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Representation of sub-grid snow variability in stream flow modelling in an Alpine catchment

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Climatic conditions, physical characteristics and major sources of runoff (e.g. rainfall, snow melt) within a catchment have a great influence on the hydrological response of the catchment. Accounting for the snow variability at a sub-grid level within a distributed stream flow model should improve flow simulation. Inclusion of sub-grid snow variability requires the inclusion of an additional model parameter that requires calibration. Any improvement in model output may be through the wider range of potential output hydrographs that the extra parameter enables, and not necessarily through a closer alignment of model states to physical reality. This paper investigates the effect of a sub-grid snow variability parameterisation on stream flow modelling in an alpine catchment. The study was carried out using the TopNet model applied to the Jollie catchment located in the Southern Alps of New Zealand. For a range of different "sub-grid snow variability" parameters, the model was calibrated to optimise the fit of the modelled hydrograph to the observed hydrograph. This provided an optimal parameter set for each sub-grid variability value. The sub-grid variability value that led to the best calibration was compared to physically derived values to test how physically reasonable the optimised value was. The full range of sub-grid snow variability values tested led to log Nash Sutcliffe values ranging from 0.66 to 0.74, indicating that the model is relatively sensitive to the sub-grid snow variability value chosen. The value of the sub-grid snow variability parameter that led to the best calibration matches that observed in the catchment. This result indicates that inclusion of the parameter improves the physical realisation of the model giving weight to the value its inclusion in the model for steep alpine catchments.