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1 Distributed model calibration using snow cover images

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The present work investigates the inter-annual stability of snow routine parameter maps in a distributed hydrological model operating at 1km resolution. Time series of MODIS snow cover images are used to calibrate the parameters in grid cell specific snow depletion curves (SDCs). During the melt season, each snow depletion curve relates local snow storage to the sub-grid snow covered area (SCA). Bayes theorem is used to assimilate the SCA observations into the model. The SDC concept enables a Monte Carlo approach to calibration, without needing a full-season model re-run for each parameter vector. Uncertainty features common to the whole region are identified by transforming the parameter set, and for two of the SDC parameters, a spatial covariance structure is built into the prior model.

Bayesian estimation is performed for six years of data, with between 14 and 25 SCA images per melt season. For each year, gridded SDC parameter maps are estimated using the marginal posterior expectation. Calibrated parameter maps are then averaged over five years and compared to the remaining year's map, for all six perturbations. The spatial correspondence is evaluated by the squared correlation coefficient R^2. For the six experiments, R^2 ranges from 0.01 to 0.80 with an average of 0.55 for a snow storage re-scaling, and from 0.20 to 0.66 with average 0.54 for the sub-grid coefficient of variation. A third parameter denoting the initial (pre-melt) bare ground fraction showed no stable behaviour. Using 1:1 correspondence rather than the best-fit correla-

tion includes also systematic inter-annual variability in the evaluation, revealing that one year differ significantly from the others. Excluding this year, fractional variance explained by the 1:1 line ranges from 0.06 to 0.72 with an average of 0.33 for the snow storage re-scaling, and from 0.06 to 0.58 with average 0.36 for the sub-grid coefficient of variation.