





# Modeling flow and pesticide transport through surface water diversions in the California Central Valley



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- Background: Agriculturally intensive Central Valley Region in California with need to control pests drains to the California Bay-Delta
- Goal: Characterize pesticide concentrations in the Delta
- Challenges: Modeling the many surface water diversions in and around Delta that have major effects on flow rates and pesticide concentrations





- Drainage area includes entire
  Central Valley
- Intensive agricultural region
- Surface water diverted hundreds of miles
  - Delta Mendota Canal
  - California Aqueduct





- Flood control structures
- Irrigation canals
- Pumping stations









Time-varying High flow rates Lack temporal patterns 20000 (*f*<sup>2</sup>, /s) 15000 0000 Sacramento River Monthly Avg. 0 Tisdale Spillage 

Monthly Avg. Outflow ( $m^3$  /s)

Time



### Currently

- Transfer amount options
  - Constant fraction of flow rate
  - Constant volume
- Constant mass transfer

#### Improved

- Daily or monthly time-series
- Destinations in or out of watershed
- Daily or monthly pesticide, nutrient, sediment transfer proportional to transferredflow:total-flow ratio
- Corrected monthly output indices





- Daily and monthly point source files
  - ##p.dat, ##m.dat
  - NEGATIVE flows
- fig.fig file
- Transfer removed from source after routing
- Destination receives transfer before routing on next time-step
- Transfer codes
  - 1 Constant fraction
  - 2 Minimum flow remains
  - 3 Constant volume
  - 4 Timeseries

### fig.fig excerpt



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- Topography: 30-m NHDPlus V2
  Hydrologically Conditioned DEM
- Soils Data: Soil Survey Geographic database, 1:25,000 scale
- Land Use Data: Cropland Data
  Layer (CDL), 30-m, multiple crop
  classes
- 344 Subbasins
  - Average 140 km<sup>2</sup> (1000 .01 km<sup>2</sup>)
  - 37,041 HRUs
- 24 Point Source Inlets
  - Drain 26,300 square miles or 40% of watershed area
  - 30-year daily average time-series
  - US Geological Survey gage data





#### Weirs and Channels

- Moulton, Colusa, Tisdale Weir transfers to Sutter Bypass
- Fremont, Sacramento Weirs to Yolo Bypass
- Delta Cross Channel connection to Mokelumne River
- Little Potato Slough connection to San Joaquin River
- All returned to watershed

#### Pumping Plants

- Central Valley Project Jones Pumping Plant to Delta-Mendota Canal
- State Water Project Banks Pumping Plant to CA Aqueduct
- Contra-Costa Canal
- All exported out of watershed

#### Daily Datasets

US Geological Survey, DAYFLOW





- 33 Irrigation Diversions
- No "Typical Year"
- Monthly datasets
  - CA Department of Water Resources







- Few days to few years of missing observations
- Estimation strategies
  - Linear interpolation
  - Average or similar year





- More accurate estimation of flow rates
- Mass transport, ex. pesticides
- Old River natural flow overwhelmed by export flow
- Still missing some diverted floodwater

**Modeled Flow** 

#### **Old River Monthly Average Flow Rate**





- Improved spatial distribution of pesticide mass
- Natural flow would move San
  Joaquin County mass toward San
  Joaquin River





- Improved spatial distribution of pesticide mass
- Natural flow would move San
  Joaquin County mass toward San
  Joaquin River
- Actual flow due to Pumping Plants dilutes mass and exports out of watershed







## Improved SWAT Results: Pesticide Concentrations

- Observed maximum concentrations were compared with modeled 90<sup>th</sup> percentile concentrations.
- The magnitude of modeled concentrations was generally equivalent to the monitoring data.



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- Improved scheme: time-varying transfer of water, pesticide, nutrient, sediment mass
- Daily or monthly options
- More accurate magnitude and spatial distribution
- Fig.fig and point source input files
- Useful in large watersheds like
  Central Valley with many
  engineering controls on surface
  water
- However, not a dynamic model only as good as input data







- Monthly transfer
- Follows routing
- Transfer destination out of watershed
- Processes before route unaltered
- Point source inflows okay

	U	C	
recday	10 412 5		
Pnt.Source 42p.dat			
add	5 413 42 41	12	
route	2 414 42 4	13	
000420000.rte000420000.swq			
recmon	7 415 1		
Pnt.Source 42m.dat			
add	5 416 414 4	15	
transfer	4 1 42 1	-9999 414.	4 1
1	12 416		

fig.fig