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Uncertainty quantification of continuous streamflow monitoring in high elevation Alpine catchments

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Correct streamflow measurements are of fundamental importance for hydrology. Mountain catchments are particularly complex systems to obtain reliable discharge time series and several challenges have to be overcome. For example, turbulent flow of mountain streams leads to unstable streambed conditions by erosion and sedimentation and the irregular stream profile makes any streamflow measurements through the velocity-area method difficult. The salt dilution method provides reliable streamflow estimation for specific injection times. We can construct rating curves when these and river stage data are available. However, this relationship entails intrinsic uncertainties that derive from experimental errors as well as from extrapolation outside the measured range. In this work, we provide a rigorous quantification of the uncertainty of discharge measurement based on rating curves using error propagation techniques. During multiple field campaigns in 2019, we collected 74 streamflow measurements for nine sites over three high Alpine catchments (Horlachtal, Kaunertal and Martelltal). We then consider also continuous measurements of water level, water temperature and electrical conductivity. The aim is not only to get more information about the hydrological processes and response of these catchments but also to use this information to construct more robust and less uncertain rating curves. Our results show the high uncertainty affecting measured discharges in Alpine catchments and they are relevant for model applications as well. In fact, the uncertainty in river discharge observations affects the optimal value of the model objective function (e.g., Nash-Sutcliff Efficiency).