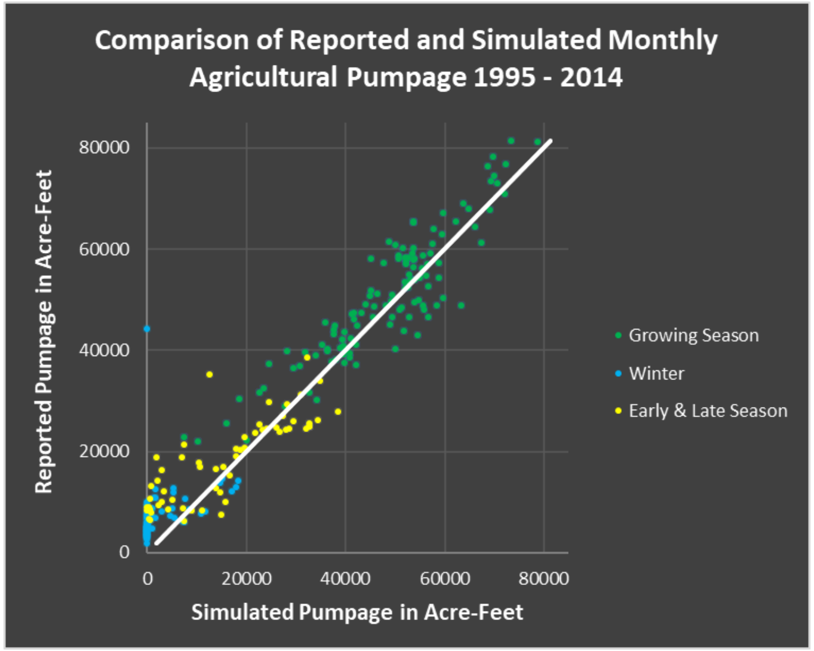
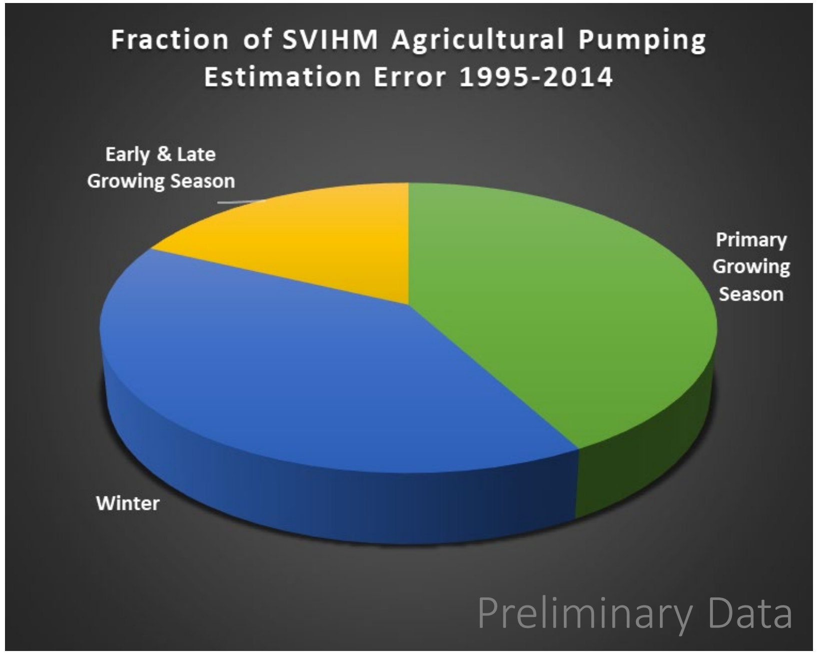
SVIHM simulates reported agricultural pumping well.





- Nash Sutcliffe Error Metric is 0.87 (Perfect model is 1.0)
- Average annual estimation error from 1995-2014 is 9.3%
- More than half of estimation error is due to underprediction of pumping in winter (Dec, Jan., Feb.) and early and late growing season (Mar., Oct., Nov.).
- The error in prediction could be improved by:
  - Representation of agricultural storage ponds in the model
  - Regular validation of land use
  - Better understanding and simulation of water used for agricultural production

    (field preparation, sanitation, processing, livestock, dust management)

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Estimated Timeline for Salinas Valley Model Suite Public Release (SVGM[1], SVWM[1], SVIHM[1], SVOM[2])

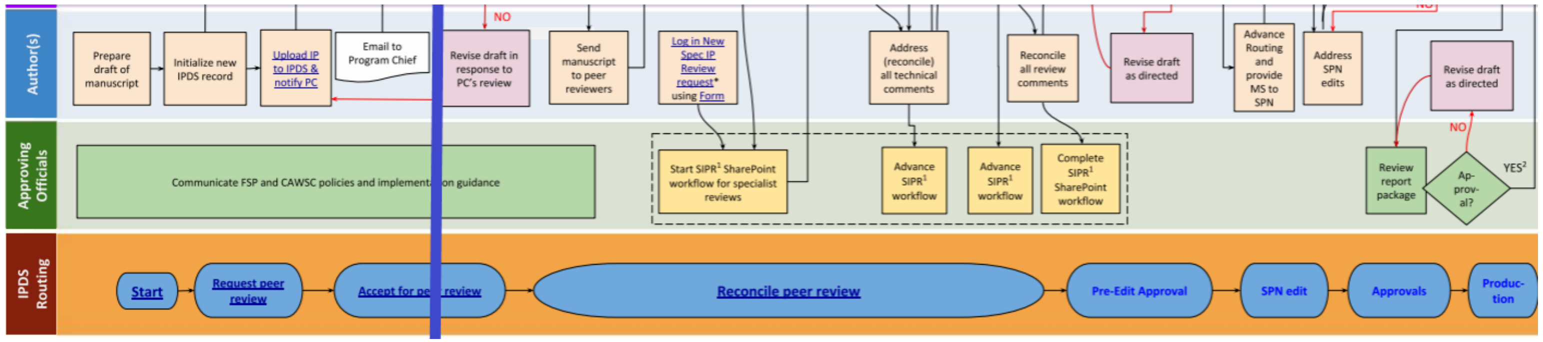
Summer/Fall 2021
- USGS Peer Review[1]
- SWO Module Release[2]
- SVOM Report Writing[2]

Winter 2021
- USGS Specialist/Director Review[1]
- SVOM USGS Peer Review[2]

Spring 2022
- USGS Editorial Review and Layout[1]
- Final Approval by Secretary of Interior[1]
- USGS Specialist Review[2]

Summer 2022
- Publication[1], Model Archive[1]

Fall 2022
- Publication[2], Model Archive[2]



Expanded illustration of USGS review process. Blue vertical line illustrates current status. Lines along top of figure indicate transfer of report among reviewers and editors.

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USGS Collaboration with Monterey County resulted in tools and products with far reaching impact at the national and state scale.

- Substantial contributions to the development and testing of MODFLOW One Water Hydrologic Model and new features that are currently being used in a case before the Supreme Court.
- Aggregated data from SVIHM is contributing to nationwide mapping of irrigated lands
  - Validation and testing of new remotely-sensed land use characterization, irrigation estimation methods and models.
- CalPUR method that is being further developed with California Department of Water Resources with statewide mapping of irrigated lands.
- Collaborative development of:
  - model updating tools
  - model post processing tools
  - new water budget estimation methods
- SVBGSA Coordination with related efforts in the basin.

Monterey County Basin Investigation Progress Update

Monterey County
Board of Supervisors

May 18, 2021

Prepared by
Pete Dennehy
Abby Ostovar
Derrik Williams

MONTGOMERY
& ASSOCIATES

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Presentation Outline

- Timeline
- Purpose of Study
- Objectives
- Background
- Study Methods
- Next steps

Monterey County Groundwater Study Timeline

2008
Final EIR

County analyzed groundwater conditions and pumping from 1995-2005 and projected 2030

2010
General Plan

County created policies for sustainable growth based on 2008 EIR

2012
Settlement Agreement

County agreed to provide proof of a long-term, sustainable water supply for new development

2015
State of the Basin Report

MCWRA assessed near-term groundwater conditions, supply, and demand in Zone 2C

2016-2021
SVIHM & SVOM

USGS developing SVIHM and SVOM groundwater models for assessing historical and operational hydrology

2020-2022
SCRBS, GSPs, This Study

USBR, GSAs, and MCWRA preparing concurrent sustainable groundwater managemen t studies

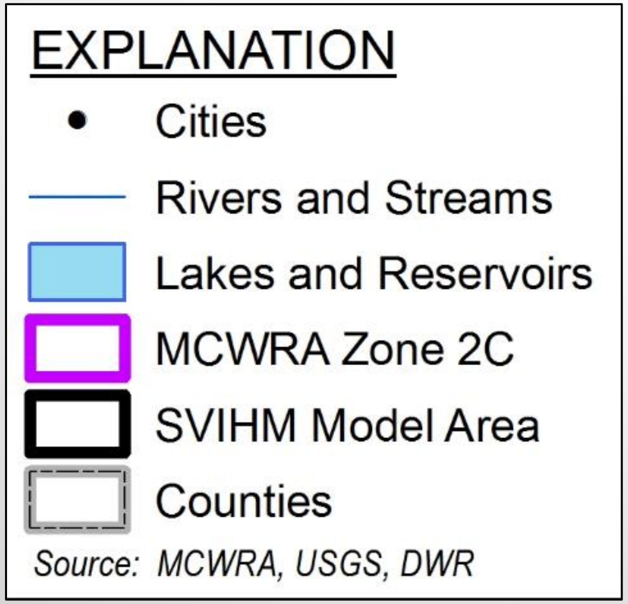
Purpose

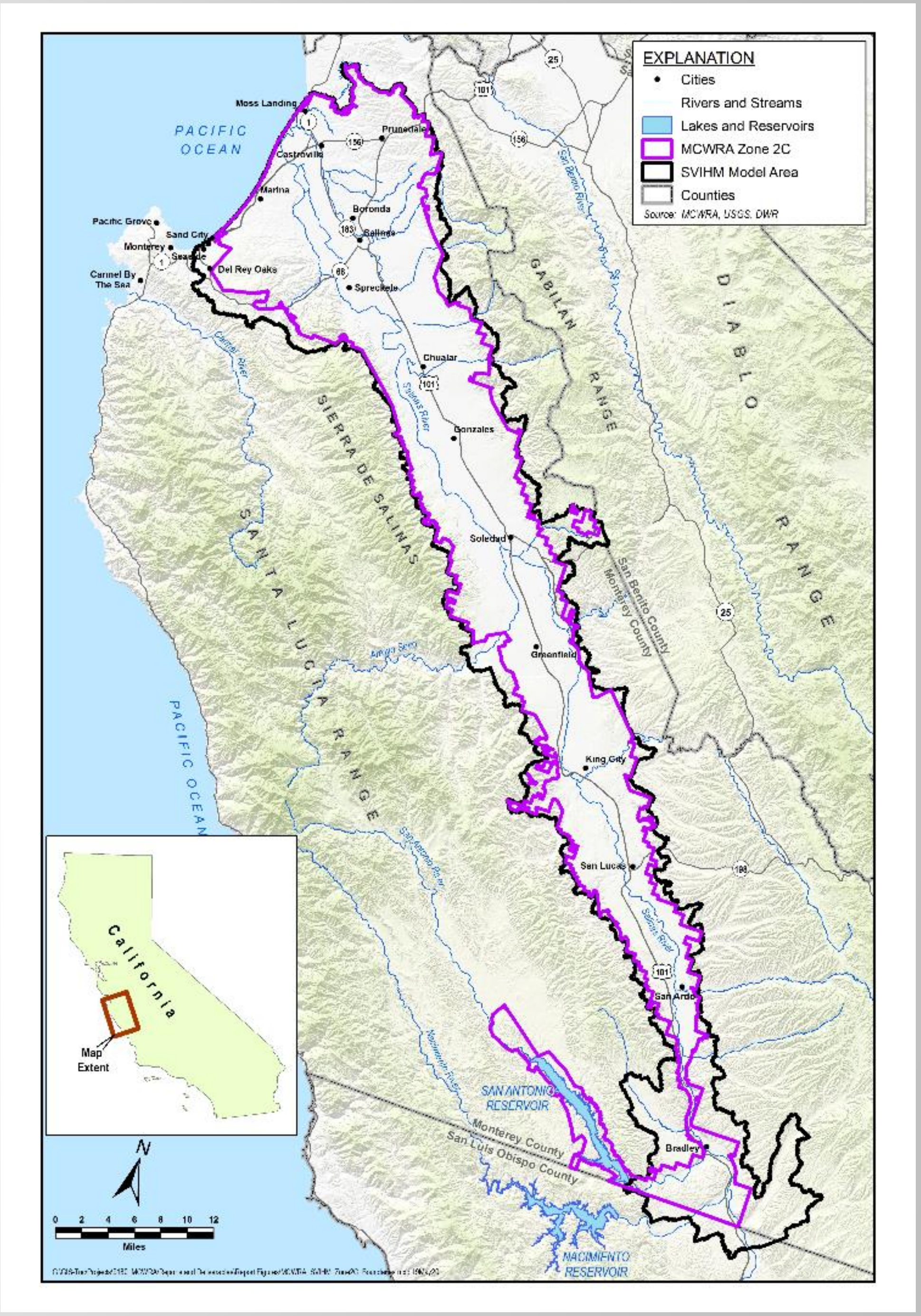
- This study addresses terms of the 2012 Salinas Valley Water Coalition et al. v County of Monterey Settlement Agreement.
- Specifically, the study re-assesses assumptions made in the EIR and 2010 General Plan related to land use, population, and water demands in 2030.
- In general, seek to align this study with the GSPs and SCRBS being compiled concurrently

Specific Study Objectives from Settlement Agreement

- Evaluate current groundwater conditions and projected 2030 groundwater conditions
  - Includes water demand, water budget, groundwater elevation declines, and seawater intrusion
- Compare current and projected groundwater conditions to EIR and General Plan
- Make recommendations on measures the County could take, should the groundwater conditions exceed 2030 projections

Study Uses the Groundwater Models Being Developed by USGS and MCWRA





Approach to Developing Water Use Projections

- Agricultural water use:
  - Estimate using groundwater model
  - Incorporate projected land use change, crop water use coefficients, and climate change.
- Urban water use:
  - Estimate urban growth from multiple sources
  - Incorporate urban water use coefficients (gallons / capita / day)

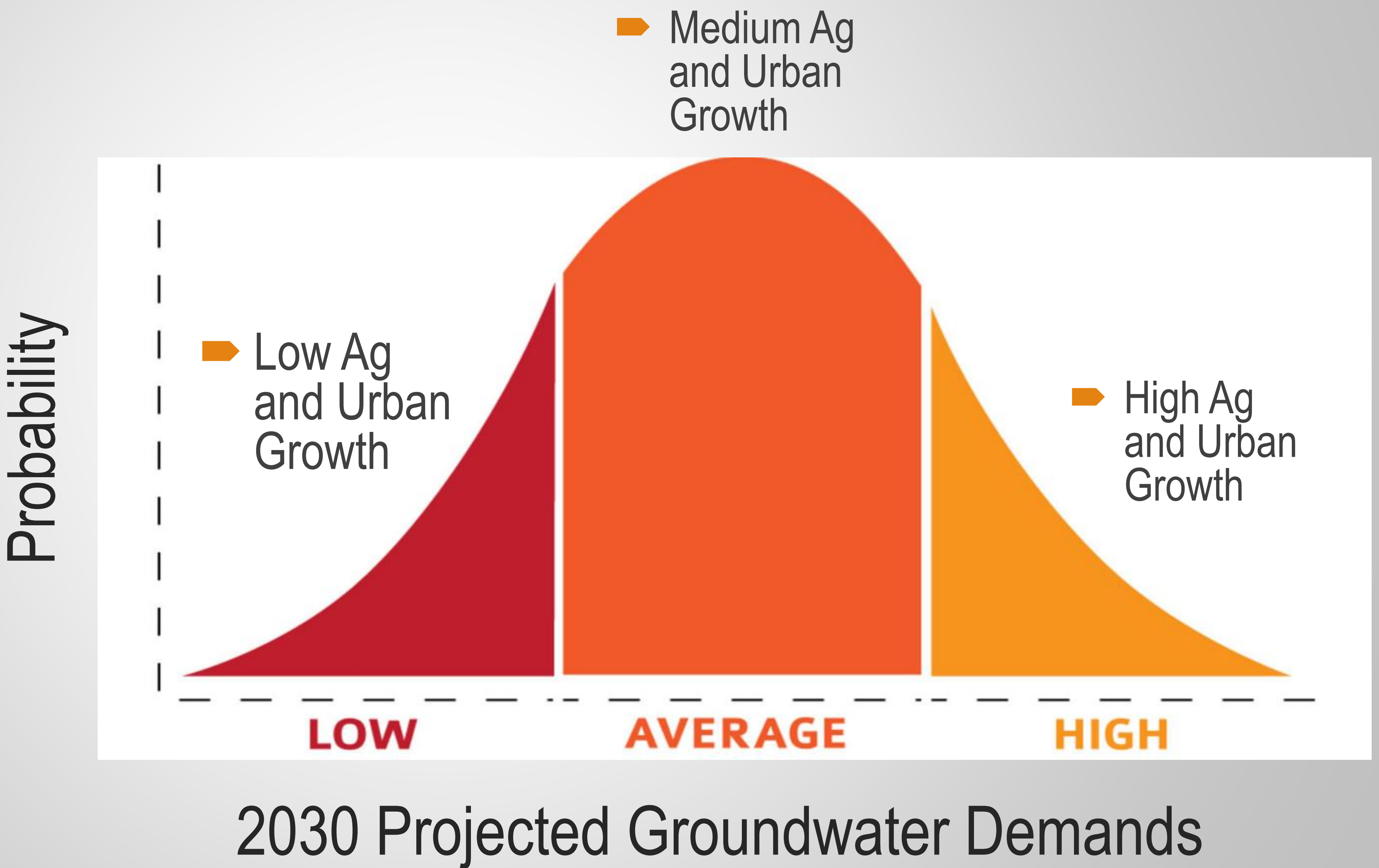
Data Sources for Developing Water Use Projections

- Agricultural water use:
  - Land use change – USGS LUCAS, 2017
    - Incorporated into SVIHM land use map
    - Checked against Department of Conservation Farmland Monitoring and Mapping Program
  - Crop coefficients remain constant
  - Climate change – DWR 2030 climate change scenario including sea level rise

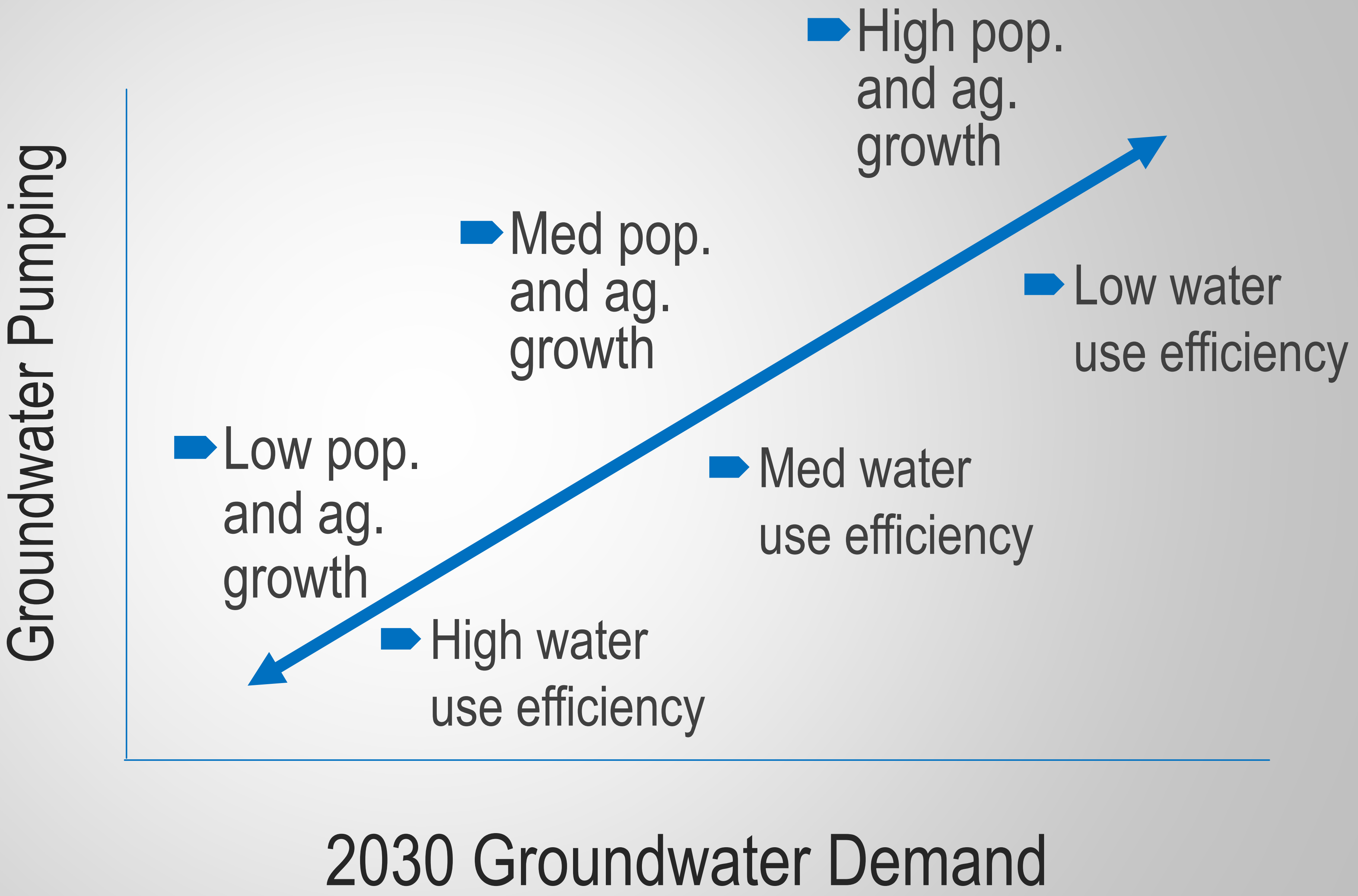
Data Sources for Developing Water Use Projections

- Urban water use:
  - Population – AMBAG, 2018
    - Verified and refined with California Department of Finance data
    - Verified and refined with US Census Bureau data
  - Water efficiency – Local urban water mgmt. plans and guidance from draft efficiency legislation
    - Low - No change
    - Medium - 10% reduction
    - High - 20% reduction (used in SCRBS)

Analyzing Three Scenarios:



Urban Water Demands



Next Steps

- Compile projections
- Generate model input files
- Run models to estimate range of possible future outcomes for groundwater conditions
- Re-assess findings of EIR based on new information
- Prepare Groundwater Investigation Report

Timeline

- Will need about 5 months to complete the study after MCWRA, USGS and consultants agree the models are suitable
  - Run model scenarios
  - Process results
  - Analyze data
  - Draft report for MCWRA review
  - MCWRA review and comments
  - Finalize report

Discussion and Questions