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Complexity regularized hydrological model selection

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Ill-posed hydrological model selection problems (that may be unstable or have non-unique solutions) are regularized with hydrological model complexity as the stabilizer. We propose and apply a notion of model complexity, based on Vapnik-Chervonenkis generalization theory, to complexity regularized hydrologic model selection. Better hydrologic models (better performance on future unseen data) on small sample sizes are identified using complexity regularized model selection than when using traditional model selection (without regularization) while both converge in performance for large samples (i.e. regularized model selection is 'consistent'). Case studies using SAC-SMA, SIXPAR and flexible model structures are used to 1) compute and compare model complexities of different model structures, 2) demonstrate the 'consistency' of complexity regularized model selection and 3) demonstrate that regularized model selection identifies the best model structure (out of a set of competing structures) on small sample sizes better than un-regularized model selection.