Tour of the KREW/CZO field site

Today’s field visit is located at the Kings River Experimental Watershed/Critical Zone Observatory (KREW/CZO), approximately 30-miles southeast of the SNAMP Sugar Pine site. Much of the same instrumentation exists in the SNAMP research areas, however, there are several installations here that are not present at the SNAMP sites and will be useful to the water team’s research.

1) Wireless sensor network

SNAMP currently has wired instrument clusters, centered around a single datalogger. Sensors at this research site have been updated to a wireless configuration, allowing for observations over a greater distribution of the landscape. These networks are gradually being added to the SNAMP sites, starting with the upper elevation meteorological station at Last Chance (Duncan Peak Met).

2) Flux Towers

Flux towers measure the exchange (flux) of water vapor and carbon dioxide between the atmosphere and forest. The exchange of these gases are measures of plant photosynthesis (carbon dioxide) and respiration (water vapor), and give us an indication of forest growth.

3) Nutrient Cycling

Passive and throughfall collectors located in and around the KREW/CZO sites capture atmospheric deposition of nitrogen, providing a measure of external nitrogen inputs to the forested watersheds. Additional investigations into watershed carbon and nitrogen pools have already been completed, but continue to progress along with the measurement of sediment, nitrogen, and carbon exports by stream discharge.

Importance to SNAMP Water Team research

The KREW/CZO watersheds have a history of research and established instrumentation that extends beyond the history and objectives of the SNAMP hydrology studies. This provides the water team with more information than can be obtained through SNAMP-only installations. The purpose of SNAMP water team instruments is to inform hydrologic modeling of the forest treatments, determining effects on water quantity and water quality. Our instruments obtain on-site observations of meteorological conditions, snow depth, soil moisture, stream flow, and water quality to determine the performance of model simulations. However, the specific model being used (Regional Hydro-Ecological Simulation System, RHESSys), also has a biogeochemical component that allows nutrients to cycle and the forest to grow. This element of watershed modeling is important when projecting stream conditions decades after forest treatments have been completed, as vegetation grows back in the treated areas and the non-treated areas continue to mature. The flux towers, atmospheric deposition collectors, and other research on carbon and nitrogen cycling performed at KREW/CZO, will be instrumental in guiding this portion of the model. For this reason, and to display the future implementation of wireless sensor technology at the SNAMP sites, we are showing you this field site today.
SNAMP Catchments – Sierra NF

Study Area Sites
- Water: Treatment
- Water: Control
- Treatment
- Control
- Fisher Study Area*
- Other Projects
- Natural Areas

Federal Lands
- Forest Service
- National Park Service
- County borders
- Interstate
- Highway
- Major Road

*Study boundary indicated on the inset above.

Southern Sierra CZO

N-S transect of research catchments

San Joaquin Experimental Range 400 m
Soaproot Saddle 1100 m
CZO P301 2000 m
Shorthair Creek 2700 m

E-W transect of flux towers

Last Chance
Gin Flat
Sugar Pine
CZO
Wolverton

MODIS Image

NEON to follow same E-W transect

Elev., m
Providence catchments with instrument locations

- CZO
- P301
- Flux tower
- Upper met
- Lower met
- P303
- P304
- Sensors
- CZT_1
- Met station
- Stream gauge
Wireless Sensor Network/ Water balance instrument cluster

Sensor node architecture: (1) mote, (2) custom data-logger to interface the sensor array, (3) on-site memory storage, (4) 12V battery, (5) snow-depth sensor, (6) humidity and temperature sensor, (7) solar radiation sensor, (8) 10W solar panel, (9) external 8dBi antenna, (10) four soil moisture, temperature, and matric potential sensors at varying depths.

Figure _. Current layout of the SSCZO wireless sensor network.
Temperature, precipitation and snow data for WY 2008 and 2009: a) daily average air temperature and precipitation measured in rain gauges. b) mean and standard deviation of snow depths. WY 2008 record begins in Feb, when the sensor network became fully operational.
Daily water balance for WY 2008 and 2009: a) daily precipitation for Providence met stations and average SWE; b) streamflow for P303, daily snowmelt (based on changes in SWE in upper panel) and average moisture storage in upper meter of soils (average of 27 sensors); c) cumulative snowmelt, precipitation and discharge, from a and b panels; and d) cumulative fluxes into and out of catchment soils, where difference between rain + melt and loss + discharge curves represents change in storage. Note that for WY 2008 data were only available beginning mid December.
Average water-balance components for WY 2009, averaged over P301 and P303: a) average monthly and b) seasonal water-balance terms from Figure 9, and c) Loss term corrected for canopy interception, compared with seasonal distribution of ET based on CZT-1. Quarters are 1) October, November, December, 2) January, February, March, 3) April, May, June, 4) July, August, September.
Max stream velocity

Bank erosion is highest where the max stream velocity is closest to bank

Sediment accumulation & entrainment

Shear stress drives sediment transport

M = E₀ * uₐ

M = migration  
E₀ = erosion  
uₐ = near bank excess velocity

Sediment accumulation & entrainment

Max stream velocity

During low flows sediment accumulates at the base of bank slopes

During high flows where velocity and shear stress is greater sediment from banks is entrained and transported downstream

Higher discharges result in higher erosion and transport