CLIMATE-SMART Agriculture 2015

Global Science Conference

March 16-18, 2015
Le Corum, Montpellier France

Climate-Smart Agriculture and Water Management in California

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Montpellier

March 16-18, 2015

Climate Smart Agriculture: California

- California Climate – Full of Extremes
- CSA Strategies in Water Management
  - Efficient Use of Water
  - Optimizing Water Storage
- Conclusions

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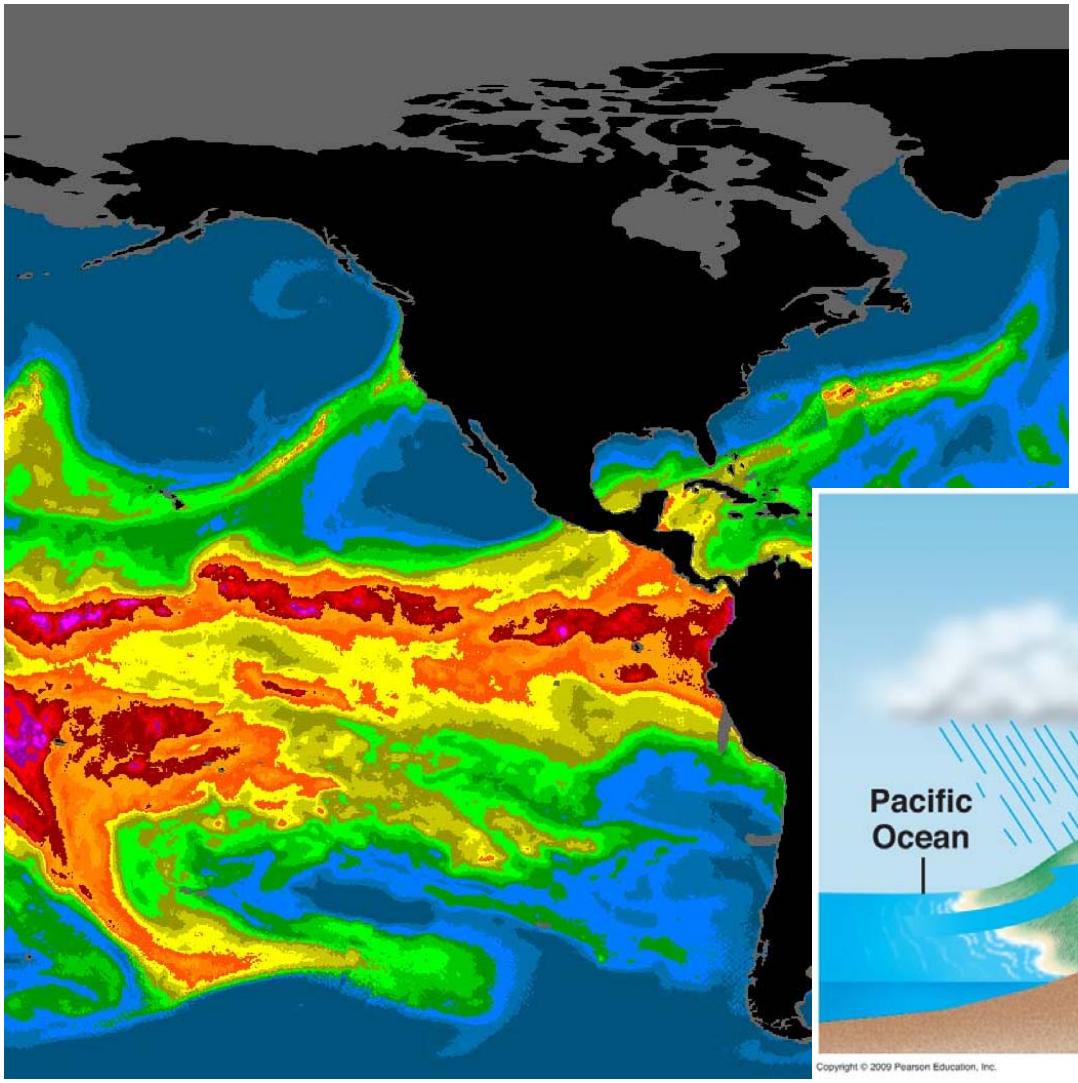
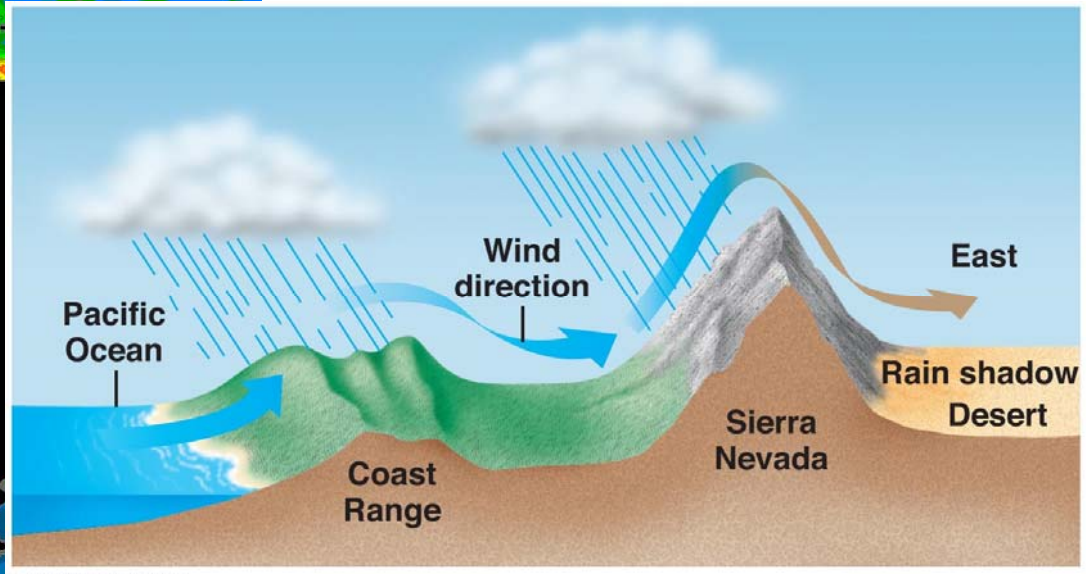
California Climate: Full of Extremes



Mediterranean Climate

- Dry Summers
- Wet Winters

Atmospheric Rivers



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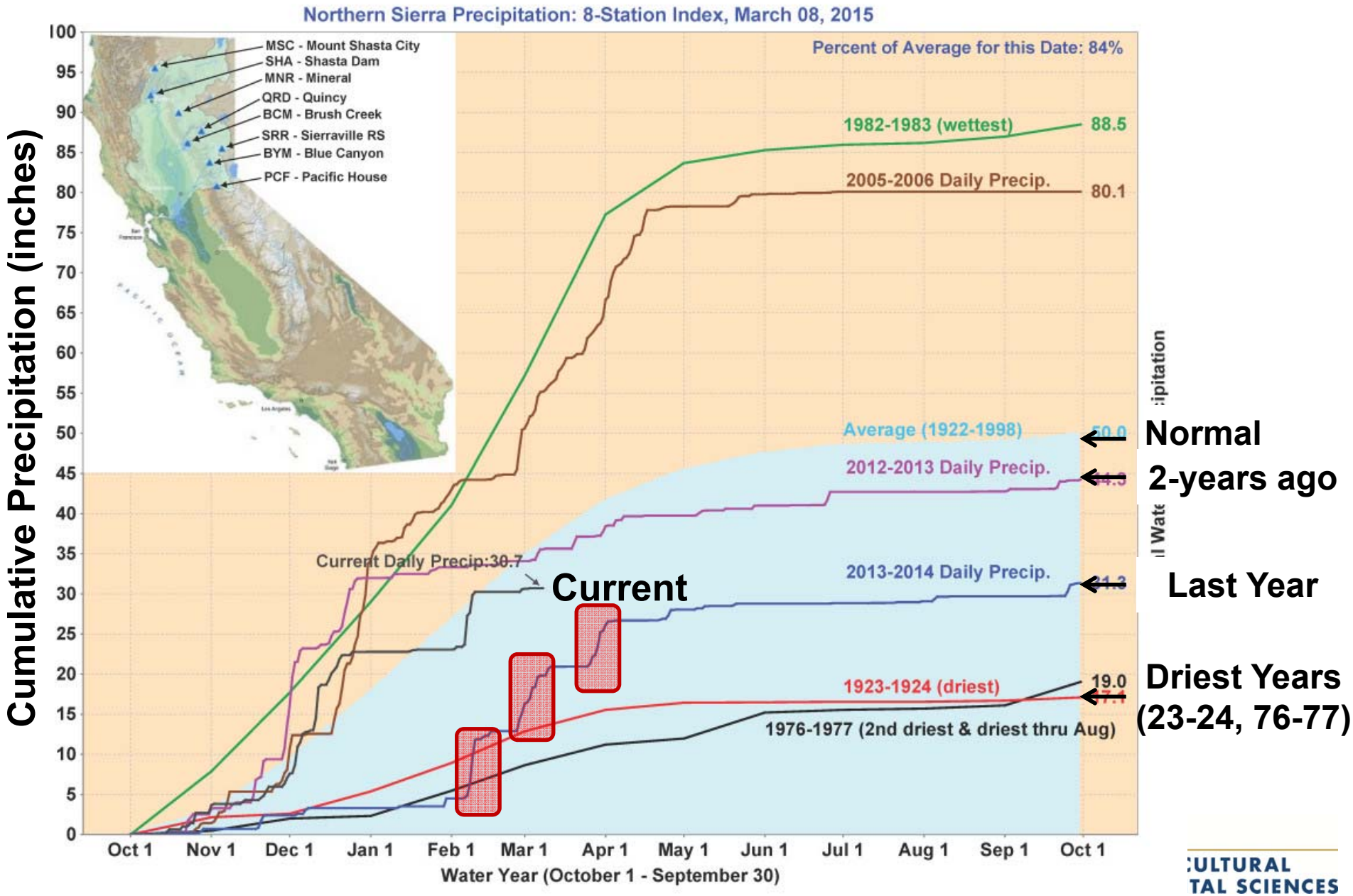
California Climate: Full of Extremes



Normal

2-years ago

Last Year

Driest Years (23-24, 76-77)

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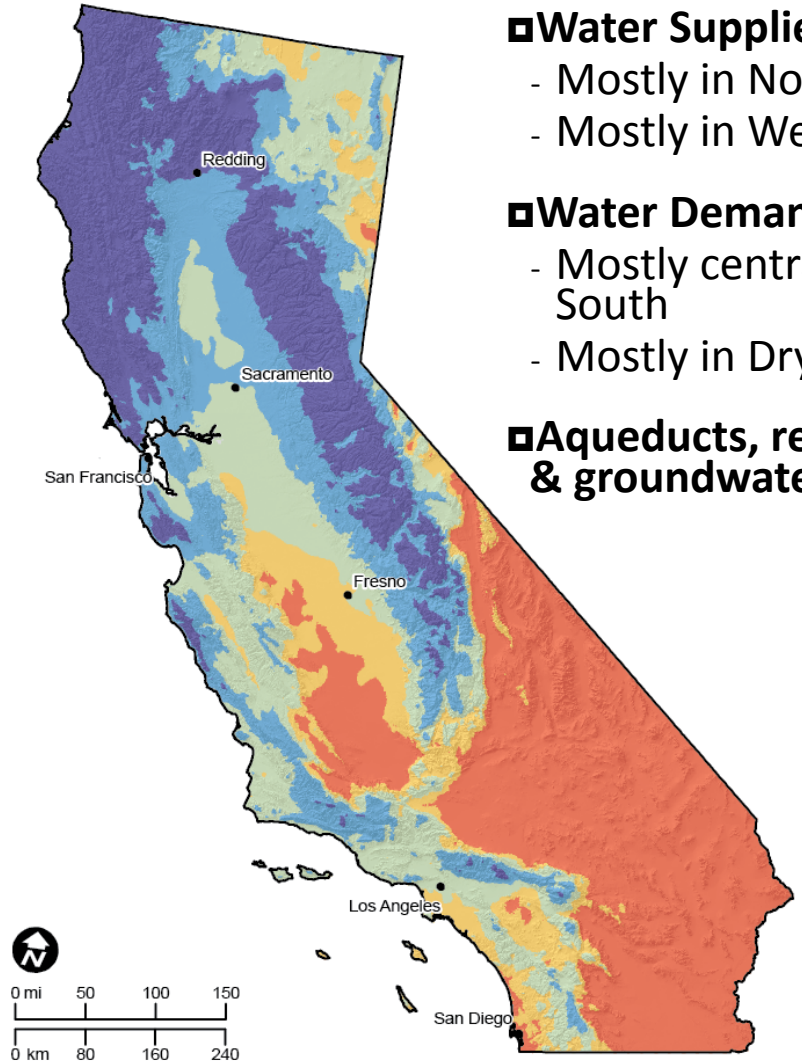
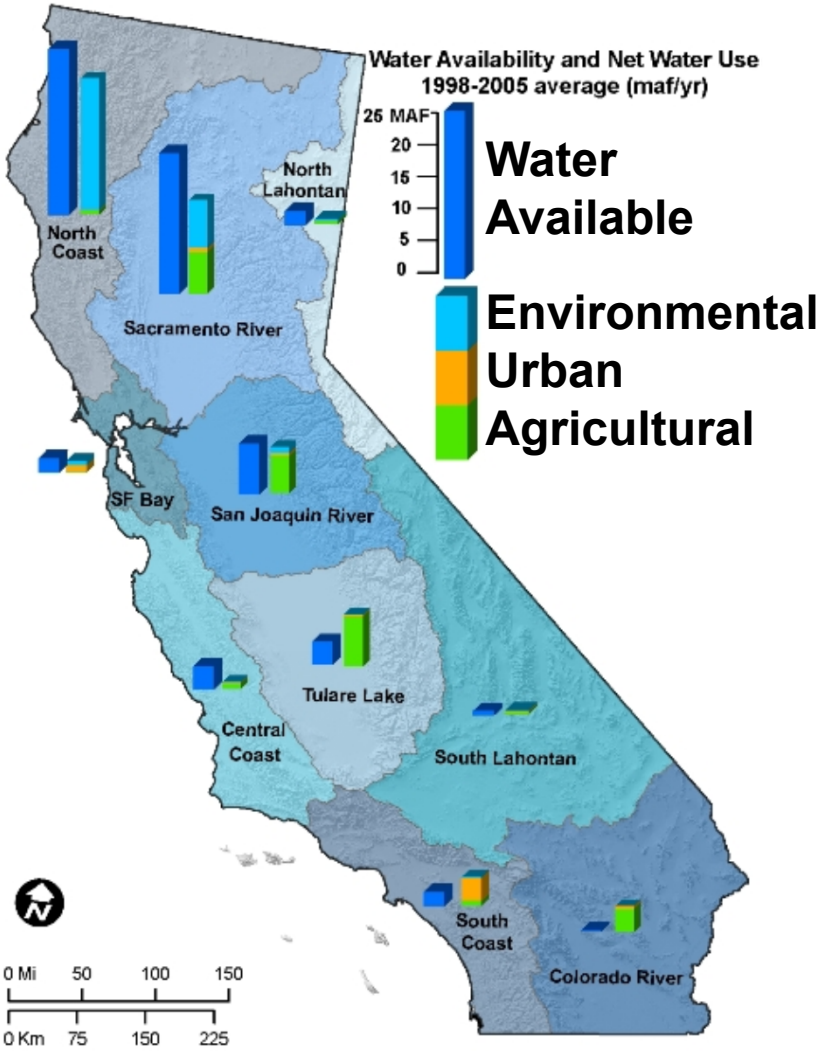
California: Water Supply Vs. Demand



- **Water Supplies**
  - Mostly in North
  - Mostly in Wet Season
- **Water Demands**
  - Mostly central and South
  - Mostly in Dry Season
- **Aqueducts, reservoirs, & groundwater use**



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* Hanak et al. (2011). "Managing California's Water. From Conflict to Reconciliation" <http://watershed.ucdavis.edu/research/waterpolicy.html>

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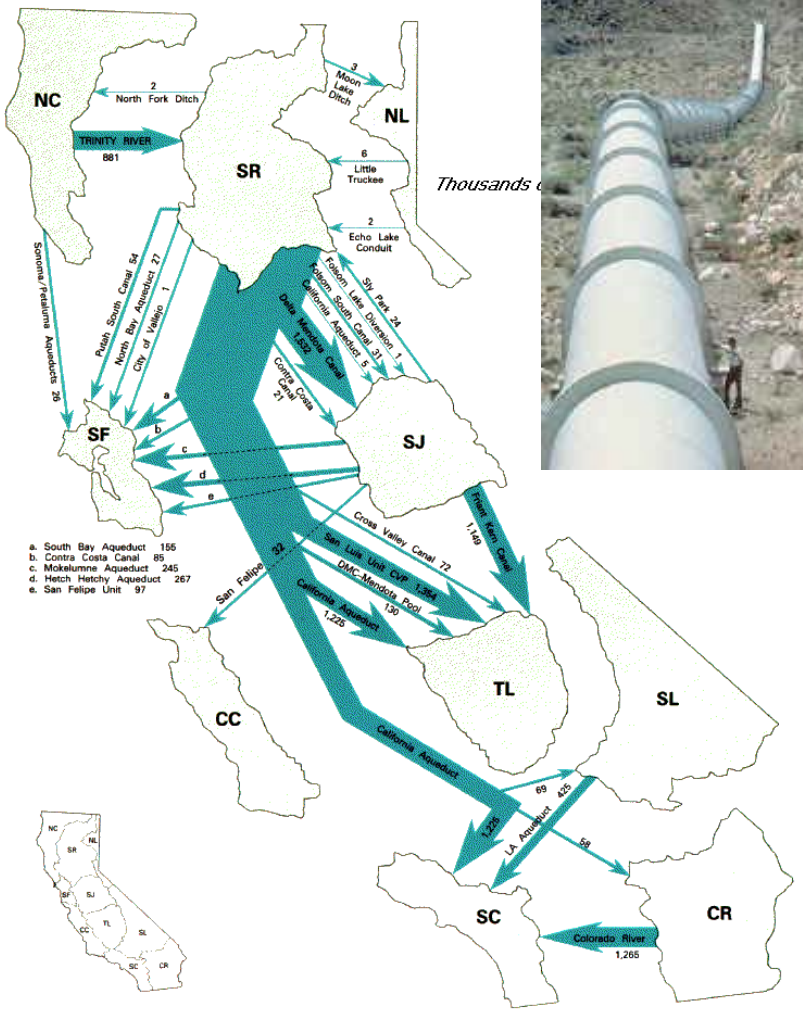
California: Infrastructure



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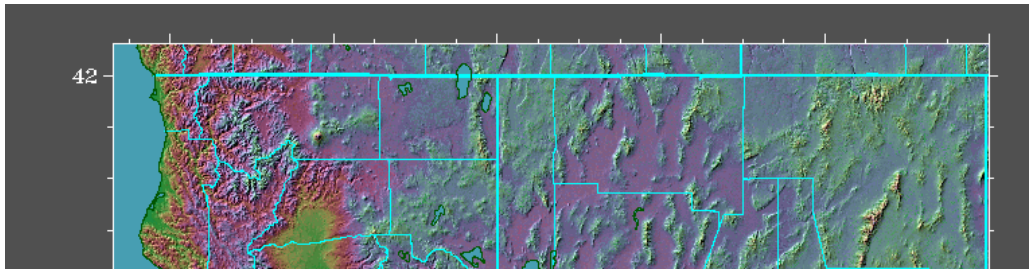

California Physiography

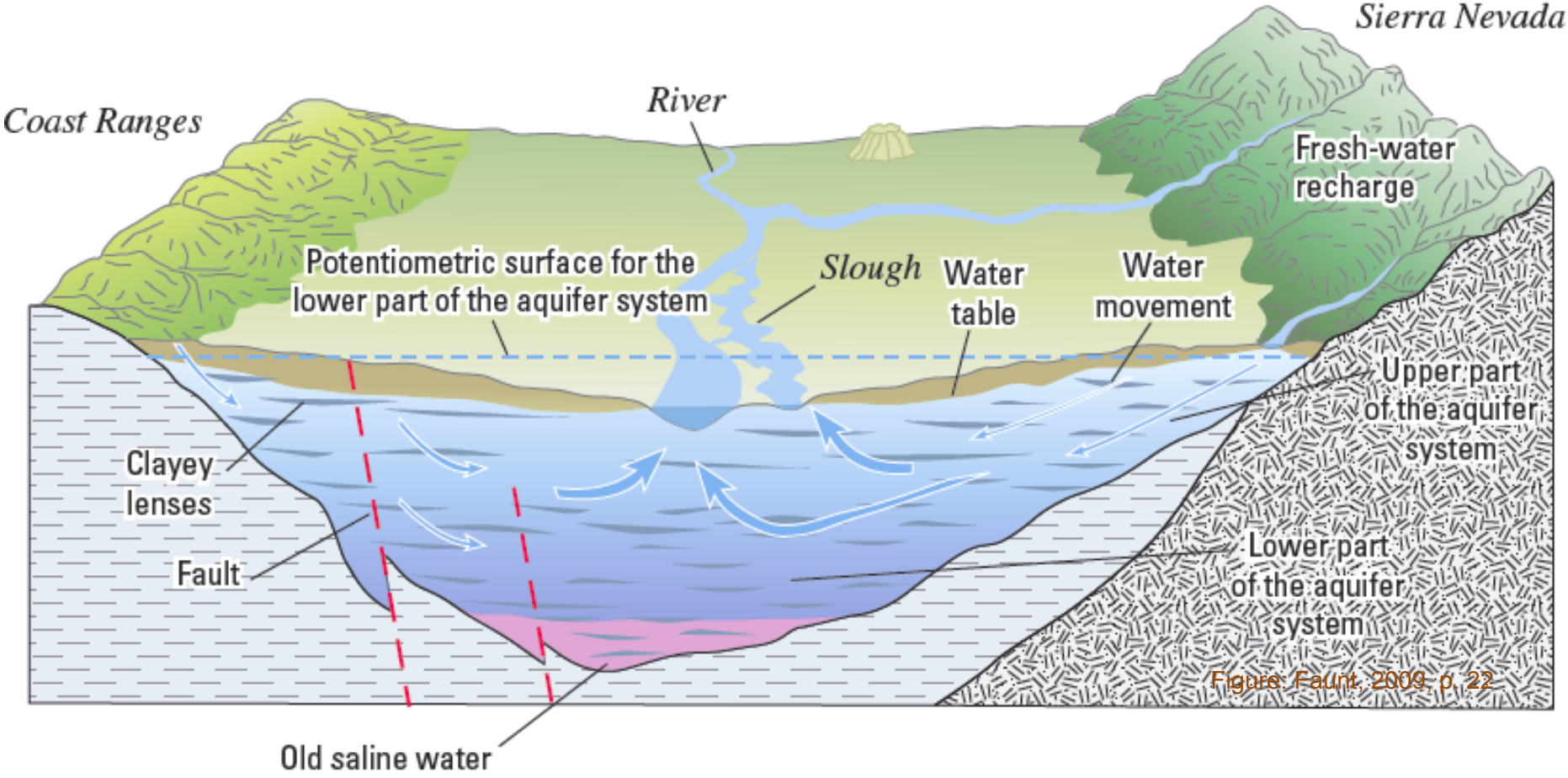

Figure: Faunt, 2009, p. 22

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CSA STRATEGY #1:
IRRIGATION EFFICIENCY

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Irrigation Survey: 1972, 1980, 1991, 2001 and 2010

20 crops

Corn, cotton, dry beans, grains, safflower, sugar beet, field crops, alfalfa, pasture, cucurbit, onions & garlic, potato, tomato, truck crops, almond & pistachio, deciduous, subtropical trees, turf grass & landscape, vineyard

Irrigation Methods

- Sub-surface Irrigation
  - underground pipes
  - ditches blocked
- Surface Irrigation
  - wild flow, border, basin and furrow w/o sprinklers
  - wheel line and hand move sprinklers followed by furrow
- Sprinkler Irrigation
  - solid set, hand and linear move
  - wheel line, hose pull
- Drip Irrigation
  - micro and mini sprinklers
  - Surface and buried drip irrigation

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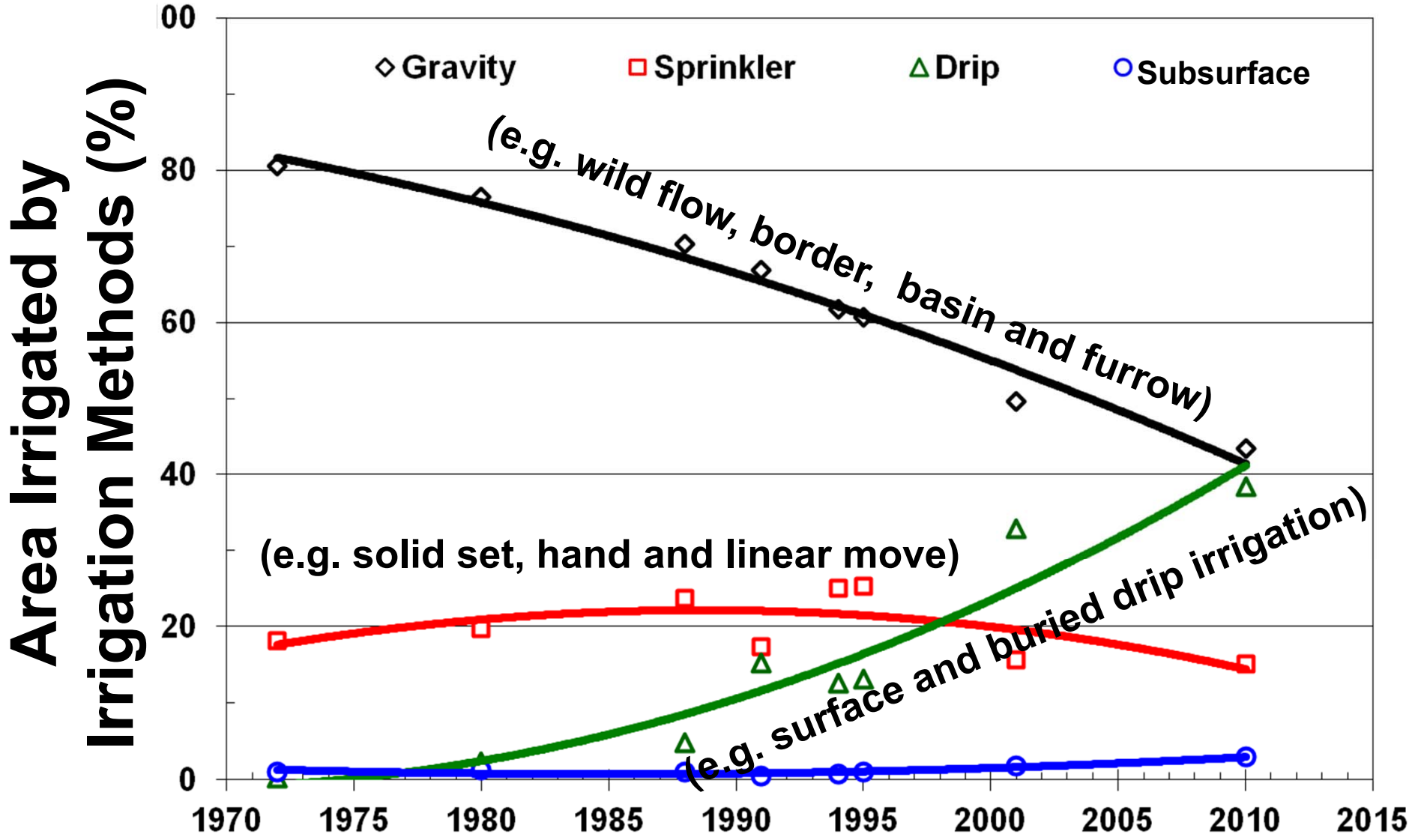
Irrigation Methods in California



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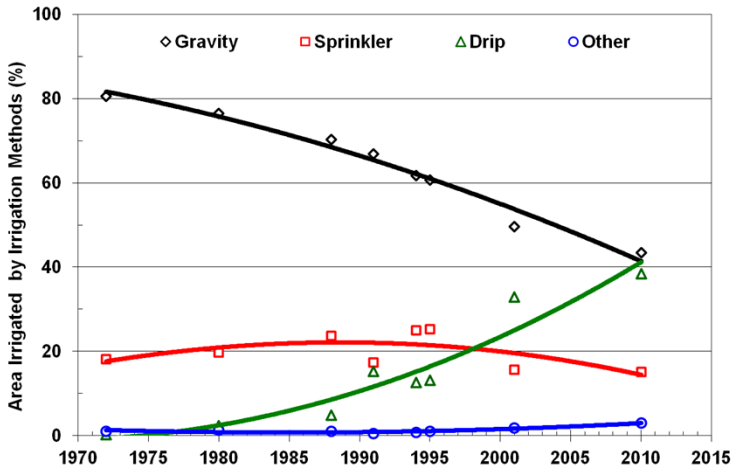


Irrigation System	Application Efficiencies (%) Low	Mean	High
Surface Irrigation			
Wild Flood	50	68	86
Border	62	73	83
Basin	72	83	93
Furrow	60	73	85
Surface – Sprinkler Side-Roll	60	68	75
Surface – Sprinkler Hand- Move	60	68	75
Sprinkler			
Permanent	70	78	85
Hand-Move	60	70	80
Linear-Move	73	82	90
Side-Roll	60	70	80
Micro-Mini	73	81	88
Hose-Pull	70	73	75
Center –Pivot	70	80	90
Drip			
Above ground	77	86	95
	77	86	95

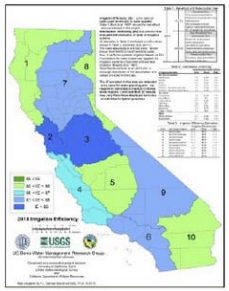
Irrigation Surveys
20 Crops + 16 Irr. Methods
Time: 2001 & 2010

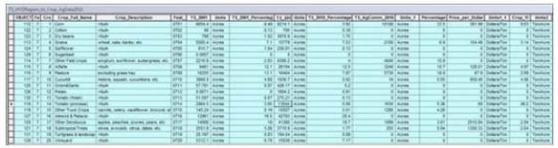
Application Efficiencies
For 15 Irrigation Methods
Mean, low & high values
Considerations of DU and AE

Statistical Analysis
Weighted Average per Acreage
Surveys: 2001 & 2010
Comparison with Ag. Comm. Reports

California Irrigation Information System (CALIIS)

Geographic + Tabular Information





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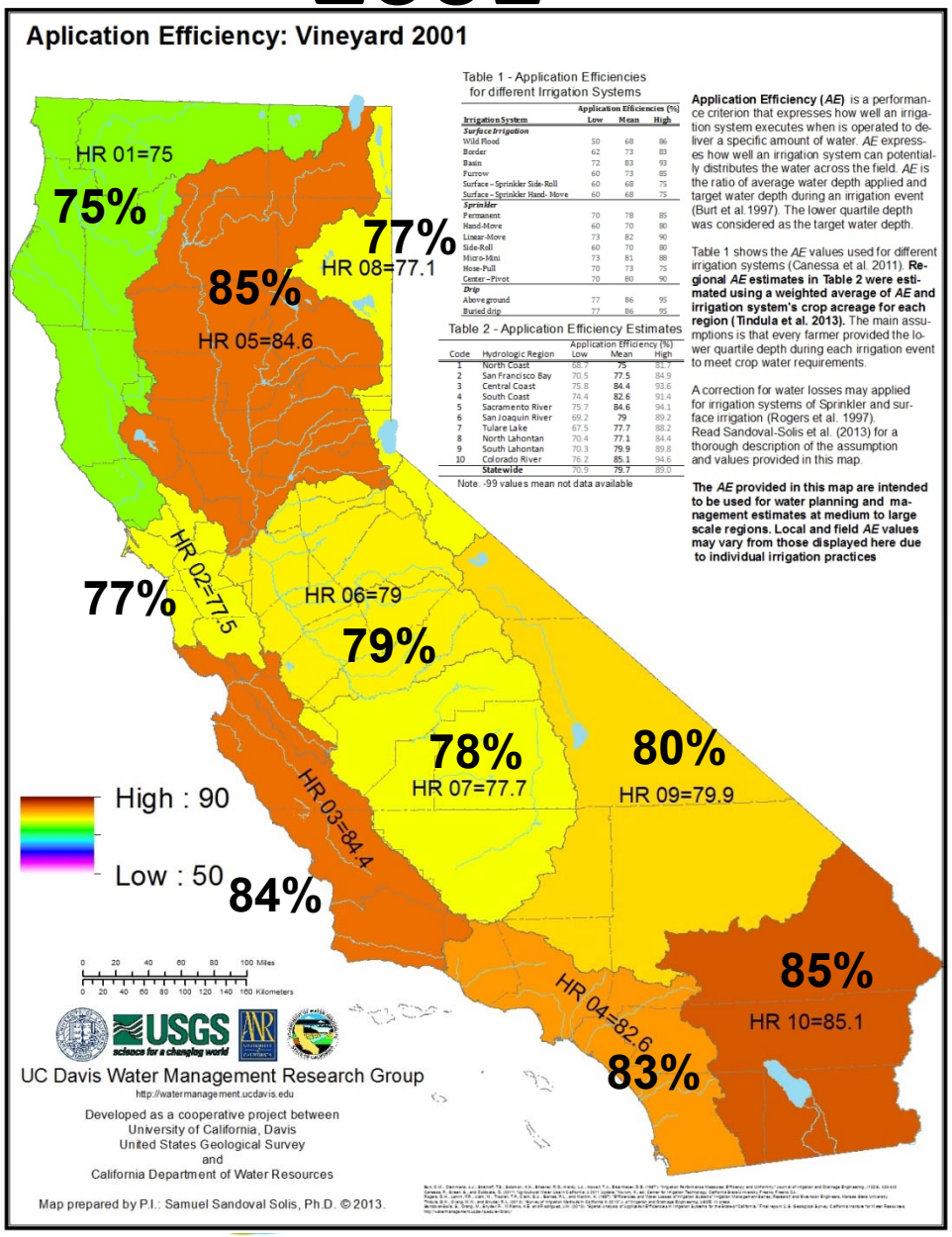
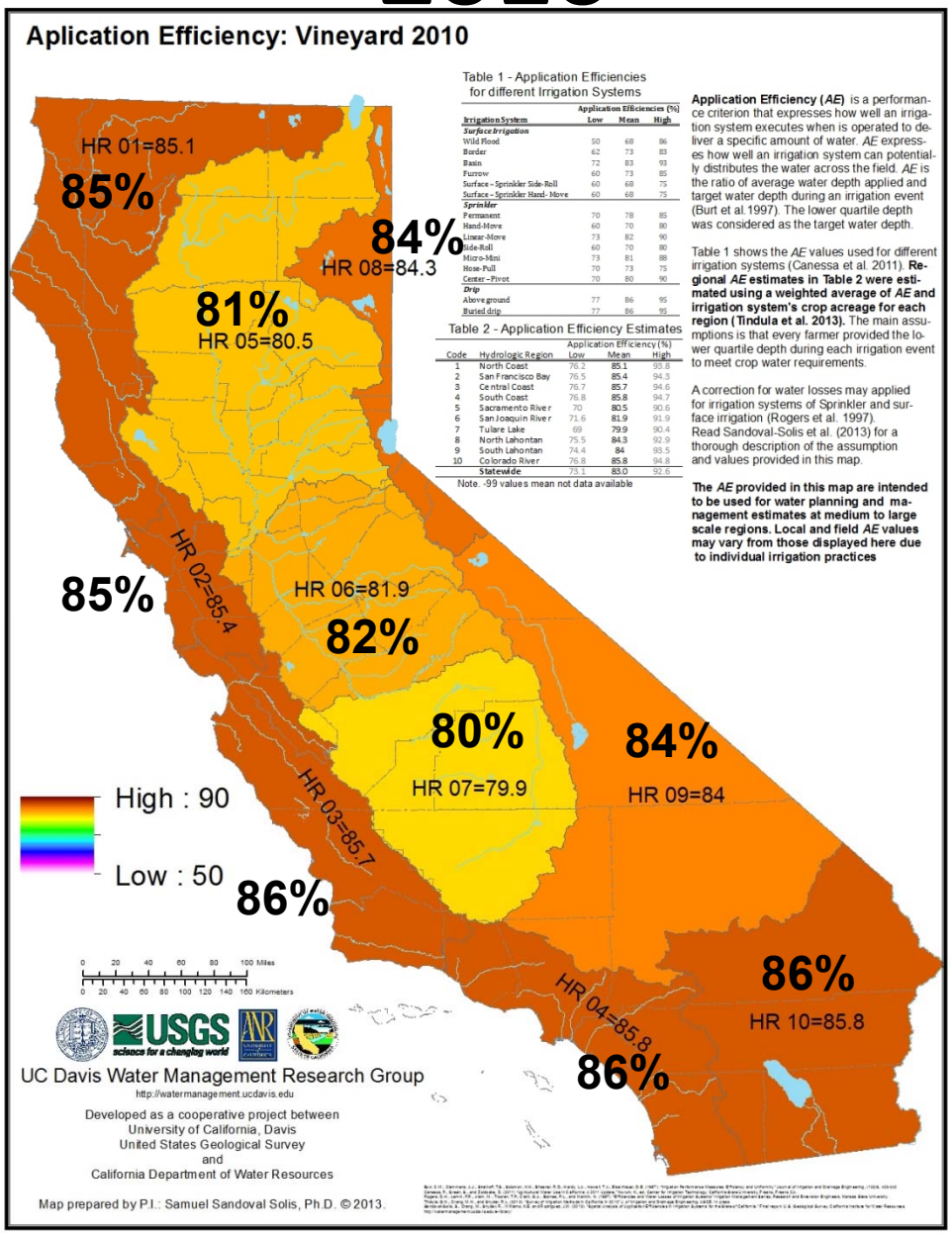
Vineyard

2001



2010



Application Efficiencies in California

- An overall increase in AE of 3%
- Crops with higher AE increase are:
  - Vineyards,
  - Subtropical trees,
  - Pistachio and almond and
  - Tomato
- Unintended consequences

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Eff. Vs not that Eff. Irr. Methods

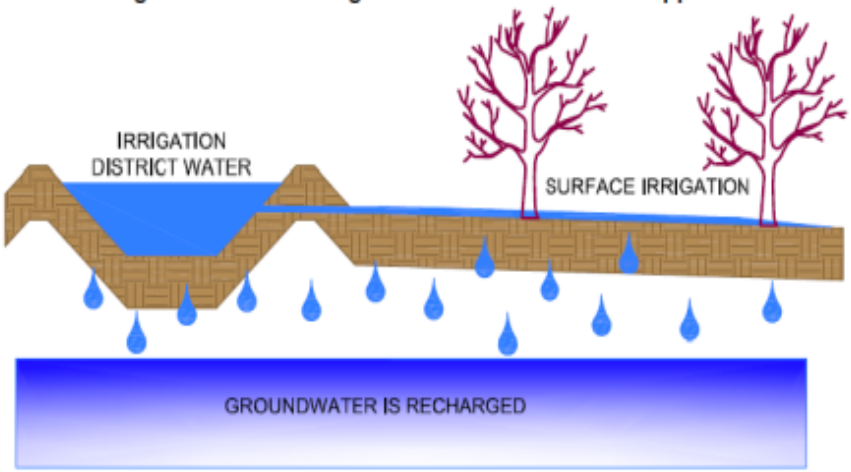
Advantages:

- Reduced crop stress, more efficient crop fertilization
- Increased yields, improved crop quality
- More food grown per unit of water and land

Consequences:

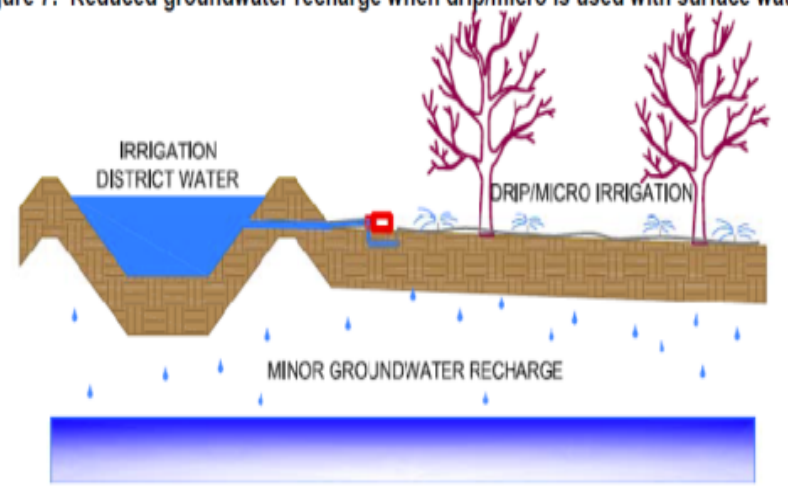
- Less groundwater recharge
- Irrigation "inefficiency" is a major source of groundwater recharge!
- More reliance on groundwater than surface water for drip/micro-irrigation (timing, sediment)

Figure 6: Surface irrigation with surface water supplies



Source: Irrigation Training and Research Center

Figure 7: Reduced groundwater recharge when drip/micro is used with surface water



Source: Irrigation Training and Research Center

Increase in Irr. Eff. caused reduction in GW recharge

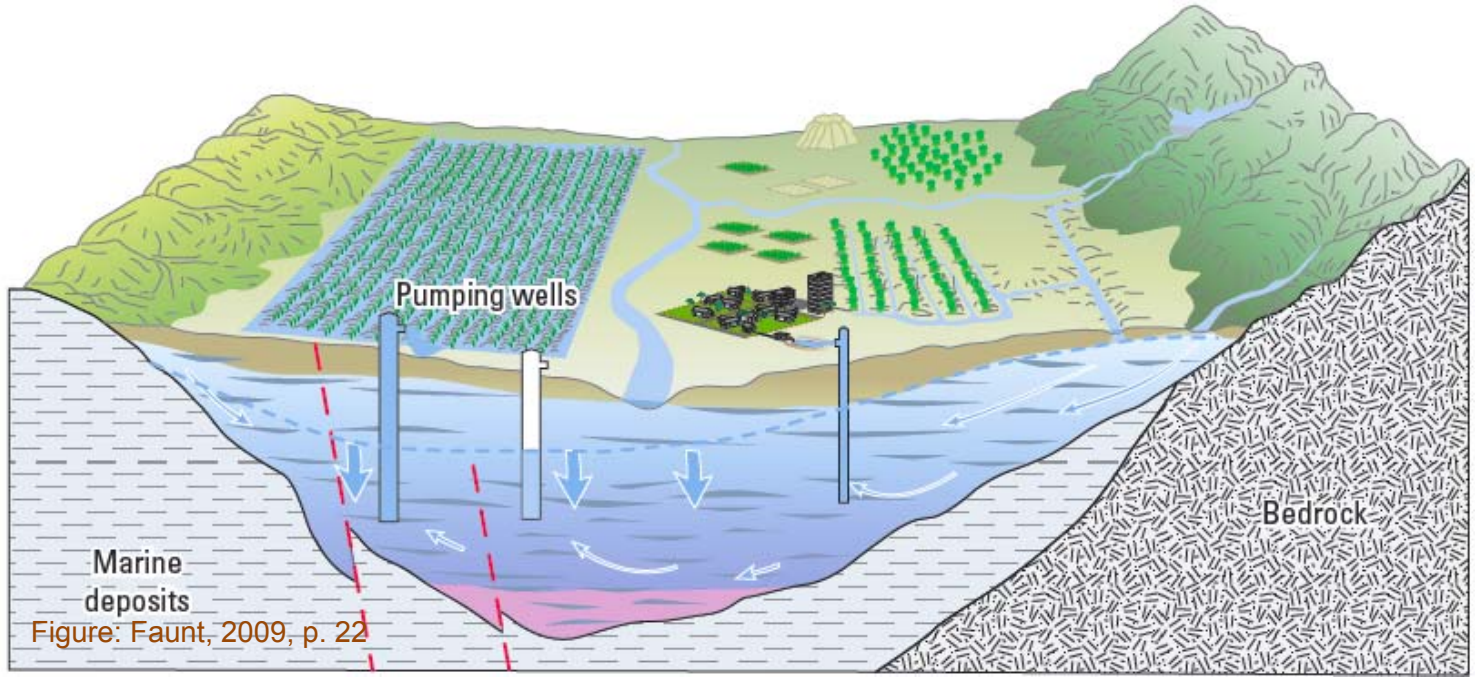


Figure: Faunt, 2009, p. 22

Reduction in flow due to Reservoir

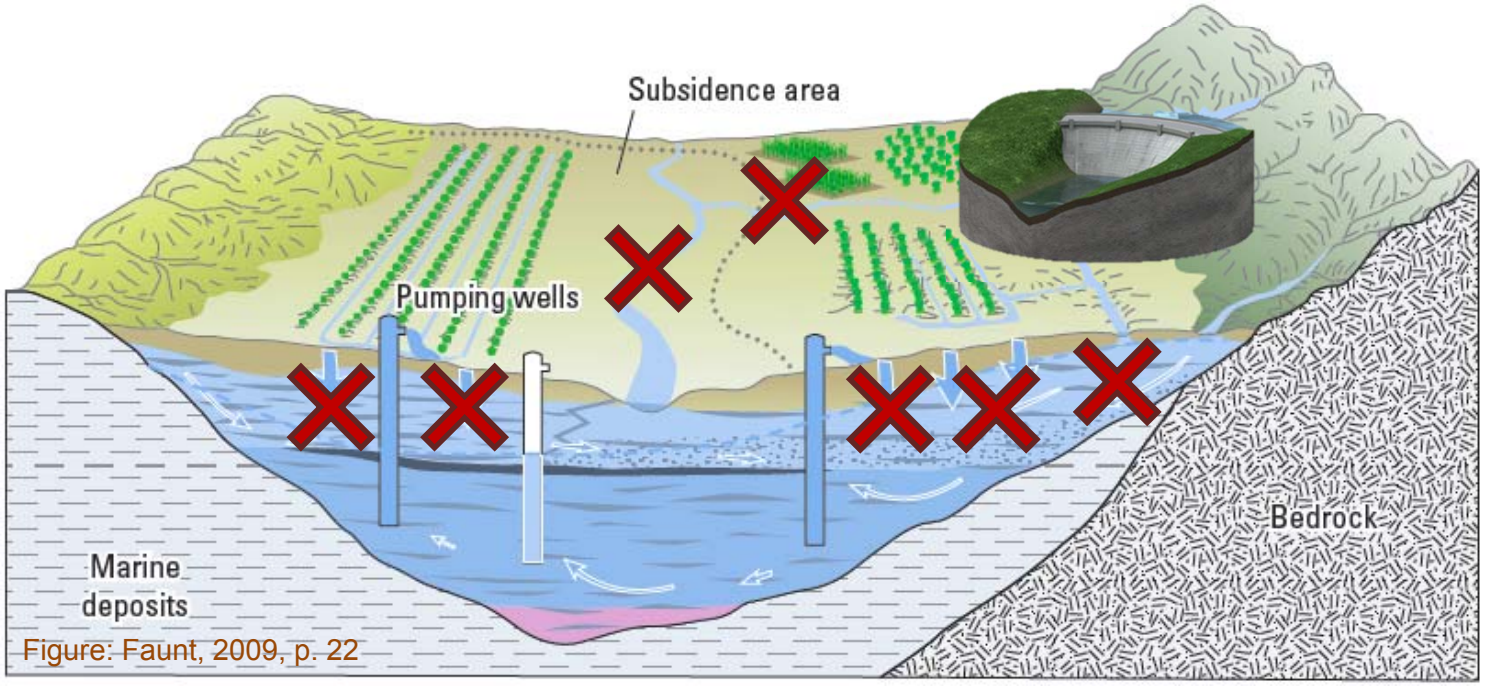


Figure: Faunt, 2009, p. 22

Increase in Irrig. Eff. & Water Use

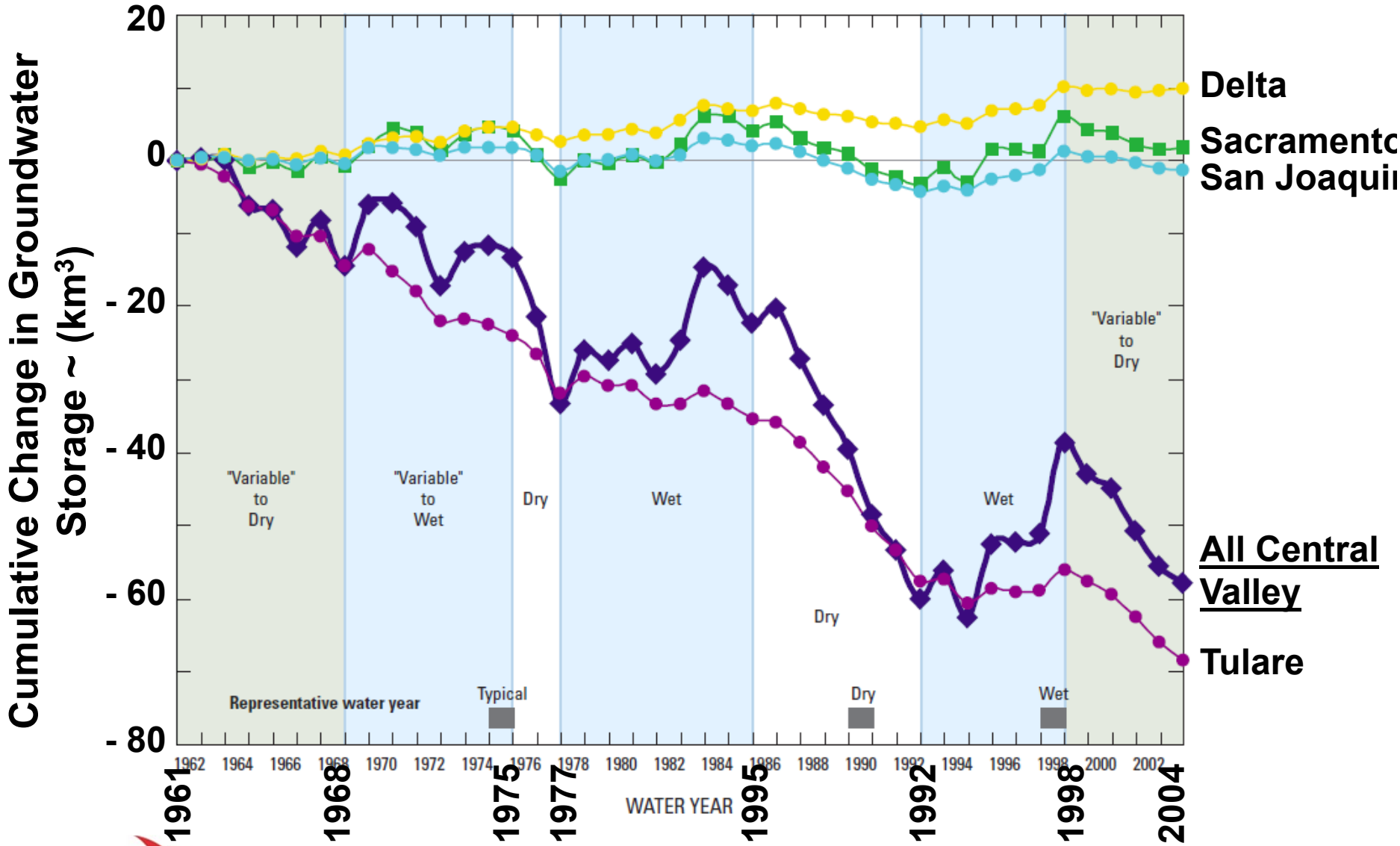
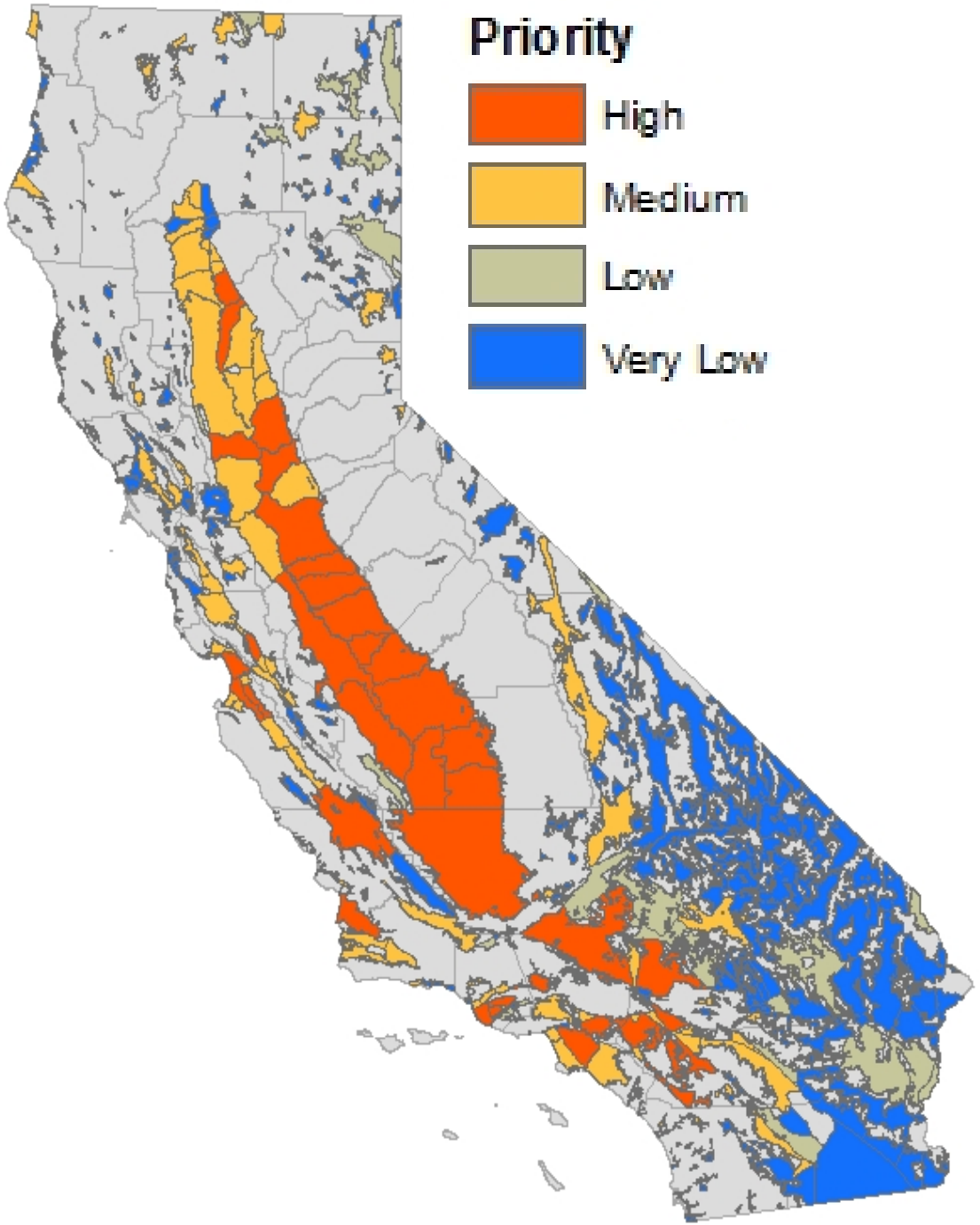


Figure: Faunt, 2009, p. 22



- GW-SW disconnection
- GW Overdraft
- Land Subsidence
- Wat. Quality Degradation

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CSA STRATEGY #2:
AGRICULTURAL *GROUNDWATER BANKING*

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- **What is groundwater banking?**

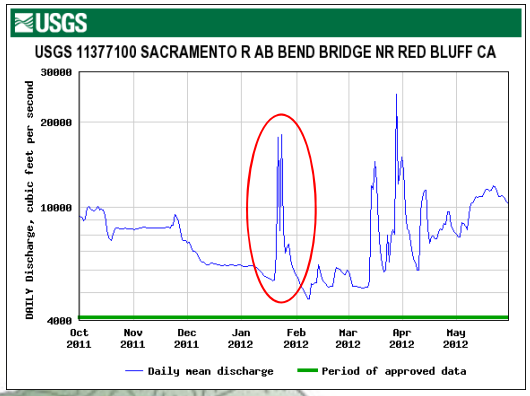
  …is the active and intentional recharge of groundwater aquifers during years when rainfall is abundant to increase water supply reliability during drought years

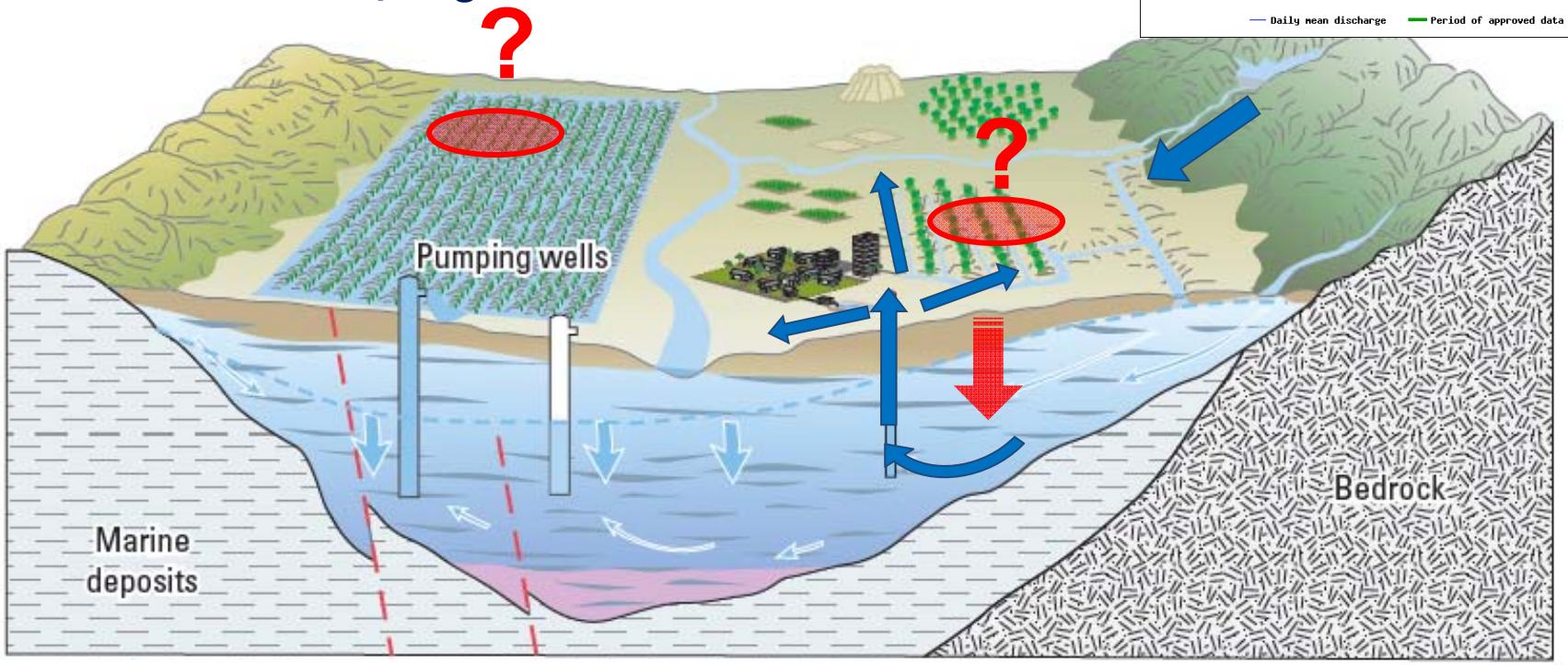
- **Agricultural groundwater banking (Ag-GB)**:

  Infiltrate/percolate water on agricultural fields to recharge groundwater

Feasibility Study of Ag-GB

- **Surface water source and conveyance**
- **Suitable cropping system**
- **"Clean" recharge and effective retention**
- **Cost-benefit, legal constraints**





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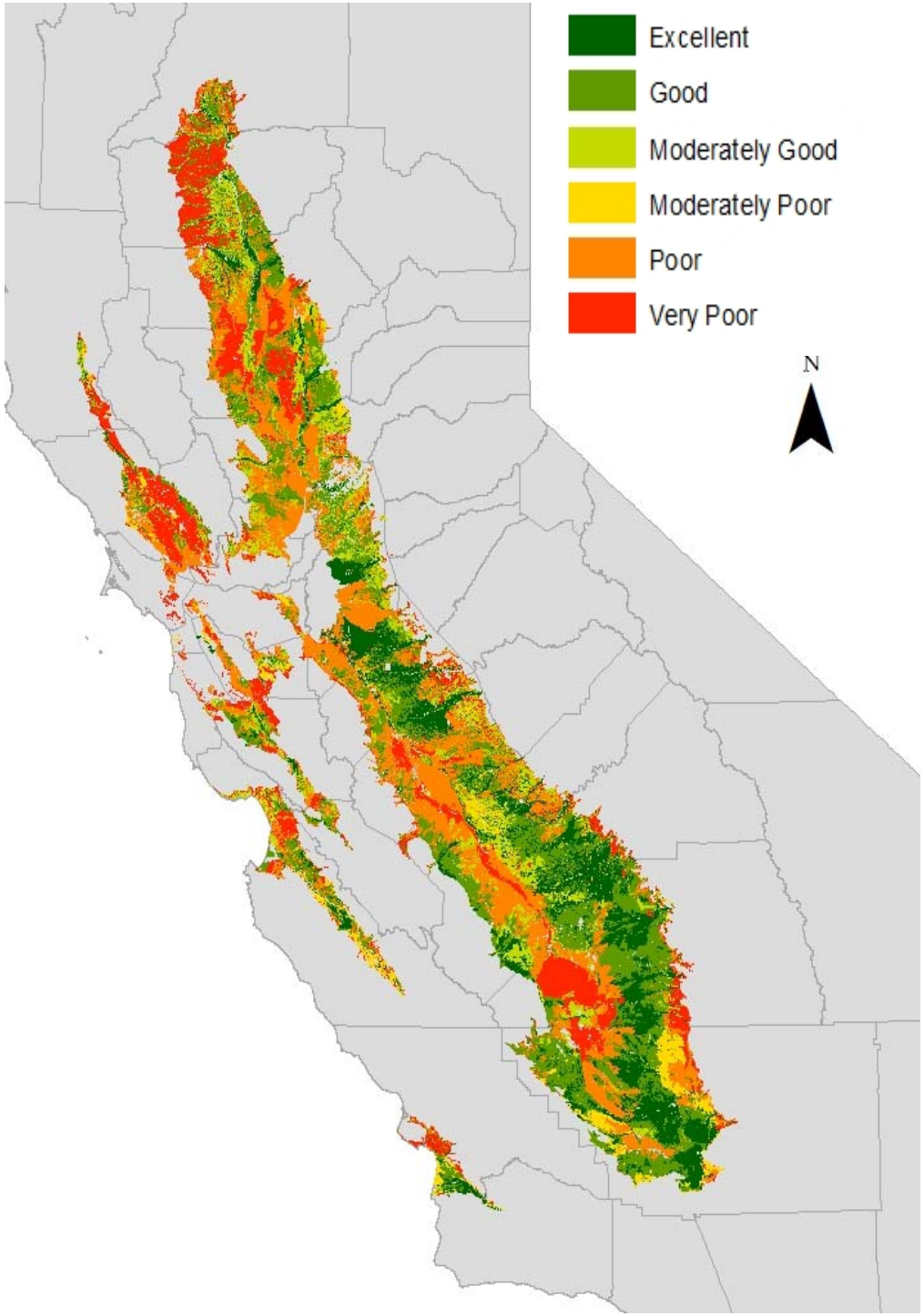
Soil Agricultural GW Banking Index

A. Deep percolation
B. Root zone residence
C. Topography
D. Salinity & Nutrient
E. Surface condition

2.3 million hectares of good soils for Ag-GB



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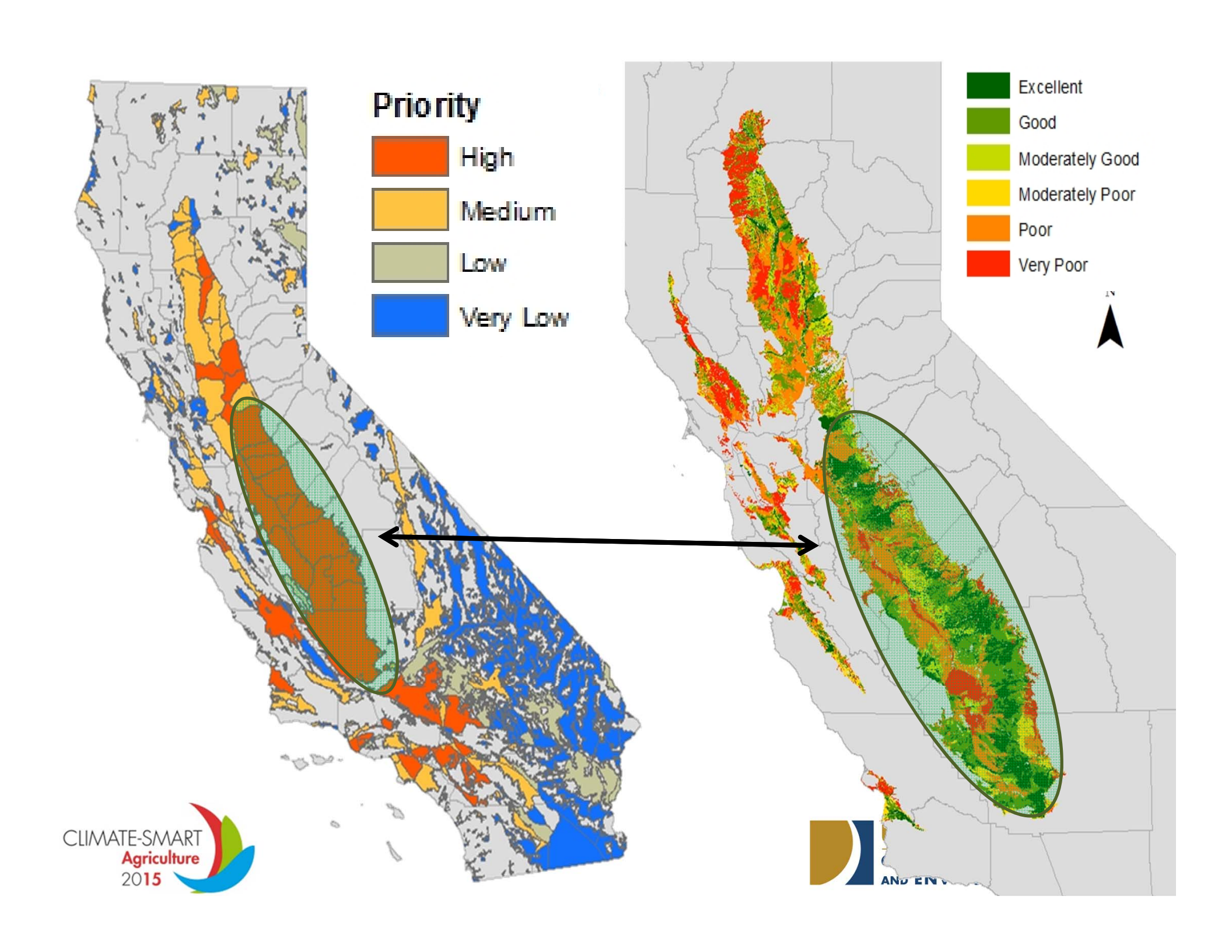
Priority
High
Medium
Low
Very Low
Excellent
Good
Moderately Good
Moderately Poor
Poor
Very Poor
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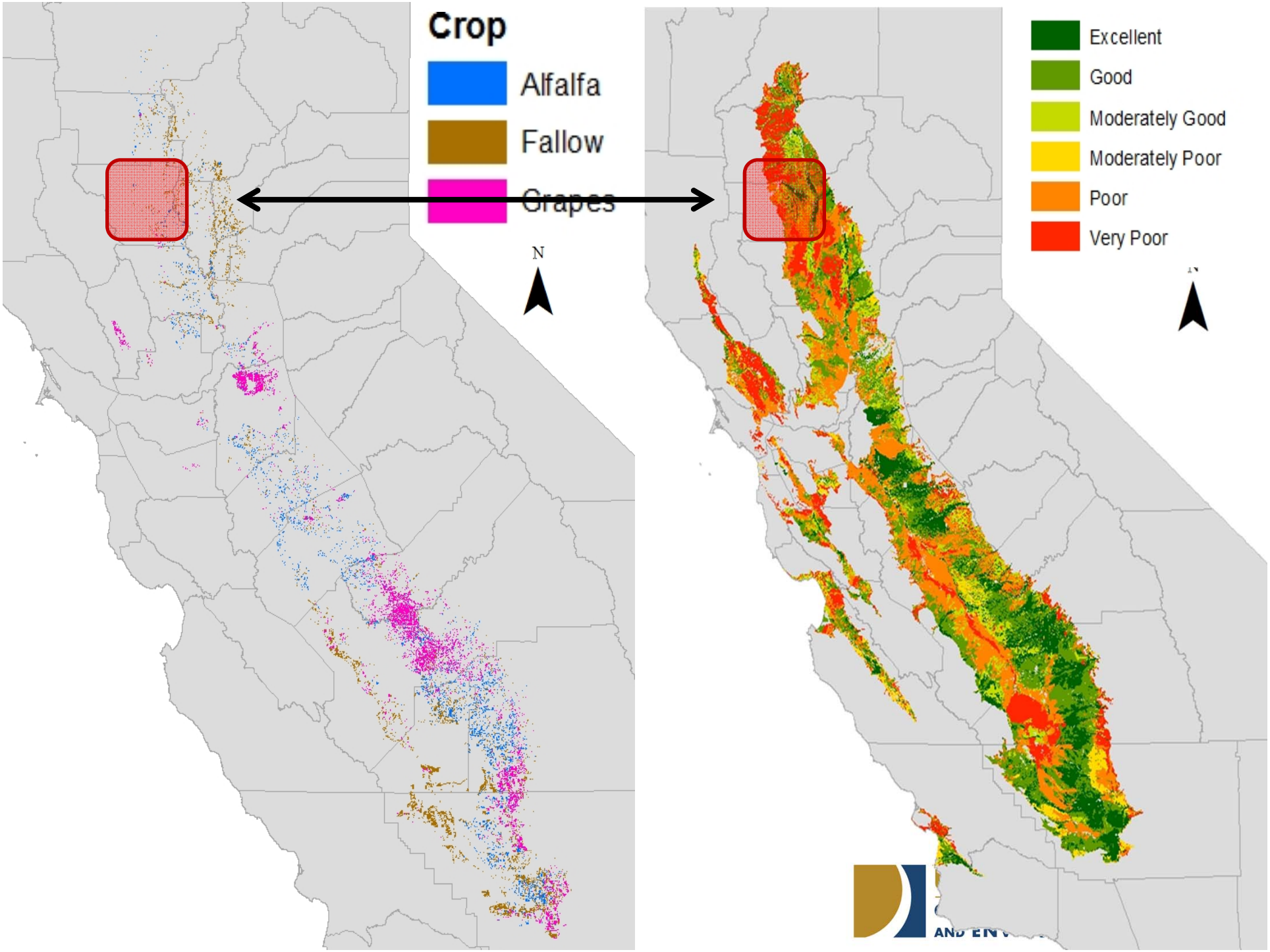
Crop
Alfalfa
Fallow
Grapes
N
Excellent
Good
Moderately Good
Moderately Poor
Poor
Very Poor

Climate Smart Agriculture and Water Management California

- No silver bullet, instead a mosaic of strategies
  - Efficient Use of Water
  - Conjunctive use of SW and GW: Agricultural Groundwater Banking
  - Water Supply and Flood Management
  - Others
- Take home message: Consider other countries experience

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Thank you

Merci

Gracias

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