LONG MEADOW DTS SURVEY RESEARCH PLAN

The objective of this project is to determine variations in diurnal temperature change, inflow and outflow of ground water into the stream, quantify interactions between vegetation and water, and understand the water balance in Long Meadow. To do this, we will exploit temperature as a hydrologic tracer utilizing a distributed temperature sensor (dts). In order to enhance the effectiveness of the dts, it will be coupled with already established temperature sensors (pressure transducers) and additional cost effective sensors (hobo tidbits).

Experimental approach

The experiment will consist of laying an optical cable in the stream running the length of Long Meadow. This dts system is a new approach that will allow us to measure real-time stream temperatures with high resolution and high accuracy over the length of the stream (Selker, van de Giesen, et al 2006). Once in place, the cable will be undisturbed until approximately 5 days later. Additional supporting measurements will be point measures of temperature and continuous flow measurements. To determine response times of the system, salt dilution tracer tests and cold tracer experiments will be conducted. Evapotranspiration (ET) will be evaluated with both ET tent measurements and with a mobile flux tower.

The dts system will be comprised of a data logging and operating computer (approximately 18 X 18 X 4 inches), two 1 km long fiber optic cables, and a power source. An in depth description of dts systems is provided by Selker, Thevenaz, et al 2006. The hobo tidbits are small temperature sensors approximately 5 cm in diameter and 1.5 cm thick. The tidbits will be deployed by mounting them to 2.5 m ski-patrol style bamboo stakes speared into the meadow soil. Additional tidbits may be anchored to 10 cm concrete or metal discs and placed in the bottom of standing pools of water. Stage measurements will be made with solinst leveloggers. These will be related to flow by measuring a velocity profile of the stream or conducting a salt dilution tracer experiment before and after the dts deployment. Some tidbits may be left in the stream or standing pools after the dts deployment to evaluate temperature changes as the stream and meadow dry out.

The dts and tidbits will be deployed for approximately five days in July (after the July 4th weekend); the solinst leveloggers are already deployed in wells and piezometers in Long Meadow—the leveloggers pose no additional threat to impact on the meadow or to visitors. The dts fiber optic cable will be placed in the stream bed from the meadow inlet to the stream junction with Wolverton Creek. An additional cable will be run from the junction to either the Wolverton parking lot or up Wolverton Creek to the water plant. An extension cord run from the snack bar or water plant will provide power to the dts system.

During the deployment of the dts and tidbits the research team intends to conduct salt dilutions to assess stream flow, perform an ice slug test, and assess evapotranspiration with tent experiments and with a mobile flux tower. The salt dilutions will be conducted according to previous processes included with the previous research permit. The ice slug test will consist of placing one approximately 30 kilogram slug of ice at the high point of the stream and tracking its movement with the dts system.
The evapotranspiration tent experiment will be conducted using methods described by *Arnone and Obrist 2003*, however we will not embed any wood in the meadow soil. This system utilizes a tent like dome structure (approximately 4 meters diameter by 2 meters high) encasing two 100 watt window fans (50 cm by 50 cm) and one Licor 7500 open-path infrared gas analyzer (IRGA). The fans are set on cinder blocks and the IRGA is mounted on a tripod 50 cm above the ground surface. The ET tent system will be powered by deep cycle marine batteries. The ET tent will be deployed in up to six locations in the meadow for up to four hours at a time. The mobile flux tower will be no more than 3 m in height and be mounted on a tripod base no more than 3 m diameter. The tower will be powered by attached solar panels. The mobile flux tower will be deployed in one selected location in the meadow for the duration of the five day experiment.

Deployment information and Impacts

This experiment may involve up to ten researchers and technicians during the field work phase.

Potential impacts resulting from the dts system include impact to meadow soil and vegetation from foot traffic during the installation and removal of the dts system. In order to minimize the impacts, all personnel working in the meadow will wear mudders to reduce stress to meadow vegetation and soil; they will take care to avoid walking on the same paths inside the meadow and will follow trails outside the meadow.

Potential impact of deployment and removal of the tidbits is limited to vegetation and soil damage as a result of foot traffic in the meadow. As with the dts system, foot traffic impact will be limited by the use of mudders and avoiding same-path walking in the meadow. Tidbits may be installed one or two days before the experiment by a reduced staff of one or two researchers.

The salt dilutions and ice slug test pose little to no threat of impact to the meadow. The ice slug will only cool the stream water in the immediate vicinity of the slug. The ice slug will melt out and not affect the overall stream temperature. The salt dilutions will be conducted with low concentration salt water (less than 1kg NaCl per 20L water). The electrical conductivity of the added water will not exceed 7.5 siemens/m (the EC of seawater is approximately 5 siemens/m) and no more than 30 liters of water will be added per dilution event, resulting in a maximum electro conductivity recorded 30 m downstream no greater than 0.01 siemens/m at the beginning of the test and dilution to background levels by the time it reaches Wolverton Creek. The affect of the salt dilution on biota in the stream can “be viewed as a low-magnitude disturbance with little spatial and temporal impact” (Wood and Dykes 2001).

Potential impacts resulting from the deployment of the ET tent and mobile flux tower include soil and vegetation impact from foot traffic and placement of the instruments in the meadow. The mobile flux tower tripod will be staked into the meadow soil to a depth of approximately 20 cm at the base of each of the legs. The impact from the tripod legs may be minimized by using plywood “feet” to disperse the weight of the tower over greater surface area. Again, foot traffic impact will be minimized by the use of mudders and avoiding same-path walking in the meadow; also, because the ET tent and mobile flux tower will be deployed for short periods of time, it is not anticipated that they will have permanent effects on vegetation and soil in the meadow. However, the
size of the ET tent and mobile flux tower may detract from the observed aesthetic value experienced by park visitors.

Additional Considerations
No excavation of meadow soil will be conducted by the research team. The experiment, instrumentation, and equipment will be monitored by the research team during all daylight hours for the duration of the experiment. In order to better address public concern during the experiment, signs will be posted where potential contact with the public may occur. These signs will state:

Hydrologic Research in Long Meadow
Conducted by UC Merced led Research Team
By Permission of the National Park Service
Questions or Comments Contact Martha Conklin
mconklin@ucmerced.edu
DTS references:


ET tent reference:


Salt Dilution reference: