RECLAMATION

Managing Water in the West

Modeling in the Deschutes Basin

Jennifer Johnson, P.E., Bureau of Reclamation

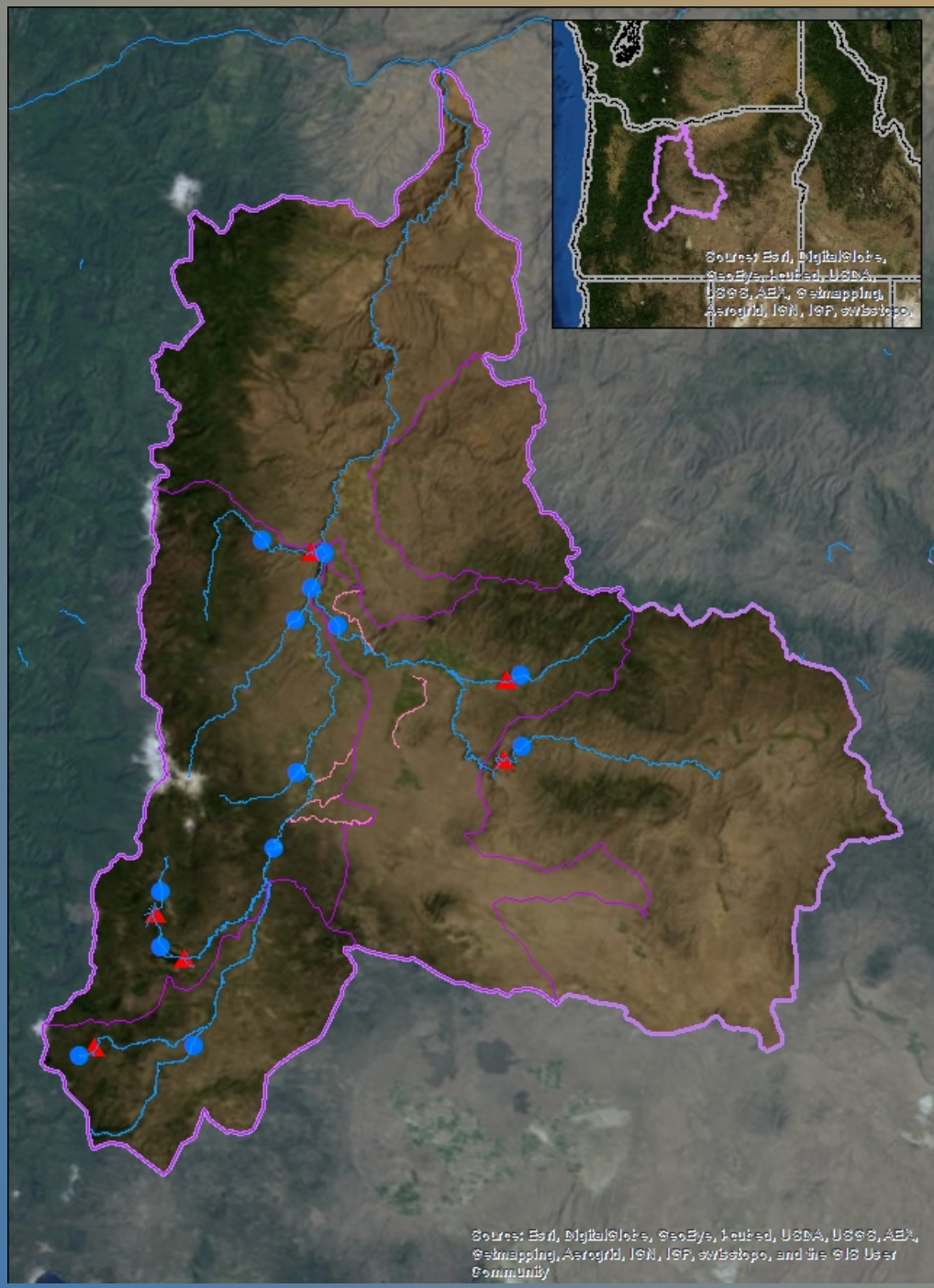
U.S. Department of the Interior
Bureau of Reclamation

Outline

- Review of Models
- Climate Modeling Process

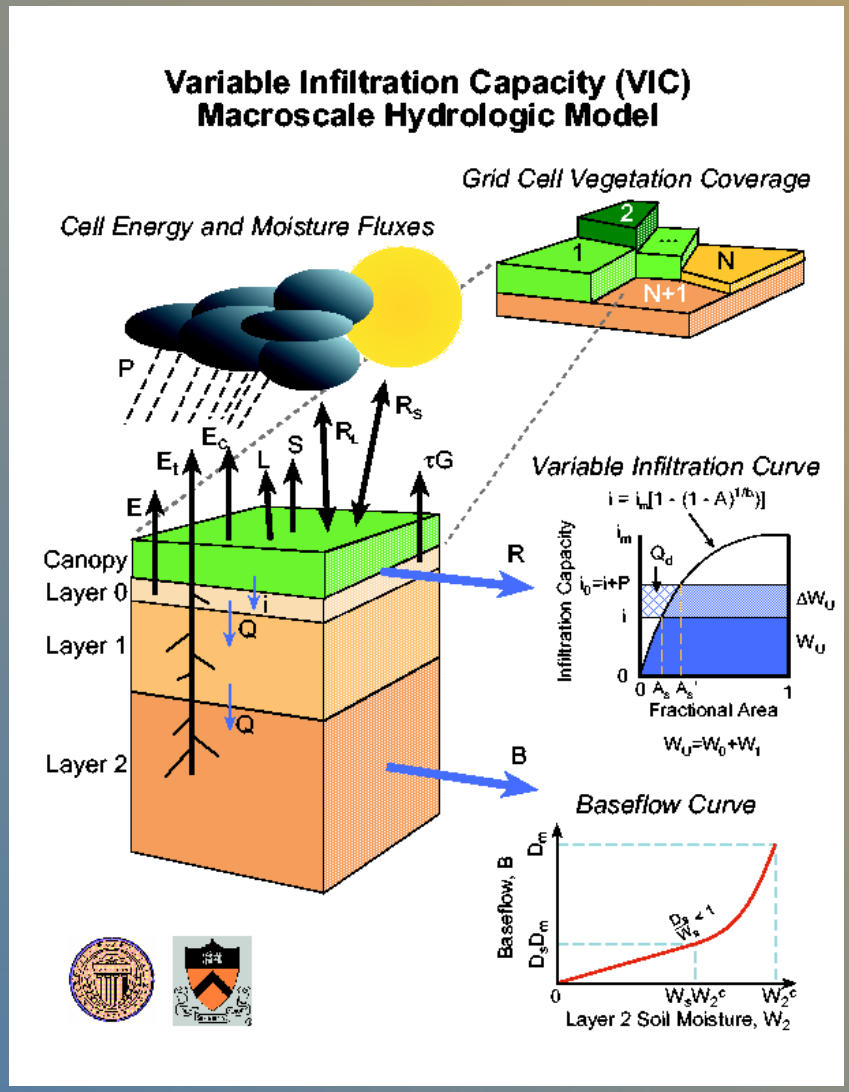
Models

- Hydrologic
  - VIC, PRMS
- Groundwater
  - MODFLOW (2004, current)
- Combined
  - GSFlow
- Water Resources
  - MODSIM, RiverWare



Hydrologic Models

- VIC
  - Takes temperature and precipitation as input
  - Simulates rainfall-runoff process
  - Generates flow at each cell which is then routed to specific points
  - Does not simulate deep groundwater flow



RECLAMATION

Hydrologic Models

- PRMS
  - Takes temperature and precipitation as input
  - Simulates rainfall-runoff process
  - Generates routed flows at specified points

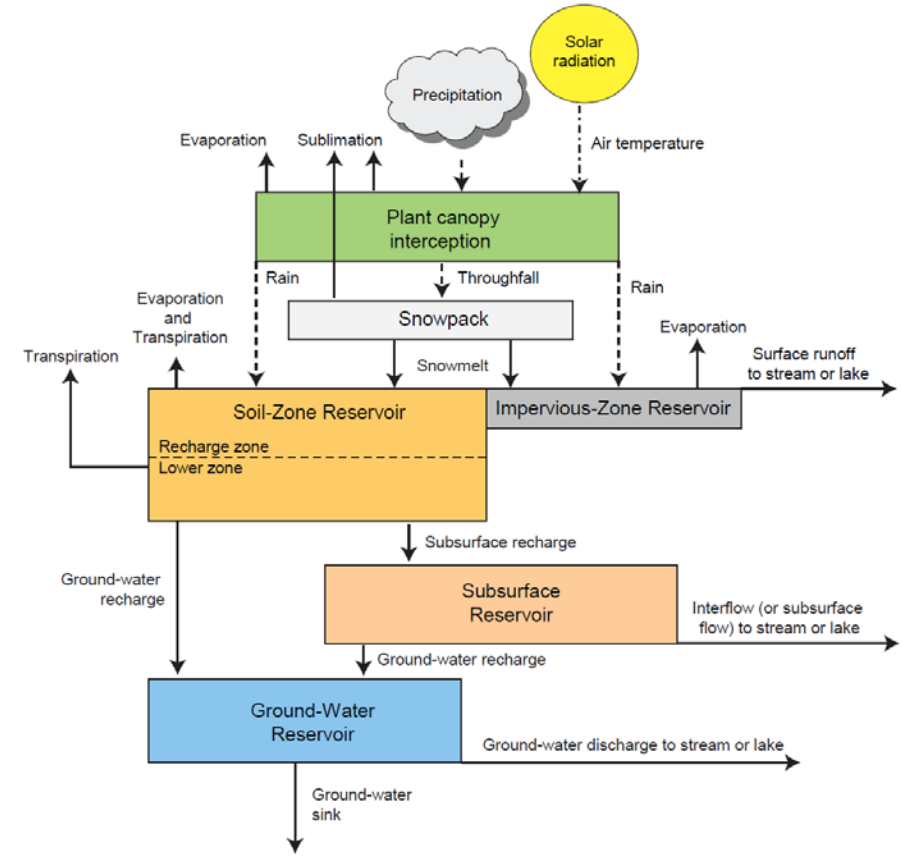
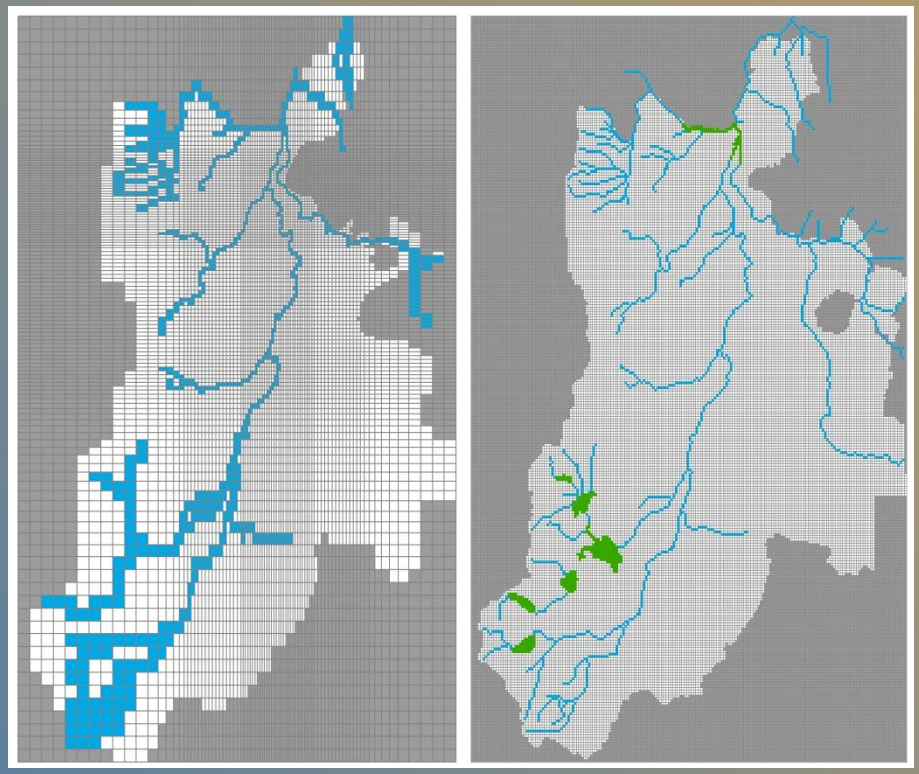


Figure 2. Schematic diagram of a watershed and its climate inputs (precipitation, air temperature, and solar radiation) simulated by PRMS (modified from Leavesley and others, 1983).

RECLAMATION

Groundwater

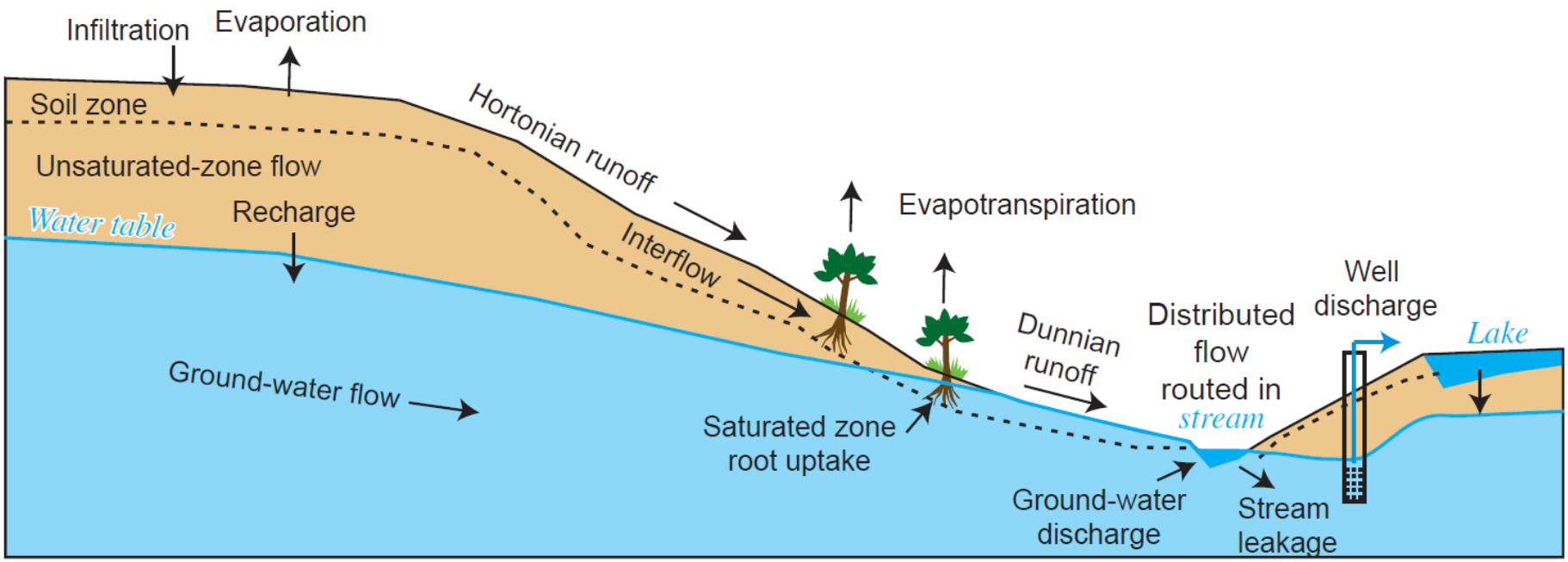
- MODFLOW
  - USGS updated their MODFLOW model of the basin
    - Refined grid allowing for better stream definition
    - Refined layering



RECLAMATION

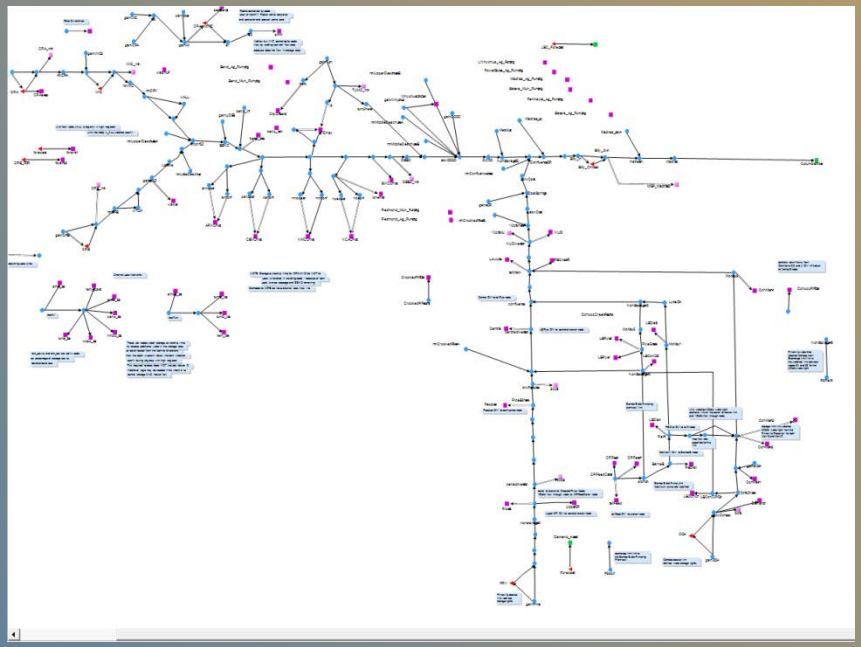
Coupled

- GSFlow
  - Combines PRMS with MODFLOW
    - Better representation of streamflows that are highly influenced by groundwater
  - Takes inputs of temperature and precipitation
  - Generates flow at specified points



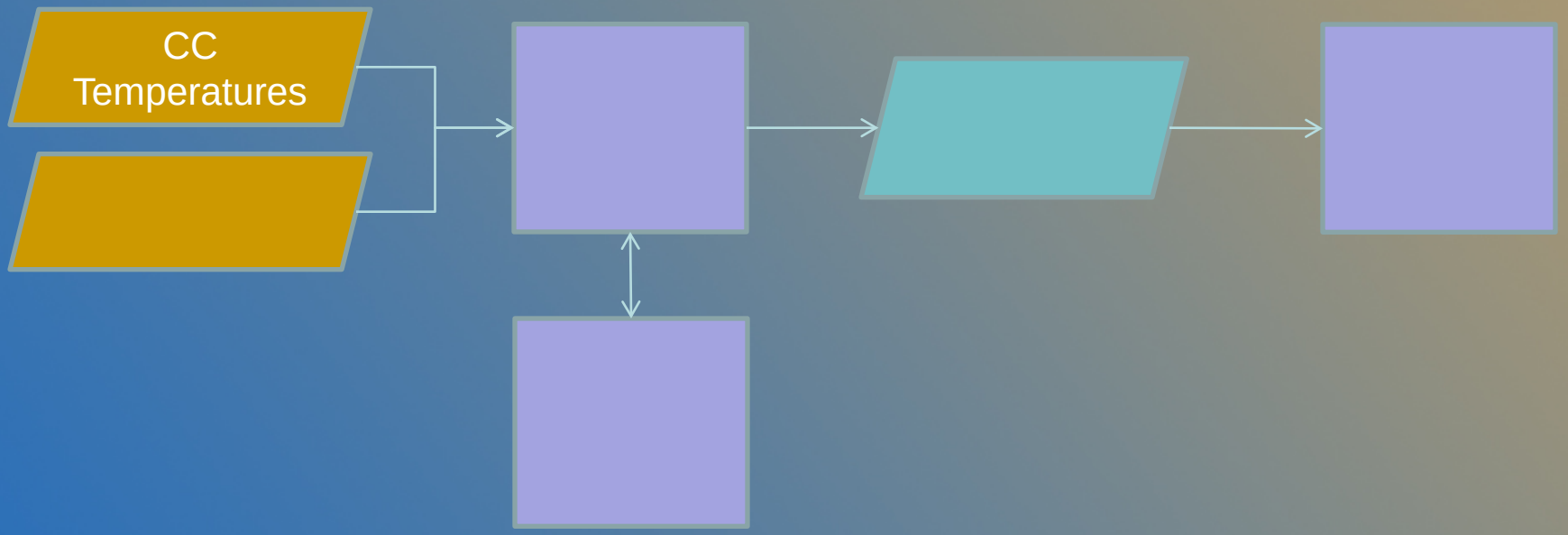
Water Resources

- MODSIM and RiverWare
  - MODSIM – monthly timestep
  - RiverWare – daily timestep
- Networks are similar
  - Upper Deschutes, Crooked River, Whychus Creek
- Both simulate
  - Reservoir operations
  - Irrigation diversions
  - Flow in the river
  - Groundwater return flows
  - Water rights

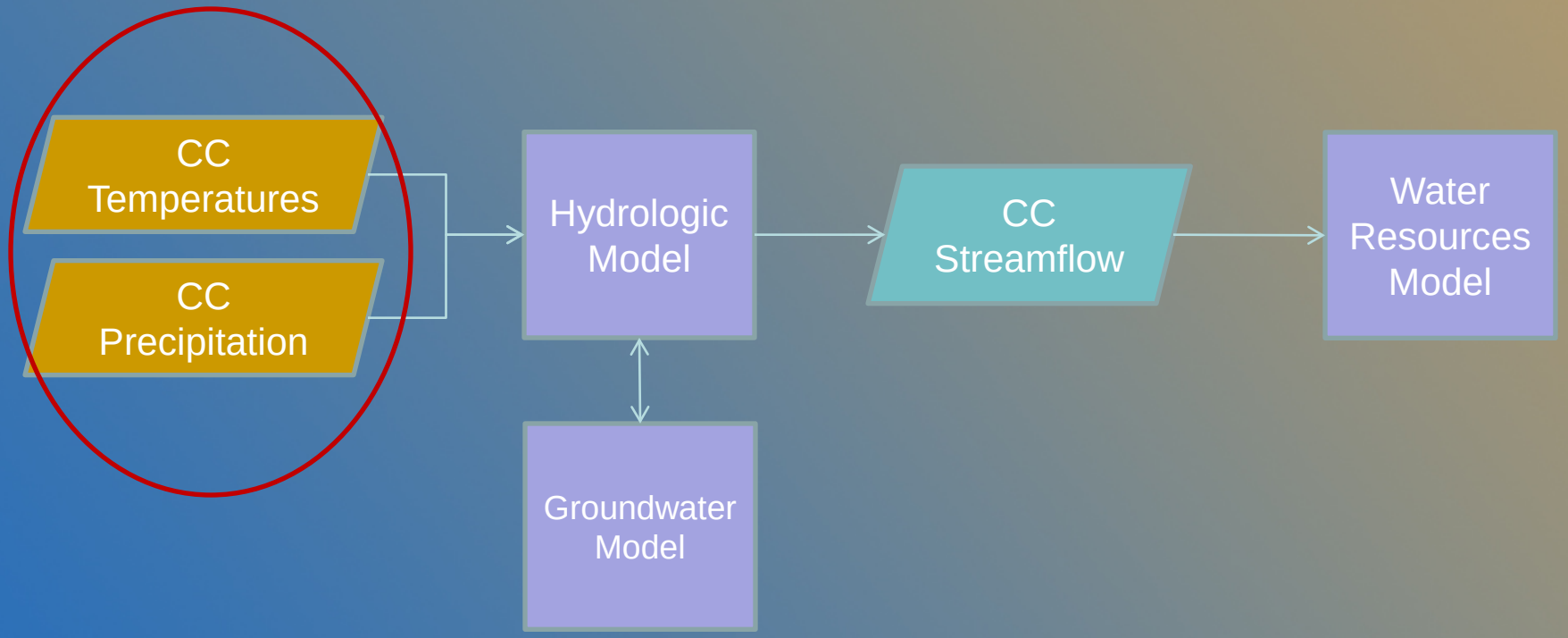


RECLAMATION

Climate Process



Climate Process



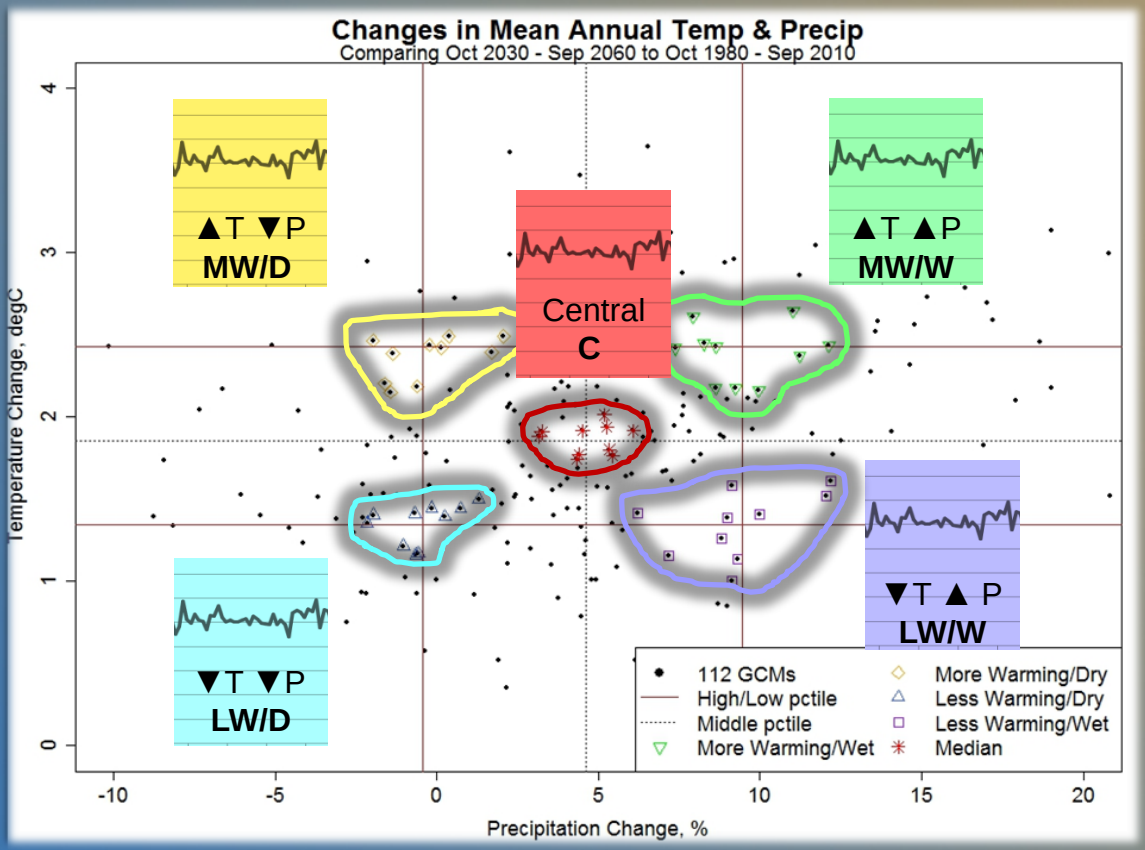
RECLAMATION

Climate Process

CC Temperatures

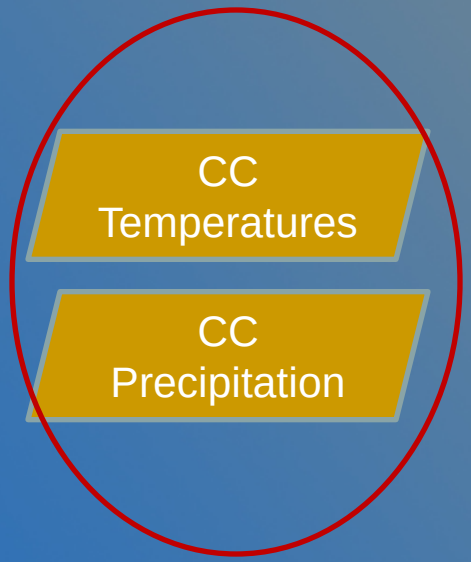
CC Precipitation

- 1. Generate future projected temperature and precipitation.



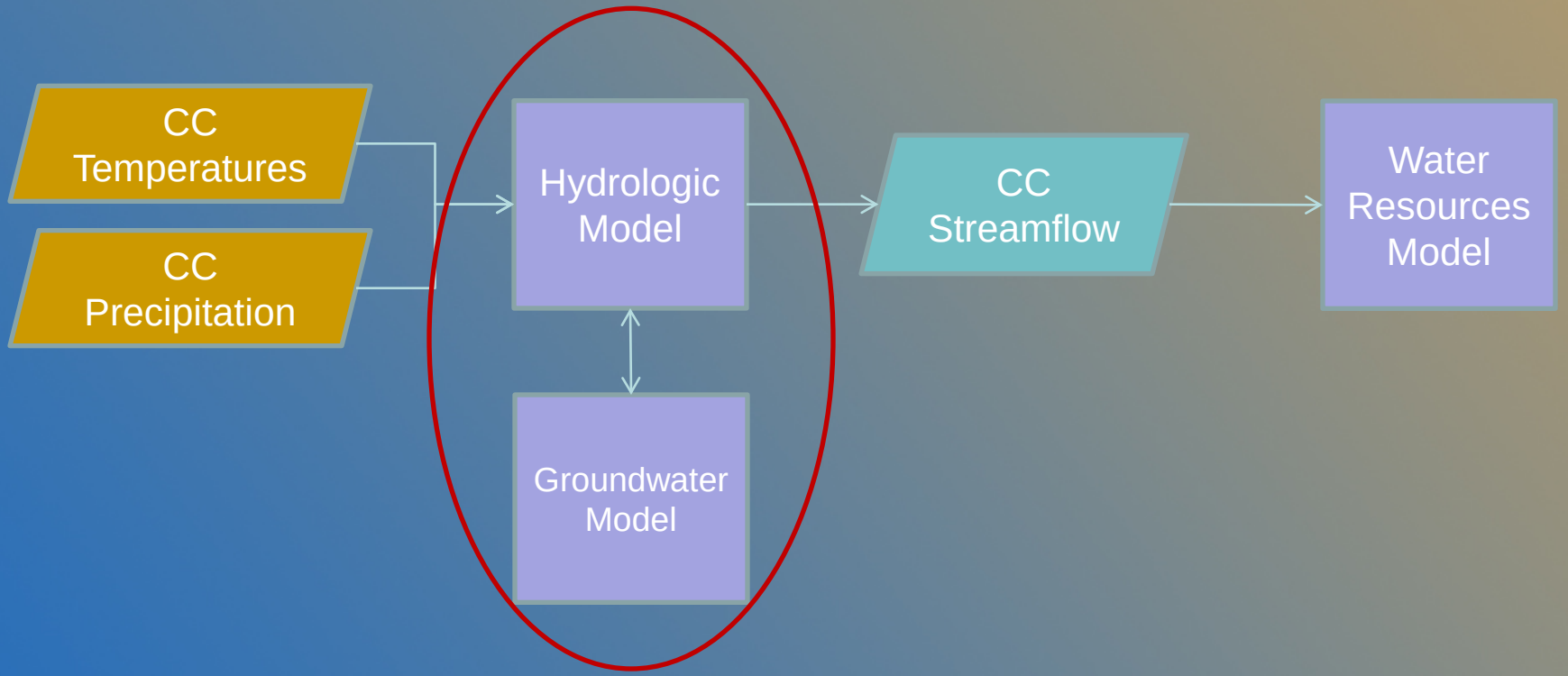
RECLAMATION

Climate Process



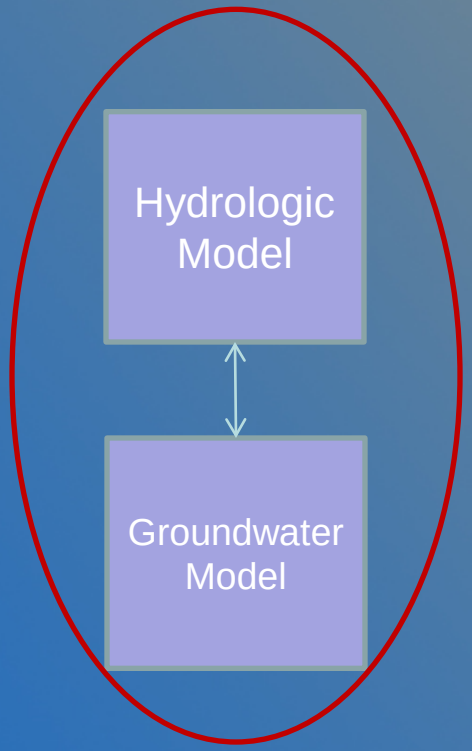
- 1. Generate future projected temperature and precipitation.
  - Decisions:
    - CMIP3 vs CMIP5
    - Extreme or Moderate Risk
      - 10/50/90 or 20/50/80
    - Future time periods
      - Investigate the change between recent history and 2020s, 2040s, 2060s, 2080s
    - Number of climate scenarios
      - 3 or 5

Climate Process



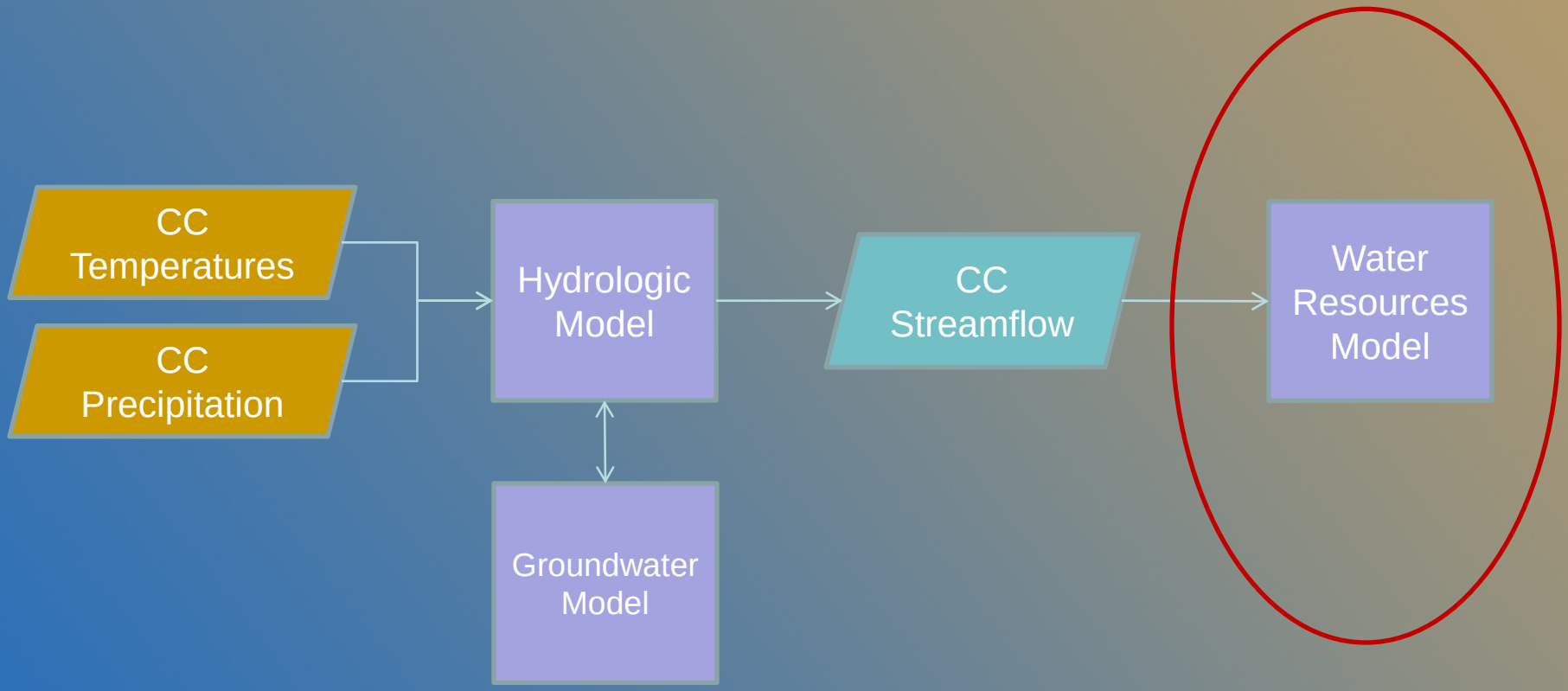
RECLAMATION

Climate Process



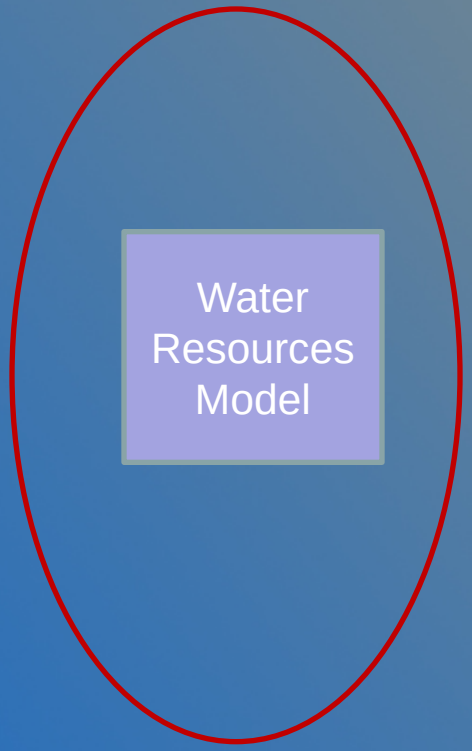
- 2. Generate future projected stream flows
  - Decisions:
    - VIC or GSFlow
      - VIC recommended for Crooked
      - GSFlow recommended for Upper Deschutes
        - » GSFlow dependent on USGS schedule
- 3. Simulate impacts to groundwater
  - Primary impacts
    - Changes in recharge
  - Secondary impacts
    - Changes in behavior

Climate Process



RECLAMATION

Climate Process



- 4. Run generated flows through water resources model
  - Decisions
    - MODSIM or RiverWare
    - Irrigation demands
      - Pattern of historic diversions?
      - Adjusted for future ET?
      - Adjusted for future land use and crop type?
    - Metrics
      - Probability of reservoir fill
      - Irrigation shortages
      - Probability of meeting flow targets
    - Number of scenarios is multiplied by climate scenarios

Questions

Presenter:

Jennifer Johnson| Civil Engineer (Hydrologic) | Pacific Northwest Regional Office – River & Reservoir Operations

(208) 378-5225 | jmjohnson@usbr.gov

RECLAMATION