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A new spatial snow distribution in hydrological models parameterized from observed spatial variability of precipitation.

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The traditional catchment hydrological model with its many free calibration parameters is not a well suited tool for prediction under conditions for which is has not been calibrated. Important tasks for hydrological modelling such as prediction in ungauged basins and assessing hydrological effects of climate change are hence not solved satisfactory. In order to reduce the number of calibration parameters in hydrological models we have introduced a new model which uses a dynamic gamma distribution as the spatial frequency distribution of snow water equivalent (SWE). The parameters are estimated from observed spatial variability of precipitation and the magnitude of accumulation and melting events and are hence not subject to calibration. The relationship between spatial mean and variance of precipitation is found to follow a pattern where decreasing temporal correlation with increasing accumulation or duration of the event leads to a levelling off or even a decrease of the spatial variance. The new model for snow distribution is implemented in the, already parameter parsimonious, DDD (Distance Distribution Dynamics) hydrological model and was tested for 71 Norwegian catchments. We compared the new snow distribution model with the current operational snow distribution model where a fixed, calibrated coefficient of variation parameterizes a log-normal model for snow distribution. Results show that the precision of runoff simulations is equal, but that the new snow distribution model better simulates snow covered area (SCA) when compared with MODIS satellite derived snow cover. In addition, SWE is simulated more realistically in that seasonal snow is melted out and the building up of “snow towers” is prevented and hence spurious trends in SWE.