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On the Value of Model Parsimony: Testing the Transferability of a Snow Sensitivity Model Across a Large Snow Monitoring Network in the Western U.S.

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The related challenges of predictions in ungauged basins and predictions in ungauged climates require environmental models that transfer well across both space and time. Hydrologic modeling has historically focused on modelling one or only a few basins using highly parameterized conceptual or physically based models. However, model parameters and structures have been shown to change significantly when calibrated to new basins or time periods, suggesting that model complexity and model transferability may be antithetical. Space-for-time models provide a simple framework within which to assess model transferability and any tradeoff with model complexity. Using 497 SNOTEL sites in the western U.S., we develop space-for-time models of April 1 SWE and Snow Residence Time based on mean winter temperature and cumulative winter precipitation. The transferability of the models to new conditions (in both space and time) is assessed using non-random cross-validation tests with consideration of the influence of model complexity on transferability. The models provide strong fits to the data and capture the nonlinear relationship between temperature, precipitation, and snow metrics. Transferability depends on the representation of temperature and precipitation observations in calibration and is generally more successful for more parsimonious model configurations than for complex configurations. The ability of the empirical space-for-time models to predict in new time periods and locations lends confidence to its application to gridded climate futures data for projecting future snow metrics across large areas.