# Geostatistical Methods for Estimating Snowmelt Contribution to the Annual Water Balance in an Alpine Watershed

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**Abstract.** The performance of nine spatial interpolation models was evaluated to estimate snowmelt contributions to streamflow in the West Glacier Lake watershed (0.61 $km^2$), in the Snowy Range Mountains of Wyoming. West Glacier Lake watershed has a unique problem in that measured streamflow out of the watershed has been previously estimated at 40% to 130% greater than measured precipitation inputs. Additional input into the watershed was thought to be from the permanent snowfield in the upper portion of the watershed; although the excess output may be a result of improper estimation of water quantities using current precipitation and stream gauging methods.

In April 2005, peak accumulation snow depth and snow density measurements were collected within the West Glacier Lake watershed. The distribution of snow water equivalent (SWE) was calculated as the product of snow depth, snow density, and snow-covered-area (SCA). The nine spatial snow depth models explained 21% to 97% of the observed variance in the measured snow depths. Co-kriging with solar radiation produced the best results explaining 97% of the observed variance in snow depth measurements. Estimated SWE from the field survey data was 24% greater than winter precipitation gauge estimates. The annual water balance, expressed as equivalent water depths was total precipitation (1395 mm), snow sublimation (251 mm), and streamflow (1000 mm), resulting in an estimate of evapotranspiration (144 mm). Winter precipitation as snow accounted for 85% of the annual precipitation. Summer precipitation was not a significant contributor to the annual hydrograph and was less than snowpack losses from sublimation. Results show that precipitation gauge estimates were unrepresentative of actual precipitation, and that several spatially distributed snow depth models provided better estimates of precipitation inputs.