Statistical Modeling of Daily Stream Temperature for Mitigating Fish Mortality

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Abstract. Water allocations in the Central Valley Project (CVP) of California require the consideration of short- and long-term needs of many socioeconomic factors including, but not limited to, agriculture, urban use, flood mitigation/control, and environmental concerns. The Endangered Species Act (ESA) ensures that the decision-making process provides sufficient water to limit the impact on protected species, such as salmonids, in the Sacramento River Valley. Current decision support tools in the CVP were deemed inadequate by the National Marine Fisheries Service due to the limited temporal resolution of forecasts for monthly stream temperature and fish mortality. Finer scale temporal resolution (e.g., daily or hourly) is necessary to account for the stream temperature variations critical to salmonid survival and reproduction. To enhance the current methodology, we propose a statistical modeling technique using a Generalized Linear Model (GLM) framework to provide skillful projections of daily stream temperatures and related attributes such as daily stream temperature range, average daily temperature exceeding threshold, and number of hours of threshold temperature exceedance. A suite of predictors that impact stream temperatures will be considered, including streamflow, air temperature, solar radiation, relative humidity, and wind speed, among others. The GLM approach will make a best subset and model selection using objective criteria. Models will be developed for each stream temperature variable of interest and for each month and location of interest along the stream. The developed framework can be used in conjunction with seasonal climate forecasts to generate ensembles of stream temperature scenarios by season that can be used for seasonal scale water allocation planning and decisions. Short-term weather forecasts can also be used in the framework to provide near-term scenarios useful for making water release decisions on a daily basis. The proposed general framework can be easily translated to other locations and is intended to be a complement to the physical stream temperature modeling efforts that are underway on the river.

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