IDAHO DEPARTMENT OF
WATER RESOURCES

Soil Moisture Reservoir

PRESENTED BY ALEX MOODY

WRV MTAC 19 APRIL 2023

- **WRV 1.1 - No soil moisture in irrigated areal recharge estimates**
  - High early spring season pumping when estimating unrecorded groundwater diversions
- **WRV 1.2 – include soil moisture reservoir in incidental recharge and unmeasured ground water pumping estimates**

  Recharge = SWDiv – SWRet – CanalSeepage + GWDiv – WWDiv – CIRi + SMRi

  CIRi = initial stress period crop irrigation requirement (Evap – Precip)

  SMRi = initial available soil moisture

Implementation

1. **Available SMR fills initial CIR, giving a soil moisture adjusted CIR**
   - CIRadj = CIRi – SMRi
   - Calculated separately for each entity source type (sw, gw, mixed)
   - CIR allowed to be negative (P > ET) to allow excess precip to fill SMR and recharge
2. **Adjusted CIR is used in recharge water balance to calculate available recharge**
   - All stress periods for irrigated lands
3. **Recharge first fills SMR. Excess is applied to model layer 1**
   - Each source is handled separately

1) Meet surface water demands

$$SWDel_{sw} = max\left(\frac{CIR_{adj,sw}}{Eff}\middle|SWDel\right)$$

$$SWDel_{mix} = \left(\frac{CIR_{adj,mix}}{Eff}\middle|max(\mathbf{SWDel} - SWDel_{sw}|\mathbf{0})\right)$$

$$SWDel_{excess} = (SWDel - SWDel_{sw} - SWDel_{mix}|\mathbf{0})$$

2) Estimate pumping

$$GWDivEst$$

$$= max\left(\frac{CIR_{adj,mix} + CIR_{adj,gw}}{Eff} - GWDiv + WWTP - SWDel_{mix} \middle| 0\right)$$

3) Fill soil moisture and recharge excess

$$Fill_{gw} = \mathrm{w}(GWDiv + GWDivEst - WWTP) - CIR_{adj,gw}$$

$$SMR_{gw,t+1} = min(Fill_{gw}, rz_{gw})$$

$$Fill_{mix} = SWDel_{mix} + w(SWDel_{excess}) + \mathrm{w}(GWDiv + GWDivEst - WWTP) - CIR_{adj,mix}$$

$$SMR_{mix,t+1} = min(Fill_{mix}, rz_{mix})$$

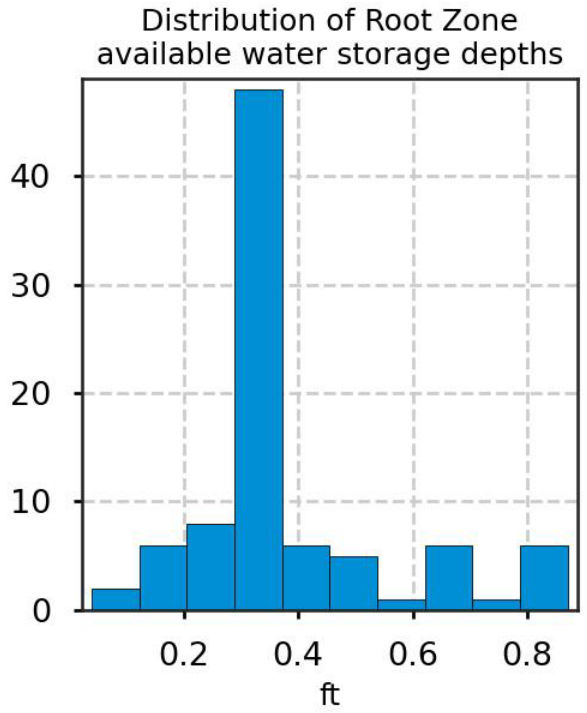
$$Fill_{sw} = SWDel_{sw} + w(SWDel_{excess}) - CIR_{adj,mix}$$

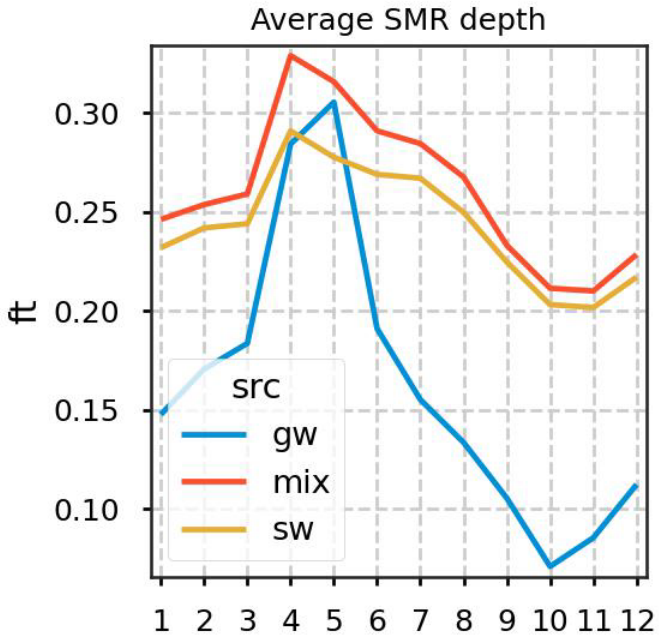
$$SMR_{sw,t+1} = min(Fill_{sw}, rz_{sw})$$

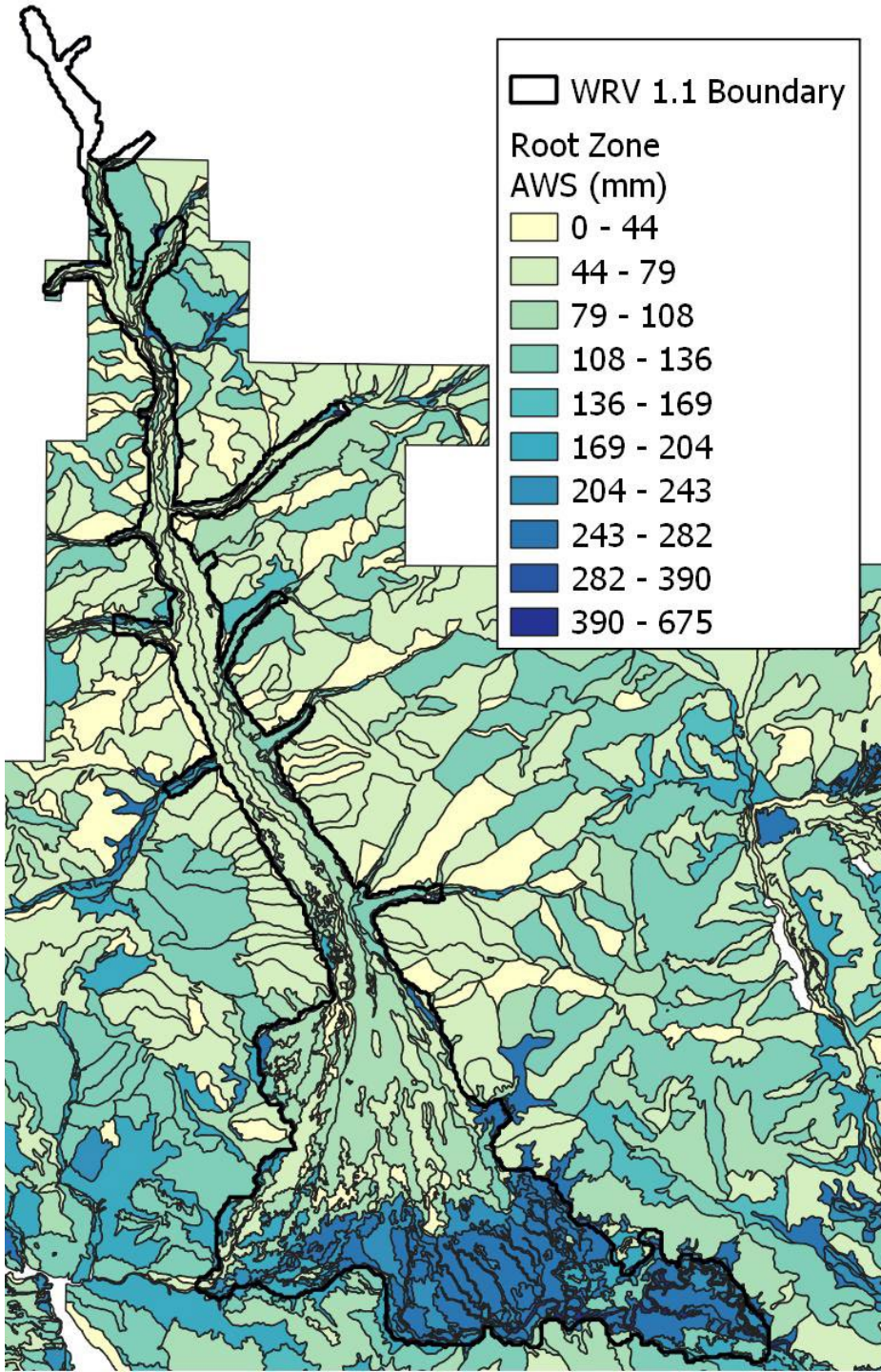
*w=area weights

Root zone storage depths

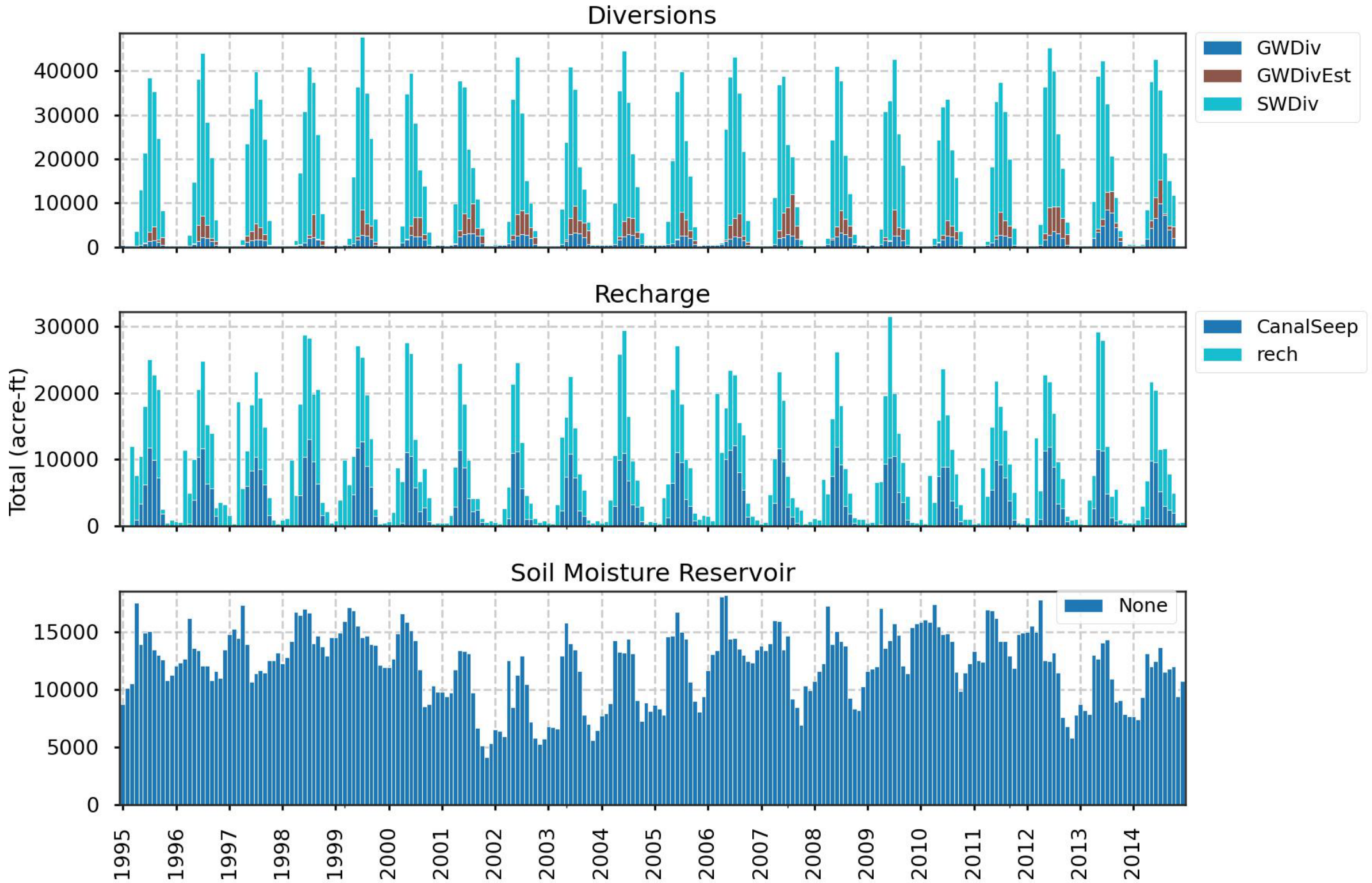
- NRCS Soil Survey Geographic Database (SSURGO) & Value Added Look Up Table Database
- Average depth per entity after masking out wetland and developed areas.
- Initial condition on Jan 1995: 50%
- 18.3 KAF available within model



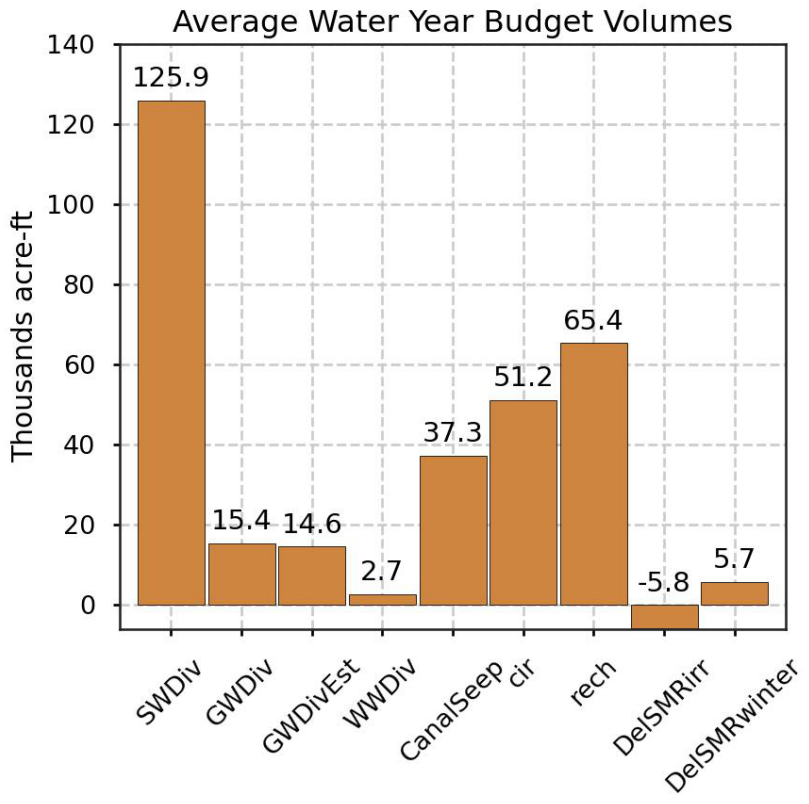


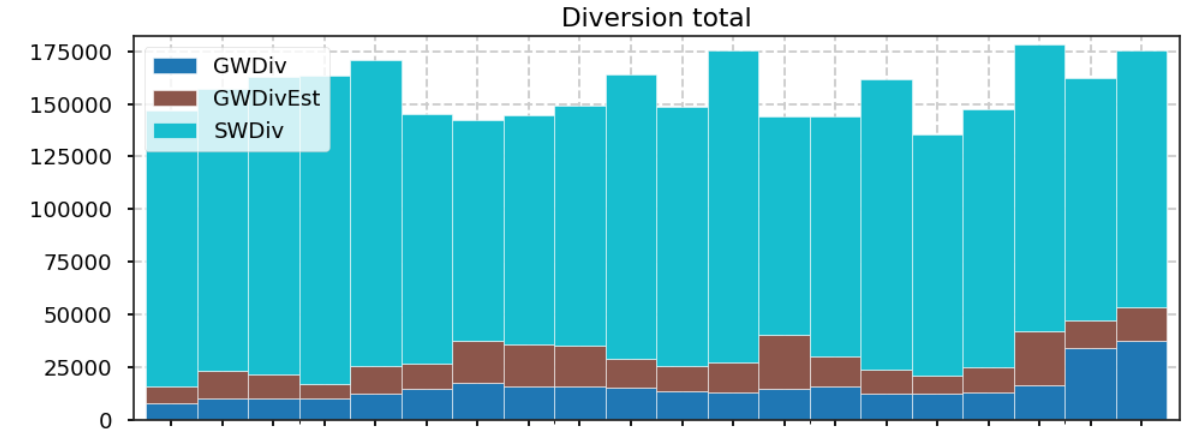


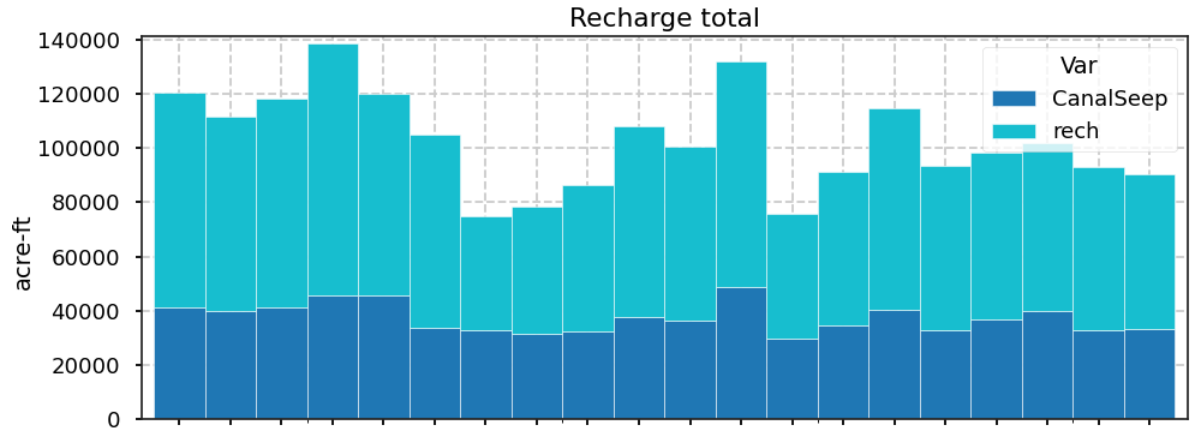
Monthly diversions and recharge with soil moisture reservoir

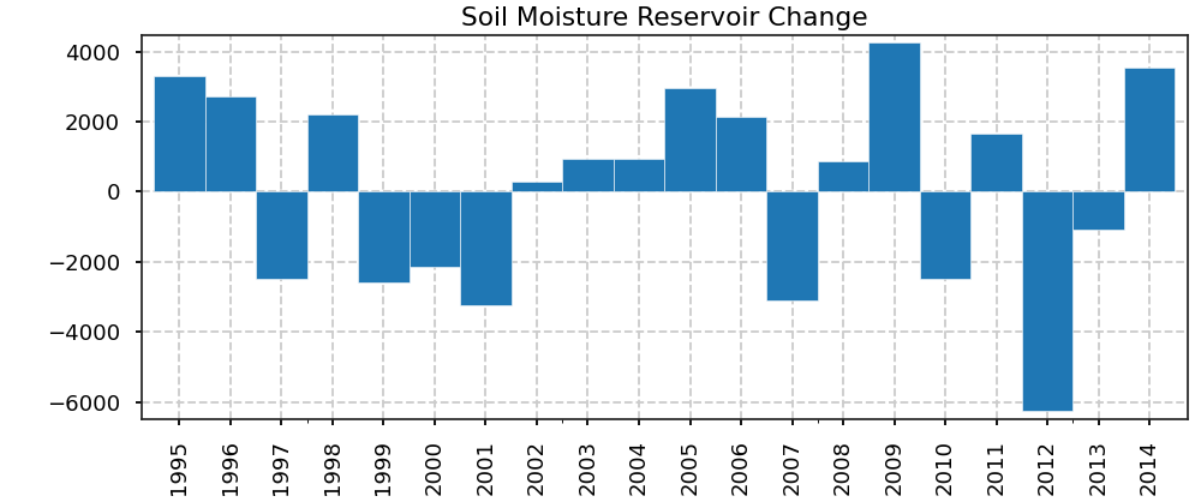


Model Wide Annual Volumes







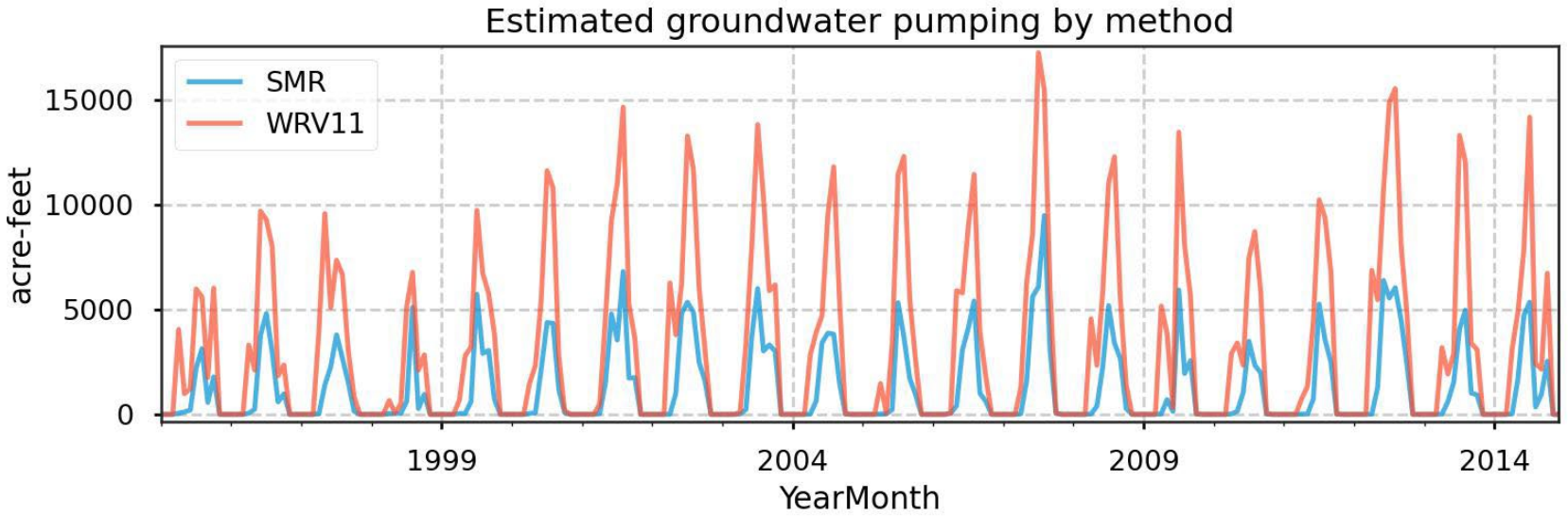


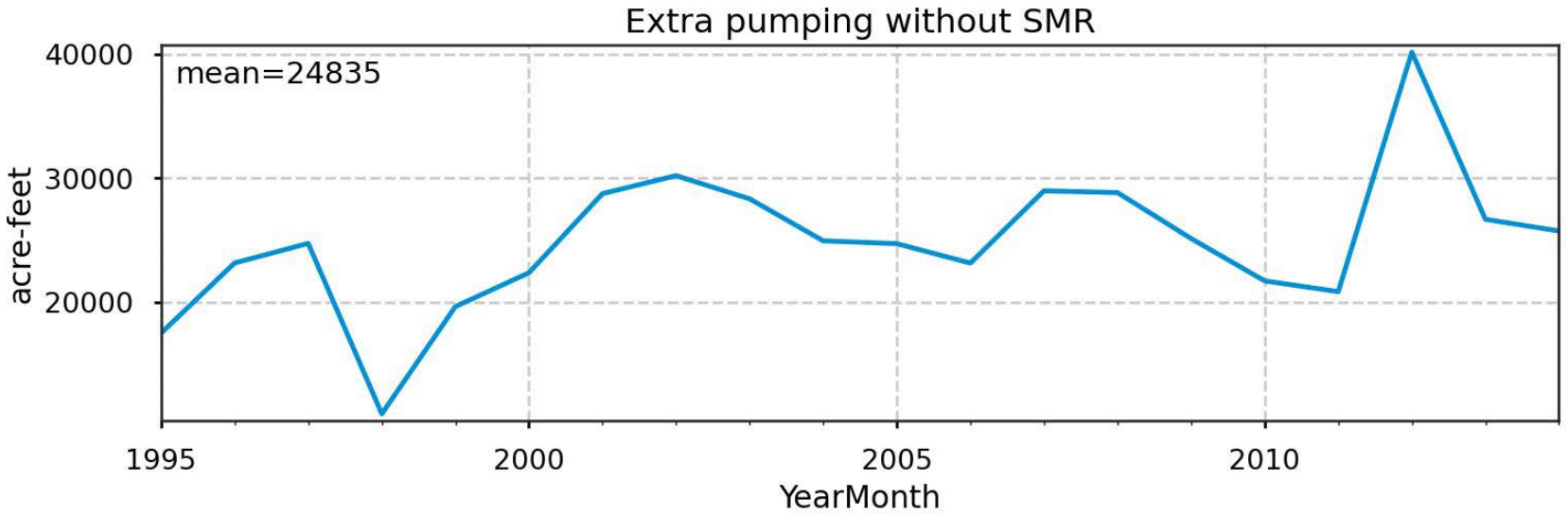
Estimated groundwater pumping

- Annual Average With SMR = 14.6 KAF, without SMR = 39.5 KAF

- Less early season pumping

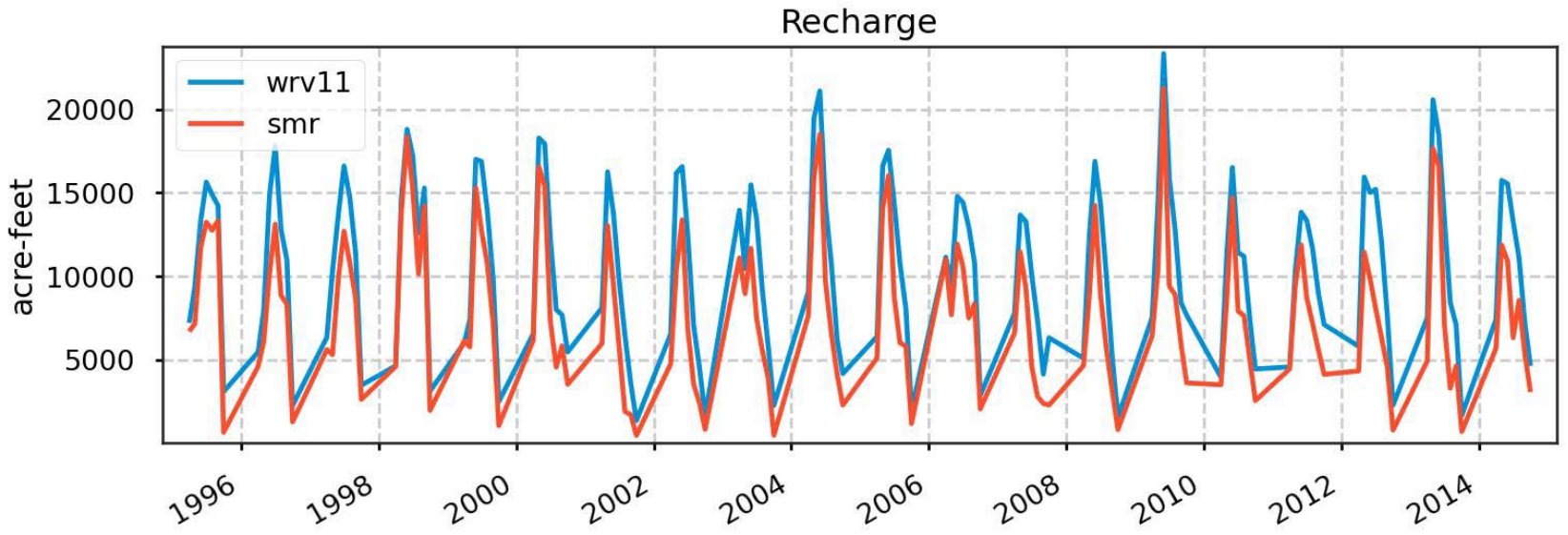
- Pumping peaks typically lower

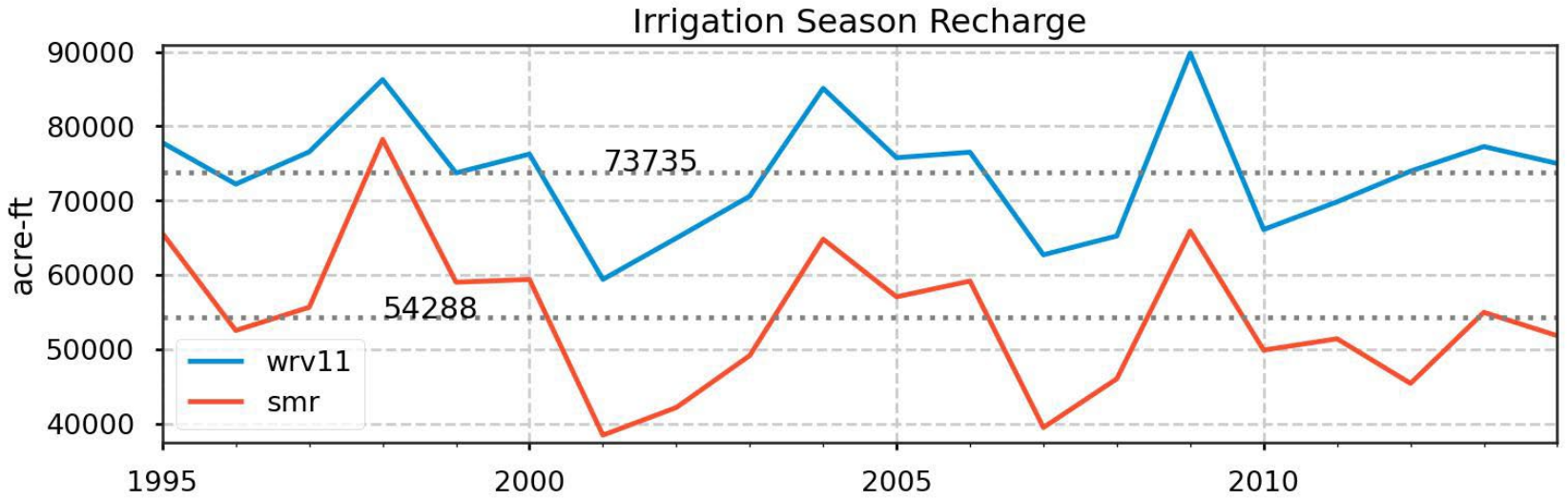




Recharge comparison

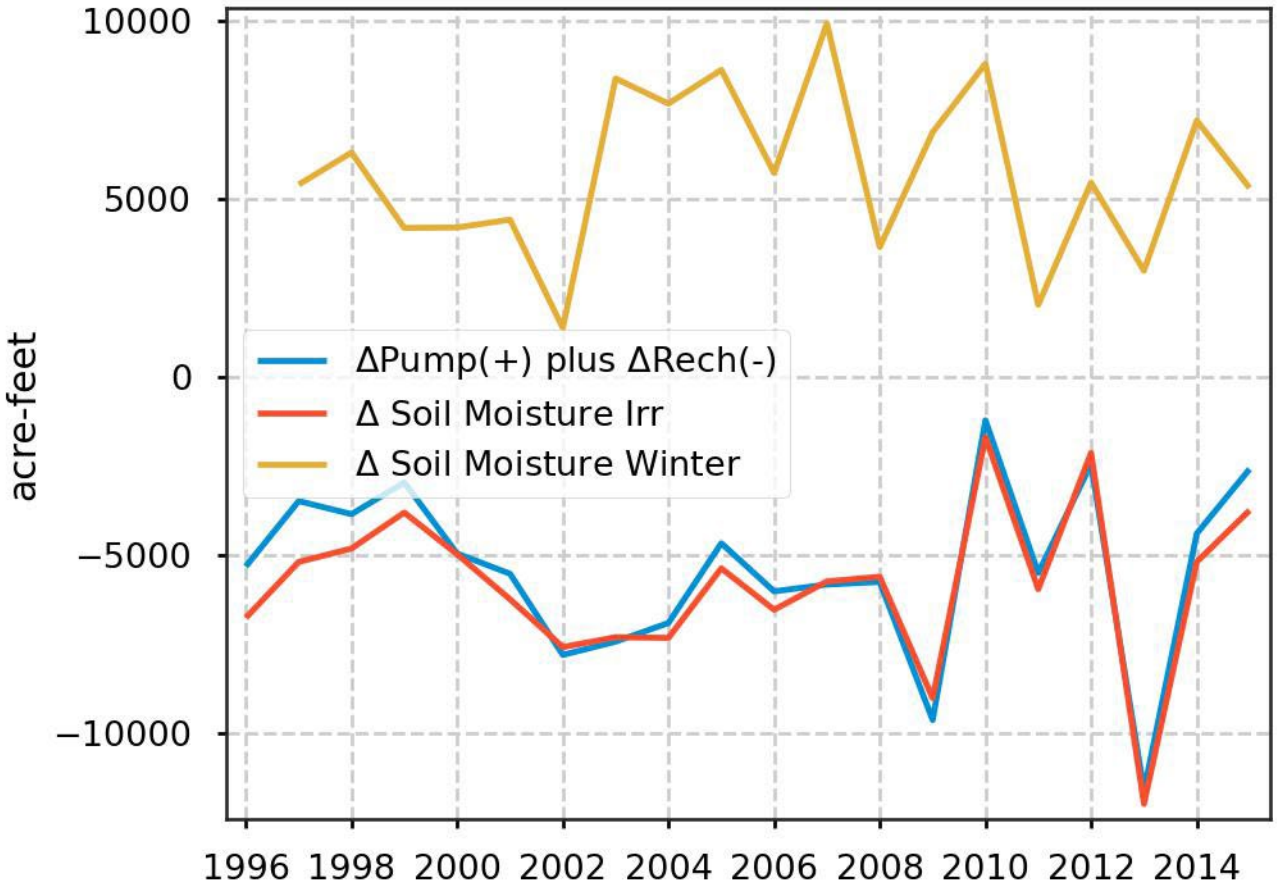
- Recharge starts earlier in irrigation season
- Smaller peak
- Annual recharge volumes with SMR are 19.5 KAF less on average





Overall changes to the water balance are minimal

- Pumping difference plus recharge difference should equal the change in soil moisture during the irrigation season
- Soil moisture depleted about 5.8 KAF during growing season and filled about 5.7 KAF over winter



Summary

- 25 KAF reduction in pumping
- 19.5 KAF less irrigation season recharge.
- Soil moisture decreases 5.8 KAF from April-October and increases equally November to March
- Parameterize soil storage with a scalar (0.5 – 1.1?)
- Average annual pumping with estimates is ~30 KAF