Integrating Drones & Drone-derived Data into Watershed Management

some examples from the field

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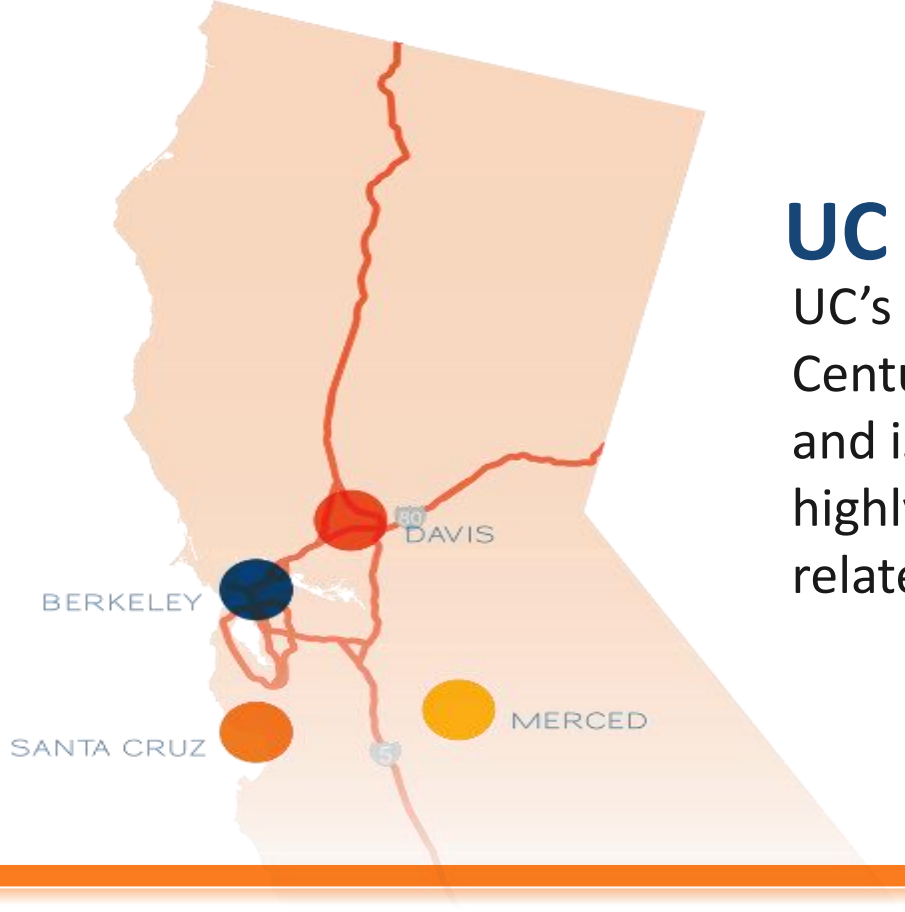
CENTER FOR INFORMATION TECHNOLOGY RESEARCH
IN THE INTEREST OF SOCIETY

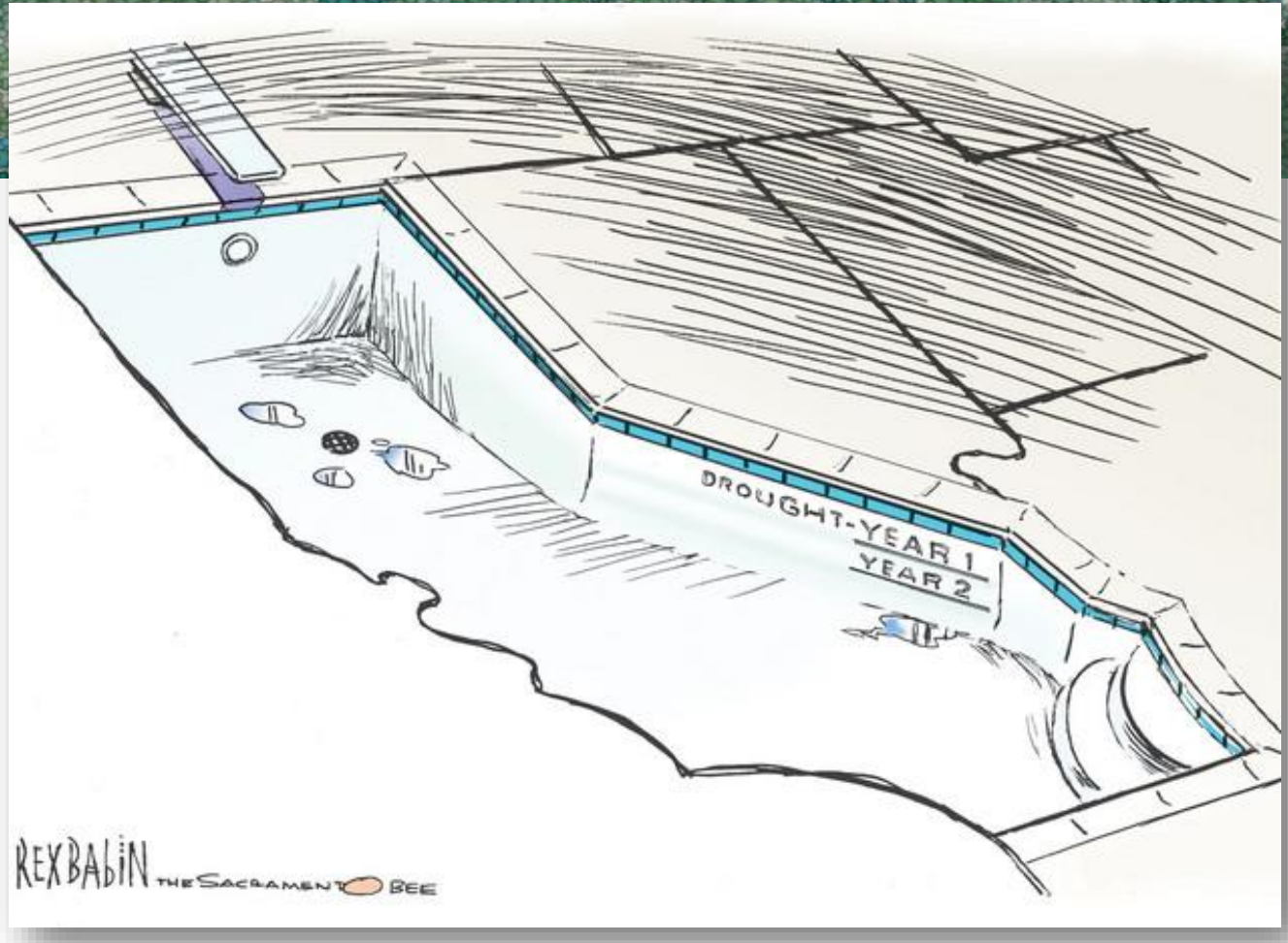
UC BERKELEY / UC DAVIS / UC MERCED / UC SANTA CRUZ

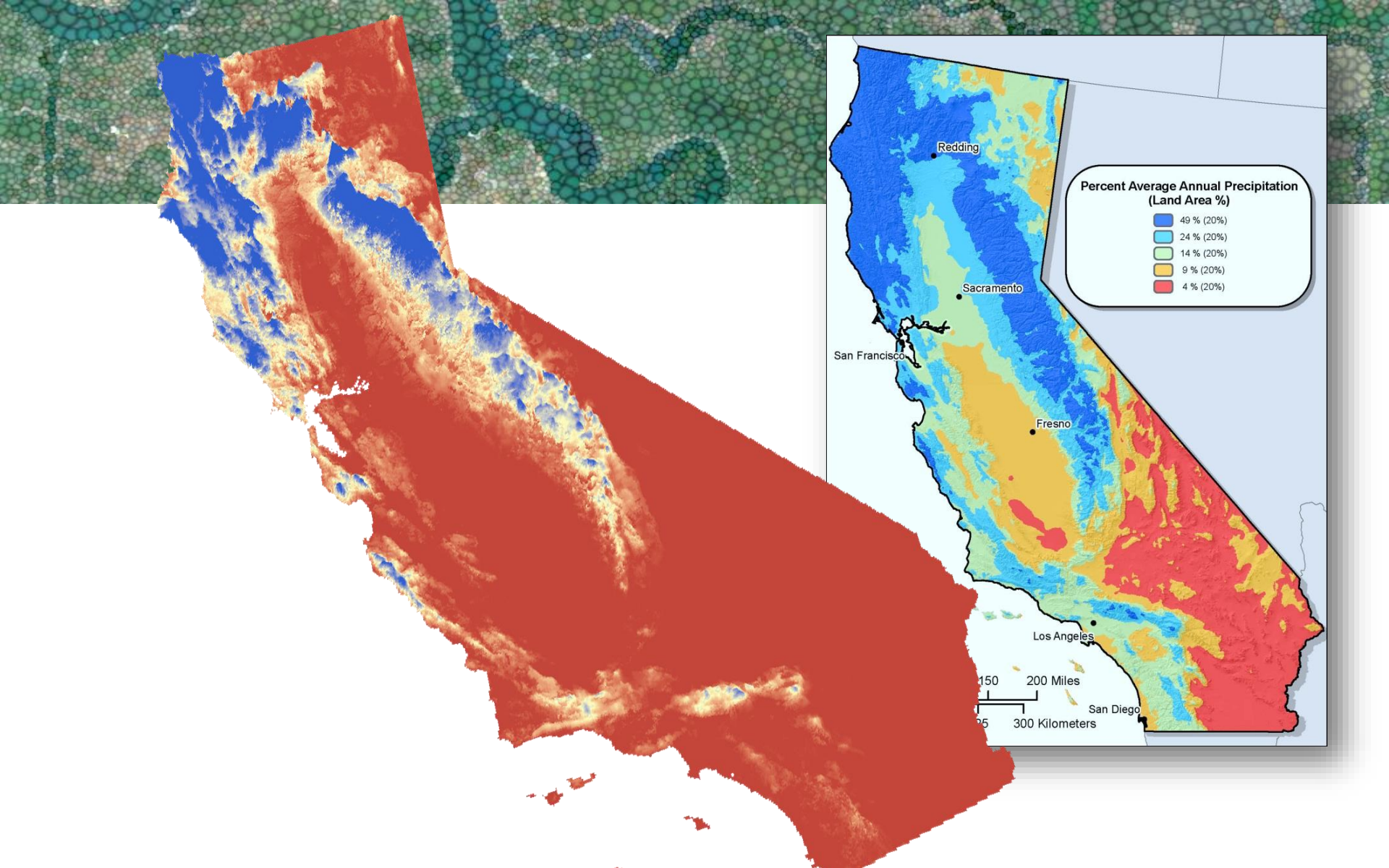


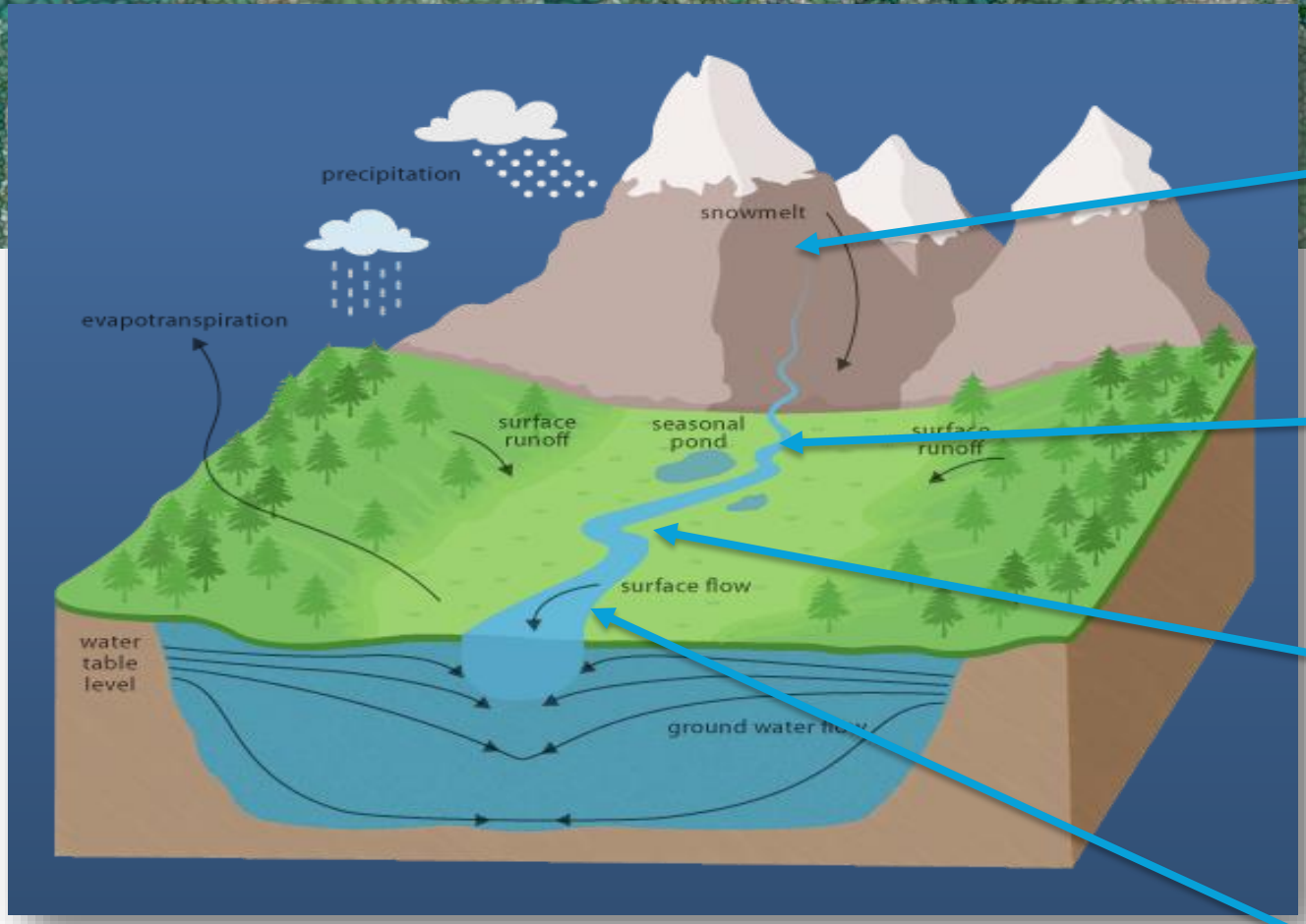
UC Merced

UC's tenth campus is the first 21st Century research university in the US, and is recognized for supporting a highly-diverse student body in STEM related fields.

UC Merced


DROUGHT-YEAR 1
YEAR 2
REX BABIN THE SACRAMENTO BEE


Redding
Sacramento
San Francisco
Fresno
Los Angeles
San Diego
Percent Average Annual Precipitation
(Land Area %)
49 % (20%)
24 % (20%)
14 % (20%)
9 % (20%)
4 % (20%)
150
200 Miles
300 Kilometers



Meadow Integrity

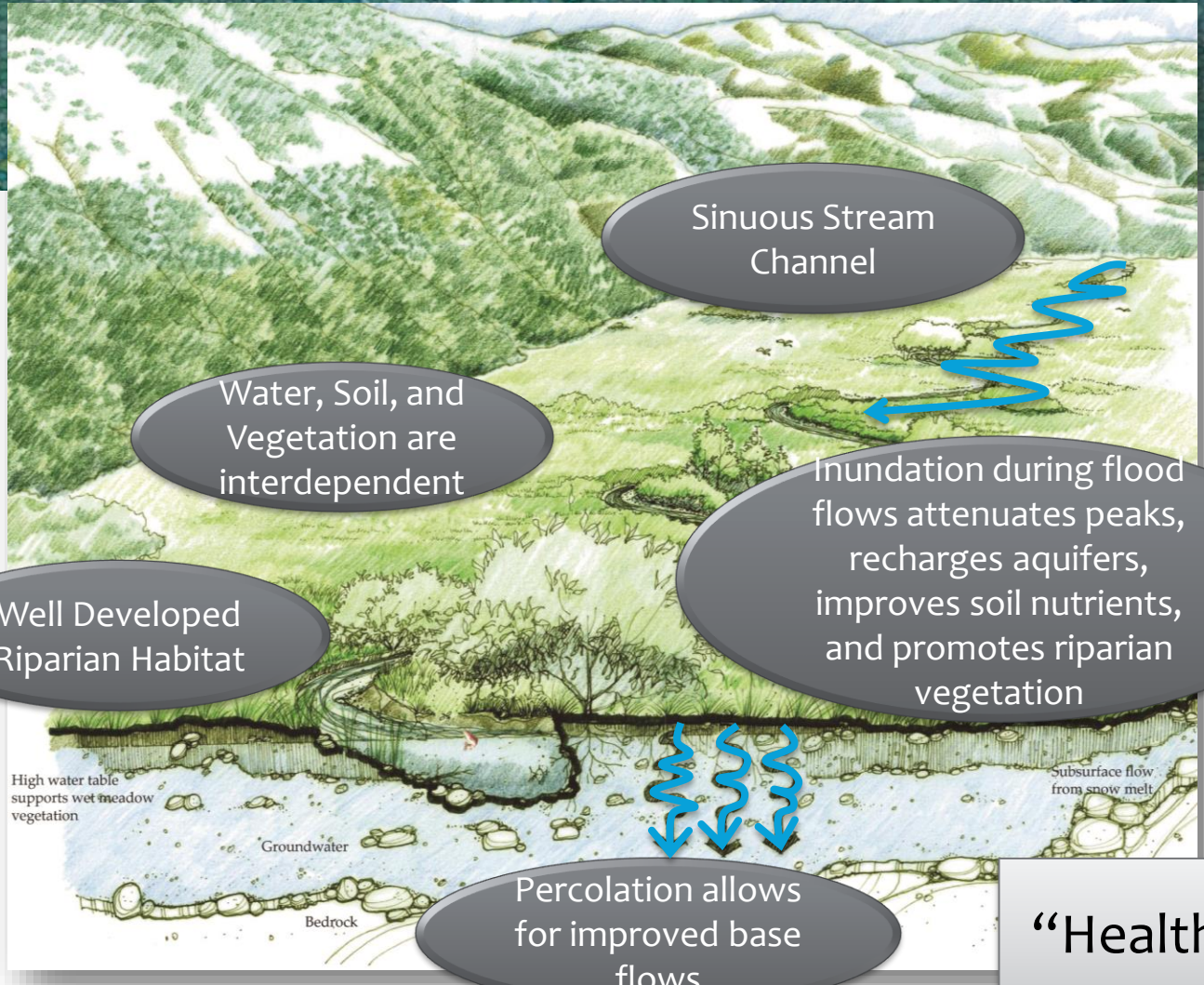
Floodplain Restoration

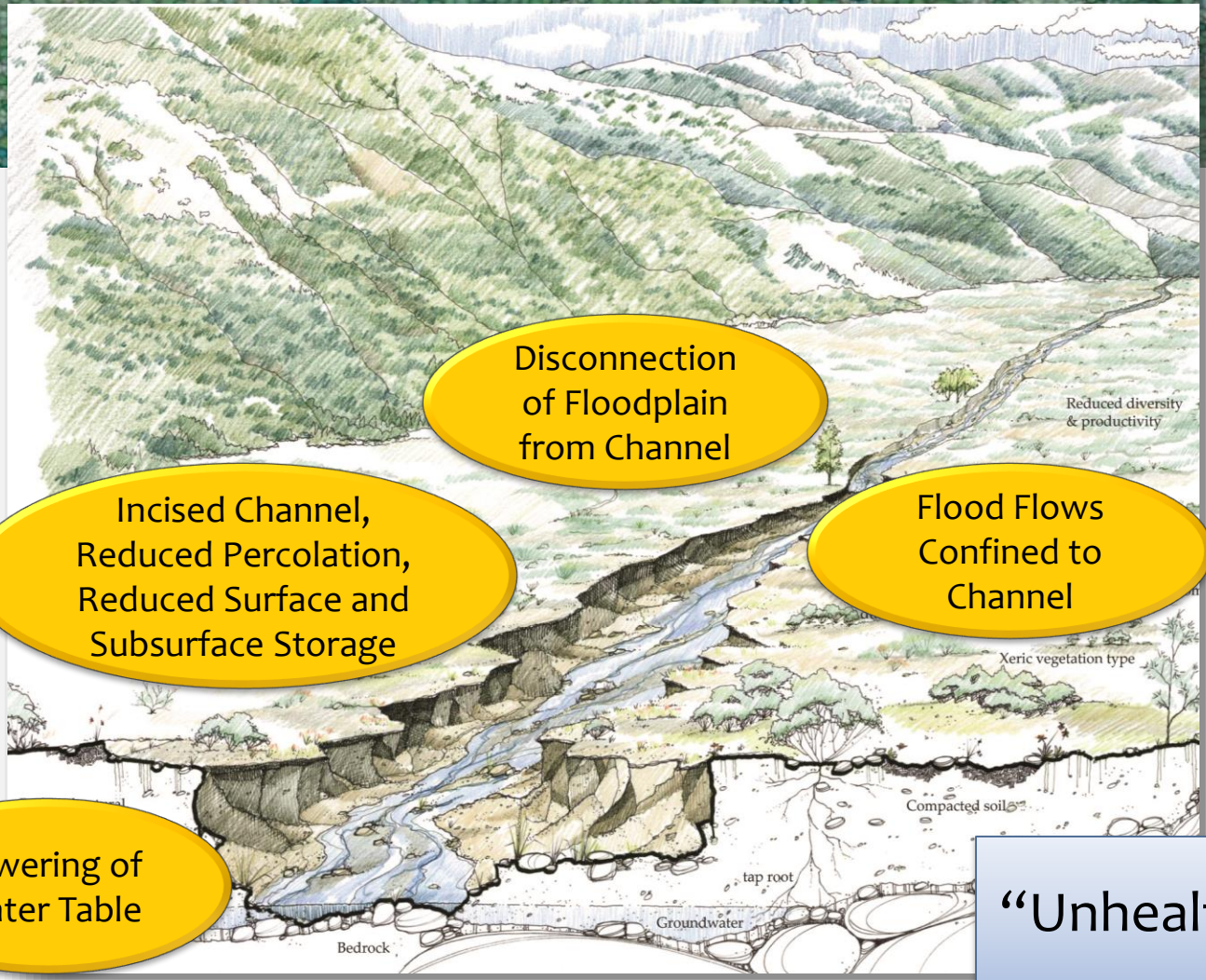
Waterfowl Habitat

Water Quality

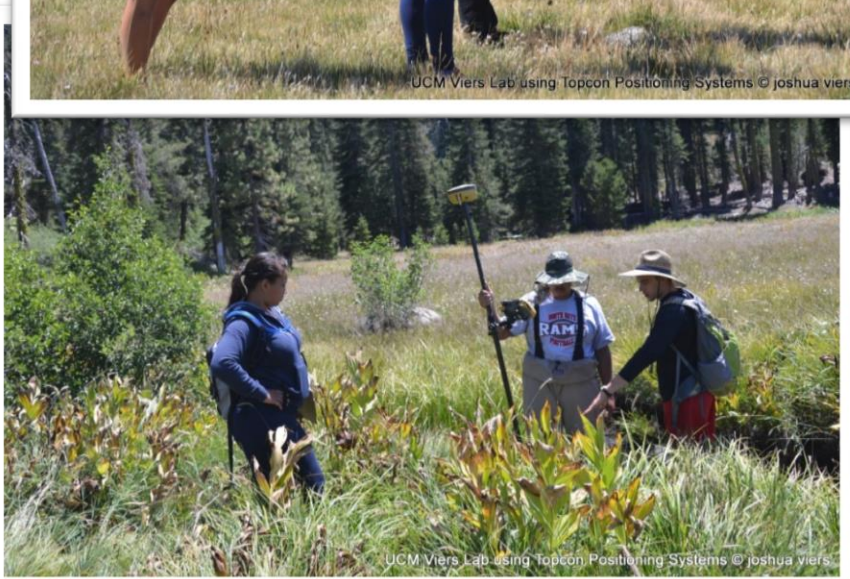
from source to sea

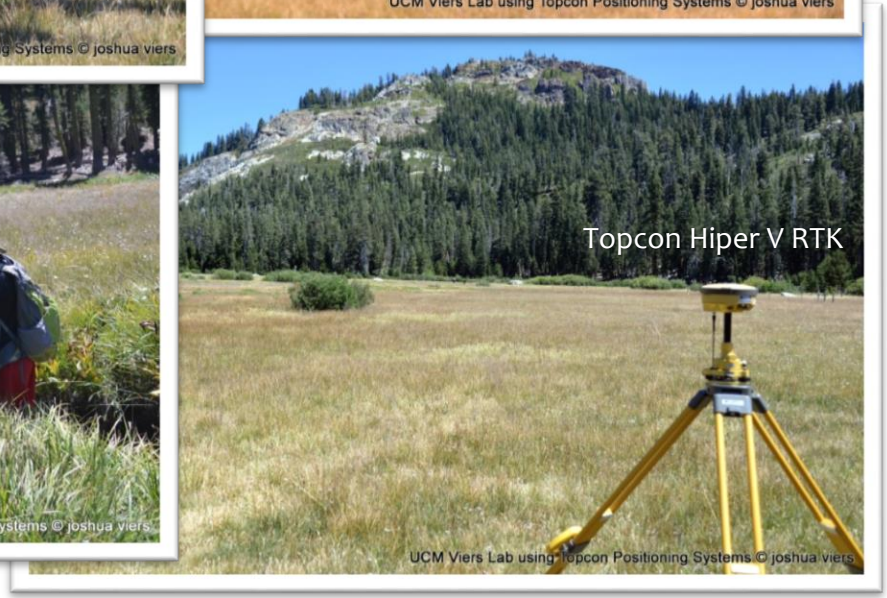
Easy, Reliable, Novel, & Safe


Sinuous Stream Channel
Water, Soil, and Vegetation are interdependent
Inundation during flood flows attenuates peaks, recharges aquifers, improves soil nutrients, and promotes riparian vegetation
Well Developed Riparian Habitat
High water table supports wet meadow vegetation
Groundwater
Subsurface flow from snow melt
Bedrock
Percolation allows for improved base flows
"Healthy"


Disconnection of Floodplain from Channel
Incised Channel, Reduced Percolation, Reduced Surface and Subsurface Storage
Flood Flows Confined to Channel
Lowering of Water Table
"Unhealthy"
Reduced diversity & productivity
Xeric vegetation type
Compacted soil
tap root
Groundwater
Bedrock

Earthwatch Institute & UCM “Sierra to Sea”

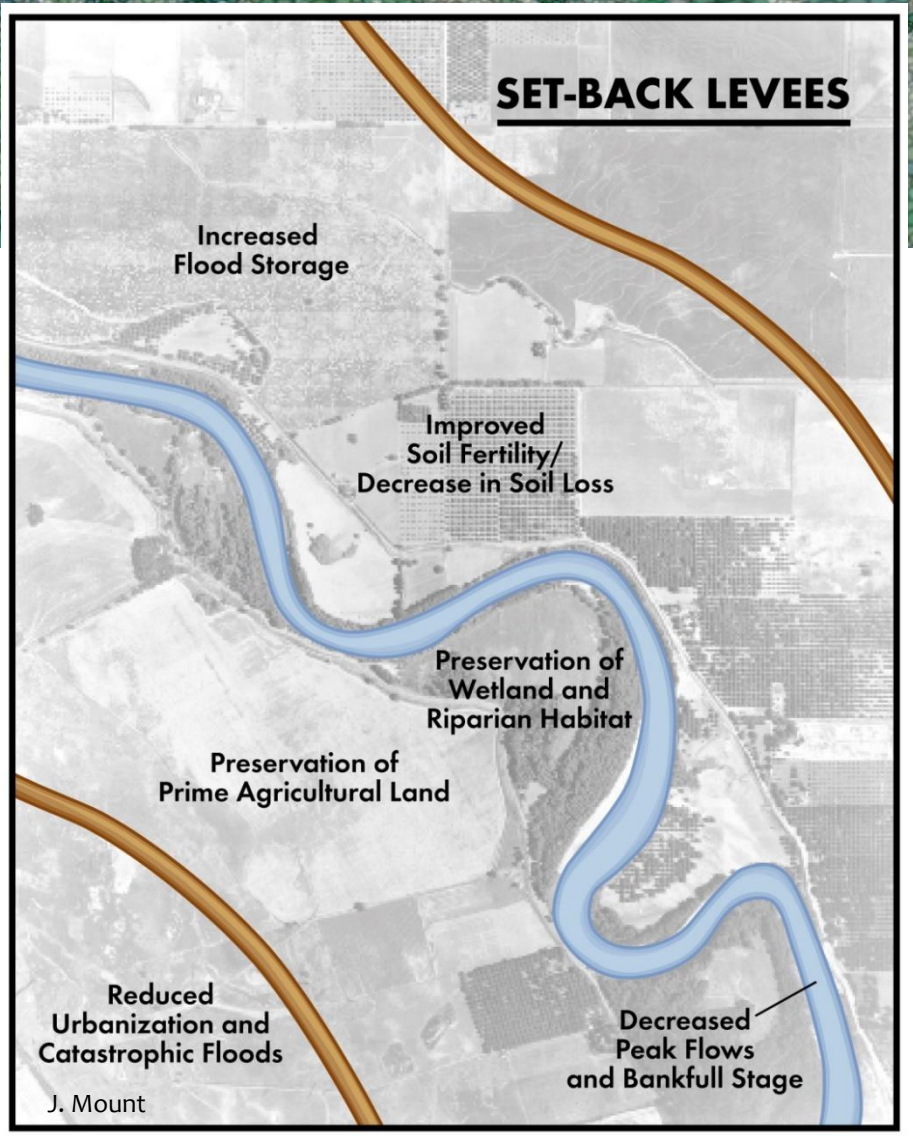





Easy
5 cm stitch with AgiSoft, flown with DJI Phantom2 and GoPro3

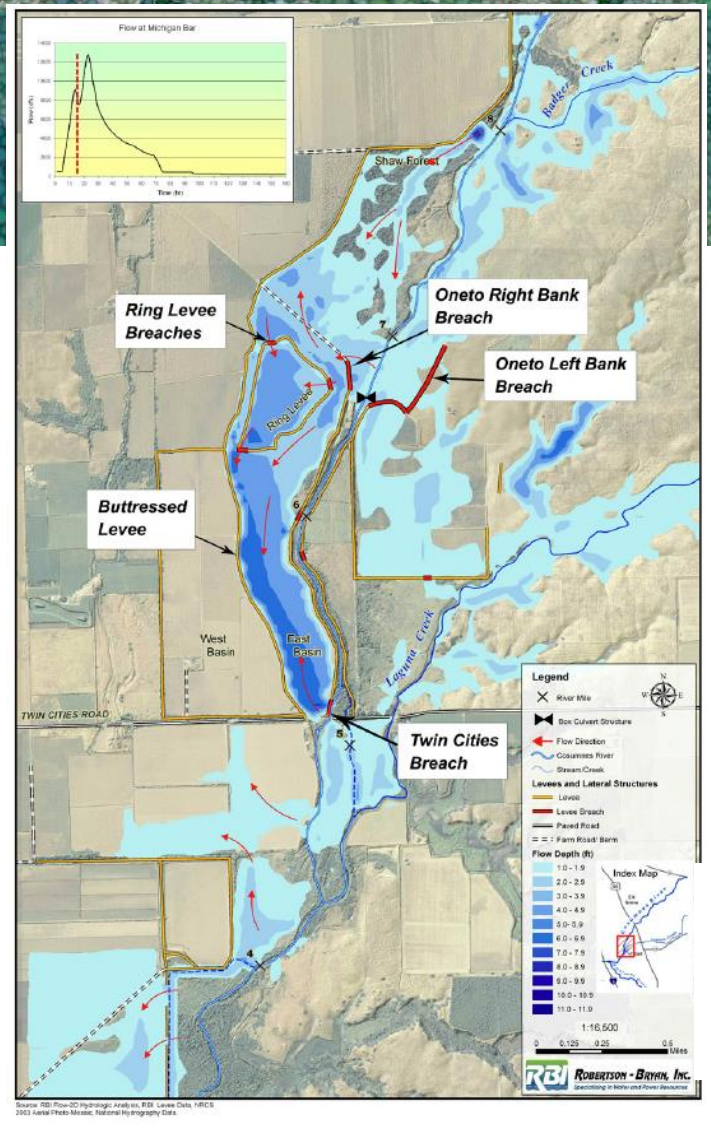
Reconnecting floodplains is a "No Regrets" policy with multiple benefits.

- **Water Supply Improvement**
  - groundwater recharge
  - flood abatement
- **Water Quality Improvement**
  - trap nutrients and sediments
- **Recreation Benefits**
  - enhanced hunting, fishing, birding
- **Agricultural Benefits**
  - flood compatible ag increases economic certainty
- **Ecosystem Benefits**
  - ecosystem functioning underlies all ecosystem services for human benefit



Cosumnes River

- Multi-Benefit
- Multi-Discipline
- Multi-Modal

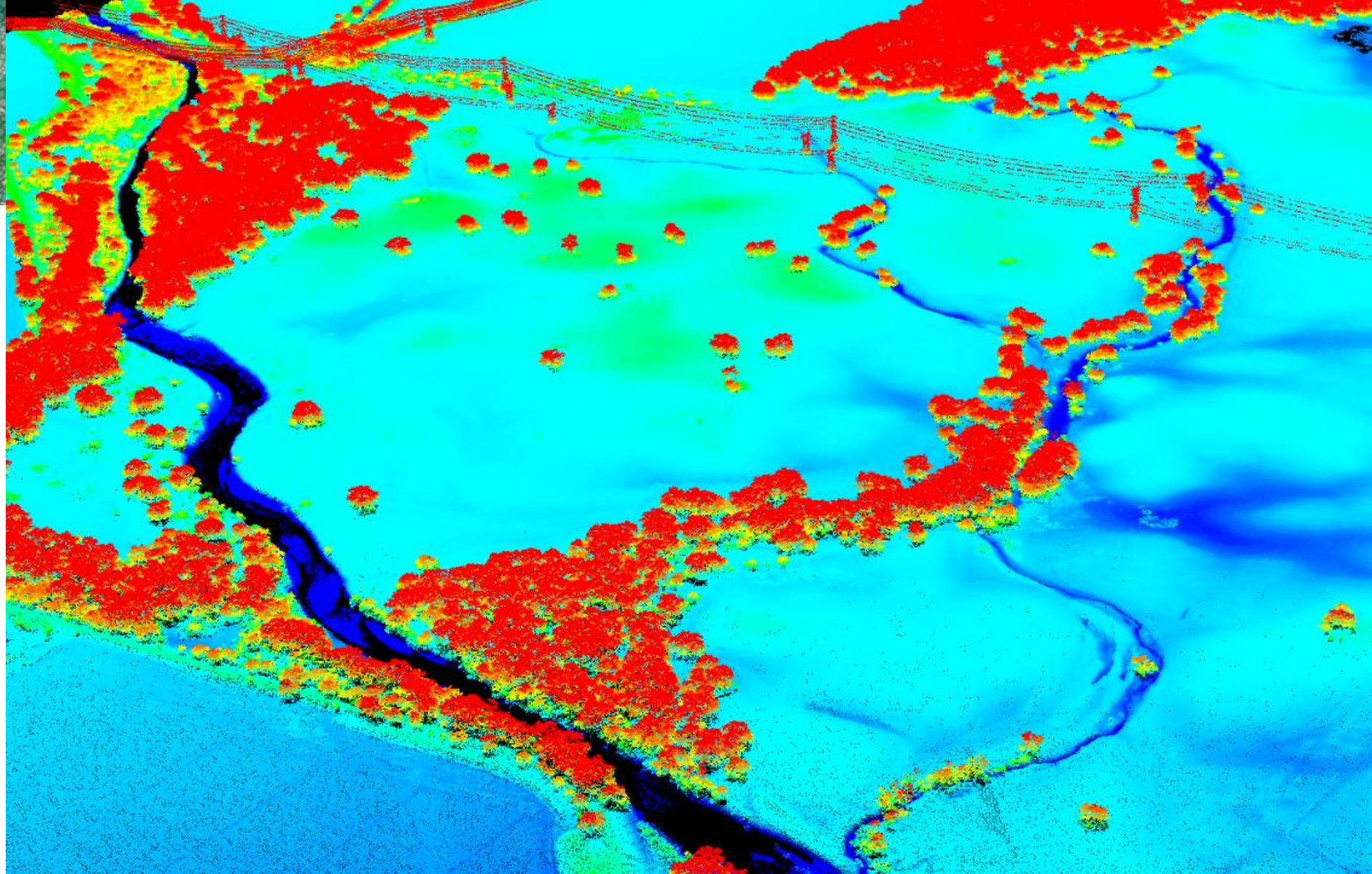


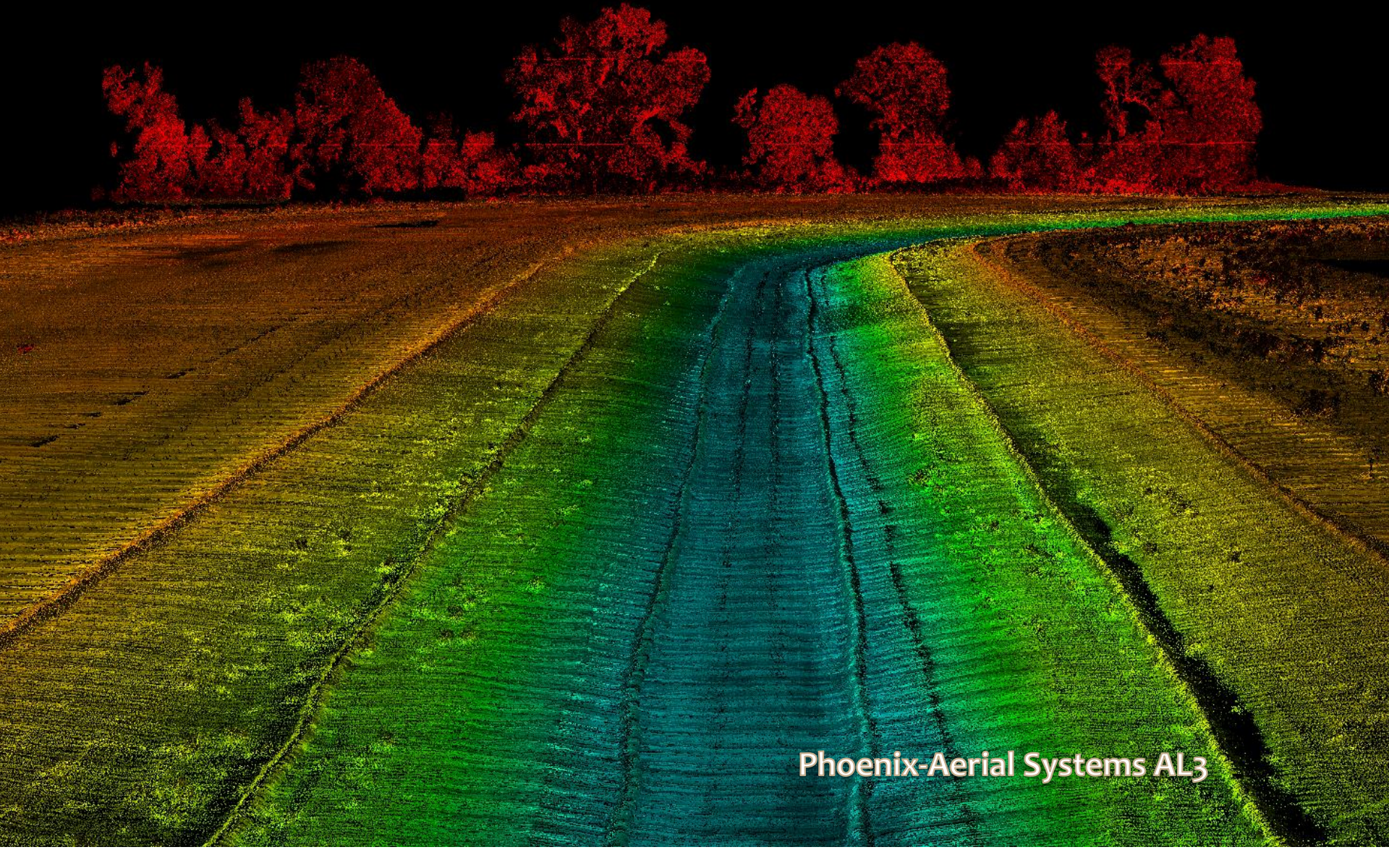
The Nature Conservancy
Protecting nature. Preserving life.™


Consecutive Days < 100 cfs
Cosumnes River Feb. 2014
© joshua viers

Ephemeral floodplain habitats provide best growth conditions for juvenile chinook salmon in a California river

C.A. Jeffres, J.J. Opperman, & P.B. Moyle (*Environmental Biology of Fishes, 2008*)




Phoenix-Aerial Systems AL3

Change Detection & Quantification of Floodplain Topography & Processes

NIR

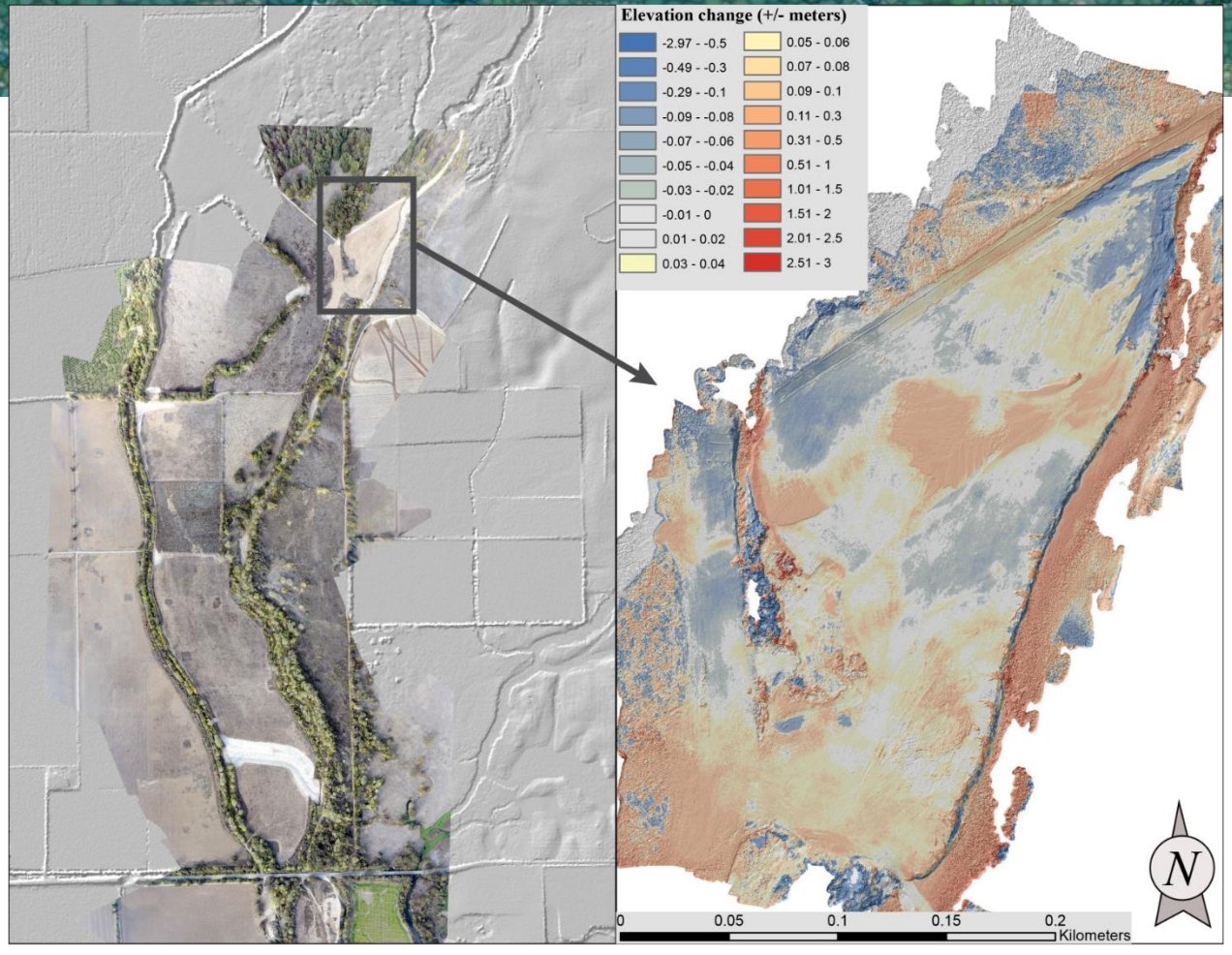
AggieAir

November 2014

RGB

Comparative Topography

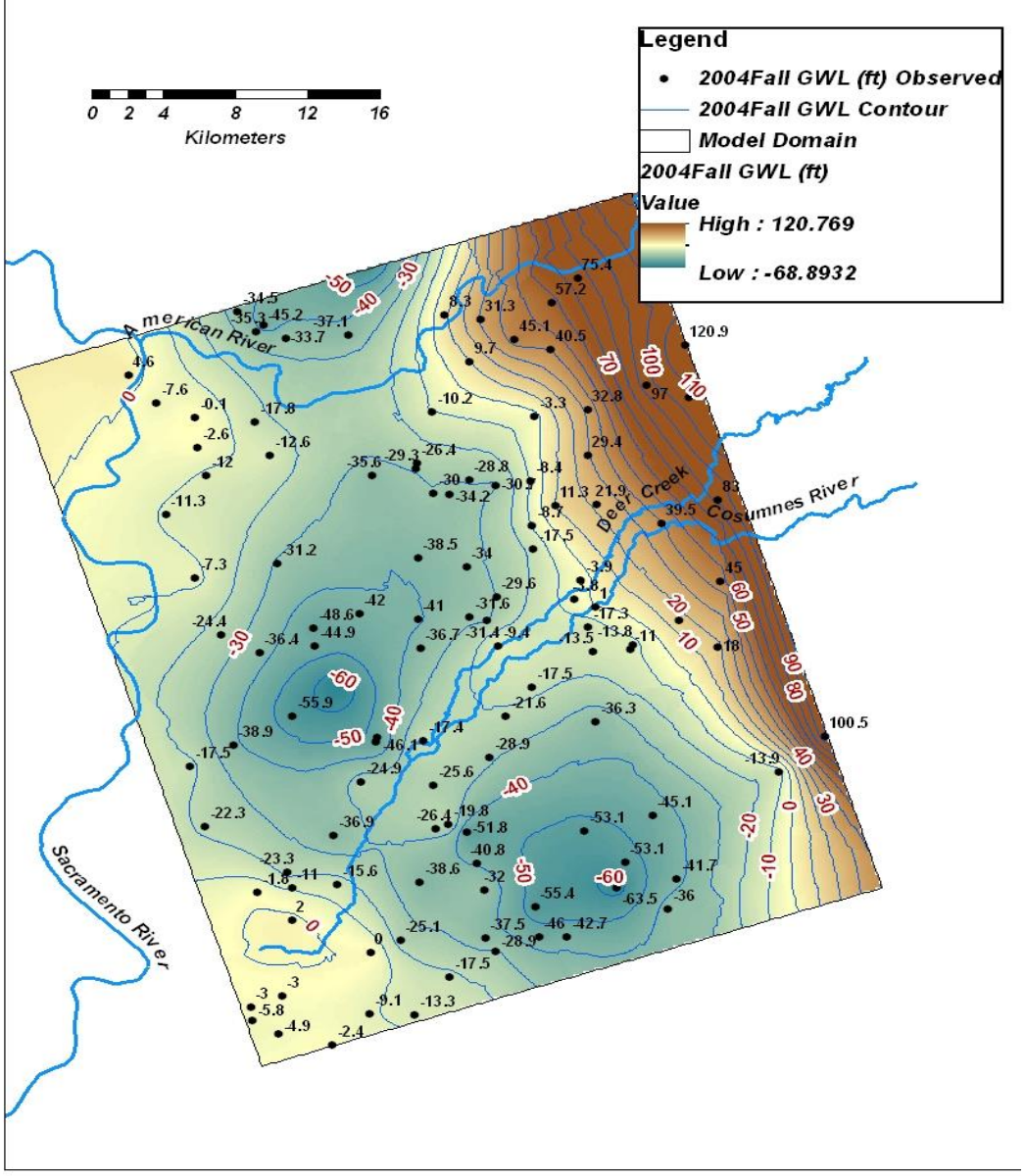
Change Detection & Quantification



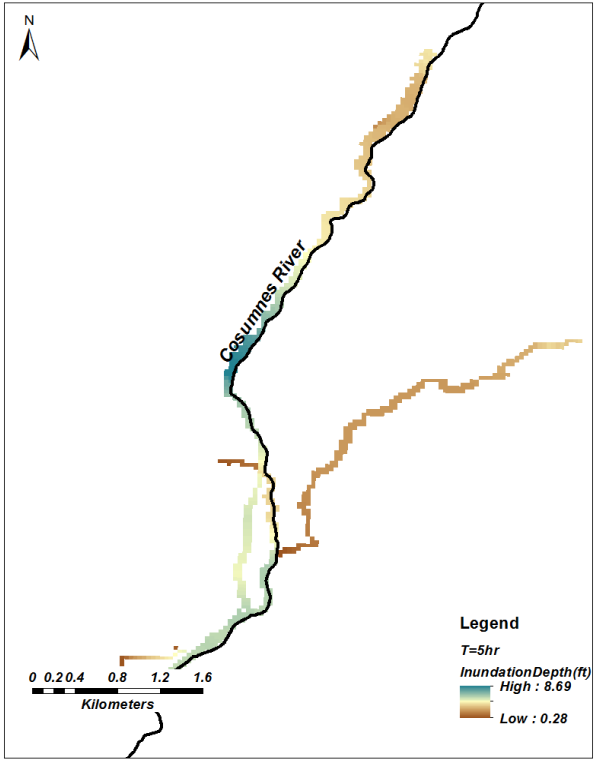
Floodplain scour and deposition after February flooding

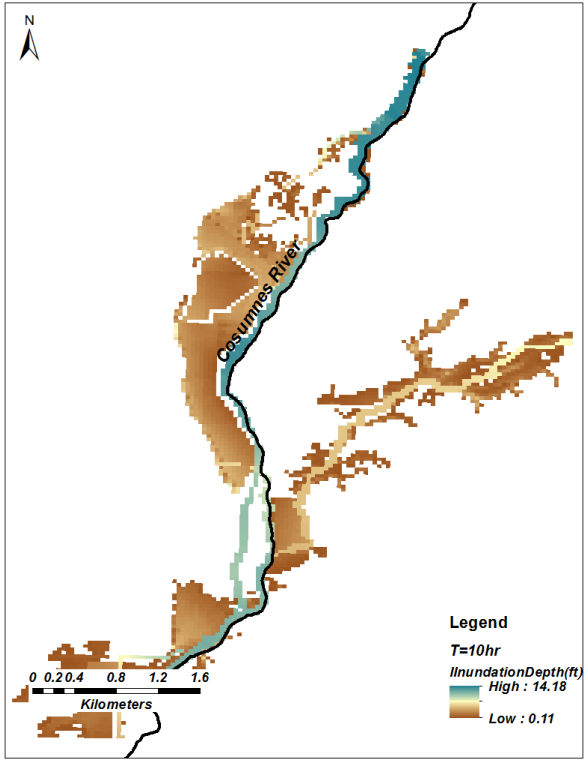
documenting floodplain processes

Reliable

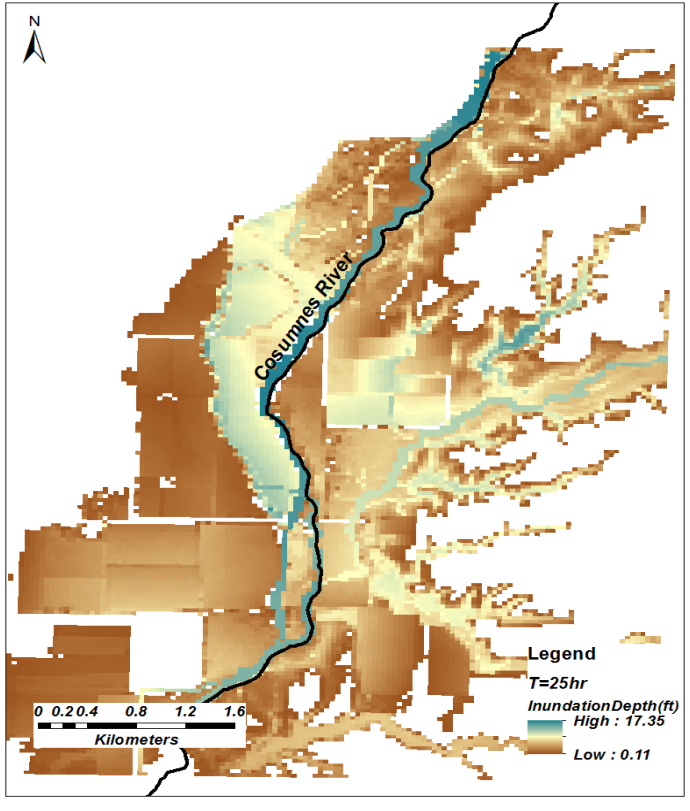

Legend
2004Fall GWL (ft) Observed
2004Fall GWL Contour
Model Domain
2004Fall GWL (ft)
Value
High : 120.769
Low : -68.8932
0 2 4 8 12 16
Kilometers
American River
Deer Creek
Cosumnes River
Sacramento River

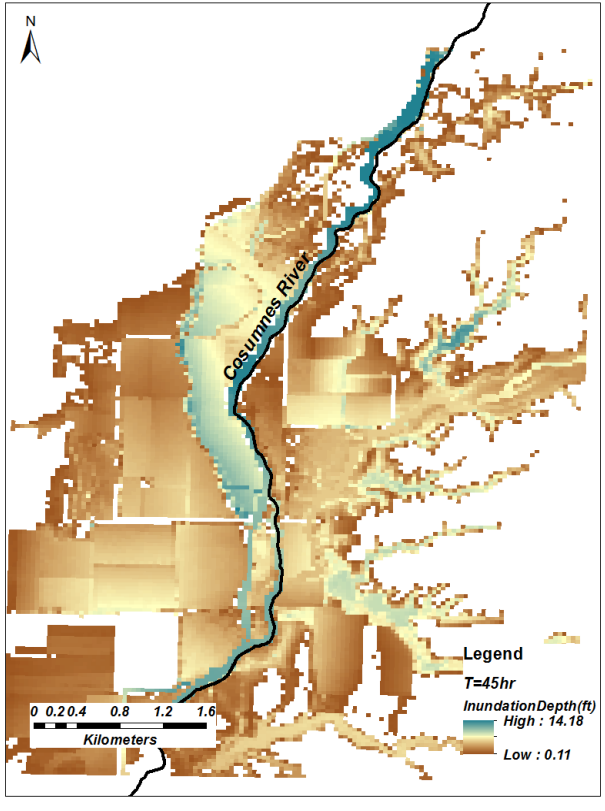
3.5 yr floodplain inundation map at t=5 hour and t=10 hour



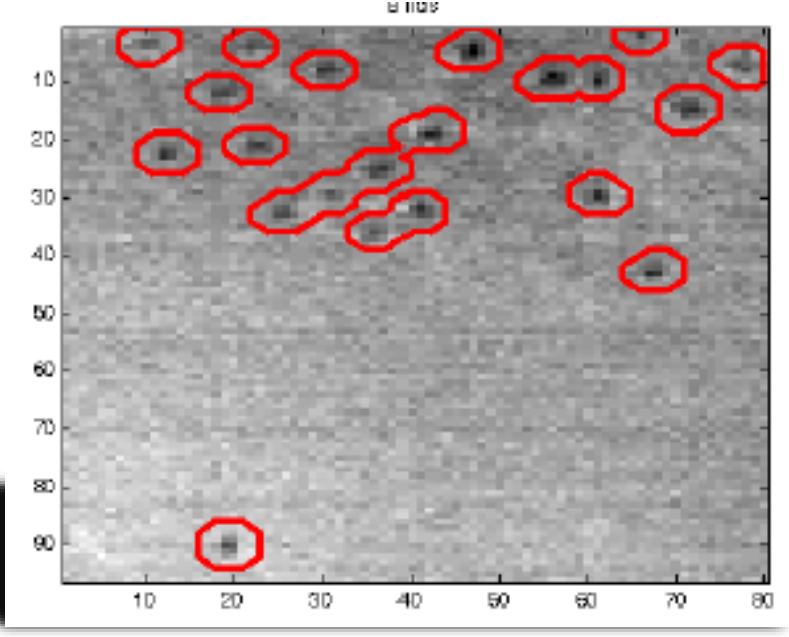


3.5 yr floodplian inundation map at t=25 hour and t=45 hour



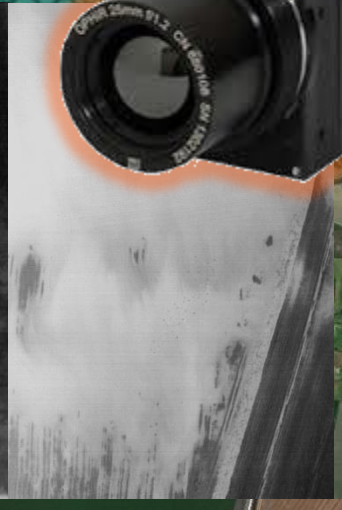


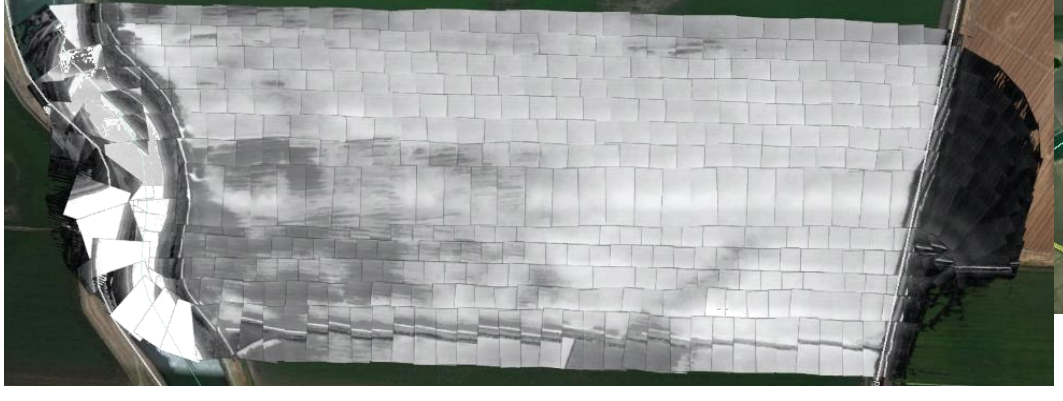
Lesser Sandhill Crane

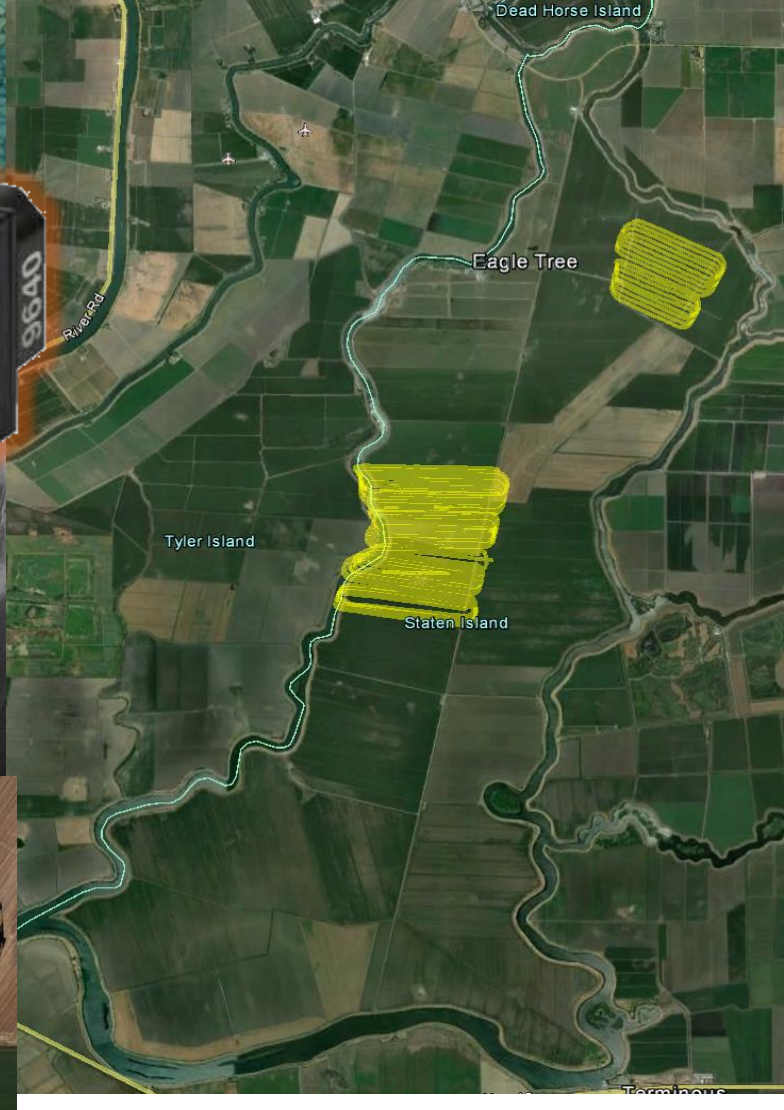


Critical for Water & Habitat Management

Delta: Staten Island

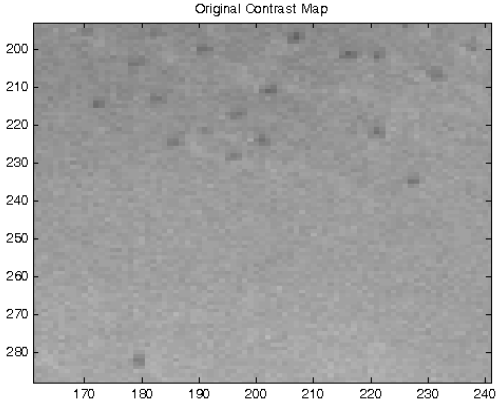


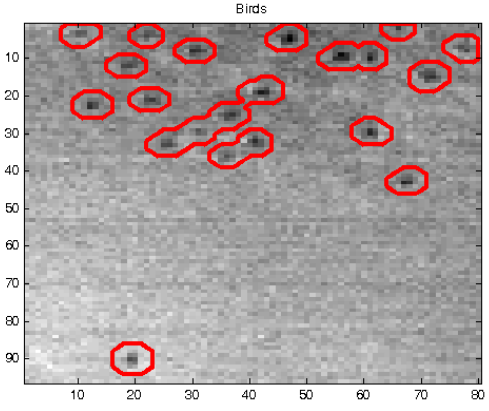


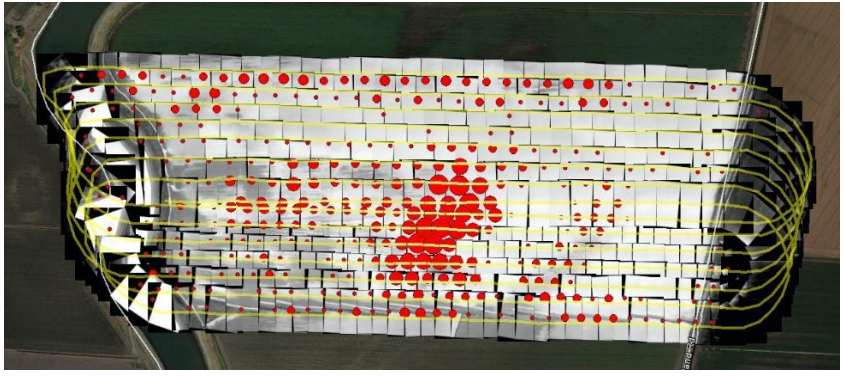


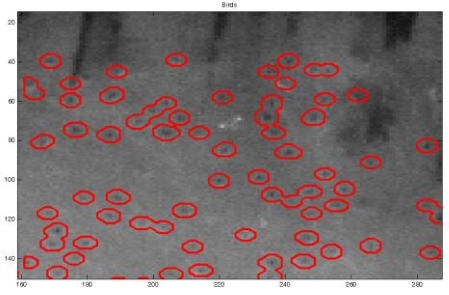
Stark & Chen

Bird Detection Algorithm





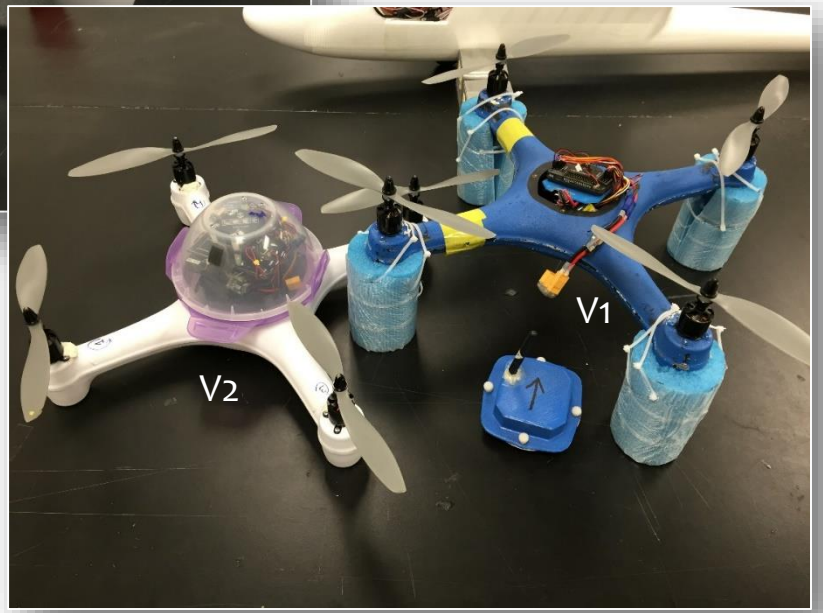




Novel

Stark & Chen

CITRIS AquaCopter



Waterproof Quadrotor
Autopilot and Power Supply:

- Pixhawk AP
- 4000 mAh 4-Cell Lipo
- WayPoint Navigation
- 0.75 kg payload

AquaCopter Water Quality Sampling

Waterproof Quad
Autopilot and Power Supply:
- Pixhawk AP
- WayPoint Navigation
- .75 kg payload

In-situ sensors: pH, E.C., D.O., Temp, Humidity, Baro

AquaCopter Sampling Payload

- Vacuum pump to draw sample through filters
- A network of solenoid and check valves to control flow
- Vacuum pump is reversed for sample evacuation
- Cleanse cycle between samples
- In-situ sensors:

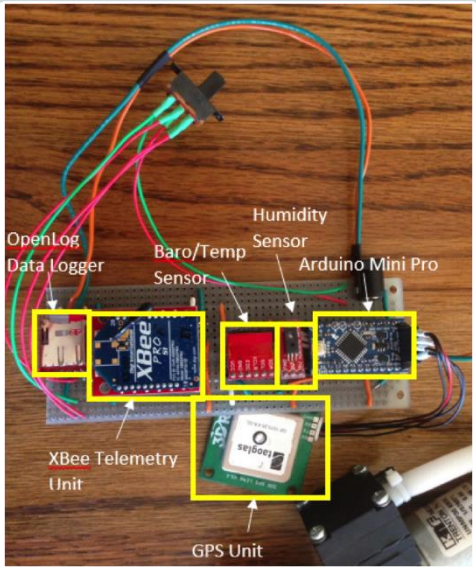
pH, EC, DO, T,
Humidity, Baro

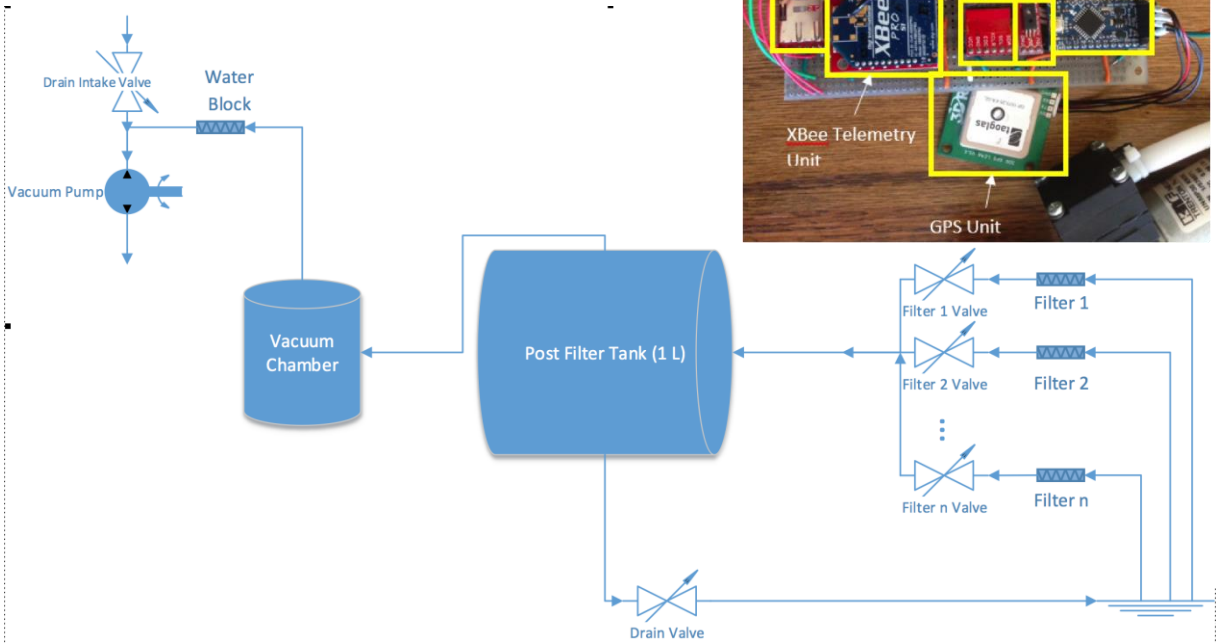
- Target payload:

0.75 kg

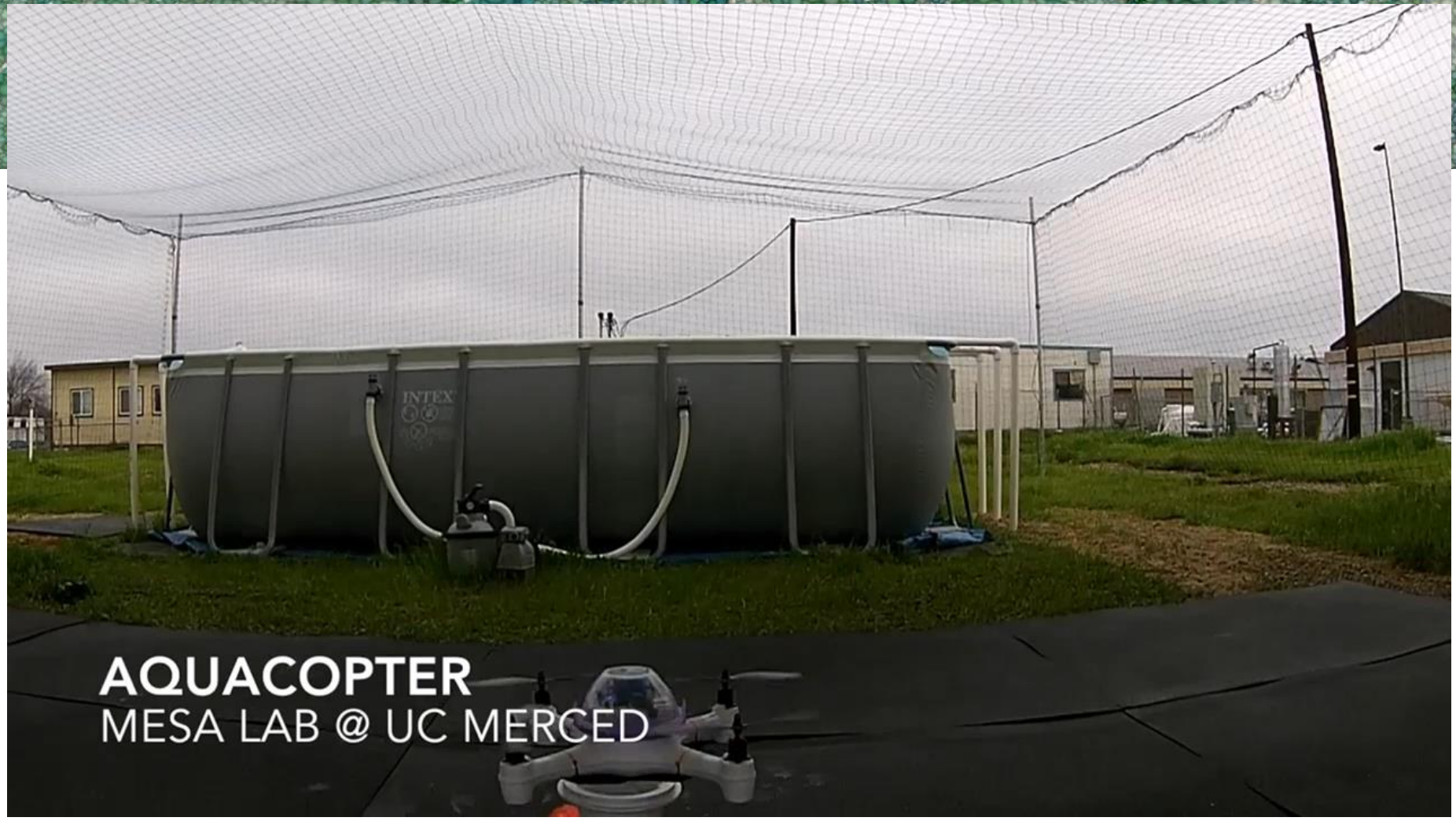
- Conductivity

sensors for water
landing and tank water level





B. Smith & Y. Chen



Safe

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Easy, Reliable, Novel, & Safe