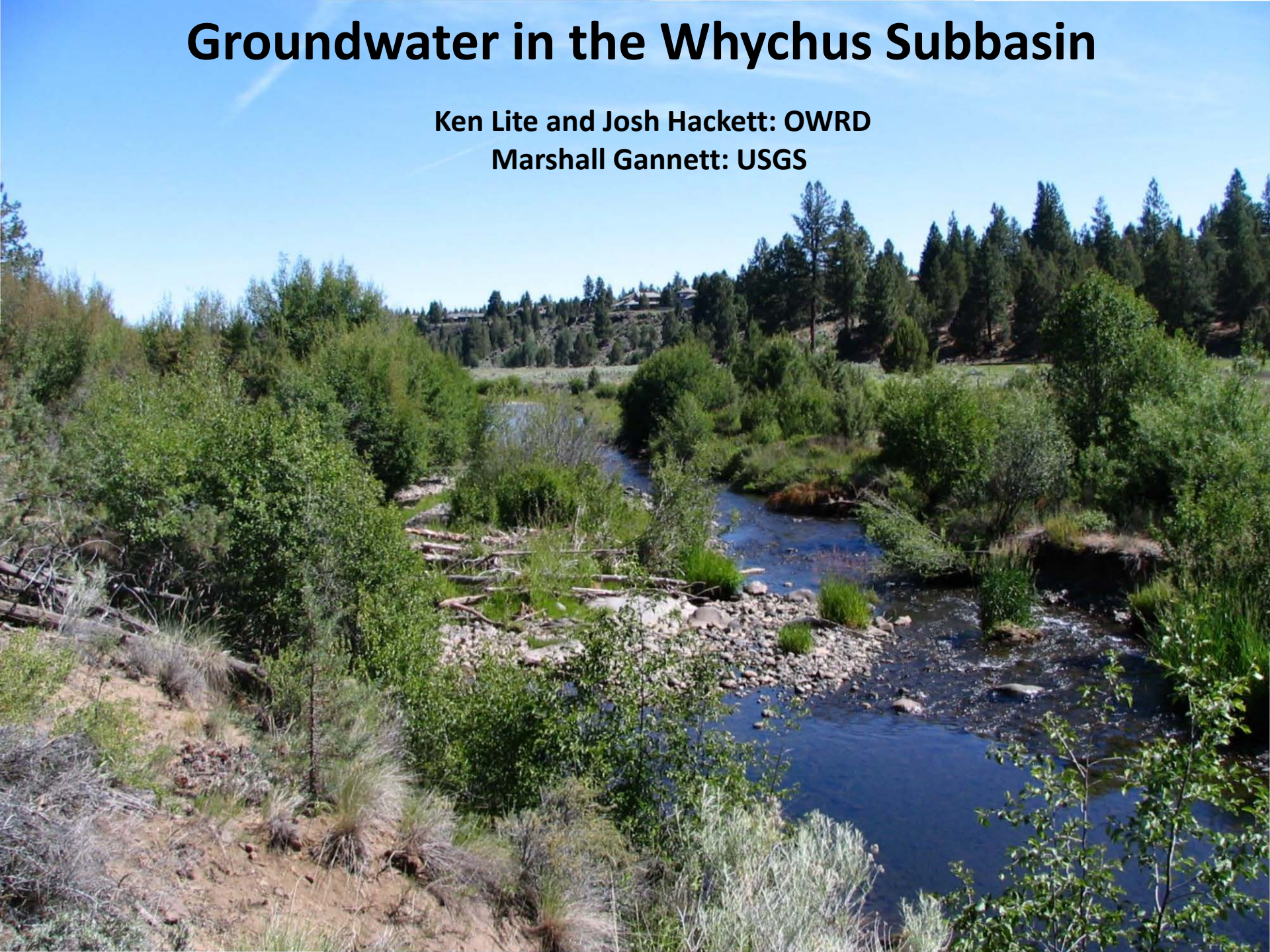
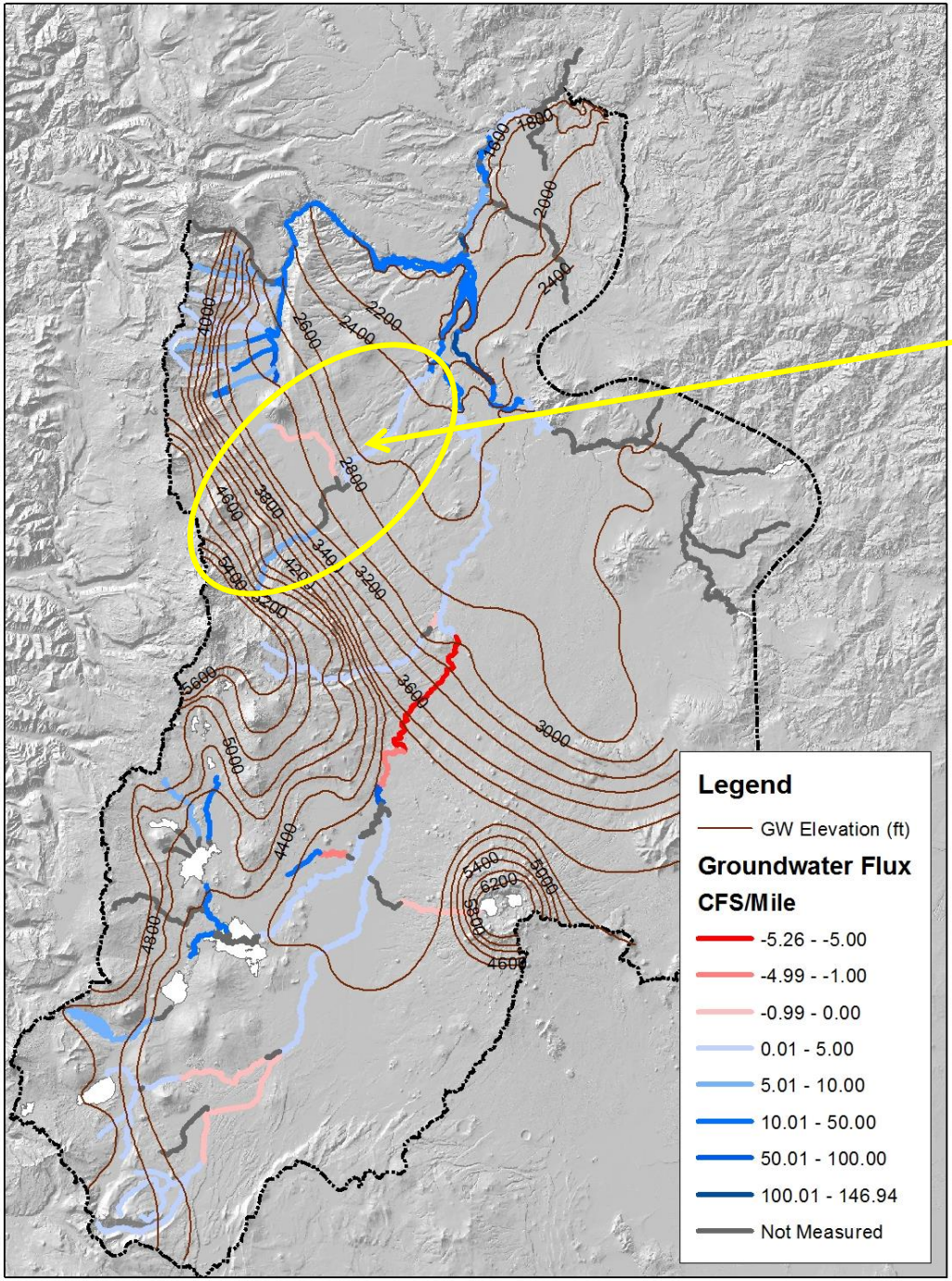
Groundwater in the Whychus Subbasin

Ken Lite and Josh Hackett: OWRD
Marshall Gannett: USGS

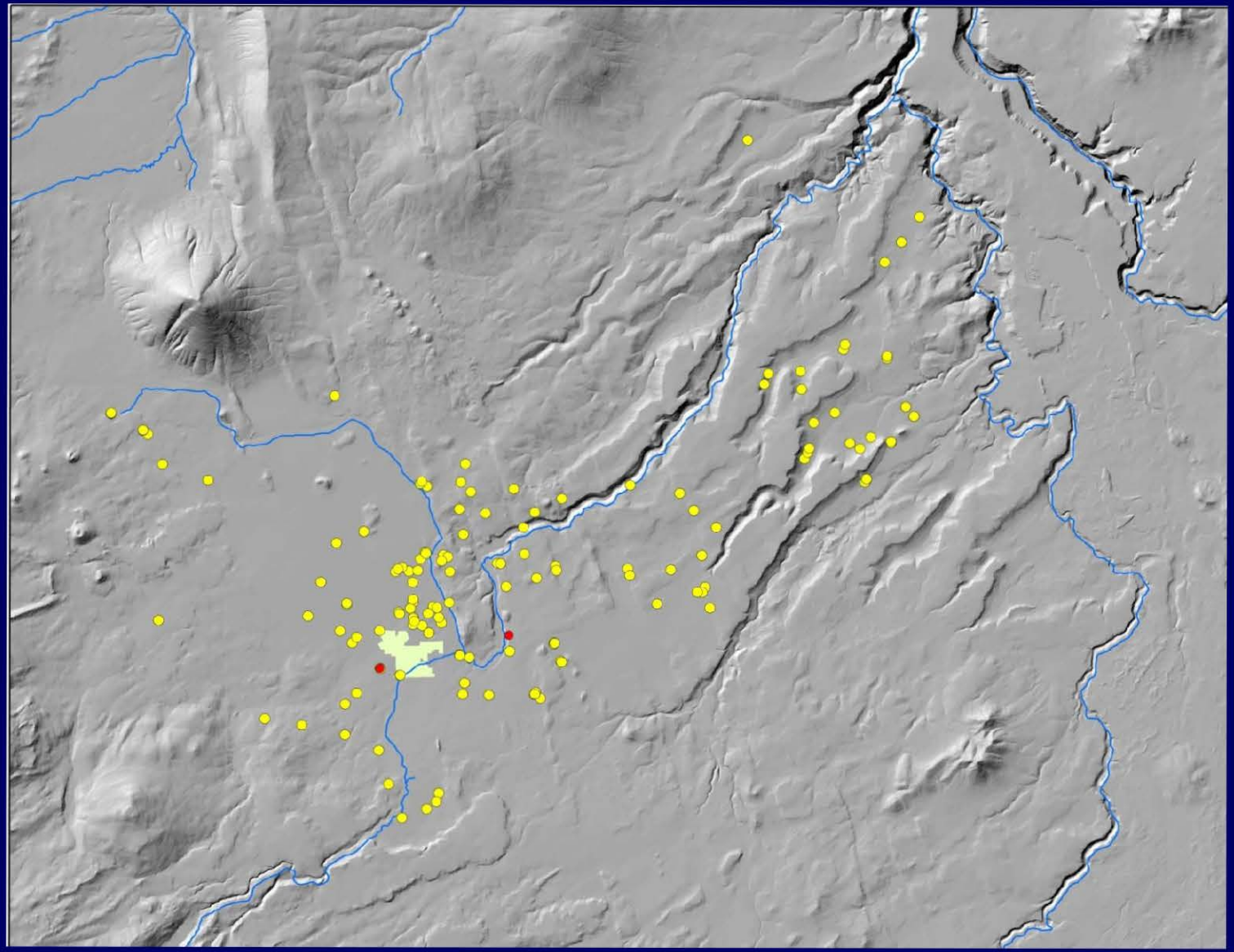


Upper Deschutes Basin Groundwater Flow System

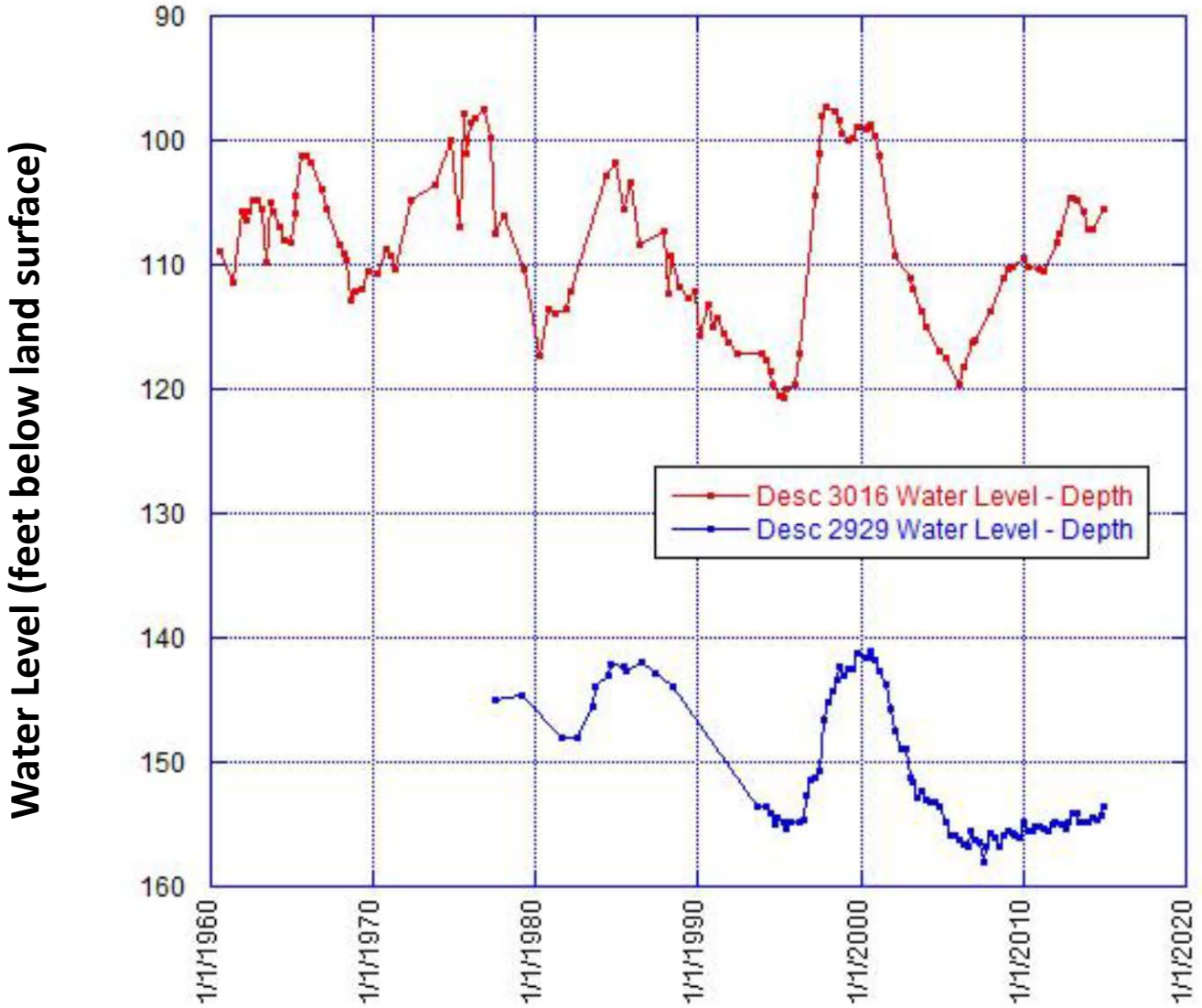


170 Groundwater Points of Appropriations (Wells with Water Rights)

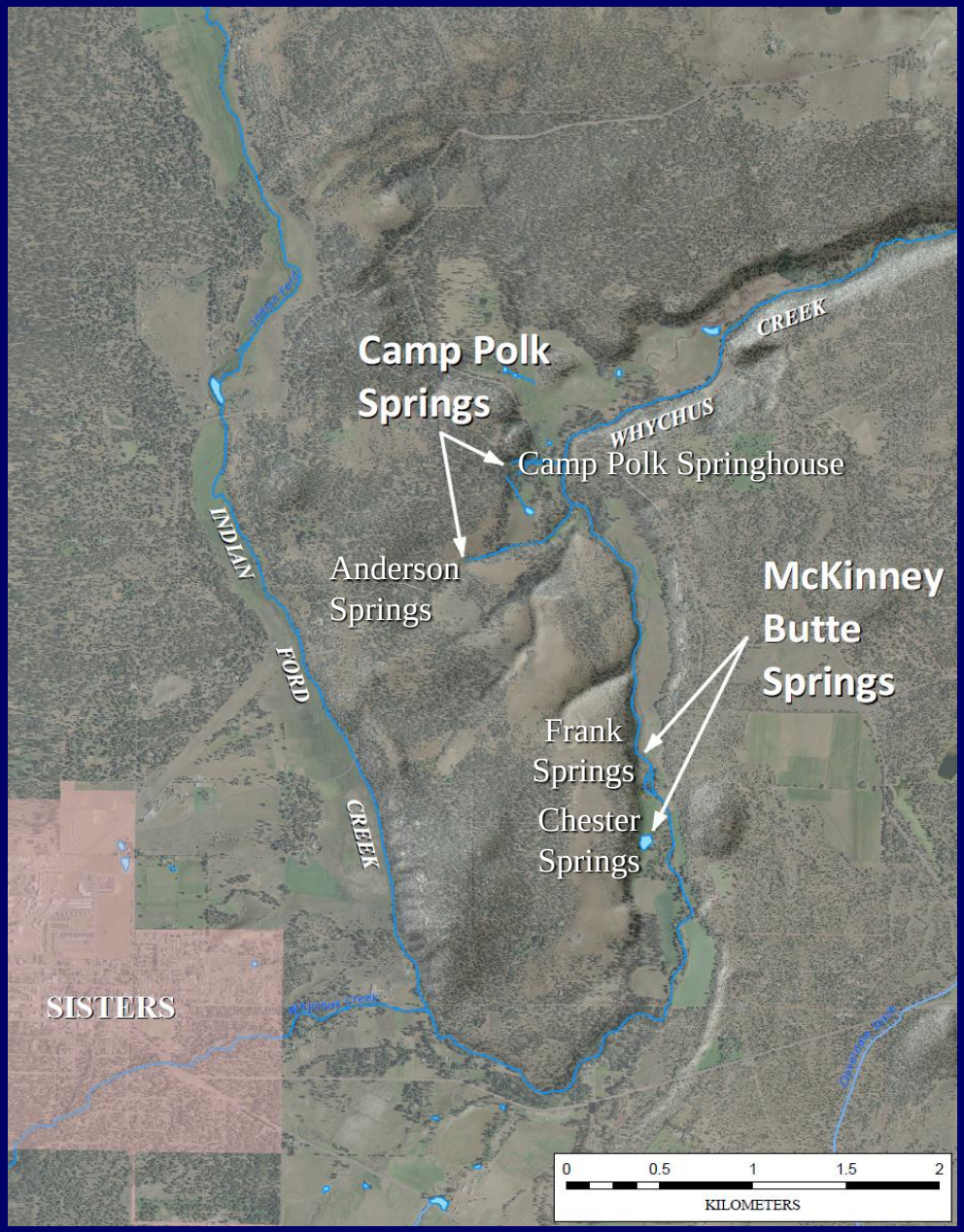
96 Cubic Feet Per Second (CFS): Face Value Rate



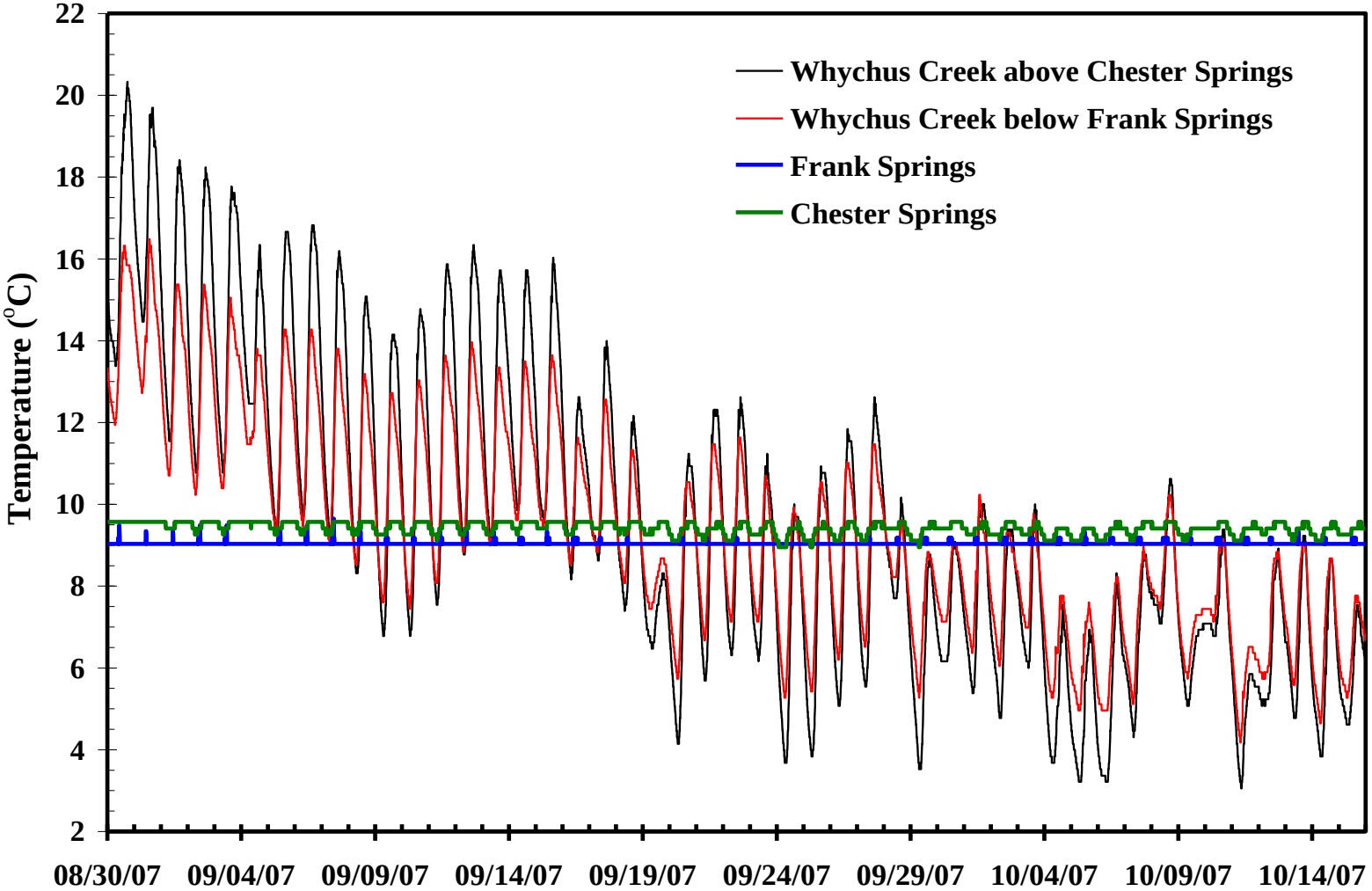
Time Series of Groundwater Levels in the Sisters Area



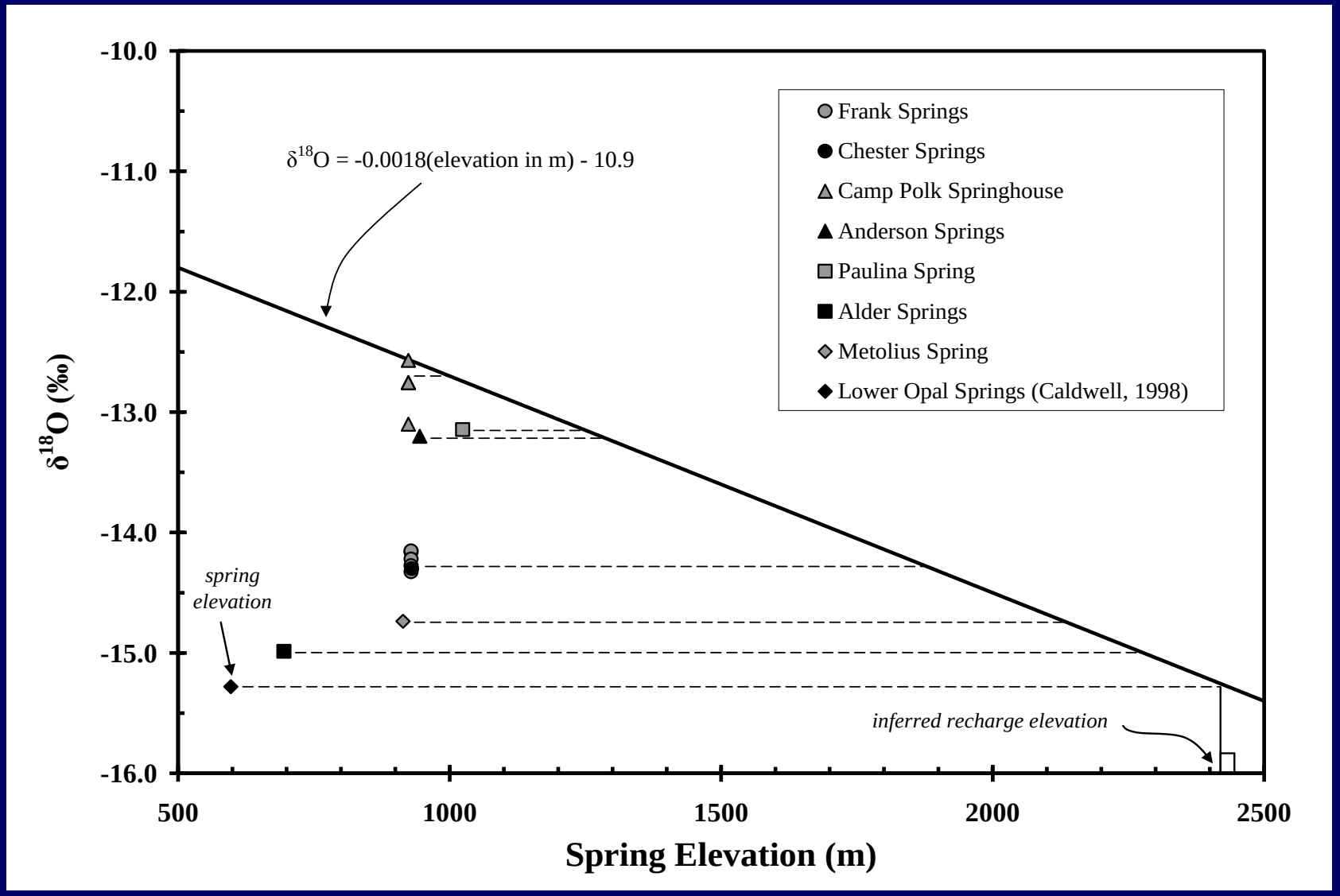
Springs on McKinney Butte



Thermal Contribution to Whychus Creek

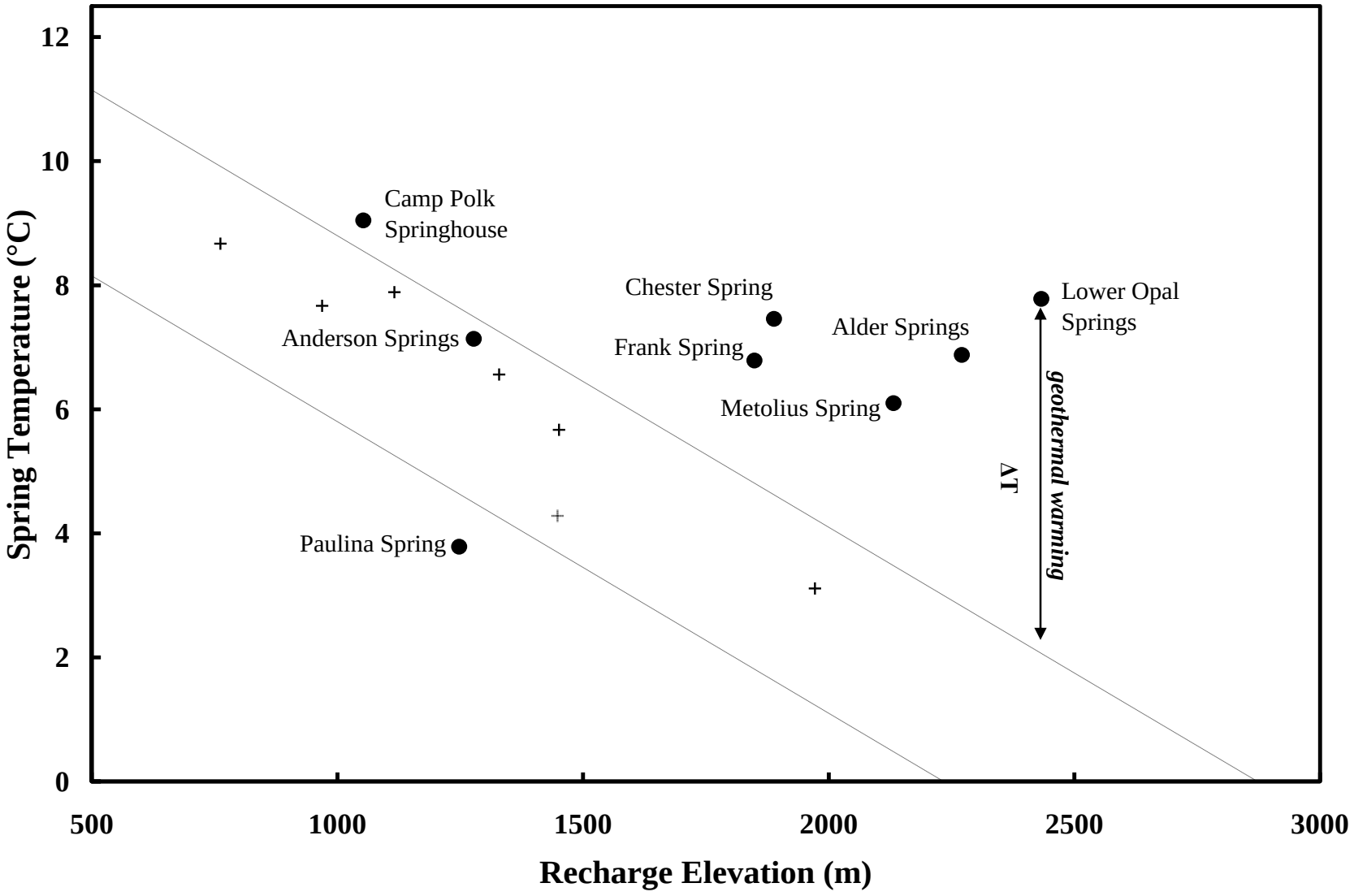


Stable Isotopes



After James (1999)

Temperature



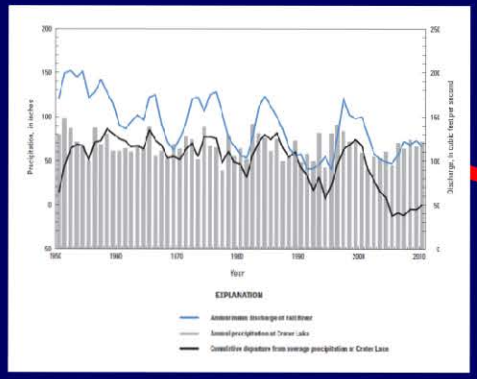
After Manga and Kirchner (2004)

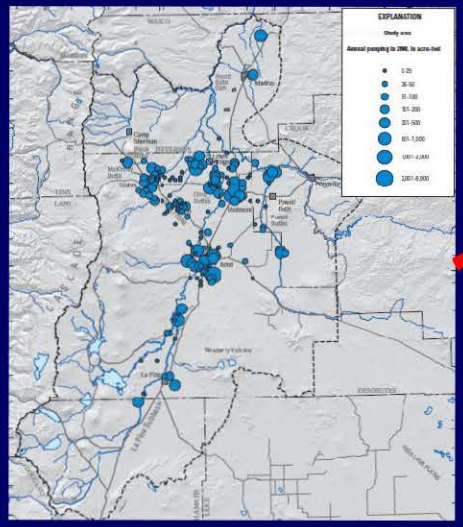
Source of Springs Summary

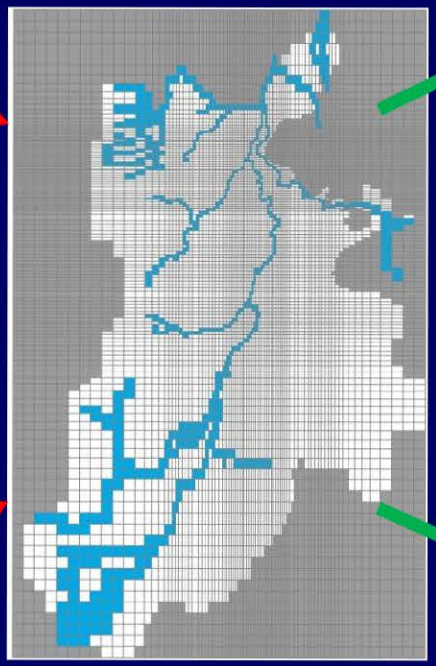
	Camp Polk Springs	McKinney Butte Springs
MAJOR IONS	Anthropogenic influence	No contamination
STABLE ISOTOPES	Low recharge elevations	High recharge elevations
TEMPERATURE	No geothermal warming	Geothermal warming
GROUNDWATER SCALE	Local	Intermediate or regional

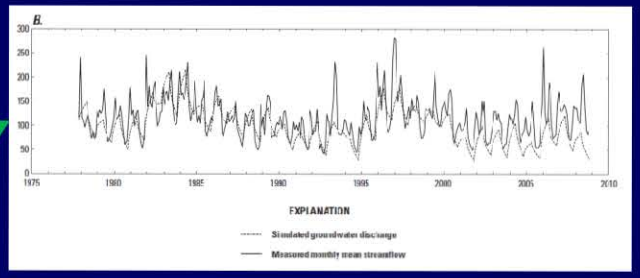
Improving Groundwater Modeling Capabilities in the Upper Deschutes Basin

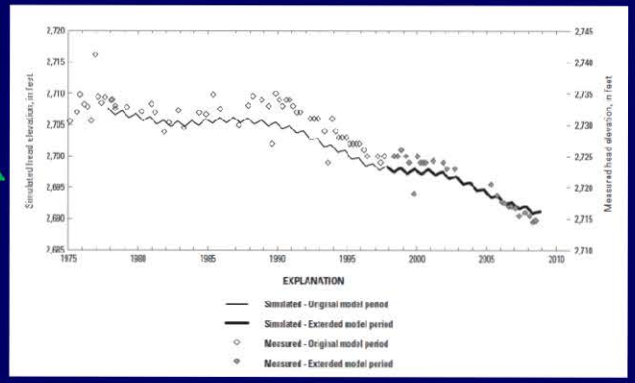
Inputs → Simulation Model → Outputs

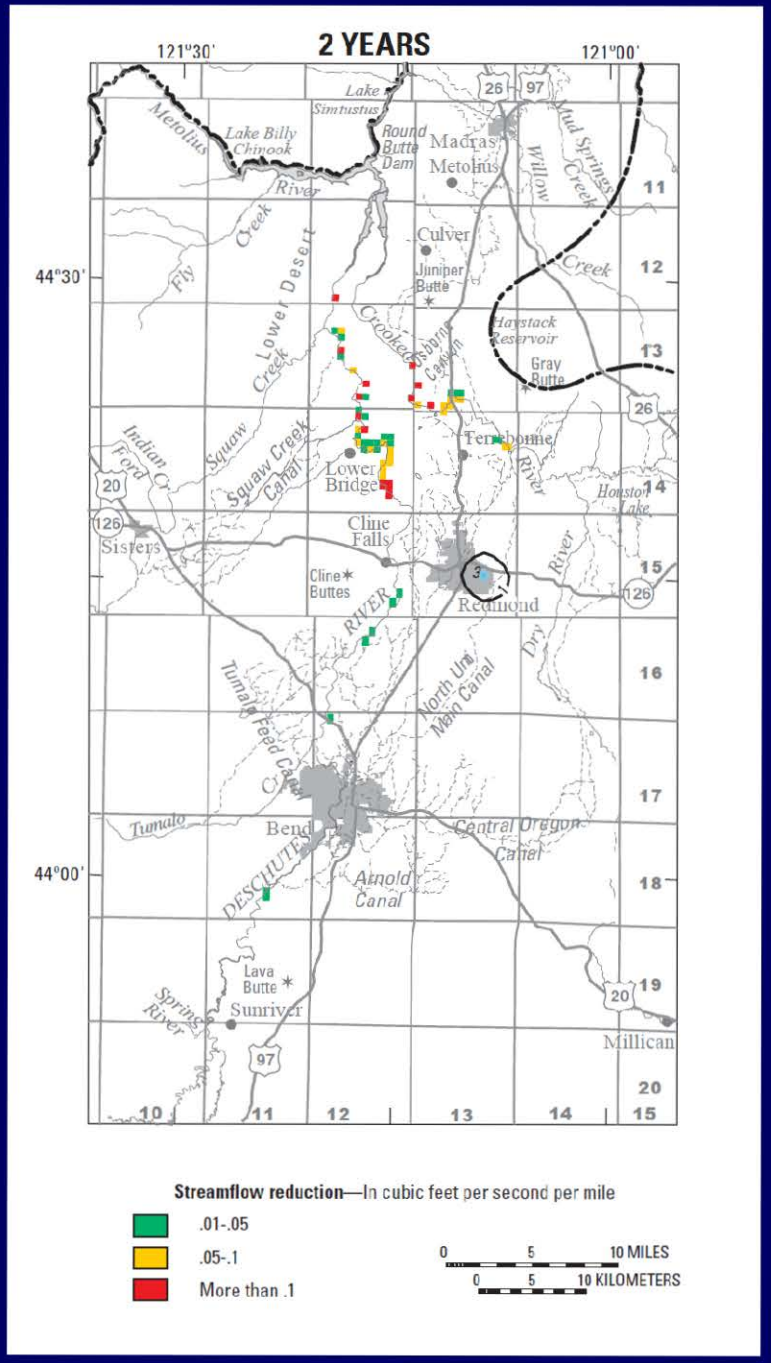


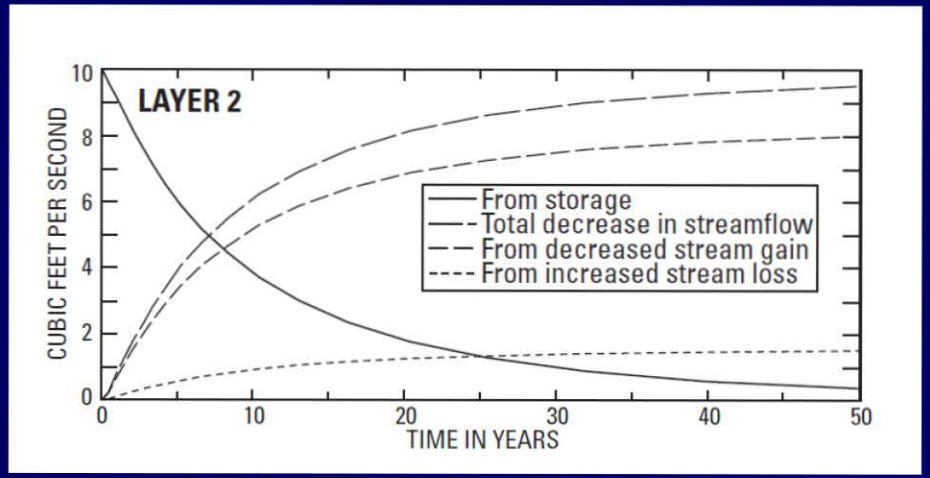






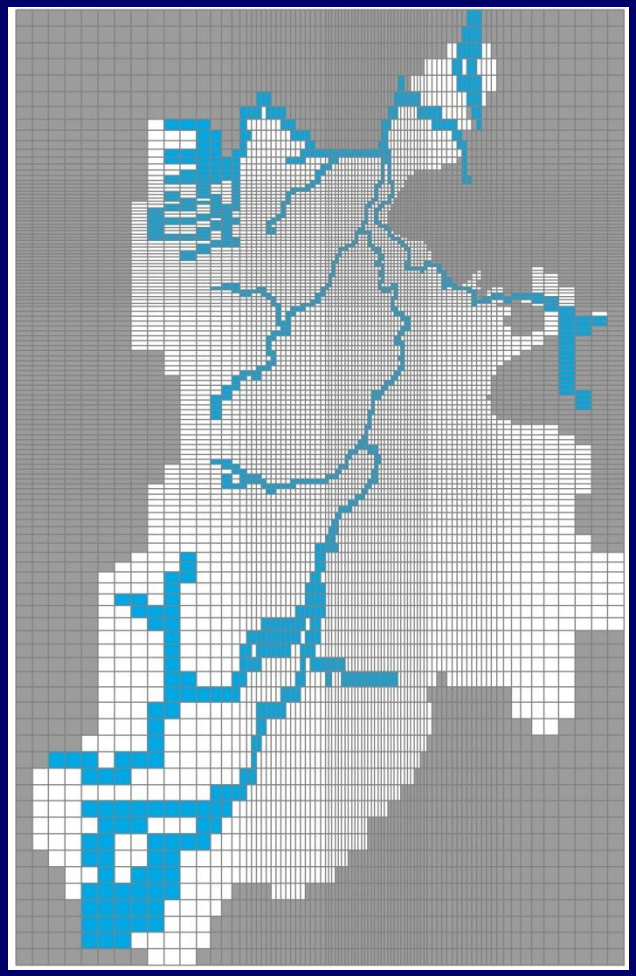



2 YEARS
121°30'
121°00'
44°30'
44°00'
Lake Simtustus
Round Butte Dam
Madras
Metolius
Lake Billy Chinook
Metolius River
Fly Creek
Lower Desert
Culver
Juniper Butte
Willow Creek
Mud Springs Creek
Haystack Reservoir
Gray Butte
Crooked River
Osburn Canyon
Lower Bridge
Squaw Creek Canal
Indian Ford Cr.
Terrebonne
Houston Lake
Sisters
Cline Falls
Cline Buttes
Redmond
Dry River
North Unit Main Canal
Tumalo Feed Canal
Tumalo Cr.
Bend
Central Oregon Canal
Arnold Canal
Lava Butte
Sunriver
Spring River
Millican
Streamflow reduction—In cubic feet per second per mile
.01-.05
.05-.1
More than .1
0 5 10 MILES
0 5 10 KILOMETERS

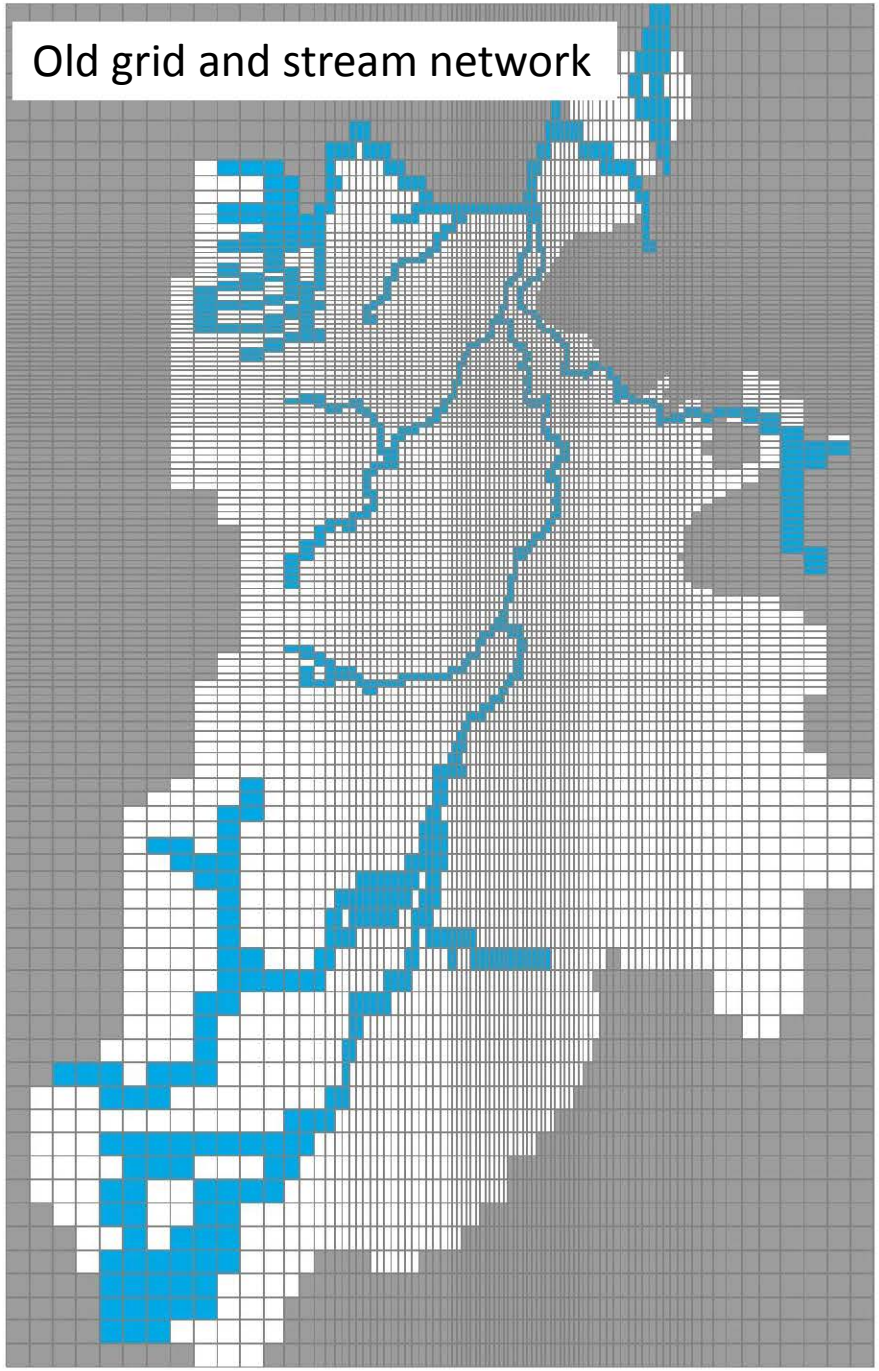

LAYER 2
CUBIC FEET PER SECOND
TIME IN YEARS
From storage
Total decrease in streamflow
From decreased stream gain
From increased stream loss
0
2
4
6
8
10
0
10
20
30
40
50

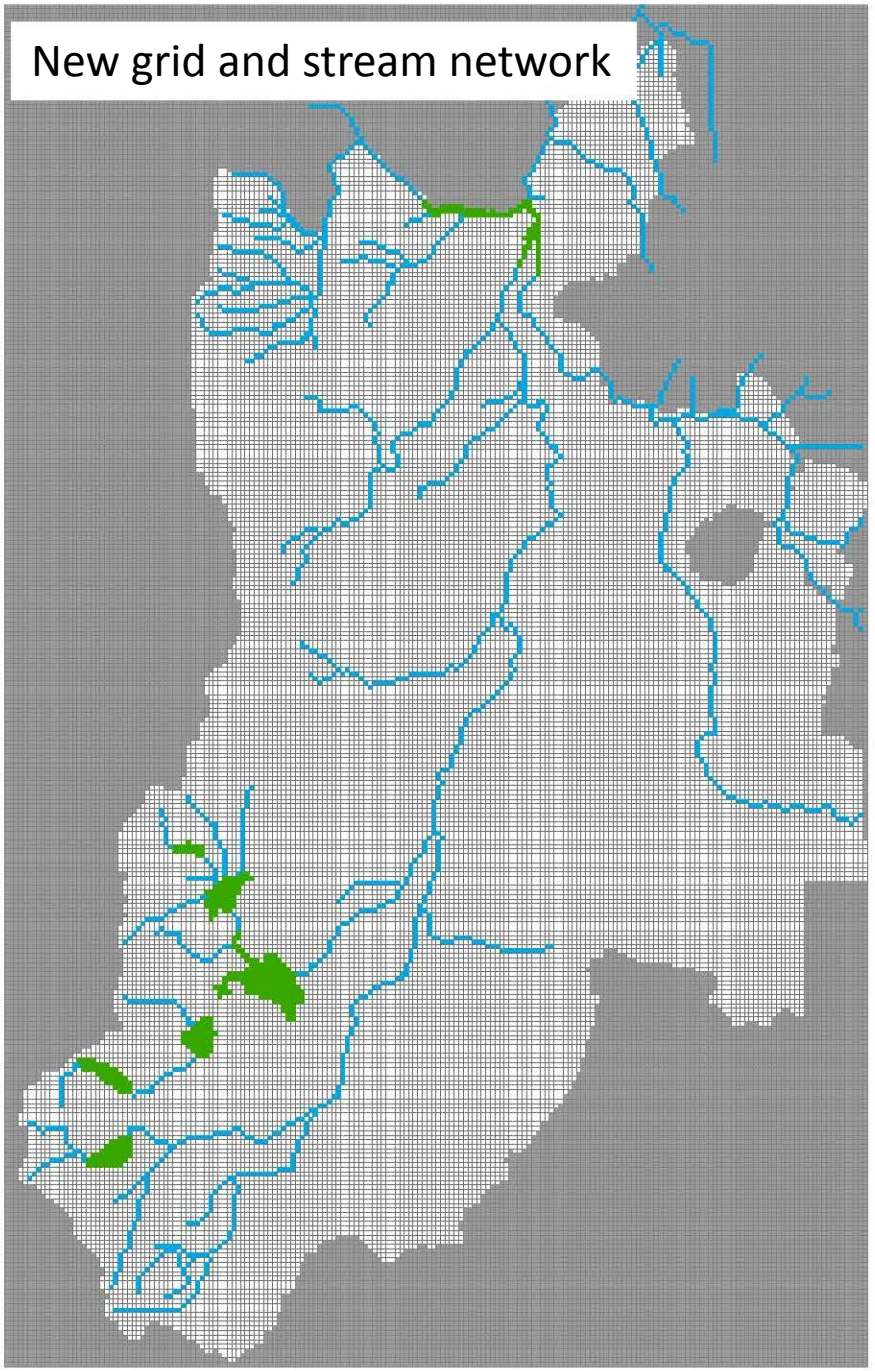

Crooked River

Existing Model Limitations



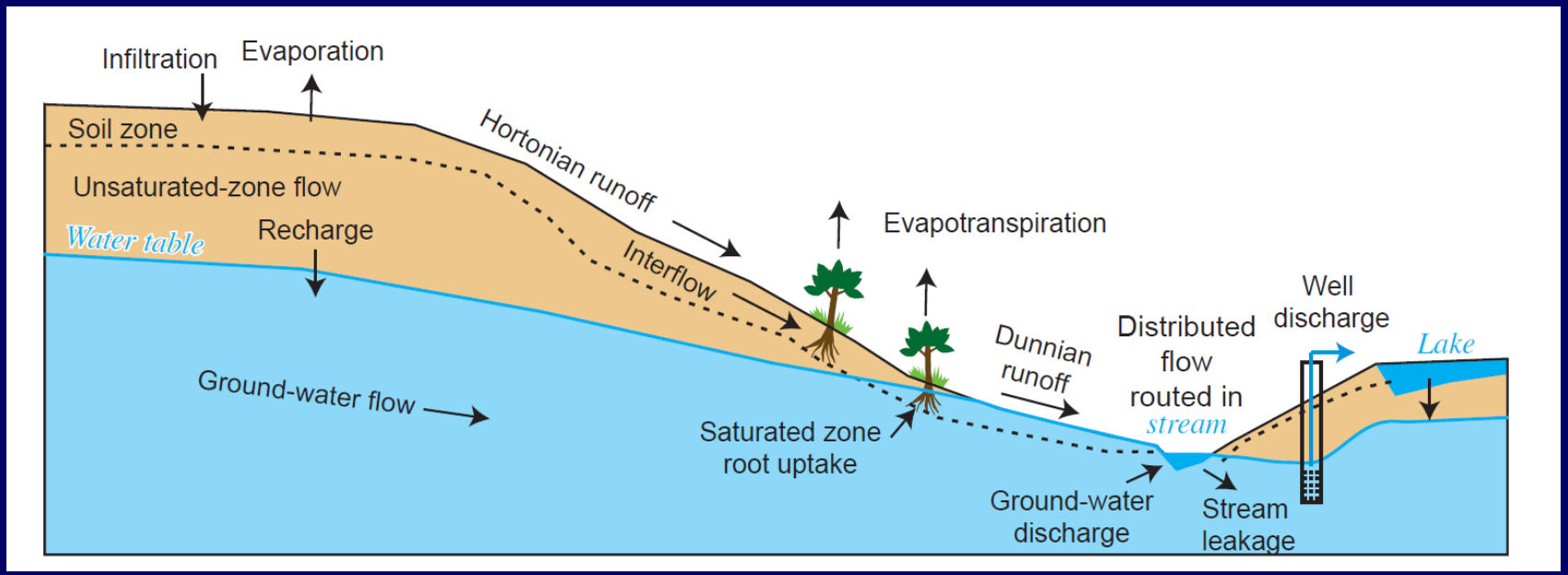
- Coarse grid (up to 10,000 ft)
- Lakes not simulated
- Limited representation of faults
- Unsaturated zone not simulated
- Intermittent streams not simulated
- Runoff component of streamflow not simulated


Old grid and stream network


New grid and stream network

GSFLOW: An integrated hydrologic model that simulates:

- Surface processes (PRMS)
  - Plant canopy interception
  - Snowpack accumulation, storage, and melting
  - Evapotranspiration
  - Soil moisture storage
  - Deep percolation and runoff
- Unsaturated zone process
- Groundwater flow (MODFLOW)



Time Line

Presently in the model development phase

Model calibration phase: March –May

Preliminary scenario testing: June-August

Report development, model approval and release, early 2016


Questions?
Deer Creek Fen

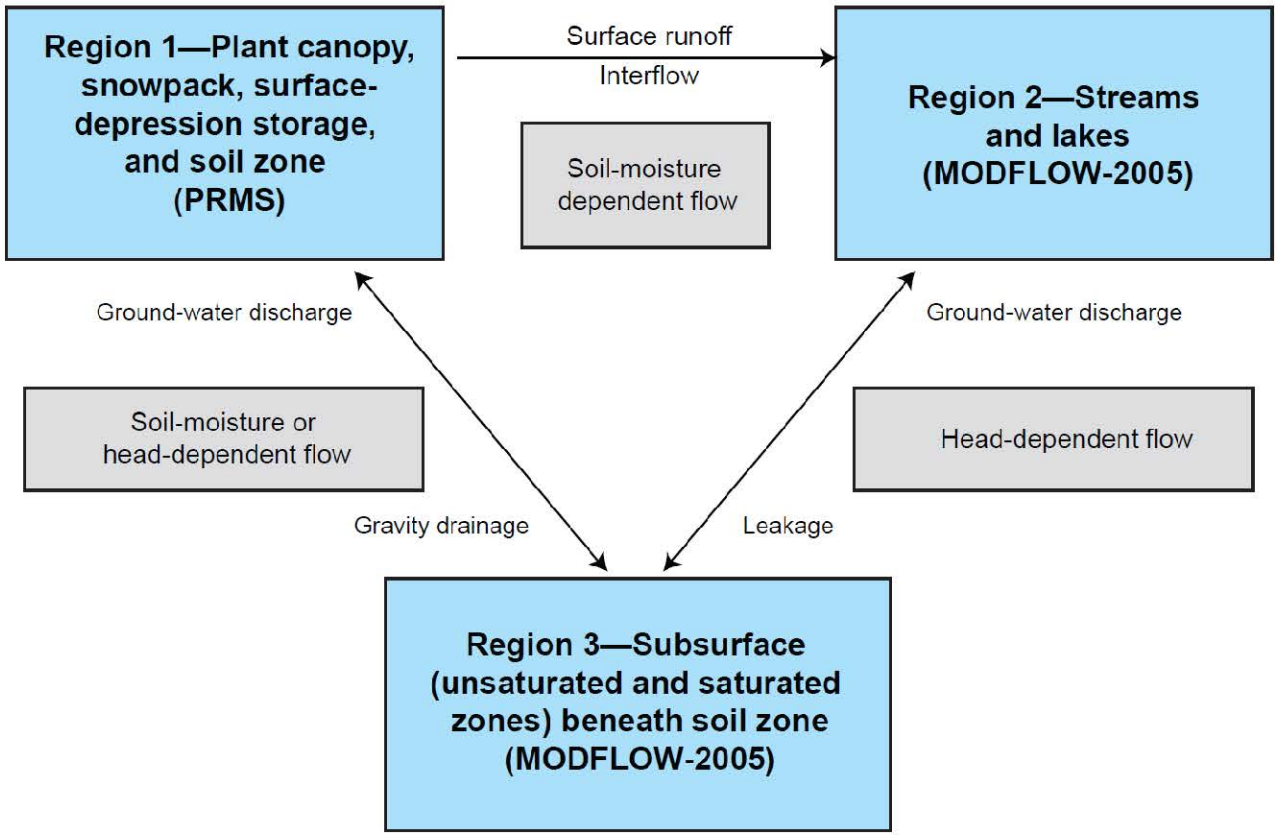


Figure 11. Schematic diagram of the exchange of flow among the three regions in GSFLOW. The dependency on soil moisture and head in the computation of flow among the regions also is shown.

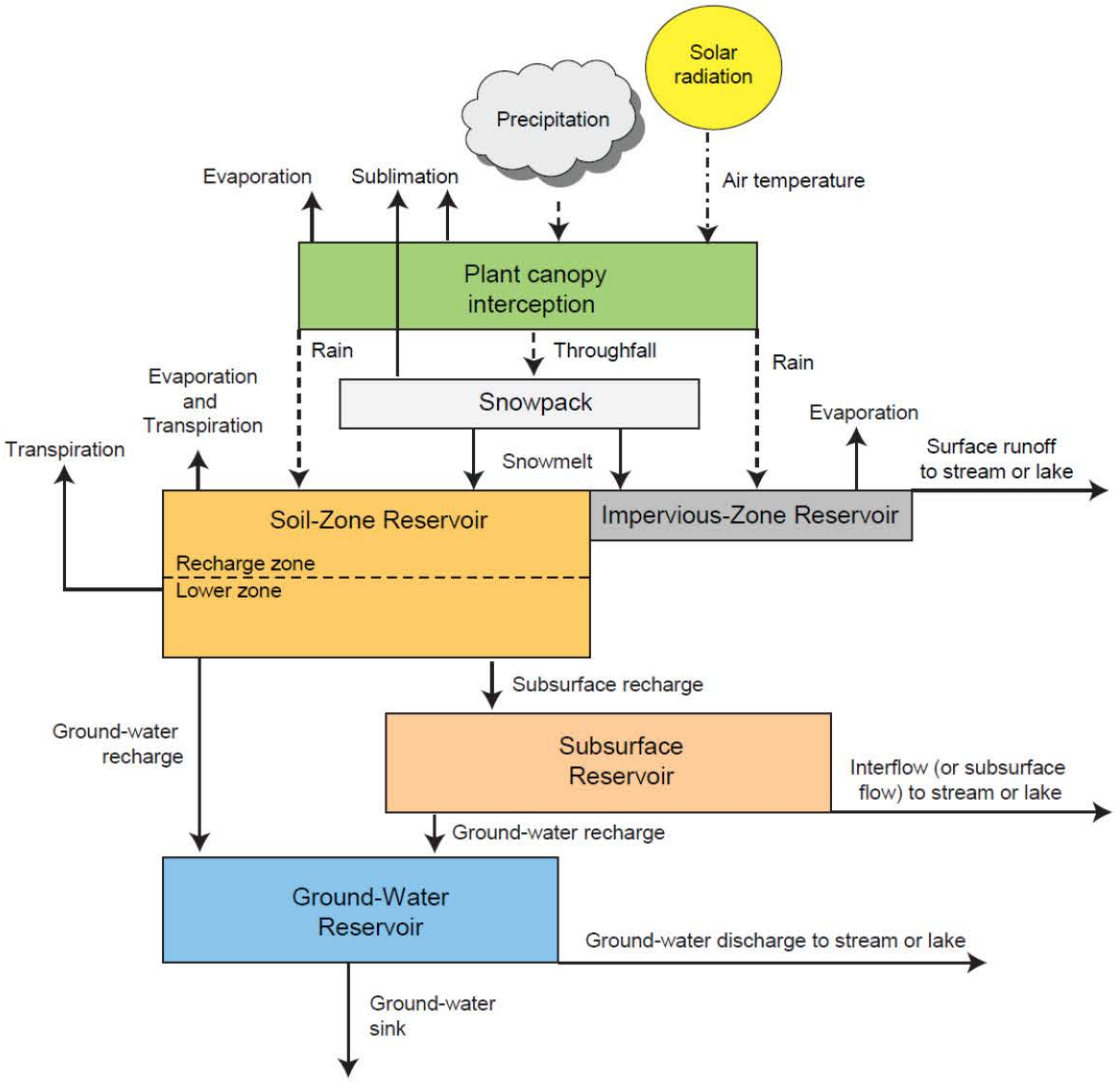


Figure 2. Schematic diagram of a watershed and its climate inputs (precipitation, air temperature, and solar radiation) simulated by PRMS (modified from Leavesley and others, 1983).