Estimating the uncertainty associated with calculated snowpack sublimation

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Abstract. Snowpack sublimation is an important hydrologic process which can account for significant water losses to the atmosphere. Snowpack sublimation has been estimated to account for 19% of total winter precipitation in the Wyoming Medicine Bow National Forest, 15% in the Colorado Rocky Mountains, and 18% in the Sierra Nevada Mountains. Errors can be in the range of +/-20% for these sublimation totals. The large degree of uncertainty can have significant consequences on hydrologic studies, water supply forecasting, and water supply modelling.

We modeled snowpack sublimation by calculating snowpack latent heat flux using the bulk aerodynamic flux equation for water year 2005 at West Glacier Lake watershed within the Glacier Lakes Ecosystem Experiments Site (GLEES), Wyoming. This method has the advantage of requiring meteorological measurements at only one height above the snow surface. To evaluate the sensitivity of modeled sublimation values to uncertainties of the input data, we performed a Monte Carlo analysis. Input variable time series were uniformly adjusted by a normally distributed random variable with zero mean and a standard deviation given as follows. For temperature, wind speed, relative humidity and pressure, the standard deviation equaled the manufacturer's stated instrument accuracy (0.3°C, 0.3m/s, 2%, 1mb). We set the surface aerodynamic roughness length (Zo) standard deviation to 0.0093 m, based on Zo standard deviation calculated from multiple heights. We held the measurement height (Z) constant with a standard deviation of 0.08 m, and subsequently altered Z to account for the change in snow depth.