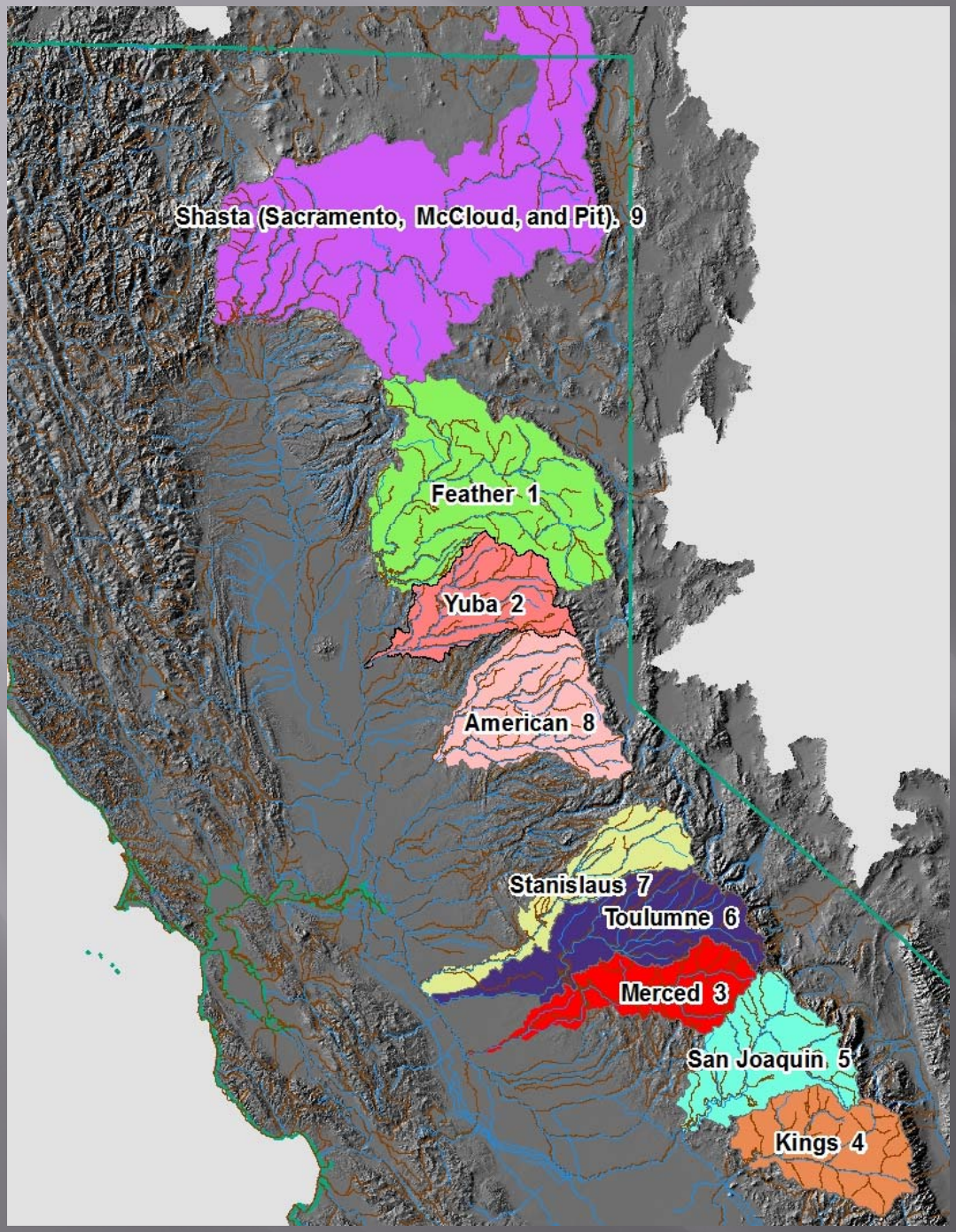
# THE FUTURE OF PRMS WITH SNOW SURVEYS

*Dave Rizzardo, CA DWR*
*daver@ca.water.gov*

*Kate Koczot USGS San Diego CA*
*kmkoczot@usgs.gov*

# OUTLINE

- Current Work
- Design:  Merced and Yuba PRMS
- Discussion: Future Collaborative Work




# Purpose of Study

- Cooperative work with CA DWR
- Provide a physically based model
- AJ calibrations
- Assess basins response to landcover and climate variability

# STATUS (High Resolution Models):

## Feather PRMS

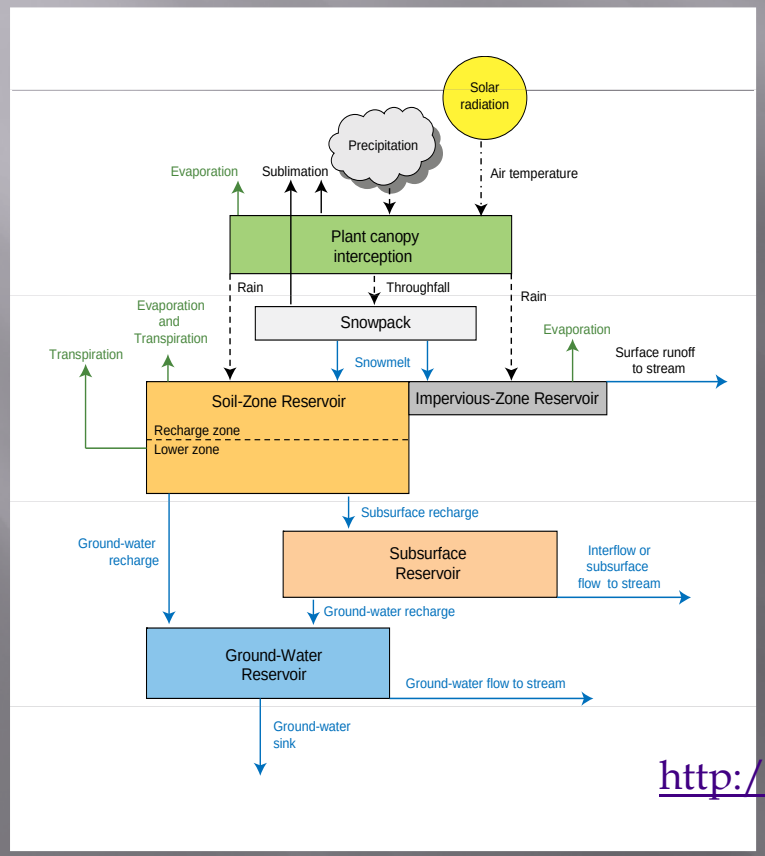
- PRMS/OUI Complete
- Transferred to DWR

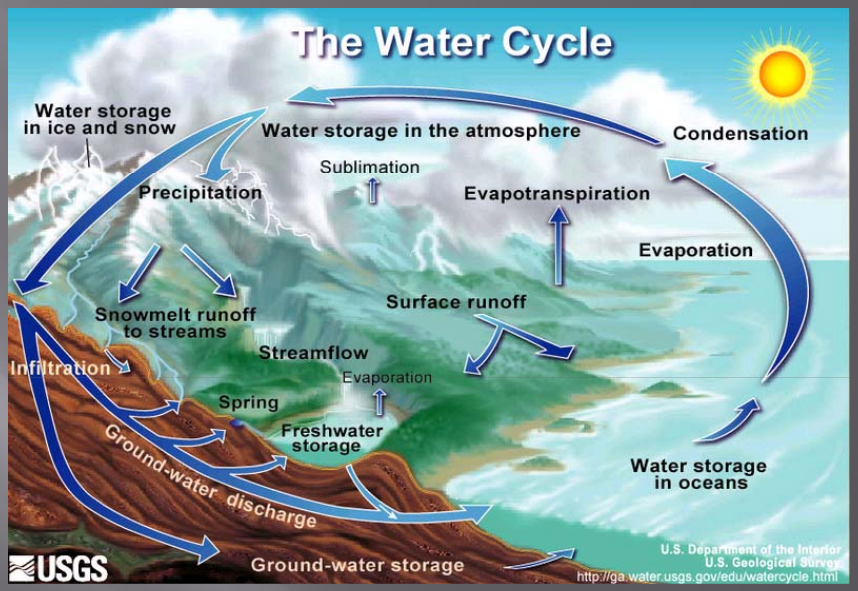
## Merced and Yuba PRMS

- PRMS/OUI constructed
- Migrated to version 3.0.2
- Calibrating
- Release/Published 2013

# PRMS

PRMS is a modular, deterministic, distributed-parameter, physical-process watershed model that simulates watershed response to various combinations of climate and land use.

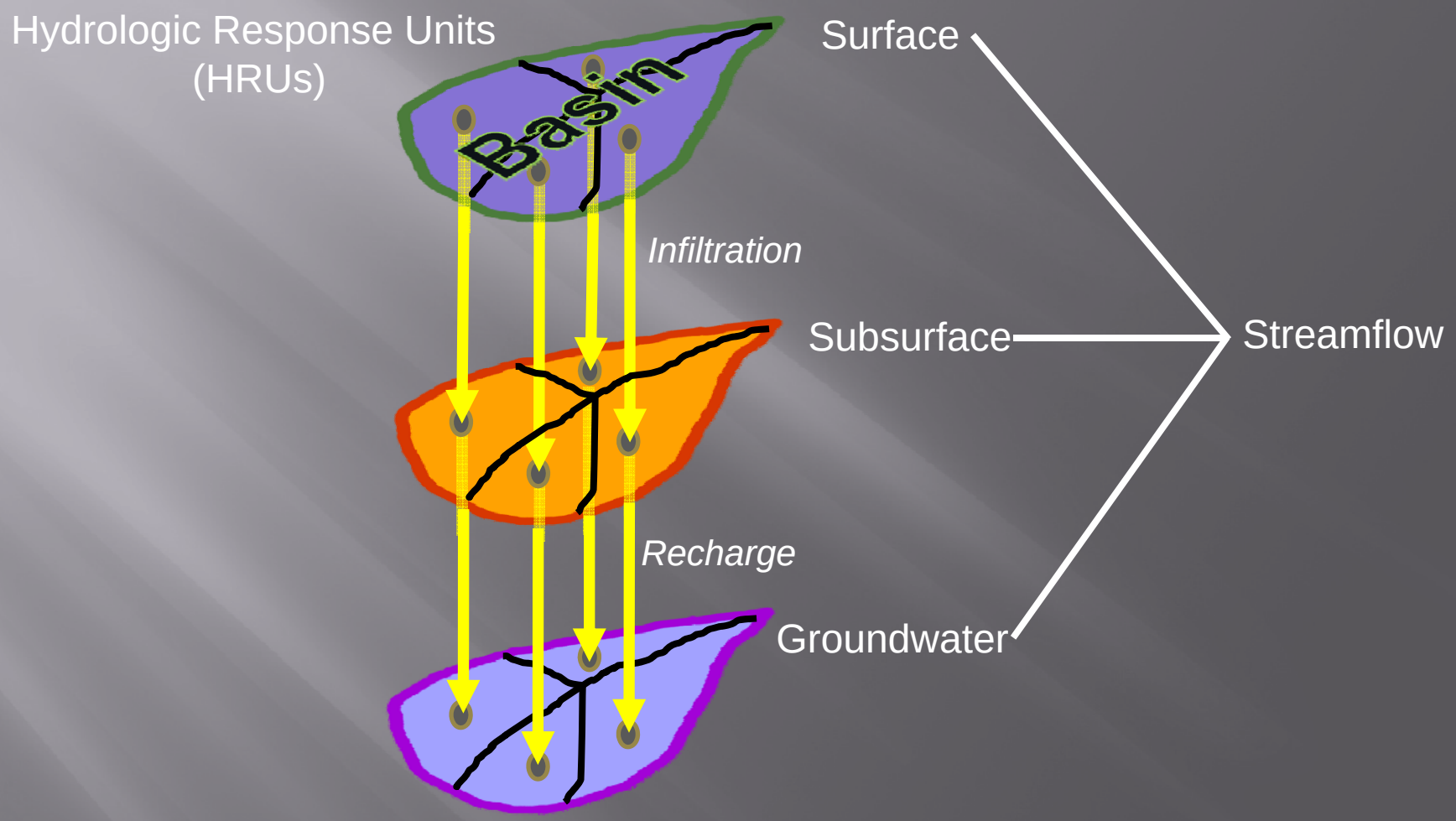



Normal and extreme rainfall and snowmelt can be simulated to evaluate changes in water-balance relations, streamflow regimes, soil-water relations, and ground-water recharge.

http://wwwbrr.cr.usgs.gov/projects/SW_MoWS/PRMS.html

# PRMS Conceptualization



# Data of Merced PRMS

Radiation*

Vegetation Cover

Stream network

Slope

Geology

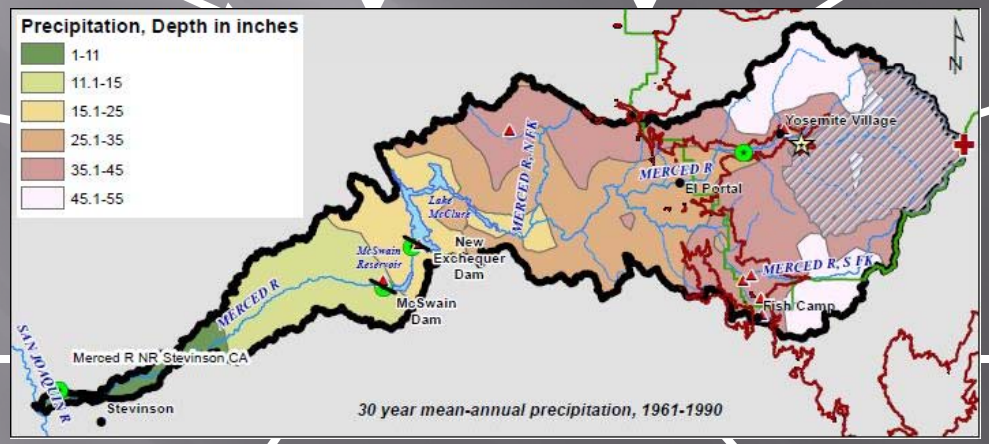
Aspect

Soils

Elevation

Precipitation

Temperature



# Temporal Data

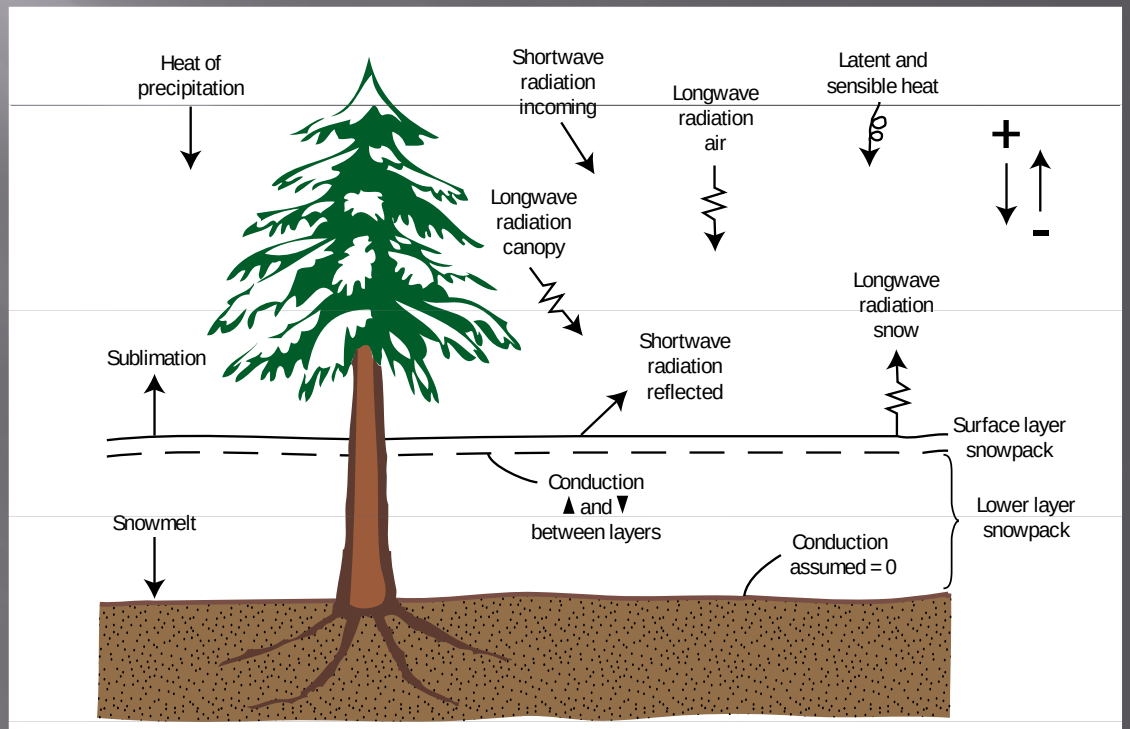
- **Temperature** and Precipitation
- SWE*
- Solar Radiation*
- AET/Pan Evaporation*
- Streamflow data*

*Used in calibration

# Snowpack Module

*Develops a snowpack and simulates snow accumulation and depletion processes using an energy-budget approach for each HRU*

- **Computes:**
- water and energy balances
- snowpack formation
- melting
- sublimation
- albedo
- snow-covered area
- evaporation from exposed earth
- depth
- Snow-water equivalent(SWE)
- accretion/ablation of the snowpack across HRUs

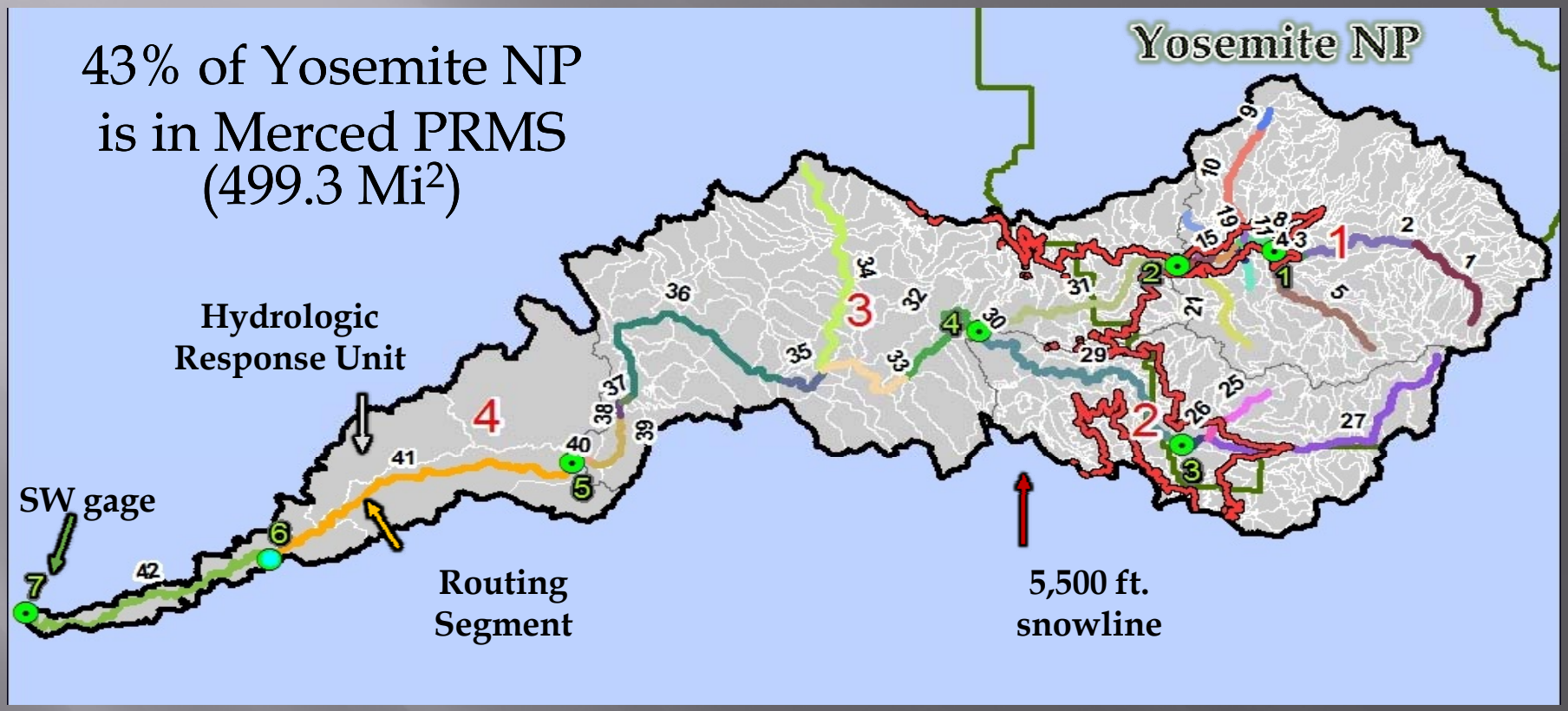



Modified from Leavesley, G.H., Lichty, R.W., Troutman, B.M., and Saindon, L.G., 1983, Precipitation-runoff modeling system—User's manual: U.S. Geological Survey Water Resources Investigations Report, 83-4238, 207 p., figures 2 and 9.

# DESIGN

- Customized
- Listen to the Locals

# MERCED PRMS "Wiring"

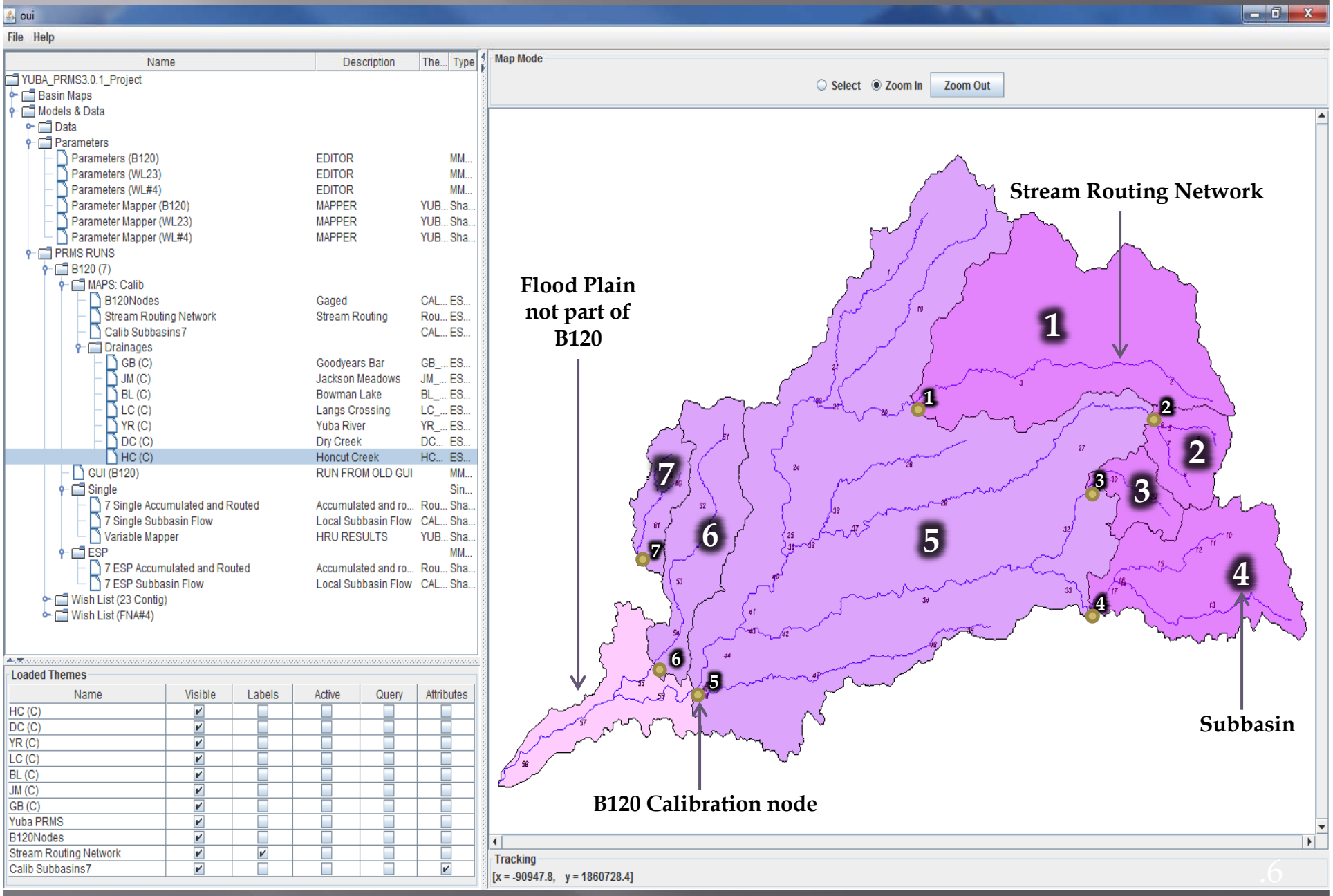



MERCED PRMS Stats:
Total area: 1,267Mi² (3281.5 km²)
Elevation Range: 134 – 12,270ft (23 – 3,962m)
HRU area range: 0.08 – 67Mi² (0.2-173.5 km²)

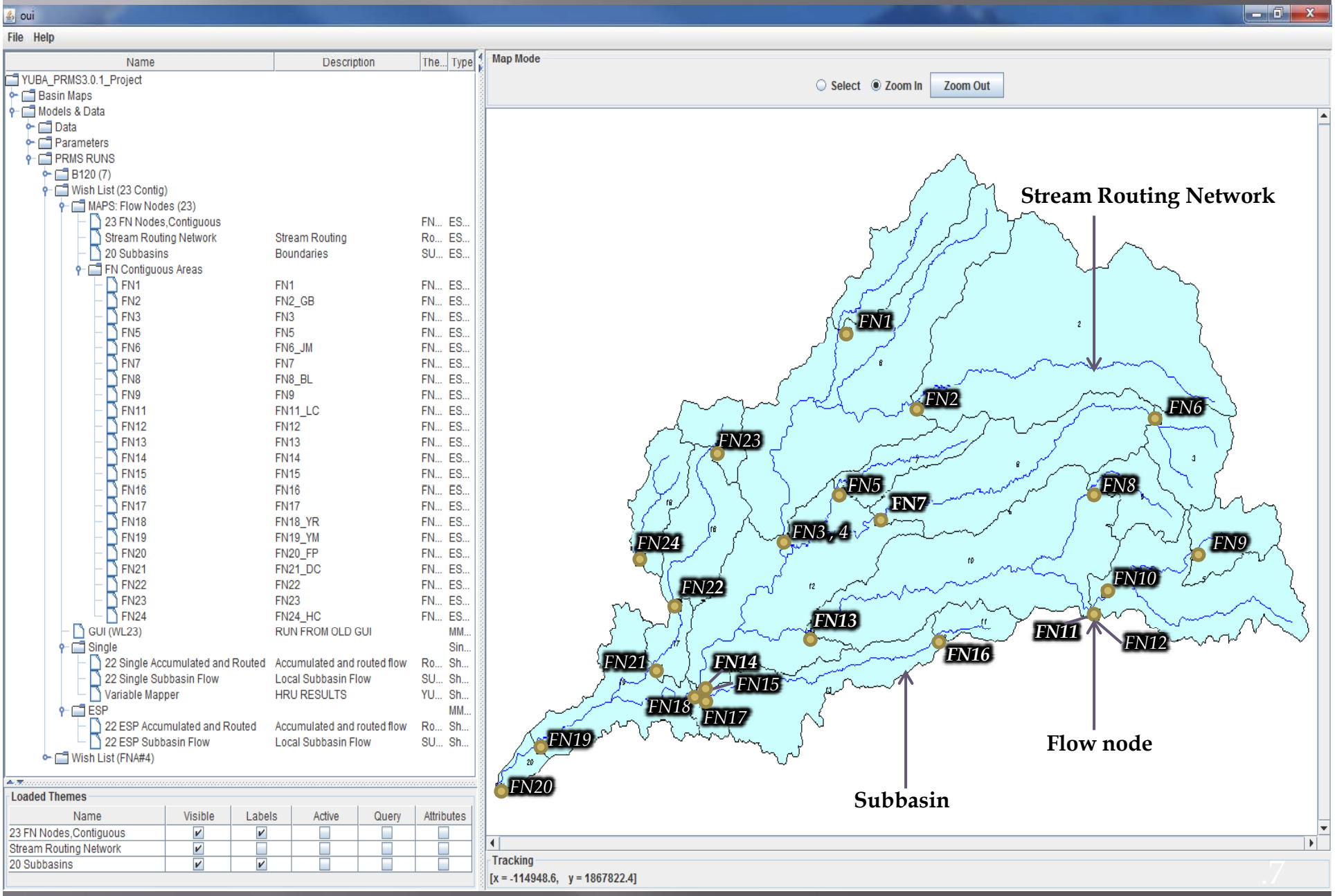
# Yuba PRMS Nodes

| YUBA PRMS | | | | | | | | | | 5/29/2012 |
|---|---|---|---|---|---|---|---|---|---|---|
| FLOW_NODE | CALIB_NODE | (outflow) SEGMENT_CFS | DRAIN_ID | AREA NAME | LAT | LONG | ACRES | MI_SQ | RPTD_MI_SQ | NODE SOURCE |
| 1 | 0 | 1 | | Slate Ck | 39.600000 | -121.050000 | 32636 | 51 | PGE 49.4 | DWR/PGE |
| 2 | 1 | 3 | GB | Goodyears Bar | 39.524894 | -120.938007 | 160103 | 250 | 250 | DWR |
| 3 | 0 | 25 | | Bullards Bar | 39.390447 | -121.144401 | 313115 | 489 | 489 | DWR |
| 4 | 0 | 25 | | Bullards Bar-FN1 | 39.390447 | -121.144401 | 280479 | 438 | part of #3 | PGE |
| 5 | 0 | 26 | | Orange Creek | 39.438333 | -121.057833 | 18612 | 29 | PGE 29.1 | DWR/PGE |
| 6 | 2 | 9 | JM | Jackson Meadows | 39.516012 | -120.562157 | 24509 | 38 | 38.3 | DWR/PGE/NID |
| 7 | 0 | 28 | | Hour House-FN6 | 39.411560 | -120.998007 | 92574 | 144 | 145 | DWR/PGE |
| 8 | 3 | 31 | BL | Bowman Lake | 39.439622 | -120.661326 | 18414 | 29 | 28.3 | DWR/PGE/NID |
| 9 | 0 | 12 | | Lake Fordyce | 39.379903 | -120.499374 | 19813 | 31 | 31.7 | DWR/PGE |
| 10 | 0 | NA node only | | Texas-Fall Ck Canal | 39.342123 | -120.641601 | 0 | 0 | ? | PGE |
| 11 | 4 | 18 | LC | Langs Crossing | 39.318512 | -120.657712 | 77848 | 122 | 120 | DWR/PGE |
| 12 | 0 | 18 | | Lake Spaulding-FN9 | 39.318512 | -120.657712 | 58035 | 91 | part of #11 | PGE |
| 13 | 0 | 34 | | Jones Bar | 39.292115 | -121.104675 | 199128 | 312 | 308 | DWR |
| 14 | 0 | 45 | | Englebright | 39.235171 | -121.274126 | 710414 | 1110 | 1108 | DWR |
| 15 | 0 | 45 | | Englebright-FN4-5-7-13 | 39.235171 | -121.274126 | 86985 | 136 | part of #14 | PGE |
| 16 | 0 | 35 | | Scotts Flat | 39.290000 | -120.900000 | 9613 | 15 | DaveRs coords/part of #17 | DWR/NID |
| 17 | 0 | 47 | | Deer Ck NR Smartville | 39.224338 | -121.268570 | 54084 | 84 | 84.6 | DWR |
| 18 | 5 | 50 | YR | Yuba River | 39.230422 | -121.281456 | 768215 | 1200 | 1200 | DWR |
| 19 | 0 | 57 | YM | Yuba at Marysville | 39.176000 | -121.524000 | 861530 | 1346 | KATEs Coords | DWR |
| 20 | 0 | 58 | FP | Flood Plain | 39.133900 | -121.586881 | 0 | 0 | KATEs Coords | |
| 21 | 6 | 54 | DC | Dry Creek | 39.256281 | -121.343850 | 55768 | 87 | 87.1 | DWR |
| 22 | 0 | 53 | | Virginia Ranch | 39.322113 | -121.313572 | 45577 | 71 | 71.3 | DWR |
| 23 | 0 | 51 | | Dry C NR Brownsville | 39.477666 | -121.255239 | 13074 | 20 | 20.4 | DWR |
| 24 | 7 | 61 | HC | Honcut Creek | 39.367668 | -121.372186 | 19604 | 31 | 30.6 | DWR |

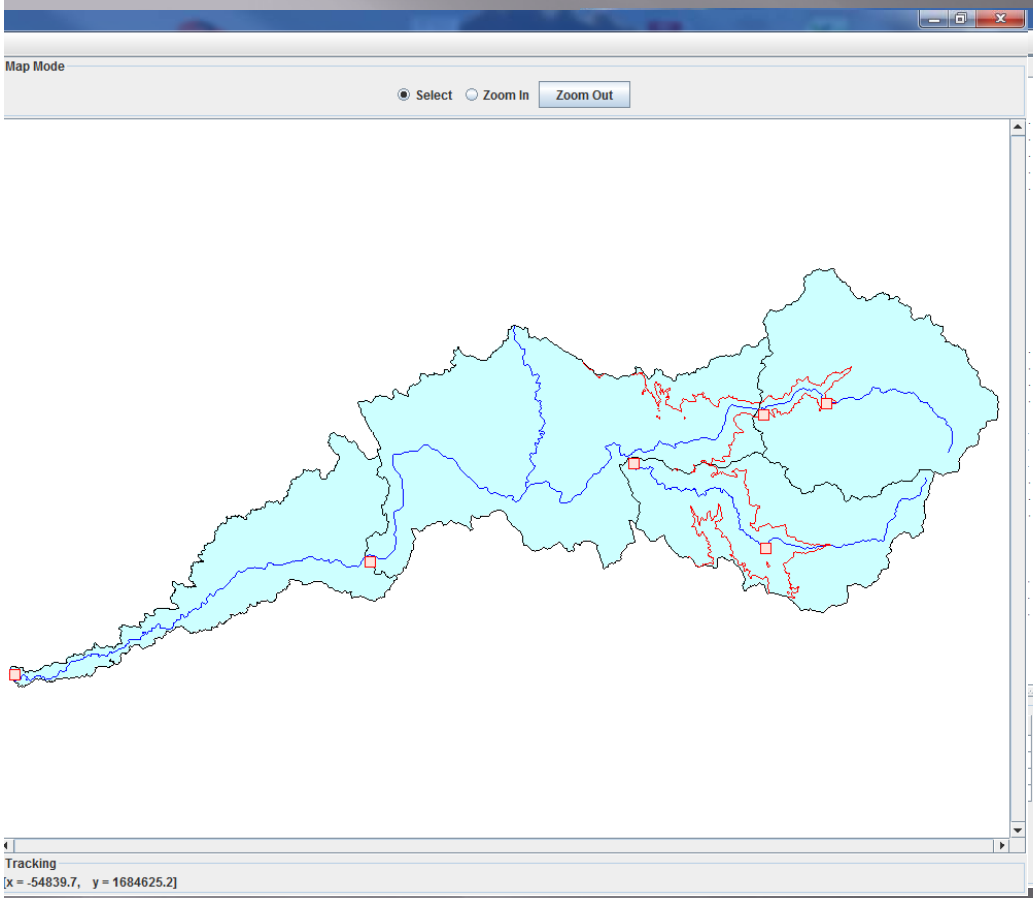
# Yuba "Wiring": B120 Areas of Interest

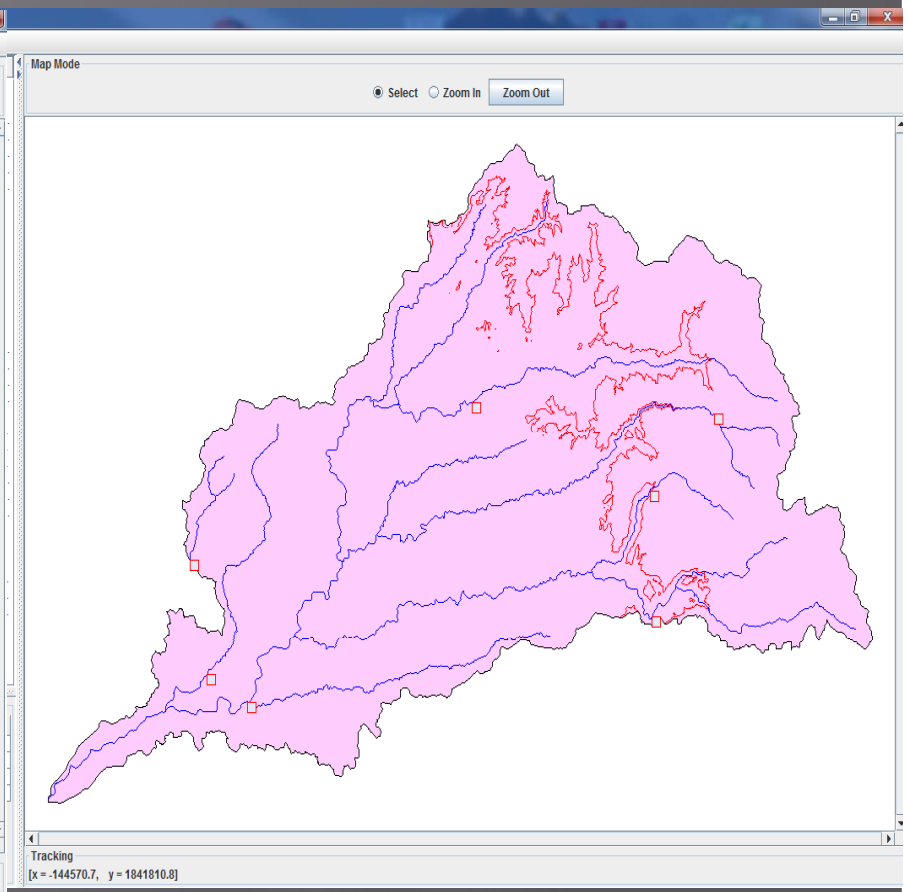


# Yuba 24 Flow Nodes (Wish List), 20 Subbasins



# Summary




## Merced

Area= 1,267 mi2
Elevation Range = 134 - 12,270 ft
HRUs = 652
Segments = 42
Subbasins = 4
Nodes = up to 15

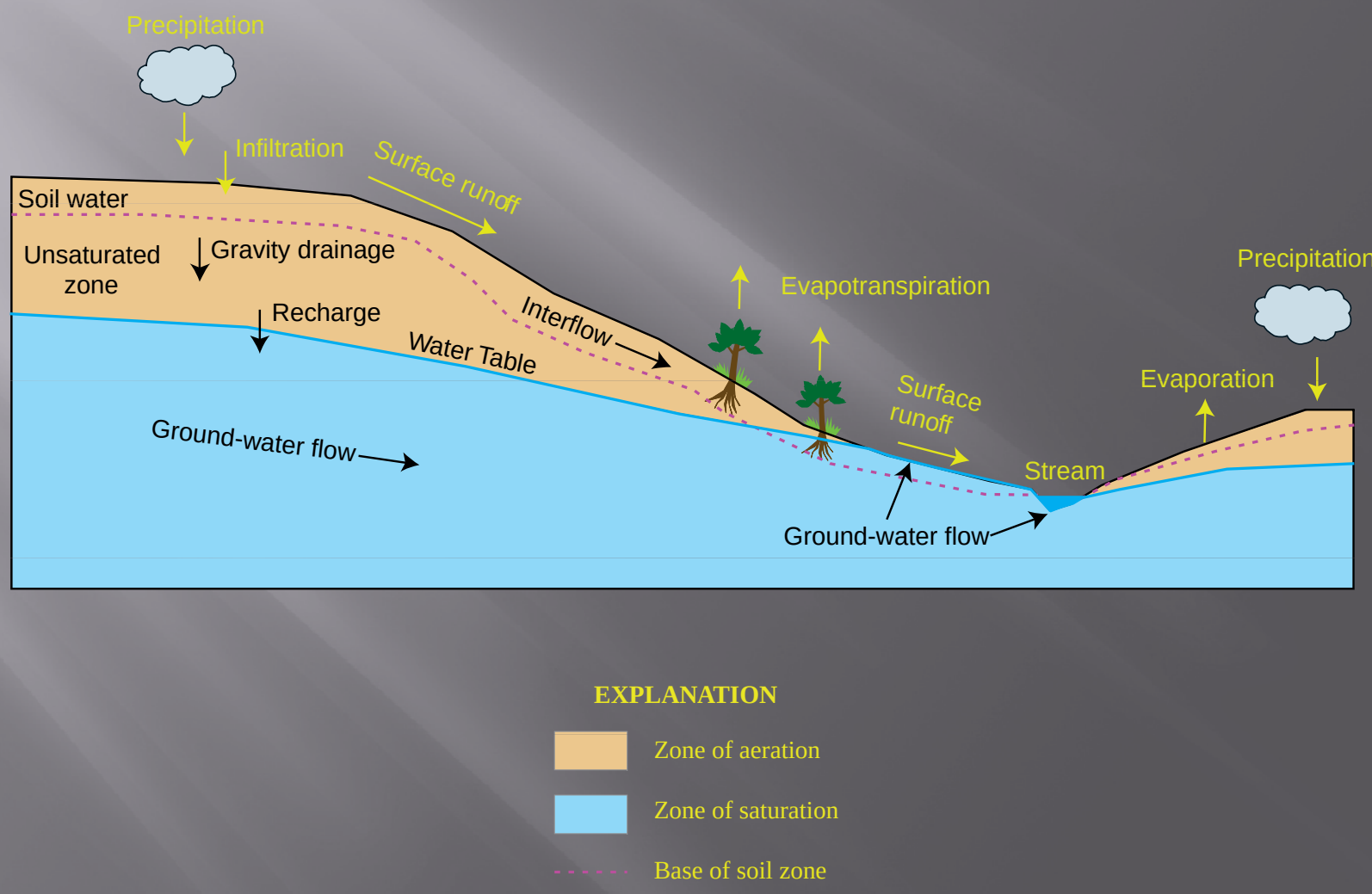
## Yuba

Area = 1,386 mi2
Elevation Range = 84 - 8,367 ft
HRUs = 946
Segments = 61
Subbasins = up to 20
Nodes = up to 24

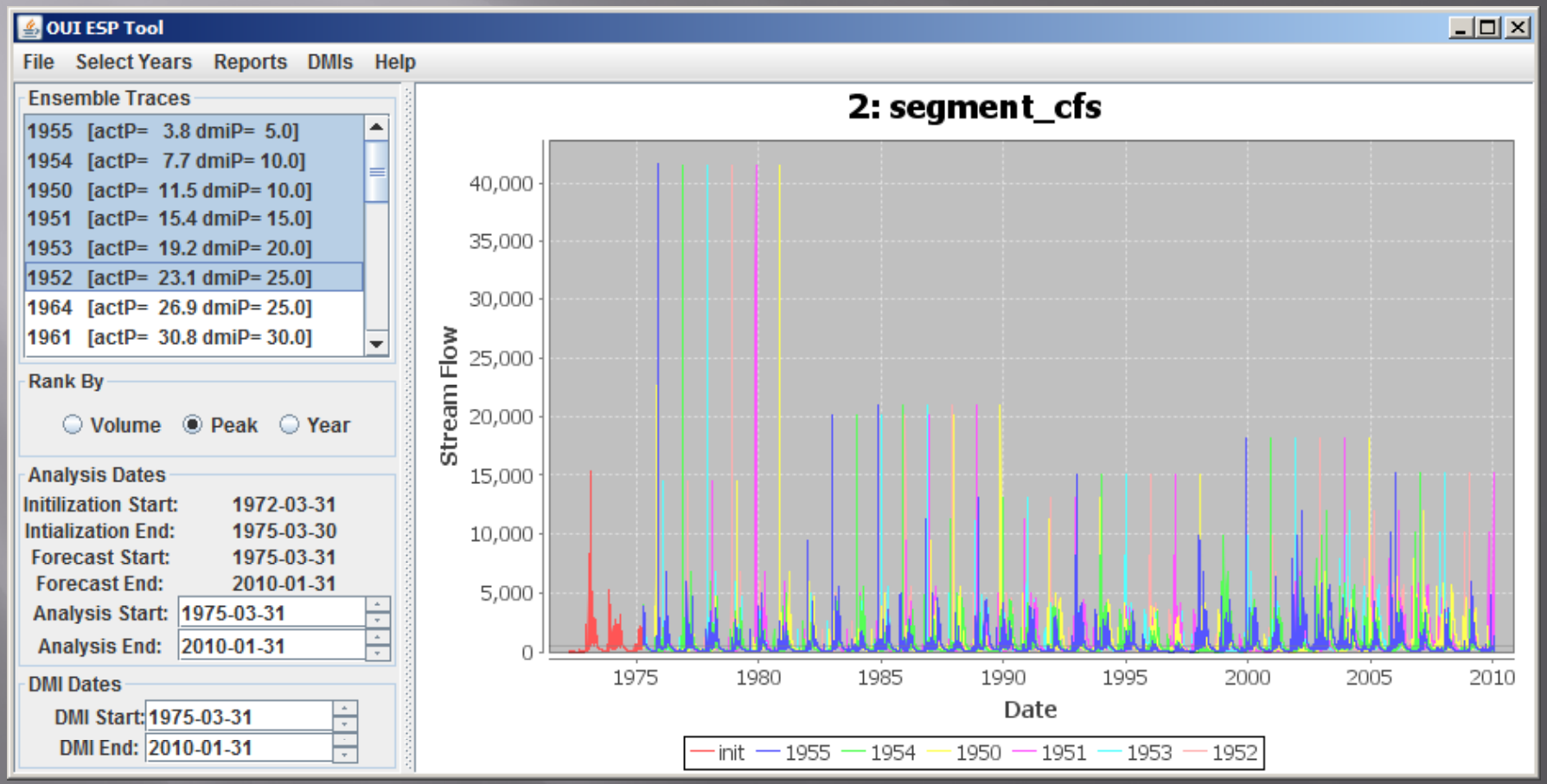
# Leveraging PRMS

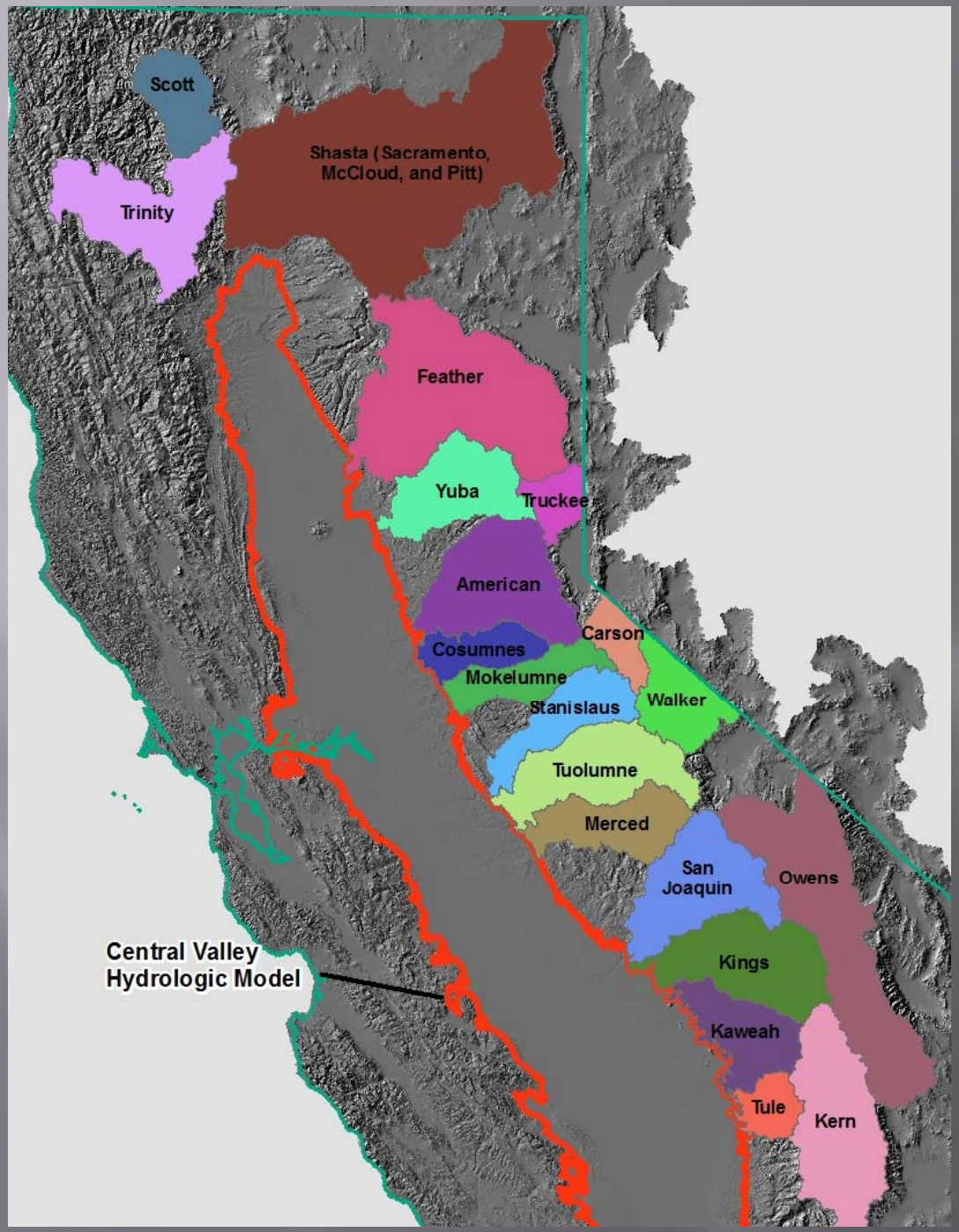
# GSFLOW CONCEPTUAL MODEL
# SW/GW Interactions

## PRMS Coupled with MODFLOW



# Evaluating Climate Variability






# FUTURE

- SAME:
- Cooperative work with CA DWR
- Provide physically based models (Kings)
- Assess basins response to landcover and climate variability

- NEW:
- Provide a regional model with nested high resolution models
- Link to Central Valley Model
- PRMS 4.0 new modules

# Questions?

# END SHOW

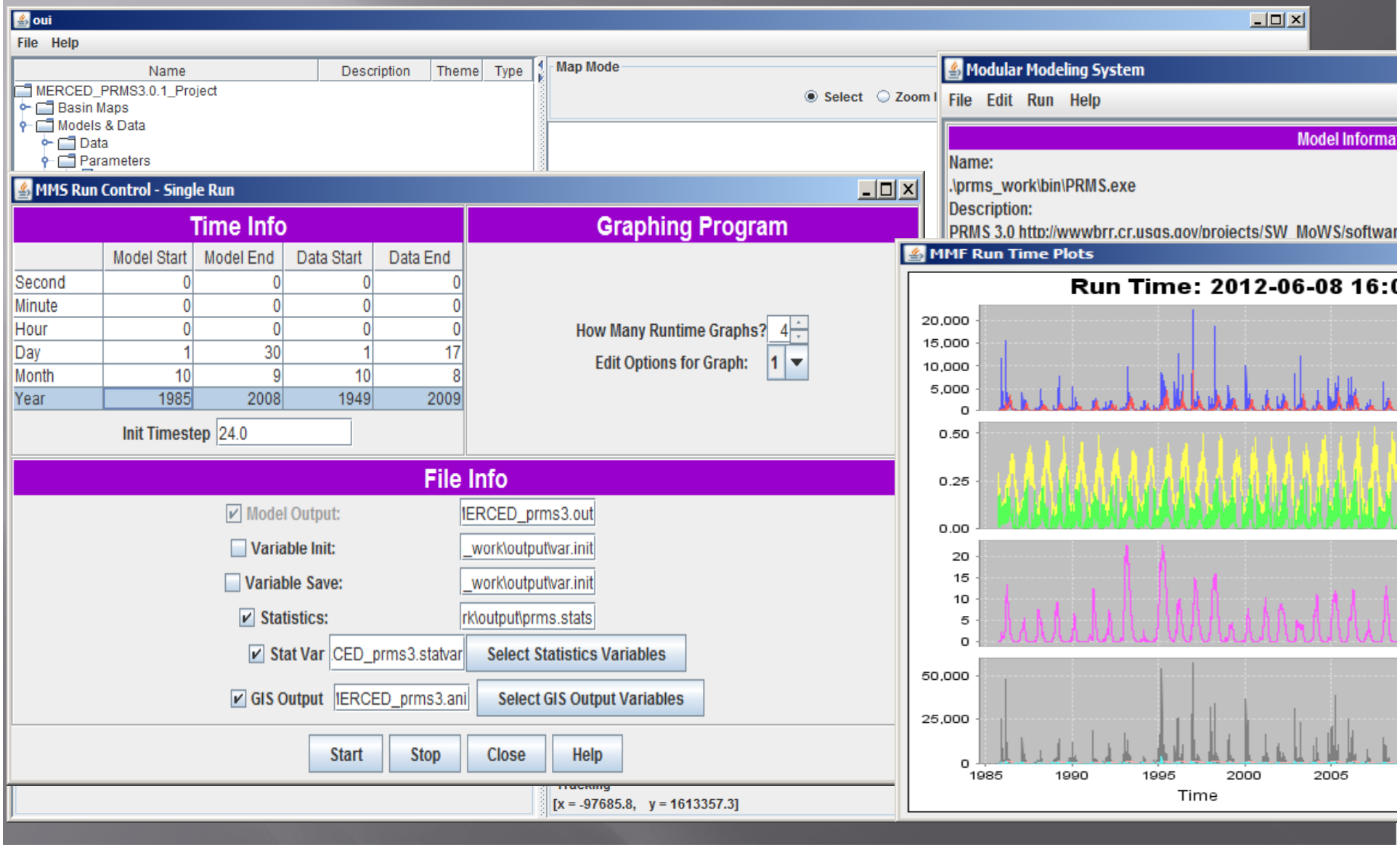
# How can PRMS be used?

- Watershed management for inflows to reservoirs, hydropower, high flows, and downstream water users (irrigation and domestic)
- Snowpack formation, SWE, storage and melt
- SW/GW interactions (GSFLOW)
- Evaluating Climate Variability

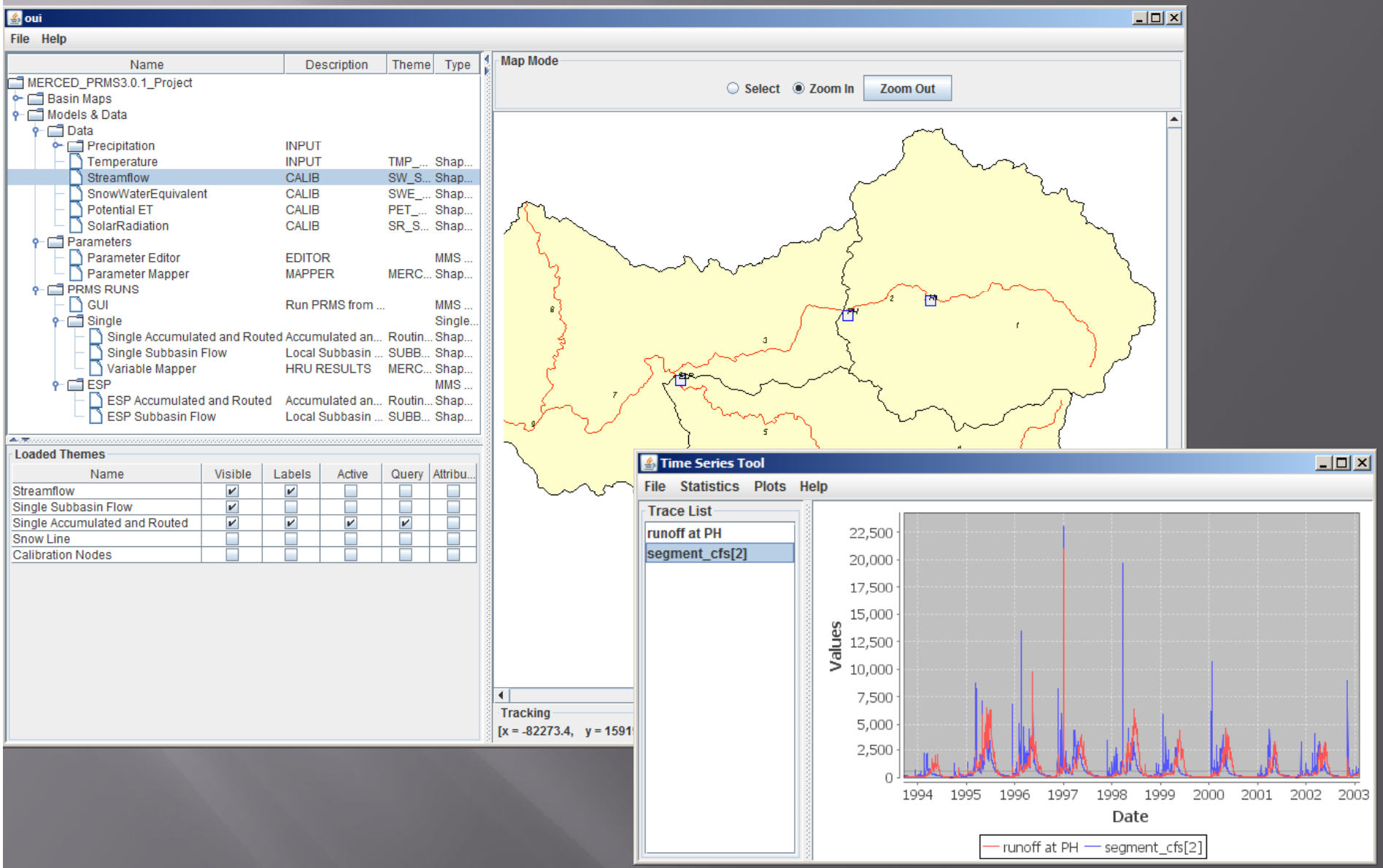
# 3 Formats For Running PRMS

- GUI (Legacy code)
- Single Run and Downstream Routing
- ESP and Downstream Routing

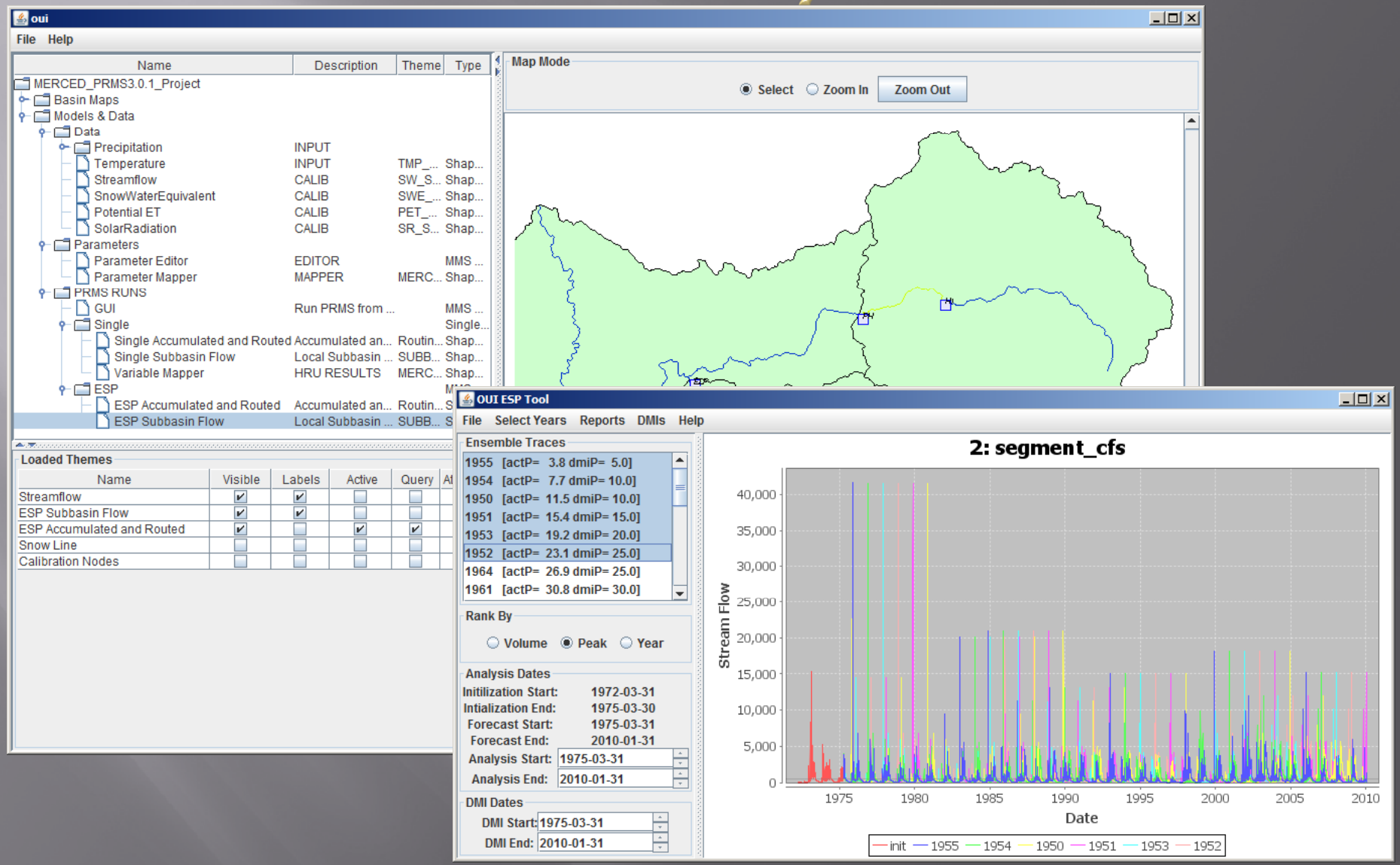
# Legacy: GUI PRMS RUN



# Single Run

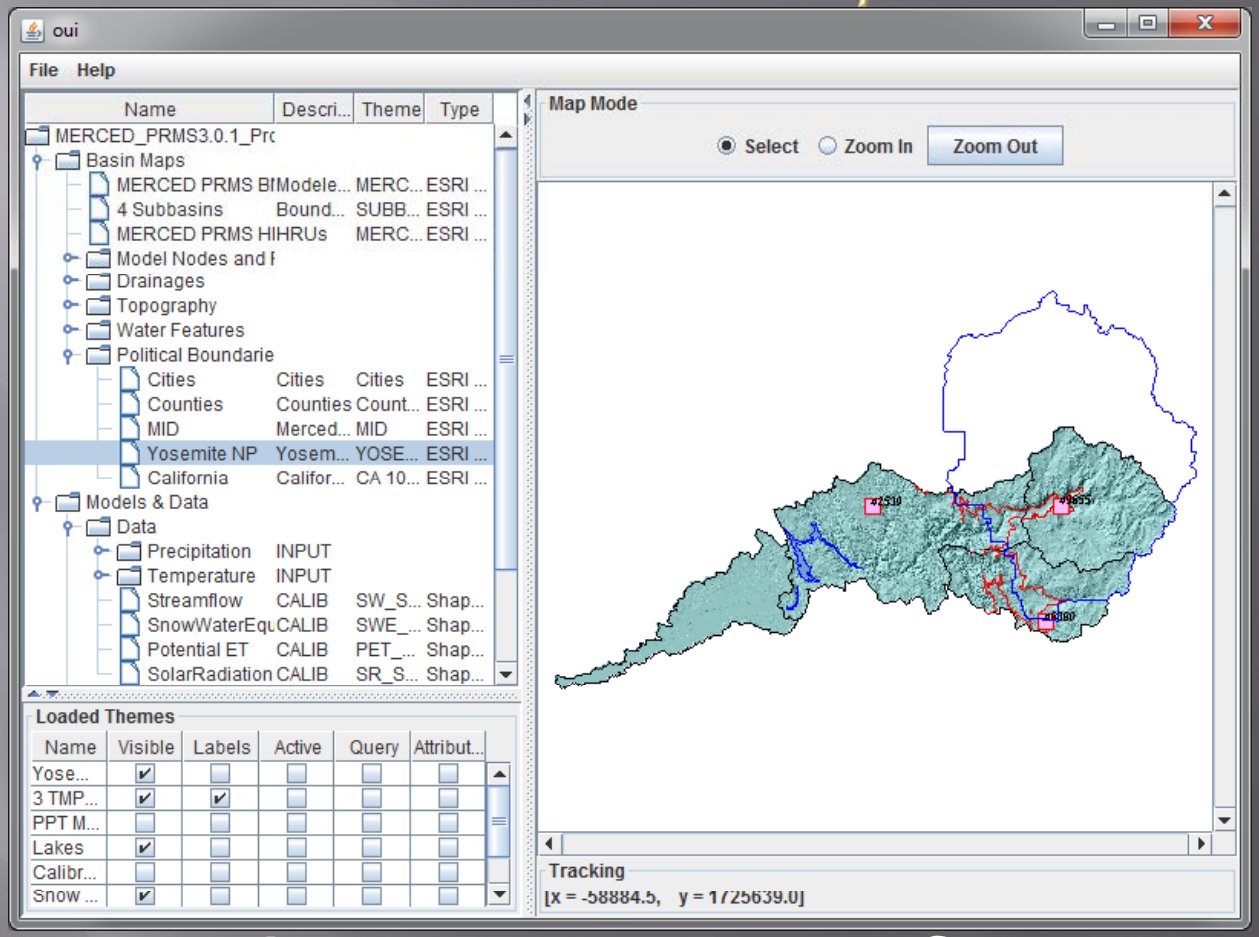

oui
File Help
Name Description Theme Type
MERCED_PRMS3.0.1_Project
Basin Maps
Models & Data
Data
Precipitation INPUT
Temperature INPUT TMP_... Shap...
Streamflow CALIB SW_S... Shap...
SnowWaterEquivalent CALIB SWE_... Shap...
Potential ET CALIB PET_... Shap...
SolarRadiation CALIB SR_S... Shap...
Parameters
Parameter Editor EDITOR MMS ...
Parameter Mapper MAPPER MERC... Shap...
PRMS RUNS
GUI Run PRMS from ... MMS ...
Single Single...
Single Accumulated and Routed Accumulated an... Routin... Shap...
Single Subbasin Flow Local Subbasin ... SUBB... Shap...
Variable Mapper HRU RESULTS MERC... Shap...
ESP MMS ...
ESP Accumulated and Routed Accumulated an... Routin... Shap...
ESP Subbasin Flow Local Subbasin ... SUBB... Shap...
Loaded Themes
Name Visible Labels Active Query Attribu...
Streamflow
Single Subbasin Flow
Single Accumulated and Routed
Snow Line
Calibration Nodes
Map Mode
Select Zoom In Zoom Out
Tracking
[x = -82273.4, y = 1591
Time Series Tool
File Statistics Plots Help
Trace List
runoff at PH
segment_cfs[2]
Values
22,500
20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
0
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003
Date
runoff at PH segment_cfs[2]

# ESP Analysis



# OUI Advancements

# Merced PRMS/OUI



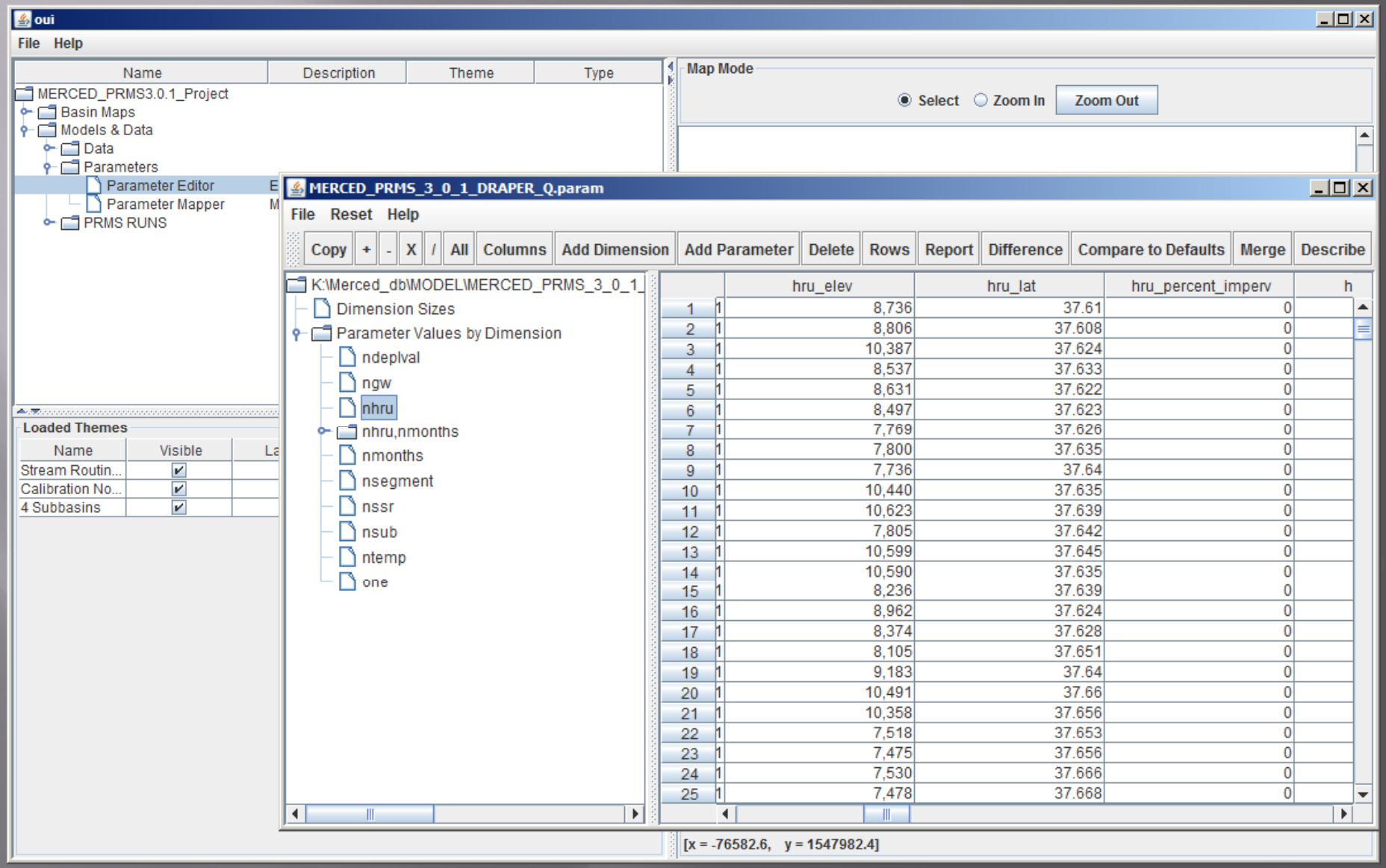

## PRMS Object User Interface (OUI)

## (PRMS, ESP, Route, MMI, DMI)

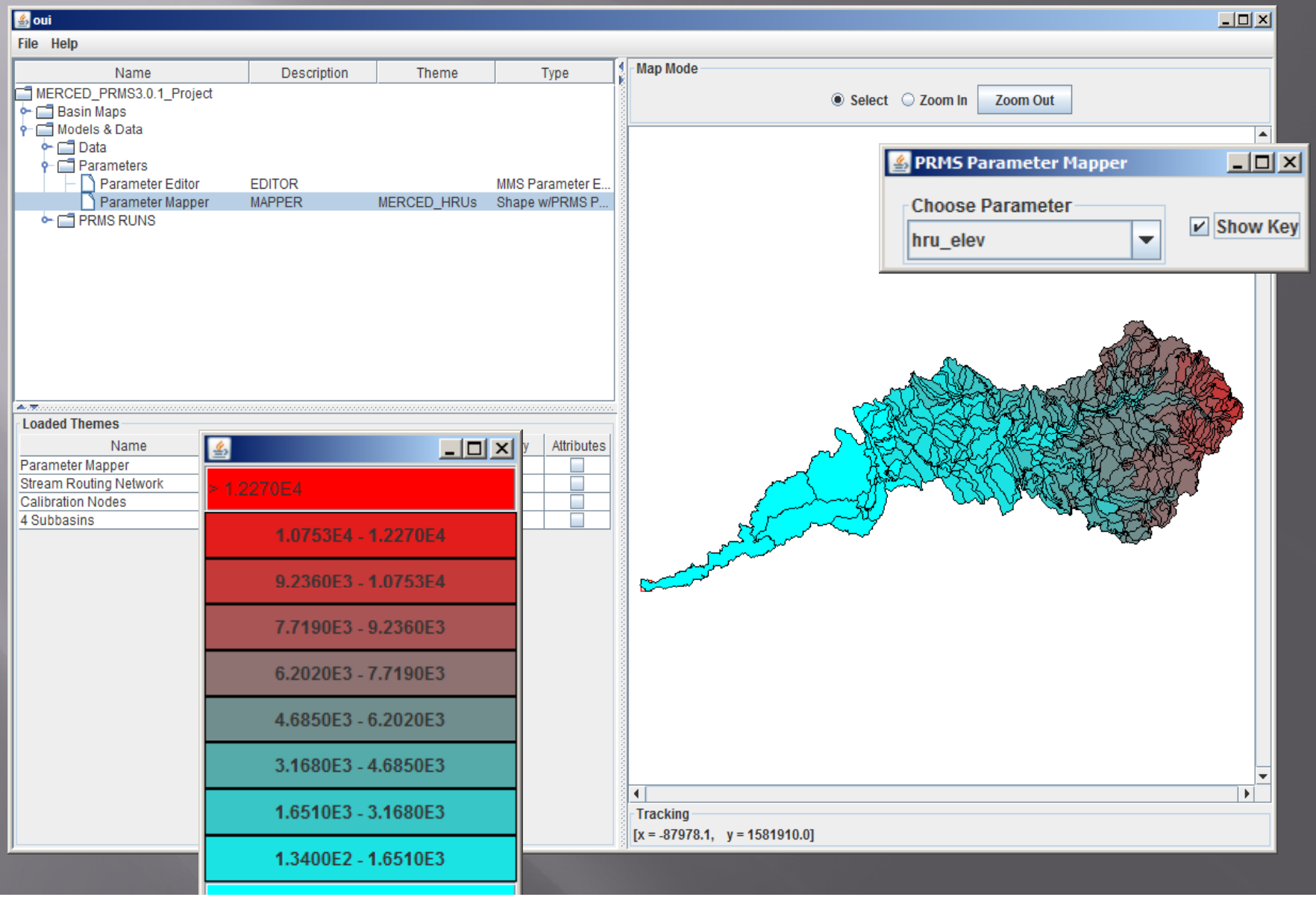
Markstorm and Koczot, OFR 2008

http://wwwbrr.cr.usgs.gov/projects/SW_MoWS/OUI.html

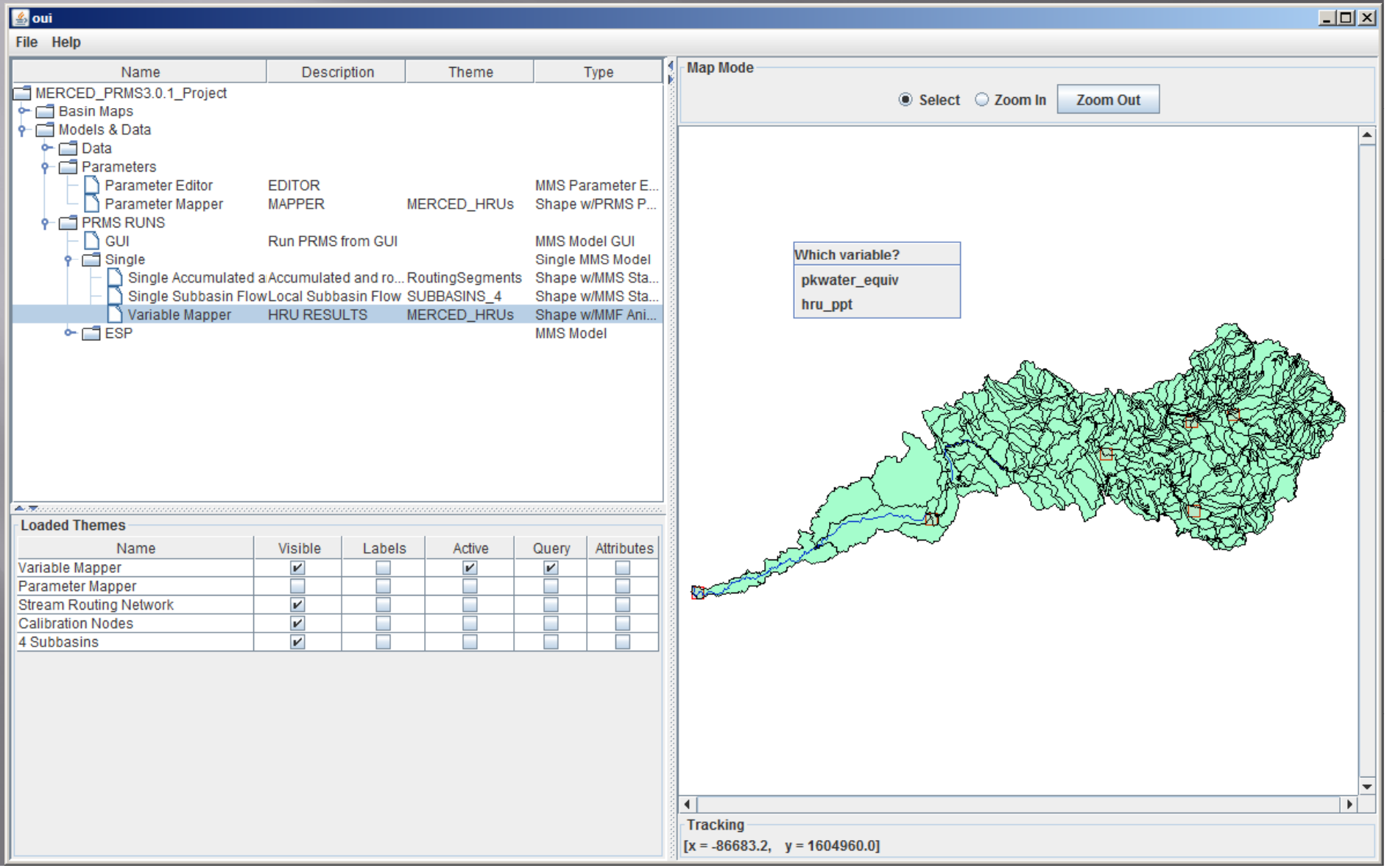
# PARAMETER EDITOR



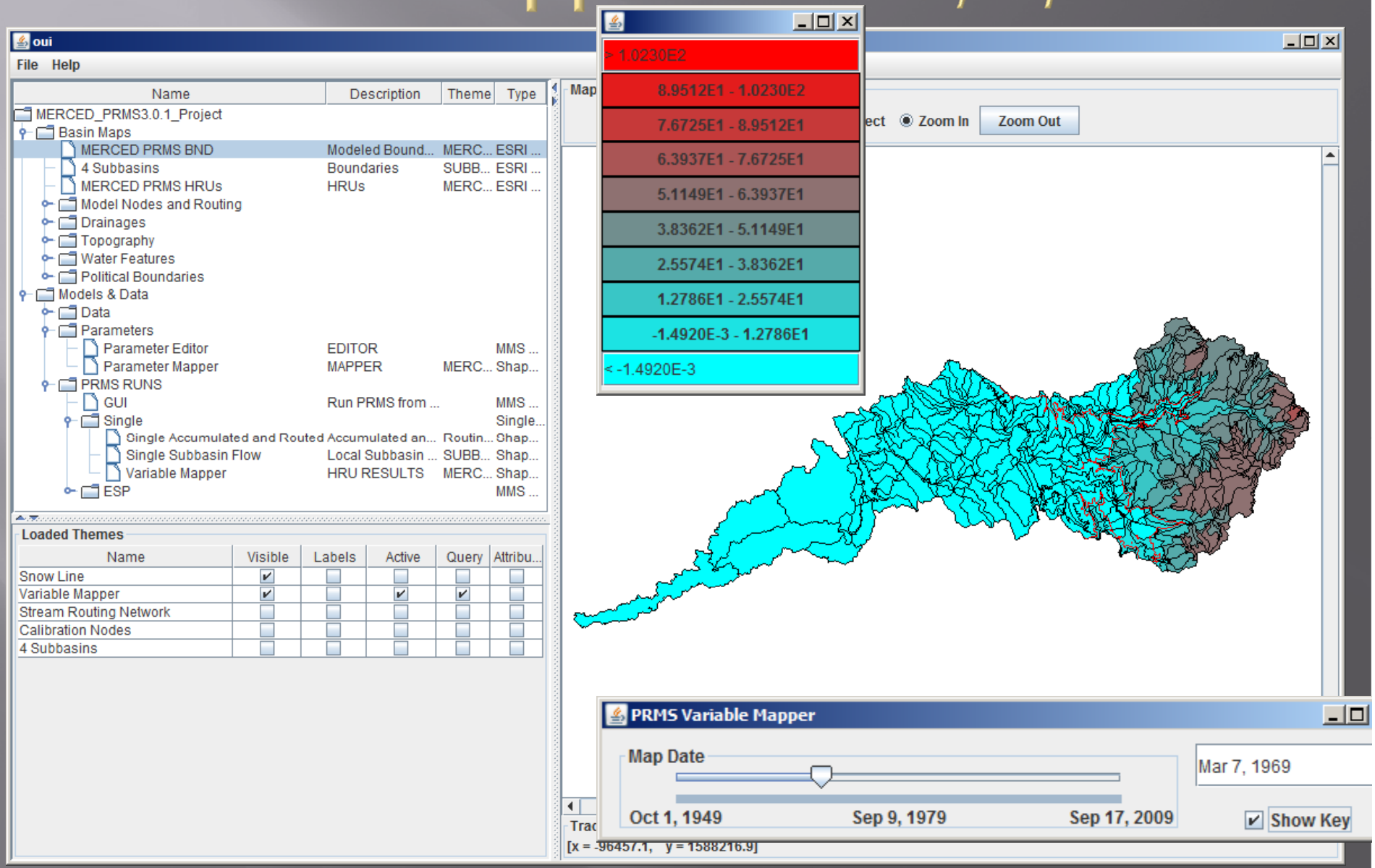
# Parameter Mapper: HRU elevations



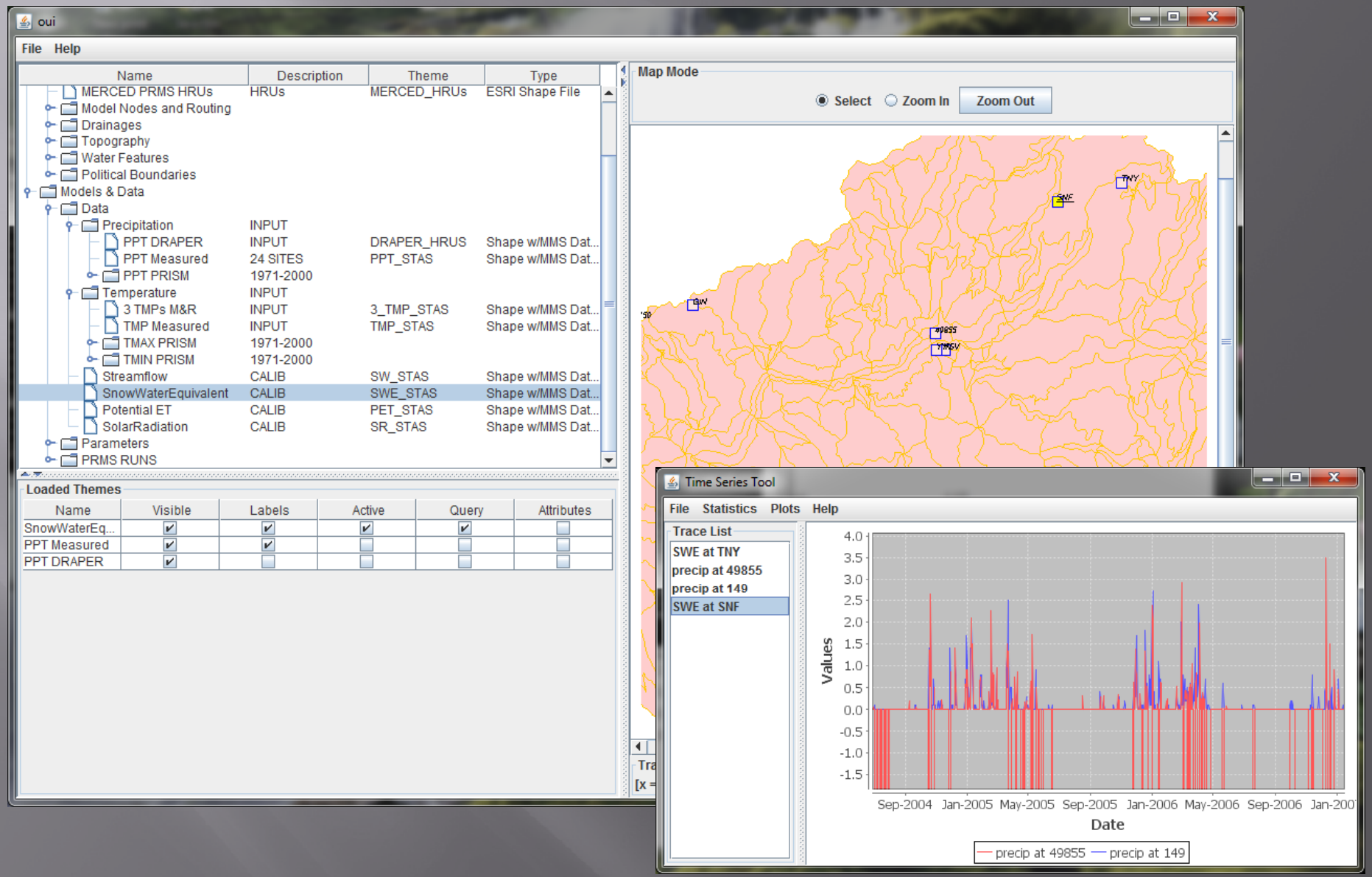
# Start: Variable Mapper



# Variable Mapper: SWE 3/7/1969



# Loop back and view input data



# Conclusions

- Cooperative study with CA DWR
- Merced PRMS and OUI can be installed without administrative privileges.
- OUI can be run without ARC/GIS.
- Applications: aid management of fisheries, forests, reservoir operations (snowpack, flooding, storage)
- Applications: plan for hydropower, flooding and summer water availability to downstream users.
- Applications: Contribute to FCO suite of models.
- Merced/Yuba PRMS complete/published 2013